



THYTRONIC

PROX

Protection Relays

XA10

MULTIFUNCTION CURRENT PROTECTION RELAY



— Applications

The XA10 protection relay can be used in radial networks to protect lines, power transformers and rotating machinery. In systems with a solidly grounded neutral, it offers reliable protection against earth faults on lines of any length, while in systems with an insulated or grounded neutral via Petersen coil and/or resistor, it provides protection on lines of limited length to avoid unwanted tripping due to the contribution of the line capacitive current to external faults.

It provides the following protection functions in addition to the phase overcurrent and residual overcurrent protection functions:

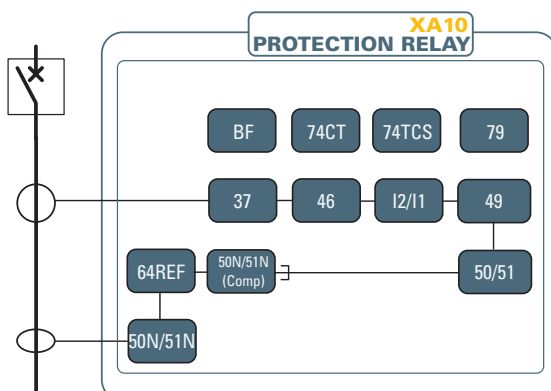
- undercurrent
- negative sequence voltage
- negative/positive sequence current ratio
- thermal image for line and transformer protection
- thermal image for motor and generator protection
- low impedance restricted earth fault
- rotor block and maximum number of permitted motor starts.

Furthermore, the XA10 relay integrates supervision and control functions, such as circuit breaker opening circuit supervision or breaker failure, automatic reclosing with the possibility of selecting the closing sequence type.

The availability of binary inputs and final relays, which can be expanded if necessary by means of optional external add-on modules, as well as the presence of communication interfaces with Modbus® RTU/TCP, IEC60870-5-103, DNP3 and IEC 61850 protocols, provides a multifunctional relay for customised system management compliant with modern requirements for supervision and control of electrical networks.



IEC 61850 ed. 2



- Protection, supervision and control functions

26	Thermal protection with RTD thermometric probes
37	Undercurrent
46LT	Negative sequence overcurrent transformer/line protection)
12/11	Negative sequence direct current ratio
49LT	Thermal image for Line or Transformer protection (49LT)
50/51	Phase overcurrent
50N/51N	Residual overcurrent (measured)
50N/51N(Comp)	Calculated residual overcurrent
64REF	Low impedance restricted earth fault
2ndh-REST	Second harmonic restraint
52	Circuit breaker supervision
74CT	Amperometric transformer supervision
74TCS.1 74.TCS.2	Circuit breaker circuit supervision
BF	Breaker Failure
79	Automatic reclosing
Remote trip	Remote trip
	Logical selectivity and pilot wire diagnostics

— Construction characteristics

According to the hardware configurations, the relay can be supplied in various case styles depending on the required mounting options (flush, projecting mounting, rack or with separate operator panel) and with connections to the input signals for inductive CTs (screw terminals) with 1 A or 5 A rated secondary current.

— Phase and residual current inputs

Three phase currents and one residual current input, with programmable rated current 1 A or 5 A, separately for phase and residual inputs, using Thyvisor software.

The inputs are connected to two or three phase CTs and a residual current input (the latter with direct measurement to the secondary of a single CT or measure calculated through three phase CTs sum residual current connection).

— Output relays

Six output relays are available (two with take-over contact, three with a make contact and one with an opening contact); they can be individually programmed as operating mode (normally energised, de-energised or pulse) and reset mode (manual or automatic).

Each final relay is associated with a timer that allows the minimum activation time to be adjusted.

— Binary inputs

Depending on the hardware configuration requested in the order, six binary inputs are available with programmable activation status (active ON or active OFF) and associated adjustable timer (active on OFF/ON or ON/OFF transition).

Several default functions can be associated to each input. In addition to traditional assignments, other functions can be programmed for supervision and control.

— Modularity

To extend I/O capability, the relay can be customized through external auxiliary modules:

- MRI - Final relays and binary inputs
- MCI - 4...20 mA current converters
- MPT - Inputs for eight Pt100 thermistors

— Supervision and control

Several default functions are implemented:

- Second harmonic restraint
- Circuit breaker circuit supervision
- Breaker Failure
- Automatic reclosing
- Circuit breaker supervision
- Current transformers supervision
- Remote trip
- Breaker status verified by acquisition of the status of the auxiliary breaker contacts (52a or 52b)
- Switch status
- Acquisition of digital input signals for motor control (speed control, reset number of starts, motor acceleration)

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

— Multiple setting profiles (A, B, C, D)

Four independent setting profiles are available; switching from one profile to another can be activated by keyboard command, binary input or communication (ThyVisor).

— Self diagnostics

All hardware and software functions are continuously checked and any faults are signalled by display messages, communication interfaces, LEDs and final relays.

The anomalies concern:

- HW faults (auxiliary power supply, output relay coil interruptions, MMI board, etc.)
- Circuit breaker faults (CB)
- SW faults (boot and runtime anomalies, EEPROM checksum, data BUS faults, etc.).

— Firmware update

The use of flash memory allows updating in the field.

— 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 pickup/start and trip (yellow for Start, red for Trip) and five red LEDs are user assignable.

— Measurements

Measurements of frequency, phase and residual currents, positive and negative sequence currents, thermal image, harmonic content and input logic status are available on the display and on communication interfaces. The input signals are sampled 64 times per period and the RMS value of the fundamental component is processed using DFT (Discrete Fourier Transform) algorithms and numerical filtering. The measurements can be shown on an alphanumeric display with reference to rated values or expressed directly in primary values (A, Hz).

— Registrations

- Events: the last 1000 events are recorded in a circular memory when the status of a binary input or a final relay changes
- Faults: following a trip (pickup and/or trip), or from an external trigger (binary input), the last 20 faults are recorded in a circular memory
- Counter.

— Digital Fault Recorder (DFR)

Following a trigger signal triggered by pickup/stop of protection functions or an external signal and/or software command from ThyVisor, the relay records in COMTRADE format:

- Instantaneous values for transient analysis
- RMS values for long time periods analysis (trends)
- Digital signal states (binary inputs and output relays).

