NA60

FEEDER PROTECTION RELAY

THE COMPREHENSIVE SOLUTION FOR FEEDERS AND TRANSFORMERS PROTECTION

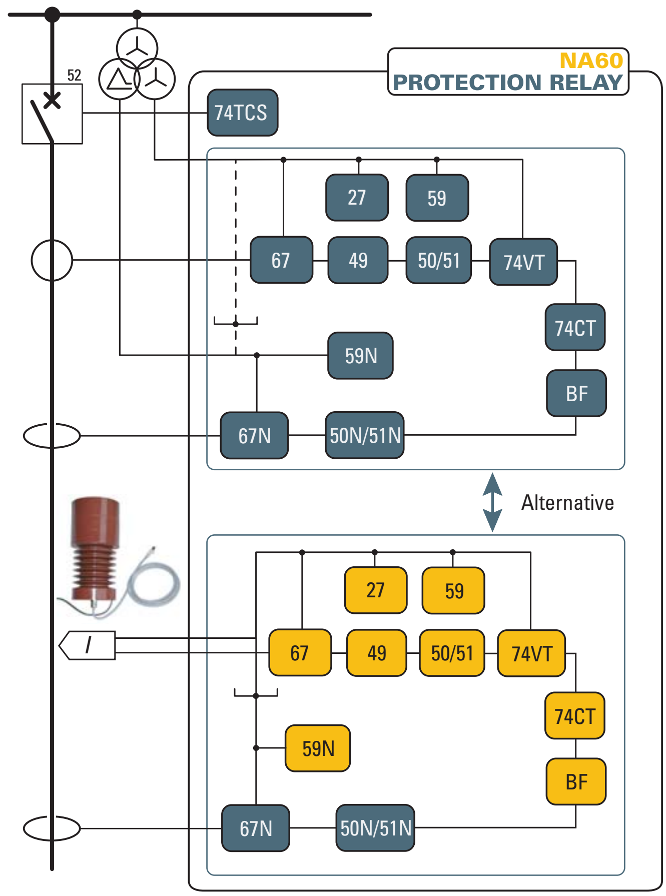
Application

The relay type NA60 can be typically used in radial or meshed MV and LV networks as feeder or power transformer protection:

- On radial, ring and parallel feeders of any length in solidly grounded, ungrounded, Petersen coil and/or resistance grounded systems.
- On parallel connected generators and transformer on the same Busbar.

Moreover undervoltage and overvoltage functions are provided as protections or voltage controls.

The relay type NA60 can be can be provided with circuits for input phase current suitable for traditional CTs and VTs, or combined ThySensor devices.



- Protective & control functions

27	Undervoltage
49	Thermal image (for lines and transformers)
50/51	Phase overcurrent
50N/51N	Residual overcurrent
59	Overvoltage
59N	Residual overvoltage
67	Phase directional overcurrent
67N	Ground directional overcurrent
BF	Circuit breaker failure
74CT	CTs monitoringMonitoraggio TA di fase
74TCS	Trip circuit supervision

Control functions

METERING
- $I_{L1}..I_{L3}, I_E$
- Oscillography
- Events & Faults log

COMMUNICATION
- RS232
- Modbus RS485
- Modbus TCP/IP
- IEC 870-5-103/DNP3

Measuring inputs with traditional CTs and VTs

- Three phase current inputs and one residual current input, with nominal currents independently selectable at 1 A or 5 A through DIP-switches.
- Three phase voltage inputs with programmable nominal voltages within range 50...130 V (U_R =100 V) or 200...520 V (U_R =400 V) and one residual voltage input, with programmable nominal voltage within range 50...130 V (U_{ER} =100 V).

Measuring inputs with ThySensor devices

- Three phase current inputs, with 630 A nominal current (primary).
- One residual current input, with nominal currents independently selectable at 1 A or 5 A through DIP-switches.
- Three phase voltage inputs with nominal voltage 20/√3 kV (primary); the residual voltage has been obtained by vector calculation measures of phase voltages

Firmware updating

The use of flash memory units allows on-site firmware updating.

Construction

According to the hardware configurations, the NA60 protection relay can be shipped in various case styles suitable for the required mounting options (flush, projecting mounting, rack or with separate operator panel) and with connections to input signals suitable for traditional VTs and CTs (screw terminals) or combined sensors ThySensor (RJ45 connectors for connecting embedded cables)

Modular design

In order to extend I/O capability, the NA60 hardware can be customized through external auxiliary modules:

- MRI - Output relays and LEDs
- MID16 - Binary inputs
- MCI - 4...20 mA converter
- MPT - Pt100 probe inputs.

Binary inputs

Two binary inputs are available with programmable active state (active-ON/active-OFF) and programmable timer (active to OFF/ON or ON/OFF transitions).
Several presettable functions can be associated to each input.

Measures

NA60 provides metering values for phase and residual currents, phase and residual voltage, making them available for reading on a display or to communication interfaces.
The input signals can be acquired through the traditional CTs and VTs, or through combined sensors ThySensor including current, voltage measures, standardized lamp voltage presence and isolated in the same component.
For residual current measurement (protection 50N/51N and 67N) the installation of a balance current transformer is required, while the residual voltage is derived through vector calculus on the three phase voltages using the sensors ThySensor, or is selectable from the above calculation and the broken Delta VT in versions with traditional VT inputs.
Input signals are sampled 24 times per period and the RMS value of the fundamental component is measured using the DFT (Discrete Fourier Transform) algorithm and digital filtering.
With DFT the RMS value of 2nd, 3rd, 4th and 5th harmonic of phase current are also measured.
On the basis of the direct measurements, several calculated (min, max, average,...), phase, sequence, power, harmonic, demand and energy measures are processed.
Measures can be displayed with reference to nominal values or directly expressed in amperes and volts.

Blocking input/outputs

One output blocking circuit and one input blocking circuit are provided.
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 upstream in the electric plant. The output circuit works as a simple contact, whose condition is detected by the input circuit of the upstream protection relay.
Use of suitable pilot wire to fiber optic converters (BFO) allows to perform fast and reliable accelerated logic selectivity on radial and closed ring networks.

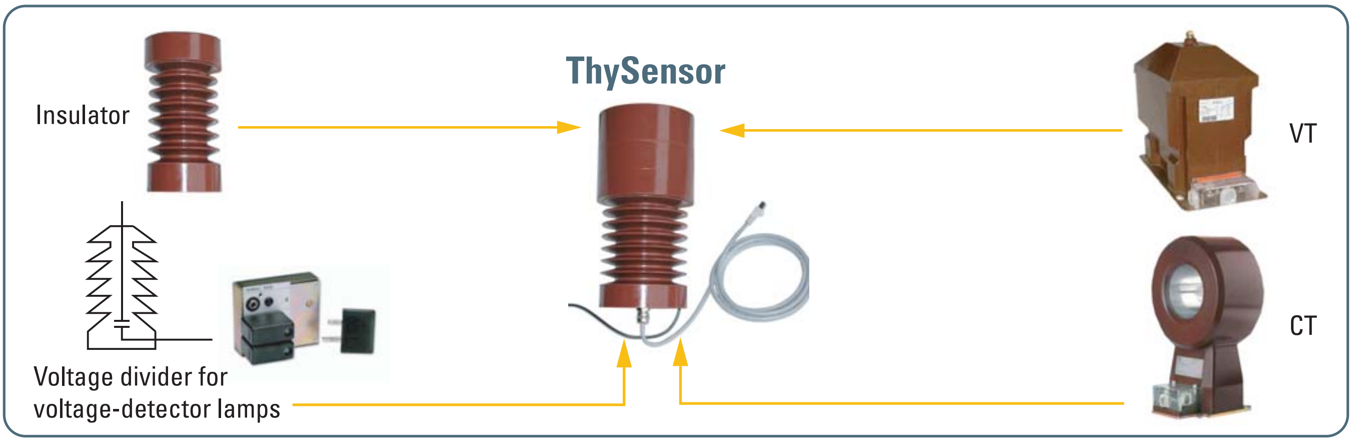
Output relays

Six output relays are available (two changeover, three make and one break contacts); each relay may be individually programmed as normal state (normally energized, de-energized or pulse) and reset mode (manual or automatic).
A programmable timer is provided for each relay (minimum pulse width). The user may program the function of each relay according to a matrix (tripping matrix) structure.

Communication

Multiple communication interfaces are implemented:

- One RS232 local communication front-end interface for communication with ThySetter setup software.
- Two back-end interfaces for communication with remote monitoring and control systems by:
  - RS485 port using ModBus® RTU, IEC 60870-5-103 or DNP3 protocol.
  - Ethernet port (RJ45 or optical fiber) using ModBus/TCP protocol.



MMI (Man Machine Interface)

The user interface comprises a membrane keyboard, a backlight LCD alphanumeric display and eight LEDs.
The green ON LED indicates auxiliary power supply and self diagnostics, two LEDs are dedicated to the Start and Trip (yellow for Start, red for Trip) and five red LEDs are user assignable.

Control and monitoring

Several predefined functions are implemented:
- Activation of two set point profiles
- Phase CTs and VTs monitoring (74CT and 74VT)
- Logic selectivity
- Cold load pickup (CLP) with block or setting change
- Trip circuit supervision (74TCS)
- Second harmonic restraint (inrush)
- Remote tripping
- Circuit Breaker commands and diagnostic

User defined logic may be customized according to IEC 61131-3 standard protocol (PLC).

Circuit Breaker commands and diagnostic

Several diagnostic, monitoring and control functions are provided:
- Health thresholds can be set; when the accumulated duty (ΣI or ΣI^2t), the number of operations or the opening time exceeds the threshold an alarm is activated.
- Breaker failure (BF); breaker status is monitored by means 52a-52b and/or through line current measurements.
- Trip Circuit Supervision (74TCS).
- Breaker control; opening and closing commands can be carried out locally or remotely.

Cold Load Pickup (CLP)

The Cold Load Pickup feature can operate in two following modes:
- Each protective element can be blocked for a adjustable time.
- Each threshold can be increased for a programmable time.

It is triggered by the circuit breaker closing.

Second harmonic restraint

To prevent unwanted tripping of the protective functions on transformer inrush current, the protective elements can be blocked when the ratio between the second harmonic current and the relative fundamental current is larger than a user programmable threshold.
The function can be programmed to switch an output relay so as to cause a blocking protection relays lacking in second harmonic restraint.

Logic selectivity

With the aim of providing a fast selective protection system some protective functions may be blocked (pilot wire accelerated logic). To guarantee maximum fail-safety, the relay performs a run time monitoring for pilot wire continuity and pilot wire shorting. 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 upwards 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 logic selectivity function can be realized through any combination of binary inputs, output relays and/or committed pilot wires circuits.

