ZPrAE
Sp.z o.o.

MSA-9

Table of Contents

1. INTRODUCTION

For over twenty years, ZPrAE has been manufacturing and supplying central emergency signalling devices (MSA-51, MSA-6, MSA-8, and now MSA-9) for the power industry, used for optical and acoustic signalling of protection trips, as well as signalling failures and disruptions in the operation of devices at power and industrial facilities. These systems enable the creation of group summary signals in line with the requirements of the operations and maintenance staff, as well as repeating signals as they arise for remote signalling purposes. These devices are used in power plants and power distribution stations as basic signalling systems, providing the staff operating the station with precise and quick information on emerging threats, protection trips and failures.

2. GENERAL INFORMATION

2.1. General Safety Rules

During the operation of the device, some of its components may be at a hazardous voltage. Improper or inappropriate use of the device may pose a risk to the operators and may also result in damage to the device. The device should be placed in a highly restricted-access area, inaccessible to unauthorised individuals. The installation site should be appropriately marked, informing users that they are operating in a protected area. Installation in lockable cabinet enclosures is recommended. The installation and operation of the device may only be carried out by appropriately trained personnel. The proper and faultless operation of the device requires appropriate transport, storage, assembly, installation, and commissioning, as well as correct operation, maintenance, and servicing. Before commissioning and operating the device, verify its nameplate ratings and read the operating instructions and installation manual. Due to the risk of electric shock, before commencing work on the auxiliary power supply circuits and on the binary inputs and outputs, disconnect them from their power sources.

In the production process, compliance with standards has been adopted, the fulfilment of which ensures the implementation of the established safety principles and measures, provided that the user adheres to the installation and commissioning guidelines as well as the operation procedures. Before carrying out any work, ensure that protective conductor continuity is intact. The protective circuit clamp on the device should be connected to the main protective circuit of the cabinet using a copper wire with a cross-section of at least 4 mm². In table 2.1, an explanation of the symbols used to denote the device is presented.

Table 2.1 Explanation of the symbols used to denote the device.

⚠	Attention, reference to documentation.
⬠	Insulation withstand test voltage of 500 V AC
⬠ 1	Insulation withstand test voltage of 1000 V AC
⬠ 2,5	Insulation withstand test voltage of 2500 V AC
⬠ 5	Insulation impulse withstand test voltage: 5 kV.
♲	Prohibition on disposing of waste in regular waste containers.

2.2. ICT Security

On start-up and during operation, the device checks the operation of key system components and the integrity of the software, configuration and settings. Upon detection of a failure or an integrity breach, the system's operation is halted. Information on undesirable activities is stored in the non-volatile memory of the event recorder and in the device security logs. It can be accessed via the ZPrAE Edit utility software or the Syslog service (if enabled).

The device enables communication with SCADA-class systems or via an engineering link, using various protocols and data transmission media. The ICT network to which the device may be connected should provide a high level of security, preventing access by unauthorised persons from outside the network. If the device communication with the SCADA system is to take place outside the protected area, it is recommended that additional cryptographic security measures be applied to the communication channel, including, among others, a VPN.

External communication is provided by MGB-9 communication modules, which are available in a range of variants that differ, among other things, in the number and type of communication channels. To ensure a high level of ICT security, it is recommended to use the module version **MGB-9F.1/S**. A device equipped with an appropriate communication module provides, among other things, the following functions related to remote access control:

- communication using encryption protocols,
- Ethernet port filtering,
- event and security logging,
- Syslog service,
- defined user permission levels,
- authentication using username and password,
- password-setting policy,
- automatic logout after a specified period of inactivity,
- blocking access to the account after a specified number of failed login attempts.

Access to the device configuration from within the ZPrAE Edit tool requires entering valid login credentials: a username and a password. In the default factory configuration, a user with **administrator** privileges named "**admin**" and password "**Haslo_1234**" is available.

When first connecting to the device, it is recommended that you change the default login credentials (username and password) and configure other users with lower permission levels. The device configuration process, together with a description of the available permission levels, is presented in Chapter 5.

For security reasons, there is no remote administrator password recovery procedure. In the event of its loss, intervention by ZPrAE's service department is required.

2.3. Applications

The MSA-9 digital central signalling system has been developed drawing on many years of experience in the manufacture and installation of signalling systems, as well as the latest technological trends and capabilities. Compared with the MSA-6 or MSA-8, the internal data transfer rate has been increased, which has resulted in very precise operation and event logging; furthermore, the use of very high-brightness RGB LEDs enables multicolour signalling of incoming activations. In addition to standard signalling functions, the MSA-9 simultaneously acts as an event recorder and enables data to be transmitted to the station supervisory system. Compared with previous versions of the MSA, the communication capabilities have also been enhanced; depending on the option selected, various communication channels are available, also offering the IEC61850 protocol, which has become very popular recently. The software supplied with the device enables remote communication with the signalling system, monitoring its status, reading stored data, and, if necessary, modifying the settings.

MSA devices can be used both in permanently attended substations and as essential supplementary equipment in unattended high- and extra-high-voltage substations. In stations of this kind, remotely controlled from a higher-level dispatch centre, it is essential to ensure the capability to carry out commissioning and test operations, and a backup means of operating the station must also be provided in the event of a failure of the remote control and supervisory systems. Nor can failures of station computer systems be completely ruled out, necessitating the temporary deployment of staff to the station who, for a time, will have to manage operations in the 'traditional' way and must be provided with suitable conditions for sound decision-making. In such cases, an independent local warning and fault signalling system is required, operating in parallel with the station's computer-based control system. Electronic central emergency and warning signalling systems may, in this respect, provide redundancy for station-based computer systems for control, logging and data processing.

3. CONSTRUCTION

The development of digital technology has enabled the creation of a new universal central signalling device designated MSA-9, which is capable of accepting and signalling a large number of activated input channels, while maintaining clear labelling fields and large multicoloured LED indicators on the front of the device. Because the device is fully configurable, the user can freely group inputs and assign them to individual indicator LEDs, as well as to repeater relays. Each indicator LED, as well as the repeater relay, can be activated by any independently selected signal input, or by a selected group of between two and eight signal inputs. The cassette-integrated control unit for four acoustic sounders is triggered by input signals that the user assigns in software to the appropriate acoustic output. Of course, each signal input can be configured independently to trigger on a falling or rising edge, and a time delay can also be set. The Test and Reset panel allows, directly from the device front panel, manual testing of the optics and the individual acoustic channels, as well as their resetting.

External circuit connections are provided by the multi-pin connectors available on the device rear panel. The device is equipped with a dual power supply featuring two independent converters, ensuring continuous operation in the event of the loss of one of the supply voltages. One MZA power supply ensures the continuous operation of a two-cassette MSA-9 set; this means that for 128-signal systems a single power supply is sufficient. For additional cassettes, allow for one more MZA power supply for every two cassettes. The cassette's operation is supervised by the MLB internal logic module installed in each cassette. On the rear panel of this module there are also connectors for inter-cassette communication, used in complex, distributed multi-cassette systems. Additionally, the cassette with the Test and Reset panel – that is, the first of the expansion-set cassettes – contains a hub that supervises the operation of the entire unit, archives the recorded data, and provides communication with the device. In this module, there is also room for the optional GPS clock. The selected eight-channel binary input module enables remote resetting and testing of the system via the contacts of push-buttons or relays located outside the device. The selected module with eight relay outputs controls the acoustic sounders and signals the operating status via contacts. The MSA-9 signalling system may be supplemented by a PSA-4 panel of electronic, programmable acoustic sounders.

The "Standard" version of the software supplied with the device makes it easy to configure the MSA-9's basic functions and to operate it thereafter. It enables you to monitor the current status of the signalling online on a computer monitor, read data from the event logger, and, if necessary, change the input configuration. The 'Plus' version of the software, available as an optional add-on, enables advanced configuration. It allows signals to be grouped and an input to be freely assigned to a selected LED indicator or repeater relay.

3.1. External dimensions

MSA-9 signalling systems are supplied as a cassette or as a set of EURO-19"/3U cassettes, made from chromated aluminium, ensuring enhanced immunity to EMC interference.
The MSA-9 64-signal set fits into one cassette with the following dimensions:
19"/3U/240 (483×133.5×245 mm),
The MSA-9 128-signal set fits into two cassettes with overall dimensions:
19″/6U/240 (483×267×245 mm).
Each subsequent expansion of the device by further 64 signals adds further cassettes to the set, with dimensions of:
19"/3U/240 (483×133.5×245 mm).

Additionally, at the rear of the device, a space about 55 mm deep should be provided for connecting the external installation wiring using multi-pin connectors. All the drawings on this page show the 128-signal set, comprising a cassette with a Test and Reset panel, an additional cassette without it, and a panel of audible indicators.
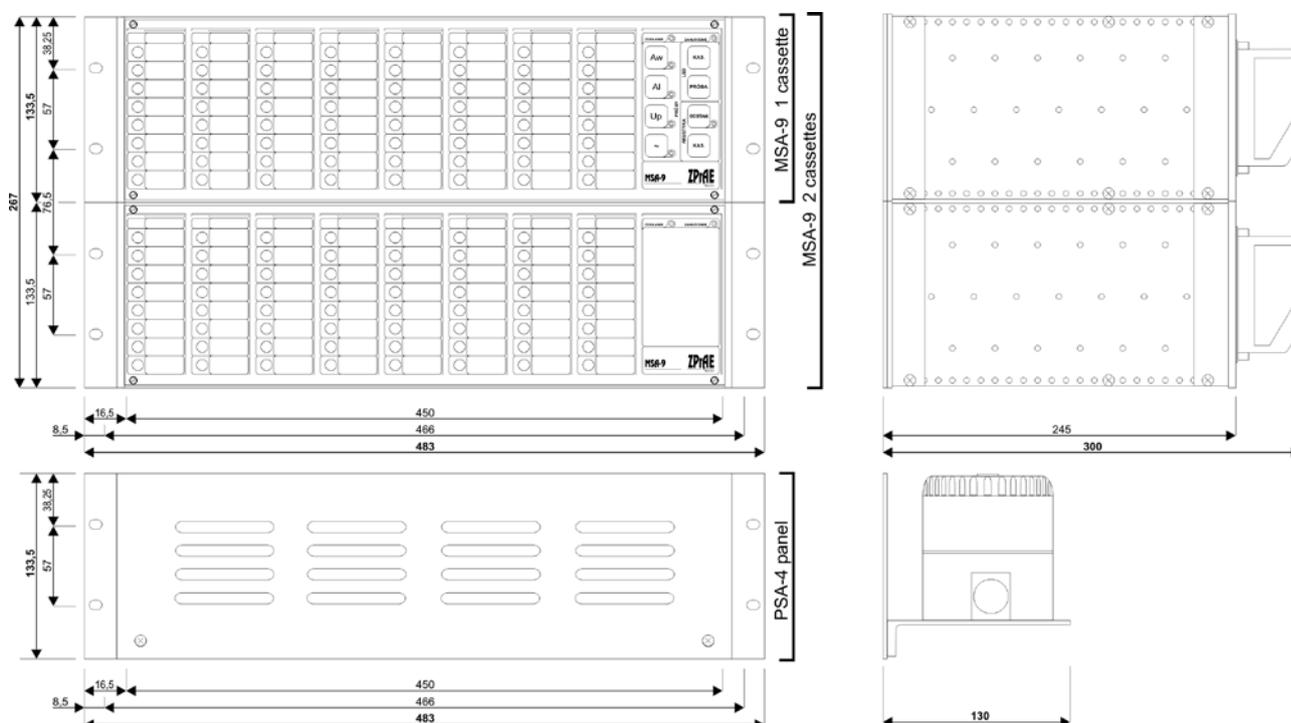

Fig. 3.1 Overall dimensions of the MSA-9 signalling system and the PSA-4 panel.

The following subsections describe the individual parts of the MSA-9, such as the front panel, rear panel with connector layout, and individual cards.

3.2. Front panel
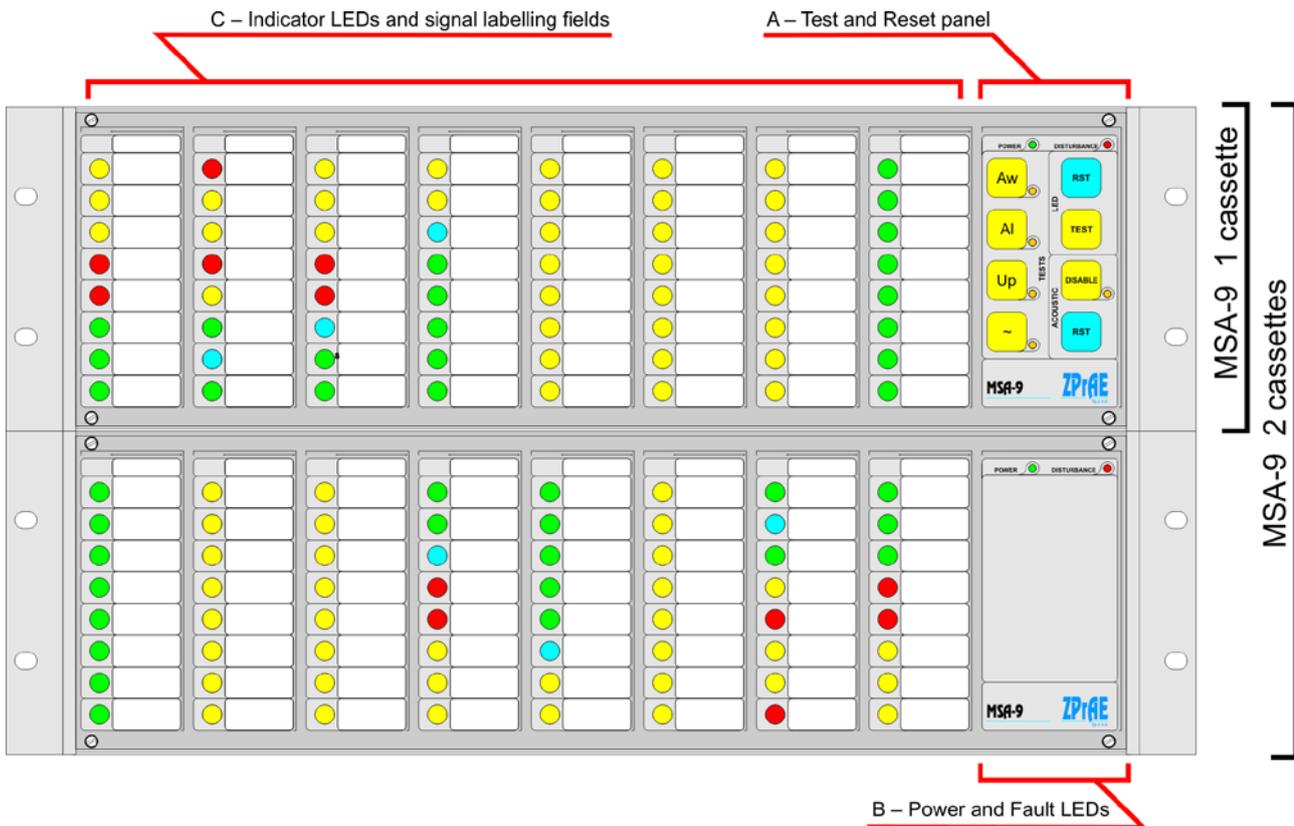
Fig. 3.2 Front panel of the MSA-9 signalling system.

The MSA-9 front panel includes:

A – Test and Reset panel

On the right-hand side of the front panel is a control panel consisting of eight buttons arranged in three groups for resetting and testing, and five LED indicators. In multi-cassette sets, this panel is present only on the first cassette.

- **LED** group:
  - *- KAS* - allows for resetting of the activated optical signals.
  - *- TEST* - causes all indicator LEDs to illuminate.
- **ACOUSTICS** group:
  - *- KAS* - allows for resetting of the activated acoustic signals.
  - *- DISABLE* - disables the acoustic function.

Disabling of the acoustic signalling is indicated by the yellow LED on the side of the button lighting up.

- **TESTS** group:
  - *- Aw* - allows you to check the Aw audio channel.
  - *- AI* - allows you to check the AI audio channel.
  - *- Up* - allows you to test the Up audio channel.
  - *- ~* - allows checking of the ~ audio channel.

Activation of the given group is indicated by the illumination of the corresponding yellow LED located on the side of the button.

B – Power and Fault LEDs

In the upper right corner of the cassette there are two LEDs indicating the operating condition of the unit.

- ***POWER*** – glows green when the unit is powered.
- ***FAULT*** – lights up red in the event of an internal fault.

C – Indicator LEDs and signal labelling fields

This part of the front panel features sixty-four signal LEDs and labelling fields enabling their identification with the appropriate signal text. The MSA-9's optical signalling elements are multicolour high-brightness RGB LEDs with a light-emitting area diameter of eight millimetres. The LEDs are grouped in sets of eight across eight rows, with a labelling field beside each row. For a single LED, the signal label field measures 27 mm × 13 mm (W × H); in addition, above each row there is an auxiliary label field for the group name measuring 27 mm × 7 mm (W × H). Signal labels can be printed on foil or paper and inserted behind the transparent section of the front panel. In the standard configuration with 'Standard' software, the indicator LEDs are assigned sequentially to their corresponding inputs, whereas with 'Plus' software inputs can be freely assigned to the indicator LEDs. This means, for example, that activating input 1 of module 1 does not necessarily cause the first LED in the first group to light up. This is only the default setting; however, the circuit can be configured in any way, and this signal can be used to light a different LED chosen by the user. It is also possible to group signals, which means that any inputs (from one to ten) can cause only one selected LED to light up. This capability allows signals to be organised into logical groups easily and clearly, for example by switchgear panels or by the devices being controlled. Grouping signals in this way does not result in any loss of information about them, either in the monitoring system or in the internal event logger. They are still treated as independent inputs there, only activating a common signal LED.

Fig. 3.31 Front panel of the MSA-9 signalling system for the PMS configuration.

3.3. Rear panel and modules

Fig. 3.4 Rear panel of the MSA-9 signalling system – dual-cassette, 128-signal set.

Fig. 3.5 Rear panel of the MSA-9 signalling system – single-cassette, 64-signal set.

The drawings show the maximum possible number of cards and connectors available on the rear panel.
Depending on the signalling arrangement, it may vary.

On the rear panel, there are card connectors that allow for establishing external connections. Plugs with casings are provided with the device. LgY cables are recommended for external connections. All cassettes are fitted with power and inter-cassette communication connectors, as well as signal input connectors and, when used, repeating connectors. One cassette normally accommodates eight signal input modules (8 cards × 8 input channels = 64 input channels) and eight optional repeater modules (8 cards × 8 repeater contacts = 64 repetitions); the exception is a single-cassette set using the MWA acoustics control card, in which case the number of repeater relays is reduced by eight. In the standard version with "Standard" software, the inputs, indications LEDs and repeating contacts are linked together in a sequential order. Where repeater relays are not required, the modules need not be fitted. It is also possible to configure the signalling with fewer input modules. However, remember that when a number of input channels other than 64 is used, the signals must be grouped and collectively assigned to a selected indicator LED, since the number of optical indicators and labelling fields on the cassette front panel is limited to 64. This means that a single indicator LED can be activated by more than one input signal. It is also possible not to assign the input signal to an LED; it will then not be indicated optically, but it will be visible in the event log and will be transmitted over the communication channels to any supervisory system. Despite a few signals being assigned to a single indicator LED, the fault channels in the monitoring system and in the internal event logger will be recognised and logged separately. Such configurations can be achieved either by using the MSA-9 software in the 'Plus' version, or by specifying them during documentation preparation and when ordering the device. In that case, the device will be supplied in accordance with the customer's requirements. It is also possible to make changes later, for example during start-up or even while the system is running. On the cassette's rear panel there are also connectors for the acoustic control card and the card enabling remote contact-based resetting and testing. In two-cassette units, the Acoustic Control Module (MWA) and the Remote Test and Reset Module (MWS) are located in the lower cassette on its right-hand side; in single-cassette units, unfortunately, the limited space necessitates installing these optional modules in place of the last MWP and MWD modules. This means that, if the acoustic control module is used, the number of repeater relays is limited to 56. When the Remote Test and Reset module is used, the number of input channels is limited to 56. Communication connectors are grouped separately and their types depend on the chosen MGB module version. Optionally, when the clock module is fitted, a GPS antenna connector is also provided there. Connectors and functions of specific cards are described in the paragraphs below.