*Note - A license for digital fault recorder function is required
All recordings are stored in a non-volatile memory*

— Communication

The following interfaces are present:

- A local USB port on the front, which can be used for setting, reading and editing settings, reading logical states, events, measurements and for test and reset commands
- Two communication ports on the rear terminal block for fieldbus connections:
 - RS485 with ModBus® RTU protocol, IEC 60870-5-103, DNP3.
 - Ethernet port (RJ45 or optical fiber) - ModBus/TCP protocol and IEC61850.

— Signal reception capability on IEC 61850 protocol

It is defined as a set of signals aimed at governing the distribution network in the presence of Diffuse Generation (GD).

These signals, received remotely, can be used directly by the protection relay thanks to the protocol implemented in the XA10 device (IEC61850 embedded), or they can be acquired by logical inputs after being "converted" into dry contacts by an external device to control, for example, the opening of the circuit breaker if the relevant remote trip signal is received by assigning the *Remote Trip function* to a logical input.

— Programming and settings

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

— Measurements

- Frequency f
- Phase currents I_{L1} , I_{L2} , I_{L3}
- Residual current I_E
- Phase currents RMS value I_{L1rms} , I_{L2rms} , I_{L3rms}
- Thermal image $D\theta_{theta}$
- Calculated residual current I_{Ec}
- Phase currents maximum, minimum and average values I_{Lmax} ,

- I_{Lmin}, I_L
- Positive and negative sequence current I_1, I_2
- Negative sequence and positive sequence current values ratio I_2/I_1
- Harmonics
 - Phase currents second harmonic $I_{L1-2nd}, I_{L2-2nd}, I_{L3-2nd}$
 - Phase currents maximum second harmonic values and fundamental component percentage ratio I_{2nd}/I_1
 - Phase currents third harmonic $I_{L1-3rd}, I_{L2-3rd}, I_{L3-3rd}$
 - Residual current third harmonic I_{E-3rd}
 - Phase currents fourth harmonic $I_{L1-4th}, I_{L2-4th}, I_{L3-4th}$
 - Phase currents fifth harmonic $I_{L1-5th}, I_{L2-5th}, I_{L3-5th}$

PROTECTION FUNCTIONS

— Thermal protection with RTD thermometric probes - 26

Temperature measurements are acquired through the optional external XMPT module with 8 PT100 thermal probes (RTD – Resistive Thermal Device). For each measurement, an alarm threshold (ThALx) and a trip threshold (Th>x) can be set, with programmable trip times (tThALx and tTh>x).

— Undercurrent - 37

The protection function compares each of the three measured currents with the set threshold value ($I <$) in selectable OR or AND logic. It includes an independent time threshold. If a binary input with a logic block function is configured and the protection function threshold 37 is enabled to receive this logic block ($I < BLK1$), the threshold is blocked for a time equal to the activation time of the binary input itself.

— Negative sequence overcurrent for Line or Transformer protection - 46LT

The protection function calculates the negative sequence current I_2 from the phasor measurement of the three phase currents. It includes two adjustable thresholds with programmable operate time.

The first selectable threshold ($I_{2LT} >$) is time-independent or time-dependent according to IEC 60255-151/BS142 or ANSI/IEEE standards or according to the equation $t = K/I^2$ or, again, according to a breaking curve that can be coordinated with electromechanical (EM) relays. The second threshold ($I_{2LT} >>$) is time-independent.

It is selectable to enable or disable each protection threshold, inhibit the first threshold ($I_{2LT} >$) to start the second threshold. The second harmonic restraint can be selected for each of the two thresholds.

The function can operate under logical selectivity (BLK2IN, BLK2OUT).

— Negative/positive sequence current ratio - I2/I1

The protection function calculates the value of the ratio between the negative sequence currents I_2 and positive sequence currents I_1 from the phasor measurements of the three phase currents by comparing it with the set threshold value ($I_{21} >$); it includes an adjustable threshold with independently programmable operate time.

The second harmonic restraint can be selected for each of the two thresholds.

— Thermal image for Line or Transformer protection - 49LT

It is used as overheating protection for lines and transformers. It employs the measurement of the three phase currents in an algorithm that reproduces both the heating produced by the Joule effect and the cooling as a result of load shedding. The thermal state also depends on the previous heating and cooling cycles.

It has two thresholds providing alarm signals (DthLTAL1, DthLTAL2) and a breaker threshold (DthLT>), all adjustable.

The second harmonic restraint can be selected and operate under logical selectivity (BLK2IN, BLK2OUT). The tripping threshold can be inhibited to start the phase overcurrent protection functions (50/51).

— Phase overcurrent - 50/51

It includes three adjustable thresholds with programmable operate time.

The selectable first and second thresholds ($I >$, $I >>$) are time-independent or time-dependent according to IEC 60255-151/BS142 or ANSI/IEEE operate characteristics or according to the equation $t = K/I^2$ as well as for rectifier protection applications and coordination with electromechanical (EM) relays. The third threshold ($I >>$) is time independent.

The inhibition of the first threshold ($I >$) for starting at least one of the two thresholds can be selected, as the inhibition of the second threshold for starting the third threshold.

The second harmonic restraint and the possibility of operating under logical selectivity (BLK2IN, BLK2OUT) can be selected for each threshold.

— Residual overcurrent - 50N/51N

The protection function measures earth fault currents in radial networks protecting lines, machines and power transformers.

It includes three adjustable thresholds with programmable operate time.

The first selectable threshold ($I_E >$) is time-independent or dependent according to operate characteristics in accordance with IEC 60255-151/BS142 or ANSI/IEEE or electromechanical (EM) standards. The second and third thresholds ($I_E >$, $I_E >>$) are time-independent.

The inhibition of the first threshold ($I_E >$) for starting at least one of the two thresholds can be selected, as the inhibition of the second threshold for starting the third threshold.

The second harmonic restraint and the possibility of operating under logical selectivity (BLK2IN, BLK2OUT) can be selected for each threshold.

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

The protection function uses the residual current measurement calculated by vector summation of the three phase currents. It can be used in cases in which directly measured residual current is not available, such as in the absence of a core balance toroidal transformer.

It includes three adjustable thresholds with programmable operate time.

The first selectable threshold ($I_{EC} >$) is time-independent or dependent according to operate characteristics according to IEC 60255-151/BS142 or ANSI/IEEE standards or for applications in which coordination with electromechanical (EM) relays is required. The second and third thresholds ($I_{EC} >$, $I_{EC} >>$) are time-independent.

