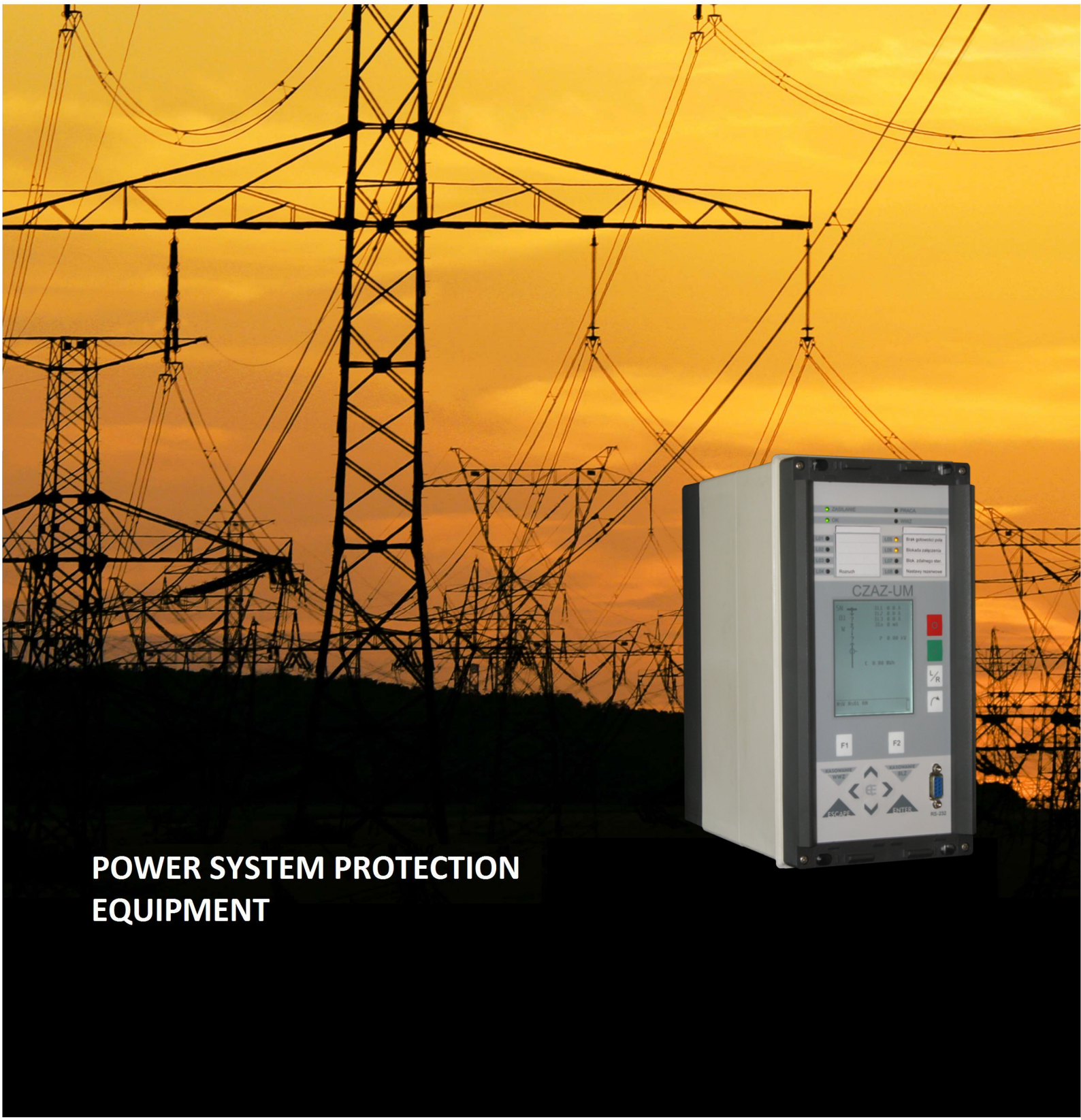
ZEG-ENERGETYKA

CZAZ-UM

PROTECTION AND CONTROL UNIT DEDICATED FOR MV MOTORS

PRODUCT DATASHEET



POWER SYSTEM PROTECTION EQUIPMENT

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1. GENERAL CHARACTERISTICS

1.1. APPLICATION

Digital protection and control unit CZAZ-UM is a universal, comprehensive protection relay designed for asynchronous and synchronous motor.
The hardware platform and software of the relay provide flexible and reliable implementation of protection, control and measurement functions. The relay embedded software consist of two parts. A dedicated controller, which realizes the defined functions of cooperation with the motor feeder, and a programmable logic.

The relay is designed for use in networks with direct grounded or insulated neutral point and compensated networks. A rich library of the systems of bay diagrams allows to adjust the configuration parameters of the set to the configuration of protected object. A set of protections and additional features enable the use of the relay in custom solutions.

CZAZ-UM relay, marked at the last position with an extra (+) symbol, is fitted with a diagnostic system of the induction rotor cage, which enables an early indication of failure at the stage of developing damage.

1.2. BASIC CHARACTERISTICS

- Digital technology and design of the set ensuring high accuracy, stability and reliability.
- Uniform, universal equipment, software tailored to the needs of the protected object.
- A set of protection features and additional functions with the possibility of versatile configuration.
- Arc protection cooperating with the VAMP system flash sensor.
- Features of a dedicated bay controller with standard logic implemented in the set, ensuring safe operation of the bay at the local and remote control, depending on the state of the location of switches, defined external lockouts and lockouts on emergency tripping, as well as the implementation of recovery automation and interoperability with the systems of acoustic signalling stations.
- Adapting cooperation with switches in the bay to the requirements of the systems of switchgears and requirements for motor bays via software configuration.
- Features of a field programmable controller with the possibility to freely configure custom solutions.
- System of cooperation with the bus-bars protection and the breaker failure protection, configured in the PLC.
- Output circuits with direct switch controlling, including 2 output relays of emergency control with the continuity test of tripping circuits.
- Measurements of electric values.
- Temperature measurements (inputs 4÷20mA).
- Logger of events and disturbances as well as tripping parameters from the last disturbance.
- Local signalisation of the most important states of operation and the protected field.
- Self-monitoring of the proper operation of the set.
- Full support using the operator's local panel.
- Remote serial communication with the PC host or a master system.
- Real time clock.
- Screw-less terminals for current measurement inputs, connectors for other circuits.
- Surface mounting (panel) or rack mounting case.

Provided are two versions of the construction of the set: with alphanumeric display and graphic display. The graphical display allows a clear presentation of the field operation state (synoptical), switch control via dedicated keyboard, also facilitates the analysis of interference as well as the reading of the current values of the state of the field operation.

2. PROTECTION FUNCTIONS

• Differential protection (Rt) 87

Designed to detect the internal interphase short-circuits.

Setting ranges:

starting current	(0.2÷1.0)In per 0.1In
restrain factor	(0.2÷0.6) per 0.1
time delay	(0÷100)ms per 1ms

for $I_h \leq \frac{I_{ro}}{k_h} \Rightarrow I_r \geq I_{ro}$

for $I_h > \frac{I_{ro}}{k_h} \Rightarrow I_r \geq k_h \cdot I_h$

where:
I_r - value of the differential current
I_y - value of the braking current
I_{ro} - initial braking current
k_h – restrain factor (tgα – slope of starting characteristics)

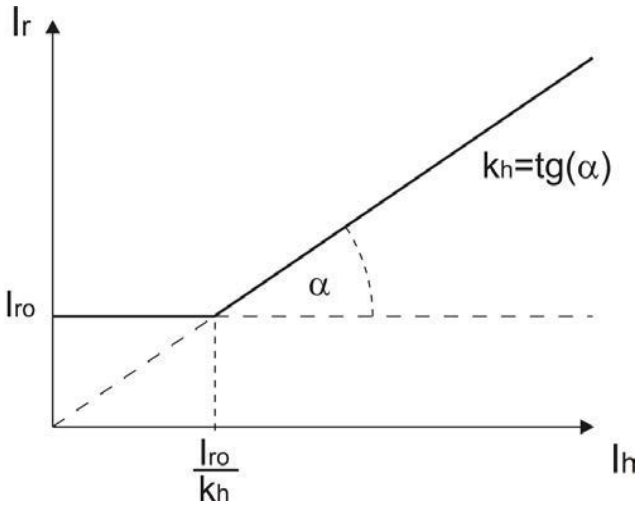


Fig. 1. Operation characteristics of current differential protection Rt

Additional features:
- configuration of locking the protection activation by programmable logic,
- close command interlock after function operation.

• Definite-time overcurrent protection (I>1) 50/51

with a possibility to select the measurement criterion for the effective signal value or effective value of the fundamental component.

Designed to detect the internal and external interphase short-circuits.

Setting ranges:

starting current	(0.2÷25.0)In per 0.1
time delay	(0÷60000)ms per 1ms

Additional features:
- configuration of locking the protection activation by programmable logic,
- close command interlock after function operation

- **Definite / Inverse time overcurrent protection (I>4) 51**

with a possibility to select the measurement criterion for the effective signal value or effective value of the fundamental component.
Designed to detect phase-to-phase short circuits and operational overloads. Three types of dependent characteristics enable to adapt the operating time to the requirements of motor feeders.

