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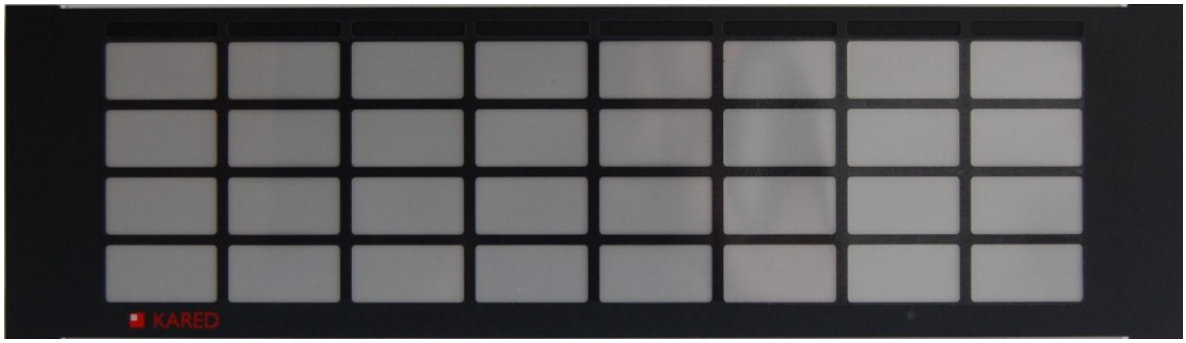
Signaling cassette KSR-32

Type: KSR-32-M-XXX-XXX



Usage instruction

(version 2.07)

CE

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IMPORTANCE OF THE USAGE INSTRUCTION

In case of any doubts regarding interpretation of this usage instruction, please contact directly with the manufacturer.
We look forward to hear from our users about any suggestions, opinions and critical remarks. All suggestions and opinions can be submitted by telephone or in written form. This will help us to make this instruction more friendly for our users, including their request and requirements.

The device, to which this instruction is attached contains impossible to remove potential threats for peoples and material properties. Therefore, each person who operates this device or performs any activities connected with operation and maintenance of this device must be properly trained and familiar with potential threats generated by this device. Each user of this device must carefully read, understand and observe all usage instruction, especially guidelines regarding safety.

CE

Table of contents:

INFORMATION ABOUT CONFORMITY

The device described in this instruction is designed for use in industrial environment. During construction and production of this device were used norms that provide realization of safety rules and measures provided that, all instructions described below regarding installation, start-up and usage of this device will be observed by the user.

This device is Class A device. In residential buildings it can generate radio-electrical interferences. In such cases, the user of this device can be requested to apply proper remedial measures and actions.

This device is in conformity with the following EU directives:

- **LVD 2006/95/WE** - LVD - directive of the European Parliament and of the Council of December 12, 2006, on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits - applied on the territory of the Republic of Poland by the Ordinance of the Minister of Economy of August 21, 2007 regarding essential requirements for electric equipment (Journal of Laws, No. 155, item 1089)

- **EMC 2004/108/WE** - EMC - directive of the European Parliament and of the Council of December 15, 2004, on the harmonization of the laws of Member States relating to electromagnetic compatibility – applied on the territory of the Republic of Poland by the Act of April 13, 2007 about electromagnetic compatibility (Journal of Laws, No. 82, item 556).

Harmonized norm with Directive LVD 2006/95/WE

- **PN-EN 60255-5:2005** - Power-electric transmitters – Part 5: Coordination of measuring transmitters and protecting devices insulation – Requirements and examinations.

Harmonized norm with Directive EMC 2004/108/WE

- **PN-EN 50263:2003(U)** - Electromagnetic compatibility (EMC). Norm regarding measuring transmitters and protective devices.

1. Applicability of the device

Signaling cassette KSR-32 is designed to provide visual and sound control of 32 limit states in supervised facilities. It informs operating personnel that the set-points of limit values of a variety of parameters – such as pressure, temperature, flow, time limit, etc. – have been exceeded during the technological process. The state of controlled devices is presented in the form of fields with captions, highlighted with constant or pulsating color light (green, red, yellow).
The KSR-32 signaling cassettes have a modular structure and allow to build signaling boards with the number of inputs being a multiple of 32. It is possible to use any number of KS-P button modules.

2. Safety rules

Information provided in this chapter are meant for familiarizing the user with proper installation and operation of the product. It is assumed, that personnel responsible for installation, start-up and usage of this device has proper qualifications and is aware of potential threats connected with handling and operating electric equipment.
This device conforms all requirements regarding safety rules and standards. During designing stage of this device, a special attention was paid to user safety.

Installation of the device

This device should be installed in place that provides proper environmental conditions described in the technical data. The device should be firmly mounted and protected against any mechanical damages and also against accidental access of non-authorized personnel. All cross-section ans connection types of wiring should be conformable with guidelines described in this instruction.

Start-up of the device

During start-up of the device, it is important to check informations provided on the rating plate and the following conditions:

- continuity of the earthing cables (if required),
- conformity of the measuring values (voltage, current),
- whether the permissible value of relay outputs is not exceeded,
- conformity of voltage values for two-states inputs,
-

Insulation test can cause load of dispersed capacities to the dangerous voltage value. After finishing each test, such capacities should be discharged.

After applying supply voltage, the proper settings should made.

Usage of the device

This device should operate in the conditions described in the technical data.
All persons who operate this device should be authorized and familiarized with usage instruction.

Removing the enclosure

Before starting any works that require removal of the enclosure, all measuring and auxiliary voltages should be completely disconnected. Dangerous voltages can be active on the parts the device for the period of about 1 minute from the disconnection time.

All integrated circuits used in this device are very sensitive to electrostatic discharges, and therefore opening of the device without proper anti-electrostatic equipment can cause damage to the device.

Usage

After installation this device does not require any additional service, except periodical inspections required by the applicable regulations. In case of any failures, please contact with the manufacturer.
Manufacturer of this device is responsible for any services regarding start-up and any warranty/after warranty services. All warranty conditions are provided on the warranty card.

Modifications and changes

Because of safety precautions, all modifications and changes regarding functionality of the device described in this instruction are prohibited. Any modification of the device performed without written consent of the manufacturer will cause loss of right to any contractual and tort liability claims against PUP Kared Spółka z o.o.
Replacement of parts and sub-assemblies included in this device and usage of parts originated from third parties can disturb safety of the device users and can cause improper operation of the device.
PUP KARED Sp. z o.o. should not be liable for any damages caused by application of improper parts and sub-assemblies.

Abnormalities

The competent person should be informed about any abnormalities in functioning of the device and other damages and failures.
All repairs should be performed only by authorized professionals with proper qualifications.

Rating plates, information plates and stickers

All advices provided in the form of descriptions placed on the device and on the information plates and stickers should be absolutely observed. All damaged or illegible plates and stickers should immediately replaced for new ones.

Threats impossible to elimination

During normal usage of the device, the user should not touch terminals, because of active voltages with values very dangerous for people.

3. Technical description

3.1. General description

Signaling cassette KSR-32 is designed to provide visual and sound control of 32 limit states in supervised facilities.
Reaction manner for excitation with alarming state is defined by the user. The device is equipped with 2 communication connections RS485 with Modbus-RTU and IEC 60870-5-103 protocols. One connection is used for communication with master systems and provides readings of the actual alarming input state, signaling state and registered events. In digital input writing state it provides alteration of luminous fields state with using commands send from the master system. Second connection provides connection of second, "slave" cassette that reproduces signaling state of the "master" cassette or usage of the binary inputs concentrator instead of embedded inputs. Embedded or external buttons provide reception and cancellation of alarming signalization, and also test of LED diodes illumination correctness. The device can be equipped with a relay with WatchDog function which determines correct operation.
The device is supplied with 24 V ± 10% DC voltage. It is possible to equip the device with a power supply adapted to work with a voltage of a different value. Communication ports, input terminals and relay outputs are galvanically insulated.

3.2. Enclosure

Enclosure of signaling cassette KSR-32 is shown on Figure 3.1.

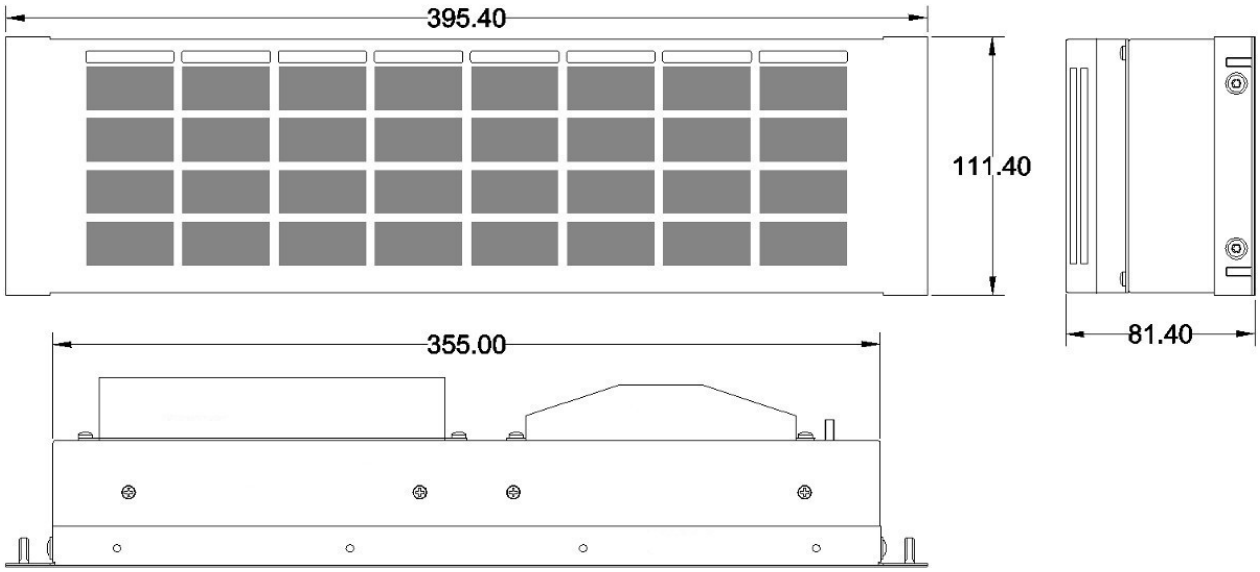


Fig. 3.1. Enclosure dimensions

Optional button module is shown on Figure 3.2.

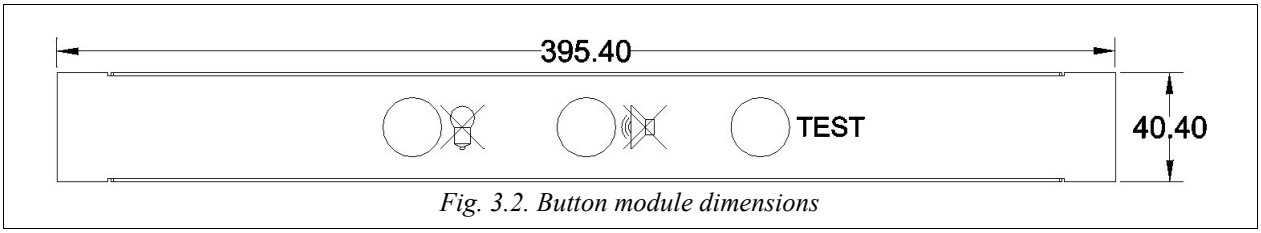


Fig. 3.2. Button module dimensions

3.3. Operation description

Signaling cassette provides the following functions:
- Cyclical (1 ms period – in standard mode) reading of the input states,
- Input signals filtration with time constant set by the user,
- Excitation response delay with set time,
- Elongation of excitation duration time,
- Events writing – appearance of the alarming state, disappearance of the alarming state and alarm take-over by the operating personnel

The block diagram of the device is showed on Figure 3.2.

