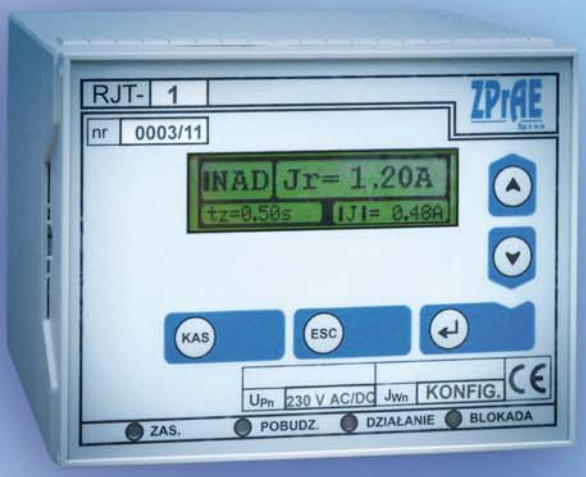
ZPrAE Sp.z o.o.

REline® ENERGETIC STANDARDS



RJT-1

TIME - CURRENT DC

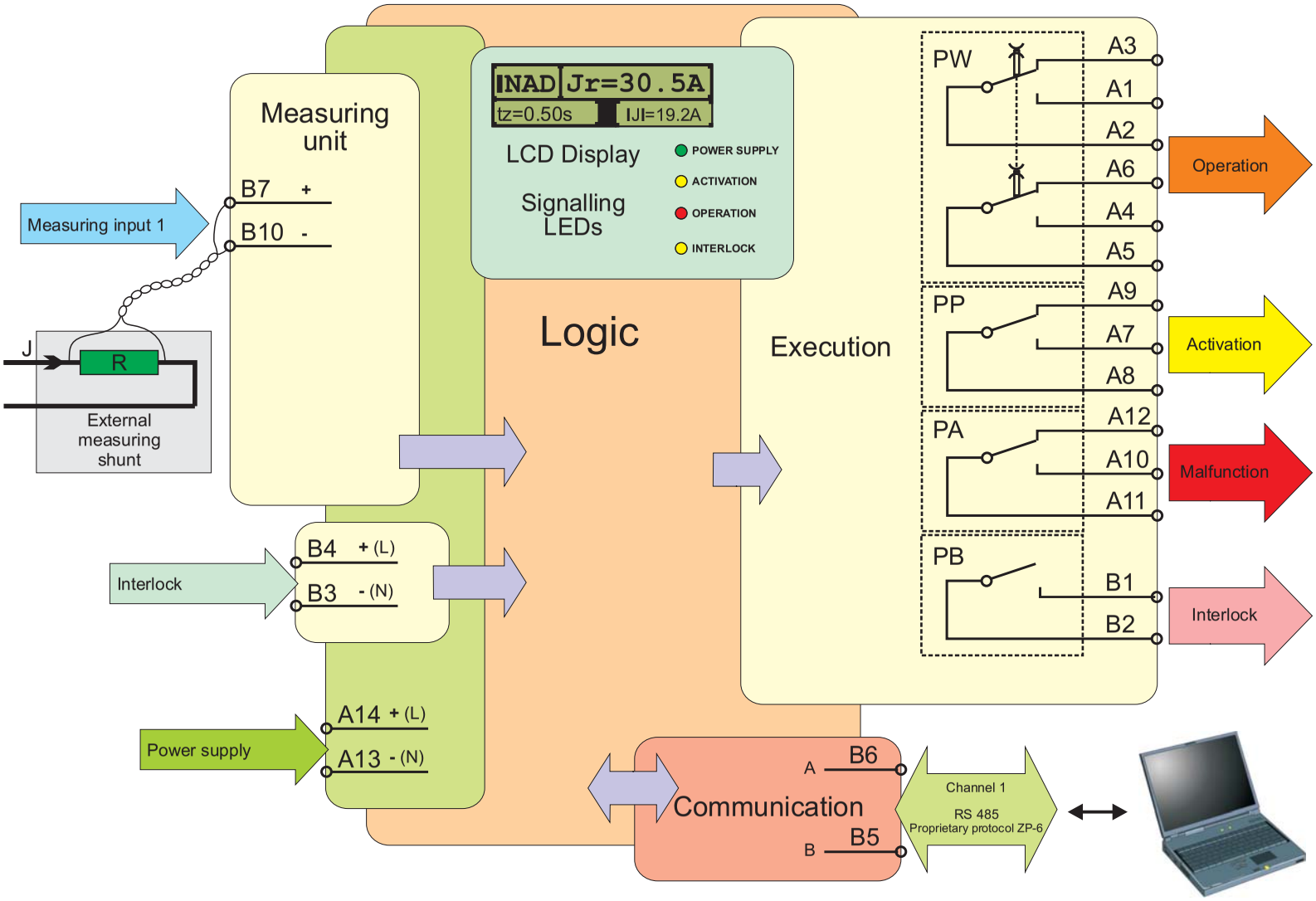


Fig. 1. Structural diagram of RJT-1 relay.

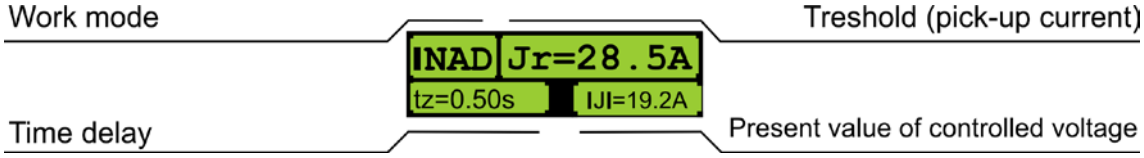
APPLICATION

The RJT-1 relays are meant for use in the automation and protection circuits as a current monitoring element with a programmable time delay and depth of hysteresis (absolute value of a difference between pickup and drop-off current). The relay is designed for cooperation with shunt resistors of 0.6 A ÷ 600 A rated current and 50 mV ÷ 150 mV rated voltage. The relays enable the following work modes:

1. **POD-PRD** – operation after identifying decrease of controlled current below set value (Time-delay under-current protection);
2. **NAD-PRD** – operation after identifying increase of controlled current over set value (Time-delay over-current protection);
3. **KPW** – operation when controlled current is within a set range (Time-delay within-range protection),
4. **KPZ** – operation when controlled current is beyond a set range (Time-delay out of-range protection),

CONSTRUCTION

The RJT-1 relay has one isolated measuring input, and controls values of direct current DC by measuring drop of voltage on a measuring shunt. Current level detector controls values of current measured, and the steering system executes programmed functions basing on information from the detector, and state of the input blockade. The relay has one instantaneous changeover contact of the starting relay (PP), two programmable time-delay changeover contacts of the final controlling relay (PW), one make contact of the relay signalling internal fault or lack of power supply (PA) and one make contact of a relay signalling activation of a blockade (PB). The RJT-1 relay is mounted in a housing, sizes 110 × 100 × 77 mm, with 28 terminations in a form of 2 plugs, suitable to be mounted in typical GZ-14 sockets (plate-mounting), GZ-14U (bus-mounting) or GZ14Z – to be mounted in a relay chassis R8614Z type. Dimensions of the relay are presented on Picture 15.
An LCD display, enabling preview of status and configuration, is located on the front panel



of the relay.

Communication with the user is ensured with five buttons, enabling:

	Settings preview (available in „PRACA” mode) Setting up values (available in „PROGRMOWANIE” mode)
	One step back (exit)
	Entering another level (confirmation) Confirmation of settings (available in „PROGRMOWANIE” mode)
	Reset (confirmation of operation)

Four LED diodes are located on the front panel, signalling the following:

LED	Turned off	Continuous Light	Blinking Light
ZAS. *(green)*	RJT-1 has no power supply	RJT-1 has power supply	----------
POBUDZ. *(yellow)*	RJT-1 is not and has not been activated, and the PP relay is not and has not been operating since the last reset or loss of power supply.	RJT-1 i is activated, and the PP relay is operating	RJT-1 is not activated, but the PP relay was operating. The POBUDZ diode is blinking till manual reset or loss of power supply.
DZIAŁANIE *(red)*	RJT-1 is not and has not been activated, and the PW relay is not and has not been operating since the last reset or loss of power supply.	RJT-1 is or was activated and operating, and the PW relay is operating	RJT-1 is not activated, but the PW relay has been in operation. The D diode is blinking till manual reset or loss of power supply.
BLOKADA *(yellow)*	RJT-1 is not locked	RJT-1 has power voltage and is locked	----------

The structural scheme of the RJT-1 is presented on picture 1.