Setting ranges:

starting current	(0.20÷5.00)In per 0.01In
time delay	
- type D independent characteristics	(0÷60000)ms per 1ms
- type A, B, C current time dependent characteristics	acc. to PN-EN 60255-3:1999
- multiplication factor k_2 for A, B, C type	(0.05÷3.00) per 0.01

$$t = \frac{k_1 \cdot k_2}{\left(\frac{I}{I_r}\right)^{\alpha} - 1}$$

where:
t - theoretical operating time (in seconds)
I - value of measuring current
I_r - setting value of the starting current
α - exponent defining the type of characteristics, as described below
k_1 - constant defining the type of characteristics (seconds), as described below
k_2 - multiplication factor

Type A inverse time characteristic, standard (k1=0.14s; α=0.02; k2=0.05÷3.00 per 0.01)
Type B very inverse time characteristic (k1=13.5s; α=1; k2=0.05÷3.00 per 0.01)
Type C extremely inverse time characteristic (k1=80s; α=2; k2=0.05÷3.00 per 0.01)

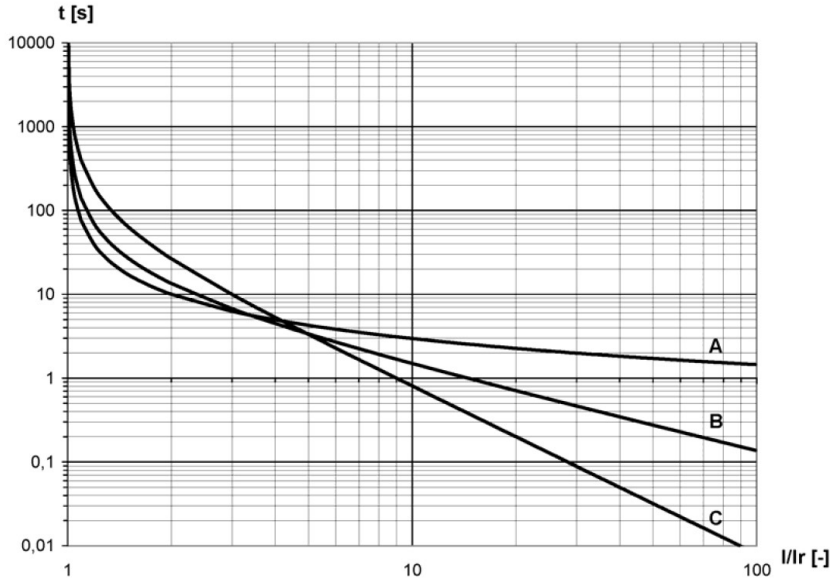


Fig. 2. Characteristics of inverse-time current protection I>4 (k2=1.00)

Additional features:

- configuration of locking the protection activation by programmable logic,
- close command interlock after function operation

- **Instantonous overcurrent functions (I>5, I>6) 50/51**

Additional overcurrent function dedicated to use in programmable logic (eg. current criteria for breaker failure function or bus-bar protection circuit).

Setting ranges:
starting current (0.05÷25.00)In per 0.01In

- **Time-delayed current unbalance protection, with depending time characteristic (ItA) 46**

Designed to detect the current unbalance.

Setting ranges:
starting current unbalance (0.1÷1.0)In per 0.1In
operating time for Ias=2Iasr (5000÷50000) ms per 1 ms

Starting value Ias=Imax - 1.2Imin

$$t = 2t_2 \cdot \left(\frac{Iasr}{Ias}\right)$$

where:
Iasr - starting value of current unbalance
Ias - current unbalance, difference of phase currents
t2 - adjustable operation time for Ias=2Iasr
t - time of protection activation
Imax, Imin - maximum and minimum effective value of fundamental component of phase currents

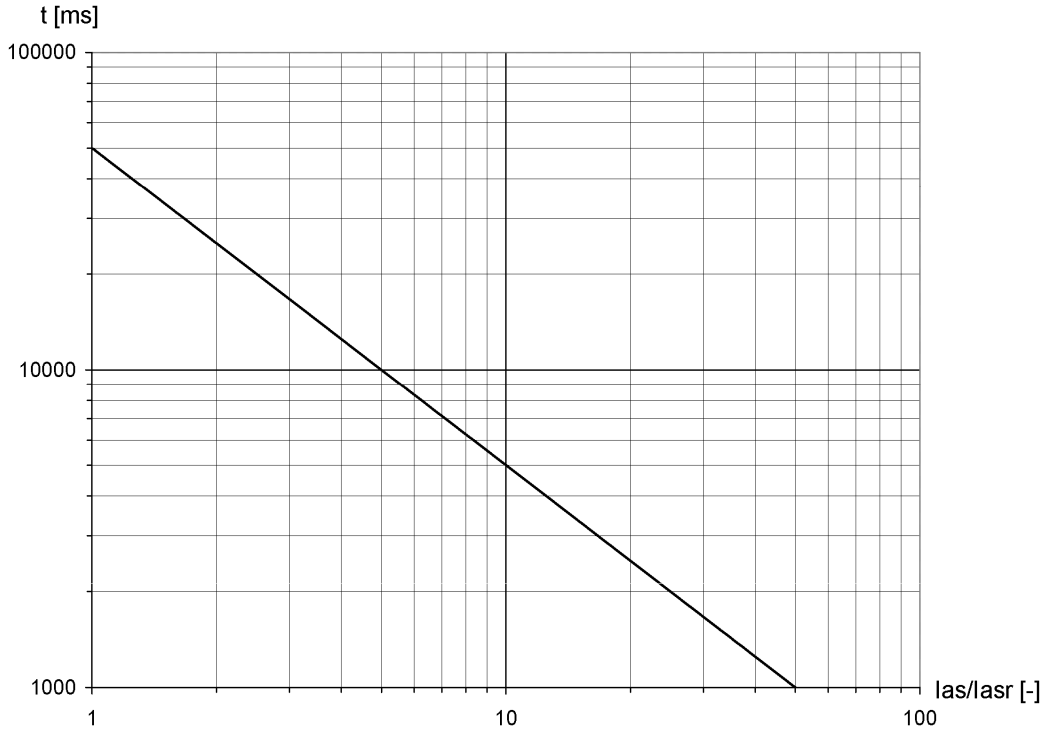


Figure. 3. Operating characteristics of protection ItA (t2=25s)

Additional features:
- configuration of locking the protection activation by programmable logic,

- close command interlock after function operation

• Time-delayed overcurrent protection for locked rotor detection purposes, independent(ItU) 51LR

Designed to protect against the effects of current increase in the locked rotor condition.

Setting ranges:

starting current	(0.5÷4.0)In per 0.1In
operation time	(1000÷20000)ms per 1ms

Additional features:

- configuration of locking the protection activation by programmable logic,
- close command interlock after function operation

• Time-delay overcurrent protection, independent (It>) 51

Designed to protect the motor from the effects of disturbances in the technological process of the motor-driven machine. This protection is dedicated to detect overloads.

Setting ranges:

starting current	(0.9÷2.0)Ib per 0.1Ib
operation time	(1÷300)s per 1s

Additional features:

- configuration of locking the protection activation by programmable logic

• Time-delay undercurrent protection, independent (It<) 37

Designed to protect the motor against idle operation. Protection active only during motor operation, i.e. when the load current $I \geq 0{,}1I_b$.

Setting ranges:

starting current	(0.3÷0.6)Ib per 0.1Ib
operation time	(1÷60)min per 1min

Additional features:

- configuration of locking the protection activation by programmable logic

• Time-delay overcurrent protection, independent (Iws) 51

Designed exclusively for synchronous motors, protecting the motor against falling out of sync. The measurement units are the pulsations of the effective value of the fundamental components of phase currents of motor stator.

Setting ranges:

starting current	(0.9÷6.0)Ib per 0.1Ib
operation time	(6000÷60000)ms per 1ms

Additional features:

- configuration of locking the protection activation by programmable logic.

- **Earth fault protection (Io)**

Function dedicated to detect earth faults in networks with direct grounded or insulated neutral point and compensated networks. Protection function work properly and reliably also in the case of intermittent faults. The algorithm of the protection operation controls the current pulse durations and the durations of intervals between these pulses. Protection is activated when a sequence of these time points indicates the ground fault, and will be activated after the time which results from the durations of activations and intervals between the activation pulses.

- **Inverse-time ground overcurrent protection (Io2) 51N**

Dedicated to be used as a ground fault protection in networks with directly earthed neutral point, and in networks with insulated neutral point, where the use of the measurement of ground current is sufficient for the correct fault identification.

