

**Impulse Locator type: LIM05
Operating Manual
Software version V5.1**



levr

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1. Preinsulated heat distribution network as a subject of research.

The process of production of preinsulated pipes with detection cables makes it possible to obtain a high rate of repeatability of the products in case of both: physical properties of used materials and certain geometrical dimensions. Thus all the products show repeatability of some electrical properties. One of the electrical quantities typical for heat distribution networks is surge impedance, value of which is about 200Ω . The measurement of impedance is done between the carrier pipe and a copper detection cable. It needs to be emphasized that its value does not depend on the lengths and diameter of the heat distribution network. Impedance can change due to local alteration of distance between the copper wire and the steel pipe, the presence of moisture in the polyurethane insulation, badly made connection or break in the detection cable. The above listed cases are treated as emergencies to be localized and repaired. A reflectometer is used to locate the fault. The measurement method applied in the device requires creating a very short electrical impulse. It is introduced between the copper wire and the steel pipe. Due to a constant value of surge impedance of the measured system, the impulse moves freely along the monitored pipeline with speed almost equal to the speed of light. If at any point in the preinsulated heat distribution network one of the above mentioned emergency cases occurs with accompanying variable change of the surge impedance value, a total or partial reflection of measurement impulse will occur. The reflectometer measures the time between the moment of electric signal departure and return of its reflection. Then, with recorded value of measurement impulse speed and measured time, it calculates the distance between the measuring station and the point of reflection, i.e. the fault site.

The fault localization method in heat distribution network with detection loop described above is executed by LIM05 device.

2. General information on LIM05 device.

LIM05 fault detector is a stationary device. It can simultaneously monitor four sections of a preinsulated heat distribution network with an impulse alarm system. The monitored section of detecting cable should be no longer than 2500m. The measurement reading for each individual section is presented on a graphical display as a chart with description. It is created as a difference between the last saved values and recent values. Until an emergency is detected the chart is a straight line (x axis). This axis is scaled in length units [m]. All the check runs are automatically saved in digital memory of the unit short after the operator launches the measurement procedure. As a preliminary calibration of the device, it is necessary, among other things, that the length of x axis on the chart is a proportional equivalent of the length of monitored heat distribution network section, whereas the fault information is presented as an image of the reflected measurement impulse with its exact, actual shape being shown. The location (over or under the x axis) of the reflected impulse and its shape contain information on the type of fault (leak, breach) and its scale (i.e. leak, electrical short-circuit)

of the detection cable with the steel pipe). The rate/size/scale of emergency is shown by the amplitude (height) of the reflected impulse. The amplitude is measured in voltage units [mV] i [V]. The default y axis is scaled in these units. The distance between the beginning of x axis (x=0) to the beginning of the impulse is proportional to the distance between the beginning of the heat distribution network and the location of the fault. The actual value of the distance is shown in the chart in [m]. Fig. no. 1 and no. 2 show the way of presenting measurement data.

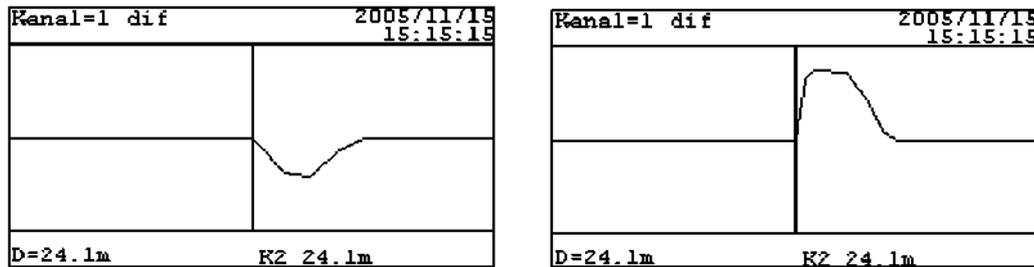


Fig. 1 Visualization of reflected measuring impulse on the screen of the detector in case of a leak or a short-circuit of the detecting cable with the steel pipe (left chart) and a cable being broken (right chart)

