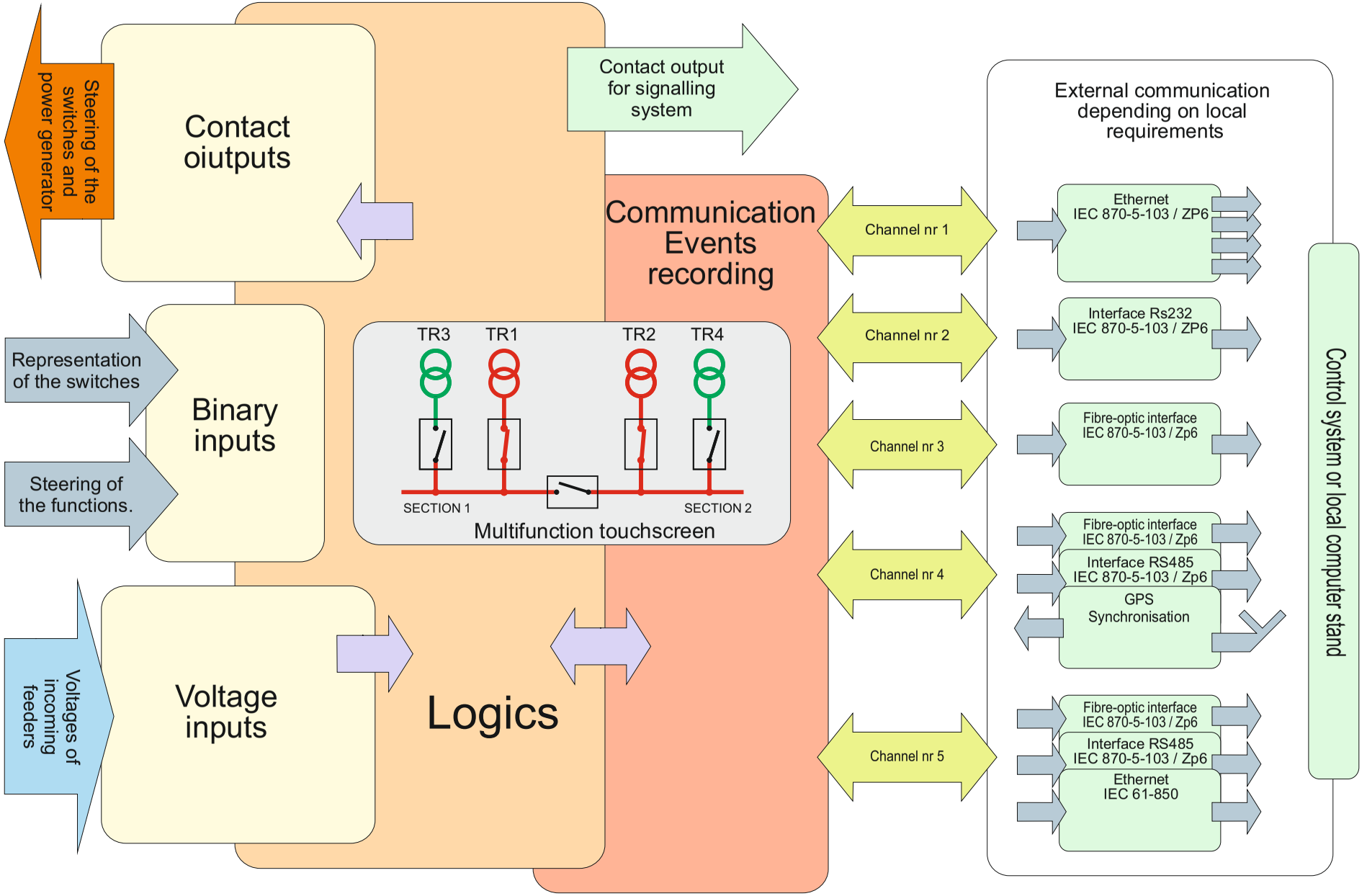
ZPrAE Sp.z o.o.

SZR-9

AUTOMATIC STAND-BY SWITCHING-ON



Structural scheme of SZR-09 Relay.

1. APPLICATION.

The SZR-9 device is used for automatic transfer to backup power source in 400/230 V AC switchgears working in spinning and non-spinning reserve systems, as well as with a power-generator. It continuously monitors voltages at different incoming feeders and busbar of the section as well as readiness status of circuit breakers. Incoming feeder with voltage loss or decay is disconnected and considered to be faulty. Disconnection activates the ATS (Automatic Transfer Switch) and an automatic sequence of switches to ensure continuous power supply to busbar of the section. Apart from its core function of completing an ATS sequence, the SZR-9 also comes with other equipment and features facilitating switchgear control and monitoring as a standard. These include but are not limited to:

- colour touchscreen on the front panel for previewing operation and status of the substation, as well as for controlling and performing simple configuration from the front panel of the device,
- internal event recorder,
- set of configurable multicolour LEDs displaying information selected by the user from a list,
- selection between one step/multi-step (so-called return) ATS modes,
- *PTS (Planned Transfer Switch) function integrated with power supply priority selection*, enabling switching between power supplies without locking the ATS,
- fire protection function, for remote shutdown of the substation as required by fire protection regulations,
- *Locking by manual shut off* function, for quick manual shut off with buttons (controls) in emergency and life threatening situations,
- *Locking by circuit breaker protections* function, locking the ATS sequence if circuit breaker protections in a given section are triggered,
- communication ports using standard IEC 870-5-103 protocol and proprietary ZP protocol, with IEC 61-850 protocol available as an option,
- software for previewing operating conditions, configuration of setups and remote control of the switchgear from the computer keyboard level,
- set of relay outputs for contact indication of operation and potential interruptions in operation,
- function for independent locking of ATS sequences for both sections.

The SZR-9 digital automatic transfer switch system is a device designed based not only on many years of experience in production and installation of switchgears, but also the latest trends and technologies. In comparison to SZR-6, internal data exchange speed was improved increasing precision of operation; furthermore, colour touchscreen provides an accurate way to preview the status of the substation and facilitates operation. SZR-9 is an alternative to ATS systems constructed based on freely programmable controllers, which require multiple auxiliary elements (a power supply unit, input transformers, operating relays, communication cards etc.), and therefore do not guarantee operational reliability and convenience.

2. DESIGN.

The SZR-9 relay may be used for designing comprehensive controlling systems for a 400/230 V AC switchgear. The device is compatible with manual switchgear control panel equipped with buttons or controls, and control systems using remote control relays. Manual or remote control is possible after prior locking of an SZR-9 (ATS sequence). The exception is control of switches using the PTS function, which is performed while the SZR-9 is active. A switchgear equipped with an SZR-9 has not only guaranteed ATS transfer sequence meeting expectations of the operating personnel, but with use of additional functions and proper engineering of external circuits provides its own control and operation monitoring system. This system includes external communications, remote control, event recording, contact signals for signalling circuits, as well as its own monitoring and configuration software. Two versions of the SZR-9 device are available, enabling control of two to nine circuit breakers or contactors, and two power-generators. The number of internal cards depends on the number of controlled circuit breakers. The SZR-9-1 in a 3U high, 19" unit is dedicated for switchgears with up to five circuit breakers (four incoming feeders and a section switch); the SZR-9-2 in a 6U high, 19" unit is dedicated for switchgears with more circuit breakers and equipped with generators (four permanent feeders, two power-generator feeders, a section switch, two switches of class I and II subsections).