The inhibition of the first threshold ($I_{EC} >$) for starting at least one of the two thresholds can be selected, as the inhibition of the second threshold for starting the third threshold.

The second harmonic restraint and the possibility of operating under logical selectivity (BLK2IN, BLK2OUT) can be selected for each threshold.

— Low impedance restricted earth fault - 64REF

The function allows the detection of faults between a phase and earth in a three-phase winding with a star centre connected to earth located between the current sensors (CT) inserted on the phases and the corresponding current sensor inserted on the neutral earth connection.

It includes an adjustable threshold with independent operate time characteristic.

CONTROL AND SUPERVISION FUNCTIONS

— Second harmonic restraint - 2ndh-REST

When a power transformer is energised, the current inrush takes place, the magnitude and duration of which depends on various factors, such as the instantaneous value of the supply voltage, the construction characteristics of the transformer, and the residual flux. However, the inrush current contains a second harmonic component of significant value.

The measured second harmonic component of each phase current is compared with an adjustable threshold ($I_{2ndh}>$). Exceeding the threshold of at least one of the three second harmonic components causes the threshold itself to be triggered, with the possibility of blocking the protection functions enabled by the restraint function.

— Circuit breaker supervision - 52

Various diagnostic, measurement and control functions are available such as:

- determining, by acquiring the status of auxiliary contacts 52a and 52b, the position of the switch or calculating the opening time and, if high, programming the emission of an alarm signal setting and calculation of the number of breaker opening manoeuvres above which the protective relay will emit an alarm signal.

— Amperometric transformer supervision - 74TC

The function allows the interruption of the secondary circuits of the phase CTs and/or the input circuits of the protective relay to be detected by measuring the degree of symmetry of the secondary currents of the CTs themselves.

The function is tripped when the current and symmetry threshold conditions are exceeded and at the end of the set timing.

— Circuit breaker circuit supervision - 74TCS.1 74TCS.2

The circuit breaker opening circuit can be controlled by the protective relay to signal any faults that would lead to the breaker not opening due to tripping of the protections or intentional operator command.

The function detects anomalies, such as circuit interruptions or lack of auxiliary voltage or interruption/short circuit of the opening coil. Supervision can be implemented using one or two binary inputs with function 74TCS.1 or/and 74TCS.2.

— Breaker Failure - BF

When the protective relay issues a tripping command but, due to a fault, the controlled breaker does not open, the BF breaker protection function issues an emergency tripping command to open adjacent breakers.

The function can be started if both of the following conditions are met:

- activation by internal protection functions (if associated with BF) or external protection relays
- the circuit breaker is closed or the fundamental component of at least one phase current $IL1$, $IL2$, $IL3$ is greater than the adjustable threshold ($IBF>$) or the fundamental component of the IEC residual current is greater than the adjustable threshold ($IEBF>$).

— Automatic reclosing - 79

This function allows the system to be powered again after the circuit breaker has been opened as a result of the operation of a protective relay. This improves service continuity in the presence of transient failures.

The following closing sequences can be selected:

- quick closing
- quick closing followed by slow closing.

Sequences can be initiated by various programmable combinations of events, either internal (phase or residual overcurrent protection functions) or external with signals connected to and activated at the binary inputs of the protection relay.

The following logic signals relevant to the closing function can

be activated by associating them with one of the digital inputs:

- 52a 52b (switch status); acquisition of the switch status is indispensable for correct closing operation
- closing block
- closing enable
- external closing trip; start of closing sequence

The following output functions can be associated with the final relays:

- closing cycle in progress
- circuit breaker closing command
- failed closing.

— Remote trip

One or more final relays can be programmed for the telescopic function. In this case, they are controlled directly by the associated binary input.

— Logical selectivity and pilot wire diagnostics

The logical selectivity function can be implemented by using any combination of the following I/O signals:

- dedicated block input/output (BLIN1/BLOUT1)
- one or more digital inputs programmed with an input block function
- one or more final relays programmed with an output blocking function.

The use of dedicated inputs and blocking outputs also enables the pilot wire continuity control function.

TECHNICAL DATA

GENERAL

— Mechanical data

Mounting:	
flush, projecting, rack or with separate operator panel	
Weight (flush mounting)	2.0 kg
Dimensions (H x L x P)	177 x 107 x 235 (Flush mounting)
IP protection rating (EN 60529)	
front / terminals	IP52 / IP20

— Insulation tests

Reference standards	EN60255-27
Test at 50 Hz	2 kV 60 s
Impulse voltage withstand test (1.2/50 µs)	5 kV common mode, 2 kV differential mode
Insulation resistance	>100 MΩ

— Voltage dip immunity

Reference standards	EN61000-4-29, EN60255-22-11
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— Noise immunity (EMC)

Electrostatic discharge	EN60255-22-2	6 kV, 8 kV
Fast pulse trains (5/50 ns)	EN60255-22-4	4 kV
Conducted electromagnetic field	EN60255-22-6	10 V
Radiated electromagnetic field	EN60255-4-3	10 V/m
High energy pulse	EN61000-4-5	2 kV
Magnetic field at 50 Hz	EN61000-4-8	100 A/m, 1 kA/m
Damped oscillatory field	EN61000-4-18	2.5 kV
Ring wave	EN61000-4-12	2 kV
Conducted common mode interference	EN61000-4-16	10 V

— Emission

Reference standards	EN61000-6-4 (formerly EN50081-2)
Conducted emission 0.15...30 MHz	Class A
Radiated emission 30...5000 MHz	Class A

— Climatic conditions

Reference standards	IEC60068-x, ENEL R CLI 01, CEI 50
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— Mechanical tests

Reference standards	IEC60068-2-x, EN60255-21-1, 21-2
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— Safety requirements

Reference standards	EN60255-27
Pollution degree	3
Reference voltage	250 V
Overvoltage category	III

— Climatic conditions

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

— Certifications

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

COMMUNICATION INTERFACES

Local PC USB	Type B
Network:	
• RS485	1200...57600 bps
• 100BaseT Ethernet	100 Mbps
Protocol	ModBus® RTU/IEC 60870-5-103/DNP3, TCP/IP, IEC61850 - level A

