THYTRONIC

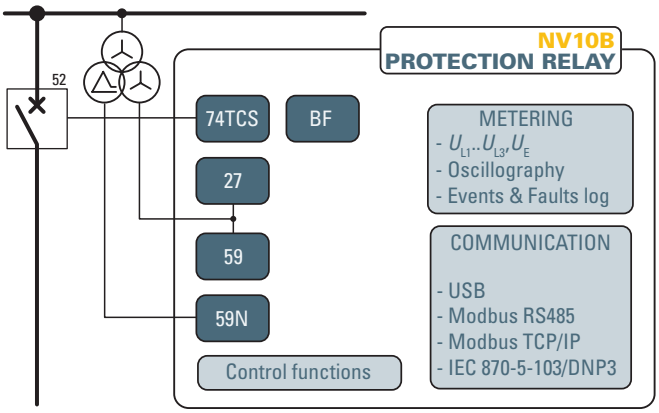
PRO-N
Protection Relays

NV10B

FEEDER&LoM PROTECTION RELAY
VOLTAGE AND FREQUENCY PROTECTION

— Application

The relay type NV10B can be typically used in HV, MV and LV distribution systems, on transformers or for electrical machines.
It can be used for system decoupling, load shedding and loss of main (islanding) protection.



- Protective & control functions

27	Phase undervoltage
59	Phase overvoltage
59N	Residual overvoltage
BF	Circuit breaker failure
74TCS	Trip circuit supervision

— Measuring inputs

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).

— Firmware updating

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

— Construction

According to the hardware configurations, the protection relay can be shipped in various case styles depending on the required mounting options (flush, projecting mounting, rack or with separate operator panel).

— 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 in accordance with a matrix (tripping matrix) structure.

— Modular design

In order to extend I/O capability, the NV10B hardware can be customized through external auxiliary modules:

- MRI - Output relays and LEDs
- MID16 - Binary inputs
- MCI - 4...20 mA converters
- 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.

— Two set point profiles (A,B)

Two independent groups of settings are provided. Switching from profiles may be operated by means of MMI, binary input and communication.

— Communication

Multiple communication interfaces are implemented:

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

— 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.

— 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,...)
- Circuit breaker faults.

— Control and monitoring

Several predefined functions are implemented:

- Trip circuit supervision (74TCS)
- Remote tripping
- Automatic reclosure for photovoltaic plants (optional)
- Circuit Breaker commands and diagnostic

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

— Metering

NV10B provides metering values for phase, residual voltages and frequency, making them available for reading on a display or to communication interfaces. Voltages 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. The measured voltages can be displayed with reference to nominal values or directly expressed in volts. With DFT the RMS value some harmonic are also measured.

— 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 (ThyVisor) 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).
- Trip counters.

— Digital Fault Recorder (Oscillography)

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, The records are stored in nonvolatile memory

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 USB	Type B
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)

— Voltage inputs

Reference voltage U_R	100 V or 400 V selectable on order
Nominal voltage U_n	50...130 V or 200...520 V selectable by sw
Permanent overload	1.3 U_R
1s overload	2 U_R
Rated consumption (for any phase)	≤ 0.5 VA

— Residual voltage input

Reference voltage U_{ER}	100 V
Nominal voltage U_{En}	50...130 V selectable by sw
Permanent overload	1.3 U_{ER}
1s overload	2 U_{ER}
Rated consumption	≤ 0.5 VA

— Binary inputs

Quantity	2
Type	dry inputs
Max permissible voltage	19...265 Vac/19...300 Vdc
Max consumption, energized	3 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

— LEDs

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

GENERAL SETTINGS

— Rated values

Relay nominal frequency (f_n)	50, 60 Hz
Relay nominal voltage (U_n)	50...130 V or 200...520 V
Relay residual nominal voltage (direct measure) (U_{En})	50...130 V
Relay residual nominal voltage (calculated) (U_{ECN})=$U_n \cdot \sqrt{3}$	50...130 V
Line VT primary nominal voltage (U_{np})	50 V..500 kV
Residual primary nominal voltage (phase-to-phase) $\cdot \sqrt{3}$ (U_{Enp})	50 V...500 kV

— 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	0.000...0.500 s

PROTECTIVE FUNCTIONS

— Undervoltage - 27

Common configuration:

- 27 Operating logic (*Logic*27) — AND/OR

U< Element

- *U<* Curve type (*U<*Curve) — DEFINITE INVERSE [1]