OPERATION

When supply voltage is applied the relay is ready for work accordingly to chosen operating mode. Execution of all four operating modes is ensured by independent set up of working parameters:
For work modes **POD-PRD** - time-delay under-current protection, and **NAD-PRD** - time-delay over-current protection (with and without control of current direction) the following parameters can be configured:

- Pick-up current **Jr** (current to operate),
- hysteresis **Jh** (depth of the current hysteresis)
- delay time **tz** (delay time to operate)
- work mode of PW relay (operation of the PW relay with hold up **ZP**, and without hold up **BP**)
- averaging filter (elimination of random interferences)

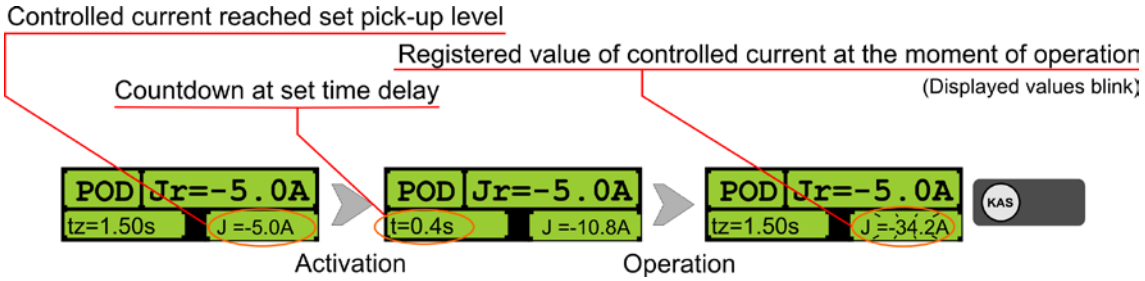
For work modes **KPW** - time-delay within-range protection, and **KPZ** - time-delay out of-range protection (with and without control of current direction) the following parameters can be configured:

- upper threshold **G** (upper threshold of current to operate),
- bottom threshold **D** (bottom threshold of current to operate)
- hysteresis **Jh** (depth of the voltage hysteresis)
- delay time **tz** (delay time to operate)
- work mode of PW relay (operation of the PW relay with hold up **ZP**, and without hold up **BP**)
- averaging filter (elimination of random interferences)

The RJT-1 relay controls value of direct current by measuring voltage drop on a measuring shunt. Rated current (J_{Wn}) of the measuring shunt used, as well as its voltage drop (U_{bn}) for given rated current are to be given in the setup of the relay for each measuring shunt. Changing parameters of the shunt resistor will result with setting up default values of remaining parameters:

- Type of work ▌ NAD-PRD
- Starting current: Jr = 0.8 J_{Wn}
- Upper threshold: G = 1.2 J_{Wn}
- Bottom threshold : D = 0.8 J_{Wn}
- Hysteresis: Jh = 1 A (for J_{Wn} – 60 ÷ 600 A) Jh = 0.1 A (for J_{Wn} 6 – 59 A) Jh = 0.01 (for J_{Wn} – 0.6A ÷ 5.9 A)
- Delay time: tz = 0.5 s
- Work mode of PW relay: PW-BP
- Averaging filter: „OFF”

In case of detection of pick-up current the PP relay is activated, and POBUDZ. LED turns on with permanent light signalling its activation. Countdown of the set delay time begins simultaneously.



During the countdown symbol “tz” changes into “t”. At the same time effective value of controlled current (input current) is displayed. At the moment of activation they are saved, and displayed cyclically until button KAS is pushed.

In each work mode the PP relay is energised for as long, as activation lasts. If during countdown of time “tz” the activation is lost the POBUDZ. diode turns into blinking light, and the PP relay drops-off. If the activation lasts longer than “tz” the PW relay is activated and the diode DZIAŁANIE lights up. The PW relay may operate in two programmed work modes – with or without hold up. In the hold-up mode (PW-ZP) the PW relay is held up until reset with KAS button, in the non-hold up mode (PZ-BP) the PW relay is activated only for as long as the activating pulse lasts. If the activation decays after operation of the PW relay the diodes marked DZIAŁANIE and POBUDZ. change light into blinking. This state lasts till moment of manual reset. Activation of the relay ends when all controlled currents return to values not exceeding the set pick-up values. The difference between pick up current and release current is called hysteresis (Jh) and is programmable.

Additionally, in any moment of time it is possible to interlock activity of the PW relay by application of voltage on terminations B3/B4 of the relay. The blocked status is signalled with continuous light of BLOKADA diode.

The RJT-1 is equipped with an averaging filter with programmable averaging time T, which enables elimination of accidental pick-ups resulting from interferences in controlled inputs lasting no longer than 0,5T. Turing on the averaging filter results with longer response time of the relay by 0,5T ±20 ms.

Changing of the work mode results with changing of all settings to their default values:

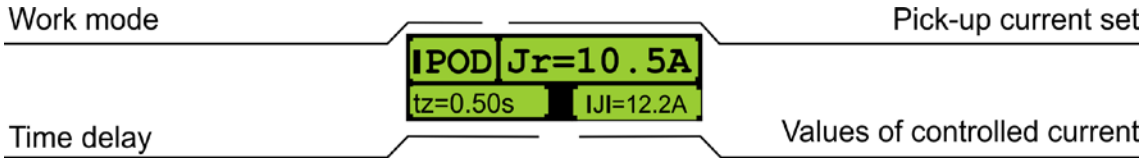
- Pick-up current: Jr = 0.8 J_{Wn}
- upper threshold: G = 1.1 J_{Wn}
- bottom threshold: D = 0.8 J_{Wn}

- Hysteresis: Jh = 1 A (for J_{Wn} = 1 A) or Jh = 0.1 A (for J_{Wn} = 5 A)
- Delay-time: tz = 0.5 s
- work mode of the PW relay: PW-BP
- averaging filter: „OFF”

AVAILABLE WORK MODES

POD-PRD – time-delay under-current protection without current direction control.

The relay controls value of current flowing through the shunt resistor and activates after detecting decrease of controlled current below set value (regardless its direction), and operates with a specified time delay. Information on chosen work mode, starting current Jr, and time delay tz as well as present values of effective input current are presented in real time on a display.



The below diagram presents working algorithm of the relay after detecting decrease of controlled voltage below set value.

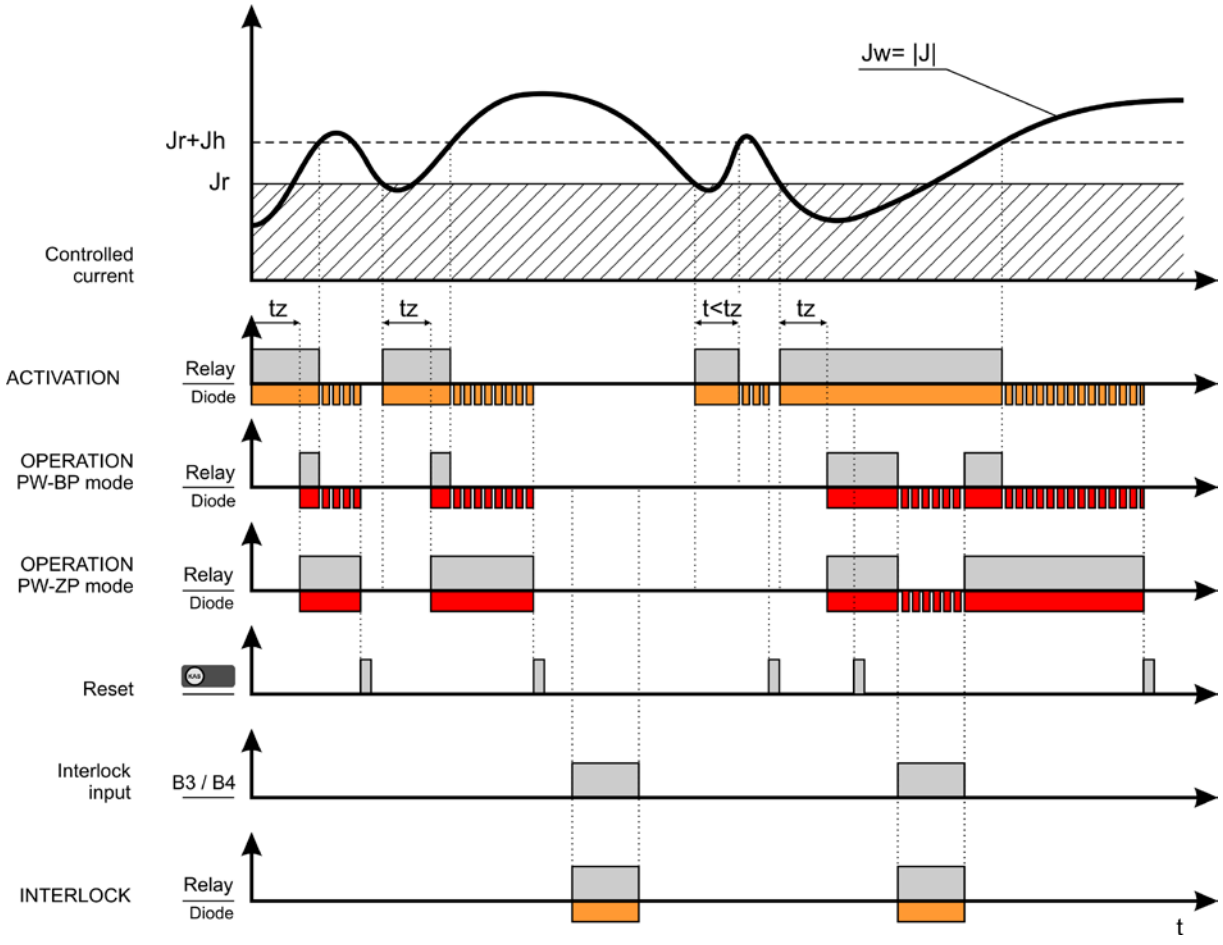
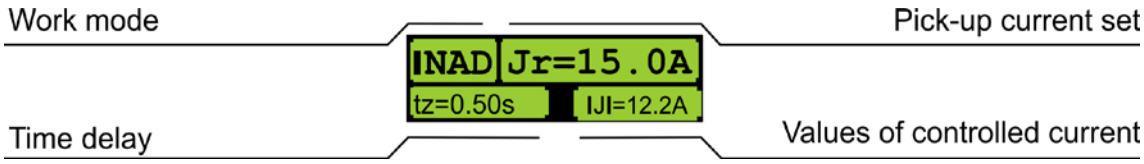


Fig 2. Operation of the relay for the POD-PRD working mode

NAD-PRD time-delay over-current protection without current direction control.

The relay controls value of current flowing through shunt resistor and activates after detecting increase of controlled current over set value (regardless its direction), and operates with a specified time delay. Information on chosen work mode, pick-up current Jr, and time delay tz as well as present values of effective input current are presented in real time on a display.