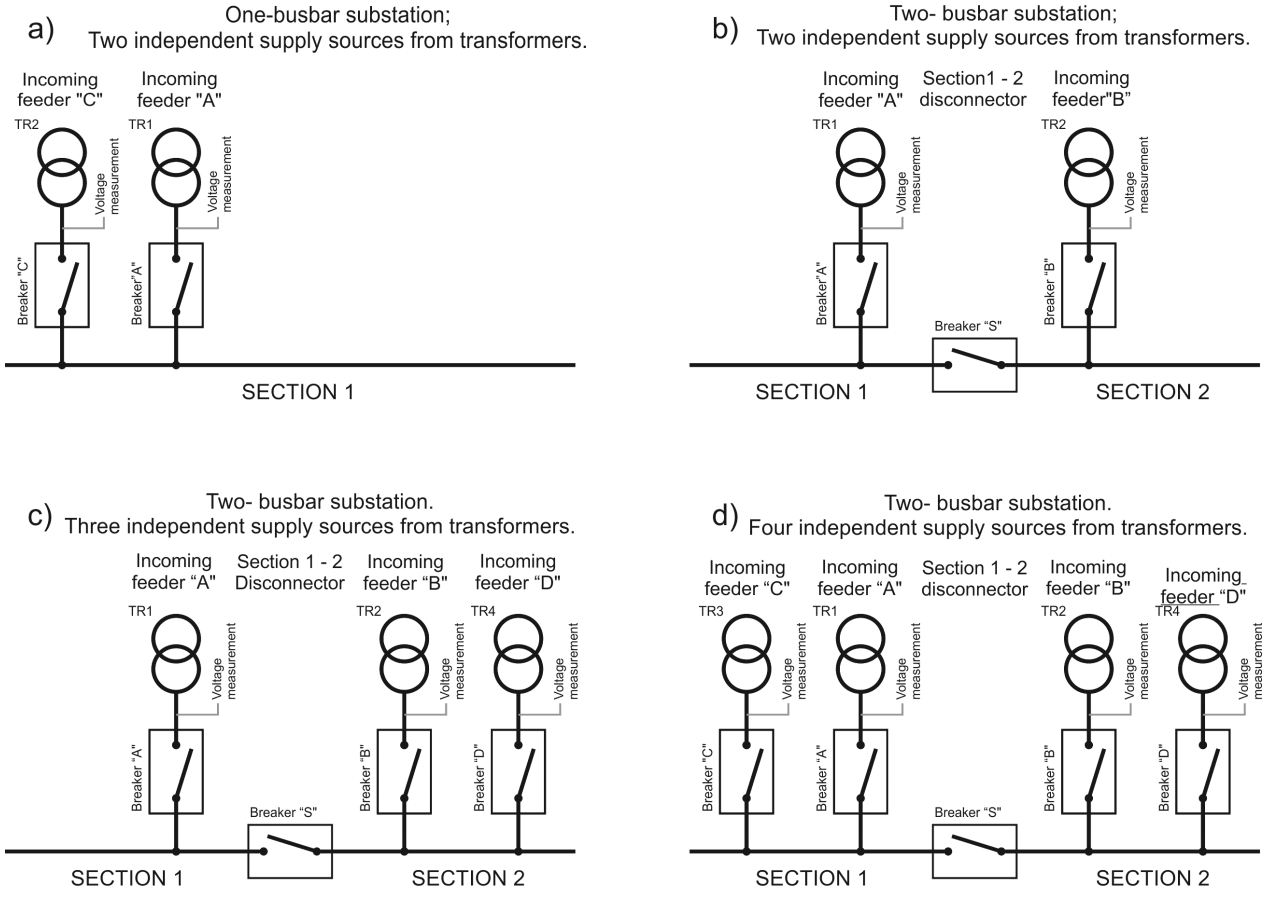
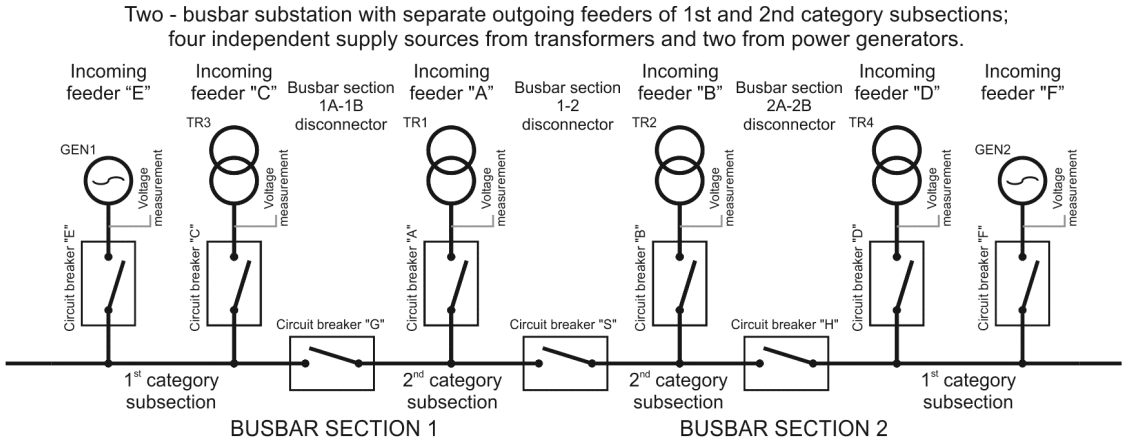


Fig. 2.1. Example drawings of switchgears with an SZR-9-1.

a)



b)

