



NA11
PHASE & RESIDUAL OVERCURRENT
PROTECTION RELAY,
AUTOMATIC RECLOSING

MANUAL

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1 INTRODUCTION

Scope and liability



This document describes the functions, the technical data of NA11 devices; instructions for mounting, setting and commissioning are included.

This manual has been checked out, however, deviations from the description cannot be completely ruled out, so that no liability in a legal sense for correctness and completeness of the information or from any damage that might result from its use is formally disclaimed.

The information given in this document is reviewed regularly; any corrections and integration will be included in subsequent editions that are identified by the date of revision.

We appreciate any suggestions for improvement.

We reserve the right to make technical improvements without notice.

Applicability

This manual is valid for NA11 devices with firmware version 2.10 and following.

Revision history is listed in appendix.

Conformity

The product complies with the CEE directives:

- EMC Council Directives: 2014/30/EC
- Low voltage Directives: 2014/35/EC



Technical support

Contact: THYTRONIC Technical Service www.thytronic.it

Copyright

All right reserved; It is forbidden to copy, modify or store material (document and sw) protected by copyright without Thytronic consent.

Warranty

Thytronic warrants devices against defects in materials and workmanship under normal use for a period of ONE (1) year from the date of retail purchase by the original end-user purchaser ("Warranty Period").

Safety recommendations

The warning contained in this document are all-important for safety; special attention must be paid to the following symbols:



WARNING

Death, severe personal injury or substantial property damage can result if proper precautions are not taken.



CAUTION

Minor personal injury or property damage can result if proper precautions are not taken

Installation and commissioning must be carried out by qualified person; Thytronic assumes no responsibility for damages caused from improper use that does not comply all warning and caution in this manual.

In particular the following requirements must be met:

- Remove power before opening it.
- Verify the voltage absence by means suitable instrumentation on relay connections; attention must be paid to all circuits supplied by external sources (binary input, CT, etc...)
- Care must be taken when handling metal parts (front panel, connectors).



CAUTION

Settings must be established on the basis of a coordination study.

Numerical values inside examples have educational purpose only; they don't be used, in no way, for actual applications.

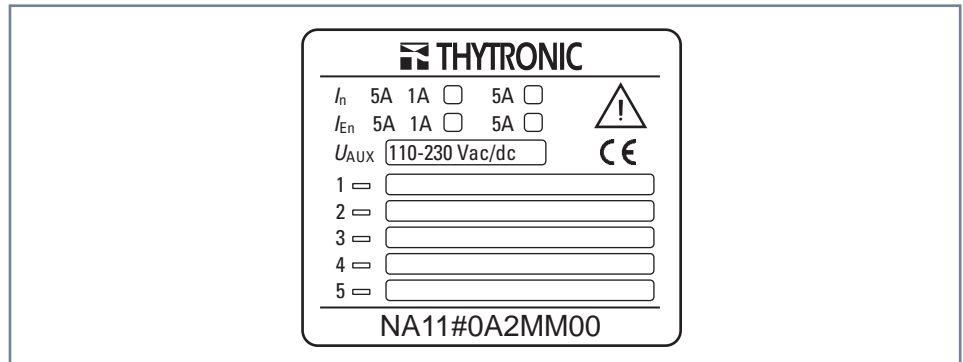
Insulation tests

After insulation tests, hazardous voltages (capacitor charges,...) may be arise; it is advisable to gradually reduce the test voltage avoiding to erase it abruptly.

Product identification

Each device is equipped with:

- Identification label installed on the front side with following informations: code number, phase and residual nominal currents, auxiliary voltage range and CE mark:



- Test label with following informations: data, serial number and test operator signature.

Environment

The NA11 device must be employed according to the environment conditions shown (see technical data).

In case of different environment conditions, appropriate provisions must be provided (conditioning system, humidity control, etc...).

If contaminants are present (dust, corrosive substances, etc...), filters must be provided.

Graphical conventions

The CEI/IEC and ANSI symbols is employed where possible:

e.g.: 51 = ANSI code concerning the overcurrent element.

Following text formats are used:

The ThyVisor^[1] menu:

Phase overcurrent -50/51

The parameter description (measures, thresholds, operate time,...) and related value:

First threshold 50/51 definite time

I > def

The display messages (MMI) are shown as:

NA11

Notes are highlighted with cursive letters inside colored bar

Note: Useful description note

Glossary/definitions

I_{En}	Relay residual nominal current
I_{Enp}	Residual CT primary nominal current
I_n	Relay phase nominal current
I_{np}	Phase CT primary nominal current
50/51	Phase overcurrent ANSI code
50N/51N	Residual overcurrent ANSI code
74CT	CT supervision
79	Automatic reclosing
74TCS	Trip Circuit Supervision
DFR	Digital Fault Recorder (Oscillography)
SER	Sequential Event Recorder
SFR	Sequential Fault Recorder
ANSI	American National Standard Institute
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electrotechnical Commission
CENELEC	Comité Européen de Normalisation Electrotechnique
52 o CB (Circuit Breaker)	Circuit Breaker
52a	Auxiliary contact in the breaker that is in the same position as the breaker. It can be assigned to a binary input to locate the CB position (Breaker failure and/or CB diagnostic functions). (52a open = CB open)
52b	Auxiliary contact in the breaker that is in the opposite position as the breaker (52b open = CB closed)
K1...K6...K10	Output relays
Pulse	Output relay with pulse operation
tTR	Output relay minimum pulse width

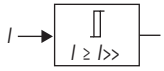
Note 1 The graphic interface and the operation of the ThyVisor software are described in the relative chapters

Latched	Output relay with latched operation (manual reset) Output relay with latched operation (automatic reset)
No-latched	Output relay with no-latched operation (automatic reset)
CT	Current Transformer
LPCT	Low Power Current Transformer
P1	IEC nomenclature for primary polarity mark of CTs (as an alternative to a ANSI dot)
P2	IEC nomenclature for primary polarity mark of CTs (as an alternative to a ANSI no-dot)
S1	IEC nomenclature for secondary polarity mark of CTs (as an alternative to a ANSI dot)
S2	IEC nomenclature for secondary polarity mark of CTs (as an alternative to a ANSI no-dot)
Self test	Diagnostic
Start	Leave an initial condition or reset condition (Pickup)
Trip	Operation (with operate time)
Operating time	Duration of time interval between the instant when the characteristic quantity in reset condition is changed, under specified conditions, and the instant when the relay operates
Dropout ratio	The ratio of a reset value to an operate value in well-specified conditions. The dropout ratio may be lower or greater than 1 according as an over or under element is considered
Reset time	Duration of the time interval between the instant when the characteristic quantity in operate condition is changed, under specified conditions, and the instant when the relay operates. The stated reset time is related to a step variation of characteristic quantity in operate condition to the reset condition.
Overshoot time	The critical impulse time for a relay which is in its reset condition, is the longest duration a specified change in the input energizing quantity(ies) (characteristic quantity), which will cause the relay to change to operate condition, can be applied without the relay switches. The overshoot time is the difference from the operate time and the critical impulse time. The declared values for the overshoot time are applicable with the lower setting value of the operation time.
MMI (Man Machine Interface)	Operator front panel
ThyVisor	Setting and monitoring software
Log file	A text file that lists actions that have occurred (ThyVisor).
J2SE	Java Platform Standard Edition
Subnet Mask	(Ethernet nomenclature)
Sw	Software
Fw	Firmware
Upgrade	Firmware upgrade
XML	eXtensible Markup Language

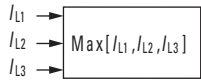
Symbols



Threshold setting (e.g. pickup $I_{>>}$).
The value is available for reading and is adjustable by means ThyVisor + MMI.



Limit block ($I >$ threshold).



Computation block (Max phase current)



Curve type (definite/inverse time)



Logic internal signal (output); may be a logical state (e.g. $I_{>>}$ Start) or a numerical value
It is available for reading (ThyVisor + communication interface)



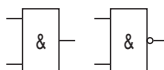
Logic external signal (input); may be a command coming from a binary input or a sw command
It is available for reading (ThyVisor + communication interface)



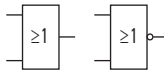
Internal signal (e.g. Breaker Failure output state concerning to the 2nd threshold of the 50 element)
It is not available for reading (missing arrow)



Switch



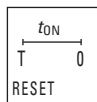
AND and NAND logic gates



OR and NOR logic gates



EXOR logic gate



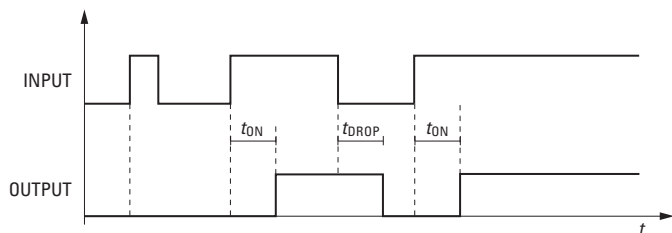
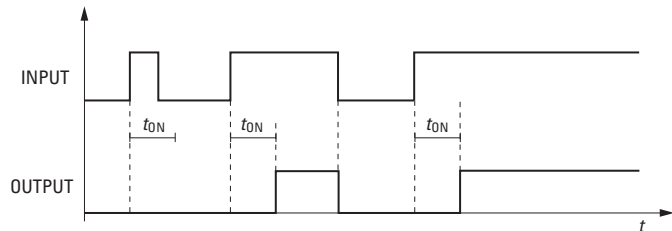
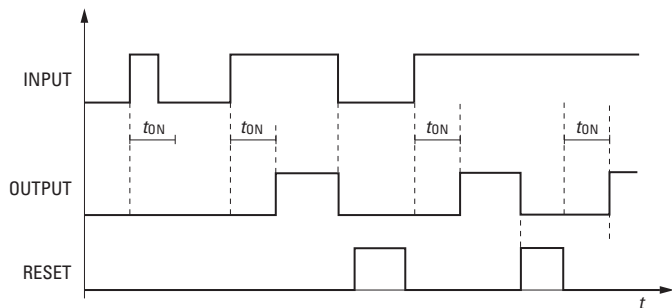
ON delay timer with reset (t_{ON} delay)

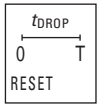


ON delay timer without reset (t_{ON} delay)

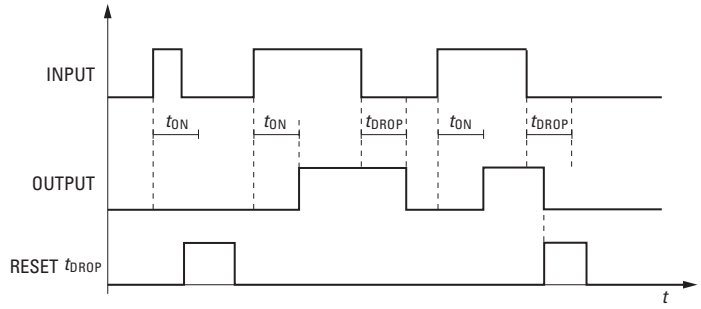


OFF delay timer (dropout) without reset (t_{DROP} delay)

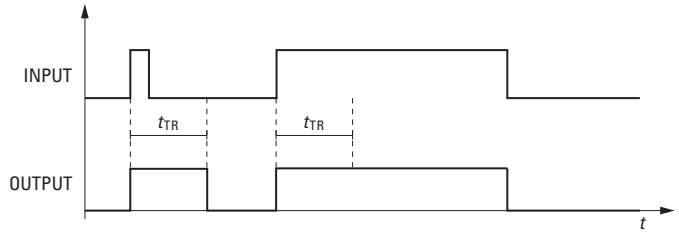




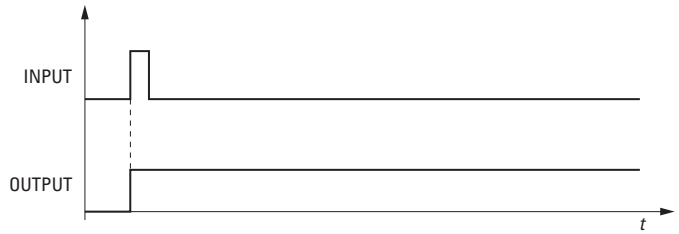
OFF delay timer (dropout) with reset (t_{DROP} delay)



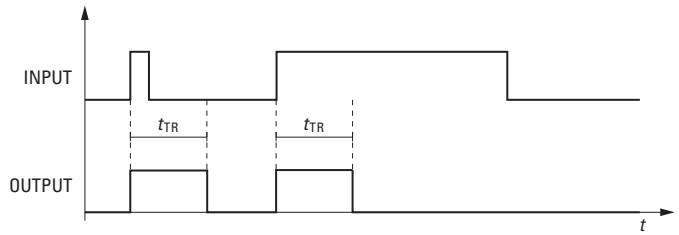
Minimum pulse width operation for output relays (t_{TR})



Latched operating mode for output relays and LEDs



Pulse operating mode for output relays



2 GENERAL

Preface

The relay type NA11 can be used in radial networks as feeder or power transformer protection. In solidly grounded systems the residual overcurrent protection can be used on feeders of any length, while in ungrounded or Petersen coil and/or resistance grounded systems, the residual overcurrent protection can be used on feeders of small length in order to avoid unwanted trippings due to the capacitive current contribution of the feeder on external ground fault. Beside to the phase and residual overcurrent protections, the automatic reclosing function is provided. The NA11 protection relay may be shipped with traditional CTs or low power (LPCT) current inputs.

Following input circuits are available:

- Three phase current and one residual current inputs with nominal currents independently selectable at 1 A or 5 A using DIP-switch (traditional CTs input versions).
- Three phase current inputs from Low Power Current Transformer with nominal currents selectable in the range 50 A...1250 A using DIP-switch (LPCTs input versions); the residual current is calculated using the vector sum of the three phase currents.
- Two or five (optional) binary inputs.
- One block input (logic selectivity).

In addition to the main protection element, the breaker failure (BF), CT monitoring (74CT), Trip Circuit Supervision (TCS), Programmable Logic Controller (PLC) and automatic reclosing function (79) are also provided.

Setting, programming and reading operations must be effected by means of Personal Computer with ThyVisor software or by means of remote communication interface (RS485 bus and Ethernet network); all operations must be performed through MMI.

According to the hardware configurations, the NA11 protection relay can be shipped in various case styles depending on the required mounting options:

- Flush.
- Projecting mounting.
- Rack.
- With separate operator panel.

Other options are:

- Auxiliary power supply operating range.
- Communication protocols.

Photo



Main features

- Metallic case.
- Backlight LCD 4x16 Display.
- Eight LEDs that may be joined with matrix criteria to many and various functions.
- RESET key to clear LED indications and latched output relays.
- Free settable two or five (optional) binary inputs.
- Independently settable for start, trip, self-test and control six output relay (K1...K6) Each output relay may be set with normally energized or normally de-energized operating mode and manual or automatic reset (latched/no-latched).
- Rear Ethernet communication port, with MODBUS TCP/IP® protocol, with RJ45 (copper wires) or FX (optical fiber) connection.
- Rear RS485 port, with ModBus protocol.
- USB front port (local communication for ThyVisor).
- Real time clock with super capacitor backup.

The most significant constructive features of the NA11 protection relay are:

- Galvanically insulated input and output circuits (communication and binary circuits included).
- Fast sampling rate for inputs (24 samples per power cycle).
- Optimum filtering of input signals through combined use of analog and digital filters.
- Traditional electromechanical-type final output contacts with continuous monitoring of control coil continuity.
- Auxiliary supply comprising a switching-type voltage stabilizing circuit having a very wide working range and a very small power dissipation
- Nominal frequency: 50 or 60 Hz.

The most significant operating features are:

- Programming of operating modes and parameters by means of the front keys and alphanumeric display, with a programming procedure based on carrying out guided selections and on explicit and immediate signalling of the operations being performed, so that such procedure can be carried out without coding tables or mnemonic informations.
- The feature modification operations do not interrupt the normal functions of the relay.
- Impossibility of programming unacceptable parameter values, thanks to the automatic limitation of top and bottom scale values for the relative setting ranges.
- Currents are sampled 24 times per period and measured in the effective value (RMS) of the fundamental component using the DFT (Discrete Fourier Transform) algorithm and digital filters.
- The fault recorder (SFR) runs continuously capturing in circular mode the last twenty events upon trigger of binary input/output and/or element pickup (start-trip).
- The event recorder (SER) runs continuously capturing in circular mode the last three hundred events upon trigger of binary input/output.
- Digital fault recorder (DFR) in COMTRADE format (oscillography).

3 TECHNICAL DATA

3.1 GENERAL

□ Product standard for measuring relays

Reference standards

IEC 60255-1 **Part 1: Common requirements**

□ Mechanical data

Mounting:

- Flush.
- Projecting.
- Rack.
- Separated operator panel.

External dimensions (Flush mounting)

177 x 107 x 235 (high x width x depth)
screw connection

Terminals

Mass (Flush mounting)

2.0 kg

Reference standards

EN 60529, EN 60529/A1

Degrees of protection provided by enclosures (IP Code)

- Front
- Terminals

IP52
IP20

□ Insulation

Reference standards

EN 60255-5, IEC 60255-27

High voltage test (50 Hz - 60 s)

- Auxiliary power supply
- Input circuits
- Output circuits
- Output circuits (between open contacts)

2 kV
2 kV
2 kV
1 kV

Impulse voltage withstand test (1.2/50 µs):

- Auxiliary power supply
- Input circuits
- Output circuits
- Output circuits (between open contacts)

5 kV (Common mode) - 2kV (Differential mode)
5 kV
5 kV
1 kV

Insulation resistance

>100 MΩ

□ Voltage dip and interruption

Reference standards

EN 61000-4-29, IEC 60255-22-11

Voltage dips, short interruptions and voltage variations on dc input power port immunity tests

- Interruption (UT=40%)
- Interruption (UT=0%)
- Voltage variations (UT=80...120%)

100 ms
50 ms
10 s

□ EMC tests for interference immunity

Reference standards

IEC 60255-26, EN 60255-26

Product standard for measuring relays

Generic standards immunity for industrial environments

EN 61000-6-2

- Electromagnetic compatibility requirements for measuring relays and protection equipment

Apparati di automazione e controllo per centrali e stazioni elettriche

- Compatibilità elettromagnetica - Immunità
- Normativa di compatibilità elettromeccanica per apparati e sistemi

ENEL REMC 02
ENEL REMC 01

Reference standards

EN 60255-22-1 IEC 60255-22-1
EN 61000-4-12 EN 61000-4-12

Damped oscillatory wave

- 0.1 MHz and 1 MHz common mode
- 0.1 MHz and 1 MHz differential mode
- Ring wave common mode
- Ring wave differential mode

2.5 kV
1.0 kV
2.0 kV
1.0 kV

Reference standards

EN 60255-22-2 IEC 60255-22-2
EN 61000-4-2 IEC 61000-4-2

Electrostatic discharge

- Contact discharge
- Air discharge

6 kV
8 kV

Reference standards

EN 60255-22-3 IEC 60255-22-3
EN 61000-4-3 IEC 61000-4-3

Radiated radio-frequency fields

- 80...1000 MHz AM 80%
- 900 MHz Pulse modulated

10 V/m
10 V/m

	<i>Reference standards</i>	EN 60255-22-4 IEC 60255-22-4 EN 61000-4-4 IEC 61000-4-4
	Fast transient burst (5/50 ns)	
	• Auxiliary power supply	2 kV
	• Input circuits	4 kV
	<i>Reference standards</i>	EN 60255-22-5 IEC 60255-22-5 EN 61000-4-5 IEC 61000-4-5
	High energy pulse	
	• U_{aux} (line-to-ground 10 ohm, 9 μ F)	2 kV
	• U_{aux} (line-to-line 0 ohm, 18 μ F)	1 kV
	• I/O ports (line-to-ground 40 ohm, 0.5 μ F)	2 kV
	• I/O ports (line-to-line 40 ohm, 0.5 μ F)	1 kV
	<i>Reference standards</i>	EN 60255-22-6 IEC 60255-22-6 EN 61000-4-6 IEC 61000-4-6
	Conducted radio-frequency fields	
	• 0.15...80 MHz AM 80% 1kHz	10 V
	<i>Reference standards</i>	EN 60255-22-7 IEC 60255-22-7 EN 61000-4-16 IEC 61000-4-16
	Power frequency immunity tests	
	• Dc voltage	30 V
	• 50 Hz continuously	30 V
	• 50 Hz 1 s	300 V
	• 0.015...150 kHz	30 V
	<i>Reference standards</i>	EN 61000-4-8 IEC 61000-4-8
	Magnetic field 50 Hz	
	• 50 Hz continuously	100 A/m
	• 50 Hz 1 s	1 kA/m
	<i>Reference standards</i>	EN 61000-4-10 IEC 61000-4-10
	Damped oscillatory magnetic field	
	• Damped oscillatory wave 0.1 MHz	30 A/m
	• Damped oscillatory wave 1 MHz	30 A/m
□ Emission	<i>Reference standards</i>	EN 60255-25 IEC 60255-25 EN 61000-6-4 IEC 61000-6-4 EN 55011 CISPR 11
	Electromagnetic emission tests	
	• Conducted emission auxiliary power supply 0.15...0.5 MHz	79 dB μ V
	• Conducted emission auxiliary power supply 0.5...30 MHz	73 dB μ V
	• Radiated emission 30...230 MHz	40 dB μ V/m
	• Radiated emission 230...1000 MHz	47 dB μ V/m
□ Mechanical tests	<i>Reference standards</i>	EN 60255-21-1 EN 60255-21-2 RMEC01
	Vibration, shock, bump and seismic tests on measuring relays and protection equipment	
	• EN 60255-21-1 Vibration tests (sinusoidal)	Class 1
	• EN 60255-21-2 Shock and bump test	Class 1
□ Climatic tests	<i>Reference standards</i>	IEC 60068-x ENEL R CLI 01 CEI 50
	Environmental testing	
	Ambient temperature	-25...+70 °C
	Storage temperature	-40...+85 °C
	Relative humidity	10...95 %
	Atmospheric pressure	70...110 kPa
□ Safety	<i>Reference standards</i>	IEC 60255-27
	Safety requirements for electrical equipment for measurement, control and laboratory use	
	Pollution degree	3
	Reference voltage	250 V
	Overvoltage category	III
□ Certifications	<i>Reference standards</i>	EN 50263
	Product standard for measuring relays	
	CE Conformity	
	• EMC Directive	2004/108/EC
	• Low Voltage Directive	2006/95/CE
	Type tests	

3.2 INPUT CIRCUITS

□ Auxiliary power supply U_{aux}

Voltage	
Nominal value (range) ^[1]	24...48 V~/- 115...230 V~/110...220 V-
Operative range (each one of the above nominal values)	19...60 V~/- 85...265 V~/75...300 V-
<i>Inrush current (max)</i>	
• 24 V-	6 A, 5 ms
• 48 V-	14 A, 5 ms
• 110 V-	20 A, 1 ms
• 230 V~	50 A, 1 ms
Frequency (for alternate voltage supply)	45...66 Hz
Max distortion factor (for alternating voltage supply)	15%
<i>Max alternating component (for dc voltage supply):</i>	
• Full wave rectified sine wave	100 %
• Sine wave	80 %
<i>Power consumption:</i>	
• Maximum (energized relays, Ethernet TX)	10 W (20 VA)
• Maximum (energized relays, Ethernet FX)	15 W (25 VA)

□ Phase current input circuits

Standard CTs:

Connections	M4 terminals
Relay nominal phase current I_n	1 A or 5 A selectable by DIP-switch
Permanent overload	25 A
Thermal overload (1 s)	500 A
Dynamic overload (half cycle)	1250 A
Rated consumption (for any phase)	≤ 0.002 VA with $I_n=1$ A ≤ 0.04 VA with $I_n=5$ A

LPCT - Low Power Current Transformers:

Connections	RJ45 plug
Relay nominal phase current I_n	50 A
Extended primary current	50 A...1250 A selectable by DIP-switch
Max primary current	22.5 kA
Nominal secondary voltage (with $I_{np} = 50$ A)	22.5 mV

□ Residual current input circuit

Relay nominal residual current I_{En}	1 A or 5 A selectable by DIP-switch
Permanent overload	25 A
Thermal overload (1 s)	500 A
Dynamic overload (half cycle)	1250 A
Rated consumption	≤ 0.006 VA with $I_{En}=1$ A ≤ 0.12 VA with $I_{En}=5$ A

□ Binary input circuits

Quantity	2 or 5 ^[2]
Type	optocoupler
Operative range	24...265 V~/-
Min activation voltage U_{DIGmin}	18 V
Max consumption, energized	3 mA

□ Block input (logic selectivity)

Quantity	1
Type (powered by internal isolated supply)	polarized wet input
Max consumption, energized	5 mA

3.3 OUTPUT CIRCUITS

□ Output relays

Quantity	6
Type of contacts K1, K2	changeover (SPDT, type C)
Type of contacts K3, K4, K5	make (SPST-NO, type A)
Type of contacts K6	break (SPST-NC, type B)
Nominal current	8 A
Nominal voltage/max switching voltage	250 V~/400 V~
<i>Breaking capacity:</i>	
• Direct current (L/R = 40 ms)	50 W
• Alternating current ($\lambda = 0,4$)	1250 VA
Make	1000 W/VA

Note 1 The different versions must be select on order

Note 2 The different versions must be select on order

Short duration current (0,5 s)	30 A
Minimum switching load	300 mW (5 V/ 5 mA)
Life:	
• Mechanical	10 ⁶ operations
• Electrical	10 ⁵ operations

□ Block output (Logic selectivity)

Quantity	1
Type	optocoupler

3.4 MMI

Display	16x4 LCD backlight module
LEDs	
Quantity	8
• ON/fail (green)	1
• Start (yellow)	1
• Trip (red)	1
• Freely allocatable (red)	5
Keyboard	8 keys

3.5 COMMUNICATION INTERFACES

□ Local port

Connection Protocol	USB Type B Modbus RTU®
---------------------	---------------------------

□ Remote ports

<i>RS485</i>	
• Connection	screw terminals
• Baud rate	1200...57600 bps
• Protocol ^[1]	ModBus®RTU IEC 60870-5-103 DNP3
<i>Ethernet 100BaseT</i>	
• Connection ^[2]	Optical fiber 1300 nm, ST 100 Base TX, RJ45
• Baud rate	100 Mbps
• Protocol	ModBus®TCP/IP

3.6 GENERAL SETTINGS

Relay nominal frequency (f_n)	50, 60 Hz
<i>Standard CTs:</i>	
Relay phase nominal current (I_n)	1 A or 5 A ^[3]
Phase CT primary nominal current (I_{np})	1 A...10 kA 1...499 A (step 1 A) 500...4990 A (step 10 A) 5000...10000 A (step 100 A)
Relay residual nominal current (I_{En})	1 A or 5 A ^[1]
Residual CT primary nominal current (I_{Enp})	1 A...10 kA 1...499 A (step 1 A) 500...4990 A (step 10 A) 5000...10000 A (step 100 A)
<i>LPCT - Low Power Current Transformers:</i>	
Relay phase nominal current (I_{np})	1 A...10 kA 1...499 A (step 1 A) 500...4990 A (step 10 A) 5000...10000 A (step 100 A)
Relay residual nominal current I_{En} ^[4]	-

3.7 PROTECTIVE FUNCTIONS

Note 1 The different versions must be select on order

Note 2 The different versions must be select on order

Note 3 The nominal current settings doesn't concern the protection elements; they must agree with hardware setting (dip-switch 1 A or 5 A).

Note 4 The computed residual current is employed for NA11 protection relays equipped with LPCT sensor inputs

□ Thermal protection with Pt100 probes - 26^[1]

<i>ThAL1...8 Alarm:</i>	Alarm threshold 26 PT1...PT8 (<i>ThAL1...8</i>)	0...200 °C
	Operating time <i>ThAL1...8</i> (<i>tThAL1...8</i>)	0...100 s
<i>Th>1...8 Trip:</i>	Trip threshold 26 PT1...PT8 (<i>Th>1...8</i>)	0...200 °C
	Operating time <i>ThAL1...8</i> (<i>tTh>1...8</i>)	0...100 s

□ Phase overcurrent - 50/51 - settings for 1/5 A standard CTs version

<i>I> Element</i>	<i>I></i> Curve type (<i>I>Curve</i>)	DEFINITE IEC/BS A, B, C ANSI/IEEE MI, VI, EI RECTIFIER, I ² t or EM
	<i>I</i> _{CLP>} Activation time (<i>t</i> _{CLP>})	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>I></i> Reset time delay (<i>t</i> _{RES})	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>Definite time</i>	
	50/51 First threshold definite time (<i>I</i> _{def})	0.100...40.0 I _n 0.100...0.999 I _n (step 0.001 I _n) 1.00...9.99 I _n (step 0.01 I _n) 1.00...40.0 I _n (step 0.1 I _n)
	<i>I</i> _{def} within CLP (<i>I</i> _{CLP>def})	0.100...40.0 I _n 0.100...0.999 I _n (step 0.001 I _n) 1.00...9.99 I _n (step 0.01 I _n) 1.00...40.0 I _n (step 0.1 I _n)
	<i>I</i> _{def} Operating time (<i>t</i> _{def})	0.04...200.0 s 0.04...9.99 s (step 0.01 s) 10.0...99.9 s (step 0.1 s) 100...200 s (step 1 s)
	<i>Inverse time</i> ^[2]	
	50/51 First threshold inverse time (<i>I</i> _{inv})	0.100...20.00 I _n 0.100...0.999 I _n (step 0.001 I _n) 1.00...20.00 I _n (step 0.01 I _n)
	<i>I</i> _{inv} within CLP (<i>I</i> _{CLP>inv})	0.100...20.00 I _n 0.100...0.999 I _n (step 0.001 I _n) 1.00...20.00 I _n (step 0.01 I _n)
	<i>I</i> _{inv} Operating time (<i>t</i> _{inv})	0.02...60.0 s 0.02...9.99 s (step 0.01 s) 10.0...60.0 s (step 0.1 s)
<i>I>> Element</i>	<i>I>></i> Curve type (<i>I>>Curve</i>)	DEFINITE or I ² t
	<i>I</i> _{CLP>>} Activation time (<i>t</i> _{CLP>>})	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>I>></i> Reset time delay (<i>t</i> _{RES})	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>Definite time</i>	
	50/51 Second threshold definite time (<i>I</i> _{>>def})	0.100...40.0 I _n

Note 1 The 26 element is available when the MPT module is connect on Thybus and enabled

Note 2

Standard Inverse Time (IEC 255-3/BS142 type A or SIT):	$t = 0.14 \cdot t_{inv} / [(I/I_{inv})^{0.02} - 1]$
Very Inverse Time (IEC 255-3/BS142 type B or VIT):	$t = 13.5 \cdot t_{inv} / [(I/I_{inv}) - 1]$
Extremely Inverse Time (IEC 255-3/BS142 type C or EIT):	$t = 80 \cdot t_{inv} / [(I/I_{inv})^2 - 1]$
Moderately Inverse (ANSI/IEEE type MI):	$t = t_{inv} \cdot \{0.01 / [(I/I_{inv})^{0.02} - 1] + 0.023\}$
Very Inverse (ANSI/IEEE type VI):	$t = t_{inv} \cdot \{3.922 / [(I/I_{inv})^2 - 1] + 0.098\}$
Extremely Inverse (ANSI/IEEE type EI):	$t = t_{inv} \cdot \{5.64 / [(I/I_{inv})^2 - 1] + 0.024\}$
I-squared-t (I ² t = K):	$t = 16 \cdot t_{inv} / (I/I_{inv})^2$
Electromechanical (EM):	$t = 0.28 \cdot t_{inv} / [-0.236 \cdot (I/I_{inv})^{-1} + 0.339]$
RECTIFIER (RI):	$t = 2351 \cdot t_{inv} / [(I/I_{inv})^{5.6} - 1]$

t: operate time

I_{inv}: pickup value

t_{inv}: operate time setting

Asymptotic reference value: 1.1 I_{inv}

Minimum operate time: 0.1 s

Equation is valid for 1.1 ≤ I/I_{inv} ≤ 20

With I_{inv} pickup ≥ 2.5 I_n, the upper limit is 50 I_n

		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...40.0 I_n (step 0.1 I_n)
	$I_{>>def}$ within CLP ($I_{CLP>>def}$)	0.100...40.00 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...40.0 I_n (step 0.1 I_n)
	$I_{>>def}$ Operating time ($t_{>>def}$)	0.02...10.00 s (step 0.01 s)
<i>Inverse time</i>		
	50/51 Second threshold inverse time ($I_{>>inv}$)	0.100...20.00 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...20.00 I_n (step 0.01 I_n)
	$I_{>>inv}$ within CLP ($I_{CLP>>inv}$)	0.100...20.00 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...20.00 I_n (step 0.01 I_n)
	$I_{>>inv}$ Operating time ($t_{>>inv}$)	0.02...10.00 s (step 0.01 s)
<i>$I_{>>>}$ Element</i>		
	$I_{CLP>>>}$ Activation time ($t_{CLP>>>}$)	0.00...100.0 s
		0.00...9.99 s (step 0.01 s)
		10.0...100.0 s (step 0.1 s)
	$I_{>>>}$ Reset time delay ($t_{>>>RES}$)	0.00...100.0 s
		0.00...9.99 s (step 0.01 s)
		10.0...100.0 s (step 0.1 s)
<i>Definite time</i>		
	50/51 Third threshold definite time ($I_{>>>def}$)	0.100...40.0 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...40.0 I_n (step 0.1 I_n)
	$I_{>>>def}$ within CLP ($I_{CLP>>>def}$)	0.100...40.0 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...40.0 I_n (step 0.1 I_n)
	$I_{>>>def}$ Operating time ($t_{>>>def}$)	0.03...10.00 s (step 0.01 s)
	Pickup time	≤ 0.03 s
	Dropout ratio	0.95...0.98
	Dropout time	≤ 0.05 s
	Overshoot time	0.03 s
	Pickup accuracy	$\pm 0.5\%$ with 0.1 I_n , $\pm 0.2\%$ with 1 I_n
	Operate time accuracy	5% or ± 10 ms

□ Phase overcurrent - 50/51 - settings for low power CTs version (LPCT)

I> Element

	$I>$ Curve type ($I>Curve$)	DEFINITE IEC/BS A, B, C ANSI/IEEE MI, VI, EI RECTIFIER, I^2t or EM
	$I_{CLP>}$ Activation time ($t_{CLP>}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	$I>$ Reset time delay ($t_{>RES}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>Definite time</i>		
	50/51 First threshold definite time ($I_{>def}$)	0.100...35.0 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...35.0 I_n (step 0.1 I_n)
	$I_{>def}$ within CLP ($I_{CLP>def}$)	0.100...35.0 I_n
		0.100...0.999 I_n (step 0.001 I_n)
		1.00...9.99 I_n (step 0.01 I_n)
		10.0...35.0 I_n (step 0.1 I_n)
	$I_{>def}$ Operating time ($t_{>def}$)	0.04...200.0 s 0.04...9.99 s (step 0.01 s) 10.0...99.9 s (step 0.1 s) 100...200 s (step 1 s)

<i>Inverse time^[1]</i>		
50/51 First threshold inverse time ($I_{>inv}$)		0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{>inv}$ within CLP ($I_{CLP>inv}$)		0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{>inv}$ Operating time ($t_{>inv}$)		0.02...60.0 s 0.02...9.99 s (step 0.01 s) 10.0...60.0 s (step 0.1 s)
<i>I>> Element</i>		
$I_{>>}$ Curve type ($I_{>>Curve}$)		DEFINITE or I^2t
$I_{CLP>>}$ Activation time ($t_{CLP>>}$)		0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
$I_{>>}$ Reset time delay ($t_{>>RES}$)		0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>Definite time</i>		
50/51 Second threshold definite time ($I_{>>def}$)		0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{>>def}$ within CLP ($I_{CLP>>def}$)		0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{>>def}$ Operating time ($t_{>>def}$)		0.03...10.00 s (step 0.01 s)
<i>Inverse time</i>		
50/51 Second threshold inverse time ($I_{>>inv}$)		0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{>>inv}$ within CLP ($I_{CLP>>inv}$)		0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{>>inv}$ Operating time ($t_{>>inv}$)		0.02...10.00 s (step 0.01 s)
<i>I>>> Element</i>		
$I_{CLP>>>}$ Activation time ($t_{CLP>>>}$)		0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
$I_{>>>}$ Reset time delay ($t_{>>>RES}$)		0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>Definite time</i>		
50/51 Third threshold definite time ($I_{>>>def}$)		0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{>>>def}$ within CLP ($I_{CLP>>>def}$)		0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{>>>def}$ Operating time ($t_{>>>def}$)		0.03...10.00 s (step 0.01 s)

Note 1

Standard Inverse Time (IEC 255-3/BS142 type A or SIT):

Very Inverse Time (IEC 255-3/BS142 type B or VIT):

Extremely Inverse Time (IEC 255-3/BS142 type C or EIT):

Moderately Inverse (ANSI/IEEE type MI):

Very Inverse (ANSI/IEEE type VI):

Extremely Inverse (ANSI/IEEE type EI):

I -squared- t ($I^2t = K$):

Electromechanical (EM):

RECTIFIER (RI):

t : operate time

$I_{>inv}$: pickup value

$t_{>inv}$: operate time setting

Asymptotic reference value: 1.1 $I_{>inv}$

Minimum operate time: 0.1 s

Equation is valid for $1.1 \leq I/I_{>inv} \leq 20$

With $I_{>inv}$ pickup $\geq 2.5 I_n$, the upper limit is 35 I_n

$$t = 0.14 \cdot t_{>inv} / [(I/I_{>inv})^{0.02} - 1]$$

$$t = 13.5 \cdot t_{>inv} / [(I/I_{>inv}) - 1]$$

$$t = 80 \cdot t_{>inv} / [(I/I_{>inv})^2 - 1]$$

$$t = t_{>inv} \cdot \{0.01 / [(I/I_{>inv})^{0.02} - 1] + 0.023\}$$

$$t = t_{>inv} \cdot \{3.922 / [(I/I_{>inv})^2 - 1] + 0.098\}$$

$$t = t_{>inv} \cdot \{5.64 / [(I/I_{>inv})^2 - 1] + 0.024\}$$

$$t = 16 \cdot t_{>inv} / (I/I_{>inv})^2$$

$$t = 0.28 \cdot t_{>inv} / [-0.236 \cdot (I/I_{>inv})^{-1} + 0.339]$$

$$t = 2351 \cdot t_{>inv} / [(I/I_{>inv})^{5.6} - 1]$$

Pickup time	≤ 0.03 s
Dropout ratio	0.95...0.98
Dropout time	≤ 0.05 s
Overshoot time	0.03 s
Pickup accuracy	± 0.5% with 0.1 I _n , ± 0.2% with 1 I _n
Operate time accuracy	5% or ± 10 ms

□ Residual overcurrent - 50N/51N - settings for 1/5 A standard CTs version

I_E> Element

<i>I_E></i> Curve type (<i>I_E>Curve</i>)	DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, EM
<i>I_E></i> Activation time (<i>t_E></i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>I_E></i> Reset time delay (<i>t_E>RES</i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>Definite time</i>	
50N/51N First threshold definite time (<i>I_E>def</i>)	0.002...10.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...10.00 I _{En} (step 0.01 I _{En})
<i>I_E>def</i> within CLP (<i>I_E>def</i>)	0.002...10.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...10.00 I _n (step 0.01 I _{En})
<i>I_E>def</i> Operating time (<i>t_E>def</i>)	0.04...200.0 s 0.04...9.99 s (step 0.01 s) 10.0...99.9 s (step 0.1 s) 100...200 s (step 1 s)

Inverse time^[1]

50N/51N First threshold inverse time (<i>I_E>inv</i>)	0.002...2.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...2.00 I _{En} (step 0.01 I _{En})
<i>I_E>inv</i> within CLP (<i>I_E>inv</i>)	0.002...2.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...2.00 I _{En} (step 0.01 I _{En})
<i>I_E>inv</i> Operating time (<i>t_E>inv</i>)	0.02...60.0 s 0.02...9.99 s (step 0.01 s) 10.0...60.0 s (step 0.1 s)

I_E>> Element

<i>I_E>></i> Activation time (<i>t_E>></i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>I_E>></i> Reset time delay (<i>t_E>>RES</i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>Definite time</i>	
50N/51N Second threshold definite time (<i>I_E>>def</i>)	0.002...10.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...10.00 I _{En} (step 0.01 I _{En})
<i>I_E>>def</i> within CLP (<i>I_E>>def</i>)	0.002...10.00 I _{En} 0.002...0.999 I _{En} (step 0.001 I _{En}) 1.00...10.00 I _{En} (step 0.01 I _{En})
<i>I_E>>def</i> Operating time (<i>t_E>>def</i>)	0.03...10.00 s (step 0.01 s)

I_E>>> Element

<i>I_E>>></i> Activation time (<i>t_E>>></i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
<i>I_E>>></i> Reset time delay (<i>t_E>>>RES</i>)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)

Note 1 Standard Inverse Time (IEC 255-3/BS142 type A or SIT):

Very Inverse Time (IEC 255-3/BS142 type B or VIT):

Extremely Inverse Time (IEC 255-3/BS142 type C or EIT):

Moderately Inverse (ANSI/IEEE type MI):

Very Inverse (ANSI/IEEE type VI):

Extremely Inverse (ANSI/IEEE type EI):

Electromechanical (EM):

I_E: residual current input

t: operate time

I_E>inv: pickup value

t_E>inv: operate time setting

Asymptotic reference value: 1.1 I_E>inv

Minimum operate time: 0.1 s

Equation is valid for 1.1 ≤ *I_E* / *I_E>inv* ≤ 20, with *I_E>inv* pickup ≥ 0.5 I_{En}, the upper limit is 10 I_{En}

$$t = 0.14 \cdot t_{E>inv} / [(I_E / I_{E>inv})^{0.02} - 1]$$

$$t = 13.5 \cdot t_{E>inv} / [(I_E / I_{E>inv}) - 1]$$

$$t = 80 \cdot t_{E>inv} / [(I_E / I_{E>inv})^2 - 1]$$

$$t = t_{E>inv} \cdot \{0.01 / [(I_E / I_{E>inv})^{0.02} - 1] + 0.023\}$$

$$t = t_{E>inv} \cdot \{3.922 / [(I_E / I_{E>inv})^2 - 1] + 0.098\}$$

$$t = t_{E>inv} \cdot \{5.64 / [(I_E / I_{E>inv})^2 - 1] + 0.024\}$$

$$t = 0.28 \cdot t_{E>inv} / [-0.236 \cdot (I_E / I_{E>inv})^{-1} + 0.339]$$

Definite time

50N/51N Third threshold definite time ($I_{E>>>def}$)	0.002...10.00 I_{En} 0.002...0.999 I_{En} (step 0.001 I_{En}) 1.00...10.00 I_{En} (step 0.01 I_{En})
$I_{E>>>def}$ within CLP ($I_{ECLP>>>def}$)	0.002...10.00 I_{En} 0.002...0.999 I_{En} (step 0.001 I_{En}) 1.00...10.00 I_{En} (step 0.01 I_{En})
$I_{E>>>def}$ Operating time ($t_{E>>>def}$)	0.03...10.00 s (step 0.01 s)
Pickup time	≤ 0.03 s
Dropout ratio	0.95...0.98
Dropout time	≤ 0.05 s
Overshoot time	0.03 s
Pickup accuracy	± 0.5% with 0.01 I_{En} , ± 0.2% with 1 I_{En}
Operate time accuracy	5% or ± 10 ms

□ Residual overcurrent - 50N/51N - settings for low power CTs version (LPCT) ^[1]

I_{E>} Element

$I_{E>}$ Curve type ($I_{E>Curve}$)	DEFINITE IEC/BS A, B, C ANSI/IEEE MI, VI, EI EM
$I_{ECLP>}$ Activation time ($t_{ECLP>}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
$I_{E>}$ Reset time delay ($t_{E>RES}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)

Definite time

50N/51N First threshold definite time ($I_{E>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{E>def}$ within CLP ($I_{ECLP>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
$I_{E>def}$ Operating time ($t_{E>def}$)	0.04...200.00 s 0.04...9.99 s (step 0.01 s) 10.0...99.9 s (step 0.1 s) 100...200 s (step 1 s)

Inverse time^[2]

50N/51N First threshold inverse time ($I_{E>inv}$)	0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{E>inv}$ within CLP ($I_{ECLP>inv}$)	0.100...20.00 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...20.00 I_n (step 0.01 I_n)
$I_{E>inv}$ Operating time ($t_{E>inv}$)	0.02...60.0 s 0.02...9.99 s (step 0.01 s) 10.0...60.0 s (step 0.1 s)

I_{E>>} Element

$I_{ECLP>>}$ Activation time ($t_{ECLP>>}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
---	--

Note 1 The computed residual current (vector sum of the phase currents) is employed for NA11 protection relays equipped with LPCT sensor inputs

Note 2

Standard Inverse Time (IEC 255-3/BS142 type A or SIT):	$t = 0.14 \cdot t_{E>inv} / [(I_{EC} / I_{E>inv})^{0.02} - 1]$
Very Inverse Time (IEC 255-3/BS142 type B or VIT):	$t = 13.5 \cdot t_{E>inv} / [(I_{EC} / I_{E>inv}) - 1]$
Extremely Inverse Time (IEC 255-3/BS142 type C or EIT):	$t = 80 \cdot t_{E>inv} / [(I_{EC} / I_{E>inv})^2 - 1]$
Moderately Inverse (ANSI/IEEE type MI):	$t = t_{E>inv} \cdot \{0.01 / [(I_{EC} / I_{E>inv})^{0.02} - 1] + 0.023\}$
Very Inverse (ANSI/IEEE type VI):	$t = t_{E>inv} \cdot \{3.922 / [(I_{EC} / I_{E>inv})^2 - 1] + 0.098\}$
Extremely Inverse (ANSI/IEEE type EI):	$t = t_{E>inv} \cdot \{5.64 / [(I_{EC} / I_{E>inv})^2 - 1] + 0.024\}$
Electromechanical (EM):	$t = 0.28 \cdot t_{E>inv} / [-0.236 \cdot (I_{EC} / I_{E>inv})^2 + 0.339]$

I_{EC} : calculated residual current input

t : operate time

$I_{E>inv}$: pickup value

$t_{E>inv}$: operate time setting

Asymptotic reference value: 1.1 $I_{E>}$

Minimum operate time: 0.1 s

Equation is valid for $1.1 \leq I_{E>} / I_{E>inv} \leq 20$

With $I_{E>inv}$ pickup $\geq 0.5 I_n$, the upper limit is 10 I_n

	$I_{E>>>}$ Reset time delay ($t_{E>>>RES}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>Definite time</i>	
	50N/51N Second threshold definite time ($I_{E>>>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
	$I_{E>>>def}$ within CLP ($I_{ECLP>>>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
	$I_{E>>>def}$ Operating time ($t_{E>>>def}$)	0.03...10.00 s (step 0.01 s)
<i>$I_{E>>>}$ Element</i>		
	$I_{ECLP>>>}$ Activation time ($t_{ECLP>>>}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	$I_{E>>>}$ Reset time delay ($t_{E>>>RES}$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
	<i>Definite time</i>	
	50N/51N Third threshold definite time ($I_{E>>>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
	$I_{E>>>def}$ within CLP ($I_{ECLP>>>def}$)	0.100...35.0 I_n 0.100...0.999 I_n (step 0.001 I_n) 1.00...9.99 I_n (step 0.01 I_n) 10.0...35.0 I_n (step 0.1 I_n)
	$I_{E>>>def}$ Operating time ($t_{E>>>def}$)	0.03...10.00 s (step 0.01 s)
	Pickup time	≤ 0.04 s
	Dropout ratio	0.95...0.98
	Dropout time	≤ 0.05 s
	Overshoot time	0.04 s
	Pickup accuracy	$\pm 4\%$ with 0.1 I_n , $\pm 1\%$ with 1 I_n
	Operate time accuracy	5% or ± 10 ms
<hr/>		
□ Breaker failure - BF - settings for 1/5 A standard CTs version		
	BF Phase current threshold ($I_{BF>}$)	0.05...1.00 I_n (step 0.01 I_n)
	BF Residual current threshold ($I_{EBF>}$)	0.01...2.00 I_n (step 0.01 I_n)
	BF Time delay (t_{BF})	0.06...10.00 s (step 0.01 s)
	Dropout ratio	0.95...0.98
	Dropout time	≤ 0.05 s
	$I_{BF>}$ Pickup accuracy	$\pm 0.5\%$ with 0.1 I_{nL} $\pm 0.2\%$ with 1 I_{nL}
	$I_{EBF>}$ Pickup accuracy	$\pm 0.5\%$ with 0.01 I_{En} $\pm 0.2\%$ with 1 I_{En}
	Operate time accuracy	5% or ± 10 ms
<hr/>		
□ Breaker failure - BF - settings for low power CTs version (LPCT) ^[1]		
	BF Phase current threshold ($I_{BF>}$)	0.05...1.00 I_n (step 0.01 I_n)
	BF Residual current threshold ($I_{EBF>}$)	0.10...2.00 I_n (step 0.01 I_n)
	BF Time delay (t_{BF})	0.06...10.00 s (step 0.01 s)
	Dropout ratio	0.95...0.98
	Dropout time	≤ 0.05 s
	$I_{BF>}$ Pickup accuracy	$\pm 0.5\%$ with 0.1 I_n $\pm 0.2\%$ with 1 I_n
	$I_{EBF>}$ Pickup accuracy	$\pm 4\%$ with 0.1 I_n $\pm 1\%$ with 1 I_n
	Operate time accuracy	5% or ± 10 ms

Note 1 The computed residual current (vector sum of the phase currents) is employed for NA11 protection relays equipped with LPCT sensor inputs

3.8 CONTROL AND MONITORING

□ Automatic reclosing - 79

Number of delayed reclosures	0...5
Rapid reclosure dead time t_{rdt}	0.1...60 s 0.0...19.9 s step 0.1 s, 20..60 s step 1 s
Slow reclosure dead time t_{sdt}	1...200 s (step 1 s)
Reclaim time t_r	1...200 s (step 1 s)
Slow reclosure fault discrimination time t_{d1}	0...10 s (step 1 s)
Delayed reclosure fault discrimination time t_{d2}	0...10 s (step 1 s)
Manual close (R+S only) fault discrimination time t_d	1...10 s (step 1 s)

□ Second harmonic restraint - 2ndh-REST

Second harmonic restraint threshold ($I_{2ndh}>$)	10...50 %
$I_{2ndh}>$ reset time delay ($t_{2ndh}>RES$)	0.00...100.0 s 0.00...9.99 s (step 0.01 s) 10.0...100.0 s (step 0.1 s)
Dropout ratio	0.95...0.98
Dropout time	≤ 0.04 s
Pickup accuracy $I_{2ndh}>$	$\pm 4\% \pm 1\% I_n$
Operate time accuracy	5% or ± 10 ms

□ Trip Circuit Supervision - 74TCS

<i>Operate time:</i>	
• One binary input supervision	40 s
• Two binary inputs supervision	2 s
<i>Reset time delay:</i>	
• One binary input supervision	6 s
• Two binary inputs supervision	0.6 s

□ Selective block - BLOCK2

Selective block IN:

• BLIN1 Selective block operating mode (ModeBLIN1)	OFF-ON IPh/IE-ON IPh-ON IE
• BLIN maximum activation time for phase protections (t_{B-IPh})	0.10...10.00 s (step 0.01 s)
• BLIN maximum activation time for ground protections (t_{B-IE})	0.10...10.00 s (step 0.01 s)

Selective block OUT:

• BLOUT1 Selective block operating mode (ModeBLOUT1)	OFF-ON IPh/IE-ON IPh-ON IE
• BLOUT Dropout time for phase protections (t_{F-IPh})	0.00...1.00 s (step 0.01 s)
• BLOUT Dropout time for ground protections (t_{F-IE})	0.00...1.00 s (step 0.01 s)
• BLOUT Dropout time for ground and phase protections ($t_{F-IPh/IE}$)	0.00...10.00 s (step 0.01 s)

□ Circuit Breaker monitoring

Circuit breaker diagnostic

Number of CB trips threshold ($N.Open$)	0...10000 (step 1)
Cumulative CB tripping currents threshold ($SumI$)	0...5000 I_n (step 1 I_n)
Cumulative CB tripping I^2t threshold ($SumI^2t$)	0...5000 (I_n) ² -s (step 1 (I_n) ² -s)
Circuit Breaker opening time for I^2t calculation (t_{break})	0.05...1.00 s (step 0.01 s)
Circuit Breaker maximum allowed opening time ($t_{break}>$)	0.05...1.00 s (step 0.01 s)

□ CT supervision - 74CT

74CT Threshold ($S<$)	0.10...0.95 (step 0.01)
74CT Overcurrent threshold (I^*)	0.10...1.00 I_n (step 0.01 I_n)
$S<$ Operating time delay ($t_{S<}$)	0.03...200 s 0.03...9.99 s (step 0.01 s) 10.0...99.9 s (step 0.1 s) 100...200 s (step 1 s)
Dropout ratio for the I^* pickup	0.95...0.98
Dropout time	≤ 0.05 s
Pickup accuracy $S<$	$\pm 1\%$ with 0.1 I_n , $\pm 0.5\%$ with 1 I_n
Pickup accuracy I^*	$\pm 0.5\%$ with 0.1 I_n , $\pm 0.2\%$ with 1 I_n
Operate time accuracy	5% or ± 10 ms

□ Pilot wire diagnostic

• BLOUT1 Diagnostic pulse period ($PulseBLOUT1$)	OFF-0.1-1-5-10-60-120 s
• BLIN1 Diagnostic pulse control time interval ($PulseBLIN1$)	OFF-0.1-1-5-10-60-120 s

□ Demand measures

• Fix on demand period (t_{FIX})	1...60 min (step 1 min)
• Rolling on demand period (t_{ROL})	1...60 min (step 1 min)
• Number of cycles for rolling on demand ($N.ROL$)	1...24 (step 1)

□ Oscillography (DFR)^[1]

Format	COMTRADE
Recording mode	circular
Sampling rate	24 samples / power cycle
<i>Set trigger:</i>	
• Pre-trigger time	0.05...1.00 s (step 0.01 s)
• Post-trigger time	0.05...60.00 s (step 0.05 s)
<i>Set sampled channels:</i>	
Instantaneous currents	$i_{L1}, i_{L2}, i_{L3}, i_E^{[2]}$
<i>Set analog channels:</i>	
Analog 1...Analog 12	Frequency, $i_{L1}, i_{L2}, i_{L3}, i_E^{[3]}, i_{EC}^{[4]}$, $i_{L1-2nd}, i_{L2-2nd}, i_{L3-2nd}, i_{-2nd}/i_{T1...T8}^{[5]}$
<i>Set digital channels:</i>	
Digital 1...Digital 12	K1... K6, K7...K10, IN1, IN2, IN3...IN42 ^[6]

□ PLC and PLC2 (Programmable Logic Controller)^[7]

Reference standard	IEC 61131-3
Language ^[8]	IL (Instruction List)
<i>Inputs:</i>	
Binary inputs	IN1, IN2 (IN1...IN5) on board IN3...IN10 with MRI module IN11...IN26 with one MID16 module IN27...IN42 with two MID16 modules
Delayed binary inputs ^[9]	IN1, IN2 (IN1...IN5) on board IN8...IN10 with MRI module IN11...IN26 with one MID16 module IN27...IN42 with two MID16 modules
Start (all elements)	Start I>, Start I>>,...etc
Trip (all elements)	Trip I>, Trip I>>,...etc
Measures	IL1, IL2,...ecc
Temperature	Pt100
Block inputs	BLK2IN-Iph, BLK2IN-IE,...etc
<i>Outputs:</i>	
Relays	K11...K6 on board K7...K10 with MRI module
LEDs	START, TRIP, L1...L6 on board L7...L10 with MRI module
Block outputs	BLK2OUT-Iph, BLK2OUT-IE,...etc
Current converter	DAC

Note 1 For the DFR function a licence is required; call Thytronic for purchasing.

Note 2 The measured residual current is available only for NA11 protection relays equipped with standard CTs sensor inputs

Note 3 The measured residual current is available only for NA11 protection relays equipped with standard CTs sensor inputs

Note 4 The computed residual current i_{EC} (vector sum of the phase currents) is available for NA11 protection relays equipped with LPCT sensor inputs

Note 5 The temperature measuring is acquired by means of RTD probes Pt100 (eight Pt100 inputs with one MPT module); if the module is not available the concerning measure is meaningless

Note 6 The K7...K10 and IN3...IN42 state is meaningful only when the corresponding I/O circuits are available (MRI and MID16 modules)

Note 7 For the PLC function a licence is required; call Thytronic for purchasing.

Note 8 With ThyVisor V3.4.3 release and compiler IEC 61131-3 V1.2.7 only the IL language is implemented (Instruction List); other languages, according with IEC 61131 standard (ST (Structured Text)), LD (Ladder Diagram), FBD (Function Block Diagram), SFC (Sequential Functional Chart), will be available soon

Note 9 The input state is acquired downstream the t_{ON} and t_{OFF} timers

3.9 MEASURES

More data (range and accuracy) are available inside Section 5 - MEASURES, LOGIC STATES AND COUNTERS

□ Accuracy (type tests)

MEASURE	Reference values	Accuracy	Reference values	Accuracy
Phase current	0.1 I_n	0.2%	1 I_n	0.03%
Measured residual current	0.01 I_{En}	0.3%	1 I_{En}	0.02%
Frequency	0.02 U_n	3 mHz	1 U_n	2 mHz
Pickup and operate time	1.5 x setting for first element	5% ± 10 ms	2.5 x setting for other elements	5% ± 10 ms

□ Measures

Direct

Frequency	(f)
RMS value of the fundamental component for phase currents	(I_{L1}, I_{L2}, I_{L3})
RMS value of the fundamental component for residual current	(I_E)
Calculated residual current ^[1]	(I_{Ec})

Calculated

Maximum current between I_{L1} - I_{L2} - I_{L3}	(I_{Lmax})
Minimum current between I_{L1} - I_{L2} - I_{L3}	(I_{Lmin})
Average current between I_{L1} - I_{L2} - I_{L3}	(I_L)

2nd harmonic

Second harmonic component of phase currents	($I_{L1-2nd}, I_{L2-2nd}, I_{L3-2nd}$)
Maximum of the 2nd harmonic phase currents/fundamental component ratio	(I_{-2nd}/I_L)

3rd harmonic

Third harmonic component of phase currents	($I_{L1-3rd}, I_{L2-3rd}, I_{L3-3rd}$)
Third harmonic component of residual current	(I_{E-3rd})

4th harmonic

Fourth harmonic component of phase currents	($I_{L1-4th}, I_{L2-4th}, I_{L3-4th}$)
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5h harmonic

Fifth harmonic component of phase currents	($I_{L1-5th}, I_{L2-5th}, I_{L3-5th}$)
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On demand

Phase fixed currents demand	($I_{L1FIX}, I_{L2FIX}, I_{L3FIX}$)
Phase rolling currents demand	($I_{L1ROL}, I_{L2ROL}, I_{L3ROL}$)
Phase peak currents demand	($I_{L1MAX}, I_{L2MAX}, I_{L3MAX}$)
Phase minimum currents demand	($I_{L1MIN}, I_{L2MIN}, I_{L3MIN}$)

PT100^[2]

Temperature PT1	(T_1)
Temperature PT2	(T_2)
Temperature PT3	(T_3)
Temperature PT4	(T_4)
Temperature PT5	(T_5)
Temperature PT6	(T_6)
Temperature PT7	(T_7)
Temperature PT8	(T_8)

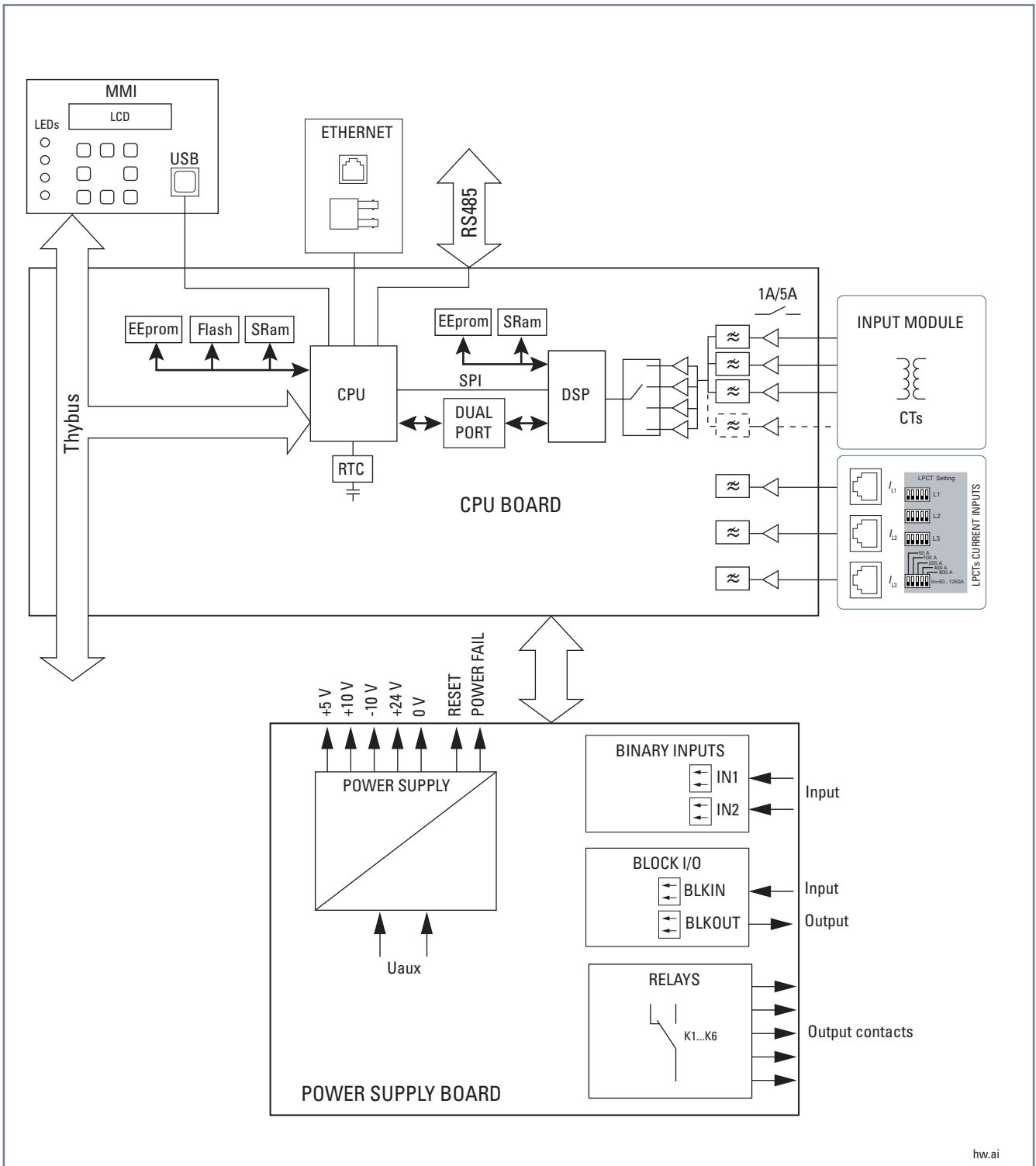
Note 1 The computed residual current (vector sum of the phase currents) is provided for NA11 protection relays equipped with LPCT sensor inputs

Note 2 The temperature measuring is acquired by means of RTD probes Pt100 (eight Pt100 inputs with one MPT module); if the module is not available the concerning measure is meaningless.

4 FUNCTION CHARACTERISTICS

4.1 HARDWARE DESCRIPTION

The following figure illustrates the basic structure of the NA11 relay



Printed boards hold the circuit components arranged according to a modular allocation of the main functions.

Power supply board

All the components necessary for conversion and stabilization functions are present. Two versions are envisaged suited to the input ranges 24...48 V and 115...230 V. The circuit provides stabilized voltages of +10 V and -10 V, required for the analogue measurement, +24V for relays and +5 V for supplying the digital circuits.

The circuit board additionally comprises:

INPUT CIRCUITS:

- Two binary input circuits,
- One block input circuit (BLIN1).

The logical input circuits and the block circuits include photo-couplers which provide for galvanic separation.

OUTPUT CIRCUITS:

- One block output circuit (BLOUT 1),
- Six output relays (k1...K6).

CPU board

This circuit board contains all the circuits necessary for performing the analogue and digital processing of the signals.

Analog processing

The following are envisaged:

- Anti aliasing filter circuits,
- Amplifier circuits for conditioning the input signals,
- Reference voltage adjustment circuits for the measurement A/D converter.

The Pro-n relays use a DSP processor operating at 40 MHz; it performs all the processing on the analogue signals and furthermore coordinates management of the TX-RX signals to the CPU.

The input currents are sampled at a frequency of 24 samples per period by means of a dual conversion system which allows the attainment of information pertaining to polarity and amplitude with high resolution. The measurement criterion allows precise measurement of even those signals having a unidirectional component, such as transient currents with overlapping exponential, which typically appear during faults.

The circuit board also houses the output relays with the corresponding command and control circuits, communication circuits, buttons, LCD display, LEDs and the key switch.

CPU

A 32 bit CPU is provided.

The following are envisaged:

- Real Time Clock circuits with oscillator and super capacitor,
- USB communication port,
- RS485 communication port,
- Thybus communication circuits for external modules and MMI board,
- Network communication circuits (optional Ethernet).

Memories:

- SRam: high speed static memory, used for data and cache,
- Flash memory: used for fw storage and upgrade,
- EEprom memory: used for calibration data storage,
- Dual port Ram for data transfer between CPU and DSP.

Input board

- Three CTs committed for phase currents acquisition (traditional CTs^[1] or Low Power Current transformer,
- One CT committed for residual current acquisition,^[2]

MMI (keyboard, LED and display)

The MMI module (Man Machine Interface) includes:

- An eight keys 8 keyboard,
- a backlight LCD display,
- Eight signalling LEDs,

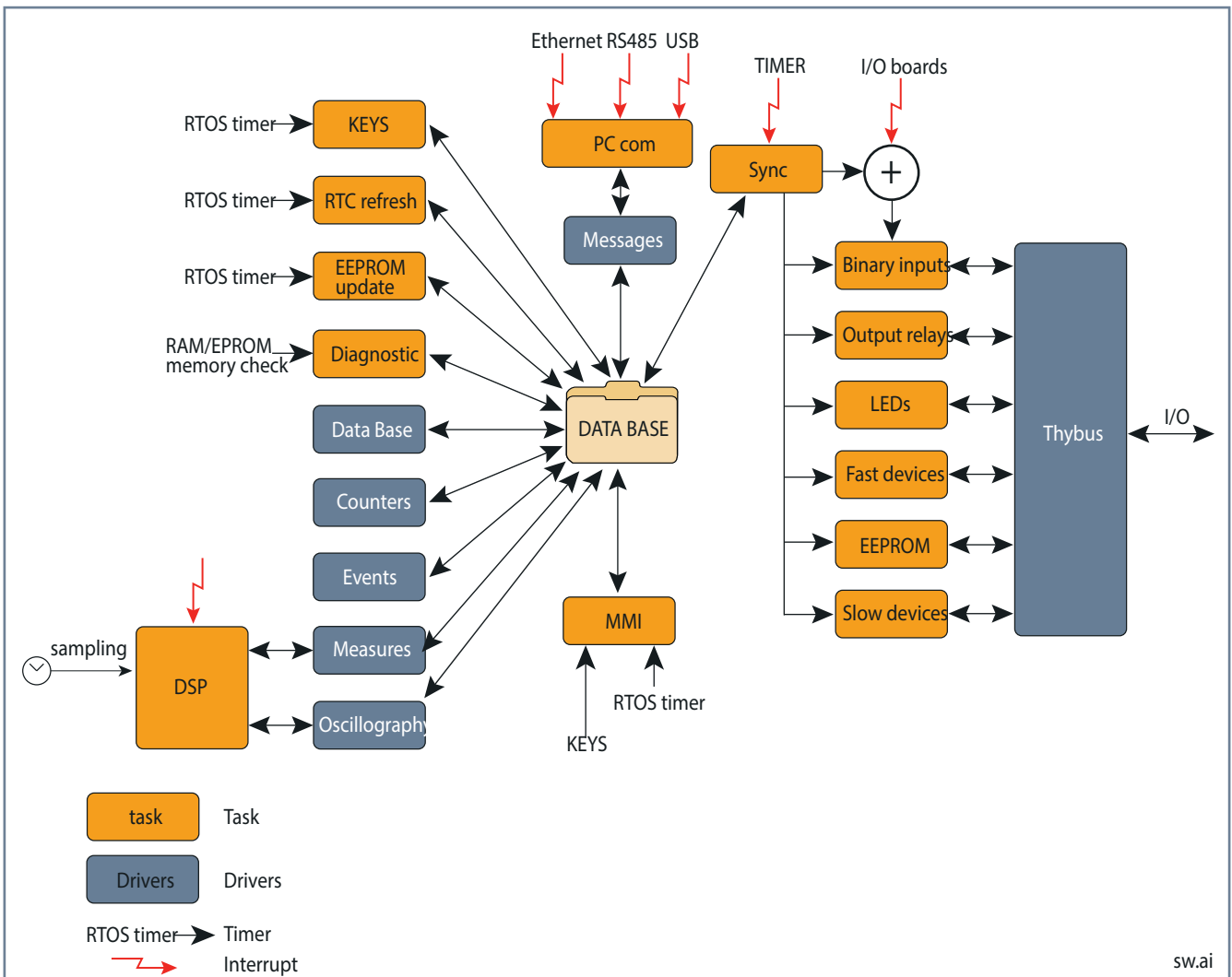
The removable plug allows separation of the MMI module for free access to the CPU board when DIP-switch setting is required.

Note 1 The phase and residual nominal currents must be adjusted by means dip-switch.

Note 2 Not available with LPCT input versions

4.2 SOFTWARE DESCRIPTION

The program which handles operation of the Pro-N relays is made up of three fundamental elements shown in the following block diagram.



Base software

Single modules are application independent with modular and scalable structure. The system can be assimilated to the PC BIOS (Basic Input-Output System); three main function are provided:

- Start-up test execution;
- RAM loading of the operating system;
- Provide a suitable interface to access the relay hardware.

Real-time operating system

An embedded operative system is employed suitable for real-time applications (RTOS). A multithread preemptive structure is able to manage several task with multiple priority levels . The kernel represents the nucleus of the system: it includes the processing functions closest to the electronic circuits.

In addition, the kernel manages a service communication protocol known as Basic Protocol (BP).

Task

The task (process e thread) are the base components.

- Example are:
- Keyboard management
 - RTC (Real Time Clock) updating
 - RAM/EEPROM updating
 - Diagnostic
 - Input acquisition
 - Output relay management
 - MMI
 - I/O updating
 - DSP data processing

Firmware DSP

By means of Discrete Fourier Transform calculation, based on 24 samples/period, information is deduced in relation to the amplitude and phase of all the current measurements; these are constantly updated and at the disposal of all the protection and control application algorithms.

Drivers

Inside the driver library, all the specialized module for protection and control function are provided. They are the link from kernel and application layer. Examples are:

- Data base management
- PC messages management
- TCP/IP messages management
- Basic Protocol management
- Counter management
- Event and fault management
- Measuring management
- Oscillography management

Application Software

The software acts the specialization of the base system; all protective and control elements are inside it.

The main modules are:

- Diagnostic function for application layer,
- Input management (binary inputs),
- Protective functions,
- Event recording,
- Output management (LEDs and relays)

Each element (Kernel, Drivers and Application) may, in turn, be split into modules:

Base protocol (kernel)

The module known as the Basic Protocol (BP) manages the service communication between the kernel and the other modules through the communication buses with the following services:

- Data and information exchange,
- Calibration,
- Upgrade fw DSP,
- Upgrade application sw

Communication (drivers)

The ModBus TCP/IP protocol, with ethernet interface, the ModBus RTU, IEC 60870-5-103 and DNP3 protocol over RS485 interface and the ModBus RTU on USB for ThyVisor are provided.

MMI (drivers)

The drivers deal with the menu management (MMi and/or communication messages).

Data Base

The data base is split into three main sections:

- RAM for volatile data,
- REE and PAR for non volatile data.

Self test (Application)

The main hw and sw function are permanently verified in background; no additional delay are introduced.

In particular the following function are tested:

- Reference voltages;
- Output relays;
- Sw flow with execution time monitoring;
- REE and PAR data congruence.

Development tools (Builder)

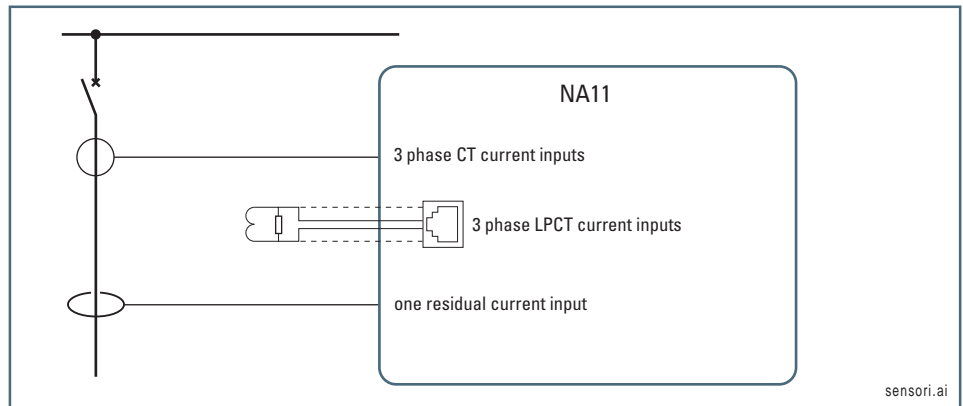
For the development of the project, a CASE instrument has been developed, responsible for the optimized production of software code for the management of collaboration, the database and the MMI data and the Xml files used for communication. The automatic code generation criteria ensures the quality of the result in terms of the reusability, verifiability and maintainability of the software life cycle.

4.3 I/O DESCRIPTION

Metering inputs

The following input are provided:

- Three phase current inputs for traditional CTs or LPCTs (Low Power Current Transformers).
- One residual current input for traditional CT versions.
- The nominal currents are independently adjustable through DIP-switches.



The input circuits are appropriately dimensioned in order to withstand the currents which arise when a fault occurs, both in transient and steady state condition.

Signal processing

Various processing levels are involved:

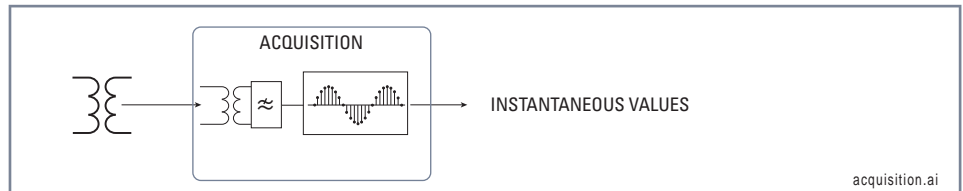
- Acquisition (base level).
- Direct measures of physical channels (first level).
- Calculated measures (second level).
- Derived (third level).

The measures concerning a level are based on data worked out in the previous level.

For each level the required resources concerning the priority for tasks (conditioning circuits, DSP and CPU) are on hand.

ACQUISITION (base level)

The input signals are sampled 24 times per power cycle



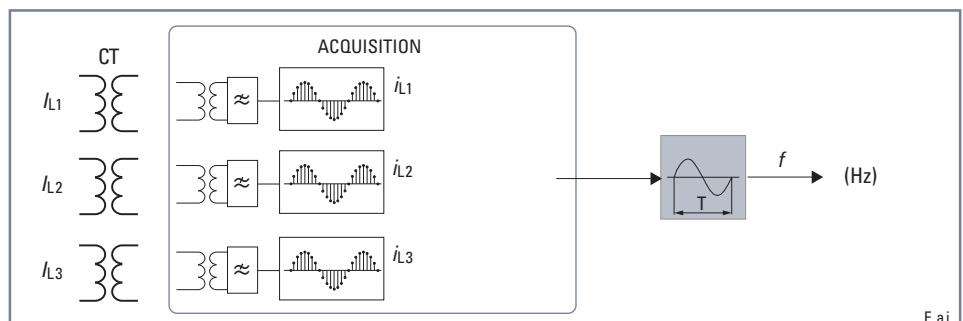
- $i_{L1}...i_{L3}$ phase currents instantaneous value
- i_E residual current instantaneous value^[1]

From the sampled quantities, several measures are computed for protection, monitoring and metering purposes.

- Direct
- Calculated
- Harmonics
- On demand

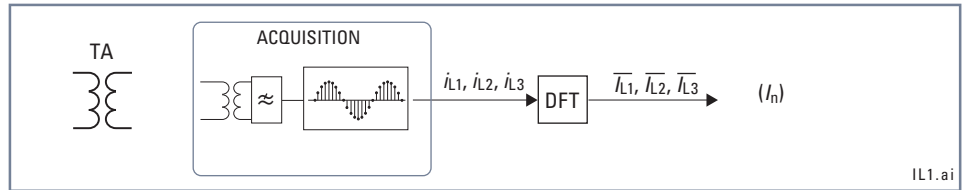
Direct

- Power frequency.

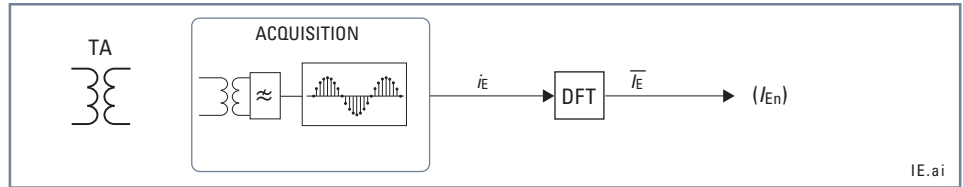


Samples are processed by means DFT (Discrete Fourier Transform) algorithm and the phase and amplitude of fundamental are computed:

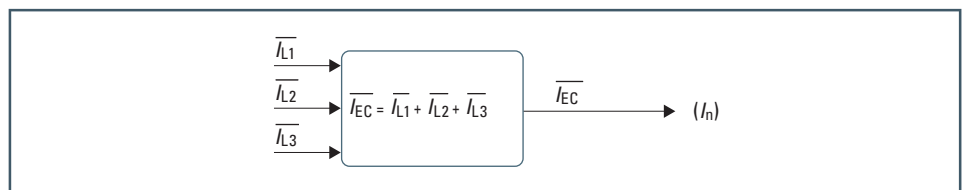
- Phase currents I_{L1}, I_{L2}, I_{L3}



- Measured residual current I_E (Traditional CT input versions)



- Fundamental component of the calculated residual current $I_{EC}^{[1]}$



Calculated

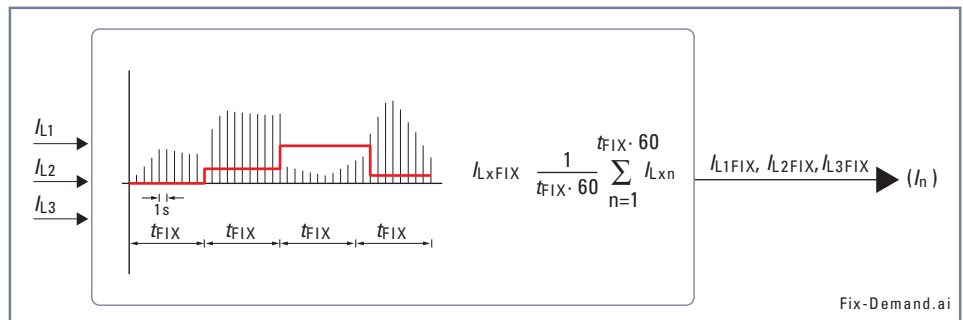
For the following measures, the RMS value of fundamental component is returned:

- Maximum current between $I_{L1}-I_{L2}-I_{L3}$ (I_{LMAX})
- Minimum current between $I_{L1}-I_{L2}-I_{L3}$ (I_{LMIN})
- Average current between $I_{L1}-I_{L2}-I_{L3}$ (I_L)

On demand

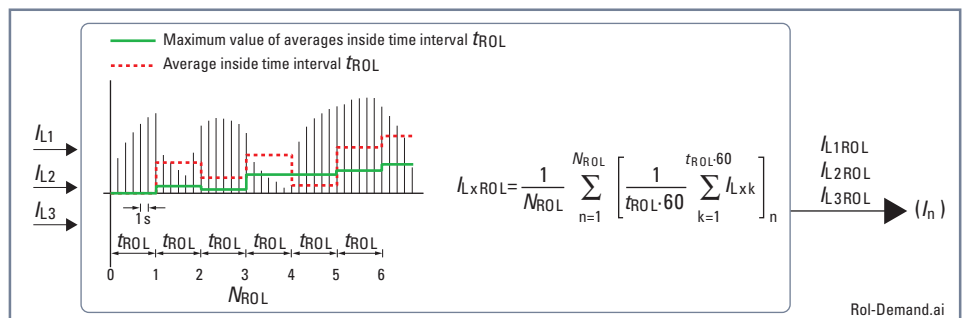
- Fixed demand ($I_{L1FIX}, I_{L2FIX}, I_{L3FI}$)

Inside an adjustable time interval t_{FIX} , an average magnitude is calculated for phase currents I_{L1}, I_{L2}, I_{L3} of measures taken every second. The average values are stored at the end of the same time interval.



