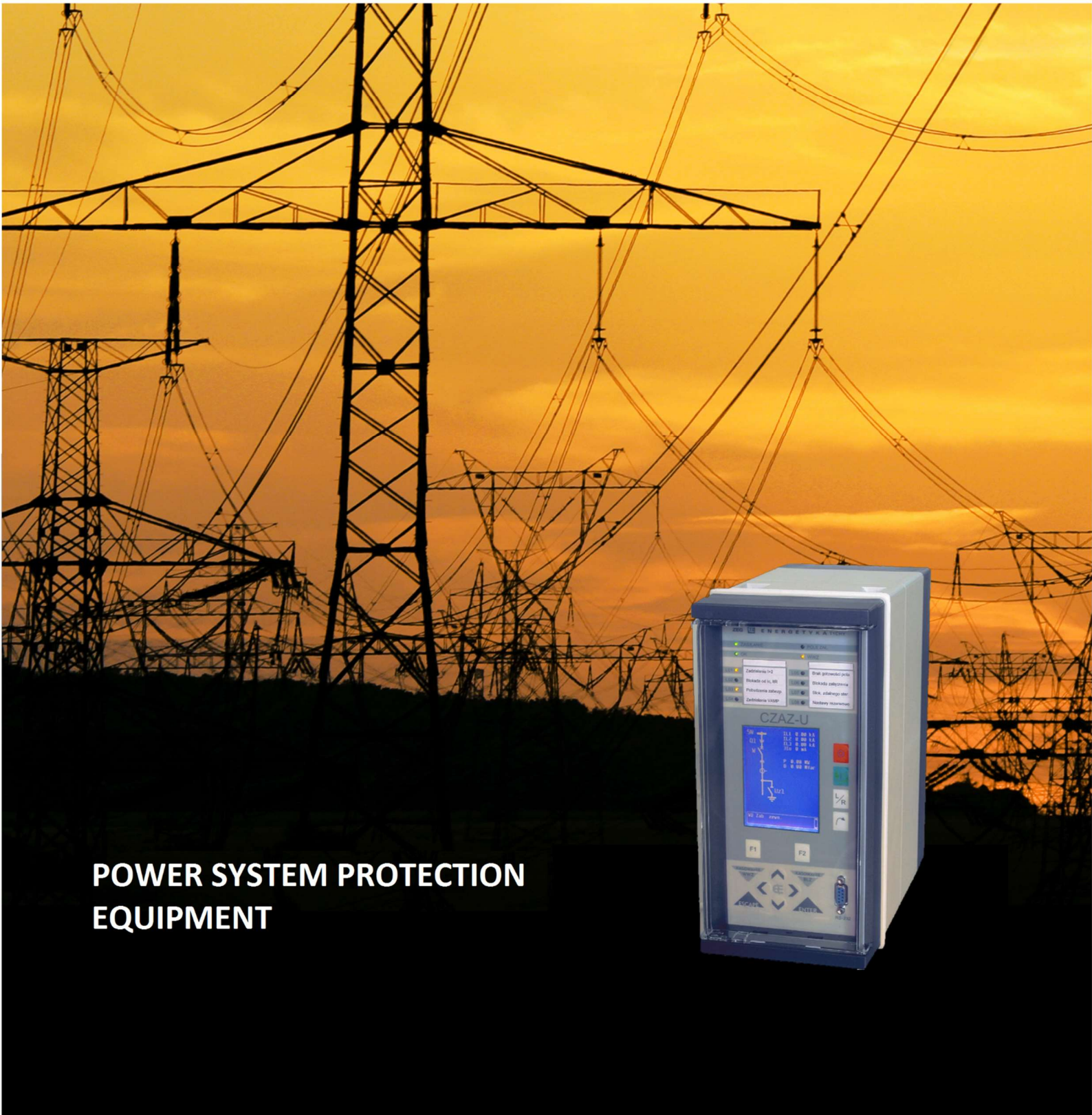
ZEG-ENERGETYKA

CZAZ-U

PROTECTION AND CONTROL UNIT FOR MV SUBSTATION

PRODUCT DATASHEET



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1. GENERAL CHARACTERISTICS

1.1. Application

The CZAZ-U-type protection relay constitutes a versatile protection of MV bays and features functions of specialized and free-programmable bay controller. It can be used for protecting incoming feeders, bus-bar coupler fields, voltage measurement fields, outgoing feeders, MV/LV transformers, capacitor battery and grounding transformer of power networks having directly grounded or isolated neutral point as well as compensated networks. It can find its application in non-standard solutions, for instance as protection of top side of HV / MV transformer. The digital design as well as high quality of relays allow to achieve high accuracy, stability and dependability of protection. The devices are offerd in three types of enclosures: for surface mount, flush mount or mixed mount (HMI flush mounted and central unit surface mounted)

1.2. Main features

- Unified and universal hardware and software allowing adaption of the relay to protected objects
- Two realisations of HMI:
  - graphic display for visualisation current bay state. It enables to simultaneously display: mimic diagram, several selected measured values and other states. Alphanumeric display also available
  - 7” touch screen with resolution of 800 x 480
- specialised bay controller with biult-in logic to provide safe maintance of bay both in local and remote control mode. Proper control functions are covered by continuous controlling of switch positions and blocking signals from protection functions.
- Programmable bay controller with programmable logic which allows to add extra logic circuits and more complex protection circuits (busbar protection or breaker failure logic). Possibility to control bay switches (with proper blocking system of opening and closing commands). Programmable logic is set by simple and user friendly graphic interface:
  - 21 binary inputs and 16 logic inputs controlled by communication port
  - 14 output relays
  - tens of signals generated by biult-in unit logic (pick-ups and trip signals from protection functions, faulty position of switches signals, substation control system signals, trip circuit supervision signals etc.)
- possibility to design user logical circuits and time delays using Boolean operators (AND, OR and NOT), multifunctional timers and other automation functions (eg. technological protection, auto-reclose automation, underfrequency load shedding). Possibility to display logic states on LCD, record in event recorder or send to remote control system
- Set of biult-in bay diagrams or possibility to build user custom bay diagram
- Output circuits allowing to direct control of bay switches, including two trip outputs with trip circuit supervision function
- 8 analog inputs: phase currents, phase to phase voltages, residual current, residual voltage
- Measuring of current electrical values (phase currents, residual current, phase or phase to phase voltages, residual voltage, active and reactive power, active and reactive energy in both directions, power factor)
- Recorders of disturbances and events:
  - recorder of approx. 150 unique events in memory of 500 records
  - disturbance recorder saves 8 waveforms and 16 binary signals
  - recorder of maximum and minimum value of voltage, current or frequency and time of duration of last fault
  - trips counter and sum of tripped currents counter
- Visual signalling (LED diodes) of key relay conditions (PWR, OK, TRIP)
- 8 or 16 user programmable LED diodes for signalling other logical values
- system of self control and autotest, signalling improper relay status
- screwless terminals for current inputs, pluggable terminals for other circuits
- communication with PC computer or SCADA system by RS 232/485 port or by fiber optic. Offered communication protocols: MODBUS RTU, MODBUS ASC, IEC 60870-5-103

