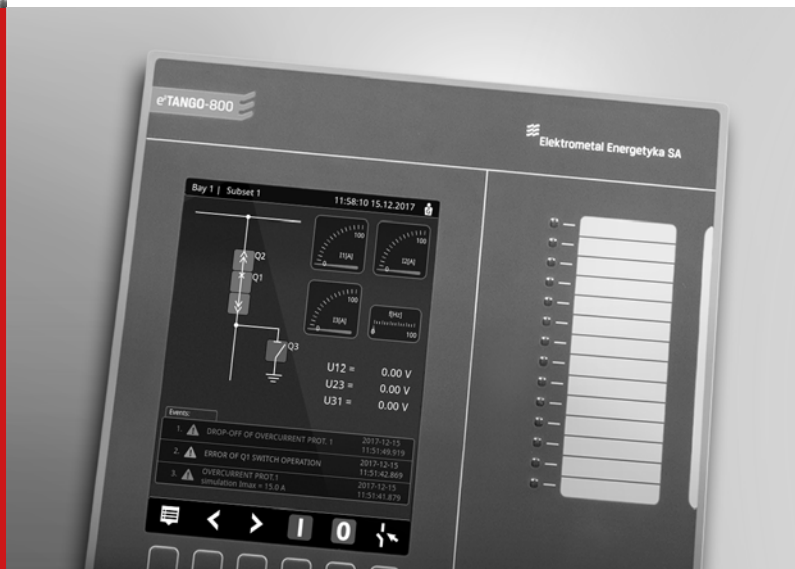




Elektrometal Energetyka SA



# e<sup>2</sup>TANGO<sup>®</sup> -600, -800, -1000, -1200 Bay Controller





## We create ideas with power!

Bay controller e<sup>2</sup>TANGO-600, -800, -1000, -1200 by ELEKTROMETAL ENERGETYKA SA has been developed by our Research and Development Team composed of engineers with vast practical knowledge and many years of professional experience in power engineering industry. Ideas and solutions which has been applied in e<sup>2</sup>TANGO are solving problems which our customers have to face every day. Finding solutions to this problems was our inspiration during our construction work. In result we have created an exceptionally friendly and intuitive e<sup>2</sup>TANGO bay controller for every day use which doesn't require an advanced introduction training.

We have designed a technically advanced device, universal in terms of software and hardware, dedicated to protection automatics, controlling, measuring, recording and supervising of MV and HV switchgear bays.

e<sup>2</sup>TANGO bay controller has a lot of interesting features but easy and convenient use are it's very special advantages. We intended to develop an extremely friendly and intuitive device for every day use, which can be applied in a system of intelligent power grids SMART GRID.

Versatility of e<sup>2</sup>TANGO enables it to be easily adapted to individual requirements and safe loads. We have strongly focused on safety because we know how it is important in the power industry. All our products, including the family of bay controllers, have certificates confirming complete type examination carried out in the most demanding laboratories.

e<sup>2</sup>TANGO is an exceptional bay controller. We strongly believe it and therefore recommend it as a special one.



Dariusz Rybak

Chief Designer of the e<sup>2</sup>TANGO series  
Elektrometal Energetyka SA



## APPLICATION

e<sup>2</sup>TANGO -600, -800, -1000, -1200 bay controller is an universal solution in terms of hardware and software. It is equipped in complete set of protection and station automatics and can be therefore applied in each kind of bay of various intended use and operation characteristics, eg. incoming-, line-, transformer-, incoming-outgoing-, measurement-, coupler- and capacitor bay. Thanks to the additional measurement of current and voltage, both on the MV and LV sides, they can be used in particular in all types of renewable power plants energy, such as wind farms and solar farms, both for low, medium and high voltage grids. Additional automatic transfer switch with auto re-transfer allows complete protection in powering the outflows in the objects which require continuous and guaranteed power supply.



### wind and solar power plant bay

- synchrocheck
- df/dt
- du/dt



### motor bay

- thermal protection
- thermal sensors PT100
- motor start-up protection



### transformer bay

- thermal protection
- flux-gas protection
- 2nd harmonic restraint



### line bays

- earth fault protection
- distance protection
- automatic frequency load shedding



### capacitor battery bay


- internal current of capacitor battery
- automatic inclusion capacitor switching bank



### incoming bays

- ATS automation
- automatic bus-bar protection
- automatic breaker failure protection

# ADVANTAGES OF THE BAY CONTROLLER



**quick start**  
first run configuration assistant, predefined synoptic diagram library, predefined protections functions

**trouble-free battery change**  
possible to change battery without turning off the feeder

**remote service acces**  
remote and local read of diagnostic data, allows to send data to manufacturer service

**high safety / increase safety**  
possible to visualise switch states on the panel screen by camera; possible to cooperate with busbar temperature sensors

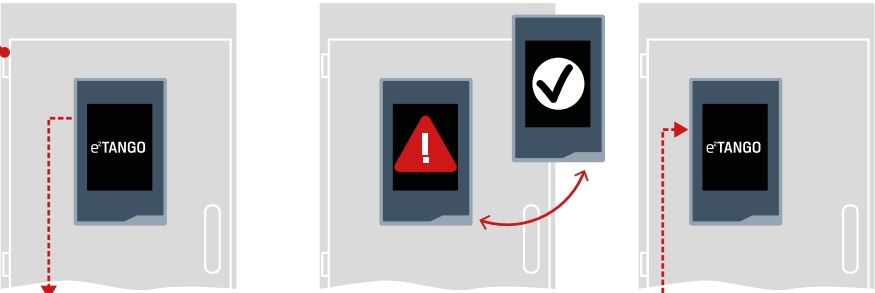
**hot reserve**  
restoring within a few minutes functioning of the bay after fail, possibility to recover all bay data such as: settings, logic, events

**variety of expansion cards**  
modular construction based on expansion and communication cards, up to 168 input and up to 39 output

**intuitive interface**  
clear menu layout, graphic expression of menu positions and other designations

**strong resistance to interference**  
up to 100% higher than required by standards


**wide array of hardware configuration**  
main units with 6, 10, 14 expansion slots, available in flush, wall and mixed mounting




**continous data backup**

**quick exchange of broken hardware**

**data restoration**





# ADVANTAGES OF THE BAY CONTROLLER

**preview of logic diagram and status**  
logic diagram, synoptic diagram

**full operating manual**  
quick access to proper sections of technical documentation

**intuitive menu**  
clarity of descriptions

**application diagram of the bay**  
access to the application diagram from the level of operator's panel

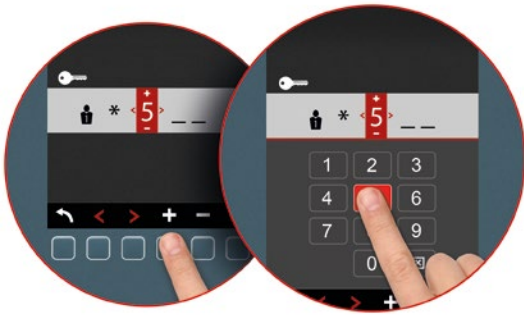
**graphic parameter presentation**  
phasor diagram, harmonic spectrum diagram

**manual-free operating**  
on-side assistance

**fully adjustable graphic interface**  
up to 5 user configurable screens, widgets

Intuitive e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller is equipped in fully configurable clear interface, extended configuration, recorders and measurement functions. Clarity of indicators and signalization, easy access manual, easy verification of logic and graphical verification of protection characteristics as well as remote service access greatly improve everyday work with device.