Definite time

- 27 First threshold definite time ($U<_{def}$) — 0.05...1.10 U_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
- $U<_{inv}$ 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
- $U<<_{def}$ Operating time ($t_{U<<def}$) — 0.03...100.0 s

Note [1] - 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*

— Overvoltage - 59

Common configuration:

- 59 Operating logic (*Logic*59) — AND/OR

U> Element

- *U>* Curve type (*U>*Curve) — DEFINITE INVERSE [1]

Definite time

- 59 First threshold definite time ($U>_{def}$) — 0.50...1.50 U_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
- $U>_{inv}$ 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
- $U>>_{def}$ Operating time ($t_{U>>def}$) — 0.03...100.0 s

Note [1] - 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*

— Residual overvoltage - 59N

Common configuration:

- Residual voltage measurement for 59N - direct/calculated (*3V0Type*59N) — U_E / U_{EC}
- 59N Operation from 74VT external (*74VText*59N) — *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:

$$t = 0.5 \cdot t_{UE>inv} / [(U/U_{E>inv})-1]$$

where:

t = trip time (in seconds)
$t_{UE>inv}$ *= operating time setting (in seconds)*
U_E *= residual input voltage*
$U_{E>inv}$ *= threshold*

— Breaker failure - BF

- BF Time delay (t_{BF}) — 0.06...10.00 s

— Circuit Breaker supervision

- Number of CB trips (*N.Open*) — 0...10000
- CB max allowed opening time ($t_{break>}$) — 0.05...1.00 s

METERING & RECORDING

— Measured parameters

Direct:

- Frequency — *f*
- Input voltages — U_{L1}, U_{L2}, U_{L3}
- Residual voltage — U_E

Calculated:

- Calculated residual voltage — U_{EC}
- Maximum voltage between U_{L1}-U_{L2}-U_{L3} — U_{Lmax}
- Average voltage between U_{L1}-U_{L2}-U_{L3} — U_L

Sequence:

- Negative sequence voltage — U_2

3rd harmonic:

- Third harmonic residual voltage — U_{E-3rd}

— Event recording (SER)

- Number of events — 300
- Recording mode — circular

Trigger:

- Start/Trip of enabled protection or control element
- Binary inputs switching (OFF/ON or ON/OFF) — IN1...INx
- Setting changes
- Auxiliary supply — Power UP/Power DOWN

Data recorded:

- Counter (resettable by ThyVisor) — $0...10^9$
- Cause — binary input/trip/setting change/Power ON/OFF
- Time stamp — Date and time

— Fault recording (SFR)

- Number of faults — 20
- Recording mode — circular

Trigger:

- Output relays of enabled protection or control element (OFF-ON)
- External trigger (binary inputs) — IN1...INx

Data recorded:

- Counter (resettable by ThyVisor) — $0...10^9$
- Time stamp — Date and time
- Cause — tripped element
- Input voltages — U_{L1r}, U_{L2r}, U_{L3r}
- Residual voltages (measured and calculated) — U_{Er}, U_{ECr}
- Binary inputs state — IN1, IN2...INx
- Output relays state — K1...K6...K10
- Fault cause info (operating phase) — L1, L2, L3

— Digital Fault Recorder (Oscillography)

File format	COMTRADE
Records	depending on setting [1]
Recording mode	circular
Sampling rate	24 samples per cycle

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	ThyVisor

Set sample channels:

• Instantaneous voltages	u_{L1}, u_{L2}, u_{L3}, u_E

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

• Frequency	*f*
• Input voltages	U_{L1}, U_{L2}, U_{L3}
• Residual voltage (measured and calculated)	U_E, U_{EC}