INPUT CIRCUITS

— Auxiliary power supply U_{aux}

Rated value (range)	24...110 V~/- - 110...230 V~/-
Operative range (each one of the above rated values)	19...132 V~/- - 88...265 V~ / 75...300 V-

Power consumption:

• Maximum (energised relays, Ethernet TX)	15 W (25 VA)
• 24 V-, with display ON and 4 energised relays	11 W
• 110 V-, with display ON and 4 energised relays	14 W
• 230 V~, with display ON and 4 energized relays	16 VA

— Amperometric input circuits for inductive phase CTs

Relay phase rated current (I_n)	1 A or 5 A
(settable via software)	
Permanent overload	25 A
Thermal overload (1 s)	500 A
Dynamic overload (0.01 s)	1250 A
Power consumption (for any phase)	≤ 0.02 VA with $I_n = 1$ A ≤ 0.04 VA with $I_n = 5$ A

— Amperometric residual current input circuit

Relay residual rated current (I_{En})	1 A or 5 A
(settable via software)	
Permanent overload	25 A
Thermal overload (1 s)	100 A
Dynamic overload (0.01 s)	1250 A
Power consumption	≤ 0.06 VA with $I_{En} = 1$ A ≤ 0.12 VA with $I_{En} = 5$ A

— Binary inputs

Number	6
(selectable when ordering)	
Type	photocoupler, dry input
Operative range	24...265 V~/-
Maximum current consumption, energised	5 mA

— Block input (logical selectivity)

Number	1
Circuit type	polarized with insulated internal supply
Maximum current consumption with energised input	5 mA

OUTPUT CIRCUITS

— Final relays K1...K6

Number	6
• Contact type K1, K2	take-over (SPDT, type C)
• Contact type K3, K4, K5	make (SPST-NO, type A)
• Contact type K6	opening (SPST-NC, type B)
Rated current	8 A
Rated voltage/max switching voltage	250 V~ / 400 V~
Interruption power:	
• Direct current ($L/R = 40$ ms)	50 W
• Alternating current ($\lambda = 0.4$)	1250 VA
Make	1000 W/VA
Short duration current (0.5 s)	30 A

— LED

Number	8
• ON/fail (green)	1
• Start (yellow)	1
• Trip (red)	1
• Programmable (red)	5

BASIC PROGRAMMING

— Nominal values

Relay rated frequency (f_n)	50, 60 Hz
Relay rated phase current (I_n)	1 A or 5 A
Relay rated residual current (I_{En})	1 A or 5 A
Rated primary phase current (I_{np})	1...10000 A
Rated primary residual current (I_{Enp})	1...10000 A

— Binary input timers

OFF/ON acquisition delay ($IN1...IN9$ t_{ON})	0.00...100.0 s
ON/OFF acquisition delay ($IN1...IN9$ t_{OFF})	0.00...100.0 s
Binary	DIRECT/NEGATIVE

— Final relay timers

Minimum pulse duration	0.000...0.500 s
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— Block output (logical selectivity)

Number	1
Circuit type	photocoupler, non-polarised contact
Applicable max current/voltage	150 mA/400 V-

PROTECTIVE FUNCTIONS OF THE PROX RELAY FAMILY

Function	ANSI Code	Compliant with CEI 0-16 standard				XC20
		PI XV10P	PG XA10	PG XA30	PG XA60	
Syncro Check	25	●				
Thermal protection with RTD thermometric probes	26	●	●	●	●	●
Undervoltage	27	●			●	●
Undervoltage	27.1 - 27.2 - 27.3 - 27.4	●				
Positive sequence undervoltage	27V1	●				
Undercurrent	37		●			●
Discharge Timer	TD					●
Negative sequence overcurrent	46 LT		●			●
Neutral unbalance current	46 N					●
Negative /Positive sequence current ratio	I2/I1		●			
Phase rotation direction check	47	●				
Thermal image	49LT		●	●	●	●
Phase overcurrent	50/51		●	●	●	●
Residual overcurrent	50N.1 / 51N-87NHIZ		●	●	●	●
Calculated residual overcurrent	50N(comp) / 51N (comp)		●			
Phase overcurrent	50 (rms) / 51 (rms)					●
Overvoltage	59	●			●	●
Overvoltage	59.1 - 59.2 - 59.3	●				
Residual overvoltage	59N	●		●	●	
Peak repetitive overvoltage	59H					●
Negative sequence overvoltage	59V2	●				
Average overvoltage	59Uavg	●				
Low impedance restricted ground fault	64REF		●			
Directional phase overcurrent	67				●	
Directional earth fault overcurrent	67N			●	●	
Auto-reclose	79		●			
Vector jump	dphi	●				
Overfrequency	81O	●				
Underfrequency	81U	●				
Frequency rate of change	81R	●				
Breaker failure	BF	●	●	●	●	●
CT supervision	74CT		●	●	●	●
VT supervision	74VT				●	●
Trip circuit supervision	74TCS.1	●	●	●	●	●
Trip circuit supervision	74TCS.2	●	●	●	●	●
Remote TRIP		●	●	●	●	●
Second Harmonic Restraint			●	●	●	●
Multiple Profiles (A, B, C, D)		●	●	●	●	●

● To enable the Function 26 protection, ProX relays require a special optional hardware module.

DISCLAIMER:

This document is updated continuously, the revision information is represented by the date of issue.

As standards, specifications and designs change periodically, the information contained in this document may be subject to change without notice.