# ADVANTAGES OF THE BAY CONTROLLER WITH TOUCH PANEL

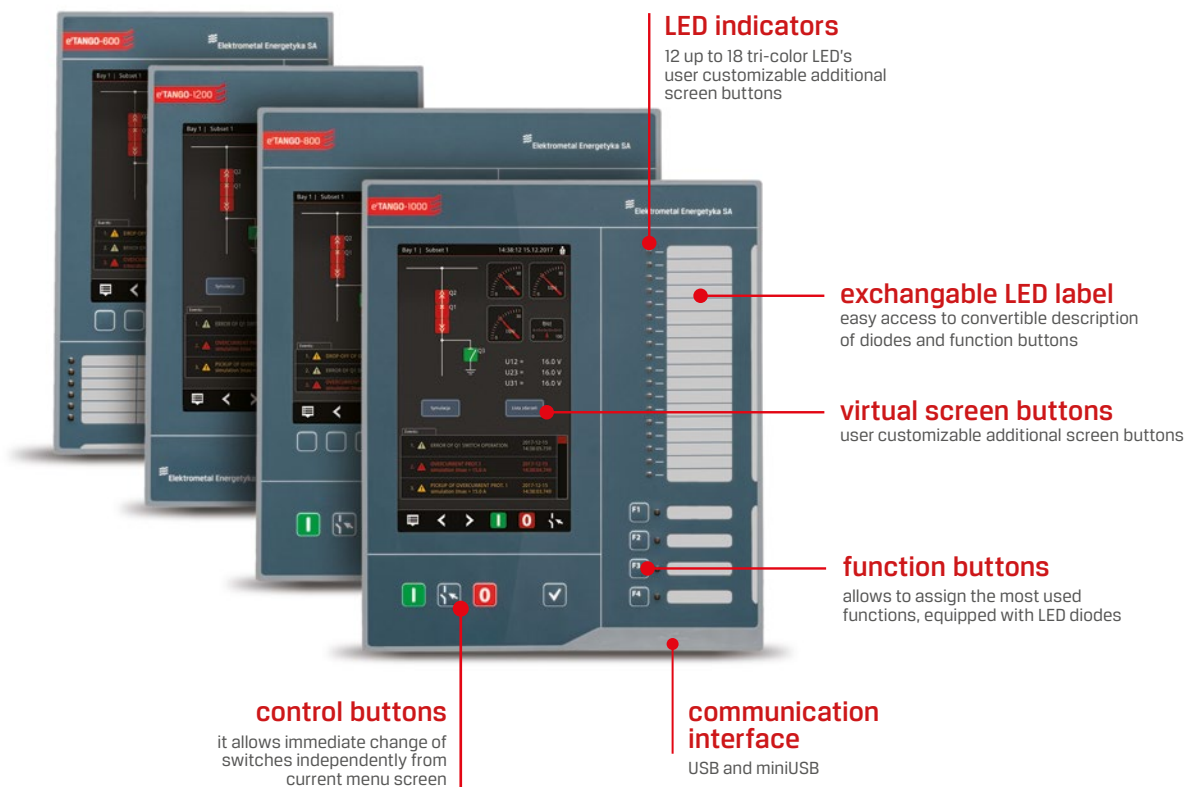


- alphanumeric keyboard
- touch control menu
- touch control for logic through fluent scrolling of diagrams
- screen buttons allowing use of bigger number of functional buttons as well as assigning them short-cuts option
- direct choice of switch for controlling from panel screen
- events scrolling on widget
- camera support

## DESIGN

e<sup>2</sup>TANGO bay controller consists of two elements: operating panel and central processing unit. Central unit is manufactured based on expansion cards and is offered in three versions of metal housing: J6 (six cards), J10 (ten cards) and J14 (fourteen cards) – depending on switchgear's bay configuration complexity and the needs of the user. Operating panels e<sup>2</sup>TANGO-600 and e<sup>2</sup>TANGO-800 in big, intelligible, 6-inch colour screens. Operating panels e<sup>2</sup>TANGO-1000 and e<sup>2</sup>TANGO-1200 have 7-inch, colour touch screens. Operating panels (depending on the version) are equipped with several of buttons allowing device control.

For small-size switchgears there is possibility to use a set of protections with the smallest available on the market operating panel e<sup>2</sup>TANGO-600 or e<sup>2</sup>TANGO-1200 with the external dimension of only 147x235 mm. Despite the small external dimension the panels are equipped with 6- or 7-inch screens, which allow displaying of any configuration, measurements, diagrams or graphs.



\* Detailed information in e<sup>2</sup>TANGO TYPES, page 8

# e<sup>2</sup>TANGO TYPES

## e<sup>2</sup>TANGO

600



800



1000



1200



### INTERFACE AND OPERATION

Display	6"	6"	7"	7"
Display resolution	640×480 px	640×480 px	800×480 px	800×480 px
Colour display	•	•	•	•
Touch display	-	-	•	•
Context buttons	6	6	-	-
Control buttons (I,0,<->,v)	•	•	•	-
Function buttons with LED (programmable) (3-color)*	2	4	4	-
LEDs (3-color)*	12	14	18	18
Virtual LED (on screen)(3-color)*	0	0	10	10
Virtual function buttons (on screen)	-	-	4	8
Exchangable LED label	•	•	•	-

### DESIGN

Panel dimensions (H×W×D)	235×147×41,5	252×215×41,5	252×215×41,5	235×147×41,5
Mounting hole dimension in flush mounting version	228×123	228×191	228×191	228×123
Detachable main unit	•	•	•	•
Unit J6 <ul style="list-style-type: none"> <li>6 slots</li> <li>dimensions: 222×187×103 (H×W×D)</li> </ul>	•	•	0	0
Unit J10 <ul style="list-style-type: none"> <li>10 slots</li> <li>dimensions: 222×234×103 (H×W×D)</li> </ul>	0	0	•	•
Unit J14 <ul style="list-style-type: none"> <li>14 slots</li> <li>dimensions: 222×281×103 (H×W×D)</li> </ul>	0	0	0	0