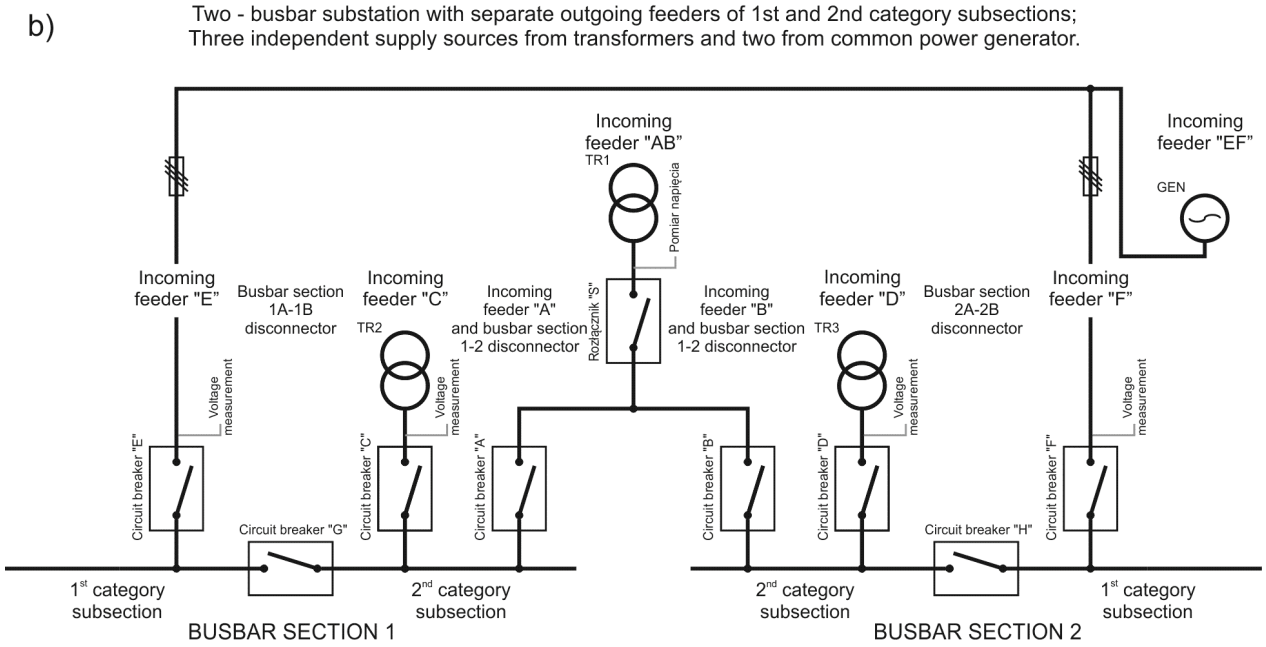


Fig. 2.2. Example drawings of switchgears with an SZR-9-2.

3. ENGINEERING CONTROLS OF A SWITCHGEAR WITH SZR-9.

Engineering process can be divided into three stages: first a “general” one that consists in defining the assumptions, second “electrical” i.e. specifying the workplace and including the control circuits of SZR-9 in the diagram, and third “programming” i.e. configuring the setups of voltage inputs, switching times, selection of power supply priorities and indication LEDs.

The main part of the switchgear controls engineering should consist in specifying the diagram and selecting the main equipment (circuit breakers or contactors). It is also important to specify the way of controlling the switchgear, whether it will be possible to control it only from a local panel or also remotely using a remote control system. Next task is to include output contacts of SZR-9 in switchgear control circuits. ATS relay requires a certain feedback (from auxiliary contacts) on all circuit breakers positions, their readiness and information on activation of protections if the circuit breakers are equipped with them. For proper functioning it is also necessary to provide all supply voltages (from before the circuit breakers) to relay voltage cards. Auxiliary circuits include inputs of additional

functions like PTS or fire protection, and contact outputs providing information about operating condition of switchgear and ATS relay to be used in indicating circuits. Auxiliary power supply of SZR-9 is not necessary, the device works properly when supplied from incoming feeder voltages. However, applying auxiliary power supply is recommended or even required when continuous operation is necessary, even after loss of all voltages, e.g. in case of cooperation with monitoring systems and usage of communication ports. Then, continuous information on substation operating condition is provided even in emergency situations! Power supply is also necessary for proper operation of SZR-9-2 adapted to cooperate with power-generators. In this case loss of all incoming feeder voltages is normal and external power supply is necessary to send an impulse for starting up the generator and constant monitoring of substation operation. Power supply units are adapted to 220 V DC or 230 V AC. Power supply units adapted to 110 V DC are also available.

Communication capabilities have been increased as compared to the previous versions of ATS. Depending on the selected option various communication channels are available, including IEC 61850 protocol which has recently become very popular. Software supplied with the device enables remote communication with the relay, monitoring of present operating status of a substation, switchgear control, reading recorded data and potential change in setups.

Note:
*We can provide a **detailed SZR-9 data sheet** including full materials on the device. We also have ready-to-use **project outlines**.*

4. CONSTRUCTION.

Digital technology made it possible to design SZR-9, a new universal relay of automatic transfer switch which can be used for complex switchgears with many additional functions. The device is an integrated relay working as an automatic transfer switch assembly inside the housing all circuits, which are necessary for proper functioning, in a form of appropriate cards. IT DOES NOT REQUIRE ANY ADDITIONAL EXTERNAL ELEMENTS![*] The device is supplied from incoming feeder voltages or from incoming feeder voltages and an auxiliary power supply. Measuring cards are adjusted for 400/230 V AC and do not require any instrument transformers or voltage transducers. Binary inputs accept voltage of 220 V both AC and DC. Output relays enable direct control of majority of the standard circuit breakers. In addition, the SZR-9 unit is equipped with a concentrator monitoring operation of the whole device, archiving data and providing communication via communication ports. Software supplied with the device enables configuration of SZR-9 functions and its further operation. It provides the ability to monitor the present status of switchgear on-line on a computer screen, read data from the event recorder and change the device configuration if required.

[*] Except for contactor systems where it is recommended to use additional tripping relay, as well as systems in which contactors and circuit breakers have coils operating at direct voltage with significant power consumption where it is necessary to use interposing relays (e.g. RSH-3).

4.1. External dimensions.

SZR-9 relay is built in an EURO-19”/3(6)U type rack, made of chromate plated aluminium that provides better resistance to electromagnetic (EMC) interference.