A – Signal inputs
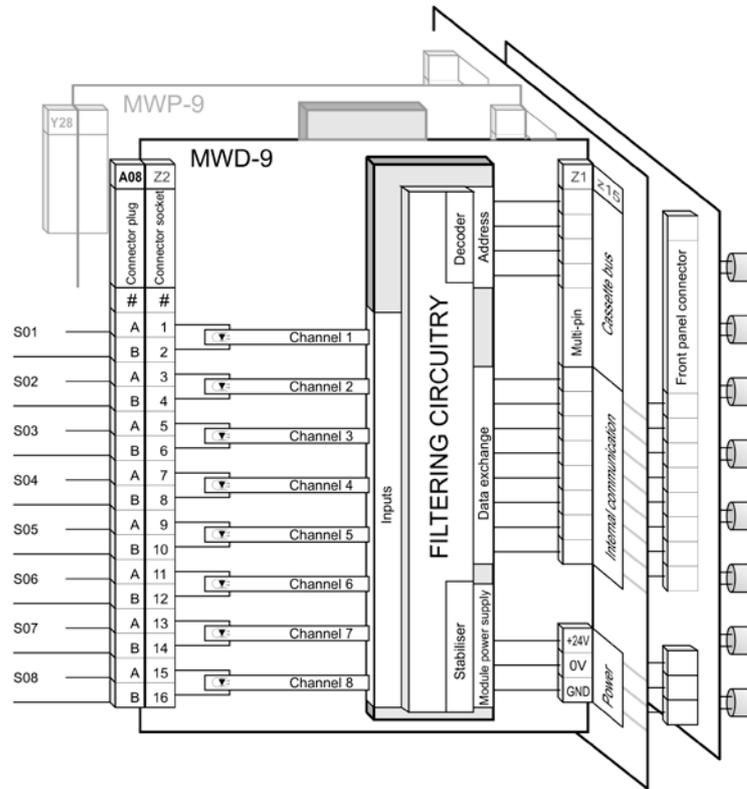
Signal inputs are handled via MWD-type modules.

Fig. 3.6 MWD-9 module.

Each MWD input module comprises 8 separate signal channels. All inputs are, as standard, rated for 220 V DC / 230 V AC. Other special versions are also available, e.g. rated for 110 V DC / 115 V AC or 24 V AC/DC, etc. Each signalling channel input is isolated from the module's internal electronic circuits by optocouplers, ensuring proper mutual isolation of these circuits. Each of the 8 signalling input channels in the MWD module is independent of and isolated from the others, so each input can operate in a different activating circuit. Each can also respond to both the appearance and disappearance of a signal, and can be delayed. The user can easily change the programmed input operating mode and the length of the time delay. Acoustic signalling is activated by three software-controlled signals, and each of the module's signal channels can be freely assigned to one of these three acoustic outputs.

B – Repeating outputs

Repeating contact outputs are supported via MWP-type modules. Their use is optional for applications where contact-based repeating of the input states is required.
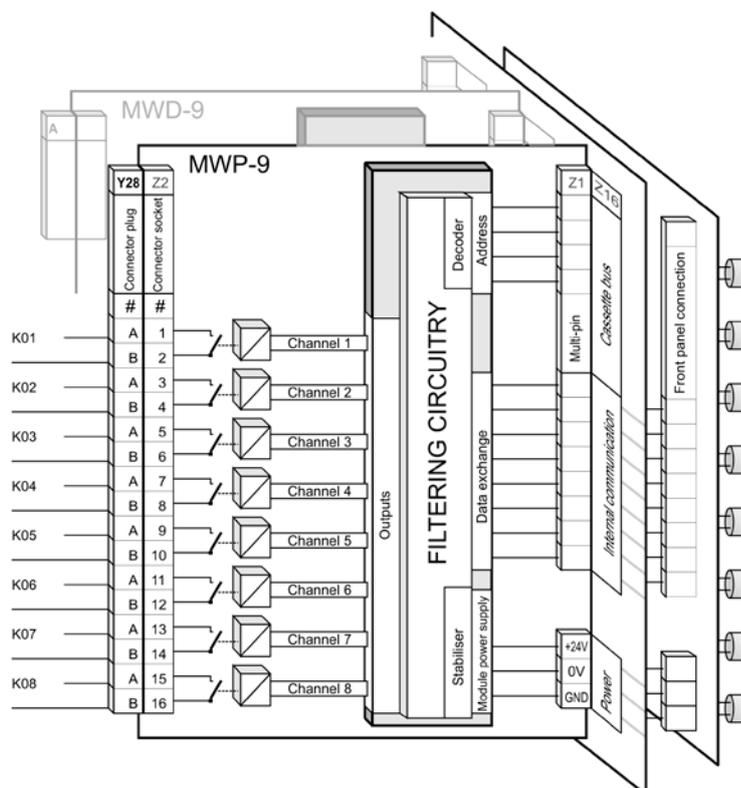
Fig. 3.7 MWP-9 module.

Each repeating outputs MWP module contains 8 individual repeater relays. With this module, input signals can be repeated individually or in groups. Each relay can repeat any fault signal or can act as a collective signal for a group of two to eight input signals. The grouping of signals for their repetition via the MWP module contact is completely independent of the grouping of optical signalling signals. This means that input activations are signalled by separate LEDs on the front panel and may be grouped into a single repeating contact.

C – Power supply

The device is powered from a twin MZA power supply unit.
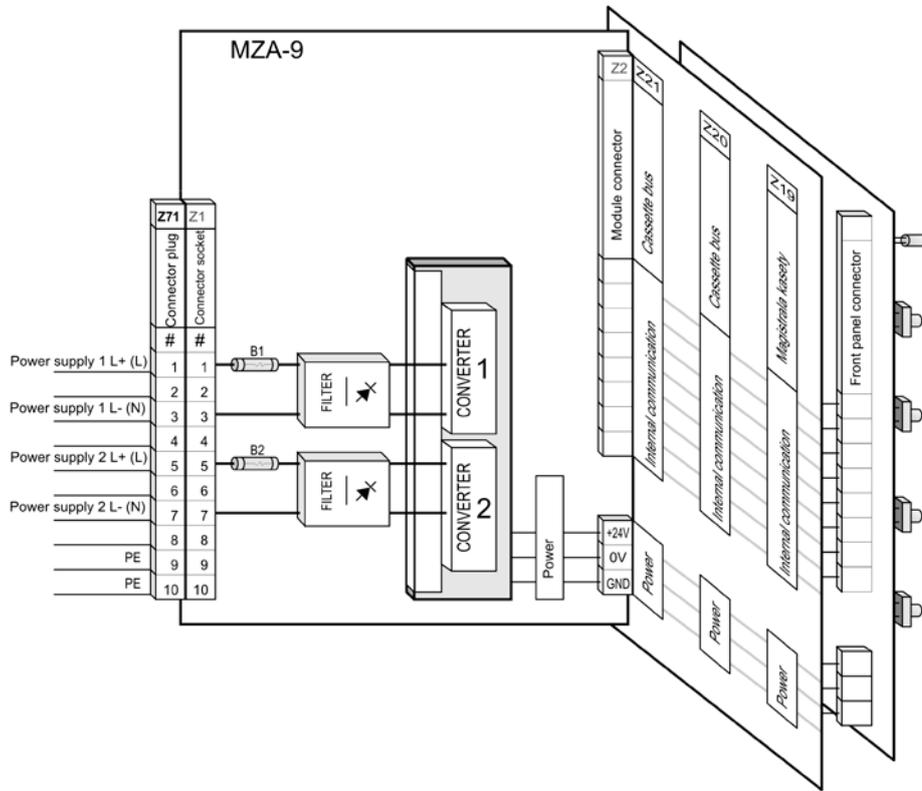
Fig. 3.8 MZA-9 module

The MZA power supply module includes two power inputs and two independent converters. Each can be powered by an independent 220 V DC or 230 V AC supply. Two independent power feeds ensure full power redundancy. The presence of any one of the MZA-9 module's power supplies ensures proper operation of one complete cassette. A single power supply ensures proper operation of the 128-signal set; larger sets are fitted with additional power supplies.

D – Acoustic control – MWA module

The MWA-type module is intended to control acoustic sounders. Use of the module is optional, depending on whether the signalling is to be fitted with an audible signalling system. This module is identical to the MWP output modules; it differs only in the software that determines its intended use.

Fig. 3.9 MWA-9 Module

By default, this module is configured with relay outputs for controlling acoustic sounders or an indicator lamp:

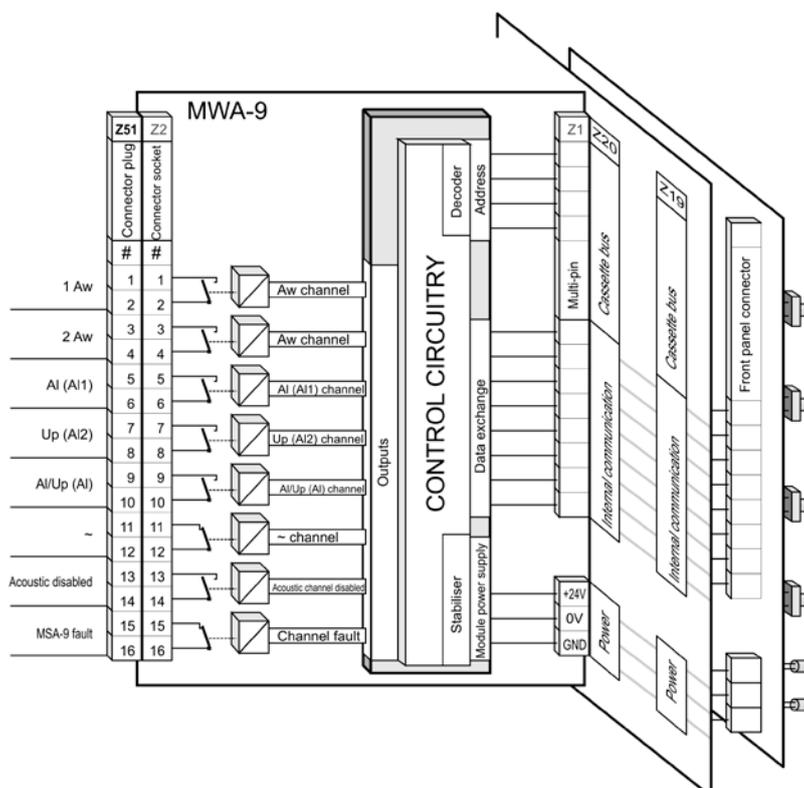- Output 1, "Aw Sounder", turns on the Aw acoustic sounder,
-
- Output 3, "AI Sounder", turns on the AI acoustic sounder,
- Output 4, "Up Sounder", turn on the Up acoustic sounder,
- Output 5, "AI / Up Sounder", turns on the common acoustic sounder for AI and Up,
- Output 6 "~ Sounder", turns on the ~ acoustic sounder. Depending on the configuration, either an active or a passive relay contact is used.
- Output 7, "Acoustics Disabled", switches on the indicator lamp to indicate that the sounders have been disabled.
- Output 8, "Device Fault" – this signal occurs in the event of loss of supply voltages or an internal device failure; a volt-free relay contact is used.

The MWA module provides several ways of disabling the audio channels:

- option to disconnect only the basic audio channels (Aw (output 1), AI (output 3), UP (output 4)
- option to disable only the auxiliary audio channels (Aw (output 2), AI/Up (output 4)
- option to disconnect the primary and auxiliary audio channels (outputs 1 to 5)
- inability to disable any audio track

In specific cases, a greater number of acoustic channels is required, e.g. for trunking communications. Support for a greater number of acoustic channels is possible through the use of additional MWA modules.

In MWA module no. 2, the output channels are arranged on the connector in the same way as in the basic acoustics module, with the difference that the optional disabling of channels will apply to all outputs (there is no distinction between basic and aux acoustics channels).

It is possible to equip the unit with MWA module no. 3, which has the same acoustic channels as the basic module. In MWA module no. 3, it is not possible to disable channels.

E – Remote test and reset inputs – MWS module

Remote test and reset inputs are handled by the MWS module. The use of the module is optional if the signalling system is to have the capability of remote resetting and testing. This module is identical to the MWP input modules; it differs only in the software that determines its intended use.
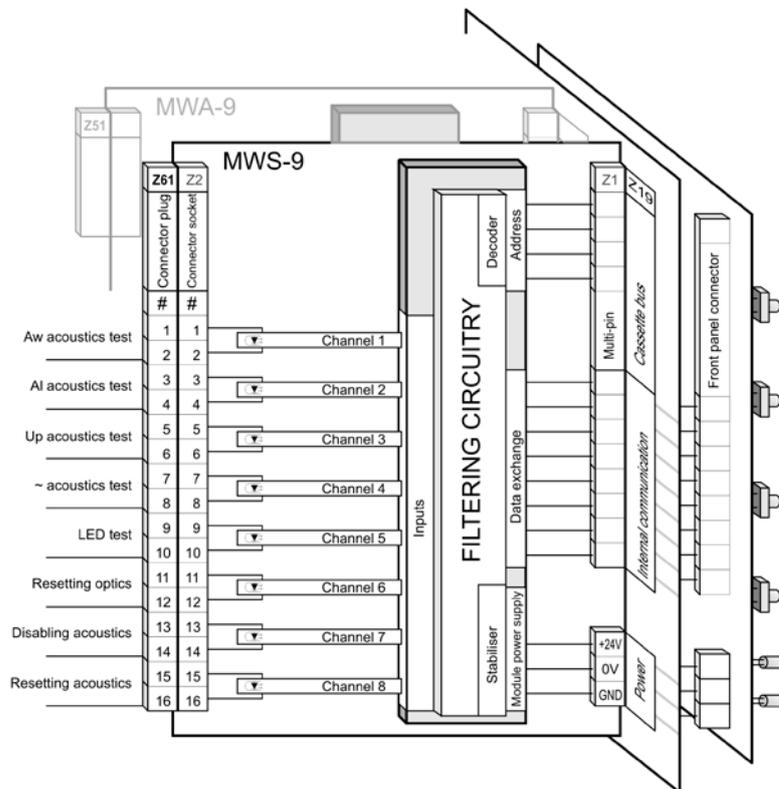
Fig. 3.10 MWS-9 Module

This module has, as standard, inputs configured for testing and remote reset via the contacts of push-buttons or relays:

- Input 1, "Aw Acoustic Test", allows the Aw acoustic channel to be checked,
- Input 2, "Al Acoustic Test", allows the Al acoustic channel to be checked,
- Input 3, "Up Acoustic Test", allows the Up acoustic channel to be checked,
- Input 4, "~ Acoustic Test", allows the ~ acoustic channel to be checked,
- Input 5, "LED Test", causes all signalling LEDs to light up in order to check that they are working correctly,
-
- Input 7, "Disable sounders", disables the audible sounders,
- Input 8, "Acoustic reset", resets active audible signals.

F – Logic – MLB module

The cassette's internal logic module is responsible for synchronising the device operation and internal inter-module communication.
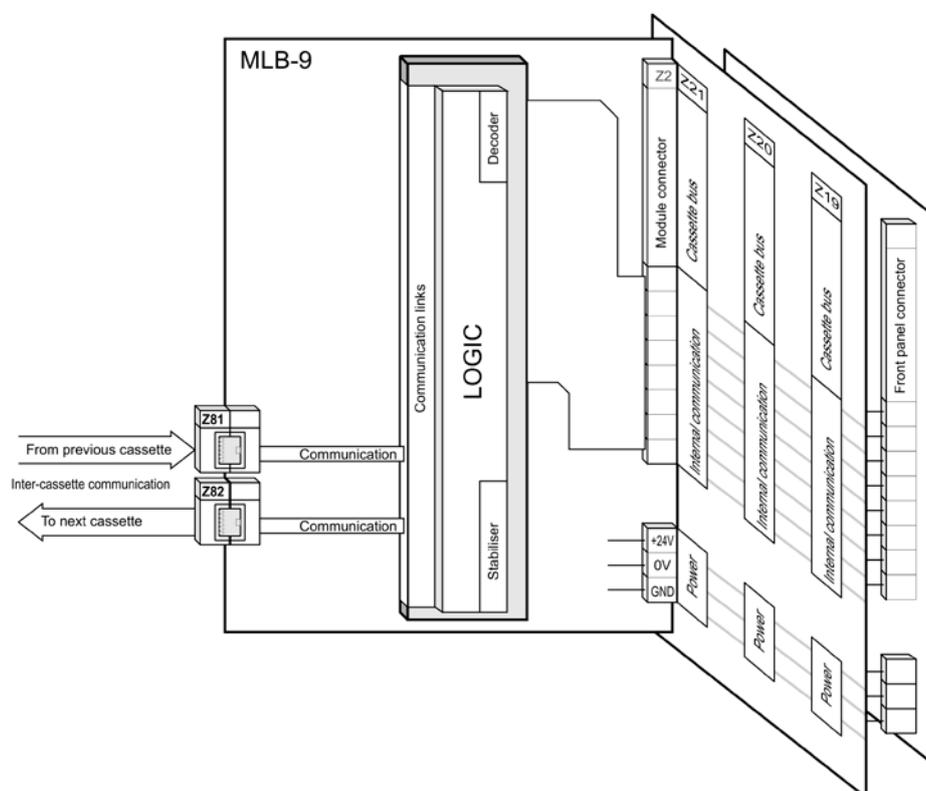
Fig. 3.11 MLB-9 module

On the rear panel of the module there are connectors for inter-cassette communication, used in complex, distributed multi-cassette systems.

G – External communication – MGB module

The MGB module is responsible for external communication with supervisory systems or station computers. This module also serves as the main data buffer. It features event log memory capable of storing up to 10,000 events with 1 ms resolution. The memory used is non-volatile, i.e. switching off the power does not erase the event buffer.

Due to the large number of available versions and the different communication options, information on the MGB modules is included in a separate MGB-9 communication modules data sheet.

3.4. Sounders

The PSA-4 panel is intended to provide audible notification of detected disturbances. It enables rapid identification of an imminent disturbance, as it is equipped with four sounders with programmable tone modulation.
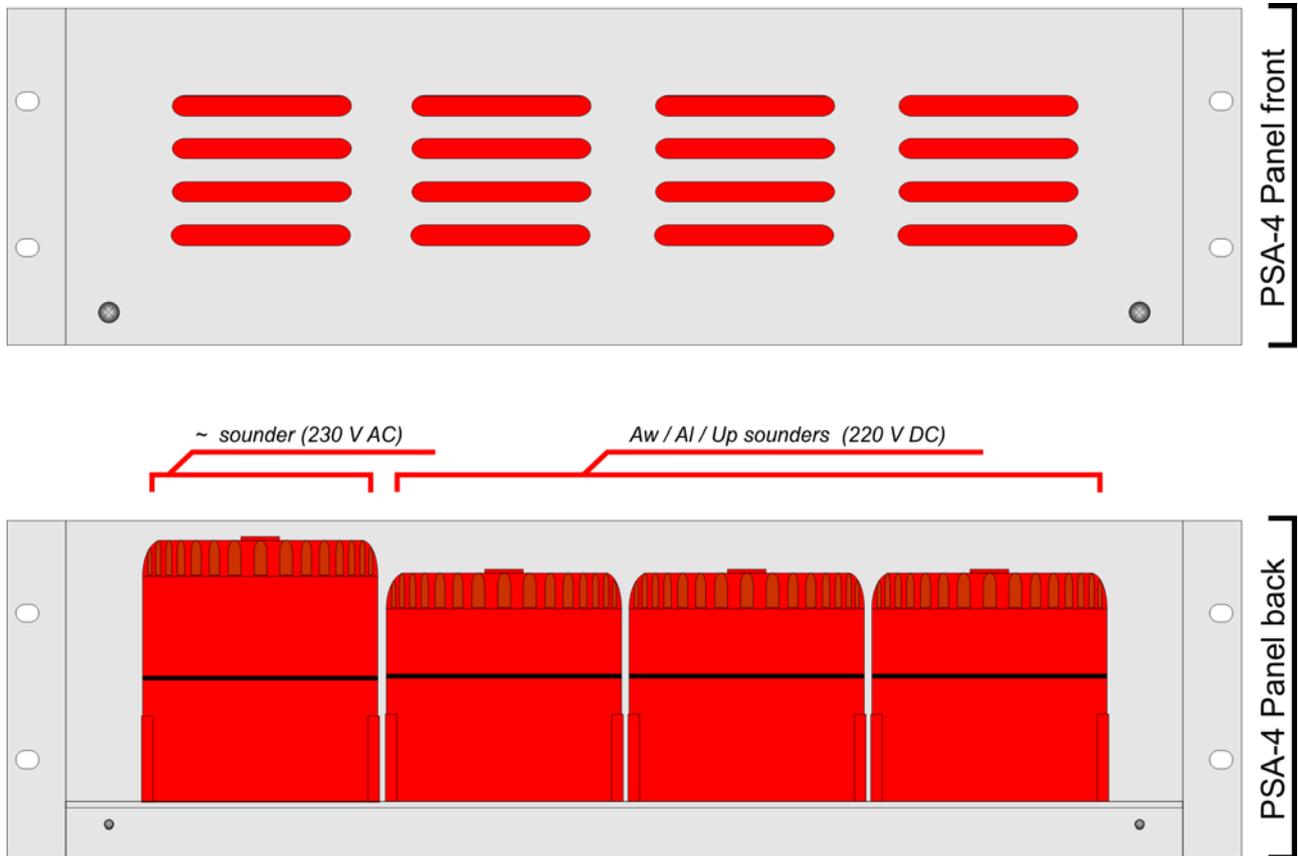
Fig. 3.12 Acoustic sounder panel

Three sounders rated for 220 (110) V DC, and one rated for 230 V AC. The panel is designed to work with the MWA acoustic control module; the individual sounders are controlled by the module's respective outputs:
-        The "Aw" sounder is activated by output E01 / Z51 / 1 - 2,
-        The "Al" sounder is activated by output E01 / Z51 / 5 - 6,
-        The "Up" sounder is activated by output E01 / Z51 / 7 - 8,
-        The "~" sounder is activated by output E01 / Z51 / 11 – 12.

