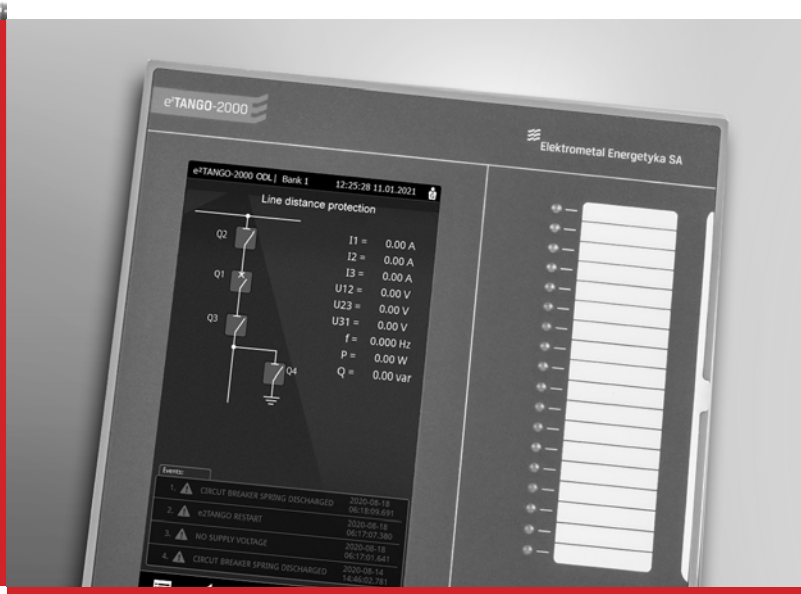
Elektrometal Energetyka SA



e²TANGO-2000-ODL®

HV protection unit

(Line distance protection)

Product Data Sheet K-44.1.3 EN

Elektrometal Energetyka SA
FR2 LINIA 110kV
STEROWNIK POLOWY
Elektrometal Energetyka SA
ZABEZPIECZENIE RÓŻNICOWO-PRĄDOWE LINII
Elektrometal Energetyka SA

We create ideas with power!

The family of the e²TANGO-2000-series HV protection relays has been developed by our R&D team consisting of engineers with extensive practical knowledge and many years of experience in the industry. The idea behind creating a high-voltage protection automation platform was to provide clients with operational surety of hardware, software, and algorithms.

The e²TANGO-50, e²TANGO-100, e²TANGO-200, e²TANGO-400, e²TANGO-600, e²TANGO-800, e²TANGO-1000, e²TANGO-1200 protection relays and bay controllers for MV have been installed in thousands of facilities across the country and Europe. The hardware platform is based on the same central unit as for the e²TANGO series, of course, with the same configuration of processors, memory cards, inputs/outputs, etc. This makes us absolutely convinced that a few years of trouble-free operation of the e²TANGO series hardware gives security for applications in sensitive areas of HV stations and switchgears.

The e²TANGO-2000 software was developed on the basis of proven versions for MV controllers, while the algorithms of protections operation were developed in cooperation with the Wroclaw University of Science and Technology. Thanks to this, the user can be sure that the applied solutions have been tested over the last few decades and work reliably in many HV facilities in Poland and Europe.

The safety of the HV protection relays' users and operated power facilities was our priority when creating e²TANGO-2000. Therefore, in addition to the certainty of the hardware and software side, we have performed a full type testing completed with a certificate confirming the workmanship quality of the HV protection relays series.

Dariusz Rybak

Chief Designer of the e²TANGO series
Elektrometal Energetyka SA

APPLICATION OF HV PROTECTIONS

The e²TANGO HV protections portfolio constitutes a wide range of protection automation devices, including overcurrent and earth-fault protections, differential protection of transformer, voltage regulator, and line differential protection and distance protection. The e²TANGO-2000 protection units can be used in bays with the various intended use and operating nature, e.g., in HV line bays or HV/MV transformer bays, but also in facilities of distribution, industrial and other power engineering, which have high-voltage (HV) stations.