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

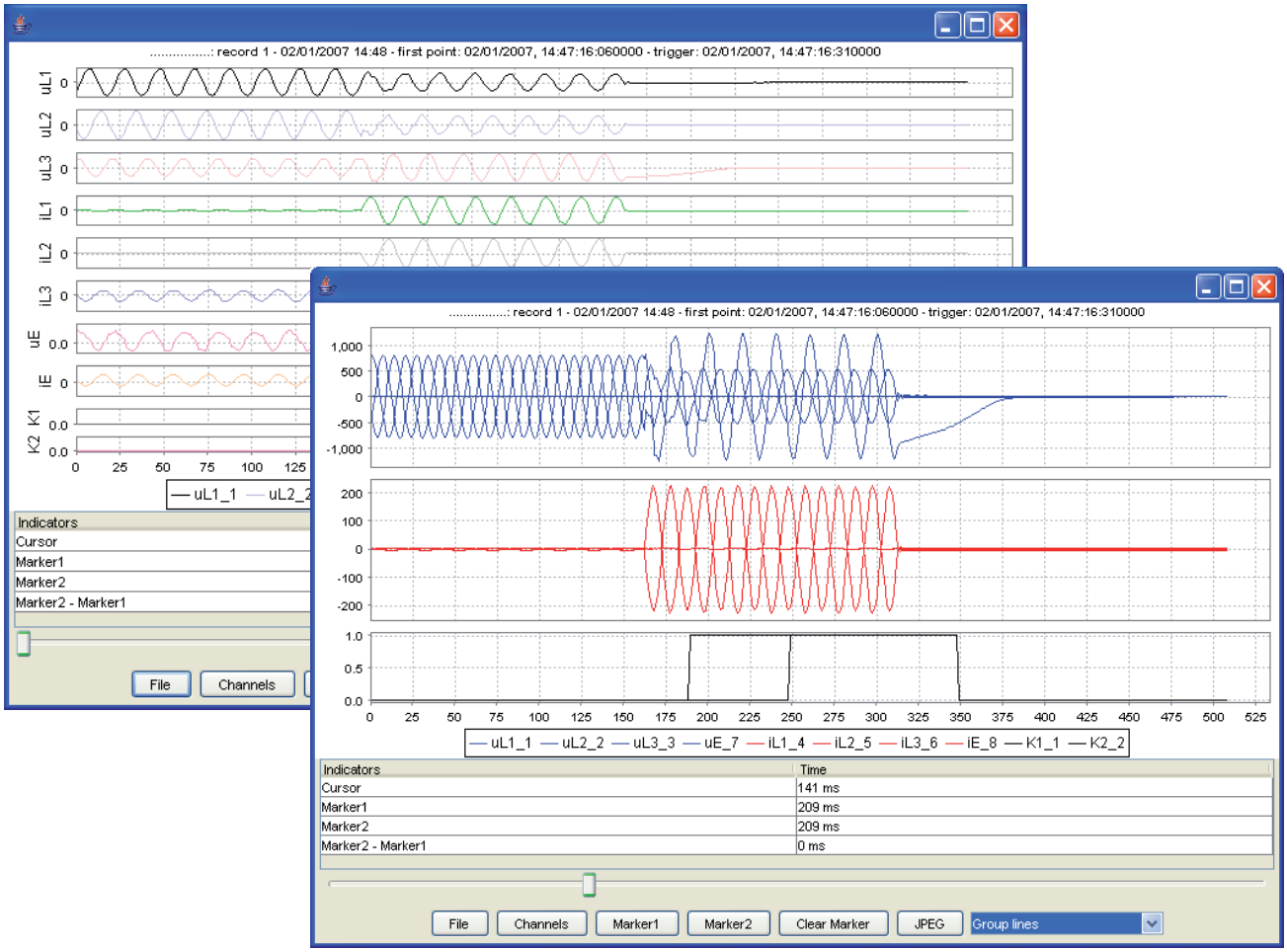
• Output relays state	K1...K6...K10
• Binary inputs state	IN1, IN2...INx

Note [1] - For instance, with following setting:

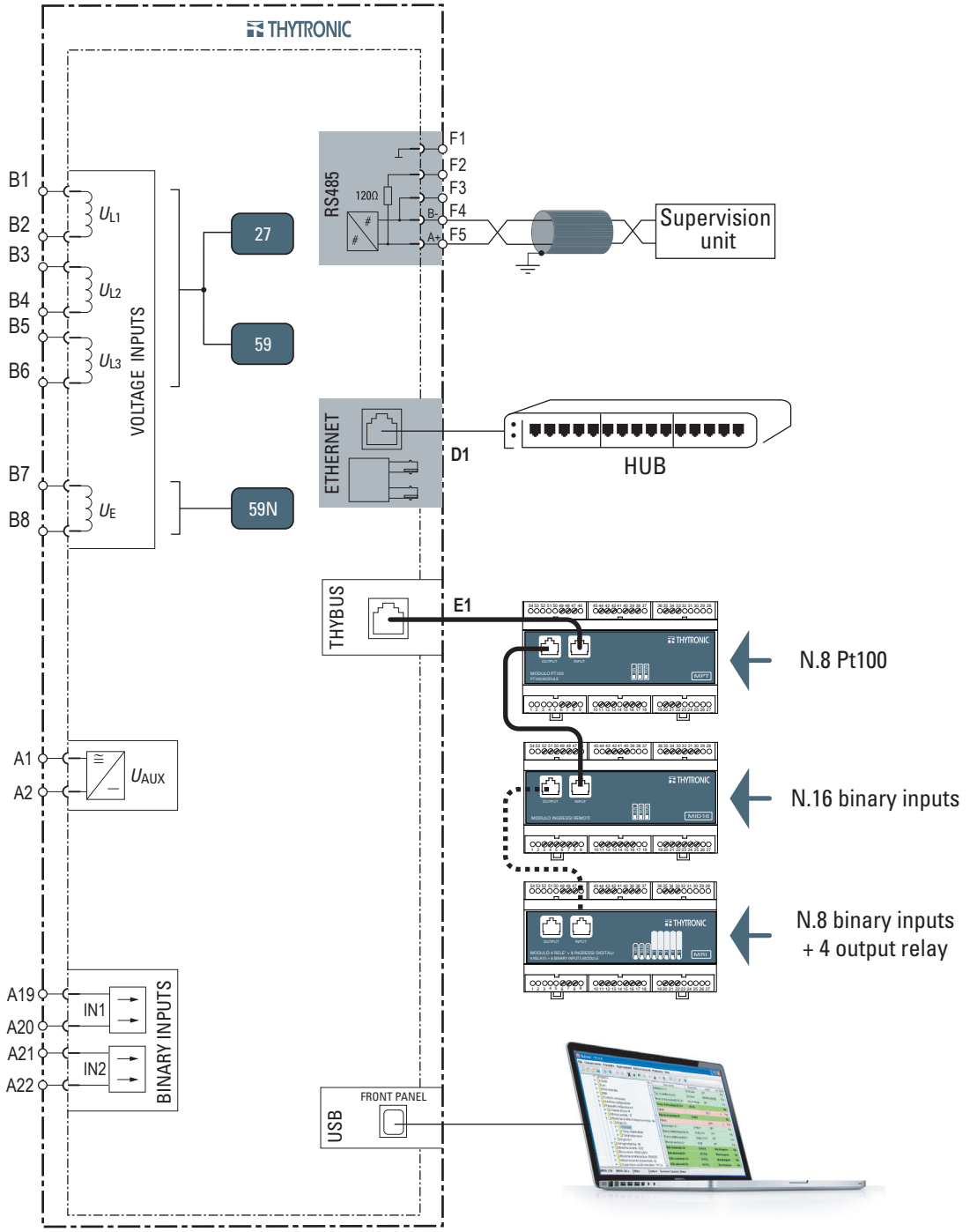
• *Pre-trigger time*	*0.5 s*
• *Post-trigger time*	*0.5 s*
• *Sampled channels*	u_{L1}, u_{L2}, u_{L3}, u_E
• *Analog channels*	U_{L1}, U_{L2}, U_{L3}, U_E
• *Digital channels*	*K1, K2, K3, K4, K5, K6, IN1, IN2*

up to 180 records can be stored

Oscillography (DFR)