The below diagram presents working algorithm of the relay after detecting increase of controlled current over set value.

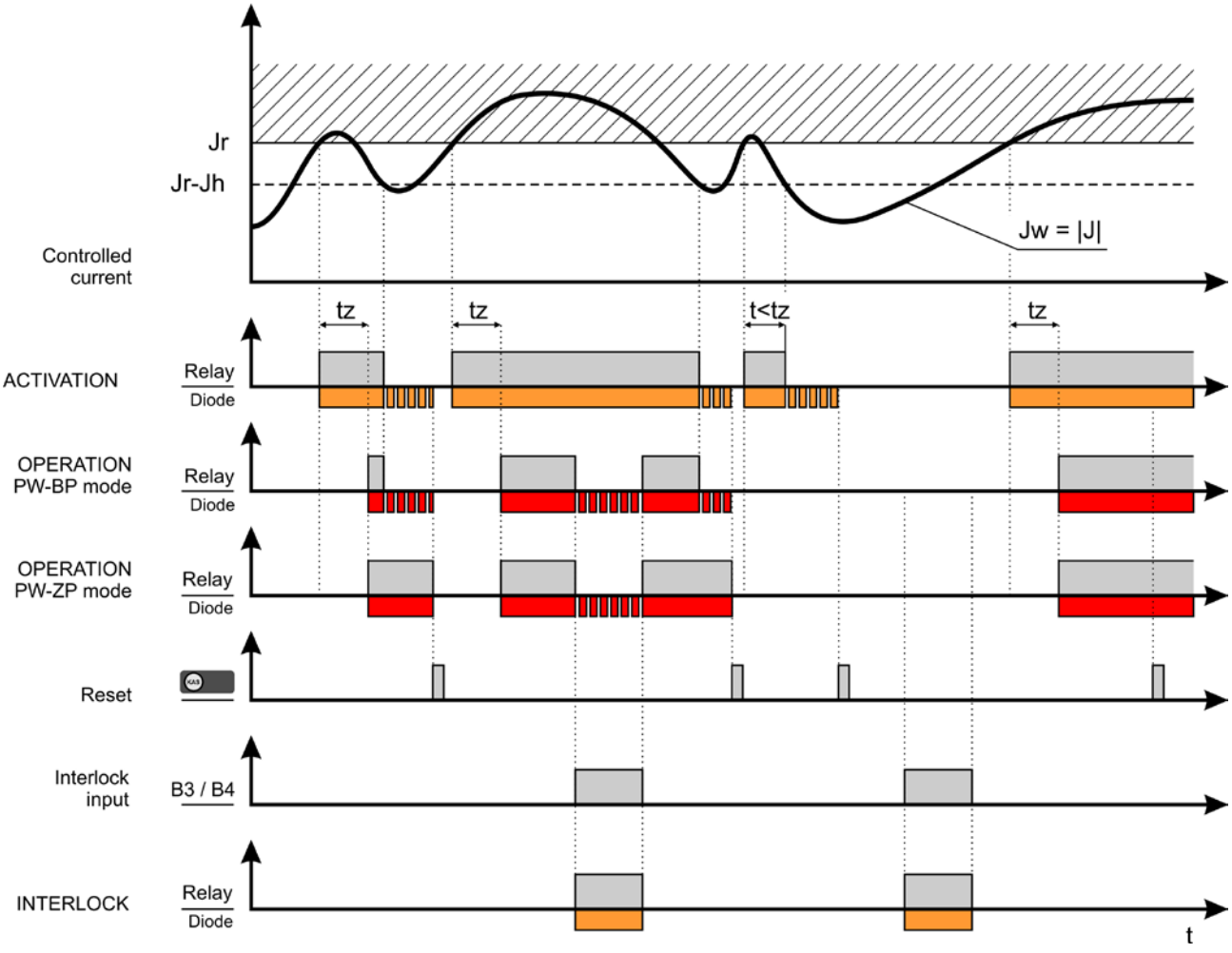
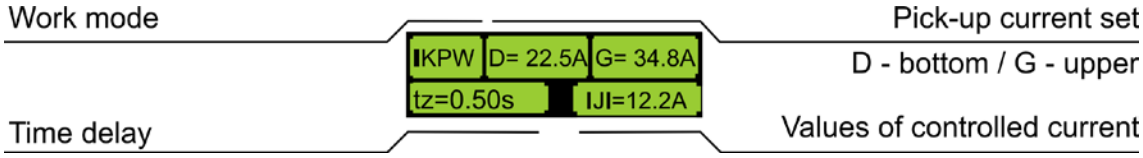


Fig 3. Operation of the relay for the NAD-PRD working mode

KPW –time-delay within-range protection without current direction control.

The relay controls value of current flowing through shunt resistor and activates when absolute value of controlled current is within a defined range, and operates with a specified time delay. Information on chosen work mode, set values of pick-up currents D (bottom threshold), G (upper threshold), and time delay tz as well as present value of controlled current are presented in real time on a display.



The below diagram presents working algorithm of the relay when value of controlled current is within a defined range.

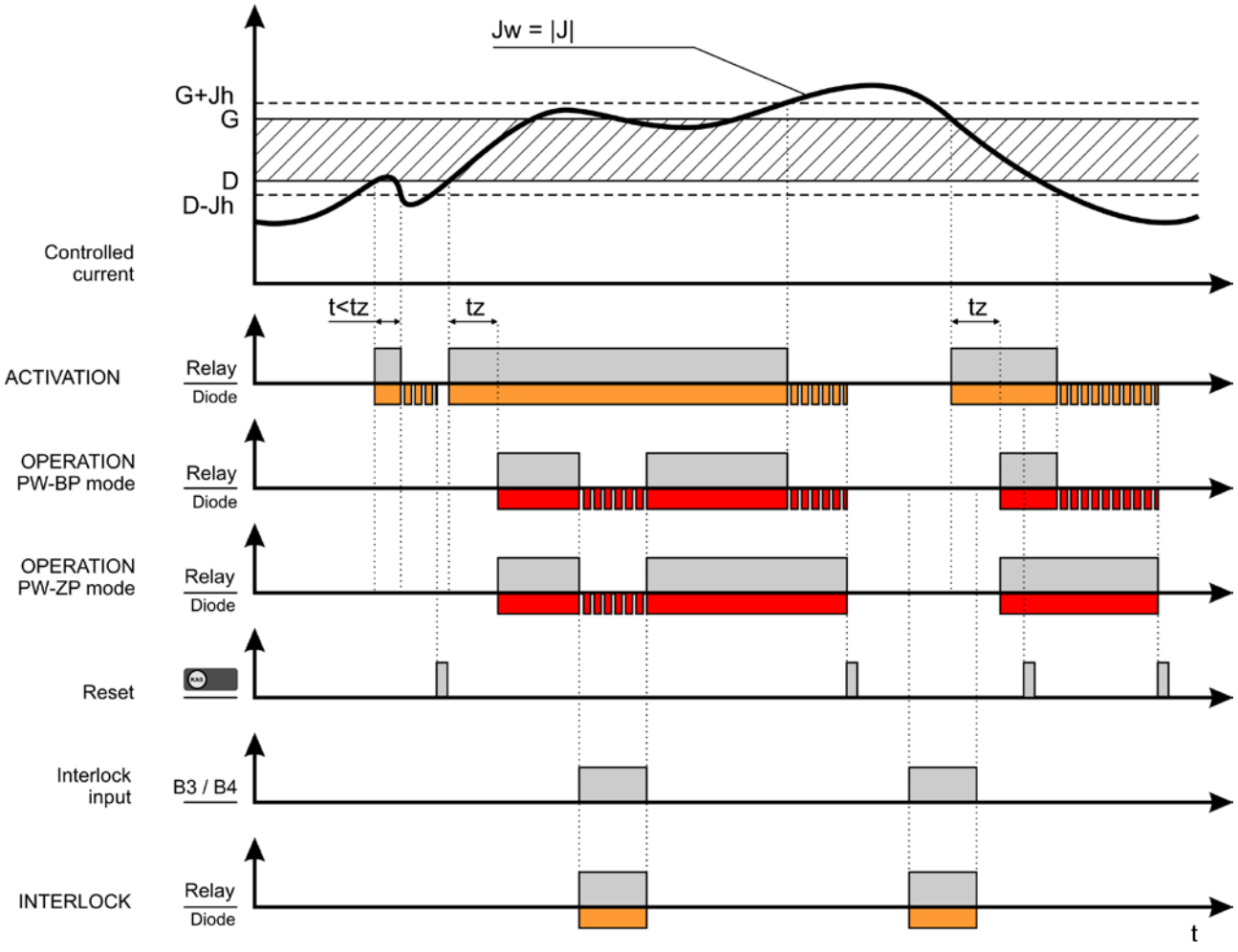
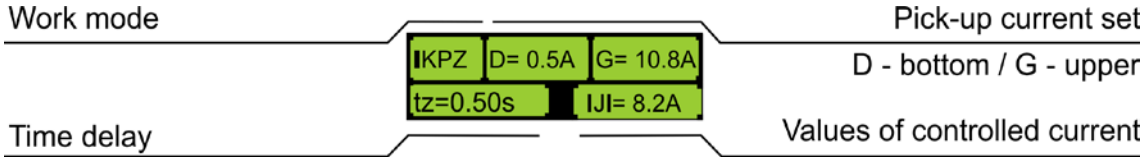


Fig 4. Operation of the relay for the KPW working mode

KPZ time-delay out of-range protection without current direction control.

The relay controls value of current flowing through shunt resistor and activates when absolute value of controlled current is outside of a defined range, and operates with a specified time delay. Information on chosen work mode, set values of pick-up currents D (bottom threshold), G (upper threshold), and time delay tz as well as present value of controlled current are presented in real time on a display.