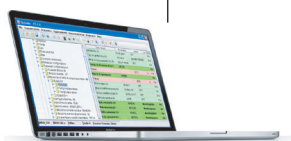
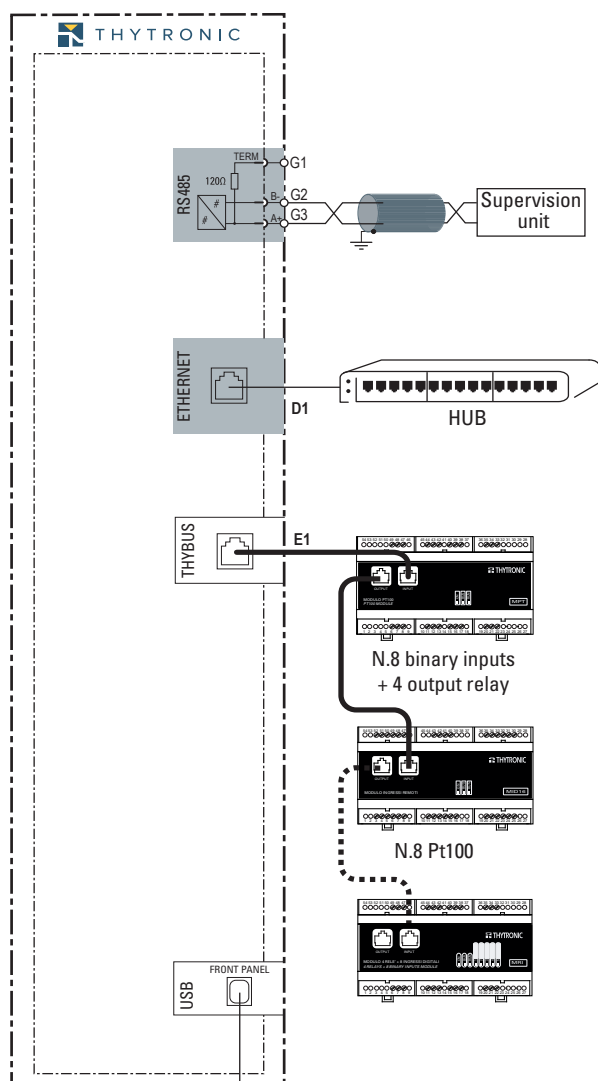
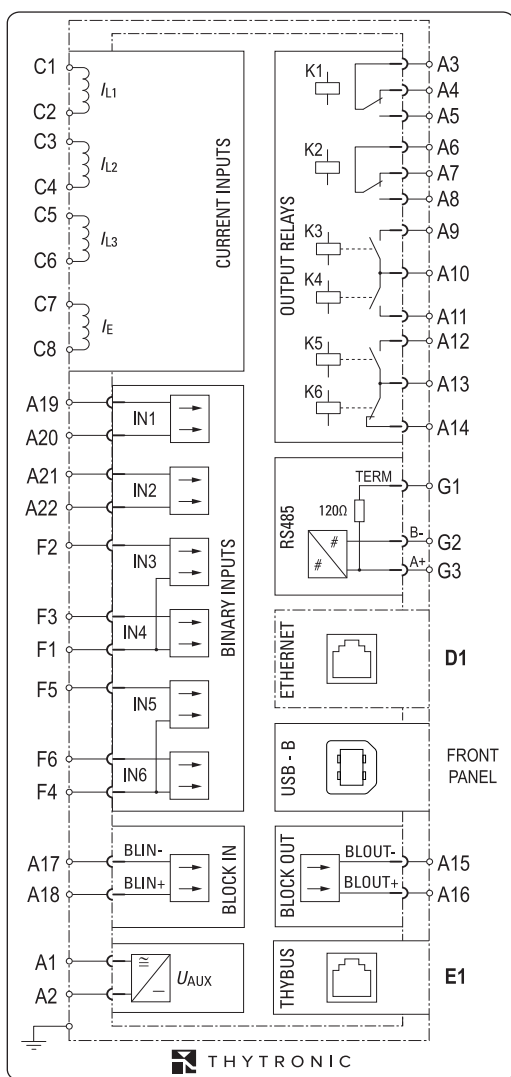
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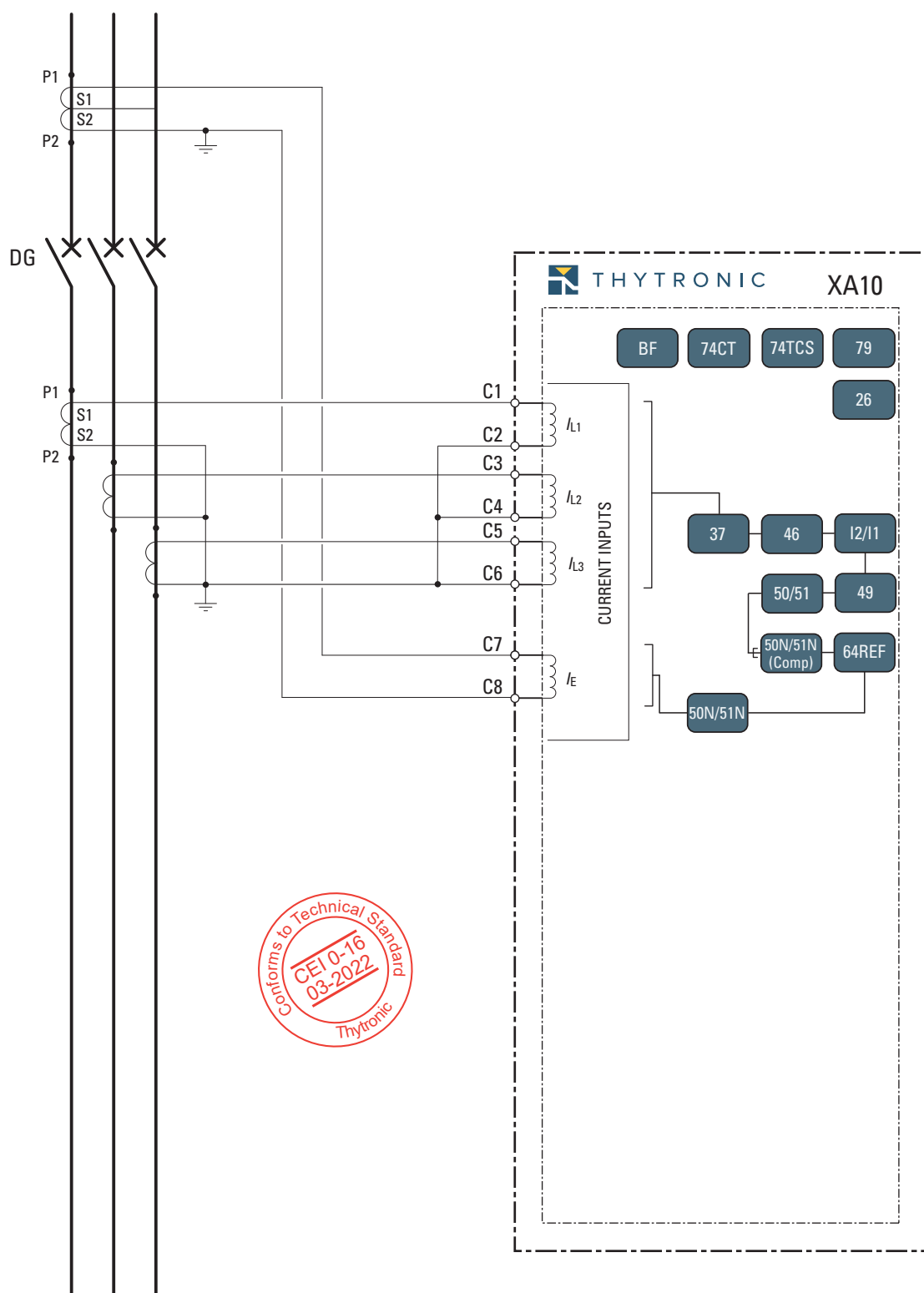
INPUTS-OUTPUTS DIAGRAMS - INTERFACE DIAGRAM