- Rolling demand ($I_{L1ROL}, I_{L2ROL}, I_{L3ROL}, \pm P_{ROL}, \pm Q_{ROL}$)

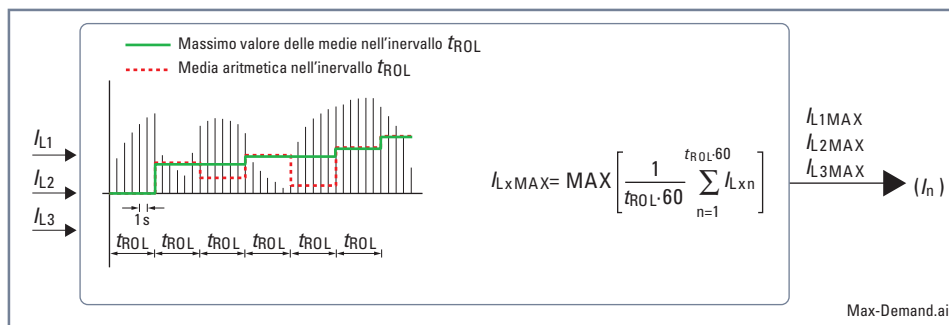
Inside an adjustable time interval $N_{ROL} \cdot t_{ROL}$, an average magnitude is calculated for phase currents I_{L1}, I_{L2}, I_{L3} of measures taken every second, where t_{ROL} is the length of any time subinterval and N_{ROL} is the number of the time intervals. The average values are stored at the end of the same time subinterval.



Note 1 In versions with LPCT inputs, the residual current is available as computed measure I_{EC} .

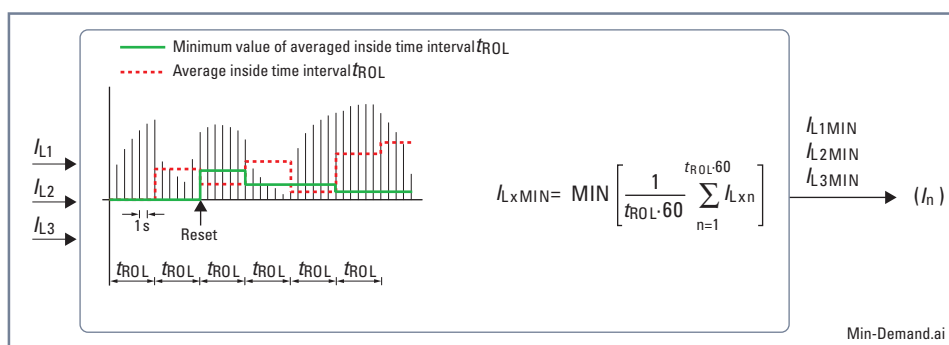
• Peak (I_{L1MAX} , I_{L2MAX} , I_{L3MAX})

Inside an adjustable time interval t_{ROL} , the maximum magnitude is calculated for phase currents I_{L1} , I_{L2} , I_{L3} of measures taken every second. The average values are stored at the end of the same time interval t_{ROL} (Rolling demand common parameter).



• Minimum (I_{L1MIN} , I_{L2MIN} , I_{L3MIN})

Inside an adjustable time interval t_{ROL} , the minimum magnitude is calculated for phase currents I_{L1} , I_{L2} , I_{L3} of measures taken every second. The average values are stored at the end of the same time interval t_{ROL} (Rolling demand common parameter).

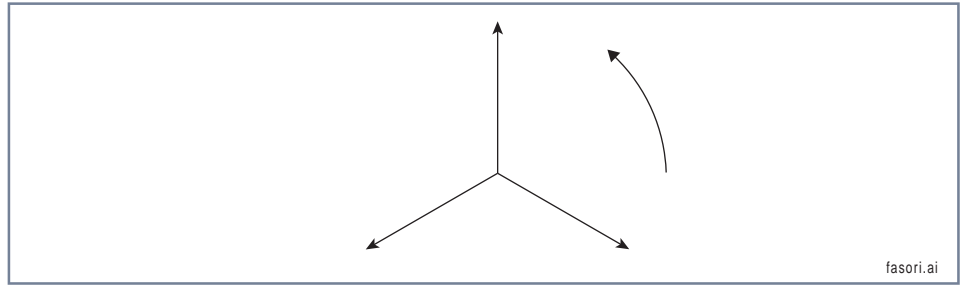


Use of over-described measures is shown in the following tables.

Conventions

Phase rotation direction

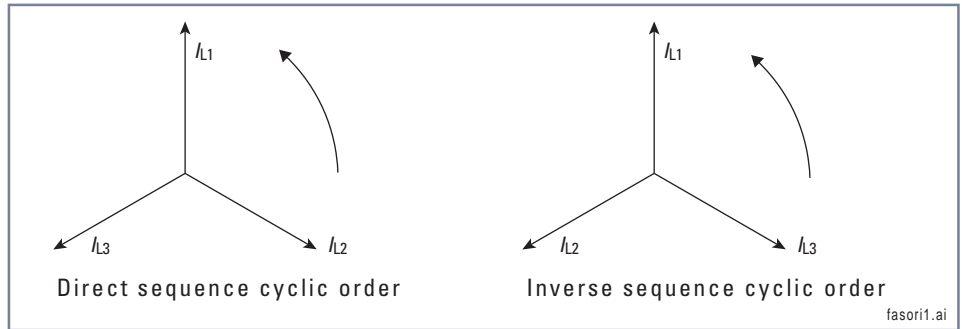
The conventional rotation direction for the current phasors is counter-clockwise.



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Cyclic phase sequence order

For three phase rotating currents, a direct cyclic sequence is defined when the three phases are L1, L2, L3 ordered, while an inverse cyclic sequence is defined when the three phases are L1, L3, L2 ordered..



Direct sequence cyclic order

Inverse sequence cyclic order

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Use of measured values

	f	I_{L1}, I_{L2}, I_{L3}	I_{L1}, I_{L2}, I_{L3}	$I_{L1-2nd}, I_{L2-2nd}, I_{L3-2nd}$	I_E	I_E	Temperature (PT1...PT8)	Binary inputs IN1, IN2	Start (START) Relays K1...K6	Trip (TRIP) Relè K1...K6	Start (START) LEDs L1...L5	Trip (TRIP) LEDs L1...L5	Selective block input - BLIN1	Selective block output BLOUT1	Cold Load Pickup (CLP)	Second harmonic restraint	Logic block - BLOCK1	Selective block - BLOCK2
PROTECTION																		
Thermal with Pt100 probes (26)							■											
Phase overcurrent (50/51)		■						■	■	■	■	■	■	■	■	■	■	■
Residual overcurrent (50N/51N)					■			■	■	■	■	■	■	■	■	■	■	■
Breaker failure (BF)		■				■		■	■	■	■	■					■	
CONTROL and MONITORING																		
CT Monitoring (74CT)		■																■
Trip Circuit Supervision (TCS)							■											
Second harmonic restraint (2NDH-REST)				■														
Logic block (BLOCK1)							■											
Selective block (BLOCK2)							■					■	■					
Diagnostic											■		■	■				
Element states																	■	
Binary input states								■										
Selective block state (Block2)												■	■					
Output relay states								■	■	■	■							
MEASURES																		
Frequency	■																	
Phase currents		■																
Residual current					■													
Temperature (Pt100 on MPT module)						■												
EVENT RECORDER																		
Event 0								■	■	■	■	■						
Event 1								■	■	■	■	■						
Event ...								■	■	■	■	■						
Event 299								■	■	■	■	■						
FAULT RECORDER																		
Fault 0		■			■			■	■	■	■	■						
Fault 1		■			■			■	■	■	■	■						
Fault ...		■			■			■	■	■	■	■						
Fault 19		■			■			■	■	■	■	■						
OSCILLOGRAPHY																		
Record 1	■	■	■	■	■	■	■	■	■	■	■	■				■		
Record 2	■	■	■	■	■	■	■	■	■	■	■	■				■		
Record ...	■	■	■	■	■	■	■	■	■	■	■	■				■		

Binary inputs

Two or five (optional) binary inputs are available.

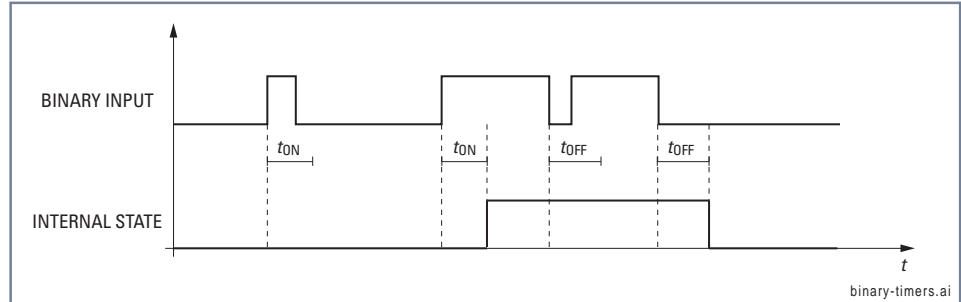
The dry inputs must be powered with an external voltage, (usually the auxiliary power supply).

The connections are shown in the schematic diagrams.

The following settings can be used to configure each input:

- Logic Active-ON (activated when powered), or Active-OFF (activated when power is turned off).
- ON Timer (OFF-to-ON time delay) and OFF Timer (ON-to-OFF time delay).
- Binary input allocation.

Adjustable debounce timer allows any transient to decay avoiding false activation of the input; the positive transition is acquired if the input is permanently high for a time interval longer than the t_{ON} setting delay; similarly for the negative transitions, the negative transition is acquired if the input is permanently high for a time interval longer than the t_{OFF} setting delay.



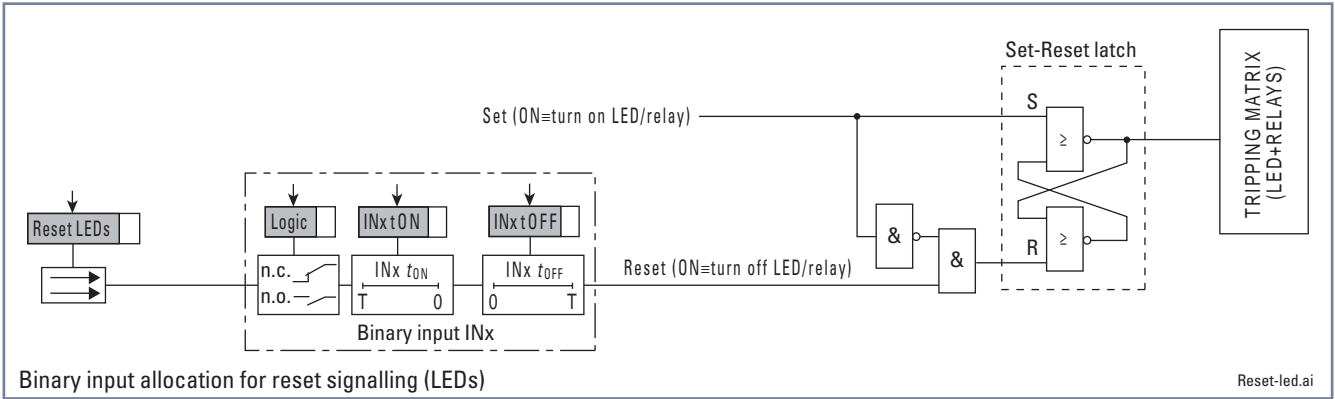
In the above shown diagram, INTERNAL STATE represents the logical state of the binary input used in the following processing.

Each binary input may be matched to one of the following default functions.

FUNCTIONS	Binary inputs		
	IN1	IN2	INx
Reset LEDs	■	■	■
Set profile (switching setting A and B))	■	■	■
Fault trigger (fault recording)	■	■	■
Block2 IPh/IE (selective block from phase and/or ground elements)	■	■	■
Block2 IPh (selective block from phase elements)	■	■	■
Block2 IE (selective block from ground elements)	■	■	■
Block1 (logic block)	■	■	■
TCS1 (Trip Circuit Supervision)	■	■	■
TCS2 (Trip Circuit Supervision)	■	■	■
Trip ProtExt (trip from external protection relays)	■	■	■
Reset counters	■	■	■
Reset CB Monitor (clear CB monitoring data)	■	■	■
52a (CB auxiliary contact)	■	■	■
52b (CB auxiliary contact)	■	■	■
Open CB	■	■	■
Close CB	■	■	■
Remote trip	■	■	■
Reset on demand measures	■	■	■
79 Enable	■	■	■
79 Block	■	■	■
79 External	■	■	■

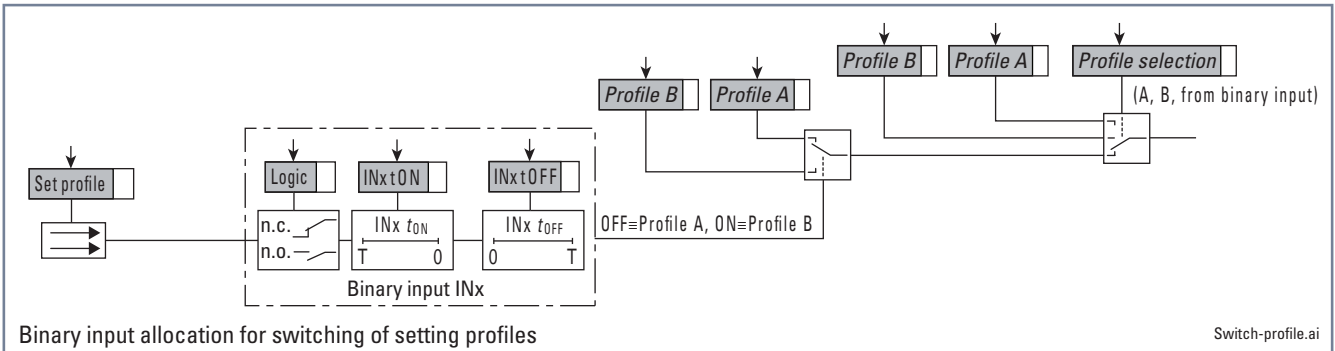
Reset LEDs

If the element tripped have gone back to rest condition, the latched LEDs and/or relays may be reset.



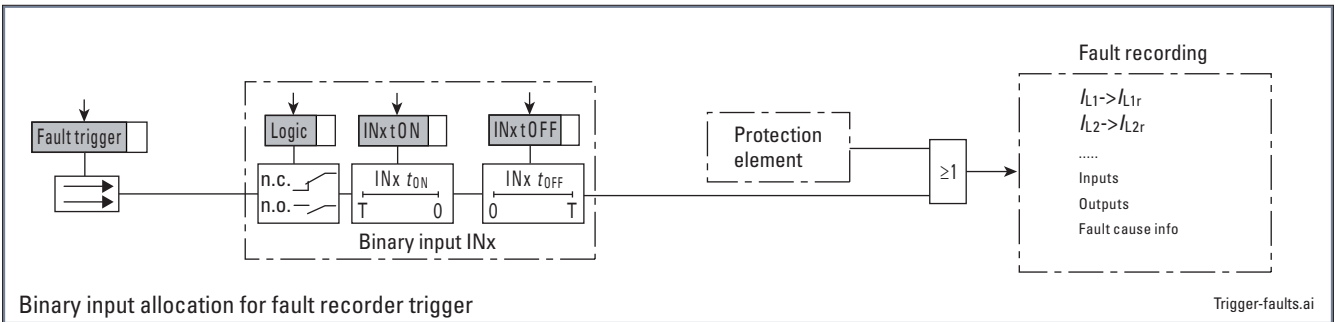
Set profile

Inside Pro-N devices, two independent setting profiles (A and B) are available. Whereas different settings are required, they are made in the setting profiles and stored in the non volatile memory of relay. Applicable setting profile is activated usually via a binary input; when the programmed input is activated, the profile B becomes operative as a replacement for the default profile A.^[1]



Fault trigger

When the programmed input is activated, a trigger is issued for fault record SFR). Data storing takes place with the same procedure resulting from a trip of any protective elements.



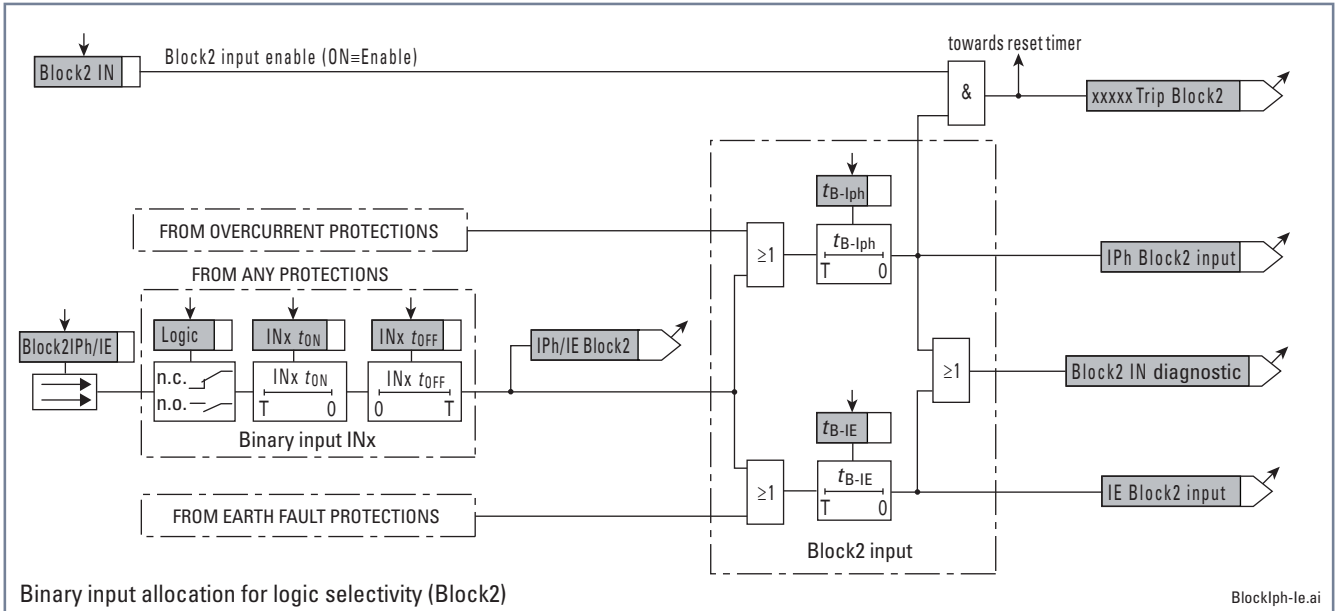
Note 1 To enable the profile switching the "Input-selected" parameter must be set inside the "Profile selection" submenu.
If multiple setting groups are not required, Group A is the default selection

Block2 IPh/IE

A change in status of a binary input effects a block^[1] common for the following phase and ground protective elements:

- $I>$, $I>>$ and $I>>>$ (50/51), and ground fault:
- $I_E>$, $I_E>>$ and $I_E>>>$ (50N/51N).

The application of the IN1 and INx binary inputs for the acquisition of Block2 (selective block) coming from external protection relays is shown in the following figure (one phase overcurrent and one phase and residual overcurrent protection).



Block2 IPh

A change in status of a binary input effects a block^[2] for the following phase protective elements:

- $I>$, $I>>$ and $I>>>$ (50/51)

Block2 IE

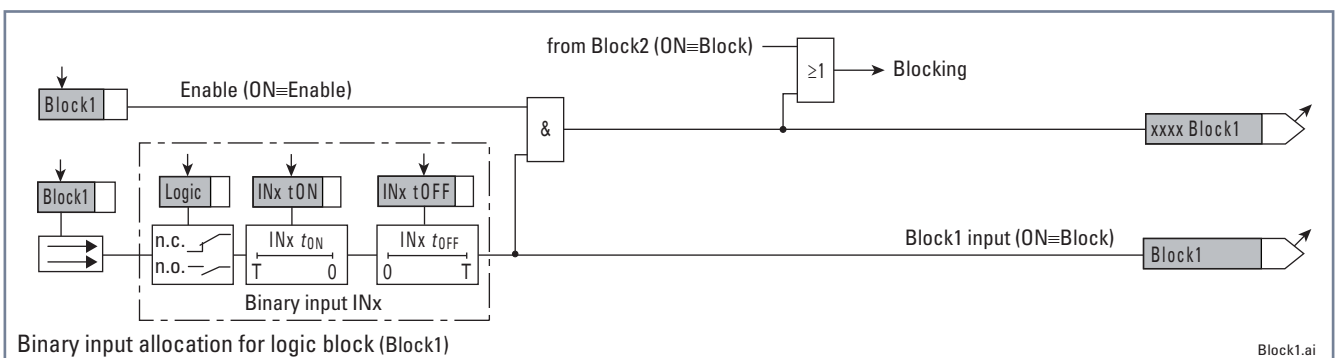
A change in status of a binary input effects a block^[1] for the following earth protective elements:

- $I_E>$, $I_E>>$ and $I_E>>>$ (50N/51N)

Block1

A change in status of a binary input effects a block for a length of time equal to the activation of the input^[3]; the element pickup that wish be blocked must be enabled (the *Block1* parameter must be set to *ON* in the concerning menu).^[4]

The application of the IN1 binary input for the acquisition of the Block1 (logic block) coming from external signal is shown in the following figure; in the example the block signal is ORed with Block2 (selective block) to block the generic (xxx) element.



Note 1 The exhaustive treatment of the Block 2 function is described in the "Logic selectivity" paragraph.

Note 2 The exhaustive treatment of the Block 2 function is described in the "Logic selectivity" paragraph.

The application of the inputs for the acquisition of Block2 (selective block) for Phase (Block2 Iph) and earth protective functions (Block2 IE) is similar to that illustrated in the scheme concerning the Block2 IphIE

Note 3 Unlike the Block2 (selective block), that houses a safety logic founded on programmable timers, the Block1 (logic block) keeps block of the protection for the whole time when the input is active.

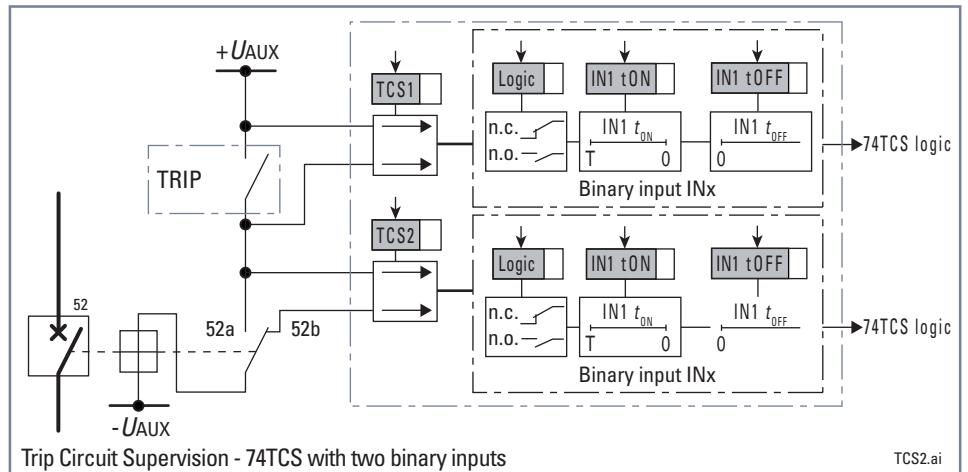
Note 4 The activation of one binary input produces indiscriminately a block of all protective elements programmed for being blocked from Block1

TCS1 and TCS2

Trip Circuit Supervision.

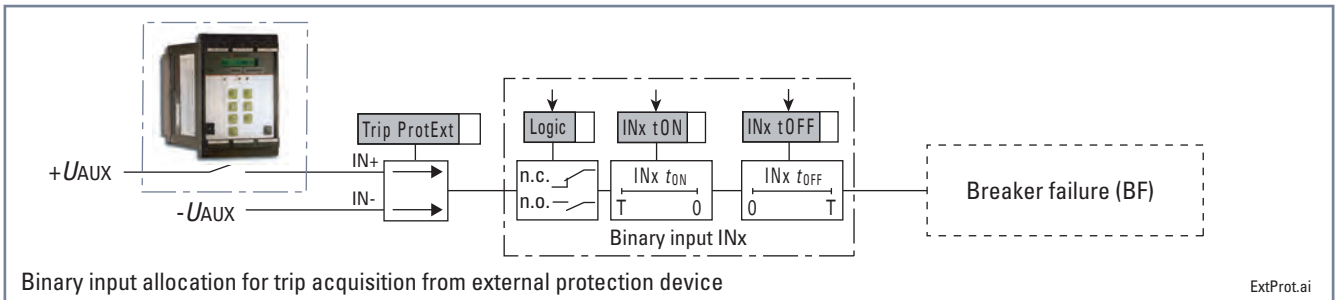
Supervision with one or two binary input can be performed.

The exhaustive treatment of the TCS function is described in the concerning paragraph.



Trip ProtExt

The binary input detects a trip coming from an external protective relay; the information is available for the breaker failure function (BF).



Reset counters

A change in status of a binary input effects a reset of all start/trip partial counters.^[1]

Reset CB Monitor

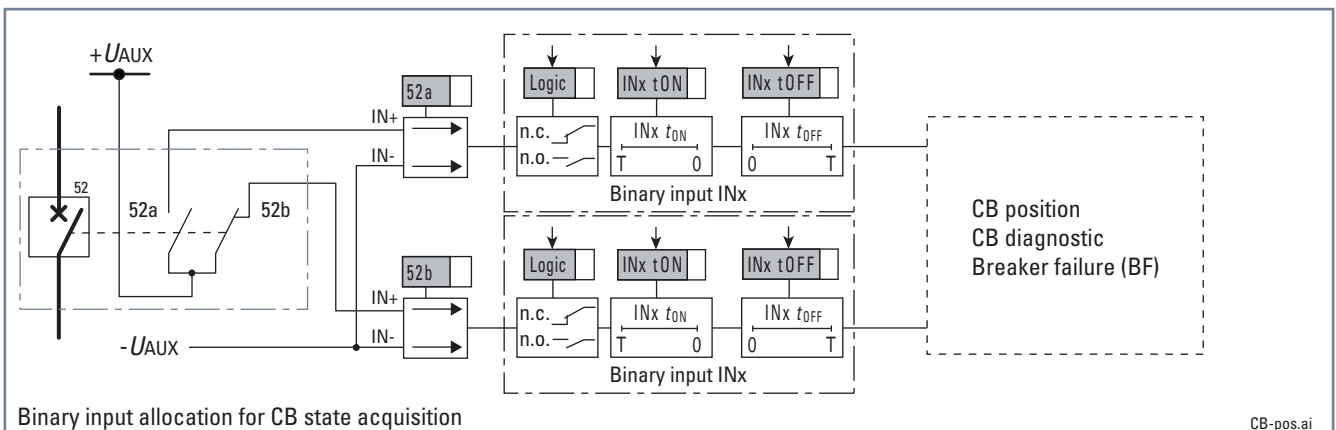
A change in status of a binary input effects a reset of all counters concerning the circuit breaker diagnostic:

- Breaking Sum phase I_{L1}
- Breaking Sum phase I_{L2}
- Breaking Sum phase I_{L3}
- Breaking Sum I^2t phase I_{L1}
- Breaking Sum I^2t phase I_{L2}
- Breaking Sum I^2t phase I_{L3}
- CB Open counter

52a and 52b

The CB position can be acquired by means of binary inputs connected to the auxiliary contacts: the information is used in the following functions:

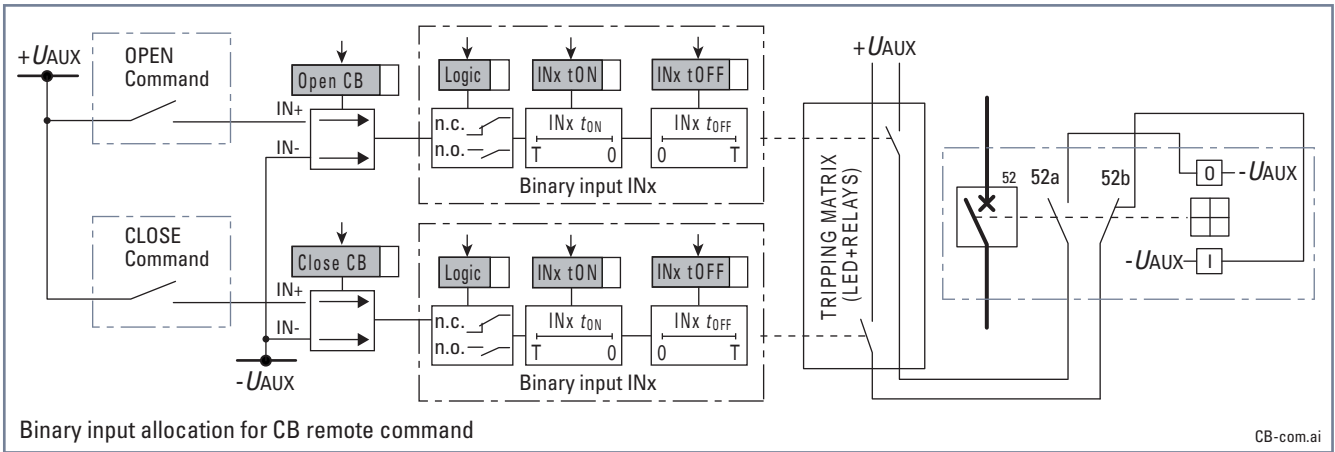
- CB position (open-closed)
- CB diagnostic (N. of operations, trip time)
- Breaker Failure (BF)



Note 1 The reset of the total counters is practicable by means ThyVisor command with Session Level 1 (available with password)

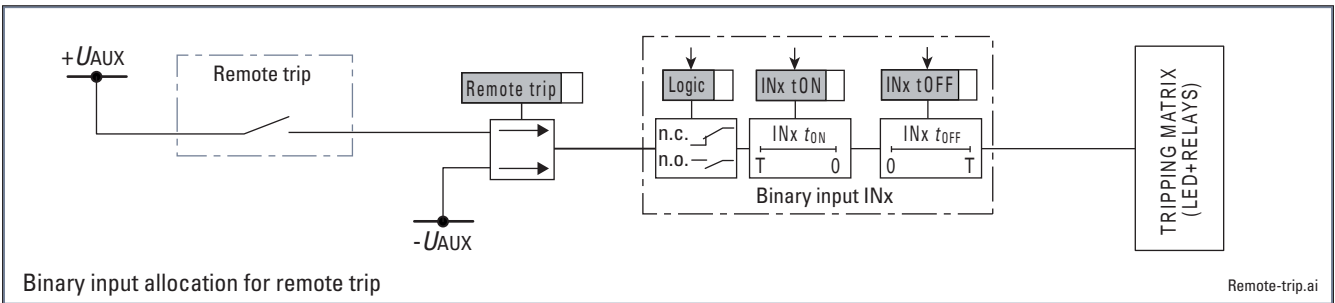
Open CB
Close CB

The external acquisition of remote commands allows to drive CB remotely



Remote trip

The input activation drives an expressly programmed output relay and LED.



Reset demand measures

The input activation makes a reset of all demand measures.

79 Enable

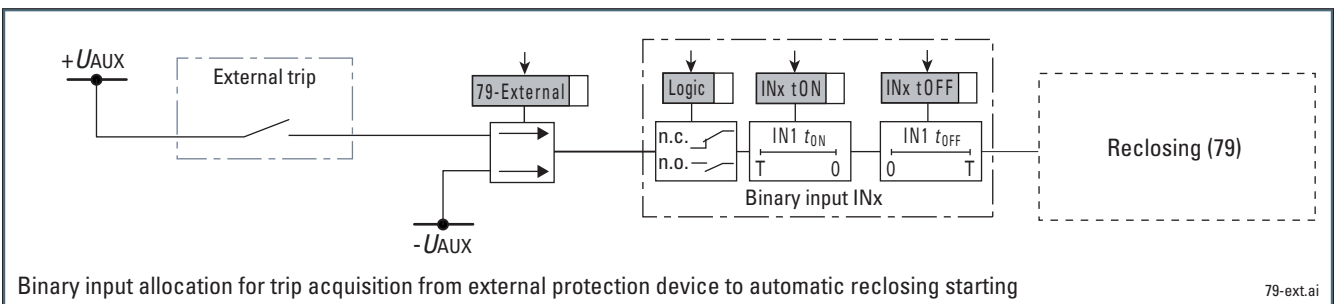
The input activation enables the auto reclosing function.

79 Block

The input activation disables the auto reclosing function.

79 External

The input activation starts the automatic reclosing sequence.



Output relays

Six output relays are available (K1...K6):^[1]

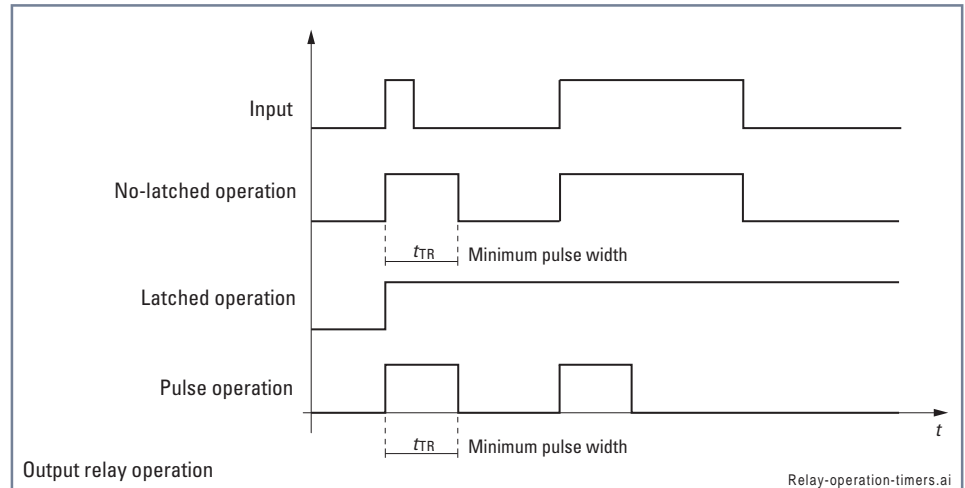
- K1 and K2 have two changeover contacts (SPDT, type C).
- K3, K4 and K5 have one make contact (SPST-NO, type A).^[2]
- K6 has one break contact (SPST-NC, type B).^[3]

Each output relay may be programmed with following operating mode:

- *Operation MODE (No latched, Pulse, Latched)*.
- *Logic (Energized/De-energized)*.

To each output relay a programmable timer is matched (*Minimum pulse width* parameter).

All parameters are available inside the **Set/Relays** menu.



Any change to the settings can be affected at any time, also with the relay on duty, separately for each relay.

Notes:

- When de-energized operating mode is set, the relay remains in rest condition if no trip command is in progress.
- When energized operating mode is set, the relay remains in operating condition if no trip command is in progress and the auxiliary supply is powered on.
- When no-latched operating mode is set (*Operation MODE No latched*), the output relay reset at the end of the trip condition. To each output relay a programmable timer is matched (minimum pulse width operation).
- When latched operating mode is set (*Operation MODE Latched*), the output relay doesn't reset at the end of the trip condition; it stays ON until a reset command is issued (RESET key, ThyVisor or communication command).
- When pulse operating mode is set (*Operation MODE Pulse*), the output relay reset after a t_{TR} programmable delay regardless of the trip condition.
- It is advisable to make sure that the output contact technical data are suitable for load (Nominal current, breaking capacity, make current, switching voltage,...).

Matching every output relay to any protective element is freely programmable inside the *Setpoints* submenus according a tripping matrix structure.^{[4][5]}

Note 1 Schematic diagram are shown inside APPENDIX B1.

Note 2 K3 and K4 have a common terminal (A10)

Note 3 K5 and K6 have a common terminal (A13)

Note 4 Matching of the output relay to the protective and control functions can be defined so that any collision from other function is avoided. All output relay are unassigned in the default setting.

Note 5 Self test relay: it is advisable to plan the following settings:

- Energized operating mode,
- No-latched ,

in order that it stays ON for normal conditions and the other way round it goes OFF if any fault is detected and/or the auxiliary supply turns OFF.

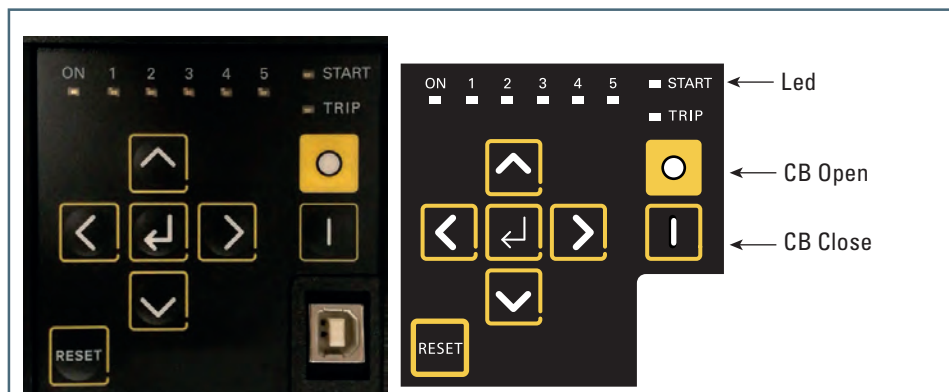
PROTECTION FUNCTIONS	RELAYS					
	K1	K2	K3	K4	K5	K6
Self-test relay	■	■	■	■	■	■
26 Alarm element (Pt1AL-K...Pt8AL-K)	■	■	■	■	■	■
26 Trip element (Pt1TR-K...Pt8TR-K)	■	■	■	■	■	■
I> Start relays (I>ST-K)	■	■	■	■	■	■
I> Trip relays (I>TR-K)	■	■	■	■	■	■
I>> Start relays (I>>ST-K)	■	■	■	■	■	■
I>> Trip relays (I>>TR-K)	■	■	■	■	■	■
I>>> Start relays (I>>>ST-K)	■	■	■	■	■	■
I>>> Trip relays (I>>>TR-K)	■	■	■	■	■	■
IE> Start relays (IE>ST-K)	■	■	■	■	■	■
IE> Trip relays (IE>TR-K)	■	■	■	■	■	■
IE>> Start relays (IE>>ST-K)	■	■	■	■	■	■
IE>> Trip relays (IE>>TR-K)	■	■	■	■	■	■
IE>>> Start relays (IE>>>ST-K)	■	■	■	■	■	■
IE>>> Trip relays (IE>>>TR-K)	■	■	■	■	■	■
I2ndh> Start relays (I2ndh>ST-K)	■	■	■	■	■	■
I2ndh> Trip relays (I2ndh>TR-K)	■	■	■	■	■	■
S< Trip relays (S<TR-K)	■	■	■	■	■	■
74TCS Start relays (74TCS-ST-K)	■	■	■	■	■	■
74TCS Trip relays (74TCS-TR-K)	■	■	■	■	■	■
tB-IPh/IE Elapsed signalling relays (tB-K)	■	■	■	■	■	■
Phase protection output selective block relays (BLK2OUT-Iph-K)	■	■	■	■	■	■
Ground protection output selective block relays (BLK2OUT-IE-K)	■	■	■	■	■	■
Phase and ground protection output selective block relays (BLK2OUT-Iph/IE-K)	■	■	■	■	■	■
BF Start relays (BF-ST-K)	■	■	■	■	■	■
BF Trip relays (BF-TR-K)	■	■	■	■	■	■
Cycle in progress (79-Run-K)	■	■	■	■	■	■
Reclosure (79-AR-K)	■	■	■	■	■	■
Reclosure fail (79-Fail-K)	■	■	■	■	■	■
Number of CB trips diagnostic relays (N.Open-K)	■	■	■	■	■	■
Cumulative CB tripping currents diagnostic relays (SumI-K)	■	■	■	■	■	■
Cumulative CB tripping I ² t diagnostic relays (SumI ² t-K)	■	■	■	■	■	■
Circuit breaker opening time diagnostic relays (tbreak-K)	■	■	■	■	■	■
Open CB command relays (CBopen-K)	■	■	■	■	■	■
Close CB command relays (CBclose-K)	■	■	■	■	■	■
Remote tripping relays (RemTrip-K)	■	■	■	■	■	■
Not received pulses at BLIN signalling relays (PulseBLIN-K)	■	■	■	■	■	■

LED indicators

Eight LEDs are available.

- One green LED "ON": if turned on it means that the device is properly working, if flashing the internal self-test function has detected an anomaly.
 - One yellow LED "START" tagged for START of one or more protective elements.^[1]
 - One red LED "TRIP" tagged for TRIP of one or more protective elements.^[1]
 - Five red LEDs "1...5" for highlight the activation of one or more user defined function.
- Each output relay may be programmed with following operating mode:
- No-latched: the LED reset at the end of the trip condition.
 - Latched: the LED doesn't reset at the end of the trip condition; it stays ON until a manual reset command is issued (RESET key, ThyVisor or communication command).

Any change to the settings can be affected at any time, also with the relay on duty, separately for each LED; the concerning parameters are available inside the **Set \ LEDs** menu.



Free allocation of each LED may be set according to the matrix structure shown in the following page.^[2]

Note 1 The START and the TRIP LED are user assignable to any function; other than starting and tripping information can be assigned to them too, just the same for L1...L5

Note 2 All LEDs are unassigned in the default setting.

PROTECTION FUNCTIONS	LED					
	START TRIP	1	2	3	4	5
26 Alarm threshold (Pt1AL-L...Pt8AL-L)	■	■	■	■	■	■
26 Trip threshold (Pt1TR-L...Pt8TR-L)	■	■	■	■	■	■
I> Start LEDs (I>ST-L)	■	■	■	■	■	■
I> Trip LEDs (I>TR-L)	■	■	■	■	■	■
I>> Start LEDs (I>>ST-L)	■	■	■	■	■	■
I>> Trip LEDs (I>>TR-L)	■	■	■	■	■	■
I>>> Start LEDs (I>>>ST-L)	■	■	■	■	■	■
I>>> Trip LEDs (I>>>TR-L)	■	■	■	■	■	■
IE> Start LEDs (IE>ST-L)	■	■	■	■	■	■
IE> Trip LEDs (IE>TR-L)	■	■	■	■	■	■
IE>> Start LEDs (IE>>ST-L)	■	■	■	■	■	■
IE>> Trip LEDs (IE>>TR-L)	■	■	■	■	■	■
IE>>> Start LEDs (IE>>>ST-L)	■	■	■	■	■	■
IE>>> Trip LEDs (IE>>>TR-L)	■	■	■	■	■	■
Cycle in progress (79-Run-K)	■	■	■	■	■	■
Reclosure (79-AR-K)	■	■	■	■	■	■
Reclosure fail (79-Fail-K)	■	■	■	■	■	■
I2ndh> Start LEDs (I2ndh>ST-L)	■	■	■	■	■	■
I2ndh> Trip LEDs (I2ndh>TR-L)	■	■	■	■	■	■
S< Trip LEDs (S<TR-L)	■	■	■	■	■	■
74TCS Start LEDs (74TCS-ST-L)	■	■	■	■	■	■
74TCS Trip LEDs (74TCS-TR-L)	■	■	■	■	■	■
tB-Iph/IE Elapsed signalling LEDs (tB-L)	■	■	■	■	■	■
Phase protection output selective block LEDs (BLK2OUT-Iph-L)	■	■	■	■	■	■
Ground protection output selective block LEDs (BLK2OUT-IE-L)	■	■	■	■	■	■
Phase and ground protection output selective block LEDs (BLK2OUT-Iph/IE-L)	■	■	■	■	■	■
BF Start LEDs (BF-ST-L)	■	■	■	■	■	■
BF Trip LEDs (BF-TR-L)	■	■	■	■	■	■
Number of CB trips diagnostic LEDs (N.Open-L)	■	■	■	■	■	■
Cumulative CB tripping currents diagnostic LEDs (SumI-L)	■	■	■	■	■	■
Cumulative CB tripping I ² t diagnostic LEDs (SumI ² t-L)	■	■	■	■	■	■
Circuit breaker opening time diagnostic LEDs (tbreak-L)	■	■	■	■	■	■
Open CB command LEDs (CBopen-L)	■	■	■	■	■	■
Close CB command LEDs (CBclose-L)	■	■	■	■	■	■
Remote tripping LEDs (RemTrip-L)	■	■	■	■	■	■
Not received pulses at BLIN signalling LEDs (PulseBLIN-L)						

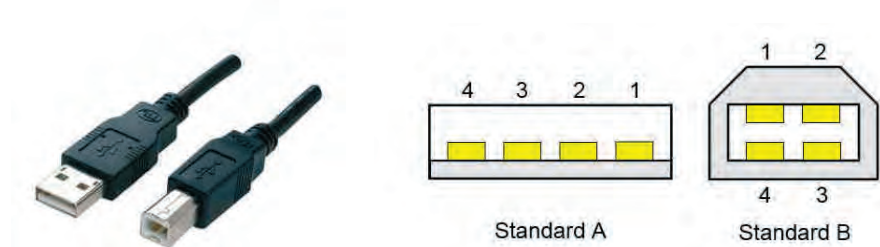
Communication interfaces

Several communication ports are provided:

- USB port on the front side for local communication (ThyVisor).
- RS485 port on the rear side for bus communication.
- Ethernet port on the rear side for bus communication.

USB

To connect the local port you need to use a cable USB Type B - Type A; the Thytronic cable code L10042 can be supplied.



The serial port is the simplest access for setting by means the ThyVisor software.

RS485

Several protocol are implemented^[1]:

- ModBus RTU. Modbus is a serial communications protocol. It is a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices also inside electric utilities and substation.
- IEC 60870-5. The IEC 60870-5 suite of protocol is used for communications from master station to substation, as well within the substation; the IEC 60870-5-103 (Protection equipment) is available together the Modbus protocol on some version of Pro-n devices (code NAXx#xxxxC x).

Ethernet

It is provided (optionally) a communication board useful for Ethernet communication with ModBus TCP/IP protocol.^[2]

Modbus/TCP basically embeds a Modbus frame into a TCP frame in a simple manner. This is a connection-oriented transaction which means every query expects a response.

This query/response technique fits well with the master/slave nature of ModBus, adding to the deterministic advantage that Switched Ethernet offers industrial users.

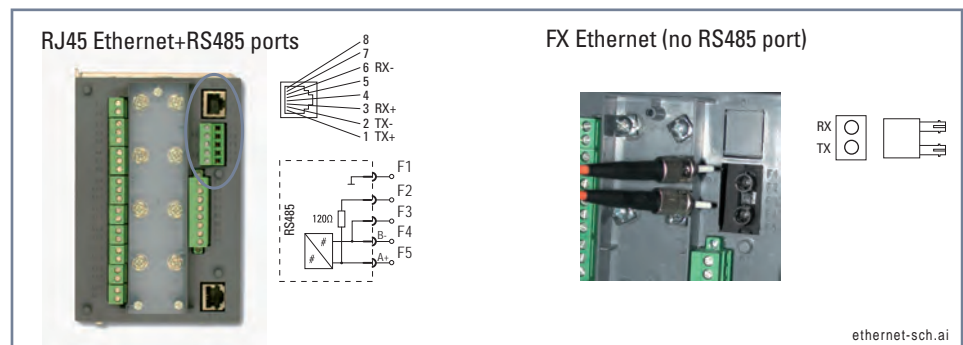
In the same way as the RS485 base Modbus, every device is identified by a personal address and the communication goes in "client-server" mode with answering request from the recipient.

The protective relay can be directly connect to the Ethernet network (no gateway, protocol converter are needed).

Two port can be implemented:

- 100BASE-TX with RJ45 connector (copper).
- 100BASE-FX with FX connector (optical fiber)^[2]

For both modules no hw preset are required.



Two LEDs are on board (RJ45):

- LINK - (green): The LED lights up if the connection is active.
- TX - (yellow): The LED lights up when data transmission is active.

Note 1 The RS485 port is not implemented on the Pro-N devices endowed with Ethernet FX port

Note 2 Information about the ModBus map may be find inside the "Remote programming manual"

4.4 PROTECTIVE ELEMENTS

Rated values

Traditional CT inputs

• Relay phase nominal current I_n

This nominal value must be set by means dip-switch to 1 A or 5 A, same as the secondary CTs nominal current.
Dip-switches are located on the CPU board; the exhaustive treatment of Dip setup is described in the "6.4 SETTING NOMINAL CURRENTS I_n AND I_{En} " paragraph.

• Relay residual nominal current I_{En}

The rated value must be set by means dip-switch to 1 A or 5 A, same as the secondary nominal current of the residual CT.
Dip-switch is located on the CPU board; the exhaustive treatment of Dip setup is described in the "6.4 SETTING NOMINAL CURRENTS I_n AND I_{En} " paragraph.

Low Power CT inputs

• Relay phase rated current I_n

All settings of the current thresholds are referred to the rated current of the relay I_n , that corresponds to the primary nominal current of the protected plant; it must be set by means dip-switch to 50 A to 1250 A^[1].
Dip-switches are located on the rear board; the exhaustive treatment of Dip setup is described in the "6.5 NOMINAL CURRENT I_n SETTING FOR LPCT" paragraph.

• Relay residual rated current I_{En}

The rated value is automatically set to p.u. of the phase nominal current.^[2]

Settings

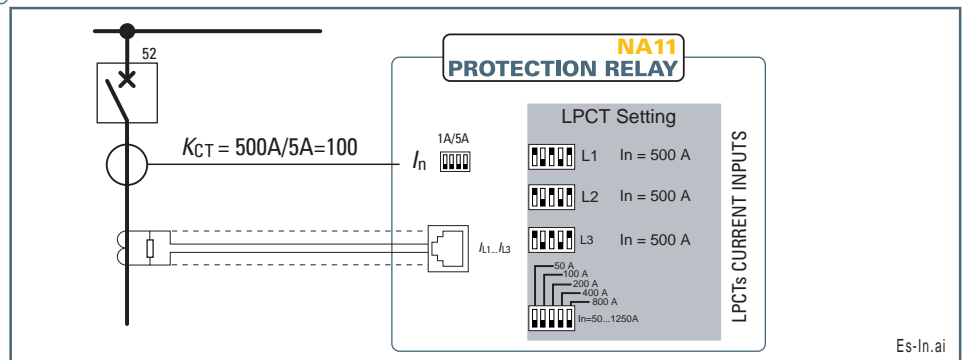
Inside the **Set \ Base** menu the following parameters can be set:

- Primary rated values (phase and residual), employed for measures relative to primary values.
- Measurements reading mode (*Reading Direct or Relative*).

• Phase CT primary current I_{np}

This parameter affects the measure of the phase currents when the primary measurement reading mode is selected (*Reading Direct*). It must be programmed to the same value of the phase CT primary nominal current Traditional CTs) or to the value set for the LPCT inputs.

Example

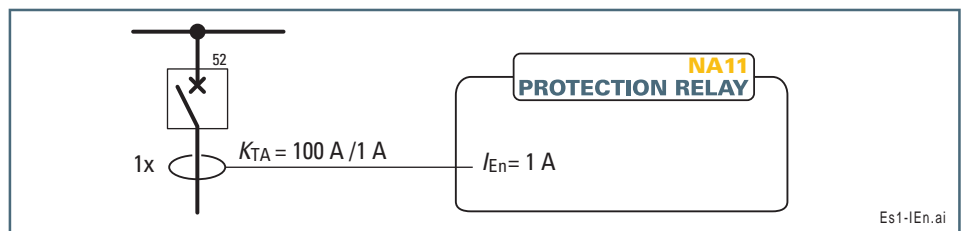


The phase CT primary current I_{np} must be set as: $I_{np} = 500$ A

• Residual CT primary current I_{Enp}

This parameter affects the measure of the residual current when the primary measurement reading mode is selected with traditional CTs inputs. It must be programmed to the same value of the residual CTs primary nominal current.

Example 1

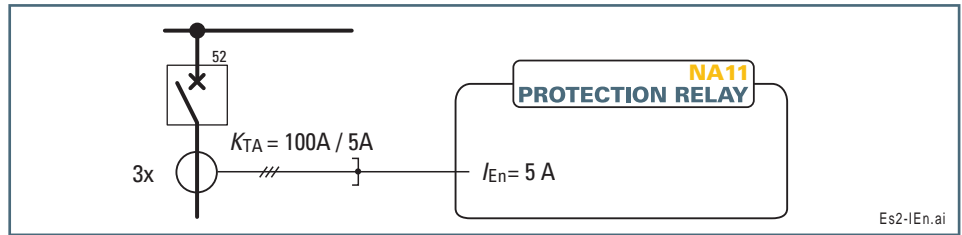


The residual CT primary current I_{Enp} must be set as: $I_{Enp} = 100$ A

Note 1 With rated current setting exceeding 400 A the setting of protective elements based on the phase current is limited to $35 \cdot 400 / I_{np}$ e.g. with $I_{np} = 1000$ A the $I_{>def}$ setting is limited to $35 \cdot 400 / 1000 = 14 I_n$

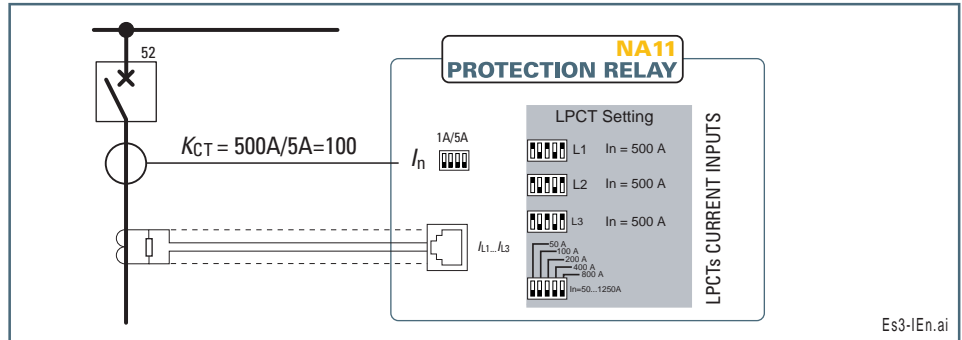
Note 2 With LPCT inputs the residual current is available as computed measure I_{EC} ,

Example 2



The residual CT primary current I_{Enp} must be set as: $I_{Enp} = 100 A$

Example 3



The residual CT primary current I_{Enp} must be set as: $I_{Enp} = 500 A$

• **Measurement reading mode**

- With *Reading Relative* setting all measures are related to the nominal value,
- With *Reading Direct* setting all measures are related to the primary value.

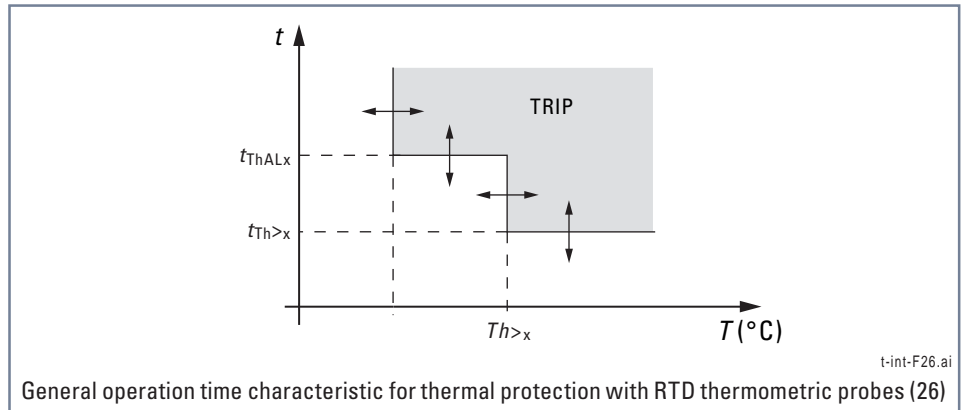
Thermal protection with RTD thermometric probes (26)

Preface

The measure of temperature is acquired by means of Pt100 (RTD Resistive Temperature sensing Devices) probed, connected to the MPT module.^[1]

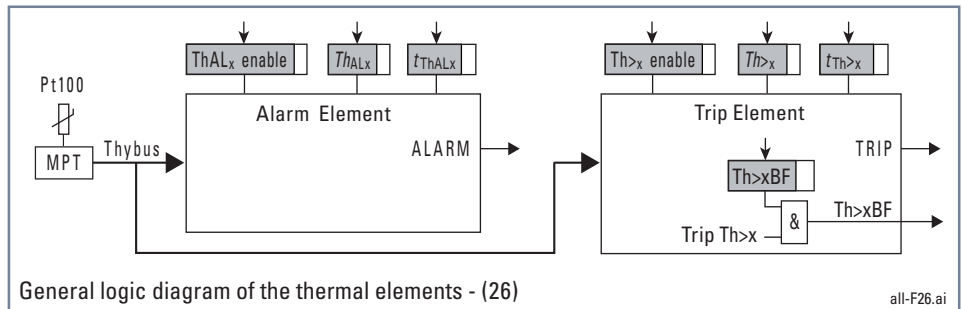
A direct thermal protection element with eight PT100 thermometric probes (RTD Resistive Thermal Device) provides protection against premature ageing or breakdown of the insulating materials through overheating.

Thermal protection using thermometric probes offers greater reliability than Thermal overload-based indirect protection, since it is not influenced by inaccuracies in the time constant for the thermal model of the machinery and by variations in the surrounding temperature.



For each thermometric probe an alarm (Th_{ALx} , where $x=1..8$ points one of the eight probes) and one trip adjustable threshold is provided ($Th_{>x}$), with adjustable operating time (t_{ThALx} and $t_{Th>x}$); if the measured temperature overcomes the threshold, the relative alarm and/or trip is issued when the timer expires.

The adjustments are operable in °C.



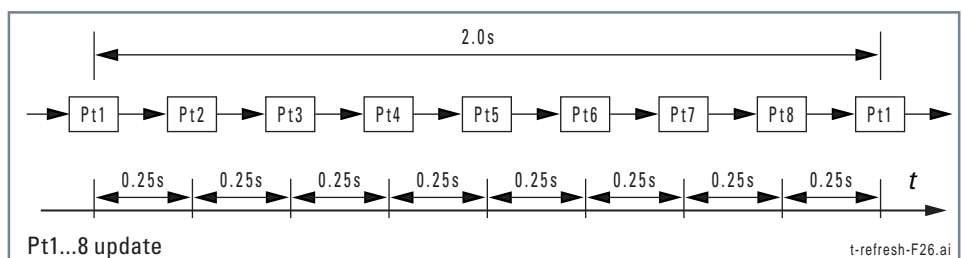
The probes should be placed in strategic points around the machinery susceptible to the greatest overheating, such as for example:

- near the generator stator windings, near the step-up transformer windings and/or in the oil, with the aim of detecting overheating produced by the overload currents,
- near the generator bearings, with the aim of detecting localised overheating due to worn or non-lubricated bearings.

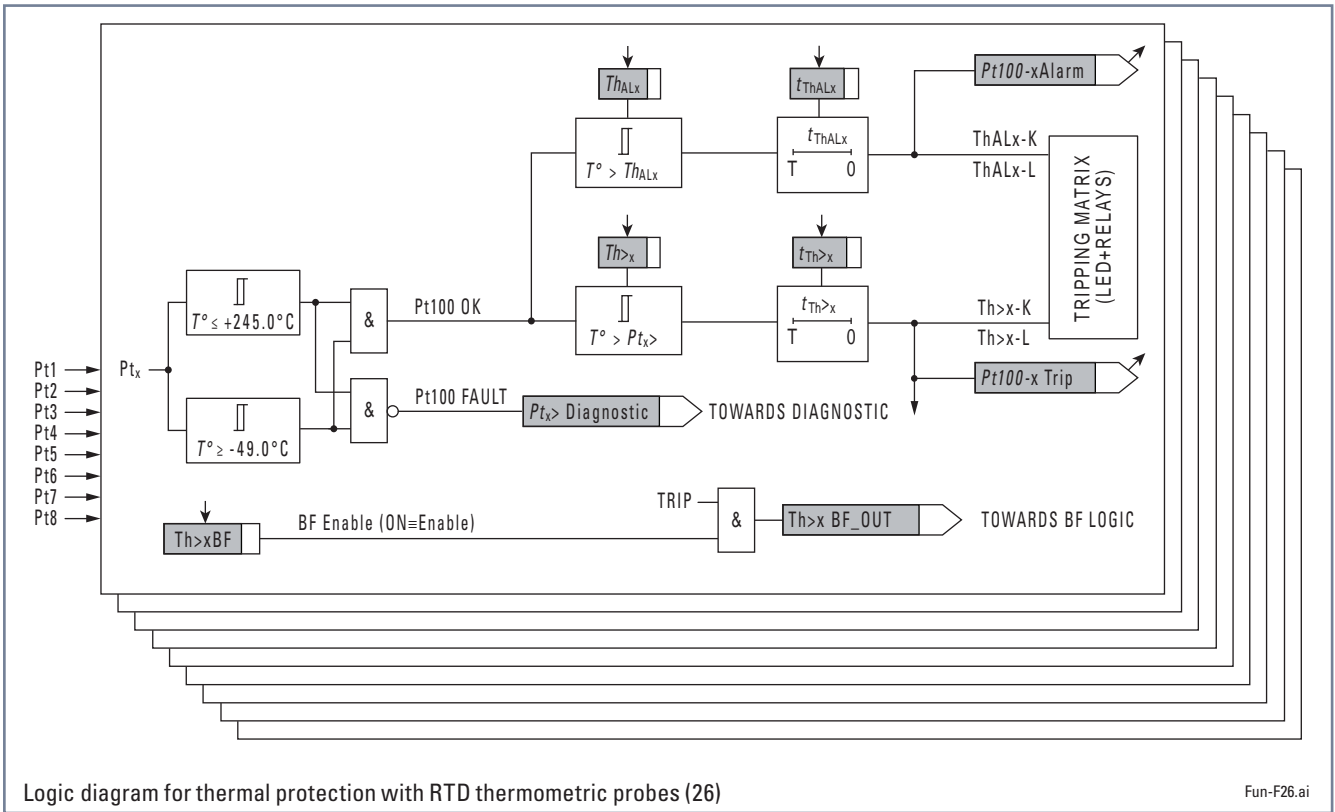
The Pt100 probes detect the temperature in the range $-50\text{ °C}..+250\text{ °C}$ (at 0 °C its resistance is 100 ohm); an alarm indicates any interruption or short-circuiting of the probe or related connections to the MPT module; the information is available inside the **Read \ PT100** menu:

- *Ptx probe ON* to point a measure inside the range
 - *Ptx probe LOW* to point a measure lower the range (short circuit of probe and/or wires)
 - *Ptx probe HIGH* to point a measure higher the range (breaking of probe and/or wires).
- Self reset is performed when faults are cleared.

The measure of each probe is updated at 2 s time intervals.



Note 1 The 26 menu is available when the MPT module is enabled

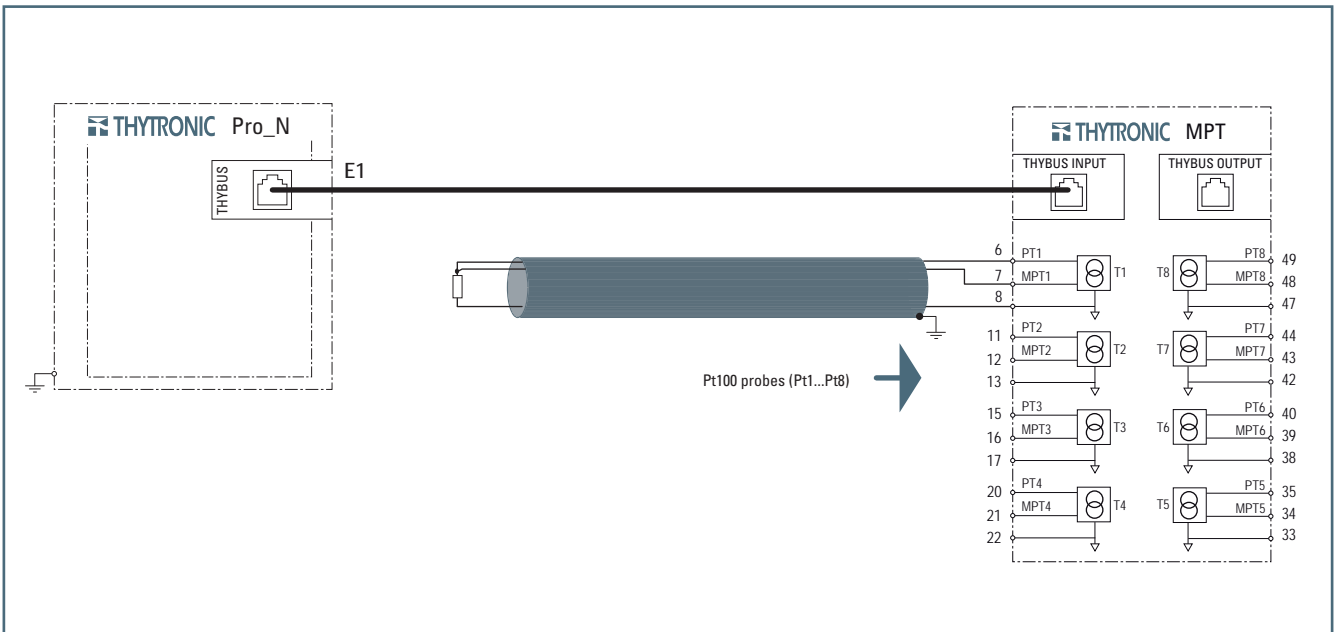


Logic diagram for thermal protection with RTD thermometric probes (26)

Fun-F26.ai

All alarm and/or trip elements can be enabled or disabled by setting *ON* or *OFF* the Th_{ALx} Enable e $Th_{>x}$ Enable parameters inside the **Set \ Profile A(or B) \ Thermal protection with RTD thermometric probes - 26 \ PTx Probe \ ThALx Alarm (ThALx Trip)** where $x = 1...8$.

Each trip threshold ($Th_{>x}$) may be associated with the breaker failure (BF) function by setting *ON* the $Th_{>x}BF$ parameters inside the **Set \ Profile A(or B) \ Thermal protection with RTD thermometric probes - 26 \ PTx Probe \ ThALx Trip** where $x = 1...8$.^[1]



Note 1 The common settings concerning the Breaker failure protection are adjustable inside the **Breaker Failure - BF** menu.

Phase overcurrent - 50/51

Preface

Three operation thresholds, independently adjustable ($I>$, $I>>$, $I>>>$) with adjustable delay ($t>$, $t>>$, $t>>>$).

The first one may be programmed with definite or inverse time according the IEC and ANSI/IEEE standard, as well as with rectifier, I^2t or EM curve.

The second threshold may be programmable with independent or dependent time according to the I^2t curve and the third threshold with independent time.

For each threshold a reset time can be set ($t_{>RES}$, $t_{>>RES}$, $t_{>>>RES}$) useful to reduce the clearing time for intermittent faults.

The first threshold trip may be inhibited by start of the second and/or third threshold ($I>>$, $I>>>$).

Similarly the second threshold trip may be inhibited by start of the third threshold ($I>>>$).

Operation and settings

Each phase fundamental frequency current is compared with the setting value. Currents above the associated pickup value are detected and a start is issued. After expiry of the associated operate time a trip command is issued; if instead the current drops below the threshold, the element is restored.

The first threshold ($I>$) may be programmed with definite or inverse time according the following characteristic curves:

- Standard Inverse Time (IEC 255-3/BS142 type A or SIT): $t = 0.14 \cdot t_{>inv} / [(I/I_{>inv})^{0.02} - 1]$
- Very Inverse Time (IEC 255-3/BS142 type B or VIT): $t = 13.5 \cdot t_{>inv} / [(I/I_{>inv}) - 1]$
- Extremely Inverse Time (IEC 255-3/BS142 type C or EIT): $t = 80 \cdot t_{>inv} / [(I/I_{>inv})^2 - 1]$
- Moderately Inverse (ANSI/IEEE type MI): $t = t_{>inv} \cdot \{ 0.01 / [(I/I_{>inv})^{0.02} - 1] + 0.023 \}$
- Very Inverse (ANSI/IEEE type VI): $t = t_{>inv} \cdot \{ 3.922 / [(I/I_{>inv})^2 - 1] + 0.098 \}$
- Extremely Inverse (ANSI/IEEE type EI): $t = t_{>inv} \cdot \{ 5.64 / [(I/I_{>inv})^2 - 1] + 0.024 \}$
- Rectifier (RI): $t = 2351 \cdot t_{>inv} / [(I/I_{>inv})^{5.6} - 1]$
- I-squared-t ($I^2t = K$): $t = 16 \cdot t_{>inv} / (I/I_{>inv})^2$
- Electromechanical (EM): $t = t_{>inv} \cdot \{ 0.28 / [-0.236 \cdot (I/I_{>inv})^{-1} + 0.339] \}$

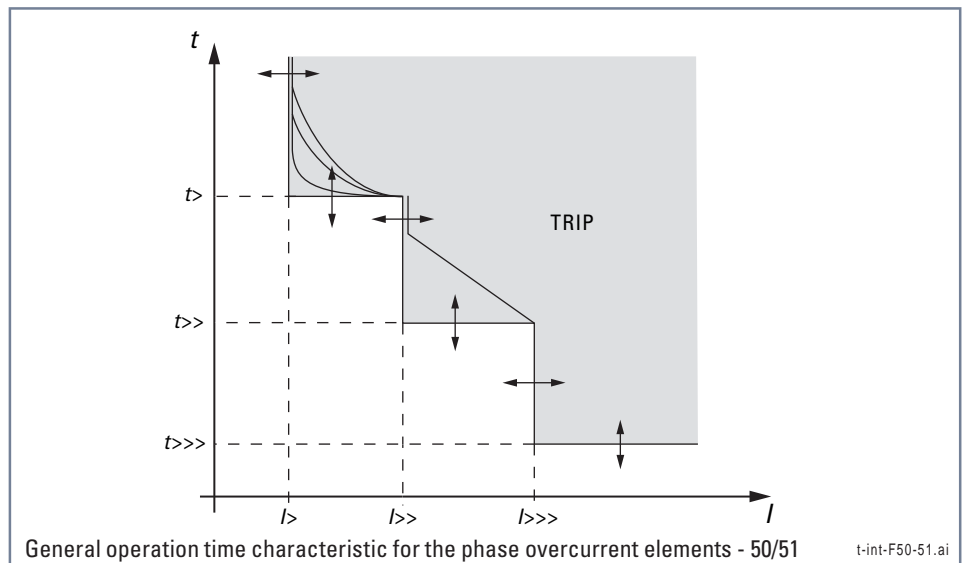
Where:

- t : operate time
- $I_{>inv}$: threshold setting
- $t_{>inv}$: operate time setting

The second threshold ($I>>$) may be programmable with definite or inverse time according to the I^2t curve:

$$t = 16 \cdot t_{>>inv} / (I/I_{>>inv})^2$$

The third threshold ($I>>>$) with definite time.



For all inverse time characteristics, following data applies:

- Asymptotic reference value (minimum pickup value): $1.1 I_{>inv}$
- Minimum operate time: 0.1 s
- Range where the equation is valid:^[1] $1.1 \leq I/I_{>inv} \leq 20$
- If $I_{>inv}$ pickup $\geq 2.5 I_n$, the upper limit is $50 I_n$ (CT versions)

For all definite time elements the upper limit for measuring is $50 I_n$ for standard CT inputs or $35 I_n$ for low power CT inputs.

All overcurrent elements can be enabled or disabled by setting *ON* or *OFF* the $I>$ Enable, $I>>$ Enable and/or $I>>>$ Enable parameters inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I> Element (I>> Element, I>>> Element) \ Setpoints** menus.

The first overcurrent element can be programmed with definite or inverse time characteristic by setting the $I>$ Curve parameter (*DEFINITE, IEC/BS A, IEC/BS B, IEC/BS C, ANSI/IEE MI, ANSI/IEE VI, ANSI/IEE EI, RECTIFIER, I2t, EM*) available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I> Element \ Setpoints** menu.

Note 1 When the input value is more than 20 times the set point, the operate time is limited to the value corresponding to 20 times the set point

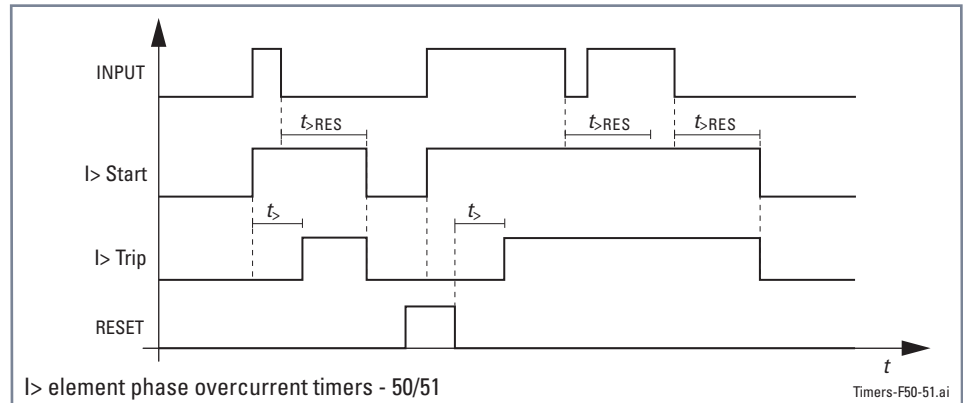
The second overcurrent element can be programmed with definite or inverse time characteristic by setting the $I >$ Time characteristic ($I >$ Curve) parameter (*DEFINITE*, $I2t$) available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element \ Setpoints** menu.

The trip of $I >$ element may be inhibited by the start of the second and/or third element ($I >>$, $I >>>$) by setting *ON* the $I >$ Disable $I >$ by start $I >>$, $I >$ Disable $I >>$ by start $I >>>$ ($I >$ disby $I >$, $I >$ disby $I >>$) parameters available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element ($I >>$ Element) \ Setpoints** menus.

Similarly the trip of the $I >>$ element may be inhibited by start of the third element ($I >>>$) by setting *ON* the $I >>$ Disable $I >>$ by start $I >>>$ ($I >>$ disby $I >>$) parameter available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >>>$ Element \ Setpoints** menu.

All the parameters can be set separately for **Profile A** and **Profile B** (**Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element ($I >>$ Element, $I >>>$ Element) \ Setpoints** menus).

An adjustable reset time delay is provided for every threshold (t_{RES} , $t_{>>RES}$, $t_{>>>RES}$).



Each overcurrent element can produce the Breaker Failure output if the $I >$ BF, $I >>$ BF and/or $I >>>$ BF parameters are set to *ON*. The parameters are available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element ($I >>$ Element, $I >>>$ Element) \ Setpoints** menus.^[1]

For all overcurrent elements, a block from the second harmonic restraint may be set by setting *ON* the $I >$ 2ndh-REST, $I >>$ 2ndh-REST, $I >>>$ 2ndh-REST parameters inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element ($I >>$ Element, $I >>>$ Element) \ Setpoints** menus.

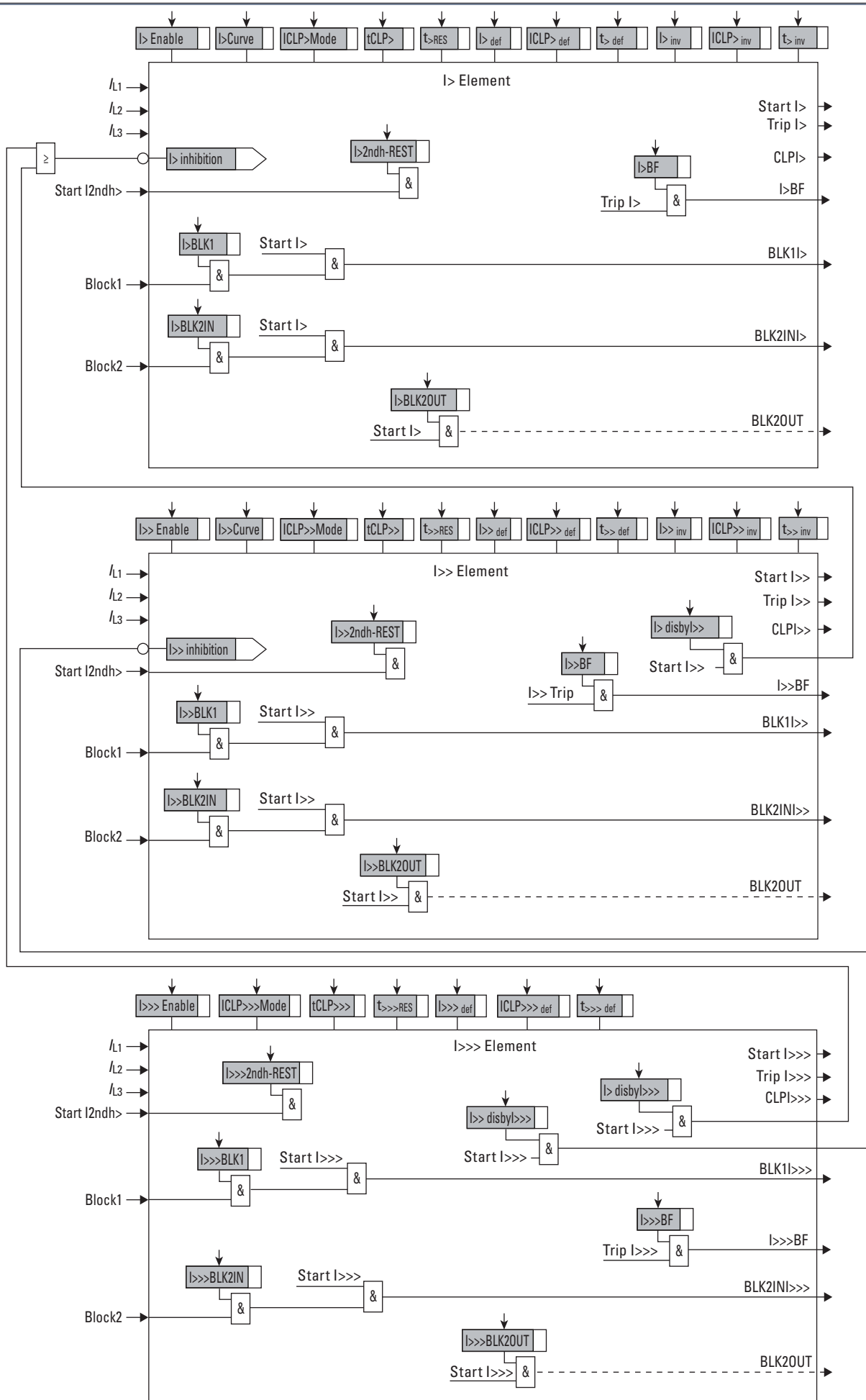
If the CLP function (Cold Load Pick-up) is enabled for element blocking, the selected threshold may be blocked for an adjustable time interval, starting from the circuit breaker closure.