2. PROTECTION FUNCTIONS

- **Definite / Inverse time overcurrent protection (I>1) 50/51**
  enabling the User to choose measuring criterion for rms. value of the signal or rms. value of the 1st harmonic.
  In particular, it is intended for the accomplishment of:
  - instantaneous or time-delayed protections against phase-to-phase faults;
  - protective automation of bus-bars and switch-onto-fault protection dedicated to be used inincoming feedees and bus-bar coupler bays

  Additional functions (adjustable):
  - interlock preventing pick-ups of the relay caused by surges of magnetizing current (2nd harmonic based);
  - directional interlock of the relay pick-ups depending on fault power flow direction (see Fig. 1);
  - additional interlocks configured by means of programmable controller;
  - pick-up / interlock of AR automation cycle;
  - switch-onto-fault protection after switch onto fault within AR cycle;
  - circuit-breaker close command interlock after relay operation.

  Setting ranges:

starting current	(0.2 ÷ 25.0)In in step of 0.1 In
time delay	(0 ÷ 5000) ms in step of 1 ms
time delay for switch-onto-fault function	(0 ÷ 2000) ms in step of 1 ms
coefficient of interlock against magnetizing current surge::	
- setting common for I>1, I>2, I>3	(17 ÷ 99) in step of 1
line characteristic angle :	
- setting common for I>1, I>2	(0 ÷ 360)° in step of 1°

- **Definite / Inverse time over-current protection (I>2) 50/51**
  enabling the User to choose measuring criterion for rms. value of the signal or rms. value of the 1st harmonic.
  In particular, it is intended for the accomplishment of:
  - instantaneous or time-delayed protections against phase-to-phase faults,
  - protections against operation overloads,
  - protective automation of bus-bars and switch-onto-fault protection dedicated to be used inincoming feedees and bus-bar coupler bays

  Setting ranges:

starting current	(0.2 ÷ 25.0) In in step of 0.1 In
time delay	(0 ÷ 60000) ms in step of 1ms
time delay for switch-onto-fault function	(0 ÷ 2000) ms in step of 1ms
coefficient of interlock against magnetizing current surge:	
- setting common for I>1, I>2, I>3	(17÷99) in step of 1
line characteristic angle :	
- setting common for I>1, I>2	(0÷360)° in step of 1°

  Additional functions (adjustable):
  - interlock preventing pick-ups of the relay caused by surges of magnetizing current (2nd harmonic based);
  - directional interlock of the relay pick-ups depending on fault power flow direction (see Fig. 1);
  - additional interlocks configured by means of programmable controller;
  - pick-up / interlock of AR automation cycle;
  - switch-onto-fault protection after switch onto fault within AR cycle;
  - circuit-breaker close command interlock after relay operation

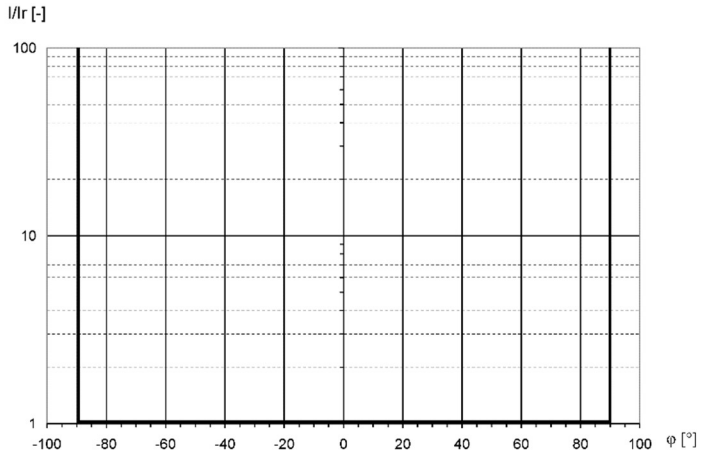


Fig.1. Operating characteristics of the I>1, I>2 protection functions with directional interlock mode (at line characteristic angle $\varphi = 0°$)

- **Definite / Inverse time overcurrent protection (I>3) 50/51**
  enabling the User to choose measuring criterion for rms. value of the signal or rms. value of the 1st harmonic. In particular, it is intended for the accomplishment of protections against operation overloads within MV/0.4 kV transformer bays as well as feeders, bus-bar coupler bays and capacitor battery bays.

  Setting ranges:

starting current	(0.20 ÷25.00) In in step of 0.01 In
time delay	(0 ÷ 60000) ms in step of 1 ms
coefficient of interlock against magnetizing current surge:	
- setting common for I>1, I>2, I>3	(17 ÷ 99) in step of 1

  Additional functions (adjustable):
  - interlock preventing pick-ups of the relay caused by surges of magnetizing current (2nd harmonic based);
  - additional interlocks configured by means of programmable controller;
  - circuit-breaker close command interlock after relay operation,

- **Inverse time overcurrent protection (I>4) 51**
  enabling the User to choose measuring criterion for rms. value of the signal or rms. value of the 1st harmonic. In particular, it is intended for the accomplishment of protections against phase-to-phase faults and operating overloads. Three types of inverse time characteristics enable to fit its operation time to requirements of outgoing feeders, incoming feeders, bus-bar coupler, capacitor battery and grounding transformer bays, as well as to ensure operation selectivity within wide-spread networks.