Setting ranges:

starting current	(5÷1000)mA per 1mA
restrain residual voltage	(1÷20)V per 1V
operation time for 3Io=2Ior	(100÷1000)ms per 1ms

Staring characteristics:

$$t = 2t_2\left(\frac{I_{or}}{3I_o}\right) \quad \text{at } U_o \geq U_{omin}$$

where:
I_{or} - setting value of the starting current
$3I_o$ - ground current
$3U_o$ – redisudal voltage
U_{omin} - setting value of the minimum residual voltage
t_2- adjustable operation time for $3I_o=2I_{or}$
t - time of protection activation

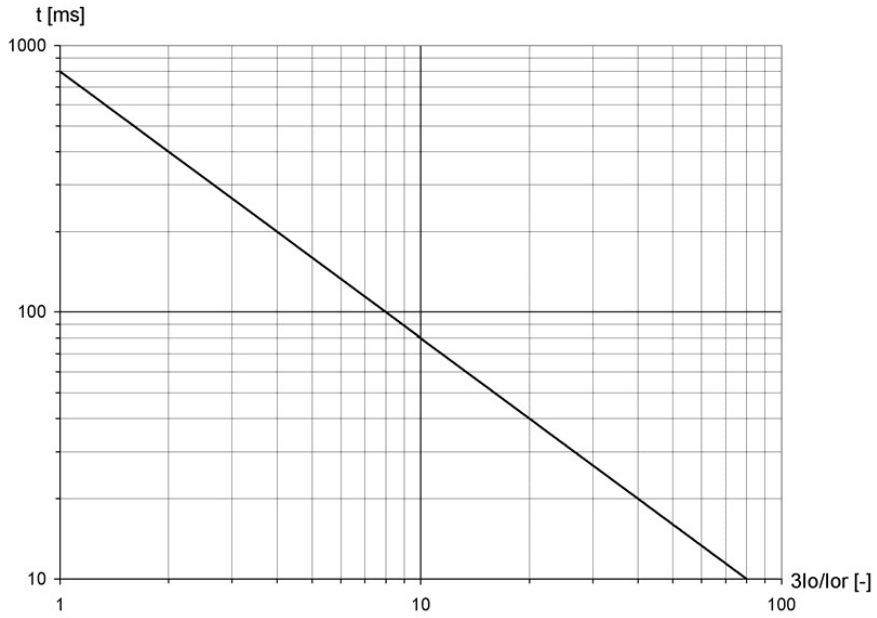


Fig. 4. Characteristics of time current protection Io2 (t_2=400ms)

Additional features:

- lockout of protection tripping by residual voltage Uo below the set value,
- configuration of locking the stimulation of protection by programmable logic,
- close command interlock after function operation

• Directional time-delayed ground overcurrent protection, definite-time (Io3) 67N

Used as a ground fault protection in networks with insulated neutral point or in compensated networks and network configurations with directly earthed neutral point, when the measurement of groundcurrent is not a sufficient criterion for the correct identification of earth fault.

Setting ranges:

starting current	(5÷1000) mA per 1mA
minimum residual voltage	(1÷20) V per 1V
angle of maximum sensitivity	(0÷90)^o per 1^o
operation time	(0÷3000) ms per 1ms

Staring characteristics:

at

$3I_o$ - ground current
$3U_o$ - residual voltage

φ - phase shift angle between $3I_o$ and $3U_o$
I_{or} - setting value of the starting current
U_{omin} - setting value of the minimum residual voltage

φ_m - value of the setting of the maximum sensitivity angle

3Io/Ior [-]

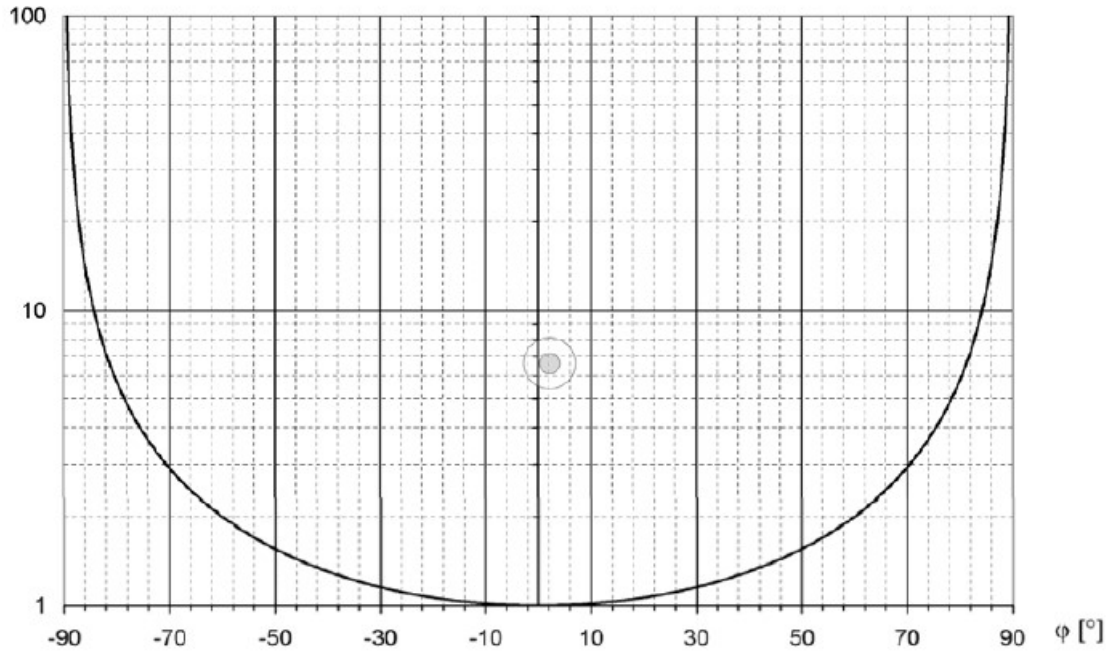


Fig. 5. Operation characteristics of protection Io3 (φ_m = 0°)

Additional features:
- configuration of locking the protection activation by programmable logic,
- close command interlock after function operation

• Motor start-up supervision (ItR) 48

Protection function dedicated to detect motor overload condition caused by: excessively prolonged motor start-up, exceeding of the allowable number of consecutive starts or locked motor during start-up condition.

Setting ranges:

permissible duration of start-up	(2÷100) s per 1s
thermal recovery time after start-up	(5÷120) min per 1min
allowable start time under overload conditions	(2÷100) s per 1 s
number of starts allowed from the cold state	(1÷5)
number of starts allowed from hot state	(1÷4)

Additional features:
- configuration of locking the protection activation by programmable logic

• Thermal overcurrent protection against overload (Ic) 49

Protection function controlling the state of heating the motor on the basis of a digital thermal model.

Setting ranges:

ambient temperature	(-10÷55) °C per 1°C
motor temperature for rated load current	(60÷120) °C per 1°C
time constant participation rate	(0÷1) per 0.1
motor thermal time constant T1	(1÷60) min per 1 min

motor thermal time constant T2	(10÷120) min per 1min
elongation rates of time constants	(1÷20) per 1
temperature of signalling stage	(60÷160) °C per 1°C
temperature of trip stage	(60÷160) °C per 1°C
temperature of close command deactivation	(30÷150) °C per 1°C

Additional features:
- configuration of locking the protection activation in PLC.

• Thermal protections, two-stage (ϑ)

Three protection functions designed to work with any temperature sensor with the transducer, via analog inputs 4÷20mA. Each input can be used only as a measurement of temperature, or to perform the thermal protection (for example, for monitoring the temperature of motor bearings) or the stator windings.
The first input of temperature measurement can be used to measure the ambient temperature for the purpose of thermal protection.

Setting ranges:

sensor minimum temperature	(-200÷+1000) °C per 1°C
sensor maximum temperature	(-200÷+1000) °C per 1°C
temperature of close command deactivation	(30÷200) °C per 1°C
temperature of signalling stage	(30÷200) °C per 1°C
temperature of trip stage	(30÷200) °C per 1°C

Additional features:
- configuration of locking the protection function by programmable logic.

• Time-delayed over/undervoltage protection (U1, U2) 27/59

Two protections function, each can be set as undervoltage or overvoltage, dedicated to be used:
- as motor protection against operation in conditions of very low voltage or against activating the switch at reduced supply voltage,
- as a criterion for undervoltage, which is one of the conditions of operation of the arc protection (only U2).

Setting ranges:

starting voltage	(0.10÷1.20)Un per 0.01Un
response time	(20÷60000)ms per 1ms

Additional features:
- configuration of locking the protection function by programmable logic,
- close command interlock after function operation
- U2 as an additional criterion of operation of arc-flash protection.

- **Arc-flash protection function**
  Compatible with the VA 1 DA-type flash sensor of the VAMP-type arc-flash protection system intended for protecting the bay against destructive effect of electric arc.
  The emergency control is activated under condition of simultaneous occurence of:
  - powerful arc-flash,
  - exceeding inrush current preset value,

When co-operating with over-voltage relay the voltage criterion can be realized.

Starting current setting range	(2.0 ÷25.0) In in step of 0.1 In

- **Rotor cage early faults detection function**

The function allows signalling failure at the stage of damage to one bar or ring and control of damage accumulation. The indicator is based on an analysis of the waveform of motor phase currents during its start-up.
Setting ranges:

diagnosis delay time	(0.5÷5.0)s per 1s
current measurement time	(5÷240)s per 1s
degree of cage damage (% of damaged rings)	(0.1÷10.0)% per 0.1%

- **Cable insulation fault detection function**

The indicator is designed to determine the progressive damage to cable insulation, based on the analysis of the ground current. Early diagnosis of such case is possible by using a system of counting of pulses (with adjustable values) appearing in the ground current, in the set time of the observation window.
Setting ranges:

pulse threshold value within the observation window	(100÷10000)mA per 1mA
duration of observation window	(1÷60000)min per 1min
allowable number of pulses	(1÷20000) per 1

- **External protections ET1 ÷ ET4**

These four protection functions are intended for co-operation with protection automation system accomplished beyond the CZAZ-UM relay, among others with relays protecting technological processes. Each of them has an input circuit which can co-operate with properly configured binary input (In01 ÷ In10) or receive any signal generated in programmable controller.