4. PRINCIPLE OF OPERATION

The primary function of central signalling systems is to receive signals, visualise them and provide audible notification, as well as to group input signals and assign them appropriate priorities. These objectives are achieved as follows:

Activation of one of the module's input channels causes fast flashing (2 Hz) of the light in that channel, actuates the repeater relay, and generates a pulse that triggers the corresponding acoustic channel in accordance with the selected configuration. The operator acknowledges an alarm by first silencing the sounder using the „KASOWANIE AKUSTYKI" button, and then, having located and observed the relevant rapidly flashing visual signal, acknowledges it by pressing the „KASOWANIE LED" button. Depending on the needs of the particular facility and the user's requirements, the MSA-9 signalling system can operate in two modes, selectable in the application. Operation with a slow-flashing light, or operation without a slow-flashing light.

When operating with a slow flashing light after the LED has been reset:
- If, during resetting, the fault persists, the indicator LED lights continuously.
- However, if the disturbance was brief and has already ceased, then after clearing the indicator LED goes out, returning to a standby state awaiting further disturbances.
- If the indicator LED is lit continuously and the input disturbance clears, it switches to slow-flashing mode. This light can be reset using the 'KASOWANIE LED' button; after resetting, the indicator LED is switched off, thereby entering a standby state awaiting any further disturbance.
- If the indicator is in slow flashing mode and the channel is activated again, the indicator reverts to steady light.

In some facilities, particularly power plants, an "AI" acoustic pulse is also generated when the slow flashing light appears. The MSA-9 has this capability, which can be enabled by the user via software. This option is selected during configuration of the device: „Pobudzenie akustyki AI od światła migowego wolnego" (Acoustic AI activation by the slow flashing light).

When operating without the slow flashing light function after resetting the LED:
- If, during resetting, the disturbance persists, the indicator LED lights continuously.
- However, if the disturbance was short-lived and has already subsided, then after reset the indicator LED is extinguished, thereby returning to standby to await further disturbances.
- If the indicator LED is lit continuously and the disturbance at the input ceases, it is automatically switched off, returning to standby to await the next disturbance.

Additionally, in the MSA-9 signalling system, two further operating modes can be selected for each input:
- "Brak światła migowego" (No flashing light): in this case, the indicator LED assigned to this channel simply mirrors the input state. There is no need to reset it; the LED's steady illumination merely reflects the activation state of the signal input.
- "Samokasowanie" (Auto-reset): in this case, the indicator LED assigned to this channel operates with a self-reset function. If the activation ceases, the LED will be switched off, thus entering standby mode and awaiting a further disturbance. Also in this case there is no need to reset the lights manually.

4.1. Signal inputs

Signal inputs can be configured to trigger on both the appearance and the disappearance of the input signal. A time delay for activation and return is also possible. The signalling detects the presence of a disturbance if it lasts at least 5 ms for DC signals and 20 ms for AC signals. A disturbance is deemed to have ceased if the disturbance-free interval lasts 10 ms for DC signals and 30 ms for AC signals. Input configuration is carried out from a computer connected to the device, on which the software supplied with the MSA-9 has been installed. The most important of the settings for individual input channels available in the 'Standard' and 'Plus' versions of the software are:

✓ activation of signalling inputs on loss or appearance of a signal at the input,
✓ assigning signal inputs to selected audio channels Aw/AI(AI1)/Up(AI2),
✓ setting the activation on- and off-delay times for signal inputs,
✓ optional selection of the operating mode with latching of the repeating contact until reset,
✓ determination of the DC or AC input signal voltage,
✓ the option to select an operating mode without a flashing light, to mirror the state,
✓ optional selection of an operating mode with automatic reset,
✓ assigning a name to the signal input; this label will be visible on the event logger list and, in the case of the 'Standard' software, in the view window for the group of eight indicator LEDs, as well as in the description of any repeating contacts. However, in the "Plus" software the indicator LED name is edited separately because signals can be grouped. One LED may be activated by a pair of input signals, for example from different panel protective relays, and the names of the inputs for the recorder and for transmission to the supervisory system will differ, while the LED may carry a general label "Disturbance in panel XX". For the same reasons, the labels of the repeating contacts in the "Plus" software are edited separately.

You can also set the operating mode for the entire device:

✓ with a slow-flashing light or without it,
✓ turning the flashing light off in the event of a transient disturbance,
✓ with the AI audible alarm activated upon switching to a slow flashing light.

4.2. Indicator LEDs

The indicator LEDs reflect the state of the inputs; their illumination and the logic for switching to flashing mode or switching off are described above in the PRINCIPLE OF OPERATION section. The multi-colour LEDs used in the device further facilitate rapid identification of the type of disturbance; the LED colour can be set to yellow, red, blue, green, violet or white. The standard factory configuration of the LED indicators for typical 64-signal cassettes with 'Standard' software is their individual assignment to the respective input channels, according to the rule: first input – first LED, second input – second LED, third input – third LED… etc. In this situation, the input label also serves as the label of the LED indicator. With the 'Plus' software, it is possible to programmatically assign a given indicator LED to any single input, or to group inputs (from two to eight) and have them signalled by a single selected LED. In this case, the label of the indicator LED is edited separately by the person configuring it.

Testing and resetting of the LED indicators is possible from the front panel or via the software, and, if an MWS-type module is used, also via relay or push-button contacts external to the MSA-9 unit.

4.3. Repeating outputs

Repeating outputs can reflect the state of the inputs. The standard configuration of the repeating outputs (if all 64 are present) for typical 64-signal cassettes with 'Standard' software is their individual assignment to the respective input channels, according to the rule: first input – first contact, second input – second contact, third input – third contact… etc. In this situation, the input label also serves as the label of the repeating contact. With the 'Plus' software, it is possible to programmatically assign a given contact to any single input, or to group inputs (from two to eight) and repeat their state. In this case, the label of the repeating contact is edited separately by the person configuring it.

Depending on the chosen input configuration option, the repeating contact assigned to a specific input signal or group of signals stays closed for as long as the activation at the input of that channel, or one of the channels in the group, lasts and isn't dependent on resetting the signalling. Or when you pick the "Podtrzymanie powielenia" (Hold repetition) option, the contact stays active until the "LED Reset" moment.

4.4. Acoustics

The signalling system has an integrated system for controlling the sounders. A specially configured MWA-type module is responsible for enabling individual circuits. This module works with three acoustic channels Aw, Al(Al1), Up(Al2) via an internal communication bus and activates the appropriate sounders connected to the contacts of its relays. The Aw acoustic channel can control two independent sounders, while the Al and Up channels can control individual sounders and a shared third one, for example an additional unit outside the building. The fourth acoustic channel is designed to control the "~" acoustic signal, which is activated in the event of a loss of +/- AwUp voltage supplying the system and the first MSA-9 power supply rail. The second MSA-9 power supply rail should be connected to 230 V AC, the same voltage used to activate the "~" sounder. If both MSA-9 power supply rails are connected to the +/- AwUp voltage, the "~" sounder is activated in the event of the loss of both voltages supplying the signalling. The "~" sounder cannot be deleted or disabled then. It's controlled by the relay's voltage-free contact, and if the power supply goes out, there's no way to turn off the signal. It's recommended to use an external two-position switch to turn off the "~" sounder.

Testing of individual acoustic channels as well as resetting the Aw, Al(Al1), Up(Al2) acoustic channels can be done from the front panel or via the software, and if an MWS-type module is used, also via relay or push-button contacts external to the MSA-9 unit. In a similar way, you can disable the acoustic signalling for the Aw, Al(Al1), Up(Al2) tracks. It is indicated by an LED on the cassette panel and a signalling contact. Internal faults in the MSA-9 are also signalled by an LED on the cassette panel and a signalling contact. As a set of sounders, it is recommended to use the PSA-4 panel consisting of three sounders for 220 V DC (110 V DC) and one operating at 230 V AC.

4.5. Testing and resetting

The MSA-9 cassette, and in the case of multi-cassette sets, one cassette from the set is equipped with a Test and Reset panel available on its front. Testing and resetting can also be performed remotely with relay contacts or buttons via a MWS module. This allows, for example, to move the acoustic reset button closer to the operating panel.

Each button on the module and the control channels of the MWS module are fitted with an error control system. This means that if any control button becomes stuck in the pressed position, its operation is disabled and a control button fault is recorded in the event logger. The permitted button operation time is 10 seconds.

4.6. Event recorder

The main memory of the recorder allows you to archive up to 10,000 events with a resolution of 1 ms. The events are generated by the logic of an MLB device and then sent to an MGB hub where they are stored in the memory. In the case of too many events, the oldest data will be lost (overwritten).

Moreover, the event recorder is also equipped with a protection against inflow of false data from the damaged (activated) input channels based on the following standard principles:
- there should be no more than 3 repeated activations within 1 s,
- there should be no more than 6 repeated activations within 10 s.

If the above criterion is exceeded, the recorder will be locked for this channel. The channel is automatically unblocked once it is determined that the above criterion is no longer exceeded. These events will be recorded as:
- channel xxx recorder locked,
- channel xxx recorder unlocked.

Data from the recorder can be sent to a primary control and monitoring system. They can also be viewed in a main program window.

5. SOFTWARE

5.1. Installing and running the software

Along with the central MSA-9 signalling device, the user receives software for its configuration and operation. The software is available in two versions: "standard" which is always supplied with each MSA-9 device, or "Plus" available as an additional option. Installation files are provided on CD-ROM discs. To kick off the installation, just run the SETUP.EXE file and then follow the prompts from the installer. Files necessary for the operation of the software will be copied to the computer, and a data folder for events at a given facility will be created (during installation, the location on the disk can be selected), in which data files copied from the device memory (with the *.ZP6 extension) will be saved. The data folder location depends on the Windows version:
- for Windows XP, the folder is:
        C:\Documents and Settings\All Users\Application Data\ZPrAE\Data
- for Windows Vista/7/10, it is:
        C:\ProgramData\ZPrAE\

After installing the software a shortcut to ZPrAE–EDIT will be added in the **Programmes** menu / **ZPrAE Sp. z o.o.** folder.

5.2. Getting started with ZPrAE - EDIT

You can launch the app from the START menu in the **ZPrAE Sp. z o.o.** folder by clicking on the **ZPrAE-EDIT** file, or by running the **ZPrAE-EDIT.exe** executable file directly (from the installation folder). After the software is launched, the main window will be displayed; it can be used to view event recorder contents or to access more windows to check the status of the indicator LEDs and configure the signalling system.

Fig. 5.1 Main window of the program.

Before starting work, the connection to the device should be configured correctly, unless the app has been used before and the configuration has been saved. In order to introduce changes make the following selection in the main menu: OPCJE (OPTIONS) and then PARAMETRY POŁĄCZENIA (CONNECTION PARAMETERS), and a port and connection speed selection window will appear.
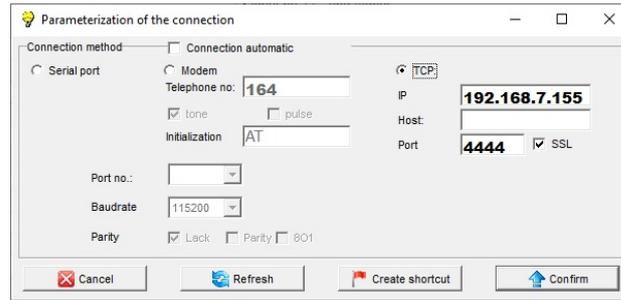
Fig. 5.2 Connection parameters window

Depending on the version of the MGB hub, you may have the option to choose the type of the transmission medium: RS232, RS485, Ethernet.

In the case of using serial connections, click on the "Port szeregowy" (Serial port) option, set "Parzystość" (Parity), and then specify the appropriate COM port number and the transmission speed, which is normally 115,200 bps.

In the case of Ethernet connectivity, click on "Łącze TCP" (TCP link) and provide the device IP address and port number, and turn on SSL encryption. If a traditional external dial-up modem is used, choose the Modem option, select the type of dialling (tone or pulse) and enter relevant start-up sequence and telephone number. Transmission speed is by default set to 115,200 bps. It is possible to use a different speed, but this must be agreed in advance.

After selecting all the transmission options, you need to click ZATWIERDŹ (CONFIRM), which will save the connection configuration. You can also create a shortcut to the program with this configured connection, for example, if you have several devices on the same TCP link, you can create a shortcut (icon) for MSA-9 No. 1 and MSA-9 No. 2.

If you're connecting via Ethernet, you can use a LAN device scanner. To do this, you need to select from the menu OPCJE (OPTIONS) > SZUKAJ URZĄDZEŃ W SIECI LAN (SEARCH FOR DEVICES ON THE LAN). Upon selecting this option, a window will appear as shown in the figure below. The program will automatically list the devices along with their IP connection parameters. To connect to a device, just double-click on the chosen one.

Fig. 5.3 LAN device search window

To establish a connection, press the START button located in the program's main button group. The software will then search for available devices on the selected transmission channel; select ZAŁĄCZ SKANER (INITIATE SCANNING) to begin. Other devices may use the same connection; therefore it is necessary to select the device to connect to. If there is one device on the channel the software displays the name of the device it is assigned to (e.g. MSA under address No. 1), and if there are more devices it displays a corresponding number of device names. Next, highlight the right device and click on POŁĄCZ Z WYBRANYM URZĄDZENIEM (CONNECT WITH THE SELECTED

DEVICE). The software initiates communication with the selected device and closes the selection window.

Fig. 5.4 Device scanner window

Under proper operation, i.e. after establishing a connection with the device and uninterrupted data transmission, the circular indicator on the upper bar of the main window pulsates yellow. A transmission error is indicated by a change of the indicator to red.

For a device with cybersecurity features, a login and password are required for proper communication with the device. You can find more about how to communicate in this mode in section 5.4 and 5.14.

In the upper part of the main window, there are also the following application icons:

- ✕ – close the application,
- 📂 – open the recorded data file,
- 📄 – record events to a *.ZP6 file
- 💾 – record events to a *.TXT text file
- 🖨 – print events (preview),
- 📄 – clear the event tables.

Below the icons, five large buttons have been placed:

- **START (STOP)** – connecting to (disconnecting from) a device,
- **Konfig. wy (Input config.)** – this option allows you to change the settings of the device inputs,
- **Konfig. wy (Output config.)** – this button is only active for the "Plus" version, and it lets you assign and group the contacts of the repeater relays to selected inputs, as well as give them independent names.
- **Widok (View)** – lets you check the status of the device indicator LEDs, and in the "Plus" version, you can also assign and group the indicator LEDs, as well as give them independent names.
- **Zapis zdarzeń do pliku (Save events to a file)** – saves a file with current events to the base folder.

5.3. Authorised actions for individual access levels (device version without information security features)

There are 4 access levels defined for the device: level 0 with no permissions, and three additional levels that give varying permissions for device control.

- Level 0 with no password, granting access to a preview of recorded events, save data to file, preview signalling LEDs, and preview settings.
- Level 1 authorises resetting and testing. Default password: haslo1

- Level 2 allows for setting time on the device based on the system time of the computer. Default password: haslo2
- Level 3 authorises sending new settings and changes to the configuration, etc. to the device. Default password: haslo3

To get to the desired access level, one has to choose OPCJE (OPTIONS), HASŁO (PASSWORD) from the application menu and enter the relevant password. The application will inform the user at which level they have logged in, for example: "Zalogowano na poziom 1" (Logged in at level 1).

To change your password, select OPCJE (OPTIONS) from the menu > ZMIANA HASŁA DOSTĘPU (CHANGE ACCESS PASSWORD) > POZIOM x (LEVEL x). In the dialog that appears after selecting the aforementioned options, enter the old password and then repeat the new access password for the appropriate access level twice. Once you are sure of the change, click the ZATWIERDŹ (CONFIRM) button, and the application confirms the operation.

5.4. Authorised actions for the device version with information security features

The device is designed for up to seven users, who log in using their username and password. The administrator may grant the desired access level to users. The administrator account has the following login credentials:
- user: "admin",
- password: "Password_1234"

The devices are designed to accommodate 7 users and one administrator account. The administrator establishes the login credentials for users by assigning them a username and password. This can be done from the user management panel. Additionally, logged-in users with access levels 3 and 4 have the ability to change the password assigned by the administrator. Access to specific features of the device is access level-dependent. Application features and the required access levels are presented in the table below.

Functionality:	Permission level			
	1	2	3	4
User account management				v
Password change for level 1 users.	v			v
Password change for level 2 users.		v		v
Password change for level 3 users.			v	v
Preview/export of the security log				v
Management of security log forwarding				v
Preview of logged-in users	v	v	v	v
Export of the user list				v
Changing telecommunications hub settings: addresses, speeds, IP addresses			v	v
Overview of events and settings	v	v	v	v
Changing settings (channel configuration, descriptions, signal logic, LED colours, delay times)			v	v
Testing acoustic signals	v	v	v	v
Resetting audible and visual signals	v	v	v	v

5.5. Reading data from the event recorder

In addition to icons and buttons providing access to further functions, the main app window is also the main event log window and contains a table with columns denoting:

- Lp. (no.) – ordinal number of the event
- Data (date) – the date of the event recorded by the device
- Czas (time) – the time of the event recorded by the device (with an accuracy of 1 ms)
- Opis ogólny (generic label) – generic signal name
- Zdarzenie (Event) – detailed signal description (corresponds to the current configuration of the device inputs), the beginnings of input activation are highlighted in bold.
- 1/0 – the beginning and end of the occurrence of a given event

The application allows for the downloading of events in ON-LINE mode (after selecting the POBIERAJ ZDARZENIA (DOWNLOAD EVENTS) option in the ZDARZENIA (EVENT) menu). Upon selecting this option, the application will download archived events from the device that have not yet been retrieved and will proceed to download events in ON-LINE mode. The progress bar visible in the main window of the application indicates the progress of the event retrieval process from the device (a full bar represents 100 events). It is also possible to download a specific number of events by selecting POBIERZ OKREŚLONĄ ILOŚĆ ZDARZEŃ (DOWNLOAD A SPECIFIED NUMBER OF EVENTS) in the ZDARZENIA (EVENTS) menu. The window shown in the figure below will be displayed; enter the number of requested events to download and press ENTER.
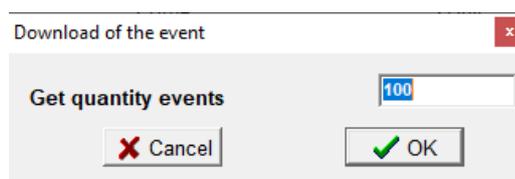
Fig. 5.5 Dialog for entering the number of events to be downloaded.

A ZAPIS AUTOMATYCZNY PO 1000 ZDARZENIACH (AUTO SAVE AFTER 1000 EVENTS) option is also available in the menu. If this option is enabled during ON-LINE download of events, the events will be automatically saved to a file after 1000 events. The file name will consist of the word ZDARZENIA (EVENTS) and the date and time of the record:

„Zdarzenia 2008_03_26 13_03_42_749. ZP6"

The file will be saved in a folder relevant for a given device and created during software installation.

