SPR10

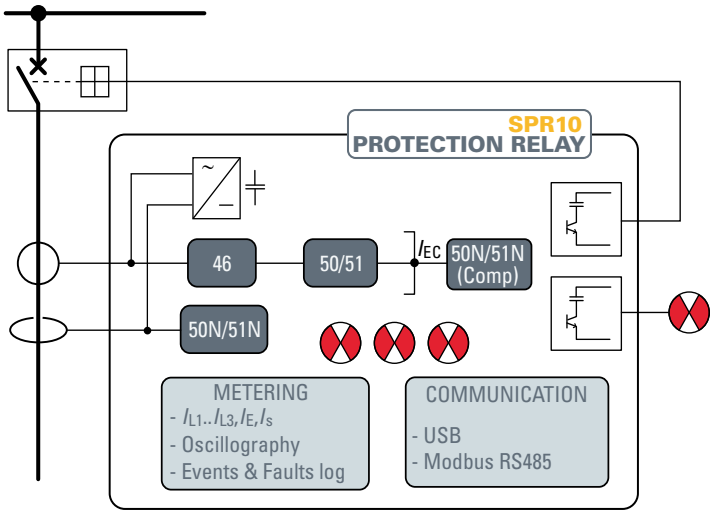
SELF POWERED / DUAL POWERED
OVERCURRENT PROTECTION RELAY

— Application

The numerical relay SPR10 is powered by the current transformers (CTs) and does not require an external power supply voltage. It is the ideal choice for installation in remote locations where auxiliary supplies are not available. The relays derive energy for operation from standard 1 A or 5 A current transformers.
The SPR10 relay 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 trips due to the capacitive current contribution of the feeder on external ground fault.

— Main features

- Insensitive to the voltage drop due to auxiliary power failures
- Independent from UPS devices, which are a weak point in the electrical installations
- Less sensitive to interference of the external environment EMC without external connections to the power supply system
- Fast switch on the fault
- USB port for local communication through Thy-Visor software
- Versions with optional power supply (Dual power)
- The device features a pulse output for an external indicator (flag) to signal the fault presence.
- Optional bistable LCD digital flags provide status signaling even without power supply. Available configurations include none, 1 or 3 flags (red/black), to be specified upon order
- Compact size
- Two residual current inputs are available in order to insert or exclude the residual current from the power supply circuit (to be specified upon order)



Protective elements

46	Phase balance overcurrent
50/51	Phase overcurrent
50N/51N	Residual overcurrent
50N/51N(Comp)	Calculated residual overcurrent

— Mechanical Features

The relay is housed in a metal enclosure suitable for various mounting options: flush-mounted, projecting (with MAS module), 19" rack-mounted (with MAR module), withdrawable (with MAE module, allowing device extraction without disconnecting wiring). This functionality is available only in versions featuring an auto-shunt connector for current inputs.

— Measuring inputs

Three phase current inputs and one residual current input, with rated currents 1 A or 5 A selected at ordering.
Two alternative residual current input circuits are available. If the device is equipped with a fixed terminal block, terminals A9 and A10 are not available (see wiring diagram on pages 5 and 6).

— Output relays

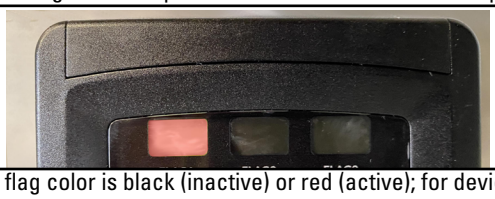
Four output relays are available (two changeover and two make contacts); each relay may be individually programmed as normal state (normally energized, de-energized or pulse) and reset mode (latched or no latched). A programmable timer is provided for each relay (minimum pulse width).

— Circuit breaker command

One capacitance discharge output is available for energization of a low power CB coil.

— Fault indicators

The operating status is signaled via a pulse output to an external indicator (flag), to be connected to terminals B4 and B5. The devices can be equipped on the front panel with none, 1 or 3 optional bistable LCD digital flags (quantity to be specified when ordering).
These flags remain operational even in the absence of power.