  Setting ranges:

starting current	(0.20 ÷ 5.00) In in step of 0.01 In
available timer modes:	
- definite time characteristics of the type D	(0 ÷ 60000) ms in step of 1 ms
- inverse time & current characteristics of the types A, B, C	acc. to the Standard PN-EN 60255-3:1999

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

where: t - theoretical operate time (in seconds)
I - measured current value
I_r - set starting curent value
α - constant determining type of characteristics in accordance with the description below
k_1 - constant value determining type of characteristics (in seconds) in accordance with the description below
k_2 - time multiplier

Type A - normal inverse time curve (k1= 0.14 s; α = 0.02; k2 = 0.05 ÷ 3.00 in step of 0.01)
Type B - very steep inverse time curve (k1= 13.5 s; α=1; k2 = 0.05 ÷ 3.00 in step of 0.01)
Type C - extremely steep inverse time curve (k1 = 80 s; α = 2; k2 = 0.05 ÷ 3.00 in step of 0.01)

Additional functions (adjustable):
- relay pick-up interlocks configured by means of programmable controller;
- circuit-breaker close command interlock after relay operation

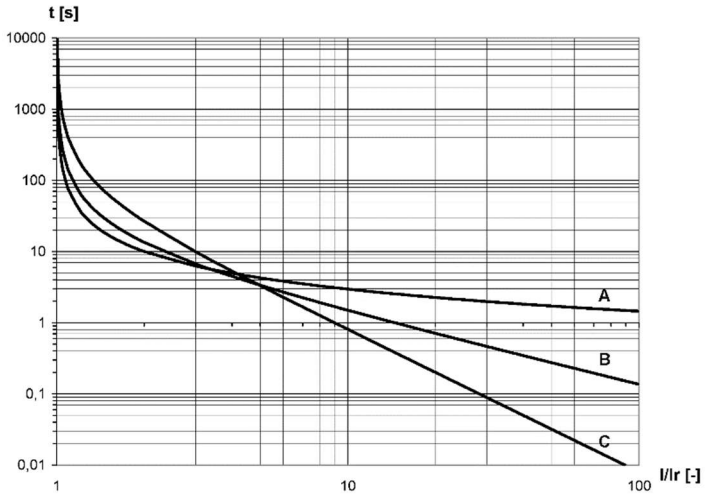


Fig. 2. Time and current operating characteristics of I>4 protection function (k2 = 1.00)

- **Ground-fault protection (Io)**
  Dedicated to detection of ground faults (among others intermittent faults) within networks with directly grounded or insulated neutral point and within compensated networks. It is possible to configure independent operation of four protection functions using different fault identification criteria. The protection functions can co-operate with Ferranti measuring transformer and Holmgreen-type measuring circuit.

Two-stage over-current inverse-time protection (Io1) 51N

Setting ranges:
starting current:
- I stage (100 ÷ 2500) mA in step of 1mA
- II stage (200 ÷ 5000) mA in step of 1mA

time-delay:
- I stage (100 ÷ 6000) ms in step of 1ms
- II stage (100 ÷ 3000) ms in step of 1ms

Additional functions (adjustable):
- relay pick-up interlocks configured by means of programmable controller;
- pick-up of AR automation cycle;
- circuit-breaker close command interlock after relay operation.

Ground overcurrent inverse-time protection (Io2) 51N

Setting ranges:

starting current	(10 ÷1000) mA in step of 1 mA
time delay	(100 ÷1000) ms in step of 1 ms

Start-up characteristics:

$$t = 2t_2\left(\frac{I_{or}}{I_o}\right)$$

where: I_{or} - starting curent value
I_o - ground current
t_2 - time-delay setting value at $I_o = 2I_{or}$

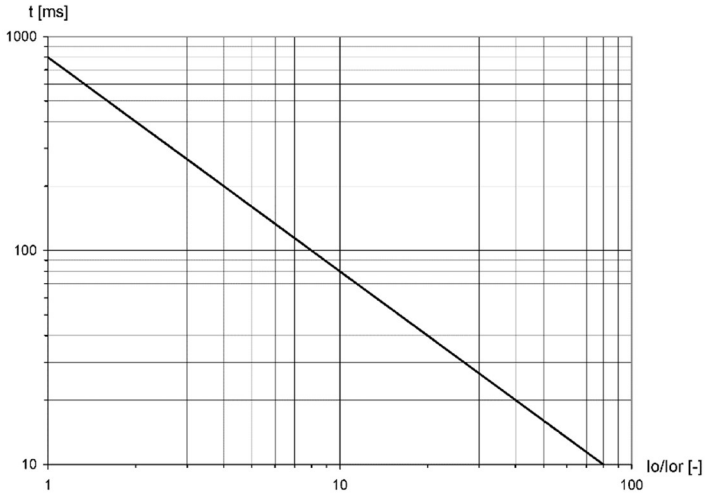


Fig. 3. Time and current operating characteristics of Io2 protection function (tr=400ms)

Additional functions (adjustable):
- operation interlock at a drop of the Uo voltage below the preset threshold value,
- additional interlocks configured by means of programmable controller;
- pick-up of AR automation cycle;
- circuit-breaker close command interlock after relay operation

Directional ground overcurrent protection (Io3) 67N

Setting ranges:

starting current	(10 ÷ 500) mA in step of 1 mA
minimum voltage	(1 ÷ 20) V in step of 1V
maximum sensitivity angle	(0 ÷ 90)° capacit. in step of 5°
time delay	(0 ÷ 3000) ms in step of 1 ms

Operating characteristic:

$$I_o \geq \frac{I_{or}}{\cos(\varphi_r - \varphi)} \qquad \text{at } U_o \geq U_{omin}$$

I_o - ground current
U_o - residual voltage
φ - phase shift angle between I_o and U_o
I_{or} - starting current value
U_{ormin} - minimum residual voltage setting value
φ_r - preset maximum sensitivity angle

Additional functions (adjustable):
- relay pick-up interlocks configured by means of programmable controller;
- pick-up of AR automation cycle;
- circuit-breaker close command interlock after relay operation