SZR-9-1 version of a relay fits inside the rack with dimensions 19”/3U/240 (483×133,5×245 mm) and SZR-9-2 version fits inside the rack with dimensions 19”/6U/240 (483×267×245 mm),

Note: additional space, approximately 55 mm deep, should be available behind the device for installation cables to be connected with multipin connectors.

Figure below shows SZR-9-1 and SZR-9-2 versions of a relay.

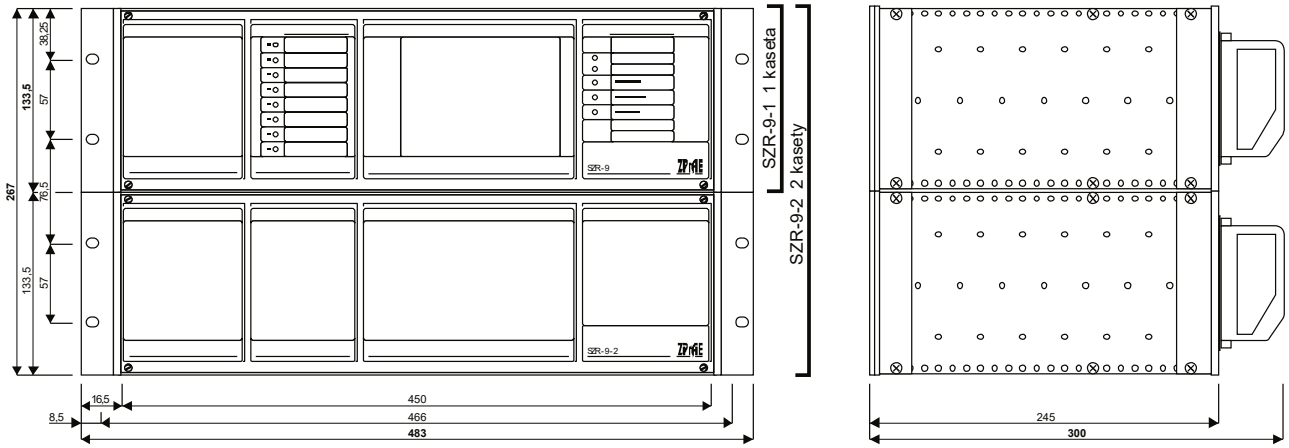


Fig. 4.1. External dimensions of an SZR-9 relay.

4.2. Front panel.

Front panel of SZR-9 includes:

4.2.1. LCD touchscreen.

The centre of the front panel has a colour touchscreen allowing checking present switchgear operation status and control. The display shows e.g. the position of circuit breakers, incoming feeder status, reading of incoming feeder voltage, etc.

The panel provides the ability to configure basic parameters of the relay like locking/unlocking the control, one-step/multi-step ATS, selection of section power supply priorities.

4.2.2. LEDs signalling power, malfunction and operations.

The right side of the unit displays three LEDs indicating the operating condition. Green LED informs that power supply is applied to the unit; yellow indicates device malfunction and red signals that the relay was activated and the power supplies were switched. Additional two LEDs are configured and described depending on the SZR-9 design e.g. they can indicate, independently for both sections, that ATS function was locked. The top description field is to be filled with the name of the substation e.g. RG 400/230 V AC