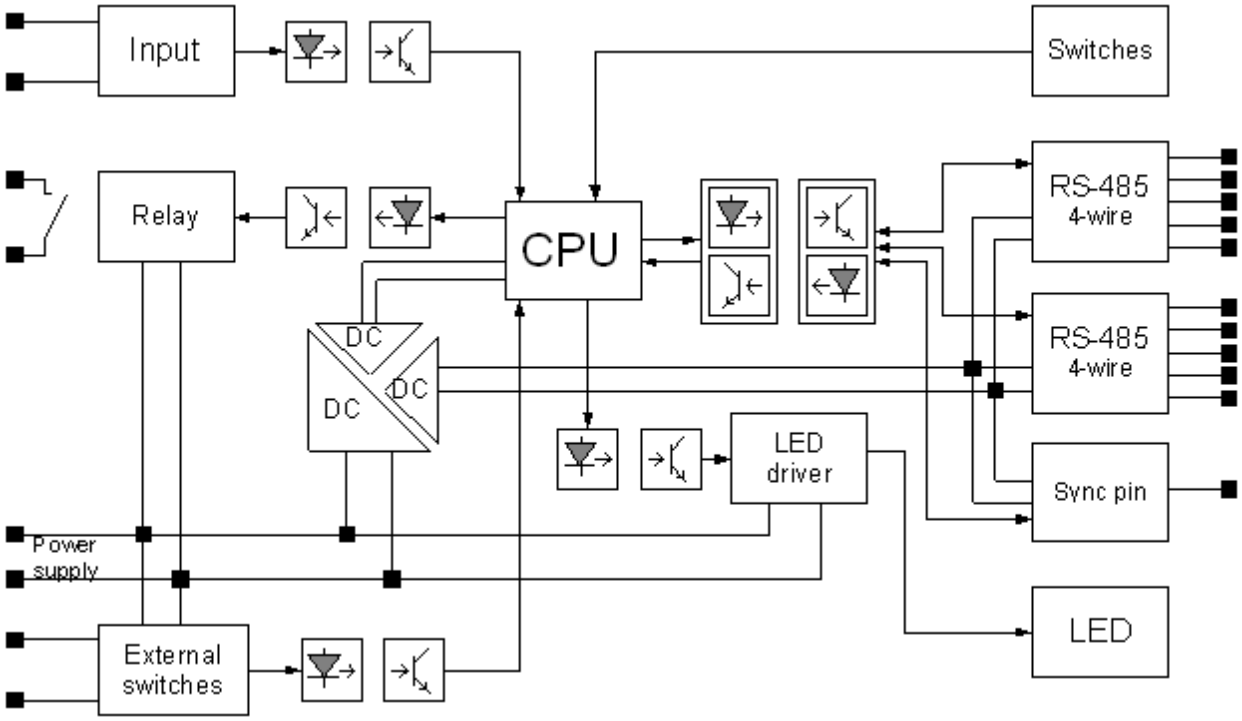


Fig. 3.2. Block diagram

3.4. Operation modes of the device

The device can be operated in the mode selected by the user.
- Standard mode – the device receives informations about alarm states with embedded binary inputs (if the device is not equipped with the binary inputs module, this operation mode is not available),
- Concentrator operation mode – the device receives informations from the binary inputs concentrator using RS485 network,
- Signaling duplication mode – the device connected to RS485 network with master cassette duplicates the illumination diode fields of the master cassette,
- Signalization enforcing mode – the device connected using RS485 network with master device that digitally interchanges the input state (no response for signal alterations from binary inputs module).

3.5. Communication

The signaling cassette can be operated in RS485 network – Modbus RTU protocol - as the „slave" type device. For this reason, the "RS485 to the system" connection is used. The master system using "Read Holding Registers (0x03)" command can download the actual binary inputs state of the device, LED diodes illumination state and recorded events.
The second connection - "local" - can be used to connect the device to the binary inputs concentrator cassette (e.g. iKAR IO manufactured by Kared) or to the second cassette used for duplication of alarm signalization.

3.6. Alarm states signalization

The response manner for alarm state is optionally defined by the user for each channel. Alarming signalization cycle consists of 5 or 7 phases depending on whether the given channel is assigned to the alarm group, for which id signaled the alarm that appeared as the first. The user is responsible for defining the following phases depending on the operation mode:

1. Lack of distinguishing of the first alarm:
   - Normal operation,
   - Alarm appearance,
   - Alarm reception,
   - Alarm disappearance before reception,
   - Alarm disappearance after reception,
2. Distinguishing of the first alarm:
   - Normal operation,
   - Appearance of the first alarm,
   - Appearance of the consecutive alarms,
   - Alarm reception,
   - First alarm disappearance before reception,
   - Other alarms disappearance before reception,
   - Alarm disappearance after reception

The user can define for each phase:

1. Illumination manner:
   - Diode field disabled,
   - Field is illuminated with continuous light,
   - Field is pulsating slowly (1 Hz),
   - Field is pulsating quickly (2 Hz),
1. Light color:
   - Green,
   - Red,
   - Yellow.
1. Additional reactions:
   - Turning on the ring relay,
   - Turning on the light relay No. 1 (only after alarm reception),
   - Turning on the light relay No. 2 (only after alarms cancellation),
1. Alarm triggering manner:
   - Increasing slope,
   - Decreasing slope.

All alarm signalization phases are presented in Table 3.1.

Table 3.1 Phases of alarm signalization cycle

Phase number	Phase description
1	Normal operation. Lack of actual alarms. Previous alarms were received and canceled.
2	Appearance of first alarm
3	Appearance of consecutive alarms
4	Reception of information about alarms by pressing **KAO** button
5	Disappearance of received alarms
6	Disappearance of first (distinguished) alarm
7	Disappearance of non received consecutive alarms

Diagrams for transition between consecutive states are represented on Figures 3.3 and 3.4.

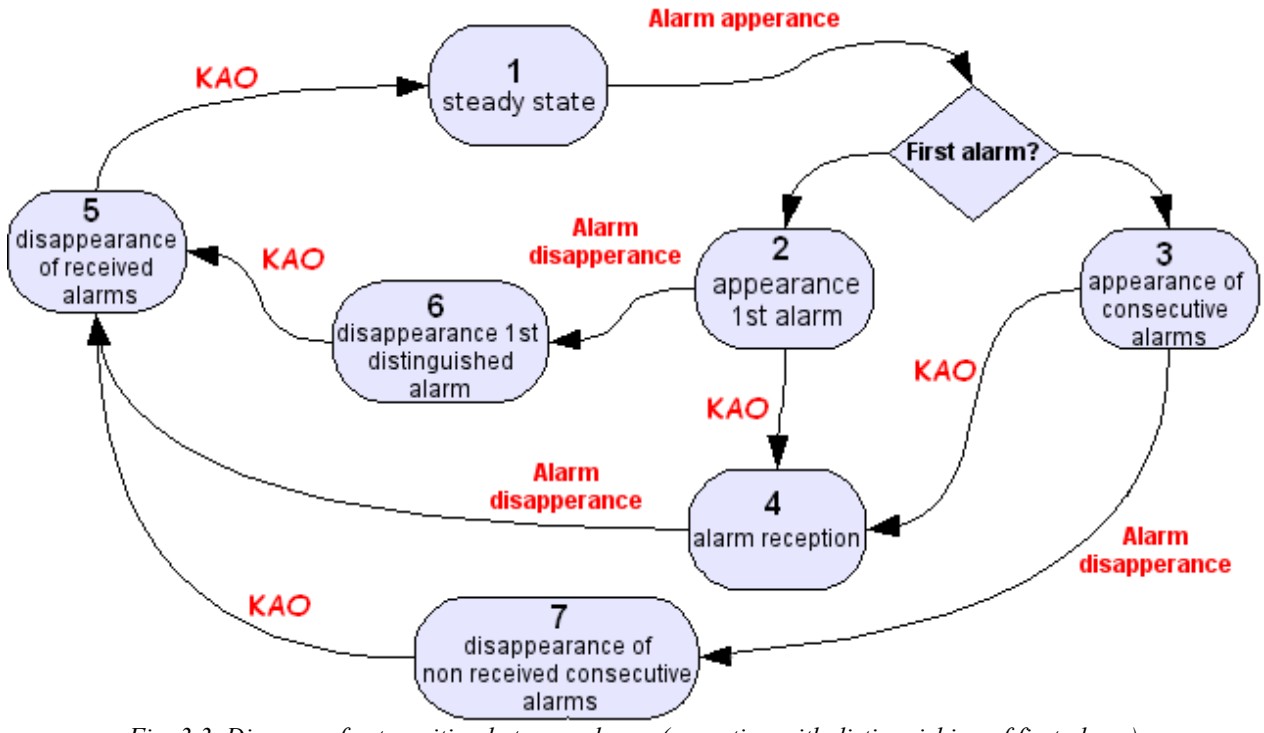


Fig. 3.3. Diagrams for transition between phases (operation with distinguishing of first alarm)

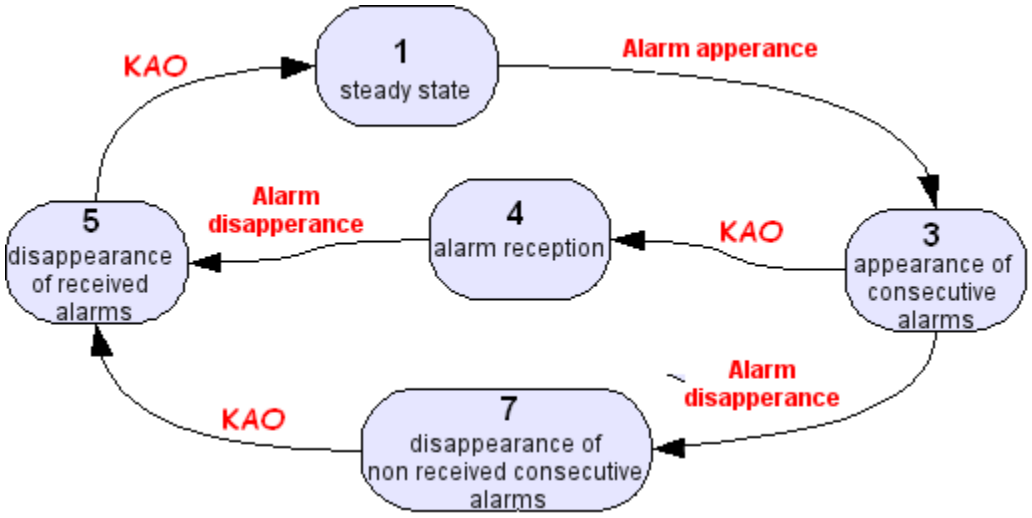


Fig. 3.4. Diagrams for transition between phases (operation without distinguishing of first alarm)

To facilitate programming activities for signaling cassettes, the manufacturer prepared proper tool and exampled alarm functions.

2-color basic function

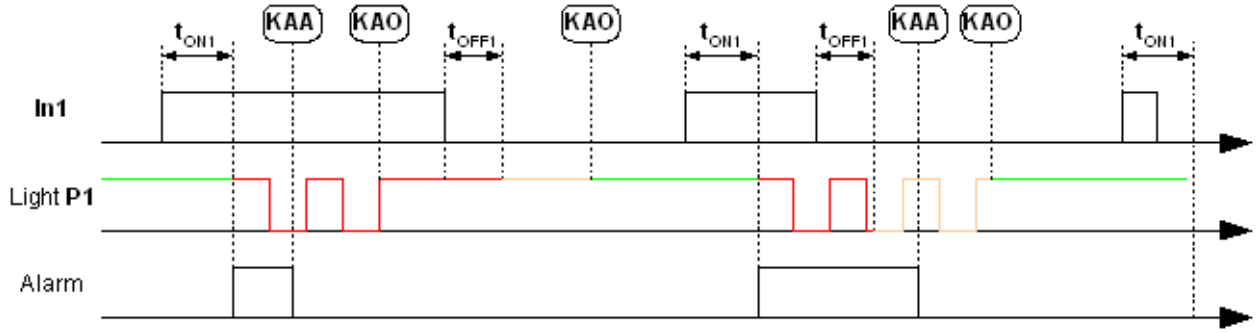


Fig. 3.5. 2-color basic function

1. In normal state (no excitation with alarm signal) the alarm signal field is illuminated with green color.
2. Change of the binary signal on the input, after filtration by control of the state with time t_{filtr}, causes illumination of the field with signal description with pulsating color, and switching-on the alarm relay of the sound signal. For each track, there is the possibility to set delay time t_{ON} of the alarm signal and delay time t_{OFF} for disappearance of the signal. Delay ranges can be set individually from 1 ms up to 60 000 ms.
3. By pressing **KAA** button (Acoustic Alarm Cancellation) the acoustic alarm can be canceled. The field on the board with actuated alarm channel still pulsates with flashing red light.
4. By pressing **KAO** button (Optical Alarm Cancellation) the illumination of the field changes from flashing to stable.