The below diagram presents working algorithm of the relay when value of controlled current is outside a defined range.

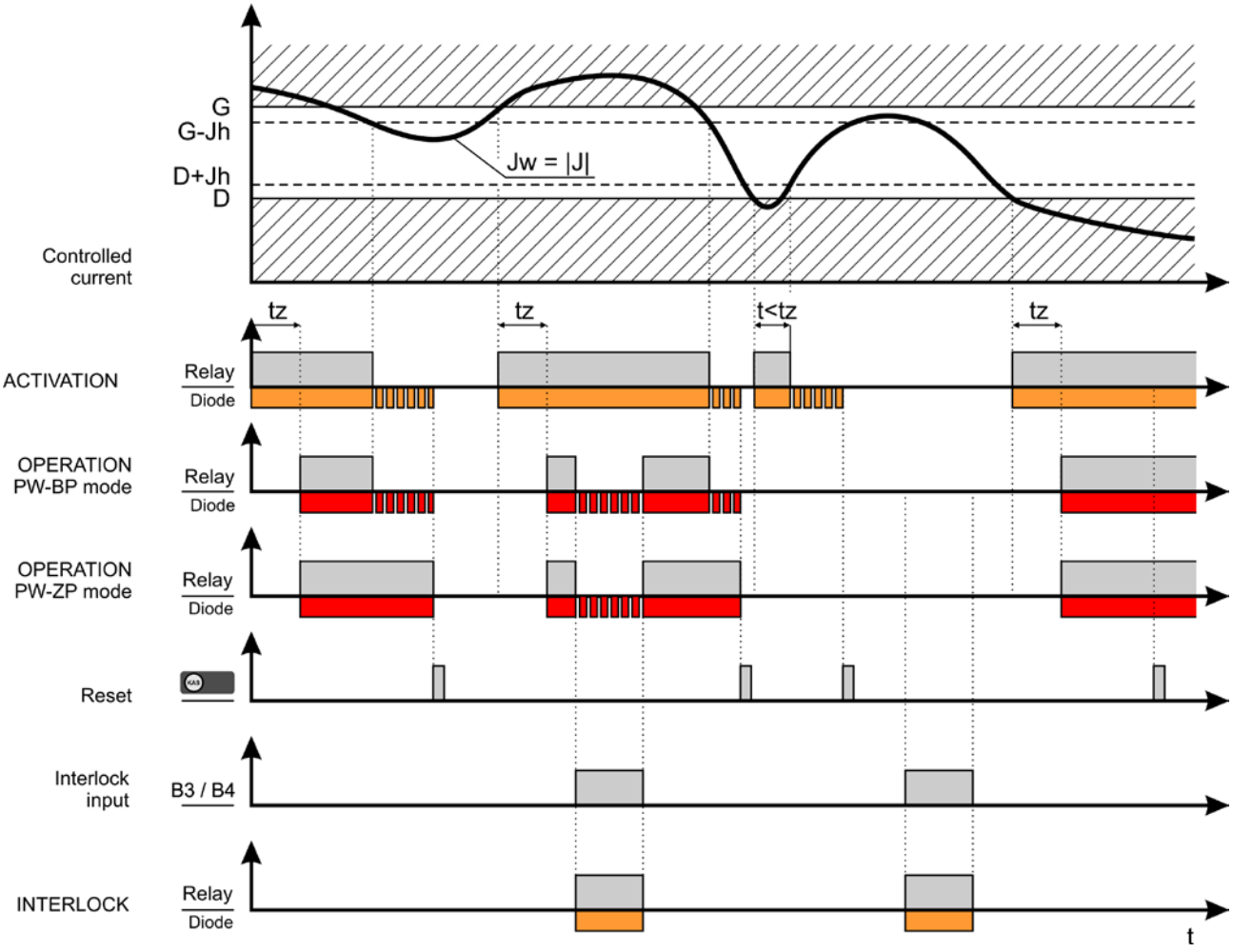
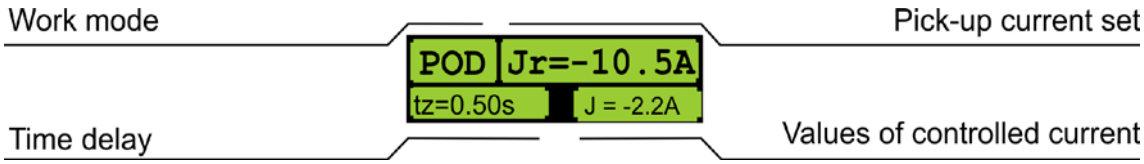


Fig 5. Operation of the relay for the KPZ working mode

POD-PRD – time-delay under-current protection with current direction control.

The relay controls value of current flowing through shunt resistor and activates after detecting decrease of controlled current below set value, and operates with a specified time delay. Information on chosen work mode, pick-up current Jr, and time delay tz as well as present values of effective input current are presented in real time on a display.



The below diagram presents working algorithm of the relay after detecting decrease of controlled voltage below set value.

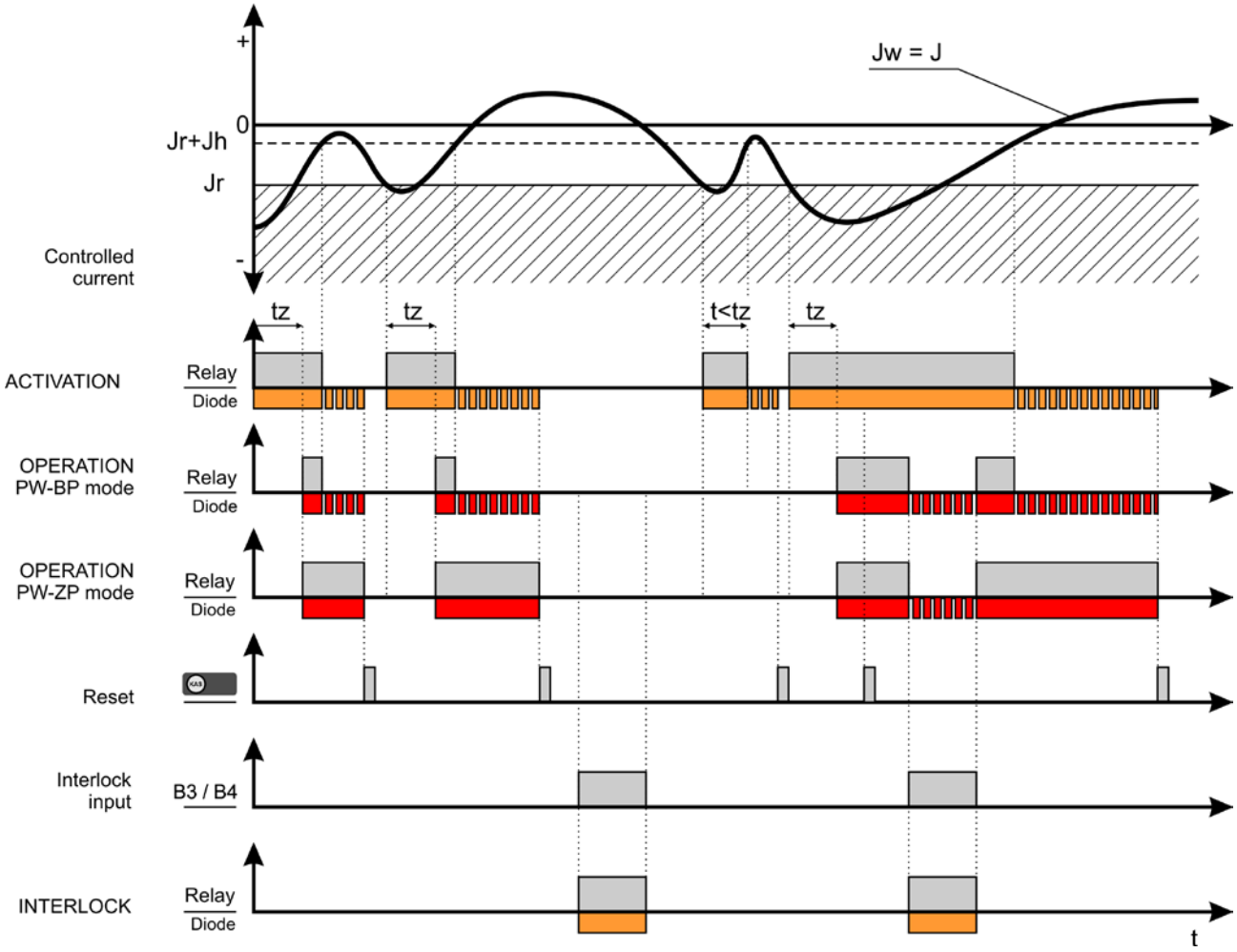
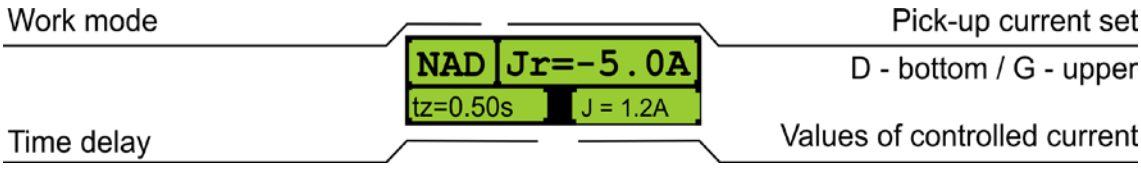


Fig 6. Operation of the relay for the POD-PRD working mode

NAD-PRD time-delay over-current protection with current direction control.

The relay controls value of current flowing through shunt resistor and activates after detecting increase of controlled current over set value, and operates with a specified time delay. Information on chosen work mode, pick-up current Jr, and time delay tz as well as present values of effective input current are presented in real time on a display.