The flag color is black (inactive) or red (active); for devices with a single flag, it must identified as flag2.

— Binary inputs

Three 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 may be associated to each input.

— MMI (Man Machine Interface)

The user interface comprises a membrane keyboard, a backlight LCD alphanumeric display, 3 LCD permanent flag and eight LEDs. Optional 1 or 3 flags for fault indication.
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
The operation of the front panel, in the absence of current by TA sufficient to power the device, requires an auxiliary power which can be supplied through the USB communication port connecting a PC or an external power supply.

— Multiple setting profiles (A, B)

Two independent setting profiles are available. Profiles can be Switched via the keypad, a logic input, or software (Thy-Visor).

— Firmware update

The use of flash memory allows on-field firmware updates.

— Communication

Multiple communication interfaces are implemented:
- One USB local communication front-end interface for communication with Thy-Visor setup software
- One back-end interface for communication with remote monitoring and control systems by RS485 port - ModBus® RTU protocol.

— 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 Thy-Visor software.
Different level session with password for sensible data access are provided.
The device can be powered using the USB port during the programming via PC when there is no current. The USB port can also be used as input for the auxiliary power supply via an external power supply.

— 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.

— Self diagnostics

All hardware and software functions are repeatedly checked and any anomalies reported via display messages, communication interfaces, LEDs and outputs.

— Metering

Metering values for phase and residual currents are available for reading on a display or to communication interfaces.
Input signals are sampled 32 times per period and the RMS value of the fundamental component is measured.
The measured signals can be displayed with reference to rated values or directly expressed in amperes.

— 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 "Show Events or Swow Faults" command (Thy-Visor) is issued:
- Sequence of Event Recorder (SER)
  The event recorder runs continuously capturing in circular mode the last 300 events upon trigger of start/trip, binary input or setting change.
- Sequence of Fault Recorder (SFR)
  The fault recorder runs continuously capturing in circular mode the last 30 faults upon trigger of element trip.
- Trip counters

— Digital Fault Recorder (Oscillography)

Upon trigger of tripping of each function or Thy-Visor command the relay records in COMTRADE format:
- Oscillography with instantaneous values for transient analysis.
- Logic states (binary inputs and outputs).

Note - A license for Digital Fault Recorder function is required, for purchase procedure please contact Thytronic.

SPECIFICATIONS

GENERAL

Mechanical data

Mounting:	flush, projecting, rack or separated operator panel
Mass (flush mounting case)	3.0 kg

Insulation tests

Reference standards	EN 60255-27
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

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	IEC 60255-1
CE conformity	
• EMC Directive	2014/30/EC
• Low Voltage Directive	2014/35/EC
Type tests	IEC 60255-6

COMMUNICATION INTERFACES

Local PC	USB
Network:	
• RS485	1200...57600 bps
• Protocol	ModBus® RTU

INPUT CIRCUITS

Auxiliary power supply *U*aux (dual power option)

Nominal value (range)	24...230 V~/-
Operative range	19...265 V~ / 19...300 V-
Power consumption Maximum	5W (8VA)

Phase current inputs

Rated current I_n (to be selected at order)	1 A or 5 A
Permanent overload	5 I_n
Thermal overload (1s)	100 I_n
Rated consumption (for any phase)	≤ 2.5 VA ≤ 3 VA (I_n = 1 A/5 A)

Residual current input

Rated current I_{En} (to be selected at order)	1 A or 5 A
Permanent overload	5 I_{En}
Thermal overload (1s)	100 I_{En}
Rated consumption	≤ 2.5 VA ≤ 3 VA (IE_n = 1 A/5 A)

Minimum current inputs for powering

Phase currents:	
• One phase minimum current	0.2 I_n
• Two phases minimum currents	0.1 I_n
• Three phases minimum currents	0.08 I_n
Residual current	
• Fault minimum current	0.2 I_{En}

Binary inputs

Quantity/type	3 / dry inputs
Activation threshold (set by jumper)	18 V, 66 V
Max consumption, energized	4 mA

