

**PRE-INSULATED HEATING PIPELINES
BATTERY-SUPPLIED
STATIONARY STATUS METER
(PULSE ALARM SYSTEM)**

SAI-2b



OPERATING MANUAL

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General information

The SAI-2b device is intended for monitoring 2 sections of a pre-insulated heating pipelines with a pulse alarm system. The meter may be supplied by external 5x1.V alkaline (5xR20) or lithium (2xR20) batteries, an external battery pack or a 7.5VDC 0.5A/230V 50Hz plug-in power supply.

During a measuring cycle, measurements of polyurethane insulation resistance, alarm loop resistance, voltages appearing in an alarm system, supply voltage (battery version), as well as device autocalibration are executed. Polyurethane insulation resistance is measured at two polarizations of the measuring voltage. **Maximum values of measuring voltages for all types of measurements do not exceed 1 mA.**

Ambient temperature variations, as well as interference resulting from physical phenomena of electric nature present on a line pipe, do not affect measurement accuracy.

In the mains power supply version of the device, measurement information is presented on an alphanumeric display in the form of numerical values of measurement results and text messages. The backlit meter indication field consists of two rows containing 16 character fields each. Each row is assigned to one measurement channel (one sensor loop). In addition, failure states are signalled by an illuminated red LED diode. A user may set a limit value for polyurethane insulation resistance, below which failure will be signalled. The selected value appears on the display immediately after energizing the device.

In the battery version, an SAI-2b device spends most of its time in dormant mode, in order not to use the supply batteries. Activation may be manual or automatic. In the automatic mode is usually executed by external systems. An activated device performs a measurement cycle, as in the mains supply version. Measurement information is shown on an alphanumeric display. In order to save power, the display field is not backlit. A button located on the side of a device is used for manual activation. After activation, a device performs one standard measurement cycle, and results and potential text messages are shown, for a certain period of time, on the alphanumeric display. The display is backlit. Then, the device switches off.

Detailed data regarding the device are included in section **5. Technical data** herein.

1. Comments regarding the technical data of an SAI-2b device

Technical conditions of pulse alarm systems stipulate the minimum value for polyurethane insulation resistance for a maximum sensor loop length (heating pipelines section). In the case of shorter sections, this value shall be determined from the formula:

$$R = \frac{R_{\min}}{L / L_{\max}}$$

R [MΩ]	- lowest permissible polyurethane insulation resistance value for a heating pipelines section length of $L \neq L_{\max}$.
R_{\min} [MΩ]	- the minimum polyurethane insulation resistance value for an L_{\max} maximum length of a heating pipelines, stated in the technical conditions
L [km]	- length of the tested heating pipelines section, $L \neq L_{\max}$.
L_{\max} [km]	- the maximum section length of a pre-insulated heating pipelines with a pulse alarm system, stated in the technical conditions.

Device indications and the provided formula may be used for potential expansion of a heating pipelines. They enable us to determine the value of polyurethane insulation resistance of a new section, in order for the resultant resistance of the entire network to be larger than the minimum resistance value determined in the technical conditions of the alarm system.

A wide range of measured values of polyurethane insulation resistance enables to rather accurately track the speed and direction of variations for the moisture between the line and

protective pipes. This enables you to distinguish the event of a leak from moisture confined within heating pipelines cable joints. The date of commencing repair works may also be forecast.

Interpreting $L > L_{max}$ and PRZERWA (GAP) messages.

As inferred by the technical data of the device, the *Zakres (Range)* message appears when a measured resistance of an alarm loop adopts a value in the range of $350\Omega \div 100k\Omega$. The bottom limit corresponds to a sensor loop with a length of ca. 20000m (10000m heating pipelines) and a specific resistance of $\sim 0.015\Omega/m$. In practice, there are cases of bad execution of connections between alarm loop sections. Connection resistance increases loop resistance, therefore, it artificially extends it. A similar effect can be experienced in the event of moisture between broken ends of a wire forming an alarm loop. Exactly these two events are signalled by the $L > L_{max}$ message. Whereas in the second of the described cases, a device indicates a measured galvanic voltage value and relatively small values of polyurethane insulation resistance.

The **Przerwa (Gap)** message signals the lack of electrical contact between the terminations of wires forming an alarm loop.

Reasons for distinguishing a leak from a short-circuit.

Leak and direct shorting of a sensor loop wire with a steel pipe are characterized by a relatively small value of resistance measured between a line pipe and an alarm loop wire. The measured galvanic voltage value indicates the presence of moisture. For the services supervising a heating pipelines, there are important reasons to distinguish both events. Starting with the fact that each of the events requires different technical preparation for failure removal, and ending with the evaluation of the situation severity and response speed.