HV line bay

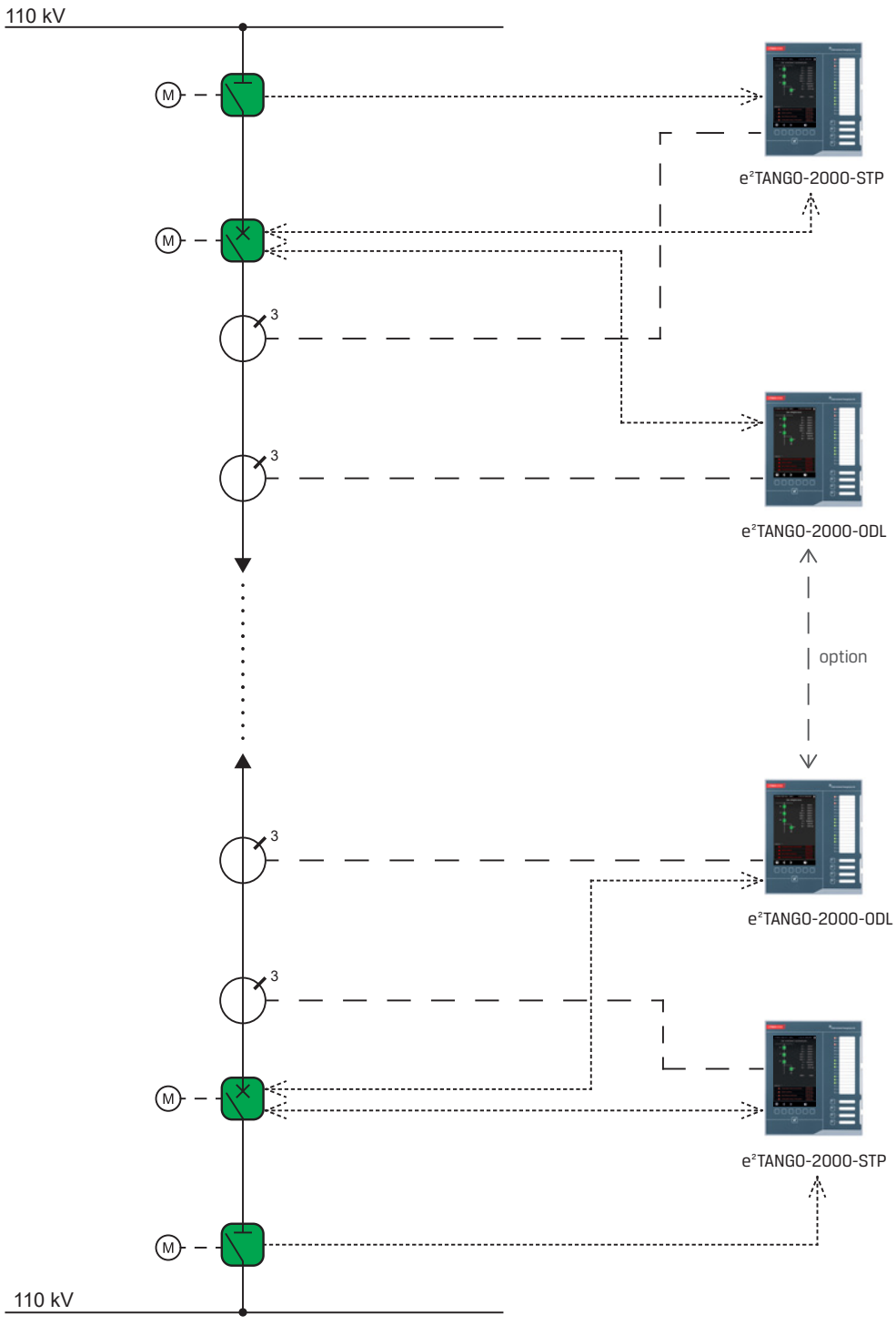
- line differential protection
- automatic reset

HV recipients

HV station

HV LINE BAY DIAGRAM

A diagram of HV line bays with marked places for installing the e²TANGO-2000-type protection automation is presented below.