### STANDARD EQUIPMENT

Inputs (max**)	20 (168)	20 (168)	28 (168)	28 (168)
Outputs (max***)	15 (39)	15 (39)	23 (39)	23 (39)
Max number of connectors****	12/31****	12/31****	12/31****	12/31****
Arc detector input (max)***	0 (12)	0 (12)	0 (12)	0 (12)
Analogue input 4-20 mA (max.)***	0 (4)	0 (4)	0 (4)	0 (4)
Analogue input 0-10 V (max)***	0 (4)	0 (4)	0 (4)	0 (4)
Analogue output 4-20 mA (max)***	0 (4)	0 (4)	0 (4)	0 (4)
Analogue output 0-10 V (max)***	0 (4)	0 (4)	0 (4)	0 (4)
PT100 input (max)***	0 (6)	0 (6)	0 (6)	0 (6)

### OTHER

Widgets	•	•	•	•
Synoptic diagram library	55	55	55	55
Number of screen tabs for configuration	5	5	5	5
Logic diagrams preview	•	•	•	•

•/o - standard/option

\* - (3-color) - red/green/orange

\*\* - for the biggest main unit filled up with one type of extension card

\*\*\* - require proper number and types of extension cards

\*\*\*\* - available on special request

## PROTECTION FUNCTIONS

13	Synchronous-Speed
21NY	Admittance directional protection
23/26	Temperature protection (PT100 sensor)
23/26	Temperature measurement from busbars with optical fiber sensors
23/26/62	Temperature protection (binary)
27/27P	Undervoltage
27/ARC	Arc protection
27ROC/59ROC	Rate of change of voltage
32P	Reverse active power protection
32Q	Reverse reactive power protection
37	Undercurrent protection
46	Phase balance or reverse sequence current protection
48	Incomplete Sequence
49	Thermal protection
50/50N/50Ns/50G	Overcurrent / ground overcurrent protection
50HS/SOTF	Switch on to fault / Accelerated Action of Protection - AAP
50LR/51LR	Locked rotor
50NC/51NC	Capacitor bank overcurrent
51/51N	Inverse overcurrent protection
51/51N/51Ns/51G	Time overcurrent / ground time overcurrent protection

51N/59N	Ground time overcurrent with voltage interlock
51Ns/51G	Inverse ground overcurrent protection
59/59P/59_1/59_2	Overvoltage
59/Ufr	Ferroresonance detection algorithm
59N	Ground overvoltage
62	External binary protection
66	Notching or Jogging Device/Maximum Starting Rate/Starts Per Hour/Time Between Starts
67/67N/67Ns/67G	Directional overcurrent / ground directional overcurrent protection
74TCS	Trip, close coil supervision
80	Flux-gas
810	Under-frequency protection
81R/7F	Rate of change of frequency
81U	Over-frequency protection
87L/87LG	Line / Ground Line differential
87M	Motor differential
87T	Transformer differential
CAM*	Preview from the cameras on the panel screen
INS*	Insulation of MV cables set of measurements
S&H*	Safety and health notice

\* special version on client's requests

## AUTOMATION SYSTEMS

- (25) Synchronism-Check
- (41N) Active component forcing
- (50/68) Busbar protection
- (50BF) Breaker failure protection
- (79) Auto reclose
- (79VF) Automatic "island" reclose function with option of locking after multiple power-up
- (81U/810) Automatic load shedding
- (83) Automatic transfer switch
- (90C) Capacitor bank switching

## ATS AUTOMATION

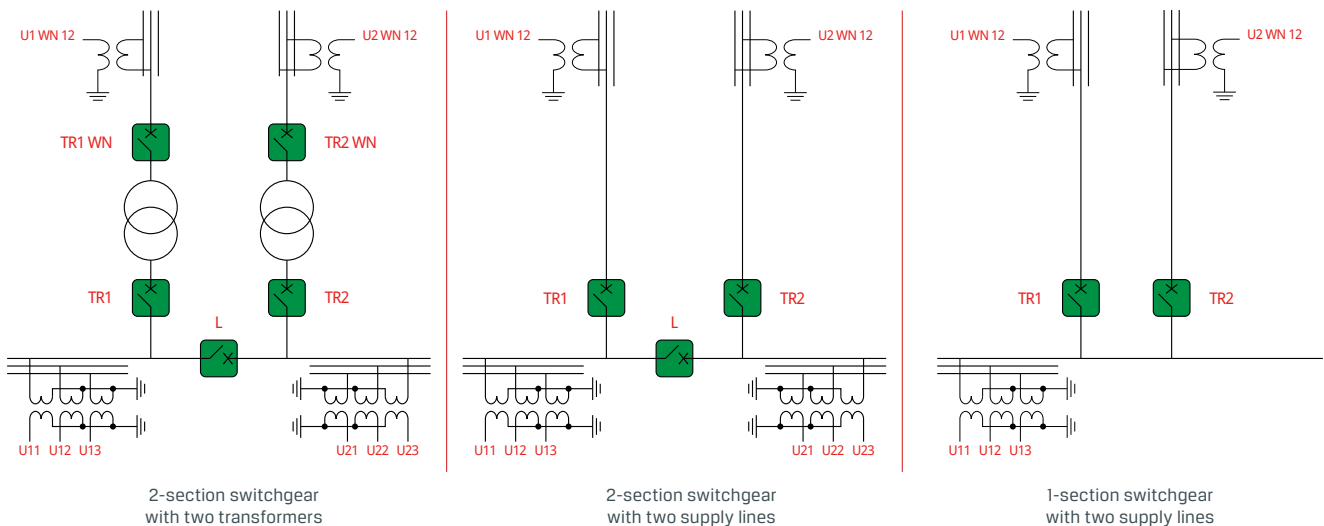
Controllers for automatic transfer switch with auto re-transfer - e<sup>2</sup>TANGO ATS have been developed on the base of e<sup>2</sup>TANGO controllers and supports the same features and functions. They are available in various configurations for LV, MV and HV network. Standard version allows implementation of automation in 1 or 2-sectional switchgears.

Controller features:

- hidden, implicit stand-by, automatic selection (based on the configuration of switches)
- fast and slow mode
- measurement of 6 phase voltages on the bus-bars and two wire voltages on the top side of power supply transformers or power lines,
- optional measurement of currents,
- optional re-transfer to the normal power supply,
- optional automatic locking of automation after operation,
- two communication ports RS485/optical fibre, Ethernet link to cooperate with the dispatch centre or as engineering link. Support for Modbus RTU, Modbus TCP, IEC870-5-103, DNP3.0, Canbus, Profibus protocols.
- event recorder for 1024 events, recording all automation operations, interlocks and emergency states.
- disturbance recorder recording the measured voltages with configurable recording time after triggering the recorder.
- planned transfer switch (PTS)
- synchronous uninterruptible switching
- synchronous switching with interruption
- quasisynchronous switching
- quasisynchronous switching with a short voltage interruption
- slow switching

Standard version of automatic transfer switch with auto re-transfer:

The controller in the standard version supports the 2-section switchgear with two transformers or two supply lines, with sections connected by a bus-bar connector or 1-section switchgear with two supply lines. In the case of 2-sectional switchgear the controller performs explicit and implicit automation with optional re-transfer to the normal power supply.