The "Zapis zdarzeń do pliku" (Save events to file) button on the toolbar in the main program window enables saving of last events received and shown in a table of events to a file with a default name described above, and clearing the table of events. When closing the program all unsaved events are saved to a file with a default name in a relevant folder.

5.6. Preview of the device operation

The app allows you to view the status of the indicator LEDs. This feature is available when you hover the cursor and click the "Widok" (View) button. The main visualisation window will display the entire signalling system along with the status of the

LED elements. The overview does not provide detailed descriptions of individual channels, but it enables rapid identification of disturbance; it shows the activated signals. The elements representing the indicator LEDs are arranged in the same way as on the device front panel and reflect their actual status, namely: fast flashing, slow flashing, steady on, and off.

The Test and Reset panel is also fitted in the same way as on the device front panel. Yellow LEDs indicating relay activation are located next to the Aw, AI, Up and ~ acoustic test buttons. Disabling the audibles alarm is also indicated by a yellow LED located next to the "Odstaw" (Disable) button.
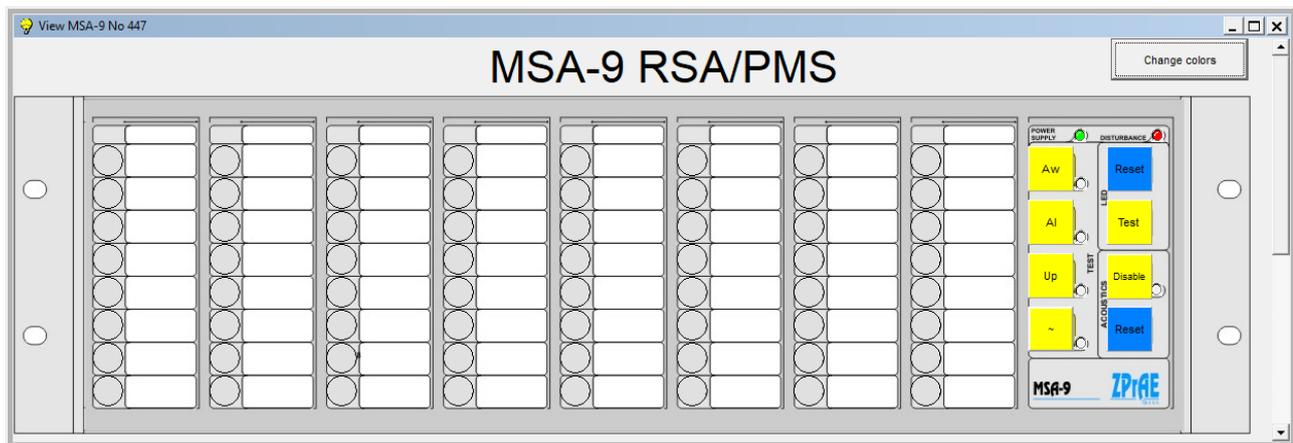
Fig. 5.6 Main visualisation window.

From this window, you can also issue the corresponding commands by hovering the cursor and using the appropriately labelled buttons:

- The "Próba LED" (LED Test) button lights all the indicator LEDs to check that they are illuminating correctly.
- The "Kas. LED" (Reset LEDs) button stops all indicator LEDs from flashing.
- The "Kas. akust." (Acoustic reset) button silences active audible signals.
- The "Aw" button allows you to check the Aw audio channel,
- The "AI" button lets you check the AI audio channel,
- The "Up" button allows you to check the Aw audio channel,
- The "~" button allows you to check the ~ audio channel,
- The "Odstaw akustykę" (Disable sounders) button disables the operation of the sounders,

To read the signal names, hover over and click the selected group of eight indicator LEDs; in the "Plus" program the window for this group will open (Fig. 5.7) or, in the "Standard" program, the input status view window (Fig. 5.10) will be shown.
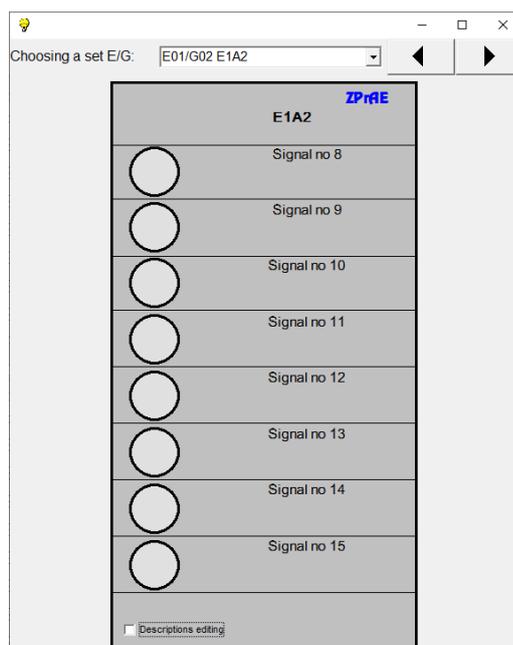
Fig. 5.7 Window of a group of eight indicator LEDs in the "Plus" program.

Like the main visualisation window, it displays the actual signalling status, but only for the selected group of indicator LEDs; this allows the signal labels for that group to be read. At the top of the window you can see which group you're currently viewing, as well as two buttons that let you navigate to the windows of neighbouring groups. If you need to change the labels, select "edycja tekstów" (text editing). Once this option is ticked, the label fields switch to editable mode (white text background) and allow you to make changes. After completing the changes to the labels, untick the "edycja tekstów" (text editing) option, which switches the label fields to preview mode (read-only, grey background) and saves the texts to the device.

The "Plus" software also allows you to assign LEDs to selected inputs; to do this, hover the cursor over the indicator and click it. After selecting this option, a window appears with an 8-input OR gate (logical sum) or an AND gate (logical product) as shown in Fig. 5.8. In the multi-cassette configuration (5 and 6 cassettes), the number of gate inputs is limited to four. In the central section there is a selection field for how many signals should activate the given LED; the maximum number is 8 (4) and the minimum is 1. After selecting the number of signals, a corresponding number of selection boxes appears on the left-hand side of the gate, by means of which the appropriate input can be assigned. The identification of the E/A/S input and the identification of the E/G/H LED are explained in detail in Chapter 6. At the bottom of the window, there are appropriate buttons for submitting the configuration or refreshing it. Above the E/G/H LED code, there are buttons that allow you to navigate to neighbouring indicator LEDs. The "Domyślna konfiguracja diody sygnalizacyjnej" (Default indicator LED configuration) option assigns the same input number as the LED number, e.g. input E01/A01/S08 to LED E01/G01/H08. Additionally, you have the option to change the colour of a single LED using the "Zmień kolor" (Change colour) button.
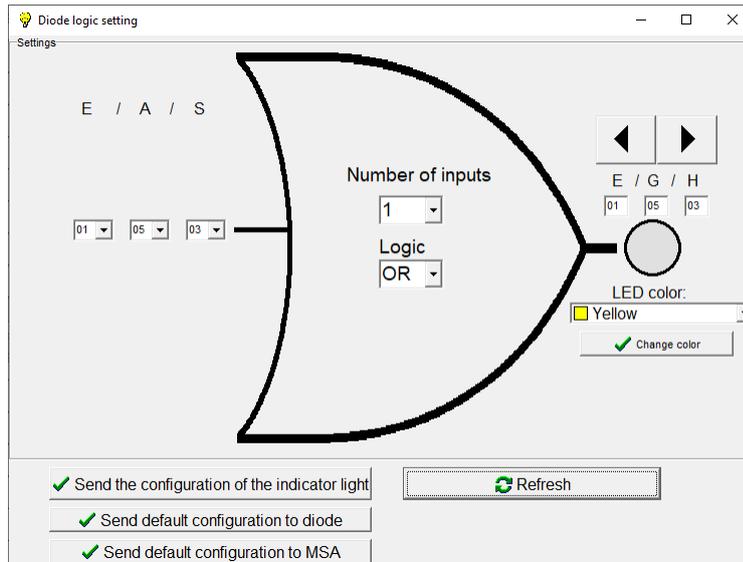
Fig. 5.8 Advanced indicator LED configuration window in the "Plus" version.

If you need to change the colour for a larger group of LEDs, you can use the "Zmień kolory" (Change colours) option available in the main visualisation window. After selecting the aforementioned option, a window appears as in REF _Ref99717562 * Lower \h * MERGEFORMAT Fig. 5.9. This window allows you to select the colours of the LEDs. Each LED can take one of the following colours:

- yellow,
- red,
- green,
- blue,
- purple,
- white,
- special no. 1 (when disturbance occurs, the LED turns red; once reset, it turns yellow),
- special no. 2 (when disturbance occurs, the LED turns yellow; once reset, it turns green),
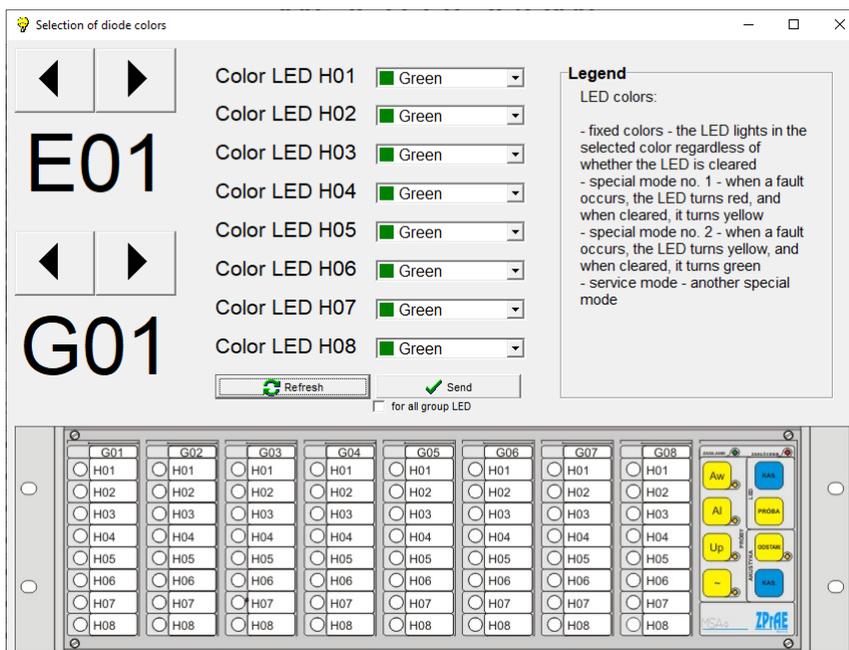
Fig. 5.9 Signalling LED colour selection window.

5.7. Input configuration

To access the window used to configure the module inputs, go to the input status window and click on the appropriate input group, or go there directly from the main window using the "Konfig. we" (Configure inputs) button.
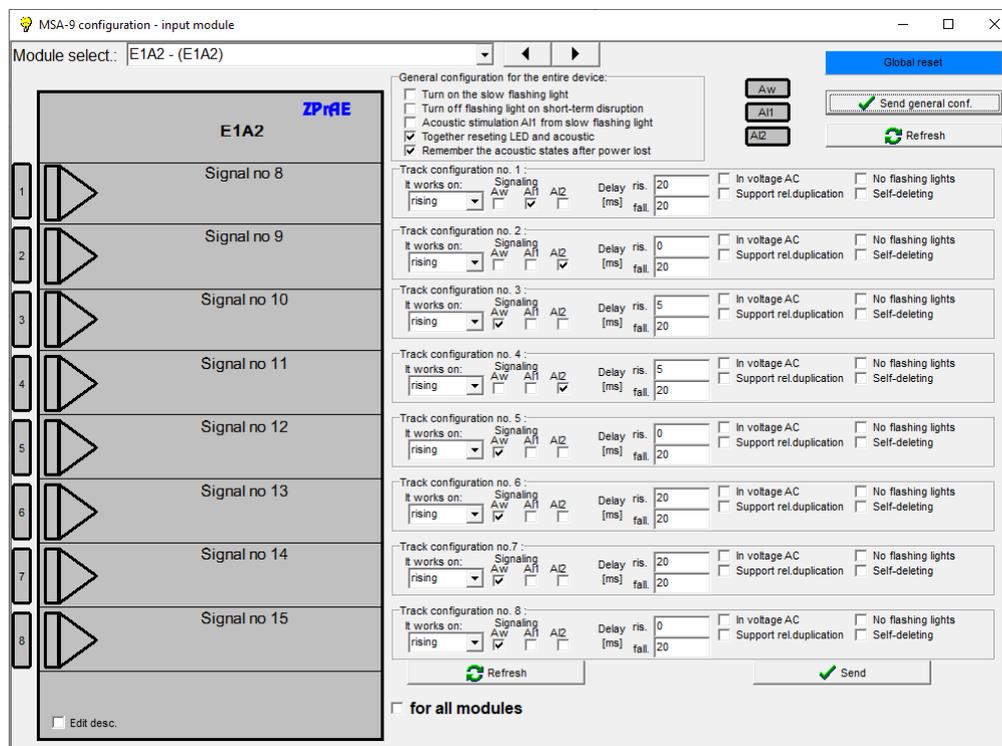
Fig. 5.10 Input configuration window

This window allows you to configure the input channels of the device. On the left side of the window, there are triangles symbolising the inputs, just like in the input status window, which can be in four states: fast flashing light, slow flashing light, continuous signal, and signal off. Next to each entry, there's a name field that you can change using the "edycja tekstów" (text editing) option. To the left of the triangles symbolising the inputs, there are orange rectangles indicating the input status (whether there is voltage), and green rectangles indicating the status of the virtual repeater relay. This signal can be routed to a physical repeater relay. The assignment operation is described in the Output Configuration chapter.

Additionally, in the top right-hand corner, three small squares are positioned, symbolising the activation of one of the audio channels: Aw/AI.(AI1)/Up(AI2).

The most important of the settings for individual input channels available in the 'Standard' and 'Plus' software are:
- ✓ activation of signalling inputs on loss or appearance of a signal at the input,
- ✓ assigning signal inputs to selected audio channels Aw/AI(AI1)/Up(AI2),
- ✓ setting the delay time for the activation and deactivation of signal inputs,
- ✓ optional selection of the operating mode with latching of the repeating contact until reset,
- ✓ determination of the DC or AC input signal voltage,
- ✓ the option to select an operating mode without a flashing light, to mirror the state,
- ✓ optional selection of an operating mode with auto-reset.
- ✓ assigning a name to the signal input; this label will be visible on the event logger list and, in the case of the 'Standard' software, in the view window for the group of

eight indicator LEDs, as well as in the description of any repeating contacts. However, in the "Plus" software the indicator LED name is edited separately because signals can be grouped. One diode can be activated by several input signals, for example from various panel protective relays. The names of the inputs for the recorder and for transmission to the supervisory system will differ, while the LED may carry a general label "Disturbance in panel XX". For the same reasons, the labels of the repeating contacts in the "Plus" software are edited separately.

You can also set the operating mode for the entire device:
- ✓ with a slow-flashing light or without it,
- ✓ turning the flashing light off in the event of a transient disturbance,
- ✓ with the AI audible alarm activated upon switching to a slow flashing light,
- ✓ simultaneous resetting of the LED and the sounder (no requirement to first silence the sounder and then reset the LED),
- ✓ with remembering audio states after a power failure.

After making changes in the input configuration window, send the selected configuration to the module using the "Wyślij" (Send) button. If you do not confirm the changes, use the "Odśwież" (Refresh) button, which will revert all the options for that module to their previous settings.

If you want to configure the entire signalling in this way, select the "dla wszystkich modułów" (for all modules) option and press the "Wyślij" (Send) button.

5.8. Output preview and configuration.

To access the window used for configuring and viewing the output module, go to the main program window and use the "Konfig. Wy" (Output config.) button or the "Widok Wy" (Output view) button in the "Standard" app version. In the "Standard" program, this window allows you to check the repeater relays in the MWP modules or the relay states in the MWA/MWZ module.
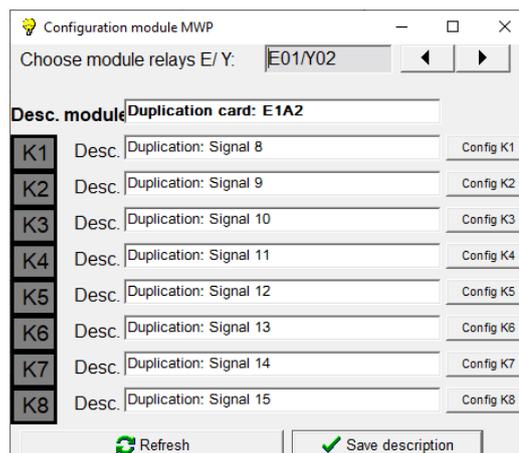
Fig. 5.11 Output module configuration window in the "Plus" app.

This window of the "Plus" app lets you change the labels of the output relays. When assigning a group of inputs to a single relay, use a general label for that signal group, e.g. "Panel number 1 is down". You need to enter the label in the edit box and then hit the "Zapisz opisy" (Save labels) button to confirm the change. If the input signals activating a given relay change, use the "Konfig. Kx" (Kx config.) button. After selecting this option, a

window appears with an 8-input OR gate (so-called logical sum) or an AND gate (so-called logical product).
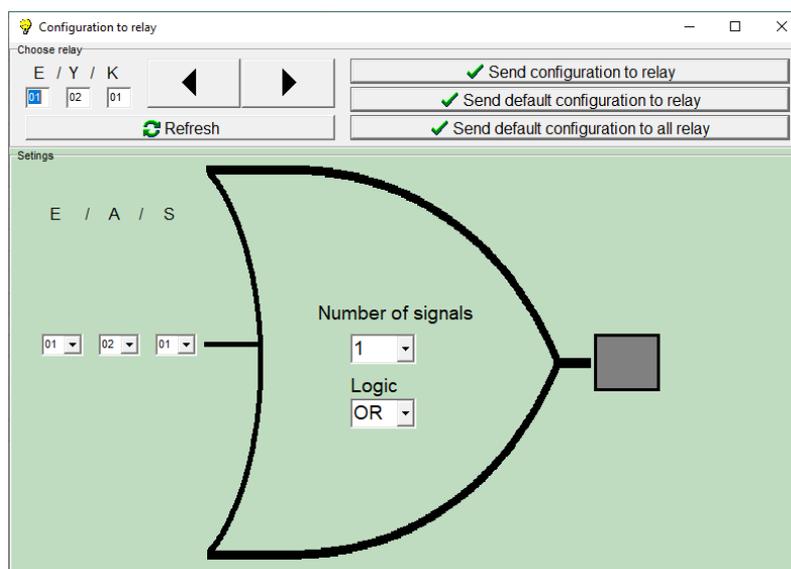
Fig. 5.12 Advanced configuration window for repeater relays in the "Plus" app.

In the central part, there is a selection box for the number of signals to activate a given relay, the maximum number is 8, and the minimum number is 1, and a selection of the logic type for the logical sum (OR) or logical product (AND) of the signals. In the multi-cassette configuration (5 and 6 cassettes), the number of gate inputs is limited to four. After selecting the number of signals, a corresponding number of selection boxes appears on the left-hand side of the gate, by means of which the appropriate input can be assigned. The identification of the E/A/S input and the identification of the E/Y/K relay are explained in detail in Chapter 7. At the top of the window, there are appropriate buttons for submitting the configuration, selecting the default configuration (E01/A01/K01 > E01/Y01/K01), and refreshing the settings. Next to the E/Y/K relay code, there are buttons that let you navigate to neighbouring repeater relays.

5.9. Export of MSA settings

The MSA application allows you to generate a file containing the device settings. Once the signalling has been correctly configured, the settings can be exported to a *.CSV file, which can be opened using software such as Excel. This file contains all the settings for the inputs, outputs and LED indicators, as well as for the serial communication channels and the TCP server. In order to generate the file, use the menu: OPCJE (OPTIONS) > EKSPORT NASTAW MSA DO CVS (EXPORT MSA SETTINGS TO CVS).

To archive settings that can serve as a backup, export the settings to a BIN file (OPCJE (OPTIONS) > EKSPORT NASTAW MSA DO BIN (EXPORT MSA SETTINGS TO BIN)). To restore settings from a file, use the menu: OPCJE (OPTIONS) > IMPORT NASTAW MSA Z BIN (IMPORT MSA SETTINGS FROM BIN).