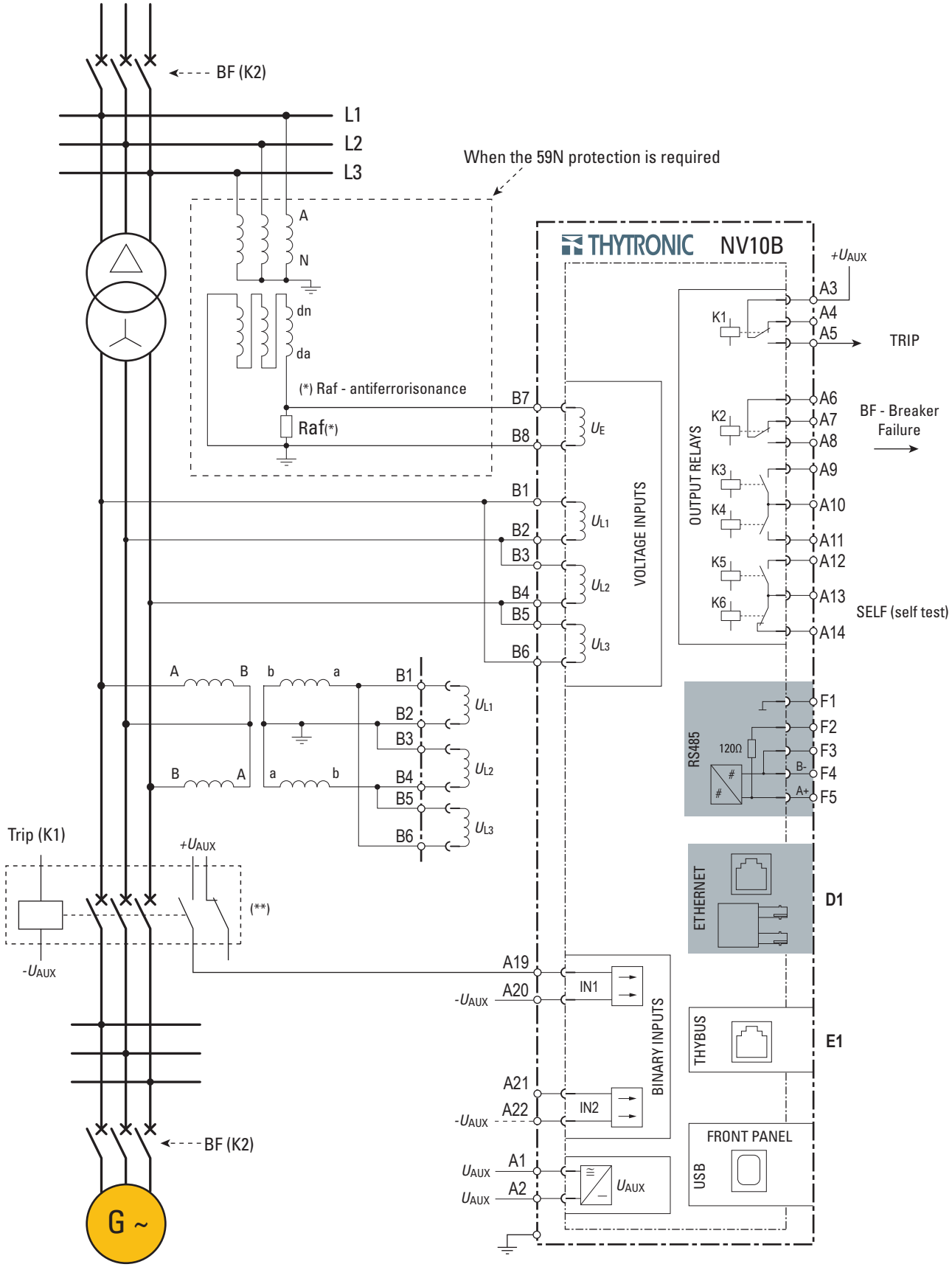


— I/O circuits and interfaces



Interfaces.ai

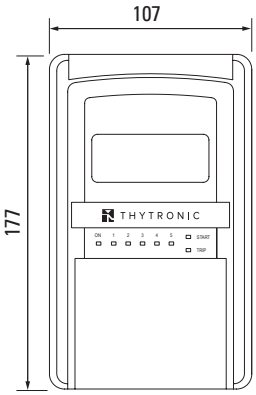
— Connection diagram example for active users



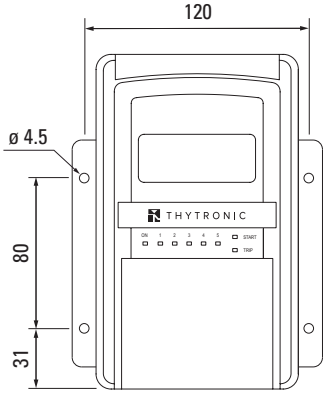
Phase-phase input voltages with direct connection to the LV side (U_R = 400 V versions) or by means of two VTs and residual voltage acquired with open delta VT