This operating mode may be select by setting *ON-Element blocking* the $I >$ CLP > Mode, $I >>$ CLP >> Mode and/or $I >>>$ CLP >>> Mode parameters.

If the CLP function (Cold Load Pick-up) is enabled for threshold change, the selected threshold may be changed for an adjustable time interval, starting from the circuit breaker closure.

This operating mode may be select by setting *ON-Change setting* the $I >$ CLP > Mode, $I >>$ CLP >> Mode and/or $I >>>$ CLP >>> Mode parameters, whereas the operating thresholds within the CLP may be adjusted inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element, ($I >>$ Element, $I >>>$ Element) \ Definite time (Inverse time)** menus.

For both operating modes the CLP Activation time parameters ($t_{CLP >}$, $t_{CLP >>}$, $t_{CLP >>>}$) may be adjusted inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ $I >$ Element ($I >>$ Element, $I >>>$ Element) \ Setpoints** menus.



General logic diagram of the phase overcurrent elements - 50/51

all-F50-51.ai

For every of the three thresholds the following block criteria are available:

Logical block (Block1)

If the $I > BLK1$, $I >> BLK1$ and/or $I >>> BLK1$ enabling parameters are set to *ON* and a binary input is designed for logical block (Block1), the concerning element is blocked off whenever the given input is active.^[1] The enabling parameters are available inside the **Set\Profile A(or B)\Phase overcurrent-50/51\I > Element (I >> Element, I >>> Element)\Setpoints** menus, while the *Block1* function must be assigned to the selected binary input inside the **Set\Inputs\Binary input IN1(2)** menus.

Selective block (Block2)

All along the protective elements the selective block may be set.

The logic selectivity function may be performed by means any combination of the following I/O:

- One committed pilot wire input (BLIN1).
- One or more binary inputs designed for input selective block.
- One committed pilot wire output (BLOUT1).
- One or more output relays designed for output selective block.

Only when the committed pilot wire are used the continuity check of the pilot wire link is active.

Use of committed pilot wire input BLIN1:

- The protection is blocked off according the selectivity block criteria when the input BLIN1 is active. The information about phase or phase+earth block may be select programming the *ModeBLIN1* parameter inside the **Set\Profile A(or B)\Selective block-BLOCK2\Selective block IN** menus.

Use of binary inputs:

- If the $I > BLK2IN$, $I >> BLK2IN$ and/or $I >>> BLK2IN$ parameters are set to *ON* and a binary input is designed for selective block (Block2), the protection is blocked off by phase elements (Block2 Iph) or by any protection element (Block2 Iph/IE) according the selectivity block criteria.^[2] The enable $I > BLK2IN$, $I >> BLK2IN$ and/or $I >>> BLK2IN$ parameters are available inside the **Set\Profile A(or B)\Phase overcurrent-50/51\I > Element (I >> Element, I >>> Element)\Setpoints** menus, while the *Block2 Iph* and *Block2 Iph/IE* functions must be assigned to the selected binary inputs inside the **Set\Inputs\Binary input IN1(2)** menus (IN1 or IN2 matching).

Use of committed pilot wire output BLOUT1:

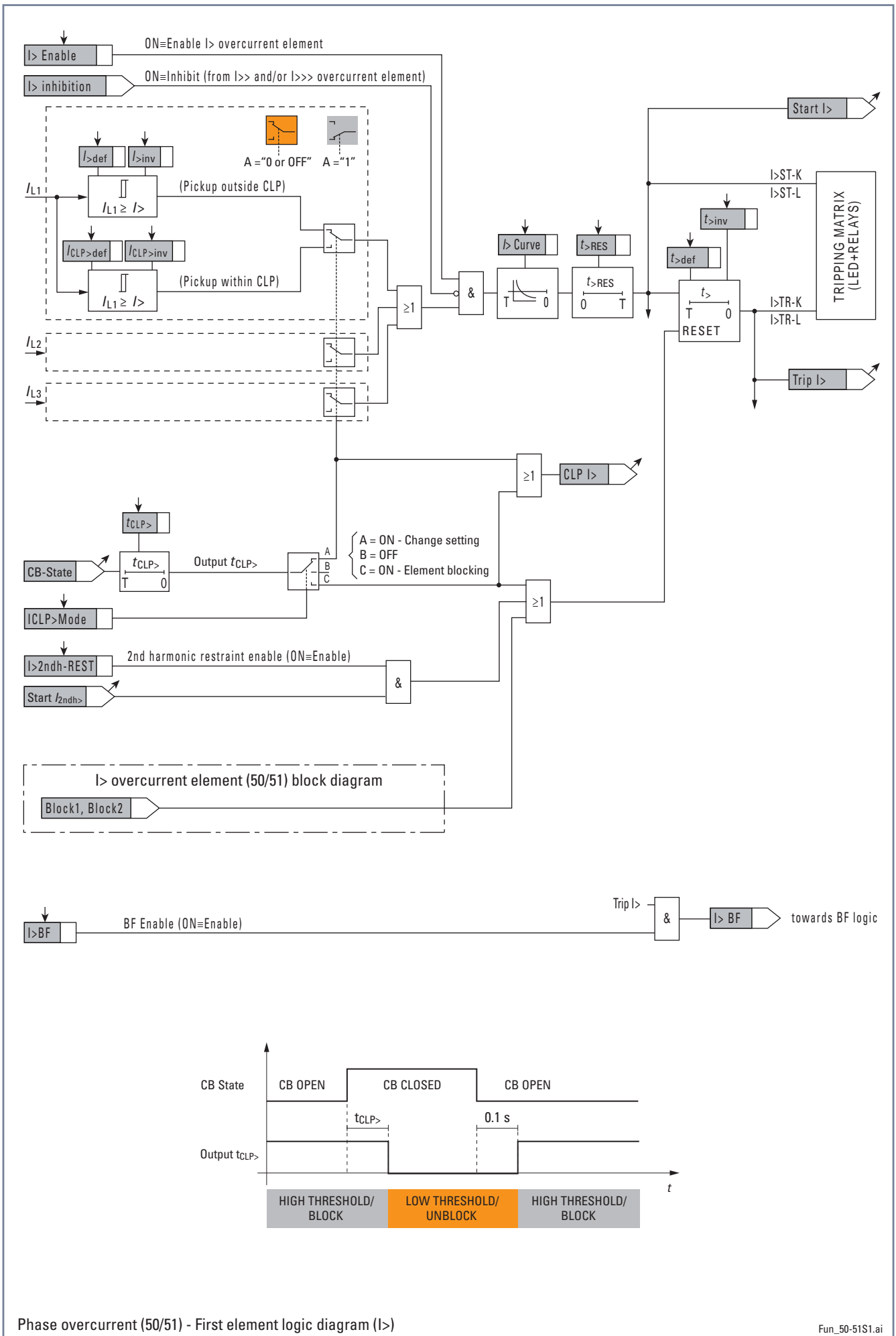
- The information about phase or phase+earth block may be select programming the *ModeBLOUT1* parameter (*OFF - ON Iph - ON Iph/IE - ON IE*) inside **Set\Profile A(or B)\Selective block-BLOCK2\Selective block OUT** menus.

Use of output relay (K1...K6):

- If the $I > BLK2OUT$, $I >> BLK2OUT$ and/or $I >>> BLK2OUT$ enable parameters are set to *ON* and a output relay is designed for selective block (Block2), the protection issues a block output by phase elements (BLK2OUT-Iph) or by any protection element (BLK2OUT-Iph/IE), whenever the given element (Start I>, Start I>> e/o Start I>>>) becomes active. The enable $I > BLK2OUT$, $I >> BLK2OUT$ and/or $I >>> BLK2OUT$ parameters (*ON* or *OFF*) are available inside the **Set\Profile A(or B)\Phase overcurrent-50/51\I > Element (I >> Element, I >>> Element)\Setpoints** menus, while the *BLK2OUT-Iph-K*, *BLK2OUT-Iph/IE-K* and/or *BLK2OUT-IE-K* output relays and LEDs (*BLK2OUT-Iph-L*, *BLK2OUT-Iph/IE-L* e/o *BLK2OUT-IE-L*) must be select inside the **Set\Profile A(or B)\Selective block-BLOCK2\Selective block OUT** menu.

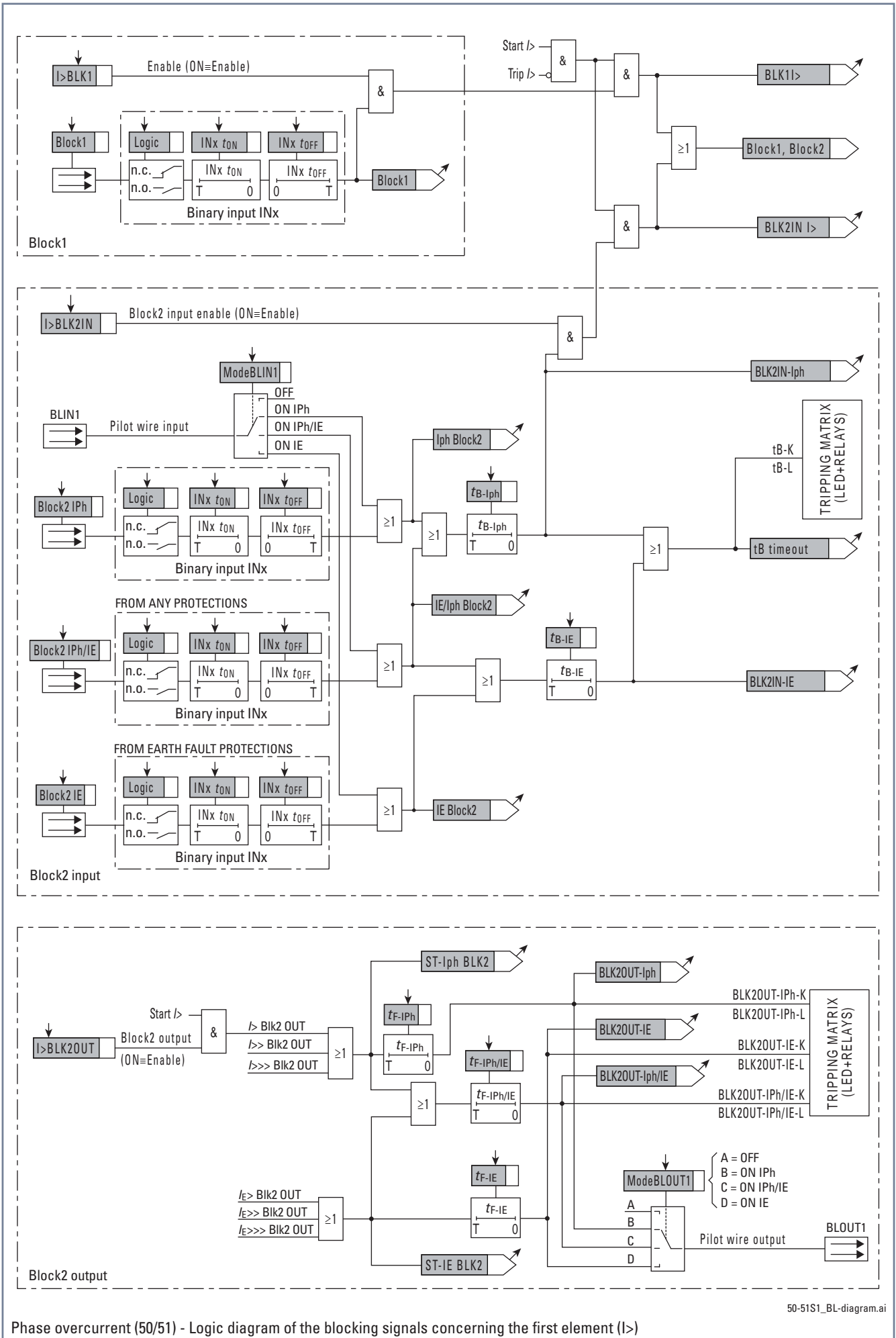
Note 1 The exhaustive treatment of the logical block (Block 1) function may be found in the "Logic Block" paragraph inside CONTROL AND MONITORING section

Note 2 The exhaustive treatment of the selective block (Block 2) function may be found in the "Selective Block" paragraph inside CONTROL AND MONITORING section



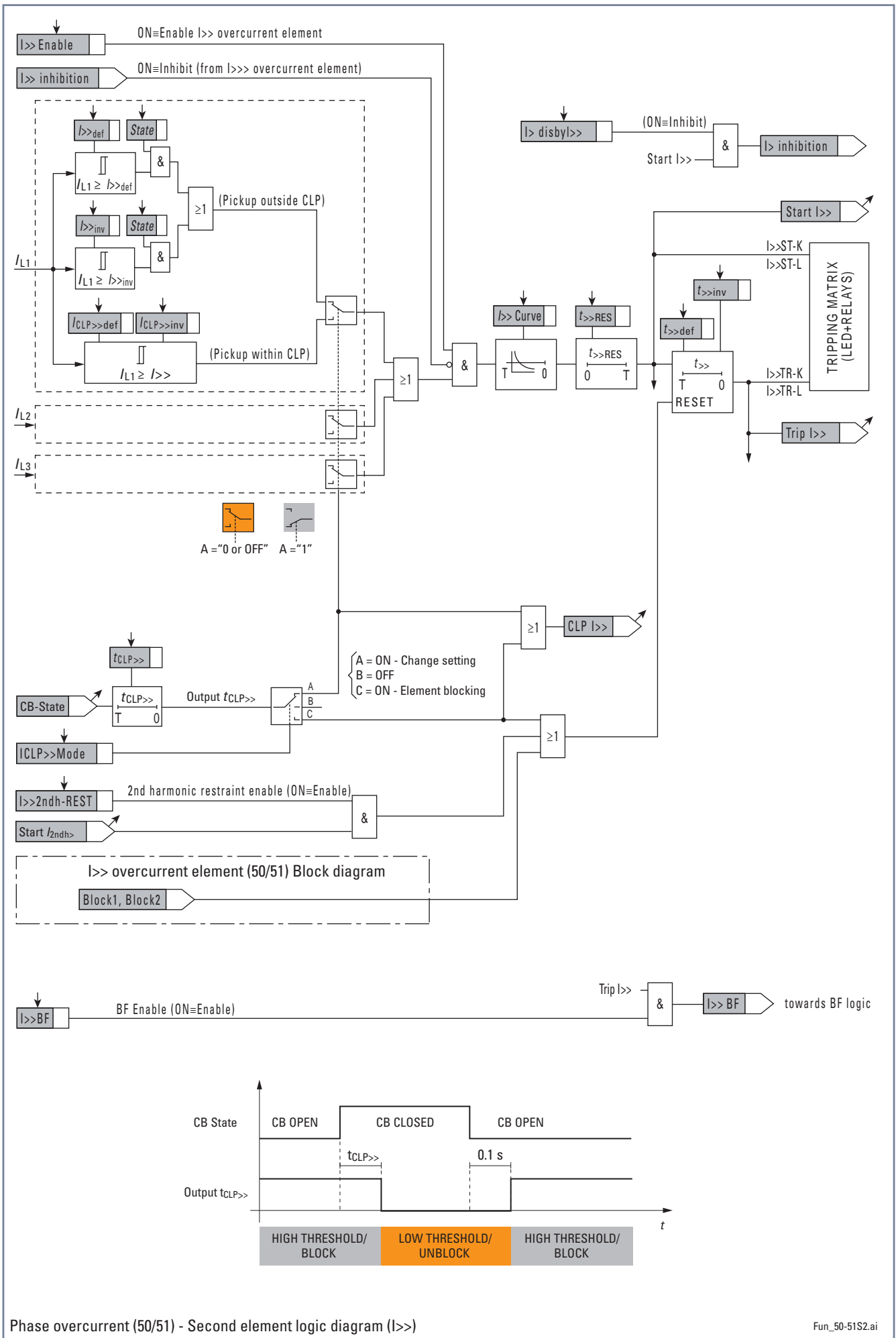
Phase overcurrent (50/51) - First element logic diagram (I>)

Fun_50-51S1.ai



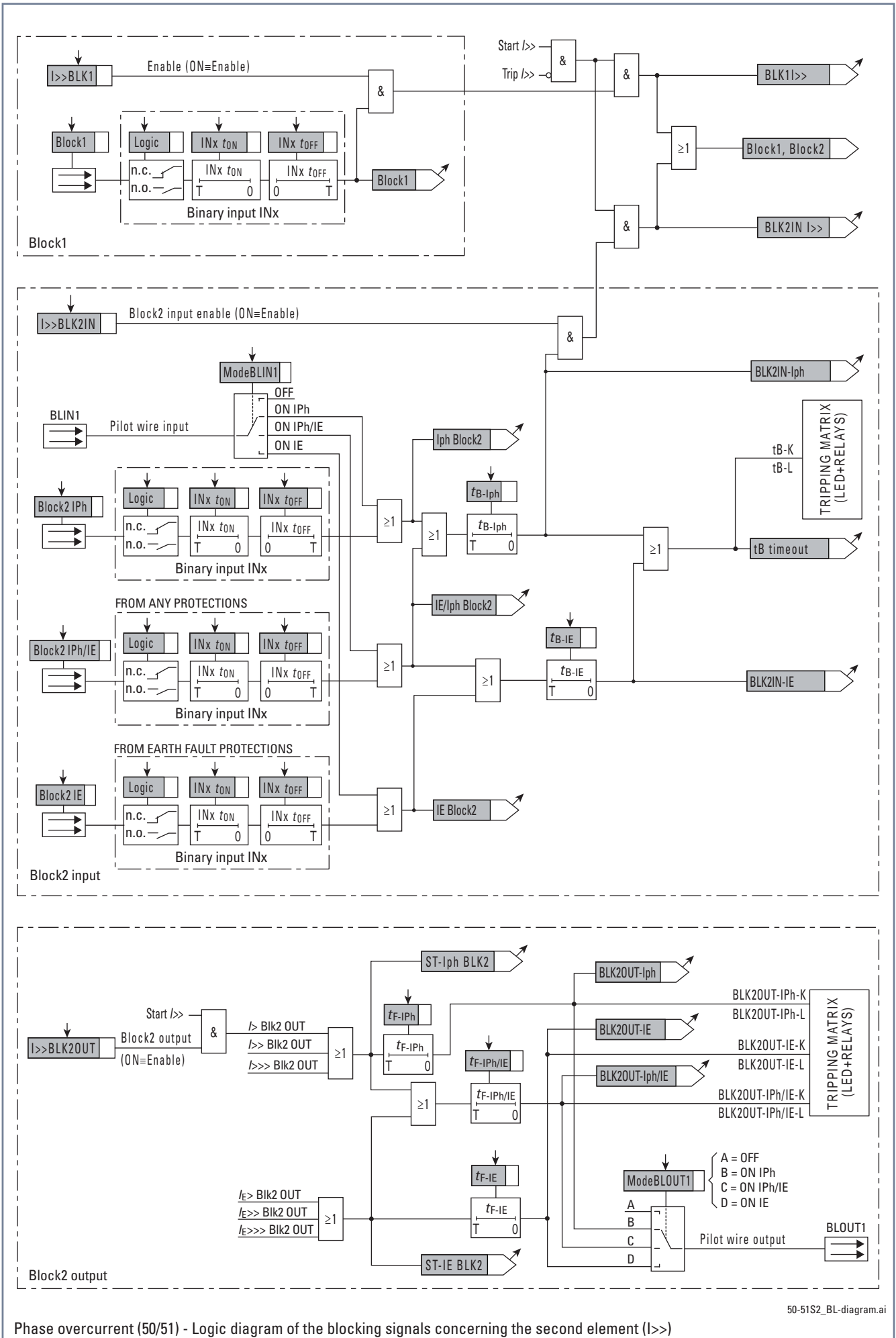
50-51S1_BL-diagram.ai

Phase overcurrent (50/51) - Logic diagram of the blocking signals concerning the first element (I>)



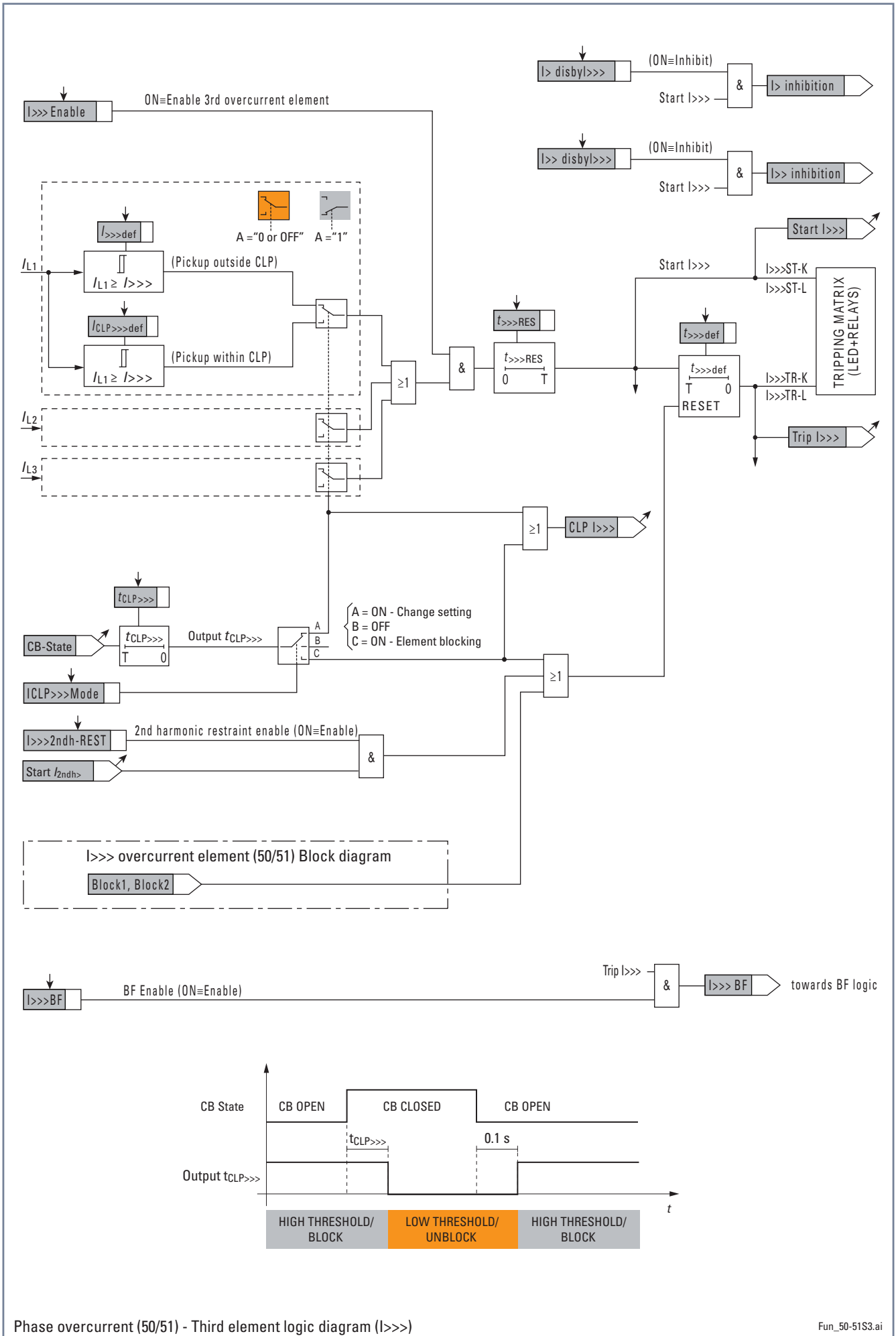
Phase overcurrent (50/51) - Second element logic diagram (I>>)

Fun_50-51S2.ai



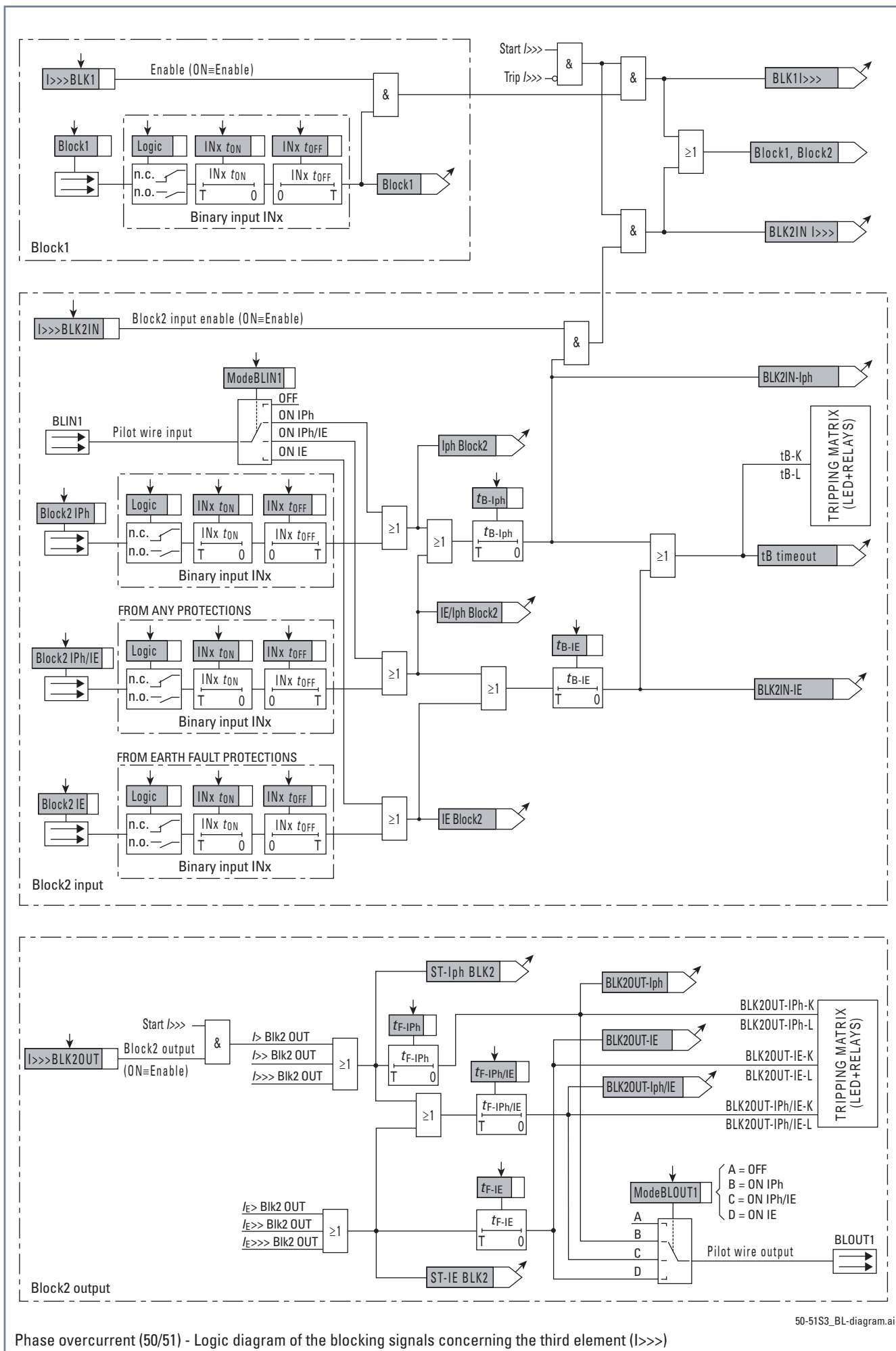
50-51S2_BL-diagram.ai

Phase overcurrent (50/51) - Logic diagram of the blocking signals concerning the second element (I>>)



Phase overcurrent (50/51) - Third element logic diagram (I>>>)

Fun_50-51S3.ai



50-51S3_BL-diagram.ai

Phase overcurrent (50/51) - Logic diagram of the blocking signals concerning the third element (I>>>)

Residual overcurrent - 50N/51N

Preface

The residual current is:

- Measured for NA11#xxx0 versions from one residual current input with secondary nominal current selectable at 1 A or 5 A through DIP-switches or,
- Calculated for NA11#xxx1 versions by the vector sum of the three phase currents, by three LPCT type sensors.

Three operation thresholds, independently adjustable with adjustable delay.

The first one may be programmed with definite or inverse time according the IEC and ANSI/IEEE standard, as well as with EM curve.

The second and third thresholds with independent time.

For each threshold a reset time can be set useful to reduce the clearing time for intermittent faults.

The first threshold trip may be inhibited by start of the second and/or third threshold.

Similarly the second threshold trip may be inhibited by start of the third threshold.

Operation and settings

The residual fundamental frequency current ^[1] is compared with the setting value.

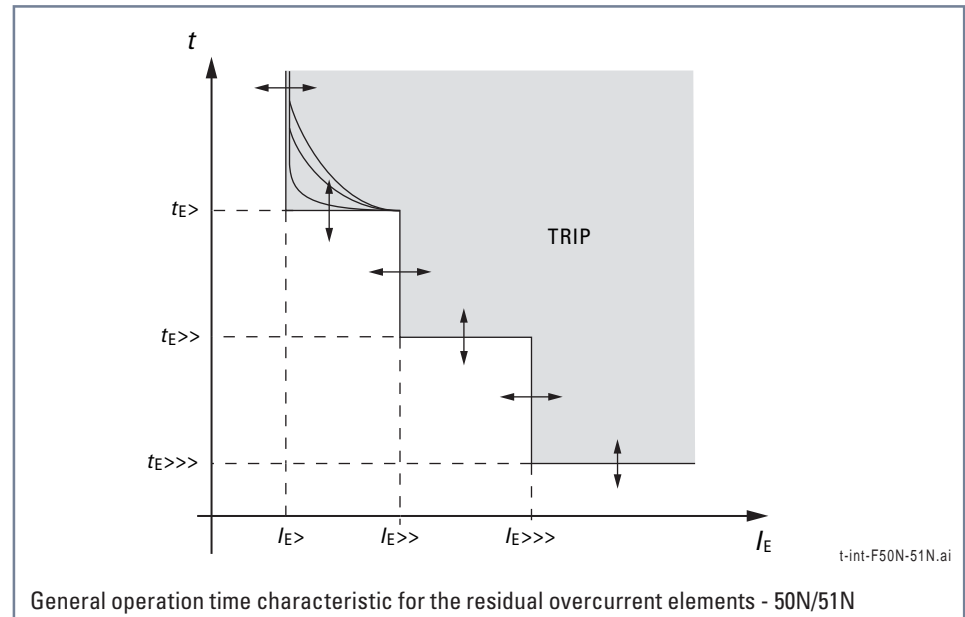
Current above the associated pickup value is detected and a start is issued. After expiry of the associated operate time a trip command is issued; if instead the current drops below the threshold, the element is restored.

The first threshold may be programmed with definite or inverse time according the following characteristic curves:^[2]

- Standard Inverse Time (IEC 255-3/BS142 type A or SIT): $t = 0.14 \cdot t_{E>inv} / [(I_E/I_{E>inv})^{0.02} - 1]$
- Very Inverse Time (IEC 255-3/BS142 type B or VIT): $t = 13.5 \cdot t_{E>inv} / [(I_E/I_{E>inv}) - 1]$
- Extremely Inverse Time (IEC 255-3/BS142 type C or EIT): $t = 80 \cdot t_{E>inv} / [(I_E/I_{E>inv})^2 - 1]$
- Moderately Inverse (ANSI/IEEE type MI): $t = t_{E>inv} \cdot \{0.01 / [(I_E/I_{E>inv})^{0.02} - 1] + 0.023\}$
- Very Inverse (ANSI/IEEE type VI): $t = t_{E>inv} \cdot \{3.922 / [(I_E/I_{E>inv})^2 - 1] + 0.098\}$
- Extremely Inverse (ANSI/IEEE type EI): $t = t_{E>inv} \cdot \{5.64 / [(I_E/I_{E>inv})^2 - 1] + 0.024\}$
- Electromechanical (EM): $t = t_{E>inv} \cdot \{0.28 / [-0.236 \cdot (I_E/I_{E>inv})^{-1} + 0.339]\}$

Where:

t : operate time
 $I_{E>inv}$: pickup value
 $t_{E>inv}$: operate time setting



For all inverse time characteristics, following data applies (CT versions):

- Asymptotic reference value (minimum pickup value): 1.1 $I_{E>}$
- Minimum operate time: 0.1 s
- Range where the equation is valid:^[3] $1.1 \leq I_E/I_{E>inv} \leq 20$
- If $I_{E>inv}$ pickup $\geq 2.5 I_{En}$, the upper limit is $10 I_{En}$

For all definite time elements the upper limit for measuring is $10 I_{En}$ for CT versions and $35 I_n$ for LPCT versions

Note 1 The measured residual current I_E is employed for NA11 protection relays equipped with standard CT sensor inputs, the computed residual current I_{EC} (vector sum of the phase currents) is employed for NA11 protection relays equipped with LPCT sensor inputs

Note 2 In the following the I_E symbol is the measured residual current in the case of CT versions, while it is the computed residual current I_{EC} (vector sum of the phase currents) for NA11 protection relays equipped with LPCT sensor inputs

Note 3 When the input value is more than 20 times the set point, the operate time is limited to the value corresponding to 20 times the set point

All residual overcurrent elements can be enabled or disabled by setting *ON* or *OFF* the *IE> Enable*, *IE>> Enable* and/or *IE>>> Enable* parameters inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus.

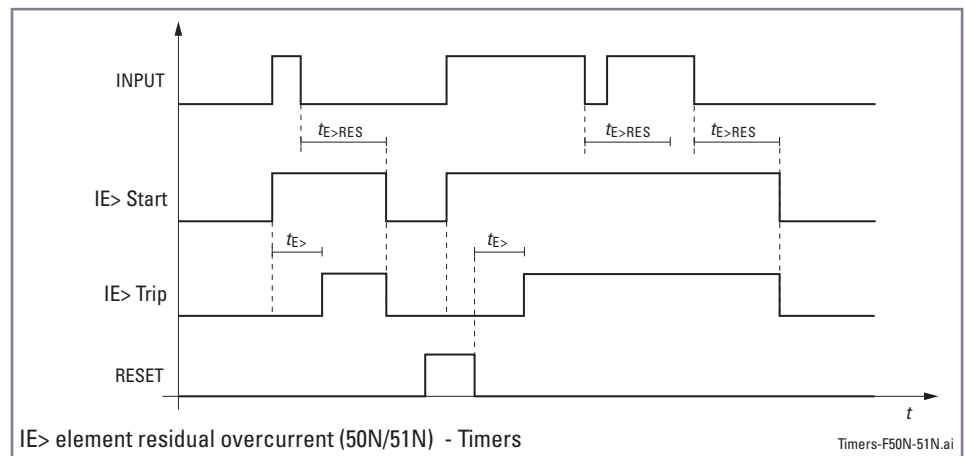
The first overcurrent element can be programmed with definite or inverse time characteristic by setting the *IE>Curve* parameter (*DEFINITE*, *IEC/BS A*, *IEC/BS B*, *IEC/BS C*, *ANSI/IEE MI*, *ANSI/IEE VI*, *ANSI/IEE EI*, *EM*) available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element \ Setpoints** menu.

The trip of *IE>* element may be inhibited by the start of the second and/or third element (*IE>>*, *IE>>>*) by setting *ON* the *Disable IE> by start IE>>*, *Disable IE> by start IE>>>* (*IE>disbyIE>>*, *IE>disbyIE>>>*) parameters available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>> Element (IE>>> Element) \ Setpoints** menus.

Similarly the trip of the *IE>>* element may be inhibited by start of the third element (*IE>>>*) by setting *ON* the *Disable IE>> by start IE>>>* (*IE>>disbyIE>>>*) parameter available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>>> Element \ Setpoints** menu.

All the named parameters can be set separately for **Profile A** and **Profile B** (**Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus).

An adjustable reset time delay is provided for every threshold ($t_{E>RES}$, $t_{E>>RES}$, $t_{E>>>RES}$).



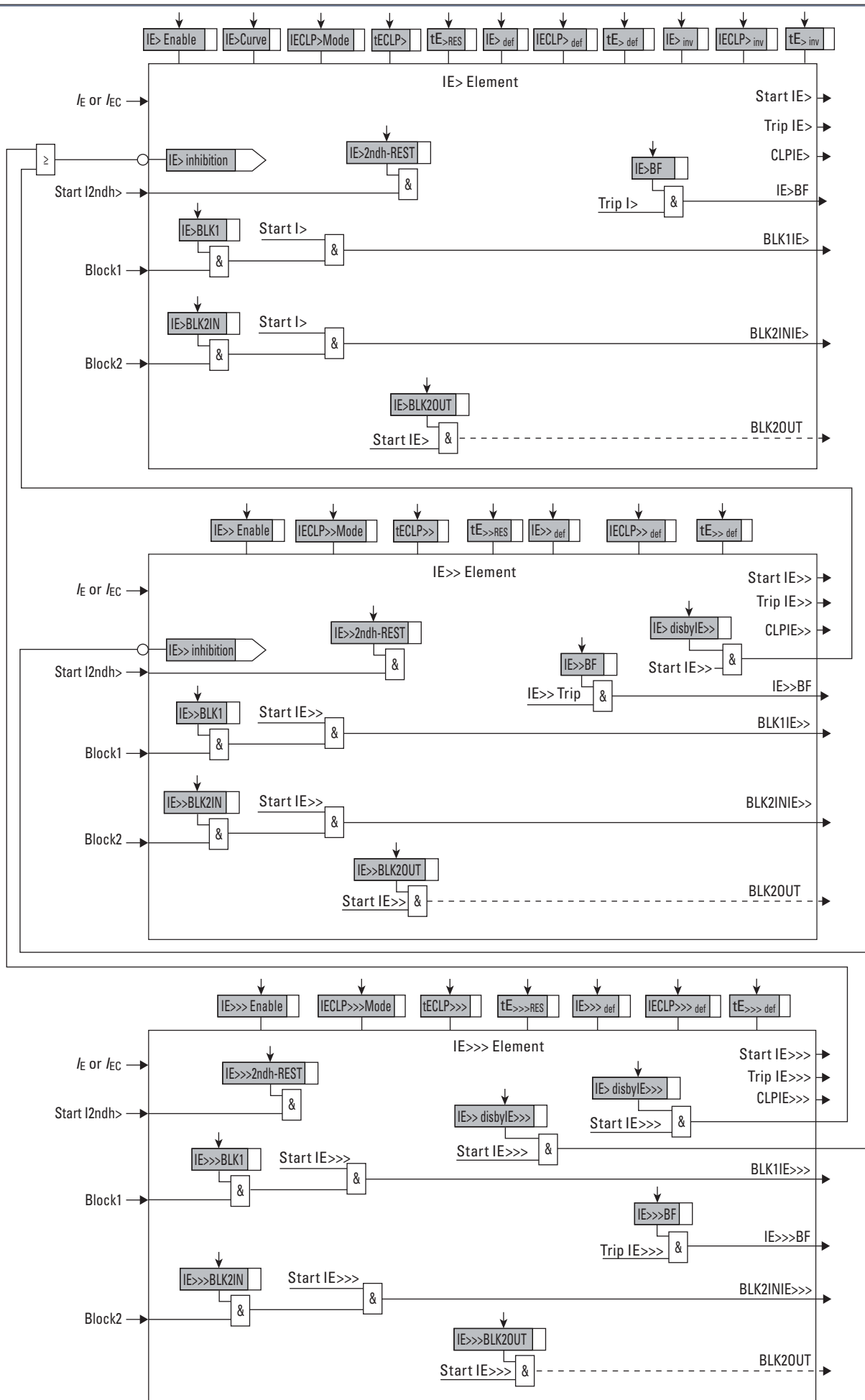
Each residual overcurrent element can produce the Breaker Failure output if the *IE> BF*, *IE>> BF* and/or *IE>>> BF* parameters are set to *ON*. The parameters are available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus.^[1]

For all overcurrent elements, a block from the second harmonic restraint may be set by setting *ON* the *IE>2ndh-REST*, *IE>>2ndh-REST*, *IE>>>2ndh-REST* parameters inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus.

If the CLP function (Cold Load Pick-up) is enabled for element blocking, the selected threshold may be blocked for an adjustable time interval, starting from the circuit breaker closure. This operating mode may be select by setting *ON-Element blocking* the *IECLP> Mode*, *IECLP>> Mode*, *IECLP>>> Mode* parameters.

If the CLP function (Cold Load Pick-up) is enabled for threshold change, the selected threshold may be changed for an adjustable time interval, starting from the circuit breaker closure. This operating mode (*ON-Change setting = IECLP> Mode*, *IECLP>> Mode*, *IECLP>>> Mode*) and the concerning operating time within the CLP ($t_{ECLP>}$, $t_{ECLP>>}$, $t_{ECLP>>>}$) may be adjusted inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus, whereas the operating thresholds within the CLP (*IECLP>def*, *IECLP>inv*,...) may be adjusted inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Definite time (Inverse time)** menus.

Note 1 The common settings concerning the Breaker failure protection are adjustable inside the **Breaker Failure - BF** menu.



General logic diagram of the residual overcurrent elements - 50N/51N

all-F50N-51N.ai

For every of the four thresholds the following block criteria are available:

Logical block (Block1)

If the *IE>BLK1*, *IE>>BLK1* and/or *IE>>>BLK1* enabling parameters are set to *ON* and a binary input is designed for logical block (Block1), the concerning element is blocked off whenever the given input is active.^[1] The enabling parameters are available inside the **Set\Profile A(or B)\Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element)\Setpoints** menus, while the *Block1* function must be assigned to the selected binary input inside the **Set\Inputs\Binary input IN1(2)** menus.

Selective block (Block2)

All along the protective elements the selective block may be set.

The logic selectivity function may be performed by means any combination of the following I/O:

- One committed pilot wire input (BLIN1).
- One or more binary inputs designed for input selective block.
- One committed pilot wire output (BLOUT1).
- One or more output relays designed for output selective block.

Only when the committed pilot wire are used the continuity check of the pilot wire link is active.

Use of committed pilot wire input BLIN1:

- The protection is blocked off according the selectivity block criteria when the input BLIN1 is active. The information about phase or phase+earth block may be select programming the *ModeBLIN1* parameter inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menus.

Use of binary inputs:

- If the *IE>BLK2IN*, *IE>>BLK2IN* and/or *IE>>>BLK2IN* parameters are set to *ON* and a binary input is designed for selective block (Block2), the protection is blocked off by phase elements (Block2 Iph) or by any protection element (Block2 Iph/IE) according the selectivity block criteria.^[2] The enable *IE>BLK2IN*, *IE>>BLK2IN* and/or *IE>>>BLK2IN* parameters are available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus, while the *Block2 Iph* and *Block2 Iph/IE* functions must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input IN1(2)** menus (IN1 or IN2 matching).

Use of committed pilot wire output BLOUT1:

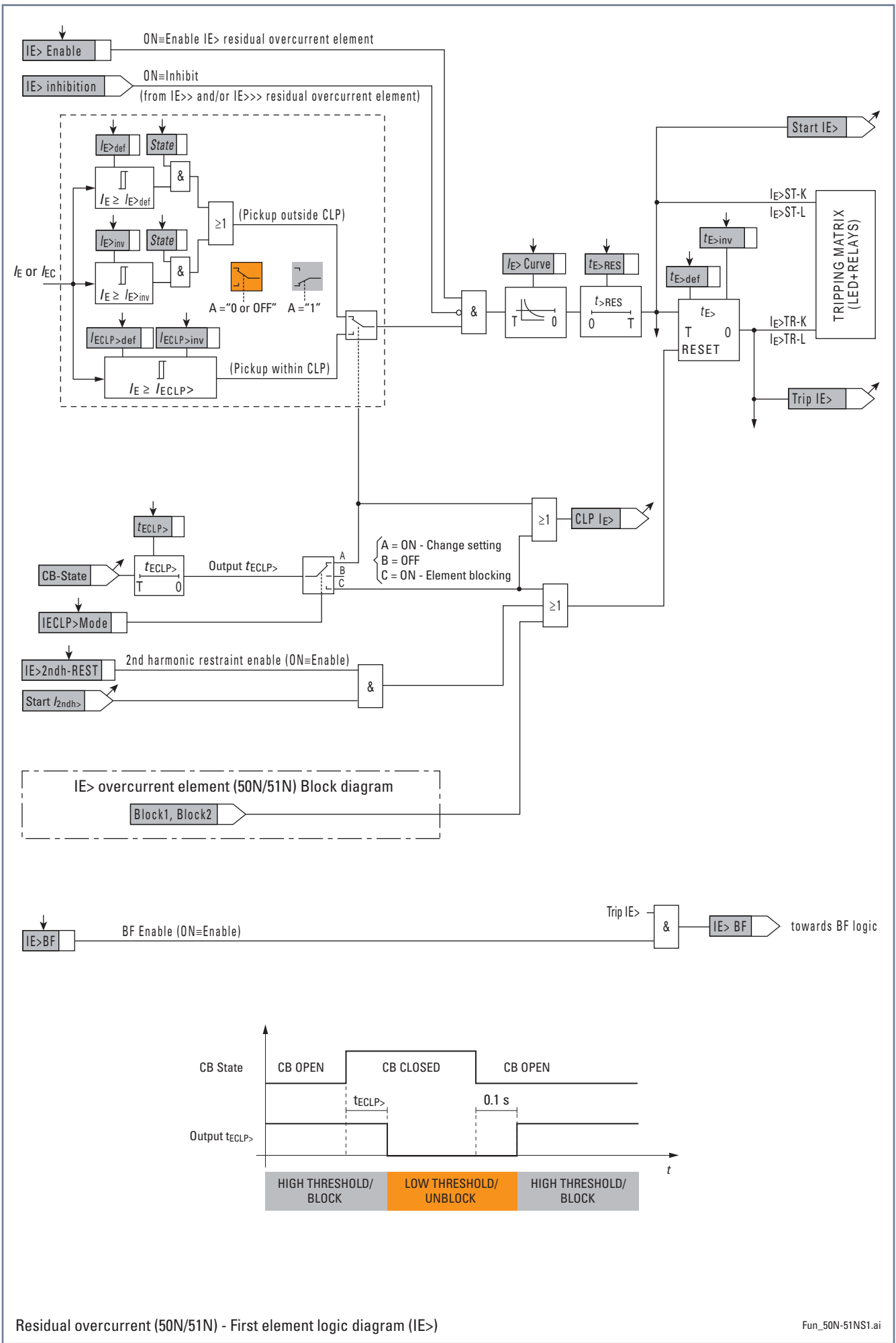
- The information about phase or phase+earth block may be select programming the *ModeBLOUT1* parameter (*OFF - ON IPh - ON IPh/IE - ON IE*) inside **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menus.

Use of output relay (K1...K6):

- If the *IE>BLK2OUT*, *IE>>BLK2OUT* and/or *IE>>>BLK2OUT* enable parameters are set to *ON* and a output relay is designed for selective block (Block2), the protection issues a block output by phase elements (BLK2OUT-Iph) or by any protection element (BLK2OUT-Iph/IE), whenever the given element (Start IED>, Start IED>>, Start IED>>> and/or Start IED>>>>) becomes active. The enable *IED>BLK2OUT*, *IED>>BLK2OUT*, *IED>>>BLK2OUT* and/or *IED>>>>BLK2OUT* parameters (*ON* or *OFF*) are available inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE> Element (IE>> Element, IE>>> Element) \ Setpoints** menus, while the *BLK2OUT-Iph-K*, *BLK2OUT-Iph/IE-K* and/or *BLK2OUT-IE-K* output relays and LEDs (*BLK2OUT-Iph-L*, *BLK2OUT-Iph/IE-L* e/o *BLK2OUT-IE-L*) must be select inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu.

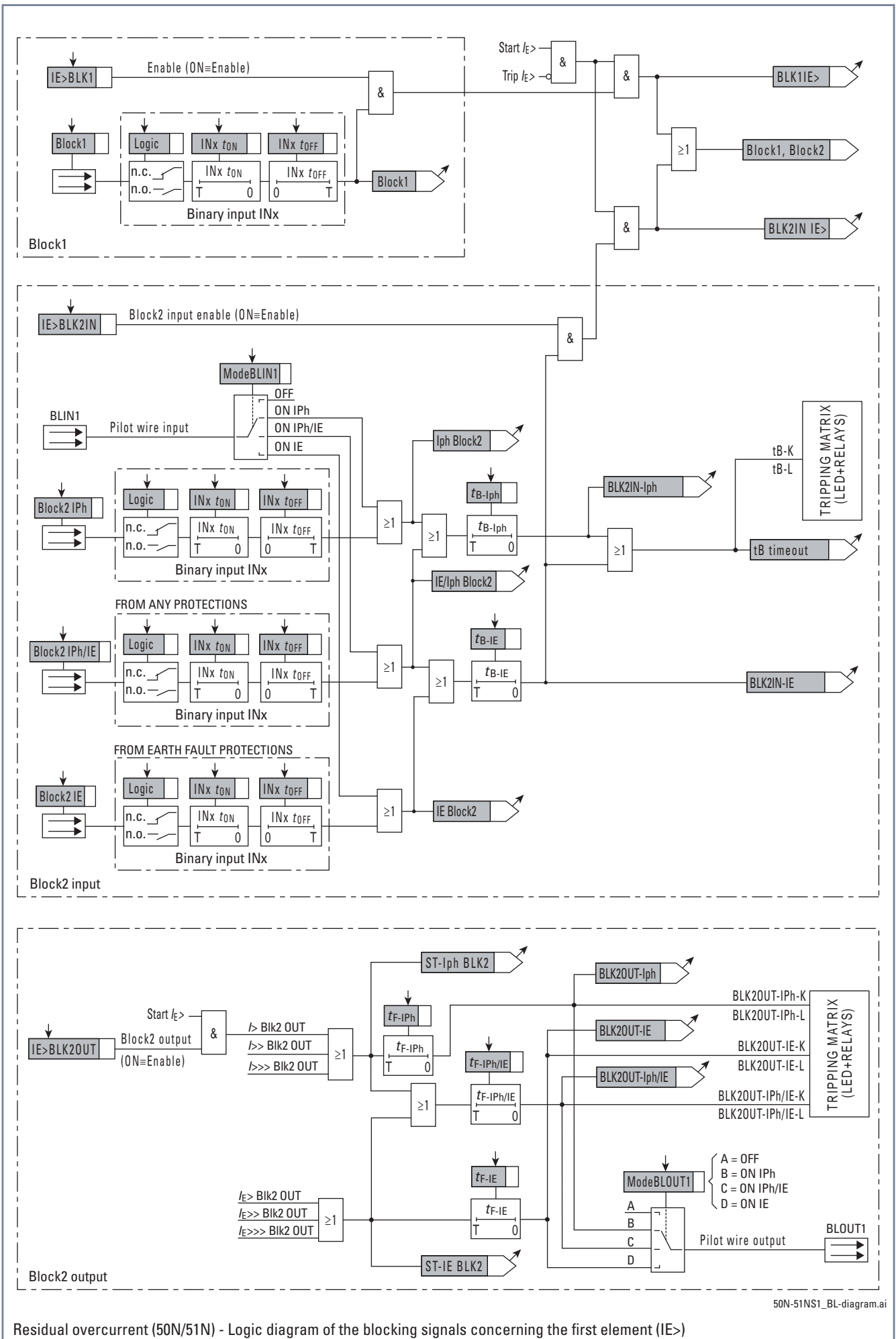
Note 1 The exhaustive treatment of the logical block (Block 1) function may be found in the "Logic Block" paragraph inside CONTROL AND MONITORING section

Note 2 The exhaustive treatment of the selective block (Block 2) function may be found in the "Selective Block" paragraph inside CONTROL AND MONITORING section



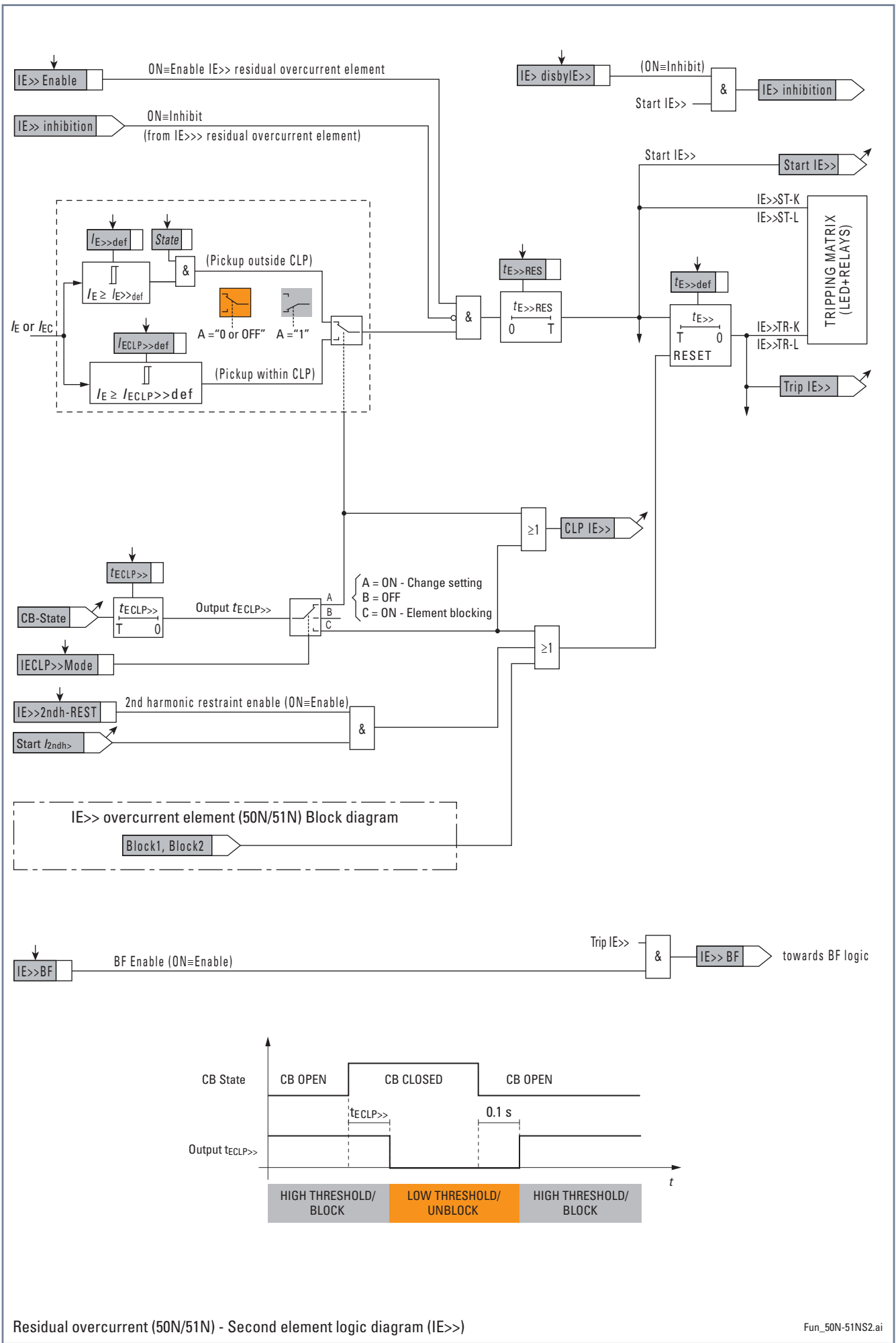
Residual overcurrent (50N/51N) - First element logic diagram (IE>)

Fun_50N-51NS1.ai



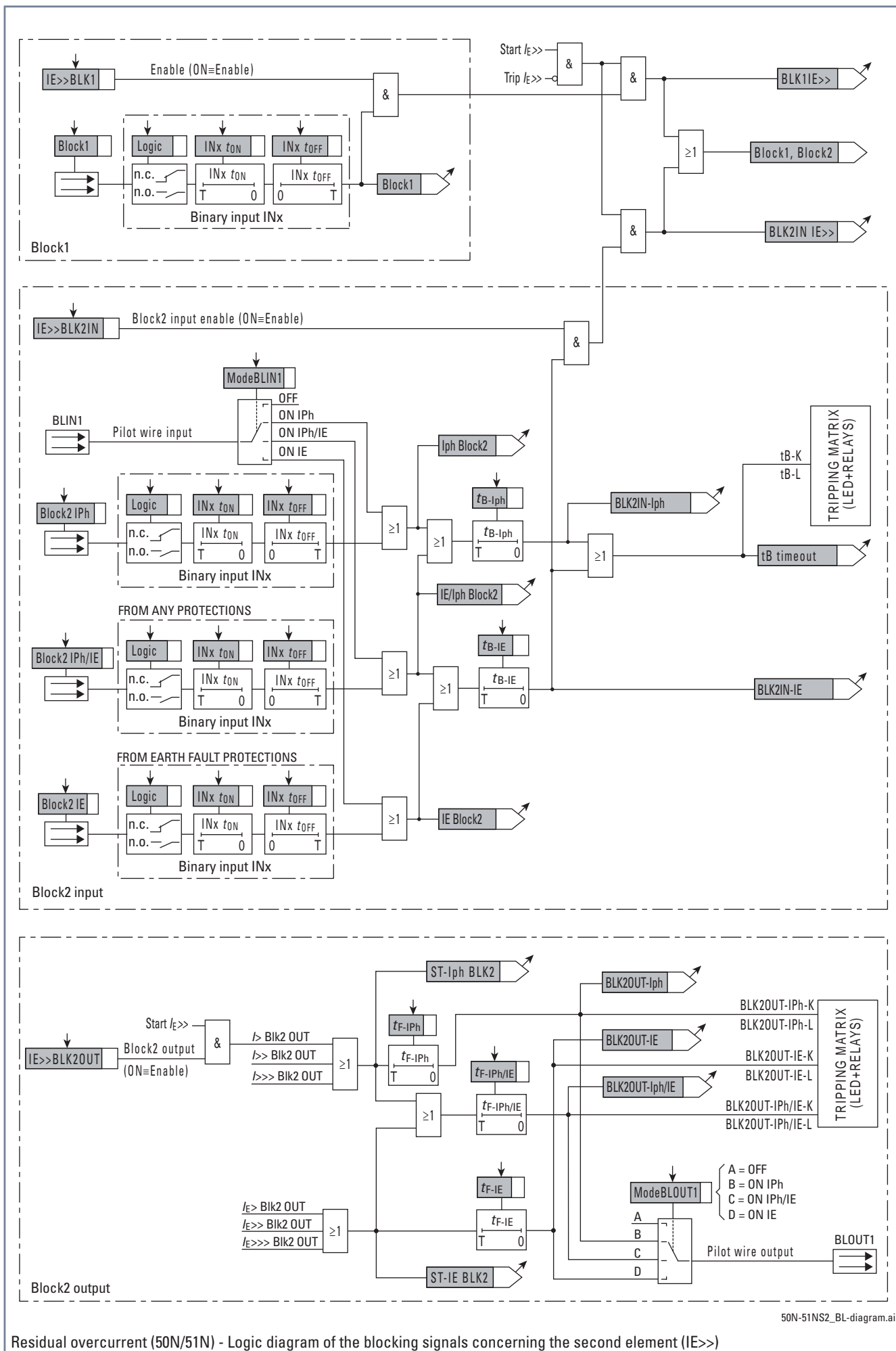
50N-51NS1_BL-diagram.ai

Residual overcurrent (50N/51N) - Logic diagram of the blocking signals concerning the first element (IE>)



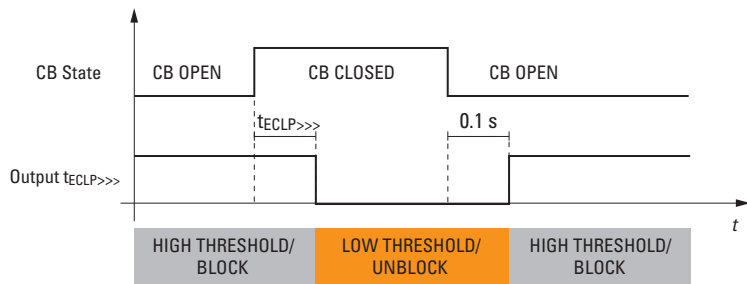
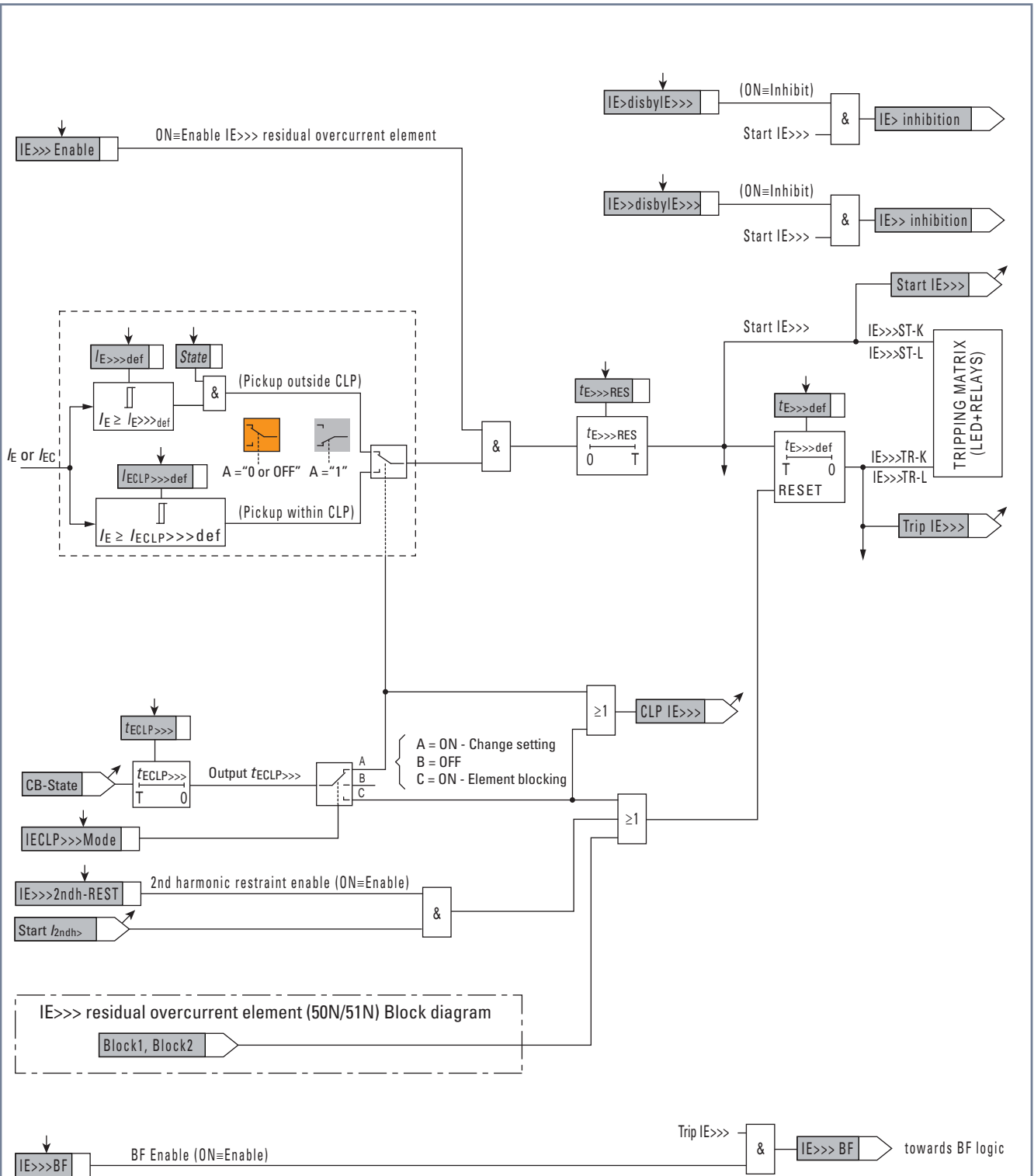
Residual overcurrent (50N/51N) - Second element logic diagram (IE>>)

Fun_50N-51NS2.ai



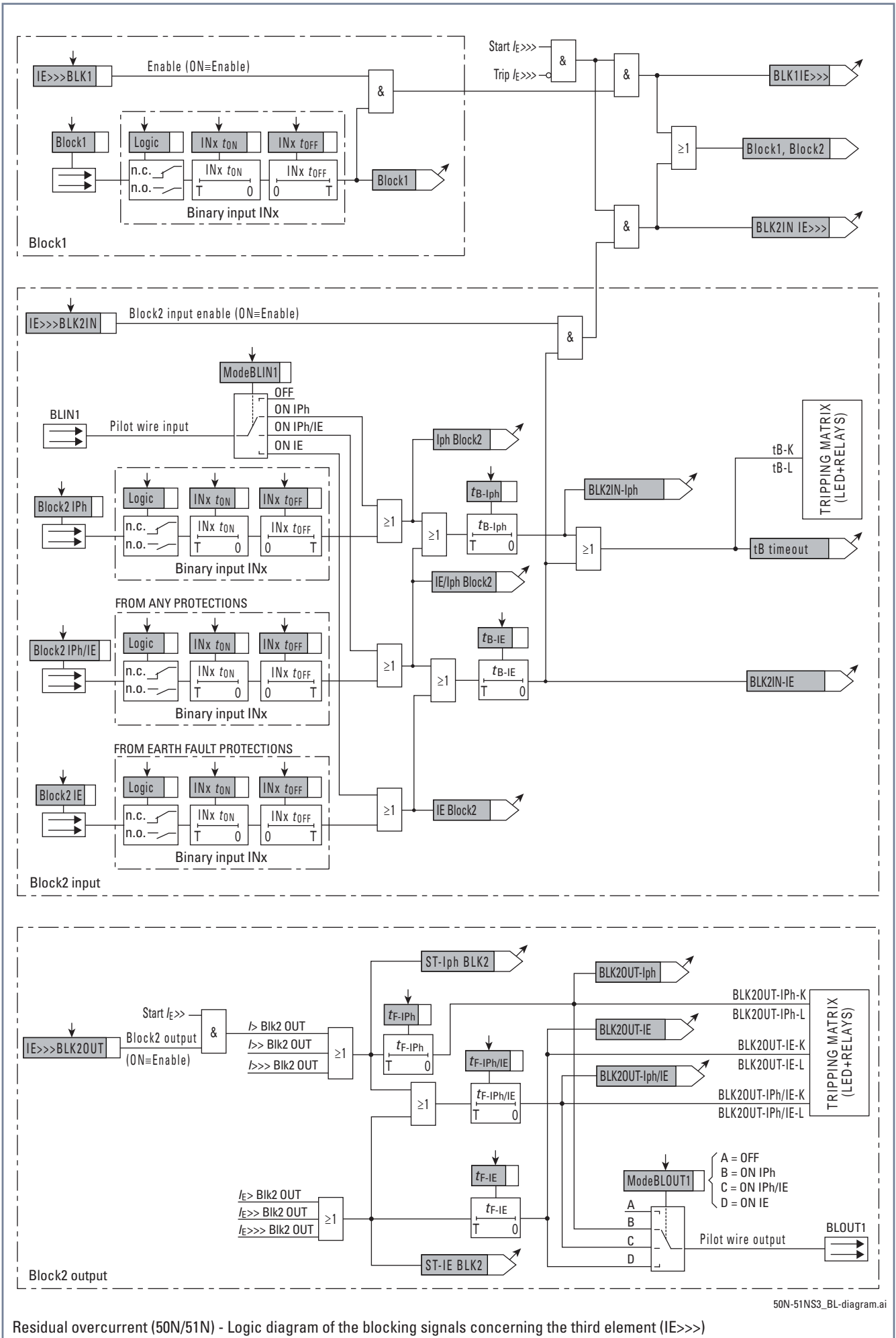
50N-51NS2_BL-diagram.ai

Residual overcurrent (50N/51N) - Logic diagram of the blocking signals concerning the second element (IE>>)



Residual overcurrent (50N/51N) - Third element logic diagram (IE>>>)

Fun_50N-51NS3.ai



50N-51NS3_BL-diagram.ai

Residual overcurrent (50N/51N) - Logic diagram of the blocking signals concerning the third element (IE>>>)

Breaker failure - BF

Preface

When the protection issues a trip command but, because an anomaly, the circuit breaker cannot open, the breaker failure protection issues a back-up trip command to trip adjacent circuit breakers. The breaker failure function may be started by internal protective function (if associated with BF) or by external protections.

Operation and settings

The starting of the timer occurs if both the following conditions are filled:

- A) Start and trip of internal protective elements (trip of elements matched with BF protection) or, trip of external protections acquired by means binary input, if enabled;
- B) The CB is closed (the CB state may be acquired by means two binary inputs connected to the auxiliary contacts 52a and 52b) or the fundamental component of at least one phase current I_{L1} , I_{L2} , I_{L3} is greater than the $I_{BF>}$ adjustable threshold or the fundamental component of the residual current I_E is greater than the $I_{EBF>}$ adjustable threshold.

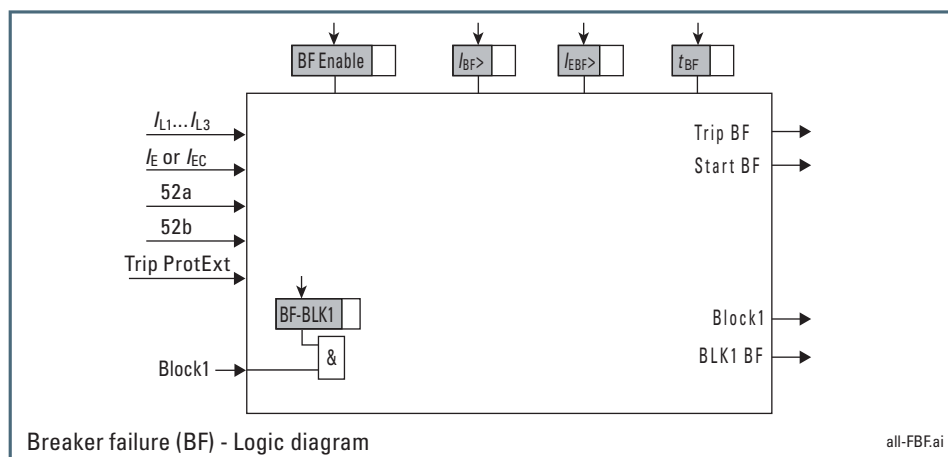
The breaker failure protection reliability is improved by means of the CB position control or phase or residual current measure; the trip can arise also for wrong auxiliary contacts state (if the current is greater than the adjustable threshold) or for trip of external protections (frequency, voltage,..) without current (with CB closed information supplied from state of auxiliary contacts).

If the information concerning the CB position is not achievable (for instance the auxiliary contacts are unavailable), such control must be disabled.

If both conditions are held along the set operate time t_{BF} , the BF element trips at deadline, vice versa the timer is cleared and the function is restored.

To the purpose to restore the BF element as quickly as possible, with start of the same protection (see A condition), additionally to the trip of some internal protections, their starts are required (start reset is faster than trip reset).

The element may be enabled or disabled by setting *ON* the *BF Enable* parameter available inside the **Set \ Profile A(or B) \ Breaker failure-BF** menu.



All the $I_{BF>}$, $I_{EBF>}$ and t_{BF} parameters can be set separately for **Profile A** and **Profile B**; they are available inside the **Set \ Profile A(or B) \ Breaker failure-BF** menu.

BF start from Circuit breaker

If the *CB Input* parameter (BF Start from circuit breaker) is set to *ON*, and two binary inputs are designed for acquire the 52a and 52b auxiliary contacts^[1], the control of the CB position is enabled. If the information concerning the CB position is not available, such control must be disabled by setting *OFF* the *CB Input* parameter. The parameter is available inside the **Set \ Profile A(or B) \ Breaker failure-BF** menu, the *52a* and *52b* function must be assigned to the selected binary inputs inside **Set \ Inputs \ Binary input IN1(x)** menus (IN1 or INx matching).

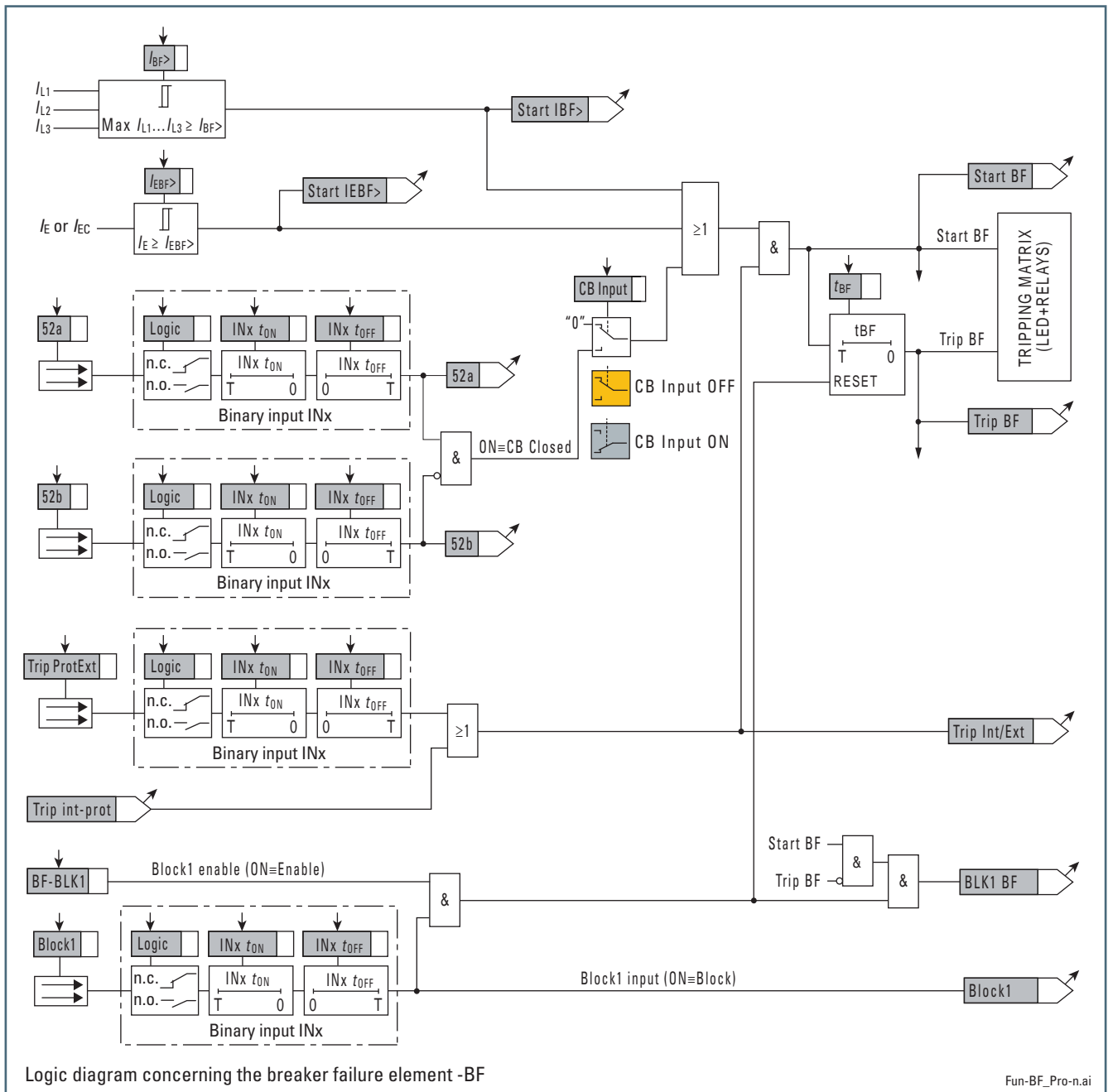
To enable the breaker failure protection to operate with trips coming from external protections, one binary input must be designed to acquire the relative contacts. The *TripProtExt* function must be assigned to the selected binary input inside the **Set \ Inputs \ Binary input IN1(2...)** menus (IN1 or IN... matching).

Logical block (Block1)

If the *BF-BLK1* parameter (BF logical block) is set to *ON*, and a binary input is designed for logical block (Block1), the breaker failure protection is blocked off whenever the given input is active. The trip timer is held in reset condition, so the operate time counting starts when the input block goes down.^[2] The enabling parameter is available inside the **Set \ Profile A(or B) \ Breaker failure-BF** menu, while the *Block1* function must be assigned to the selected binary input inside the **Set \ Inputs \ Binary input IN1(x)** menus (IN1 or INx matching).

Note 1 Both auxiliary contact state 52a and 52b must be acquired (two binary inputs are required) with Fw version previous to 1.60; with later versions, giving up an inconsistency occurs, one logical input for the acquisition of a contact (52nd or 52b) may suffice

Note 2 The exhaustive treatment of the logic block (Block 1) function may be found in the "Logic Block" paragraph inside CONTROL AND MONITORING section



Automatic reclosure - 79
Preface

The automatic reclosure function is well-used on overhead lines (when faults are self-extinguish after tripping of protection relays).

Operation and settings

The following sequences may be selected:

- Rapid reclosure,
- Rapid reclosure followed by one slow reclosure,
- Rapid reclosure followed by one slow reclosure and one or more delayed reclosures (1...5).

Starting of the automatic reclosing function can be raised by internal protective elements or externally by means binary input signals (eg: external protection device contacts or operating switches).

The following logics may be set (binary inputs allocation):

- 52a - 52b (Circuit breaker state); the CB position is indispensable for the auto reclosure function.
- 79 Enable; enable command,
- 79 Block; stop sequence command (pulse),
- 79 External; start of reclosure command (trip from external protections).

The following output functions may be coupled to the output relays:

- CB reclosing command; it is indispensable for the auto reclosure function.
- Reclosure fail.
- Cycle in progress.

The following timers are provided:

- t_{rdt} Rapid reclosure dead time
- t_{sdt} Slow reclosure dead time
- t_r Reclaim time
- t_d Manual close fault discrimination time
- t_{d1} Slow reclosure fault discrimination time
- t_{d2} Delayed reclosure fault discrimination time.

- Rapid reclosure dead time (t_{rdt})^[1]

It is the time interval from the CB opening command and the CB reclosing command.

The setting time for the rapid reclosure is a compromise from the time required for the arc extinction on the fault location and the max allowable out of service time of the line.

The parameter must be adjusted on the basis of the extension and grid voltage. The minimum value should allow the arc deionization and the insulation restoring in order to comply with the mechanical characteristics of the circuit breaker and the residual arc extinction.

- Slow reclosure dead time (t_{sdt})^[1]

It is the time interval from the failed fast reclosure and the start of slow reclosure sequence.

The setting time for the waiting time is a function of the mechanical characteristics of the circuit breaker (data must be supplied by manufacturer). For newest circuit breakers typical values are 60 s and 180 s for oldest circuit breakers.