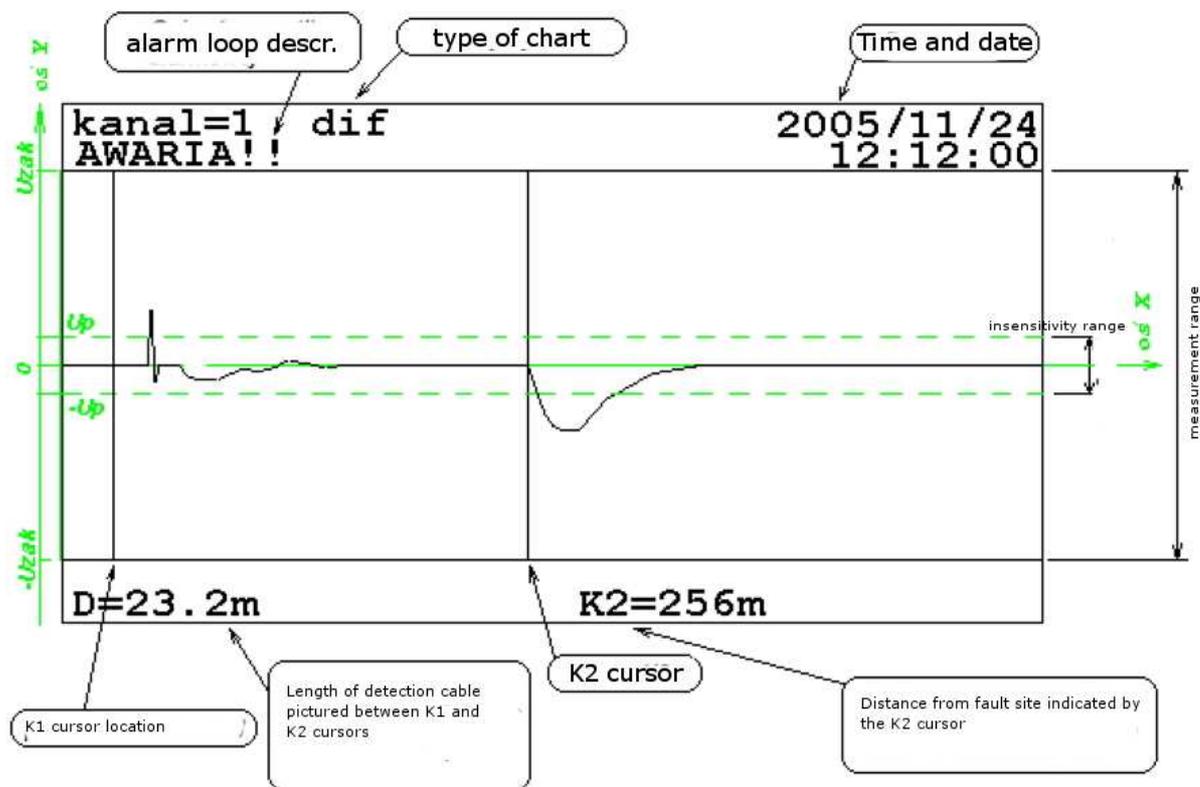


Fig. 2 The diagram shows the way of presenting measurement data, where:

- Kanal=1* (Channel=1) - number of the measurement channel (number of the monitored heat distribution network section);
- AWARIA* (FAULT)- description of the condition of the given network section;
- dif*- differential chart created as a graphical difference between the recent run and comparatory run.
- 2005/11/24; 12:12:00*- precise date and time; *K1*- cursor *K1* in $x=232.8\text{m}$ position. *K2*- cursor *K2* in $x=256\text{m}$ position (actual distance between the reflectometer and site of the fault, measured along the connection and detection wires). *D=23.2m* - distance between cursors *K1* and *K2* in relation to the actual length of the section of alarm system cable between them; *x*- default x axis. *y*- default y axis. *-Up*; *+Up*- values of threshold voltages for automatic localization activation process and fault signalization („dead zone” is $2Up$); *-Uzak* ; *+Uzak* – values of extreme voltages in the measurement range.

Figure 2. shows the influence of voltage threshold of fault detection (voltage values $-Up$ and $+Up$) on the interpretation of measurement results. During the automatic or manual analysis of the visualization, the runs with an amplitude not exceeding the threshold values are treated as if they had never occurred. *K2* cursor will ignore them. Impulses shorter than the measurement impulse will be treated in the same way. Even when the value of their amplitude will be higher than $|Up|$. Such case is also presented in the diagram.

3. Device assembly in the measuring station

LIM05 detector is a stationary device powered by a 230V 50Hz voltage supply. The device can monitor four sections of a heat distribution network simultaneously. The actual number of measurement channels used may be set during programming of the measurement conditions for the device. Unused measurement connections do not require any fittings to be attached, for instance of a 66LV72 type. The design of the device makes it unsusceptible to loss of supply voltage. Saved measurement procedure and gathered data are kept until normal working conditions are restored.