Customized version:

In addition to standard solutions for automatic transfer switch with auto re-transfer we offer to develop special versions, tailored to individual customer needs. Dedicated systems are created in close cooperation between the R&D department and the client.

Examples of custom solutions:

- switchgear with three sections (e.g. 3 power supplies, 2 coupling)
- dedicated switching algorithms
- current measurements and analysis of power supply load.

## ADDITIONAL FUNCTIONALITIES

The e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controllers offer a number of additional functionalities to support the safety of the facility as well as the operational maintenance and real-time monitoring of operation and events occurring in the distribution bay. To order the solution, the relevant information in the order form must be added.

### Camera view\*

The e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller performs the function of visualisation on the operator's panel screen the view from cameras placed in the switchgear bay. The image transmission takes place in real time and allows viewing inaccessible places, the physical location of apparatuses and operations without access to light, e.g. manoeuvring a circuit breaker, earthing switch or disconnecter. The unit supports 1 to 3 cameras with the possibility of extending the functionality to a maximum of 12 cameras.

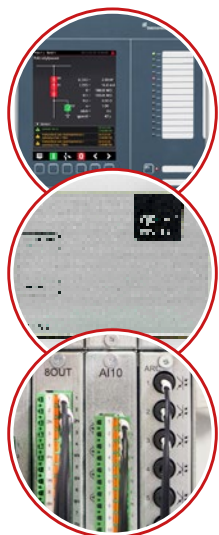
Camera parameters (the camera is an optional accessory on the customer side):

- RTSP protocol
- recommended image resolution 480x320
- recommended frame rate 10-15 frames per second



### Measurement of resistance and control of insulation state of MV cables\*

The functionality of the e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller makes it possible to measure the insulation resistance of the object being protected, e.g. a motor, which is particularly difficult in installations located in high humidity or difficult and inconvenient operating conditions.



e<sup>2</sup>TANGO protection relay

isometric attachment  
integrated with e<sup>2</sup>TANGO  
controller

AI10 analog card

The bay controller cooperates with a specialised HV generator supplying 2.5 kV DC voltage to the tested object. The generator is equipped with 0-10 V outputs mapping the current and voltage generated on the HV side. The voltages at these outputs are measured by an analogue input card (AI10) with which the controller must be equipped. Input 1 of the card measures the generator output voltage corresponding to the voltage on the HV side, input 2 of the card measures the output corresponding to the HV current.

Features of the algorithm:

- measurement of voltage, current, calculation of resistance and absorption coefficient
- measurements available on the display and communication link
- two absorption coefficient measurement methods:  
DAR 60 s/15 s or PI 180 s/30 s
- supported generator types: 4 kV 10 W; 6 kV 20 W, 6 kV 4 W supplied with the controller
- additional user calibration is possible.

### Health and safety plates

There are dedicated signs for the power industry, as specified by the PN-EN-08501:1998 standard. In the traditional solution, these signs are placed on switchgear bays in the form of hanging plates. The solution implemented in the controller allows warning signs to be displayed on the screen of the e<sup>2</sup>TANGO-600, -800, -1000, -1200 Operator Panel. The sign display can be performed directly from the Panel menu or programmed using the e<sup>2</sup>TANGO-Studio software in the device logic.



\* special version on client's requests

### Ferroresonance detection and suppression system\*

The e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller realises the possibility of detecting and suppressing the ferroresonance phenomenon by tripping protection functions and cooperating with a dedicated e<sup>2</sup>TANGO-FER power module placed in the LV compartment.

The solution consists in tripping the fast adaptive algorithm implemented in e<sup>2</sup>TANGO-600, -800, -1000, -1200 to detect the ferroresonance phenomenon, using any phase voltage (L1, L2, L3) as well as the zero sequence component of voltage. The developed ferroresonance elimination system contains two stages: the first is used to short-circuit the open delta winding of the voltage transformers (residual voltage), the second is used to short-circuit the phase windings of the voltage transformers. The solution uses impedance-free carbon resistors as actuators. The suppression of the ferroresonance phenomenon takes place in an external module, in which resistors and actuators of both protection stages are built in. It is possible to update the software on the e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controllers previously used by the customer without replacing the device with a new one.



### Enhanced cyber-security standard\*

In order to increase security and protect against unauthorised access, a software version with enhanced cyber security elements has been created in the e<sup>2</sup>TANGO-600, -800, -1000, -1200 controller with following additional elements:

- Event log in terms of SYSLOG support
- Role-based access mechanism (RBAC)
- 12-character password

#### Event log

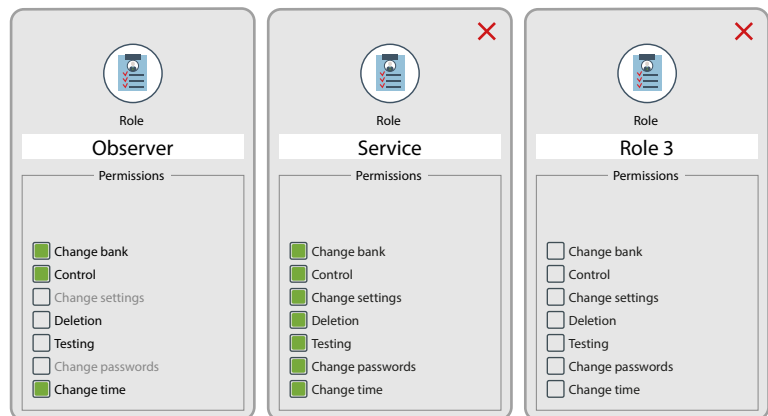
The event log contains information on device security events and critical system information. It allows the sequence of events and system information related to the device to be reconstructed at any time. It records and stores information related to user actions, system events and data access, providing a detailed description of what happened in the device system.

The event log stores up to 2048 events in a circular buffer before the oldest events are overwritten by the newest ones. It is not possible to delete or clear the event log stored in the device memory. It is possible to download the event log to external memory.

#### RBAC - Role-based access control

Role-based access control (RBAC) is a mechanism for controlling access in computer systems and applications in organization. RBAC provides a flexible and scalable approach to managing user access by defining roles and assigning permissions based on those roles. Keys components of RBAC are Roles, Permissions and Users.