A comprehensive solution for the HV line bay, which includes all protection automation elements based on the e²TANGO platform, is demonstrated. The overcurrent and earthfault protection (STP) and distance protection (ODL) have been constructed based on the e²TANGO-2000.

ADVANTAGES OF HV PROTECTIONS

remote service access

remote and local readout of diagnostic data with the possibility of sending it to the manufacturer's service

tested algorithms

protection algorithms developed in cooperation with the Institute of Power Engineering

spinning reserve

restoring the bay to work after a failure within several minutes, possibility to restore all bay data, e.g.: settings, logic, events

verified hardware base

basing on proven hardware and software of e²TANGO MV controllers

intuitive interface

legible menu layout, pictorialness of captions and markings

high interference resistance

up to 100% higher than required by the standard

wide range of hardware configurations

6-, 10-, 14-slot units are available with surface, flush or mixed installation method

expansion cards diversity

modular design based on expansion and communication cards, up to 168 inputs and up to 39 outputs

Intuitive and easy-to-use e²TANGO HV protection units are equipped with a fully configurable, clear screen and extensive configuration, registration, and measurement functions. The legibility of indications and signalling, easy access to documentation and instructions, easy verification of logic operation, and graphical verification of protections characteristics or remote service access definitely improve daily work with the device.

preview of the diagram and logic current status
logic and synoptic diagrams

complete operating manual
quick access to the associated chapters of the technical documentation

legible menu
pictorialness of captions and markings

graphic presentation of parameters
phasors, harmonics content

fully configurable graphic interface
up to five configurable screens, rich widget base

can be operated without the manual
quick-access help

DESIGN

The e²TANGO-series HV protections consist of two elements: operator panel and central unit. The central unit is made based on expansion cards and comes in three housing versions: J6 (6 cards), J10 (10 cards) and J14 (14 cards) - depending on the complexity of the switchboard bay layout and user's needs. The e²TANGO-2000 operator panel has a 7-inch, high-resolution colour screen.

signal LEDs
18 three-colour LEDs

replaceable labels
easily accessible and replaceable diode and function buttons' captions

context buttons
enable immediate operation of switches' statuses and device menu navigation

function keys with LEDs
allow for assigning them most frequently used functions

USB communication
USB and USB mini ports

INTERFACE AND OPERATION	
Display	7"
Display resolution	800×480 px
Colour display	•
Touch screen	o
Context buttons (quantity)	-
Control buttons (v)	o
Programmable function keys with LEDs	4
LED	18
Virtual LED (on LCD)	o
Virtual function keys (on LCD)	o
Replaceable labels	•
DESIGN AND EQUIPMENT	
Panel dimensions (external - HxWxD)	252×215×41,5
Mounting opening dimensions in flush version	228×191
External central unit	•
J6 unit • 6 slots • dimensions: 222 x 187 x 103 (HxWxD)	o
J10 unit • 10 slots • dimensions: 222 x 234 x 103 (HxWxD)	•
J14 unit • 14 slots • dimensions: 222 x 281 x 103 (HxWxD)	o
STANDARD EQUIPMENT**	
number of binary inputs (maks.*)	28 (168)
number of binary outputs (maks.*)	23 (39)
Max. number of switches	12
Analogue inputs 0-10 V (maks.)**	0 (4)
Analogue outputs 4-20 mA (maks.)**	0 (4)
Analogue output 0-10 V (maks.)**	0 (4)
Temperature inputs (maks.)**	0 (12)
Current measuring card for differential protection	0 (2 dla TRR)
OTHER	
Widgets	•
Number of configurable screens	5
Logic preview on display	•

•/o - standard/option
* - for the largest unit available and with all slots occupied with one type of card
** - the required number of expansion cards