2. Specification of the SAI-2b operating environment.

The device is designed for operation in confined rooms. The meter operates within ambient temperature ranges of $+5^{\circ}\text{C} \div +50^{\circ}\text{C}$, while the relative humidity should not exceed 80%. The ambient storage temperature can vary from -40°C to $+70^{\circ}\text{C}$.

After storage or transportation of the device at a temperature below $+5^{\circ}\text{C}$, it is recommended to wait at least 3 hours before energizing. After such a period, the device should reach operating temperature.

The meter may not operate in rooms with high dustiness and in an atmosphere containing explosive or corrosive/aggressive gases.

The measurements errors of parameters and quantities presented in the technical data are obtained after 30 min. of meter operation at meter-appropriate ambient conditions.

3. Maintenance of the SAI-2b.

Use a clean, dry cloth to remove dust off the device casing. The formed soiling shall be removed with a cloth moistened with a 1% detergent solution. Greasy soiling can be removed with special preparations used to maintain the cleanliness of computer hardware. Use soft cloths or special wipes for cleaning computer screens for cleaning the transparent part of the casing. It is forbidden to use spirit, washing benzene and other solvents. Such cleaning agents may cause surface damage to the meter casing. After cleaning is completed, a device shall be wiped dry with a soft cloth. In the course of the aforementioned actions, make sure that large quantities of the cleaning fluids do not penetrate inside the meter.

4. Decommissioning of an SAI-2b device.

Pursuant to the provisions of the Act of 29 July 2005 on used electrical and electronic equipment (Journal of Laws, item 1495), the device bears a following symbol:



The symbol means that it is forbidden to place used equipment with any waste. A user of equipment marked in this manner is obliged to hand the equipment over to relevant companies dealing with collecting used equipment. The obligations arise from art. 35 and 36 of the aforementioned act.

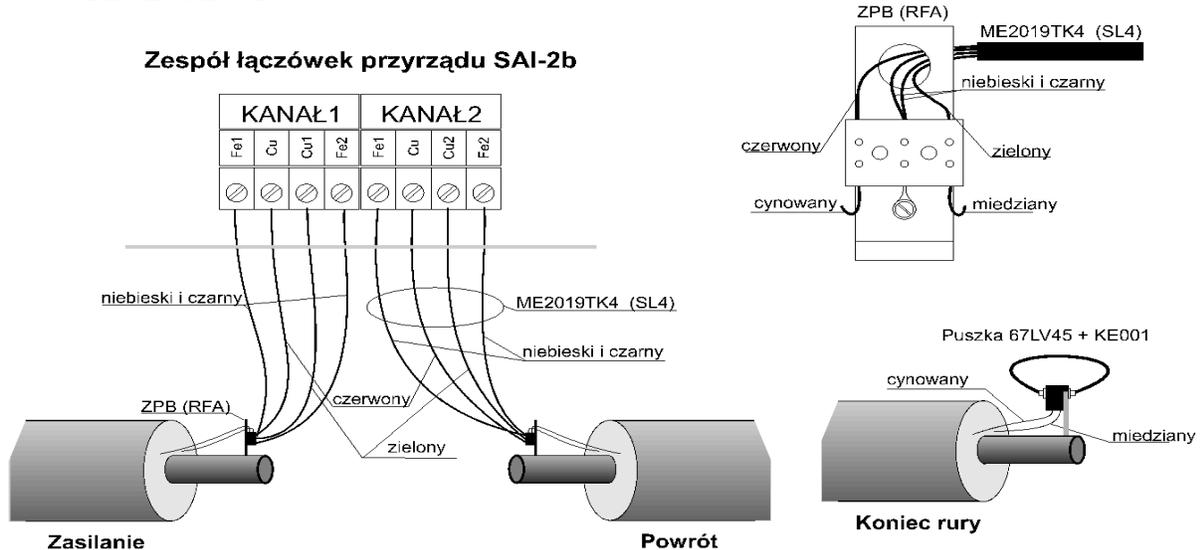
5. Installing an SAI-2b device on a test bench.

The device may be supplied from a 7.5 VDC, 0.5A plug-in power supply. The supply cable may be inserted through a cable gland with the ALARM or TRANSMISJA (*TRANSMISSION*) signs. Depending on which of these functions is not used. The red end of a power cable shall be connected to the “+” socket of the connection marked “7.5V”. Connect the second end to the “-” socket.

Fig. 1 and 2 show the method for connecting an SAI-2b meter to a pulse alarm system.