Self diagnostics

All hardware and software functions are repeatedly checked and any anomalies reported via display messages, communication interfaces, LEDs and output relays. Anomalies may refer to:
- Hw faults (auxiliary power supply, output relay coil interruptions, MMI board...).
- Sw faults (boot and run time tests for data base, EEPROM memory checksum failure, data BUS,...).
- Pilot wire faults (break or short in the wire).
- Circuit breaker faults.

Event storage

Several useful data are stored for diagnostic purpose; the events are stored into a non volatile memory.
They are graded from the newest to the older after the "Events reading" command (ThySetter) is issued:
- Sequence of Event Recorder (SER).
  The event recorder runs continuously capturing in circular mode the last three hundred events upon trigger of binary input/output.
- Sequence of Fault Recorder (SFR).
  The fault recorder runs continuously capturing in circular mode the last twenty faults upon trigger of binary input/output and/or element pickup (start-trip).
- Settings recording
  Following some setting changes the last eight changes are recorded in circular mode (Data Logger CEI 0-16)
- Trip counters.

Digital Fault Recorder (Oscillography) [1]

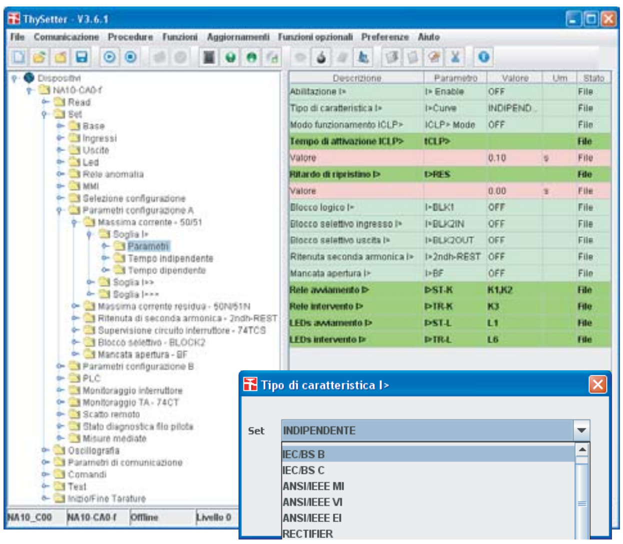
Upon trigger of tripping/starting of each function or external signals, the relay records in COMTRADE format:
- Oscillography with instantaneous values for transient analysis.
- RMS values for long time periods analysis.
- Logic states (binary inputs and output relays).

Note - A license for Digital Fault Recorder function is required, for purchase procedure please contact Thytronic.
The records are stored in nonvolatile memory

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 ThySetter software.
The same PC setup software is required to set, monitor and configure all Pro_N devices.
Two session level (User or Administrator) with password for sensible data access are provided.

ThySetter



SPECIFICATIONS

GENERAL

Mechanical data
Mounting: flush, projecting, rack or separated operator panel
Mass (flush mounting case) 2.0 kg

Insulation tests
Reference standards	EN 60255-5
High voltage test 50Hz	2 kV 60 s
Impulse voltage withstand (1.2/50 µs)	5 kV
Insulation resistance	>100 MΩ

Voltage dip and interruption
Reference standards EN 61000-4-29

EMC tests for interference immunity
1 MHz damped oscillatory wave	EN 60255-22-1	1 kV-2.5 kV
Electrostatic discharge	EN 60255-22-2	8 kV
Fast transient burst (5/50 ns)	EN 60255-22-4	4 kV
Conducted radio-frequency fields	EN 60255-22-6	10 V
Radiated radio-frequency fields	EN 60255-4-3	10 V/m
High energy pulse	EN 61000-4-5	2 kV
Magnetic field 50 Hz	EN 61000-4-8	1 kA/m
Damped oscillatory wave	EN 61000-4-12	2.5 kV
Ring wave	EN 61000-4-12	2 kV
Conducted common mode (0...150 kHz)	EN 61000-4-16	10 V

Emission
Reference standards	EN 61000-6-4 (ex EN 50081-2)
Conducted emission 0.15...30 MHz	Class A
Radiated emission 30...1000 MHz	Class A

Climatic tests
Reference standards IEC 60068-x, ENEL R CLI 01, CEI 50

Mechanical tests
Reference standards EN 60255-21-1, 21-2, 21-3

Safety requirements
Reference standards	EN 61010-1
Pollution degree	3
Reference voltage	250 V
Overvoltage	III
Pulse voltage	5 kV
Reference standards	EN 60529
Protection degree:	
• Front side	IP52
• Rear side, connection terminals	IP20

Environmental conditions
Ambient temperature	-25...+70 °C
Storage temperature	-40...+85 °C
Relative humidity	10...95 %
Atmospheric pressure	70...110 kPa

Certifications
Product standard for measuring relays	EN 50263
CE conformity	
• EMC Directive	89/336/EEC
• Low Voltage Directive	73/23/EEC
Type tests	IEC 60255-6

COMMUNICATION INTERFACES

Local PC RS232	19200 bps
Network:	
• RS485	1200...57600 bps
• Ethernet 100BaseT	100 Mbps
Protocol	ModBus® RTU/IEC 60870-5-103/DNP3, TCP/IP

INPUT CIRCUITS

Auxiliary power supply Uaux
Nominal value (range) 24...48 Vac/dc, 115...230 Vac/110...220 Vdc
Operative range (each one of the above nominal values)
19...60 Vac/dc - 85...265 Vac/75...300 Vdc

Power consumption:
- Maximum (energized relays, Ethernet TX) 10 W (20 VA)
- Maximum (energized relays, Ethernet FX) 15 W (25 VA)

Phase current inputs with traditional CTs
• Nominal current I_n	1 A or 5 A selectable by DIP Switches
• Permanent overload	25 A
• Thermal overload (1 s)	500 A
• Rated consumption (for any phase)	≤ 0.002 VA (I_n = 1 A)
	≤ 0.04 VA (I_n = 5 A)
• Connections	M4 terminals

Residual current input
• Nominal current I_{En}	1 A or 5 A selectable by DIP Switch
• Permanent overload	25 A
• Thermal overload (1 s)	500 A

- Rated consumption ≤ 0.006 VA (I_{En} = 1 A), ≤ 0.012 VA (I_{En} = 5 A)

Voltage inputs with traditional VTs
Reference voltage U_R	100 V or 400 V selectable on order
Nominal voltage U_n	50...130 V or 200...520 V adjustable via sw
Permanent overload / 1s overload	1.3 U_R / 2 U_R
Rated consumption (for any phase)	≤ 0.5 VA

Residual voltage input with traditional VTs
Reference voltage U_{ER}	100 V
Nominal voltage U_{En}	50...130 V adjustable via sw
Permanent overload / 1s overload	1.3 U_{ER} / 2 U_{ER}
Rated consumption	≤ 0.5 VA

Phase inputs with ThySensors
Secondary voltage (I_{np} = 630 A)	200 mV
Secondary voltage (U_{np} = 20/√3 kV)	1.0 V
Connections	RJ45 clamp

ThySensors primary inputs
Primary nominal current I_{np}	630 A
Extended primary current	50 A...1250 A
Permanent thermal nominal current	1.2 I_{np}
Max primary current	22.5 kA
Thermal overload (3 s)	16 kA
Dynamic overload (half cycle)	40 kA
Primary nominal voltage U_{np}	20/√3 kV
Permanent overload factor	1.8

Binary inputs
Quantity and type	2 dry inputs
Max permissible voltage	19...265 Vac/19...300 Vdc
Max consumption, energized	3 mA

Block input (Logic selectivity)
Quantity and type	1 powered by internal isolated supply
Max consumption, energized	5 mA

OUTPUT CIRCUITS

Output relays K1...K6
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 Vac/400 Vac
Breaking capacity:	
• Direct current (L/R = 40 ms)	50 W
• Alternating current (λ = 0,4)	1250 VA
Make	1000 W/VA
Short duration current (0,5 s)	30 A

Block output (Logic selectivity)

Quantity	1
Type	optocoupler

LEDs

Quantity	8
• ON/fail (green)	1
• Start (yellow)	1
• Trip (red)	1
• Allocatable (red)	5

GENERAL SETTINGS

Rated values (traditional CTs an VTs versions)

Relay nominal frequency (f_n)	50, 60 Hz
Relay phase nominal current (I_n)	1 A, 5 A
Phase CT nominal primary current (I_{np})	1 A...10 kA
Relay residual nominal current (I_{En})	1 A, 5 A
Residual CT nominal primary current (I_{Enp})	1 A...10 kA
Relay nominal voltage (phase-to-phase) (U_n)	50...130 V or 200...520 V
Relay nominal voltage (phase-to-ground)	$E_n = U_n/\sqrt{3}$
Line VT primary nominal voltage (phase-to-phase) (U_{np})	50 V..500 kV
Relay residual nominal voltage (direct measure) (U_{En})	50...130 V
Residual primary nominal voltage (phase-to-phase) · √3 (U_{Enp})	50 V...500 kV

Rated values (ThySensor input versions)

Relay nominal frequency (f_n)	50, 60 Hz
Phase CT nominal primary current (I_{np})[1]	1 A...10 kA
Relay residual nominal current (I_{En})	1 A, 5 A
Residual CT nominal primary current (I_{Enp})	1 A...10 kA
Relay nominal voltage (phase-to-phase) (U_n)	50...130 V or 200...520 V
Relay nominal voltage (phase-to-ground)	$E_n = U_n/\sqrt{3}$
Line VT primary nominal voltage (phase-to-phase) (U_{np})	50 V..500 kV
Relay residual nominal voltage (calculated)	$U_{ECN} = U_n \cdot \sqrt{3} = 3 \cdot E_n$

Note [1] - It represents the reference value to which they are expressed all the settings and corresponds to the rated primary current sensors

Binary input timers

ON delay time (IN1 t_{ON}, IN2 t_{ON})	0.00...100.0 s
OFF delay time (IN1 t_{OFF}, IN2 t_{OFF})	0.00...100.0 s
Logic	Active-ON/Active-OFF

Relay output timers

Minimum pulse width (t_{TR})	0.000...0.500 s

PROTECTIVE FUNCTIONS

Base current IB (traditional CTs versions)

Base current (I_B)
0.10...2.50 I_n

Note - The base current I_B represents the rated current of the component of the protected (line, transformer ,...), expressed in relation to the CT rated current. Since usually the secondary current rating of the line CT coincides with the current rating of the relay, the I_B value must be set to the ratio of the nominal current of the protected equipment and the CT primary rated current.