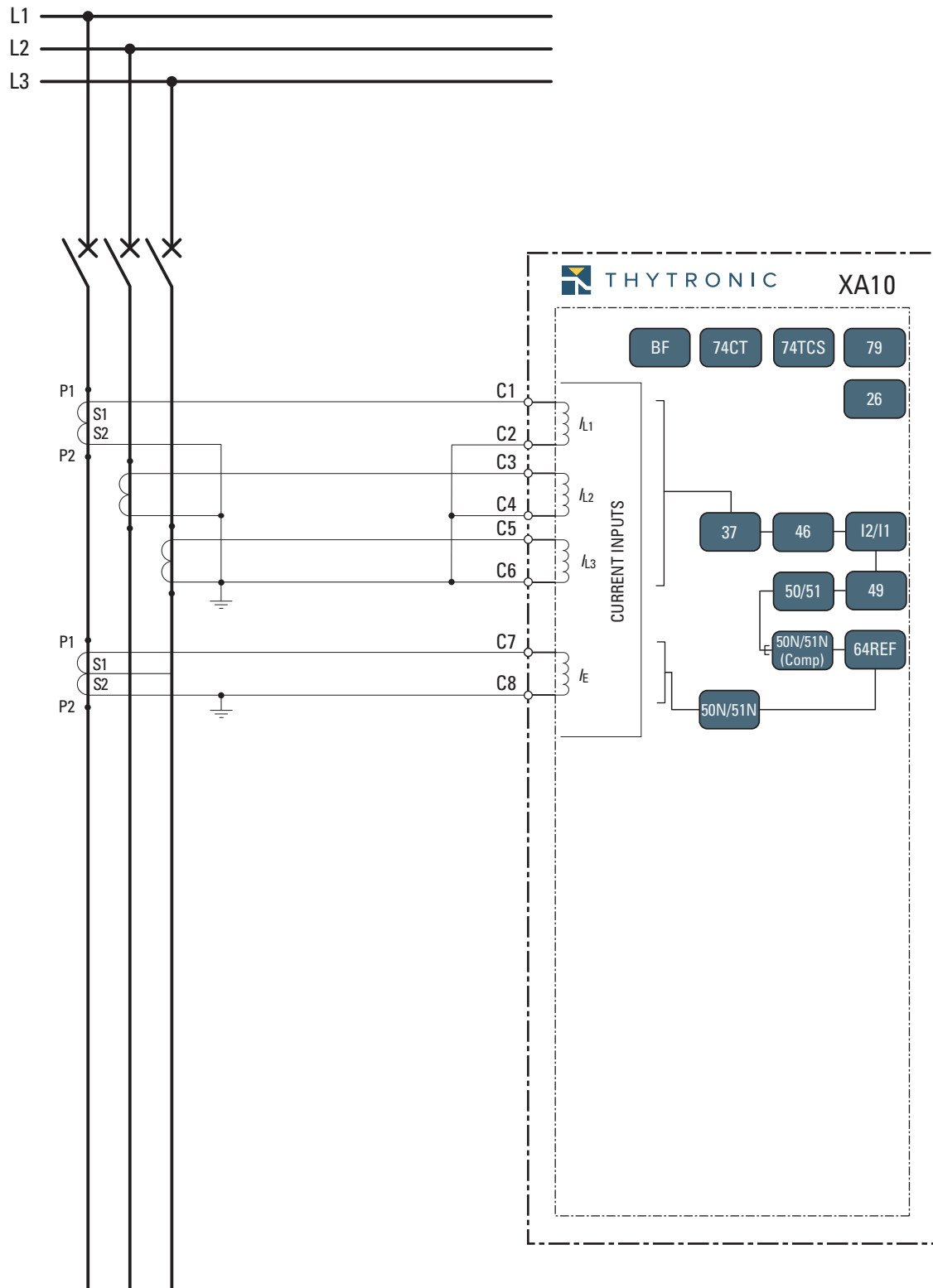
CONNECTION DIAGRAMS

Note: Some typical connection diagram are shown.