5. Disappearance of the alarm reason causes the change of the illuminated field color from red to yellow, and after another pressing if the **KAO** button to green color.
6. Disappearance of the alarm reason before pressing **KAO** button causes change of the flashing color of the illuminated field from red to yellow, and after pressing KAO button, to green color.

1-color basic function

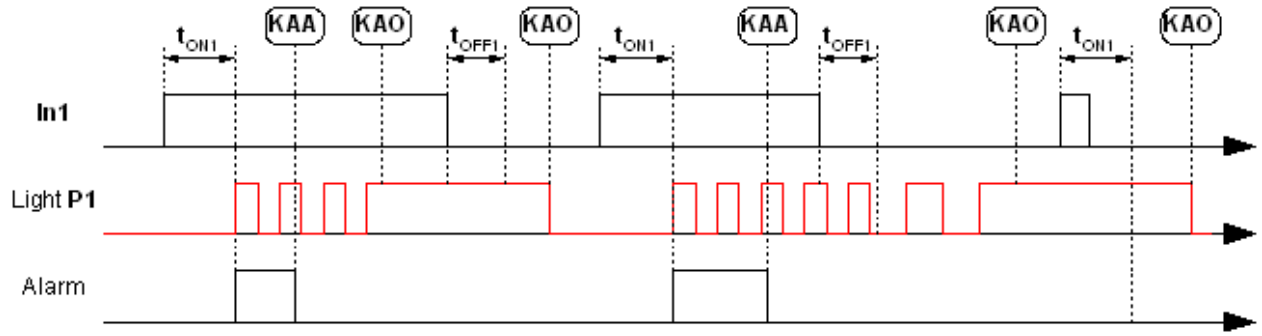


Fig. 3.6. 1-color basic function

1. In normal state (no excitation with alarm signal) the signal field is turned off.
2. Change of the binary signal on the input, after filtration by control of the state with time t_{filtr}, causes illumination of the field with signal description with red quick light (2 Hz), and switching-on the alarm relay of the sound signal. For each track, there is the possibility to set delay time t_{ON} of the alarm signal and delay time t_{OFF} for disappearance of the signal. Delay ranges can be set individually from 1 ms up to 60 000 ms.
3. By pressing **KAA** button (Acoustic Alarm Cancellation) the acoustic alarm can be canceled. The field on the board with actuated alarm channel still pulsates with flashing red light.
4. By pressing **KAO** button (Optical Alarm Cancellation) the illumination of the field changes from flashing to stable.
5. After another pressing of **KAO** button the field is disabled providing that the alarm cause was terminated.
6. Disappearance of the alarm cause before pressing **KAO** button causes change of the flashing light from 2 Hz to 1 Hz. Further cancellation of the alarm signalization is performed as described in points 4 and 5.

Function of distinguishing the first alarm

1. The actuating channels are read out every 1 ms.
2. If several actuating channels will appear in intervals greater than 1 ms, before the acoustic and optical signal will be canceled, the device will illuminate with 2 Hz flashing red light the channel which will appear as the first one, and other channels with 1 Hz red light. Disappearance of the signal that actuates the alarm track causes the change of the illuminating color from red to yellow.
3. Pressing **KAO** button with released **KAA** button causes change of the flashing red illumination to stable red illumination, and yellow to green.
4. If during the time shorter than 1 ms several channels will be actuated, such event will be treated as simultaneous and filed for these channels are illuminated (synchronously) with red flashing light, if the excitation is still active or with yellow color, if the excitation has

disappeared.

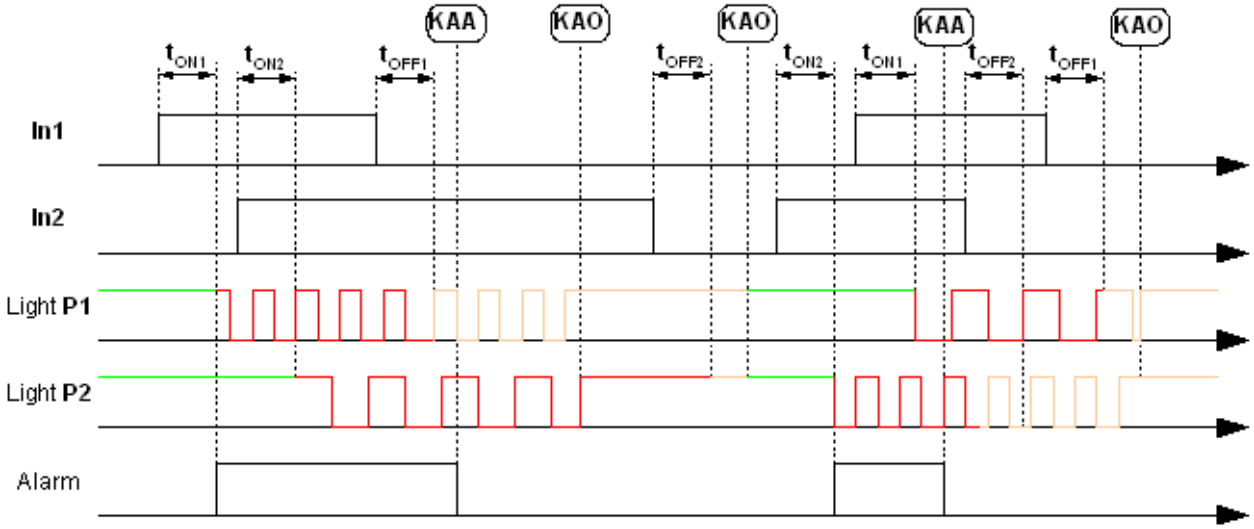


Fig. 3.7. Function of distinguishing the first alarm

Special function - control of the pump or engine operation

1. It is possible to bundle several fields with the engine or pump operation. In this case, the main field of the enabled engine is illuminated with green color, when no signaling channels connected with the engine or pump are actuated and this field is not illuminated, when the engine is turned off.
2. If during start-up time (t_1) any of the sensors connected with the engine will be actuated, its field will be illuminated with red color).
3. If during set time t_1 for engine start-up the excess signal will disappear, then the appropriate fields will be turned off (they will be no illuminated).
4. If after time t_1 of the engine start-up there will be exceeded value of the even one parameter, the acoustic and optical alarm signal will be enabled. The filed channel, in which excess state is maintained during the start-up time is illuminated with flashing red light, and engine field with stable red light.
5. Each bundled states can be individually negated, and delay times t_{ONi} can be defined for appearance of the alarm signal, and delay times t_{OFFi} for disappearance of the signal.
6. Alarm cancellation method and consequences of this operation are described in section regarding the Basic Function.
7. After engine start-up phase, excess of any admissible value of any controlled parameter by the set t_{ONi} causes actuation of acoustic and optical alarm.
8. Turning-off the engine (signal bundled with the main field) causes cessation of the information about new alarm states for the bundled parameters, however all alarms generated during engine operation are still represented, until cancellation by pressing the **KAO** button.
9. Consecutive turning-on the engine in situation, when any of the bundled parameters is exceeding the admissible level will cause illumination of the main field with red color (start-up time t1 will be omitted), and the field of the given channel will be illuminated with red flashing light, and acoustic alarm will be enabled.

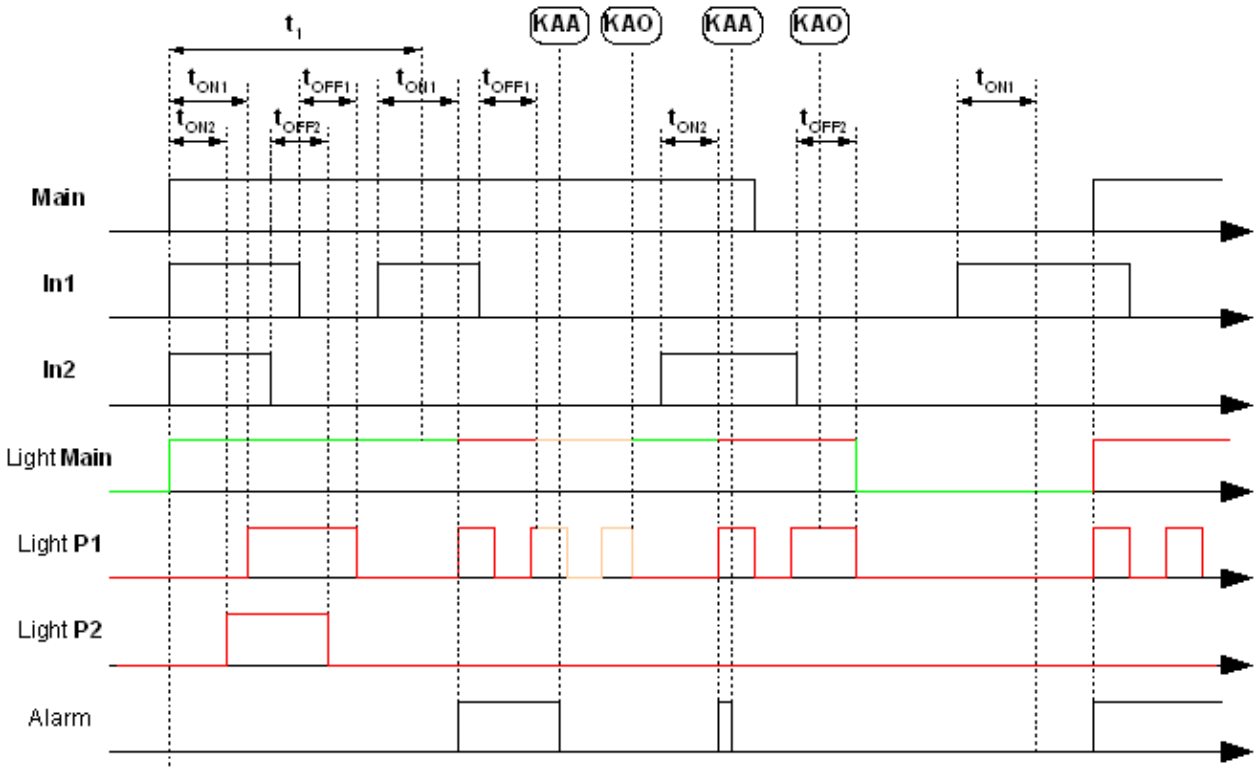


Fig. 3.8. Control function for engine or pump operation

3.7. Operating the alarm states

Personnel responsible for the facility, in which the signaling cassette is mounted can undertake the following activities:

- cancellation of the acoustic alarm signal by pressing **KAA** button on the front panel of the device or proper external button (if such button is mounted),
- reception of alarm status information by pressing KAO push-button on the front panel or relevant external key (simultaneously the relay's contacts open, should the relay have been released).
- cancellation of the information about the alarm state by pressing **KAO** button (cancellation of the information about alarm state will be possible only, when the alarm states will disappear).

3.8. Special functions for TEST, KAA and KAO buttons

- **Cassette control**

Pressing and holding the **TEST** button causes that the signaling cassette goes to the illuminated fields control mode. All fields will be illuminated with one of the colors. Each consecutive pressing of the button will cause illumination of the other color. Releasing of the **TEST** button or appearance of the alarm signal will cause termination of the control mode.

- **Brightness control for fields illumination**

During cassette control mode (when the **TEST** button is pressed), pressing of **KAA** button will cause increase of the brightness of all illuminated fields, and pressing of the **KAO** – will cause decrease of the brightness all illuminated fields.

- **Reviewing last alarm states**

Pressing and holding of **KAA** button will force transition to the reviewing mode of the last events. Pressing of **KAO** button (with pressed **KAA** button) will display consecutive actuations, starting from the most actual. Releasing of the **KAA** button or appearance of the alarm signal will cause termination of the reviewing mode.

3.9. Events registration

The device allows to register in the memory up to 1000 events. The event is meant as:
- actuation of the alarm input,
- disappearance of the input actuation,
- buttons operation.

Together with the event the duration time of the event is also recorded with 1 ms discretization. Event writing procedure is organized in the circular buffer. When the device memory is full, the most oldest event is overwritten in case of the new event.

3.10. WatchDog function

Optionaly **Relay 2** has NC (Normally Closed) contacts. After starting the device in a correct way, and switching to its normal operation mode, the relay's contacts open up.