5.10. Export of MSA labels

If there is a need to verify signalling labels, e.g. to check the labels on the device front panel or the event descriptions in the supervisory system, the MSA software allows you to generate a file containing input labels and their codes according to the IEC 103 protocol. This can be done via the menu: OPCJE (OPTIONS) > EKSPORT TEKSTÓW

MSA (EXPORT OF MSA TEXTS). The saved file in *.CSV format will contain the FT and IN codes for the entire signalling.

5.11.   Activation of the "Plus" software.

If you would like to expand the functionality of the ZPrAE-Edit "Standard" software to the "Plus" version, where signals assigned to LEDs and the repeat relay can be freely grouped, you should contact the manufacturer, ZPrAE, to obtain an activation code. The code should be entered after opening the appropriate dialog using the following menu options: OPCJE (OPTIONS) > ZPrAE-Edit Plus. Activation is subject to an additional charge.

5.12.   Using the text message sending module

The MGB-9K, MGB-9F.1/L and MGB-9E/L hub versions are fitted with a built-in GSM modem. Hub of this type are capable of sending text messages that can be generated in response to events from the device. The above-mentioned modules have a Z106 socket, where the mobile network operator's SIM card should be inserted. For correct operation, the GSM antenna must be connected to the Z105 connector. The manufacturer provides an antenna with a cable that is approximately 2.5 m long.

The module also has a GPS antenna socket (Z44), to which the synchronisation antenna is connected.

To configure the module, choose "Konfiguruj GSM" (Configure GSM) under "Opcje" (Options) / "Konfiguracja transmisji MGB" (MGB Transmission Configuration) in the main menu of the ZPrAE Edit program.

Module configuration should begin by activating users and assigning them mobile phone numbers as in Fig. 5.13. The MGB-9 module equipped with GSM connectivity allows you to specify up to four users.

If a prepaid card is used, you can specify how often the account balance will be checked. To do this, specify the code for checking the account balance, e.g. *101# for the PLAY operator, and provide the time of the check. A message showing the account balance will be sent to active users.

The user can configure up to 32 different text messages that will be generated on occurrence of an event with specific codes. A single text message can cover up to four different events, i.e. the message will be assigned to a maximum of four events. In the case of the MSA-9, the event address specifies the module number in the cassette, and the event code specifies the input number on the module; for example, for input A2S8 enter address 2 and event code 8.

Fig. 5.13 Configuration window of the MGB-9 module equipped GSM connectivity.

5.13. Configuration of the MGB-9 hub transmission parameters

5.13.1. Basic versions of the MGB-9 hub without IEC 61850 communication

The MGB-9 hub can be fitted with a range of different communication interfaces. They can be configured from the JC display panel or using the ZPrAE EDIT software. To do this, use the menu command OPCJE (OPTIONS) > KONFIGURACJA TRANSMISJI MGB (MGB TRANSMISSION CONFIGURATION).

The following settings are available to the user:

- for the Ethernet communication channel: IP address, TCP port, gateway and subnet mask,
- for serial communication channels: baud rate, transmission address and response delay.

The final parameter is applied when slower transmission converters are employed in communications circuits.
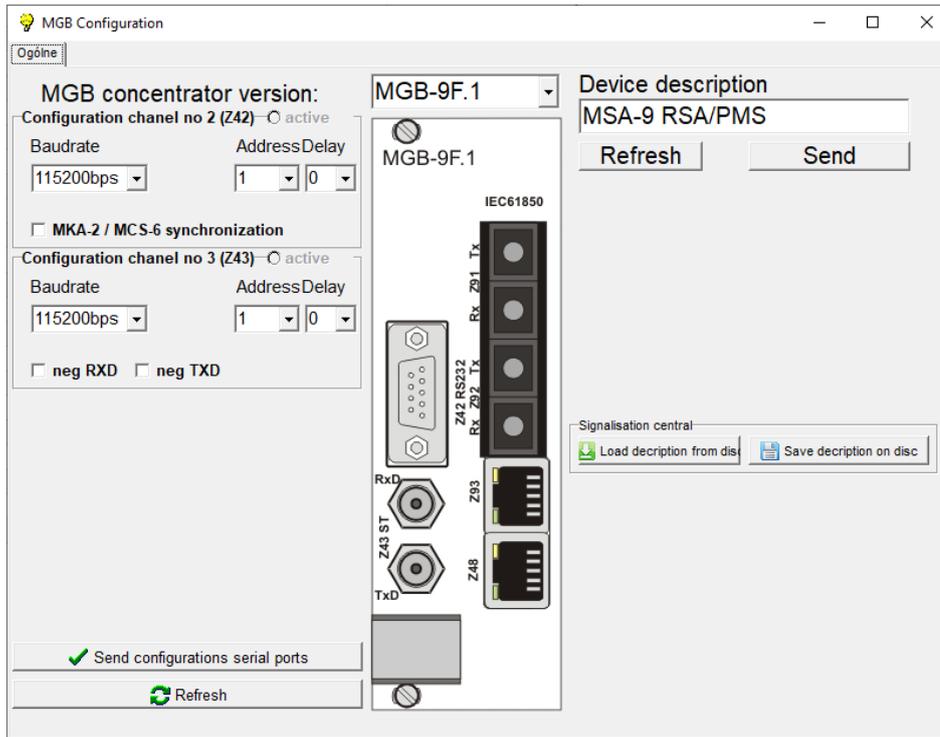
Fig. 5.14 Window for changing MGB settings

5.13.2. Versions of the MGB-9 hub equipped with IEC 61850

communication

To change the communication parameters of a device equipped with IEC61850, use the ZPrAE EDIT software to connect via the interface whose settings are to be changed. For example, to change the Z91, Z92, Z93 or Z48 network interfaces, you need to connect to one of the interfaces in this group. For network interfaces Z141, Z142, Z143 or Z144, you must connect to one of the interfaces in this group. In the device scanner, the device name hub ….. appears at address 0, which you should connect to. To change the settings of the communications hub, select the „Nastawy" (Settings) button from the main menu. After selecting this option, a window will appear as shown in the figures below. For connectors Z91..Z93 and Z48, you can change the device name and the IP address and subnet mask settings. It is possible to configure an NTP server for this interface. However, for connectors Z141…Z142 you can also change the PRP or HSR redundancy mode and select the appropriate type of SFP module. Available types of SFP modules:
- SGMII – electrical module – RJ45 connector
- 100FX – 100 Mb optical module – LC connector
- 1000X – 1000 Mb optical module – LC connector
- 1000T – service module.

Fig. 5.15 Window for changing the settings of the MGB communication connectors Z91, Z92, Z93, Z48.

Fig. 5.16 Window for changing the MGB settings of communication connectors Z141, Z142, Z143, Z144.

5.14.   Description of ICT security functions

5.14.1.   General information

The MSA-9 signalling system with an ICT security function is equipped with the MGB-9F.1/S communications hub. The block diagram is shown in the figure below.
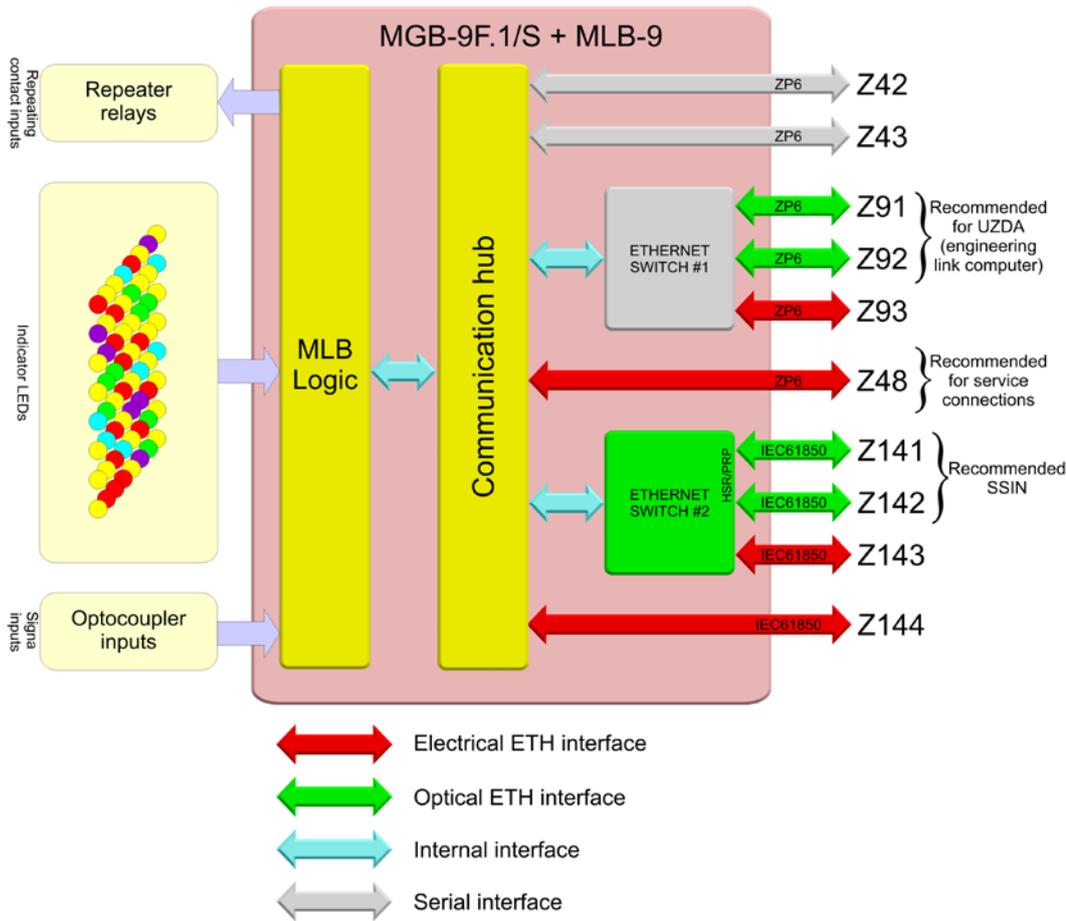
Fig. 5.17. Communication diagram for MSA-9 with the MGB-9F.1/S hub.

The MGB-9F.1/S module is equipped with an RS232 communication channel, an optical serial link and two independent Ethernet ports, optical and electrical. It is recommended for facilities equipped with an SSiN, working with data buses operating under the IEC 61850 protocol in networks with a PRP/HSR redundant topology, and with independent engineering communication using a fibre-optic Ethernet port.

The following communication connectors are present in the MGB-9F.1/S module:

Port	Link	Socket type	Protocol		
Z42	RS232	DB9 F	IEC 870-5-103 / ZP-6		
Z43	Serial optical	ST	IEC 870-5-103 / ZP-6		
Z48	Ethernet / electrical	RJ45	ZP-6/NTP		
Z91	Ethernet / optical	SC	ZP-6/NTP	**Shared IP**	
Z92	Ethernet / optical	SC	ZP-6/NTP		
Z93	Ethernet / electrical	RJ45	ZP-6/NTP		
Z141	Ethernet / optical	LC	IEC 61850/NTP	**Shared IP**	
Z142	Ethernet / optical	LC	IEC 61850/NTP		
Z143	Ethernet / optical	LC	IEC 61850/NTP		
Z144	Ethernet / electrical	RJ45	IEC 61850/NTP		

The RS232 (Z42) port is a service port; the total length of the communication cable should not exceed 3 m. Communication is possible using the IEC60870-5-103 or ZP-6 protocols.

The optical interface (Z43) can be used for communication with the SSiN using the IEC60870-5-103 protocol, or for communication with the device using the manufacturer's software via the ZP-6 protocol. The Ethernet communication channels - optical links Z141 and Z142 - operate within a single subnet and share one IP address, and can be used to communicate with the SSiN via the IEC 61850 protocol in redundant networks with PRP/HSR topology, or, with redundancy disabled, as a switch utilising the Z143 link. The Ethernet communication channels and optical links (Z143) enable the REDBOX functionality to be used by another internal module of the device in redundant operating mode. Ethernet communication channels: the electrical interface (Z144) enables an engineering connection or can be used as a service connection.

The Ethernet communication channels, optical (Z91 and Z92) and electrical (Z93), operate on a single subnet, share a single IP address, and can be used to connect the engineering link.

To improve the reliability of data transmission over electrical Ethernet links (Z48 and Z93), it is recommended to use F/UTP cable of at least Category 5e for the communication connections. **IP addresses in the Z9x and Z48 channels should be from different subnets.**
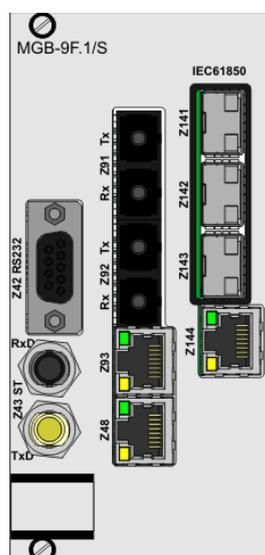
Fig. 5.18. Appearance of the MGB-9F.1/S communication module*.*

Changing the communication parameters is explained in Chapter 5.13.2.

5.14.2.   User management

When connected to the device via the UZDA channel (ports Z91–Z93 or Z48) and, in the "Skaner urządzeń" (device scan) dialog, selecting the hub at address 0, the communication hub can be managed. After pressing the "Nastawy" (settings) button in the main window   The "użytkownicy" (users) pane lets you view logged-in users and edit accounts. This section is available only during an active connection to the device for users with access level 4 (**administrator**). At the top, a table displaying active connections is presented, where one can find the connection type, client computer address, name of the computer from which the connection was established, username, login date, and ZPrAE Edit version number.
In the central part of the pane, there are settings related to security, namely:
* "Liczba dopuszczalnych błędnych prób logowania" (number of permissible failed login attempts) – a parameter that specifies the maximum number of allowable

unsuccessful user authentication attempts (e.g. in the case of entering an incorrect password) after which the user will be blocked for the duration described below.

- "Czas blokady" (lockout time) – the duration for which the user will be locked out after exceeding the maximum number of permissible failed login attempts. During this time, it will not be possible for the user to log in again or to establish a connection with the device, even if the correct credentials are provided.
- "Automatyczne wylogowanie" (Automatic logout) – the period after which a logged-in user will be automatically logged out, and the ongoing connection with the device will be terminated in the event of inactivity for the specified duration. User activity is detected after a left mouse click in any area of the ZPrAE Edit application window.
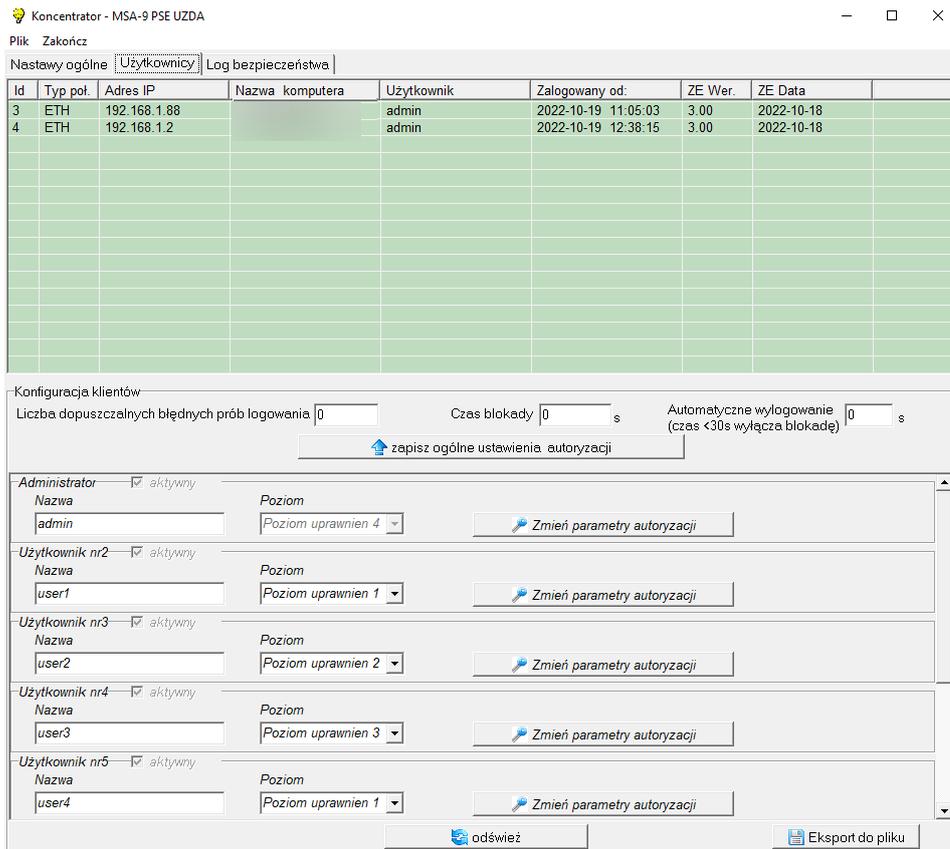
Fig. 5.19 User Accounts pane.

At the bottom of the pane, there are settings related to users, namely:
- "aktywny" (active) – confirmation that a given user account is enabled (option grayed out due to inability to delete accounts)
- "nazwa" (name) – the name of each user must be unique
- "poziom uprawnień" (access level) – the administrator may assign the appropriate access level that enables access to the software features

The modified data can be sent to the device using the "zmień parametry autoryzacji" (change authorisation parameters) button; after this operation, the administrator will be prompted to assign a new password for the user.

The administrator also can save the list of users to a text file using the "Eksport do pliku" (export to file) button.

5.14.3. Security log

This function is available to users with access level 4 (**administrator**). It displays up to 1,000 archived entries of user activity on the device. Actions performed remotely via the ZPrAE Edit software are logged, including user logins to the device, setting adjustments and configuration changes. Each entry is marked with the time of occurrence of a given activity, a connection identifier, and a description of the action performed.

At the top of the section, the following buttons are present:

- *"Pobierz log bezpieczeństwa"* (*download security log*) – retrieves data from the device again
- *"Eksportuj do pliku"* (*export to file*) – allows for the export of entries to a text file
- *"Wyślij" (send)* – allows to modify the syslog settings.

Additionally, on ports Z91, Z92, Z93 and Z48, the Syslog service can be activated, which is used for transmitting device security-related data to a central Syslog system. To this end, it is necessary to provide the correct IP address and PORT number of the Syslog server and to activate the feature. If the Syslog server address is within the Z9x ports subnet, communication will be established on those ports. However, if the Syslog server's IP address lies within the subnet of port Z48, communication will be established via that port. The figure below shows the pane with the security log function.
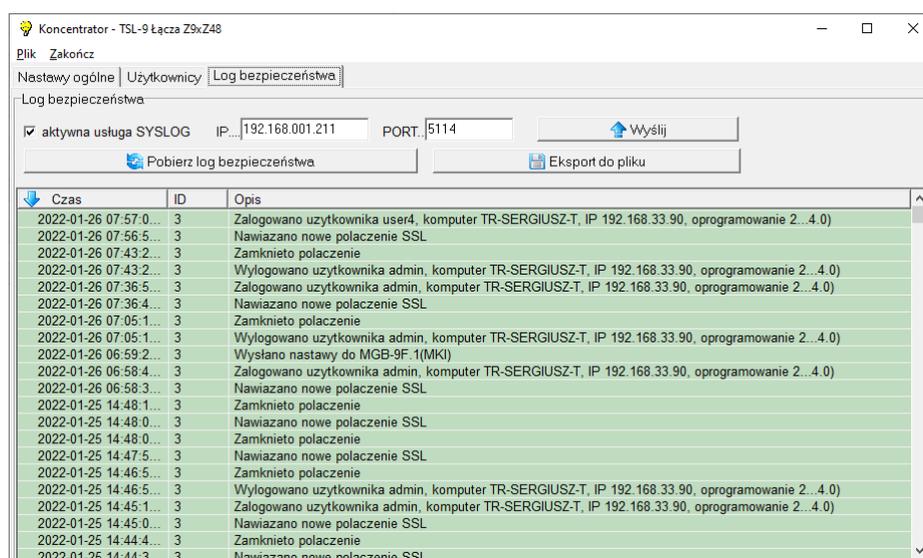
Fig. 5.20 Security log panel.

6. STRUCTURAL SOLUTIONS

Comprehensive central signalling sets can be designed using MSA system components. The central signalling system for the entire facility (e.g. a power substation) is usually installed in a standard cabinet enclosure. It is also quite common to install signalling cassettes in the switchgear mimic panels, replacing worn-out RUS-type relays or the indicator lamps of PUSZ systems. However, depending on the end user's requirements and local installation conditions, the specific solutions may vary, as their final configuration results from detailed agreements between the contractor, the investor and the designers. The number of signals that can be accommodated is limited by the available space in the cabinet or on the panel. However, for large assemblies, the limiting factor may be the size of the connection terminal block and the cabling required to carry so many signals. Digitally programmable sounders installed on the roof of a cabinet or in a special chassis installed in a mimic table are used as acoustic signalling elements.