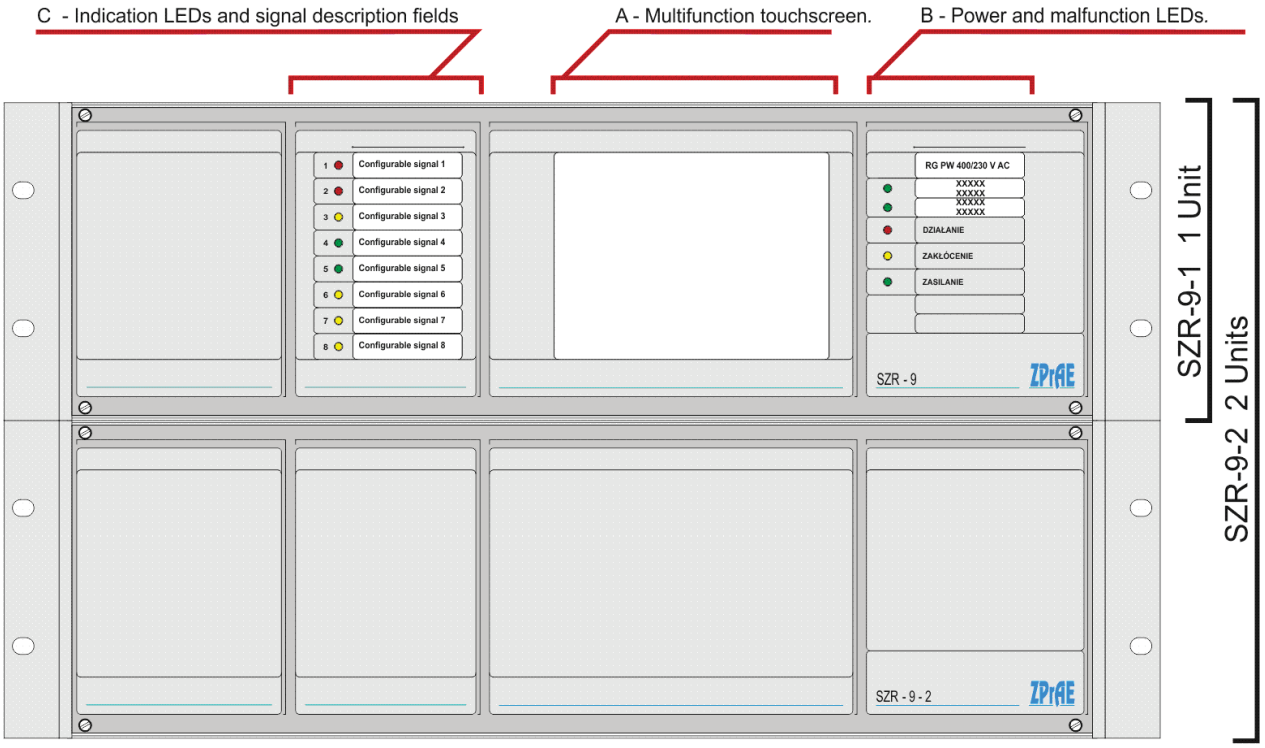


Fig. 4.2. Front panel of SZR-9 relay.

4.2.3. Signalling LEDs and signal description fields.

This part of the front panel contains 8 signalling LEDs and description fields for identification with a suitable name of the signal. Multicolour super-bright RGB LEDs function as optical indicators. It is possible to use the software supplied with the relay to select the preferred signals from a list available in the program. The LED colour can also be configured from the software level. Next to the LEDs there are description fields. A description field for one LED is 42 mm × 10 mm (W×H). Signal descriptions can be printed on foil or paper and inserted under the transparent part of the front panel.

4.3. Rear panel and modules.

Card connectors for external connections are located on the rear panel. Plugs with housings are supplied with the device. LgY cables are recommended for external connections. The units have voltage and binary inputs, contact outputs, power supply and external communication connectors.

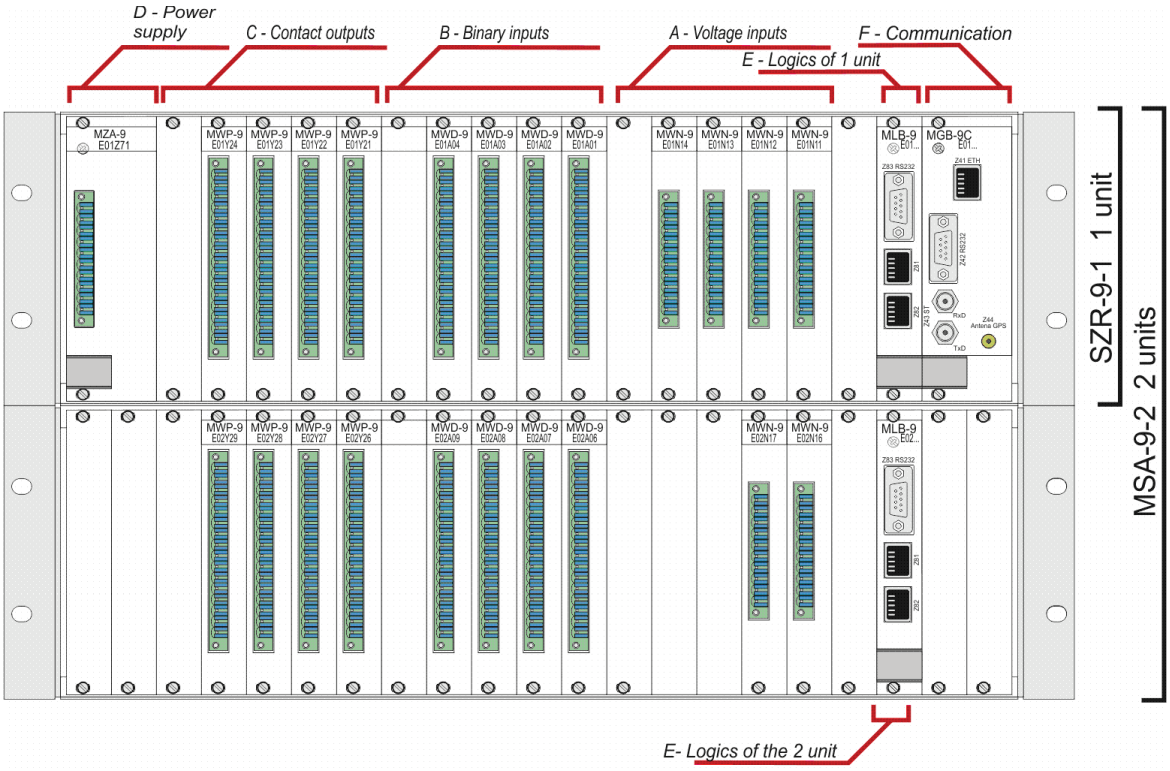


Fig. 4.3. Rear panel of an SZR-9 relay.