Time delay setting range	(0 ÷ 60000) ms in step of 1 ms

Additional features:
- close command interlock after function operation

- **Measuring inputs setting ranges**
  - rated primary current range of the current transformers (1 ÷ 5000) A
  - rated primary voltage range of the voltage transformers (100 ÷ 110000) V

3. SPECIALIZED BAY CONTROLLER

The controller is provided with predefined logical circuits for co-operation with the protected bay which ensure complete and safe maintaince of switches, basic external interlocks and interlocks caused by operation of protection functions, system restoration process accomplishment and co-operation with acoustic signaling system of the station. Adaptation to cooperation with bay switches to the various requirements of the distribution systems and requirements is possible through software configuration. Choosing the right scheme causes the automatic programming of the relay to implement the relevant locks on operational and overhaul activation of the switch, signals of the operational readiness of the bay and bay damage signalling as well as the messages on the display and in the events recorder. Figure 9 shows the external wiring diagram for the outgoing feeder, in the switchgear unit with a single busbar system.

- **Co-operation with circuit-breaker**:
  - monitoring of position and signaling of faulty position,
  - monitoring of charging status,
  - monitoring of control voltage and two tripping circuits continuity,
  - operating opening and closing of the circuit-breaker;

- **Control of circuit-breaker is available by:**
  - using Human-Machine Interface
  - using dedicated binary inputs,
  - using a signal configured within the programmable logic,
  - in remote mode, via serial interface

- **Circuit-breaker close command is blocked by following conditions**:
  - circuit-breaker uncharged,
  - opened disconnectors or closed earthing switch;
  - faulty position of any of controlled switch,
  - close command interlock activated by operation of protection function,
  - activation of close command interlock configured within programmable logic,
  - trip signal activated

- **Co-operation disconnector**
  - position monitoring,
  - faulty position signaling,
  - control of disconnectors available via programmable logic.

  Non-typical power distributing systems can co-operate with additional switches using programmable controller functions.

- **Co-operation with earthing switch**:
  - position monitoring,
  - faulty position signaling,
  - control of earthing switch available via programmable logic.

- **Monitoring of bay readiness for operation**
  consists in generation of signal informing about operating readiness of the protected bay and is carried out independently for closed and opend circuit-breaker basing on monitoring of actual condition of: switches working within the bay, continuity of tripping circuits, interlocks caused by operation of protection functions and current interlocks configured within the programmable logic.

- **Co-operation with the "emergency trip" acoustic signaling station system**
  The ET signal is shaped at the moment of the circuit-breaker trip caused by any protection system beyonf the CZAZ-U relay or in result of any trip event caused by any of protection function of the relay.

- **Co-operation with the "Bay failure" acoustic signaling station system**
  The BF signal is shaped under conditions of:
  - response of any protection functions configured only onto signaling mode,
  - faulty position of circuit-breaker, disconnectors or earthing switch,
  - uncharge of the circuit-breaker,
  - non-continuity within tripping circuits,
  - exceeded threshold of pre-set value of sum of tripped currents counter of the circuit-breaker,
  - active BF signal generated in programmable logic

- **Co-operation with the "alarm" sound signaling circuit of the station (AL)**
  The AL ("watchdog") signal is shaped at the moment of loss of auxiliary supply voltage, damage of power supply module, detection of any inefficiency during self-monitoring or programmed trip of the relay.

- **Under Frequency Load Shedding function**
  Four frequency protection functions can be utilized for accomplishment of three-stage auto-frequency-load-shedding function, and the auto-reclosing after UFLS (AR after AFR) function.

The UFLS system constitutes a logic operators and timers provided with an built-in circuit. The function can be activated by internal signals of operation of under-frequency protection functions or by an external binary signal (In01 - In10. The function is dedicated to cooperate with station UFLS system. The UFLS output signal can be directed onto any output relay (OUT01 – OUT10) assigned to adequate automation stage.
Operation of the UFLS function is the performance condition of activation of auto-reclose after under-frequency-load shedding automation function.

- **AR after UFLS automation**
  The AR after UFLS function constitutes a logic operators and timers provided with an built-in circuit.The function can be activated by an internal signal of operation of overfrequency protection function or by an external binary signal coming from binary inputs (In1 ÷ In10). Function output signal can be directed onto any output relay (OUT01 – OUT10).
  The time delay element (setting range 0 ÷ 60 min in step of 1 min.) situated within the function logic allows to wait for frequency stabilization within the system.

  The operate time-delays can be differentiated thus enabling progressive make of particular loads after failure of the controlled system.
  AR after UFLS operate time setting range (100 ÷ 20000) ms in step of 1 ms

  A signal (indicating operation of over-frequency protection function) informing about frequency rise within the system, can be used within the voltage measuring bays for generating AR after UFLS signal. The external binary inputs enable to receive the AR after UFLS signal by the line, transformer and motor feeders in order to restore loads tripped in result of previous operation of UFLS system.

4. PROGRAMMABLE LOGIC FUNCTION

The programmable bay controller is provided with such typical Boolean operators (AND, OR, NOT), special elements and multifunction timers. It communicates bidirectional with the system of protection functions and the specialized bay controller block.
A simple operational graphis interface enables to configure the controller by means of diagrams of logic and timers (see Fig. 6) using all inputs and outputs of the device.

- **Inputs:**
  - 21 external binary inputs (In01 ÷ In21),
  - 16 logical inputs transmitted by a serial interface,
  - 16 internal inputs receiving information from the specialized bay controller about current condition of the dedicated binary inputs (e.g. concerning position of bay switches),
  - over 100 internal binary signals receiving information about condition of protection functions (pick-ups, trips) and particular supporting functions of the specialized bay controller.

- **Outputs:**
  - 14 relay outputs (Out01 – Out14)
  - the signals can be sent to the system of protection functions as well as the specialized bay controller, among others circuits of emergency control and operating control over the circuit-breaker,
  - the signals can be sent to event recorder or disturbance recorder,
  - the signals can be displayed on LCD or by LED diodes on relay HMI

- **Timers**
  The relay offers 16 timers enabling to select one from the following four operation modes:
  - pulse front edge delay,
  - elongation of pulse duration over the declining edge,
  - generation of pulse with adjustable duration over the ascending edge,
  - generation of pulse with adjustable duration over the declining edge.

  Timers setting range: (0 ÷ 60000) ms in step of 1 ms or (0 ÷ 60000) s in step of 1 s

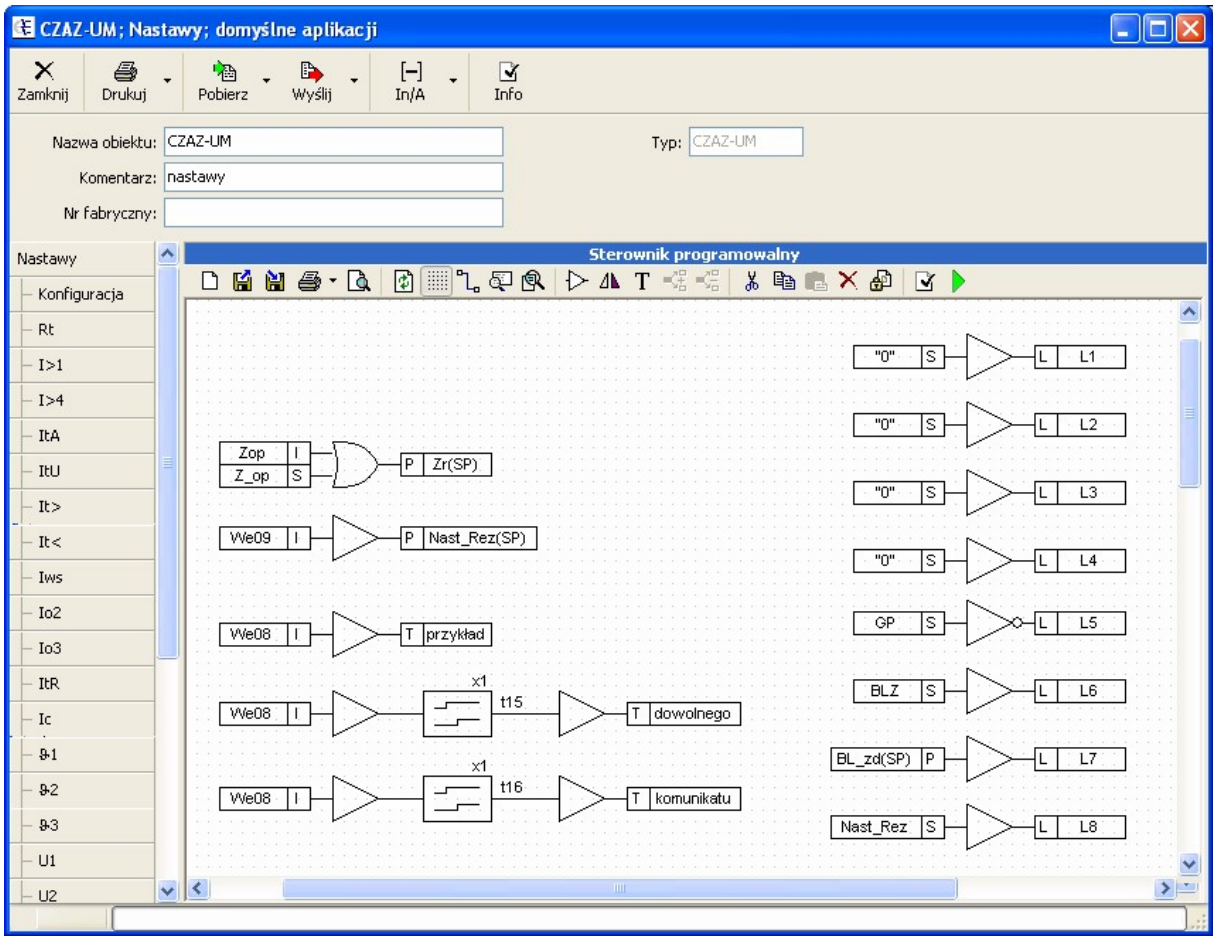


Fig. 6 Sample "screen" of SMiS tool in a graphical interface for configuring of programmable logic