- Reclaim time (t_r)

It is the time interval following the initiation of reclosure command.

If no trip operation arises within the reclaim time the reclosing operation is regarded as successful and the device is ready for a new sequence.

If any trip arises within the reclaim time the cycle goes on with sequence depending from the setting mode.

- Manual close fault discrimination time (t_d)

If any trip arises within the time interval following the intentional close CB command, the cycle goes off and the failed reclosure is issued; if no trip are detected the reclosing sequence goes on with the programmed delayed reclosures.

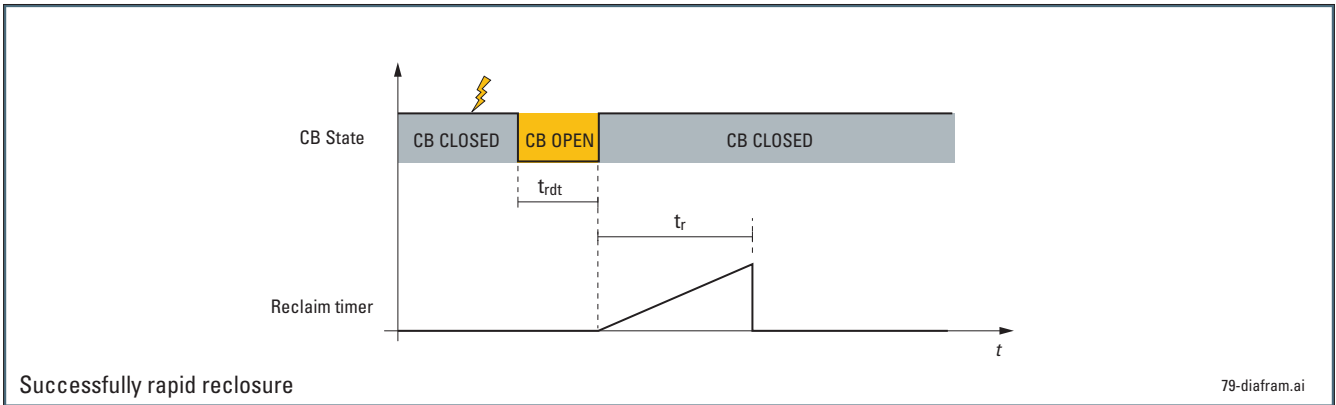
- Slow reclosure fault discrimination time (t_{d1}) and Delayed reclosure fault discrimination time (t_{d2})

If any trip arises within the time interval t_{d1} or t_{d2} (slow or delayed reclosure), the cycle goes off and the failed reclosure is issued.

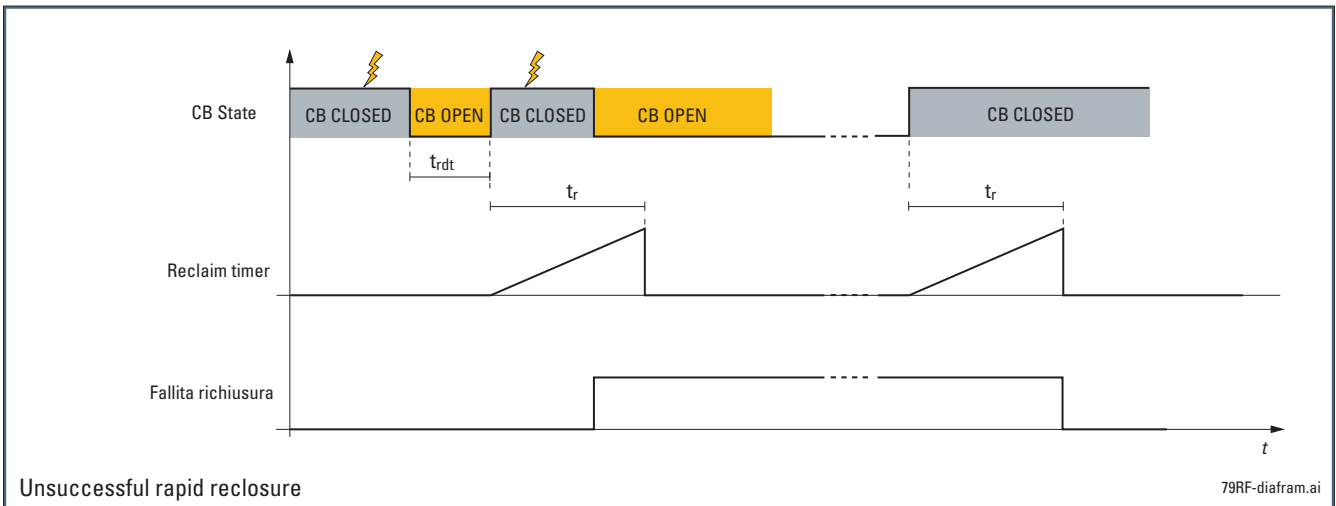
Note 1 The reclosing waiting time is calculated from the first event that is detected between the reset of the trip element and the open state acquisition of the circuit breaker

Rapid reclosing

Successful rapid reclosure; no faults (CB opening command) occurs within the reclaim time. After the reclaim time the system comes back to reset; any new trip starts a rapid reclosing sequence again.

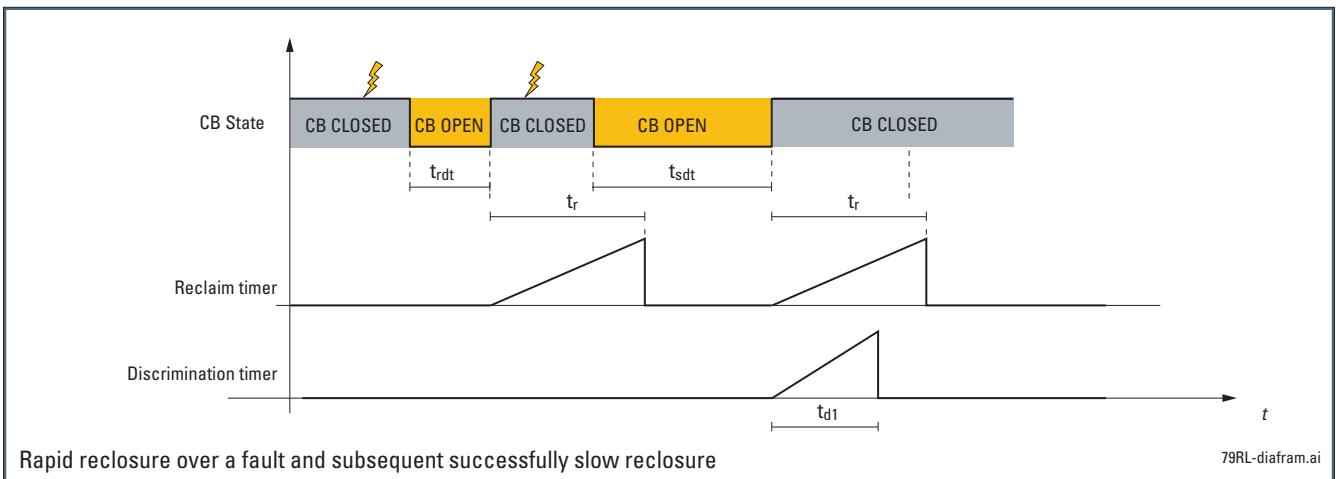


Unsuccessful rapid reclosure; new fault (CB opening command) occurs within the reclaim time. The automatic reclosing system is blocked and a failed reclosure command is issued. After the reclaim time, following a closed CB condition without any faults, the system comes back to reset.

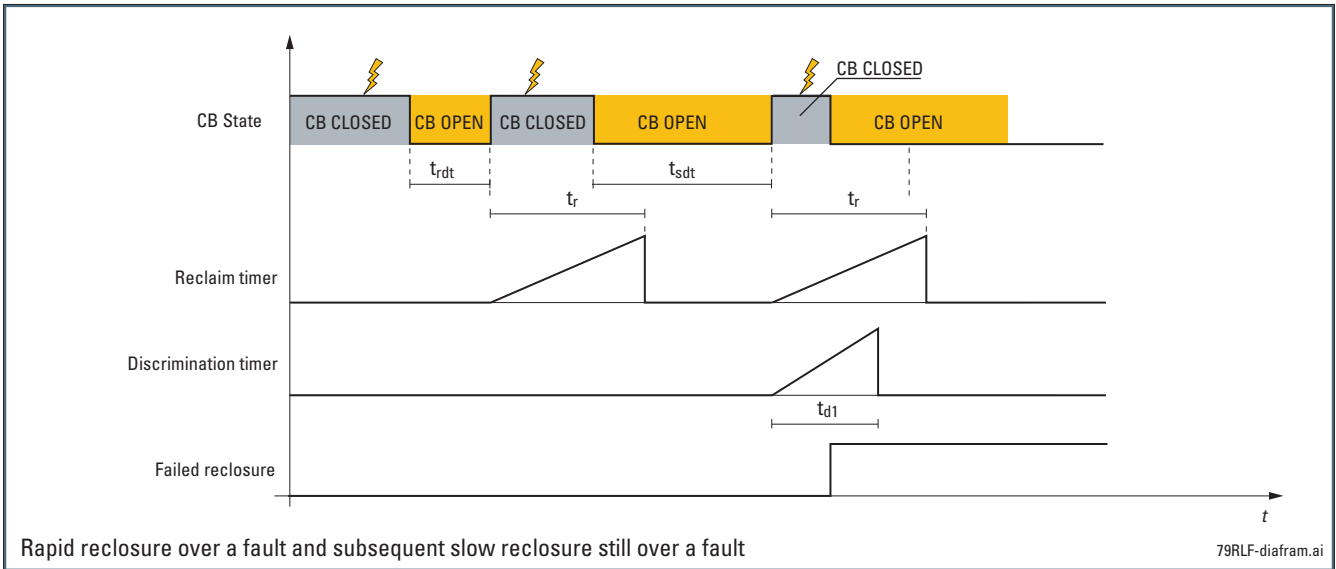


Rapid reclosing and slow reclosing

Successful rapid + slow reclosure; a fault (CB opening command) occurs within the reclaim time. After the slow reclosure dead time (t_{sdt}) a slow reclosure is operated. Because no trip occurs within the reclaim time the system comes back to reset; any new trip starts a rapid + slow reclosing sequence again.

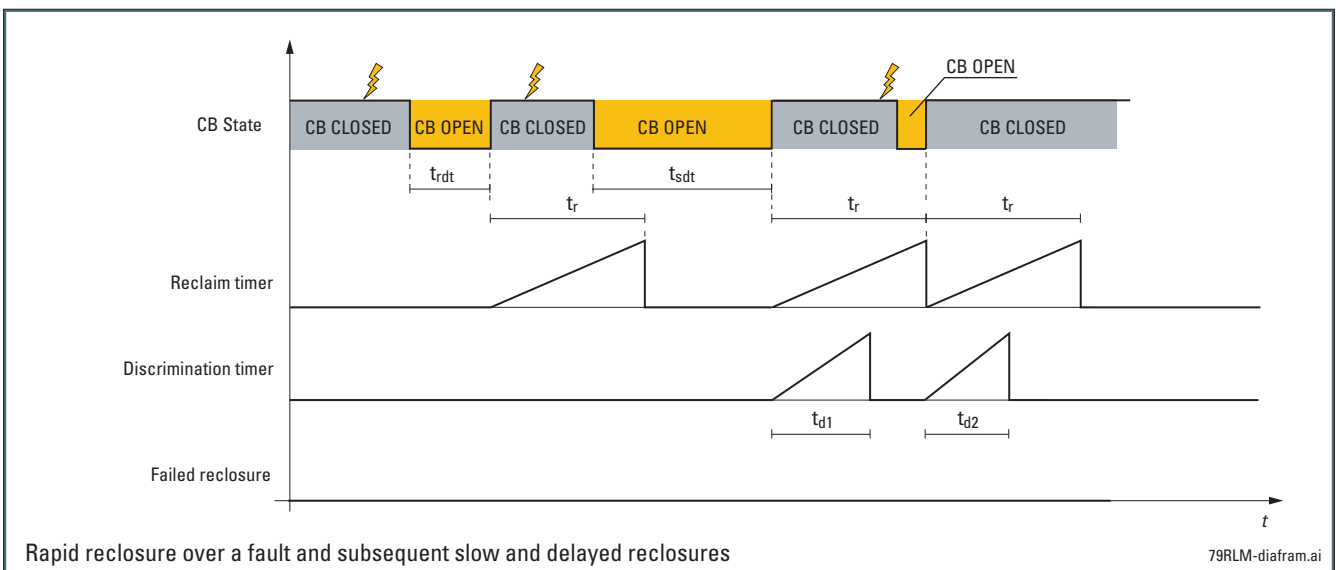


Unsuccessful rapid + slow reclosure; new fault (CB opening command) occurs within the reclaim time and the next slow reclosure is issued with fault within the slow reclosure fault discrimination time t_{d1} ;
The automatic reclosing system is blocked and a failed reclosure command is issued.



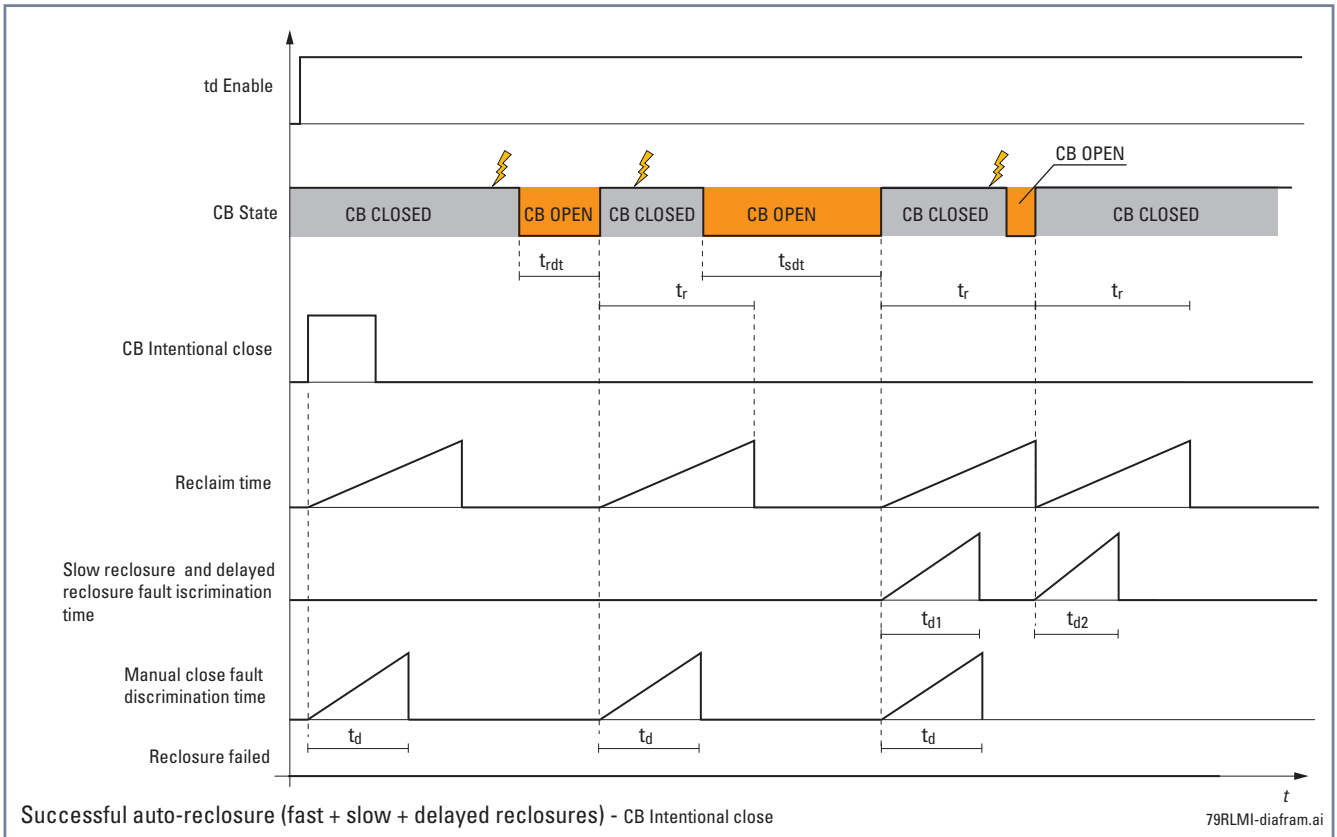
Rapid + slow reclosures and subsequent delayed reclosures

Successful rapid + slow + delayed reclosures; a fault (CB opening command) occurs within the reclaim time.
After the slow reclosure dead time (t_{sdt}) a slow reclosure is operated on fault detected later than t_{d1} but within the reclaim time t_r ; once the reclaim time has elapsed, the delayed reclosing is issued.

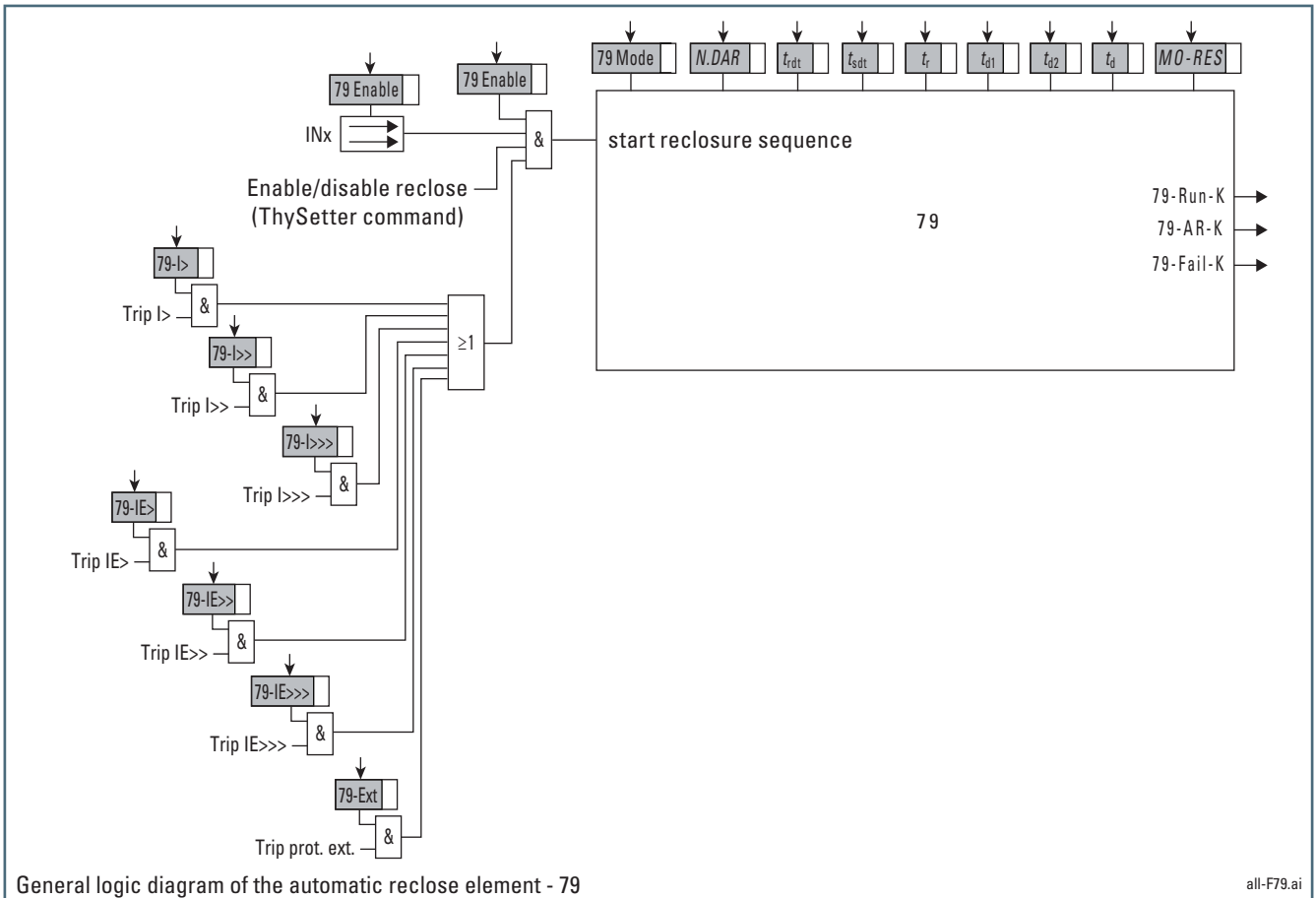


The delayed reclosure starts the timer t_{d2} (Delayed reclosure fault discrimination time); at the same time the reclaim timer t_r is started; if no more trip within t_r , once the reclaim time has elapsed, the system comes back to reset.
Vice versa, if a further trip within t_{d2} arises, the automatic reclosing system is blocked and a failed reclosure command is issued.
Following trips after the t_{d2} (Delayed reclosure fault discrimination time) up to five reclosures may be programmed by means the N.DAR parameter available inside the **Set \ Auto-reclose - 79** menu.
The intentional CB closing command start the reclaim (t_r) and Manual close fault discrimination (t_d) timers.

With Rapid-reclose setting (79 Mode = Rapid), any trip within the t_r time interval causes a blocking of the sequence and a failed reclosure signal is issued (Unsuccessful rapid reclosure).
With Rapid+Slow reclose setting (79 Mode = Rapid+Slow) and t_d timer enabled (MC-td-EN=ON), any trip inside the t_d time interval causes a a block of the reclosure sequence and a failed reclosure signal is issued, whereas any trip inside the t_r time interval and after the t_d time interval issues an open CB command and a delayed reclosure attempt.



The element may be enabled or disabled by setting *ON* or *OFF* the *79 Enable* parameter available inside the **Set \ Auto-reclose-79** menu.
 With the *79 Enable* parameter *ON* the 79 element can be enabled/disabled by means of binary input ans/or ThyVisor command (**Commands \ Reclose \ Enable reclose/Disable reclose**).



Logical block - BLOCK1

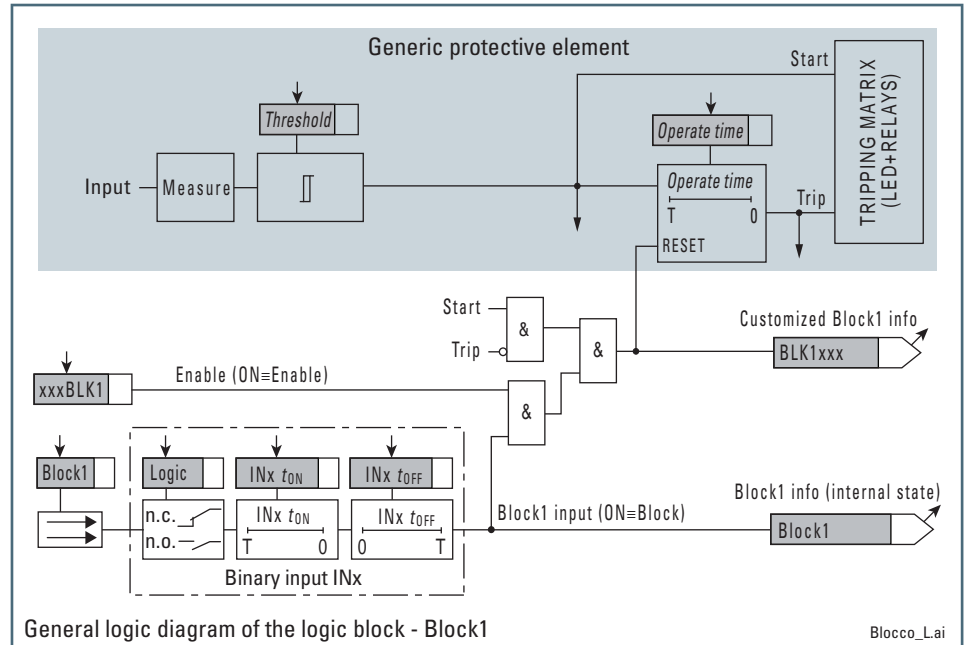
To the purpose to block off the trip of one protection element, the logical block function (Block1) may be matched with binary inputs.^[1]

The binary-matching may be set inside the **Inputs** submenu; to the purpose the *Block1* parameter must be selected for *INx matching* (x=1, 2)

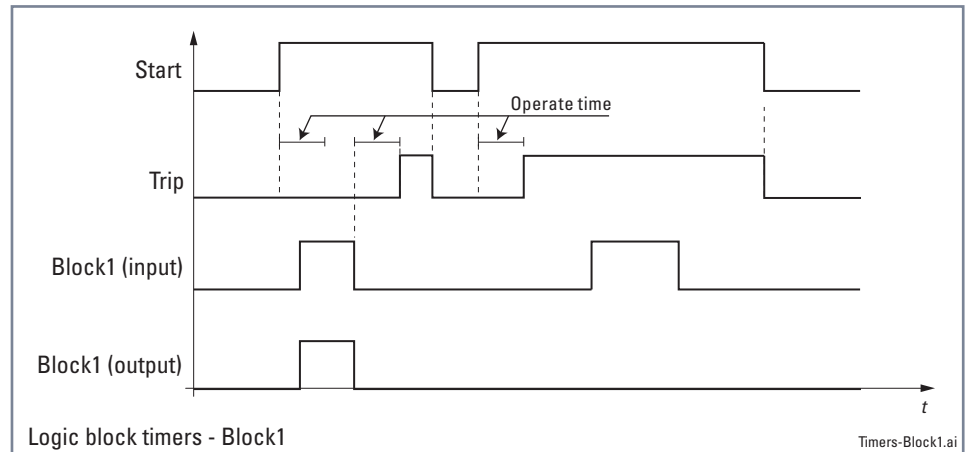
A protective element, where the logical block is enabled, is blocked off whenever the given input is ON.

For a given protective element, the logical block state is reading available (ThyVisor and communication interfaces); it is ON the following condition are at the same time observed:

- Binary input ON
- Element start ON
- Element Trip OFF.



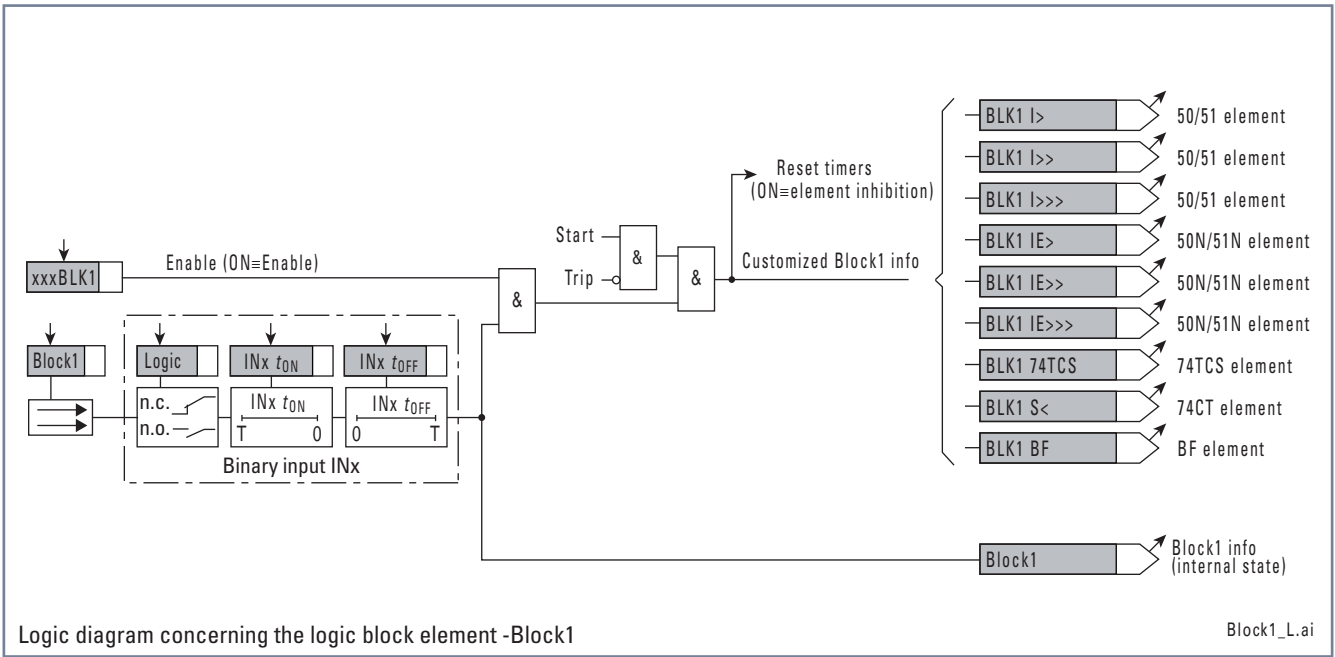
The logical block it is not liable for any inhibition time-out, so the protective element is disabled for the whole time when the input is ON.^[2]



Activation of any binary input assigned to logic block (Block1) function effects a block of all the protective elements where the logic block is enabled

Note 1 In the following treatment, the logical block is defined as "Logical block" or "Block1"

Note 2 The Block 1 signal forces a timer reset



Logic diagram concerning the logic block element -Block1

Block1_L.ai

Selective block -BLOCK2^[1]

Preface

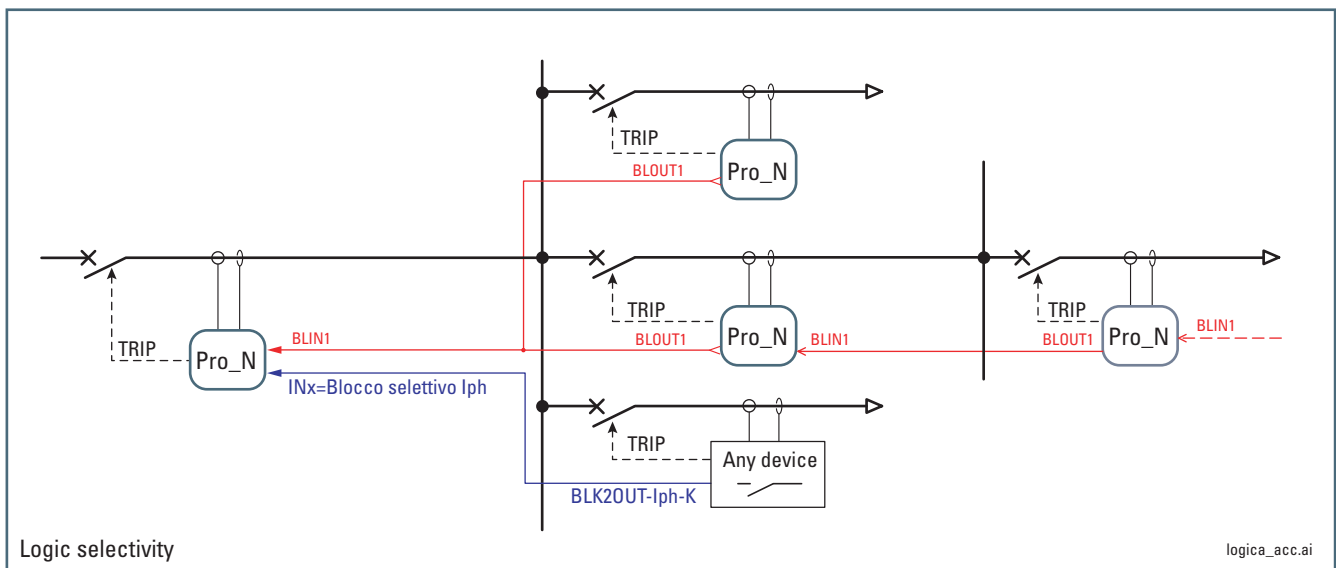
The logic selectivity function has been developed to the purpose to reduce the clearing times for faults closes to the source.

The output blocking circuits of one or several Pro_N relays, shunted together, must be connected to the input blocking circuit of the protection relay, which is installed upwards in the electric plant. The output circuit works as a simple contact, whose condition is detected by the input circuit of the upwards protection relay.

The logic selectivity function can be realized through any combination of the following I/O circuits:

- One committed pilot wire input BLIN1...ON Iph, ON...Iph/IE, ON...IE.
- One committed pilot wire output BLOUT1...ON Iph, ON...Iph/IE, ON...IE.
- One or more than one independent binary inputs programmed with *Block2 Iph*, *Block2 Iph/IE* or *Block2 IE*.
- One or more than one independent output relays programmed with *BLK2OUT-Iph-K*, *BLK2OUT-Iph/IE-K* or *BLK2OUT-IE-K*.

In reference to the following schematic diagram, the some protection functions of the relay placed on the feeder may be blocked by downstream protective relays.



Input selective block

Use of committed pilot wire input BLIN1

The input is a polarized wet type powered by internal isolated supply; it must be drive by an output block signal coming from a Pro-N device or by a free voltage contact.



WARNING

Never connect power to the block input circuit; the electronic circuit can be damaged

The protection is blocked off according the selectivity block criteria by phase elements (*Block2 Iph*), by earth elements (*Block2 IE*) or by any protection element (*Block2 Iph/IE*) when the input BLIN1 is active. The information about phase or phase+earth block may be select programming the *ModeBLIN1* parameter inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menus.

Use of binary inputs

If the *xxBLK2IN* parameters (enable) are set to *ON* and a binary input is designed for selective block (*Block2*), the protection is blocked off by phase elements (*Block2 Iph*), by earth elements (*Block2 IE*) or by any protection element (*Block2 Iph/IE*), according the selectivity block criteria, when the input (*IN1* and/or *INx*) is active.

The *Block2 Iph*, *Block2 IE* and *Block2 Iph/IE* matching must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input 1** and **Set \ Inputs \ Binary input x** menus.

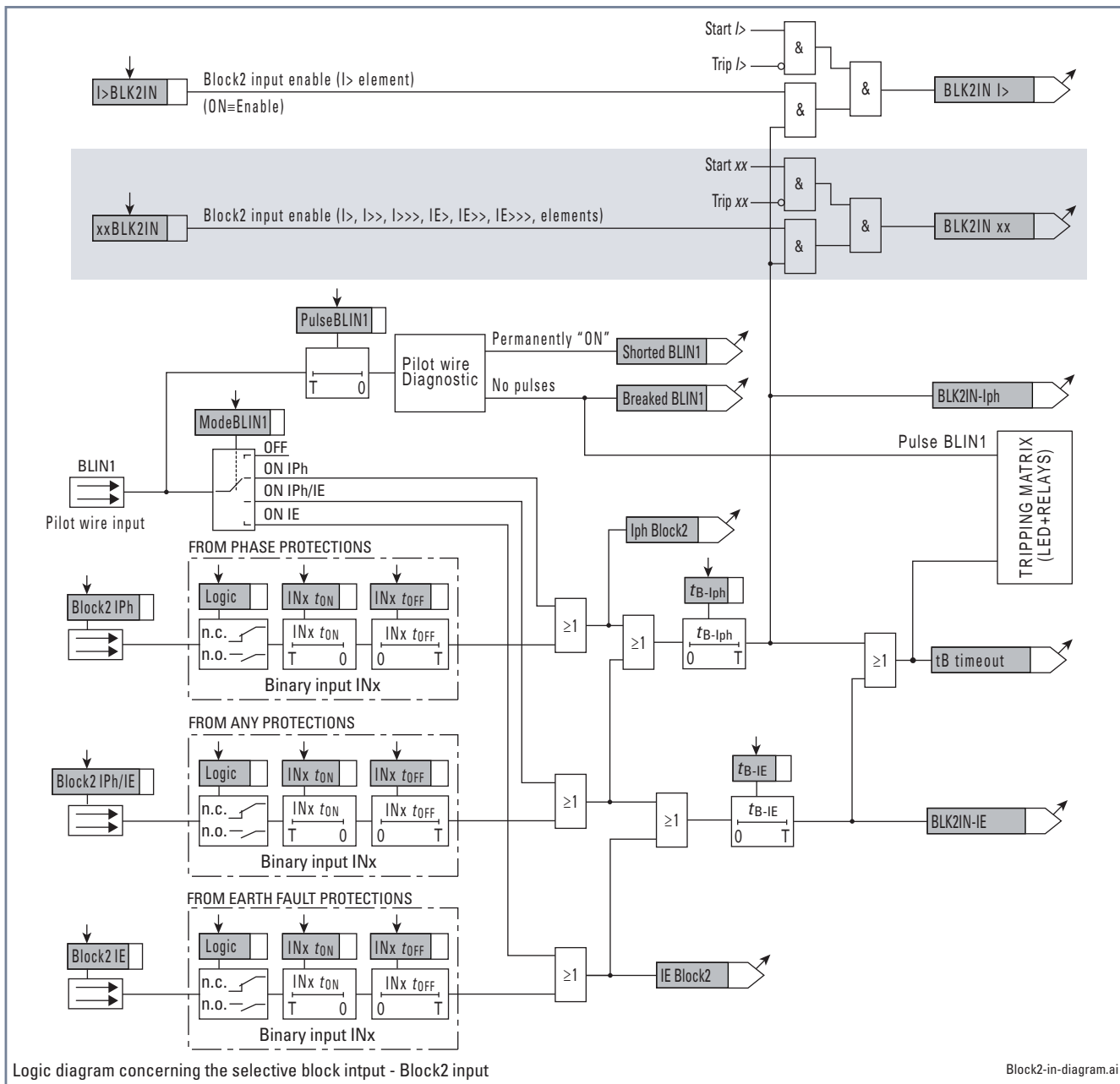
When a binary input is programmed for selective block input, the *IN1 tON*, *INx tON*, *IN1 tOFF* and *INx tOFF* time delays must be reset to zero; the *Logic* parameters (*ON/OFF*) must be programmed in the same way of the related output relay connected with-it.

Note 1 The "Logic selectivity" and "Block2" terms are employed without distinction

Operation

For any protective element, three main conditions can arise:

- A) Start = OFF: the element is at rest (no trip) regardless of the input/output blocks.
- B) Start = ON: the element trips if no selective block input becomes active during the operate time.
- C) Start = ON: if the selective block input (BLIN1 and/or binary input) becomes active, the element goes in selective block state wherein the operate timer is forced to reset, so the element cannot trip. After an adjustable time t_{B-Iph} (common for phase protection elements) or t_{B-IE} (common for earth protection elements), the selective block input is disregarded and the operate timer can start again. Information about t_{B-Iph} and or t_{B-IE} expired is available for reading (tB timeout data inside **Read \ Selective block - BLOCK2 \ Block2 input** menu) and can drive an output relay and or a LED ($tB-K$ and or $tB-K$ parameters inside **Set \ Profile A(or B) \ Selective block - BLOCK2 \ Selective block IN** submenu).



With a setting other than 0.00 s, the t_{B-Iph} and t_{B-IE} timers may be used to have a backup protection available against pilot wire short circuit.^[1]

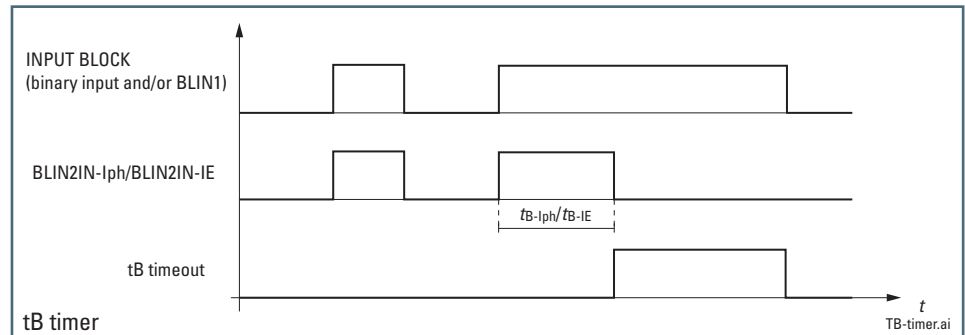
The t_{B-Iph} and/or t_{B-IE} timers must be adjusted according the following rule (example for t_{B-Iph}):

$$t_{B-Iph} = t_{FV} + \epsilon_t + \epsilon_s$$

where t_{FV} is the value of block output timer related to the downstream relay (example t_{F-Iph}), ϵ_t is a chronometric selectivity margin to apply in comparison to the t_{B-Iph} time related to the downstream relay (does not take into account if such margin has been considered for the t_{F-Iph} setting), ϵ_s is a safety margin. The chronometric selectivity applied among the t_{B-x} times of the relays in accelerated logic system allows to avoid more the contemporary circuit breaker opening after the clearing of a fault in a line of concomitant plant to the short-circuit of the pilot wires concerning the same line.

Note 1 In the absence of suitable provisions, a short circuit on a pilot wire causes the block of the receiving relay, so a possible fault (contemporary or following) inside the protected zone, cannot be cleared that being the case the protective relay blocked.

To enable the selectivity logic input for a generic xx element, the $xxBLK2IN$ parameters must be set to *ON* inside the **Set \ Parametri di configurazione A (o B) \ xxx \ Setpoints** menus concerning all element where the selective block is available, eg:
 $I > BLK2IN$ inside the **Set \ Profile A (or B) \ Phase overcurrent-50/51 \ I > Element \ Setpoints** menu.



Output selective block

Use of output relays

If the $xxBLK2OUT$, $xxBLK2OUT$ and/or $xxBLK2OUT$ enable parameters are set to *ON* and a output relay is designed for selective block (Block2), the protection issues a block output by phase elements ($BLK2OUT-Iph$), by ground elements ($BLK2OUT-IE$) or by any protection element ($BLK2OUT-Iph/IE$), whenever the given start is active.

The $BLK2OUT-Iph-K$, $BLK2OUT-Iph/IE-K$ and/or $BLK2OUT-IE-K$ output relays must be set inside the **Set \ Profile A (or B) \ Selective block-BLOCK2 \ Selective block OUT** menu; the same for addressing the LED indicators ($BLK2OUT2-Iph-L$, $BLK2OUT2-IE-L$ and $BLK2OUT2-Iph/IE_L$). When output relays are programmed for selective block output, the t_{TR} time delays must reset to zero; the operation mode must be set with self reset (*No-latched* inside **Set \ Relays** submenu) and the *Logic* parameters (*Energized/De-energized*) must be programmed in the same way of the related binary input connected with-it.

Use of committed pilot wire output BLOUT1

The output is a dry static relay.

The information about phase (*ON IPh*), earth (*ON IE*), or phase+earth (*ON IPh/IE*) concerning the sending block out signal may be select by means of the *ModeBLOUT1* parameter inside the **Set \ Profile A (or B) \ Selective block-BLOCK2 \ Selective block OUT** menu.

The parameters can be set separately for **A** and **B** profiles.

Operation

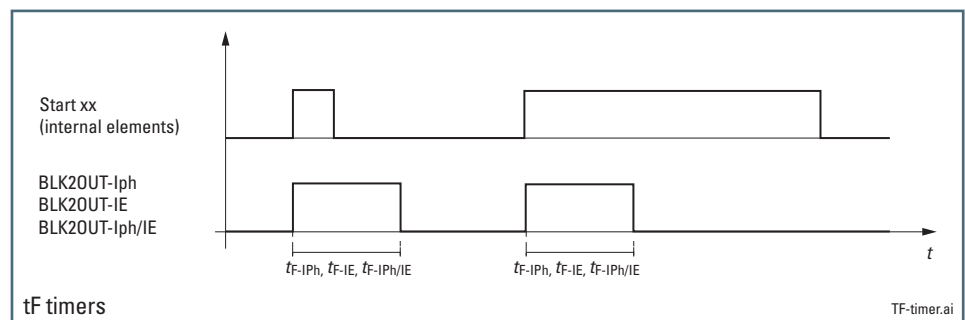
The selective block outputs go ON at the same time of the xx element start; they hold steady (even if the start reset to zero) for along the t_{F-IPh} , t_{F-IE} and $t_{F-IPh/IE}$ adjustable times for phase, earth and phase+earth functions.

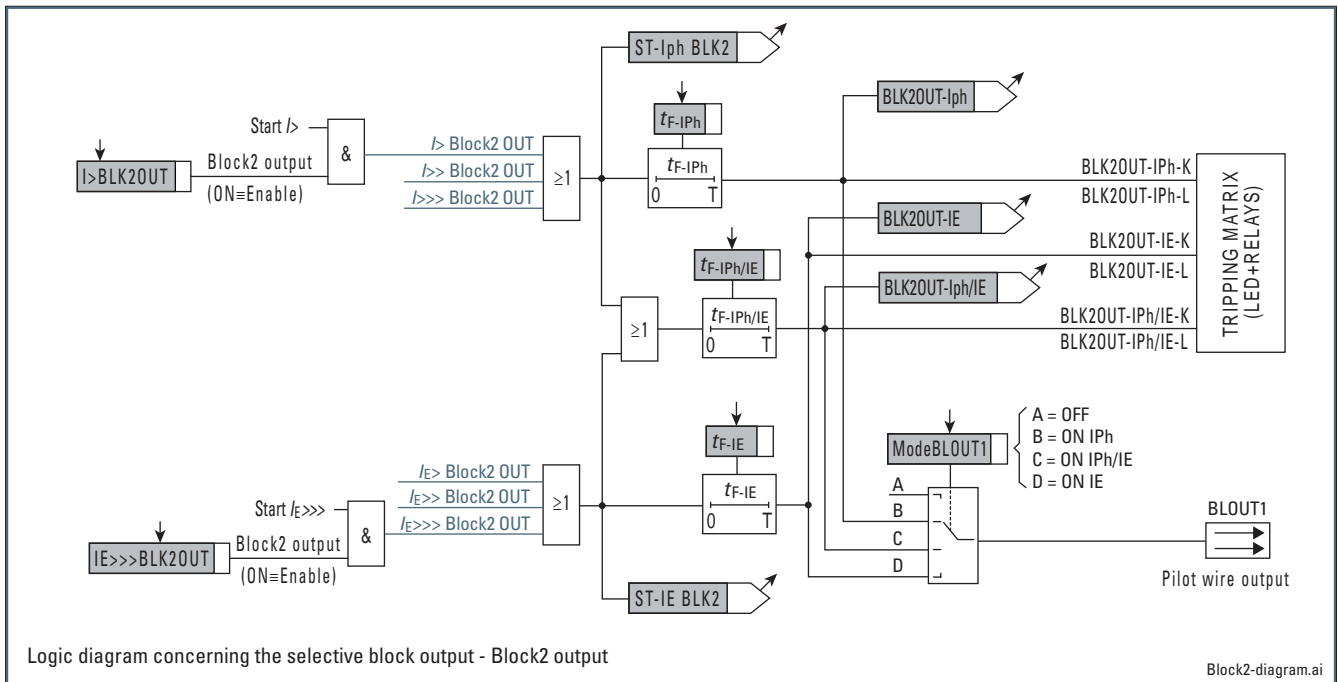
The timers starts when one or more selective block function goes ON; when a timer expires, the selective block outputs are disregarded (even if the start holds steady).

The t_{F-IPh} and t_{F-IE} counters start when the output selective block becomes active. When the counters expire the block selective output is forced off (despite the start xxx remain active).

If the t_{F-IPh} , t_{F-IE} e $t_{F-IPh/IE}$ timers are cleared the selective block output state is freeze up to the start xxx remain active.

With a setting other than 0.00 s, the t_{F-IPh} , t_{F-IE} e $t_{F-IPh/IE}$ timers may be used to provide a backup protection against breaker failure inside a selectivity logic system, as well as to hold blocked upstream protective relays up after the fault is cleared with CB opening to provide solution against unwanted trips because of a larger reset time compared with the downstream relay (the selectivity will be lost).





With traditional selective logic systems, in the absence of suitable cares, the event of a circuit breaker failure causes the block of the receiving relays situated upstream the circuit breaker, so the fault cannot be cleared.

When using the Pro-N devices inside the selective logic systems, the answer to the circuit breaker failure problem can be solved by means of, (as well as the BF-Breaker Failure element) or by means of a threshold adjusted for time selectivity, through use of the output block reset timer too with the intent that avoid permanently block of all upstream relays by downstream block signals (the only one unblocked relays deals to the fault breaker).

The t_{F-IPh} , t_{F-IE} , $t_{F-IPh/IE}$ timers must be adjusted according the following rule (example for t_{F-IPh}):

$$t_{F-IPh} = t + TAP + t_{rip} + \epsilon_t + \epsilon_s$$

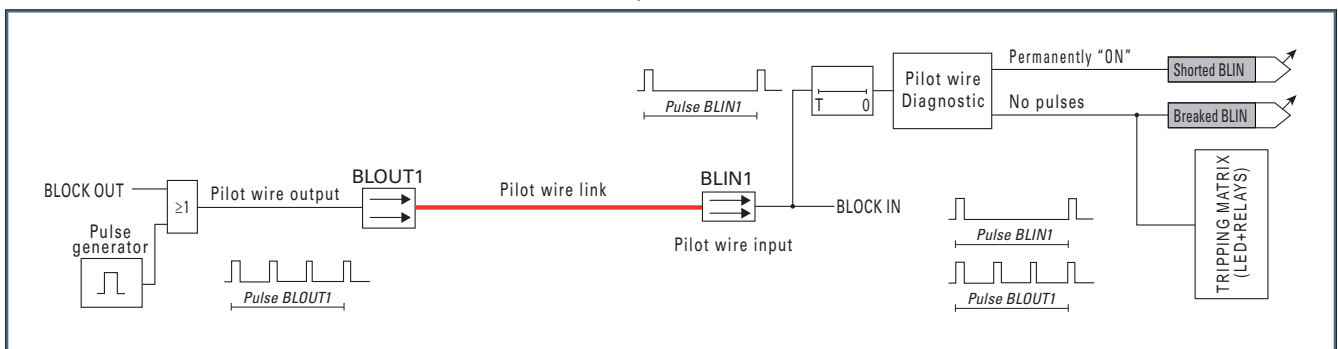
where t is the larger phase protection operate time, TAP is the circuit breaker operate time (with arc extinction), t_{rip} is the larger reset time of all protective relays inside the selective logic system, ϵ_t is an potential selectivity margin relative to the t_{F-x} time of the downstream relays, ϵ_s is a safety margin need to include timers errors (tolerances).

Diagnostic

To guarantee maximum fail-safety, the relay performs a run time monitoring for pilot wire continuity and pilot wire shorting.^[1]

Exactly the output blocking circuit periodically produces a pulse, having a small enough width in order to be ignored as an effective blocking signal by the input blocking circuit of the upstream protection, but suitable to prove the continuity of the pilot wire.

Furthermore a permanent activation (or better, with a duration longer than a preset time) of the blocking signal is identified, as a warning for a possible short circuit in the pilot wire or in the output circuit of the downstream protection.



The periodic pulses that are sent by output circuit may be enabled or disabled by means the *Pulse-BLOUT1* parameter available inside the **Set \ Pilot wire diagnostic** menu; with OFF setting the pulses are disabled.^[2]

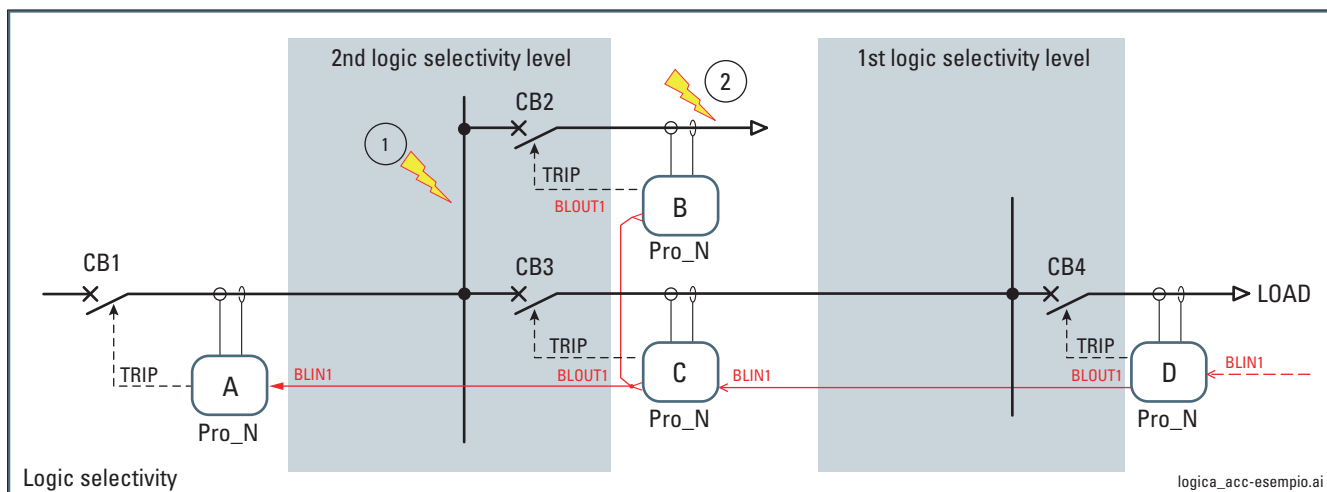
If no pulses are received inside an adjustable time window at the selective block input circuit, a break pilot wire alarm is issued; the information is available for reading (*Broken BLIN1* data inside **Read \ Pilot wire diagnostic** submenu) and can drive an output relay and or a LED (*PulseBLIN-K* and or a *PulseBLIN-L* parameters inside **Set \ Pilot wire diagnostic** submenu).

Note 1 Full diagnostic of pilot wires is only available when committed pilot wire input/outputs are employed

Note 2 When several outputs are parallel linked the pulse emission must be enabled inside one device only, sooner inside the outermost device

The control window may be programmed for OFF (no control) - 0.1 - 1 - 5 - 10 - 60 - 120 s; the *Pulse BLIN1* parameter is available inside the **Set \ Pilot wire diagnostic** menu; with OFF setting of the the *PulseBLIN1* parameter the pulse control is disabled.
The same setting must be for input and output (*PulseBLIN1* and *PulseBLOUT1*).

In the following example the output pulses must be enabled inside the device B only (2nd logic selectivity level) and D (1st logic selectivity level).



Setting example

In reference to the above shown schematic diagram, the logic selectivity is performed by means of the dedicated I/O for the short circuit elements of A, B and C protection relays, so that if a fault arises in (2), the open order or circuit breaker CB2 is issued and no trip is issued by A device. A command must be issued for the main circuit breaker CB1 by the A relay with a fault in (1).

A Protection

I>> element with definite time set to $4.5 I_n$ with operate time to 0.10 s blocked by start of B and/or C protection.

Settings:

- $I_{>>def} = 4.5 I_n$
- $t_{>>def} = 0.100$ s
- *PulseBLOUT1* = OFF
- *PulseBLIN1* = 1 s
- *I>>BLK2IN* = ON
- *I>>BLK2OUT* = OFF
- $t_{B-IPh} = 0.30$ s

B Protection

I>> element with definite time set to $4.0 I_n$ with operate time to 0.10 s with emission of block output toward A protection relay.

Settings:

- $I_{>>def} = 4.0 I_n$
- $t_{>>def} = 0.100$ s
- *I>>BLK2IN* = OFF
- *I>>BLK2OUT* = ON
- *PulseBLIN1* = OFF
- *PulseBLOUT1* = 1 s
- $t_{F-IPh} = 0.25$ s

C Protection

I>> element with definite time set to $4.0 I_n$ with operate time to 0.10 s with emission of block output toward A device and block input from D protection relay.

Settings:

- $I_{>>def} = 4.0 I_n$
- $t_{>>def} = 0.100$ s
- *I>>BLK2IN* = ON
- *I>>BLK2OUT* = ON
- *PulseBLIN1* = 1 s
- *PulseBLOUT1* = OFF
- $t_{F-IPh} = 0.25$ s
- $t_{B-IPh} = 0.30$ s

Remote tripping

Preface

Some output relays may be programmed for remote trip function resulting from a command coming from a binary input.

If a binary input is designed for remote trip acquisition, an output relay allocated to the same function is triggered when the input (IN1 and/or INx) is active.

Operation and settings

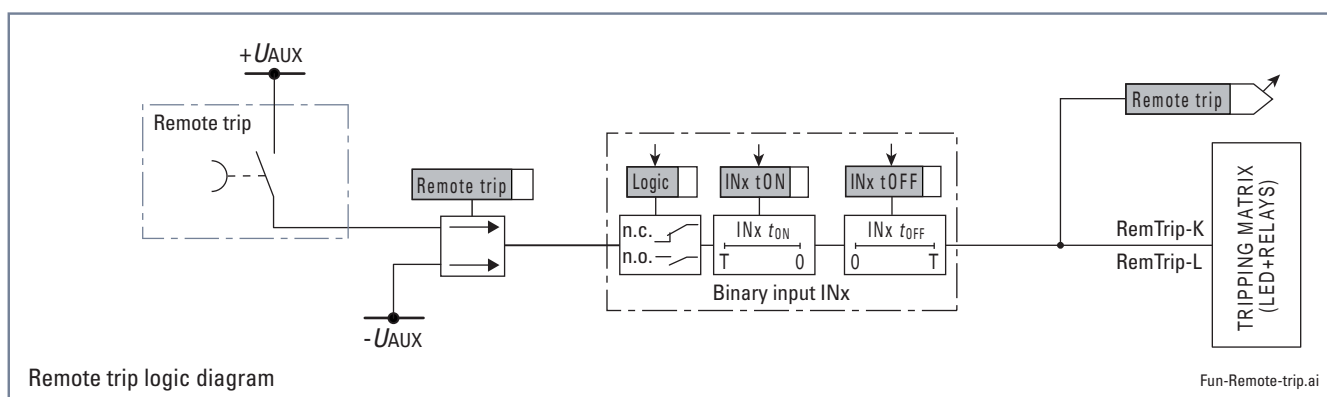
The *Remote trip* matching must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input IN1...INx** menus.

When a binary input is programmed for remote trip acquisition, the *IN1 tON*, *INx tON*, *IN1 tOFF* and *INx tOFF* time delays must be reset to zero; the *Logic* parameters (*ON/OFF*) must be programmed in the same way of the related circuit connected with-it.

The *RemTrip-K* matching must be assigned to the selected output relays inside the **Set \ Remote tripping** submenu; the same for addressing the LED indicators (*RemTrip-L*).

When output relays are programmed for remote tripping, the t_{TR} time delays must reset to zero; the operation mode must be set with self reset (*No-latched* inside **Set \ Relays** submenu) and the *Logic* parameters (*Energized/De-energized*) must be programmed in the same way of the related binary input connected with-it.

All the parameters are common for A and B Profiles.



Frequency tracking

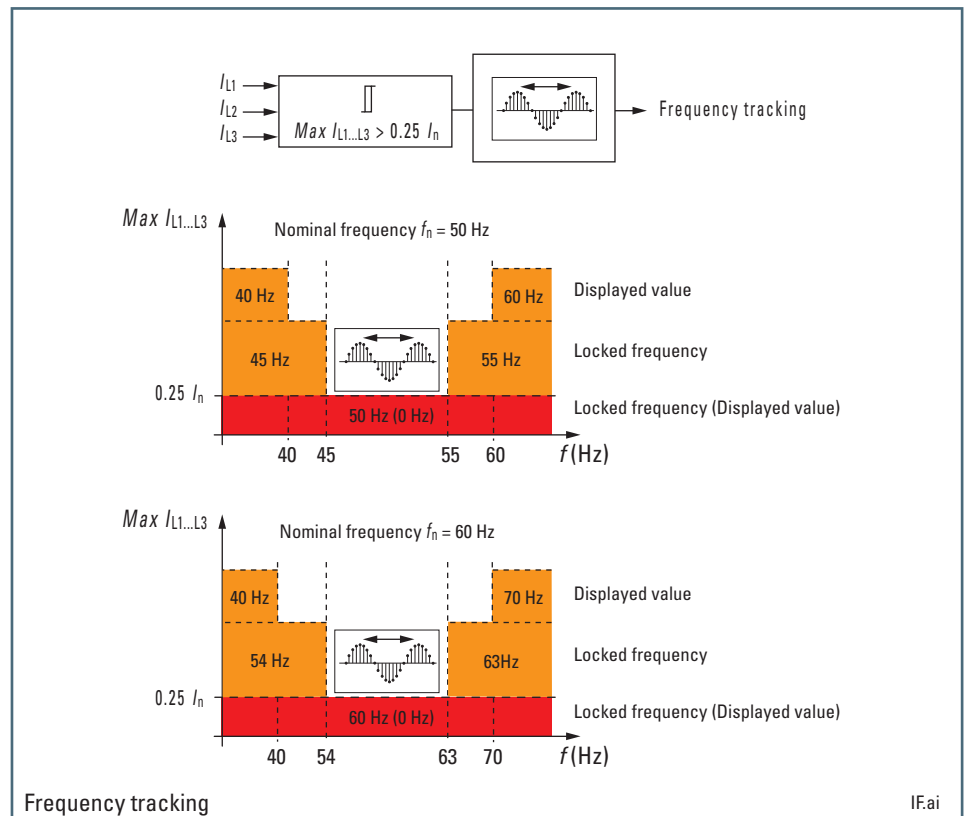
Within the frequency range 45...55 Hz ($f_n = 50$ Hz). or 54...63 Hz ($f_n = 60$ Hz), a frequency tracking algorithm adjusts the currents sampling frequency, so as to keep the number of samples in any given period constant.

With 24 samples for periods the sampling rate is adjusted from 1.08 kHz with $f = 45$ Hz to 1.512 kHz with $f = 63$ Hz

For a frequency step change the tracking response time is 10 Hz/s.

The frequency measure is based on the largest phase current.

- If the larger phase input current is lower than 25% I_n the sampling frequency is fixed to f_n (50 or 60 Hz).
- If the measured frequency is outside the locking range, the sampling frequency is fixed to the lower or upper value (45 or 55 Hz with $f_n = 50$ Hz, 54 or 63 Hz with $f_n = 60$ Hz).



All protective elements are always operative; accuracy is guaranteed inside locked frequency band.

Second Harmonic Restraint - 2ndh-REST

Preface

When a power transformer is energized, as well know an inrush current flow in the side that have been energized with an amount and duration that depend by many factors which:

- Instantaneous value of the supply voltage at the time where the transformer is energized
- Transformer design, magnetization characteristic and size
- Residual flux

The maximum amount of the inrush current is produced by energizing the transformer at the zero point of the voltage wave, when it increase or decrease with the residual flux respectively positive or negative. Moreover the ratio between the maximum amount of the inrush current and the nominal current of the transformer decrease if the size of transformer increase, whereas the duration of the inrush current increase with the size of transformer.

Since an high second harmonic component is always present in the inrush current, to avoid unwanted tripping, the second harmonic restraint is available to restraint any selected threshold of NA11 protective relay:

- Phase overcurrent - 50/51
- Residual overcurrent - 50N/51N

Moreover one or more output contacts may be allocated to the 2NDH-REST function in order to block any external protection relays where second harmonic restraint is not available.

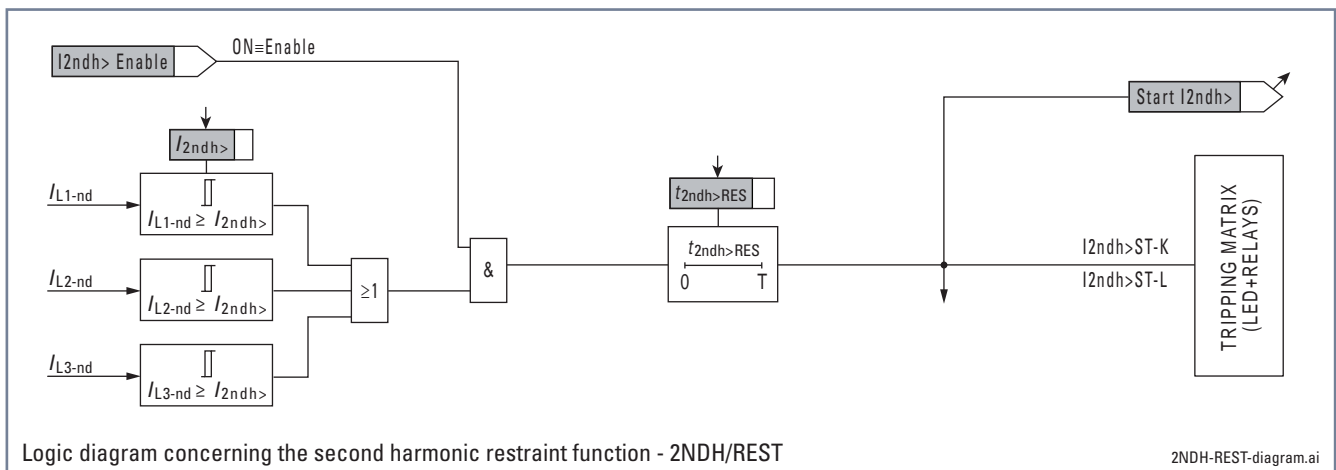
Operation and settings

Each second harmonic component of phase currents (I_{L1-2nd} , I_{L2-2nd} , I_{L3-2nd}) is compared with the $I_{2ndh>}$ adjustable threshold.

When one or more currents overcome the setting threshold a start is issued.

The start may be employed to block-off one or more 50/51/50N/51N elements or to block-off external protections by means output relays (this can be usefully used in order to restraint external protection relays where second harmonic restraint is not available).

For the purpose to keep in block state the selected elements, an adjustable $t_{2ndh>RES}$ reset delay is provided.



The setting of $I_{2ndh>}$ and $t_{2ndh>RES}$ parameters are available inside the **Set \ Profile A(B) \ Second Harmonic Restraint** menus.

The second harmonic element may be enabled or disabled; to enable it, the $I_{2ndh>}$ *Enable* parameter must be set to *ON* inside the **Set \ Profile A(B) \ Second Harmonic Restraint** menus.

All the parameters can be set separately for **Profile A** and **Profile B**.

The output may be assigned to the selected $I_{2ndh>}$ -*ST-K* output relays inside the **Set \ Profile A(B) \ Second Harmonic Restraint** submenu; the same for addressing the LED indicators ($I_{2ndh>}$ -*ST-L*).

When output relays are programmed for second harmonic element output, the t_{TR} time delays must reset to zero; the operation mode must be set with self reset (*No-latched*) inside **SetRelays** submenu) and the *Logic* parameters (*Energized/De-energized*) must be programmed in the same way of the related binary input connected with-it.

Cold Load Pickup - CLP

Preface

CLP feature allows selected thresholds of phase and ground overcurrent protections to be changed or blocked for a set time in order to overcome transient overcurrents.

The trigger of the CLP feature is the logical condition of circuit breaker closed, that Pro-N relay detect by means of two digital inputs connected to the circuit breaker auxiliary contacts 52a and 52b. When the circuit breaker closed condition is detected, the CLP timer set in the submenu of CLP function is initiated and, throughout the CLP set time:

- The threshold is blocked if CLP is set to ON threshold block.
- The threshold is changed to the value that is set if CLP is set to ON threshold change.

When CLP timer has elapsed, the threshold is unblocked if CLP is set to ON threshold block or the threshold is revert back to the original value if CLP is set to ON threshold change.

Note that when the circuit breaker is open, the threshold is already blocked if CLP is set to ON threshold block or the threshold is already changed to the value if CLP is set to ON threshold change: this is useful in order to avoid unwanted tripping due to unblocked threshold or threshold with his original value for cases where a delay of the circuit breaker closing happen, i.e. where the three poles of the CB do not close at the same time or during long CB closing time.

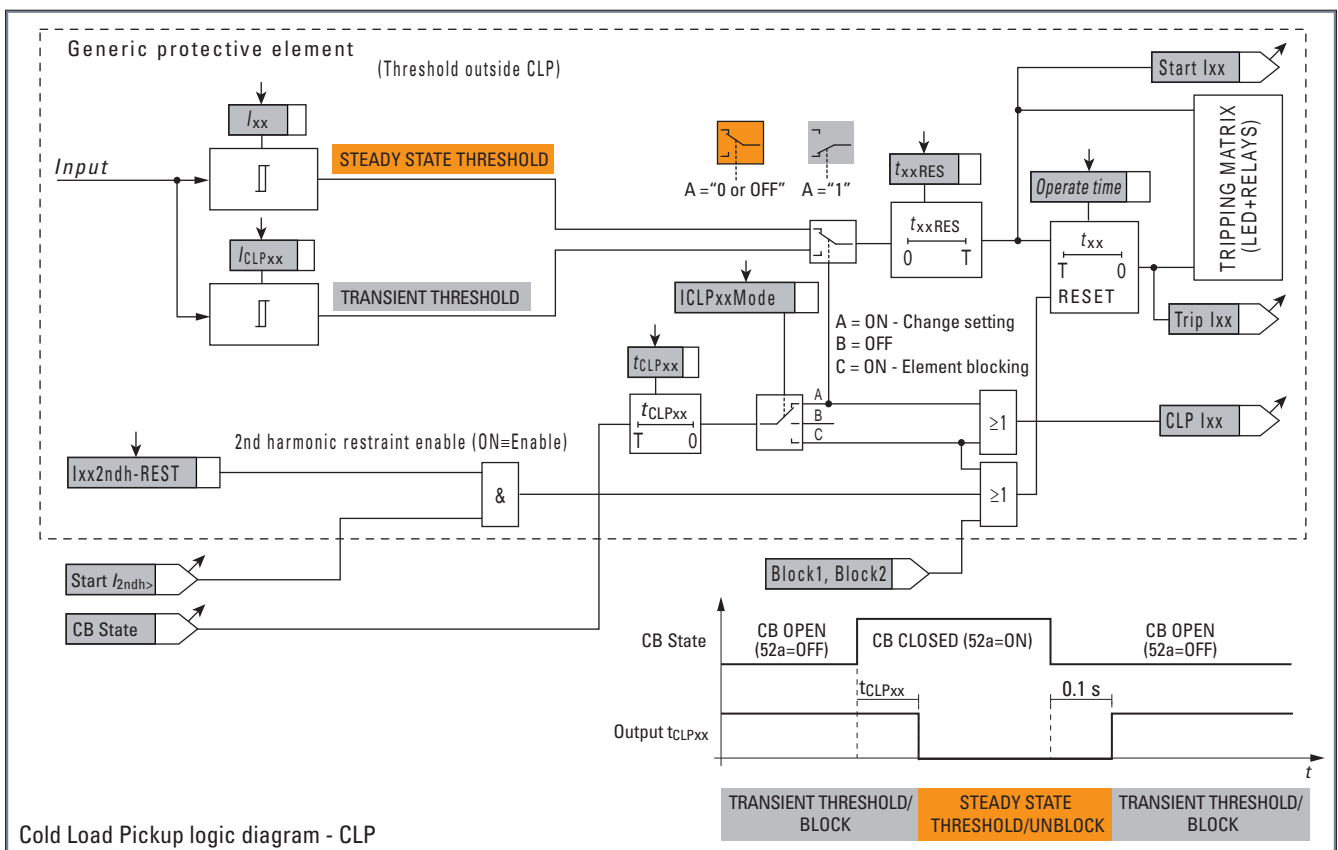
Typical applications where the CLP feature may be useful are for overcurrent protections on feeders where the circuit breaker closing starts air conditioning/heating loads after a long cooling time, motors or more generally momentary large loads.

The CLP may be also useful for instantaneous ground fault overcurrent protections on motors starting, because it is likely that incorrect operation of the protection would occur on imbalance transient secondary current due to asymmetric line CTs saturation.

Depending upon the magnitude and duration of the starting current, it may be necessary to block operation of thresholds or raising his setting. Also a combination of both blocking some thresholds and raising others may be adopted.

For each threshold the CLP function may be disabled (*OFF*), enabled with threshold blocking (*ON-Element blocking*) or enabled with threshold change (*ON-Change setting*) by means the *xx-CLPx Mode* parameter.

The operating mode and the relative activation time concerning each threshold of the 50/51 and 50N/51N elements are adjustable inside the **SetProfile A(or B)xxx - xx \ xxx Element \Setpoints** menus.



Cold Load Pickup logic diagram - CLP

Example: to change the first threshold of the definite time overcurrent element 50/51 within CLP during a 0.1 s time interval:

- The *ICLP> Mode* parameter must be set as *ON-Change setting*,
- The *tCLP>* parameter must be adjusted to a wanted value (0.1 s) inside the **SetProfile A(or B)\ Phase overcurrent - 50/51 \ Element \ Setpoints** menu,
- The threshold within CLP parameter *ICLP>def* must be adjusted to a wanted value inside the **SetProfile A(or B)\ Phase overcurrent - 50/51 \ Element \ Definite time** menu.

CB position can be acquired by means one or two binary inputs; allocation of 52a and 52b functions is available inside the **SetInputs\Binary input IN1...INx** menu.

CT supervision - 74CT

Preface

The CT monitoring function is employed to issue an alarm when secondary phase CTs and/or phase input of the NA60 relay failure are detected.

Interruptions are detected by means of a symmetry criterion of the I_{L1} , I_{L2} , I_{L3} input currents.

The symmetry factor is calculated comparing the minimum and maximum of the fundamental components of the three phase currents (I_{LMIN} / I_{LMAX}).

Operation and settings

The starting of the timer occurs if both the following conditions are filled:

A) $(I_{LMIN} / I_{LMAX}) < S_{<}$ that is the symmetry factor is lower than the $S_{<}$ adjustable threshold;

B) $I_{LMAX} > I^*$

Where

I^* : maximum phase current threshold

$S_{<}$: element pickup value

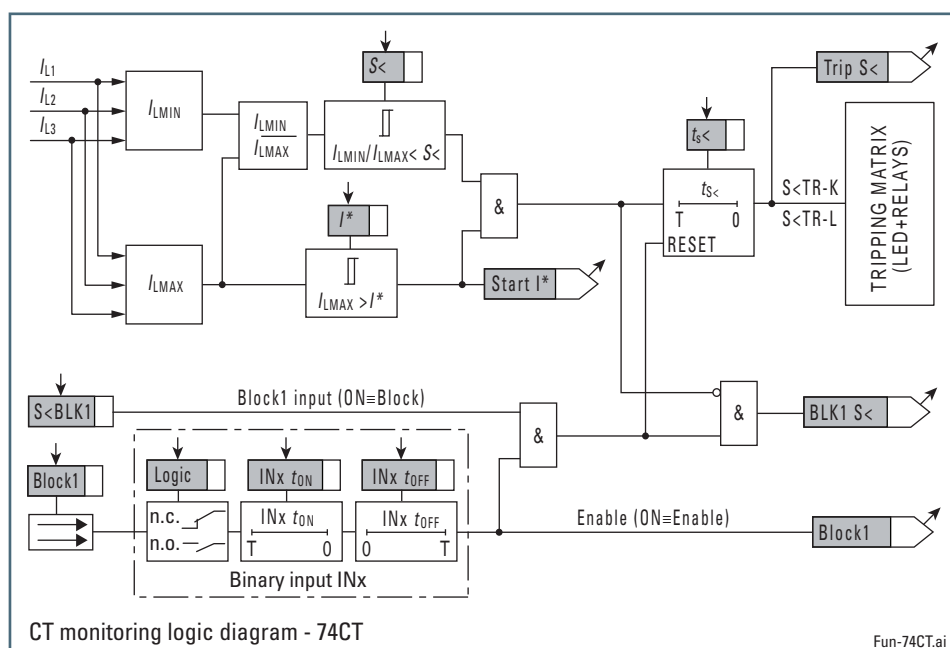
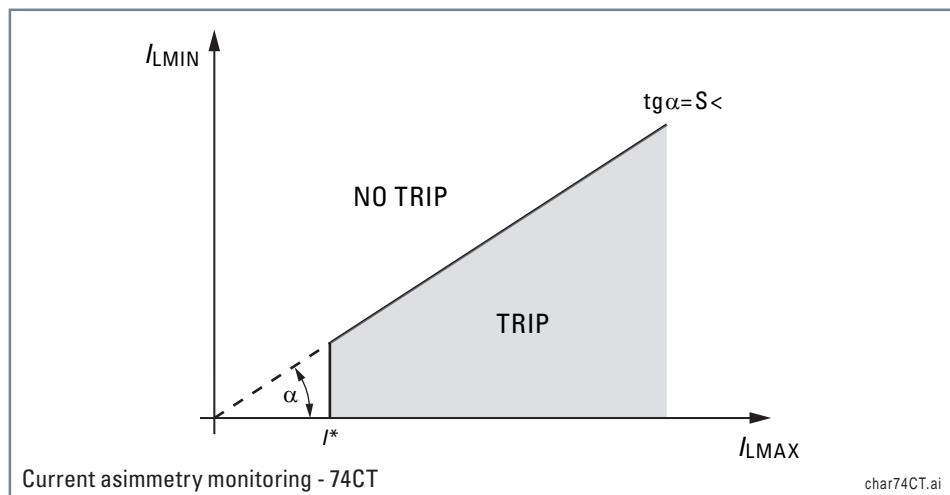
If both conditions are filled over the $t_{s<}$ adjustable time an alarm is issued

The output may be assigned to the selected $S_{<TR-K}$ output relays inside the **Set \ CT supervision-74CT** submenu; the same for addressing the LED indicators $S_{<TR-L}$

If the $S_{<-BLK1}$ parameter is set to *ON*, and a binary input is designed for logical block (Block1), the CT supervision function is blocked off whenever the given input is active. The trip timer is held in reset condition, so the operate time counting starts when the input block goes down.^[1] The $S_{<-BLK1}$ parameter is available inside the **Set \ CT supervision-74CT** submenu.

All the parameters are common for A and B Profiles

E' selezionabile l'abilitazione (ON) o disabilitazione (OFF) della funzione.



Note 1 The exhaustive treatment of the logic block (Block 1) function may be found in the "Logic Block" paragraph inside CONTROL AND MONITORING section

Trip circuit supervision - 74TCS

Preface

The trip circuit can be monitored to signal possible anomalies that would lead to the missing opening of circuit breaker when trip and/or operator command are issued.

Circuit interruption as well as missing of auxiliary voltage and/or coil faults are detected.

Supervision with one or two binary inputs can be selected; depending on association of binary inputs, the corresponding logic is automatically selected.

For this purpose the *TCS1* and *TCS2* (if two binary input are used) matching must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input IN1** and **Set \ Inputs \ Binary input INx** menus.

When a binary input is programmed for the TCS function, the *IN1 tON*, *INx tON*, *IN1 tOFF* and *INx tOFF* time delays must be reset to zero and the *Logic* parameter must be set to *Active-ON* inside the **Set \ Inputs \ Binary input IN1** and **Set \ Inputs \ Binary input INx** menus.

Operation and settings

The 74TCS element may be enabled or disabled; to enable it, the *74TCS Enable* parameter must be set to *ON* inside the **Set \ Profile A(B) \ Trip circuit supervision-74TCS** submenu.

A logic block can be set from one binary input.^[1]

If the *74TCS-BLK1* parameter is set to *ON*, and a binary input is designed for logical block (Block1), the TCS supervision function is blocked off whenever the given input is active. The trip timer is held in reset condition, so the operate time counting starts when the input block goes down. The *74TCS-BLK1* parameter is available inside the **Set \ Profile A(B) \ Trip circuit supervision-74TCS** submenu.