OUTPUT CIRCUITS

Output relays K1...K4

• Type of contacts K1, K2	changeover (SPDT, type C)
• Type of contacts K3, K4	make (SPST-NO, type A)
Rated current	8 A
Rated voltage/max switching voltage	250 V~/400 V~
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

Output commands (circuit breaker and external flags)

Quantity	2
• Type	pulse - 0.25 s
• Voltage	24 V-
Energy output	
• Circuit breaker command	0.1 Joule
• External flag	0.01 Joule

LEDs

• ON/fail (green)	1
• Start (yellow)	1
• Trip (red)	1
• Configurable (red)	5

Fault Indicator (local flag)

Quantity	0...1...3
Type	Permanent Bistable

GENERAL SETTINGS

Rated values

Relay rated frequency (f_n)	50, 60 Hz
Relay phase rated current (I_n)	1 A, 5 A
Phase CT rated primary current (I_{np})	1 A...10 kA
Relay residual rated current (I_{En})	1 A, 5 A
Residual CT rated primary current (I_{Enp})	1 A...10 kA

Binary input timers

ON delay time (IN1...IN3t_{ON})	0.00...500.0 s
OFF delay time (IN1...IN3t_{OFF})	0.00...500.0 s
Logic	Active-ON/Active-OFF

— Relay output timers

Minimum pulse width (t_{TR1}... t_{TR4})	0.00...0.50 s

PROTECTIVE FUNCTIONS

— Base current IB

Base current (I_B)	0.10...2.50 I_n

— Negative sequence overcurrent - 46

I_2> Element	
• Curve type	DEFINITE
• Reset time delay ($t_{2>RES}$)	0.00...10.00 s
Definite time	
• First threshold definite time ($I_{2>def}$)	0.08...4.00 I_n
• Time delay ($t_{2>def}$)	0.00...200.00 s

— Phase overcurrent - 50/51

I> Element	
• Curve type (*I*>Curve)	DMT, IEC/BS SI, VI, EI, LTI, STI
• Reset time delay ($t_{>RES}$)	0.00...10.00 s
Definite time	
• First threshold definite time ($I_{>def}$)	0.20...20.00 I_n
• Time delay ($t_{>def}$)	0.00...200.00 s
Inverse time	
• First threshold inverse time ($I_{>inv}$)	0.20...10.00 I_n
• Time factor ($t_{>inv}$)	0.02...1.60 s
I>> Element	
• Type characteristic	DMT, IEC/BS SI, VI, EI, LTI, STI
• Reset time delay ($t_{>>RES}$)	0.00...10.00 s
Definite time	
• Second threshold definite time ($I_{>>def}$)	0.20...20.00 I_n
• Time delay ($t_{>>def}$)	0.00...200.00 s
Inverse time	
• Second threshold inverse time ($I_{>>inv}$)	0.20...10.00 I_n
• Time factor ($t_{>>inv}$)	0.02...1.60 s
I>>> Element	
• Reset time delay ($t_{>>>RES}$)	0.00...10.00 s
Definite time	
• Third threshold definite time ($I_{>>>def}$)	0.20...20.00 I_n
• Time delay ($t_{>>>def}$)	0.00...200.00 s

— Residual overcurrent - 50N/51N

I_E> Element	
• Curve type (I_E>Curve)	DMT, IEC/BS SI, VI, EI, LTI, STI
• Reset time delay ($t_{E>RES}$)	0.00...10.00 s
Definite time	
• First threshold definite time ($I_{E>def}$)	0.01...20.00 I_{En}
• Time delay ($t_{E>def}$)	0.00...200.00 s
Inverse time	
• First threshold inverse time ($I_{E>inv}$)	0.01...10.00 I_{En}
• Time factor ($t_{E>inv}$)	0.02...1.60 s
I_E>> Element	
• Curve type (I_E>>Curve)	DMT, IEC/BS SI, VI, EI, LTI, STI
Reset time delay ($t_{E>>RES}$)	0.00...10.00 s
Definite time	
• Second threshold definite time ($I_{E>>def}$)	0.01...20.00 I_{En}
• Time delay ($t_{E>>def}$)	0.00...200.00 s
Inverse time	
• Second threshold inverse time ($I_{E>>inv}$)	0.01...10.00 I_{En}
• Time factor ($t_{E>>inv}$)	0.02...1.60 s
I_E>>> Element	
• Reset time delay ($t_{E>>>RES}$)	0.00...10.00 s
Definite time	
• Third threshold definite time ($I_{E>>>def}$)	0.01...20.00 I_{En}
• Time delay ($t_{E>>>def}$)	0.00...200.00 s