3.1 Connection of the detector to the alarm system of the heat distribution network

In order to connect the detector to a wiring pipe and a copper detection cable, a concentric cable and type 67LV15 box are used. The box is assembled on a steel connector welded to the wiring pipe. The connector enables electrical connection of the measurement coupling of the box with the wiring pipe. The box wire should be connected to the detection cable of the preinsulated pipe. For the connection of 67LV15 box with LIM05 detector, it is recommended to use one of the following measurement cables with the following 'electrical lengths': 5m (67LV09), 10m (67LV49), 15m (67LV50), 20m (67LV51), 25m (67LV52). Second end of the detection cable is connected to the 67LV15 type box, fitted with a zero terminal 67LV23.

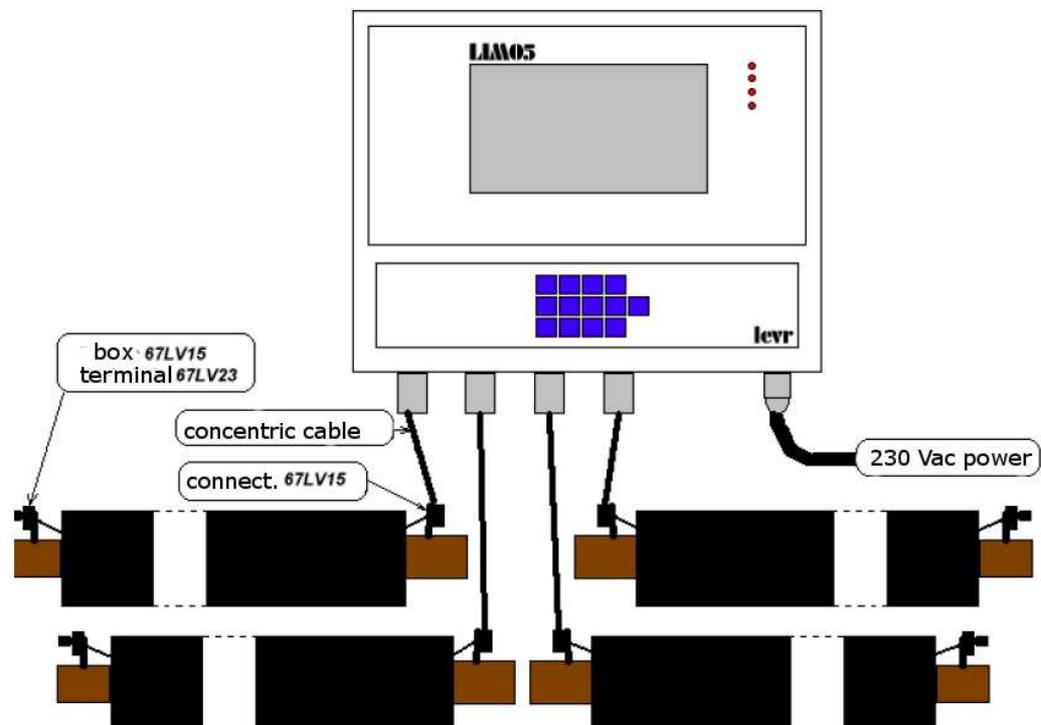


Fig. 3 An example of connecting a detector to the alarm system of a preinsulated heat distribution network.

4. Keyboard description

Fig. 4. shows LIM05 detector keyboard.



Fig. 4 Keyboard diagram

The majority of numerical keys have alternative usages. The numeric function of these keys, as well as „.” key, is activated only during the process of digital data input (option or entry selection or data entry in „Kalibracja” (Calibration) menu).

4.1 „1” key

Single pressing of „4 K1” or „6 K2” key activates the cursor movement function, K1 or K2 respectively. Selected cursor moves one leap (10 length units) each time a key with „▲” (right) or „▼” (left) symbol is pressed. If during the movement „1” key is pressed, the leap of the selected cursor becomes ten times shorter (length unit)*, whereas pressing down „▼” or „▲” keys longer than 1 second will cause the cursor to move by hundreds of units, as long as the selected key remains pressed. „1” key is superior in function of modifying cursor movement.

*) *Default cursor leap is 10 length units. One length unit is $0,23 \cdot VOP[m]$. VOP is a ratio between the speed of the electrical impulse in the examined environment and the speed of light in vacuum. For the heat distribution networks with copper detection cable this ration is in the range $0,91 \div 0,93$.*

4.2 „2 zoomH” key

Single pressing of „2 zoomH” key activates the function of widening or narrowing the chart along the x axis (length axis). Widening is chosen with the „▲” key and narrowing with the „▼” key. Activation of this function is signaled by a „zoomH” sign shown in the right lower part of the display.