5. OTHER NON-PROTECTION FUNCTIONS

5.1. MEASUREMENTS

The set carries out measurements of the following values:

PHASE CURRENT L1	**IL1**	effective value of fundamental component of current in phase L1,
PHASE CURRENT L2	**IL2**	effective value of fundamental component of current in phase L2,
PHASE CURRENT L3	**IL3**	effective value of fundamental component of current in phase L3,
DIFFERENTIAL CURRENT L1	**IrL1**	effective value of fundamental component of differential current in phase L1,
DIFFERENTIAL CURRENT L2	**IrL2**	effective value of fundamental component of differential current in phase L2,
DIFFERENTIAL CURRENT L3	**IrL3**	effective value of fundamental component of differential current in phase L3,
MAX. DIFF. CURRENT	**Ir**	effective value of fundamental component of maximum differential current,
RESTRAIN CURRENT	**Ih**	effective value of fundamental component of restrain current corresponding to the maximum differential current,

UNBALANCE CURRENT	**Ias**	difference of maximum and minimum effective values of fundamental components of phase currents, calculated according to the formula Ias=Imax - 1,2Imin,
MAX EFFECTIVE VAL.	**I**	effective value of the maximum phase current,
GROUND CURRENT	**3Io**	effective value of fundamental component of zero current,
RESIDUAL VOLTAGE	**3Uo**	effective value of fundamental component of zero voltage,
L1-L2 VOLTAGE	**U12**	effective value of fundamental component of phase-to-phase voltage L1L2,
L2-L3 VOLTAGE	**U23**	effective value of fundamental component of phase-to-phase voltage L1L3,
ACTIVE POWER	**P**	current value of the active power,
REACTIVE POWER	**Q**	current value of the reactive power,
ACTIVE POWER	**P15**	average value of the active power for the last 15 minutes,
REACTIVE POWER	**Q15**	average value of the passive power for the last 15 minutes,
ENERGY	**E**	value of active energy,
POWER FACTOR	**tg(φ)**	value of power factor,
START-UP TIME LIMIT	**t6p**	remaining time limit of motor start-up
USED TIME OF START.	**t6r**	allowed time utilised during motor start-up
LOCKING TIME	**tblok**	time of model thermal regeneration after unsuccessful start-ups,
MOTOR TEMPERATURE	**ϑm**	current motor temperature taking into account the sum of ambient and thermal model,
TEMPERATURE – SENSOR 1	**ϑ1**	current temperature measured by the sensor ϑ1,
TEMPERATURE – SENSOR 2	**ϑ2**	current temperature measured by the sensor ϑ2,
TEMPERATURE – SENSOR 3	**ϑ3**	current temperature measured by the sensor ϑ3,
SENSOR CURRENT	**Iϑ1**	measurement of current of the external sensor ϑ1,
SENSOR CURRENT	**Iϑ2**	measurement of current of the external sensor ϑ2,
SENSOR CURRENT	**Iϑ3**	measurement of current of the external sensor ϑ3,

Measurement repetition time is 100 ms. The result of measurements is given as an original value (exception: ground current and residual voltage).

5.2. RECORDERS

- **Events recorder**
  Event recorder records approx. 150 distinguishable events, operating with time resolution of 1 ms, memorizing up to 500 records, incl.:
  - operation of current and voltage protection functions as well as of arc-flash protection system;
  - operation of the external protections;
  - interlocks of: protection functions, circuit-breaker control and operation of restoration precess system;
  - operational signals of the restoration process system;
  - reset of the internal trip indication (TRIP) and the circuit-breaker close command interlock (CL BL),
  - position change and faulty position of bay switches;
  - formation of signals used by acoustic signaling system of the station;
  - signals of trips and operating control of the circuit-breaker;
  - pick-up of external programmable inputs;
  - pulses intended for remote control by the serial interface;
  - additional events configured in the programmable logic;
  - supply and failure of auxiliary supply voltage;
  - change of settings.

- **Recorder of parameters of the recent disturbances**
  records the parameters of the disturbance that caused the relay to trip, i.e.:
  - maximum rms. value of the fundamental component of phase current as well as duration of the disturbance for phase-to-phase faults,
  - maximum rms. value of ground current or residual voltage as well as duration of the disturbance for ground-faults,
  - maximum or minimum rms. value of the voltage fundamental component, as well as duration of the disturbance for the voltage protection functions (U1, U2);
  - maximum or minimum frequency value, as well as duration of the disturbance for frequency protection functions

  The record is memorized by the recorder until the next trip event occurs.

- **Counters of pick-ups and protection operations including:**
  - operation counters of particular protection functions;
  - counters of signals of discontinuity occurring within the trip circuits
  - counters of restore process operation;
  - 16 additional counters to be utilized within the programmable logic

- **Circuit-breaker supervision functions**
  - counter of the tripped current in particular phases, so called cumulated currents of the circuit-breaker, (with the resolution of up to 0.1 In).
  - Tripped currents counter setting range (Imax) (1 ÷ 65535) In
  - counter of CB opening operations: trips and operational openings as well

- **Disturbances recorder**
  Records up to 8 analog signals (such as: phase currents, ground current, phase-to-phase voltages, residual voltage) and up to 16 binary signals. Recorder signals are configured by the user as well as the pick-up signals causing the rocerd process.

  Recorded signals are sampled with frequency of 1000 Hz, and the total recording duration amounts up to 16s. The records can be divided into equal time sections (2, 4, 8, 16 or 32). A common parameter indicating partition of the recorded signal into a time section before and after the recording pick-up signal (the so-called “pre-run 1÷99%”) is set for all recorder pick-up signals. An example of screen-shot of multifunction browser of signals recorded by the disturbance recorder is shown on

Fig. 7.

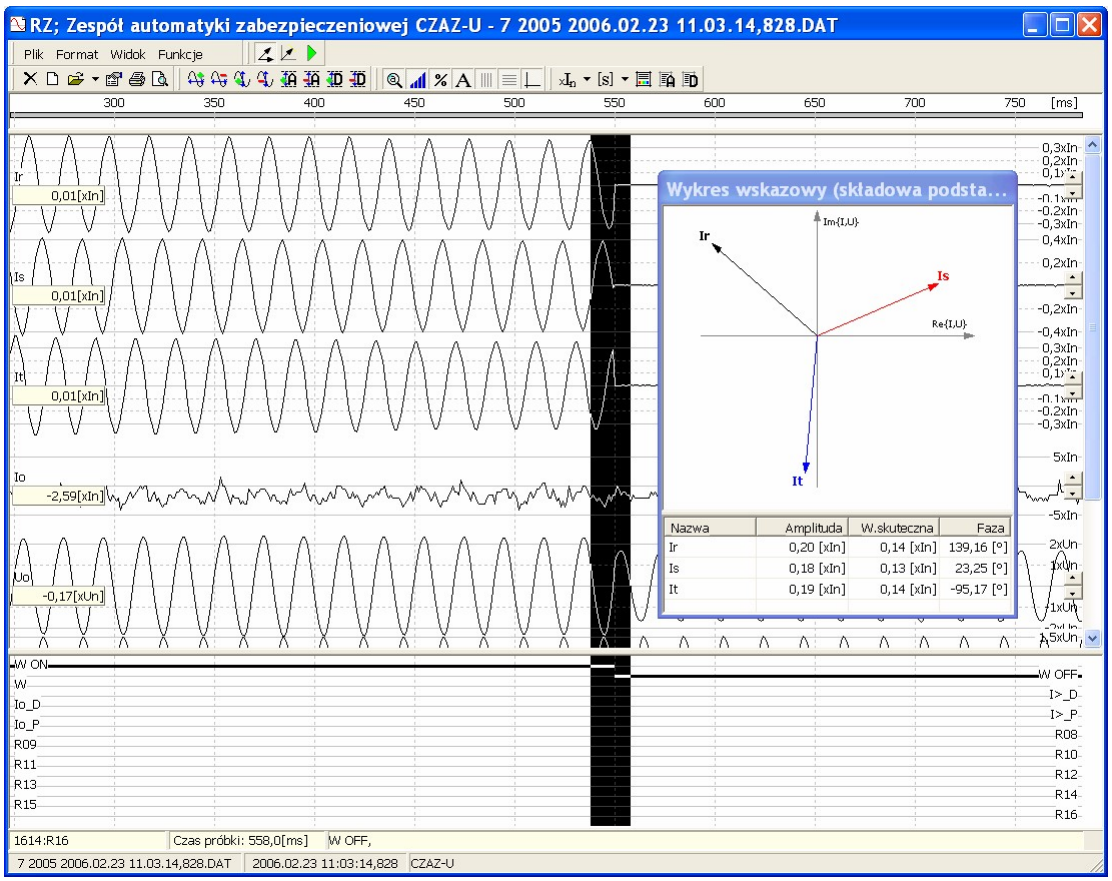


Fig. 7. Screen-shot: example of multifunction browser of signals recorded by disturbance rocerder

6. HUMAN-MACHINE INTERFACE

- **LED visual indicators including:**
  4 pre-defined LED indicators of:
  - closed circuit-breaker,
  - cumulative indication corresponding to the messages occurring on LCD display,
  - relay proper operation state,
  - correct auxiliary voltage level,

  8 free-programmable LED indicators

- **LCD visual indication of:**
  - operation of protection functions;
  - operating signals of restoration process system;
  - faulty position of bay switches;
  - discontinuity of the tripping circuits;
  - circuit-breaker uncharged condition;
  - exceeding threshold of the tripped current counter;
  - the circuit-breaker open operation (in trip and remote modes).