4. Technical data

No.	*Parameter*	*Value*
1	Voltage	24 V DC ± 10% *
2	Rating current	1 A
3	Max. dimensions with connection (W × H × D) [mm]	395x111x84
4	Weight [kg]	2,5
5	Ambient temperature	0 ÷ 40°C
6	Insulation resistance Power supply – RS485	2,25 kV / 50 Hz / 1 min.
7	Insulation resistance Power supply – CPU	2,25 kV / 50 Hz / 1 min.
8	Insulation resistance Power supply – Relay outputs	2,25 kV / 50 Hz / 1 min.
9	Insulation resistance Power supply – Outputs	2,25 kV / 50 Hz / 1 min.
10	Insulation resistance RS485 - CPU	2,25 kV / 50 Hz / 1 min.
11	Insulation resistance RS485 – Relay outputs	2,25 kV / 50 Hz / 1 min.
12	Insulation resistance RS485 – Outputs	2,25 kV / 50 Hz / 1 min.
13	Insulation resistance CPU – Relay outputs	2,25 kV / 50 Hz / 1 min.
14	Insulation resistance CPU - Outputs	2,25 kV / 50 Hz / 1 min.
15	Insulation resistance Admissible input – any relay output	2,25 kV / 50 Hz / 1 min.
16	Possible rating voltage for Un inputs	24 V DC 48 V DC 110 V DC 220 V DC

No.	*Parameter*	*Value*
17	Input resistance	17 kΩ for 24 V DC 35 kΩ for 48 V DC 82 kΩ for 110 V DC 164 kΩ for 220 V DC
18	External button input resistance	17 kΩ
19	Input switching voltage	(½ Un) ± 20%
20	Input processes resistance	Digital
21	Filtration time	Set, 1 ÷ 255 ms
22	Input signal delay	Set, 0 ÷ 60 000 ms
23	Input signal prolongation	Set, 0 ÷ 60 000 ms
24	Relay inputs ampacity	8 A / 250 V AC 8 A / 24 V DC
25	Relay input terminal type	Normally opened
26	Transmission medium	RS485 4-wire
27	Communication protocol	Modbus RTU, supported commands: - Read Holding Registers (0x03) - Write Multiple Registers (0x10) - additional defined within user functions
28	Transmission rate	9600 b/s 19200 b/s 38400 b/s 57600 b/s ** 115200 b/s **
29	Number of data bits	8
30	Number of stop bits	1 2
31	Parity bit	No Even Odd
32	Device address in Modbus network	1 – 247
33	Registration resolution	1 ms ***
34	Number of registered events	1000

* In case, when the device should be powered with the voltage other than 24 V DC, the external power supply with proper ampacity (1A) should be used, adapted to the operation with external power supply (e.g. 230 V AC, 220V DC, etc.). We suggest to use power supply from MDR series manufactured by Mean Well, for example MDR-20-24 of from DR series, for example DR-4524

** Only connection to the system

*** Only in case, when embedded binary inputs are used

5. Information about completeness

The complete delivery includes the following items:

- Signaling cassette
- CD with software
- Usage instruction

- Warranty card

6. Starting-up

6.1. Assembly of the device

The device should be unpacked and leave for min. of 1 hour in the environment scheduled for the normal usage, to compensate temperature difference.
The device should be mounted in the file prepared according to Figure 6.1.
Because of the possible heating, depending on the realized functions, the free space ca. 10 cm around the device should provided).

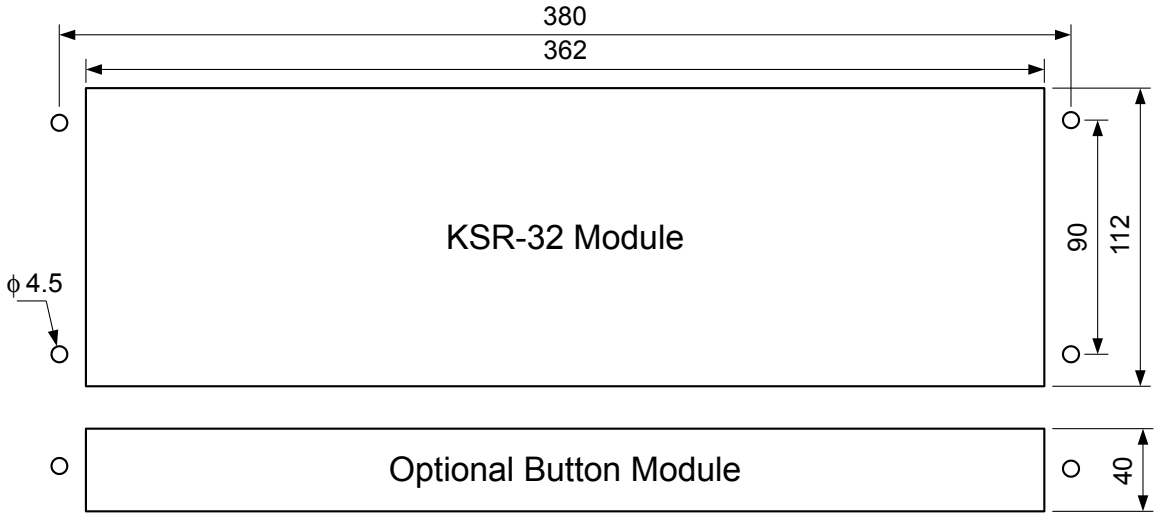


Fig. 6.1. Mounting hole

6.2. Connecting power supply and inputs

All cables should be connected using the screw cable plug connectors. Binary inputs, power supply and external buttons should be connected using the YLY types cables with cross-sections not smaller than 0,5 mm^2. Cables cross-sections for relay outputs should be selected depending on the required ampacity. Do not use cross-sections smaller than 0,5 mm^2. cables should have tighten terminations. In case, when the device will be powered with voltage other than 24 V DC, use power supply adapter that will fulfill requirements regarding ampacity (1A), adapted to the operation with external power supply (e.g. 230 V AC, 220 V DC, etc.). We suggest to use power supply from MDR series manufactured by Mean Well, for example MDR-20-24 of from DR series, for example DR-4524

Fig. 6.2. Connections view

Table 6.1. Outputs description

Terminal No.	Connector Z1		Connector Z2	Connector Z3	Connector Z4	Connector Z5	Connector Z6
1	RS485 to the system	R+	Power supply DC +	IN1 +	IN9 +	IN17 +	IN25 +
2		R-	Power supply DC -	IN1 -	IN9 -	IN17 -	IN25 -
3		T+	NC	IN2 +	IN10 +	IN18 +	IN26 +
4		T-	Relay 1	IN2 -	IN10 -	IN18 -	IN26 -
5		GND	Relay 1	IN3 +	IN11 +	IN19 +	IN27 +
6	NC		Relay 2	IN3 -	IN11 -	IN19 -	IN27 -
7	RS 485 local	R+	Relay 2	IN4 +	IN12 +	IN20 +	IN28 +
8		R-	Relay 3	IN4 -	IN12 -	IN20 -	IN28 -
9		T+	Relay 3	IN5 +	IN13 +	IN21 +	IN29 +
10		T-	NC	IN5 -	IN13 -	IN21 -	IN29 -
11		GND	TEST +	IN6 +	IN14 +	IN22 +	IN30 +
12	SYN.		TEST -	IN6 -	IN14 -	IN22 -	IN30 -
13	—		KAA +	IN7 +	IN15 +	IN23 +	IN31 +
14	—		KAA -	IN7 -	IN15 -	IN23 -	IN31 -
15	—		KAO +	IN8 +	IN16 +	IN24 +	IN32 +
16	—		KAO -	IN8 -	IN16 -	IN24 -	IN32 -

The enclosure of the device should be grounded using denominated pin (M4 thread)

Connections diagram is showed on Figure 6.3.

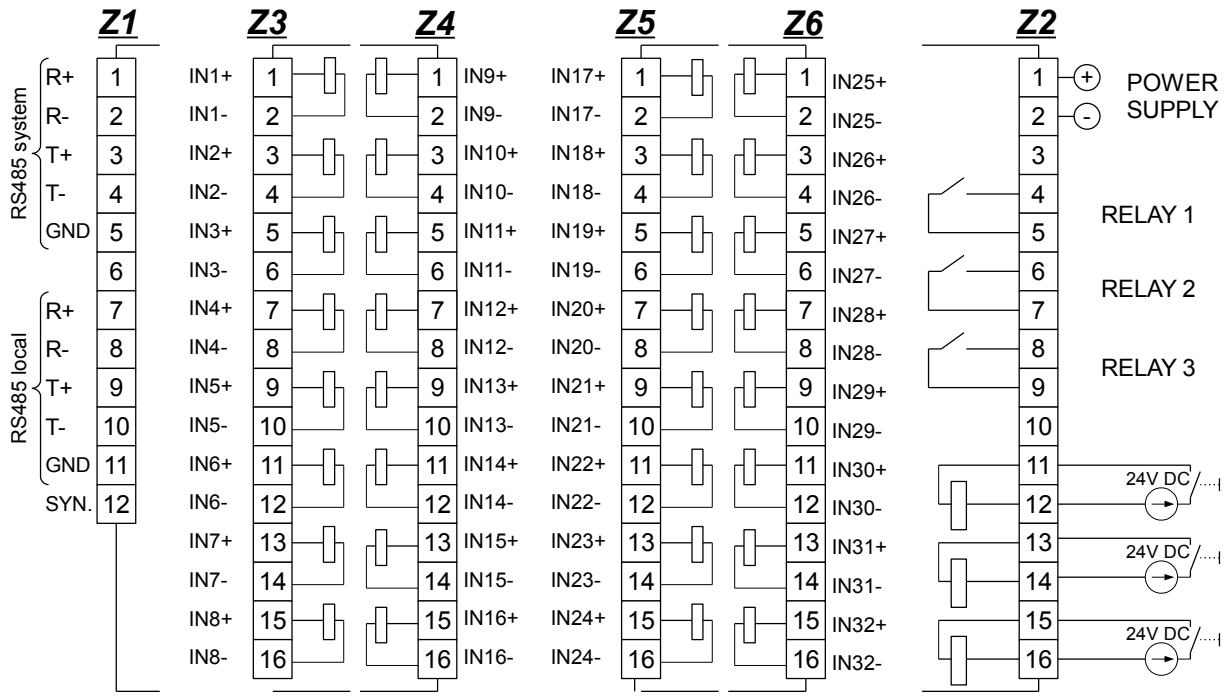


Fig. 6.3. Connections diagram

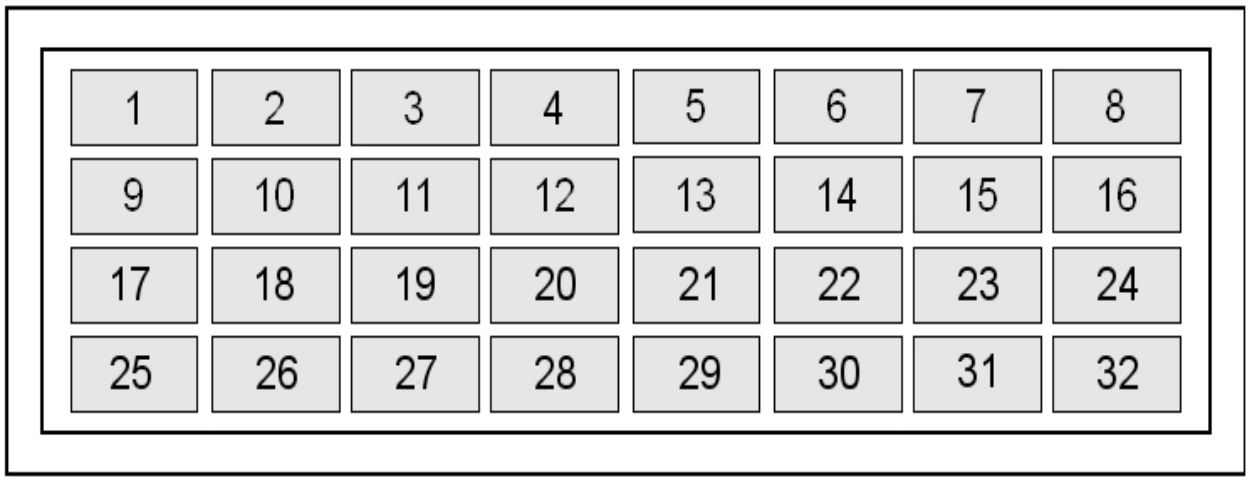


Fig. 6.4. Numbering of illuminated fields

Assign of the binary inputs to the illuminated fields is showed on Figure 6.4.