4.3 „3 zoomV” key

Single pressing of „3 zoomV” key activates the function of vertical (along y axis) increasing and decreasing the size of the runs on the screen. Using keys with „▲” and „▼” symbols causes, respectively, the increase or decrease of the size of the chart along the y axis (amplification adjustment). Activation of this function is signaled by a „zoomV” sign shown in the right lower part of the display and the value of amplification given in mV / pixel.

4.4 „4 K1” key

Single pressing of „4 K1” key activates the function of K1 cursor movement. Cursor moves one leap (10 length units) after each pressing

of the key with „▲” (right) or „▼” (left) symbol. If during the movement „1” key is pressed, the leap of the selected cursor becomes ten times shorter (length unit). On the other hand, pressing down „▼” or „▲” keys longer than 1 second will cause the cursor to move by hundreds of units, as long as the selected key remains pressed. „1” key is superior in function of modifying cursor movement.

Pressing of „4K1” key displays „K1” notice in the right lower part of the display.

4.5 „5 PAN” key

The device displays the effects which accompany the movement of the measurement impulse along the whole length of the alarm cable. A modification of display’s settings is also possible, so that the selected section of the heat distribution network is shown. Pressing „5 PAN” key restores the display that corresponds to the whole length of the monitored heat distribution network. At the same time the default values of K1, zoomV, shiftH functions are restored. K1 cursor returns to the beginning of the chart (x=0). Amplification is set to the value of 10mV/pixel. The chart (x axis) is placed in the middle of the screen (y=0mV).

4.6 „6 K2”key

Single pressing of „6 K2” key activates the K2 cursor movement function. Selected cursor moves one leap (10 length units) each time a key with „▲” (right) or „▼” (left) symbol is pressed. If during the movement „1” key is pressed, the leap of the selected cursor becomes ten times shorter (length unit), whereas pressing down „▼” or „▲” keys longer than 1 second will cause the cursor to move by hundreds of units, as long as the selected key remains pressed. „1” key is superior in function of modifying cursor movement.

Pressing of „6 K2” key displays „K2” notice in the right lower part of the display.

4.7 „7 PING” key

„PING” function activation enforces the performance of a measurement run in the selected measurement channel and display of the received run. Depending on the selected option, it can be an input run, showing the recent state of the network, or a differential run (in relation to the reference run).

4.8 „8 LOK” key

The differential run displayed on the screen may contain information on one or more faults in the monitored heat distribution network section. Activation of the „LOK” function (pressing 8 key) will result in setting the K2 cursor in the location where the first fault is being signalized. Only a part of the differential run will be visible on the screen with the maximally enlarged image of the reflected measurement impulse and K2 cursor placed at its beginning. Another pressing of the 8 „LOK” key will result in finding another fault and displaying it in the manner described above. Each time, the distance to the site of the fault is shown next to the K2 cursor. Pressing of 8 „LOK” key after last impulse reflection image has been displayed (last place of fault) will result in returning to the display of differential run chart for the whole length of the monitored heat distribution network section.

4.9 „9 shiftH” key

„shiftH” function enables moving the chart along the default y axis. While using this function, the keys with „▲” (up) i „▼” (down) are used. Activation of this function is signaled by a „shiftH” sign shown in the right lower part of the display and value of movement given in [mV].

4.10 „FN” key

Pressing of the FN key causes display of the menu contents of the main detector to on the screen.

4.11 „ENT” key

„ENT” key confirms the selected choice.

4.12 „ESC” key

„ESC” key allows the selected choice to be undone.

4.13 Klawisz „•” key

Digital dot key. By pressing it, one can change the display of measurement channels with saved runs. It is also used during numerical data input, when more precision is required (for instance when tenths of meters are to be entered as the length of the alarm loop).

4.14 „▲” and „▼” keys

Keys with the symbols shown above are used accordingly to each of the functions being active. Therefore, they are referred to as: right-left; up-down; increase-decrease.

5. Main Menu

Main Menu is shown on the screen each time “FN” key is pressed and only when a chart is being shown. Listed below are all the options available in the main menu. Digits refer to the key descriptions.

1-Kanal = (Channel)

2-Start/Stop

3-Kalibracja >[haslo] (Calibration >[password])

4-Historia (History)

5-Przebieg różnicowy (differential run)

6-Przebieg wejściowy (input run)

7-Przebieg odniesienia (comparizon run)

8-Info

5.1 „Kanał” („Channel”) option

Kanał (*Channel*) option enables display of the measurement information on one of the monitored heat distribution network sections. The choice is made by entering the ID number of the channel (digits 1÷ 4; see point 8). „•” digital dot key has a similar function.