The figures show maximum number of cards and connectors available on the rear panel, it may vary depending on the substation arrangement.

5. OPERATING PRINCIPLE.

The basic function of ATS systems is continuous monitoring of the presence of power supply in the switchgear and performance of connection sequences to guarantee the voltage at the sections in spite of the loss of supply voltages. The order of incoming feeder selection is set based on the power supply priorities predetermined by the operating personnel. An impulse activating the generator is sent in case of loss of voltage at all permanent power supply lines. After confirming its readiness and checking whether voltage at generator power supply line is correct the switchgear is supplied from the generator. In such case outgoing feeders of 2nd category subsections are also disconnected from power supplies. Depending on the needs of a given facility and user requirements the SZR-9 relay can operate in two modes selected in the program. One-step mode in which the incoming feeder is excluded from the potential power supplies once it is considered defective. In this mode when all permanent voltages are lost the SZR-9 will finish its operation after connecting to the generator even if in the meantime any of the permanent power supplies are restored. Returning to the basic operation is possible only after resetting by the user. In the multi-step mode the SZR-9 will aim at power supply priority set by the operating personnel. It is the most popular mode and is maintenance free, requiring no user intervention.

5.1. Voltage inputs.

Each voltage input module contains circuits measuring the line-to-neutral voltage and U_0 voltage. The modules also isolate voltages and by passing them to the power supply unit enable proper operation if at least one phase from any incoming feeder is

present. In case of equipment without additional auxiliary voltage supply, the SZR-9 is stopped when there is a complete loss of all incoming feeder voltages but it is restarted when at least one of the voltages reappears.

5.2. Binary inputs.

Binary inputs are handled by modules, each having eight independent optically isolated inputs. Input voltage is 220 V DC/AC or 110 V DC/AC. These inputs receive information about position of switches, their readiness, as well as generator readiness. They ensure control of PTS functions by means of external buttons on the control panel or contacts of remote control relays. They can also be used for receiving other signals in complex systems or to provide additional functions.

5.3. Contact outputs.

Contact outputs control main substation circuit breakers or contactors, and send impulses controlling the generator; they also prevent unwanted connections from manual control panel. Most of the outputs are intended for providing contact signals with the recorder's and relay's operating condition.

5.4. Event recorder.

The main recorder memory is capable of storing up to 10 thousands events, at 1 ms resolution. The events are generated by the logic of an MLB-11 device and then sent to an MGB concentrator where they are stored in the memory. In case of too many recorded events the oldest data will be lost (overwritten).

Data from the recorder can be sent to a primary control and monitoring system via the IEC870-5-103 protocol or optionally via IEC61850 protocol. They can be also viewed in a main program window via proprietary ZP-6 protocol.

Module of an MGB concentrator is available in six versions. Depending on the version various physical interfaces of serial connections and communication protocols are available, e.g.:

- RS232 connections
- RS485 half-duplex connection (two-wire)
- glass optical fibre connection 62.5/125μm, ST connectors
- Ethernet connection, RJ45 connector

6. UTILITY SOFTWARE.

Along with the SZR-9 relay the user receives software for its configuration and operation. Installation software is provided on CDs.

7. SCOPE OF SERVICES PROVIDED BY THE MANUFACTURER.

The manufacturer provides support in designing of switchgears using SZR-9 device. This data sheet contains only basic information. Upon request we can provide **a detailed SZR-9 data sheet** including full materials on the device. We can also provide ready-to-use **project outlines**. The manufacturer supplies the ATS configured as agreed, takes care of the equipment during the warranty period and ensures full service after its expiry. The manufacturer also provides services in designing of new and revamping existing switchgears – including inventory taking of the circuits and on-site installation of the supplied equipment.