Base current IB (ThySensor versions)

Base current (I_B)
0.10...2.50 I_n

Note - The base current I_B represents the rated current of the component of the protected (line, transformer ,...), expressed in relation to the CT rated current. The I_B value must be set to the ratio of the nominal current of the protected equipment and the ThySensor primary current (630 A).

Thermal protection with RTD thermometric probes - 26

Alarm	
• Alarm threshold θ_{ALx} (x=1...8)	0...200 °C
• Operating time $t_{\theta ALx}$ (x=1...8)	0....100 s
Trip	
• Trip threshold $\theta_{>x}$ (x=1...8)	0...200 °C
• Operating time $t_{\theta >x}$ (x=1...8)	0....100 s

Note: The element becomes available when the MPT module is enabled and connected to Thybus

Undervoltage - 27

Common configuration:	
• Voltage measurement type for 27 (*U*type27) [1]	U_{ph-ph}/U_{ph-n}
• 27 Operating logic (*Logic*27)	AND/OR
U< Element	
• *U<* Curve type (*U<*Curve)	DEFINITE, INVERSE [2]
Definite time	
• 27 First threshold definite time ($U_{<def}$)	0.05...1.10 U_n/E_n
• $U_{<def}$ Operating time ($t_{U<def}$)	0.03...100.0 s
Inverse time	
• 27 First threshold inverse time ($U_{<inv}$)	0.05...1.10 U_n/E_n
• $U_{<inv}$ Operating time ($t_{U<inv}$)	0.10...100.0 s
U<< Element	
Definite time	
• 27 Second threshold definite time ($U_{<<def}$)	0.05...1.10 U_n/E_n
• $U_{<<def}$ Operating time ($t_{U<<def}$)	0.03...100.0 s

Note [1] - With U_{ph-ph} setting all threshold are in p.u. U_n
With U_{ph-n} setting all threshold are in p.u. E_n

Note [2] - The mathematical formula for INVERSE curves is:
$t = 0.75 \cdot t_{U<inv} / [1 - (U/U_{<inv})]$, *where:*
t = trip time (in seconds)
$t_{U<inv}$ *= operating time setting (in seconds)*
U = input voltage
$U_{<inv}$ *= threshold setting*

Thermal image - 49

Common configuration:	
• Initial thermal image $\Delta\theta_{IN}$ (Dth_{IN})	0.0...1.0 $\Delta\theta_B$
• Reduction factor at inrush (K_{INR})	1.0...3.0
• Thermal time constant τ (*T*)	1...200 min
• DthCLP Activation time (t_{DthCLP})	0.00...100.0 s
DthAL1 Element	
• 49 First alarm threshold $\Delta\theta_{AL1}$ (Dth_{AL1})	0.3...1.0 $\Delta\theta_B$
DthAL2 Element	
• 49 Second alarm threshold $\Delta\theta_{AL2}$ (Dth_{AL2})	0.5...1.2 $\Delta\theta_B$
Dth> Element	
• 49 Trip threshold $\Delta\theta$ (*Dth>*)	1.100...1.300 $\Delta\theta_B$

Phase overcurrent - 50/51 (traditional CTs versions)

I> Element	
• *I>* Curve type (*I>*Curve)	DEFINITE IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, RECTIFIER, I²t or EM
• $I_{CLP>}$ Activation time ($t_{CLP>}$)	0.00...100.0 s
• *I>* Reset time delay ($t_{>RES}$)	0.00...100.0 s
Definite time	
• 50/51 First threshold definite time ($I_{>def}$)	0.100...40.0 I_n
• $I_{>def}$ within CLP ($I_{CLP>def}$)	0.100...40.0 I_n
• $I_{>def}$ Operating time ($t_{>def}$)	0.04...200 s
Inverse time	
• 50/51 First threshold inverse time ($I_{>inv}$)	0.100...20.00 I_n
• $I_{>inv}$ within CLP ($I_{CLP>inv}$)	0.100...20.00 I_n
• $I_{>inv}$ Operating time ($t_{>inv}$)	0.02...60.0 s
I>> Element	
• Type characteristic	DEFINITE or I²t
• $I_{CLP>>}$ Activation time ($t_{CLP>>}$)	0.00...100.0 s
• *I>>* Reset time delay ($t_{>>RES}$)	0.00...100.0 s
Definite time	
• 50/51 Second threshold definite time ($I_{>>def}$)	0.100...40.0 I_n
• $I_{>>def}$ within CLP ($I_{CLP>>def}$)	0.100...40.0 I_n
• $I_{>>def}$ Operating time ($t_{>>def}$)	0.03...10.00 s
Inverse time	
• 50/51 Second threshold inverse time ($I_{>>inv}$)	0.100...20.00 I_n
• $I_{>>inv}$ within CLP ($I_{CLP>>inv}$)	0.100...20.00 I_n
• $I_{>>inv}$ Operating time ($t_{>>inv}$)	0.02...10.00 s
I>>> Element	
• $I_{CLP>>>}$ Activation time ($t_{CLP>>>}$)	0.00...100.0 s
• *I>>>* Reset time delay ($t_{>>>RES}$)	0.00...100.0 s
Definite time	
• 50/51 Third threshold definite time ($I_{>>>def}$)	0.100...40.0 I_n
• $I_{>>>def}$ within CLP ($I_{CLP>>>def}$)	0.100...40.0 I_n
• $I_{>>>def}$ Operating time ($t_{>>>def}$)	0.03...10.00 s

Phase overcurrent - 50/51 (ThySensor versions)

I> Element
- *I*> Curve type (*I*>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI,, RECTIFIER, I²t or EM
- $I_{CLP>}$ Activation time ($t_{CLP>}$) 0.00...100.0 s
- *I*> Reset time delay ($t_{>RES}$) 0.00...100.0 s

Definite time
- 50/51 First threshold definite time ($I_{>def}$) 0.010...30.0 I_n
- $I_{>def}$ within CLP ($I_{CLP>def}$) 0.010...30.0 I_n
- $I_{>def}$ Operating time ($t_{>def}$) 0.04...200 s

Inverse time
- 50/51 First threshold inverse time ($I_{>inv}$) 0.010...20.00 I_n
- $I_{>inv}$ within CLP ($I_{CLP>inv}$) 0.010...20.00 I_n
- $I_{>inv}$ Operating time ($t_{>inv}$) 0.02...60.0 s

I>> Element
- Type characteristic DEFINITE or I²t
- $I_{CLP>>}$ Activation time ($t_{CLP>>}$) 0.00...100.0 s
- *I*>> Reset time delay ($t_{>>RES}$) 0.00...100.0 s

Definite time
- 50/51 Second threshold definite time ($I_{>>def}$) 0.010...30.0 I_n
- $I_{>>def}$ within CLP ($I_{CLP>>def}$) 0.010...30.0 I_n
- $I_{>>def}$ Operating time ($t_{>>def}$) 0.03...10.00 s

Inverse time
- 50/51 Second threshold inverse time ($I_{>>inv}$) 0.010...20.00 I_n
- $I_{>>inv}$ within CLP ($I_{CLP>>inv}$) 0.010...20.00 I_n
- $I_{>>inv}$ Operating time ($t_{>>inv}$) 0.02...10.00 s

I>>> Element
- $I_{CLP>>>}$ Activation time ($t_{CLP>>>}$) 0.00...100.0 s
- *I*>>> Reset time delay ($t_{>>>RES}$) 0.00...100.0 s

Definite time
- 50/51 Third threshold definite time ($I_{>>>def}$) 0.010...30.0 I_n
- $I_{>>>def}$ within CLP ($I_{CLP>>>def}$) 0.010...30.0 I_n
- $I_{>>>def}$ Operating time ($t_{>>>def}$) 0.03...10.00 s

Residual overcurrent - 50N/51N

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
- I_E> Reset time delay ($t_{E>RES}$) 0.00...100.0 s

Definite time
- 50N/51N First threshold definite time ($I_{E>def}$) 0.002...10.00 I_{En}
- $I_{E>def}$ within CLP ($I_{ECLP>def}$) 0.002...10.00 I_{En}
- $I_{E>def}$ Operating time ($t_{E>def}$) 0.04...200 s

Inverse time
- 50N/51N First threshold inverse time ($I_{E>inv}$) 0.002...2.00 I_{En}
- $I_{E>inv}$ within CLP ($I_{ECLP>inv}$) 0.002...2.00 I_{En}
- $I_{E>inv}$ Operating time ($t_{E>inv}$) 0.02...60.0 s

I_E>> Element
- $I_{ECLP>>}$ Activation time ($t_{ECLP>>}$) 0.00...100.0 s
- I_E>> Reset time delay ($t_{E>>RES}$) 0.00...100.0 s

Definite time
- 50N/51N Second threshold definite time ($I_{E>>def}$) 0.002...10.00 I_{En}
- $I_{E>>def}$ within CLP ($I_{ECLP>>def}$) 0.02...10.00 I_{En}
- $I_{E>>def}$ Operating time ($t_{E>>def}$) 0.03...10.00 s

I_E>>> Element
- $I_{ECLP>>>}$ Activation time ($t_{ECLP>>>}$) 0.00...100.0 s
- $I_{ECLP>>>}$ Reset time delay ($t_{E>>>RES}$) 0.00...100.0 s

Definite time
- 50N/51N Third threshold definite time ($I_{E>>>def}$) 0.002...10.00 I_{En}
- $I_{ECLP>>>def}$ within CLP ($I_{ECLP>>>def}$) 0.002...10.00 I_{En}
- $I_{ECLP>>>def}$ Operating time ($t_{E>>>def}$) 0.03...10.00 s

Overvoltage - 59

Common configuration:
- Voltage measurement type for 59 (*U*type59) [1] U_{ph-ph}/U_{ph-n}
- 59 Operating logic (*Logic*59) AND/OR

U> Element
- *U*> Curve type (*U*>Curve) DEFINITE, INVERSE [2]

Definite time
- 59 First threshold definite time ($U_{>def}$) 0.50...1.50 U_n/E_n
- $U_{>def}$ Operating time ($t_{U>def}$) 0.03...100.0 s

Inverse time
- 59 First threshold inverse time ($U_{>inv}$) 0.50...1.50 U_n/E_n
- $U_{>inv}$ Operating time ($t_{U>inv}$) 0.10...100.0 s

U>> Element

Definite time
- 59 Second threshold definite time ($U_{>>def}$) 0.50...1.50 U_n/E_n
- $U_{>>def}$ Operating time ($t_{U>>def}$) 0.03...100.0 s