PROTECTION FUNCTIONS

21L	underimpedance (distance)
50/50N	short-circuit/instantaneous earth-fault
51/51N	overcurrent/three-stage zero overcurrent delayed
50HS	shortening of the tripping time in case of activation on short-circuit
51	dependent overload (IEC characteristics or approximated in item 6)
60/67N	overcurrent/zero, directional overcurrent
59N	zero-component overvoltage
51VN	zero overcurrent with voltage monitoring/voltage interlock
59	two-stage overvoltage (operation selection from phase or line-to-line voltages)
27	two-stage undervoltage (with operation selection from phase or line-to-line voltages)
87L*	line differential protection
74TCS	control of 3 control circuits

* - option

AUTOMATION

- PDZ automation
- SCO automation
- SPZ treble automation with breaker position control and the possibility to determine the type of protection that initiates the triggering of SPZ
- LRW automation
- other based on programmable logic

EXPANSION CARDS

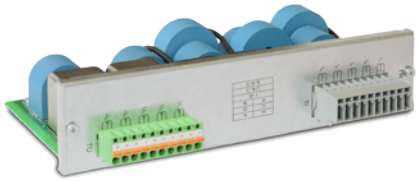
PRIMARY CARDS
- power supply or power supply with reinforced contacts (connection ability up to 10 A DC)
- processor

MEASURING CARDS
- standard (5I+4U)
- synchrocheck (4I+5U)

FUNCTION CARDS
- 8 binary inputs
- 12 binary inputs
- 8 relay outputs
- 4 relay outputs with reinforced contacts (connection ability up to 10 A DC)

ANALOGUE CARDS
- 4 analogue inputs 0-10 V
- 4 analogue inputs 4-20 mA
- 4 analogue outputs 0-10 V
- 4 analogue outputs 4-20 mA

TEMPERATURE CARDS
- 6 temperature inputs PT100
- 6 temperature inputs PT1000



PORTS AND COMMUNICATION PROTOCOLS

- Ethernet
- Single-mode optical fibre - OPTOSM
- Multi-mode optical fibre - OPTOMM
- Plastic optical fibre - OPTOP
- RS485
- CANbus 2×
- USB 2.0
- WiFi*

- Modbus RTU/TCP
- IEC 60870-5-103
- DNP 3.0
- Profibus
- CANbus/PPM 2
- IEC 61850

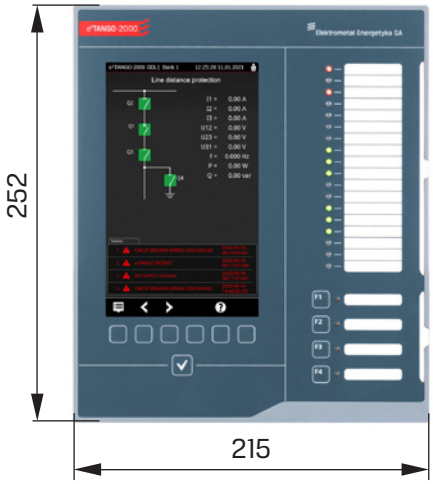
* after agreement with the manufacturer

RECORDERS

- event recorder, 1000 events
- interference recorder up to 160 s sampling frequency 1.6 - 3.2 kHz
- recording of instantaneous values, TrueRMS
- phasor