— Calculated residual overcurrent - 50N/51N(Calc)

I_{EC}> Element	
• Curve type (I_{EC}>Curve)	DMT, IEC/BS SI, VI, EI, LTI, STI
• Reset time delay ($t_{EC>RES}$)	0.00...10.00 s
Definite time	
• First threshold definite time ($I_{EC>def}$)	0.10...20.00 I_n
• Time delay ($t_{EC>def}$)	0.00...200.00 s
Inverse time	
• First threshold inverse time ($I_{EC>inv}$)	0.10...10.00 I_n
• Time factor ($t_{EC>inv}$)	0.02...1.60 s
I_{EC}>> Element	
• Curve type (I_{EC}>>Curve)	DMT, IEC/BS SI, VI, EI, LTI, STI
• Reset time delay ($t_{EC>>RES}$)	0.00...10.00 s
Definite time	
• Second threshold definite time ($I_{EC>>def}$)	0.10...20.00 I_n
• Time delay ($t_{EC>>def}$)	0.00...200.00 s
Inverse time	
• Second threshold inverse time ($I_{EC>>inv}$)	0.10...10.00 I_n
• Time factor ($t_{EC>>inv}$)	0.02...1.60 s
I_{EC}>>> Element	
• Reset time delay ($t_{EC>>>RES}$)	0.00...10.00 s
Definite time	
• Third threshold definite time ($I_{EC>>>def}$)	0.10...20.00 I_n
• Time delay ($t_{EC>>>def}$)	0.00...200.00 s

— Second Harmonic Restraint - 2ndh-REST

Second harmonic restraint threshold (I_{2ndh}>)	5...50 %
I_{2ndh}> Reset time delay ($t_{2ndh>RES}$)	0.00...100.0 s

METERING & RECORDING

— Measured parameters

Direct:	
• Fundamental RMS phase and residual currents	I_{L1}, I_{L2}, I_{L3}, I_E
Calculated:	
• Negative sequence current	I_2
• Calculated residual current	I_{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
2nd harmonic:	
• 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

— Event recording (SER)

Number of events	300
Recording mode	circular
Trigger:	
• Start/Trip of protection element	
• Binary input change	IN1,...IN3
• Setting changes	
Data recorded:	
• Cause	binary input/trip/setting change
• Time stamp	Date and time