Note [1] - With U_{ph-ph} setting all threshold are in p.u. U_n
With U_{ph-n} setting all threshold are in p.u. E_n

Note [2] - The mathematical formula for INVERSE curves is:
$t = 0.5 \cdot t_{U>inv} / [(U/U_{>inv})-1]$, where:
t = trip time (in seconds)
$t_{U>inv}$ = operating time setting (in seconds)
U = input voltage
$U_{>inv}$ = threshold setting

Residual overvoltage - 59N (traditional VTs versions)

Common configuration:
- Residual voltage measurement for 59N- direct/calc. U_E/U_{EC}
- 59N Operating mode from 74VT internal (*74VTint59N*) OFF/Block
- 59N Operating mode from 74VT external (*74VText59N*) OFF/Block

U_E> Element
- U_E> Curve type (U_E>Curve) DEFINITE, INVERSE [1]
- U_E> Reset time delay ($t_{UE>RES}$) 0.00...100.0 s

Definite time
- 59N First threshold definite time ($U_{E>def}$) 0.01...0.70 U_{En}
- $U_{E>def}$ Operating time ($t_{UE>def}$) 0.07...100.0 s

Inverse time
- 59N First threshold inverse time ($U_{E>inv}$) 0.01...0.50 U_{En}
- $U_{E>inv}$ Operating time ($t_{UE>inv}$) 0.10...100.0 s

U_E>> Element
- U_E>> Reset time delay ($t_{UE>>RES}$) 0.00...100.0 s
- 59N Second threshold definite time ($U_{E>>def}$) 0.01...0.70 U_{En}
- $U_{E>>def}$ Operating time ($t_{UE>>def}$) 0.07...100.0 s

Note [1] - The mathematical formula for INVERSE curves is:
$t = 0.5 \cdot t_{UE>inv} / [(U_E/U_{E>inv})-1$ where:
t = trip time (in seconds)
$t_{UE>inv}$ = operating time setting (in seconds)
U_E = residual input voltage
$U_{E>inv}$ = threshold setting

Residual overvoltage - 59N (ThySensor versions)

Common configuration:
- Residual voltage measurement for 59N- calculated U_{EC}
- 59N Operating mode from 74VT internal (*74VTint59N*) OFF/Block
- 59N Operating mode from 74VT external (*74VText59N*) OFF/Block

U_E> Element
- U_E> Curve type (U_E>Curve) DEFINITE, INVERSE [1]
- U_E> Reset time delay ($t_{UE>RES}$) 0.00...100.0 s

Definite time
- 59N First threshold definite time ($U_{E>def}$) 0.01...0.70 U_{En}
- $U_{E>def}$ Operating time ($t_{UE>def}$) 0.07...100.0 s

Inverse time
- 59N First threshold inverse time ($U_{E>inv}$) 0.01...0.50 U_{En}
- $U_{E>inv}$ Operating time ($t_{UE>inv}$) 0.10...100.0 s

U_E>> Element
- U_E>> Reset time delay ($t_{UE>>RES}$) 0.00...100.0 s
- 59N Second threshold definite time ($U_{E>>def}$) 0.01...0.70 U_{En}
- $U_{E>>def}$ Operating time ($t_{UE>>def}$) 0.07...100.0 s

Note [1] - The mathematical formula for INVERSE curves is:
$t = 0.5 \cdot t_{UE>inv} / [(U_{EC}/U_{E>inv})-1$ where:
t = trip time (in seconds)
$t_{UE>inv}$ = operating time setting (in seconds)
U_{EC} = residual input voltage (calculated)
$U_{E>inv}$ = threshold setting

Phase directional overcurrent - 67 (CTs and VTs versions)

Common configuration:
- 67 Operating mode (*Mode67*) *I/I·cos*
- 67 Operating logic (*Logic*67) 1/3 / 2/3
- 67 Operating mode from 74VT internal (*74VTint67*) OFF/Block/Not directional
- 67 Operating mode from 74VT external (*74VText67*) OFF/Block/Not directional

I_{PD}> Element
- I_{PD}> Curve type (I_{PD}>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, RECTIFIER, I^2t or EM
- I_{PDCLP}> Activation time ($t_{PDCLP>}$) 0.00...100.0 s
- I_{PD}> Reset time delay ($t_{PD>RES}$) 0.00...100.0 s

Definite time
- 67 First threshold definite time ($I_{PD>def}$) 0.100...40.0 I_n
- $I_{PD>def}$ characteristic angle ($Theta_{PD>def}$) 0...359°
- $I_{PD>def}$ within CLP ($I_{PDCLP>def}$) 0.100...40.0 I_n
- $I_{PD>def}$ Operating time ($t_{PD>def}$) 0.05...200 s

Inverse time
- 67 First threshold inverse time ($I_{PD>inv}$) 0.100...10.0 I_n
- $I_{PD>inv}$ characteristic angle ($Theta_{PD>inv}$) 0...359°
- $I_{PD>inv}$ within CLP ($I_{PDCLP>inv}$) 0.100...10.0 I_n
- $I_{PD>inv}$ Operating time ($t_{PD>inv}$) 0.02...60.0 s

I_{PD}>> Element
- I_{PD}> Curve type (I_{PD}>>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, RECTIFIER, I^2t or EM
- I_{PDCLP}>> Activation time ($t_{PDCLP>>}$) 0.00...100.0 s
- I_{PD}>> Reset time delay ($t_{PD>>RES}$) 0.00...100.0 s

Definite time
- 67 Second threshold definite time ($I_{PD>>def}$) 0.100...40.0 I_n
- $I_{PD>>def}$ characteristic angle ($Theta_{PD>>def}$) 0...359°
- $I_{PD>>def}$ within CLP ($I_{PDCLP>>def}$) 0.100...40.0 I_n
- $I_{PD>>def}$ Operating time ($t_{PD>>def}$) 0.04...200 s

Inverse time
- 67 Second threshold inverse time ($I_{PD>>inv}$) 0.100...10.0 I_n
- $I_{PD>>inv}$ characteristic angle ($Theta_{PD>>inv}$) 0...359°
- $I_{PD>>inv}$ within CLP ($I_{PDCLP>>inv}$) 0.100...10.0 I_n
- $I_{PD>>inv}$ Operating time ($t_{PD>>inv}$) 0.02...60.0 s

I_{PD}>>> Element
- I_{PDCLP}>>> Activation time ($t_{PDCLP>>>}$) 0.00...100.0 s
- I_{PD}>>> Reset time delay ($t_{PD>>>RES}$) 0.00...100.0 s

Definite time
- 67 Third threshold definite time ($I_{PD>>>def}$) 0.100...40.0 I_n
- $I_{PD>>>def}$ characteristic angle ($Theta_{PD>>>def}$) 0...359°
- $I_{PD>>>def}$ within CLP ($I_{PDCLP>>>def}$) 0.100...40.0 I_n
- $I_{PD>>>def}$ Operating time ($t_{PD>>>def}$) 0.04...10.00 s

I_{PD}>>>> Element
- I_{PDCLP}>>>> Activation time ($t_{PDCLP>>>>}$) 0.00...100.0 s
- I_{PD}>>>> Reset time delay ($t_{PD>>>>RES}$) 0.00...100.0 s

Definite time
- 67 Fourth threshold definite time ($I_{PD>>>>def}$) 0.100...40.0 I_n
- $I_{PD>>>>def}$ characteristic angle ($Theta_{PD>>>>def}$) 0...359°
- $I_{PD>>>>def}$ within CLP ($I_{PDCLP>>>>def}$) 0.100...40.0 I_n
- $I_{PD>>>>def}$ Operating time ($t_{PD>>>>def}$) 0.04...10.00 s

— Phase directional overcurrent - 67 (ThySensor versions)

Common configuration:
- 67 Operating mode (*Mode67*) *I/I·cos*
- 67 Operating logic (*Logic*67) 1/3 / 2/3
- 67 Operating mode from 74VT internal (*74VTint67*) OFF/Block/Not directional
- 67 Operating mode from 74VT external (*74VText67*) OFF/Block/Not directional

I_{PD}> Element
- I_{PD}> Curve type (I_{PD}>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, RECTIFIER, I^2t or EM
- I_{PDCLP}> Activation time ($t_{PDCLP>}$) 0.00...100.0 s
- I_{PD}> Reset time delay ($t_{PD>RES}$) 0.00...100.0 s

Definite time
- 67 First threshold definite time ($I_{PD>def}$) 0.010...30.0 I_n
- $I_{PD>def}$ characteristic angle ($Theta_{PD>def}$) 0...359°
- $I_{PD>def}$ within CLP ($I_{PDCLP>def}$) 0.010...30.0 I_n
- $I_{PD>def}$ Operating time ($t_{PD>def}$) 0.05...200 s

Inverse time
- 67 First threshold inverse time ($I_{PD>inv}$) 0.010...10.00 I_n
- $I_{PD>inv}$ characteristic angle ($Theta_{PD>inv}$) 0...359°
- $I_{PD>inv}$ within CLP ($I_{PDCLP>inv}$) 0.010...10.00 I_n
- $I_{PD>inv}$ Operating time ($t_{PD>inv}$) 0.02...60.0 s

I_{PD}>> Element
- I_{PD}> Curve type (I_{PD}>>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI RECTIFIER, I^2t or EM
- I_{PDCLP}>> Activation time ($t_{PDCLP>>}$) 0.00...100.0 s
- I_{PD}>> Reset time delay ($t_{PD>>RES}$) 0.00...100.0 s

Definite time
- 67 Second threshold definite time ($I_{PD>>def}$) 0.010...30.0 I_n
- $I_{PD>>def}$ characteristic angle ($Theta_{PD>>def}$) 0...359°
- $I_{PD>>def}$ within CLP ($I_{PDCLP>>def}$) 0.010...30.0 I_n
- $I_{PD>>def}$ Operating time ($t_{PD>>def}$) 0.04...200 s

Inverse time
- 67 Second threshold inverse time ($I_{PD>>inv}$) 0.010...10.00 I_n
- $I_{PD>>inv}$ characteristic angle ($Theta_{PD>>inv}$) 0...359°
- $I_{PD>>inv}$ within CLP ($I_{PDCLP>>inv}$) 0.010...10.00 I_n
- $I_{PD>>inv}$ Operating time ($t_{PD>>inv}$) 0.02...60.0 s

I_{PD}>>> Element
- I_{PDCLP}>>> Activation time ($t_{PDCLP>>>}$) 0.00...100.0 s
- I_{PD}>>> Reset time delay ($t_{PD>>>RES}$) 0.00...100.0 s