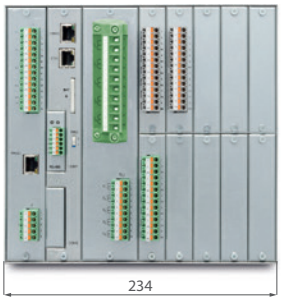
DIMENSIONS

e²TANGO-2000

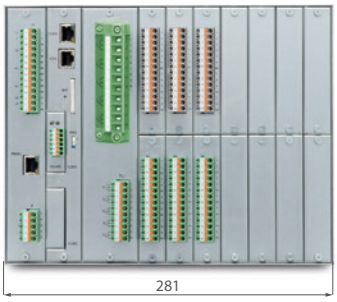


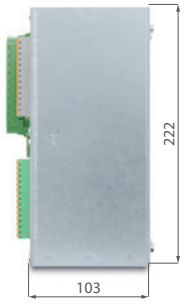
J6

J10



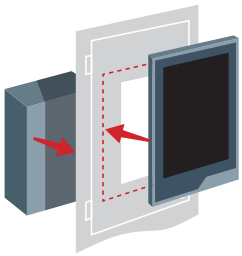
J14



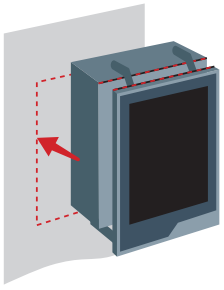


INSTALLATION METHODS

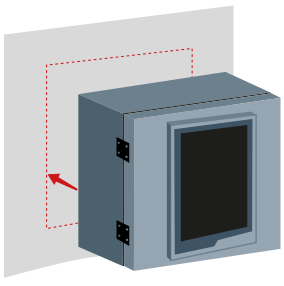
flush installation



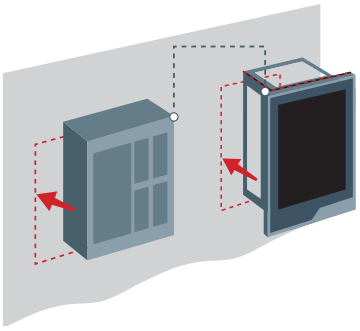
surface installation



version 1

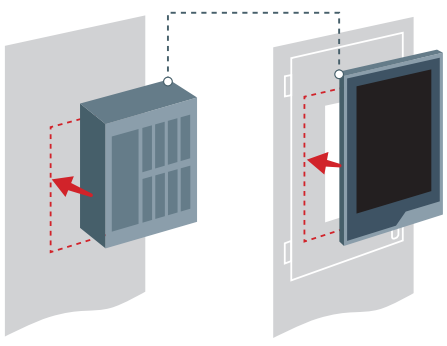


version 3

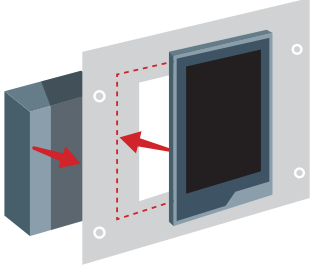


version 4

mixed installation



installation in a rack cabinet



TECHNICAL PARAMETERS

Power supply with auxiliary voltage	
DC voltage AC voltage Option	110 V, 220 V (80-300 V DC) 230 V (88-265 V AC) 24-48 V (19-58 V AC/DC)
Max. power consumption (panel and unit)	30 W (VA)
Current measurement circuits	
Rated current	1 A or 5 A
Rated frequency	50 Hz
Phase current measurement range	0.05-150 A
I0 current measurement range	0.1-100 A
Voltage measurement circuits	
Rated voltage	57,7/100 V
Rated frequency	50 Hz
Voltage measurement range	3-120 V
Measurement accuracy	
I1, I2, I3 (0.1-150A)	1%
U1, U2, U3, U0 (5-120V)	1%
I0 (0.1-100A)	1%
P, Q, EC, EB (U>5V, 0.1A<I<10A)	1%
f (U>5V)	10 mHz
φ 1, φ2, φ3, φ0 (U>5V, 0.1A<I<10A)	1°
Protections parameters	
Overcurrent protections operate time	typically 35 ms
Line differential protection operate time	typically 20 ms
Reset ratio of overload protections	Configurable
Reset ratio of underload protections	Configurable
Parameters of W1, W2, W3 binary outputs (breaker control)	
Voltage on open contacts	250 V AC, 440 V DC
Circuit activation at 220 VDC	5.0 A
Circuit deactivation at 220 VDC (L/R = 40 ms)	0.3 A 5 A (for PSUHI card)
Circuit deactivation at 220 VAC (cos φ = 0.4)	2.0 A
Parameters of binary outputs (other)	
Voltage on open contacts	250 V AC, 440 V DC
Permanent load	5.0 A
Circuit deactivation at 220 VDC (L/R = 40 ms)	0.1 A 5 A (for OUTHI card)
Circuit deactivation at 220 VAC (cos φ = 0.4)	2.0 A
Parameters of binary inputs	
Rated voltage Optional Other on request	110/230 V AC/DC 24-48 V (19-58 V AC/DC)
Maximum current consumption at 220 V DC; 230 V AC	2 mA; 15 mA
Environmental conditions	
Operating temperature	-10°C to +55°C
Storage temperature	-25°C to +70°C
Relative humidity	5% to 95%, without water vapour condensation
Vibrations and mechanical impacts	Class 1 acc. to IEC 60255-21
Electromagnetic interferences	Class B acc. to IEC 60255-26
Safety	
Insulation electric strength	2 kV/50 Hz/60 s acc. to IEC 60255-27
Dimensions	
Weight (central unit/operator panel)	5 kg/1 kg
Central unit dimensions (WxDxH mm)	222x103x187/234/281
Central unit protection class	IP 3X/IP 4X (option)
Panel protection class (front plate side)	IP 4X/IP 54 (option)