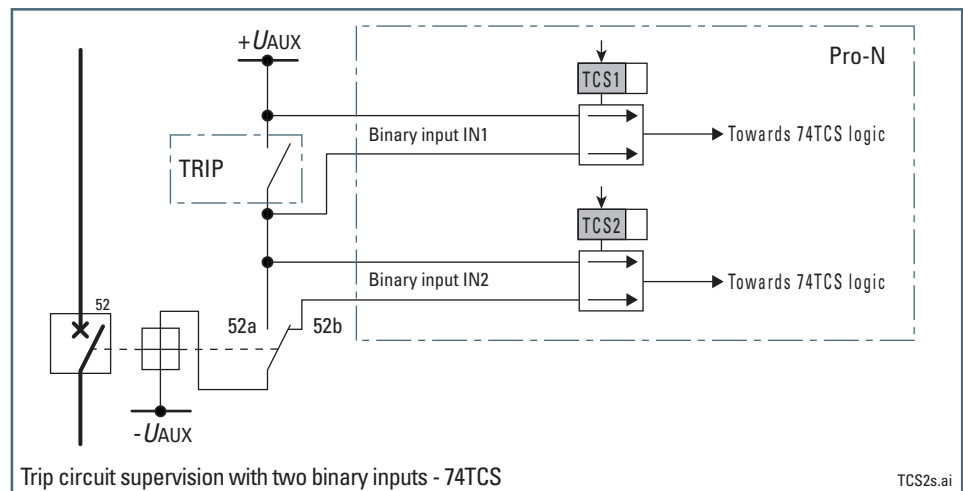
All the parameters can be set separately for **Profile A** and **Profile B**.

Two inputs supervision

With two binary input all malfunctions are detected (inclusive of mechanics faults).

The binary inputs are connected to the trip and to the 52b contacts.

The CB auxiliary voltage must be 36 V at least (twice the minimum threshold for every binary input).



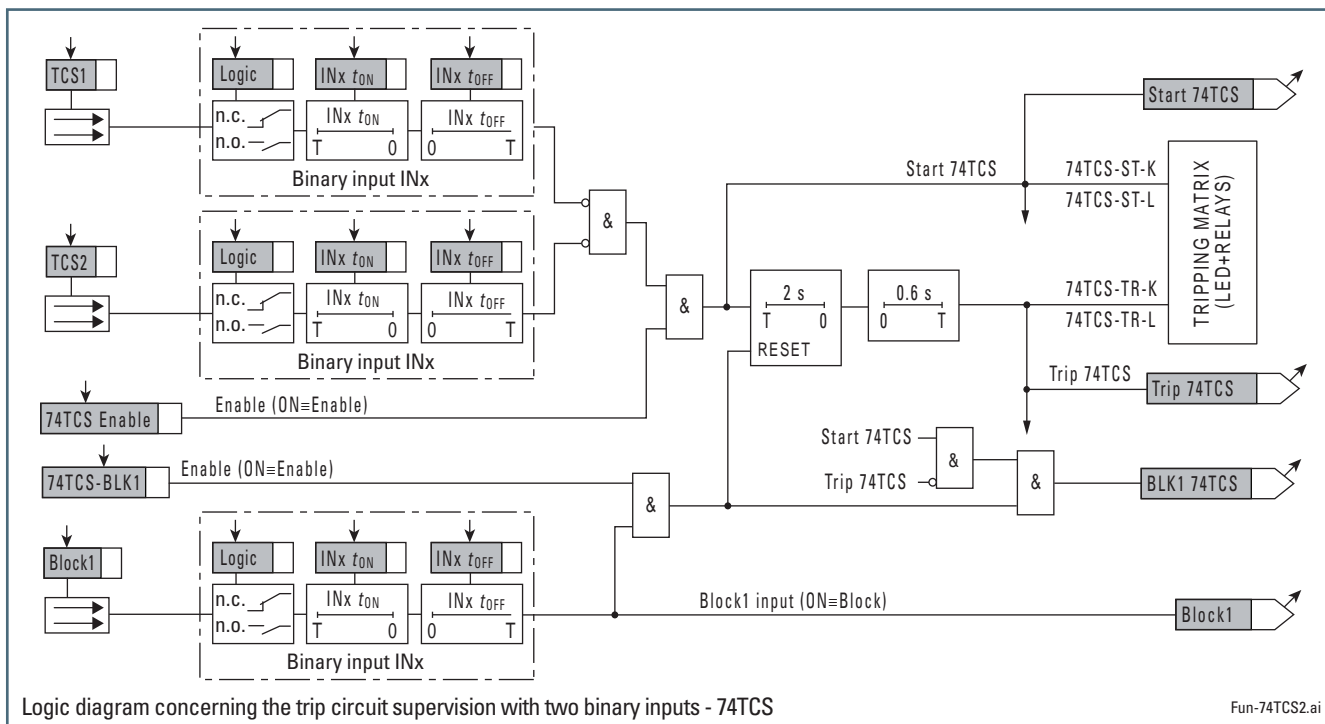
The faulty condition is detected occurs if both the following conditions are filled:

- A) The TRIP contact is closed (external protection relay tripped);
- B) The circuit breaker is closed (52a closed and 52b open).

Because such conditions can arise with healthy circuit too (e.g. a trip command is issued by the protection relay but the CB opening time is still in progress), to avoid untimely operations the previous condition are checked every 80 ms and the output is issued after a 2 s delay; outputs are reset to zero if at least the A or B condition become false after 0.6 s delay.^[2]

Note 1 Since two binary inputs are just used (*TCS1* and *TCS2*), an external I/O module is required for the logic block function. The exhaustive treatment of the logic block (Block 1) function may be found in the "Logic Block" paragraph inside CONTROL AND MONITORING section

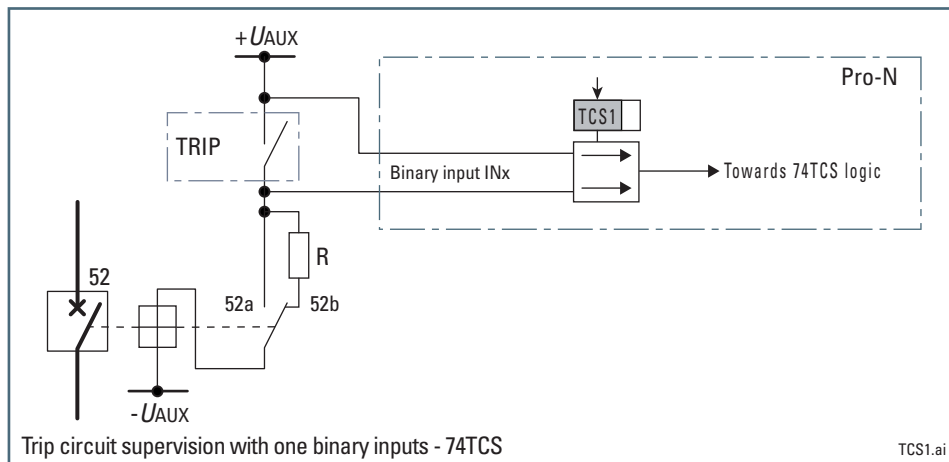
Note 2 Following assumption are considered for the framework:
Logic: ON,
Timers t_{ON} and *t_{OFF}*: reset to zero
TRIP contact of the protection: DE-energized, No latched



One input supervision

By means of the right sizing of a resistor, the trip circuit supervision may be performed even with lower control voltage (e.g. when the control voltage is less than 36 V required for driving of two binary inputs, typically $U_{AUX} = 24V$).

The binary input is connected to the trip and an external resistor must be connected the 52b auxiliary contact.



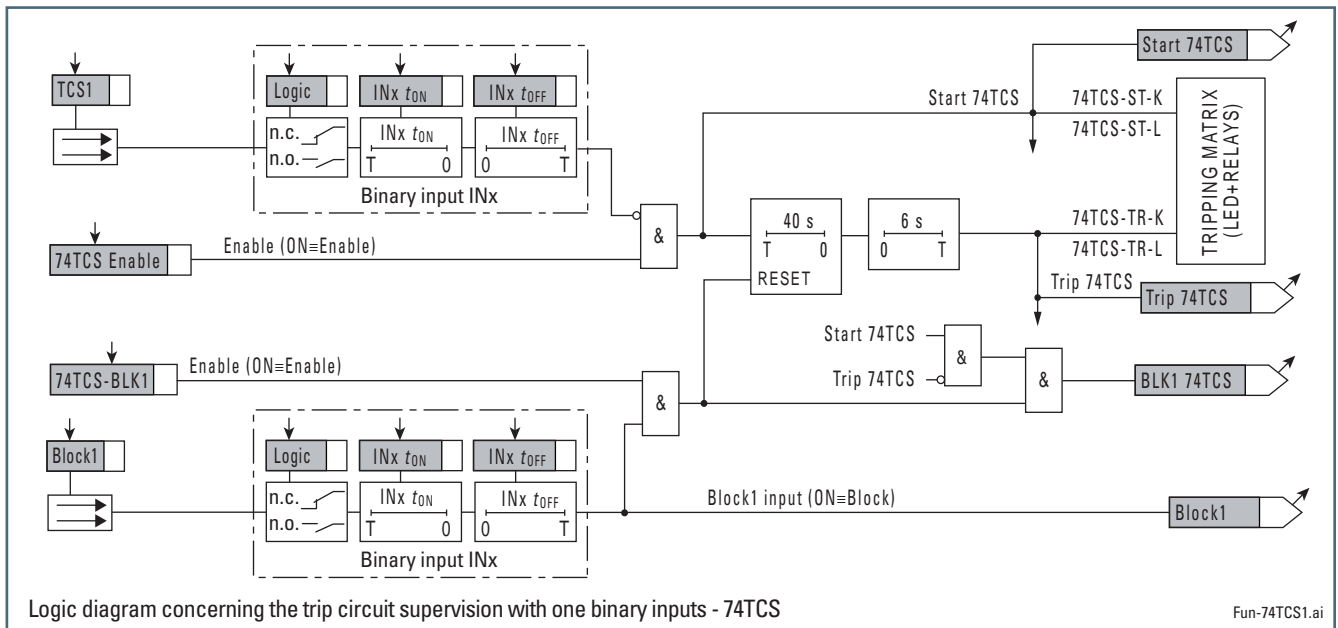
The fault condition of the trip circuit is detected by binary input power down.

With healthy circuit and TRIP contact closed, the binary input is feed across the 52a path (CB closed) or across the resistor R and 52b path (CB open).

When the TRIP contact turns ON, the binary input becomes short-circuited; to avoid untimely operations the previous condition are checked every 80 ms and the output is issued after a 40 s delay in order to allow the fault clearing and the consequent reset of the TRIP protection.

Outputs are reset to zero after 6 s from the TRIP contact open.^[1]

Note 1 The trip contact (TRIP) of the protection relays must be set with automatic reset (No-latched operating mode).



How to calculate resistance

Both the following conditions must be filled:

- 1) The circuit breaker coil must not be powered when the CB is open and an open command is issued;
- 2) The binary input is energized when the trip contact open.

- 1) If the circuit breaker is just open an unnecessary excitation must be avoided; the most critical event arises when the TRIP contact is closed (e.g. manual or test command), so with minimal series resistance. To avoid an unwanted excitation the series resistance must be higher than a minimum value defined as:

$$R_{min} = R_{TC} \cdot (U_{AUX} - U_{TCmin}) / U_{TCmin}$$

where:

- U_{TCmin} : minimum coil excitation voltage
- U_{AUX} : auxiliary voltage
- R_{TC} : coil resistance

- 2) To energize the binary input circuit when the TRIP contact and CB open, the series resistance must be lowerer than a maximum value defined as:

$$R_{max} = [(U_{AUX} - U_{DIGmin}) / I_{DIG}] - R_{TC}$$

where:

- U_{DIGmin} : minimum binary input excitation voltage (18 V)
- U_{AUX} : auxiliary voltage
- R_{TC} : coil resistance
- I_{DIG} : binary input excitation current (0.003 A)

To satisfy the above requirements, the R value must be chosen between the R_{min} and R_{max} values; typically the normalized value nearest the arithmetic mean:

$$R = (R_{min} + R_{max}) / 2$$

The power dissipated by the R resistor is:

$$P_R = R \cdot I^2 = R \cdot [U_{AUX} / (R + R_{TC})]^2$$

Example

- $U_{AUX} = 110$ Vcc (auxiliary voltage)
- $P_{TC} = 50$ W (coil power)
- $R_{TC} = U_{AUX}^2 / P_{TC} = 242 \Omega$ (coil resistance)
- $U_{TCmin} = 77$ V (minimum coil excitation voltage = 70% U_{AUX})
- $U_{DIGmin} = 18$ V (minimum binary input excitation voltage)
- $I_{DIG} = 0.003$ A (binary input excitation current)

$$R_{min} = R_{TC} \cdot (U_{AUX} - U_{TCmin}) / U_{TCmin} = 242 \cdot (110 - 77) / 77 = 103.7 \Omega$$

$$R_{max} = [(U_{AUX} - U_{DIGmin}) / I_{DIG}] - R_{TC} = [(110 - 18) / 0.003] - 242 = 30425 \Omega$$

$$R = (R_{min} + R_{max}) / 2 = (103.7 + 30425) / 2 = 15264 \Omega \sim 15 \text{ k}\Omega$$

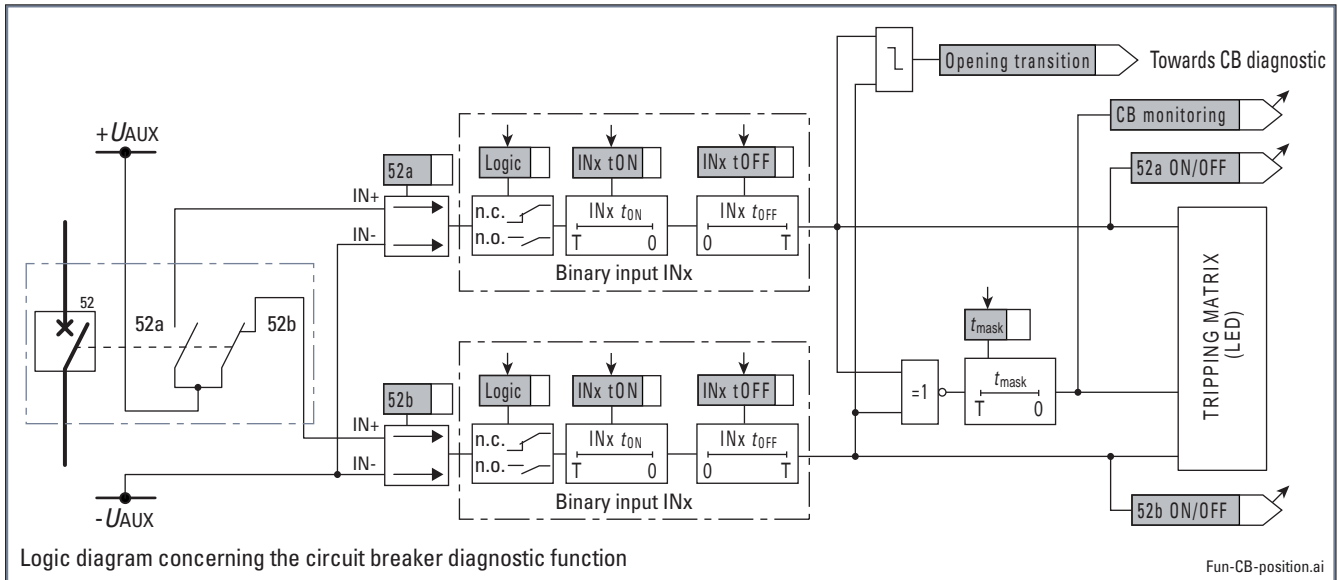
$$P_R \text{ (Power dissipated by the R resistor)} = U_{AUX}^2 / R = 110^2 / 15000 = 0.8 \text{ W}$$

Circuit breaker supervision

Preface

Several diagnostic metering and monitoring function are available:

- By means 52a and 52b auxiliary contacts, the CB position is acquired. Depending on such information the Open and/or Close commands can be safely issued by user.
- An adjustable threshold can be set for a wear estimate of the breaker contacts; the current values (ΣI or ΣI^2) are summed and compared to a user-adjustable threshold. When the threshold or the number of operations is exceeded the relay can activate an output relay. The function helps to adjust maintenance planning.
- By means 52a and 52b auxiliary contacts, the opening time is calculated and compared to a user-adjustable threshold. If the threshold is exceeded the relay can activate an output relay.



Operation and settings

According to the conventional contact position

- 52a is the auxiliary contact that is in the same position as the circuit breaker, (52a open = CB open),
- 52b is the auxiliary contact that is in the opposite position as the circuit breaker, (52a open = CB closed).

To acquire the CB position, the 52a and 52b function must be set inside the **Set \ Inputs \ Binary input 1** and **Set \ Inputs \ Binary input x** menus. The *IN1 tON*, *INx tON*, *IN1 tOFF* and *INx tOFF* time delays must be reset to zero and the *Logic* parameter must be set to *Active-ON* inside the **Set \ Inputs \ Binary input IN1** and **Set \ Inputs \ Binary input INx** menus.

CIRCUIT BREAKER COMMANDS

Two output relays can be set to command CB opening and closing; the *CBopen-K* and *CBclose-K* function must be set inside the **Set \ Circuit breaker supervision \ LEDs-relays allocation** menu; the CB position can be visualized by means two LEDs (*CBopen-L* and *CBclosed-L* parameters).

All the parameters are common for **Profile A** and **Profile B**.

CIRCUIT BREAKER DIAGNOSTIC

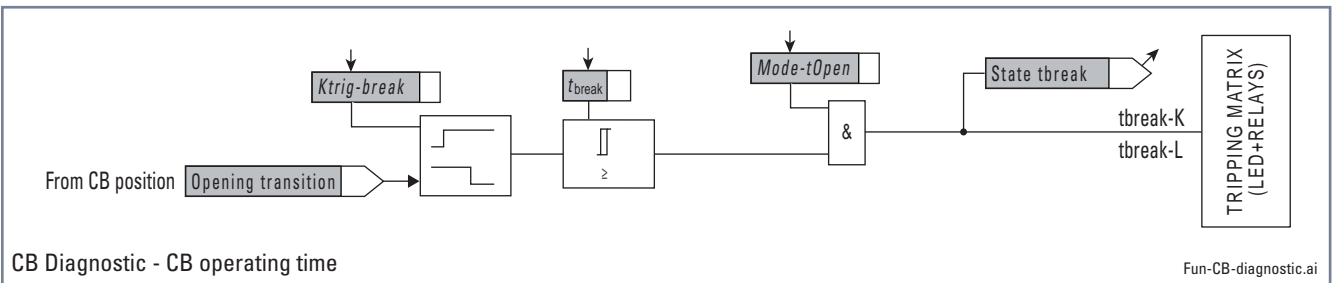
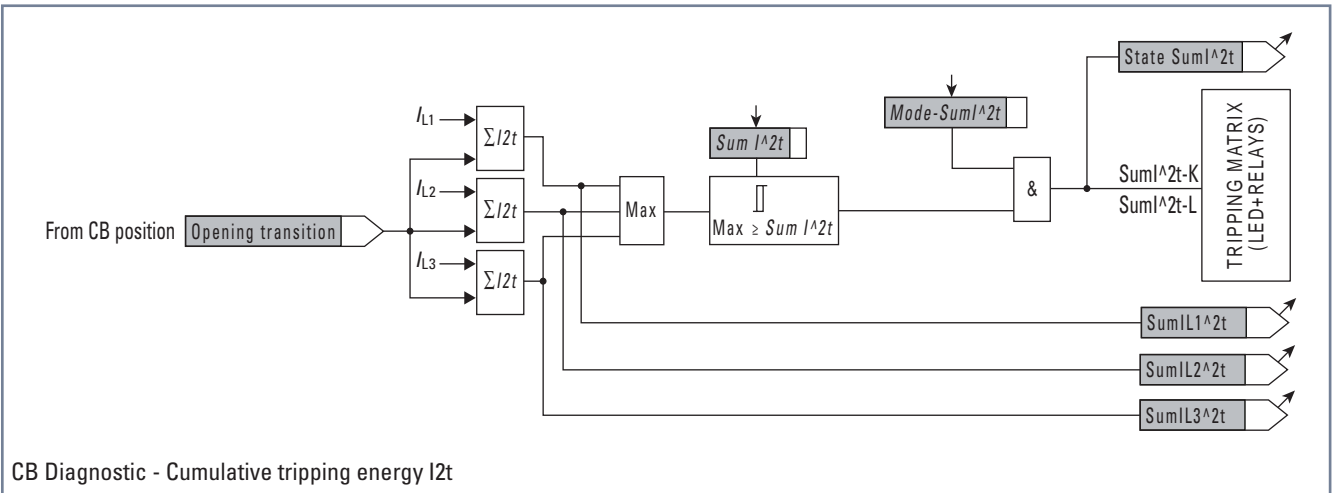
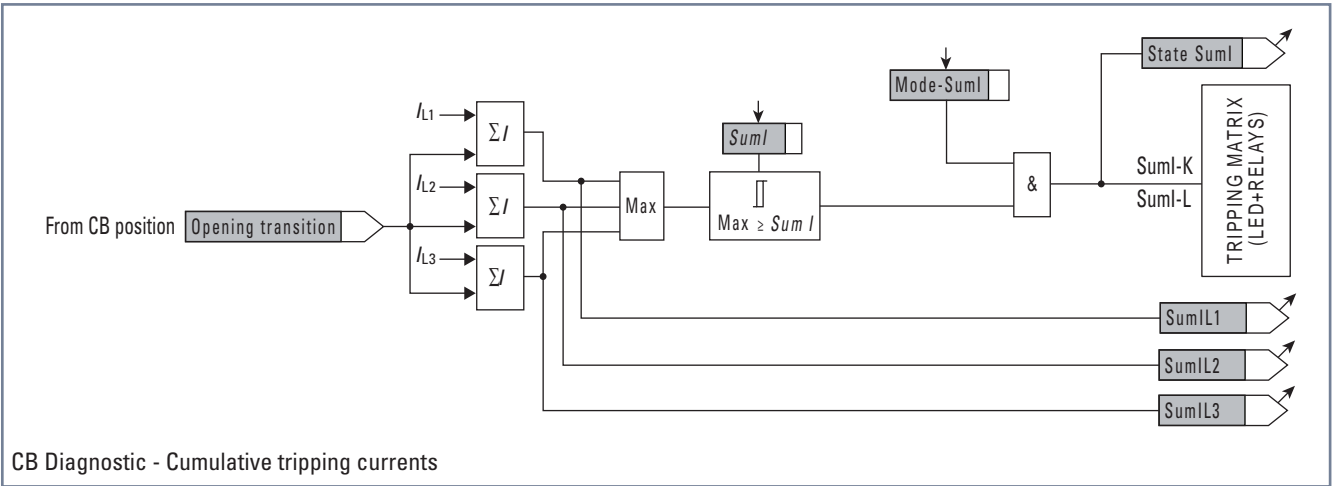
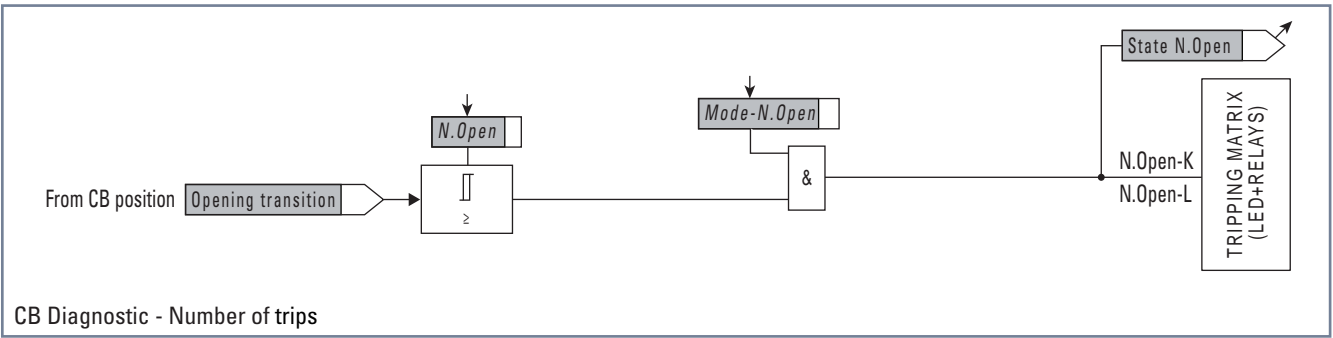
Four different criteria can be select.

- 1) Number of CB trip mode (*ModeN.Open OM*). When the number of operations (*N.Open*) is exceeded, an output relay and/or LED can be activated.
- 2) Cumulative CB currents mode (*ModeSumI OM*). When the per-phase value exceeds the threshold, an output relay and/or LED can be activated.
- 3) Cumulative CB I^2t mode (*ModeSumI^2t OM*). The tripping energy I^2t is calculated on the base of current measure at the time of the open command on the base of the circuit breaker opening time provided for I^2t calculation (*tbreak*). When the per-phase value exceeds the threshold, an output relay and/or LED can be activated.
- 4) CB operating time mode (*Mode-tOpen OM*). The time interval between the trip command and the CB open acquisition is calculated on the base of a programmable relay (*Ktrig-break*). When the time interval (*tbreak*) is exceeded, an output relay and/or LED can be activated.

The four criteria can be contemporaneously or separately set.

All the named parameters are available inside the **Set \ Circuit Breaker supervision \ CB Diagnostic** menu.

Tutti i suddetti parametri, nonché l'associazione delle uscite ai relè finali ed ai LED, sono presenti nel menù **Set \ Monitoraggio interruttore \ Diagnostica interruttore**.



Fun-CB-diagnostic.ai

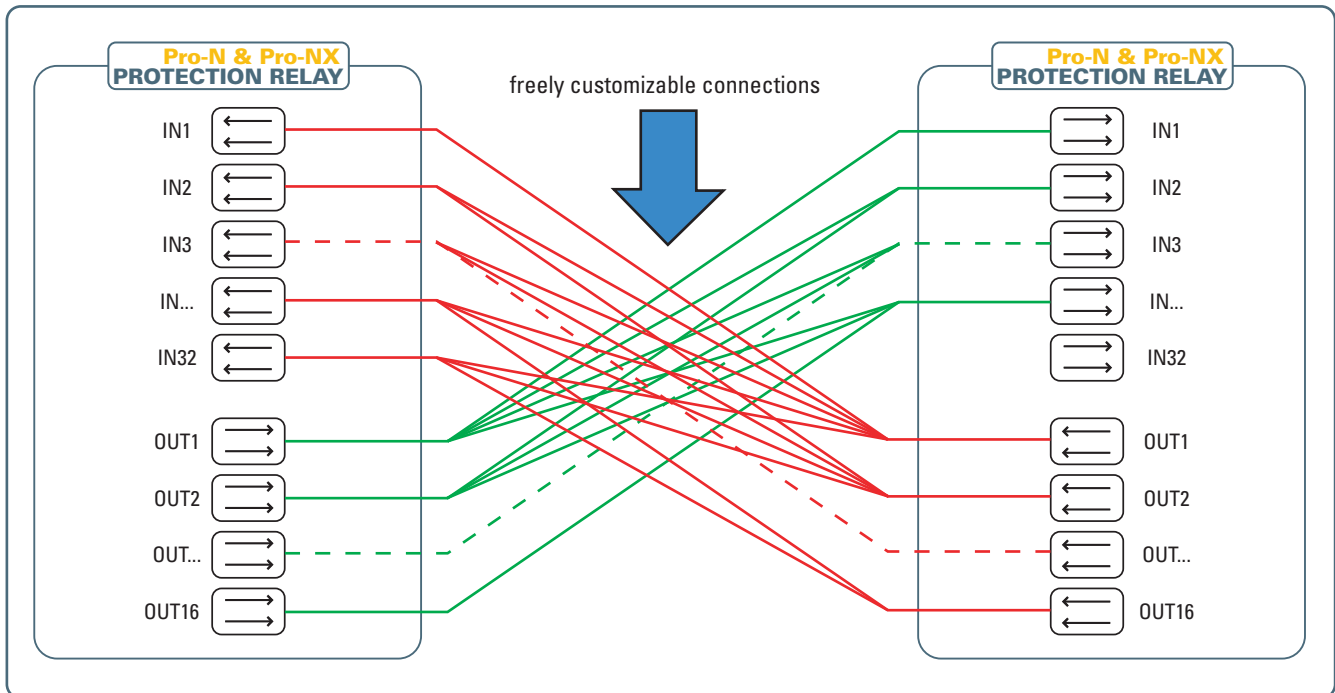
Virtual I/O

Preface

By ThySetter and ThyVisor software tools the type of operation and links between outputs (Virtual Output - VOUT1 ... 16) and virtual inputs (Virtual Inputs - VIN1 ... VIN32) may be defined using RPC or IEC 61850 communication protocols over Ethernet network.

The system allows:^[1]

- Availability of sixteen inputs and thirty-two outputs independently programmable by the user
- Simplify wiring using one channel as the Ethernet
- Eliminate the need to install communication devices and / or external conversion
- Significantly reduce costs
- Dynamically change from sw connections and associated functions.



Applications

With Pro-N and Pro-XX relay the virtual I / O can be usefully employed for:

- Transmit information between protections installed in significant distance where the traditional connections are critical in terms of reliability.
- Making OR logic for opening control of multiple DDI (simultaneous control of all DDI operated by each SPI) in cases of multiple interface protections (Smart Grids)
- Achieve accelerated logic discrimination in which some protection elements can be blocked by the activation of the downstream protection start; this allows to reduce the clearing time that, in time logic systems require trip time significantly long in correspondence of the power source.
- Circuit breaker commands
- Selection of setting profiles
- Remote trip
- Include I / O in the programmable logic (PLC)
- etc. ..

Demand measures

Demand measures are calculated as:

Fixed demand

Fixed demand I_{L1FIX} , I_{L2FIX} , I_{L3FIX}

Every fixed demand period t_{FIX} an average magnitude is calculated based on samples taken every 1 second. Update is carried out at the end of the same period. The fixed demand measures may be reset to zero by means the **Reset on demand measures command** (ThyVisor **Commands** menu).

The t_{FIX} parameter (Fixed demand period) is available inside the **SetDemand measures** menu.

Rolling demand

Rolling demand I_{L1ROL} , I_{L2ROL} , I_{L3ROL}

The average magnitude is calculated inside a mobile window of N-T length where:

- N is the user-defined number of cycles and,
- T is the user-defined sub-period.

An average magnitude is calculated based on samples taken every 1 second; update is carried out at the end of the every sub-period. The rolling demand measures may be reset to zero by means the **Reset on demand measures command** (ThyVisor **Commands** menu).

The t_{ROL} (Rolling demand period) and $N.Rol$ (Number of cycles for rolling on demand) parameters are available inside the **SetDemand measures** menu.

Peak demand

Peak demand I_{L1MAX} , I_{L2MAX} , I_{L3MAX}

Every sub-period t_{ROL} the maximum value of the average magnitude is calculated based on samples taken every 1 second. Update is carried out at the end of the same period. The peak demand measures may be reset to zero by means the **Reset on demand measures command** (ThyVisor **Commands** menu).

The t_{ROL} (Rolling demand period) parameter is the same for rolling demand setting.

Minimum demand

Minimum demand I_{L1MIN} , I_{L2MIN} , I_{L3MIN}

Every sub-period t_{ROL} the minimum value of the average magnitude is calculated based on samples taken every 1 second. Update is carried out at the end of the same period. The peak demand measures may be reset to zero by means the **Reset on demand measures command** (ThyVisor **Commands** menu).

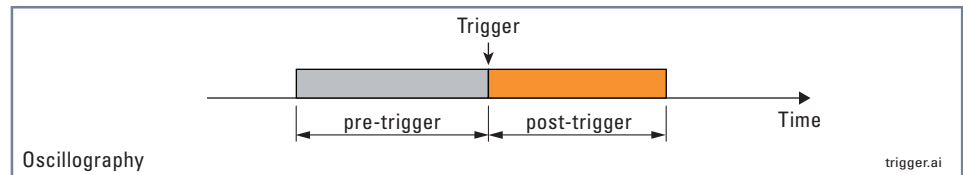
The t_{ROL} (Rolling demand period) parameter is the same for rolling demand setting.

Oscillography

Trigger Setup

Following parameters, available inside the **SetOscillography\Trigger Setup** menu, are user-programmable:

- *Pre-trigger time* and *Post-trigger time*.



- *Element pickup trigger*; the information recording starts when a state transition on any protective element occurs if the parameter is set to *ON*.
- *Trigger from outputs*; the information recording starts when a state transition on the selected output relay occurs if the parameter is set (K1...K6).
- *Binary input trigger*; the information recording starts when a state transition on the selected binary input occurs if the parameter is set to *ON*.
- *Trigger from inputs*; the information recording starts when a state transition on the selected binary input occurs if the parameter is set (IN1...INx).
- *80% Buffer alarm*; when the 80% of the buffer space is reached an alarm may be issued if the parameter is set to *ON*.

Set sampled channels

The desired sampled quantities may be select inside the **Set\Oscillography\Set sampled channels** menu (i_{L1} , i_{L2} , i_{L3} , i_E).

Set analog channels

The desired sampled quantities may be select inside the **Set\Oscillography\Set analog channels** menu.

Everyone of twelve analog channel may be associated to one of the selected measures (Frequency, I_{L1} , I_{L2} , I_{L3} , I_E , (I_{EC}) , I_{L1-2nd} , I_{L2-2nd} , I_{L3-2nd} , I_{-2nd}/I_L , T1...T8^[1]).

Set digital channels

The desired digital quantities may be select inside the **Set\Oscillography\Set digital channels** menu.

Everyone of twelve digital channel may be associated to one of the selected I/O signal (K1... K6, K7... K10, IN1, IN2, IN3...IN42^[2]).

Note 1 The temperature measure is acquired by means of Pt100 probes (eight inputs on MPT module)

Note 2 The output relay K7...K10 and binary input IN3...IN42(45) states is meaningful when the I/O circuits are present (MRI and MID16 modules)

5 MEASURES, LOGIC STATES AND COUNTERS

Measures

- Frequency (f)
- RMS value of fundamental component for phase currents (I_{L1}, I_{L2}, I_{L3})
- RMS value of fundamental component for measured residual current (I_E)
- RMS value of fundamental component for calculated residual current $(I_{Ec})^{[1]}$

Calculated

- Maximum current between $I_{L1}-I_{L2}-I_{L3}$ (I_{Lmax})
- Minimum current between $I_{L1}-I_{L2}-I_{L3}$ (I_{Lmin})
- Average current between $I_{L1}-I_{L2}-I_{L3}$ (I_L)

2nd harmonic

- Second harmonic phase currents $(I_{L1-2nd}, I_{L2-2nd}, I_{L3-2nd})$
- Maximum of the second harmonic phase currents/ fundamental component percentage ratio I_{2nd}/I_L (I_{-2nd}/I_L)

3rd harmonic

- Third harmonic phase currents $(I_{L1-3rd}, I_{L2-3rd}, I_{L3-3rd})$
- Third harmonic of residual current^[2] (I_{E-3rd})

4th harmonic

- Fourth harmonic phase currents $(I_{L1-4th}, I_{L2-4th}, I_{L3-4th})$

5th harmonic

- Fifth harmonic phase currents $(I_{L1-5th}, I_{L2-5th}, I_{L3-5th})$

Demand phase

- Phase fixed currents demand $(I_{L1FIX}, I_{L2FIX}, I_{L3FIX})$
- Phase rolling currents demand $(I_{L1ROL}, I_{L2ROL}, I_{L3ROL})$
- Phase peak currents demand $(I_{L1MAX}, I_{L2MAX}, I_{L3MAX})$
- Phase minimum currents demand $(I_{L1MIN}, I_{L2MIN}, I_{L3MIN})$

Protection

For each protection threshold, the following data are available:

- Start *ON/OFF*
- Trip *ON/OFF*
- Logic block (Block1) *ON/OFF*
- Selective block (Block2) *ON/OFF*
- Cold Load Pickup *ON/OFF*

Delayed inputs

The binary input states, acquired downstream the delay timers are available:

- IN1 *ON/OFF*
- IN2 *ON/OFF*
- INx *ON/OFF*

Internal states

The state of the functions assigned to binary inputs are available:

- Reset LEDs *ON/OFF*
- Profile selection *ON/OFF*
- Fault trigger *ON/OFF*
- IE /IPh Block2 *ON/OFF*
- IPh Block2 *ON/OFF*
- IE Block2 *ON/OFF*
- Block1 *ON/OFF*
- Tcs1 *ON/OFF*
- Tcs2 *ON/OFF*
- Trip External protections *ON/OFF*
- Reset partial counters *ON/OFF*
- Reset CB monitoring data *ON/OFF*
- 52a *ON/OFF*
- 52b *ON/OFF*
- Open CB *ON/OFF*
- Close CB *ON/OFF*
- Remote trip *ON/OFF*
- Reset on demand measures *ON/OFF*
- Auto-reclose enable *ON/OFF*
- Block auto-reclose *ON/OFF*

Note 1 The computed residual current is available for NA11 protection relays equipped with LPCT sensor inputs

Note 2 The third harmonic component of the residual current is available for NA11 protection relays equipped with CT inputs

Relays

For every output relay, the output operating state and diagnostic are available (**Read \Relays** menu):

• K1 State	ON/OFF
• K1 Diagnostic	OK/NOT OK
• K2 State	ON/OFF
• K2 Diagnostic	OK/NOT OK
•	
• K6 State	ON/OFF
• K6 Diagnostic	OK/NOT OK

Counters

For every element two set of counters are available (Partial counters and Total counters); the partial counters can be cleared by the user level, while the Total counter reset can be achieved with password (Session Level 1).

Every partial counter is reset to zero when ten thousand count is passed.

All partial counters can be cleared by means a single command; for this purpose the Reset partial counters command must be issued (**Commands\Reset** submenu).

- 79 - counter
- 50/51 - counter
- 50N/51N - counter
- 2ndh-REST - counter
- 74TCS - counter
- CB - counter
- 74CT - counter
- BF - counter

Partial counters

• xx Start partial counter (xx = l>, l>>,...)	0...9999
• xx Trip partial counter (xx = l>, l>>,...)	0...9999
• xx Block1 partial counter (xx = l>, l>>,...)	0...9999
• xx Block2 partial counter (xx = l>, l>>,...)	0...9999

Total counters

• xx Start total counter (xx = l>, l>>,...)	0...9999
• xx Trip total counter (xx = l>, l>>,...)	0...9999
• xx Block1 total counter (xx = l>, l>>,...)	0...9999
• xx Block2 total counter (xx = l>, l>>,...)	0...9999

Self test

Lower level diagnostic (MINOR) can be output or ignored; for this purpose the *MINOR Fail alarm* parameter can be set *ON* or *OFF* inside the **Set\Self test relay** submenu.

Following anomalies (MINOR) are not relevant (the protective elements continue to work):

- Errors concerning the digital fault recorder.
- Internal bus.

The self test information are:

• Protection and controls	ON SERVICE/OUT OF SERVICE
• System diagnostic	OK/NOT OK
• Device diagnostic	OK/NOT OK
• Program diagnostic	OK/NOT OK
• Data-base boot	OK/NOT OK
• Data-base runtime	OK/NOT OK
• DSP boot	OK/NOT OK
• DSP run-time	OK/NOT OK
• Memory boot	OK/NOT OK
• Memory run-time	OK/NOT OK
• Data Bus heavy	OK/NOT OK
• Data Bus minor	OK/NOT OK
• Oscillography run-time	OK/NOT OK
• PLC boot	OK/NOT OK
• PLC run-time	OK/NOT OK
• Protection I/O assigned verify startup	OK/NOT OK
• Protection I/O assigned verify run-time major	OK/NOT OK
• Protection I/O assigned verify run-time minor	OK/NOT OK
• Total protection I/O assigned not-matching	0...
• Protection I/O assigned not-matching	OK/NOT OK
• PLC I/O assigned verify startup	OK/NOT OK
• PLC I/O assigned verify run-time major	OK/NOT OK
• PLC I/O assigned verify run-time minor	OK/NOT OK
• Total PLC I/O assigned not-matching	0...
• MMI module Boot	OK/NOT OK
• MMI module Run-time	OK/NOT OK
• MRI module Boot	OK/NOT OK
• MRI module Run-time	OK/NOT OK
• MID16-1 module Boot	OK/NOT OK
• MID16-1 module Run-time	OK/NOT OK
• MID16-2 module Boot	OK/NOT OK
• MID16-2 module Run-time	OK/NOT OK

- PT100 module Boot OK/NOT OK
 - PT100 module Run-time OK/NOT OK
 - Current loop module Boot OK/NOT OK
 - Current loop module Run-time OK/NOT OK
- The diagnostic alarms can be allocated to an output relay; for this purpose the *Self-test relay* parameter can be set (*K1...K6*) inside the **Set \ Self-test Relay** submenu.

Pilot wire diagnostic

Detailed diagnostic information about the pilot wire are available. (**Read \ pilot wire diagnostic**).

- BLIN1 pilot wire breaking diagnostic state ON/OFF
- Pilot wire BLIN1 shorted ON/OFF

Selective Block - BLOCK2

The input and output state concerning the selective block are available (**Read \ Selective block-BLOCK2**).

Block2 input

- Phase protections input selective block state *BLK2IN-Iph* ON/OFF
- Ground protections input selective block state *BLK2IN-IE* ON/OFF
- tB-Iph/IE Elapsed state *tB timeout* ON/OFF

Block2 output

- Starting state of phase protections enabled for external selective block on output *ST-Iph-BLK2* ON/OFF
- Starting state of ground protections enabled for external selective block on output *ST-IE-BLK2* ON/OFF
- Phase protections output selective block state *BLK2-OUT-Iph* ON/OFF
- Ground protections output selective block state *BLK2-OUT-IE* ON/OFF
- Phase and ground protections output selective block state *BLK2-OUT-Iph/IE* ON/OFF

Fault recording - SFR

Recording is triggered by one or more causes (up to 8 simultaneous):

- Activation (OFF-ON transition) of any relay programmed for trip of protection or control element
- External trigger (binary input programmed as *Fault trigger*)

Twenty events are recorded into a circular FIFO (First In, First Out) buffer.^{[1][2]}

Following information are stored in every record:

- Fault counter^[3]
- Date and time
- Fault cause (element trip)
- Phase currents I_{L1r} , I_{L2r} , I_{L3r}
- Residual current I_{Er} or I_{ECr}
- Inputs
- Outputs
- Fault cause info (eg. faulted phase)

Event recording - SER

Recording is triggered by one or more causes:

- Start and/or trip of any enabled protection or control element
- Binary input activation (OFF-ON or ON-OFF transition)
- Power-on or power-down (Auxiliary power supply)
- Setting change.

Three hundred events are recorded into a circular FIFO (First In, First Out) buffer.^{[2][4]}

Following information are stored in every record:

- Event counter^[5]
- Date and time
- Event cause (binary input/element trip/setting change)

Oscillography - DFR

Upon programmable trigger, the fault records are recorded in COMTRADE format; the sampled measures (24 sample per cycle) are stored in a circular shift memory buffer.

The fault record are self-triggered; they are stored in sequential order up the allocated memory is used up after which the oldest memory is overwritten.

An operating procedure example for the digital fault recording is illustrated inside the ThyVisor section.

Note 1 Fault 0 is the newest fault, while the Fault 19 is the oldest fault

Note 2 Data are stored in non volatile memory; they are held in spite of power down

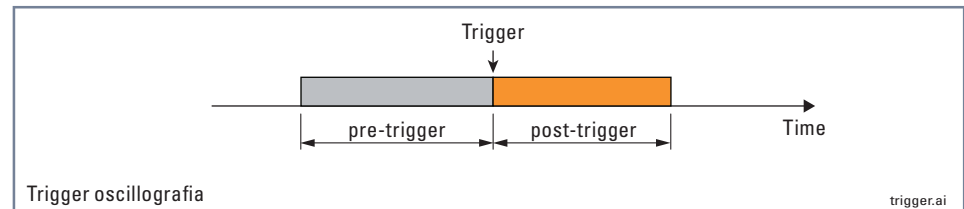
Note 3 Counter is updated at any new record; it may be cleared by means ThyVisor

Note 4 Event 0 is the newest event, while the Event 299 is the oldest event

Note 5 Counter is updated at any new record; it may be cleared by means ThyVisor

Following parameters are user-programmable:

- Pre-trigger and post-trigger time
- Selected sampled quantities.
- Analog channels (1...12) allocation.
- Digital channels (1...12) allocation (output relay and/or binary inputs).
- Trigger setup; the information storage starts when a state transition on the selected signal occurs. (protective element start and/or trip, output relay and/or binary input switching).
- Alarm: when the 80% of the buffer space is reached an alarm may be issued. The system being of linear type, the records are back-to-back recorded to the end of available memory; the alarm output is a warning in order that the user may download data^[1] to clear memory for new records



COMTRADE

Records are recorded in COMTRADE format; (Common Format for Transient Data); This is a standard for the data exchange for various types of tests or simulation datas, etc, for power system applications.

The measurements are recorded in ASCII or BINARY format. COMTRADE files always come by pairs:

- The “.CFG”-file describing the configuration: number of analog and digital channels, sampling rate, scale factors, etc.
- The “.DAT”-file containing the data

The COMTRADE is part of IEC 60255-24 standard.

The recording can be analyzed by mean of ThyVisor sw or any other standard compliant viewer.

The record quantity is depending on settings of following parameters:

- Pre-trigger and post-trigger times
- Number of allocated channels.

By means of the following formula the record quantity may be evaluated:

$$N = \text{int} \left[\frac{12000}{(34 + 20 \cdot v_i + 4 \cdot v_{\text{RMS}} + n_B) \cdot (t_{\text{pre}} + t_{\text{post}}) (\text{s})} \cdot \frac{50 (\text{Hz})}{f (\text{Hz})} \right]$$

where:

- N record quantity
- v_i sampled measures
- v_{RMS} analog measures (RMS)
- n_B logic variables (2 up to 16 variables)
- t_{pre} pre-trigger time interval
- t_{post} post-trigger time interval
- f frequency

Example 1

With the following setting:

- Pre-trigger: 0.25 s
- Post-trigger: 0.25 s
- Sampled measures: $i_{L1}, i_{L2}, i_{L3}, i_E$
- Analog measures: $i_{L1}, i_{L2}, i_{L3}, i_E$
- Logic variables: K1, K2, K3, K4, K5, K6, IN1, IN2

up to 180 record can be stored if $f = 50$ Hz, since:

$$N = \text{int} \left[\frac{12000}{(34 + 20 \cdot 4 + 4 \cdot 4 + 2) \cdot (0.25 + 0.25)} \cdot \frac{50 (\text{Hz})}{50 (\text{Hz})} \right] = 180$$

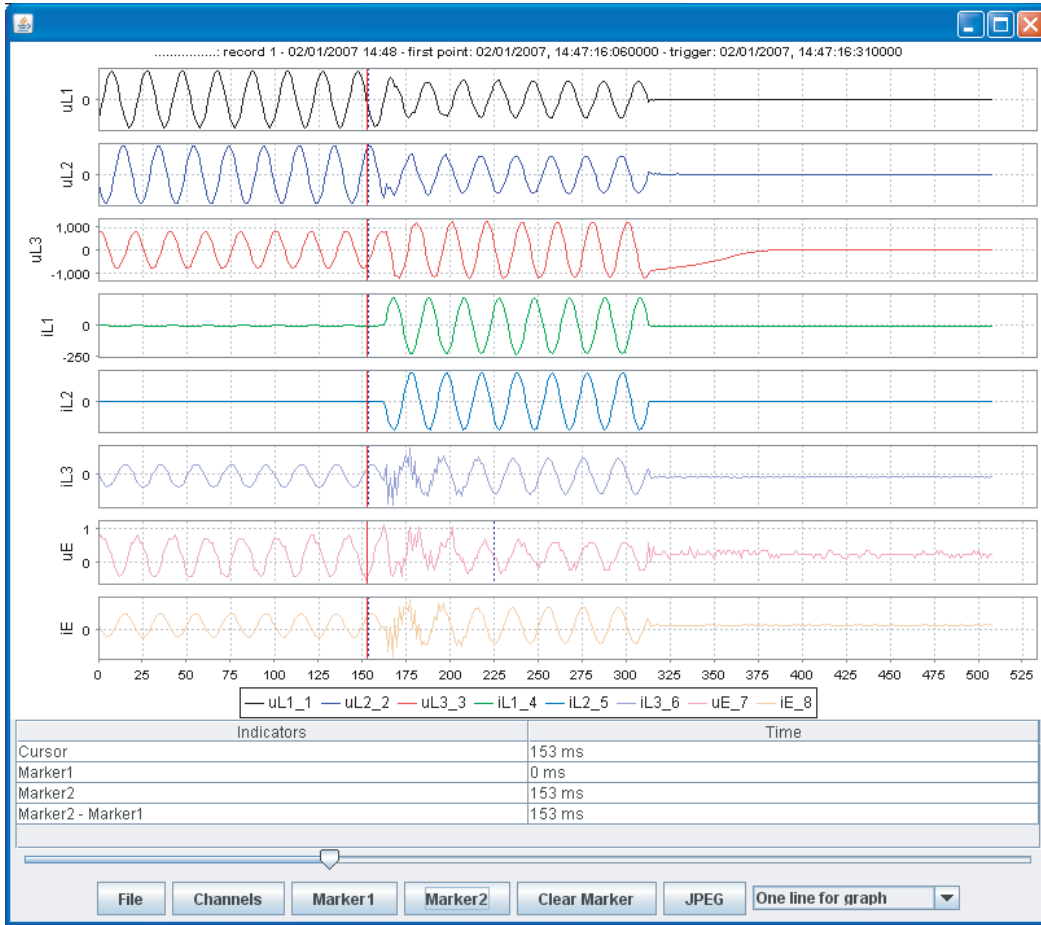
Example 2

With following setting:

- Pre-trigger: 0.5 s
 - Post-trigger: 0.5 s
 - Sampled data: $i_{L1}, i_{L2}, i_{L3}, i_E$
 - Analog channels: $i_{L1}, i_{L2}, i_{L3}, i_E$
 - Digital channels: K1, K2, K3, K4, K5, K6, IN1, IN2
- up to 75 records can be stored if $f = 60$ Hz, since:

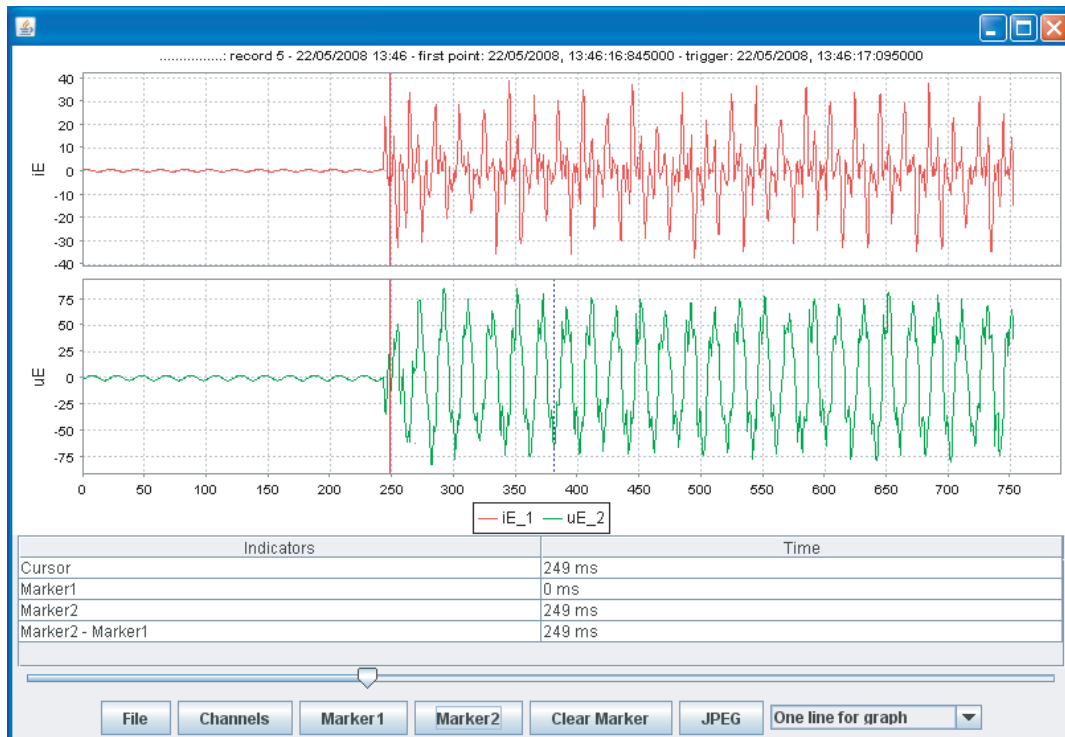
Note 1 Data are stored into non-volatile memory; they are retained once power is turned off.

$$N = \text{int} \left[\frac{12000}{(34 + 20 \cdot 4 + 4 \cdot 4 + 2) \cdot (0.50 + 0.50)} \cdot \frac{50 \text{ (Hz)}}{60 \text{ (Hz)}} \right] = 75$$



Phase/to/phase fault record

oscillo-phase.ai



Phase/to/earth fault record

oscillo-earth.ai

6 INSTALLATION

6.1 PACKAGING

Packaging consists of a paperboard packaging guaranteeing adequate protection for transport and storage under normal environmental conditions.

The Pro-N protection relays must be stored within the required temperature limits; the relative humidity should not cause condensation or formation of frost.

It is recommended that the devices are stored in their packaging; in the case of long storage, especially in extreme climatic conditions.

It is recommended that the packaging not be disposed of into the environment, but kept in case the relay should be moved at some later time.

6.2 MOUNTING

The Pro-N protection relays are housed inside metal cases suitable for various kinds of assembly:

- Flush mounting
- Projecting mounting
- With separate operator panel
- Rack.

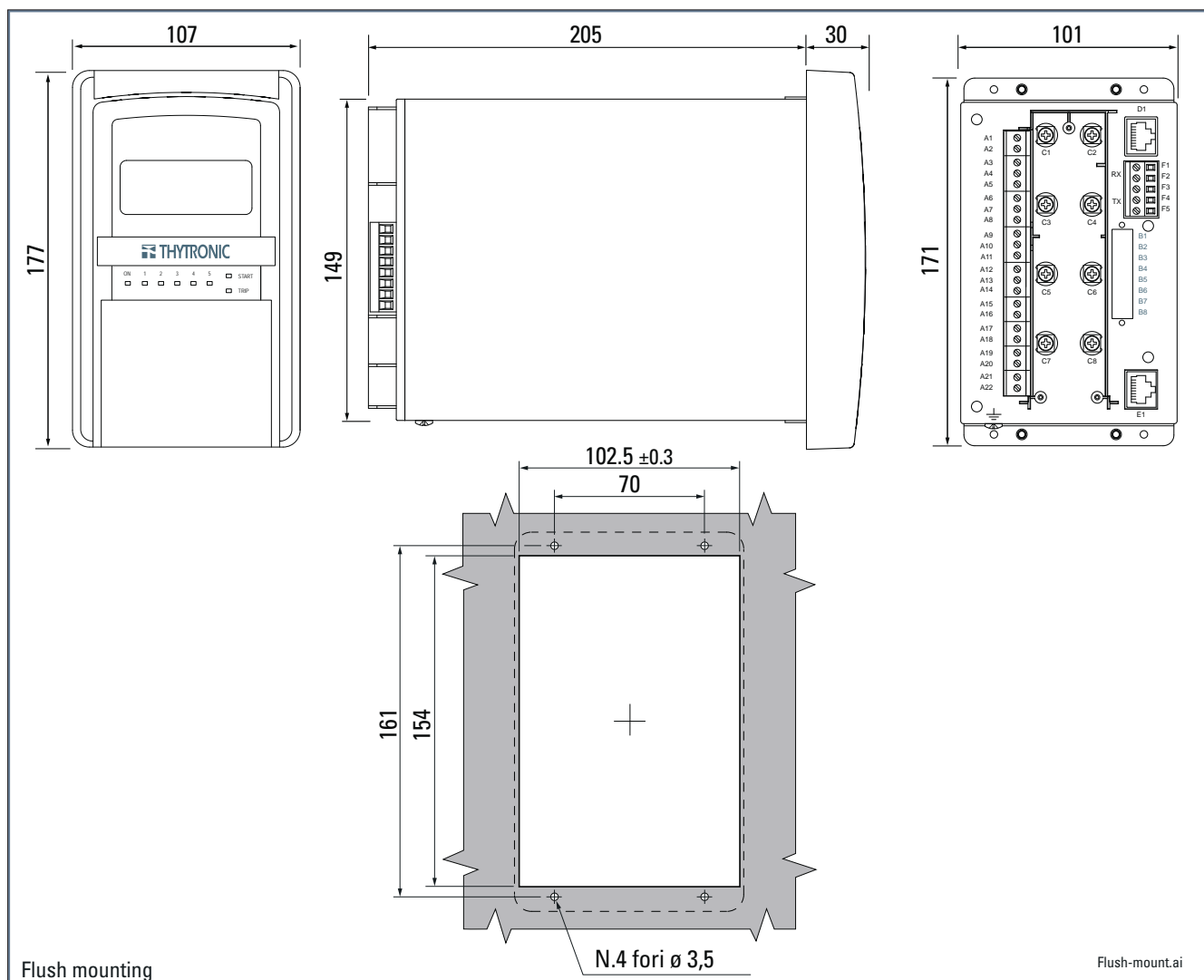
Removability is ensured to facilitate maintenance operations so that the electronic module can be replaced; this provides minimum downtime and maximum protection availability.

Flush mounting

The fixed case, fitted with special fastening brackets, is mounted on the front of electric control board, previously drilled as indicated in the drawing.

In case of side-by-side mounting of several relays the minimum drilling distance is determined by the front dimensions indicated in the overall dimensions drawing, increased by 3 mm, to ensure an adequate tolerance and gasket space between adjacent relays.

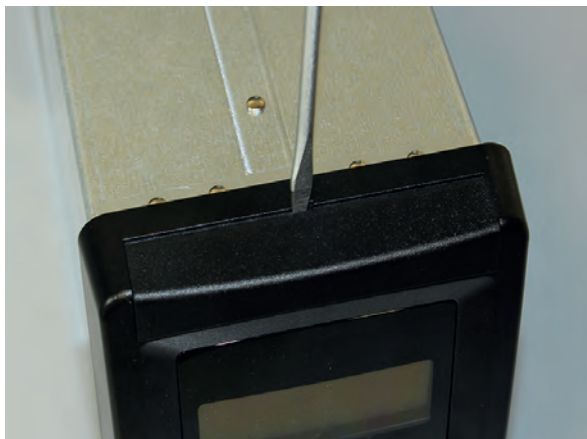
The depth dimension, as indicated in the drawing, must be increased by as much as needed to allow room for the wiring.



NOTE

Separation of fixed and removable parts is NOT required

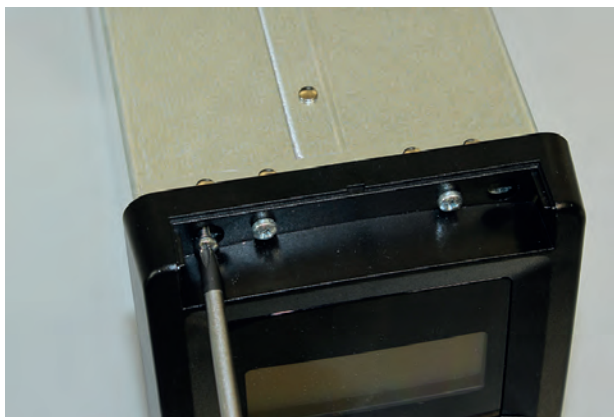
- Remove the upper tile and open the little door to access the fastening screws.



Removing tie to access the fastening screws

Remove-tile.ai

- The fixed case is fastened by means of four screws onto the panel as indicated in the drawing.

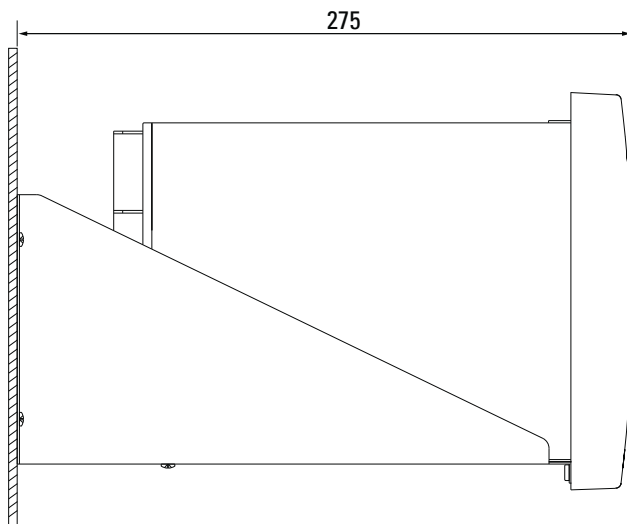
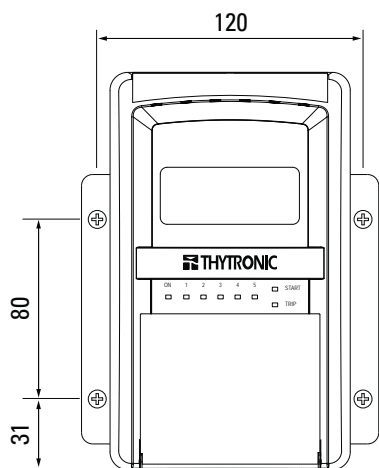


Four screws

Flush-mount1.ai

Projecting mounting

- Remove the ground screw and open the little door to access the fastening screws.
 - Make all connections and join the relay to the framework with front and earth screws.
- In case of side-by-side mounting of several relays, the minimum fixing distance is determined by the dimensions of the mounting plate indicated in the overall dimensions drawing, increased horizontally and vertically by as much as needed to allow room for the wiring and to ensure an adequate tolerance between devices.



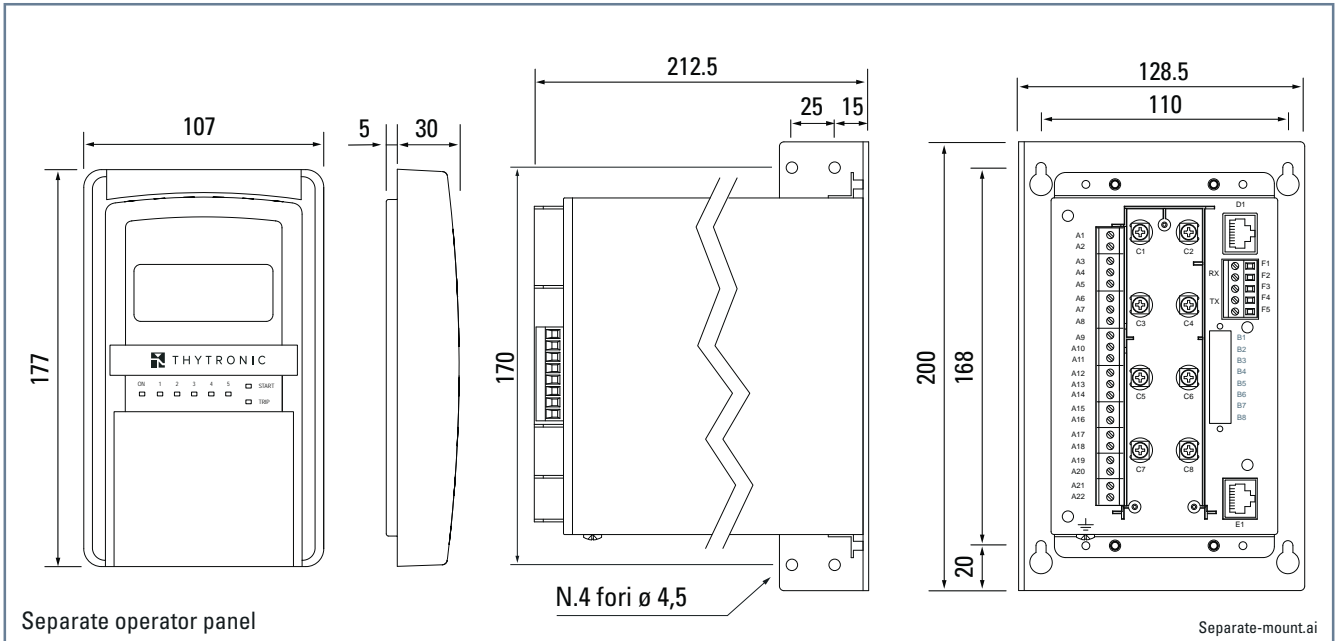
Projecting mounting

Projecting.ai

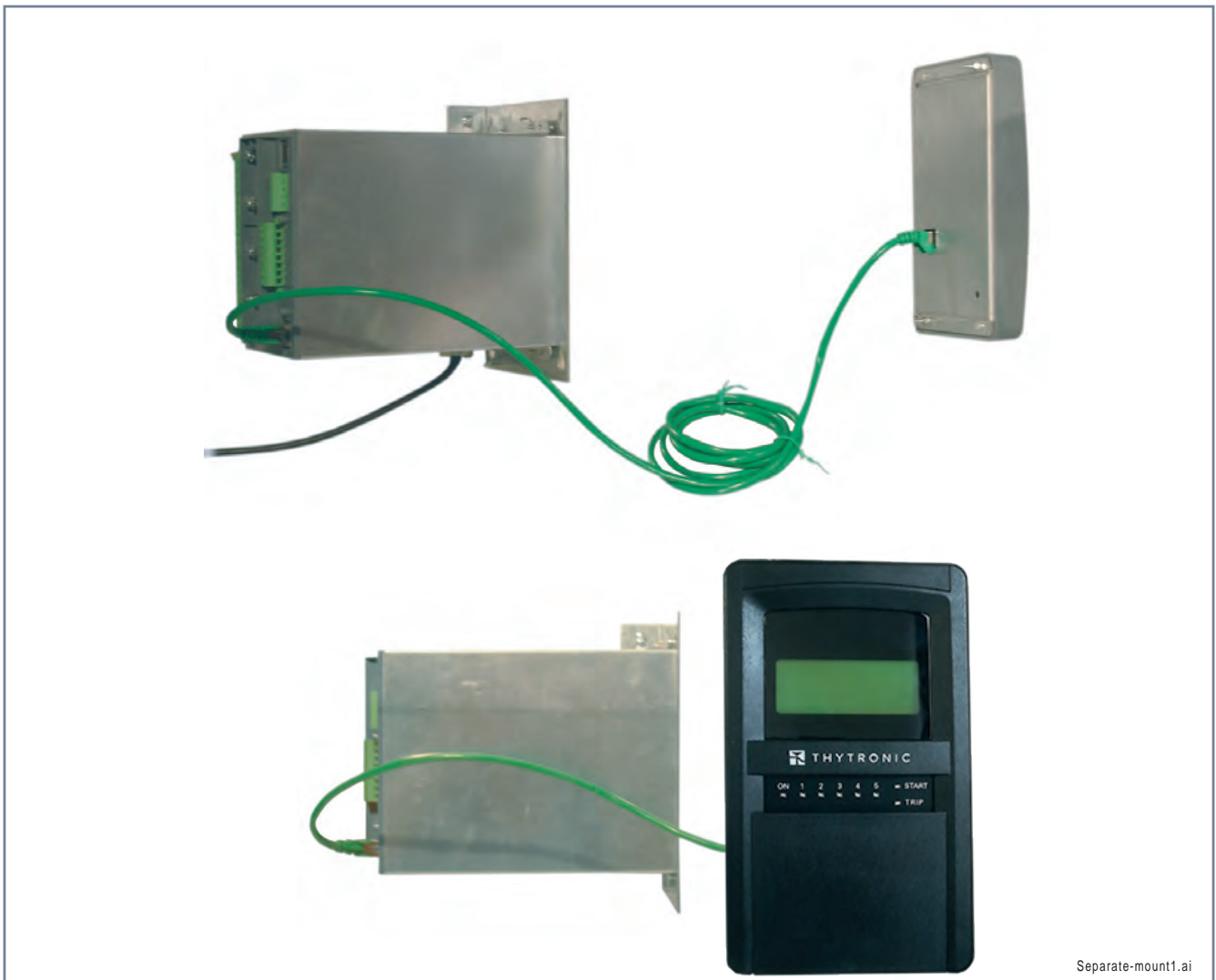
Separate operator panel

The solution with projecting assembly and a separate operator panel is particularly suitable for limited in depth installations.

Cutout dimension and mounting steps concerning the separate operator panel are the same for the flushing mounting (see previous pages).

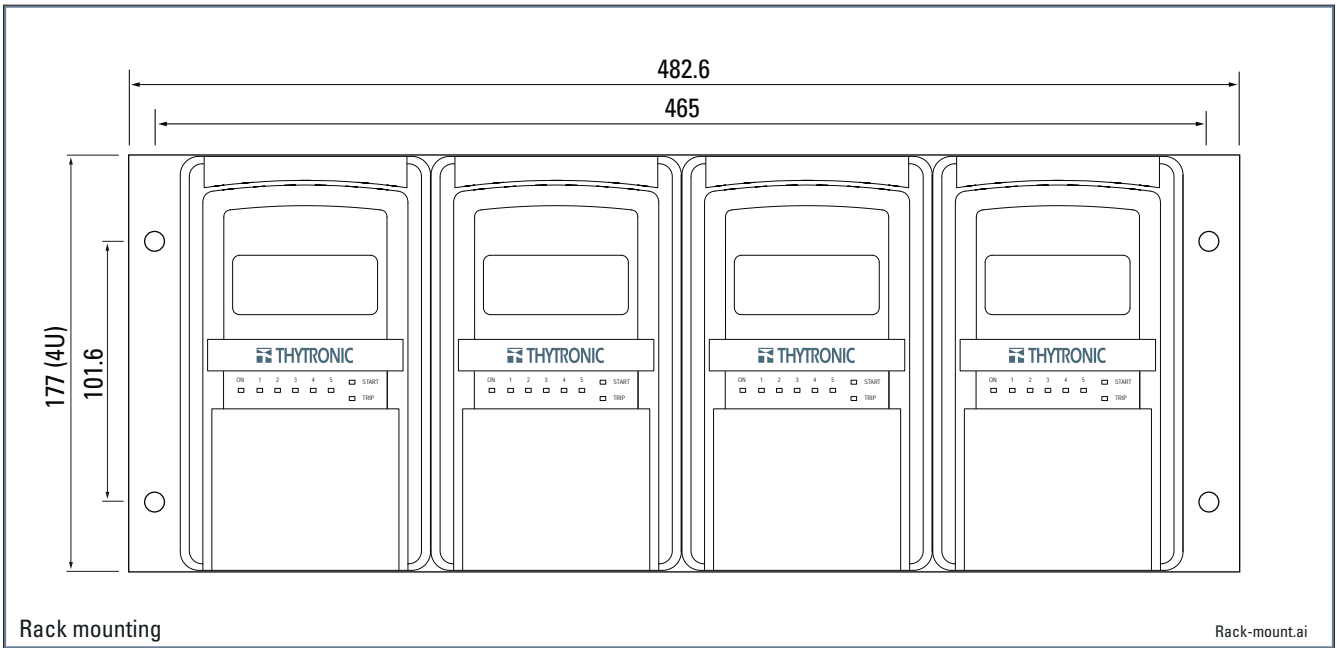


A standard direct shielded cable with RJ45 connectors must be used for connections.



Rack mounting

For mounting inside a standardized 19-inch system (EIA 310-D, IEC 60297 and DIN 41494 SC48D), the MAR adapter is required (available on request).



To allow opening of the keyboard door a one unit space must be provided when several rack are overlapping mounted.

6.3 ELECTRICAL CONNECTIONS

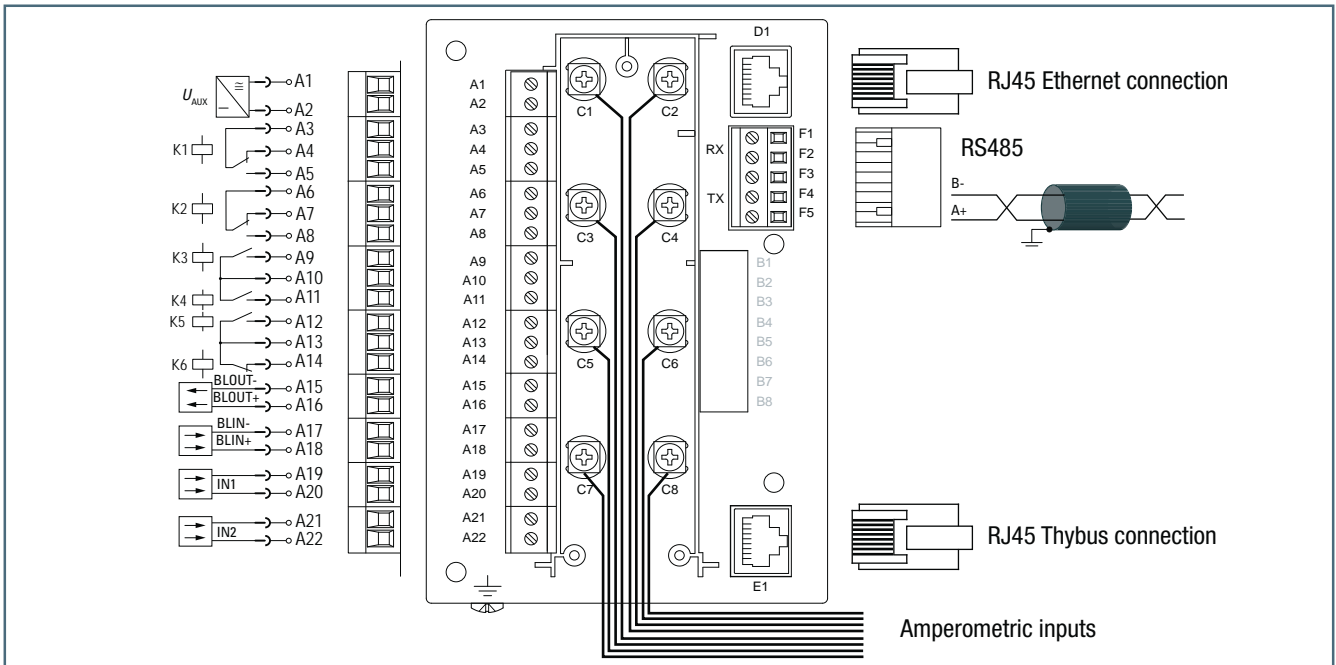
Electrical connections should be made by referring to the connection diagram; in cases where certain of the circuits (communication, block, or others) are not used, the relevant connections must remain open. Examples of connection diagrams are reported on Appendix to this manual.

CAUTION Devices must be installed by qualified personnel only. No liability is accepted from Thytronic due to improper use.

- For the A1...A22 connections, screw terminals with following characteristics are available:
- Nominal cross section: 0.14...2.5 mm² (AWG 26...16) for single conductor
da 0.14 a 0.75 mm² for two conductors with same cross section
 - Tightening torque: 0.5-0.6 Nm
 - Stripping length: 8 mm
- For the F1...F5 (RS485) connections, screw terminals with following characteristics are available:
- Nominal cross section: da 0.2 a 2.5 mm² (AWG 24...12) for single conductor
da 0.2 a 1.5 mm² for two conductors with same cross section
 - Tightening torque: 0.5-0.6 Nm
 - Stripping length: 10 mm

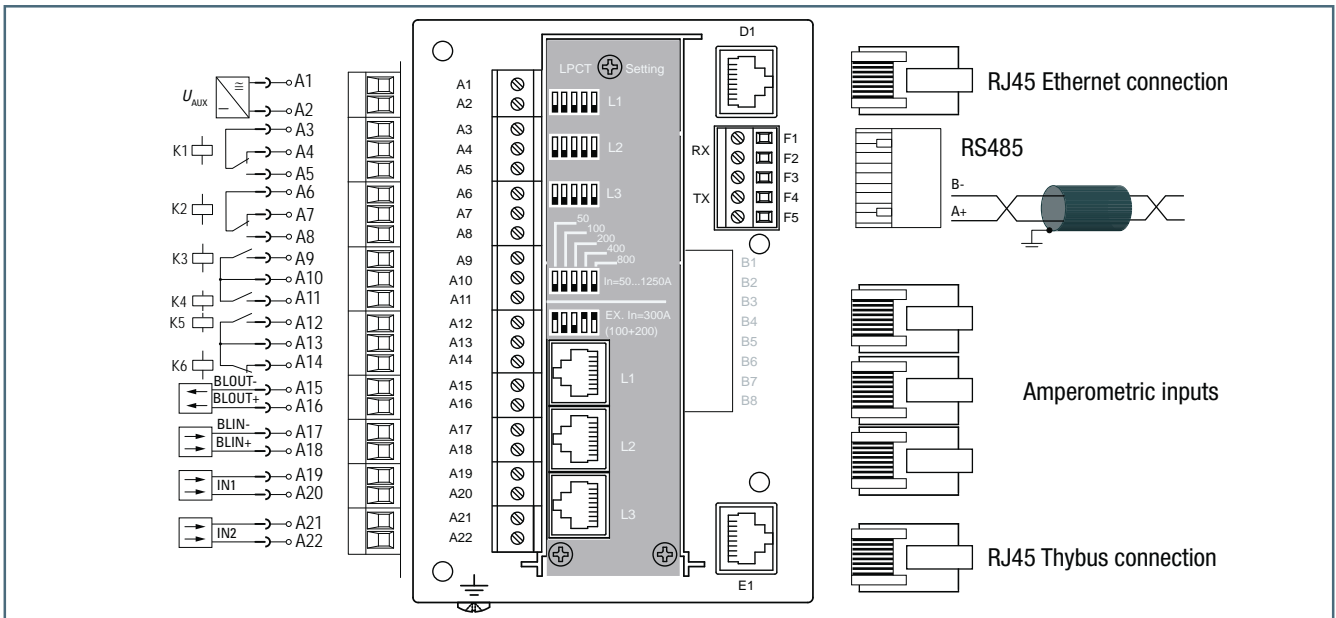
Traditional CTs inputs

The connections to the current signal inputs C1...C8 can be made by ring lugs suitable for M4 screws and an insulating panel covering the terminals may be mounted for safety purposes.



LPCTs inputs

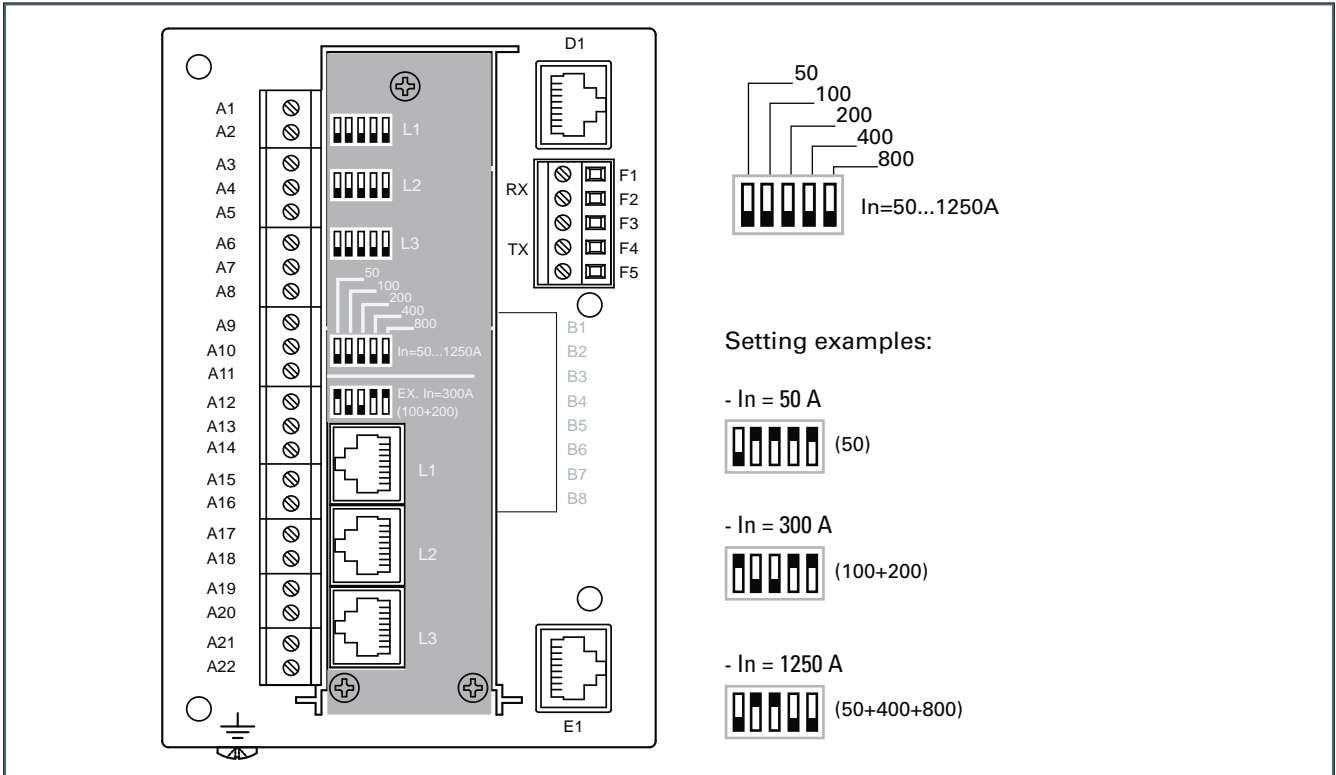
The connections to the current signal inputs L1...L3 must be made by RJ45 plugs coupled with LPCT cables.