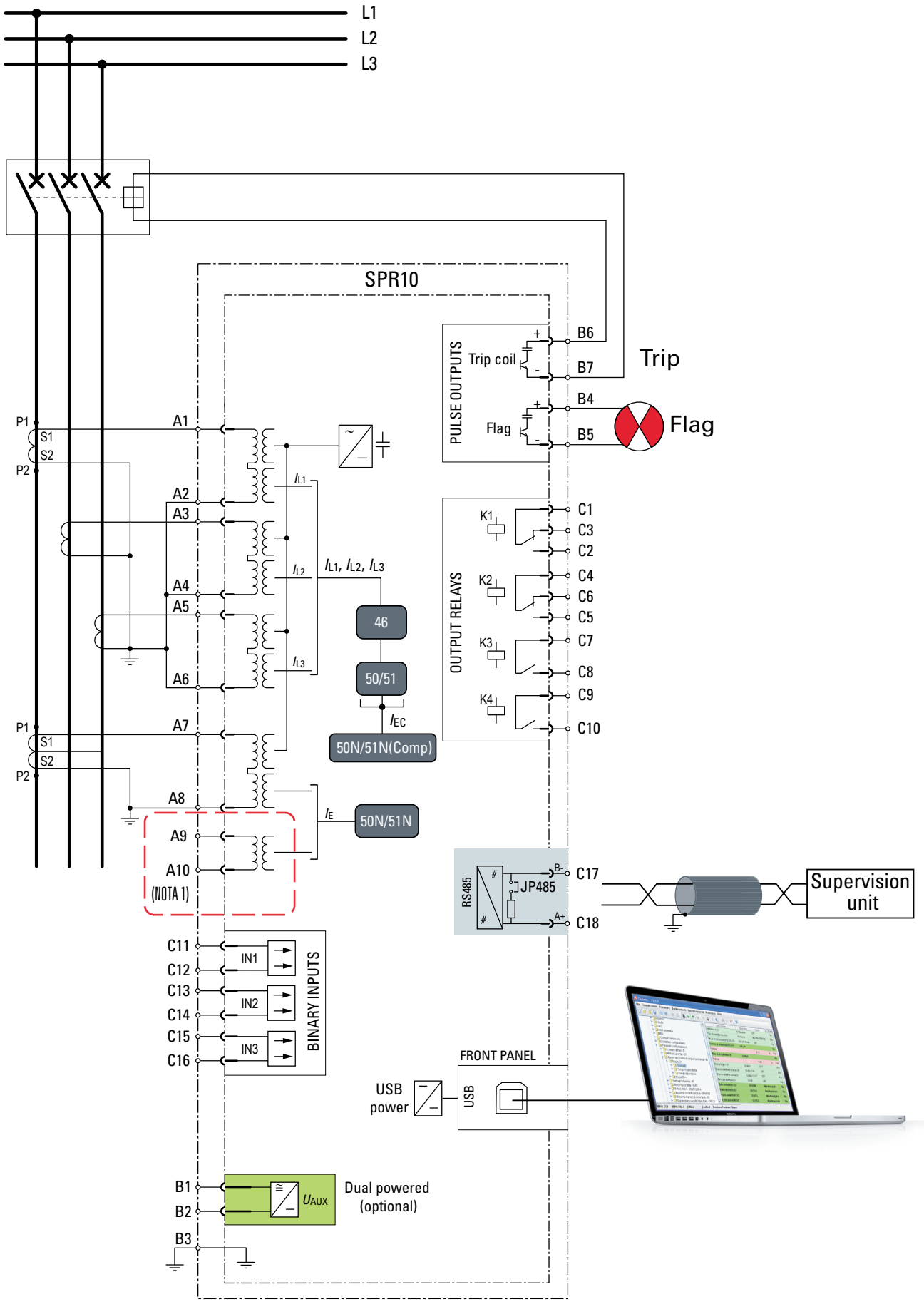
— Fault recording (SFR)

Number of faults	30
Recording mode	circular
Trigger:	
• Trip of protection element	
Data recorded:	
• Faults counter (reset by Thy-Visor)	$0...10^9$
• Time stamp	Date and time
• Cause	tripped element
• Fundamental RMS currents	I_{L1r}, I_{L2r}, I_{L3r}, I_{Er}
• Binary inputs and relays state	IN1, IN2, IN3, K1...K4

— Digital Fault Recorder (Oscillography)