Roles represent collection of permissions that usually apply to certain job function or responsibility within an organization. It defines what action and operations a user assigned to the role is allowed to perform when logged into IED. In power system engineering such roles are usually defined as: Viewer, Operator, Engineer, Installer, SECADM, SECAUD, RBACMNT. e<sup>2</sup>TANGO allows to define 5 roles. Each role has editable name and have capability of assigning any combination of permissions.



In e<sup>2</sup>TANGO up to 10 users can be defined. The construction of the password must consist at least of:

- At least one uppercase and one lower case letter
- At least one number
- At least one non-alphanumeric character

\* special version on client's requests

## EXPANSION CARDS

### BASIC CARDS

- power supply unit
- central processor unit
- power supply unit with strengthened contacts 10 A DC (110 V)



### MEASUREMENT CARDS

- synchrocheck (4I+5U)
- for Cap. Bank bays (5I+4U)
- ATS (9U)
- universal (5I+5U)
- with separated inputs for measurement CTs (5I+3Ip+4U)
- with Rogowski's coil and voltage sensors (3Irc+1I+3Usu+1U)
- with Rogowski coils and voltage transformers (3Irc+1I+4U)



### 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



### FUNCTION CARDS

- 8 binary inputs
- 12 binary inputs
- 8 binary outputs
- 4 binary outputs with strengthened contacts 10 A DC (110 V)



### ARC DETECTOR INPUT CARDS

- 6 arc detector input with CAN communication
- 6 arc detector input (passive)



### TEMPERATURE SENSORS CARDS

- 6 PT100 inputs
- 6 inputs for busbar temperature measurement



### OTHER

- additional current set measurement for differential card
- additional voltage set measurement card (4U)
- additional current set measurement card (4I)
- redundant power supply

## COMMUNICATION PORTS AND PROTOCOLS

- Ethernet
- Single mode fibre optic - OPTOSM
- Multimode fibre optic - OPTOMM
- Plastic fibre optic - OPTOP
- RS485
- CANbus 2x
- USB 2.0
- Modbus RTU/TCP
- IEC 60870-5-103
- DNP 3.0
- IEC 61850
- Profibus
- ProfiNET
- CANbus/PPM 2
- WiFi\*

\* in agreement with the producer



## RECORDERS

- event recorder, 1024 events, sampling every 1 ms
- disturbances recorder up to 166 s sampling rate 1.6-3.2 kHz
- critical recorder up to 710 s
- temporary value recorder, TrueRMS

- grid parameters recorder
- load profile recorder
- phasor diagram
- Network parameters analyzer

## BASIC SIZES

e<sup>2</sup>TANGO-600



e<sup>2</sup>TANGO-800



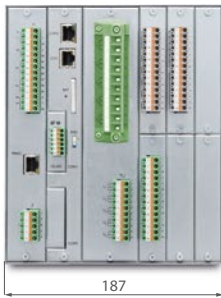
e<sup>2</sup>TANGO-1000



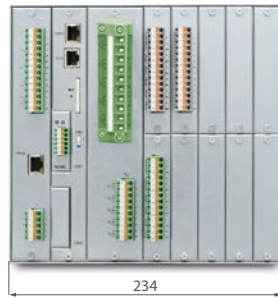
e<sup>2</sup>TANGO-1200



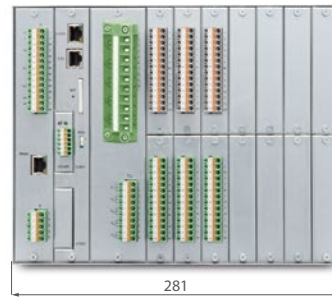
J6



J10

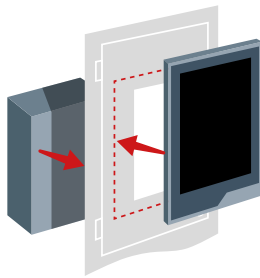


J14

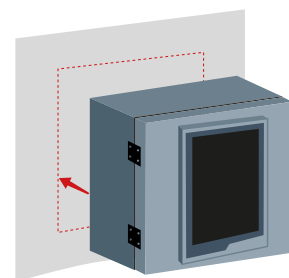
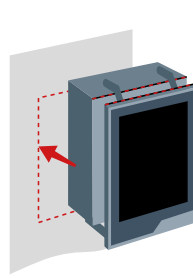