6.3. Connecting RS485 network

RS485 4-wire network should be connected with 2 twisted pairs, using for example Ethernet UTP-5 cable. Wave impedance of the cable should be 120 Ω. In case of using greater number of devices in one network, it should have the bus topology. The terminators in the form of resistors with value of

120 Ω should be connected on both ends of the network. For this, the terminators embedded in the cassette can be used, connecting them using the switch available from outside (near Z1 connection). SW1 switch is used for terminators connection for communication output „to the system", while SW2 switch – for „local" output. Do note exceed number of 32 devices in one network segment.

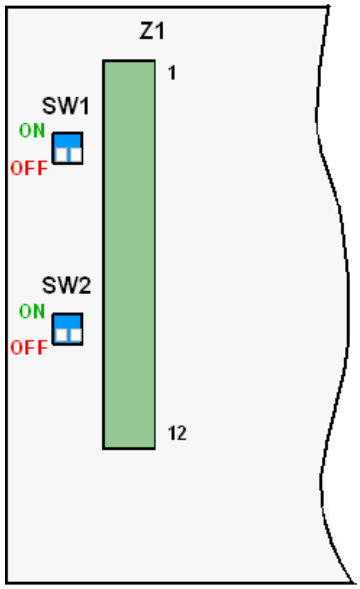


Fig. 6.5. Method of terminators connection

Connection and disconnection of the terminators should be performed with disconnected RS485 network.

Method of connection the cassette to the computer is showed on Figure 6.6 and 6.7. Proper operation during connection using RS485 2-wire is not guaranteed by the manufacturer and depends on the available converter.

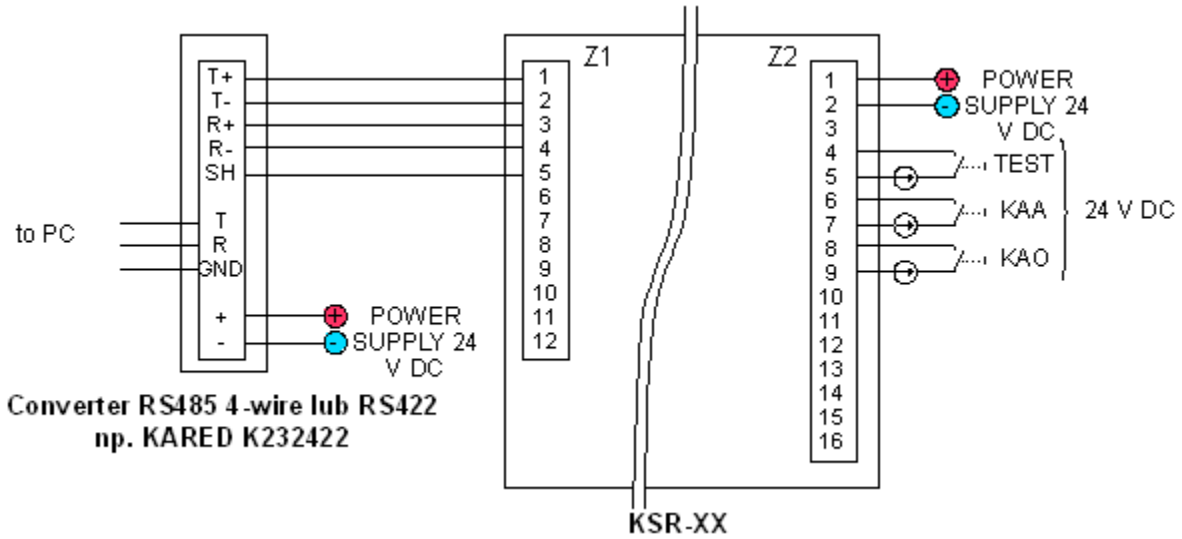


Fig. 6.6. Recommended method for connection to the computer

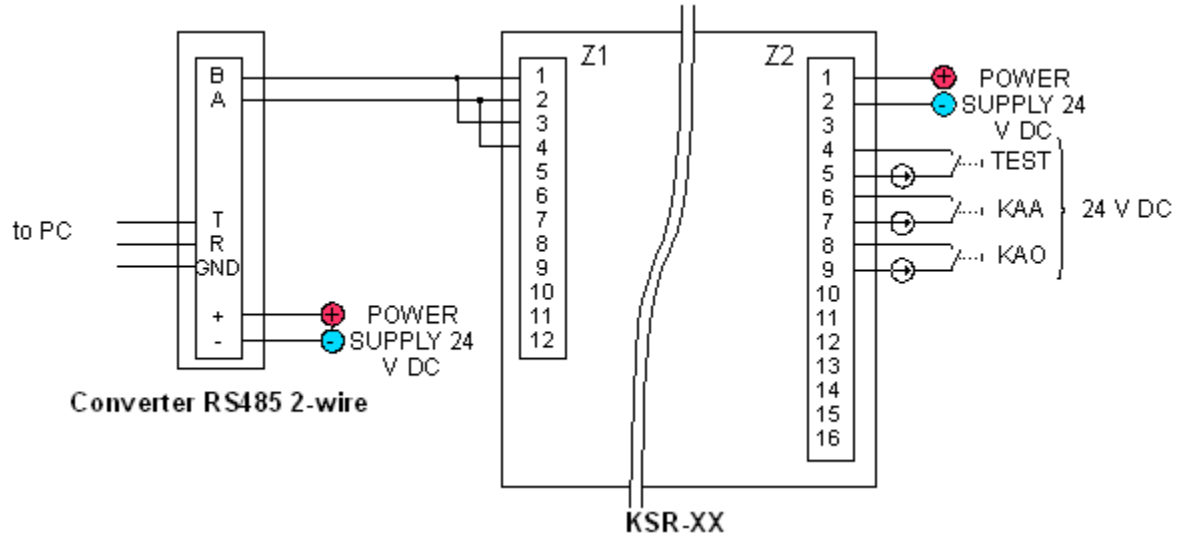
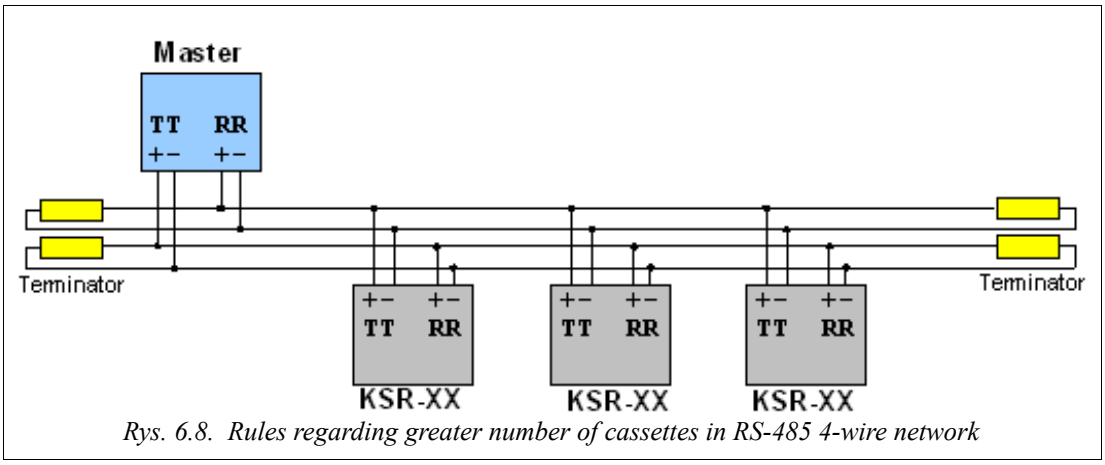


*Fig. 6.7. **Non-recommend** method for connection to the computer*

Figure 6.8. shows rules regarding greater number of cassettes in RS-485 4-wire network.



Rys. 6.8. Rules regarding greater number of cassettes in RS-485 4-wire network

6.4. Connecting devices for synchronous operation

The synchronous operation allows synchronization alarm states display (flashing light). In such case, the group of devices (up to 10) should be connected using contact 12 (SYN.) of Z1 connection and common mass (GND) available on contact 11 of Z1 connection. The device should be also properly programmed using register `%R0110`. Remember to select **only one** synchronizing device (master), and other devices should be set in slave synchronization mode.

6.5. Programming

Programming procedure for signaling cassette is possible only in service mode. To do this, disconnect the power supply, wait a few seconds, and then turn on the power supply, when pressing and holding **TEST** and **KAA** buttons. Illumination of all fields with yellow color means that the device operates in the service mode.
Programming procedure of the cassette is done the communication connection „RS485 to the system". The user can program the cassette using any device / system that is able to save proper registers using 0x10 command (Write Multiple Registers) of the Modbus RTU protocol. The manufacturer recommends to use delivered software to facilitate possibility to utilize all functionalities of the signaling cassette.
in the service mode, the device always uses **slave address `0x01`.**

6.5.1. Available registers

List of available registers is provided in Table 6.2.