By means DIP-switches the rate primary current must be adjusted.^[1]

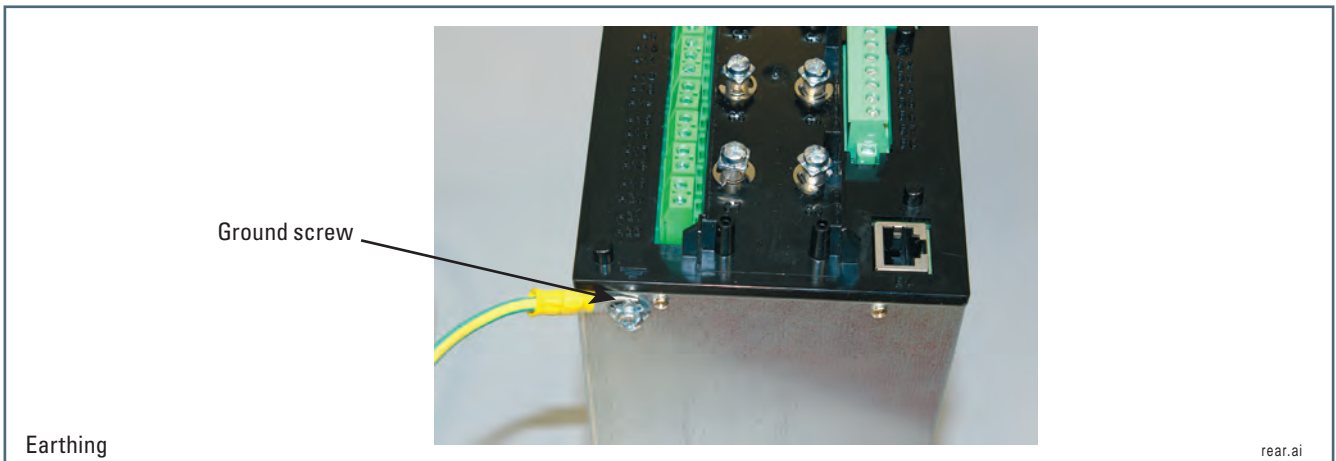
The following setting are possible for I_n (rated primary current):

- 50 - 100 - 150 - 200 - 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800 - 850 - 900 - 950 - 1000 - 1050 - 1100 - 1150 - 1200 - 1250 A.



Earthing

A protective ground connection is required, which must be connected to the suitable screw with a separate lead of at least 2.5 mm².



Earthing

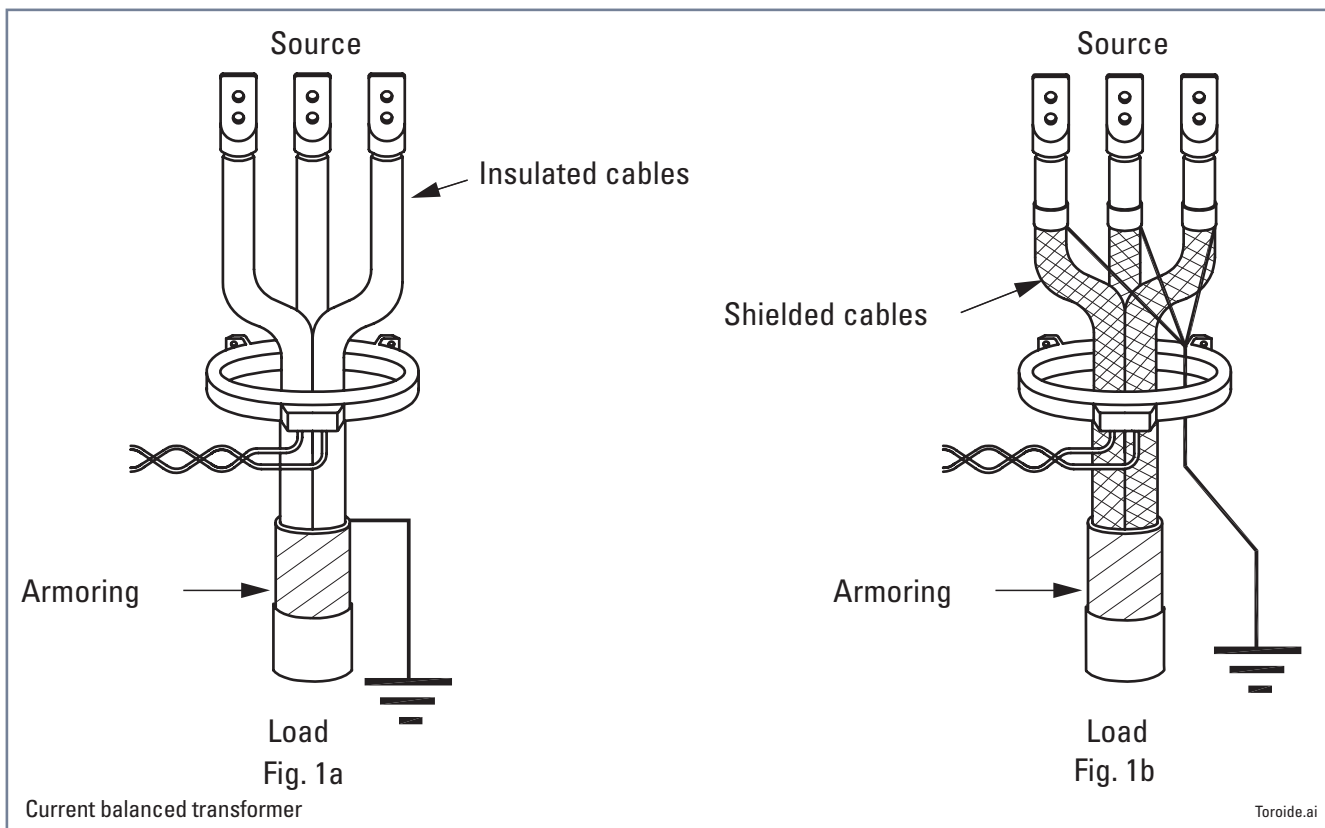
rear.ai

*Note 1 The three groups of Dip-switches must be adjusted with same setting
For more information about technical data of the LPCT current transformers please contact Thytronic*

Core balanced CT

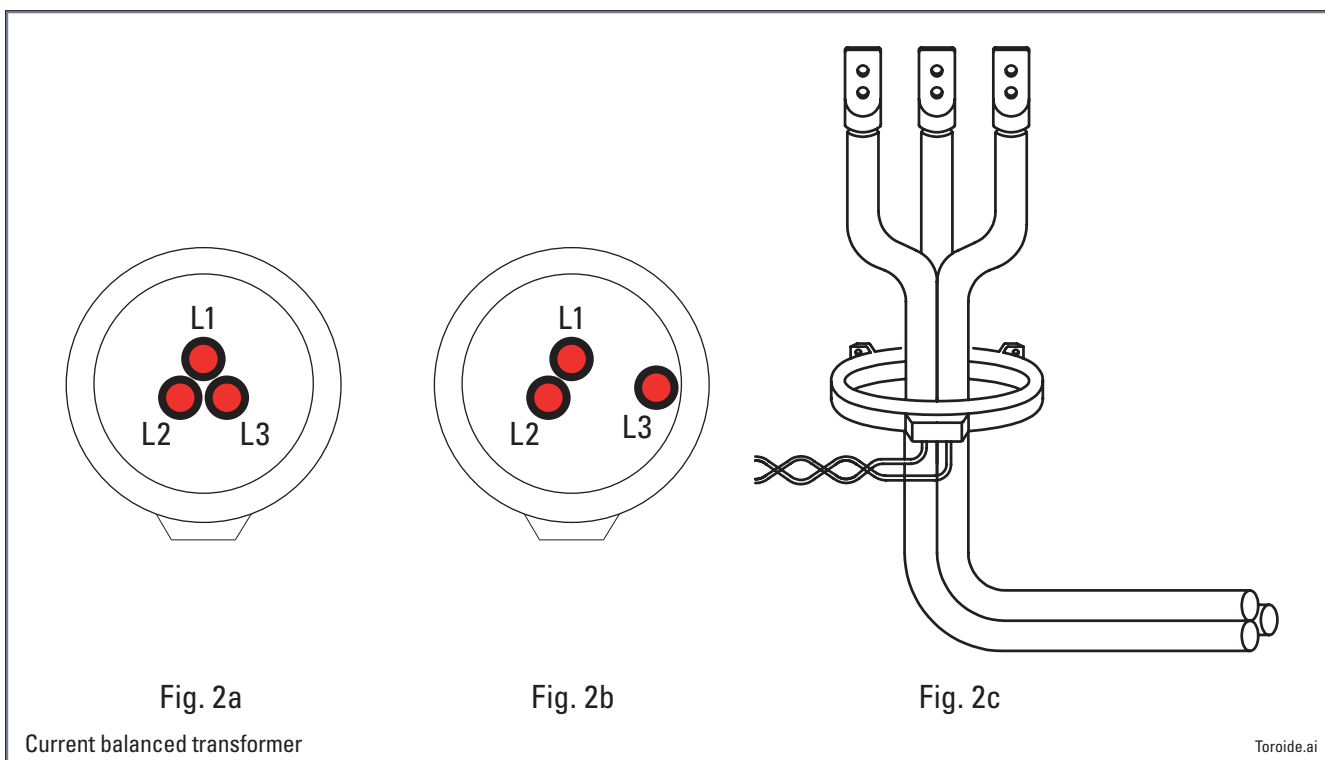
Proper installation is shown in fig. 1a and 1b.

The current balance transformer, when used for measuring residual current, must be crossed in the same direction by all active conductors and hence, also by the neutral conductor if distributed, with the exception of the ground connection protective conductor. The drawing below shows cases of assembly of the toroid on unscreened and screened cables; prior to proceeding with assembly, it is necessary to check that there are no screen-to-ground connections upstream of the sensor.



In order to ensure a linear response from the sensor, the cables must be positioned in the centre of the transformer so that the magnetic effect of the three cables is perfectly compensated in the absence of residual current (Fig.2a).

Hence, the assembly indicated in the drawing of fig.2b, in which phase L3 causes local magnetic saturation whereby the vectorial sum of the three currents would be non-null, should be avoided. The same considerations also apply when the sensor is positioned near bends in the cabling. It is recommended that the transformer be placed away from bends in the conductors).



Standard CT amperometric inputs

The amperometric input circuits are assembled inside the fixed module, so no short circuit on the secondary CTs must be provided when the removable module is pulled out
In the event of case replacement, some camps must be provided externally to shorting the secondary CTs circuits to avoid secondary open circuit of CTs that may endanger equipment or people.



CAUTION

In case of disconnection CT wiring to the case, pay attention must to do not open live circuits.

When making the current connections, attention must be paid to not exceeding the performance of the line current transformers. To be exact, the total load, constituted by the protective relay, any other protective relays or measuring instruments and the resistance of the connections, must not exceed the line CT performance. In particular, consumption of the relay input circuit must not exceed 0.2 VA while the load (expressed in VA) constituted by the conductors is given by:

$$0.018 \times L \times I_n^2 / S$$

where:

L the overall length, expressed in m, of the two conductors in relation to each phase;

I_n nominal current of the line CT expressed in A;

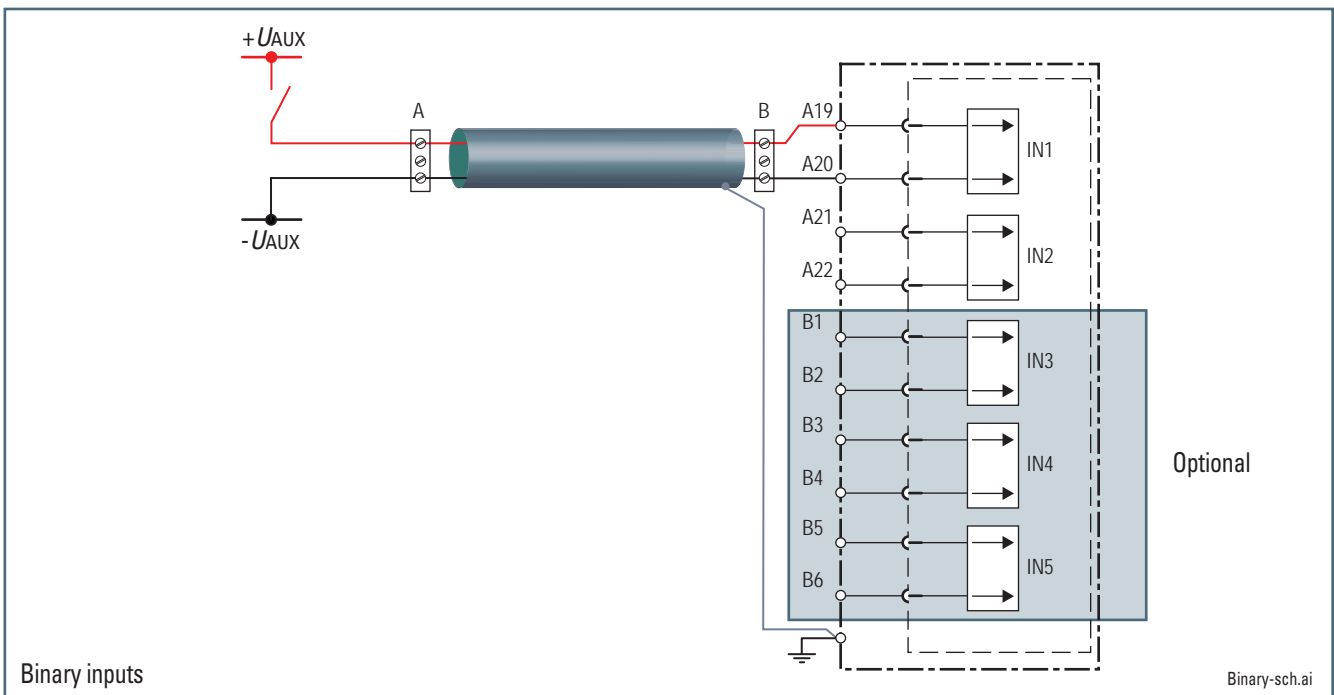
S cross sectional area of the current conductors expressed in mm².

It is recommended that cabling of a suitable thickness be used in order to limit wear of the CT secondary circuits.

Binary inputs

The dry input circuits, despite being galvanically isolated, must preferably be supplied with the same auxiliary voltage of the control panel.

The inputs are polarity free with wide voltage range.



The optoisolated inputs are immune to transitory interferences, however the following recommendation must be considered in high disturbed environments:

- Position input wiring away from high energy sources.
- Set a debounce timer (tON and/or tOFF) to allow the transient to decay.
- Use shielded cables with ground connection on only one end (preferably at the relay side).

Output relays

Six output relays are available.

It is advisable to verify that the technical characteristic of the contacts be suitable for the applied load (about current, nominal voltage, make and break current, etc..).

Output relay K1 and K2 have one change over contacts (SPDT, type C).

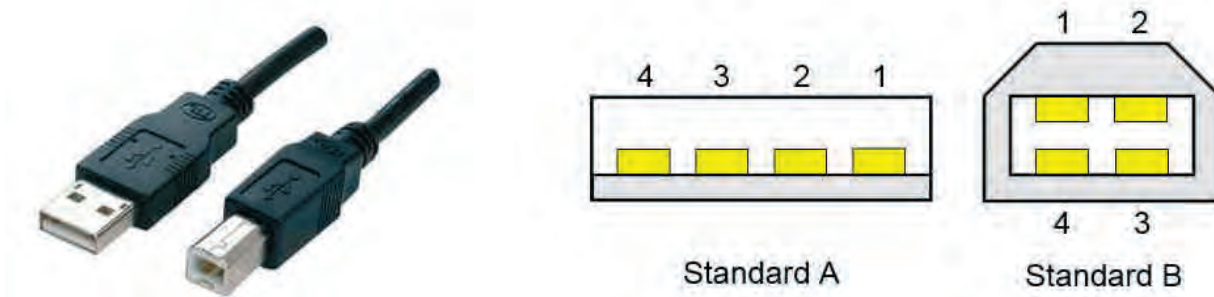
Output relay K3 and K4 have one make contact (SPST-NO, type A) and a common reference (A10 terminal).

Output relay K5 and K6 have one make contact (SPST-NO, type A for K5), one break contact (SPST-NC, type B for K6) and a common reference (A13 terminal).

All contacts are shown in de-energized state for standard reference.

USB port

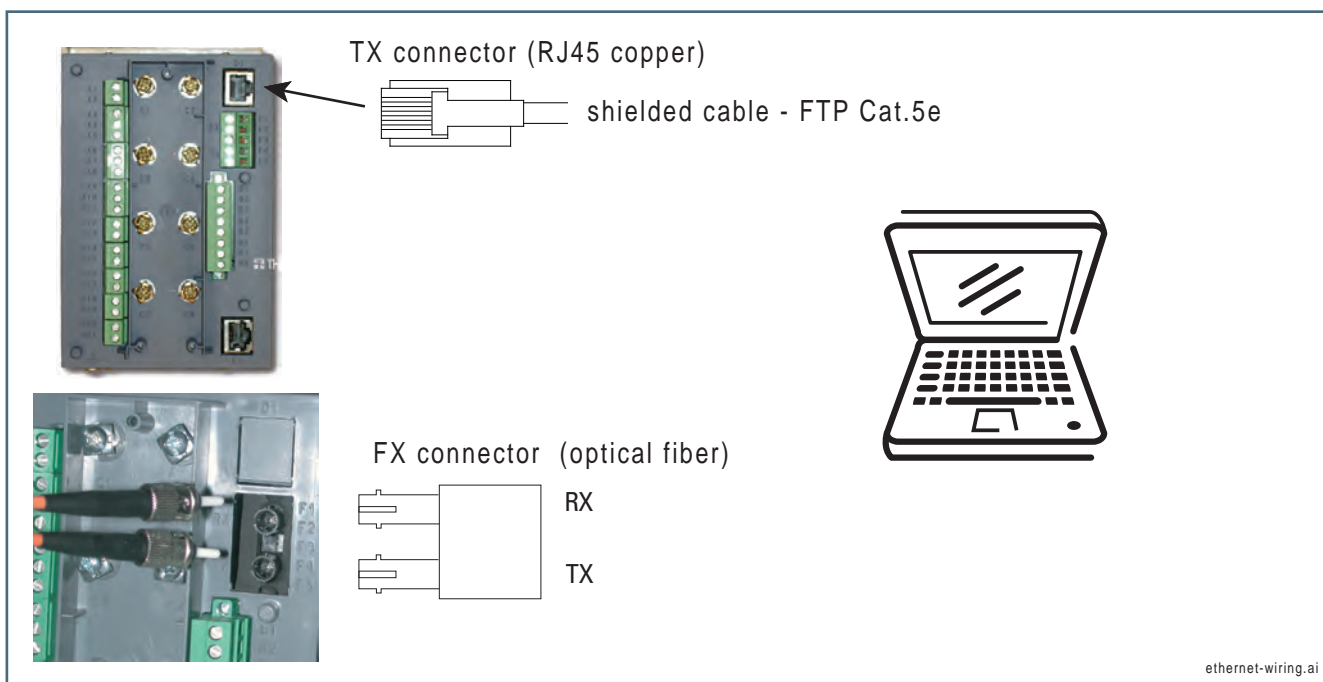
The link from PC and NA10 USB port must be established by means a L10042 cable.



After installation, the same communication port must be selected to define the ThyVisor parameters (typically COM4, COM5,...).

Ethernet port

One RJ45 (copper) or FX (optics fiber) port may be provided. Connections to the TX (RJ45) port must be made with shielded cable FTP Cat.5e category or higher. For testing a PC may be directly connect to the Ethernet port (D1) on the rear side. With TX interface a cross cable must be employed, while an Ethernet-optical fiber converter, suitable for 100 Mb data rate must be employed if an FX port is implemented.



The link must be enabled by means ThyVisor sw and USB connection:

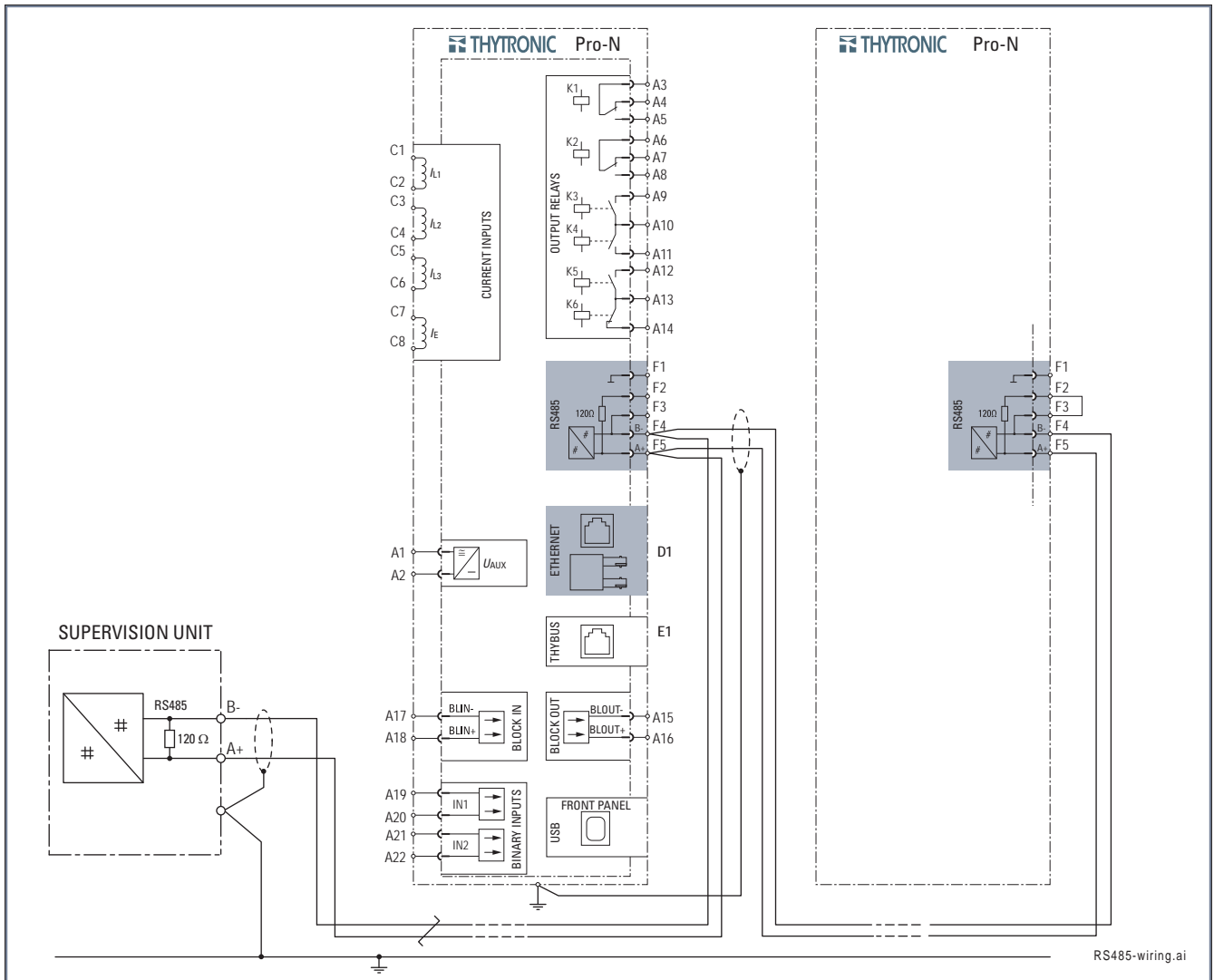
- Set the IP address (*Host IP address e IP net mask*) in order that the NA10 and PC parameters are matched; the parameters are inside the **Communication \ Ethernet** submenu.
- Set to *OFF* the *Autonegotiation* parameter of NA10 device (*Autonegotiation* parameter inside **Communication \ Ethernet** submenu).

For security reasons, a change of the Ethernet communication parameters become active only after an hw reset.

RS485 port

RS485 communication circuit connections must be made using screened twisted pair cable observ-

ing the polarities; screening must only be connected to the end terminating at the RS485 interface circuit pertaining to the monitoring unit.
 It is recommended to terminate the line at the extremities of the same; this must be performed on the RS485 line control unit and on the NA11 device placed at the furthest point connecting the specially provided resistor; termination can be made by means a jumper between the F2-F3 terminals.
 Termination resistors allow adjusting the impedance of the line, reducing the influence of the inductive components of the same, which might compromise good communication.

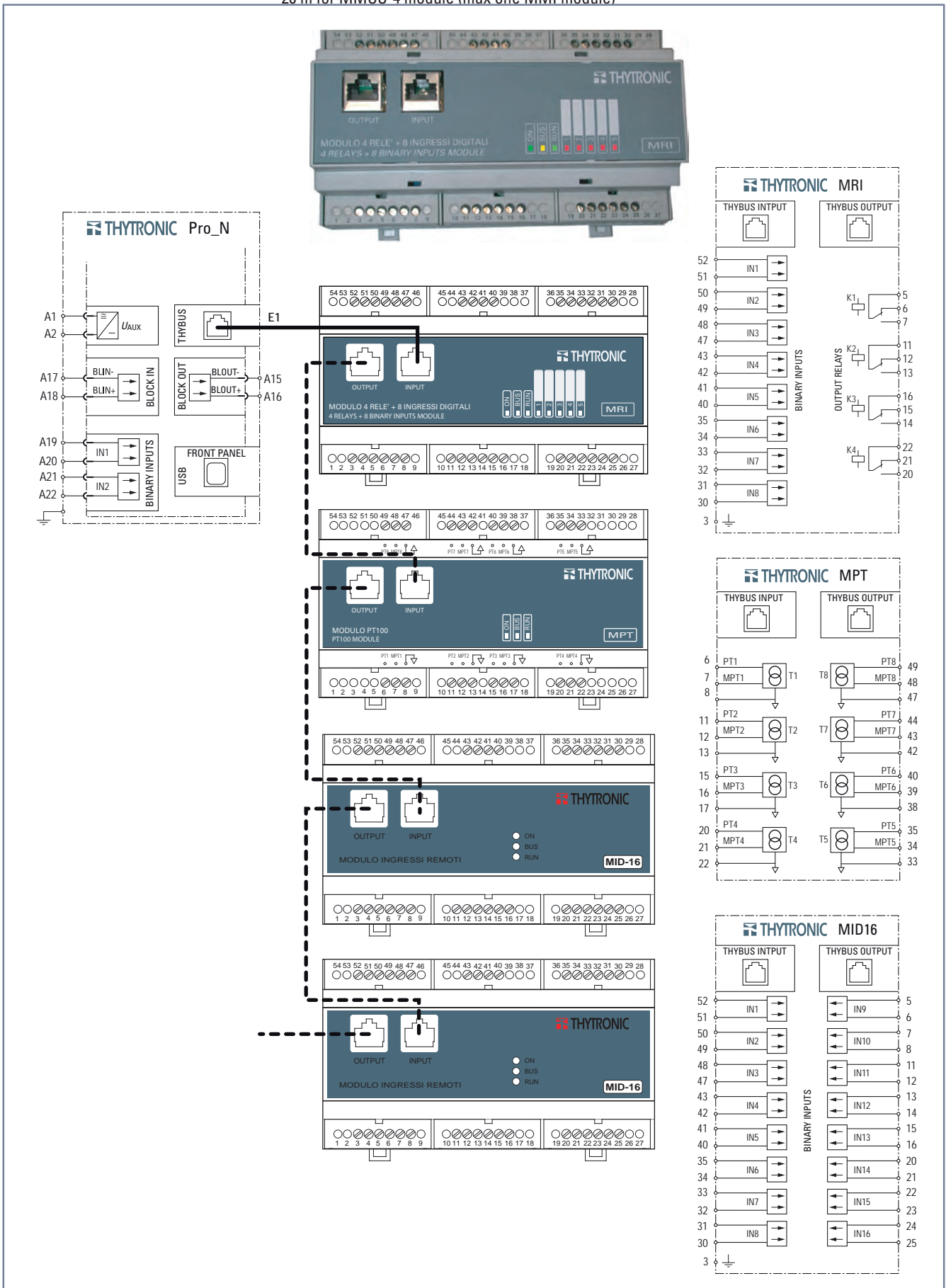


Thybus port

In order to extend I/O capability, the Pro_N relays can be customized through external auxiliary mod-

ules; moreover 4...20 mA converter and temperature measuring modules are provided. The modules do not need external auxiliary supply. It is fed directly by Thybus port. The Thybus link must be carried out by means category 5 shielded cable with RJ45 connectors. The maximum length of the Pro-N device - module link is:

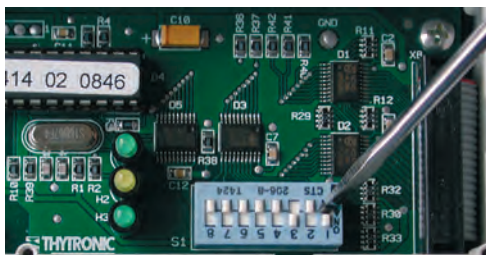
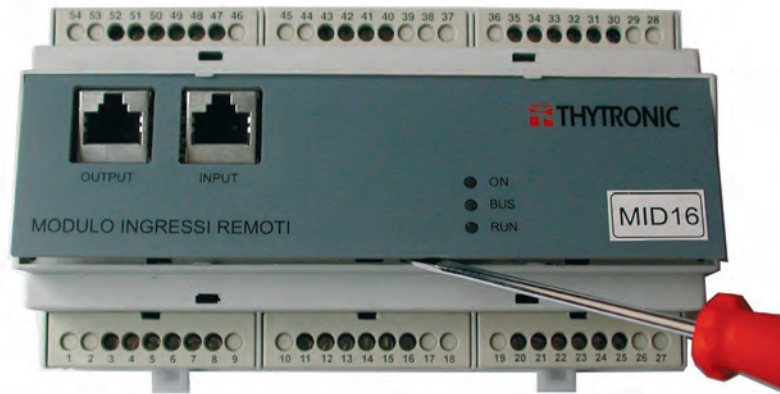
- 2 m for MRI module (max one module)
- 20 m for MMOS-4 module (max one MMI module)



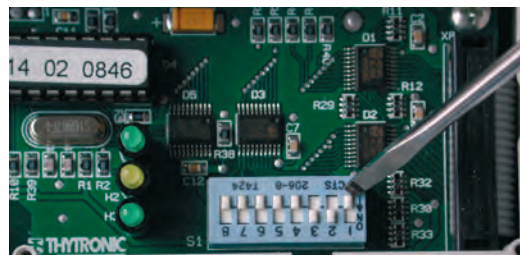
- 30 m for MID16 and MPT modules
- 2 m for MPT module (max one Pt100 module)
- 2 m for MCI module (max one current converter module)

For upgrading, that may be operated at any time with in service devices too, the following operations must be performed:

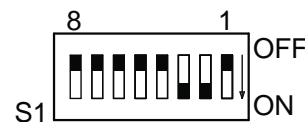
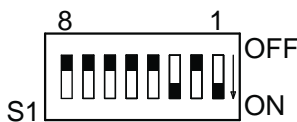
- Turn OFF power supply
- Connect the auxiliary modules to the Thybus port in daisy chain mode following the INPUT-OUTPUT sequence.^[1]
- If two MID16 (binary inputs) are installed, the hardware address must be set to avoid communication collisions on the Thybus; for this purpose the default address must be changed on one module, by means of dip-switch on the top circuit board (front plate must be removed).



default address



modified address (2nd MID16 module)



MID16 hardware address setting

DIP-MID16.ai

- Turn on power
- Go on to the sw setting (see SETTING section of instruction manual).

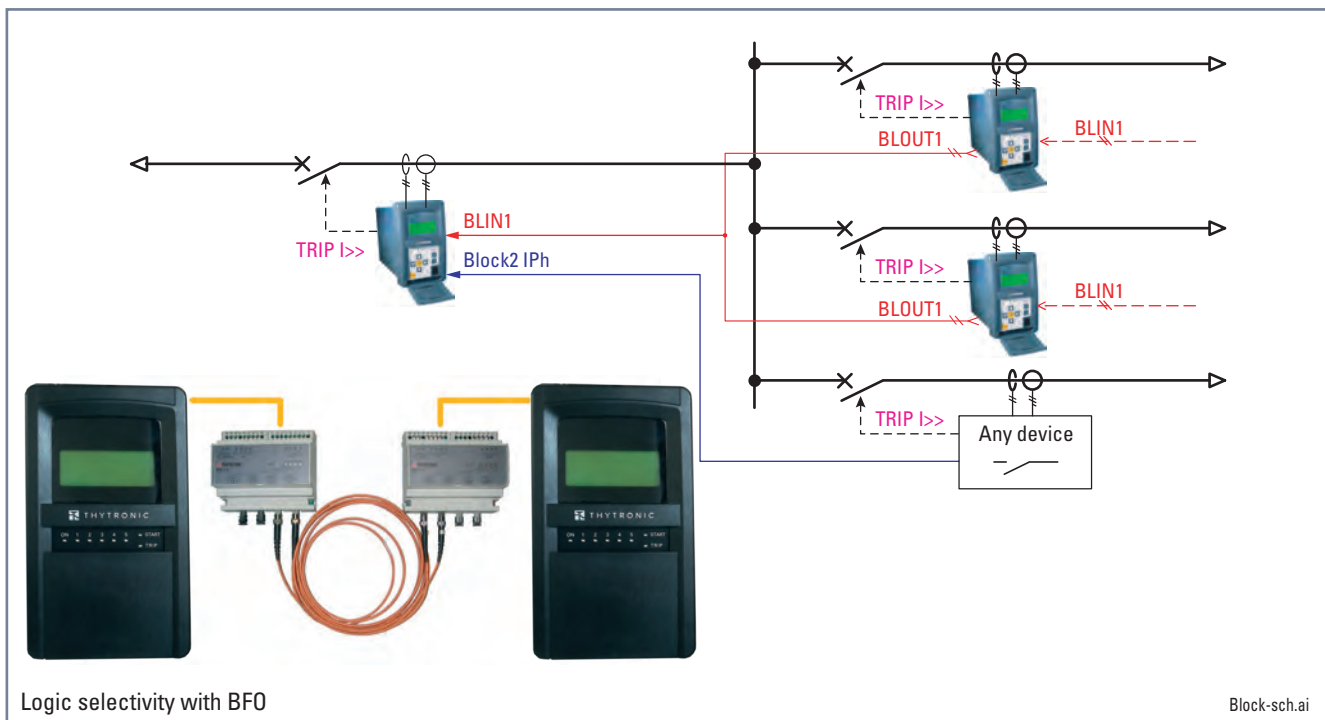
Block circuits

Block circuits may be connected to equipment located in a different switchboard: For the aim of

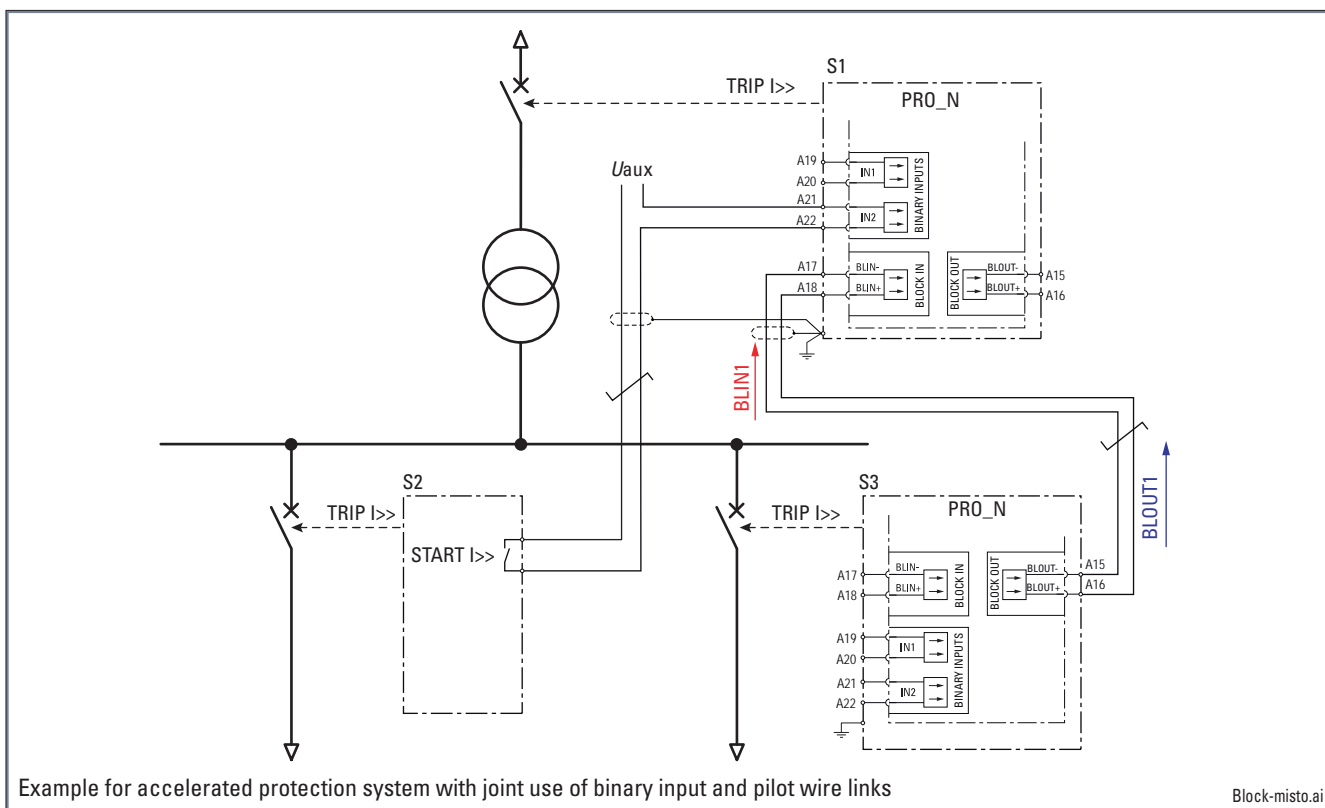
Note 1 The insertion order is free.

One MRI module, two MID16 modules, one MPT module, one MCI module and one MMI module (separate operator panel) can be connect at the same time to the Thybus port (maximum expansion).

reliability, it is recommended to use conductors having a cross sectional thickness of at least 1 mm² and to not exceed 5 km in length. For connections that are particularly critical in terms of electromagnetic pollution, it is recommended to use BFO adaptor modules with fibre optic connection.

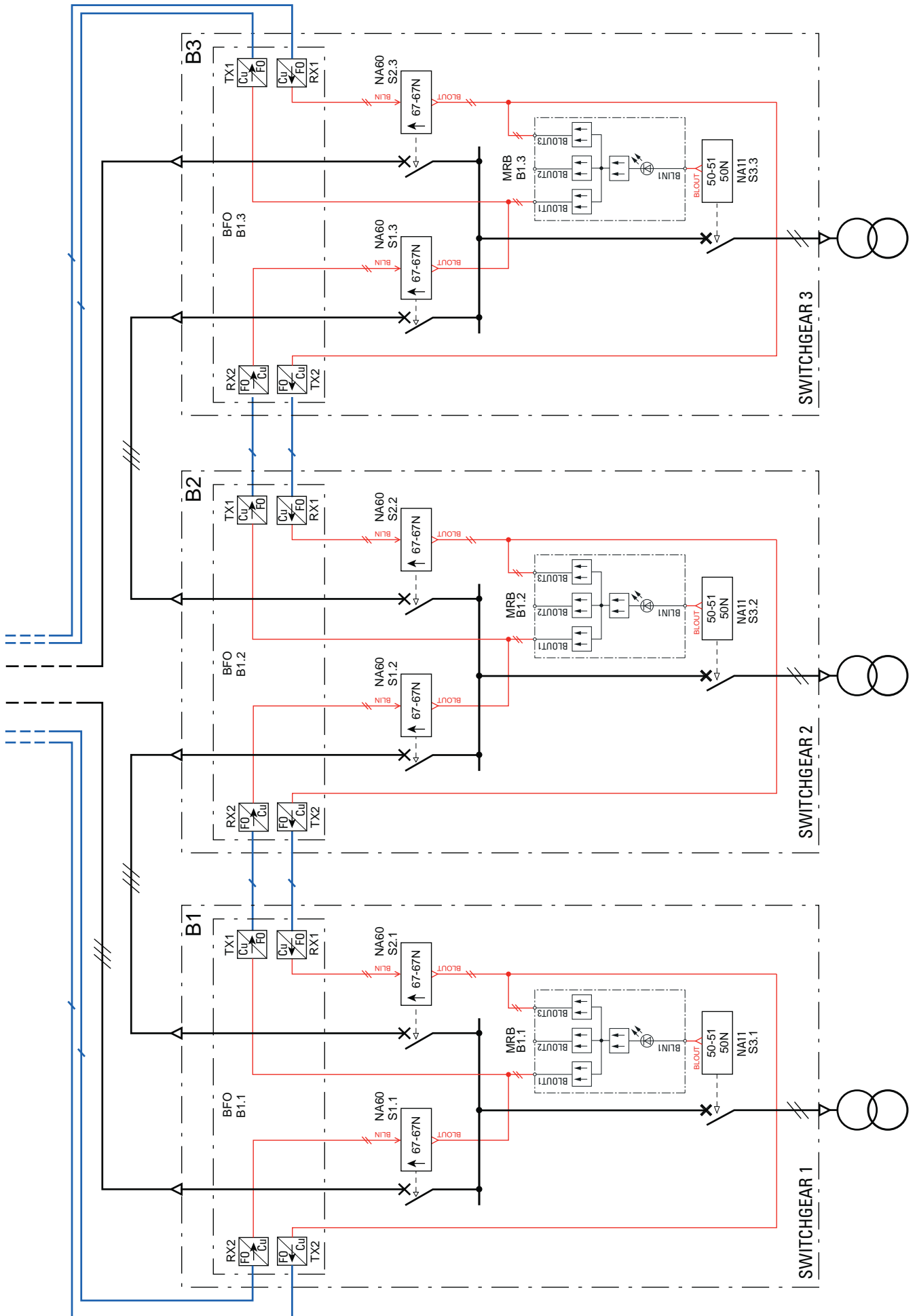


When devices without committed pilot wire circuits must be embedded (devices other than Pro_N), or in the event that further I/O circuits are need, output relays and binary inputs can be customized to work in the logic selectivity system together with the committed pilot wire circuits.

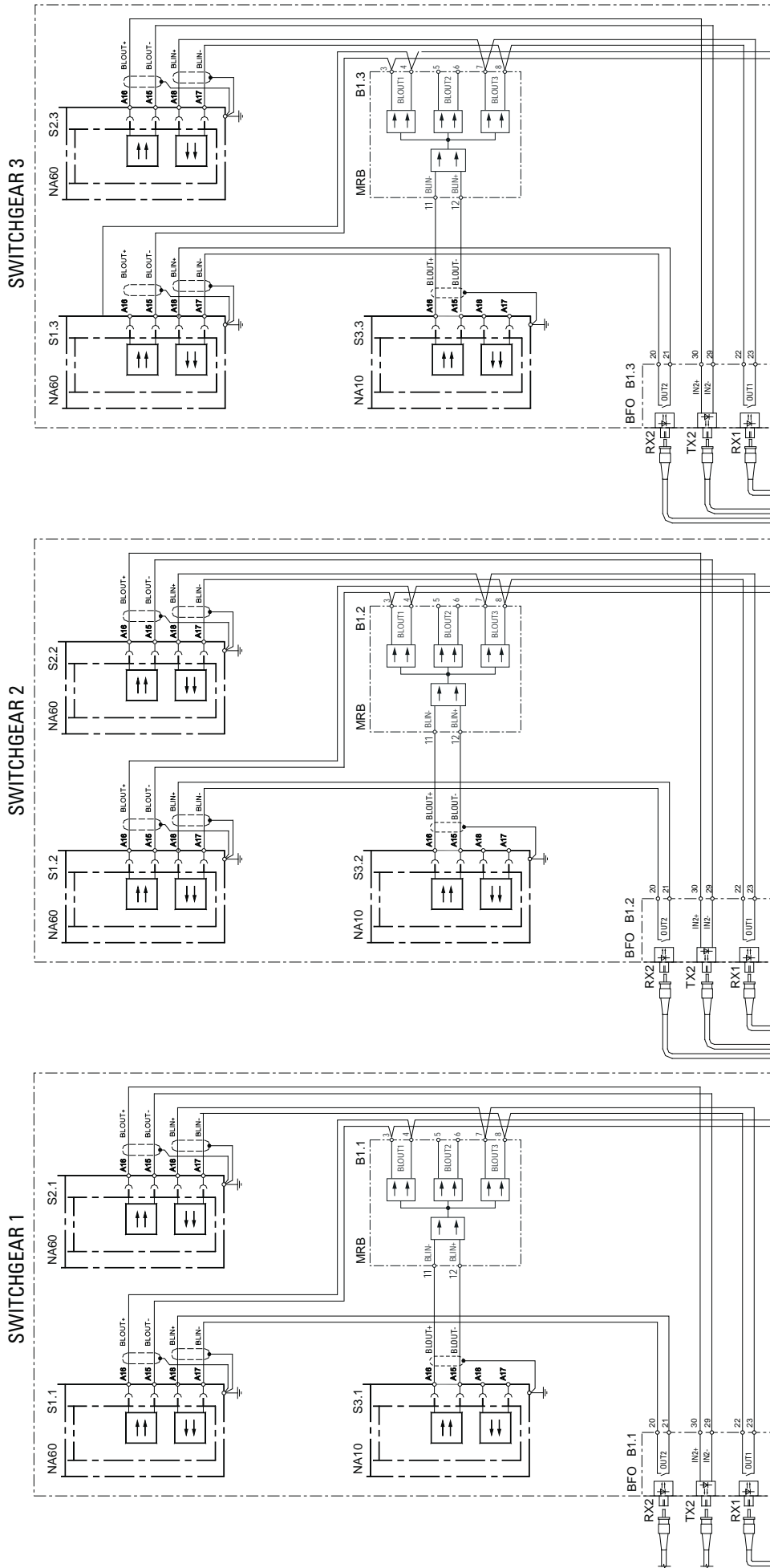


A ring network example^[1] is shown on the following pages. Block out signals concerning the NA11 devices (S3.1, S3.2 e S3.3) are split on two isolated outputs by means of MRB devices (B2.1, B2.2 and B2.3) to allow proper selectivity logic operation..

Nota 1 All diagram must be considered just as example; they cannot be comprehensive for real applications.



Selectivity logic example



6.4 NOMINAL CURRENT I_n AND I_{En} SETTING FOR TRADITIONAL CTs

Factory default settings:

- Nominal phase current I_n : 5 A
- Nominal residual current I_{En} : 1 A

To modify settings the plug-in module must be extracted from the case.



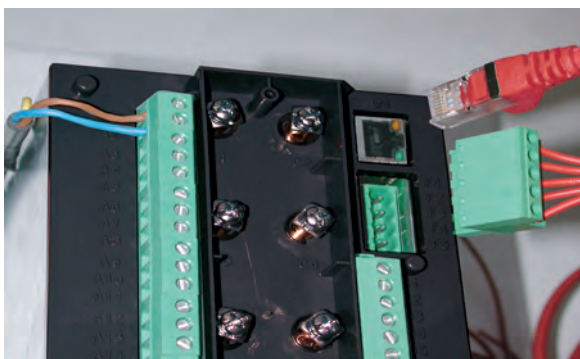
CAUTION

Turn off power supply before extracting or re-inserting the relay.

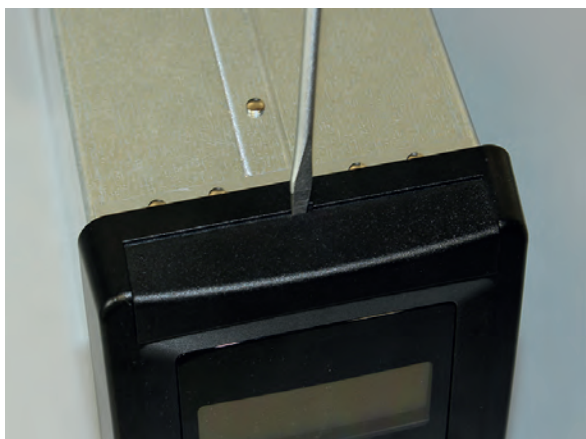
If an attempt is made to insert a relay into an un-matching case, a mechanical code will prevent full insertion. Damage can result if excessive force is applied.

The following operations must be performed:

- Remove the auxiliary supply
- Unplug the RS485 and RJ45 cables (Ethernet and/or Thybus)



- Remove the upper tile and open the little door to access the fastening screws.

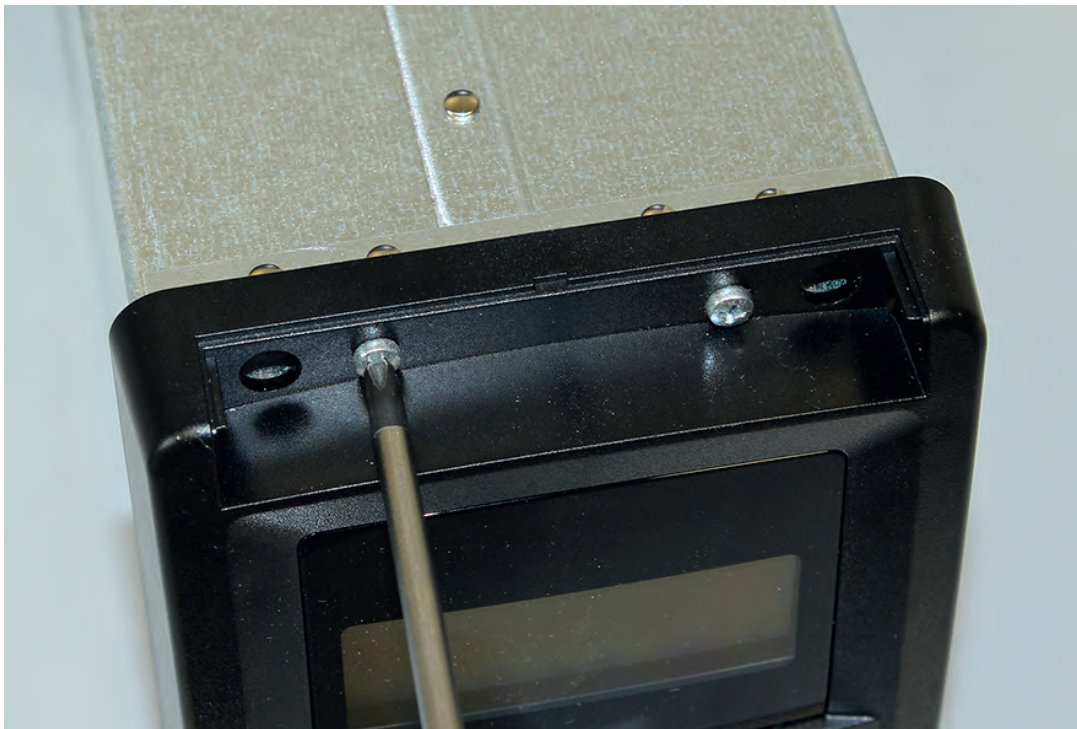


Removing tile to access the fastening screws



Remove-tile.ai

- Unscrew gradually back to back the four fastening screw in order avoid loss of the internal washer. Unmounting of the case from the switchboard is not needed.



Unmounting

set-in.ai

- Split the MMI module and disconnect cable



Split MMI module from fixed module

Split-MMI.ai

- Pull out the removable module grabbing the metal handles.



Pull-out the module from the case

extract.ai

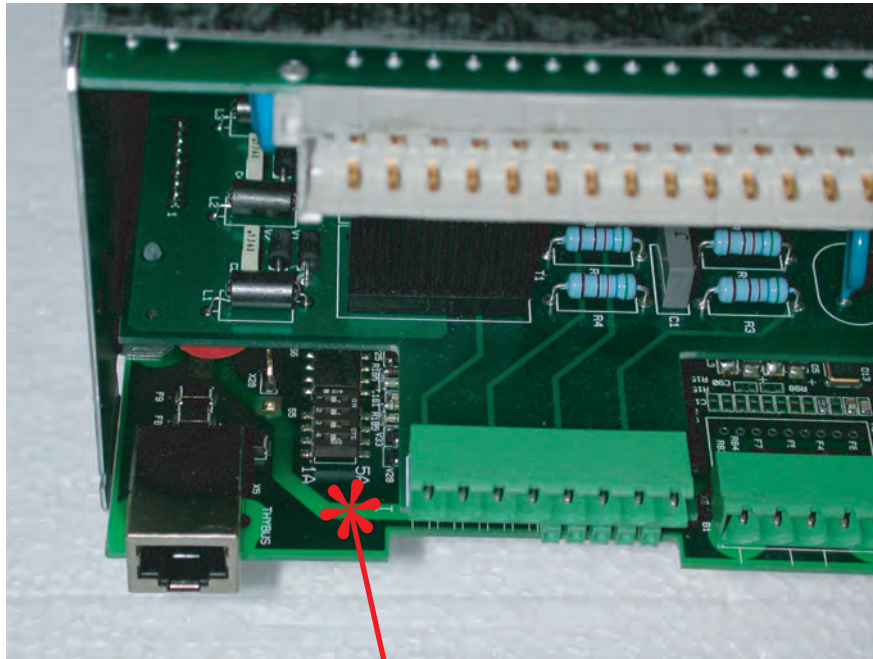
- Lean out the module on the grounded surface^[1],
- Set the dip-switches on the right-hand circuit board in accordance with the drawing shown below,

Note 1 There are components present which are sensitive to electrostatic discharge.

When the module is removed, it is important to pay particular attention to avoid any accidental contact with the internal components.

In order to avoid the static electricity accumulated in the human body from causing damage, it is recommended to observe the following precautions:

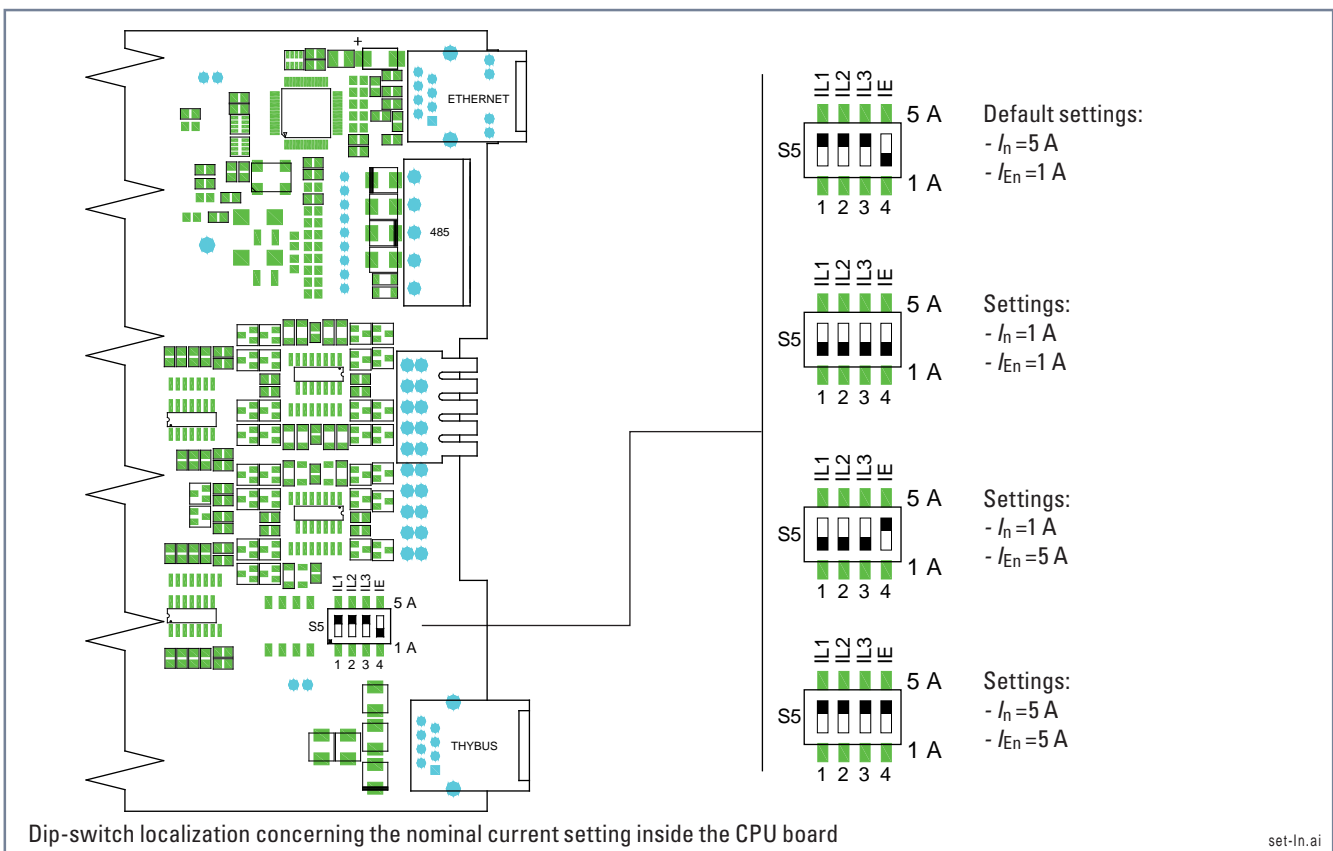
- eliminate any potential differences between the human body and the device by touching the metallic case,
- avoid touching the printed circuit and connections (tracks, component terminals),
- avoid handing the device to others,
- set the programming DIPs by using antistatic tools.



Dip-switch localization concerning the nominal current setting inside the CPU board

set-in-0.ai

- Move dip-switches according the following layout.



Dip-switch localization concerning the nominal current setting inside the CPU board

set-In.ai

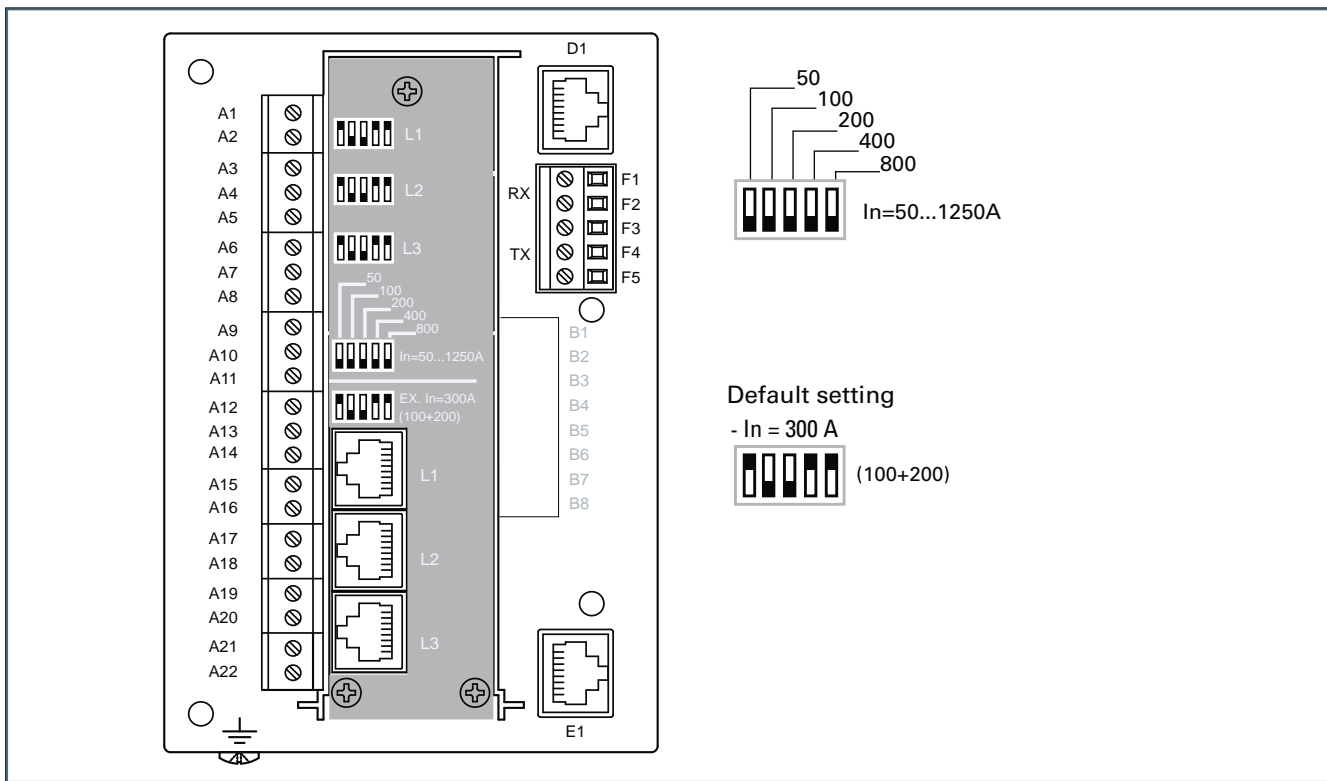
- Reassemble all parts with the previous operations in reverse order.
- Reconnect the RS485 and RJ45 cables (Ethernet and/or Thybus).

6.5 NOMINAL CURRENT I_n SETTING FOR LOW POWER CTs

Factory default settings:

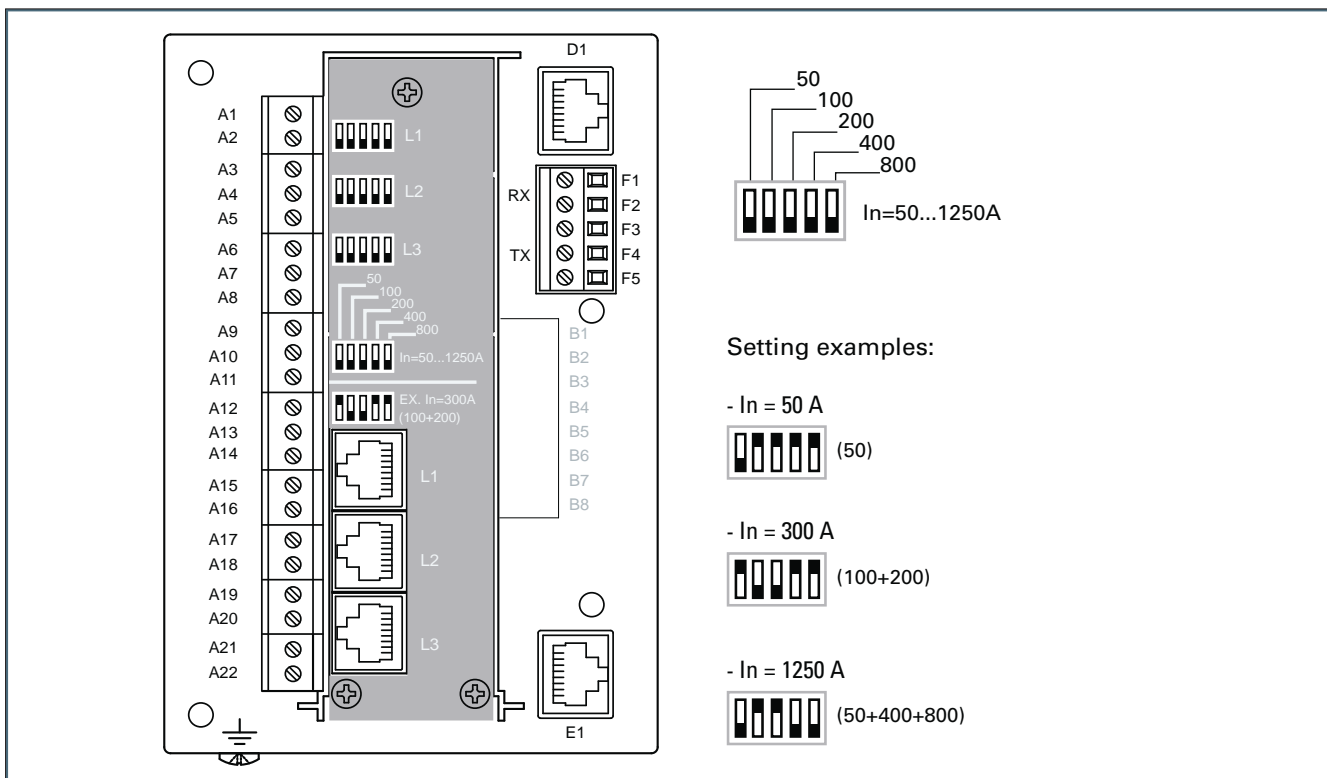
- Nominal phase current I_n : 300 A

To modify settings the plug-in module must not be extracted from the case. By means DIP-switches the rated (primary) current must be adjusted.^[1]



The following setting are possible for I_n (rated primary current):

- 50 - 100 - 150 - 200 - 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800 - 850 - 900 - 950 - 1000 - 1050 - 1100 - 1150 - 1200 - 1250 A.

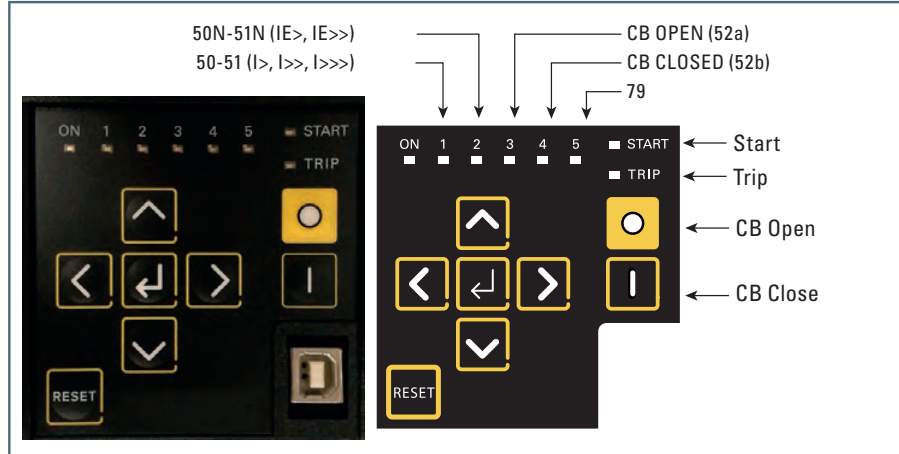


Note 1 The three groups of Dip-switches must be adjusted with same setting
For more information about technical data of the LPCT current transformers please contact Thytronic

6.6 LED ALLOCATION

Following indicator LEDs are available on the front panel:

- LED ON (green): if no diagnostic anomalies are detected, the green LED is turned ON while any fault is highlighted by flashing.
- LEDs 1...5 (red) are freely assignable from the user to any protective and/or control functions.
- LED START (yellow) committed for start information of any protective functions.
- LED TRIP (red) committed for trip information of any protective functions.



6.7 FINAL OPERATIONS

Before energizing the electric board, it is advisable to check that:

- The auxiliary voltage in the panel falls within the operative range of Pro_N relays.
- The rated current (1 A or 5 A) of the line CT's corresponds to the setting of Pro_N relays.
- All wirings are correct.
- All screws are tightly screwed.

7 PROGRAMMING AND SETTINGS

All relay programming and adjustment operations may be performed through MMI (keyboard and display) or using a Personal Computer with the aid of the ThyVisor software.



WARNING

For safety reasons, a change of the following parameters become active only after an hw reset:

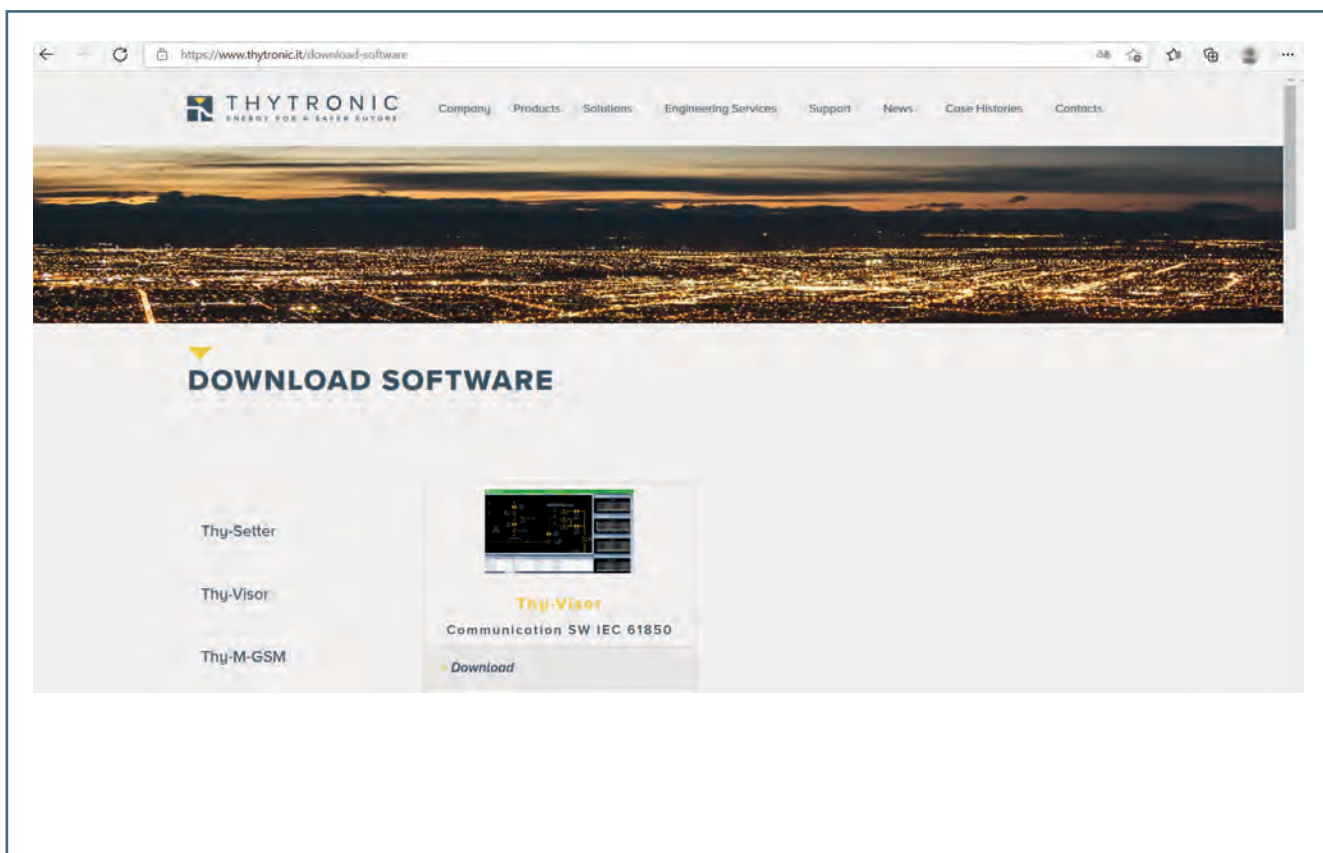
- Relay nominal frequency (f_n)
- The changes become operational after the relay is turned off and on again.

7.1 SW ThyVisor

The ThyVisor sw is a “browser” of data (setting, measure, etc..); it implements an engine that is afford to rebuild the menu set up and the relationships to data concerning all Thytronic protective relays by means of XML files.

ThyVisor installation

The latest release of ThyVisor can be downloaded free of charge from the www.thytronic.it site (Products - Software).^[1]



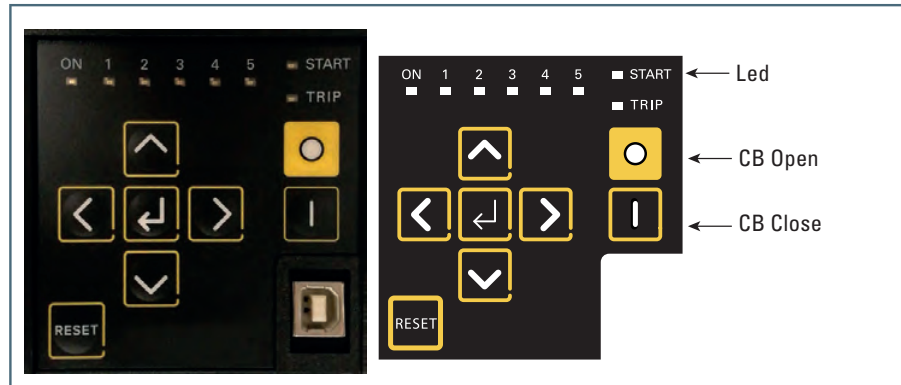
ThyVisor use

Please refer to ThyVisor user manual for detailed instructions.
The document is available on www.thytronic.it (Product / Software / ThyVisor - Download area).

Note 1 Starting from the 3.5.9 release it is necessary to download and install not only the application setup but the Template setup also. In case of updating download and install only the new release.

7.2 MMI (Man Machine Interface)

On the front panel there are eight buttons which allow the user to perform all the settings, reading and modification operations.^[1]



The adjustment of the settings and the operation mode of the output relays must be performed while the unit is electrically powered; the alphanumeric display shows the necessary information with reference to the operations performed through the keyboard. One minute after the keyboard is not more in use, the display backlight switches automatically to OFF. All preset values are permanently stored in the nonvolatile memory.

The buttons take the following operations:

- (Up) move the cursor upwards to the preceding menu options
- (Down) move the cursor downwards to the subsequent menu options
- (Left) move the cursor upwards to the preceding menu options
- (Right) move the cursor downwards to the subsequent menu options
- (Enter) access to the selected menu with the option of modifying any given parameter
- (Reset) abort the current changes and/or accessing the previous menu
- **Circuit breaker Open command**
- **Circuit breaker Close command**

At power-up, the display shows the text:

```
"THYTRONIC
PRO-NA10-xxx-x serial number
date and time: (01/01/2000 00:00"
```

The ON green Led points out the auxiliary power supply voltage (permanent lighted) and possible faults (blink lighted).

The display backlight is automatically activated when any key switch is set.

By means of the **Up** or **Down** buttons, it is possible to cyclically browse through the menu options:

READ, SET, COMMUNICATION, TEST

Having identified the sub-menu of interest, it is possible to gain access by using the **Right** button and then analogously, run through the relevant options by using the **Up** or **Down** buttons.

The full menu tree and some examples are showed in the following pages (numerical values and settings are pointed out as examples and does not agree with real situations).

Reading variables (READ)

All data (measure, settings, parameters, etc...) may be displayed:

```
"SERIAL NUMBER >>"
"INFO >>"
"MEASURES >>"
"ACTIVE PROFILE >>"
"PROTECTIONS >>"
"PLC >>"
"CIRCUIT BREAKER SUPERVISION >>"
"DELAYED INPUTS >>"
"INTERNAL STATES >>"
"RELAYS >>"
"PARTIAL COUNTERS >>"
"TOTAL COUNTERS >>"
"SELF-TEST >>"
"PILOT WIRE DIAGNOSTIC >>"
"SELECTIVE BLOCK BLOCK2 >>"
"FAULT RECORDING >>"
"EVENTS RECORDING >>"
```

Setting modifying (SET)

Note 1 Setting changes are enabled when the La mEnabling setting by MMI parameter is set

All changes in the setting parameters are carried out through MMI only if the Enable setting by MMI parameter is ON. (ENABLE SETTING BY MMI submenu inside the SET menu).

To effect a change, having identified the parameter intended for change, the following procedure must be performed:

- Select the parameter going through the menus by means the **Up**, **Down** and **Right** keys.
 - Press the **Enter** button for a few seconds; the modification in progress status is highlighted by flashing of the START and TRIP LEDs and by appearance of the pointer on the bottom.
 - Move the cursor over the parameter intended for change using the **Enter** button,
 - Change the parameter by means the **Up** (increment) or **Down** (decrement) buttons,
 - Press the **Enter** button to move the cursor over the last parameter in the display,
 - Press the **Enter** button once again; the cursor and the LED TRIP turn off (the LED START keeps flashing),
 - Press the **Enter** button for a few seconds; new message appears: "Confirm settings?"
 - Answer to the message ENTER: YES to confirm changes or RESET: NO to abort.
- The end of the START LED blinking points out the end of procedure; the changes become right now active.

The abort command may be used to abandon changes (prior to use of the ENTER: YES); the same effect is achieved by removing the auxiliary power supply to the relay.

As example, to set the operating mode of the K1 output relay as ENERGIZED, LATCHED, the following procedure must be issued:

- By means **Down** button select the Set menu "SET >>",
 - Press the **Right** button to enter; the following submenu title is displayed: "BASE >>"
 - Scroll menus by means **Down** button

"INPUTS	>>"
"RELAYS	>>"
"LEDS	>>"
"SELF-TEST RELAY	>>"
"MMI	>>"
"PROFILE SELECTION	>>"
"PROFILE A	>>"
"PROFILE B	>>"
"PLC	>>"
"CIRCUIT BREAKER SUPERVISION 52	>>"
"CT SUPERVISION 74CT	>>"
"REMOTE TRIPPING	>>"
"PILOT WIRE DIAGNOSTIC	>>"
"DEMAND MEASURES	>>"
 - Select the Set menu "RELAYS >>", the "K1 relay Setpoints >>" message is displayed,
 - Press the **Right** button to enter; the following messages are displayed: "Logic DE-ENERGIZED Mode NO LATCHED"
 - Press the **Enter** button for a few seconds; the modification in progress status is highlighted by the both START and TRIP flashing.
 - Move the cursor over the parameter intended for change using the **Enter** button, (in our case on the message "Logic DE-ENERGIZED",
 - Change the parameters by means the **Up** (increment) or **Down** (decrement) buttons, "Logic EN-ENERGIZED",
 - Press the **Enter** button to move the cursor over the last parameter in the display, "Mode NO LATCHED",
 - Change the parameters by means the **Up** (increment) or **Down** (decrement) buttons, "Mode LATCHED",
 - Press the **Enter** button once again; the cursor and the LED TRIP turn off (the LED START keeps flashing),
 - Press the **Enter** button for a few seconds; new message appears: "Confirm settings?"
 - Answer to the message ENTER: YES to confirm changes or RESET: NO to abort.
- The end of the LED blinking points out the end of procedure.

TEST

The operational tests with command of the selected output relays may be activated.