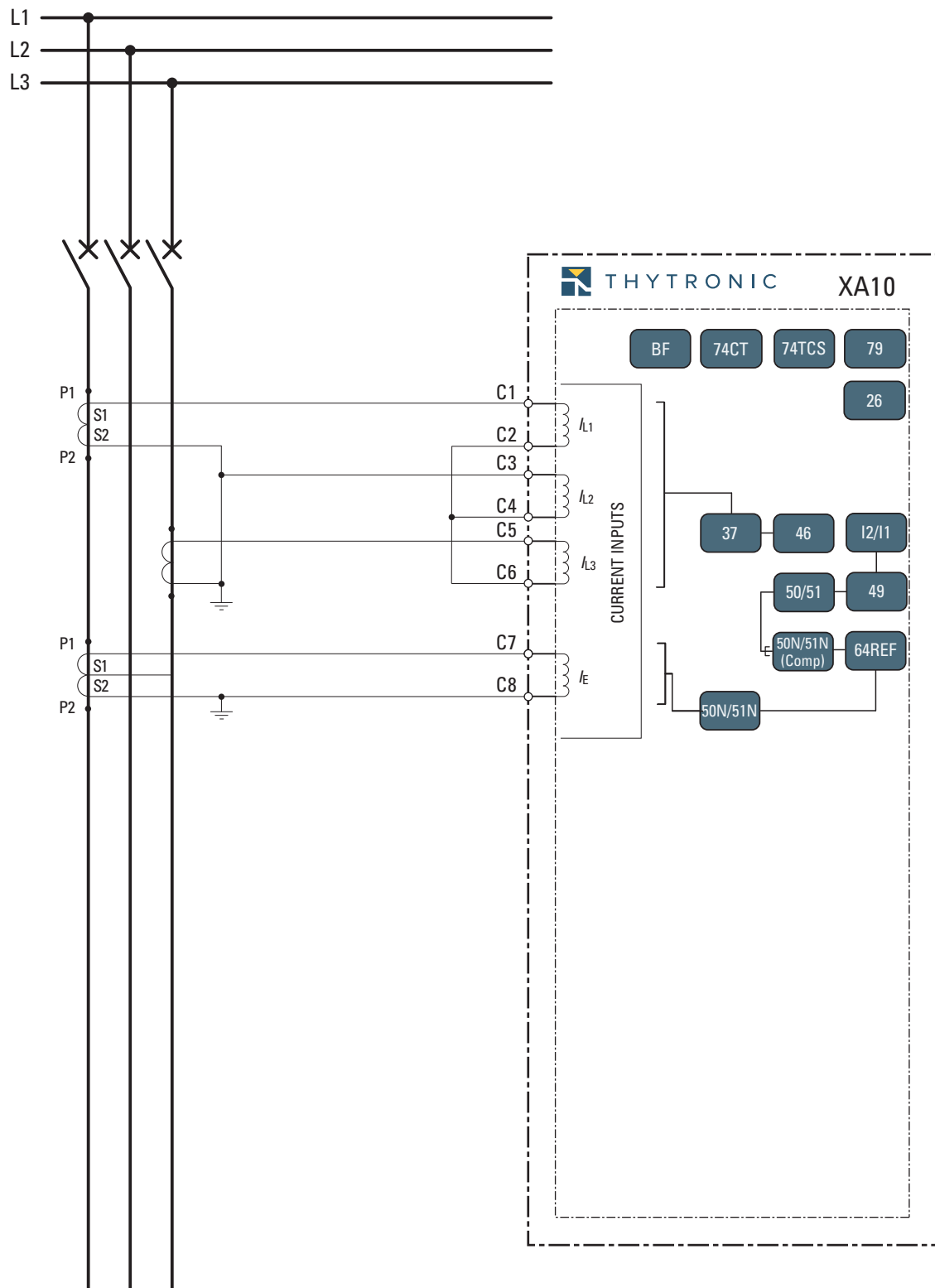
All diagrams are offered as examples and should not be considered exhaustive for real applications.



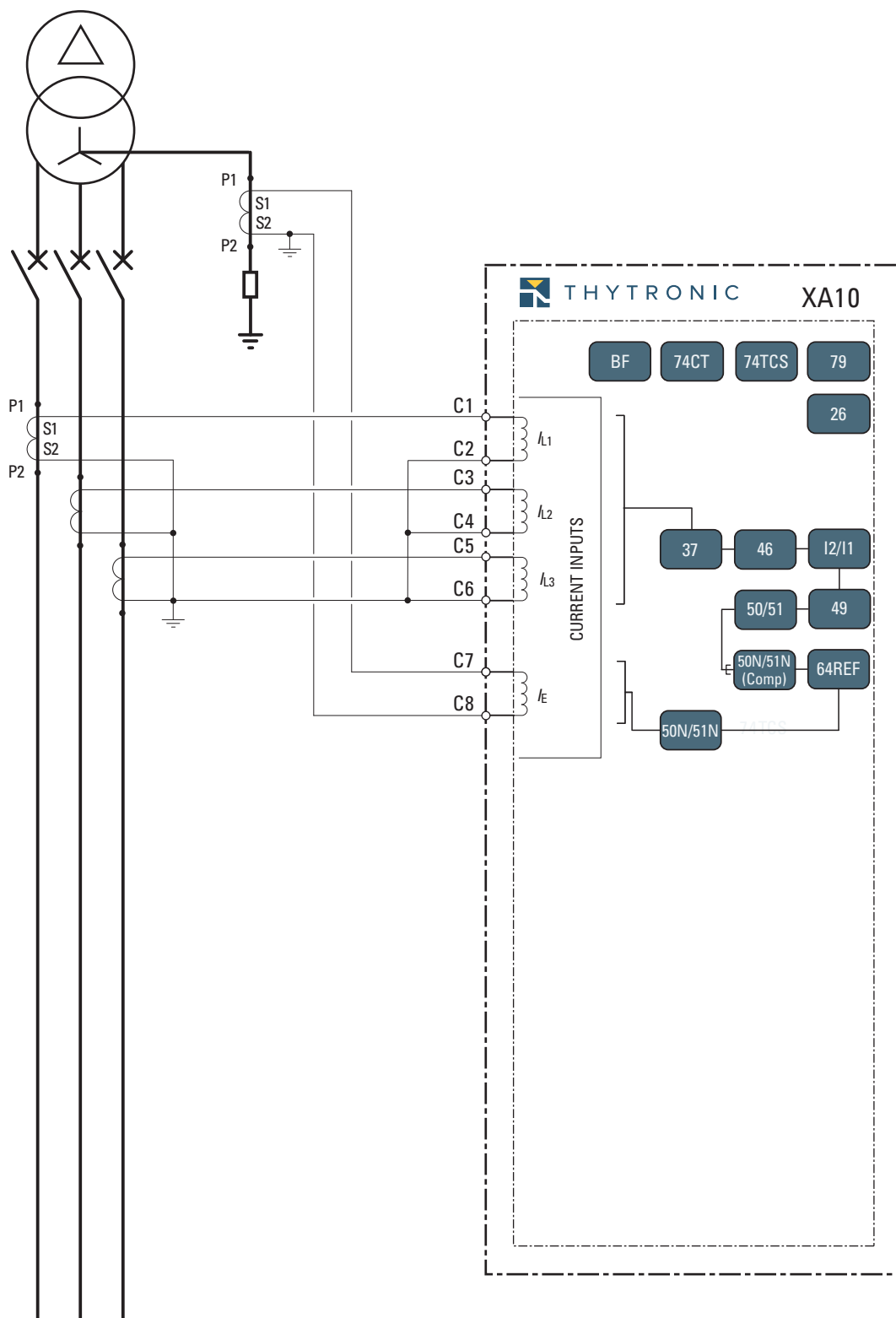
Wiring diagram for input circuits with three inductive phase CTs and residual current from core balance toroidal transformer (Positioning of core balance toroidal transformer as permitted by CEI 0-16 Annex H - para. H.1 1st ideal position)