Table 6.2. List of available registers

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0001	Filter constant 1								Filter constant 2								R/W	R
%R0002	Filter constant 3								Filter constant 4								R/W	R
%R0003	Filter constant 5								Filter constant 6								R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0004	Filter constant 7								Filter constant 8								R/W	R
%R0005	Filter constant 9								Filter constant 10								R/W	R
%R0006	Filter constant 11								Filter constant 12								R/W	R
%R0007	Filter constant 13								Filter constant 14								R/W	R
%R0008	Filter constant 15								Filter constant 16								R/W	R
%R0009	Filter constant 17								Filter constant 18								R/W	R
%R0010	Filter constant 19								Filter constant 20								R/W	R
%R0011	Filter constant 21								Filter constant 22								R/W	R
%R0012	Filter constant 23								Filter constant 24								R/W	R
%R0013	Filter constant 25								Filter constant 26								R/W	R
%R0014	Filter constant 27								Filter constant 28								R/W	R
%R0015	Filter constant 29								Filter constant 30								R/W	R
%R0016	Reserve																R/W	R
%R0017	Delay of turning-on 1																R/W	R
%R0018	Delay of turning-on 2																R/W	R
%R0019	Delay of turning-on 3																R/W	R
%R0020	Delay of turning-on 4																R/W	R
%R0021	Delay of turning-on 5																R/W	R
%R0022	Delay of turning-on 6																R/W	R
%R0023	Delay of turning-on 7																R/W	R
%R0024	Delay of turning-on 8																R/W	R
%R0025	Delay of turning-on 9																R/W	R
%R0026	Delay of turning-on 10																R/W	R
%R0027	Delay of turning-on 11																R/W	R
%R0028	Delay of turning-on 12																R/W	R
%R0029	Delay of turning-on 13																R/W	R
%R0030	Delay of turning-on 14																R/W	R
%R0031	Delay of turning-on 15																R/W	R
%R0032	Delay of turning-on 16																R/W	R
%R0033	Delay of turning-on 17																R/W	R
%R0034	Delay of turning-on 18																R/W	R
%R0035	Delay of turning-on 19																R/W	R
%R0036	Delay of turning-on 20																R/W	R
%R0037	Delay of turning-on 21																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0038	Delay of turning-on 22																R/W	R
%R0039	Delay of turning-on 23																R/W	R
%R0040	Delay of turning-on 24																R/W	R
%R0041	Delay of turning-on 25																R/W	R
%R0042	Delay of turning-on 26																R/W	R
%R0043	Delay of turning-on 27																R/W	R
%R0044	Delay of turning-on 28																R/W	R
%R0045	Delay of turning-on 29																R/W	R
%R0046	Delay of turning-on 30																R/W	R
%R0047	Reserve																R/W	R
%R0048	Reserve																R/W	R
%R0049	Prolongation of signal 1																R/W	R
%R0050	Prolongation of signal 2																R/W	R
%R0051	Prolongation of signal 3																R/W	R
%R0052	Prolongation of signal 4																R/W	R
%R0053	Prolongation of signal 5																R/W	R
%R0054	Prolongation of signal 6																R/W	R
%R0055	Prolongation of signal 7																R/W	R
%R0056	Prolongation of signal 8																R/W	R
%R0057	Prolongation of signal 9																R/W	R
%R0058	Prolongation of signal 10																R/W	R
%R0059	Prolongation of signal 11																R/W	R
%R0060	Prolongation of signal 12																R/W	R
%R0061	Prolongation of signal 13																R/W	R
%R0062	Prolongation of signal 14																R/W	R
%R0063	Prolongation of signal 15																R/W	R
%R0064	Prolongation of signal 16																R/W	R
%R0065	Prolongation of signal 17																R/W	R
%R0066	Prolongation of signal 18																R/W	R
%R0067	Prolongation of signal 19																R/W	R
%R0068	Prolongation of signal 20																R/W	R
%R0069	Prolongation of signal 21																R/W	R
%R0070	Prolongation of signal 22																R/W	R
%R0071	Prolongation of signal 23																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0072	Prolongation of signal 24																R/W	R
%R0073	Prolongation of signal 25																R/W	R
%R0074	Prolongation of signal 26																R/W	R
%R0075	Prolongation of signal 27																R/W	R
%R0076	Prolongation of signal 28																R/W	R
%R0077	Prolongation of signal 29																R/W	R
%R0078	Prolongation of signal 30																R/W	R
%R0079	Reserve																R/W	R
%R0080	Reserve																R/W	R
%R0081	Negation of MSW inputs																R/W	R
%R0082	Negation of LSW inputs																R/W	R
%R0083	Distinguishing first MSW																R/W	R
%R0084	Distinguishing first LSW																R/W	R
%R0085	Engine mask 1 MSW																R/W	R
%R0086	Engine mask 1 LSW																R/W	R
%R0087	Engine mask 2 MSW																R/W	R
%R0088	Engine mask 2 LSW																R/W	R
%R0089	Engine mask 3 MSW																R/W	R
%R0090	Engine mask 3 LSW																R/W	R
%R0091	Engine mask 4 MSW																R/W	R
%R0092	Engine mask 4 LSW																R/W	R
%R0093	Engine parameters mask 1 MSW																R/W	R
%R0094	Engine parameters mask 1 LSW																R/W	R
%R0095	Engine parameters mask 2 MSW																R/W	R
%R0096	Engine parameters mask 2 LSW																R/W	R
%R0097	Engine parameters mask 3 MSW																R/W	R
%R0098	Engine parameters mask 3 LSW																R/W	R
%R0099	Engine parameters mask 4 MSW																R/W	R
%R0100	Engine parameters mask 4 LSW																R/W	R
%R0101	Reserve																R/W	R
%R0102	Reserve																R/W	R
%R0103	Delay of start-up 1																R/W	R
%R0104	Delay of start-up 2																R/W	R
%R0105	Delay of start-up 3																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0106	Delay of start-up 4																R/W	R
%R0107	Reserve																R/W	R
%R0108	Settings USART 0																R/W	R
%R0109	Reserve																R/W	R
%R0110	Settings USART 1a																R/W	R
%R0111	Settings USART 1b																R/W	R
%R0112	Settings USART 1c																R/W	R
%R0113	Settings USART 1d																R/W	R
%R0114	Reserve																R/W	R
%R0115	Reserve																R/W	R
%R0116	Reserve																R/W	R
%R0117	Red 1 MSW																R/W	R
%R0118	Red 1 LSW																R/W	R
%R0119	Red 2 MSW																R/W	R
%R0120	Red 2 LSW																R/W	R
%R0121	Red 3 MSW																R/W	R
%R0122	Red 3 LSW																R/W	R
%R0123	Red 4 MSW																R/W	R
%R0124	Red 4 LSW																R/W	R
%R0125	Red 5 MSW																R/W	R
%R0126	Red 5 LSW																R/W	R
%R0127	Red 6 MSW																R/W	R
%R0128	Red 6 LSW																R/W	R
%R0129	Red 7 MSW																R/W	R
%R0130	Red 7 LSW																R/W	R
%R0131	Green 1 MSW																R/W	R
%R0132	Green 1 LSW																R/W	R
%R0133	Green 2 MSW																R/W	R
%R0134	Green 2 LSW																R/W	R
%R0135	Green 3 MSW																R/W	R
%R0136	Green 3 LSW																R/W	R
%R0137	Green 4 MSW																R/W	R
%R0138	Green 4 LSW																R/W	R
%R0139	Green 5 MSW																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0140	Green 5 LSW																R/W	R
%R0141	Green 6 MSW																R/W	R
%R0142	Green 6 LSW																R/W	R
%R0143	Green 7 MSW																R/W	R
%R0144	Green 7 LSW																R/W	R
%R0145	Reserve																R/W	R
%R0146	Reserve																R/W	R
%R0147	Reserve																R/W	R
%R0148	Reserve																R/W	R
%R0149	Reserve																R/W	R
%R0150	Reserve																R/W	R
%R0151	Reserve																R/W	R
%R0152	Reserve																R/W	R
%R0153	Reserve																R/W	R
%R0154	Reserve																R/W	R
%R0155	Reserve																R/W	R
%R0156	Reserve																R/W	R
%R0157	Reserve																R/W	R
%R0158	Reserve																R/W	R
%R0159	Flashing 1 MSW																R/W	R
%R0160	Flashing 1 LSW																R/W	R
%R0161	Flashing 2 MSW																R/W	R
%R0162	Flashing 2 LSW																R/W	R
%R0163	Flashing 3 MSW																R/W	R
%R0164	Flashing 3 LSW																R/W	R
%R0165	Flashing 4 MSW																R/W	R
%R0166	Flashing 4 LSW																R/W	R
%R0167	Flashing 5 MSW																R/W	R
%R0168	Flashing 5 LSW																R/W	R
%R0169	Flashing 6 MSW																R/W	R
%R0170	Flashing 6 LSW																R/W	R
%R0171	Flashing 7 MSW																R/W	R
%R0172	Flashing 7 LSW																R/W	R
%R0173	Lighting 1 MSW																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0174	Lighting 1 LSW																R/W	R
%R0175	Lighting 2 MSW																R/W	R
%R0176	Lighting 2 LSW																R/W	R
%R0177	Lighting 3 MSW																R/W	R
%R0178	Lighting 3 LSW																R/W	R
%R0179	Lighting 4 MSW																R/W	R
%R0180	Lighting 4 LSW																R/W	R
%R0181	Lighting 5 MSW																R/W	R
%R0182	Lighting 5 LSW																R/W	R
%R0183	Lighting 6 MSW																R/W	R
%R0184	Lighting 6 LSW																R/W	R
%R0185	Lighting 7 MSW																R/W	R
%R0186	Lighting 7 LSW																R/W	R
%R0187	Quick 1 MSW																R/W	R
%R0188	Quick 1 LSW																R/W	R
%R0189	Quick 2 MSW																R/W	R
%R0190	Quick 2 LSW																R/W	R
%R0191	Quick 3 MSW																R/W	R
%R0192	Quick 3 LSW																R/W	R
%R0193	Quick 4 MSW																R/W	R
%R0194	Quick 4 LSW																R/W	R
%R0195	Quick 5 MSW																R/W	R
%R0196	Quick 5 LSW																R/W	R
%R0197	Quick 6 MSW																R/W	R
%R0198	Quick 6 LSW																R/W	R
%R0199	Quick 7 MSW																R/W	R
%R0200	Quick 7 LSW																R/W	R
%R0201	Ring mask MSW																R/W	R
%R0202	Ring mask LSW																R/W	R
%R0203	Light mask 1 MSW																R/W	R
%R0204	Light mask 1 LSW																R/W	R
%R0205	Light mask 2 MSW																R/W	R
%R0206	Light mask 2 LSW																R/W	R
%R0207	Reserve																R/W	R

Register No.	Bits																Mode	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Service	Normal operation
%R0208	Reserve																R/W	R
%R0209	Reserve																R/W	R
%R0210	Reserve																R/W	R
%R0211	Reserve																R/W	R
%R0212	Reserve																R/W	R
%R0213	Reserve																R/W	R
%R0214	Reserve																R/W	R
%R0215	Name 1								Name 2								R/W	R
%R0216	Name 3								Name 4								R/W	R
%R0217	Name 5								Name 6								R/W	R
%R0218	Name 7								Name 8								R/W	R
%R0219	Name 9								Name 10								R/W	R
%R0220	Name 11								Name 12								R/W	R
%R0221	Name 13								Name 14								R/W	R
%R0222	Name 15								Name 16								R/W	R
%R0223	Name 17								Name 18								R/W	R
%R0224	Name 19								Name 20								R/W	R
%R0225	Name 21								Name 22								R/W	R
%R0226	Name 23								Name 24								R/W	R
%R0227	Name 25								Name 26								R/W	R
%R0228	Name 27								Name 28								R/W	R
%R0229	Name 29								Name 30								R/W	R
%R0230	Name 31								Name 32								R/W	R
%R0231	Actual red MSW																R/W*	R/W**
%R0232	Actual red LSW																R/W*	R/W**
%R0233	Actual green MSW																R/W*	R/W**
%R0234	Actual green LSW																R/W*	R/W**
%R0235	Reserve																R/W*	R/W**
%R0236	Reserve																R/W*	R/W**
%R0237	Actual lighting MSW																R/W*	R/W**
%R0238	Actual lighting LSW																R/W*	R/W**
%R0239	Actual flashing MSW																R/W*	R/W**
%R0240	Actual flashing LSW																R/W*	R/W**
%R0241	Actual rate MSW																R/W*	R/W**

Table 6.3 Description of the registers

Register	Bits and corresponding inputs																	Word
%Rxxxx	Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	MSW
	Inputs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
%Rxxxx+1	Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	LSW
	Inputs	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Register No.	***Bits***																***Mode***	
	15	***14***	***13***	***12***	***11***	***10***	***9***	***8***	***7***	***6***	***5***	***4***	***3***	***2***	***1***	***0***	***Service***	***Normal operation***
%R0242	Actual rate LSW																R/W*	R/W**
%R0243	Actual input state MSW																R/W*	R/W**
%R0244	Actual input state LSW																R/W*	R/W**
%R0245	Identification 1																R	R
%R0246	Identification 2																R	R
%R0247	Identification 3																R	R
%R0248	Identification 4																R	R
%R0249	B	R	X	X	X	X	X	X	Number of inputs								R	R
%R0250	Program version																R	R
%R0251	Triggering of channels 1-16 – digital control																-	W
%R0252	Triggering of channels 17-32 – digital control																-	W
%R0253	Changing cassette operating mode																R/W	R

6.5.2. Description of the registers

Among all registers, there are grouped in pairs registers that forming 32-bit variables. First - with lower address - register from a pair determines more significant word (MSW) of 32-bit variable, and second register determines less significant word (LSW). Logical connection of individual bits with corresponding inputs of the device (Fig. 6.3 and 6.4) is showed in Table 6.3.
Other registers are forming independent variables. Detailed description of the registers is provided in Table 6.4.

Table 6.4 Description of the registers

Registers	***Description***
%R0001 ÷ %R0015	Filtration time constants [ms] for corresponding inputs (channels). Individual register is divided on 2 bytes. Each byte includes constant for another channel according to description in the Table 6.2. Allowable range of individual byte value (half of register): 1 ÷ 255  The filtration time should be selected taking into account foreseen disturbances on the signaling lines. A special attention should be paid in case, when instead of constant voltage, pulsating rectified voltage will be applied. In this case, to short filtration time will cause multiple alarm triggering. It is recommended to use filtration time ca. 0.75 of the length of voltage period before rectifying process (for network 50 Hz - ca. 15 ms).
%R0016	Registers reserved for further applications
%R0017 ÷ %R0046	Alarm triggering delay for corresponding channel in [ms]. Allowable range of register value: 1 ÷ 60000
%R0047 ÷ %R0048	Registers reserved for further applications
%R0049 ÷ %R0078	Prolongation of alarm duration time for corresponding channel in [ms]. Allowable range of register value: 1 ÷ 60000
%R0079 ÷ %R0080	Registers reserved for further applications
%R0081 ÷ %R0082	Mask of inputs negation. Pair of registers forms 32-bit mask, in which particular bites are corresponding to binary inputs of the device (Fig. 6.4). Setting the bite (recorded as logical "1") triggers the alarm in case of appearance of low state on the input (no voltage).
%R0083 ÷ %R0084	Mask of distinguishing the first alarm. 32-bit mask defining which inputs belong to the group, in which appearance of the first alarm signal will be signalized in special way. Setting the bite (recorded as logical "1") will assign the corresponding input to the distinguished signals.
%R0085 ÷ %R0092	4 masks that allow to establish max. four groups of signals used in "engine or pump control" function (described in ....). In each of 4 masks can be set max. 1 bite defining, from which input the signal will be treated as the information about start-up of the pump or engine.  Settings of the channel in the engine or pump control mode has priority over the settings in programmable alarm signalization mode.