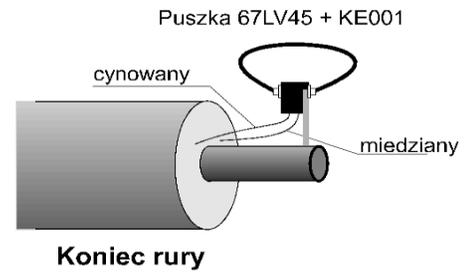
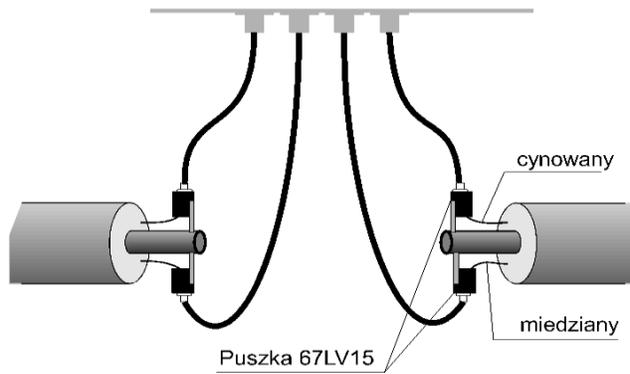
If a device is supplied by batteries, place used batteries in containers intended for that purpose.

Method no. 1.



Method no. 2.

Gniazda przyrządu SAI-2b



All terminations should be executed through 67LVxx coaxial cables or 67LV15 and 67LV45 junction boxes. **As a last resort** terminations of the alarm system copper wires may be directly “short-circuited”.

SAI-2b

(pulse alarm system)

5. TECHNICAL DATA.

1. Power supply alkaline batteries inside the device 5x1.5V (5xR20);
external battery or an internal power supply 7.5VDC 0.5A/230V50Hz
2. Number of measurement cycles (cycle=2 channels) per 1 set of internal batteries min.. 25 000
3. Number of monitored sections of a pre-insulated heating pipelines 2
4. Maximum length of a monitored heating pipelines section 7000m¹
5. Manner of presenting measurement information alphanumeric LCD display, 2x16 characters
backlit;
red LED diode
6. Measuring voltage ±15V
7. Measurement error for all measurement types max. 1mA
8. Polyurethane insulation resistance measurement range 0.1k Ω ÷ 200M Ω
Polyurethane insulation resistance measurement accuracy: ±5% reading value ±2 digits
9. Alarm loop resistance measurement range 0.1 ÷ 350)¹
Measurement resolution 0.1Ω
Alarm loop resistance measurement accuracy ±1% of the measured value ±2 digits
10. Heating pipelines section length measurement range 0 ÷ 7000m
11. Measurement range for the voltage between a sensor wire and a line pipe..... 0÷14V)²
Voltage measurement accuracy ±1% of measured value
12. Measurement range for supply batteries voltage 0÷14V
Voltage measurement accuracy..... ±1% of measured value
13. Measurement ranges distinguished with illuminated red LED diode with an AWARIA (*FAILURE*) sign:
 - Leak (moisture) resistance limit value range 0.1k Ω ÷ 1M Ω
The selection is made with a switch in a 1;2;5 sequence.
Examples: 2kΩ; 10kΩ; 500kΩ.
 - Resistance value range for a direct shorting between an alarm loop wire and a line pipe 1 Ω ÷ 0.45M Ω
 - Alarm loop maximum resistance value for a L>L_{max} message <100k Ω
 - Alarm loop minimum resistance value for a Przerwa (*Gap*) message ≥100k Ω
14. Content and meaning of symbols and text messages:
 - value of coded limit resistance of polyurethane insulation XYkΩ
 - symbols of measuring channels (heating pipelines sections)..... 1;2
 - Value of polyurethane insulation resistance is larger than 200MΩ Sucho (*Dry*)
 - symbol of heating pipelines section resistance..... r
 - symbol of a direct shorting between a sensor loop wire and a line pipe..... C
 - symbols of resistance units Ω, k Ω, M Ω
 - voltage unit symbols V
 - no correct connection between the device and a line pipe Dołącz Rurę (*Connect Pipe*)
 - measurement range for a heating pipelines section length measurement exceeded L>L_{max}
 - Electrical gap in a sensor loop Przerwa (*Gap*)
15. Method of transmitting information to the data collection system:
 - contact status (closed/open) of the ALARM junction;
When supplying power from the batteries (periodic measurements), the conditions of contacts between the measurements depends on the results of the previous measurement cycle.
 - LPS-RS 232 digital data transmission module;
 - LPS-MBus digital data transmission module;
 - LPS-Modbus-RTU or TRACON 1.2 digital data transmission model (compatibility with CONTROL);
 - LPS-GSM radio data transmission external module.
16. Operating temperature range +5 ÷ +50C
17. Maximum relative ambient humidity value 80%
18. Casing tightness class..... IP65
17. Device dimensions (also with batteries) 154x125x90

¹ Standard setting. Settings are changed as per the conditions set out by a manufacturer of pre-insulated pipes. They apply to the maximum length of a heating pipelines (alarm loop length) and the permissible, minimum resistance of polyurethane insulation.

²...Voltage may be generated by various sources (e.g. welder). It can also be galvanic voltage, appearing in the event of moisture between a sensor wire and a pipe.