7. DESIGN OF SIGNALLING SYSTEMS WITH THE MSA-9

We can divide the design process into three stages: the first, 'general', defining the assumptions; the second, 'electrical', determining the operating location and adding the MSA-9 signalling circuits to the schematic; and the third, 'programming', configuring input settings, input signal names, indicator LEDs, and repeating outputs.

The first step is to make a preliminary determination of the set size and specify the equipment requirements. So, to begin with, you should answer the following questions:

- Approximately how many signals will be received?
- Is contact repetition required and, if so, should all input signals be repeated or only selected ones, or should the input signals be grouped and repeated collectively in groups of up to ten selected signals?
- Should all input signals be signalled by indicator LEDs; if not, should the input signals be indicated collectively, in groups of up to ten, each group signalled by a single LED?
- Should the signalling system be equipped with audible signals?
- Should it be possible to perform resets and tests from outside the device front panel, for example from the operator's console?
- Should the signalling communicate with supervisory systems and with a station or engineering computer, and if so, how?
- Is time synchronisation essential, and will it be implemented through the facility monitoring system or by an optional GPS clock?

The choice of cards, the type of software, and the basic shape and size of the MSA-9 system will depend on the answers to these questions.

The most important thing is probably the answer to the first question about the number of inputs. A single cassette can receive, provide optical indication of, and repeat up to 64 signals. Each additional cassette increases the capacity to handle further 64 signals. Specifying the number of inputs makes it possible to determine how many cassettes should be in the set; in theory, the number of cassettes can be very large, and each has its own independent power supply and internal CPUs and memory. In most cases, however, it seems that four cassettes provide a sufficient number of inputs (4 cassettes x 64 inputs = 256 inputs); in special configurations, a version with up to six cassettes is available. The cassettes can be assembled into a single unit or operate in a distributed configuration, for example in the control panels of different panels. In that case, it is necessary to connect them using the communication cables supplied with the kit.
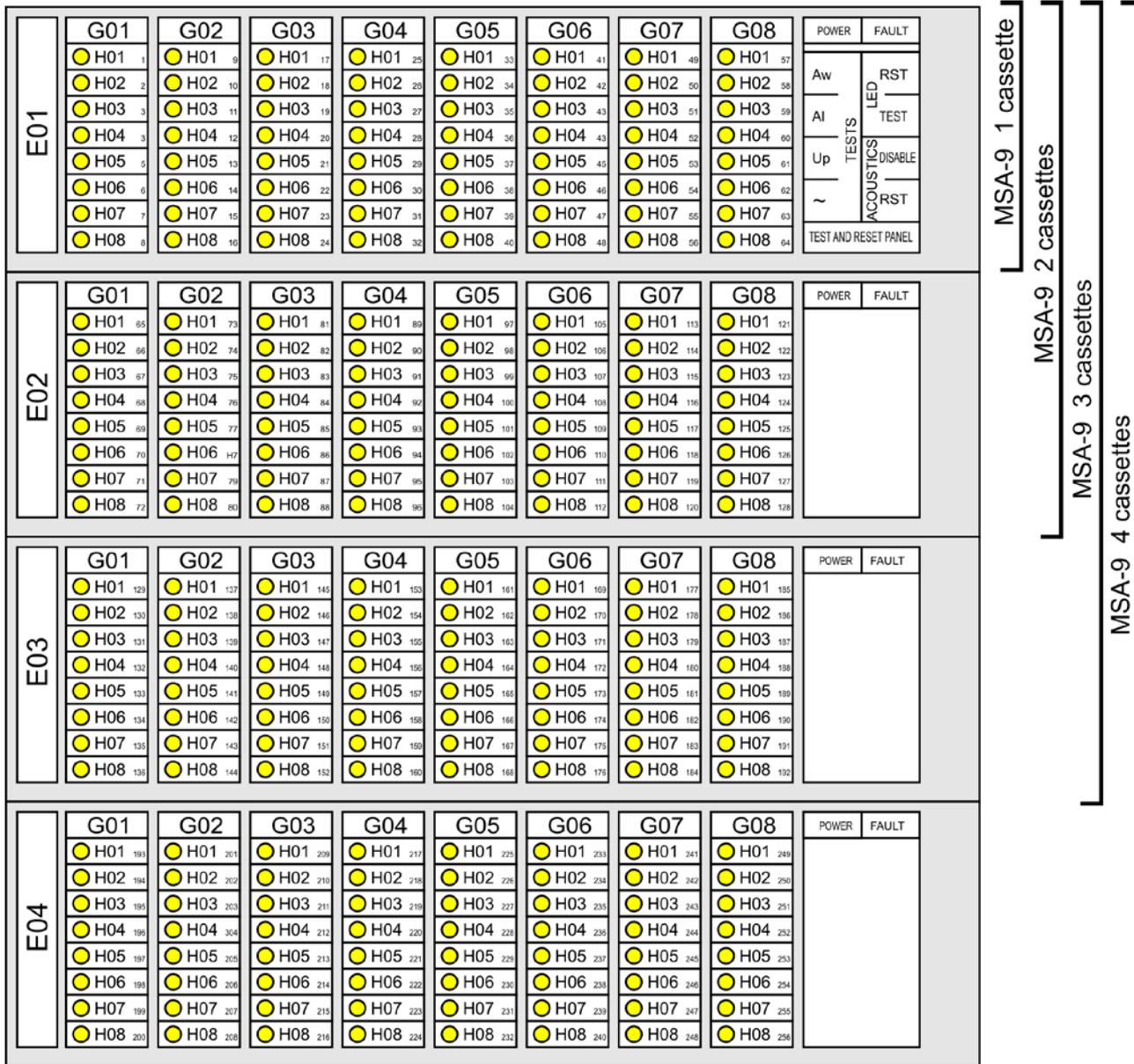
Fig. 7.1 Identification of indicator LEDs in MSA-9 cassettes

Once the set size has been specified, determine whether repeater relays are required. Depending on whether or not there is such a requirement, the set will be fitted with MWP repeater-relay output cards, or it will not be equipped with them.

To better illustrate the possible configurations, a four-cassette set is shown, in which the cassettes:

E1: is equipped with 8 MWD cards and 8 MWP cards; in this configuration, the use of 64 inputs and their corresponding repetition is assumed. Visual indication of all inputs is possible.

E2: is equipped with 8 MWD cards and 3 MWP cards; in this configuration, it was assumed that 64 inputs would be used, with repetition limited to the inputs of selected cards. Visual indication of all inputs is possible.

Fig. 7.2 Identification of connectors in MSA-9 cassettes

E3: fitted with 8 MWD cards; in this configuration, it is assumed that 64 inputs are used without repetition. It is possible to group inputs and indicate them collectively using designated LEDs. Requires the "Plus" software or a configuration commissioned at the device production or commissioning stage.

E4: is equipped with 8 MWD cards and 4 MWP cards; in this configuration, it is assumed that 64 inputs and 32 repetitions will be used. It is possible to repeat only selected inputs, or to group them and repeat them to selected contacts. Visual indication is only available for 64 selected inputs; inputs can be grouped and signalled in groups by selected LEDs. Requires the "Plus" software or a configuration commissioned at the device production or commissioning stage.

It is also possible to repeat only some of the selected signals and, in situations where only a few signals need to be repeated, for example from a given input card, the corresponding repetition card for that input card may be used. In the basic version with "Standard" software, the repeating contacts are assigned to the corresponding inputs and indicator LEDs. For example, E01/A06/S04 (the fourth input of the sixth input card in the first cassette) causes the indicator LED E01/G06/H04 (the fourth LED of the sixth group in the first cassette) to light, and is repeated at the contact output E01/Y06/K04 (the fourth contact output of the sixth output card in the first cassette). In this situation, the input label also serves as the label of the repeating contact. However, it is possible to select a more advanced option with the "Plus" software, which allows a given contact to be programmatically assigned to any single input of choice. Thus, for example, activation of input E01/A06/S04 (the fourth input of the sixth input card in the first cassette) can be repeated on contact E01/Y04/K06 (the sixth contact output of the fourth output card in the first cassette). It is also possible to group inputs (from two to eight) and repeat their state on one selected contact. Thus, for example, activation of one of the inputs E01/A02/S01; E01/A03/S02; E01/A05/S07; .... to a maximum of eight selected ones, may cause repetition, for example via the E01/Y04/K05 contact. In this case, the label of the repeater contact should be specified separately. Assigning repeating contacts to inputs is completely independent of assigning inputs to LED indicators. Such configurations can be implemented using the "Plus" software by the user, by our specialists on site during commissioning or subsequent operation, or, if the requirements are specified in the configuration tables, already at the design and device-ordering stage. In this situation, the device will already be configured during the factory programming stage.

Assigning indicator LEDs to subsequent inputs is very similar. In the basic version with 'Standard' software, the status LEDs are assigned to the corresponding inputs and to the repeating contacts. For example, E01/A06/S04 (the fourth input of the sixth input card in the first cassette) causes the indicator LED E01/G06/H04 (the fourth LED of the sixth group in the first cassette) to light, and is repeated at the contact output E01/Y06/K04 (the fourth contact output of the sixth output card in the first cassette). In this situation, the input label also serves as the label of the LED indicator. However, it is possible to choose a more advanced option with the "Plus" software, which allows for the programmatic assignment of a given indicator LED to any single input of your choice. Thus, for example, activating input E01/A06/S04 (the fourth input of the sixth input card in the first cassette) may, for example, cause indicator LED E01/G04/H06 (the sixth indicator of the fourth group in the first cassette) to light up. It is also possible to group inputs (from two to ten) and indicate their status using a single selected indicator LED. Thus, for example, activation of one of the inputs E01/A02/S01; E01/A03/S02; E01/A05/S07; .... of up to ten selected may activate the E01/G04/H05 indicator LED. In this case, the description of the indicator LED should be specified separately. The assignment of indicator LEDs to inputs is completely independent of the assignment of inputs to repeating contacts. Such configurations can be implemented using the "Plus" software by the user, by our specialists on site during commissioning or subsequent operation, or, if the requirements are specified in the configuration tables, already at the design and device-ordering stage. In this situation, the device will already be configured during the factory programming stage.

Depending on the answers to two questions concerning repeating contacts and indicator LEDs, the appropriate number of MWD and MWP input modules should be selected, and the software version should be specified. "Standard" for simple set-ups or where advanced configuration will be handled by our specialists, or "Plus" when configurations need to be advanced and user-adjustable.

Further issues include determining whether audible signalling is required. If the signalling is to work with acoustic sounders, the system must be fitted with an MWA

acoustic control card. It is recommended to use the MSA-9 in conjunction with a panel of four (3 × 220 V or 110 V DC + 1 × 230 V AC) programmable PSA-4 electronic sounders.

The next question is whether there should be the option of remotely resetting the signalling operation via a contact input and performing tests. This can be helpful for the facility staff; the sounder-silence button can, for example, be placed on the control panel. If these functions are to be implemented, the signalling system must be equipped with an MWS test and reset card.

A completely separate issue is determining the communication channels and protocols with any facility supervisory systems or local workstation computers. The time synchronisation method required for the internal event logger should also be specified. If the supervisory system cannot provide the correct time via the communication protocol, it is recommended to use the version of the MGB module equipped with a GPS-synchronised clock.

Once the overall design and specific equipment of the signalling assembly have been specified, you can proceed to the second stage, namely the actual process of designing the connection for the signalling system. Since all auxiliary connections are made inside the cassette (set of cassettes), this is straightforward. Only the circuits described in the bullet points below are to be designed:

7.1. Signal input circuits

An essential part of designing signalling systems is specifying the signals and incorporating them into the signalling input circuits. Each signalling input is independent and isolated from the others and, in the standard version, can accept voltages of 220 V DC or 230 V AC. Other voltages – 110 V DC, 48 V DC/AC, 24 V DC/AC – are available on request.
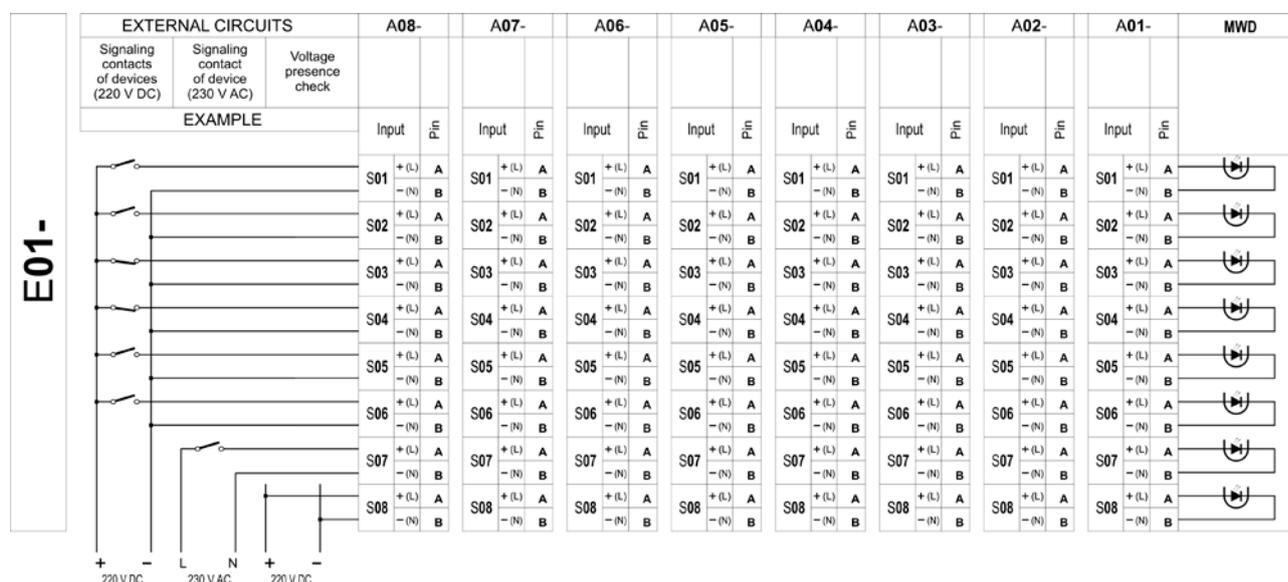

Fig. 7.3 Enabling the signal input circuits

The addresses of the MWD card connectors are specified in accordance with the following convention:

E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),

A – sequential number of the MWD signal input card in the cassette (typically from 01 to 08),

S – sequential input number in a given MWD module (from 01 to 08),
P – sequential input pin number (A / B)

The address of a specific pin on an MWD E/A/S/P card, e.g. E01-A05-S07-PA (01.05.07A), means the first cassette, the fifth card, the seventh input, the first pin. The pin assignment for connectors no. 01A/01B - 08A/08B is shown in the block diagram of the MWD module (Fig. 3.4), and an example depiction in the signalling input circuitry is shown in the application schematic (Fig. 7.3).

7.2. Repeating output circuts

If required, input signals can be repeated via the contacts of the MWP module, either individually (all or selected) or in selected groups. All contacts are isolated from one another and can repeat the signal while operating at independent voltages.
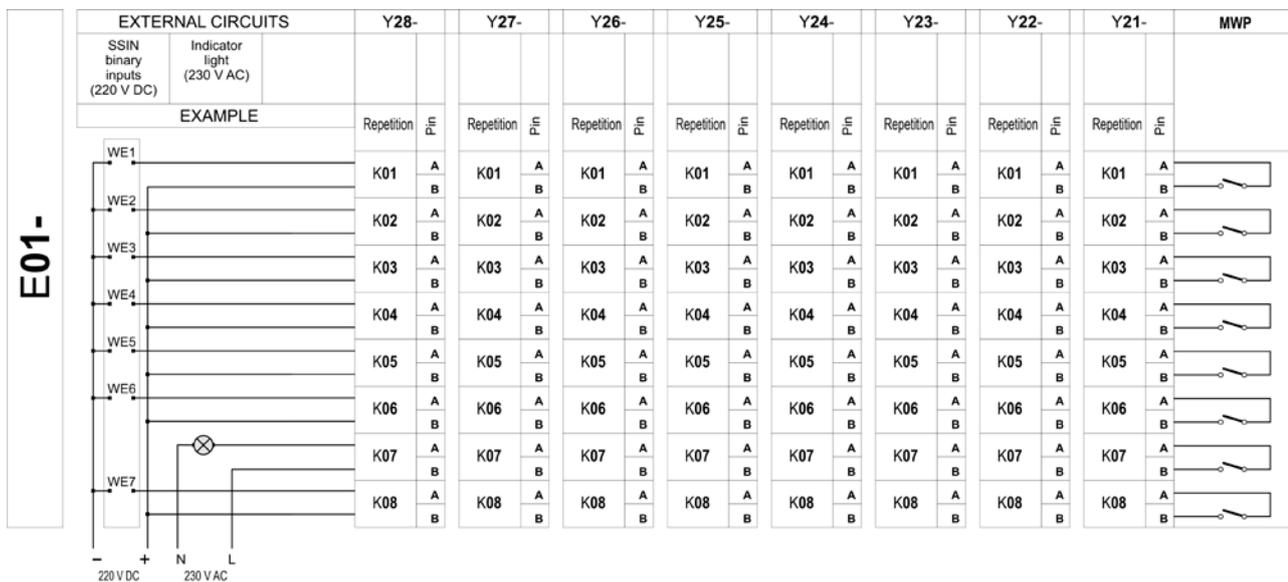
Fig. 7.4 Switching on the repeating output circuits.

The addresses of the MWP card connectors are described according to the following rule:
E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),
Y – sequential number of the MWP repeating-output card in the cassette (typically from 21 to 28),
K – sequential output number in a given MWP module (from 01 to 08)
P – sequential output pin number (A / B)

The address of the specific pin of the MWP E/Y/KP card, e.g. E02-Y23-K02-PB (02.23.02 B), means the second cassette, the third card, the second output, the second pin. The pin assignment for connectors no. 21A/21B - 28A/28B is shown in the block diagram of the MWP module (Fig. 3.6), and an example depiction in the repeating output circuitry is shown in the application schematic (Fig. 7.4).

7.3. Power supply circuits

It is recommended to power the MSA-9 from two independent rails, separately for each MZA-9 power supply channel. This will ensure uninterrupted operation of the device even in the event of a power failure. In the case of single and double cassette sets, the

power supply is located in the upper cassette; in the case of more complex sets, power supplies are also located in subsequent cassettes, according to the principle of one power supply for a maximum of 128 signals. The suggested solution is connecting all first power supply rails in parallel to the first power supply and all second power supply rails in parallel to the second power supply. The power supplies are suitable for operation with 220 V DC +10/-30% or 230 V AC +10/-30%. Power supplies designed to operate from 110 V DC +10/-30%, or with one channel at 110 V DC +10/-30% and the other at 230 V AC +10/-30% are also available. The recommended solution is to power the first channel with the +/-AwUp signalling voltage, and the second from an independent 230 V AC auxiliary supply. This is particularly important when used with four sounders, in systems where one of the sounders is triggered by AC voltage upon loss of the +/-AwUp voltage.
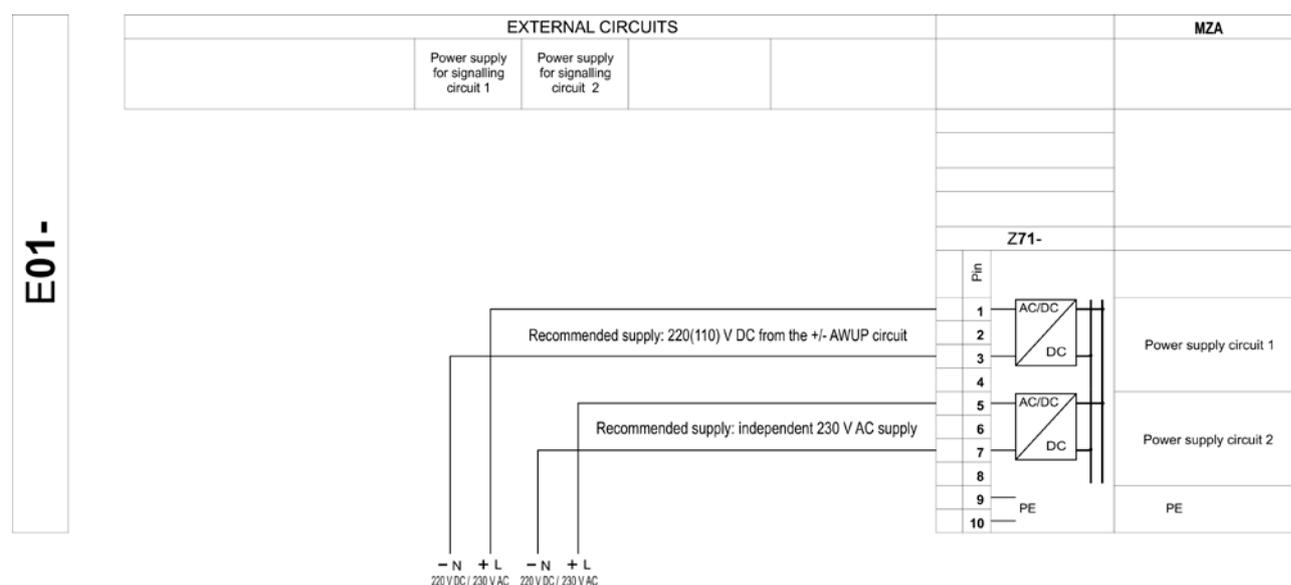
Fig. 7.5 Switching on the signalling power supply circuits

The addresses of the MZA-9 power supply connector are described according to the following rule:

E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),

Z – number of the power connector of the MZA-9 power supply in the cassette (typically 71),

P – the sequential pin number of the power connector in a given MZA-9 power supply (from 01 to 10).