The below diagram presents working algorithm of the relay after detecting increase of controlled current over set value.

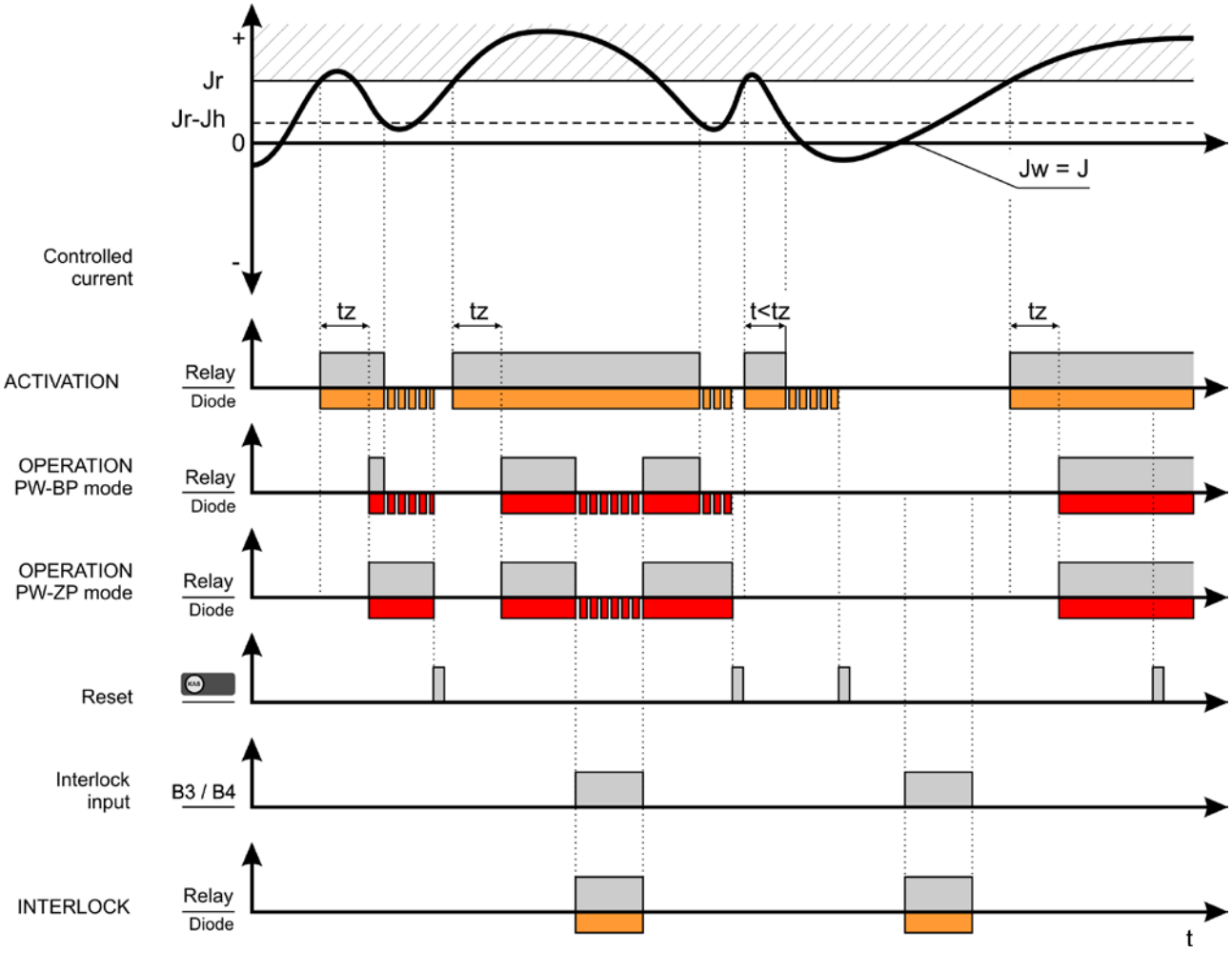
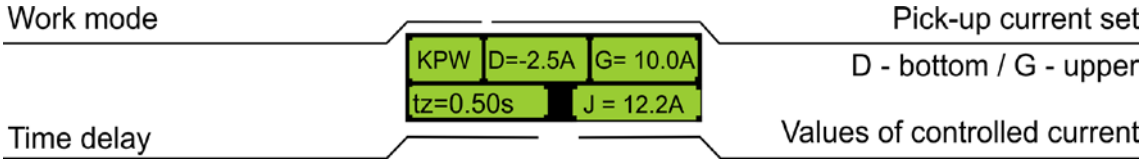


Fig 7. Operation of the relay for the NAD-PRD working mode

KPW –time-delay within-range protection with current direction control.

The relay controls value of current flowing through shunt resistor and activates when value of controlled current is within a defined range, and operates with a specified time delay. Information on chosen work mode, set values of pick-up currents D (bottom threshold), G (upper threshold), and time delay tz as well as present value of controlled current are presented in real time on a display.



The below diagram presents working algorithm of the relay when value of controlled current is within a defined range.

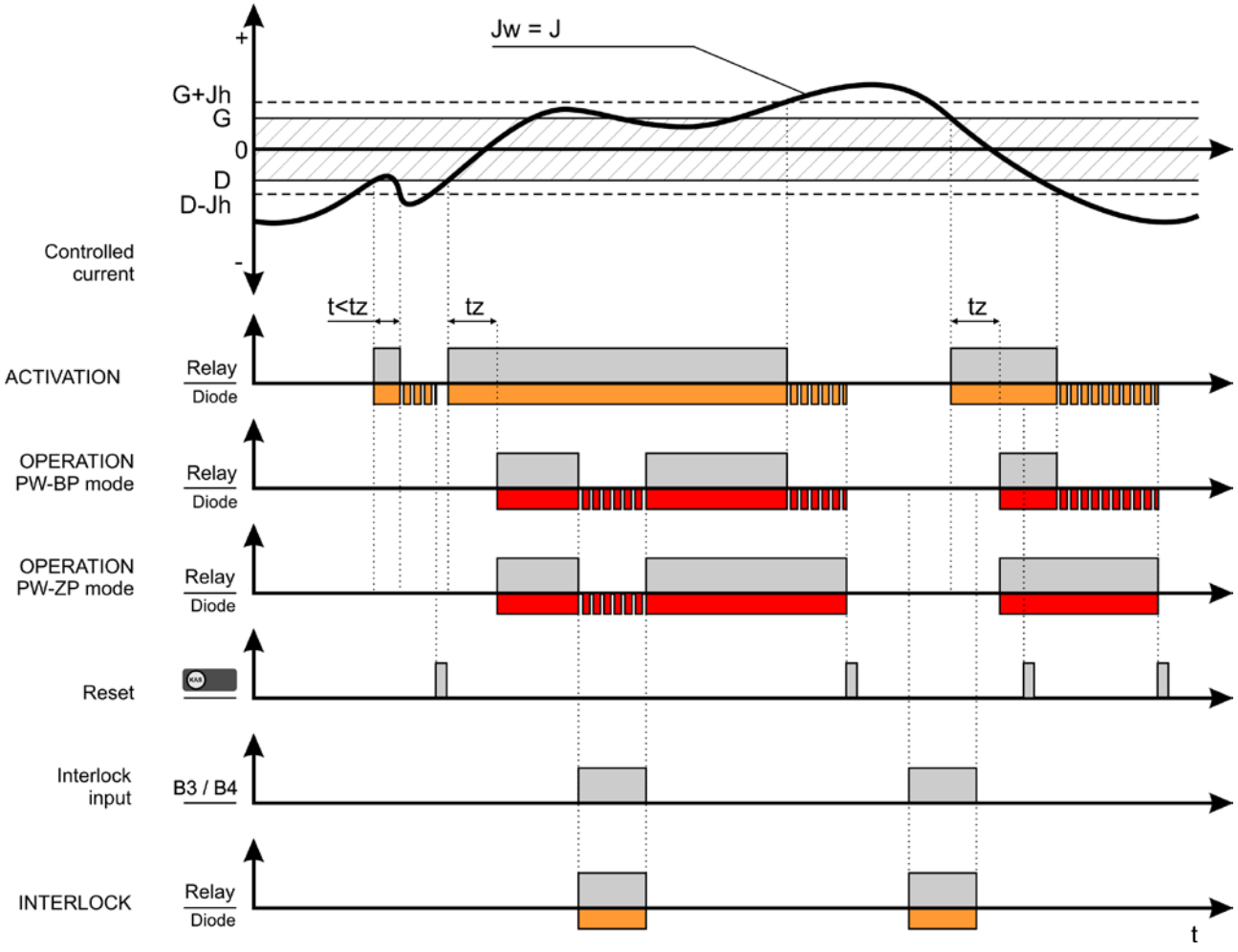
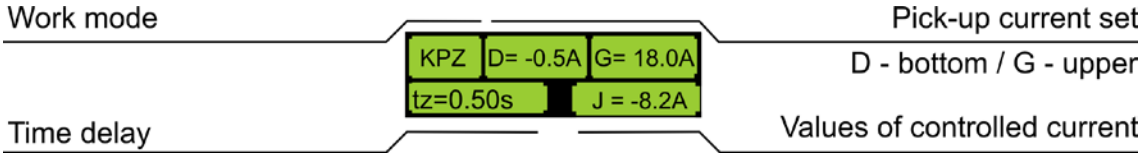


Fig 8. Operation of the relay for the KPW working mode

KPZ time-delay out of-range protection without current direction control.

The relay controls value of current flowing through shunt resistor and activates when value of controlled current is outside of a defined range, and operates with a specified time delay. Information on chosen work mode, set values of pick-up currents D (bottom threshold), G (upper threshold), and time delay tz as well as present value of controlled current are presented in real time on a display.