## MOUNTING METHOD

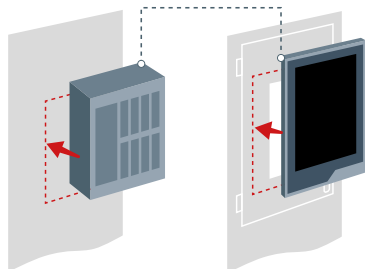
flush mounting



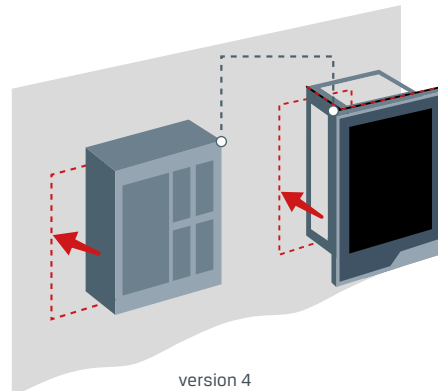
wall mounting



mixed mounting



version 1



version 3

version 4

# TECHNICAL PARAMETERS

<b>AUXILIARY POWER SUPPLY</b>	
DC Voltage	110 V, 220 V (80-300 V)
AC Voltage	230 V (88-265 V)
Optional	24 V (19-58 V AC/DC)
Maximal power consumption (central unit with operating panel)	30 W (VA)
<b>MEASUREMENT CIRCUITS</b>	
Rated frequency	50 Hz
<b>CURRENT MEASUREMENT CIRCUITS</b>	
Rated current	5 A/1 A (configurable)
Measurement range for currents: CT inputs	0.05-150 A
Measurement range for currents: Rogowski coil inputs	3-3000 mV/ 9-9000 mV/ 30-30000 mV (configurable) Other range on request
Measurement range for current $I_0$	0.001-10 A
Measurement range for current $I_0$ in feeder TU	0.01-10 A
<b>VOLTAGE MEASUREMENT CIRCUITS</b>	
Rated voltage for transformers	57,7 V/100 V
Rated voltage for additional set of measurements	57,7 V/100 V/230 V
Rated voltage for sensors	$2/\sqrt{3}$ V or $3,25/\sqrt{3}$ V
Voltage measurement range with current transformers	1-130 V
Voltage measurement range for additional set	4-276 V
Voltage measurement range for sensors	0.03-3.9 V
Rated load of measuring circuits (designed for voltage sensors)	200 k $\Omega$ 350 pF; 2 M $\Omega$ 50 pF
Heat resistance voltage 10 s	150 V
<b>BASIC PROTECTION PARAMETERS</b>	
Return coefficient for overload protections	Configurable
Return coefficient for under-load protections	Configurable
Operate time	Typically 35 ms
Operate time for arc protection	<10 ms
<b>MEASUREMENT ACCURACY</b>	
CT inputs $I_1, I_2, I_3$ (0.1-150 A)	1% $\pm$ 5 mA
Rogowski coil inputs: $I_1, I_2, I_3$ (3-3000 mV)	1% $\pm$ 0.5 mV
$I_1, I_2, I_3$ (9-9000 mV)	1% $\pm$ 1.5 mV
$I_1, I_2, I_3$ (30-30000 mV)	1% $\pm$ 5.0 mV
CT inputs $U_1, U_2, U_3$ (5-120 V)	1% $\pm$ 100 mV
Voltage sensor inputs $U_1, U_2, U_3$ (0.1-3.6 V)	1% $\pm$ 500 $\mu$ V
$I_0$ (calculated):	
CT inputs (0.1-10 A)	1% $\pm$ 5 mA
Rogowski coil inputs: (3-3000 mV)	2% $\pm$ 0.5 mV
(9-9000 mV)	2% $\pm$ 1.5 mV
(30-30000 mV)	2% $\pm$ 5.0 mV
$I_0$ (measured) (0.001-10 A)	1% $\pm$ 100 $\mu$ A

P, Q, EC, EB	
CT inputs ( $U$ )5 V, 0.1 A(<10 A)	1%
Rogowski coil and voltage sensor inputs ( $U$ )0.3 V, 10 mV(<1000 mV)	2%
f PN( $U$ )5 V)/SU( $U$ )0.3 V)	10 mHz
$\Phi_1, \Phi_2, \Phi_3, \Phi_0$	
CT and VT inputs ( $U$ )5 V, 0.1 A(<10 A)	1°
Rogowski coil or voltage sensor inputs ( $U$ )0.3 V, 10 mV(<3000 mV)	2°
<b>BINARY INPUTS CIRCUITS</b>	
Rated voltage	110 V/230 V AC/DC
Option	24 V (19-58 V AC/DC) Other on request
Maximal power consumption: 220 V DC, 230 V AC	2 mA, 15 mA
<b>BINARY OUTPUTS CIRCUITS – CONTROLLING CIRCUIT BREAKER</b>	
Permitted voltage with opened contacts	250 V AC/440 V DC
Closing circuit at 220 V DC	30 A/3 s
Opening circuit at 220 V DC (L/R = 40 ms)/PSU HI	0.3 A 10 A (for PSUHI card)
<b>BINARY OUTPUTS CIRCUITS – OTHERS</b>	
Permitted voltage with opened contacts	250 V AC/440 V DC
Long-term current-carrying capacity	8 A
Opening circuit at 220 V DC (L/R = 40 ms)/OUTH	0.1 A 10 A (for 4OUTH card)
Opening circuit at 220 V AC ( $\cos\phi=0.1$ )	2 A
<b>ENVIRONMENTAL CONDITIONS</b>	
Working temperature	-10°C ... +55°C
Storage temperature	-25°C ... +70°C
Relative humidity	5 to 95%
Vibration and mechanical shock resistance	Class 1 acc. IEC 60255- 21
Electromagnetic disturbances	Class B acc. IEC 60255- 26
<b>SAFETY</b>	
Insulation electric strength	2 kV/50 Hz/60 s acc.IEC 60255-27
<b>DIMENSIONS</b>	
Weight (main unit/operating panel)	5 kg/1 kg
Main unit size (height x width x depth, mm)	187/234/281x103x222
Degree of protection for main unit	IP3X/IP4X (option)
Degree of protection for operating panel (front side)	IP4X/IP54 (option)

# e<sup>2</sup>TANGO-STUDIO SOFTWARE

e<sup>2</sup>TANGO-Studio software intended to operate e<sup>2</sup>TANGO protection relays. It is at the same time configuration tool for the operating panel. This software has been equipped with extended set of functions, which are combined with clear graphic interface. Finally it creates great tool which supports every-day work and allows creation of projects for many devices, bays, switchgears and stations.



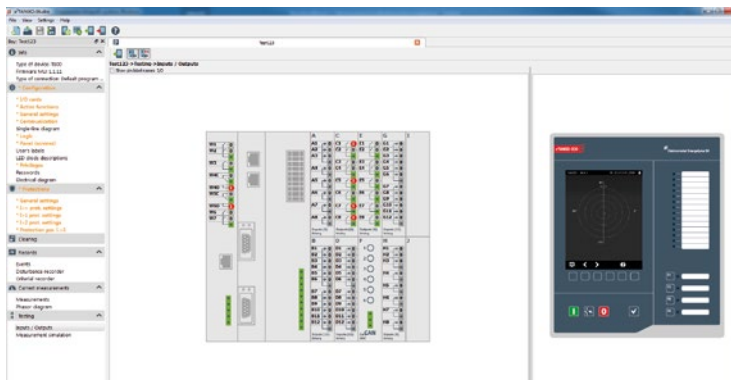
## quick configuration assistant

helps first time users of the software and facilitates regular use



## advanced design functions

ability to prepare device configuration for an entire switchgear on a PC and distribute it using USB

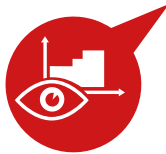


## on-line preview

real-time preview of measurement input/output status displaying actual LCD screen content

## display conformity

preview of the actual panel screen

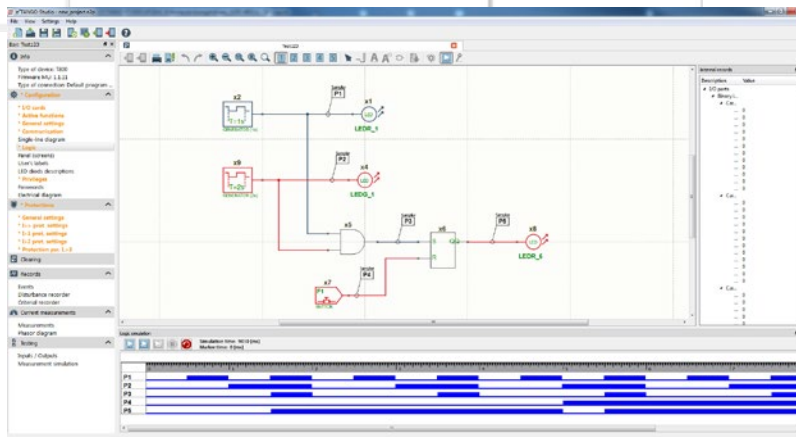


## visual characteristic modification

graphical and classic protection setpoint configuration

## easy setpoint and selectivity verification

displaying setpoints of all related overcurrent protection functions on one chart



## full status preview

access to all internal device and protection function statuses



## possible expansion using plug-ins



## logic simulator

possibility to simulate whole logic without connection with device

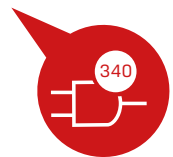
## logic clarity

possibility to split logic in blocks and sheets



## ultra-fast design of custom screens

drag&drop element placement



## support for sophisticated logical dependencies

up to 340 logic gates / elements

## „miniSCADA” FUNCTIONALITY

e<sup>2</sup>TANGO-Studio has possibility to expand with "miniSCADA" functionality that lets you visualise state of switchgear and allows to manipulate switches, alarms and events preview and online access to measured parameters of protection relay (e.g. current, voltage, power, energy) installed in switchgear. Functionality was designed to share engineering link (one communication port) to bay controllers, which gives possibilities for costs optimization by wiring and infrastructure simplifying.