e²TANGO-STUDIO SOFTWARE

The e²TANGO-Studio is an engineering program dedicated to the e²TANGO bay controller and, at the same time, a configuration tool for the panel. The programme has been developed and equipped with a rich set of functionalities, which, combined with a clear visual configuration of widgets, becomes excellent support in everyday work, enabling the creation of projects for many devices, panels, switchboards, or stations.

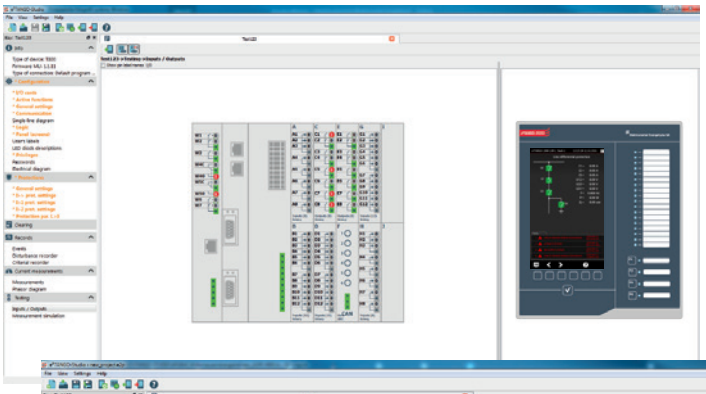
advanced designing
possibility of preparing the devices' configuration for the whole switchboard on the PC and its distribution using USB

user elements
defining customised graphic elements of the synoptic diagram

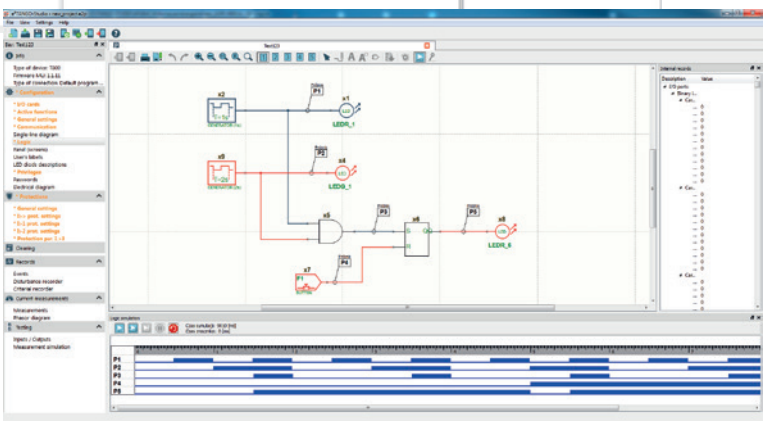
quick configuration assistant
facilitating the first use of the programme and support during regular work

on-line preview
live preview of I/O statuses, measurements; real preview of the image displayed on the LCD screen

displaying compliance
preview of the actual view of the panel screen



possible further expansion
using plug-ins



visual characteristics' shaping
graphical and standard configuration of protections' settings

prosta weryfikacja nastaw i selektywności
presentation of the whole overcurrent protections' family presentation on one chart

full statuses' view
access to all internal statuses of the device and protections