Definite time
- 67 Third threshold definite time ($I_{PD>>>def}$) 0.010...30.0 I_n
- $I_{PD>>>def}$ characteristic angle ($Theta_{PD>>>def}$) 0...359°
- $I_{PD>>>def}$ within CLP ($I_{PDCLP>>>def}$) 0.010...30.0 I_n
- $I_{PD>>>def}$ Operating time ($t_{PD>>>def}$) 0.04...10.00 s

I_{PD}>>>> Element
- I_{PDCLP}>>>> Activation time ($t_{PDCLP>>>>}$) 0.00...100.0 s
- I_{PD}>>>> Reset time delay ($t_{PD>>>>RES}$) 0.00...100.0 s

Definite time
- 67 Fourth threshold definite time ($I_{PD>>>>def}$) 0.010...30.0 I_n
- $I_{PD>>>>def}$ characteristic angle ($Theta_{PD>>>>def}$) 0...359°
- $I_{PD>>>>def}$ within CLP ($I_{PDCLP>>>>def}$) 0.010...30.0 I_n
- $I_{PD>>>>def}$ Operating time ($t_{PD>>>>def}$) 0.04...10.00 s

— Directional earth fault overcurrent - 67N (traditional CTs)

Common configuration:
- 67N Operating mode (*Mode67N*) *I/I·cos*
- Residual voltage measurement type for 67N - direct/calculated (*3VoType67N*) U_E / U_{EC}
- 67N Multiplier of threshold for insensitive zone (*M*) 1.5...10.0
- 67N Operating mode from 74VT internal (*74VTint67N*) OFF/Block/Not directional
- 67N Operating mode from 74VT external (*74VText67N*) OFF/Block/Not directional

I_{ED}> Element
- I_{ED}> Curve type DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, EM
- I_{EDCLP}> Activation time ($t_{EDCLP>}$) 0.00...100.0 s
- I_{ED}> Reset time delay ($t_{ED>RES}$) 0.00...100.0 s

Definite time

67N First threshold definite time ($I_{ED>def}$ - $U_{ED>def}$)
- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>def}$ within CLP ($I_{EDCLP>def}$) 0.002...10.00 I_{En}
- $I_{ED>def}$ Operating time ($t_{ED>def}$) 0.05...200 s

Inverse time

67N First threshold inverse time ($I_{ED>inv}$ - $U_{ED>inv}$)
- Residual current pickup value 0.002...2.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>inv}$ within CLP ($I_{EDCLP>inv}$) 0.002...2.00 I_{En}
- $I_{ED>inv}$ Operating time ($t_{ED>inv}$) 0.02...60.0 s

I_{ED}>> Element
- I_{ED}> Curve type (I_{ED}>>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, EM
- I_{EDCLP}>> Activation time ($t_{EDCLP>>}$) 0.00...100.0 s
- I_{ED}>> Reset time delay ($t_{ED>>RES}$) 0.00...100.0 s

Definite time

67N Second threshold definite time ($I_{ED>>def}$ - $U_{ED>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>def}$ within CLP ($I_{EDCLP>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>def}$ Operating time ($t_{ED>>def}$) 0.05...10.00 s

Inverse time

67N Second threshold inverse time ($I_{ED>>inv}$ - $U_{ED>>inv}$)

- Residual current pickup value 0.002...2.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>inv}$ within CLP ($I_{EDCLP>>inv}$) 0.002...2.00 I_{En}
- $I_{ED>inv}$ Operating time ($t_{ED>>inv}$) 0.02...10.00 s

I_{ED}>>> Element

- I_{EDCLP}>>> Activation time ($t_{EDCLP>>>}$) 0.00...100.0 s
- I_{ED}>>> Reset time delay ($t_{ED>>>RES}$) 0.00...100.0 s

Definite time

67N Third threshold definite time ($I_{ED>>>def}$ - $U_{ED>>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>>def}$ within CLP ($I_{EDCLP>>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>>def}$ Operating time ($t_{ED>>>def}$) 0.05...10.00 s

I_{ED}>>>> Element

- I_{EDCLP}>>>> Activation time ($t_{EDCLP>>>>}$) 0.00...100.0 s
- I_{ED}>>>> Reset time delay ($t_{ED>>>>RES}$) 0.00...100.0 s

Definite time

67N Fourth threshold definite time ($I_{ED>>>>def}$ - $U_{ED>>>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>>>def}$ within CLP ($I_{EDCLP>>>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>>>def}$ Operating time ($t_{ED>>>>def}$) 0.05...10.00 s

— Directional earth fault overcurrent - 67N (Thysensor)

Common configuration:

- 67N Operating mode (*Mode67N*) *I/I·cos*
- Residual voltage measurement U_{EC}
- 67N Multiplier of threshold for insensitive zone (*M*) 1.5...10.0
- 67N Operating mode from 74VT internal (*74VTint67N*) OFF/Block/Not directional
- 67N Operating mode from 74VT external (*74VText67N*) OFF/Block/Not directional

I_{ED}> Element

- I_{ED}> Curve type DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, EM
- I_{EDCLP}> Activation time ($t_{EDCLP>}$) 0.00...100.0 s
- I_{ED}> Reset time delay ($t_{ED>RES}$) 0.00...100.0 s

Definite time

67N First threshold definite time ($I_{ED>def}$ - $U_{ED>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>def}$ within CLP ($I_{EDCLP>def}$) 0.002...10.00 I_{En}
- $I_{ED>def}$ Operating time ($t_{ED>def}$) 0.05...200 s

Inverse time

67N First threshold inverse time ($I_{ED>inv}$ - $U_{ED>inv}$)

- Residual current pickup value 0.002...2.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>inv}$ within CLP ($I_{EDCLP>inv}$) 0.002...2.00 I_{En}
- $I_{ED>inv}$ Operating time ($t_{ED>inv}$) 0.02...60.0 s

I_{ED}>> Element

- I_{ED}> Curve type (I_{ED}>>Curve) DEFINITE, IEC/BS A, B, C, ANSI/IEEE MI, VI, EI, EM
- I_{EDCLP}>> Activation time ($t_{EDCLP>>}$) 0.00...100.0 s
- I_{ED}>> Reset time delay ($t_{ED>>RES}$) 0.00...100.0 s

Definite time

67N Second threshold definite time ($I_{ED>>def}$ - $U_{ED>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>def}$ within CLP ($I_{EDCLP>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>def}$ Operating time ($t_{ED>>def}$) 0.05...10.00 s

Inverse time

67N Second threshold inverse time ($I_{ED>>inv}$ - $U_{ED>>inv}$)

- Residual current pickup value 0.002...2.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>inv}$ within CLP ($I_{EDCLP>>inv}$) 0.002...2.00 I_{En}
- $I_{ED>inv}$ Operating time ($t_{ED>>inv}$) 0.02...10.00 s

I_{ED}>>> Element

- I_{EDCLP}>>> Activation time ($t_{EDCLP>>>}$) 0.00...100.0 s
- I_{ED}>>> Reset time delay ($t_{ED>>>RES}$) 0.00...100.0 s

Definite time

67N Third threshold definite time ($I_{ED>>>def}$ - $U_{ED>>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>>def}$ within CLP ($I_{EDCLP>>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>>def}$ Operating time ($t_{ED>>>def}$) 0.05...10.00 s

I_{ED}>>>> Element

- I_{EDCLP}>>>> Activation time ($t_{EDCLP>>>>}$) 0.00...100.0 s
- I_{ED}>>>> Reset time delay ($t_{ED>>>>RES}$) 0.00...100.0 s

Definite time

67N Fourth threshold definite time ($I_{ED>>>>def}$ - $U_{ED>>>>def}$)

- Residual current pickup value 0.002...10.00 I_{En}
- Residual voltage pickup value 0.004...0.500 U_{En}
- Characteristic angle 0...359°
- Half operating sector 1...180°
- $I_{ED>>>>def}$ within CLP ($I_{EDCLP>>>>def}$) 0.002...10.00 I_{En}
- $I_{ED>>>>def}$ Operating time ($t_{ED>>>>def}$) 0.05...10.00 s

— Selective block - BLOCK2

Selective block IN:

- BLIN Max activation time for phase protections (t_{B-IPh})0.10...10.00 s
- BLIN Max activation time for earth protections (t_{B-IE}) 0.10...10.00 s

Selective block OUT:

- BLOUT Dropout time delay for phase protections (t_{F-IPh}) 0.00...1.00 s
- BLOUT Drop-out time delay for phase protections (t_{F-IE}) 0.00...1.00 s
- BLOUT Drop-out time delay for phase and earth protections ($t_{F-IPh/IE}$) 0.00...1.00 s

— Internal selective block - BLOCK4

- Output internal selective block dropout time for phase protections (t_{F-IPh}) 0.00...10.00 s
- Output internal selective block dropout time for ground protections (t_{F-IE}) 0.00...10.00 s

— Breaker failure - BF

BF Phase current threshold (I_{BF}>) 0.05...1.00 I_n

BF Residual current threshold (I_{EBF}>) 0.01..2.00 I_{En}

BF Time delay (t_{BF}) 0.06...10.00 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

— VT supervision - 74VT

74VT Negative sequence overvoltage threshold ($U_{2VT>}$) 0.05...0.50 E_n

74VT Negative sequence overvoltage threshold ($I_{2VT>}$) 0.05...0.50 I_n

74VT Phase undervoltage threshold ($U_{VT<}$) 0.05...0.50 E_n

74VT Minimum change of current threshold 74VT ($D_{IVT<}$)0.05...0.50 I_n

74VT Undercurrent inhibition threshold ($I_{VT<}$) 0.100...40.0 I_n

74VT Alarm time delay (t_{VT-AL}) 0.0...10.0 s

CT supervision - 74CT

74CT Threshold (*S<*)	0.10...0.95
74CT Overcurrent threshold (*I**)	0.10...1.00 I_n
S< Operating time ($t_{S<}$)	0.03...200 s

Circuit Breaker supervision

Number of CB trips (*N.Open*)	0...10000
Cumulative CB tripping currents (*SumI*)	0...5000 I_n
CB opening time for I^2t calculation (t_{break})	0.05...1.00 s
Cumulative CB tripping I^2t (*SumI^2t*)	0...5000 $I_n^2 \cdot s$
CB max allowed opening time (t_{break}>)	0.05...1.00 s

Pilot wire diagnostic

BLOUT1 Diagnostic pulses period (*PulseBLOUT1*)
OFF - 0.1-1-5-10-60-120 s

BLIN1 Diagnostic pulses control time interval (*PulseBLIN1*)
OFF - 0.1-1-5-10-60-120 s