By means of **Up** or **Down** buttons it is possible to browse the main menu till the “TEST” message; to enter you must press the **Right** button.^[1]

The display message “Test state: OFF” shows the test state (OFF or test in progress).

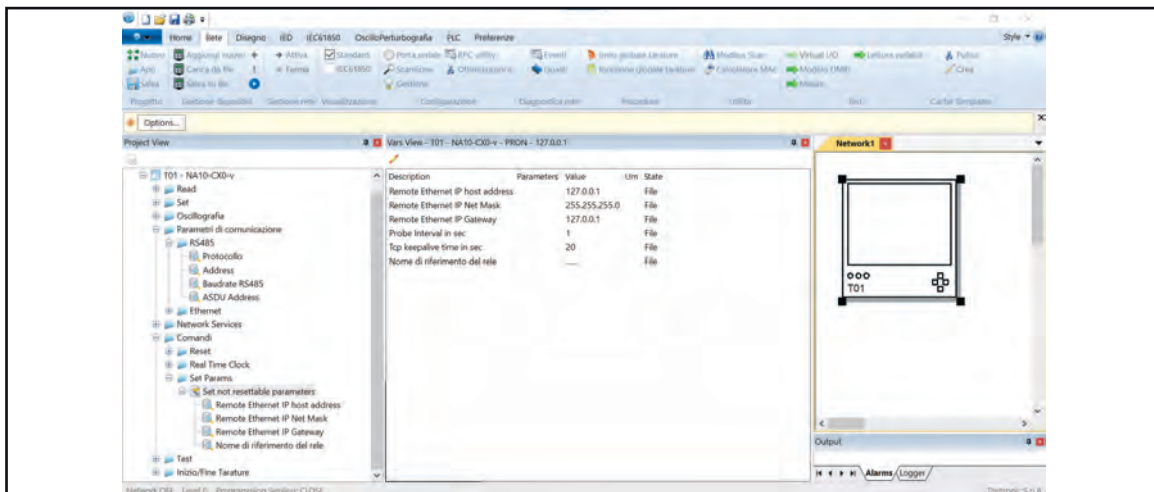
- Test K2
- Test K3
- Test K4
- Test K5
- Test K6

As example, to start the test of K1, the following procedure must be issued:

- Select the Start test menu “Start test >>”.
- Press the **Right** button to start; the test in progress status is highlighted by activation of all LEDs,
- Come back by pressing the **Left** button and select the relay to be tested by means the **Up** or **Down** buttons until the message “Test K1 >>” is displayed.
- Press the **Right** button to start the test.
- To terminate the test, it is necessary to select the “Stop test >>” message and press the **Right** button to end the test. In any case the test will be automatically terminated after a delay of one minute.

COMMUNICATION

Inside the **COMMUNICATION** menu it is possible to read/modify the setting data of the RS485 Protocol and Ethernet parameters.



By means of **Up** or **Down** buttons it is possible to browse the main menu till the “RS485 Protocol >>” or “Ethernet parameters >>” message; to enter you must press the **Right** button.

As example, to select the address 12 for the ModBus protocol, the following procedure must be issued:

- Select the Communication menu “COMMUNICATION >>”.
 - By means **Down** button select the “RS485 Protocol >>”.
 - Press the **Right** button to enter; the following message is displayed:
“Protocol MODBUS”
“Address 1”
“9600 baud”
 - Start the procedure to effect a change explained in the Setting modifying (SET) paragraph:
 - Press the **Enter** button for a few seconds; the modification in progress status is highlighted by the both START and TRIP flashing.
 - Move the cursor over the parameter intended for change using the **Enter** button, (in the example on the 1 address),
 - Change the parameters by means the **Up** (increment) button (up to 12 address),
 - Press the **Enter** button to move the cursor over the last parameter in the display,
 - Press the **Enter** button once again; the cursor and the LED TRIP turn off (the LED START keeps flashing),
 - Press the **Enter** button for a few seconds; new message appears: “Confirm settings?”
 - Answer to the message ENTER: YES to confirm changes or RESET: NO to abort.
- The end of the LED blinking points out the end of procedure.

Note 1 Instantly all the relays are switched in rest state, including relays programmed as “normally energized”

Circuit breaker commands

By means of the **Open command** and **Close command** keys, the circuit breaker commands may be issued.

The committed output relays must be enabled inside the **Circuit Breaker supervision \ LEDs-relays allocation** menu.

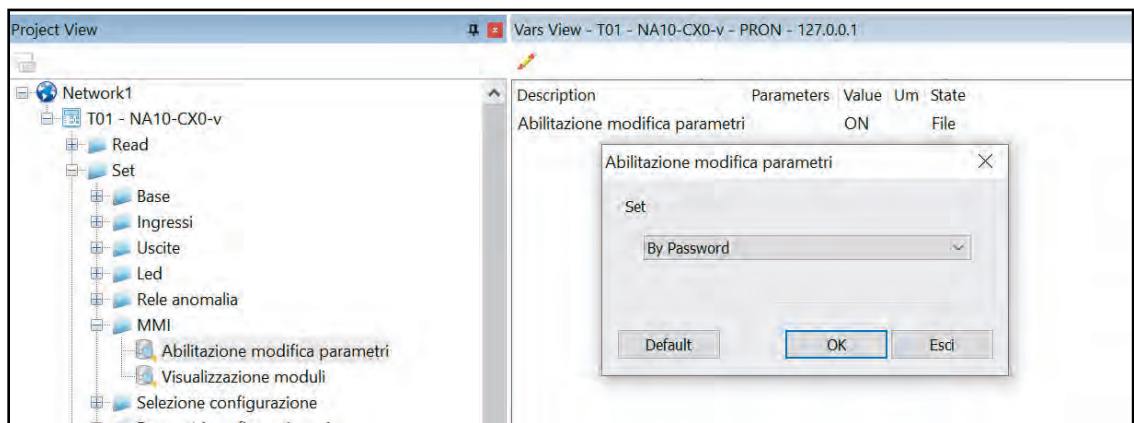
Enable / block changes via keyboard - Password

All parameters (measurements and settings) are available for reading from the operator panel (MMI), while the setting changes are enabled or disabled depending on possible operation modes:

- Enable without password (factory setting)
- Enable with password
- Disabled

The choice of operation modes is possible only through ThyVisor operating at the session level 1:

- Connect the PC serial port to the relay socket on the RJ10 front panel
- Run the ThyVisor sw (the latest version latest version available on the site is recommended).
- Select the *Preference - Session* menu; when you start the session level is set to 0 as shown in the bottom of the window
- Select the level 1. Prompted for a password (the default *level1*) to move to level 1. Confirm twice with "OK". (Level 1, as shown in the bottom of the window).
- Open the communication session by executing the menu command *Communication - Open*. Verify that inside the modality box *Serial* and *Automatic* are selected
- ThyVisor will search automatically the relay from the template, regardless of what is selected in the *device family*.
- Inside the Serial Configuration panel select the COM port (eg COM1, COM4 etc), give the *Start* command and wait for the opening of the new window
- Save the file. Choose the location to save the file and give the *Save* command. The configuration data of the relay are transferred to the PC (the progress bar is displayed from 0 ... 100%). A folder on a yellow background with the name of the file is highlighted on the left side of the windows. The serial connection is operative, at the bottom of the screen the word *ON-LINE* is highlighted in green field.
- Select the **Set \ MMI** folder (MMI stands for Man-Machine-Interface = keyboard). On the right side of the window (first row) select *Parameter setting enable*; with a "click" on the column value 3 options are available:
 - *OFF* = keyboard enabled only for reading
 - *By password* = keyboard enabled for reading and setting by means of password
 - *ON* = keyboard enabled for reading and setting without password



To modify any parameter the calibration session must be open by means of *Start setting* command from the menu or directly by clicking on F4 key. the opening of the session setting is highlighted by its *Programming state: Open* on yellow field on the bottom bar. To save the monifiche it is necessary to send the command from the menu "IED / close" or directly by clicking on F5 key.

Operation with Password

If the *By password* mode is selected a new menu *password* is inserted at the top of the display menu.

- Press the **Right** key the: `password not ok >>` message is displayed and any changes of parameters is disabled
- Press the **Right** key; you can enter the password page `enter password` where you are prompted to enter the 4 characters password (the default password is 0000)
- Press the **Enter** button for a few seconds; the modification in progress status is highlighted by flashing of the START and TRIP LEDs and by appearance of the pointer on the bottom
- Change the parameters by means the **Up** (increment) or **Down** (decrement) buttons, using the **Left** and **Right** keys to move to the previous or next character

- Press the **Enter** button; the cursor and the LED TRIP turn off (the LED START keeps flashing),
- Press the **Enter** button for a few seconds; new message appears: `Confirm settings?`
- Answer to the message `ENTER: YES` to confirm changes or `RESET: NO` to abort.
- The message: `password ok >>` is displayed
- To exit from password menu use **Left** or **Up** keys: if you press the **Right** button you go back in the password menu and the password must be entered. The parameter changes are enabled from the keyboard. After any confirming with (Enter) or abandoning the change (reset button) the password must be entered again.
- The possibility of modifying the parameters from the keyboard is automatically disabled after about 3 minutes elapsed without pressing any button. If you do not want to wait three minutes of waiting, it must go back to the password menu and come out without input any data (**Left** and **Right** until the the message `password not ok >>` is displayed.

Changing the password

Changing the password is possible only after entering the correct password (`password ok >>` message); press the **Down** key, a new menu is displayed `change password` that you access with the **Right** key. Inside this menu the password can be changed.

- Press the **Enter** button for a few seconds; the modification in progress status is highlighted by flashing of the START and TRIP LEDs and by appearance of the pointer on the bottom
- Change the parameters by means the **Up** (increment) or **Down** (decrement) buttons, using the **Left** and **Right** keys to move to the previous or next character
- Press the **Enter** button; the cursor and the LED TRIP turn off (the LED START keeps flashing),
- Press the **Enter** button for a few seconds; new message appears: `Confirm settings?`
- Answer to the message `ENTER: YES` to confirm changes or `RESET: NO` to abort.

Lost password

If password is lost the data base of the device must be restored, proceed with the following steps:

- Activate the session level 1
- Send `Set default settings` command available inside the **Command \ Default settings** menu.




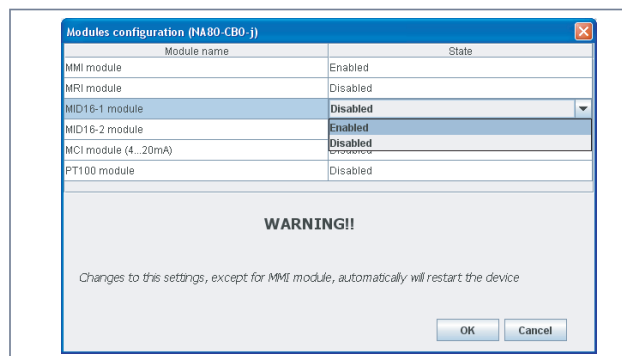
WARNING

The command `Set default settings` restores the factory settings, all user- defined adjustments are cleared. Be carefully to enter the correct parameter !
The device serial number should be set to avoid IP address conflicts for devices connected to the Ethernet network.

Following the `Set default settings` command the password is reset to `0000`.

7.3 MODULES MANAGEMENT

After installation, the modules must be enabled (working with level 1 session level). The Thybus modules may be set inside the *Procedure* menu (or by means a click on the  icon). Following up any module configuration an automatic reset is issued and the I/O devices are included inside the device menu. ^[1] When two MID16 modules are enabled, the hardware address must be set; the dip-switch layout is showed inside the *INSTALLATION* section.



Note 1 Binary inputs and output names (ThyVisor):

Binary inputs for devices with two inputs onboard

*IN1, IN2 on board
IN3...IN10 with MRI module
IN11...IN26 with one MID16 module
IN27...IN42 with two MID16 modules*

Binary inputs for devices with five inputs onboard

*IN1...IN5 on board
IN6...IN13 with MRI module
IN14...IN29 with one MID16 module
IN30...IN45 with two MID16 modules*

Output relays

*K1...K6 on board
K7...K10 with MRI module*

LEDs:

*ON, START, TRIP, L1...L5 on board
L6...L10 with MRI module*

7.4 MAINTENANCE

The Pro-N relays do not require any particular maintenance; all circuits use high quality static components, the subassembly products undergo dynamic checks on their functioning before the final assembling of the complete equipment. The dedicated circuits and the firmware for the self-test function continuously check the relay operation; the continuously operating auto-zeroing function dynamically corrects the measuring errors due to offset, heat dependent drifts, aging of components, etc. The processor is equipped with a watch-dog circuit which restores the correct operation of the firmware in case of fault.

If the following criteria are properly implemented:

- comprehensive functional tests at commissioning,
 - absence of significant modification on the protection system,
 - activation and permanent remote control of self-test alarms through supervision,
 - control of self-test undetectable failures (comparing of measures with the external instruments, auxiliary voltage control, etc ..)
 - analysis of the stored information (faults and events, and oscillographic records),
- periodic checks can be avoided. In the absence of some of the criteria listed above, it is advisable to perform periodic checks every five years.

7.5 REPAIR

No repair of possible faults by the client is foreseen; if following to any irregularity of operation, the above tests confirm the presence of a fault, it will be necessary to send the relay to the factory for the repair and the consequent settings and checks.

7.6 PACKAGING

The Pro-N devices must be stored within the required temperature limits; the relative humidity should not cause condensation or formation of frost.

It is recommended that the devices are stored in their packaging; in the case of long storage, especially in extreme climatic conditions, it is recommended that the device is supplied with power for some hours before the commissioning, in order to bring the circuits to the rating conditions and to stabilize the operation of the components.

8 APPENDIX

8.1 APPENDIX A1 - Inverse time IEC curves

□ Mathematical formula

The mathematical formula, according to the IEC 60255-3/BS142 standards is:^[1]

$$t = t_{>inv} \cdot \left[\frac{K}{\left[\left(I / I_{>inv} \right)^{\alpha} - 1 \right]} \right]$$

Where:

- t = operate time (in seconds)
- $t_{>inv}$ = setting time multiplier (in seconds)
- I = input current
- $I_{>inv}$ = threshold setting

K coefficient:

- $K = 0.14$ for IEC-A curve (Normal inverse)
- $K = 13.5$ for IEC-B curve (Very inverse)
- $K = 80$ for IEC-C curve (Extremely inverse)

α curve shape constant:

- $\alpha = 0.02$ for IEC-A curve (Normal inverse)
- $\alpha = 1$ for IEC-B curve (Very inverse)
- $\alpha = 2$ for IEC-C curve (Extremely inverse)

For all inverse time characteristics, following data applies:

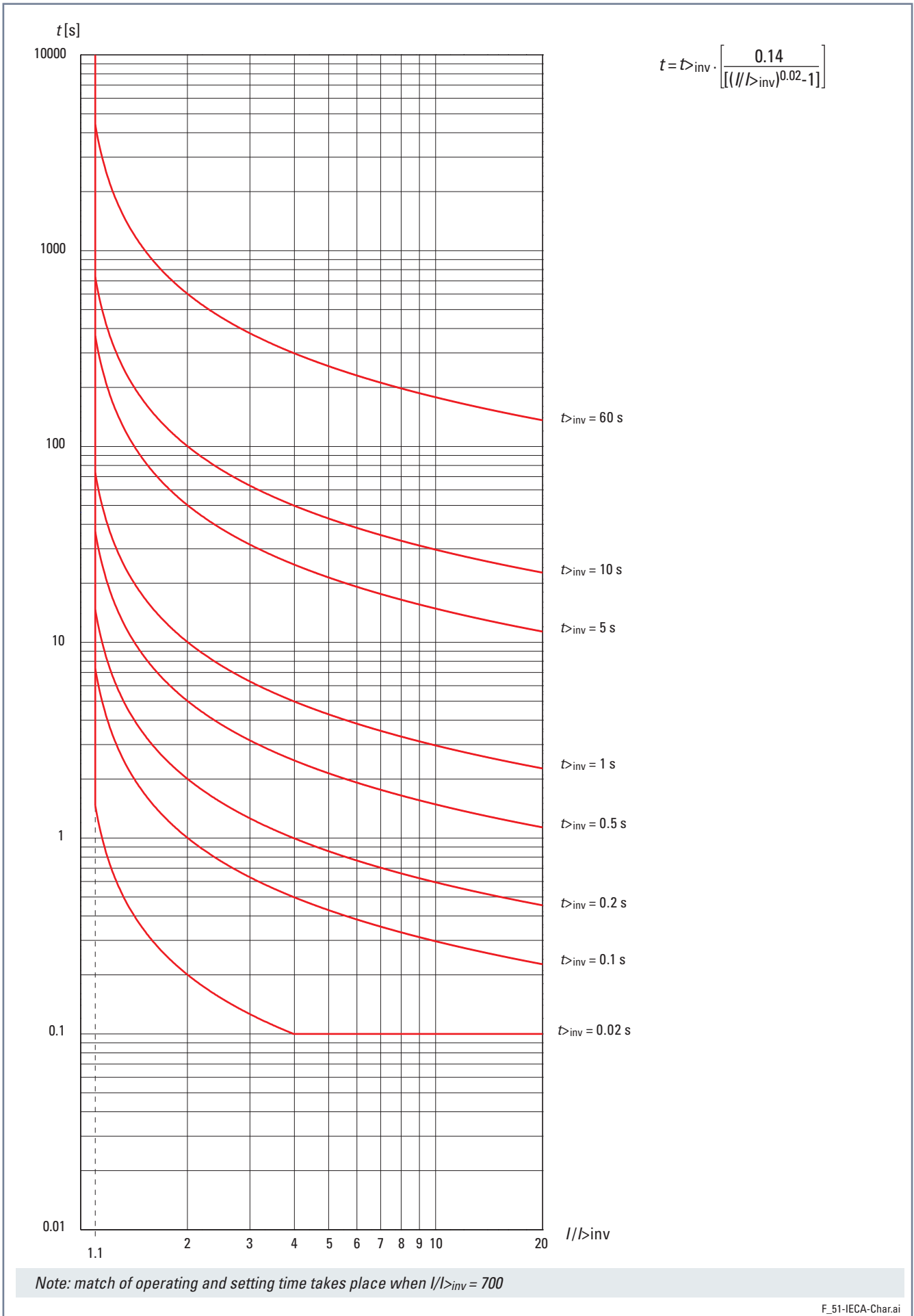
- Asymptotic reference value (minimum pickup value): $1.1 I_{>inv}$
- Minimum operate time: 0.1 s
- Range where the equation is valid:^{[2][3]} $1.1 \leq I / I_{>inv} \leq 20$
- If $I >$ pickup $\geq 2.5 I_n$, the upper limit is $50 I_n$

Note 1 Symbols are concerning the overcurrent element. The comprehensive overview of the inverse time characteristics concerning the 50/51 and 50N/51N elements is dealt within the PROTECTIVE ELEMENTS section

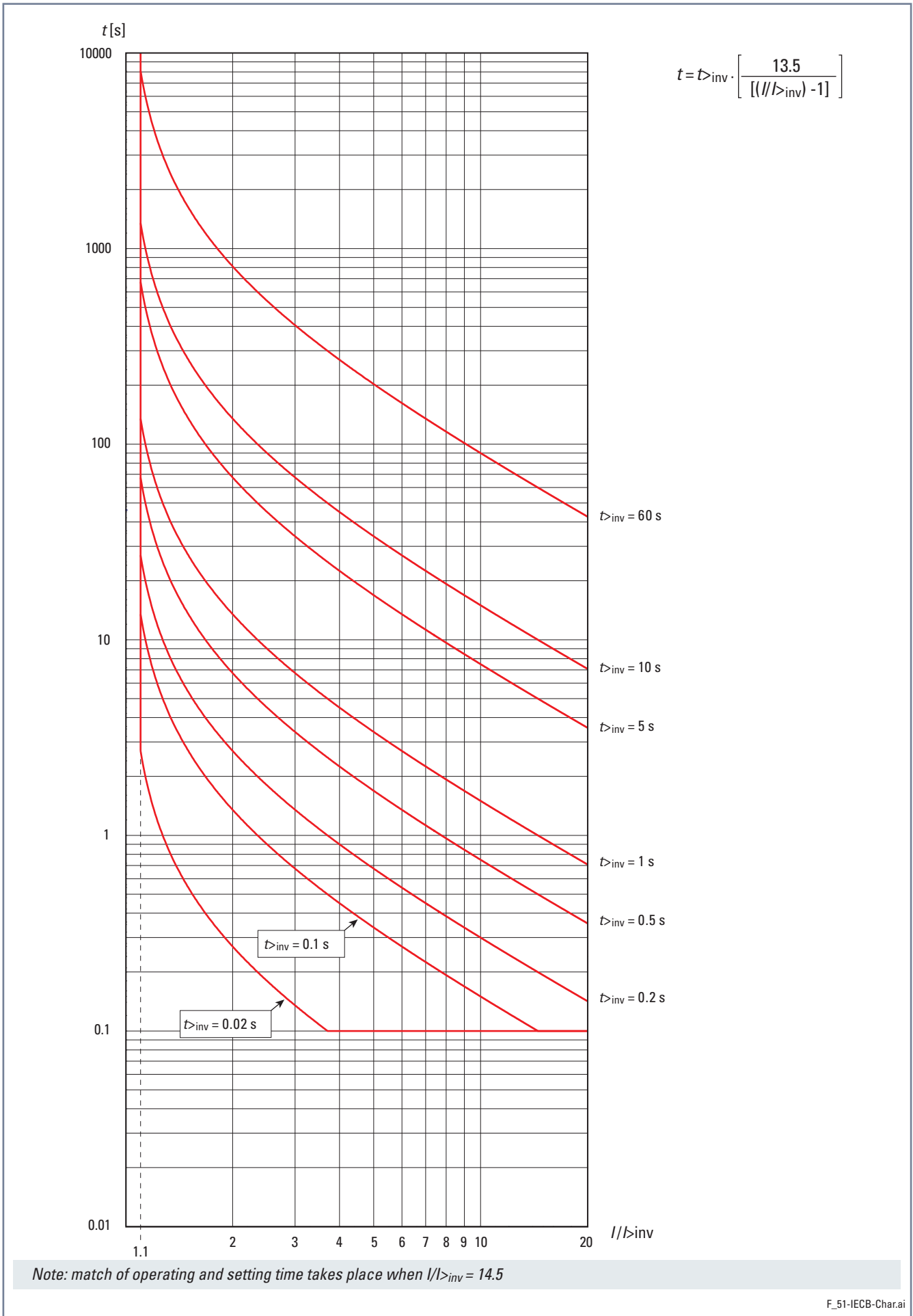
Note 2 When the input value is more than 20 times the set point, the operate time is limited to the value corresponding to 20 times the set point

Note 3 With setting more than $2.5 I_n$ for the 50/51 elements and $0.5 I_n$ for the 50N/51N elements, the upper limit of the measuring range is limited to $50 I_n$ and $10 I_n$ respectively.

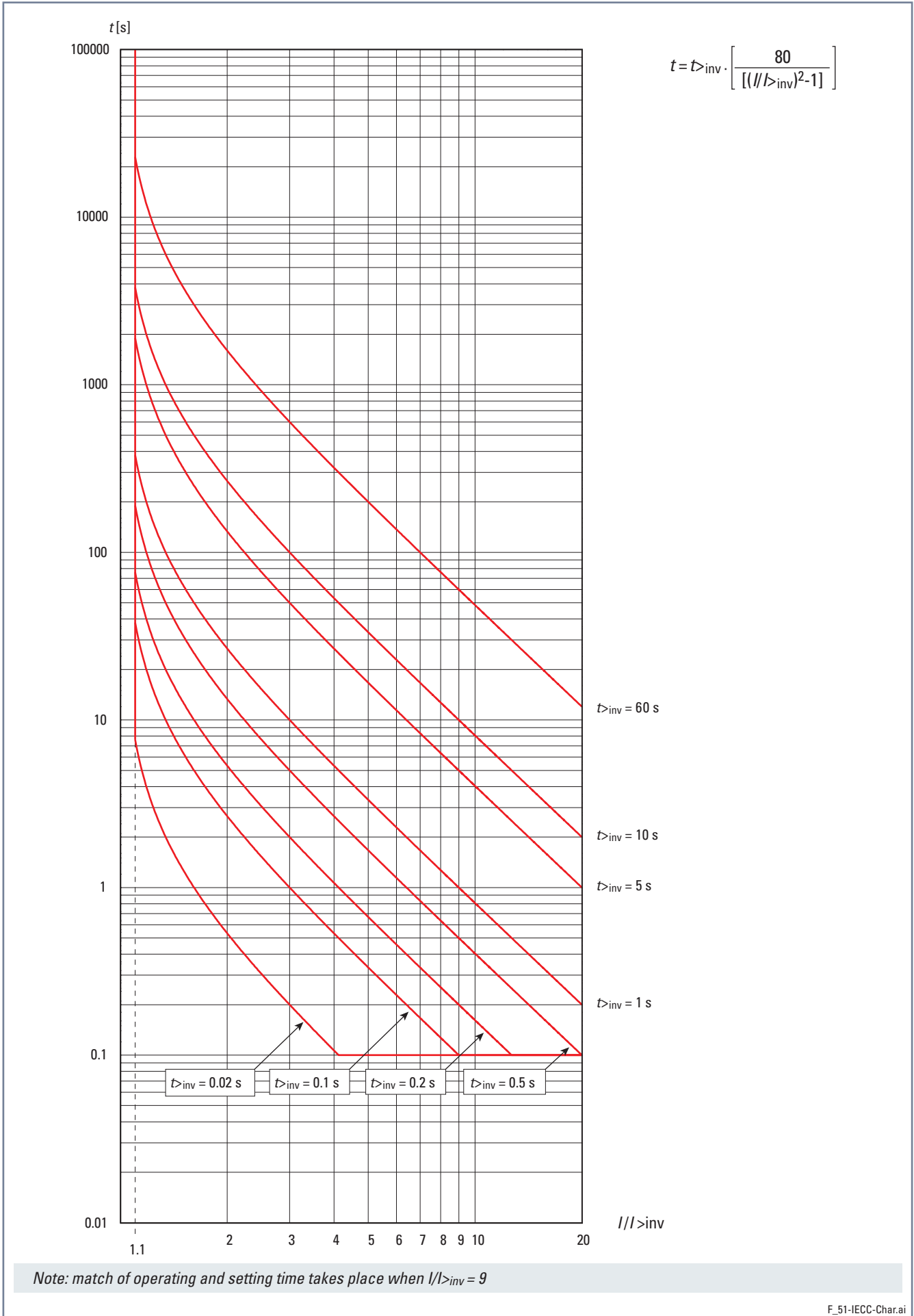
Phase overcurrent 50/51 - Standard inverse time curve (IEC 60255-3/BS142 type A)



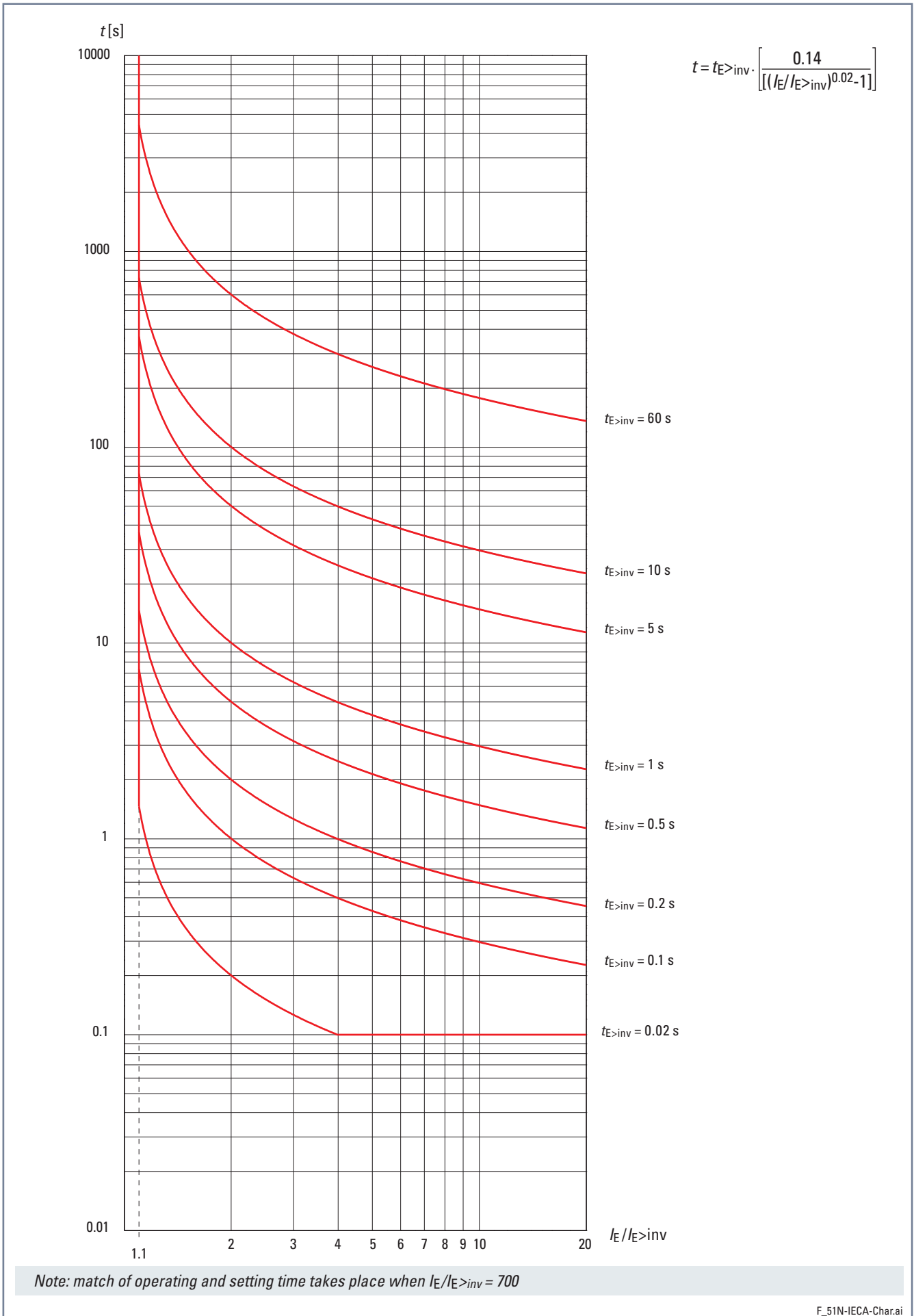
Phase overcurrent 50/51 - Very inverse time curve (IEC 60255-3/BS142 type B)



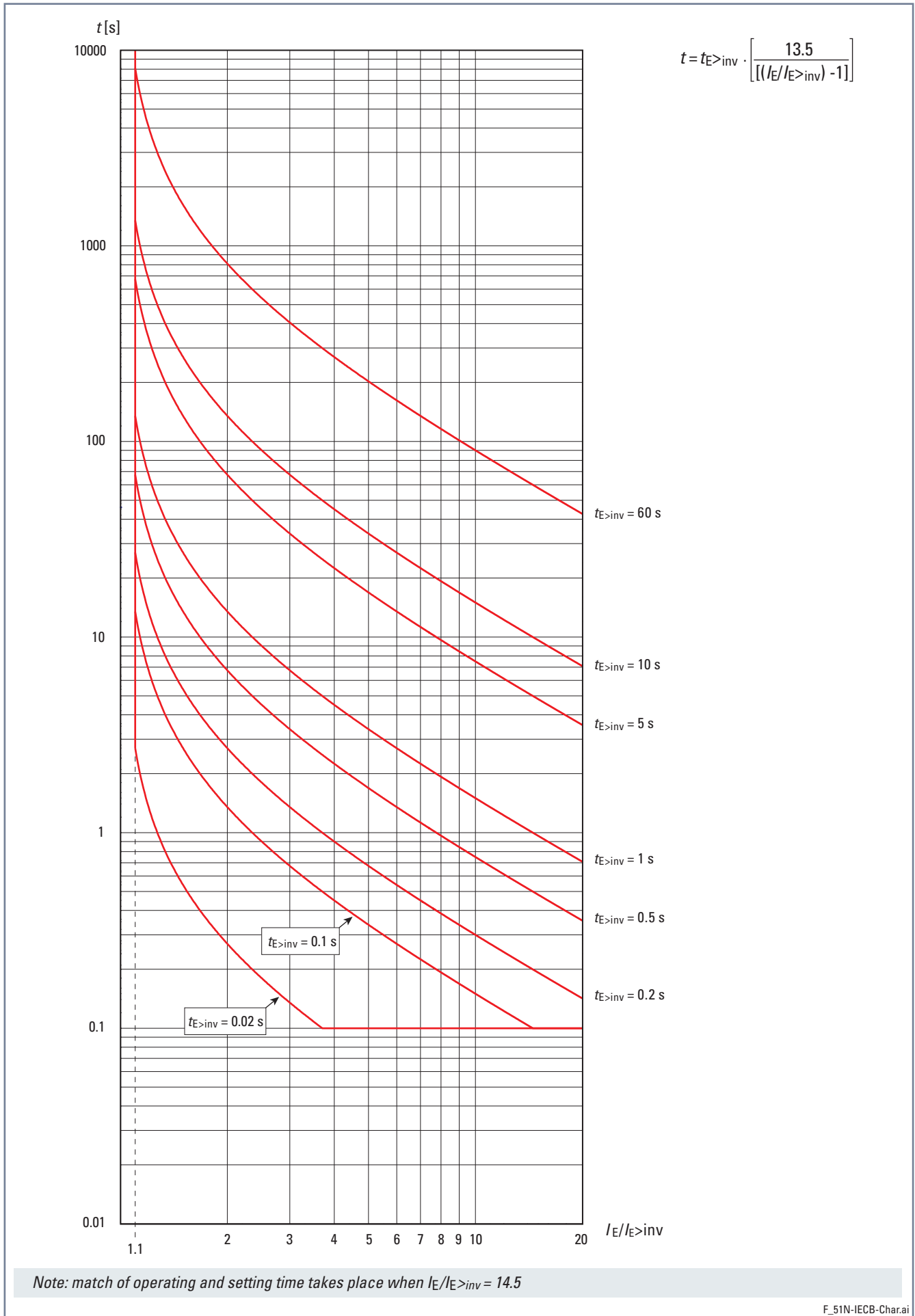
Phase overcurrent 50/51 - Extremely inverse time curve (IEC 60255-3/BS142 type C)



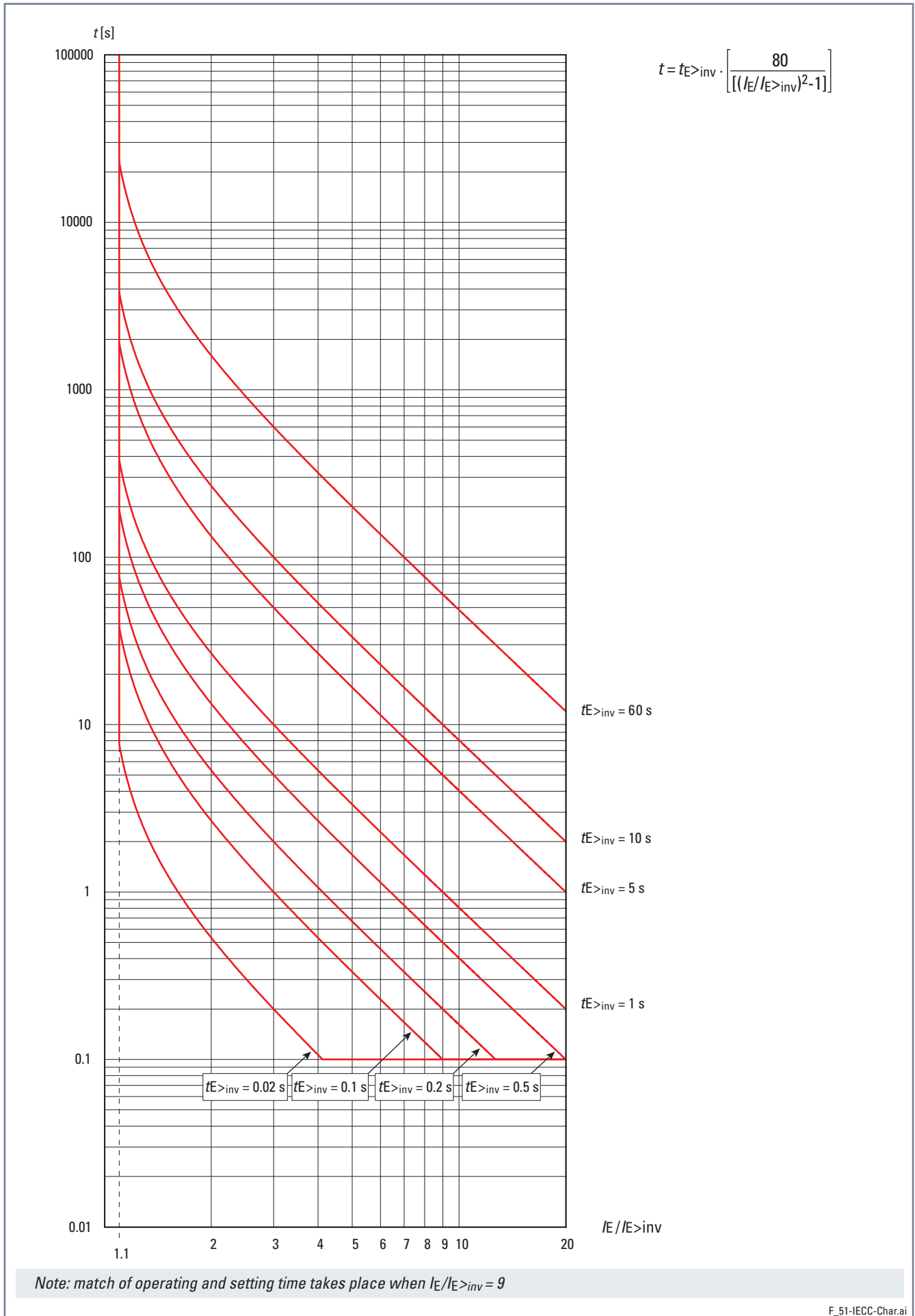
Residual overcurrent 50N/51N - Standard inverse time curve (IEC 60255-3/BS142 type A)



Residual overcurrent 50N/51N - Very inverse time curve (IEC 60255-3/BS142 type B)



Residual overcurrent 50N/51N - Extremely inverse time curve (IEC 60255-3/BS142 type C)



8.2 APPENDIX A2 - Inverse time ANSI/IEEE curves

□ Mathematical formula

The mathematical formula, according to the ANSI/IEEE standards is:^[1]

$$t = t_{>inv} \cdot \left[\frac{K}{\left[\left(I / I_{>inv} \right)^{\alpha} - 1 \right]} + L \right]$$

Where:

- t = operate time (in seconds)
- $t_{>inv}$ = setting time multiplier (in seconds)
- I = input current
- $I_{>inv}$ = threshold setting

K coefficient:

- $K = 0.01$ for ANSI/IEEE Moderately inverse curve
- $K = 3.922$ for ANSI/IEEE Very inverse curve
- $K = 5.64$ for ANSI/IEEE Extremely inverse curve

α curve shape constant:

- $\alpha = 0.02$ for ANSI/IEEE Moderately inverse curve
- $\alpha = 2$ for ANSI/IEEE Very inverse curve
- $\alpha = 2$ for ANSI/IEEE Extremely inverse curve

L coefficient:

- $L = 0.023$ for ANSI/IEEE Moderately inverse curve
- $L = 0.098$ for ANSI/IEEE Very inverse curve
- $L = 0.024$ for ANSI/IEEE Extremely inverse curve

For all inverse time characteristics, following data applies:

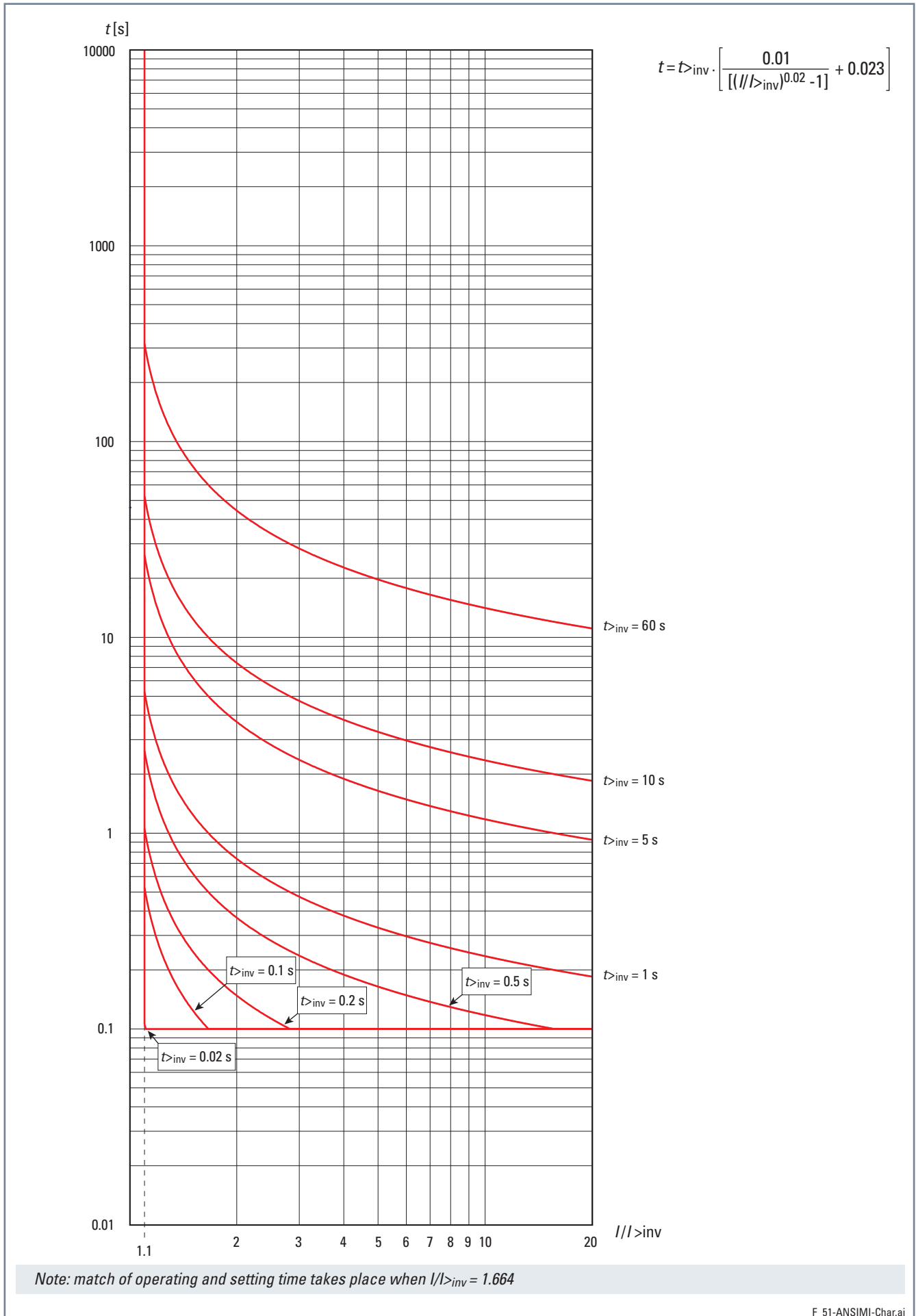
- Asymptotic reference value (minimum pickup value): $1.1 I_{>inv}$
- Minimum operate time: 0.1 s
- Range where the equation is valid:^{[2][3]} $1.1 \leq I / I_{>inv} \leq 20$
- If $I > \text{pickup} \geq 2.5 I_n$, the upper limit is $50 I_n$

Note 1 Symbols are concerning the overcurrent element. The comprehensive overview of the inverse time characteristics concerning the 50/51 and 50N/51N elements is dealt within the PROTECTIVE ELEMENTS section

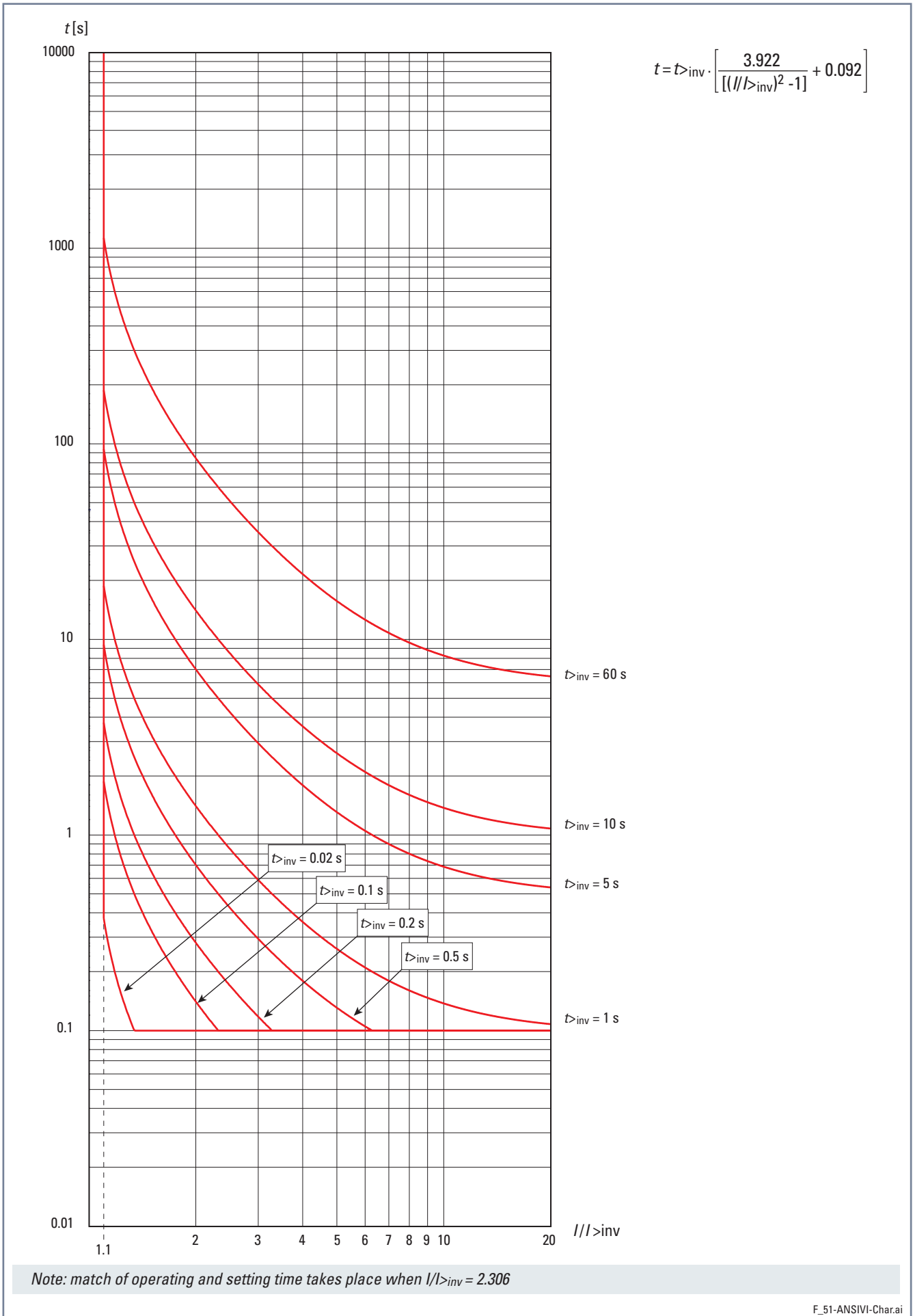
Note 2 When the input value is more than 20 times the set point, the operate time is limited to the value corresponding to 20 times the set point

Note 3 With setting more than $2.5 I_n$ for the 50/51 elements and $0.5 I_n$ for the 50N/51N elements, the upper limit of the measuring range is limited to $50 I_n$ and $10 I_n$ respectively.

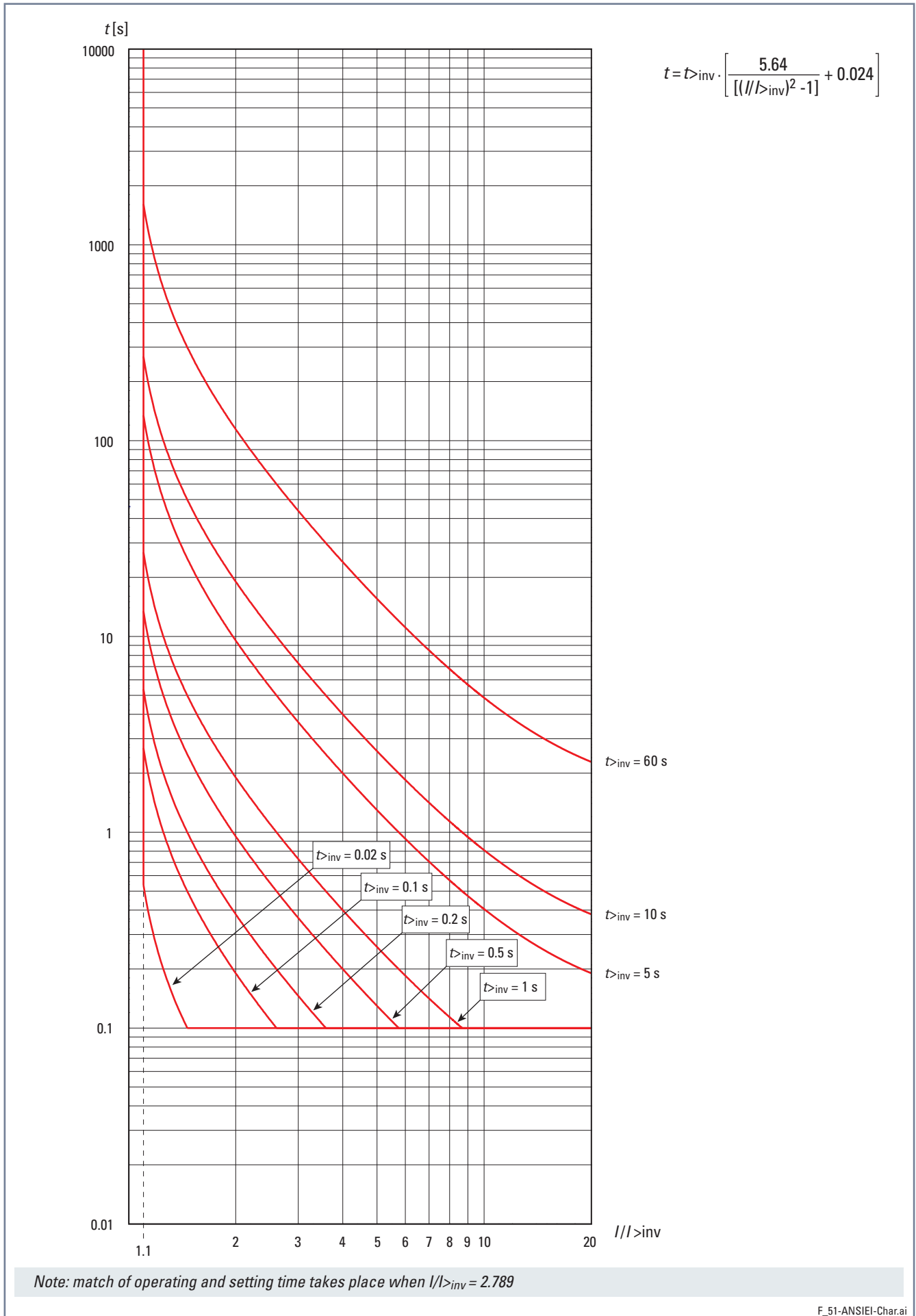
Phase overcurrent 50/51 - Moderately inverse time curve (ANSI/IEEE type MI)



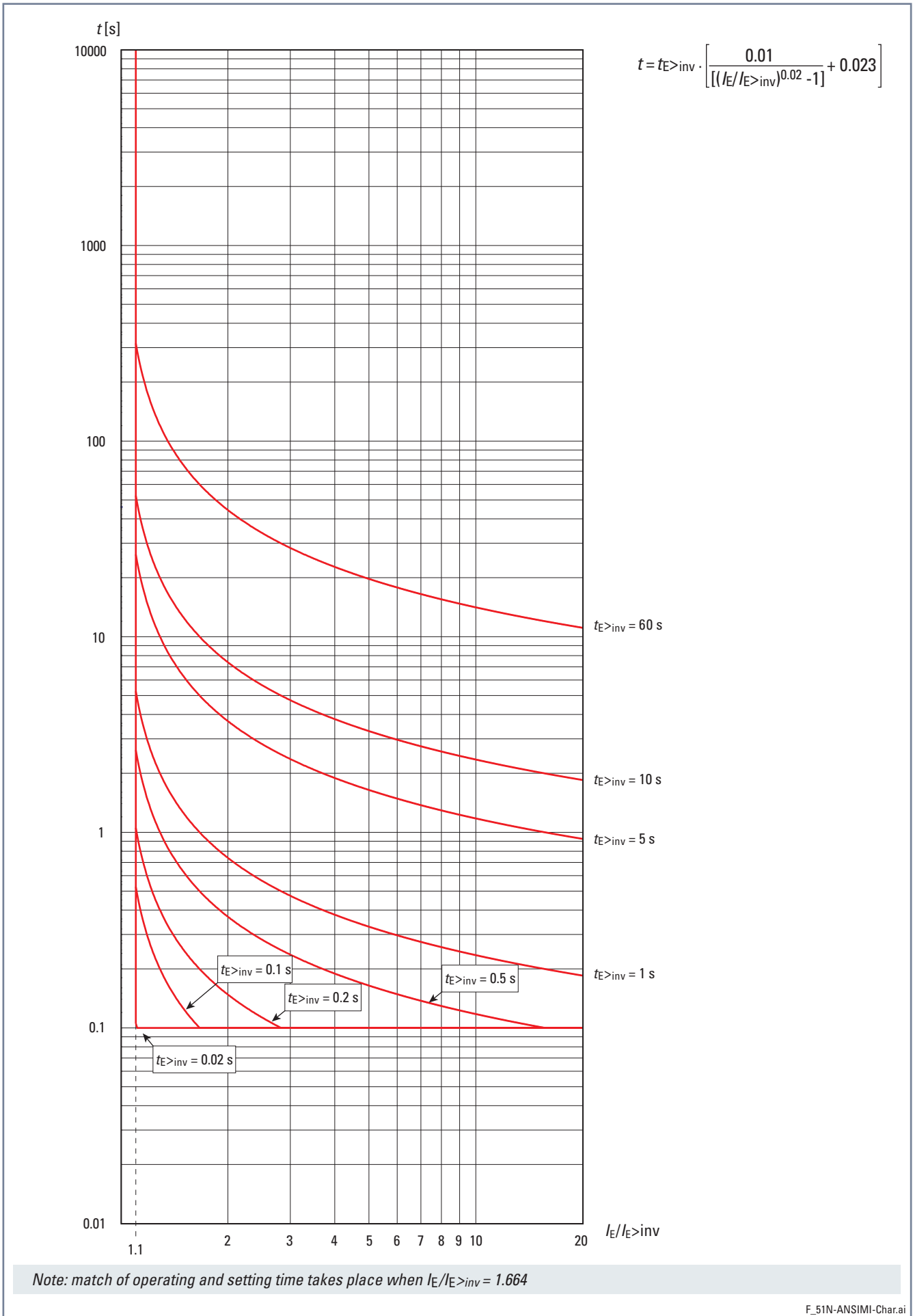
Phase overcurrent 50/51 - Very inverse time curve (ANSI/IEEE type VI)



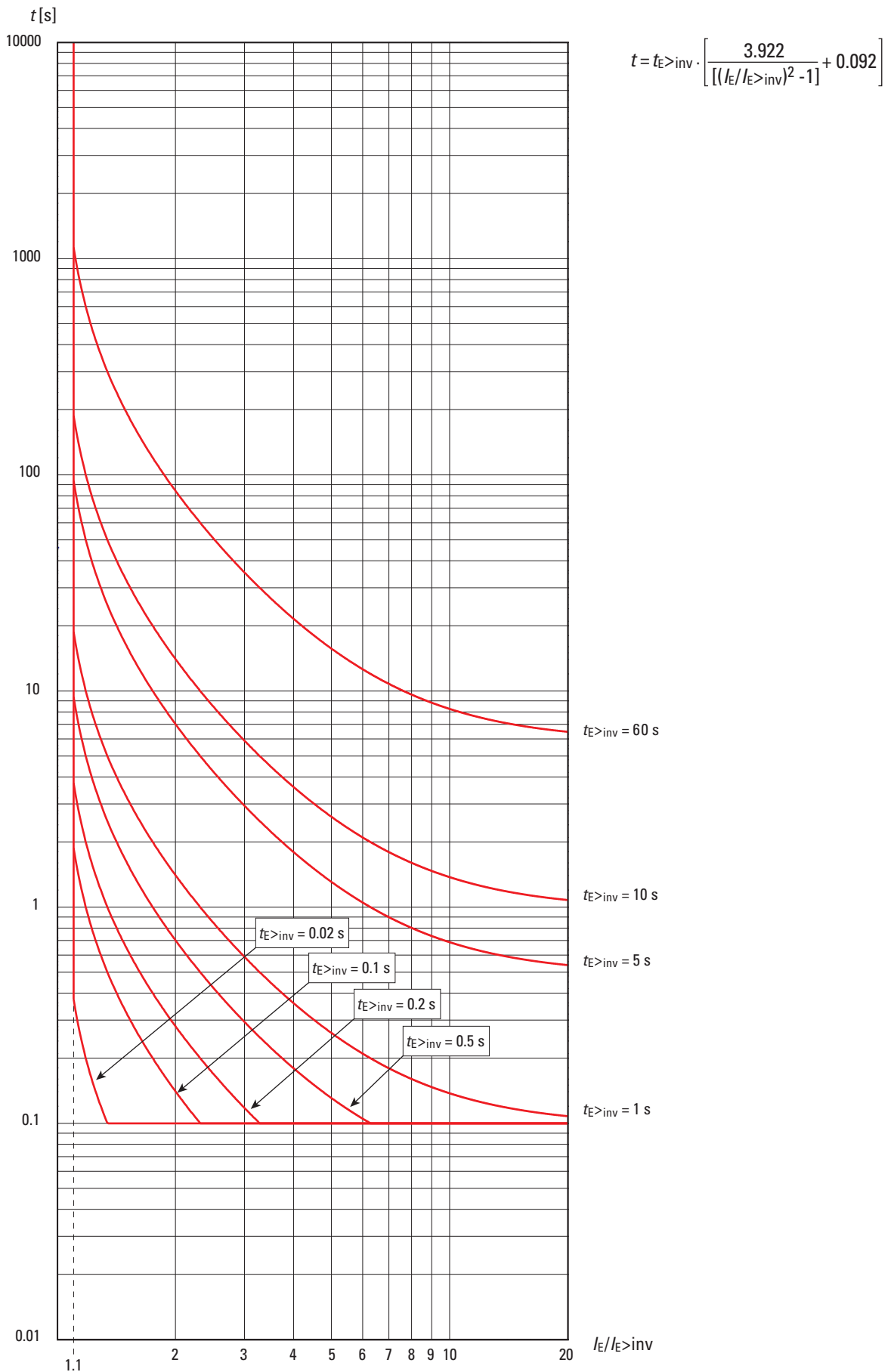
Phase overcurrent 50/51 - Extremely inverse time curve (ANSI/IEEE type EI)



Residual overcurrent 50N/51N - Moderately inverse time curve (ANSI/IEEE type MI)

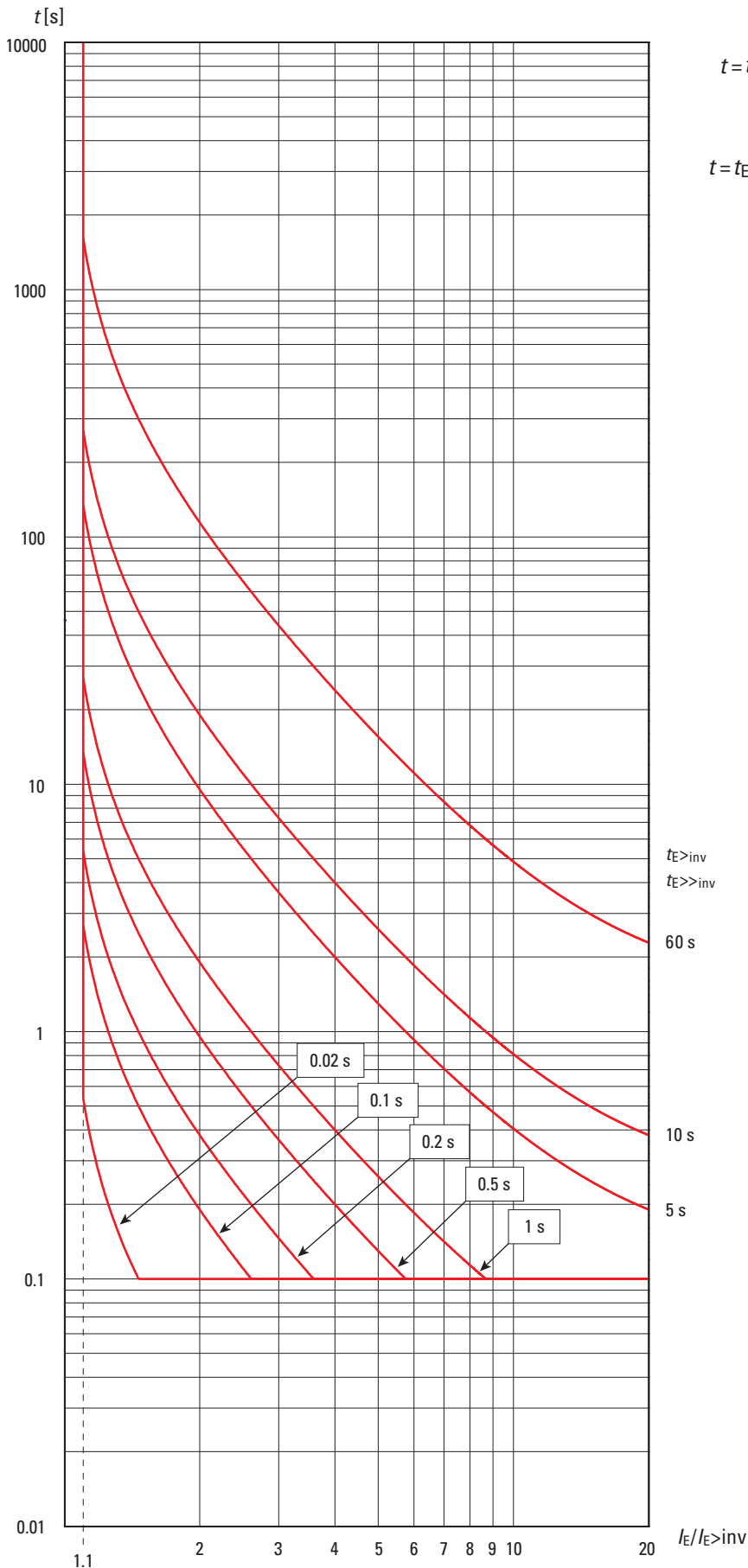


Residual overcurrent 50N/51N - Very inverse time curve (ANSI/IEEE type VI)



Note: match of operating and setting time takes place when $I_E/I_{E>inv} = 2.306$

Residual overcurrent 50N/51N - Extremely inverse time curve (ANSI/IEEE type EI)



$$t = t_{E>inv} \cdot \left[\frac{5.64}{[(I_E/I_{E>inv})^2 - 1]} + 0.024 \right]$$

$$t = t_{E>>inv} \cdot \left[\frac{5.64}{[(I_E/I_{E>>inv})^2 - 1]} + 0.024 \right]$$

$t_{E>inv}$
 $t_{E>>inv}$
 60 s
 10 s
 5 s

Note: match of operating and setting time takes place when $I_E/I_{E>inv}$ or $I_E/I_{E>>inv} = 2.789$

8.3 APPENDIX A3 - Inverse time - RECTIFIER, I²t and EM curves

□ Mathematical formula

The mathematical formula for RECTIFIER, I-squared-t (I²t) and Electromechanical curves (EM) is:^[1]

$$t = t_{>inv} \cdot \left[\frac{K}{A \cdot (I/I_{>inv})^{\alpha} - B} \right]$$

Where:

- t = operate time (in seconds)
- $t_{>inv}$ = setting time multiplier (in seconds)
- I = input current
- $I_{>inv}$ = threshold setting

K = coefficient:

- $K = 2351$ for RECTIFIER curve (RI)
- $K = 16$ for I²t curve
- $K = 0.28$ for Electromechanical curve (EM)

α = curve shape constant:

- $\alpha = 5.6$ for RECTIFIER curve (RI)
- $\alpha = 2$ for I-squared-t (I²t) curve
- $\alpha = -1$ for Electromechanical curve (EM)

A = coefficient:

- $A = 1$ for RECTIFIER curve (RI)
- $A = 1$ for I-squared-t (I²t) curve
- $A = -0.236$ for Electromechanical curve (EM)

B = coefficient:

- $B = 1$ for RECTIFIER curve (RI)
- $B = 0$ for I-squared-t (I²t) curve
- $B = -0.339$ for Electromechanical curve (EM)

For all inverse time characteristics, following data applies:

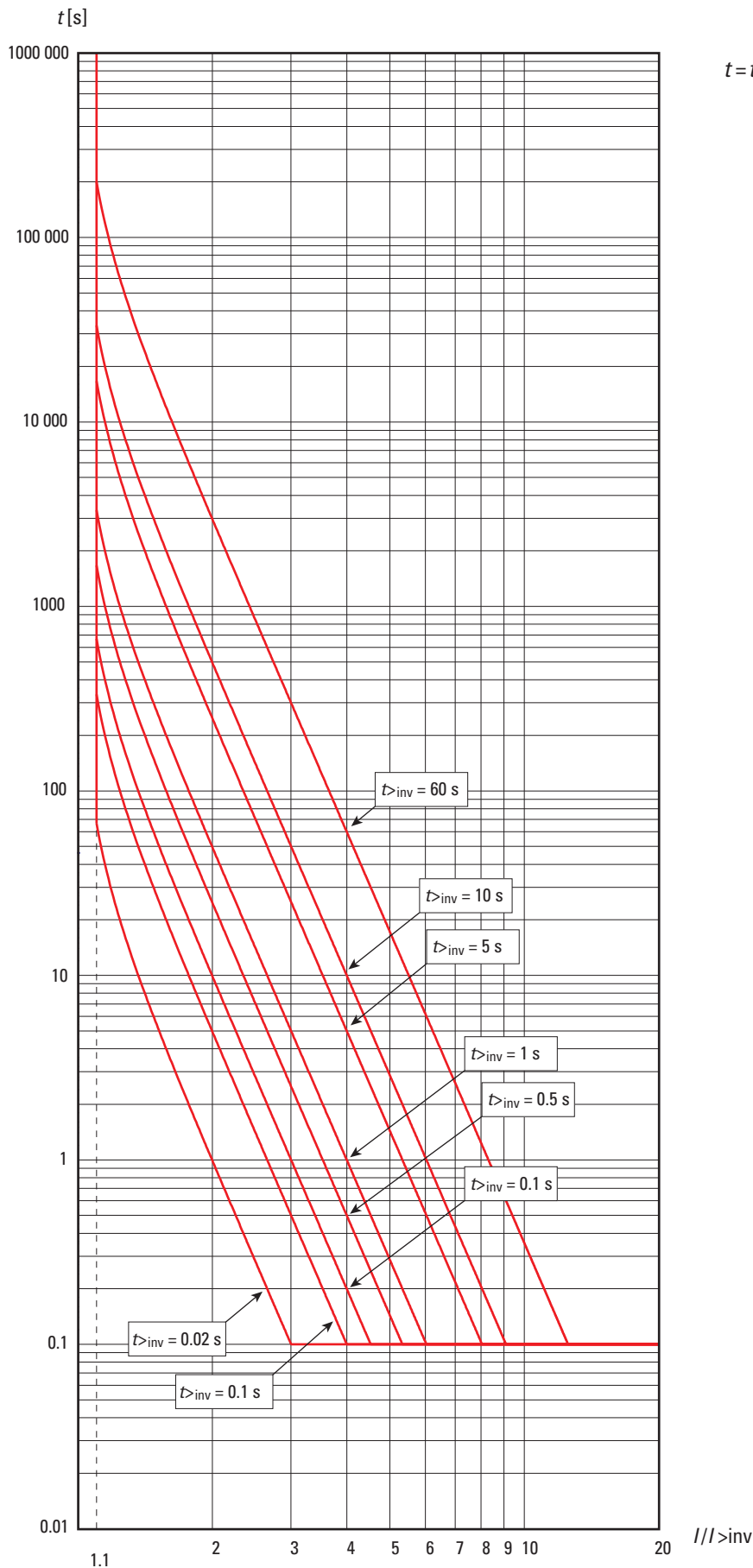
- Asymptotic reference value (minimum pickup value): $1.1 I_{>inv}$
- Minimum operate time: 0.1 s
- Range where the equation is valid:^{[2][3]} $1.1 \leq I/I_{>inv} \leq 20$
- If $I >$ pickup $\geq 2.5 I_n$, the upper limit is $50 I_n$

Note 1 Symbols are concerning the overcurrent element. The comprehensive overview of the inverse time characteristics concerning the 50/51 and 50N/51N elements is dealt within the PROTECTIVE ELEMENTS section

Note 2 When the input value is more than 20 times the set point, the operate time is limited to the value corresponding to 20 times the set point

Note 3 With setting more than 2.5 I_n for the 50/51 elements and 0.5 I_n for the 50N/51N elements, the upper limit of the measuring range is limited to 50 I_n and 10 I_n respectively.