The ‚miniSCADA’ extension is available in a PC version, which requires a dongle, or in a phone app version, which requires setting up an external license.

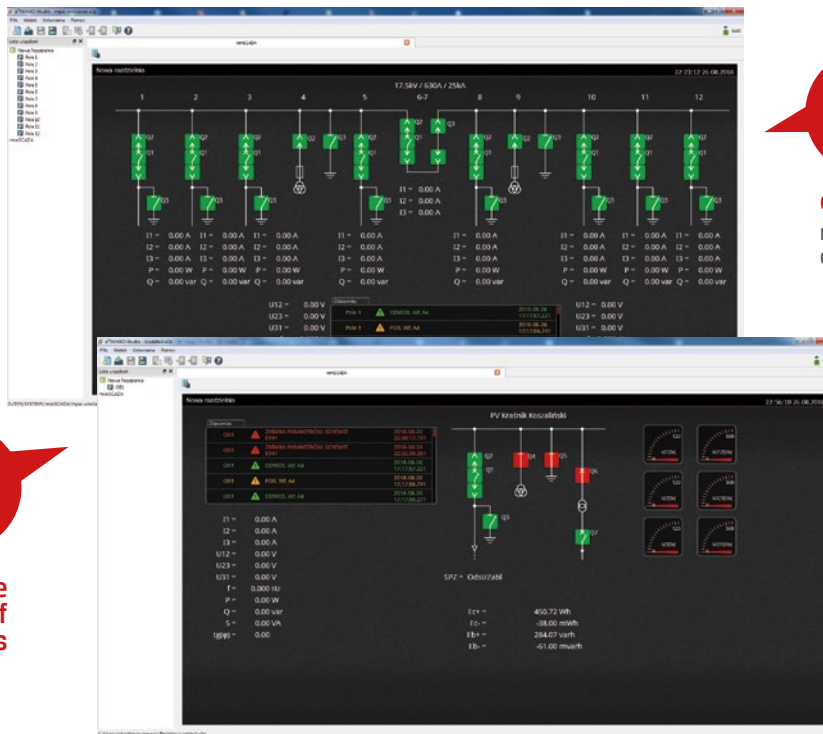


**Intuitive display configuration**  
possible to use widgets



**data transmission uses available communication ports**

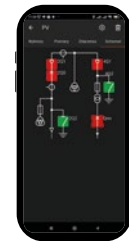
RS485, OPTO, Ethernet and others



**costs optimization**  
no need to use expanded SCADA systems



**universal software to all kinds of e<sup>2</sup>TANGO relays**



**available to every operating system**



**available also for mobile devices**

## ADVANCED LOGIC EDITOR AND SIMULATOR

e<sup>2</sup>TANGO-Studio is characterized by advanced and extended logic editor which allows to perform logic simulation visible also on the panel level without device connecting. It gives possibility to view logic state while working with the device. It ensures easier project preparation as well as start-up and service of the switching stations. It allows to use non-standard logics dedicated to the specific customer's requirements.

## STANDARDISATION

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



**Conformity certificate IEn-**  
no DZC.521.59.3.2023



**International DNV-GL (KEMA)**  
**Certificate of Compliance**  
for the IEC 61850 Protocol



**Gold medal**  
ENERGETAB 2015 fair



**The Minister of Energy Cup**  
ENERGETAB 2018 fair



**Forbes Diamonds 2026**



**The Kazimierz Szpotanski Golden**  
**Lion Award**  
ENERGETAB 2014 fair

## ELEKTROMETAL ENERGETYKA SA QUALITY

Implemented Integrated Management System based on following standards:

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

# ORDER FORM

To order e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller, please fill in this form in accordance to FORM INSTRUCTIONS on the next page.

## STEP 1

① panel type	<input type="checkbox"/> 600	<input checked="" type="checkbox"/> 800	<input type="checkbox"/> 1000	<input type="checkbox"/> 1200	
② main unit type	<input checked="" type="checkbox"/> J6	<input type="checkbox"/> J10	<input type="checkbox"/> J14		
TR measurement card type	<input checked="" type="checkbox"/> TRS (for synchrocheck, 4I+5U)	<input type="checkbox"/> TR (for Cap. Bank bays 5I+4U)	<input type="checkbox"/> TRU (for ATS, 9U)	<input type="checkbox"/> TRSG (5I+5U)	<input type="checkbox"/> TRP (5I+3Ip+4U)
③ change the way of measurement method (from core transformer) <sup>1)</sup>	<input type="checkbox"/> TRC (Rogowski coils 3I <sub>CR</sub> +1I+5U) <input type="checkbox"/> TRCZ [Rogowski coils 3I <sub>CR</sub> +1I+ voltage sensors 3U+1Us (synchronizing voltage)]				
④ rated current of the measurement card <sup>2)</sup>	<input checked="" type="checkbox"/> 5 A, 100 V (for TR, TRS, TRP, TRSG card) <sup>2)</sup>	<input type="checkbox"/> 100 V, 230 V (TRU)	<input type="checkbox"/> 200k (for TRCZ card)	<input type="checkbox"/> 2M (for TRCZ card)	<input type="checkbox"/> X (none for TRC card)
⑤ binary input voltage	<input checked="" type="checkbox"/> UNI (110/230 V AC/DC)	<input type="checkbox"/> UNIH <sup>3)</sup> (110/230 V AC/DC)	<input type="checkbox"/> 24V (24/48 V AC/DC) <sup>4)</sup>	<input type="checkbox"/> 24VH <sup>3)</sup> (24/48 V AC/DC) <sup>4)</sup>	<input type="checkbox"/> other (on consultation with the manufacturer)
communication ETHERNET (standard equipment in each central unit)					
⑥ COM1	<input checked="" type="checkbox"/> X-none	<input type="checkbox"/> RS485	<input type="checkbox"/> CANx2	<input type="checkbox"/> OPTOMM	<input type="checkbox"/> OPTOSM
		<input type="checkbox"/> OPTOP	<input type="checkbox"/> Profibus	<input type="checkbox"/> ProfiNET	<input type="checkbox"/> others
⑦ COM2	<input checked="" type="checkbox"/> X-none	<input type="checkbox"/> RS485	<input type="checkbox"/> CANx2	<input type="checkbox"/> OPTOMM	<input type="checkbox"/> OPTOSM <sup>5)</sup>
		<input type="checkbox"/> OPTOP	<input type="checkbox"/> Profibus	<input type="checkbox"/> ProfiNET	<input type="checkbox"/> others
⑧ mounting method	<input checked="" type="checkbox"/> Z- flush	<input type="checkbox"/> N1- wall version 1	<input type="checkbox"/> N3-wall version 3 <sup>6)</sup>	<input type="checkbox"/> N4-wall version 4	<input type="checkbox"/> M-mixed
⑨ panel-main unit cable length <sup>7)</sup>	<input checked="" type="checkbox"/> S-1 m	<input type="checkbox"/> L-2 m	<input type="checkbox"/> other (in agreement with manufacturer)		
⑩ IP protection level	<input checked="" type="checkbox"/> IP4X	<input type="checkbox"/> IP54 <sup>8)</sup>			
⑪ communication IEC 61850 <sup>9)</sup>	<input checked="" type="checkbox"/> EX-none	<input type="checkbox"/> EG	<input type="checkbox"/> E2G	<input type="checkbox"/> E	<input type="checkbox"/> E2
		<input type="checkbox"/> OG	<input type="checkbox"/> O2G	<input type="checkbox"/> O	<input type="checkbox"/> O2
⑫ language version	<input type="checkbox"/> PL	<input checked="" type="checkbox"/> EN	<input type="checkbox"/> other (in agreement with manufacturer)		