METERING & RECORDING

Measured parameters

Direct:

- Frequency — *f*
- Fundamental RMS phase currents — I_{L1}, I_{L2}, I_{L3}
- Fundamental RMS phase voltages — U_{L1}, U_{L2}, U_{L3}
- Fundamental RMS residual current — I_E
- Fundamental RMS residual voltage (Traditional VTs) — U_E

Calculated:

- Thermal image — *DTheta*
- Fundamental RMS phase-to-phase voltages — U_{12}, U_{23}, U_{31}
- Fundamental RMS calculated residual voltage — U_{EC}
- 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
- Maximum voltage between U_{L1}-U_{L2}-U_{L3} — U_{Lmax}
- Average voltage between U_{L1}-U_{L2}-U_{L3} — U_L
- Maximum voltage between U_{12}-U_{23}-U_{31} — U_{max}
- Average voltage between U_{12}-U_{23}-U_{31} — U

Phase:

- Displacement angle of I_{L1} respect to U_{L1} — *PhiL1*
- Displacement angle of I_{L2} respect to U_{L2} — *PhiL2*
- Displacement angle of I_{L3} respect to U_{L3} — *PhiL3*
- Displacement angle of I_{L1} respect to U_{23} — *Alpha1*
- Displacement angle of I_{L2} respect to U_{31} — *Alpha2*
- Displacement angle of I_{L3} respect to U_{12} — *Alpha3*
- Displacement angle of U_E respect to I_E (traditional VTs) — *PhiE*
- Displacement angle of U_{EC} respect to I_E — *PhiEC*

Sequence:

- Positive sequence current — I_1
- Negative sequence current — I_2
- Negative sequence current/positive sequence current ratio — I_2/I_1
- Negative sequence voltage — U_2

Power:

- Total active power — *P*
- Total reactive power — *Q*
- Total apparent power — *S*
- Power factor — *cosPhi*
- Phase active powers — P_{L1}, P_{L2}, P_{L3}
- Phase reactive powers — Q_{L1}, Q_{L2}, Q_{L3}
- Power factors — *cosPhiL1, cosPhiL2, cosPhiL3*

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

3rd harmonic:

- Third harmonic phase currents — I_{L1-3rd}, I_{L2-3rd}, I_{L3-3rd}
- Third harmonic residual current — I_{E-3rd}
- Third harmonic residual voltage (traditional VTs) — U_{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 currents:

- 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}

Demand power:

- Fixed active power demand — P_{FIX}
- Fixed reactive power demand — Q_{FIX}
- Rolling active power demand — P_{ROL}
- Rolling reactive power demand — Q_{ROL}
- Peak active power demand — P_{MAX}
- Peak reactive power demand — Q_{MAX}
- Minimum active power demand — P_{MIN}
- Minimum reactive power demand — Q_{MIN}

Energy:

- Positive active energy — E_{A+}
- Negative active energy — E_{A-}
- Total active energy — E_A
- Positive reactive energy — E_{Q+}
- Negative reactive energy — E_{Q-}
- Total reactive energy — E_Q

Fault recording (SFR)

Number of faults	20
Recording mode	circular

Trigger:

- External trigger — binary input set as Fault trigger
- Element and control pickup — output relays OFF-ON transition

Data recorded:

- Fault counter (resettable by ThySetter) — $0...10^9$
- Time stamp — Date and time
- Fault cause — start, trip, binary input
- Fundamental RMS phase currents — I_{L1r}, I_{L2r}, I_{L3r}
- Fundamental RMS residual current — I_{Er}
- Fundamental RMS phase voltages — U_{L1r}, U_{L2r}, U_{L3r}
- Fundamental RMS phase-to-phase voltages — U_{12r}, U_{23r}, U_{31r}
- Fundamental RMS residual voltages (measured and calculated) — U_{Er}, U_{ECr}
- Displacement angles (I_{L1}-U_{L1}, I_{L2}-U_{L2}, I_{L3}-U_{L3}) — Phi_{L1r}, Phi_{L2r}, Phi_{L3r}
- Displacement angles (I_{L1}-U_{23}, I_{L2}-U_{31}, I_{L3}-U_{L3}) — $Alpha_{1r}$, $Alpha_{2r}$, $Alpha_{3r}$
- Displacement angle U_E-I_E (traditional VTs) — Phi_{Er}
- Displacement angle U_{EC}-I_E — Phi_{ECr}
- Thermal image — *DTheta-r*
- Binary inputs state — IN1, IN2...INx
- Output relays state — K1...K6...K10
- Fault cause info (operating phase) — L1, L2, L3

Event recording (SER)

Number of events	300
Recording mode	circular

Trigger:

- Start and trip of any enabled protection or control function
- Binary inputs switching (off/on and on/off)
- Power ON and power OFF (auxiliary power supply)
- Setting changes

Data recorded:

- Event counter (resettable by ThySetter) — $0...10^9$
- Event cause — binary input/output relay/setting changes
- Time stamp — Date and time

Settings recording

Number of setting changes	8
Recording mode	circular

Data recorded:

- Setting counter — $0...10^9$
- Setting data — description and parameter
- Time stamp — Date and time

Digital Fault Recorder (Oscillography) [1]

File format	COMTRADE
Records	depending on setting [2]
Recording mode	circular
Sampling rate	> 1 kHz

Trigger setup:

• Pre-trigger time	0.05...1.00 s
• Post-trigger time	0.05...60.00 s
• Trigger from inputs	IN1, IN2...INx
• Trigger from outputs	K1...K6...K10
• Communication	ThySetter

Set sample channels:

• Instantaneous currents	i_{L1}, i_{L2}, i_{L3}, i_E
• Instantaneous voltages	u_{L1}, u_{L2}, u_{L3}, u_E

Set analog channels (Analog 1...12):

• Frequency	f
• Fundamental RMS phase currents	I_{L1}, I_{L2}, I_{L3}
• Fundamental RMS residual current	I_E
• Fundamental RMS phase voltages	U_{L1}, U_{L2}, U_{L3}
• Fundamental RMS residual voltage	U_E
• Fundamental RMS phase-to-phase voltages	U_{12}, U_{23}, U_{31}
• Fundamental RMS calculated residual voltage	U_{EC}
• Displacement angles I_{L1}-U_{L1}, I_{L2}-U_{L2}, I_{L3}-U_{L3}	Phi_{L1}, Phi_{L2}, Phi_{L3}
• Displacement angles I_{L1}-U_{23}, I_{L2}-U_{31}, I_{L3}-U_{L3}	$Alpha_1$, $Alpha_2$, $Alpha_3$
• Displacement angle U_E-I_E (traditional VTs)	Phi_E
• Displacement angle U_{EC}-I_E	Phi_{EC}
• Second harmonic phase currents	$I_{L1\text{-}2nd}$, $I_{L2\text{-}2nd}$, $I_{L3\text{-}2nd}$
• Maximum of the second harmonic phase currents/fundamental component percentage ratio	$I_{\text{-}2nd}$ / I_L
• Temperature	T1...T8

Set digital channels (Digital 1...12):

• Output relays state	K1...K6...K10
• Binary inputs state	IN1, IN2...INx

Note 1- A licence for the digital fault recorder function is required. The oscillography records are stored in non-volatile memory.

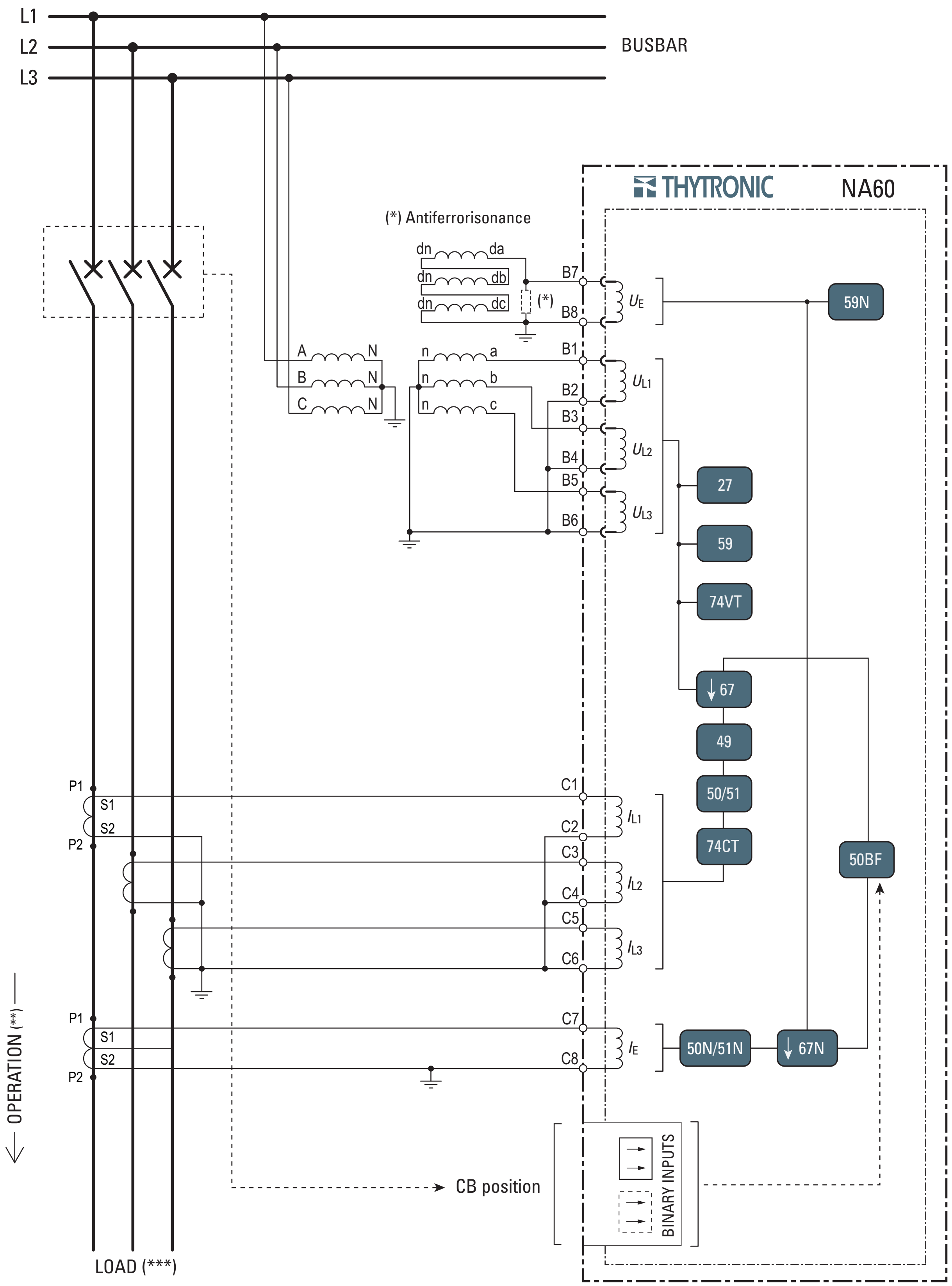
Note [2] - For instance, with following setting:

• *Pre-trigger time*	*0.25 s*
• *Post-trigger time*	*0.25 s*
• *Sampled channels*	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*

More than three hundred records can be stored

Oscillography (DFR)

Protective elements



(**) OPERATION FOR:
- 67 elements with characteristic angle adjusted within 0°... 90° or 270° ...359° ranges
- 67N elements for insulated neutral systems and characteristic angle setting = 90°

(***) MEASUREMENTS:
- Positive sign for measurement of active power and energy with passive load
- Negative sign for measurement of active power and energy with generators

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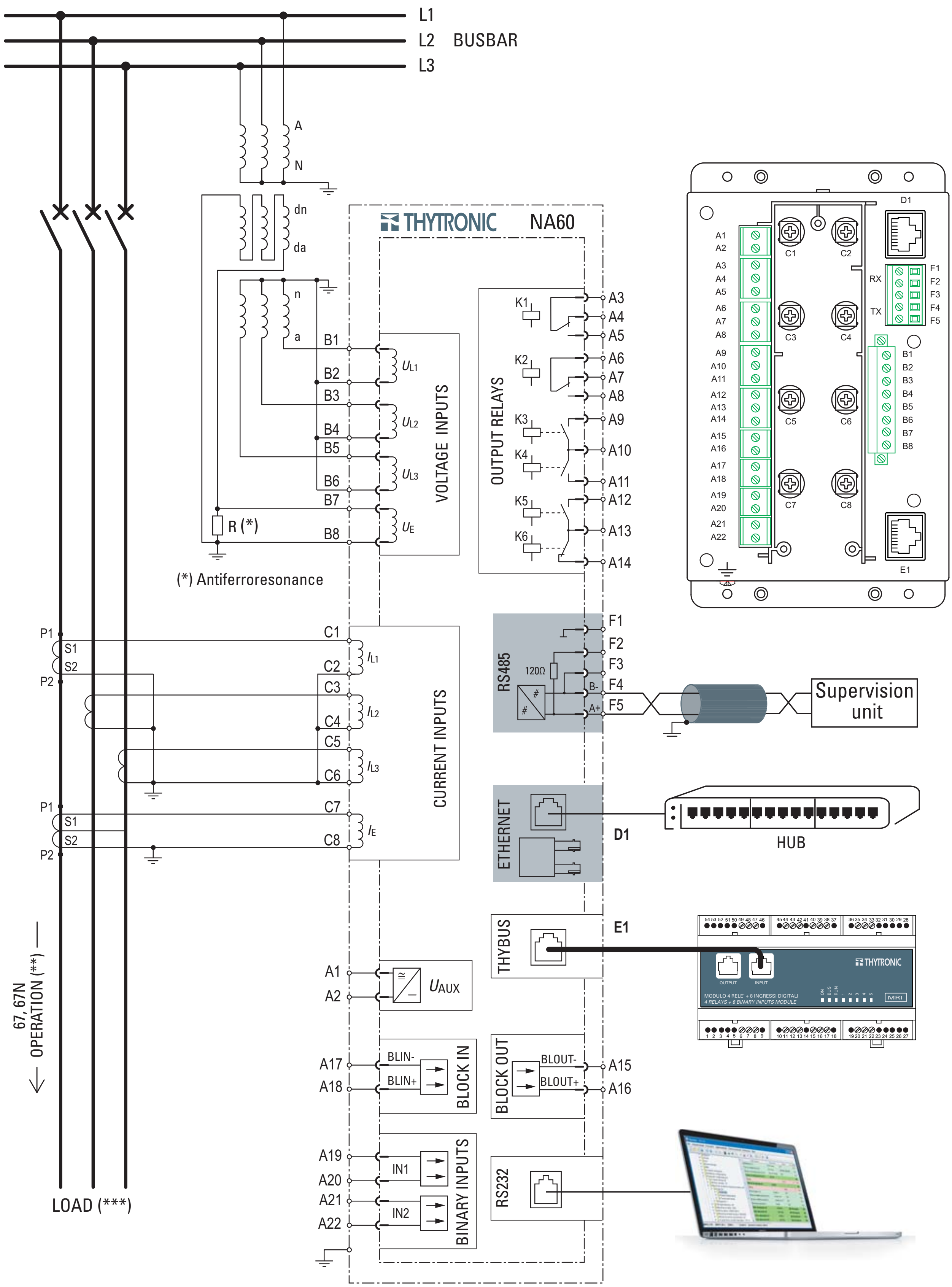
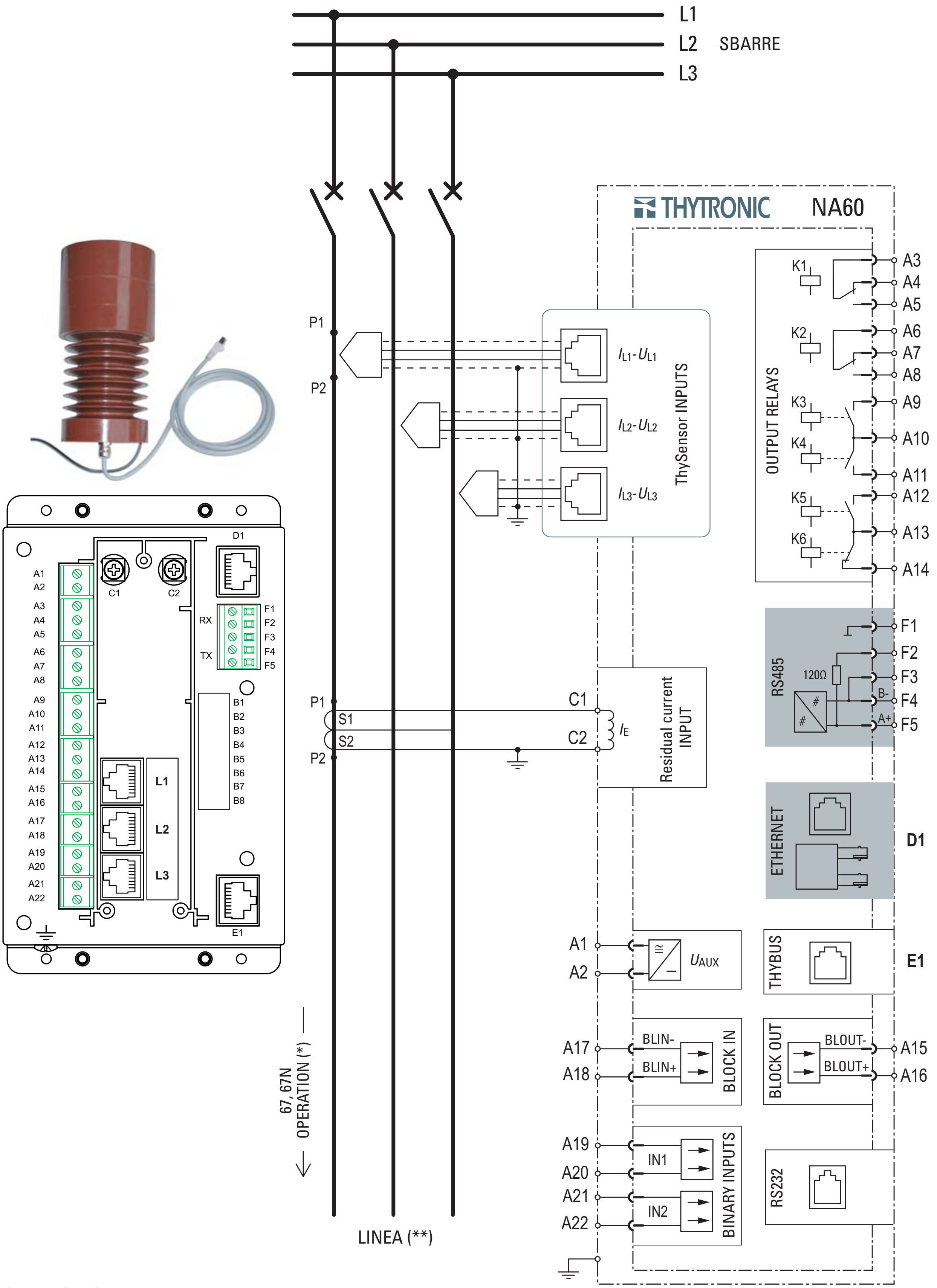
Connection diagram example with CTs and VTs inputs



(**) OPERATION FOR:
- 67 elements with characteristic angle adjusted within 0°... 90° or 270° ...359° ranges
- 67N elements for insulated neutral systems and characteristic angle setting = 90°