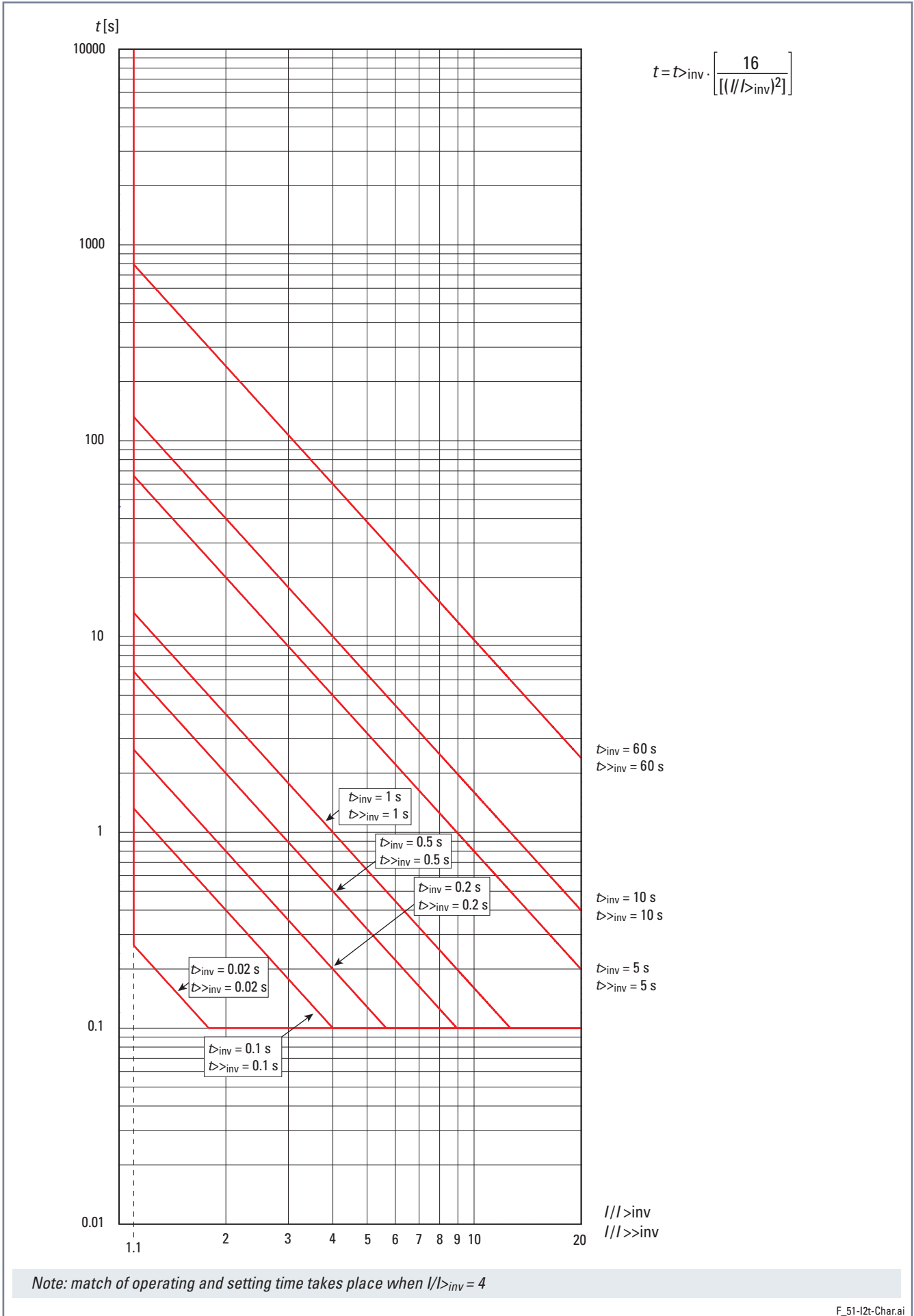
Phase overcurrent 50/51 - Rectifier curves



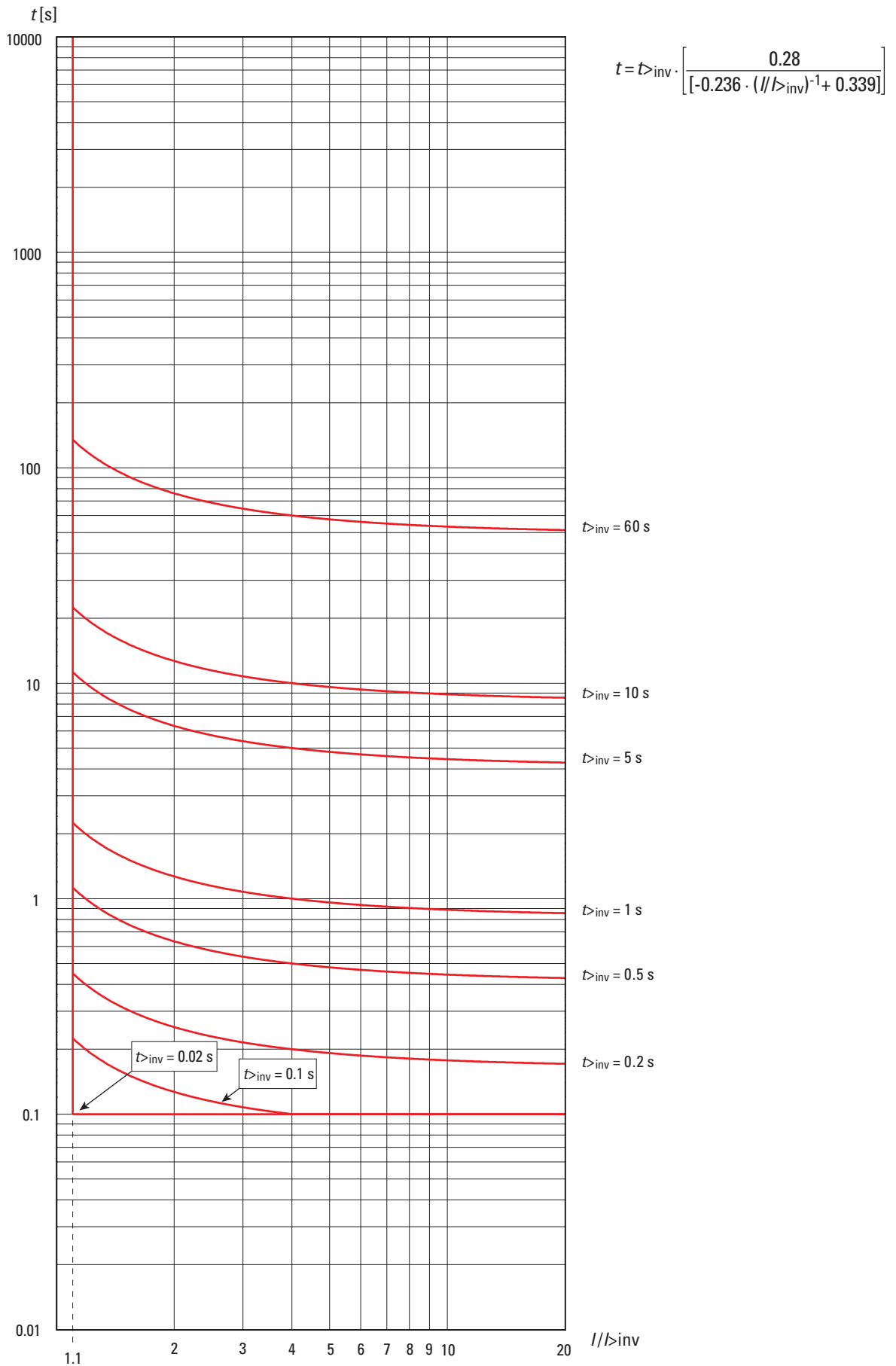
$$t = t_{>inv} \cdot \left[\frac{2351}{\left[\left(I/I_{>inv} \right)^{5.6} - 1 \right]} \right]$$

Note: match of operating and setting time takes place when $I/I_{>inv} = 4$

Phase overcurrent 50/51 - I^2t inverse curves ($I^2t=K$)

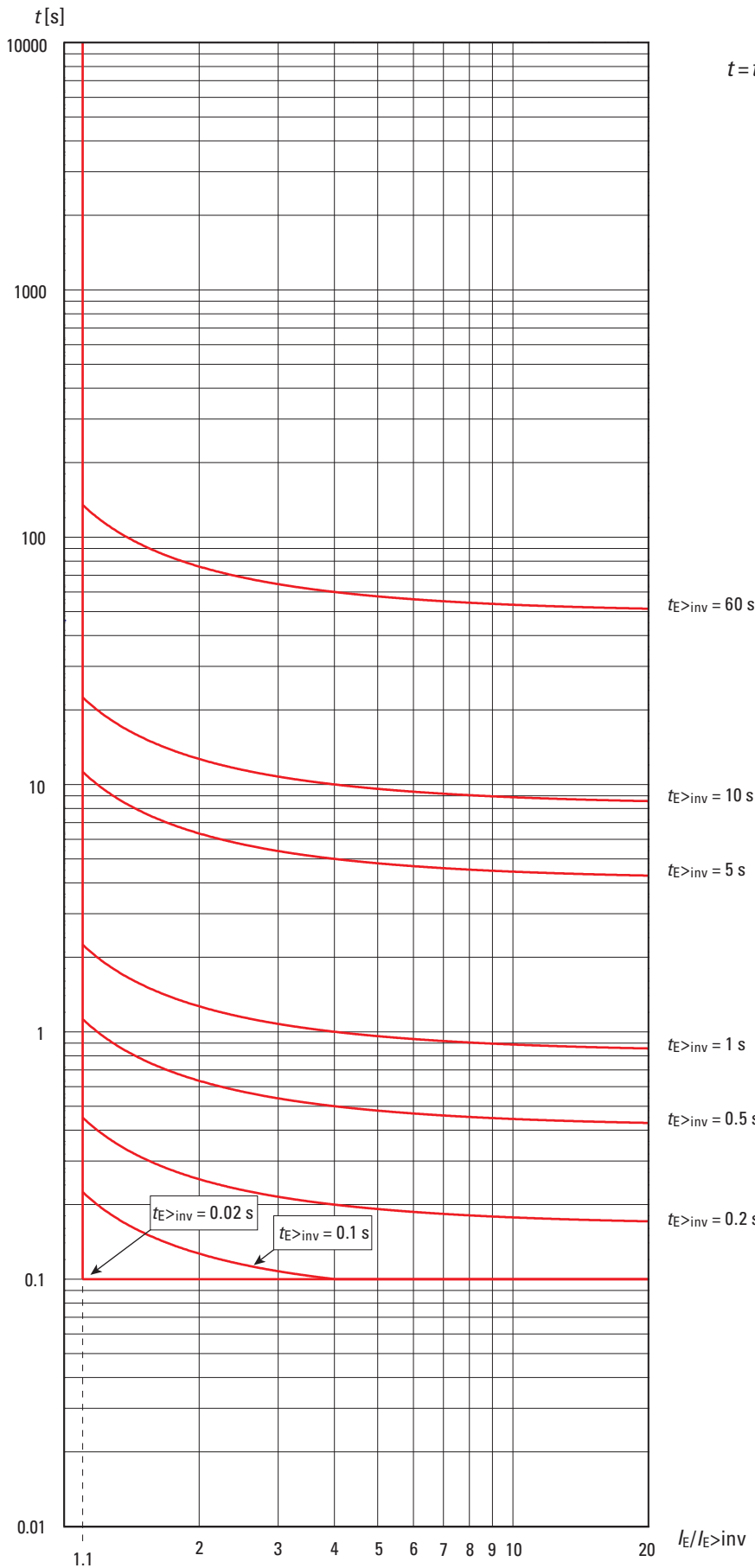


Phase overcurrent 50/51 - Electromechanical inverse curves (EM)



Note: match of operating and setting time takes place when $I/I_{inv} = 4$

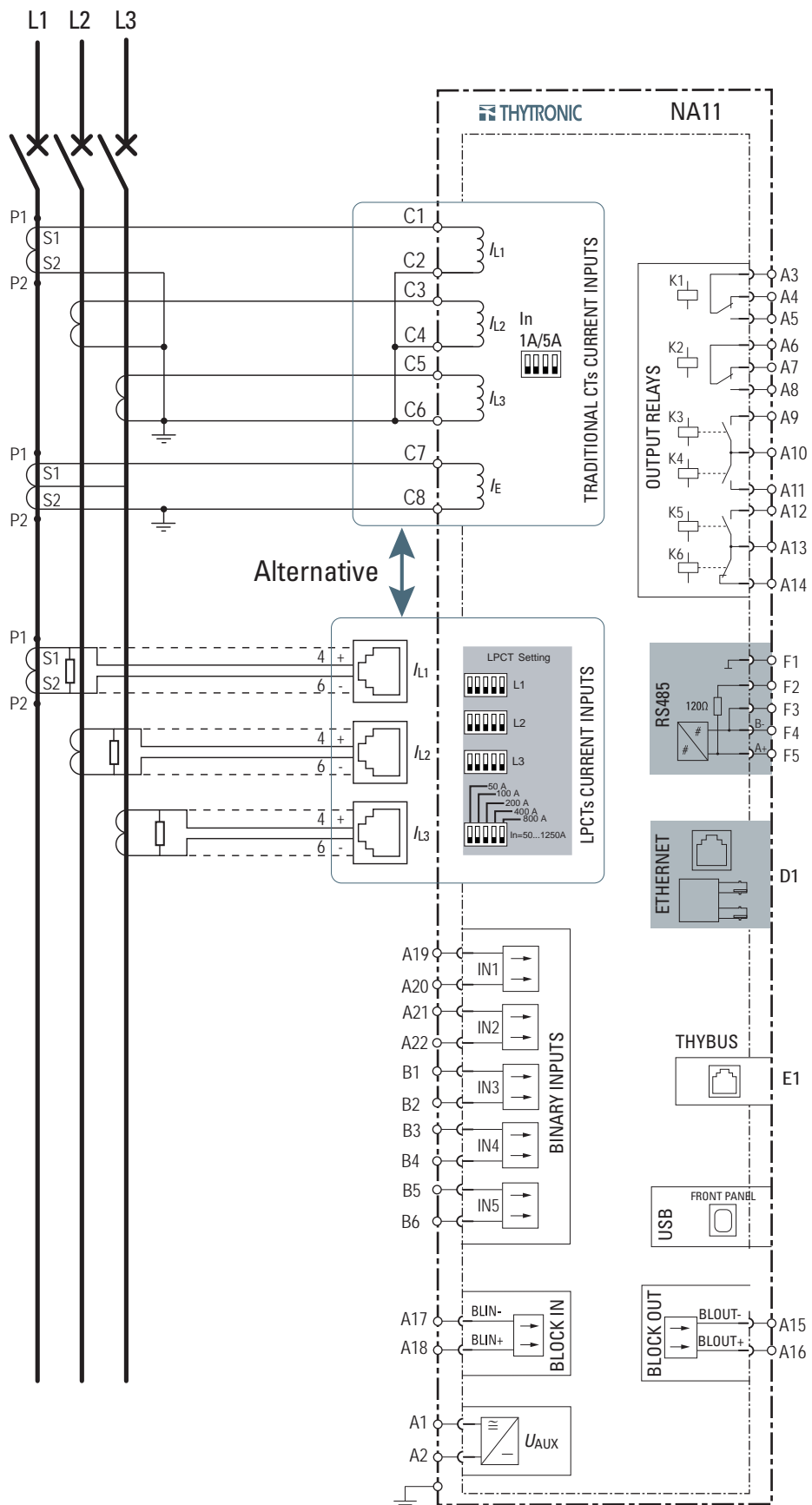
Residual overcurrent 50N/51N - Electromechanical inverse curves (EM)



$$t = t_{E>inv} \cdot \left[\frac{0.28}{[-0.236 \cdot (I_E/I_{E>inv})^{-1} + 0.339]} \right]$$

Note: match of operating and setting time takes place when $I_E/I_{E>inv} = 4$

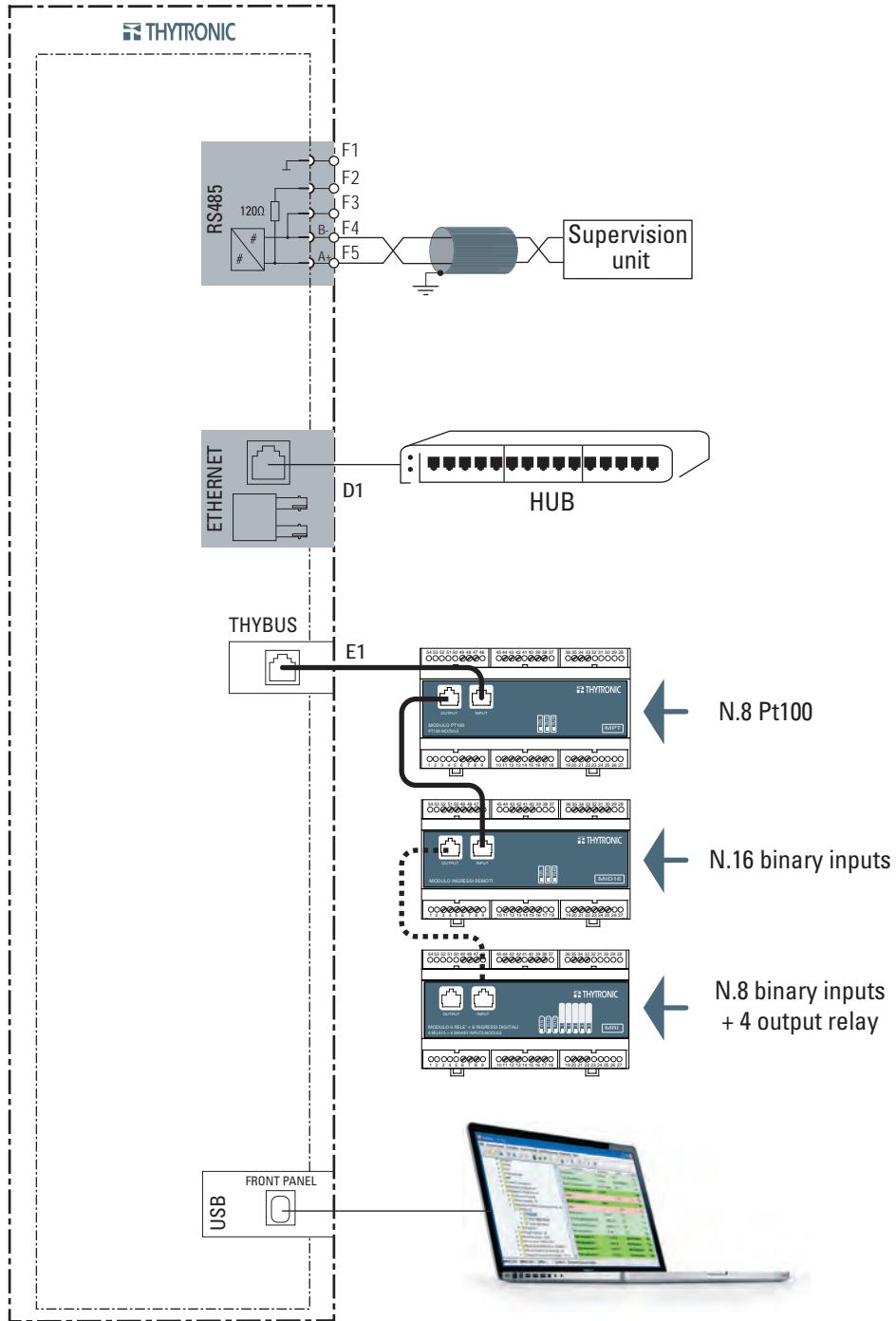
8.4 APPENDIX B1 - I/O Diagram



I/O schematic diagram (five binary inputs version)

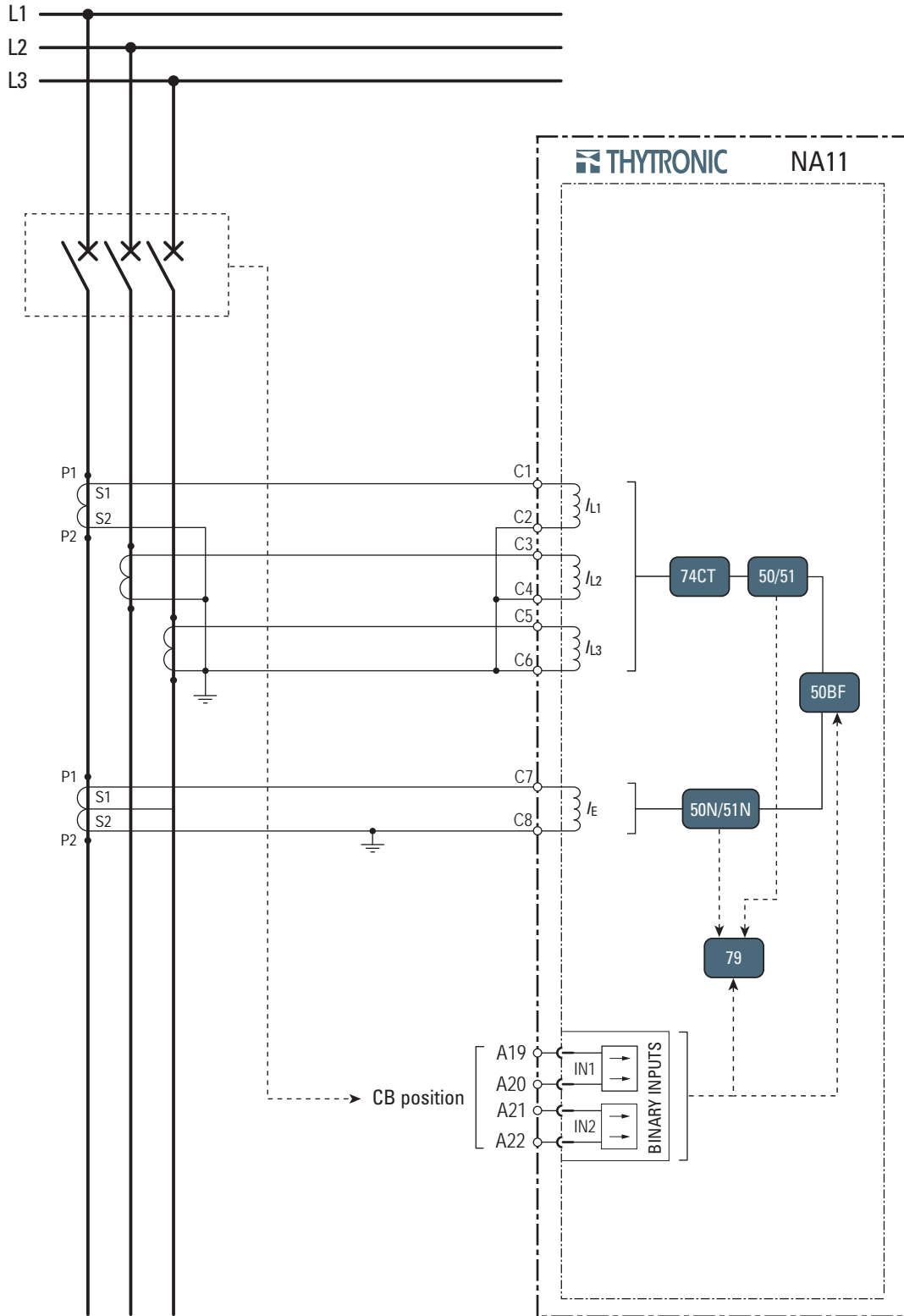
NA11-I-0.ai

8.5 APPENDIX B2 - Interfaces



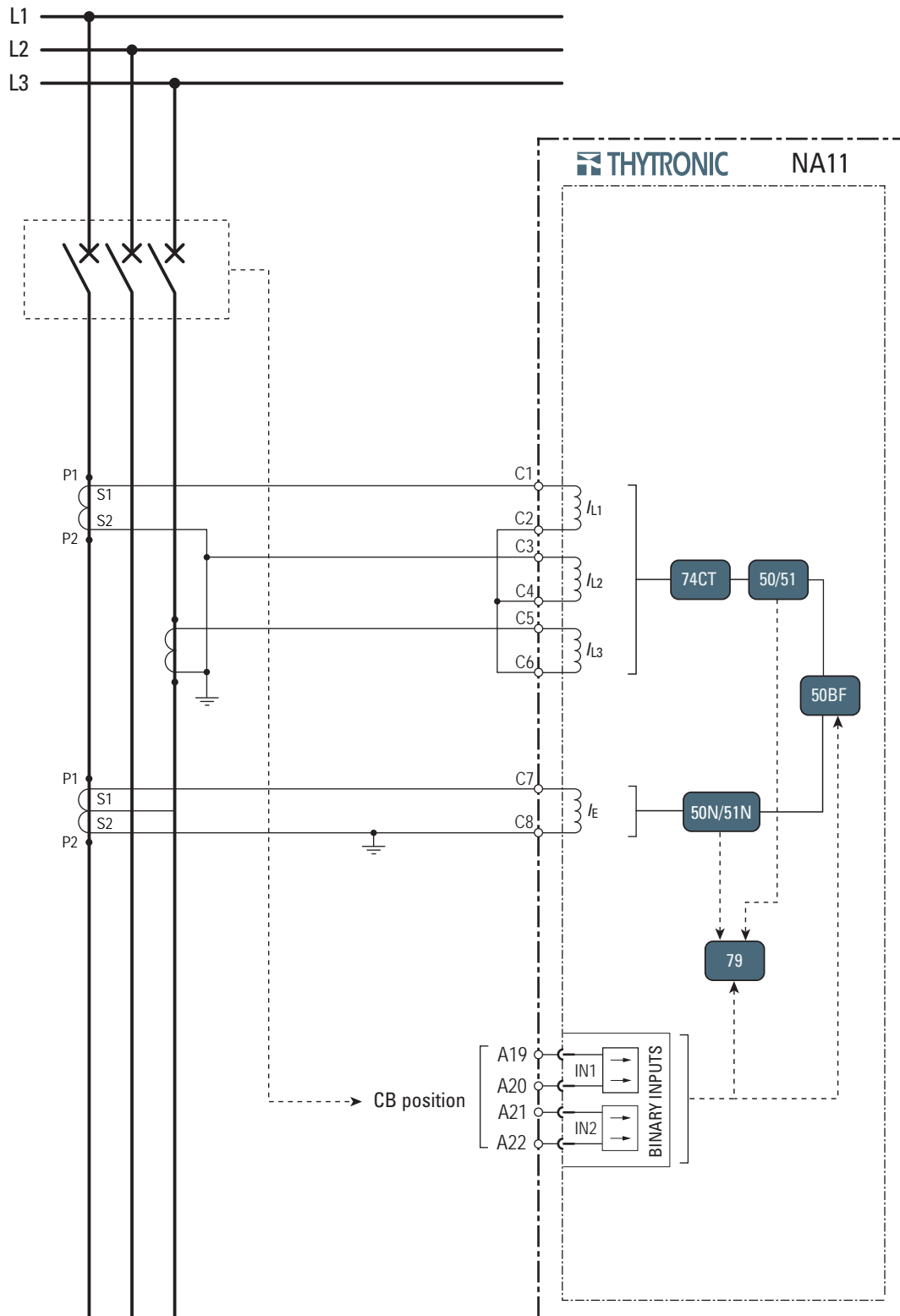
8.6 APPENDIX B3 - Connection diagrams

Note: Some typical connection diagram are shown.
 All diagram must be considered just as example; they cannot be comprehensive for real applications.
 For all diagrams the output contacts are shown in de-energized state for standard reference.

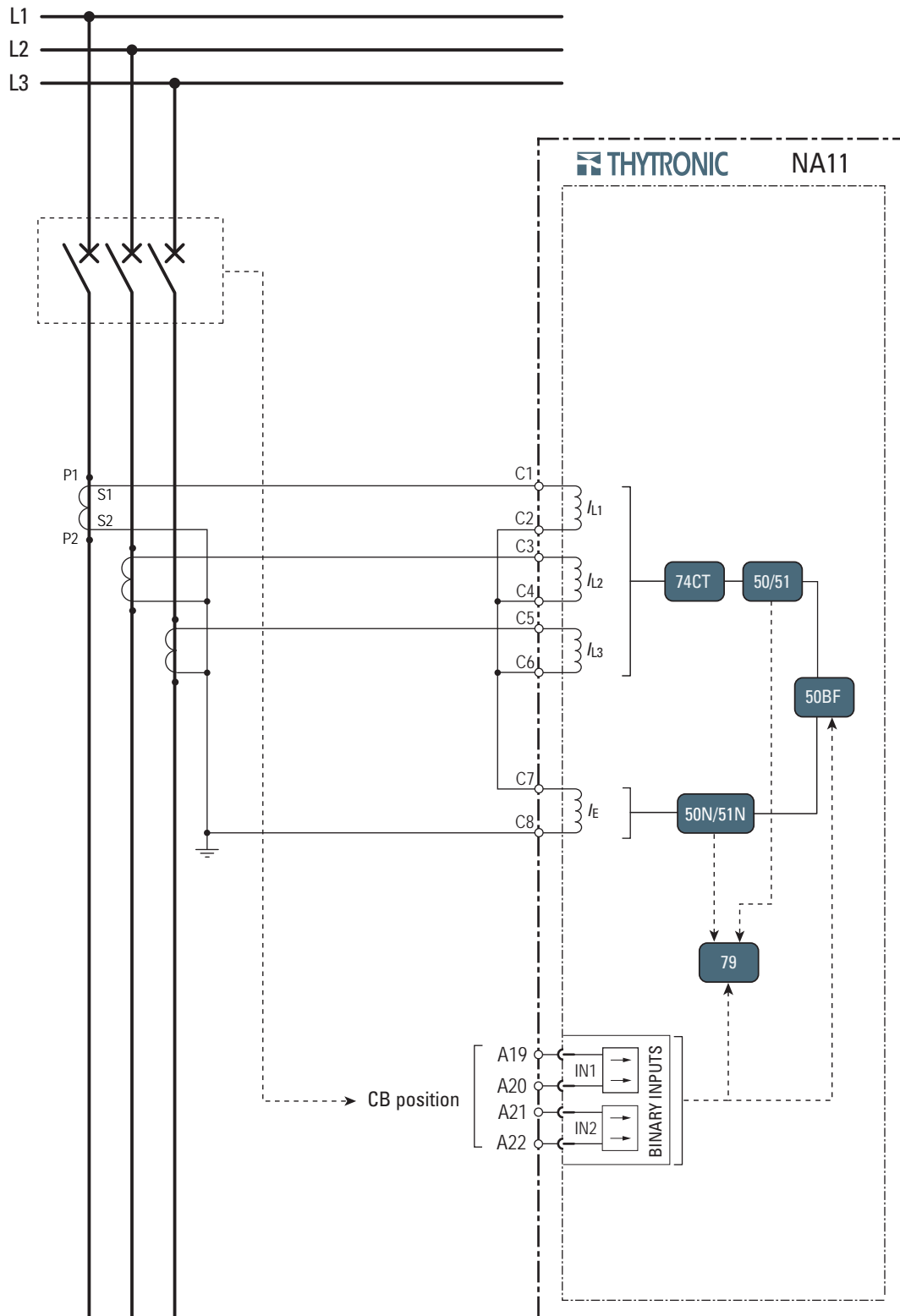


Three phase CTs and residual current from core balanced CT

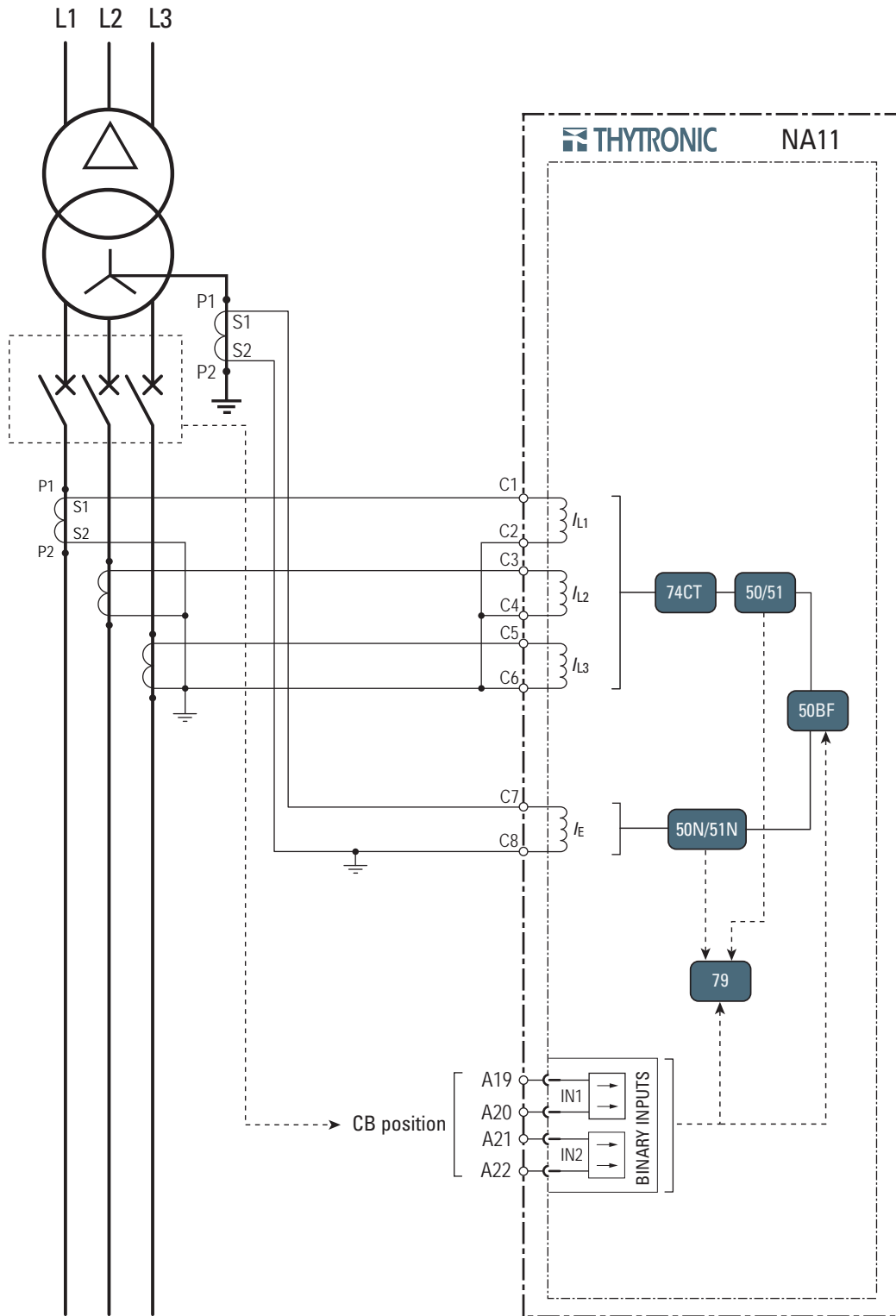
NA11-SCH.ai



Two phase CTs and residual current from core balanced CT



Three phase CTs and residual current from common return of phase CTs (Holmgreen)

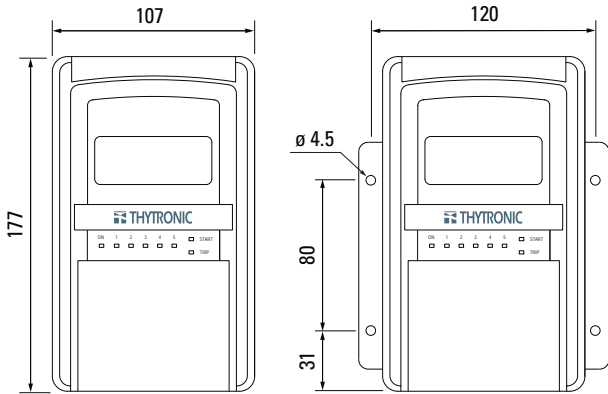


Transformer protection example - low voltage side

NA11-SCH5.ai

8.7 APPENDIX C - Dimensions

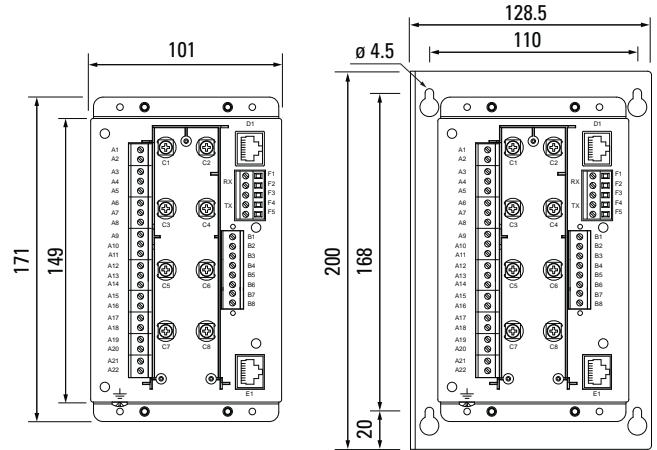
FRONT VIEWS



FLUSH MOUNTING

PROJECTING MOUNTING

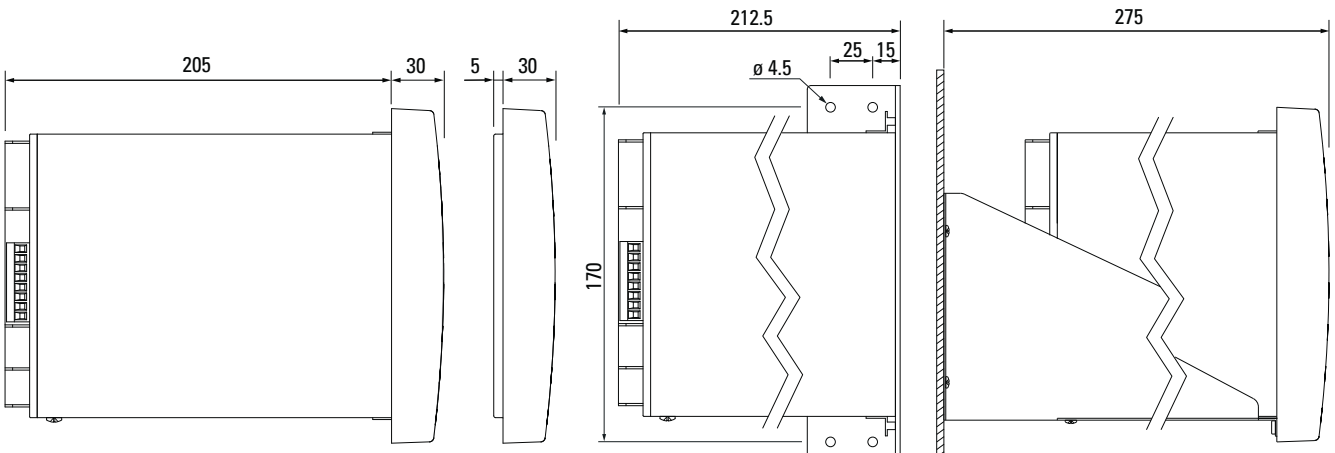
REAR VIEWS



FLUSH MOUNTING

PROJECTING MOUNTING
(Separate operator panel)

SIDE VIEWS



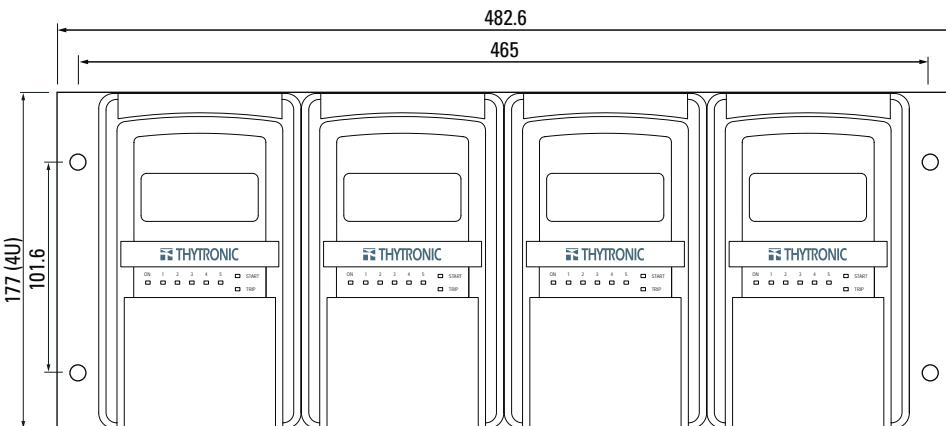
FLUSH MOUNTING

SEPARATE
OPERATOR PANEL

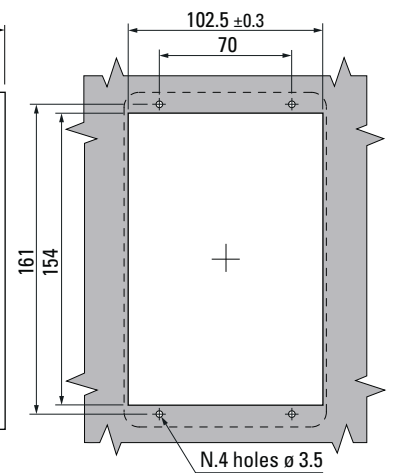
PROJECTING MOUNTING
(Separate operator panel)

PROJECTING MOUNTING
(Stand alone)

RACK MOUNTING



FLUSH MOUNTING CUTOUT



8.8 APPENDIX D - Setting table

Description	Parameter	Unit	Setting range
<i>Note The temperature (26 element), output relay K7...K10, L6...L10 LEDs and binary input IN3...IN42 settings are available only when the concerning I/O circuits are implemented (MPT, MRI and MID16 modules on Thybus)</i>			
Set			
Base			
Relay reference name			
Relay nominal frequency - fn		Hz	50 ... 60 step = 10
Relay phase nominal current - In			1 A 5 A
Relay residual nominal current - IEn			1 A 5 A
Phase CT primary nominal current - Inp		A	1 ... 499 step = 1 500 ... 4990 step = 10 5000 ... 10000 step = 100
Residual CT primary nominal current - IEnp		A	1 ... 499 step = 1 500 ... 4990 step = 10 5000 ... 10000 step = 100
Measurements reading mode			RELATIVE PRIMARY
Language			English Turkish Russian
Inputs			
Binary input IN1			
IN1			
Logic			Active-ON Active-OFF
IN1 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN1 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN1 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN2			
IN2			
Logic			Active-ON Active-OFF
IN2 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN2 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN2 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN3			
IN3			
Logic			Active-ON Active-OFF
IN3 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN3 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN3 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN4			
IN4			
Logic			Active-ON Active-OFF
IN4 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN4 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN4 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN5			
IN5			
Logic			Active-ON Active-OFF
IN5 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN5 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN5 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN6			
IN6			
Logic			Active-ON Active-OFF
IN6 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN6 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN6 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN7			
IN7			
Logic			Active-ON Active-OFF
IN7 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN7 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN7 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN8			

IN8			
Logic			Active-ON Active-OFF
IN8 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN8 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN8 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN9			
IN9			
Logic			Active-ON Active-OFF
IN9 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN9 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN9 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN10			
IN10			
Logic			Active-ON Active-OFF
IN10 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN10 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN10 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN11			
IN11			
Logic			Active-ON Active-OFF
IN11 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN11 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN11 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN12			
IN12			
Logic			Active-ON Active-OFF
IN12 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN12 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN12 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN13			
IN13			
Logic			Active-ON Active-OFF
IN13 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN13 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN13 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN14			
IN14			
Logic			Active-ON Active-OFF
IN14 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN14 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN14 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN15			
IN15			
Logic			Active-ON Active-OFF
IN15 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN15 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN15 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN16			
IN16			
Logic			Active-ON Active-OFF
IN16 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN16 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN16 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN17			
IN17			
Logic			Active-ON Active-OFF
IN17 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN17 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN17 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN18			
IN18			
Logic			Active-ON Active-OFF
IN18 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN18 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN18 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN19			
IN19			
Logic			Active-ON Active-OFF
IN19 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN19 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN19 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN20			
IN20			
Logic			Active-ON Active-OFF
IN20 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN20 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN20 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN21			

IN21			
Logic			Active-ON Active-OFF
IN21 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN21 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN21 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN22			
IN22			
Logic			Active-ON Active-OFF
IN22 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN22 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN22 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN23			
IN23			
Logic			Active-ON Active-OFF
IN23 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN23 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN23 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN24			
IN24			
Logic			Active-ON Active-OFF
IN24 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN24 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN24 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN25			
IN25			
Logic			Active-ON Active-OFF
IN25 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN25 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN25 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN26			
IN26			
Logic			Active-ON Active-OFF
IN26 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN26 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN26 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN27			
IN27			
Logic			Active-ON Active-OFF
IN27 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN27 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN27 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN28			
IN28			
Logic			Active-ON Active-OFF
IN28 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN28 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN28 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN29			
IN29			
Logic			Active-ON Active-OFF
IN29 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN29 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN29 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN30			
IN30			
Logic			Active-ON Active-OFF
IN30 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN30 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN30 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN31			
IN31			
Logic			Active-ON Active-OFF
IN31 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN31 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN31 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN32			
IN32			
Logic			Active-ON Active-OFF
IN32 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN32 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN32 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN33			
IN33			
Logic			Active-ON Active-OFF
IN33 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN33 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN33 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN34			

IN34			
Logic			Active-ON Active-OFF
IN34 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN34 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN34 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN35			
IN35			
Logic			Active-ON Active-OFF
IN35 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN35 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN35 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN36			
IN36			
Logic			Active-ON Active-OFF
IN36 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN36 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN36 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN37			
IN37			
Logic			Active-ON Active-OFF
IN37 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN37 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN37 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN38			
IN38			
Logic			Active-ON Active-OFF
IN38 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN38 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN38 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN39			
IN39			
Logic			Active-ON Active-OFF
IN39 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN39 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN39 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN40			
IN40			
Logic			Active-ON Active-OFF
IN40 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN40 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN40 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN41			
IN41			
Logic			Active-ON Active-OFF
IN41 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN41 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN41 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Binary input IN42			
IN42			
Logic			Active-ON Active-OFF
IN42 tON			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IN42 tOFF			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

IN42 matching			Reset LEDs Set profile Fault trigger Block2 IPh/IE Block2 IPh Block2 IE Block1 TCS1 TCS2 Trip ProtExt Reset counters Reset CB Monitor 52a 52b Open CB Close CB Remote trip Reset on demand measures 79 Enable 79 Block None
Relays			
K1			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K2			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K3			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K4			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K5			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K6			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K7			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K8			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K9			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
K10			
Logic			De-energized Energized
Operation MODE			No-latched Pulse Latched
Minimum pulse width		ms	0 ... 500 step = 5
LEDs			
START			
Type			No-latched Latched
TRIP			
Type			No-latched Latched
L1			
Type			No-latched Latched
L2			

Type			No-latched Latched
L3			
Type			No-latched Latched
L4			
Type			No-latched Latched
L5			
Type			No-latched Latched
L6			
Type			No-latched Latched
L7			
Type			No-latched Latched
L8			
Type			No-latched Latched
L9			
Type			No-latched Latched
L10			
Type			No-latched Latched
Analog outputs			
Current loop 1			
Loop 1 Measure assigned	Loop1-Mis		Frequency IL1 IL2 IL3 IE IL PLC None
Loop 1 Output range	Loop1-Range		0-2 mA 0-4 mA 0-5 mA 1-5 mA 0-6 mA 1-6 mA 0-10 mA 4-20 mA
Loop 1 Sign	Loop1-Sign		Unipolar Bipolar
Loop 1 Nominal multiplier	Loop1-M		0.01 ... 100.00 step = 0.01
Current loop 2			
Loop 2 Measure assigned	Loop2-Mis		Frequency IL1 IL2 IL3 IE IL PLC None
Loop 2 Output range	Loop2-Range		0-2 mA 0-4 mA 0-5 mA 1-5 mA 0-6 mA 1-6 mA 0-10 mA 4-20 mA
Loop 2 Sign	Loop2-Sign		Unipolar Bipolar
Loop 2 Nominal multiplier	Loop2-M		0.01 ... 100.00 step = 0.01
Current loop 3			
Loop 3 Measure assigned	Loop3-Mis		Frequency IL1 IL2 IL3 IE IL PLC None
Loop 3 Output range	Loop3-Range		0-2 mA 0-4 mA 0-5 mA 1-5 mA 0-6 mA 1-6 mA 0-10 mA 4-20 mA
Loop 3 Sign	Loop3-Sign		Unipolar Bipolar
Loop 3 Nominal multiplier	Loop3-M		0.01 ... 100.00 step = 0.01
Current loop 4			
Loop 4 Measure assigned	Loop4-Mis		Frequency IL1 IL2 IL3 IE IL PLC None
Loop 4 Output range	Loop4-Range		0-2 mA 0-4 mA 0-5 mA 1-5 mA 0-6 mA 1-6 mA 0-10 mA 4-20 mA
Loop 4 Sign	Loop4-Sign		Unipolar Bipolar
Loop 4 Nominal multiplier	Loop4-M		0.01 ... 100.00 step = 0.01
Self-test Relay			
MINOR Fail alarm			NO YES
Self-test relay			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
MMI			
Display modules			Assigned modules All modules
Auto-reclose - 79			
79 Enable	79 Enable		OFF ON
79 Function mode	79 Mode		Rapid Rapid+Slow
Number of delayed reclosures	N.DAR		0 ... 5 step = 1
Rapid reclosure dead time	trdt	s	0.1 ... 19.9 step = 0.1 20 ... 60 step = 1
Slow reclosure dead time	tsdt	s	1 ... 200 step = 1
Recalim time			

Value		s	1 ... 200 step = 1
Slow reclosure fault discrimination time	td1	s	0 ... 10 step = 1
Delayed reclosure fault discrimination time	td2	s	0 ... 10 step = 1
Manual close (only R+S) fault discrimination time set	MC-td-EN		OFF ON
Manual close fault discrimination time	td	s	1 ... 10 step = 1
Reset cycle from manual open	MO-RES		OFF ON
79-l> Start	79-l>		OFF ON
79-l>> Start	79-l>>		OFF ON
79-l>>> Start	79-l>>>		OFF ON
79-IE> Start	79-IE>		OFF ON
79-IE>> Start	79-IE>>		OFF ON
79-IE>>> Start	79-IE>>>		OFF ON
Relays cycle in progress	79-Run-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Relays reclosure	79-AR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Relays reclosure fail	79-Fail-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
LEDs cycle in progress	79-Run-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
LEDs reclosure	79-AR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
LEDs reclosure fail	79-Fail-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Profile selection			
Active profile			A B By INPUT
Profile A			
Thermal protection with RTD thermometric probes - 26			
PT1 Probe			
ThAL1 Alarm			
ThAL1 Enable	ThAL1 Enable		OFF ON
26 PT1 Alarm threshold	ThAL1	^C	0 ... 200 step = 1
ThAL1 Operating time			
Value		s	0 ... 100 step = 1
ThAL1 Alarm relays	ThAL1-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL1 Alarm LEDs	ThAL1-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>1 Trip			
Th>1 Enable	Th>1 Enable		OFF ON
26 PT1 Trip threshold	Th>1	^C	0 ... 200 step = 1
Th>1 Operating time			
Value		s	0 ... 100 step = 1
Th>1 Breaker failure	Th>1BF		OFF ON
Th>1 Trip relays	Th>1-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>1 Trip LEDs	Th>1-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT2 Probe			
ThAL2 Alarm			
ThAL2 Enable	ThAL2 Enable		OFF ON
26 PT2 Alarm threshold	ThAL2	^C	0 ... 200 step = 1
ThAL2 Operating time			
Value		s	0 ... 100 step = 1
ThAL2 Alarm relays	ThAL2-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL2 Alarm LEDs	ThAL2-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>2 Trip			
Th>2 Enable	Th>2 Enable		OFF ON
26 PT2 Trip threshold	Th>2	^C	0 ... 200 step = 1
Th>2 Operating time			

Value		s	0 ... 100 step = 1
Th>2 Breaker failure	Th>2BF		OFF ON
Th>2 Trip relays	Th>2-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>2 Trip LEDs	Th>2-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT3 Probe			
ThAL3 Alarm			
ThAL3 Enable	ThAL3 Enable		OFF ON
26 PT3 Alarm threshold	ThAL3	^C	0 ... 200 step = 1
ThAL3 Operating time			
Value		s	0 ... 100 step = 1
ThAL3 Alarm relays	ThAL3-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL3 Alarm LEDs	ThAL3-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>3 Trip			
Th>3 Enable	Th>3 Enable		OFF ON
26 PT3 Trip threshold	Th>3	^C	0 ... 200 step = 1
Th>3 Operating time			
Value		s	0 ... 100 step = 1
Th>3 Breaker failure	Th>3BF		OFF ON
Th>3 Trip relays	Th>3-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>3 Trip LEDs	Th>3-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT4 Probe			
ThAL4 Alarm			
ThAL4 Enable	ThAL4 Enable		OFF ON
26 PT4 Alarm threshold	ThAL4	^C	0 ... 200 step = 1
ThAL4 Operating time			
Value		s	0 ... 100 step = 1
ThAL4 Alarm relays	ThAL4-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL4 Alarm LEDs	ThAL4-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>4 Trip			
Th>4 Enable	Th>4 Enable		OFF ON
26 PT4 Trip threshold	Th>4	^C	0 ... 200 step = 1
Th>4 Operating time			
Value		s	0 ... 100 step = 1
Th>4 Breaker failure	Th>4BF		OFF ON
Th>4 Trip relays	Th>4-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>4 Trip LEDs	Th>4-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT5 Probe			
ThAL5 Alarm			
ThAL5 Enable	ThAL5 Enable		OFF ON
26 PT5 Alarm threshold	ThAL5	^C	0 ... 200 step = 1
ThAL5 Operating time			
Value		s	0 ... 100 step = 1
ThAL5 Alarm relays	ThAL5-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL5 Alarm LEDs	ThAL5-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>5 Trip			
Th>5 Enable	Th>5 Enable		OFF ON
26 PT5 Trip threshold	Th>5	^C	0 ... 200 step = 1
Th>5 Operating time			
Value		s	0 ... 100 step = 1
Th>5 Breaker failure	Th>5BF		OFF ON

Th>5 Trip relays	Th>5-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>5 Trip LEDs	Th>5-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT6 Probe			
ThAL6 Alarm			
ThAL6 Enable	ThAL6 Enable		OFF ON
26 PT6 Alarm threshold	ThAL6	^C	0 ... 200 step = 1
ThAL6 Operating time			
Value		s	0 ... 100 step = 1
ThAL6 Alarm relays	ThAL6-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL6 Alarm LEDs	ThAL6-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>6 Trip			
Th>6 Enable	Th>6 Enable		OFF ON
26 PT6 Trip threshold	Th>6	^C	0 ... 200 step = 1
Th>6 Operating time			
Value		s	0 ... 100 step = 1
Th>6 Breaker failure	Th>6BF		OFF ON
Th>6 Trip relays	Th>6-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>6 Trip LEDs	Th>6-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT7 Probe			
ThAL7 Alarm			
ThAL7 Enable	ThAL7 Enable		OFF ON
26 PT7 Alarm threshold	ThAL7	^C	0 ... 200 step = 1
ThAL7 Operating time			
Value		s	0 ... 100 step = 1
ThAL7 Alarm relays	ThAL7-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL7 Alarm LEDs	ThAL7-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>7 Trip			
Th>7 Enable	Th>7 Enable		OFF ON
26 PT7 Trip threshold	Th>7	^C	0 ... 200 step = 1
Th>7 Operating time			
Value		s	0 ... 100 step = 1
Th>7 Breaker failure	Th>7BF		OFF ON
Th>7 Trip relays	Th>7-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>7 Trip LEDs	Th>7-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT8 Probe			
ThAL8 Alarm			
ThAL8 Enable	ThAL8 Enable		OFF ON
26 PT8 Alarm threshold	ThAL8	^C	0 ... 200 step = 1
ThAL8 Operating time			
Value		s	0 ... 100 step = 1
ThAL8 Alarm relays	ThAL8-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL8 Alarm LEDs	ThAL8-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>8 Trip			
Th>8 Enable	Th>8 Enable		OFF ON
26 PT8 Trip threshold	Th>8	^C	0 ... 200 step = 1
Th>8 Operating time			
Value		s	0 ... 100 step = 1
Th>8 Breaker failure	Th>8BF		OFF ON
Th>8 Trip relays	Th>8-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10

Th>8 Trip LEDs	Th>8-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Diagnostic			
PT100 probe diagnostic relays	PT100Diag-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
PT100 probe diagnostic LEDs	PT100Diag-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Phase overcurrent - 50/51			
↳ Element			
Setpoints			
↳ Enable	↳ Enable		OFF ON
↳ Curve type	↳Curve		IEC/BS A IEC/BS B IEC/BS C ANSI/IEEE MI ANSI/IEEE VI ANSI/IEEE EI RECTIFIER I2t EM DEFINITE
ICLP> Mode	ICLP> Mode		OFF ON - Element blocking ON - Change setting
ICLP> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
↳ Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
↳ Logical block	↳BLK1		OFF ON
↳ Input selective block	↳BLK2IN		OFF ON
↳ Output selective block	↳BLK2OUT		OFF ON
↳ Second harmonic restraint	↳2ndh-REST		OFF ON
↳ Breaker failure	↳BF		OFF ON
↳ Start relays	↳ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
↳ Trip relays	↳TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
↳ Start LEDs	↳ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
↳ Trip LEDs	↳TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 First threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
↳def within CLP	ICLP>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
↳def Operating time			
Value		s	0.04 ... 9.99 step = 0.01 10.0 ... 99.9 step = 0.1 100 ... 200 step = 1
Inverse time			
50/51 First threshold inverse time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
↳inv within CLP	ICLP>inv	In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
↳inv Operating time	↳inv	s	0.02 ... 9.99 step = 0.01 10.0 ... 60.0 step = 0.1
↳>> Element			
Setpoints			
↳>> Enable	↳>> Enable		OFF ON
↳>> Curve type	↳>>Curve		I2t DEFINITE
ICLP>> Mode	ICLP>> Mode		OFF ON - Element blocking ON - Change setting
ICLP>> Activation time			

Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>> Logical block	l>>BLK1		OFF ON
l>> Input selective block	l>>BLK2IN		OFF ON
l>> Output selective block	l>>BLK2OUT		OFF ON
l>> Second harmonic restraint	l>>2ndh-REST		OFF ON
l>> Breaker failure	l>>BF		OFF ON
l> Disabling by l>> start	l>disbyl>>		OFF ON
l>> Start relays	l>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>> Trip relays	l>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>> Start LEDs	l>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
l>> Trip LEDs	l>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 Second threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>def within CLP	ICLP>>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
Inverse time			
50/51 Second threshold inverse time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 20.00 step = 0.01
l>>inv within CLP	ICLP>>inv	In	0.100 ... 0.999 step = 0.001 1.00 ... 20.00 step = 0.01
l>>inv Operating time	t>>inv	s	0.02 ... 10.00 step = 0.01
l>>> Element			
Setpoints			
l>>> Enable	l>>> Enable		OFF ON
ICLP>>> Mode	ICLP>>> Mode		OFF ON - Element blocking ON - Change setting
ICLP>>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>>> Logical block	l>>>BLK1		OFF ON
l>>> Input selective block	l>>>BLK2IN		OFF ON
l>>> Output selective block	l>>>BLK2OUT		OFF ON
l>>> Second harmonic restraint	l>>>2ndh-REST		OFF ON
l>>> Breaker failure	l>>>BF		OFF ON
l> Disabling by l>>> start	l>disbyl>>>		OFF ON
l>> Disabling by l>>> start	l>>disbyl>>>		OFF ON
l>>> Start relays	l>>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>>> Trip relays	l>>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>>> Start LEDs	l>>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10

l>>> Trip LEDs	l>>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 Third threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>>def within CLP	lCLP>>>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
Residual overcurrent - 50N/51N			
IE> Element			
Setpoints			
IE> Enable	IE> Enable		OFF ON
IE> Curve type	IE>Curve		IEC/BS A IEC/BS B IEC/BS C ANSI/IEEE MI ANSI/IEEE VI ANSI/IEEE EI EM DEFINITE
IECLP> Mode	IECLP> Mode		OFF ON - Element blocking ON - Change setting
IECLP> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE> Logical block	IE>BLK1		OFF ON
IE> Input selective block	IE>BLK2IN		OFF ON
IE> Output selective block	IE>BLK2OUT		OFF ON
IE> Second harmonic restraint	IE>2ndh-REST		OFF ON
IE> Breaker failure	IE>BF		OFF ON
IE> Start relays	IE>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE> Trip relays	IE>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE> Start LEDs	IE>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE> Trip LEDs	IE>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N First threshold definite time			
State			OFF ON
Pickup value		IE _n	0.002 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>def within CLP	IECLP>def	IE _n	0.002 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>def Operating time			
Value		s	0.04 ... 9.99 step = 0.01 10.0 ... 99.9 step = 0.1 100 ... 200 step = 1
Inverse time			
50N/51N First threshold definite time			
State			OFF ON
Pickup value		IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>inv within CLP	IECLP>inv	IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>inv Operating time	tE>inv	s	0.02 ... 9.99 step = 0.01 10.0 ... 60.0 step = 0.1
IE>> Element			
Setpoints			

IE>> Enable	IE>> Enable		OFF ON
IECLP>> Mode	IECLP>> Mode		OFF ON - Element blocking ON - Change setting
IECLP>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE>> Logical block	IE>>BLK1		OFF ON
IE>> Input selective block	IE>>BLK2IN		OFF ON
IE>> Output selective block	IE>>BLK2OUT		OFF ON
IE>> Second harmonic restraint	IE>>2ndh-REST		OFF ON
IE>> Breaker failure	IE>>BF		OFF ON
IE> Disabling by IE>> start	IE>disbyIE>>		OFF ON
IE>> Start relays	IE>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>> Trip relays	IE>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>> Start LEDs	IE>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE>> Trip LEDs	IE>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N Second threshold definite time			
State			OFF ON
Pickup value		IEn	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>def within CLP	IECLP>>def	IEn	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
IE>>> Element			
Setpoints			
IE>>> Enable	IE>>> Enable		OFF ON
IECLP>>> Mode	IECLP>>> Mode		OFF ON - Element blocking ON - Change setting
IECLP>>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE>>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE>>> Logical block	IE>>>BLK1		OFF ON
IE>>> Input selective block	IE>>>BLK2IN		OFF ON
IE>>> Output selective block	IE>>>BLK2OUT		OFF ON
IE>>> Second harmonic restraint	IE>>>2ndh-REST		OFF ON
IE>>> Breaker failure	IE>>>BF		OFF ON
IE> Disabling by IE>>> start	IE>disbyIE>>>		OFF ON
IE>> Disabling by IE>>> start	IE>>disbyIE>>>		OFF ON
IE>>> Start relays	IE>>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>>> Trip relays	IE>>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>>> Start LEDs	IE>>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE>>> Trip LEDs	IE>>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N Third threshold definite time			
State			OFF ON

Pickup value		IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>>def within CLP	IECLP>>>def	IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
Second Harmonic Restraint - 2ndh-REST			
Second harmonic restraint threshold			
State			OFF ON
Pickup value		%	10 ... 50 step = 1
I2ndh> reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
I2ndh> Start relays	I2ndh>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
I2ndh> Start LEDs	I2ndh>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Trip circuit supervision - 74TCS			
74TCS Enable	74TCS Enable		OFF ON
74TCS Logical block	74TCS-BLK1		OFF ON
74TCS Start relays	74TCS-ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
74TCS Trip relays	74TCS-TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
74TCS Start LEDs	74TCS-ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
74TCS Trip LEDs	74TCS-TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Selective block - BLOCK2			
Selective block IN			
BLIN1 Selective block operating mode	ModeBLIN1		OFF ON IPh/IE ON IPh ON IE
BLIN maximum activation time for phase protections			
Value		s	0.10 ... 10.00 step = 0.01
BLIN maximum activation time for ground protections			
Value		s	0.10 ... 10.00 step = 0.01
tB-Iph/IE Elapsed signalling relays	tB-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
tB-Iph/IE Elapsed signalling LEDs	tB-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Selective block OUT			
BLOUT Dropout time for phase protections			
Value		s	0.00 ... 1.00 step = 0.01
BLOUT Dropout time for ground protections			
Value		s	0.00 ... 1.00 step = 0.01
BLOUT Dropout time for ground and phase protections			
Value		s	0.00 ... 1.00 step = 0.01
BLOUT1 Selective block operating mode	ModeBLOUT1		OFF ON IPh/IE ON IPh ON IE
Phase protections output selective block relays	BLK2OUT-Iph-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Ground protections output selective block relays	BLK2OUT-IE-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Phase and ground protections output selective block relays	BLK2OUT-Iph/IE-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Phase protections output selective block LEDs	BLK2OUT-Iph-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Ground protections output selective block LEDs	BLK2OUT-IE-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Phase and ground protections output selective block LEDs	BLK2OUT-Iph/IE-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Breaker failure - BF			
BF Enable	BF Enable		OFF ON
BF Phase current threshold			
State			OFF ON

Pickup value		In	0.05 ... 1.00 step = 0.01
BF Residual current threshold			
State			OFF ON
Pickup value		IEn	0.01 ... 2.00 step = 0.01
BF Time delay			
Value		s	0.06 ... 10.00 step = 0.01
BF Logical block	BF-BLK1		OFF ON
BF Start from circuit breaker	CB Input		OFF ON
BF Start relays	BF-ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
BF Trip relays	BF-TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
BF Start LEDs	BF-ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
BF Trip LEDs	BF-TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Profile B			
Thermal protection with RTD thermometric probes - 26			
PT1 Probe			
ThAL1 Alarm			
ThAL1 Enable	ThAL1 Enable		OFF ON
26 PT1 Alarm threshold	ThAL1	^C	0 ... 200 step = 1
ThAL1 Operating time			
Value		s	0 ... 100 step = 1
ThAL1 Alarm relays	ThAL1-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL1 Alarm LEDs	ThAL1-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>1 Trip			
Th>1 Enable	Th>1 Enable		OFF ON
26 PT1 Trip threshold	Th>1	^C	0 ... 200 step = 1
Th>1 Operating time			
Value		s	0 ... 100 step = 1
Th>1 Breaker failure	Th>1BF		OFF ON
Th>1 Trip relays	Th>1-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>1 Trip LEDs	Th>1-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT2 Probe			
ThAL2 Alarm			
ThAL2 Enable	ThAL2 Enable		OFF ON
26 PT2 Alarm threshold	ThAL2	^C	0 ... 200 step = 1
ThAL2 Operating time			
Value		s	0 ... 100 step = 1
ThAL2 Alarm relays	ThAL2-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL2 Alarm LEDs	ThAL2-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>2 Trip			
Th>2 Enable	Th>2 Enable		OFF ON
26 PT2 Trip threshold	Th>2	^C	0 ... 200 step = 1
Th>2 Operating time			
Value		s	0 ... 100 step = 1
Th>2 Breaker failure	Th>2BF		OFF ON
Th>2 Trip relays	Th>2-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>2 Trip LEDs	Th>2-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT3 Probe			
ThAL3 Alarm			
ThAL3 Enable	ThAL3 Enable		OFF ON
26 PT3 Alarm threshold	ThAL3	^C	0 ... 200 step = 1

ThAL3 Operating time			
Value		s	0 ... 100 step = 1
ThAL3 Alarm relays	ThAL3-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL3 Alarm LEDs	ThAL3-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>3 Trip			
Th>3 Enable	Th>3 Enable		OFF ON
26 PT3 Trip threshold	Th>3	^C	0 ... 200 step = 1
Th>3 Operating time			
Value		s	0 ... 100 step = 1
Th>3 Breaker failure	Th>3BF		OFF ON
Th>3 Trip relays	Th>3-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>3 Trip LEDs	Th>3-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT4 Probe			
ThAL4 Alarm			
ThAL4 Enable	ThAL4 Enable		OFF ON
26 PT4 Alarm threshold	ThAL4	^C	0 ... 200 step = 1
ThAL4 Operating time			
Value		s	0 ... 100 step = 1
ThAL4 Alarm relays	ThAL4-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL4 Alarm LEDs	ThAL4-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>4 Trip			
Th>4 Enable	Th>4 Enable		OFF ON
26 PT4 Trip threshold	Th>4	^C	0 ... 200 step = 1
Th>4 Operating time			
Value		s	0 ... 100 step = 1
Th>4 Breaker failure	Th>4BF		OFF ON
Th>4 Trip relays	Th>4-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>4 Trip LEDs	Th>4-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT5 Probe			
ThAL5 Alarm			
ThAL5 Enable	ThAL5 Enable		OFF ON
26 PT5 Alarm threshold	ThAL5	^C	0 ... 200 step = 1
ThAL5 Operating time			
Value		s	0 ... 100 step = 1
ThAL5 Alarm relays	ThAL5-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL5 Alarm LEDs	ThAL5-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>5 Trip			
Th>5 Enable	Th>5 Enable		OFF ON
26 PT5 Trip threshold	Th>5	^C	0 ... 200 step = 1
Th>5 Operating time			
Value		s	0 ... 100 step = 1
Th>5 Breaker failure	Th>5BF		OFF ON
Th>5 Trip relays	Th>5-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>5 Trip LEDs	Th>5-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT6 Probe			
ThAL6 Alarm			
ThAL6 Enable	ThAL6 Enable		OFF ON
26 PT6 Alarm threshold	ThAL6	^C	0 ... 200 step = 1
ThAL6 Operating time			
Value		s	0 ... 100 step = 1

ThAL6 Alarm relays	ThAL6-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL6 Alarm LEDs	ThAL6-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>6 Trip			
Th>6 Enable	Th>6 Enable		OFF ON
26 PT6 Trip threshold	Th>6	^C	0 ... 200 step = 1
Th>6 Operating time			
Value		s	0 ... 100 step = 1
Th>6 Breaker failure	Th>6BF		OFF ON
Th>6 Trip relays	Th>6-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>6 Trip LEDs	Th>6-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT7 Probe			
ThAL7 Alarm			
ThAL7 Enable	ThAL7 Enable		OFF ON
26 PT7 Alarm threshold	ThAL7	^C	0 ... 200 step = 1
ThAL7 Operating time			
Value		s	0 ... 100 step = 1
ThAL7 Alarm relays	ThAL7-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL7 Alarm LEDs	ThAL7-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>7 Trip			
Th>7 Enable	Th>7 Enable		OFF ON
26 PT7 Trip threshold	Th>7	^C	0 ... 200 step = 1
Th>7 Operating time			
Value		s	0 ... 100 step = 1
Th>7 Breaker failure	Th>7BF		OFF ON
Th>7 Trip relays	Th>7-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>7 Trip LEDs	Th>7-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PT8 Probe			
ThAL8 Alarm			
ThAL8 Enable	ThAL8 Enable		OFF ON
26 PT8 Alarm threshold	ThAL8	^C	0 ... 200 step = 1
ThAL8 Operating time			
Value		s	0 ... 100 step = 1
ThAL8 Alarm relays	ThAL8-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
ThAL8 Alarm LEDs	ThAL8-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Th>8 Trip			
Th>8 Enable	Th>8 Enable		OFF ON
26 PT8 Trip threshold	Th>8	^C	0 ... 200 step = 1
Th>8 Operating time			
Value		s	0 ... 100 step = 1
Th>8 Breaker failure	Th>8BF		OFF ON
Th>8 Trip relays	Th>8-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Th>8 Trip LEDs	Th>8-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Diagnostic			
PT100 probe diagnostic relays	PT100Diag-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
PT100 probe diagnostic LEDs	PT100Diag-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Phase overcurrent - 50/51			
↳ Element			
Setpoints			
↳ Enable	↳ Enable		OFF ON

l> Curve type	l>Curve		IEC/BS A IEC/BS B IEC/BS C ANSI/IEEE MI ANSI/IEEE VI ANSI/IEEE EI RECTIFIER I2t EM DEFINITE
ICLP> Mode	ICLP> Mode		OFF ON - Element blocking ON - Change setting
ICLP> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l> Logical block	l>BLK1		OFF ON
l> Input selective block	l>BLK2IN		OFF ON
l> Output selective block	l>BLK2OUT		OFF ON
l> Second harmonic restraint	l>2ndh-REST		OFF ON
l> Breaker failure	l>BF		OFF ON
l> Start relays	l>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l> Trip relays	l>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l> Start LEDs	l>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
l> Trip LEDs	l>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 First threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
l>def within CLP	ICLP>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
l>def Operating time			
Value		s	0.04 ... 9.99 step = 0.01 10.0 ... 99.9 step = 0.1 100 ... 200 step = 1
Inverse time			
50/51 First threshold inverse time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
l>inv within CLP	ICLP>inv	In	0.100 ... 0.999 step = 0.001 1.00 ... 5.00 step = 0.01
l>inv Operating time	t>inv	s	0.02 ... 9.99 step = 0.01 10.0 ... 60.0 step = 0.1
l>> Element			
Setpoints			
l>> Enable	l>> Enable		OFF ON
l>> Curve type	l>>Curve		I2t DEFINITE
ICLP>> Mode	ICLP>> Mode		OFF ON - Element blocking ON - Change setting
ICLP>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>> Logical block	l>>BLK1		OFF ON
l>> Input selective block	l>>BLK2IN		OFF ON
l>> Output selective block	l>>BLK2OUT		OFF ON
l>> Second harmonic restraint	l>>2ndh-REST		OFF ON
l>> Breaker failure	l>>BF		OFF ON
l> Disabling by l>> start	l>disbyl>>		OFF ON

l>> Start relays	l>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>> Trip relays	l>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>> Start LEDs	l>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
l>> Trip LEDs	l>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 Second threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>def within CLP	ICLP>>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
Inverse time			
50/51 Second threshold inverse time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 20.00 step = 0.01
l>>inv within CLP	ICLP>>inv	In	0.100 ... 0.999 step = 0.001 1.00 ... 20.00 step = 0.01
l>>inv Operating time	t>>inv	s	0.02 ... 10.00 step = 0.01
l>>> Element			
Setpoints			
l>>> Enable	l>>> Enable		OFF ON
ICLP>>> Mode	ICLP>>> Mode		OFF ON - Element blocking ON - Change setting
ICLP>>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
l>>> Logical block	l>>>BLK1		OFF ON
l>>> Input selective block	l>>>BLK2IN		OFF ON
l>>> Output selective block	l>>>BLK2OUT		OFF ON
l>>> Second harmonic restraint	l>>>2ndh-REST		OFF ON
l>>> Breaker failure	l>>>BF		OFF ON
l> Disabling by l>>> start	l>disbyl>>>		OFF ON
l>> Disabling by l>>> start	l>>disbyl>>>		OFF ON
l>>> Start relays	l>>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>>> Trip relays	l>>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
l>>> Start LEDs	l>>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
l>>> Trip LEDs	l>>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50/51 Third threshold definite time			
State			OFF ON
Pickup value		In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>>def within CLP	ICLP>>>def	In	0.100 ... 0.999 step = 0.001 1.00 ... 9.99 step = 0.01 10.0 ... 40.0 step = 0.1
l>>>def Operating time			

Value		s	0.03 ... 10.00 step = 0.01
Residual overcurrent - 50N/51N			
IE> Element			
Setpoints			
IE> Enable	IE> Enable		OFF ON
IE> Curve type	IE>Curve		IEC/BS A IEC/BS B IEC/BS C ANSI/IEEE MI ANSI/IEEE VI ANSI/IEEE EI EM DEFINITE
IECLP> Mode	IECLP> Mode		OFF ON - Element blocking ON - Change setting
IECLP> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE> Logical block	IE>BLK1		OFF ON
IE> Input selective block	IE>BLK2IN		OFF ON
IE> Output selective block	IE>BLK2OUT		OFF ON
IE> Second harmonic restraint	IE>2ndh-REST		OFF ON
IE> Breaker failure	IE>BF		OFF ON
IE> Start relays	IE>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE> Trip relays	IE>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE> Start LEDs	IE>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE> Trip LEDs	IE>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N First threshold definite time			
State			OFF ON
Pickup value		IE _n	0.002 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>def within CLP	IECLP>def	IE _n	0.002 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>def Operating time			
Value		s	0.04 ... 9.99 step = 0.01 10.0 ... 99.9 step = 0.1 100 ... 200 step = 1
Inverse time			
50N/51N First threshold definite time			
State			OFF ON
Pickup value		IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>inv within CLP	IECLP>inv	IE _n	0.010 ... 0.999 step = 0.001 1.00 ... 2.00 step = 0.01
IE>inv Operating time	tE>inv	s	0.02 ... 9.99 step = 0.01 10.0 ... 60.0 step = 0.1
IE>> Element			
Setpoints			
IE>> Enable	IE>> Enable		OFF ON
IECLP>> Mode	IECLP>> Mode		OFF ON - Element blocking ON - Change setting
IECLP>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE>> Logical block	IE>>BLK1		OFF ON
IE>> Input selective block	IE>>BLK2IN		OFF ON
IE>> Output selective block	IE>>BLK2OUT		OFF ON

IE>> Second harmonic restraint	IE>>2ndh-REST		OFF ON
IE>> Breaker failure	IE>>BF		OFF ON
IE> Disabling by IE>> start	IE>disbyIE>>		OFF ON
IE>> Start relays	IE>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>> Trip relays	IE>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>> Start LEDs	IE>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE>> Trip LEDs	IE>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N Second threshold definite time			
State			OFF ON
Pickup value		IEn	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>def within CLP	IECLP>>def	IEn	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
IE>>> Element			
Setpoints			
IE>>> Enable	IE>>> Enable		OFF ON
IECLP>>> Mode	IECLP>>> Mode		OFF ON - Element blocking ON - Change setting
IECLP>>> Activation time			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
tE>>> Reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1
IE>>> Logical block	IE>>>BLK1		OFF ON
IE>>> Input selective block	IE>>>BLK2IN		OFF ON
IE>>> Output selective block	IE>>>BLK2OUT		OFF ON
IE>>> Second harmonic restraint	IE>>>2ndh-REST		OFF ON
IE>>> Breaker failure	IE>>>BF		OFF ON
IE> Disabling by IE>>> start	IE>disbyIE>>>		OFF ON
IE>> Disabling by IE>>> start	IE>>disbyIE>>>		OFF ON
IE>>> Start relays	IE>>>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>>> Trip relays	IE>>>TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
IE>>> Start LEDs	IE>>>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
IE>>> Trip LEDs	IE>>>TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Definite time			
50N/51N Third threshold definite time			
State			OFF ON
Pickup value		IEn	0.100 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>>def within CLP	IECLP>>>def	IEn	0.010 ... 0.999 step = 0.001 1.00 ... 10.00 step = 0.01
IE>>>def Operating time			
Value		s	0.03 ... 10.00 step = 0.01
Second Harmonic Restraint - 2ndh-REST			
Second harmonic restraint threshold			
State			OFF ON
Pickup value		%	10 ... 50 step = 1
I2ndh> reset time delay			
Value		s	0.00 ... 9.99 step = 0.01 10.0 ... 100.0 step = 0.1

I2ndh> Start relays	I2ndh>ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
I2ndh> Start LEDs	I2ndh>ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Trip circuit supervision - 74TCS			
74TCS Enable	74TCS Enable		OFF ON
74TCS Logical block	74TCS-BLK1		OFF ON
74TCS Start relays	74TCS-ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
74TCS Trip relays	74TCS-TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
74TCS Start LEDs	74TCS-ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
74TCS Trip LEDs	74TCS-TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Selective block - BLOCK2			
Selective block IN			
BLIN1 Selective block operating mode	ModeBLIN1		OFF ON IPh/IE ON IPh ON IE
BLIN maximum activation time for phase protections			
Value		s	0.10 ... 10.00 step = 0.01
BLIN maximum activation time for ground protections			
Value		s	0.10 ... 10.00 step = 0.01
tB-Iph/IE Elapsed signalling relays	tB-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
tB-Iph/IE Elapsed signalling LEDs	tB-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Selective block OUT			
BLOUT1 Selective block operating mode	ModeBLOUT1		OFF ON IPh/IE ON IPh ON IE
BLOUT Dropout time for phase protections			
Value		s	0.00 ... 1.00 step = 0.01
BLOUT Dropout time for ground protections			
Value		s	0.00 ... 1.00 step = 0.01
BLOUT Dropout time for ground and phase protections			
Value		s	0.00 ... 1.00 step = 0.01
Phase protections output selective block relays	BLK2OUT-Iph-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Ground protections output selective block relays	BLK2OUT-IE-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Phase and ground protections output selective block relays	BLK2OUT-Iph/IE-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Phase protections output selective block LEDs	BLK2OUT-Iph-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Ground protections output selective block LEDs	BLK2OUT-IE-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Phase and ground protections output selective block LEDs	BLK2OUT-Iph/IE-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Breaker failure - BF			
BF Enable	BF Enable		OFF ON
BF Phase current threshold			
State			OFF ON
Pickup value		In	0.05 ... 1.00 step = 0.01
BF Residual current threshold			
State			OFF ON
Pickup value		IEn	0.01 ... 2.00 step = 0.01
BF Time delay			
Value		s	0.06 ... 10.00 step = 0.01
BF Logical block	BF-BLK1		OFF ON
BF Start from circuit breaker	CB Input		OFF ON
BF Start relays	BF-ST-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
BF Trip relays	BF-TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
BF Start LEDs	BF-ST-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10

BF Trip LEDs	BF-TR-L	START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
PLC		
Setpoints		
Enable	PLC Enable	OFF ON
Relays	PLC-K	K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
LEDs	PLC-L	START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Switches		
Switch 1		0 1
Switch 2		0 1
Switch 3		0 1
Switch 4		0 1
Switch 5		0 1
Switch 6		0 1
Switch 7		0 1
Switch 8		0 1
Switch 9		0 1
Switch 10		0 1
Switch 11		0 1
Switch 12		0 1
Switch 13		0 1 2
Switch 14		0 1 2
Switch 15		0 1 2
Switch 16		0 1 2
Switch 17		0 1 2
Switch 18		0 1 2
Switch 19		0 1 2
Switch 20		0 1 2
Switch 21		0 1 2 3
Switch 22		0 1 2 3
Switch 23		0 1 2 3
Switch 24		0 1 2 3
Switch 25		0 1 2 3 4 5 6 7 8 9
Switch 26		0 1 2 3 4 5 6 7 8 9
Switch 27		0 1 2 3 4 5 6 7 8 9
Switch 28		0 1 2 3 4 5 6 7 8 9
Switch 29		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99
Switch 30		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

Switch 31			0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99
Switch 32			0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99
Timers			
Timer 1		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 2		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 3		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 4		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 5		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 6		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 7		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 8		s	0.00 ... 0.99 step = 0.01 1.0 ... 60.0 step = 0.1
Timer 9		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 10		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 11		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 12		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 13		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 14		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 15		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 16		s	0.0 ... 59.9 step = 0.1 60 ... 299 step = 1 300 ... 3600 step = 10
Timer 17		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600

Timer 18		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 19		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 20		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 21		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 22		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 23		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Timer 24		s	0 ... 59 step = 1 60 ... 3540 step = 60 3600 ... 86400 step = 600
Circuit Breaker supervision			
LEDs-relays allocation			
Open CB command relays	CBopen-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Close CB command relays	CBclose-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
CB Closed LEDs	CBclose-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
CB Open LEDs	CBopen-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
CB Diagnostic			
Number of CB trips mode	ModeN.Open		OFF ON
Number of CB trips threshold	N.Open		0 ... 10000 step = 1
Cumulative CB tripping currents mode	ModeSumI		OFF ON
Cumulative CB tripping currents threshold	SumI	In	0 ... 5000 step = 1
Cumulative CB tripping I ² t mode	ModeSumI ² t		OFF ON
Circuit breaker opening time for I ² t calculation	tbreak	s	0.05 ... 1.00 step = 0.01
Cumulative CB tripping I ² t threshold	SumI ² t	In ² s	0 ... 5000 step = 1
CB operating time mode	Mode-tOpen		OFF ON
Trigger relay for CB opening time trigger measurement	Ktrig-break		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Circuit breaker maximum allowed opening time			
Value		s	0.05 ... 1.00 step = 0.01
Number of CB trips diagnostic relays	N.Open-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Cumulative CB tripping currents diagnostic relays	SumI-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Cumulative CB tripping I ² t diagnostic relays	SumI ² t-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Circuit breaker opening time diagnostic relays	tbreak-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Number of CB trips diagnostic LEDs	N.Open-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Cumulative CB tripping currents diagnostic LEDs	SumI-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Cumulative CB tripping I ² t diagnostic LEDs	SumI ² t-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Circuit breaker opening time diagnostic LEDs	tbreak-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
CT supervision - 74CT			
74CT Enable	74CT Enable		OFF ON
74CT Threshold	S<		0.10 ... 0.95 step = 0.01
74CT Overcurrent threshold			
State			OFF ON

Pickup value		In	0.10 ... 1.00 step = 0.01
S< Operating time			
Value		s	0.03 ... 9.99 step = 0.01 10.0 ... 99.9 step = 0.1 100 ... 200 step = 1
S< Logical block	S<BLK1		OFF ON
S< Trip relays	S<TR-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
S< Trip LEDs	S<TR-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Remote tripping			
Remote tripping relays	RemTrip-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Remote tripping LEDs	RemTrip-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Pilot wire diagnostic			
BLOUT1 Diagnostic pulses period	PulseBLOUT1		OFF 100ms 1s 5s 10s 60s 120s
BLIN1 Diagnostic pulses control time interval	PulseBLIN1		OFF 100ms 1s 5s 10s 60s 120s
Not received pulses at BLIN signalling relays	PulseBLIN-K		K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Not received pulses at BLIN signalling LEDs	PulseBLIN-L		START TRIP L1 L2 L3 L4 L5 L6 L7 L8 L9 L10
Demand measures			
Fixed demand period	tFIX	min	1 ... 60 step = 1
Rolling demand period	tROL	min	1 ... 60 step = 1
Number of cycles for rolling on demand	N.ROL		1 ... 24 step = 1
Oscillography			
Readings			
State			Initialization Start recording Acquire Trigger Stopped Wait Fail Off
Records			0 ... 0 step = 0
Buffer storage		%	0 ... 0 step = 0
Trigger Setup			
Pre-trigger time		s	0.05 ... 1.00 step = 0.01
Post-trigger time		s	0.05 ... 60.00 step = 0.05
Element pickup trigger			ON OFF
Trigger from outputs			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10
Binary input trigger			ON OFF
Trigger from inputs IN1-IN32			IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32
Trigger from inputs IN33-IN42			IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42
80% Buffer alarm			OFF ON
Set sample channels			
iL1			On Off
iL2			On Off
iL3			On Off
iE			On Off
Set analog channels			
Analog 1			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 2			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 3			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off

Analog 4			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 5			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 6			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 7			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 8			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 9			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 10			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 11			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Analog 12			Frequency IL1 IL2 IL3 IE IL1-2nd IL2-2nd IL3-2nd I-2nd/IL T1 T2 T3 T4 T5 T6 T7 T8 Off
Set digital channels			
Binary 1			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 2			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 3			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 4			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 5			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off

Binary 6			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 7			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 8			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 9			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 10			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 11			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Binary 12			K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 IN1 IN2 IN3 IN4 IN5 IN6 IN7 IN8 IN9 IN10 IN11 IN12 IN13 IN14 IN15 IN16 IN17 IN18 IN19 IN20 IN21 IN22 IN23 IN24 IN25 IN26 IN27 IN28 IN29 IN30 IN31 IN32 IN33 IN34 IN35 IN36 IN37 IN38 IN39 IN40 IN41 IN42 Off
Communication			
RS485			
Protocol			MODBUS IEC60870-5-103
Address			1 ... 254 step = 1
Baudrate RS485			1200 baud 2400 baud 4800 baud 9600 baud 19200 baud 38400 baud 57600 baud
Ethernet			
IP host address			
IP net mask			
Autonegotiation			OFF ON
NTP synchronizing			OFF ON

8.9 APPENDIX E - EC Declaration of conformity

Manufacturer:	THYTRONIC S.p.A.
Address:	Piazza Mistral 7 - 20139 MILANO

The undersigned manufacturer herewith declares that the product

Protection relay - type NA11

is in conformity with the provisions of the following EC directives (including all applicable amendments) when installed in accordance with the installation instructions:

Reference n°	Title
2014/35/EC 2014/30/EC	Low Voltage Directive EMC Directive

Reference of standards and/or technical specifications applied for this declaration of conformity or parts thereof:

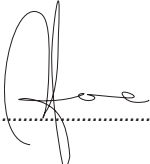
- harmonized standards:

Reference n°	Issue	Title
EN 61010-1	2010	Safety requirements for electrical equipment for measurement, control and laboratory use
EN 50263	2000	Electromagnetic compatibility (EMC) Product standard for measuring relays and protection equipments
EN 61000-6-4	2007-2011	Electromagnetic compatibility (EMC) Emission standard for industrial environments
EN 61000-6-2	2005	Electromagnetic compatibility (EMC) Immunity standard for industrial environments

- other standards and/or technical specifications:

Reference n°	Issue	Title
EN 60255-1	2011	Electrical relays Part 6: General requirements for measuring relays and protection equipment

Year of CE marking: 2005

Signature.....

Name **FIORE Mattia**
Title **Managing director**
Date **12-2005**



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