The below diagram presents working algorithm of the relay when value of controlled current is outside a defined range.

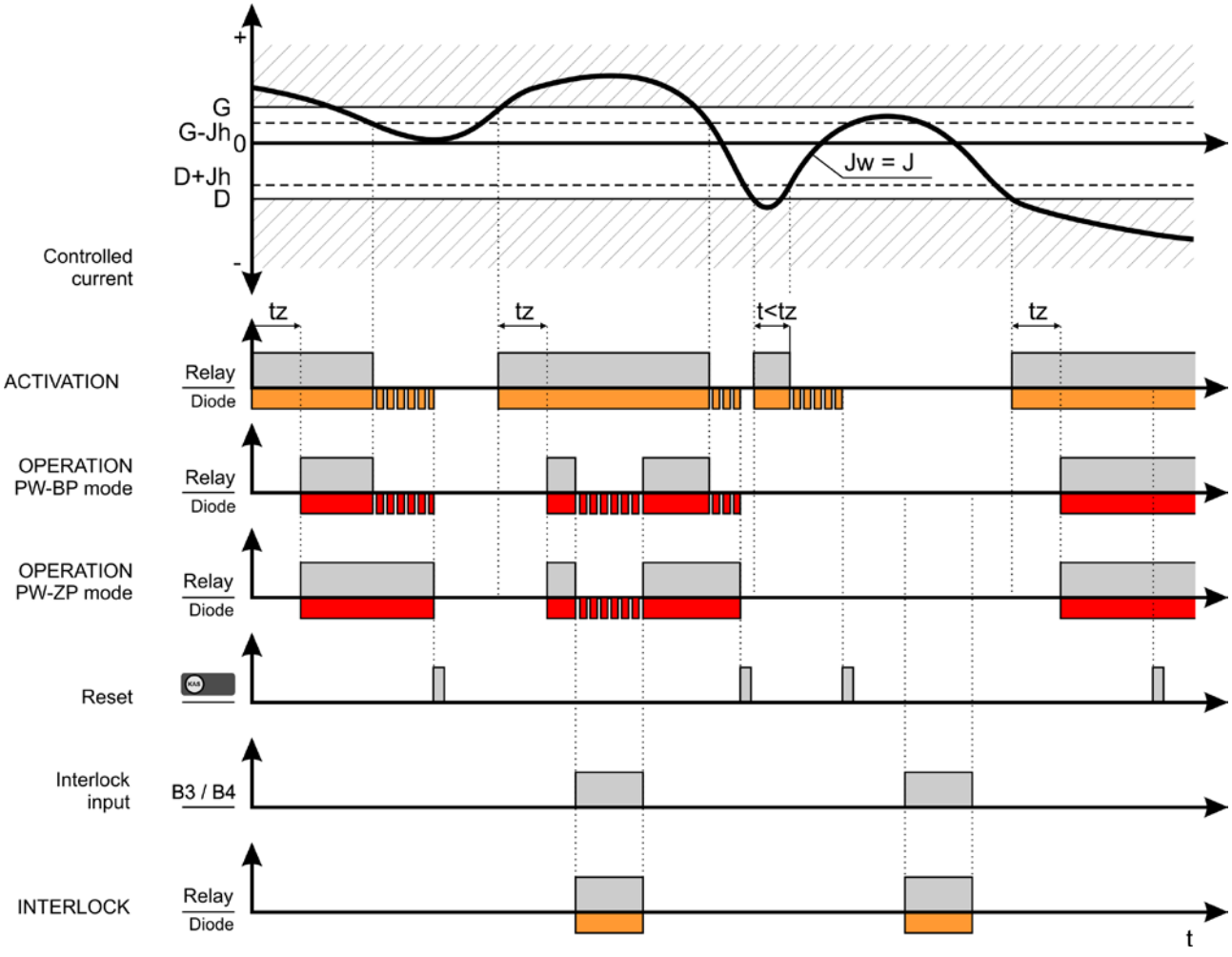


Fig 9. Operation of the relay for the KPZ working mode

SETUP PREVIEW AND PROGRAMING

SOFTWARE VERSION

When the relay has power supply it is possible to check software version of the device. In order to do so, push buttons ▲ ▼ simultaneously. The LCD shows information on type of the device, software version, producer, and serial number. To exit to the main menu is press the ESC (ESC) button or wait for automatic exit after 25 seconds.

Figure 10. Display - type of device, software version, producer, and serial number

SETUP PREVIEW

During work of the relay it is possible to preview set parameters. Pushing buttons ▲ or ▼ results with change of the main view into setup preview accordingly to diagram presented on figure 7. Exit to the main menu is done by pressing the ESC (ESC) button or automatically after 25 seconds.

SETUP OF THE PARAMETERS

Pushing buttons ▲ or ▼ changes the main view into the setup preview, as described above. To enter editing of the setup push ↵ (enter) on the chosen preview. The parameter displayed on the screen starts blinking. Buttons ▲ or ▼ enable changing setup of displayed parameter. Pressing the ↵ (enter) button confirms changes made to the setup. After confirming new setup the system requires entering password. To choose values of selected input figures push buttons ▲ or ▼. Pressing the ↵ (enter) button confirms each digit and moves to the next one. After entering correct password the relay saves new setup, and confirms this by presenting “Zapisano ust” on the screen. In case wrong password was given the screen will display „Błędne hasło” communicate, and return to entering the password menu. To exit entering the password mode press ESC (ESC) button or wait 25 seconds.

Attention: *Default password is **0 0 0 0.** Changing the password is possible only from the front panel of the relay. In case of losing the new password please contact the producer.*