7. COMMUNICATION

The remote communication is available using either PC host or another system supervising operation of the relay.
Data transmission standard:

- port — RS232 and RS485 (two-wire: „A", „B")
- protocol — MODBUS-ASCII, MODBUS-RTU
- data transmission rate — 1200, 2400, 4800, 9600, 19200 or 38400 Bd

NOTICE: Fiber connection by using fiber optic converter MOXA type TCF-142M.

8. CONTROL AND MONITORING Software 'SMiS'

The relay can be engaged to remote communication and operation in a system working under control of the SMiS – control and monitoring software. The SMiS software is a versatile and coherent tool intended for full parallel supporting and archiving of data gathered and processed by all CZAZ-family multifunction relays as well as all independent relays manufactured by the ZEG-ENERGETYKA.

The SMIS software comprised by standard equipment of the relay enables to operate the relay within the entire range of:

- configuration of protection and automation functions,
- configuration of the programmable logic,
- upload and download of relay settings,
- preview current measured values,
- browsing events,
- browsing records of disturbance recorder,
- previw and testing of binary inputs and outputs,
- relay internal time

Examples of the SMiS software screen-shots are presented on Fig. Nos. 6, 7 and 8

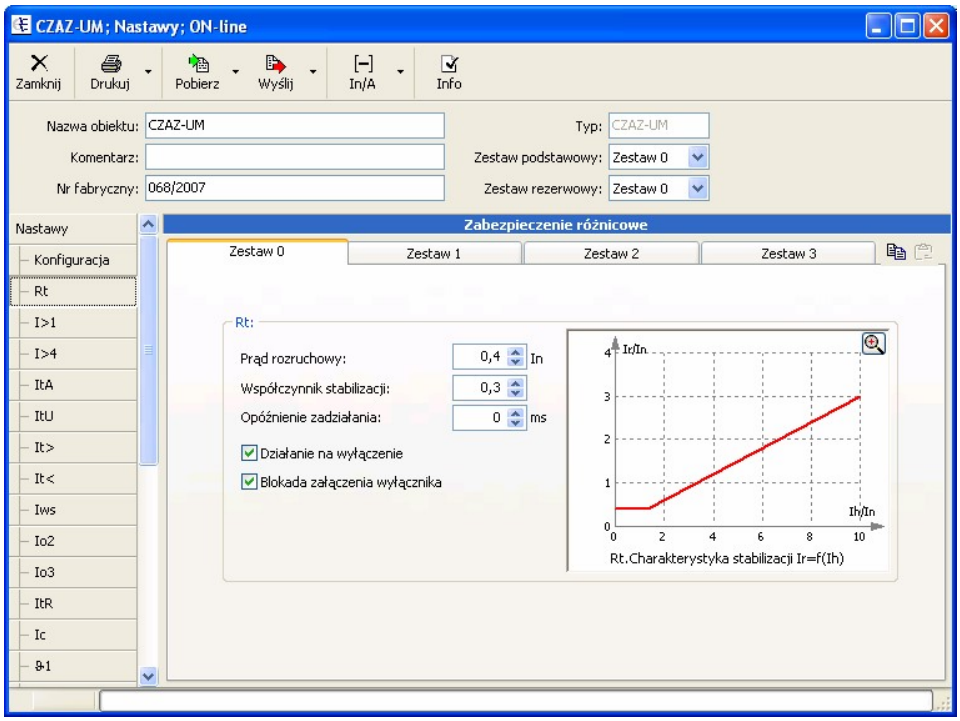


Fig. 8 Sample screen of SMiS software

9. INPUT/OUTPUT CIRCUITS

Table 1. Terminals of CZAZ-UM description

Terminal No.	Contact No.	Signal description	Remarks
X1	**1-4**	measuring current of phase L1	-
	2-5	measuring current of phase L2	-
	3-6	measuring current of phase L3	-
	7-10/11	differential measuring current of L1 phase	
	8-10/11	differential measuring current of L2 phase	
	9-10/11	differential measuring current of L3 phase	
	9-10	ground measuring current Io	-
X2	**1-2**	phase-to-phase measuring voltage U_{1-2}	-
	2-3	phase-to-phase measuring voltage U_{2-3}	-
	4-5	residual measuring voltage Uo	-
X3	1	auxiliary supply voltage Up	⊕ Up
	2	auxiliary supply voltage Up	⊖ Up
	3	control voltage Us	**..... / .....**
	4	control voltage Us	**..... / .....**
	5	relay output for CB close coil control	NO contact
	6	relay output for CB open coil 1 control	NO contact
	7	relay output for CB open coil 2 control	NO contact
	8-9	duplication of relay output for CB open	NO contact
	10	Programmable binary input In11 or Disconnector D3 open position monitoring*	⊕ Up
	11	Programmable binary input In12 or Disconnector D3 close position monitoring*	⊕ Up
	12	CB charging condition monitoring	⊕ Up
	13	Programmable binary input In13 or Earthing switch Es1 open position monitoring*	⊕ Up
	14	Programmable binary input In14 or Earthing switch Es1 close position monitoring*	⊕ Up
	15	CB open position monitoring	⊕ Up
	16	CB close position monitoring	⊕ Up
	17	Programmable binary input In15 or Disconnector D2 open position monitoring*	⊕ Up
	18	Programmable binary input In16 or Disconnector D2 close position monitoring*	⊕ Up
	19	Programmable binary input In17 or Disconnector D1 open position monitoring*	⊕ Up
	20	Programmable binary input In17 or Disconnector D1 close position monitoring*	⊕ Up
X4	1-2	programmable binary input In01	⊕ / ⊖ Up
	3-4	programmable binary input In02	⊕ / ⊖ Up
	5-6	programmable binary input In03	⊕ / ⊖ Up
	7-8	programmable binary input In04	⊕ / ⊖ Up
	9-10	programmable binary input In05	⊕ / ⊖ Up
	11-12	programmable binary input In06	⊕ / ⊖ Up
	13-14	programmable binary input In07	⊕ / ⊖ Up
	15-16	programmable binary input In08	⊕ / ⊖ Up
	17-18	programmable binary input In09	⊕ / ⊖ Up
	19-20	programmable binary input In10	⊕ / ⊖ Up
	21-22	input of VAMP arc flash sensor	⊕ / ⊖ Up

Terminal No.	Contact No.	Signal description	Remarks
X5	1	CB operational close command input	⊕ **Up**
	2	CB operational open command input	⊕ Up
	3	reset binary input of TRIP signaling	⊕ Up
	4	reset binary input of close command interlock	⊕ Up
	5-6	Trip signaling relay	NO contact
	5-7	Bay failure signaling relay	NO contact
	5-8	Watchdog signaling relay	NC contact
X6	1-2	COM2 – serial communications port RS485	-
	3-4	COM1 – serial communications port RS485 (optional)	-
X7	1-2	programmable relay output Out01	NO contact
	1-3	programmable relay output Out02	NO contact
	4-5	programmable relay output Out03	NO contact
	4-6	programmable relay output Out04	NO contact
	7-8	programmable relay output Out05	NO contact
	9-10	programmable relay output Out06	NO contact
	11-12	programmable relay output Out07	NO contact
	13-14	programmable relay output Out08	NO contact
	15-16	programmable relay output Out09	NO contact
	17-18	programmable relay output Out10	NO contact
X8	1-2	temperature measuring input from ϑ1 sensor	(4÷20)mA
	3-4	temperature measuring input from ϑ2 sensor	(4÷20)mA
	5-6	temperature measuring input from ϑ3 sensor	(4÷20)mA
	7-8	free terminals	-

* - programmable binary input or dedicated control input of switch, depending on chosen bay diagram

⊕ / ⊖ Up – plus / minus of auxiliary supply voltage Up
⊞ / ⊟ Us – plus / minus of control voltage Us
Description of the binary inputs in the active state (energized). Description of relay outputs in deenergized condition.