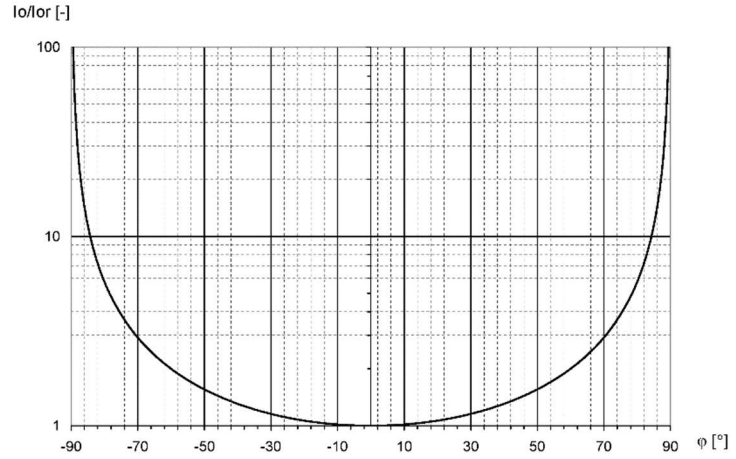


Fig. 4. Operating characteristics of Io3 protection function (φ_r = 0°)

Admittance-based ground fault protection (Yo) 21N

Setting ranges:

setting current	(10 ÷ 500) mA in step of 1 mA
minimum voltage	(1 ÷ 20) V in step of 1V
maximum sensitivity angle	(0 ÷ 90)° poj. in step of 5°
time delay	(0 ÷ 3000)ms in step of 1 ms

Operating characteristic:

$$Y \geq \frac{Y_{or}}{\cos(\varphi_r - \varphi)} \qquad \text{at } U_o \geq U_{omin} \qquad \text{where: } Y_{or} = \frac{I_{or}}{100V}$$

Y_{or} – starting admittance setting value
I_{or} – starting ground current setting value
U_o – residual voltage
U_{omin} – minimum residual voltage setting value
φ_r – maximum sensitivity angle (preset value)
φ – phase shift angle between ground current and residual voltage

Additional functions (adjustable):
- relay pick-up interlocks configured by means of programmable controller;
- pick-up of AR automation cycle;
- circuit-breaker close command interlock after relay operation

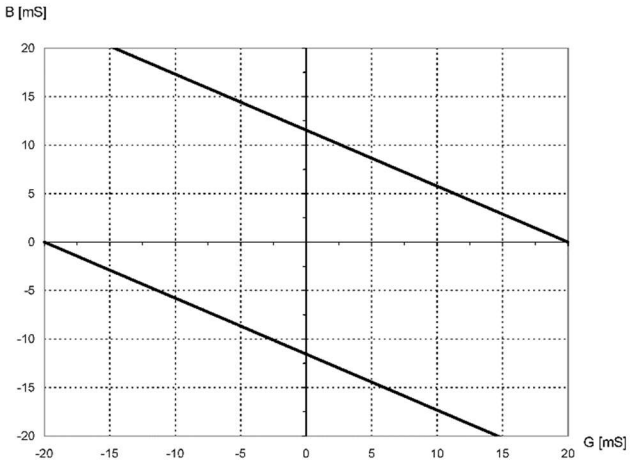


Fig. 5. Operating characteristics of Yo protection function (directional characteristics at $\varphi_r = 60°$)

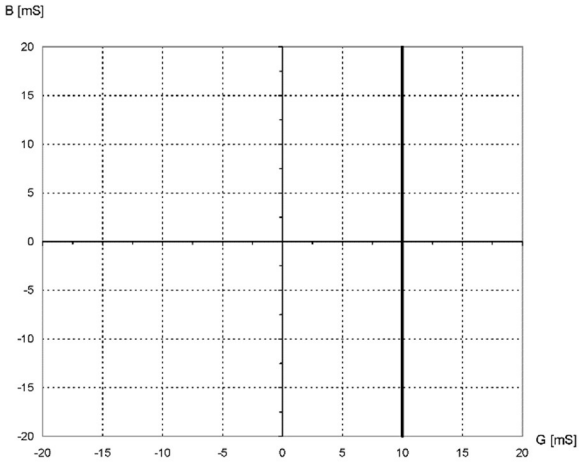


Fig. 6. Operating characteristics of Yo protection function (undirectional at $\varphi_r = 0°$)

- **Independent over / undervoltage protection functions (U1, U2) 27/59**

  CZAZ-U offers two independent relays configurable as over-voltage or under-voltage relays applicable within:
  - voltage measuring bays as collective under-voltage relay intended for protecting HV motors working within the given switchgear section,
  - MV / 0.4 kV transformer bays as under-voltage protection intended for protecting motor-type loads on LV side,
  - capacitor battery bays as over-voltage protection,
  - incoming feedres or voltage measuring bays as over-voltage protection intended for protecting outgoing feeders against voltage rise on MV bus-bars

  Setting ranges:

starting voltage	(0.10 ÷ 1.20) Un in step of 0.01 Un
time delay	(20 ÷ 60000) ms in step of 1ms

  Additional functions (adjustable):
  - additional interlocks configured by means of programmable controller
  - circuit-breaker close command interlock after relay operation

- **Independent ground overvoltage protection (Uo) 59N**
  Protecion energizing value is residual voltage and can be used as ground-fault protection operating within networks with insulated zero point or intended for co-operation with other protection functions, e.g. ground-fault protection Io2.

  Setting ranges:

starting voltage	(1 ÷ 100) V in step of 1V
time delay	(0 ÷ 60000) ms in step of 1ms

  Additional functions (adjustable):
  - additional interlocks configured by means of programmable controller
  - circuit-breaker close command interlock after relay operation

- **Independent over/underfrequency protection functions (f1 - f4) 81**
  CZAZ-U offers four independent protection functions configurable as under-frequency or over-frequency protections and applicable a.o. within voltage measuring bays in order to build a multi-stage under-frequency load shedding automation and auto-reclose after under frequency load shedding automation functions

  Setting ranges:

starting frequency	(45.0 ÷ 55.0) Hz in step of 0.1 Hz
time delay	(0 ÷ 60000) ms in step of 1 ms
blocking voltage	(0.10 ÷ 0.80) Un in step of 0.01 Un

  Additional functions (adjustable):
  - additional interlocks configured by means of programmable controller;
  - pick-up interlock of the protection functions if phase-to-phase voltage is below the preset value;
  - circuit-breaker close command interlock after relay operation

- **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 occerance of:
  - powerful light-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

- **External protections ET1 ÷ ET4**
  These four protection functions are intended for co-operation with protection automation system accomplished beyond the CZAZ-U 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

- **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.