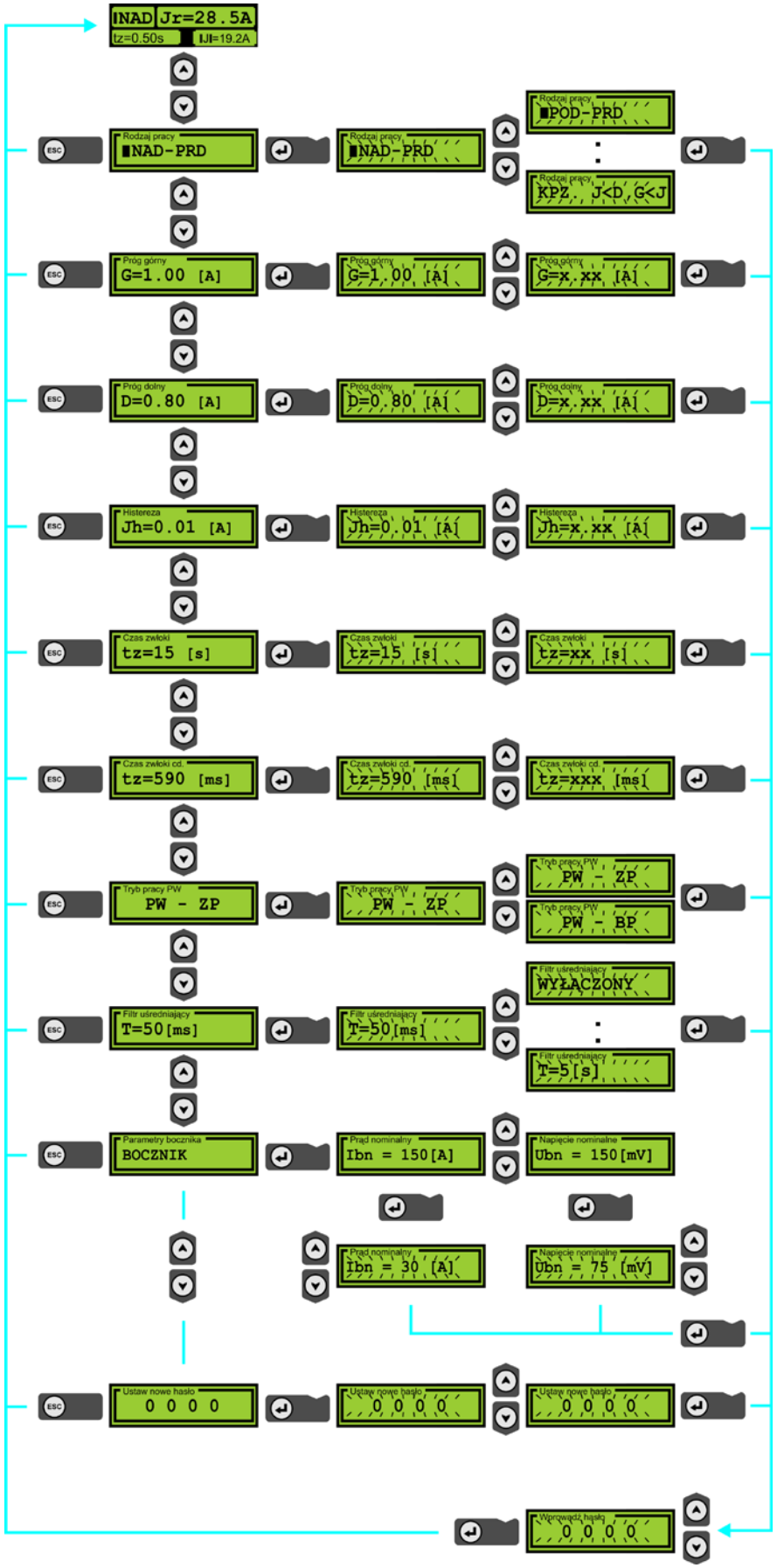


Fig 11. Diagram of preview and editing the setup

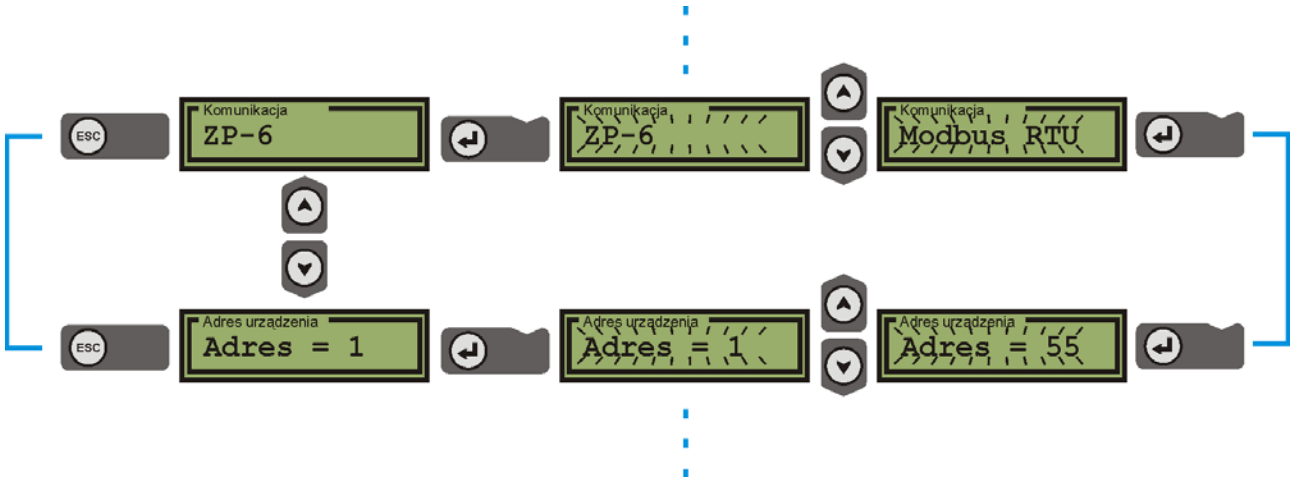


Fig 11b. Diagram of preview and editing the setup – options available in relays version v2.xx and later.

FUNCTIONAL SOFTWARE

Installation and launching the software.

Along with the relay, user receives software enabling its setup and use. The installation pack is delivered on a CD. In order to start the installing process launch SETUP.EXE file, and then follow the instructions displayed by the installing programme. All files required for the programme to operate will be copied to the computer. After installing the software a shortcut to ZPrAE–EDIT will be added in the Programmes menu / ZPrAE Sp. z o. o. folder.

Starting work with ZPrAE-EDIT application.

The programme can be launched from the START menu ZPrAE Sp. z o.o. folder ZPrAE-EDIT file, or by launching the execution file ZPrAE-EDIT.exe (located in the installation catalogue). Starting the programme opens the main window, and allows entering further windows enabling preview of the status and setup of the relay. Connect the relay to the computer with a RS-485 link. Initiating work the programme should be proceeded by successful configuration the connection, unless the programme was used before, and the configuration was saved. In order to input changes choose OPCJE/PARAMETRY POŁĄCZENIA from the main menu. A window with choice of port and transmission speed will appear on the screen. For the RJT relay, standard speed is 9600 bps and no parity.

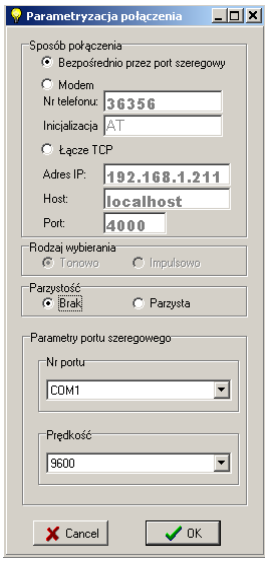


Figure 12. Window of parameterisation of the connection

After correct configuration of the connection the START button on the main menu opens window enabling search for connected relays. Search for devices begins after pushing button “Załącz skaner”. The scanning result is presented as list of devices, their types and addresses. In order to connect to a relay with chosen address, pick it on the list and push button „Połącz z wybranym urządzeniem”. The RJT-1 relays with software version 1.xx have fixed address being a result of operation: number of the relay modulo 255 ([Adr] = [Nr] mod [255]). Address of the RJT-1 relay in version 2.xx and later can be set up from the front panel of the relay. While connecting a larger number of relays into one RS485 system it is crucial that addresses of the relays are not repeated.

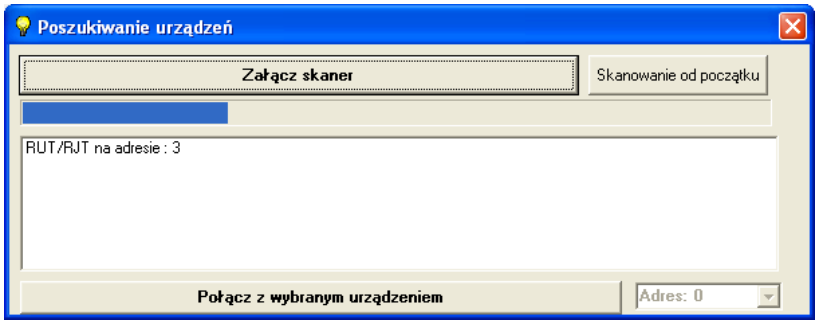


Figure 13. Window of search for connected devices.

The programme displays window showing elevation of the relay and its configuration. The view is divided into two parts. The left hand side of the picture represents elevation of the RJT relay, on which the following data is displayed: current settings, state of the relay, values of currents on measuring inputs, values of currents registered during the last activation as well as basic information describing the relay like type of the relay, serial number, rated current on the measuring shunt, rated auxiliary voltage. The right hand side of the window represents a panel dedicated for configuration of the relay. The panel contains editable fields enabling setup of new values of specific parameters, and two buttons: “Odśwież” (reading current setup from the relay) and „Wyślij” (enabling saving the new set up after entering correct password). The picture of the

elevation of the relay has an active “KAS” button enabling remote erasing the relay after operation.

REMOTE COMMUNICATION – RTU MODBUS in version 2.xx and later

Records and functions

The RJT-1 relay in version 2.xx and later has a RTU MODBUS communication protocol implemented. It enables remote setup of alerts, resetting and preview of current voltages. In order to enable remote change of setup a command with actual password shall be sent to the device. Such command activates remote setup for 60s. Address of the device can be set up from the front panel of the relay in range from 1 to 254.

MODBUS functions supported

0x01	Read Coils
0x02	Read Discrete Inputs
0x03	Read Holding Registers
0x04	Read Input Registers
0x05	Write Single Coil
0x06	Write Single Register
0x11	Report Slave ID

Report Slave ID:	
	Functions supported: 0x11 In response for function 0x11 we obtain: Slave ID: 0x04 Run Indicator Status: 0xFF = ON Additional Data: „RJT1 230 [VAC] P>S> ZPrAE v X.XX” (X.XX – describes software version)

Addressing

Discrete State:	Functions supported: 0x02				
Address:	**Parameter**	**Data type:**	**Value:**	**Range:**	**Attribute:**
1	RJT-1 activated	Bit	Off=0, On=1	0-1	read
2	RJT-1 operated	Bit	Off=0, On=1	0-1	read
3	RJT-1 interlocked	Bit	Off=0, On=1	0-1	read
4	RJT-1 was_activated	Bit	Off=0, On=1	0-1	read
5	RJT-1 was_operated	Bit	Off=0, On=1	0-1	read
6	RJT-1 malfunction	Bit	Off=0, On=1	0-1	read

Coils:	Functions supported: 0x01, 0x05				
Address:	**Parameter**	**Data type:**	**Value:**	**Range:**	**Attribute:**
100	Reset	Bit	Off=0, On=1	0-1	read/write

Holding Register:	Functions supported: 0x03, 0x06				
Address:	**Parameter**	**Data type:**	**Value:**	**Range:**	**Attribute:**
3000	Permission for writing	Unsigned 16	0-9999	0 – 9999	write - aktualne hasło
3001	New password setup	Unsigned 16	0-9999	0 – 9999	write
3002	Operation mode	Unsigned 16	0-7	0 - 3	read/write
3003	Upper current threshold	Signed 16	*1	-1,2In – 1,2In	read/write
3004	Start-up / Bottom current threshold	Signed 16	*1	-1,2In – 1,2In	read/write
3005	Hysteresis	Unsigned 16	*1	0 – (2,5In - 1)	read/write
3006	Delay time of the relay	Unsigned 16	0-30099	0ms – 300,99s	read/write
3007	Operating mode of PW	Unsigned 16	0-1	0= Off / 1= On	read/write
3008	Averaging filter	Unsigned 16	0-5	0-5	read/write
3009	Nominal current of a shunt	Unsigned 16	6 - 6000	0,6A – 600A	
3010	Nominal value of a shunt	Unsigned 16	50-150	50mV – 150mV	

Input Register:	Functions supported: 0x04				
Address:	**Parameter**	**Data type:**	**Value:**	**Range:**	**Attribute:**
4000	Input current	Signed 16	*1	-1,3In – 1,3In	read
4001	Input current in the moment of operation	Signed 16	*1	-1,3In – 1,3In	read