9.1. WIRING DIAGRAM

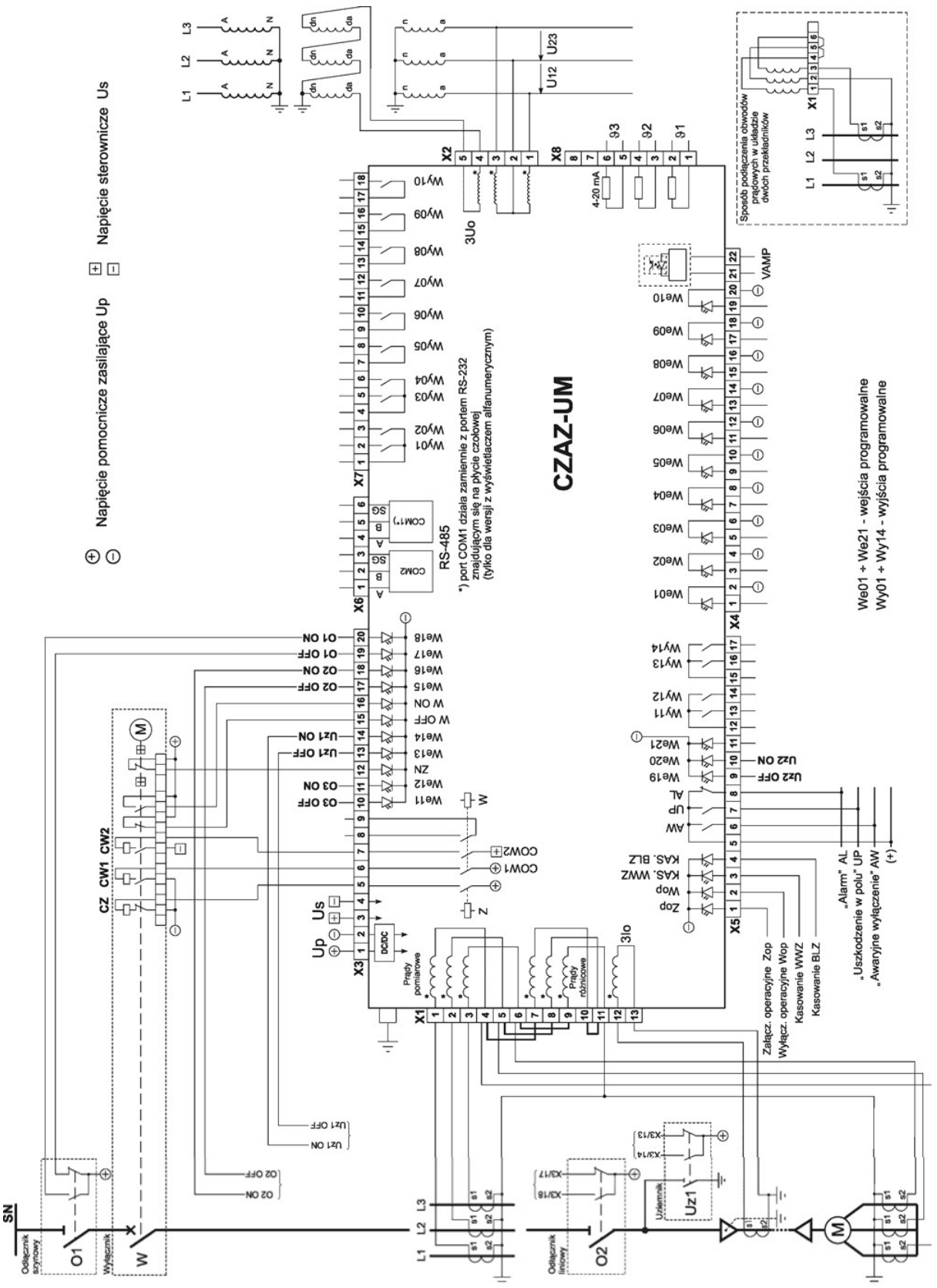


Fig. 9 Wiring diagram of external connections of CZAZ-UM

10. CONSTRUCTION

The relay is housed in the BOPLA-type case adapted for mount in two ways: surface-mounting – see Fig. 11 or flush-mounting – see Fig.12. The input measuring circuits are conducted via screw-less connectors enabling to connect wires of a cross-section up to 4 mm^2. The remaining circuits are led via pin connectors enabling to connect wires of a cross-section up to 2.5 mm^2.

The front panel of the device includes: graphical LCD, a keyboard enabling to operate the entire relay and visual LED indicators.

10.1. DIMENSIONAL SHEET

Surface mounting case

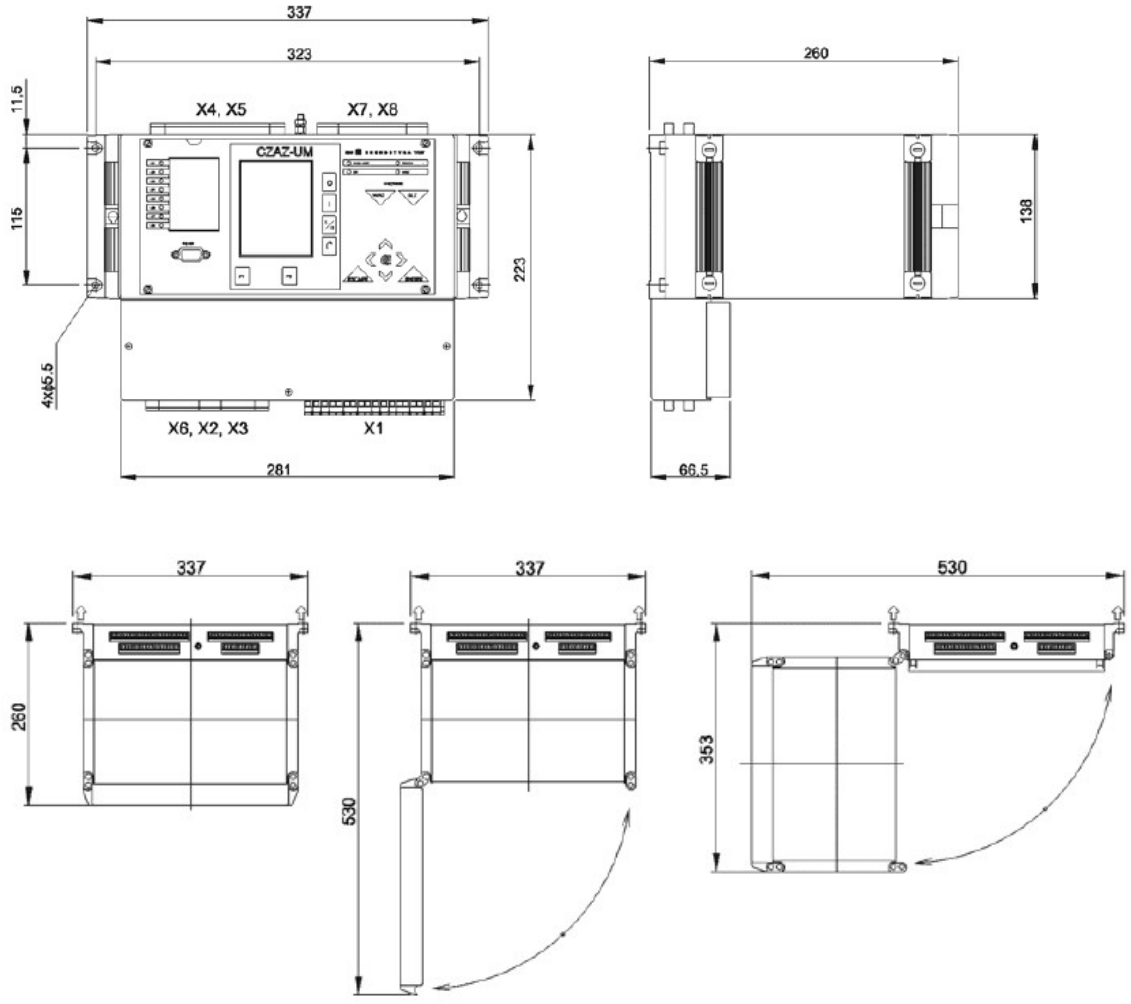
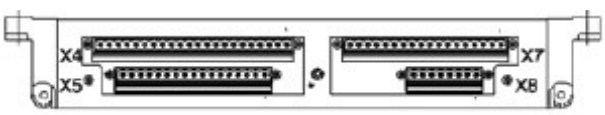
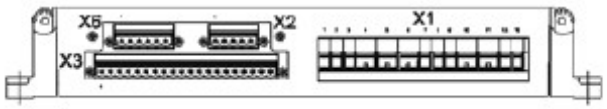


Fig. 10 Dimensional sheets of the surface mounting case.

Terminals arrangement – upper side



Terminals arrangement – bottom side



Flush mounting case

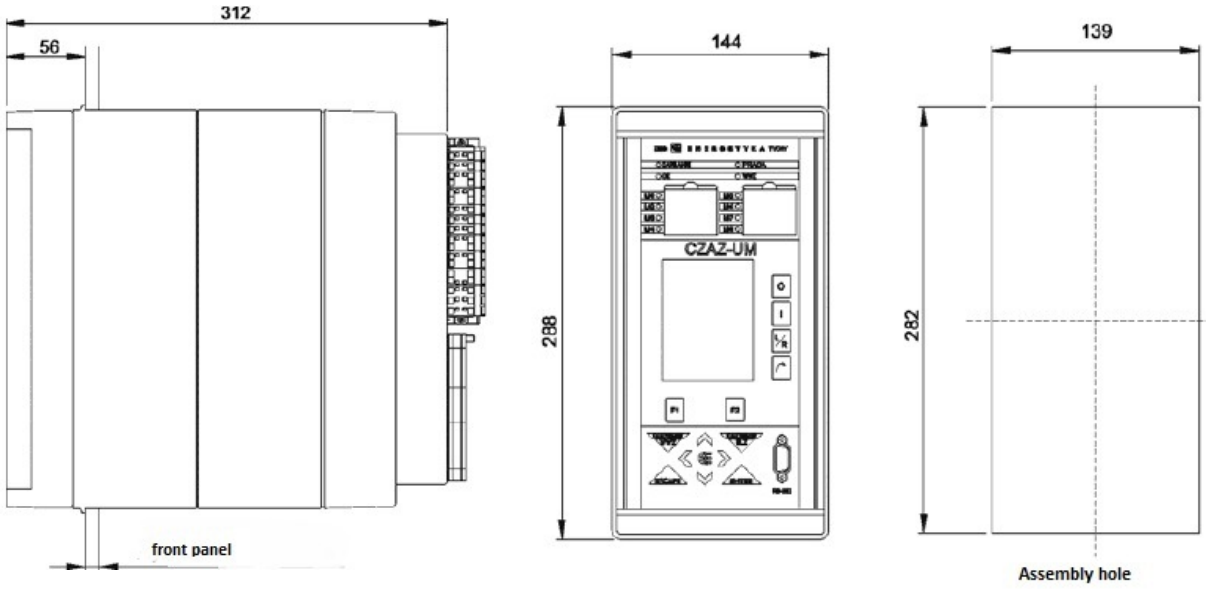
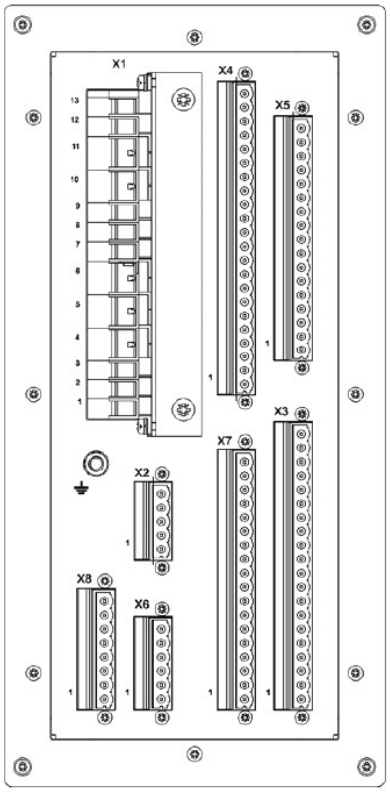