- **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

- **Voltage memory circuit**
  Enables co-operation with against-fault protection functions (I>1, I>2) under active directional mode.

- **Co-operation with bus-bar and line disconnectors**
  - position monitoring,
  - faulty position signaling,
  - control of disconnectors available via programmable logic.

  Non-typical power distributing systems can co-operate with additional breakers 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.

- **AR auto-reclose function**
  The auto-reclose automation function (AR) constitutes a logic operators and timers cooperating with the pre-selected protection functions, and with an output circuit forming close pulse of the circuit-breaker.

  Settings:
  Number of operations within single AR cycle (1 ÷ 5)
  The AR cycle is activated by pick-up of protectionfunctions I>1, I>2, Io2, Io3, Yo

  Time delay setting range (0 ÷ 20000) ms in step of 1 ms
  The timer is intended for for confirmation of the circuit-breaker position change (opening after operation of protection relay, or reclosing within the given AR auto-reclosing cycle) as well as for re-opening after re-closing within the given AR auto-reclosing cycle in the case of uncleared short-circuit.

  Outage time setting range (100 ÷ 20000) ms in step of 1 ms
  The outage time is counted after opening of the circuit-breaker caused by operation of the relay and finished by a pulse sent in order to close the circuit-breaker. This time period is set individually for each attempt of re-closing the circuit-breaker within the given AR cycle.

  Additional functions:
  - operation speed-up of the I>1 and I>2 protection functions within AR cycle

  The AR automation is blocked due to:
  - pick-up of overcurrent protection function I>1,
  - faulty position or uncharged condition of the circuit-breaker,
  - the set time in the range of 0 ÷ 20 s in step of 1 ms after each close operation of the controlled line initiated by means of the CZAZ-type controller or by means of a supervision system via serial interface or resulting from operation of the AR auto-reclosing after Under Frequency Load Shedding (AR after UFLS) system,
  - the signal configured within the programmable logic.

- **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. 7) 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

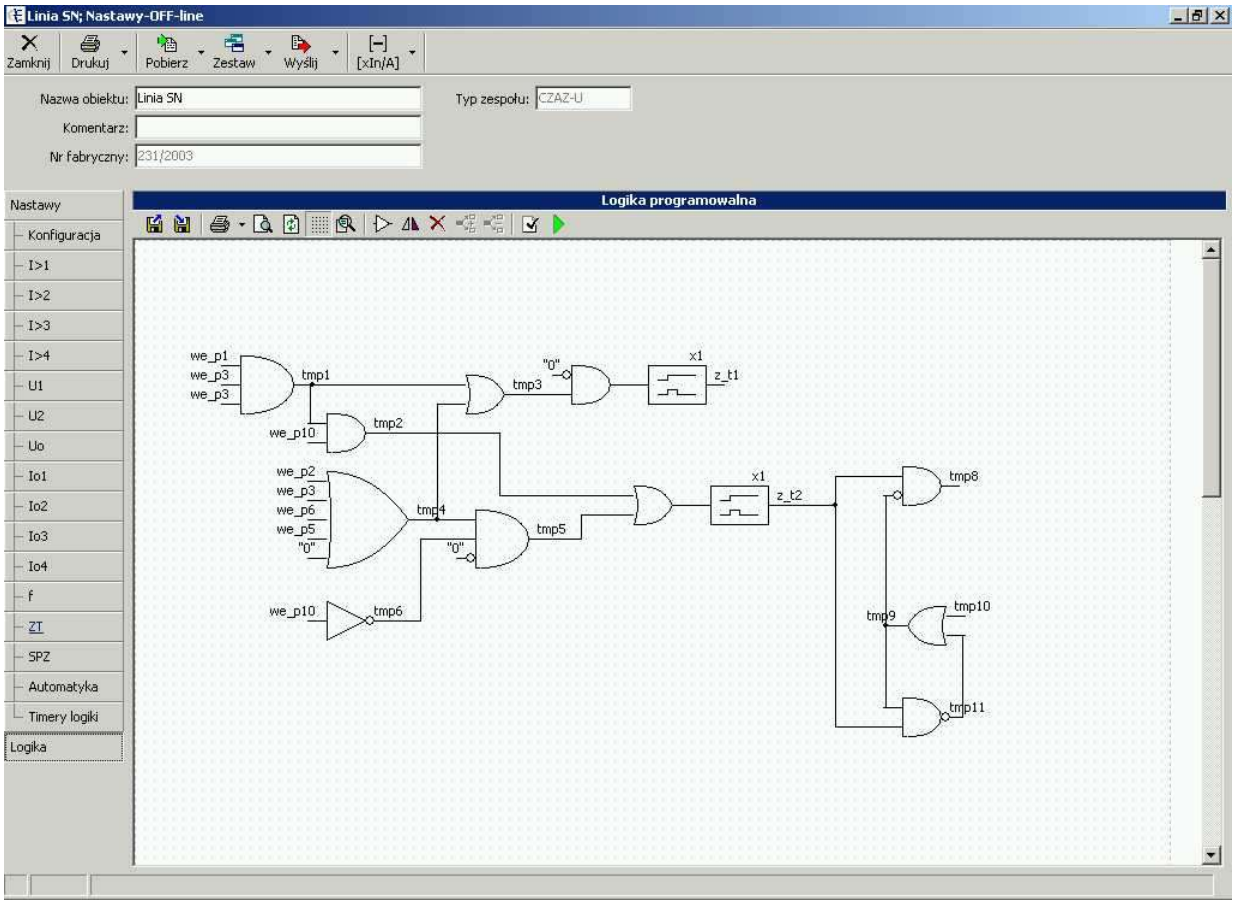


Fig. 7. Screen-shot example of the SMIS interface

5. OTHER NON-PROTECTION FUNCTIONS

5.1 MEASUREMENTS

During its operation, the relay measures such magnitudes as:

PHASE CURRENT L1	- rms. value of the current fundamental component in the phase L1.
PHASE CURRENT L2	- rms. value of the current fundamental component in the phase L2,
PHASE CURRENT L3	- rms. value of the current fundamental component in the phase L3,
RMS. VALUE	- rms. value of the maximum phase current,
GROUND-FAULT CURRENT	- rms. value of the ground current,
VOLTAGE Uo	- rms. value of the residual voltage,
PHASE-TO-PHASE VOLTAGE	- rms. value of the fundamental component of the lowest phase-to-phase voltage,
FREQUENCY	- current frequency value,
ACTIVE POWER	- current value of the active power,
REACTIVE POWER	- current value of the reactive power,
ACTIVE POWER P15	- average value of the active power from the last 15 minutes
REACTIVE POWER Q15	- average value of the reactive power from the last 15 minutes.,
ENERGY	- current value of the active energy,
POWER COEFFICIENT	- current value of the power factor
DIRECTION	- power flow direction for each phase

Measuring cycle repetition time is 100 ms. The measuring result is given as primary quantity.

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. 8.

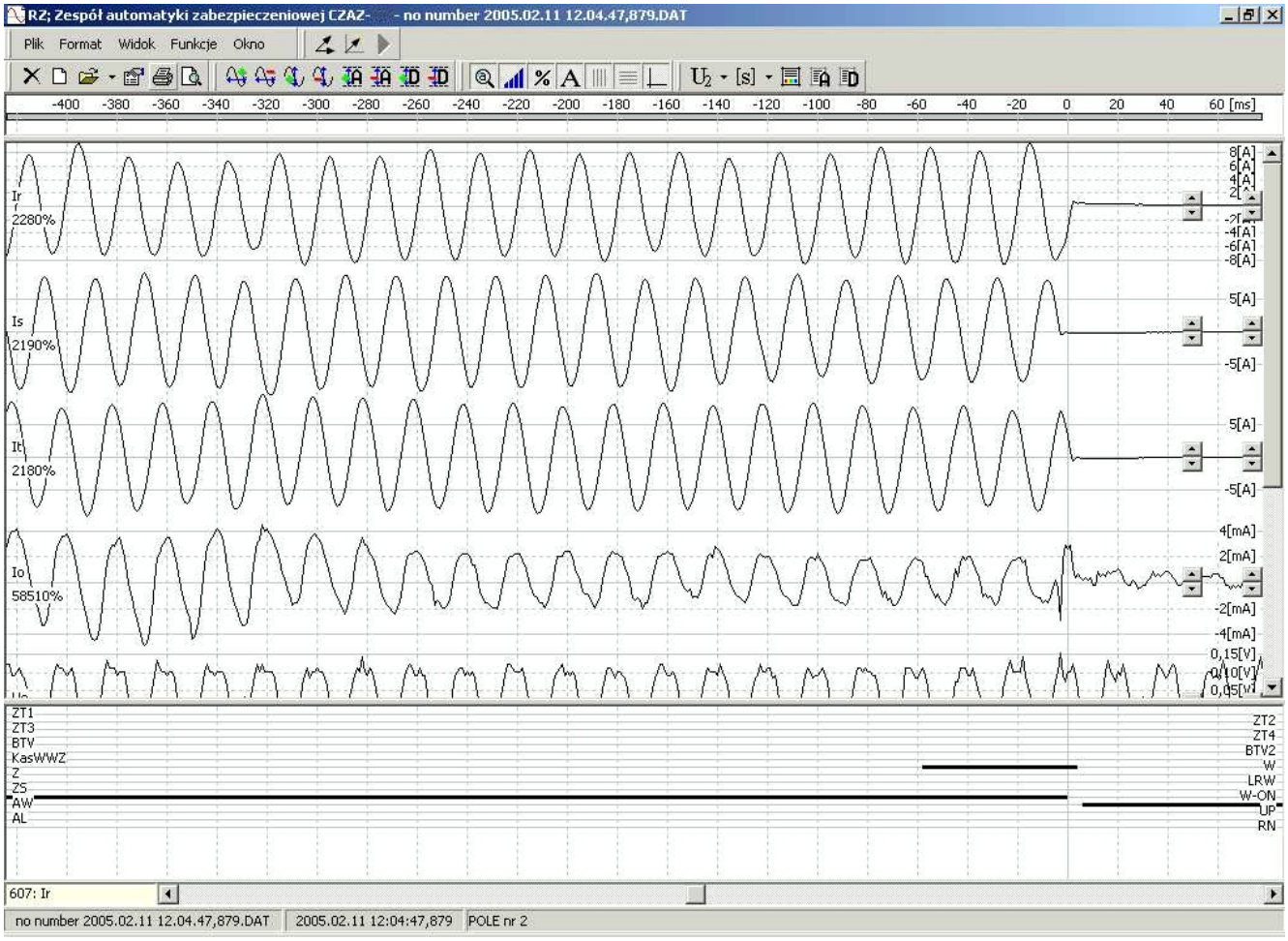


Fig. 8. Screen-shot: example of multifunction browser of signals recorded by disturbance rocerder

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

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. 7, 8 and 9.