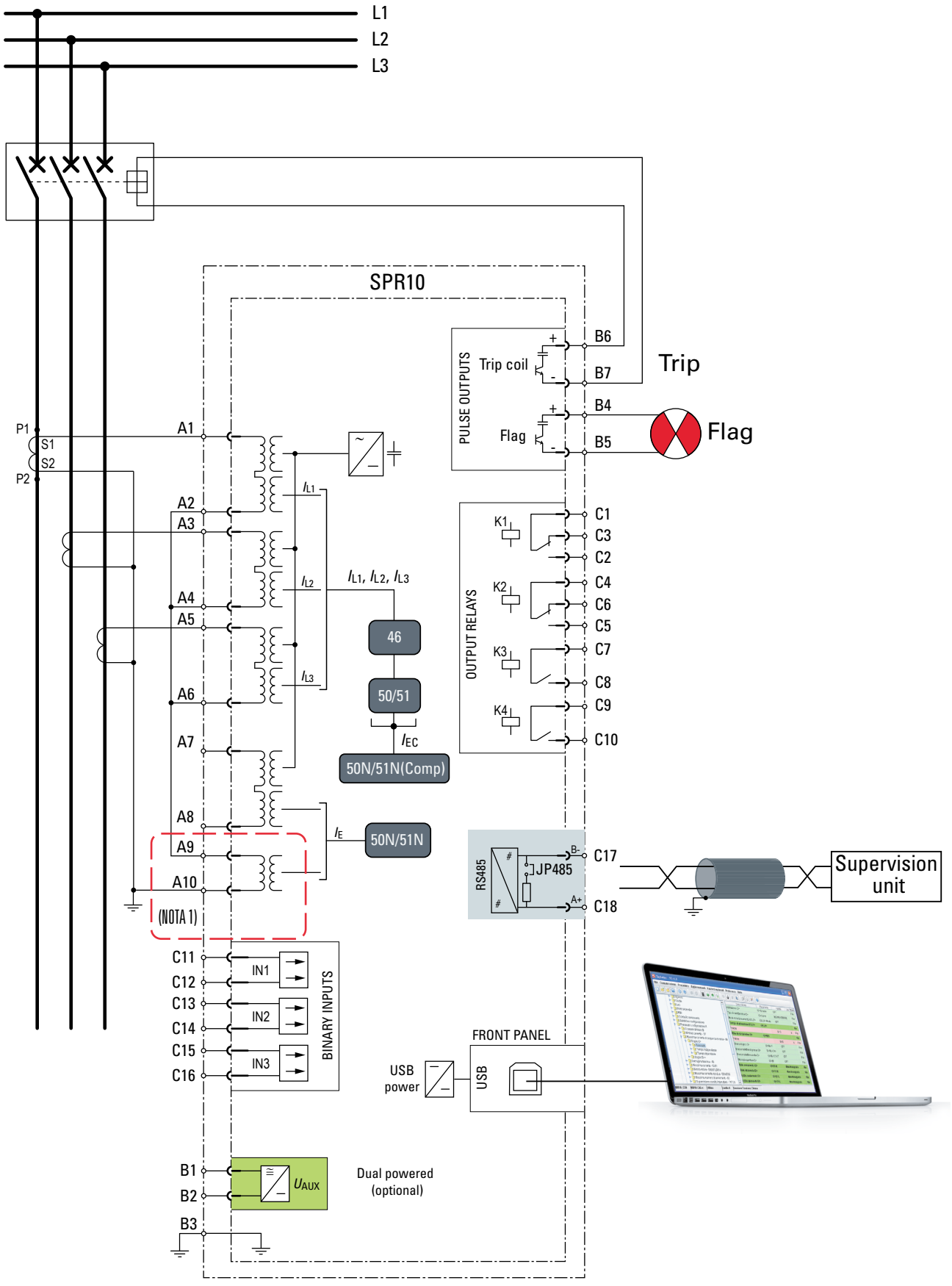
Max number of records	20
File format	COMTRADE
Recording mode	circular
Sampling rate	32 per power frequency cycle
Trigger setup:	
• Pre-trigger time	0.05...1.00 s
• Post-trigger time	0.05...5.00 s
• General trigger	Trip
• Manual trigger	ThySetter command
Data recorded	
• Instantaneous currents	i_{L1}, i_{L2}, i_{L3}, i_E
• Binary inputs and output relay state	IN1,...IN3, K1,... K4
• Trip state	Trip

— Connection diagram examples



NOTE 1: In the version with a fixed terminal block, terminals A9 and A10 are not available

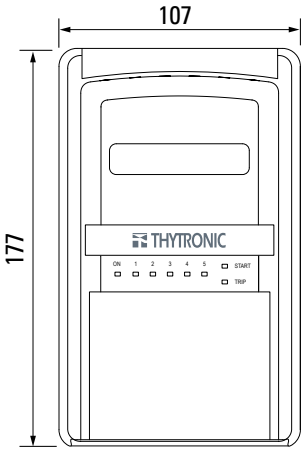
Three phase CTs and residual current from core balanced CT