Wiring diagram for input circuits with three phase CTs and residual current from core balance toroidal transformer



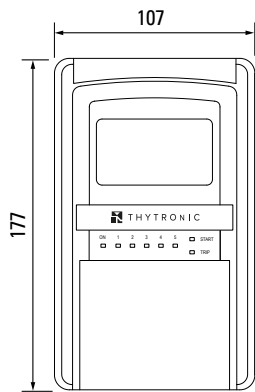
Wiring diagram for input circuits with two phase CTs and residual current from core balance toroidal transformer



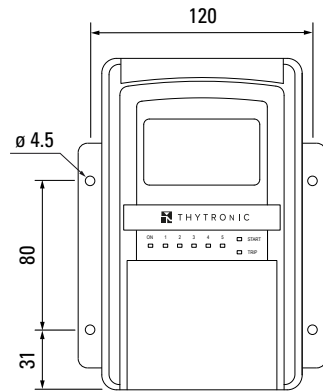
Wiring diagram for input circuits with three phase CTs and residual current from transformer inserted in the star point-to-earth connection of a three-phase winding transformer

DIMENSIONS

FRONT VIEWS

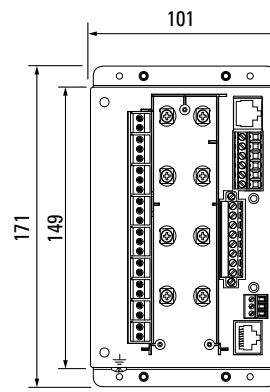


FLUSH MOUNTING

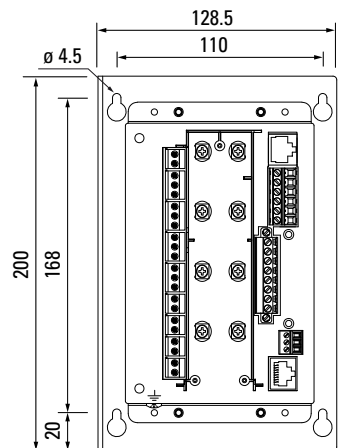


PROJECTING MOUNTING

REAR VIEWS

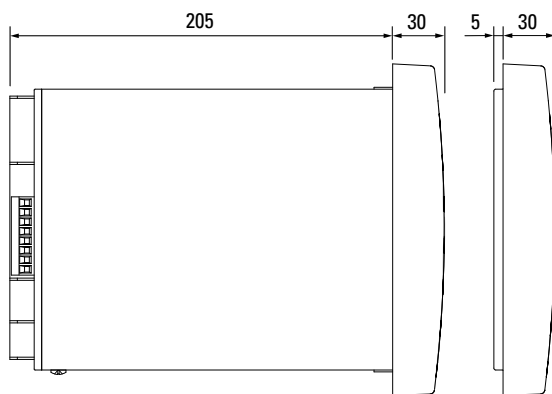


FLUSH MOUNTING

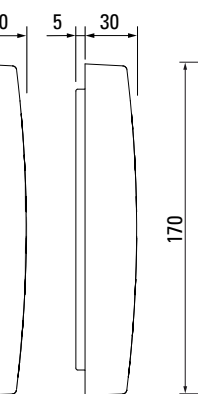


PROJECTING MOUNTING
(Separate operator panel)

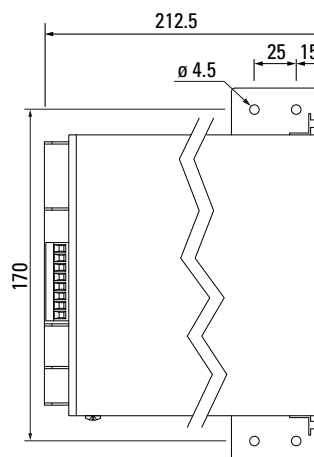
SIDE VIEWS



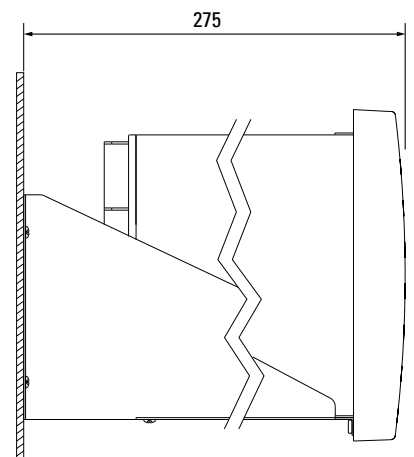
FLUSH MOUNTING



SEPARATE OPERATOR
PANEL

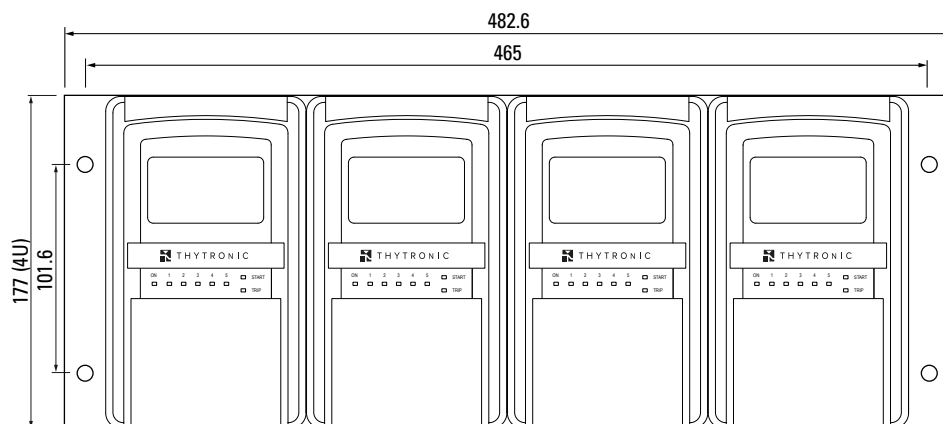


PROJECTING MOUNTING
(Separate operator panel)



PROJECTING MOUNTING

RACK MOUNTING



FLUSH MOUNTING DRILLING JIG