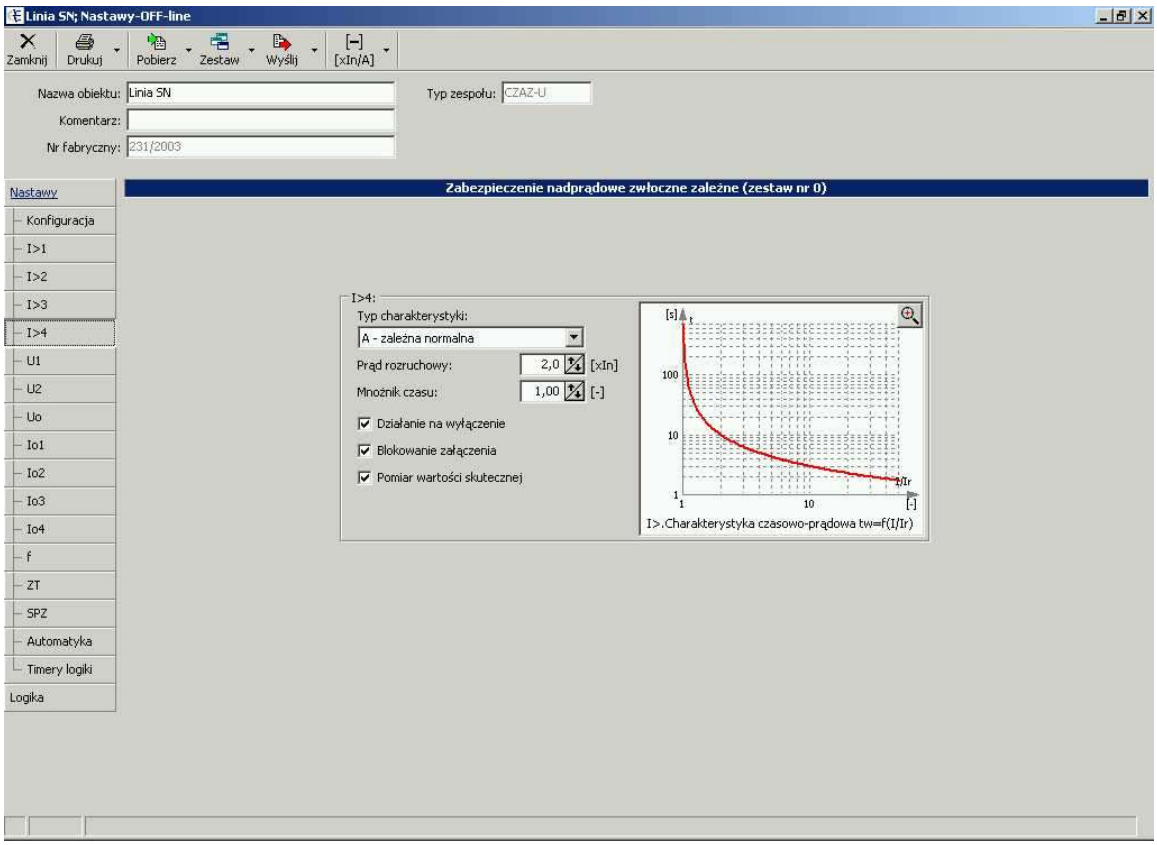


Fig. 9. Example screen-shot of the SMIS program

9. WIRING DIAGRAM

External connection diagrams are presented on Fig. 10 and described in Table 1.
The binary inputs are described in their active condition (i.e. after supplying voltage on the input terminals).
The relay outputs are described in their unergized condition.

Fig. 10. CZAZ-U – Wiring diagram (Legend):

Polski	**=**	**English**
SN	=	MV (Medium Voltage)
nn	=	LV (Low Voltage)
COM1 (opcja)	=	COM1 (optional)
Wyjścia programowalne	=	Programmable outputs
Wejscia programowalne	=	Programmable inputs
Kasowanie BLZ	=	Reset of BLZ
Kasowanie WWZ	=	Reset of WWZ
Wyłączenie operacyjne Wop	=	Operating trip Wop
Załączenie operacyjne Zop	=	Operating make Zop
Napięcie pomocnicze zasilające Up	=	Auxiliary supply voltage Up
Napięcie sterownicze Us	=	Control voltage Us

Table 1. Terminals of CZAZ-U description

Terminal No.	Contact No.	**Signal description**	**Remarks**
1	**2**	**3**	**4**
X1	1-4	measuring current of phase L1	-
	2-5	measuring current of phase L2	-
	3-6	measuring current of phase L3	-
	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
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

⊕ / ⊖ Up – auxiliary supply voltage; ..... / ..... – control voltage

* - 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 two-state input in the active state (after applying voltage to input terminals). Description of relay outputs in non-voltage state.

10. CONSTRUCTION

The relay is housed in the BOPLA-type case adapted for assembly on the operator control board (surface-mounting case – see Fig. 11) or behind it (flush-mounting case – see Fig.12). The input measuring circuits are conducted via screw-less connectors enebling to connect wires with a cross-section up to 4 mm^2. The remaining circuits are led via pin connectors enabling to connect wires with 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 DIMENSION DRAWINGS