The address of a specific E/Z/P power supply pin, e.g. E01-Z71-P04 (01.71.04), indicates the first cassette, the first power supply, and the fourth pin. The pin assignment of connector no. 71 is shown in the block diagram of the MZA module (Fig. 3.7), and an example of how it is depicted within the power supply circuit is shown in the application schematic (Fig. 7.5)

7.4. Acoustics control circuits

Where the signalling system is to be fitted with an audible fault indication system, a schematic diagram showing the wiring of the sounders must be included. The MWA module is responsible for controlling the audible sounders; it enables the connection of two independent Aw audible sounders (which may, for example, operate on separate power

supply circuits), an Al (Al1) sounder, an Up (Al2) sounder, as well as a common Al(Al1)/Up(Al2) sounder, for example installed remotely outside the control building. Another audible channel indicates a loss of the +/-AwUp voltage; this sounder must be connected to an independent AC power supply, and the second MSA-9 channel should also be supplied from this voltage. In such a case, the internal supply-voltage monitoring circuit activates the "~" audible indicator via the MWA card's active contact upon detection of a loss of ±AwUp supply feeding the first power rail of the MSA-9. In this case, there is no need to use any additional elements.
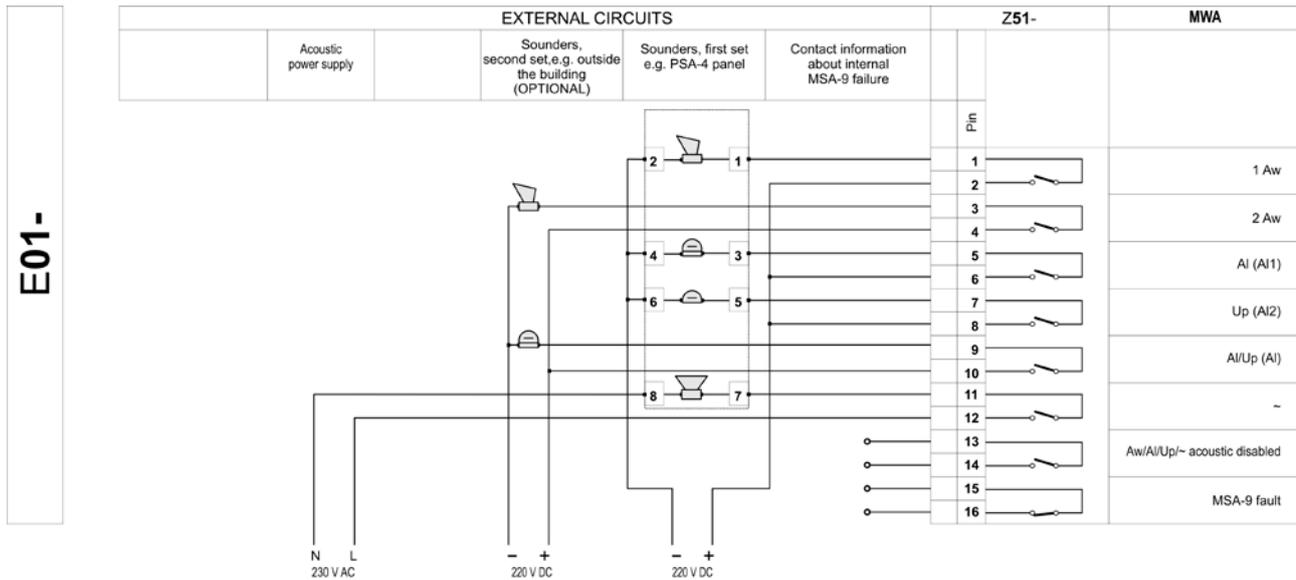
Fig. 7.6 Switching on the acoustic circuits, system 1.

If both MSA-9 supply rails are connected to the ±AwUp voltages and the fourth sounder "~" is powered from an additional, independent 230 V AC supply, it is activated by the volt-free contact of the MWA card relay responsible for monitoring both power-supply rails. (The relay drops out when the MSA-9 power supply is completely lost.) Note, however, that if the supply voltages fail, the signal cannot be reset. It's recommended to use an external two-position switch to turn off the "~" sounder.
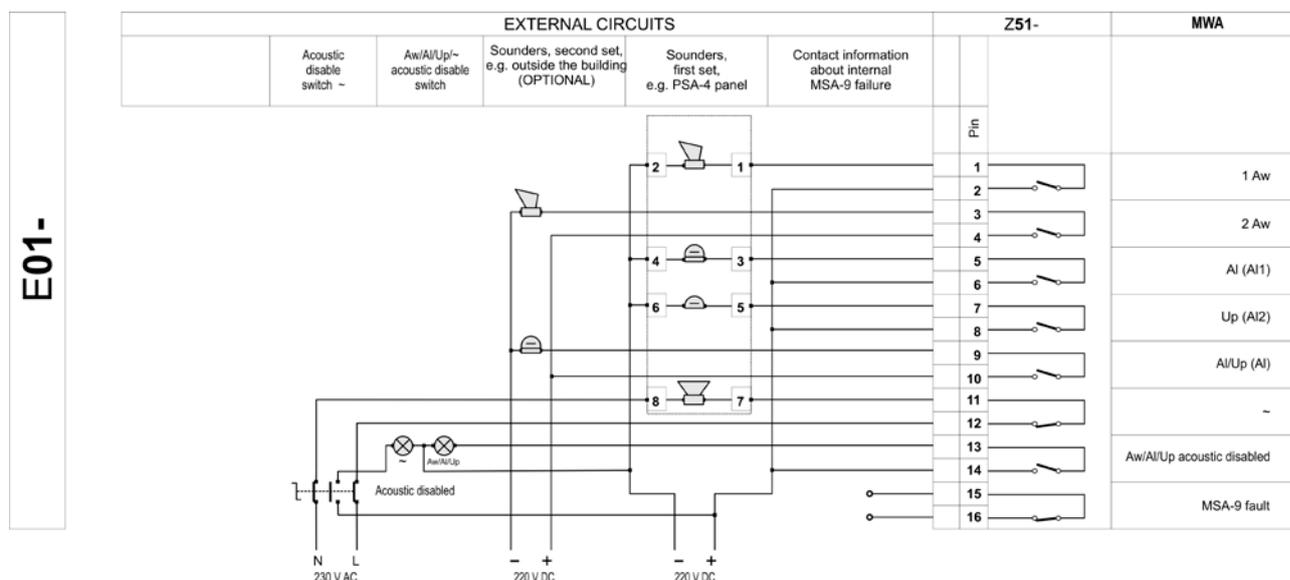
Fig. 7.7 Switching on the acoustic circuits, system 2
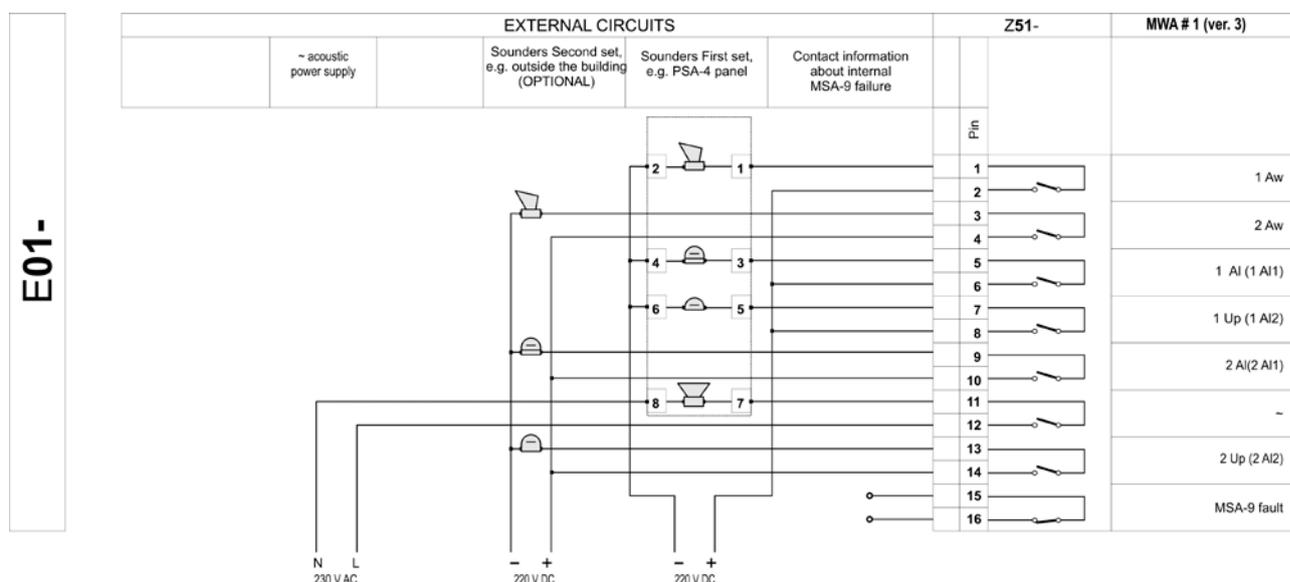
Fig. 7.8 Activation of the audio circuits, system 3.

The MWA card connector addresses are specified according to the rule:
E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),
Z – number of the MWA acoustic control card in the cassette (typically 51),
P – successive pin of the MWA acoustic control card connector (from 01 to 16).

The address of a specific pin on an MWA E/Z/P card, e.g. E01-Z51-P06 (01.51.06), denotes cassette one, card one, pin six. The assignment of the individual pins of connector No. 51 is shown in the block diagram of the MWA module (Fig. 3.8), and an example of its incorporation into the acoustic control system in the application schematic (Fig. 7.6).

Disabling of the audible alarm, as well as any internal device fault, is indicated via contacts; if required, this information can be used by sending it, for example, to the input cards of the supervisory system or to indicator lamps on the control panels.

The signalling system may be fitted with additional MWA-9 modules. The MWA-9 No. 2 and MWA-9 No. 3 modules have the same pinout as the MWA-9 No. 1 module.
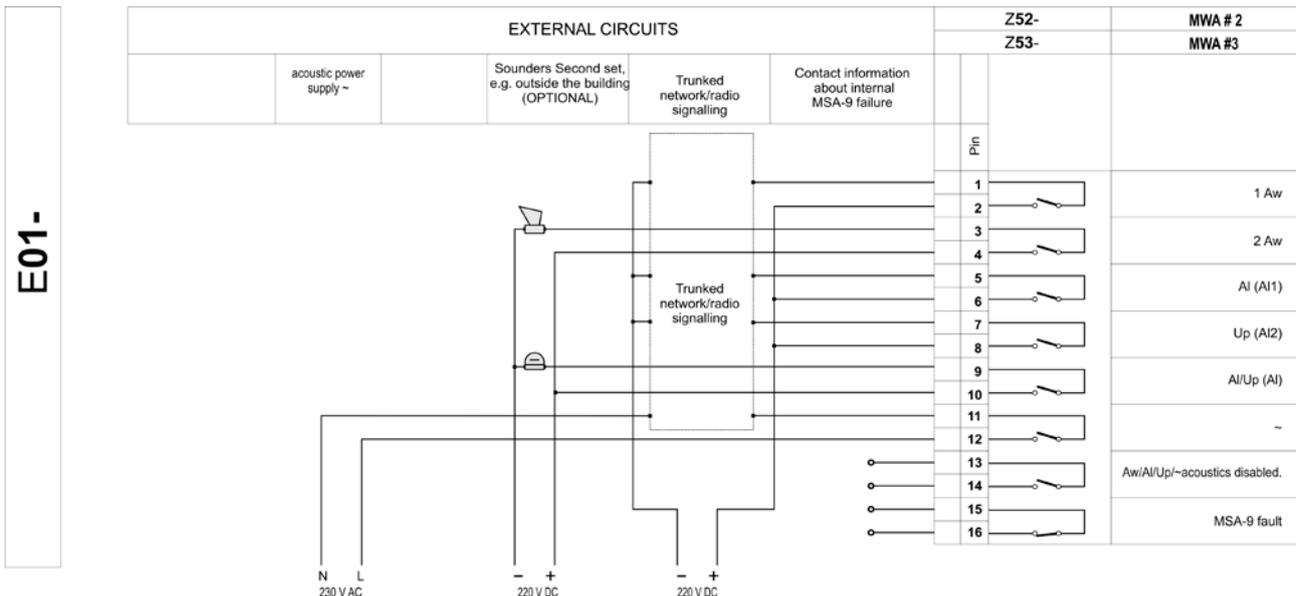
Fig. 7.9 Activation of MWA acoustic circuits no. 2 and 3

7.5. Remote test and reset circuits

When an MWS-9 module is used, the signalling can be remotely reset and tested via relay or push-button contacts external to the MSA-9 device. All connected push-buttons should be momentary; pressing them causes, depending on the input, the corresponding test and reset to be carried out. The exception is the "Odstawienie sygnalizacji akustycznej" (Disabling of acoustic signalling) input; pressing the button toggles between operation with or without audible signalling.

Fig. 7.10 Enabling remote test and reset circuits

The MWS card connector addresses are described according to the following principle:

E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),
Z – number of the MWS test-and-reset card in the cassette (default 61),
P – sequential pin on the MWS test and reset card connector (from 01 to 16).

The address of a specific pin of an MWS E/Z/P card, e.g. E01-Z61-P11 (01.61.11), means the first cassette, the first card, the eleventh pin. The pin assignment of connector no. 61 is shown in the block diagram of the MWS-9 module (Fig. 3.9), and an example of how it is depicted within the test-and-reset circuit is shown in the application schematic (Fig. 7.10)

7.6. External communication circuits

The MGB hub is available in many versions that differ in the types of connectors and communication protocols. Detailed information is contained in a separate datasheet for the MGB-9 communication modules.

The addresses of the MGB card connectors are described according to the following rule:
E – cassette sequential number (typically from 01 to 04; for extended sets, possibly higher),
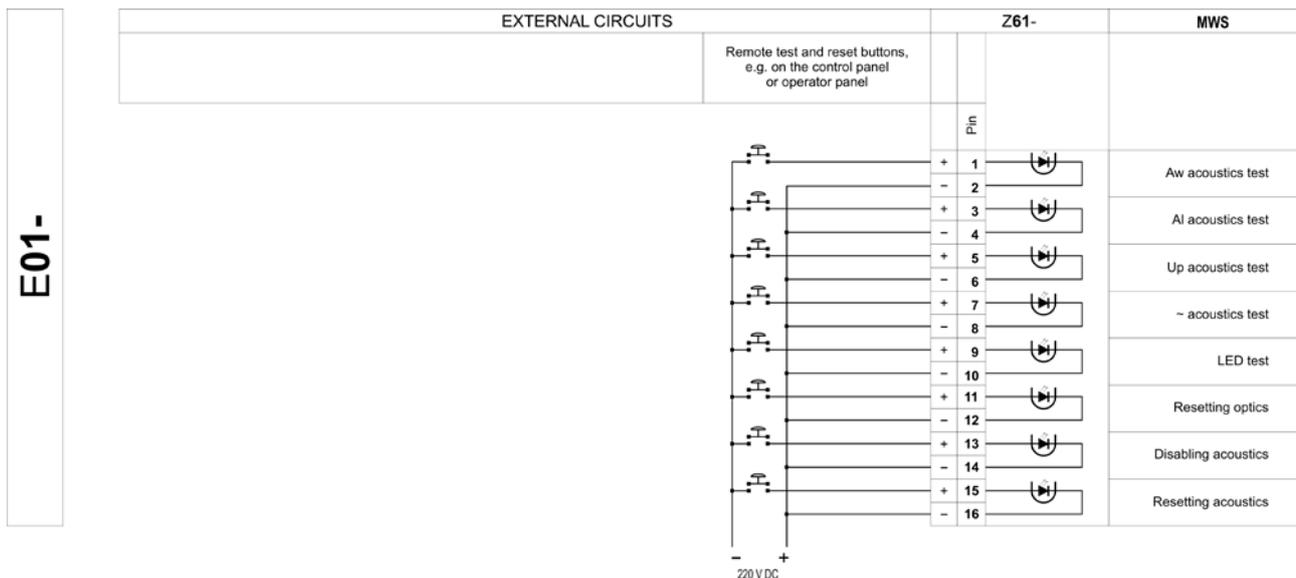Z – the sequential number of the MGB card communication port (typically from 41 to 49).
P – the sequential pin number of the MGB card communication port connector (01 to 08).
The address of a specific MGB E/Z/P communication connector, e.g. E01-Z42-P03 (01.42.03), denotes the first cassette, the RS232 communication port, pin 3 of the DB09 connector.

7.7. Configuration tables

If the ordered device is to be built for a specific facility and delivered to the customer preconfigured, you can use the input configuration table. In the table, the following should be specified:
- cassette E number, *(entering a number from 1 to 4),*
- Card A number, *(entering a number from 1 to 8),*
- a general name for the group of eight inputs, *(by entering the group name),*
Next, independently for each of the inputs from S1 to S8
- assign a name to the input (signal), *(by entering the input name),*
- determine whether activation should happen on decay or rise, *(marking X as appropriate),*
- should the signal have contact repetition, *(by ticking X),*
- should repetition be maintained, *(by ticking X),*
- whether it should operate with or without a flashing light, *(by ticking X),*
- should the signal operate with automatic reset, *(tick X),*
- specify the audio channels the signal is to use, *(by marking X),*
- specify the signal delay time, *(by entering the delay time in milliseconds, and if the delay is to be longer, then in seconds),*
- specify the input activation voltage, *(by entering its value in volts and stating whether it's AC / DC by ticking X),*
- specify the colour of the LED (by ticking the X).
If the order is accompanied by correctly completed input tables, the device will also be configured and supplemented with signal labels on the front panel during the verification stage. Of course, all changes, with the exception of the input activation voltage, which requires a hardware change, are also possible later using the ZPRAE Edit software provided with the MSA-9. In cases of unusual configurations, input grouping, selective or

group repetition of signals, it is necessary to specify the requirements in the project. The device will be manufactured and configured according to it. Subsequent changes to such configurations are possible using the "Plus" version of the software.

8. SCOPE OF SERVICES PROVIDED BY THE MANUFACTURER

The manufacturer provides assistance in designing central signalling systems using the MSA-9 modular system (ready-made **design templates** are available), supplies system devices in any agreed configuration, and provides support for the supplied equipment during the warranty period and full service after that period.

The manufacturer also provides services in the design of signalling systems and the modernisation of existing systems, including surveying of circuits and installation works at the installation site of the supplied equipment.

If you have any questions or concerns, please contact us by phone.

Input configuration panel

Cassette	General label for 8 inputs	Card
E		A

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Input	Input name
S	

Rise / Loss · Aw / Al. / Up · ms / s · V · AC / DC

Repetition	No flashing		Yellow	Green	Red	Blue	Purple	White	Spec 1	Spec 2
Sustain rep.	Self-reset	LED colour								

Fig. 8.1 Input configuration table.

The table is available in electronic form as an Excel spreadsheet to facilitate data entry.