instant user screen designing
placement of elements supported by drag&drop method

logic simulator
possibility of full simulation of logic without connecting to the device

logic legibility
possibility of dividing the logic into blocks and sheets

operation of extended logical dependencies
up to 340 logical gates/functors

ADVANCED LOGIC EDITOR AND SIMULATOR

The e²TANGO-Studio features an advanced and extended logic editor that allows for simulating the logic circuit, also visible from the panel, without connecting the device. It allows previewing logical statuses while working with the device, which facilitates project preparation, as well as commissioning and servicing of switching stations. It gives the possibility to design non-standard logics dedicated to the requirements of the client's infrastructure.

STANDARISATION

PN-EN 60255-1	Measuring relays and protection equipment. Part 1: Common requirements
PN-EN 60255-26	Measuring relays and protection equipment. Part 26: Electromagnetic compatibility requirements
PN-EN 60255-27	Measuring relays and protection equipment. Part 27: Product safety requirements

CERTIFICATES AND AWARDS

IEn Certificate of Compliance
No. 005/2019

for the e²TANGO-2000 HV protection units

DNV-GL International Certificate of Conformity (KEMA)
IEC 61850 Edition 2.0. level (A)

Gold medal
ENERGETAB 2015 trade fair

Minister of Energy Cup
ENERGETAB 2018 trade fair

Mazovian Quality Award

Forbes Diamond 2023

ELEKTROMETAL ENERGETYKA SA QUALITY

Integrated Management System is implemented in the company, based on the following standards:

- PN-EN ISO 9001 Quality Management Systems
- PN-EN ISO 14001 Environmental Management Systems
- PN-EN ISO 45001 Occupational Health and Safety Management Systems

ORDER FORM

To order the e²TANGO-2000 protections, please fill in this part of the form according to the INSTRUCTIONS FOR FILLING IN THE FORM on the next page.

STEP 1

①	panel version	☐ 2000-ODL	☐ 2000-ODL+LRR[1]						
②	central unit version	☐ J6	☐ J10	☐ J14	☐ J6H[2]	☐ J10H[1]	☐ J14H[2]		
③	TR measuring card version	☐ TR (standard, 5I+4U)	☐ TRS (4I+5U)						
④	measuring card parameters	☐ 5 A	☐ 1 A						
⑤	power supply voltage	☐ UNI (110/230 V AC/DC)	☐ 24V (24/48 V AC/DC)	☐ others					
	Ethernet communication port (standard on each central unit)								
⑥	COM1	☐ x-none	☐ RS485	☐ CANx2	☐ OPTOMM	☐ OPTOSM	☐ OPTOP	☐ Profibus	☐ others
⑦	COM2	☐ x-none	☐ RS485	☐ CANx2	☐ OPTOMM	☐ OPTOSM	☐ OPTOP	☐ Profibus	☐ others
⑧	installation method	☐ Z - flush	☐ N1 - surface ver. 1	☐ N3 - surface ver. 3	☐ M - Mixed	☐ ZR - flush in rack cabinet			
⑨	panel-unit cable length	☐ S-1 m	☐ L-2 m	☐ other					
⑩	IP protection class	☐ IP 4X	☐ IP 54[3]						
⑪	communication IEC 61850	☐ EX-none	☐ O-ETH fibre optic	☐ O2-ETH fibre optic with PRP	☐ O2G-O2+GOOSE	☐ E2-electric			
		☐ E-ETH electric	☐ EG-ETH electric+GOOSE	☐ OG-ETH fibre optic+GOOSE	☐ E2G-electric+GOOSE				
⑫	language version	☐ PL	☐ EN	☐ other - in agreement with manufacturer					

1) e²TANGO-2000-ODL version combined with e²TANGO-2000-LRR line differential protection available on special order
2) reinforced W1, W2, W3 outputs
3) protection class IP 54 only available in version with flush and mixed installation