Surface-mounting case

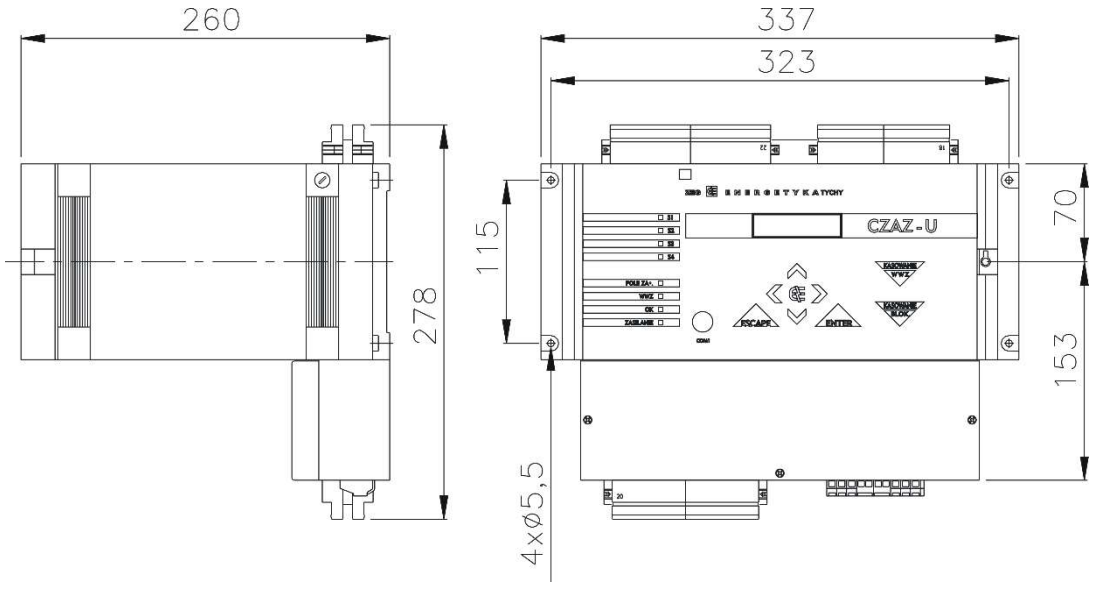


Fig.11. Rear and side view of the surface-mounting case – dimension drawing

Flush-mounting case

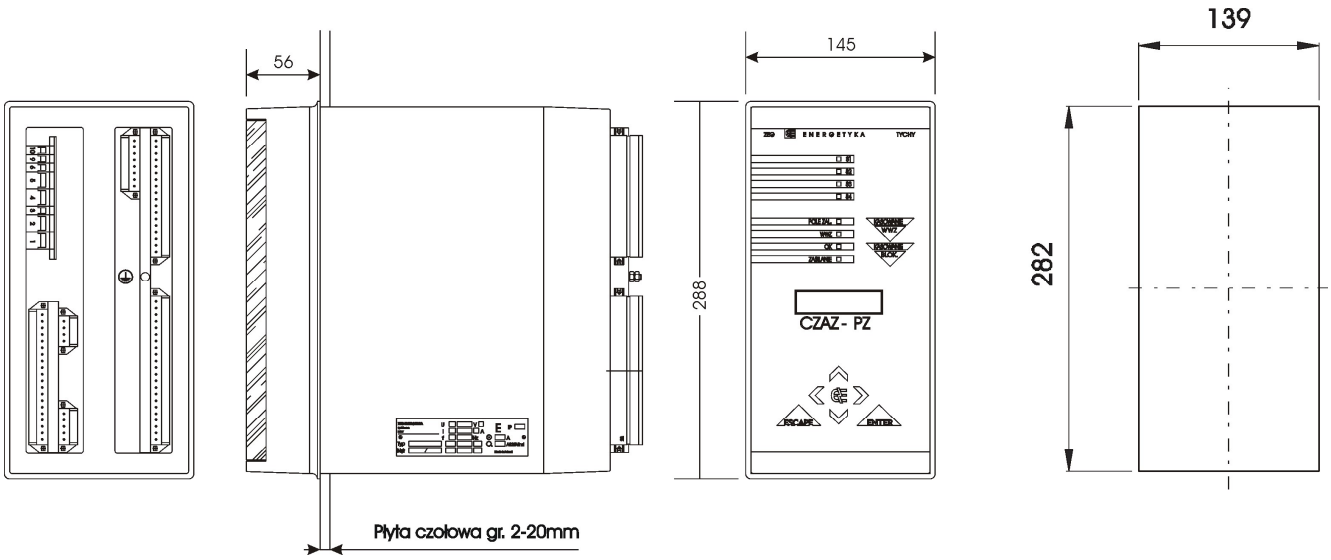


Fig.12. Front, rear and side view of flush-mounting case – dimension drawing

Front panel 2 – 20 mm thick;

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. CONFORMITY WITH REQUIREMENTS OF STANDARDS

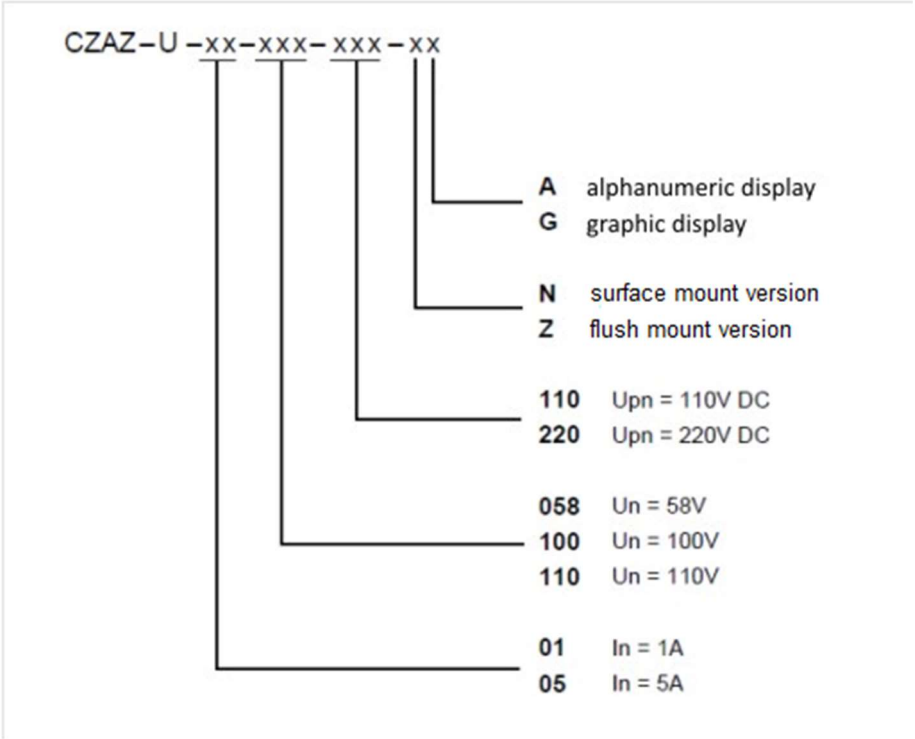
• **Electromagnetic compatibility (EMC)**	PN-EN 50263:2004
• **Insulation**	PN-EN 60255-5:5
• **Others**	PN-86/E-88600
	PN-EN 60255-3:1999
	PN-EN 60255-6:2000
	PN-EN 60255-25:2002
	PN-EN 61000-4-2:1999
	PN-EN 61000-4-3:2003
	PN-EN 61000-4-4:1999
	PN-EN 61000-4-5:1998
	PN-EN 61000-4-6:1999
	PN-IEC 255-11:1994

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.

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 - U - 05 - 100 - 220 - NG+**
- **CZAZ-U** featuring**:** In=5A, Un=100V, Upn=220V DC, housed in surface-mounting case, version with graphic display

15. COMPANY ADDRESS:

ZEG-Energetyka Sp. z o.o.
ul. Fabryczna 2, 43-100 Tychy
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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