<table>
<tr><th>Registers</th><th>Description</th></tr>
<tr><td>%R0093
÷
%R0100</td><td>4 masks of signals connected with engine inputs described above. Setting of given bites in the corresponding mask causes connecting of signals with corresponding engine input defined in the given engine mask.</td></tr>
<tr><td>%R0101
÷
%R0102</td><td>Registers reserved for further applications</td></tr>
<tr><td>%R0103
÷
%R0106</td><td>Start-up delay for 4 engine inputs. It defines max. start-up time during which the alarm states on the inputs connected with corresponding engine inputs will not actuate the alarm, only the temporary optical signalization.
Permissible range of register value: 1 ÷ 60000</td></tr>
<tr><td>%R0107</td><td>Registers reserved for further applications</td></tr>
<tr><td>%R0108</td><td>Register defining operation mode of system RS485 connection
<table>
<tr><td>Bite</td><td>15 (MSB)</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0 (LSB)</td></tr>
<tr><td rowspan="2">Description</td><td colspan="8">Address slave</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">S2</td><td rowspan="2">S1</td><td rowspan="2">S0</td><td rowspan="2">B</td><td rowspan="2">P1</td><td rowspan="2">P0</td></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table>
Slave address - address of slave device in Modbus network
<table>
<tr><td><u>transmission rate:</u>
S2 S1 S0
1 0 0 – 115200 b/s
0 1 1 – 57600 b/s
0 1 0 – 38400 b/s
0 0 1 – 19200 b/s
0 0 0 – 9600 b/s</td><td><u>stop bites</u>
B
0 – 1 bite
1 – 2 bites</td><td><u>parity:</u>
P1 P0
1 0 – odd
0 1 – even
0 0 – no</td></tr>
</table></td></tr>
<tr><td>%R0109</td><td>Registers reserved for further applications</td></tr>
</table>

<table>
<tr><th>Registers</th><th>Description</th></tr>
<tr><td>%R0110</td><td>
Register defining operation mode of local RS485 connection
<table>
<tr><td>Bite</td><td>15 (MSB)</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0 (LSB)</td></tr>
<tr><td rowspan="2">Description</td><td colspan="8">Address slave</td><td rowspan="2">S1</td><td rowspan="2">S0</td><td rowspan="2">S2</td><td rowspan="2">S1</td><td rowspan="2">S0</td><td rowspan="2">B</td><td rowspan="2">P1</td><td rowspan="2">P0</td></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table>
Slave address - address of slave device in Modbus network
<table>
<tr><td><u>transmission rate [b/s]:</u>
S2 S1 S0
0 1 0 – 38400
0 0 1 – 19200
0 0 0 – 9600</td><td><u>Synchronization of flashing light:</u>
S1 s2
1 0 – master
0 1 – slave
0 0 – no</td><td><u>stop bites</u>
B
0 – 1 bite
1 – 2 bites</td><td><u>parity:</u>
P1 P0
1 0 – odd
0 1 – even
0 0 – no</td></tr>
</table>
</td></tr>
<tr><td>%R0111</td><td>
Register defining operation mode of local RS485 connection
<table>
<tr><td>Bite</td><td>15 (MSB)</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0 (LSB)</td></tr>
<tr><td rowspan="2">Description</td><td colspan="8">Concentrator address</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">T1</td><td rowspan="2">T0</td></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table>
Concentrator address – concentrator slave address of binary inputs, from which the signaling cassette can receive information about alarm inputs state.
<table>
<tr><td><u>Operation mode:</u>
T1 T0
1 1 – cassette is operating as the duplicator (slave)
1 0 – cassette receives information about alarms from own binary inputs and additionally sends duplication of lighting state to the slave cassette
0 1 – cassette receives information about alarms from data concentrator
0 0 – cassette receives information about alarms from own binary inputs</td></tr>
</table>
</td></tr>
<tr><td>%R0112</td><td>Address of first register of the concentrator, from which the cassette will read the input states. The cassette will read 2 consecutive registers beginning from the given one. The concentrator can support 0x03 command of Modbus RTU protocol („Read Holding Registers”)</td></tr>
</table>

<table>
<tr><th>Registers</th><th>Description</th></tr>
<tr><td>%R0113</td><td>Register defining address of the slave cassette, for which will be (optionally) send duplication of the master cassette lighting states.
<table>
<tr><td>Bite</td><td>15 (MSB)</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0 (LSB)</td></tr>
<tr><td rowspan="2">Description</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td colspan="8">Cassette address</td></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table></td></tr>
<tr><td>%R0114
÷
%R0116</td><td>Registers reserved for further applications</td></tr>
<tr><td>%R0117
÷
%R0130</td><td>Seven 32-bit masks defining color of field illumination as red (or yellow - in combination with green). Each of seven masks refers to other phase of the signalization cycle. Signalization cycles are provided in Table 3.1. Writing of the given bite in the logical mask "1" causes selection of the red color for the given input in the given cycle phase. Selection of the light color with which the given field will be illuminated on the given phase provided that the corresponding bite in the lighting mask (%R0173 ÷ %R0186) or flashing (%R0159 ÷ %R0172) will be set.</td></tr>
<tr><td>%R0131
÷
%R0144</td><td>Seven 32-bit masks defining color of field illumination as green (or yellow - in combination with red). Each of seven masks refers to other phase of the signalization cycle. Signalization cycles are provided in Table 3.1. Writing of the given bite in the logical mask "1" causes selection of the red color for the given input in the given cycle phase. Selection of the light color with which the given field will be illuminated on the given phase provided that the corresponding bite in the lighting mask (%R0173 ÷ %R0186) or flashing (%R0159 ÷ %R0172) will be set.</td></tr>
<tr><td>%R0145
÷
%R0158</td><td>Registers reserved for further applications</td></tr>
<tr><td>%R0159
÷
%R0172</td><td>Seven 32-bit masks defining whether the given field must be flashing. Each of seven masks refers to other phase of the signalization cycle (more information is provided in Table 3.1). Writing of the given bite in the logical mask "1" will cause illumination of the given field with the flashing light. The light color is defined by the masks in registers (%R0117 ÷ %R0144).</td></tr>
<tr><td>%R0173
÷
%R0186</td><td>Seven 32-bit masks defining whether the given field must be illuminated with the continuous light. Each of seven masks refers to other phase of the signalization cycle (more information is provided in Table 3.1). Writing of the given bite in the logical mask "1" will cause illumination of the given field with the continuous light. The light color is defined by the masks in registers (%R0117 ÷ %R0144). The continuous light masks have priority over the flashing light masks. This means, that in case when the same bite is set in two masks in the same phase, then the given field will be illuminated with the continuous light.</td></tr>
<tr><td>%R0187
÷
%R0200</td><td>Seven 32-bit masks defining whether the given field must be flashing quickly (2Hz) or slowly (1Hz). Writing of the given bite with the logical "1" will cause flashing with frequency 2Hz providing that the corresponding bite will be set in registers (%R0159 ÷ %R0172).</td></tr>
</table>

Registers	***Description***
%R0201 ÷ %R0202	32-bit mask defining, which alarms (from which inputs) will cause turning-on of the **RELAY 1**.
%R0203 ÷ %R0204	32-bit mask defining, which alarms (from which inputs) will cause turning-on of the **RELAY 2**.
%R0205 ÷ %R0206	32-bit mask defining, which alarms (from which inputs) will cause turning-on of the **RELAY 3**.
%R0207 ÷ %R0214	Registers reserved for further applications
%R0215 ÷ %R0230	Registers provided for saving description of the device prepared by the user.
%R0231 ÷ %R0232	Actual red color. Logical "1" means selection of the red color.
%R0233 ÷ %R0234	Actual green color. Logical "1" means selection of the green color.
%R0235 ÷ %R0236	Registers reserved for further applications
%R0237 ÷ %R0238	Fields actually set in the continuous light operation.
%R0239 ÷ %R0240	Fields actually set in the flashing light operation.
%R0241 ÷ %R0242	Flashing light frequency
%R0243 ÷ %R0244	Actual input state
%R0245	First register used for identification of the device. Recorded with constant value 0x1234
%R0246	Second register used for identification of the device. Recorded with constant value 0xABCD
%R0247	Third register used for identification of the device. Recorded with constant value 0x9876

<table>
<tr><th>Registers</th><th>Description</th></tr>
<tr><td>%R0248</td><td>Fourth register used for identification of the device. Recorded with constant value 0xFEDC</td></tr>
<tr><td>%R0249</td><td>Register defining ability of the CPU module to support binary inputs and number of the supported inputs.
<table>
<tr><td>Bite</td><td>15 (MSB)</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0 (LSB)</td></tr>
<tr><td rowspan="2">Description</td><td rowspan="2">B</td><td rowspan="2">R</td><td rowspan="2">U</td><td rowspan="2">S</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2">X</td><td colspan="8">Number of supported inputs</td></tr>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
</table>
<u>Binary inputs (B):</u>
0 – Program does not support the binary inputs (read-out possible from the external concentrator or operation as the duplicator)
1 – Program supports the binary inputs

<u>RTC timer (R):</u>
0 – RTC timer operates correctly
1 – RTC timer generates the error. The timer should be set.

<u>RTC timer failure(U):</u>
0 – RTC timer operates correctly
1 – Hardware damage has been detected, please contact your supplier

<u>Service mode (S):</u>
0 – The device is working in normal mode
1 – The device is working in service mode</td></tr>
<tr><td>%R0250</td><td>Processor program version. 100 refers to version 1.00, 123 – version 1.23, etc.</td></tr>
<tr><td>%R0251</td><td>Input state writing. Writing of the register will cause triggering of the corresponding channels according to the cassette configuration.
MSW – fields 1-8 are triggered
LSW – fields 9-16 are triggered</td></tr>
<tr><td>%R0252</td><td>Input state writing. Writing of the register will cause triggering of the corresponding channels according to the cassette configuration.
MSW – fields 17-24 are triggered
LSW – fields 25-32 are triggered</td></tr>
<tr><td>%R0253</td><td>Changing cassette operating mode:
0 : standard mode
1 : signalization forcing mode</td></tr>
</table>

6.5.3. Programming example

We assume the following program for the signaling cassette:

Table 6.5 sample program for the cassette

Inputs	Function
1	Engine inputs, start-up delay time 5 s
2 ÷ 6	Sensor inputs connected with the engine
7 ÷ 25	User function (with distinguishing the first alarm): – Normal operation **(1)**: field is illuminated with continuous green light, – Appearance of the first alarm **(2)**: field is illuminated with the quickly flashing red light, – Appearance of the consecutive alarms **(3)**: field is illuminated with the slowly flashing red light, – Reception of the alarm **(4)**: field is illuminated with continuous red light, – Disappearance of the first alarm **(5)**: field is illuminated with the quickly flashing yellow light, – Disappearance of the other alarms before reception **(6)**: field is illuminated with the slowly flashing yellow light, – Disappearance after reception **(7)**: field is illuminated with continuous yellow light

The following registers should be registered:

Table 6.6 Realization of the sample program

Register(s)	Value	Phase	Remarks
%R0083-84	0x0000FFC0	*	Assignment of the inputs 7 - 25 to the input group with distinguishing the first signal
%R0085-86	0x00000001	*	Input 1 as the engine input in group 1
%R0087-88	0x00000000	*	Other engine groups disabled
%R0089-90	0x00000000	*	
%R0091-92	0x00000000	*	
%R0093-94	0x0000003E	*	Inputs 2 - 6 as the inputs connected with engine input 1
%R0095-96	0x00000000	*	Other engine groups disabled
%R0097-98	0x00000000	*	
%R0099-100	0x00000000	*	
%R0103	0x1388	*	Delay time of the engine 1 start-up equal to 5 s (5000 ms)
%R0104	0x0000	*	No delay for engine 2 start-up
%R0105	0x0000	*	No delay for engine 3 start-up
%R0106	0x0000	*	No delay for engine 4 start-up
%R0117-118	0x00000000	1	Red color in phase 1
%R0131-132	0x0000FFC0	1	Green color in phase 1