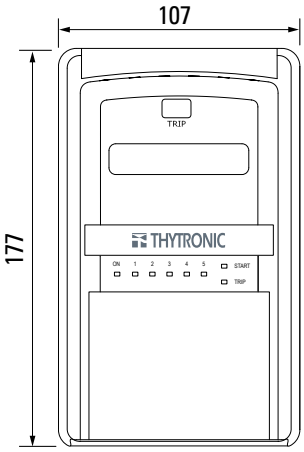
NOTE 1: In the version with a fixed terminal block, terminals A9 and A10 are not available
Three phase CTs and residual current from common return of phase CTs (Holmgreen)

DIMENSIONS

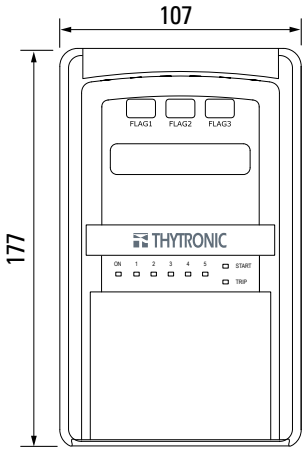
FRONT VIEW



WITHOUT FLAGS

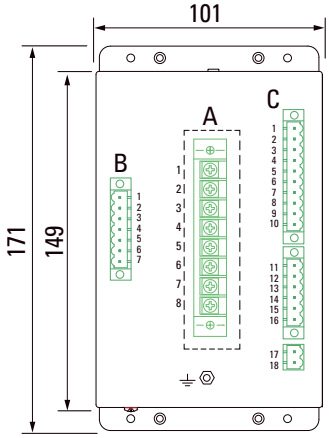


WITH 1 FLAGS

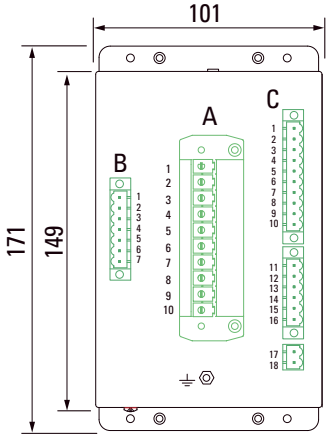


WITH 3 FLAGS

REAR VIEW

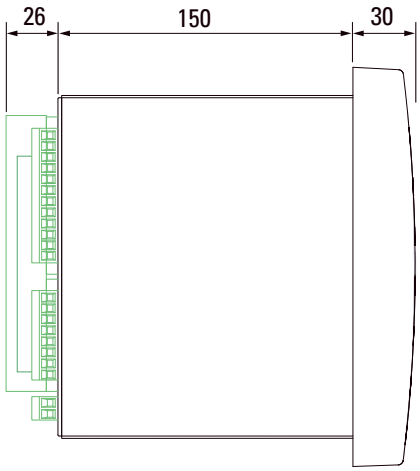


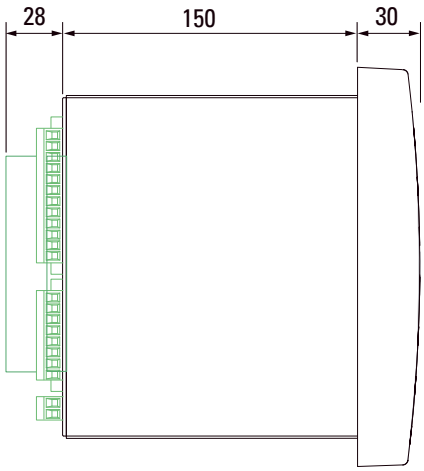
VERSION WITH FIXED TERMINAL BLOCK
WITH CONTACT PROTECTION COVER



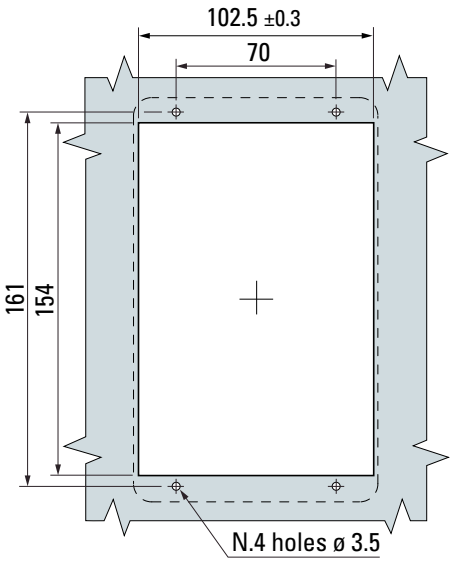