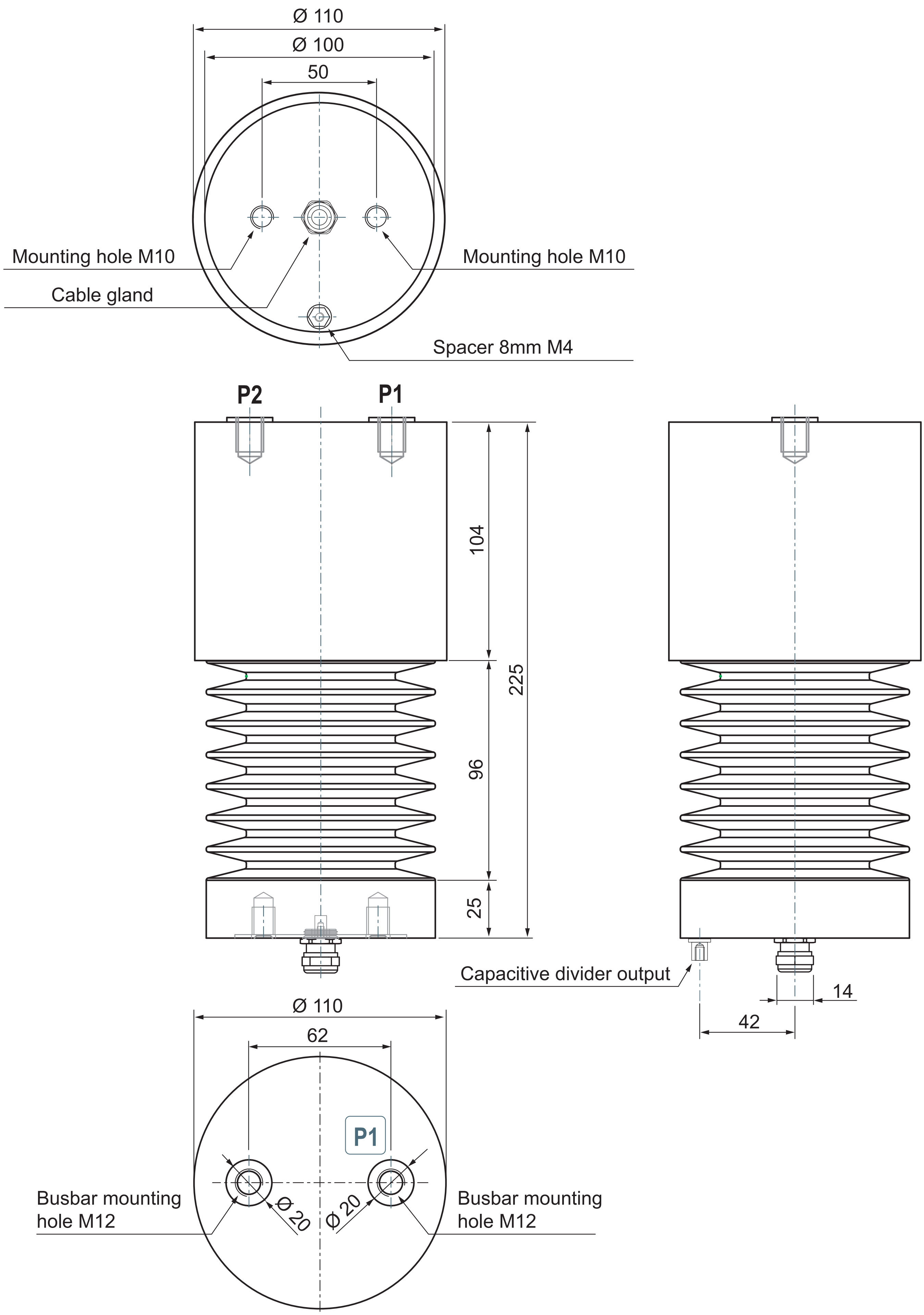
(***) MEASUREMENTS:
- Positive sign for measurement of active power and energy with passive load
- Negative sign for measurement of active power and energy with generators

Connection diagram example with ThySensor inputs



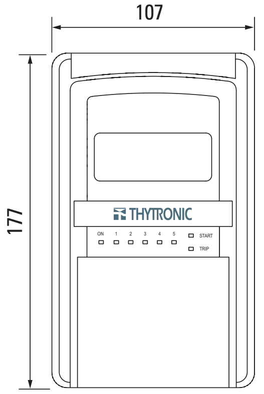
(*) OPERATION FOR:
- 67 elements with characteristic angle adjusted within 0°... 90° or 270° ...359° ranges
- 67N elements for insulated neutral systems and characteristic angle setting = 90°

(**) MESUREMENTS:
- Positive sign for measurement of active power and energy with passive load
- Negative sign for measurement of active power and energy with generators

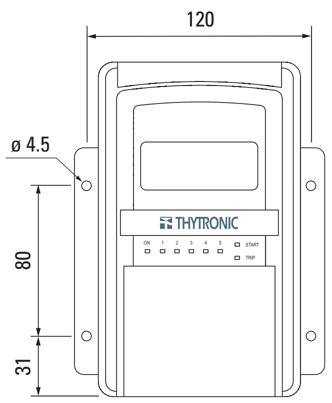

Ø 110
Ø 100
50
Mounting hole M10
Cable gland
Mounting hole M10
Spacer 8mm M4
P2
P1
104
225
96
25
Capacitive divider output
14
42
Ø 110
62
P1
Busbar mounting hole M12
Ø 20
Ø 20
Busbar mounting hole M12

DIMENSIONS

FRONT VIEW

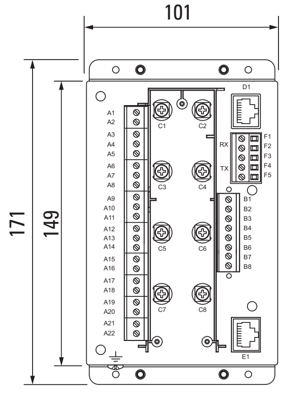


FLUSH MOUNTING

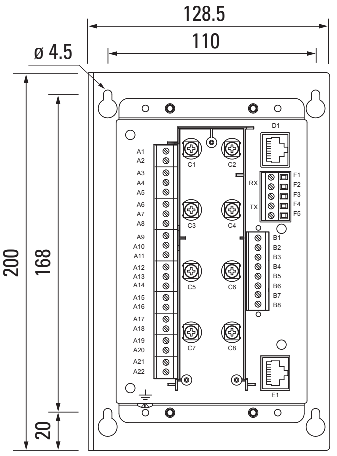


PROJECTING MOUNTING

REAR VIEW

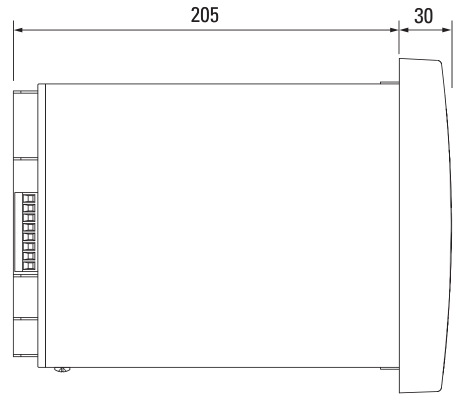


FLUSH MOUNTING

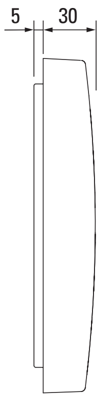


PROJECTING MOUNTING
(Separate operator panel)

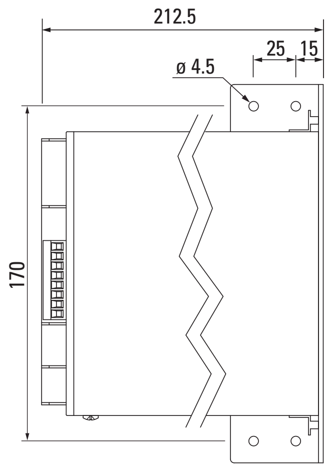
SIDE VIEW



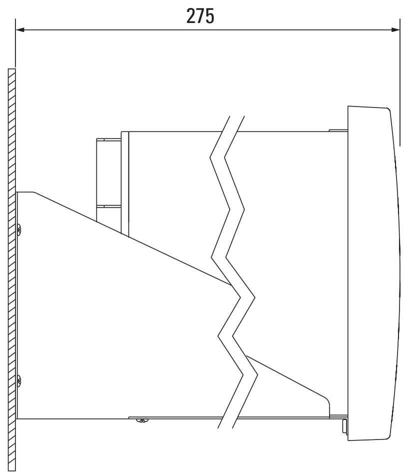
FLUSH MOUNTING



SEPARATE
OPERATOR PANEL

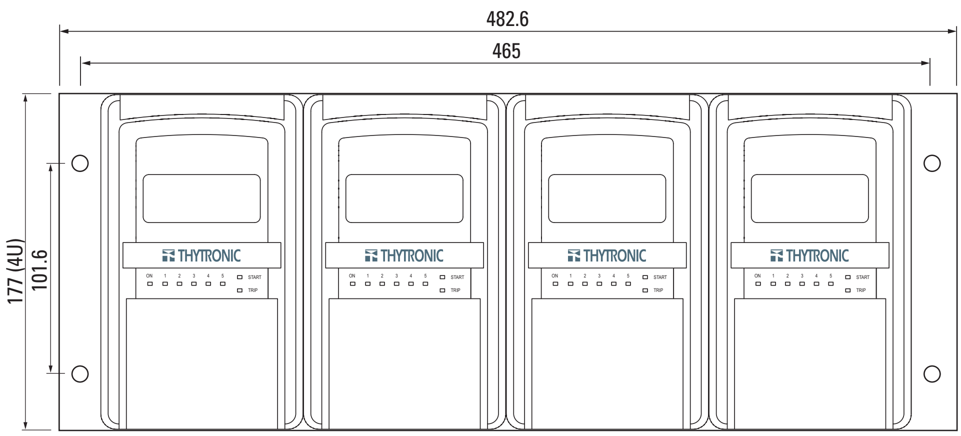


PROJECTING MOUNTING
(Separate operator panel)

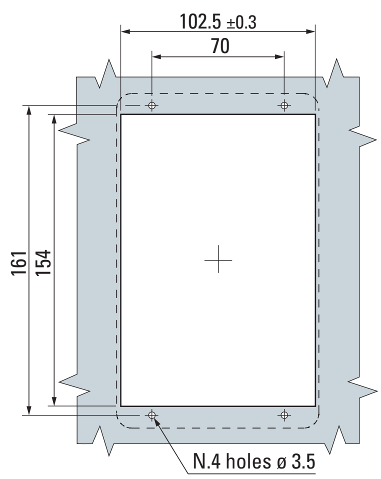


PROJECTING MOUNTING
(Stand alone)

RACK MOUNTING



FLUSH MOUNTING CUTOUT



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A PERSONALISED SERVICE OF THE PRODUCTION, A RAPID DELIVERY, A COMPETITIVE PRICE AND AN ATTENTIVE EVALUATION OF OUR CUSTOMERS NEEDS, HAVE ALL CONTRIBUTED IN MAKING US ONE OF THE BEST AND MOST RELIABLE PRODUCERS OF PROTECTIVE RELAYS. FORTY YEARS OF EXPERIENCE HAS MADE STANDARD THESE ADVANTAGES THAT ARE GREATLY APPRECIATED BY LARGE COMPANIES THAT DEAL ON THE INTERNATIONAL MARKET. A HIGHLY QUALIFIED AND MOTIVATED STAFF PERMITS US TO OFFER AN AVANT-GARDE PRODUCT AND SERVICE WHICH MEET ALL SAFETY AND CONTINUITY DEMANDS, VITAL IN THE GENERATION OF ELECTRIC POWER. OUR COMPANY PHILOSOPHY HAS HAD A POSITIVE REACTION FROM THE MARKET BY BACKING OUR COMMITMENT AND HENCE STIMULATING OUR GROWTH.

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Factory: 35127 Padova - Z.I. Sud - Via dell'Artigianato, 48 - Tel. +39 049 894 770 1 ra - Fax +39 049 870 139 0

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