Register(s)	*Value*	*Phase*	*Remarks*
%R0159-160	0x00000000	1	Flashing light in phase 1
%R0173-174	0x0000FFC0	1	Continuous light in phase 1
%R0187-188	0x00000000	1	Rate of change for the flashing light in phase 1
%R0119-120	0x0000FFC0	2	Red color in phase 2
%R0133-134	0x00000000	2	Green color in phase 2
%R0161-162	0x0000FFC0	2	Flashing light in phase 2
%R0175-176	0x00000000	2	Continuous light in phase 2
%R0189-190	0x0000FFC0	2	Rate of change for the flashing light in phase 2
%R0121-122	0x0000FFC0	3	Red color in phase 3
%R0135-136	0x00000000	3	Green color in phase 3
%R0163-164	0x0000FFC0	3	Flashing light in phase 3
%R0177-178	0x00000000	3	Continuous light in phase 3
%R0191-192	0x00000000	3	Rate of change for the flashing light in phase 3
%R0123-124	0x0000FFC0	4	Red color in phase 4
%R0137-138	0x00000000	4	Green color in phase 4
%R0165-166	0x00000000	4	Flashing light in phase 4
%R0179-180	0x0000FFC0	4	Continuous light in phase 4
%R0193-194	0x00000000	4	Rate of change for the flashing light in phase 4
%R0125-126	0x0000FFC0	5	Red color in phase 5
%R0139-140	0x0000FFC0	5	Green color in phase 5
%R0167-168	0x0000FFC0	5	Flashing light in phase 5
%R0181-182	0x00000000	5	Continuous light in phase 5
%R0195-196	0x0000FFC0	5	Rate of change for the flashing light in phase 5
%R0127-128	0x0000FFC0	6	Red color in phase 6
%R0141-142	0x0000FFC0	6	Green color in phase 6
%R0169-170	0x0000FFC0	6	Flashing light in phase 6
%R0183-184	0x00000000	6	Continuous light in phase 6
%R0197-198	0x00000000	6	Rate of change for the flashing light in phase 6
%R0129-130	0x0000FFC0	7	Red color in phase 7
%R0143-144	0x0000FFC0	7	Green color in phase 7
%R0171-172	0x00000000	7	Flashing light in phase 7
%R0185-186	0x0000FFC0	7	Continuous light in phase 7
%R0199-200	0x00000000	7	Rate of change for the flashing light in phase 7

- N/A

6.5.4. Setting the time for the internal timer – service mode

Settings for RTC timer are possible in the service mode using the specially defined function represented below.

Address	Function	Year	Month	Day	Time	Minute	Second	CRC-LSB	CRC-MSB
0x01	0x6A	X	X	X	X	X	X	X	X

Date and time is represented in BCD format. In case of year, 2 last digits should be set, e.g. for 2008 setting is 08. sample date 2008-10-25 and time 14:15:00 should be entered in the form:

Address	Function	Year	Month	Day	Time	Minute	Second	CRC-LSB	CRC-MSB
0x01	0x6A	0x08	0x10	0x25	0x14	0x15	0x00	X	X

RTC timer is supported by the capacitor with very high capacity. To avoid any corrupted data, do not disconnect the power supply from the device for the period longer than 6 weeks. All timer errors are signalized in the register %R0249 (see registers description in Table 6.4.)

6.5.5. Setting the time for the internal timer – broadcast

Starting from software version 2.06, it is possible to broadcast the RTC time. Broadcasts are made at addres 0x00.

Address	Function	Year	Month	Day	Time	Minute	Milisecond MSB	Milisecond LSB	CRC-LSB	CRC-MSB
0x01	0x66	X	X	X	X	X	X	X	X	X

The two bytes described as "Milliseconds" contain information about the current second. For example, if you want to send information about the time of 2s, 555ms, you should enter the value of 2555 in the mentioned two bytes: 0x09 (MSB) and 0xFB (LSB) respectively.
According to the modbus protocol, the device does not respond to broadcast frames.

6.5.6. Writing and reading of the inputs channel names

Writing and reading of the input channels names is possible in the device software in version **2.03** and later. Writing the the name is possible only in the service mode, read-out - in any operation mode.
The name can be entered using specially defined command presented below:

Address	Function	Channel No.	Z0	Z1	...	Z62	Z63	CRC-LSB	CRC-MSB
0x01	0x69	0÷31	X	X	. . .	X	X	X	X

Command frame contains address of the target device (always 0x01 in the service mode), function number 0x69, channel number, 64 characters (Z0, Z1, ... , Z62, Z63) corresponding to the channel description and control sum CRC. The channels are numbered from "0", therefore first channel (first input) corresponds to "0", second channel to "1", etc. Complete fame contains 69 bytes, and it should such length always, even when the description contains less than 64 characters. In such case, the description should be completed with null characters (NULL - 0x00) or for example with blank characters (0x20) to provide the proper length of the frame.
The response of the device after sending the proper frame includes 4 bytes as represented below:

Address	Function	CRC-LSB	CRC-MSB

0x01	0x69	X	X

Response of the device in case of registering attempt using the channel outside of the range 0÷31 is represented in the following way:

Address	Function with error	Error code	CRC-LSB	CRC-MSB
0x01	0xE9	0x02	X	X

Response of the device, when the command was send in the normal operation mode:

Address	Function with error	CRC-LSB	CRC-MSB
X	0xE9	X	X

Read-out of the channel name is possible in both operation modes and is performed by the special command:

Address	Function	Channel number	CRC-LSB	CRC-MSB
X	0x68	0÷31	X	X

The frame contains device address, function number (0x68), channel number and control sum CRC. The channels are numbered from "0", therefore first channel (first input) corresponds to "0", second channel to "1", etc.

Response of the device for the properly entered query:

Address	Function	Channel No.	Z0	Z1	...	Z62	Z63	CRC-LSB	CRC-MSB
X	0x68	0÷31	X	X	. . .	X	X	X	X

Response frame includes device address, function number, channel number, which name id read-out, 64 characters (Z0, Z1, ... , Z62, Z63) assigned to the given channel and control sum CRC.
Response of the device in case of read-out attempt using the channel outside of the range 0÷31 is represented in the following way:

Address	Function with error	Error code	CRC-LSB	CRC-MSB
X	0xE8	0x02	X	X

6.5.7. Forcing service mode activation

Software forcing (via RS transmission) service mode activation is possible in the device software version 2.06 and later. Receiving the frame below by the device working in normal mode results in forcing the service mode.

Address	Function	Command	CRC-LSB	CRC-MSB
X	0x65	0x01	X	X

In response to the correct frame, the device returns the same sequence of bytes.

Sending the above frame to the device working in the service mode will couse the restart of the device, load new settings (if sent) and start normal operation mode.

6.5.8. Address request

The Address request is supported in the device software version 2.06 and later. The request is sent as a broadcast:

Address	Function	CRC-LSB	CRC-MSB
0x00	0x67	X	X

In response the device returns a frame with its own address:

Address	Function	CRC-LSB	CRC-MSB
X	0x67	X	X

The function should be used with care considering that there is no collision detection and avoidance mechanism in the Modbus based on RS485 network. The address request should be used for service purposes.

7. Usage

Usage of Modbus RTU protocol is limited only to 2 functions: - „Read Holding Registers” (0x03) and „Write Multiple Registers” (0x10). There are available additionally defined functions for writing the RTC timer (see description in chapter 6.5.4), functions for writing and reading the channels names (available from firmware version 2.03, described in chapter 6.5.5) and also function used for read-out of the registered events.
The query send to the signaling cassette from the master device to receive the registered event is represented below:

Address	Function	MSB event	LSB event	CRC-LSB	CRC-MSB
X	0x6C	X	X	X	X

2 event bytes define, which event must be send. Entering 0 will cause that most actual event will be send, entering 999 will cause that the oldest event, last in the buffer,will be send.
The device responding on the query sends the frame in the following form:

Byte number	***Description***
0	Slave device address
1	Function (0x6C)

Byte number	*Description*
2	Year (last two digits in the binary code)
3	Month (in the binary code)
4	Day (in the binary code)
5	Hour (in the binary code)
6	Minute (in the binary code)
7	Second (in the binary code)
8	Millisecond (in the binary code - oldest byte)
9	Millisecond (in the binary code - youngest byte)
10	Mask of alarm appearance (oldest byte)
11	Mask of alarm appearance
12	Mask of alarm appearance
13	Mask of alarm appearance (youngest byte)
14	Mask of alarm signal disappearance (oldest byte)
15	Mask of alarm signal disappearance
16	Mask of alarm signal disappearance
17	Mask of alarm signal disappearance (youngest byte)
18	Additional informations
19	Reserved
20	Record CRC (day and time of event) – LSB
21	Record CRC (day and time of event) – MSB
22	Transmission frame RCR– LSB
23	Transmission frame RCR– MSB

Masks of alarm signal appearance or disappearance are connected with the binary inputs according to the Table 7.1.

Table 7.1 Events mask

Byte	Bits and corresponding inputs								
MSB	Bits	7	6	5	4	3	2	1	0
	Inputs	32	31	30	29	28	27	26	25
	Bits	7	6	5	4	3	2	1	0
	Inputs	24	23	22	21	20	19	18	17
	Bits	7	6	5	4	3	2	1	0
	Inputs	16	15	14	13	12	11	10	9
LSB	Bits	7	6	5	4	3	2	1	0
	Inputs	8	7	6	5	4	3	2	1

Logical "1" registered in the given byte means appearance of the alarm signal (mask of alarm appearance) or disappearance (mask of alarm signal disappearance).

Table 7.2 Additional informations

Bits	7	6	5	4	3	2	1	0
Events	RTC	X	SERVICE	OFF	ON	KAA	KAO	X

Field for additional informations (byte No. 18 in the frame) is presented in Table 7.2.

This field contains information about pressing KAA or KAO buttons, turning-on (ON) and turning-off (OFF) the device, enabling service mode (SERVICE) and eventual timer errors (RTC).

In case, when the cassette is operating in signalization forcing mode, writing data to register %R0251 will cause triggering of the corresponding channel of the device.

8. Storage

Transport packaging should have same degree of resistance to vibrations and shocks, as defined in PN-EN 60255-21-1:1999 and PN-EN 60255-21-2:2000 norms for class 1 severity.
The device delivered by the manufacturer should be carefully unpacked without using excessive force and improper tools. After unpacking, the visual inspection should be performed to check any possible external damages.
The device should be stored in dry and clean place, with temperature from –25 °C to +70 °C.
Relative humidity should be in the range that will not cause condensation or frosting phenomenon.
Before applying power supply, the device should be installed in the operation place ca. one hour earlier, to compensate temperatures and avoid humidity and condensation impacts.
During very long storage periods it is recommended to power the device with auxiliary voltage for two days in every year, to regenerate electrolytic condensers.

9. Utilization

If, as a result of damage or decommissioning, disassembly of the device is needed (and eventually

utilized), all power supplies and other active connections should be disconnected.
Disassembled device should be treated as the electronic scrap material, that should be handled according to the regulations regarding scrap materials management.

10. Warranty and service

KARED warrants the delivered device for the period of 12 months from the date of sale (unless the agreement stipulates otherwise).
In case, when the device will be started by the KARED personnel, the warranty period can be prolonged.
Manufacturer offers the technical support during start-up of the device and other warranty and after-warranty services, as defined in the corresponding agreement fir such service.
In case, when the instructions provided in this document will not be observed, the warranty will be void.

11. Ordering method

The purchase order should contain informations regarding whether the device should be equipped with own binary inputs and information about value of the rating voltage.

Input rating voltage	*Code denomination*
24 V DC	KSR-32-M-XXX-**024**
48 V DC	KSR-32-M-XXX-**048**
110 V DC	KSR-32-M-XXX-**110**
220 V DC	KSR-32-M-XXX-**220**
No binary inputs	KSR-32-M-XXX-**000**
Others	To be approved by the manufacturer

Power supply voltage	*Code denomination*
24 V DC	KSR-32-M-**024**-XXX
110 V DC	KSR-32-M-**110**-XXX
220 V DC / 230 V AC	KSR-32-M-**220**-XXX

All orders should submitted directly to the manufacturer to the following address:

PUP KARED Sp. z o.o.
ul. Kwiatowa 3/1 Kowale
post office: 80-180 Gdańsk
Tel. (+48-58) 32 282 31
fax (+48-58) 32 282 33
e-mail: kared@kared.com.pl
www: http://www.kared.com.pl/