VERSION WITH AUTO-SHUT CONNECTOR

SIDE VIEW

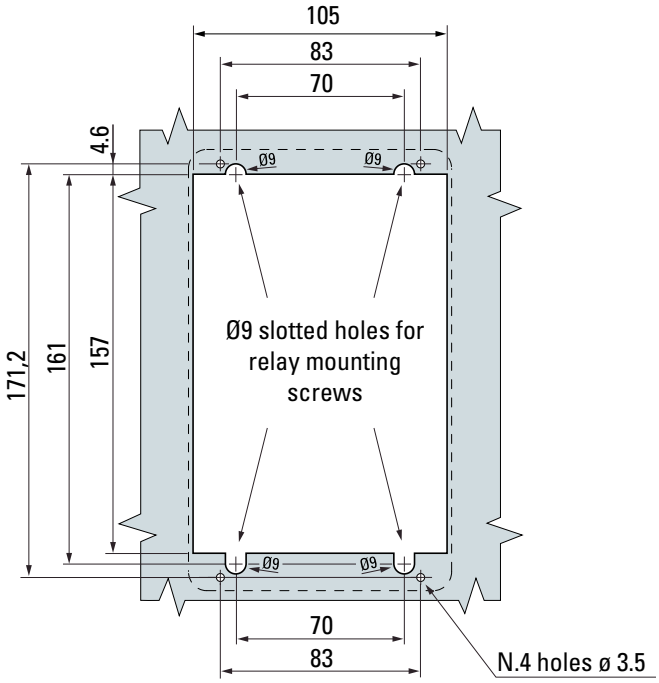




CUTOUT
FLUSH MOUNTING

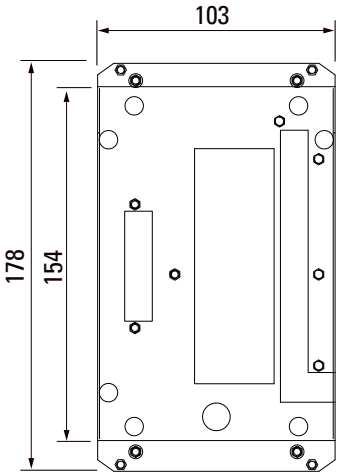


CUTOUT
WITHDRAWABLE (WITH MAE MODULE)

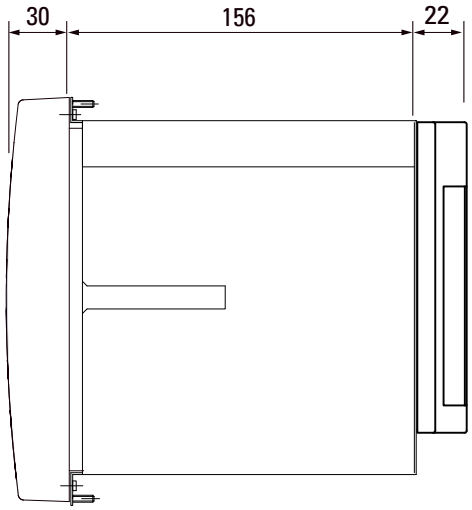


PRODUCT WITH MAE WITHDRAWABLE MODULE INSTALLED

REAR VIEW



SIDE VIEW



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Headquarter: 20139 Milano - Piazza Mistral, 7 - Tel. +39 02 574 957 01 ra - Fax +39 02 574 037 63
Factory: 35127 Padova - Z.I. Sud - Via dell'Artigianato, 26 - Tel. +39 049 894 770 1 ra - Fax +39 049 870 139 0

www.thytronic.it **www.thytronic.com** **thytronic@thytronic.it**