DIMENSIONS

FRONT VIEW

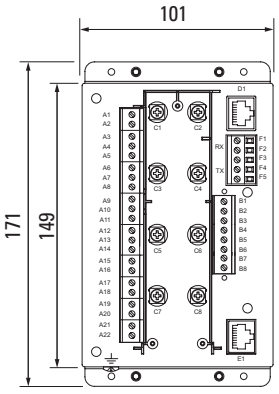


FLUSH MOUNTING

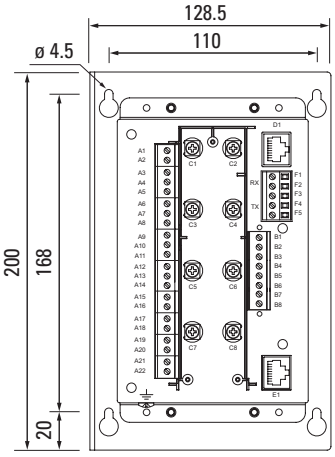


PROJECTING MOUNTING

REAR VIEW

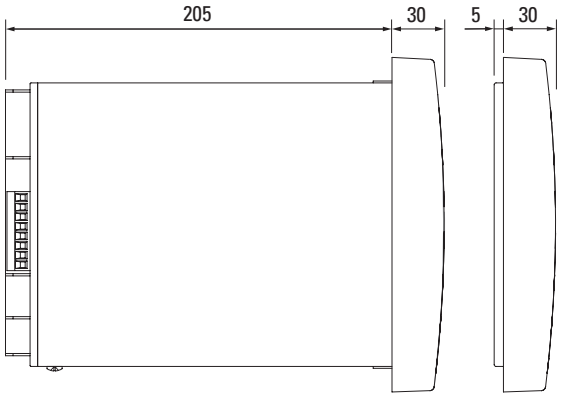


FLUSH MOUNTING



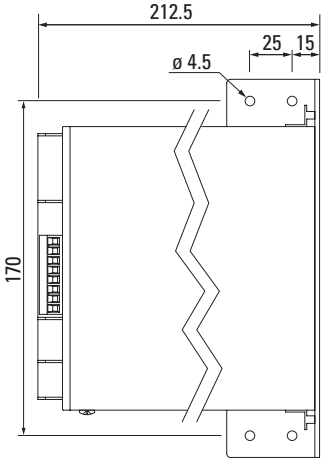
PROJECTING MOUNTING
(Separate operator panel)

SIDE VIEW

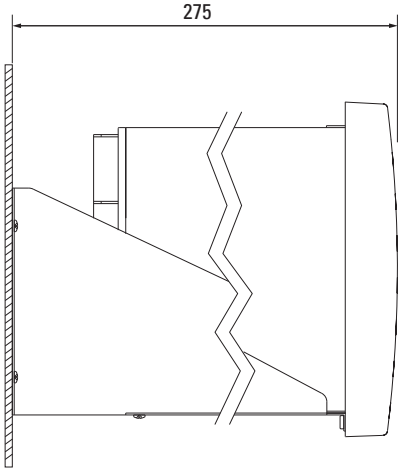


FLUSH MOUNTING

SEPARATE
OPERATOR PANEL

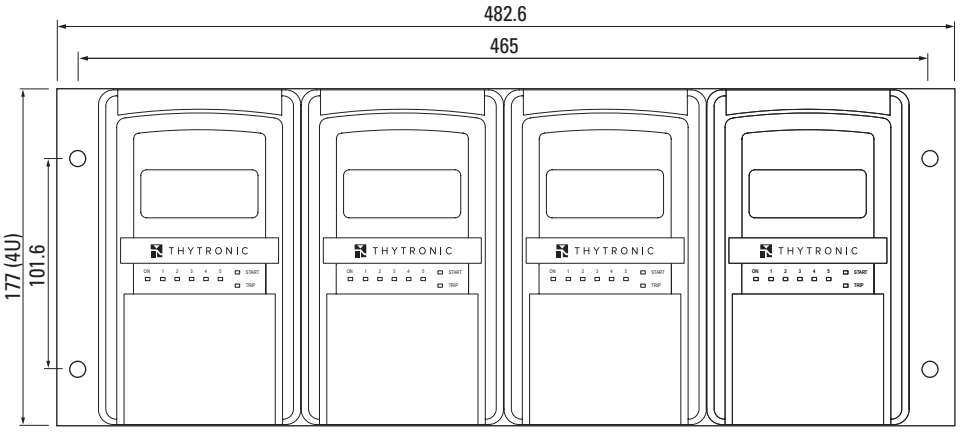


PROJECTING MOUNTING
(Separate operator panel)

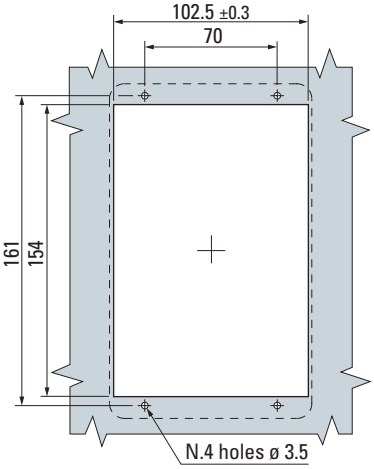


PROJECTING MOUNTING
(Stand alone)

RACK MOUNTING



FLUSH MOUNTING CUTOUT



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