*1) – Value depending on rated voltage of the relay

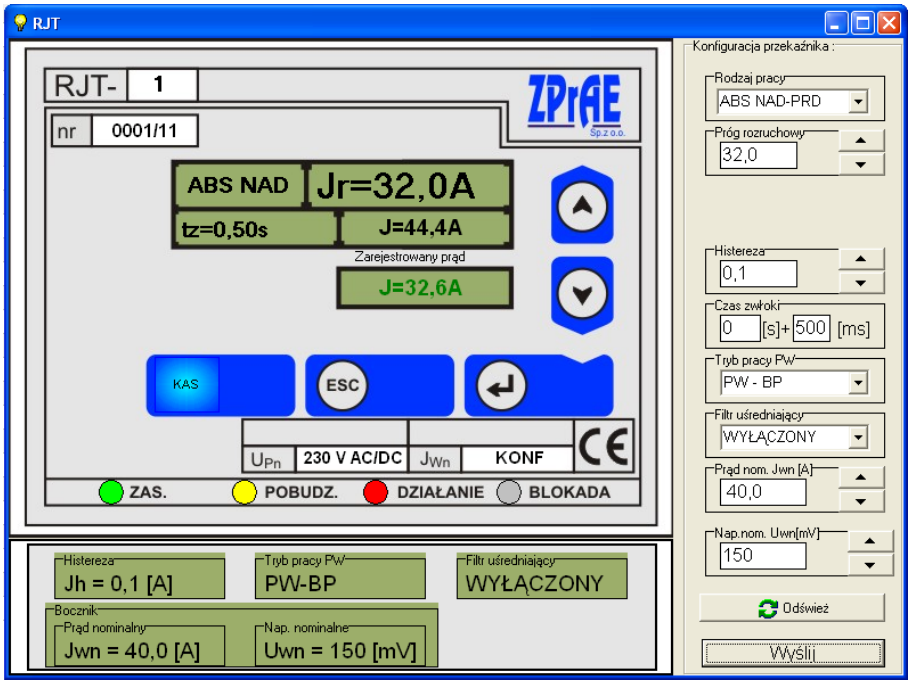


Figure. 14.Window of the ZPrAE-Edit edit programme for RJT-1

TECHNICAL INFORMATION

Auxiliary power supply	
Rated voltage	U_n = 220 V or other as ordered
Operate range	0,8 ... 1,15 U_{Pn}
Power consumption	P ≤ 2,5 W
Control inputs (for cooperation with a measuring shunt)	
Number of inputs	1 galvanic insulated
Input voltage range U_{Wn} (to be configured)	from 50 mV to 150 mV by 5 mV
Measuring uncertainty of input voltage	±0,5 mV
Rated Current J_{Wn} of the measuring shunt (to be configured)	from 0,6 A to 5,9 A by 0,1 A
	from 6 A to 59 A by 1 A
	from 60 A to 600 A by 10 A
Maximal programmable operation threshold	1,2 J_{Wn}
Resolution of setup	0,01A for JWn from 0,6 A to 5,9 A
	0,1A for JWn from 6 A to 59 A
	1A for JWn from 60 A to 600 A
Current measuring accuracy	±1% J_{Wn} ±1 digit
Response time (without averaging filter)	≤ 20 ms
Blocking input	
Rated Voltage	U_n = 220 V DC (230 V AC) or other as ordered.
Operation threshold	0,7 U_n DC (0,5 U_n AC)
Power consumption	≤0,3 W

Available working modes of the relay		
Time-delay under-current protection		POD-PRD. 37 (IEEE Standard C37.2-1996)
Time-delay over-current protection		NAD-PRD. 51 (IEEE Standard C37.2-1996)
Time-delay within-range current protection		KPW. D<J<G
Time-delay outside-range current protection		KPZ. J<D,G<J
Option for the above work modes		■ operation without current direction control
		operation with current direction control
Hysteresis of the measuring circuits		
Maximal depth of the hysteresis	■POD-PRD	Jh < (1,3 JWn – Jr)
	■NAD-PRD	Jh < Jr
	■KPW	Jh < min(D; (1,3 JWn – G))
	■KPZ	Jh < (G-D)/2
	POD-PRD	Jh < (1,3 JWn – Jr)
	NAD-PRD	Jh < (1,3 J_{Wn} + Jr)
	KPW	Jh < min((1,3 J_{Wn} + D); (1,3 J_{Wn} – G))
	KPZ	Jh < (G-D)/2
Resolution of the hysteresis setup		0,01A for JWn from 0,6 A to 5,9 A
		0,1A for JWn from 6 A to 59 A
		1A for JWn from 60 A to 600 A
Delay time of the controlling relay		
Setup range		0 ÷ 300,99 s
Resolution of the setup		10 ms
Accuracy of the set time		±10 ms
Averaging filter		
Time constant T (adjustable)		OFF, 50 ms, 100 ms, 500 ms, 1 s, 5 s
Response time with averaging filter		0,5 T ±20 ms
Contacts of the relay		
Maximal breaking capacity DC		I = 0,2 A for U = 220 V; L/R = 40 ms
Maximal continuous current		I = 5 A
Response time of the relay		<10 ms
Insulation		
Rated insulation voltage		250 V
Overvoltage category		III
Proof voltage between the coil and the contacts		2 kV; 50 Hz; 1 min
Proof voltage of the contact gap		1 kV; 50 Hz; 1 min
Communication		
Type / Protocol / Speed		RS-485 / ZP6 / 9600 bps
Software		ZPrAE-Edit

***General* Data**	
Ingress Protection of the housing (IP)	IP40
Ambient temperature	from -5 °C to +40 °C
Ambient protection	RT II
Signalisation of Operation	Four LED diodes
Terminations (socket / plug)	2x GZ14
Dimensions (without socket)	77 × 55 × 110 mm (W×S×G)

DESIGN AND DIEMNSIONS OF THE RELAY

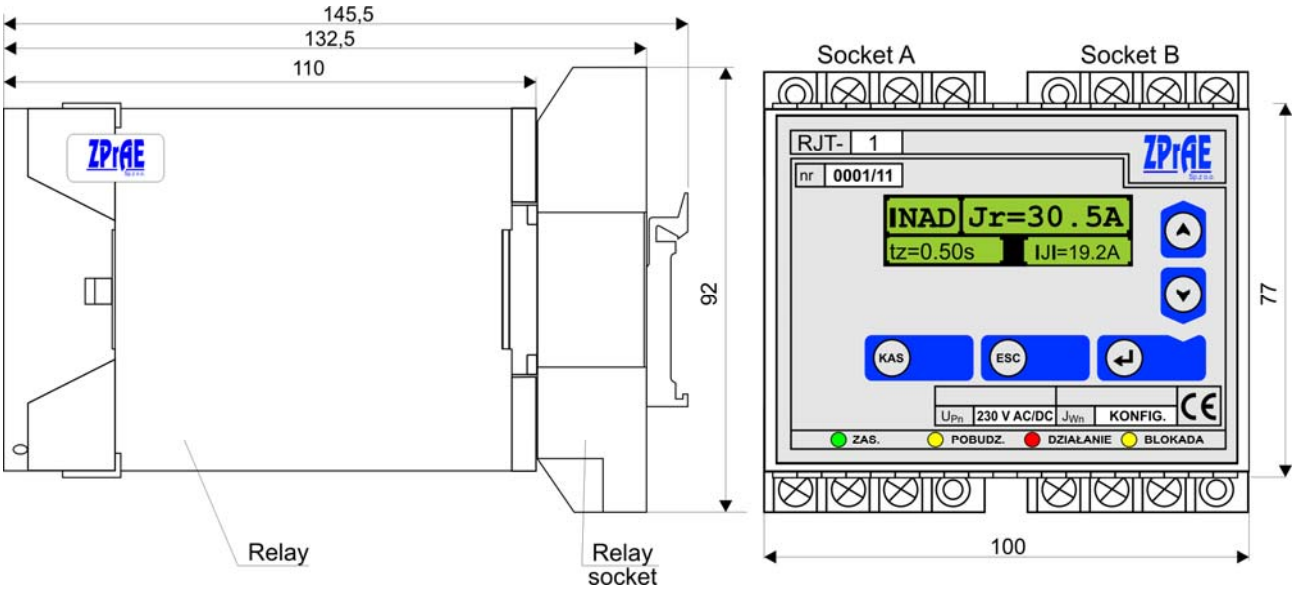


Figure 15. Dimensions of the RJT-1 relay

Attention:
We have prepared a vast offer of auxiliary equipment in order to support mounting of our relays (cases, sockets, plugs). The auxiliary equipment is designed based on our clients suggestions and many years of our own experience. More information can be found in catalogue: "GZ-14/GZ-14Z, R-8614/R8614Z, ZAS-55, ZAS-70, plugs, sockets and relay-chassis" available at www.zprae.pl

RJT-1

OFFER

RE line® ENERGETIC STANDARDS

- RSH-3, RSH-3S - tripping
- RS-6, RPD-2, RPP-4, RPP-6 - interposing
- RMS-2 - signalling
- RCW-3, RCDW-1 - circuit continuity monitoring
- RKO-3 - power supply circuit continuity monitoring
- RB-1, RBS-1, RBS-2 - bistable
- RT-22 - time
- RUT-2, RUT-3 - time-voltage
- RJT-1, RJT-3 - time-current
- RKU-1, RKS-1 - final controlling
- LZ-1, LZ-2 - operation counters
- RPZ-1 - supply source switching
- GPS-1 - time synchronisation
- MDD-6, MDS-12 - Diode modules
- PH-XX, PS-XX - Modules of switches, pushbuttons and control lamps
- Relay racks

- Busbar protections and breaker failure protections type TSL-9r, TSL-11
- Auxiliary and signalization relays
- Reserve Central Signalling System type MSA-9, MSA-12, MSA-24
- Protection relays type AZT-9, APP-9
- Disturbance recorder RZS-9
- Energy measurement system and event recorder ZRZ-28
- Load Resistors for measuring transformers
- DC and AC auxiliary power supply switchgears
- Cubicle-contained sets of control and supervision protections
- Modular power supplies, measuring suitcases, measuring and registering system RFQ-8
- PROFIL-L cubicles
- Periodical and post-failure tests, as well as repairs and overhauls of busbar protections TSL
- Servicing, strting-up and post assembly tests

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