STEP 2

Card name	Kod	Slot A	B	C	D	E	F	G	H	I	J	K	L	M	N
CPU processor card	-	standard in every device													
PSU power supply card - 7 relay outputs	-	standard in every device													
Ethernet communication port	-	standard in every device													
8 binary inputs	8IN	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12 binary inputs	12IN	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8 binary inputs 24-48 V*	8IN24	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12 binary inputs 24-48 V*	12IN24	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8 relay outputs	8OUT	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4 relay outputs, reinforced	4OUTHI	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4 analogue inputs 0-10 V	AI10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4 analogue inputs 4-20 mA	AI20	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4 analogue outputs 0-10 V	AO10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4 analogue outputs 4-20 mA	AO20	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6 temperature inputs PT100	PT1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6 temperature inputs PT1000	PT10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		J6						J10				J14			

* universal card for voltages between 24-48 V AC/DC

additional requirements:

STEP 3

Your code:

e²TANGO	1	2	3	4	5	6	7	8	9	10	11	12
A	B	C	D	E	F	G	H	I	J	K	L	M	N

INSTRUCTIONS FOR FILLING IN THE FORM

STEP 1

The presented table includes basic technical parameters of the e²TANGO-2000 protections. Only 1 item should be selected from each item numbered from 1 to 10. If "other" is selected, enter the ordered value in the corresponding field in STEP 3.

Explanation for step 1.

- ☐ - recommended basic configuration
- OPTOMM - multi-mode fibre optic
- N1 - surface installation ver. 1
- N3 - surface installation ver. 3

STEP 2

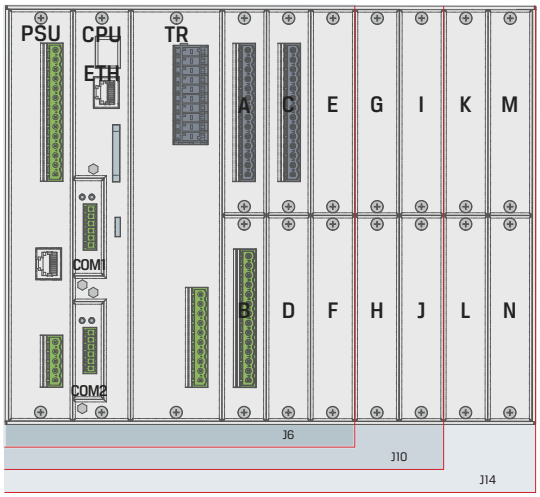
The presented table includes a list of available expansion cards and possible places for their installation in the e²TANGO-2000 HV protection central unit. No tick box ☐ means that the given card cannot be installed in a given place. Select the cards to be ordered from the list and mark with the "X" slot in which they are to be installed. The cards' distribution should start with the A slot. The unit capacities are marked with a background colour in the table, respectively.

Describe additional requirements in the designated area.

Explanation for step 2.

- ☐ - recommended basic configuration
- maximum 4 8OUT cards
- maximum 1 AI10 card or 1 AI20 card
- maximum 1 AO10 card or 1 AO20 card
- maximum 1 PT1 card or 1 PT10 card

View of the central unit with a selection of the slot arrangement for expansion cards



STEP 3

The above-selected parameters of the e²TANGO bay controller should be completed in appropriate fields. The e²TANGO code created in such a way together with other requirements or a scanned page of the form should be sent with the order to: export@elektrometal-energetyka.pl

Example of the e²TANGO-2000 HV protection unit configuration:

① e²TANGO-2000-ODL	⑨ 8 m cable
② J6 central unit	⑩ protection class IPX4
③ TRS measuring card	⑪ IEC 61850 communication (electric)
④ rated current of the measuring card 5 A	⑫ EN
⑤ universal binary inputs voltage	Ⓐ slot A: card 8IN
⑥ RS485	Ⓑ slot B: card 8OUT
⑦ OPTOSM	Ⓒ slot C: card 12IN
⑧ mixed installation	

Example of correct code completion:

e²TANGO	2000-ODL	J6	TRS	5A	UNI	RS485	OPTOSM	M	3	IP4X	E	EN
8IN	8OUT	12IN										

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