1) Eg. page 21.

2) 5A/1A configurable from the software level.

3) W1, W2, W3 strengthened outputs..

4) Universal card for voltages in the range of 24-48 V AC/DC.

5) OPTOSM card required for communication with the other side in the case of line differential protection.

6) In the 3rd wall mounting version, a 0,25 m long cable is used.

7) Degree of protection for operating panel (front side).

8) IP54 protection level available only in version with flush and mixed mounting.

9) IEC 61850 communication is supported by additional communication ports located on the operator panel. If the device is ordered with IEC 61850 protocol support, it is not possible to implement additional functionality for camera preview.

Description of the symbols:

G - equipped with GOOSE communication

E - connection through twisted pair with RJ-45 connector

O - connection through multimode optical fibre with SC/(ST on special order) connector

2 - equipped with two redundant ports in PRP/(HSR on special order) standard



# FORM INSTRUCTIONS

## STEP 1

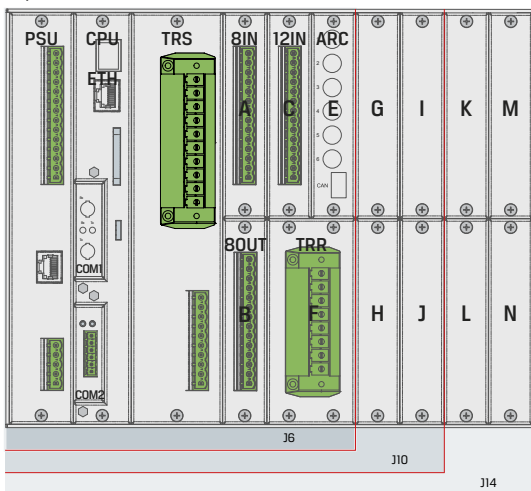
In the presented table there are the basic technical parameters of the e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller. From each position marked with a numbers from 1 to 11 there is only one position to be selected. If you choose "other", in STEP 3 in the corresponding field, please enter the requested value.

## STEP 2

In the presented table there is a list of available expansion cards and their possible installation locations in the central unit of e<sup>2</sup>TANGO-600, -800, -1000, -1200. Missing field  for marking means that the card cannot be installed in a given place. Please choose from the list the ordered cards and mark with "X" a slot, in which they have to be installed. Arranging the cards has to be started from the A slot. Capacity of the units are marked appropriately with the background colour in the table.

Additional requirements have to be described in a designated area.

View of the central unit indicating the arrangement of slots for expansion cards.



## STEP 3

Selected above parameters of the e<sup>2</sup>TANGO-600, -800, -1000, -1200 bay controller have to be inserted in the corresponding space. The code created in that way together other requirements or scanned order form page has to be sent along with an order to the following address:

[eaz@elektrometal-energetyka.pl](mailto:eaz@elektrometal-energetyka.pl)

### Step 1 instructions

- - recommended basic configuration
- OPTOMM - multi-mode optic fibre
- N1-wall mounting version 1
- N3-wall mounting version 3
- N4-wall mounting version 4

### Step 2 instructions

- - recommended basic configuration
- max 4 cards 8OUT
- max 1 card AI10 or 1 card AI20
- max 1 card AO10 or 1 card AO20
- max 1 card PT1
- maximum 1 3TMP or 6TMP card
- TRR card can only be installed in slot F in J10 and J14 units, occupy two slots D and F
- the ARP card can be placed in the device only if an ARC card is already installed
- TV card for additional voltage set measurement can only be installed in slot E; TV card can't be installed simultaneously with TR card in the same equipment
- 3TMP and 6TMP cards for busbar temperature measurement is equipped with 5 m long communication fiber optic, other length on customer's request; Dimensions of the busebar must be specified as additional requirement
- the standard length of the flash sensors optical fiber is 5 m, other lengths in consultation with the manufacturer

### Example of e<sup>2</sup>TANGO bay controller configuration:

① e <sup>2</sup> TANGO-1000 panel	⑩ IP4X protection level
② J10 main unit	⑪ standard IEC 61850
③ TRS measurement card	⑫ EN
④ rated current of measurement card 5A: X	<input type="checkbox"/> A slot A: 8IN card
⑤ universal binary input voltage	<input type="checkbox"/> B slot B: 8OUT card
⑥ OPTOMM	<input type="checkbox"/> C slot C: 12IN card
⑦ RS485	<input type="checkbox"/> D slot D: X card
⑧ mixed mounting	<input type="checkbox"/> E slot E: ARC card
⑨ 8 m cable	<input type="checkbox"/> F slot F: TRR card

Example of correct filled code:

e <sup>2</sup> TANGO	1000	J10	TRS	5A	UNI	OPTOMM	RS485	M	8	IP4X	EX	EN
8IN	8OUT	12IN	X	ARC	TRR							

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[www.elektrometal-energetyka.pl](http://www.elektrometal-energetyka.pl)