Fig. 11 Dimensional sheets of the flush mounting case.

Terminals arrangement



11. TECHNICAL DATA

Nominal auxiliary voltage Upn	DC 220V or DC 110V
Working range of the auxiliary voltage Up	(0.8 ÷ 1.1) Upn
– Burden of auxiliary voltage supply	≤ 20 W
– Control voltage Us	DC 220 V or DC 110 V
– Working range of the control voltage Us	(0.8 ÷ 1.1) Us
– Burden of control voltage input	≤ 2 W
– Current measuring inputs:	
– rated measuring current I_n	5 A or 1 A
– rated frequency f_n	50 Hz ±5%
- burden at I = I_n	≤ 0.5 VA per phase
– continuously thermal withstand	2.2 I_n
– 1-second thermal withstand	80 I_n
– dynamic withstand (10 ms)	200 I_n
Ground current measuring input:	
– measuring current range	12 A
- rated frequency f_n	50 Hz ±5%
- burden at I_o=5A	≤ 0.4 VA
– continuously thermal withstand	11 A
– 1-second thermal withstand	250 A
– dynamic withstand (10 ms)	625 A
Voltage measuring inputs:	
– rated measuring voltage U_n	100 V
– rated frequency f_n	50 Hz ±5%
– burden at U=U_n	≤ 0.5VA
- 10-second thermal withstand	1.5 U_n
- continuously voltage withstand	1.2 U_n
Residual voltage measuring input:	
– rated measuring voltage U_{on}	100 V
- rated frequency f_n	50 Hz ±5%
- burden at U=U_{on}	≤ 0.5 VA
- 10-second thermal withstand	1.5 U_{0n}
- continuously voltage withstand	1.2 U_{0n}
Binary inputs:	
- input voltage	DC 220V or DC 110V
- burden	< 5 mA
Accuracy of current protection functions	5%
Accuracy of voltage protection functions	5%
Additional accuracy deviation caused by frequency oscillations	5%
Frequency measurement accuracy	0.05 Hz
Time measurement accuracy	1% ±5 ms
Pick-up and drop-out time (except frequency protection functions)	≤ 40 ms
Pick-up and drop-out time of frequency protection functions	≤ 80 ms
Sustain time	tp ≥ 50ms
Reset coefficient:	
- for overload protections	≥ 0.97
- for underload protections	≤ 1,03

Relay outputs data:	
- Continous contact carry	5 A
Max. breaking capacity:	
- at U = DC 250 V	
- at resistance load	0.3 A
- at inductive load L/R = 40 ms	0.12 A
- at U = AC 250 V / 50 Hz	
- at inductive load cosφ = 0.4	3A
Operating temperature range:	(268 ÷ 328) K (-5 ÷ 55°C)
Relative humidity (with no condensation)	up to 80%
Ingress protection	IP40
Weight	6.5 kg
Electromagnetic compatibility standard	acc. to PN-EN 50263
Electric strength of insulation:	PN-EN 60255-5
- at AC voltage	2 kV / 50 Hz / 1min.
- surge voltage	5 kV; 1,2/50 μs
Communication	
RS-232:	
- insulation electric strength	1 kV
Data transmission parameters:	
- parity	None, Even
- data bits	7, 8, 9
- stop bits	1, 2
- data transmission rate	1200, 2400, 4800,
- 9600, 19200, 38400 bps	
- data transmission protocols	Modbus / ASCII Slave Modbus / RTU Slave Modbus / RTU Modicon Slave

12. COMPLIANCE WITH REQUIREMENTS OF STANDARDS

- **Electromagnetic compatibility (EMC)** **PN-EN 50263:2004**
- **Isolation** **PN-EN 60255-5:2005**
- **Other** (related standards)

PN-86/E-88600
PN-EN 61000-4-2:1999+A2:2003
PN-EN 61000-4-3:2006(U)
PN-EN 61000-4-4:2005(U)
PN-EN 61000-4-5:1998+A1:2003
PN-EN 61000-4-6:1999+A1:2003
PN-EN 61000-6-2:2003
PN-EN 60255-6:2000
PN-EN 60255-21-1:1999
PN-EN 60255-21-2:2000
PN-EN 60068-2-6:2002
PN-EN 60068-2-27:2002
PN-EN 60255-22-2:1999
PN-EN 60255-22-3:2002
PN-EN 60255-22-4:2005
PN-EN 60255-22-5:2005
PN-EN 60255-22-6:2004
PN-EN 60255-25:2002
PN-IEC 255-11:1994

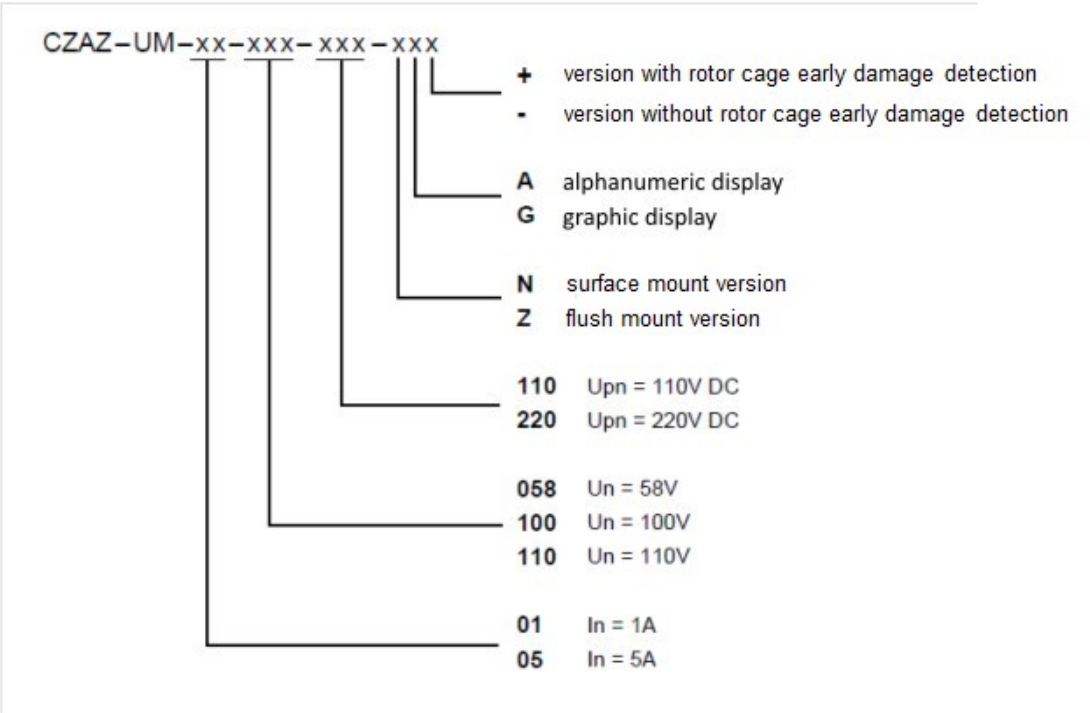
13. GUARANTEE AND MAINTENANCE

CZAZ-UM set is under a 24-month guarantee from the date of sale. The manufacturer provides warranty and post warranty services in the scope of post-assembly and periodic testing of sets.
Telephone numbers:

- technical information (0-32) 775 07 98
- reporting service repairs (0-32) 327 14 57
- hotline (24h) (0-32) 327 14 57

14. HOW TO ORDER

Please specify full name, rated measuring current In, rated measuring voltage Un, auxiliary voltage Upn and kind of outer case in your order.



Example of ordering:

- Device type **CZAZ - UM - 05 - 100 - 220 - NG+**,
- **CZAZ-UM** with parameters: In=5A, Un=100V, Upn=220VDC, for surface mounting, version with graphic display, with rotor cage early damage detection.

Company address:

ZEG-Energetyka Sp. z o.o.
ul. Fabryczna 2, 43-100 Tychy, Poland
tel.: +48 32 775 07 80
fax: +48 32 775 07 83

e-mail: biuro@zeg-energetyka.pl, www.zeg-energetyka.pl

NOTICES

NOTICES

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www.zeg-energetyka.pl