8. TECHNICAL PARAMETERS OF THE SZR-9 RELAY.

Auxiliary power supply	Rated power supply voltage: U_{PN}:		220 V DC / 230 V AC or other as agreed.
	Permissible range of power supply voltage:		0.8 ÷ 1.1,5 U_{PN}
	Maximal power consumption of the unit		< 30 W / 30 VA
Controlled Voltage	Count of controlled voltages		
	In the voltage input module MWN:		400/230 V 50 Hz (L1-N / L2-N / L3-N / U_0)
	For SZR-9-1 (max four incoming feeders):		4 modules * 400/230 V 50 Hz
	For SZR-9-2 (max six incoming feeders):		6 modules * 400/230 V 50 Hz
	Rated controlled voltage:		230 V; 50 Hz
	Power consumption from controlled circuits		< 0,2 VA
	Setup range of line-to-neutral voltage		50-250 V
	Setup range of permissible U_0 voltage		10-250 V
	Operation threshold of phase-to-neutral control circuit		0,8 $U_{N\ nast}$
	Guaranteed error of setup of the current elements		± 2,5% of the setup
	Setup range of time delay for de-energizing / energizing		0 – 25 sec. by 0,1 sek.
	Guaranteed error of the time delay setup		± 2,5% of the setup ± 0,1sec
Binary inputs	Count of binary inputs		
	In the MWD module:		8 inputs.
	In SZR-9-1 (standard / max):		4 / 5 modules* 8 inputs = 32 / 40 inputs.
	In SZR-9-2 (standard / max):		6 / 8 modules * 8 inputs = 48 / 64 inputs.
	Rated voltage in circuits of binary inputs U_{WN}. (Binary inputs, optically, galvanic isolated).		220 V DC / 230 V AC or other as agreed.
	Power consumption from signal inputs circuits		< 0.3 W / input
	Triggering event		Programmable: decay or increase
	Activation threshold:		0,8 U_{WN}
LED's and the signalling panel.	Count of signalling LED's:		
	User configurable:		8 diodes
	Functional:		2 diodes
	Operation / Malfunction / Power supply:		3 diodes
	Diameter of the LEDs lighting point		3 mm
	Dimensions of the LEDs signal description field		42 mm × 10 mm (W×H),
	Colour of the signalling LED (configured with software):		Yellow/Red/Green/Blue/Purple
	Dimensions of the touchscreen:		115 mm × 85 mm (W×H),
Contact inputs.	Count of contact outputs:		
	In the MWP module:		8 contacts.
	In SZR-9-1 (standard / max):		4 / 5 modules * 8 outputs = 32 / 40 outputs.
	In SZR-9-2 (standard / max):		6 / 8 modules * 8 outputs = 48 / 64 outputs.
	Maximal current of the contacts:		4 A
	Making capacity of the contacts:		3 A / 250 V AC 0,15 A / 250 V DC; L/R=40 ms
Communication.	Count of communication channels active at the same time - 5 channels (+ 1 service channel)		
	Types of connections and communication protocols depend on type of MGB-9 module used.		
	Channel 1 / Z41	MGB-9 C / D / E / G	Ethernet - RJ-45 - IEC 60870-5-103 / ZP-6
	Channel 2 / Z42	MGB-9 A / B / C / D / E / F.1 / G	RS232 – IEC 870-5-103 / ZP-6
	Channel 3 / Z43	MGB-9 A / B / C / D / E / F.1 / G	Fibre-optic ST – IEC 60870-5-103 / ZP-6
	Channel 4 / Z44	MGB-9 B / C	GPS – antenna connection type SMA - NMEA
	Channel 5 / Z45	MGB-9 D	Fibre-optic ST – IEC 60870-5-103 / ZP-6
	Channel 6 / Z46	MGB-9 D	Fibre-optic ST – IEC 60870-5-103 / ZP-6
	Channel 7 / Z47-1,2	MGB-9 E	RS485 - 8-pin connection - IEC 60870-5-103 / ZP-6
	Channel 8 / Z47-5,6	MGB-9 E	RS485 - 8-pin connection - IEC 60870-5-103 / ZP-6
	Channel 9 / Z48	MGB-9 F.1	Ethernet - RJ-45 connection - service
	Channel 10 / Z91	MGB-9 F.1	Ethernet – Fibre-optic SC - IEC 61850
	Channel 11 / Z92	MGB-9 F.1	Ethernet - Fibre-optic SC - IEC 61850
	Channel 12 / Z93	MGB-9 F.1	Ethernet - RJ-45 connection - IEC 61850
Insulation	Rated voltage of insulation:		250 V
	Proof impulse voltage:		4000 V (1,2/50 μs)
	Overvoltage category:		III
	Electrical strength of the insulation:		2,0 kV; 50Hz; 1 min.
	Enclosure protection degree:		IP-40 (front); IP-20 (remaining parts and contacts)
General Data	Dimensions of SZR-9-1 (single - 3U rack) Dimensions of SZR-9-2 (double - 6U rack)		19"/3U/240 (483×133,5×245 mm), W×H×D 19"/6U/240 (483×267×245 mm), W×H×D
	Weight (one unit):		App. 6 kg. (depending on count of modules)
	Ambient temperature range for operation:		263 – 328 K (od -10 do +55 C)
	Permissible ambient humidity:		< 95 %
	Permissible ambient pressure:		70-106 kPa (0 – 3000 m npm)

SZR-9

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

ZPrAE Sp.z o.o.

ZAKŁAD PRODUKCYJNY APARATURY ELEKTRYCZNEJ
Sp. z o.o. 41-100 Siemianowice Śląskie, ul. Marii Konopnickiej 13
tel: (032) 2200120; fax: (032) 2200125; e-mail: biuro@zprae.pl