9. OPERATING INSTRUCTIONS

9.1. Work on the device circuits.

MSA-9 signalling systems enable station operation and the rapid detection and localisation of disturbances arising in circuits and equipment installed at electrical power facilities. These systems must remain in a state of continuous readiness for operation. Any changes to the configuration may only be carried out by authorised personnel. After any repair or replacement of devices interfacing with the MSA-9 signalling system, it is necessary to verify that these devices interact correctly.

9.2. Periodic inspections

The manufacturer recommends carrying out a periodic inspection every 5 years.
The periodic inspection should include at least:
- external inspection and visual assessment of the technical condition of the device,
- measurement of the insulation resistance of power supply circuits, input circuits and signalling circuits,
- verification of the correct reproduction of disturbance signals,
- functional tests concerning the disabling of collective signals,
- verification of interworking with signalling and remote signalling circuits (including with supervisory control centres)
- removal of any defects found during the inspection,
- checking the operation of internal event logging.

9.3. Insulation resistance test

During insulation resistance testing, a 500 V insulation resistance tester shall be used. Required value of R_{izol} >100 MΩ.

9.4. Battery replacement

The MGB-9 communication module of the MSA-9 signalling system is equipped with CR2032 (3 V) lithium batteries. They maintain the supply voltages for the RTC circuits and the event data memory in the event of a loss of the auxiliary supply voltage. These batteries must be replaced after 10 years of operation, or when the cumulative time for which the device was without supply voltage exceeds 2 years.

The battery can be replaced after removing the MGB-9 module together with the MLB-9 logic module from the cassette – because the modules are connected by a ribbon cable, they must be removed simultaneously. When fitting the battery into the holder, ensure the polarity is correct.

Note: replacing the battery in the MGB-9 module will result in the loss of archived events – it is recommended to archive them beforehand on a PC using the ZPrAE Edit software.

9.5. Disabling and enabling the acoustic control function.

Disabling of the acoustic control function may only be carried out on special instruction or with the approval of competent maintenance personnel.

Disabling and enabling the acoustic control function can be carried out:
- using the keys on the front panel of the device. To do this, press the "ODSTAW" (Disable) button; the indicator lamp will light up to indicate that the acoustic function has been disabled.
- remotely using the engineering connection and the ZPrAE-Edit application.
- by applying voltage to the appropriate binary inputs of the MWS module, if this option has been provided for in the device application schematic

9.6. Testing the device

As part of periodic inspections, the following checks should be carried out:
- Check the operation of the indicator lights and the audible alarm.
- Check the status of the event recorder - whether it is working and recording data.
- Check communication with supervisory systems.

9.7. Procedure in the event of a failure

MSA-9 signalling systems have built-in mechanisms for the technical diagnostics of the internal circuits and the configuration. If a module fault is detected, the device switches to emergency mode, i.e. data from the faulty module are not included in the device functions. It is indicated by the illumination of the "*Zakłócenie*" (*Disturbance)* LED on the front panel, the generation of an appropriate entry in the event recorder and a signal to supervisory systems, and the operation of the "*Awaria*" (Fault) relay (if configured).

If the device is not working correctly, first check the messages stored in the device event log (if possible). Using them, the cause of the failure can be easily identified, e.g. incorrect configuration, damage or a missing module, etc. If the maintenance personnel cannot identify the cause of the fault or rectify it, contact the manufacturer.

If you have any questions or concerns, please call us at +48 32 220 01 20.

10. INSTALLATION AND OPERATION GUIDELINES

10.1. Installation of MSA-9-type devices

Only enclosed rooms that are adequately heated, dust-free, dry, and do not contain gases, corrosive vapours, etc., should be selected as the installation location for devices of type MSA-9 (environment classified as 3C1, 3S1).

It is recommended that the ambient temperature be between -10°C and +55°C, with relative humidity not exceeding 95%. Avoid areas subject to heavy vibration or shock. The mounting location for the protective device should allow for routing the connecting cables with the plugs of the individual modules.

Before installing the device, it is essential to check that the technical specifications on the nameplate match the power supply system specs.

It is recommended to make external connections using a cable with a suitable cross-section depending on the circuits being connected:
- auxiliary power supply circuits using LgY cables with a cross-section of 1.5 mm^2,
- binary input circuits using LgY cables with a cross-section of 1.5 mm^2,
- binary output circuits using LgY cables with a cross-section of 1.5 mm^2,
- device earthing circuits using a green-and-yellow LgY cable with a cross-section of 4 mm^2.

In auxiliary power supply circuits, it is recommended to use an overcurrent protection device rated at a minimum of 6 A, with a type B tripping characteristic.

The device can be mounted in a 19-inch Euro-standard rack or on a distribution board. The space required for the device and the spacing of the mounting screws are shown, respectively, in the figures:
- for the Euro 19-inch 3U enclosure in Fig. 10.1,
- for the ATx-4U enclosure with panel mounting in Fig. 10.2,
- for the 19-inch Euro 6U enclosure in Fig. 10.3,
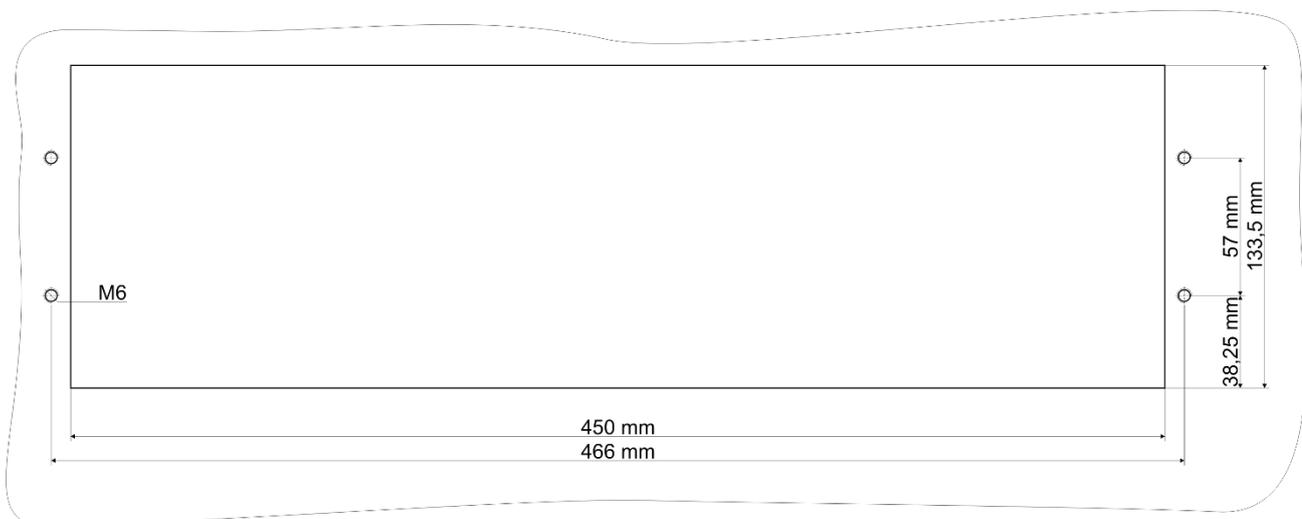- for the ATx-8U enclosure with panel mounting in Fig. 10.4.

Fig. 10.1. Installation guidelines for the device in a 3U Euro cassette.
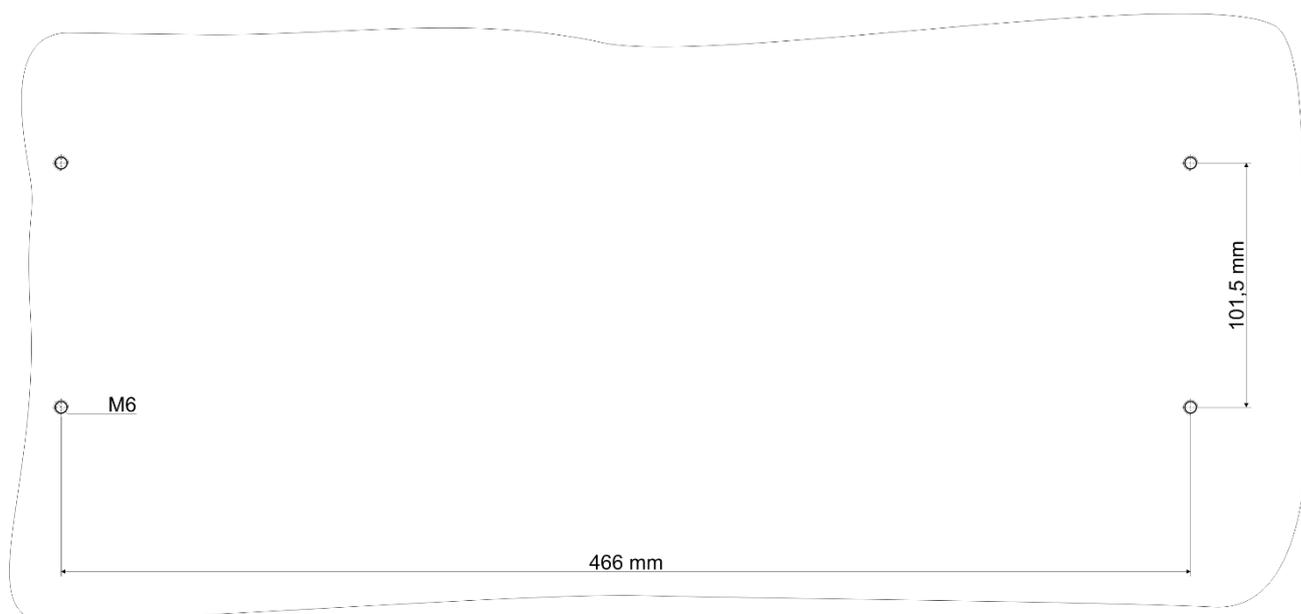
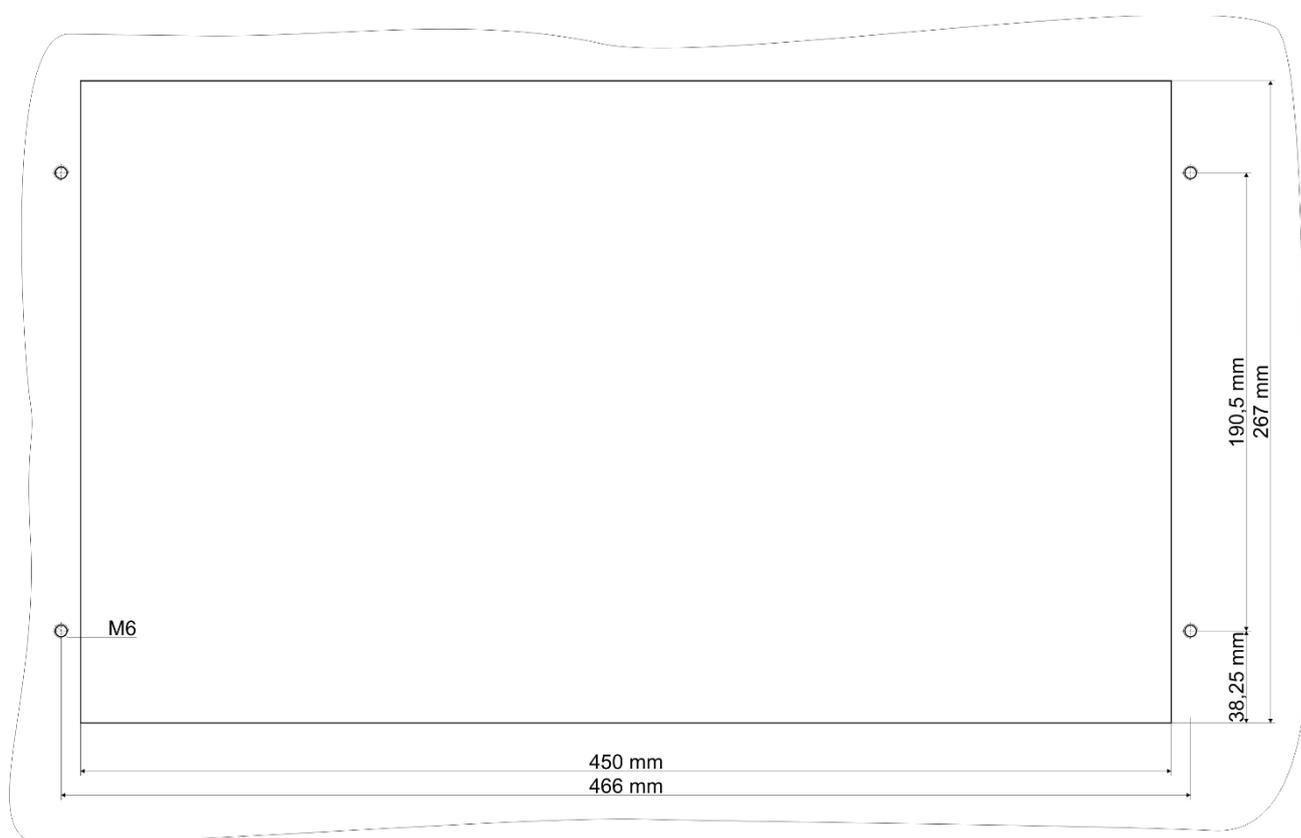Fig. 10.2. Mounting guidelines for a 4U-high panel-mount device.

Fig. 10.3. Installation guidelines for a 6U-high device.

Fig. 10.4. Installation guidelines for an 8U panel-mount device.

10.2. Operating conditions for the MSA-9-type device

The auxiliary supply voltage should lie within the range (0.8 to 1.15) Un. The peak-to-peak values of the AC component of the DC voltage should not exceed 15% of Un. Frequency deviations of alternating currents and voltages should not exceed (-2.5 to +2.5)% of the rated frequency.

The enclosure permits effective earthing of the structure. Earthing should be carried out in accordance with the applicable regulations. A dedicated earthing screw is located on the lower side of the enclosure.

10.3. General health and safety rules for work related to the operation, use

and maintenance of an MSA-9-type device

During operation of the device, hazardous voltage is present. Failure to comply with safety regulations may result in injury to operating personnel or other damage. In particular, the following rules must be observed:

- The equipment chassis should always be securely connected to the protective earthing conductor of the distribution board.
- Do not, under any circumstances, look into the openings of fibre-optic connectors due to the risk of eye injury.
- The equipment may only be operated by qualified personnel with experience and appropriate qualifications in power system protection.

11. TECHNICAL SPECIFICATIONS OF THE MSA-9 SIGNALLING SYSTEM

Category	Parameter		Value
Power supply	Rated auxiliary power supply voltage U_{PN}		220 V DC / 230 V AC or other by agreement
	Permissible range of the auxiliary supply voltage		(0.8 to 1.15) U_{PN}
	Power consumption of the auxiliary power supply circuit		< 55 W / 100 VA for one cassette
Signal inputs	Number of signal inputs		
		On the MWD input card	8 inputs.
		In a single cassette (standard)	8 cards * 8 inputs = 64 inputs
		Included in the standard cassette set:	4 cassettes * 8 cards * 8 inputs = 256 inputs
		Included in the cassette set (special edition):	6 cassettes * 8 cards * 8 inputs = 384 inputs
	Rated voltage of input signal circuits U_{WN}		220 V DC / 230 V AC or other by agreement
	Power consumption of signal input circuits		< 0.35 W / input
	Activation mode		Programmable: decay or rise
	Activation threshold		0.8 U_{HV}
	Activation delays		0 s (no delay) or 0.02 s to 65 s
	Return delays		0 s (no delay) or 0.02 s to 65 s
Indicator LEDs	Number of indicator LEDs		
		In a LED group	8 LEDs
		Maximum in one cassette	8 groups * 8 LEDs = 64 LEDs
		Maximum in the cassette set (special version)	4(6) cassettes * 8 groups * 8 LEDs = 256(384) LEDs
	Diameter of the LED light spot		8 mm
	Size of the LED label field		27mm × 13mm (W×H)
	Colour of the indicator LED (software-selectable)		Yellow/Red/Green/Blue/Purple/White
Repeating outputs	Number of repeater contacts		
		On the MWD input card	8 contacts
		In a single cassette (standard)	8 cards * 8 outputs = 64 outputs
		In the cassette set (standard)	4 cassettes * 8 cards * 8 outputs = 256 outputs
	Contact current rating		4 A
	Contact switching capacity		3 A / 250 V AC 0.15 A / 250 V DC; L/R=40 ms
Control inputs	Number of inputs		
		On the MWS input card	8 inputs
	Rated voltage of the signal input circuits U_{we} (Binary inputs, optically and galvanically isolated)		220 V DC or other DC as agreed
	Power consumption of the test and reset input circuits		< 0.35 W / input
Acoustic outputs	Number of acoustic control channels		
		On the MWA output card	8 channels
	Contact current rating		4 A
	Contact switching capacity		3 A / 250 V AC 0.15 A / 250 V DC; L/R=40 ms
Insulation	Rated insulation voltage		300 V
	Rated impulse voltage		5000 V (1.2/50 µs)
	Overvoltage category		III
	Dielectric strength of insulation		2.5 kV; 50 Hz; 1 min
	Chassis IP rating	Front	IP50
		Back	IP20
General	Device dimensions (single cassette) Additional cassettes increase the height of the assembly.		19"/3U/240 (483×133.5×245) mm; W×H×D
	Weight (one cassette)		Approximately 6 kg (depending on the number of cards)
	Permissible storage temperature range		248 K to 343 K (from -25 °C to +70 °C)
	Permissible operating temperature range		263 K to 328 K (from -10 °C to +55 °C)
	Permissible ambient air humidity		< 95 %
	Permissible atmospheric pressure		70 to 106 kPa (0 to 3000 m above sea level)

MSA-9

PRODUCTION PROGRAM

Zabezpieczenia szyn zbiorczych
typu: TS-6/TSL-6, TSL-9r, TSL-11

Układy lokalnej rezerwy wyłącznikowej
typu: TL-6r, TLH-5, TSL-9r, TSL-11

**Terminal zabezpieczeniowy TZX-11, do konfiguracji
przez użytkownika, lub fabrycznie skonfigurowany jako:**

Rejestratory zakłóceń typu: RZS-9

Układy sygnalizacji centralnej
typu: MSA-9, MSA-12, MSA-24

Szafowe zestawy zabezpieczeń sterowania i nadzoru

**Autonomiczne zabezpieczenie
transformatora typu: AZT-9**

**Układy pomiaru energii elektrycznej wraz
z aparaturą pomocniczą typu: RFQ-8, ZRZ-28, RD-50**

**Rozdzielnice zasilania potrzeb własnych
prądu stałego i przemiennego**

Przekaźniki pomocnicze i sygnalizacyjne *RE line*® ENERGETIC STANDARDS

Układy kontroli doziemienia typu: KDZ-3

Przekaźnik automatyki SZR typu: SZR-9

Obudowy szafowe typu: PROFIL-L

**Badania okresowe, usługi serwisowe,
uruchomienia i badania pomontażowe**

TZZ-11 – zabezpieczenie ziemnozwarciowe /
sterownik polowy,
TZO-11 – zabezpieczenie odległościowe linii,
TZL-11 – zabezpieczenie różnicowe linii,
TZT-11 – zabezpieczenie różnicowe transformatora,
TZS-11 – moduł wyłącznikowy z funkcją SPZ
i kontrolą synchronizmu,
TZP-11 – przekaźnika automatyki
przeciwprzepięciowej,
TZU-11 – uniwersalny terminal zabezpieczeniowy
wyposażony zgodnie z wymaganiami
Zamawiającego.

RSH-3, RSH-3S – szybkie wyłączające
RS-6 – szybkie pośredniczące
RPD-2,RPP-4, RPP-6 – pomocnicze
RMS-2 – sygnalizacyjne
RCW-3, RCDW-1 – kontroli ciągłości
obwodów wyłączających
RKO-3 – kontroli ciągłości obwodów zasilania
RB-1, RBS-1 i RBS-2 – bistabilne
RT-22 – czasowe
RUT-1, RUT-2 i RUT-3 – napięciowo-czasowe
RJT-1 i RJT-3 – prądowo-czasowe
RKU-1, RKS-1 – wykonawcze
LZ-1 i LZ-2 – liczniki zadziałań
RPZ-1 – przełączania zasilań
GPS-1 – synchronizacji czasu
MDD-6 i MDS-12 – moduły diodowe
PH-XX, PS-XX – moduły przełączników,
przycisków i lampek kontrolnych
Osprzęt pomocniczy

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