5.2 „Start/Stop” option

LIM05 device is designed for non-stop operation, heavy duty type. However, during its usage there might be a need to stop the measurement process for any time required. In cases like this, one must use a *Start/Stop* option. Each pressing of a 2 key changes the setting to the opposite one.

Start setting begins a cyclic measurement execution. It is signaled by a continuous „>AUTO<” notice, which appears in the right lower corner of the display. *Stop* setting (measurements stopped) is not indicated on the display.

5.3 „Kalibracja”(„Calibration”) option

Using *Kalibracja* option is possible only after entering a password (arbitrary digit sequence). The default password is „123” sequence. A user can use it to enter the calibration option and change it into their own. This option makes it possible to set the conditions of the measurement, such as the VOP ratio value, length of the alarm loop, etc.

5.4 „Historia”(„History”) option

Using the *History* option one can view the first saved image of the reflected impulse at the fault location, read the distance to the fault site, as well as the date and time of the data recording. One can move along the contents of the *History* option by using „▲” and „▼” keys.

5.5 „Przebieg różnicowy” („differential run”) option

Przebieg różnicowy option is a way of showing the measurement information, which is always a described chart. In such case the chart is a graphical difference between two runs: reference and differential. A run which has been made and saved after short time of device operation at the measuring station is called a reference run. Each measurement channel (examined section of the heat distribution network) has its own recorded reference run. However, the input run contains information on the last run made. *Differential run* is marked as „dif”. The notice is visible in the first verse of the text field at the top of the screen. (see fig.2).

5.6 „Przebieg wejściowy” („Input run”) option

The measurement starts at the moment of electrical impulse being sent to the monitored alarm system of the network. From this moment the device records the time of return and shape of all returning impulses (echoes). Those data are recorded in a digital form in the input buffer of the detector. The described measurement process is repeated after each selected period of time. *Przebieg wejściowy* option makes it possible to show the gathered digital data in a form of a chart. The data reflect the last made measurement. During the display of the input run, a „inp” notice appears in the first verse of the text field at the top of the screen.

5.7 „Przebieg odniesienia” („reference run”) option

Selection of *Przebieg odniesienia* option activates the display of a required chart for the selected measurement channel. Each of these channels (monitored network section) has its own recorded reference run. They are made and stored during the detector initial operation on the measuring station. Displaying of *Przebieg odniesienia* is signaled by a „ref” notice, which appears in the first verse of the text field at the top of the screen. At the same time the second verse displays the date and time of recording.

5.8 „Info” option

Selecting *Info* option results in displaying information on, for example, the name of the monitored object, reference number of the installed software version and the reason for the last processor reset operation.

6. Description of Calibration option from Main Menu

One can enter the calibration (*Kalibracja*) option via the Main Menu (FN) after pressing key (3). A request for PIN code will show up. The default setting is 123. User should set his own access code which can be any number from 100 to 32000. After entering the correct PIN it is possible to enter parameters values and define conditions of the measurements. A full list of available entries is shown below. Numbers refer to the key symbols.

- 1-Długość pętli> (Length of loop>)
- 2-Napięcie progowe U_p = (threshold voltage U_p)
- 3-Liczba kanałów = (number of channels)
- 4-Przebieg odniesienia (reference run)
- 5-Czas martwy = ('dead time')
- 6-VOP =
- 7-Parametry impulsu> (impulse parameters)
- 8-Zakres pomiarowy U_{zak} = (measurement range)
- 9-Wyświetlenie nastaw (settings display)
- 0-Kod PIN (PIN code)

6.1 „ Długość pętli >” (length of loop>) entry

During the measurements one should follow the rule of matching the measurement range to the measured value. In the case of LIM05 detector the measurement range is set in such a way that it corresponds as precisely as possible to the length of the measured detection cable. X axis refers to both the measurement range and the length of the alarm cable. The beginning of the x axis has a set value of $x=0[m]$, and the value of the length at the end of the axis (end of measurement range) should be equal to the length of the monitored detection cable. The presented method of x axis calibration makes it possible to achieve the highest possible measurement resolution. The method of calibration of x axis allows also for the faithful representation of the actual state using the image. For instance: if any fault occurs near the end of the network, it is shown near the end of the x axis and not, for example, in its middle part. The calibration of the device (setting the measurement length range) can be done in two ways, after entering the „Długość pętli>” option. Below you can find names and descriptions of the two methods.

Method 1

"3-Autokalibracja" („3-Autocalibration")– Before the procedure starts, a shorting should be made (for instance by unscrewing the zero terminal from the connection at the end of the detecting cable) at the end of the heat network. Next, key (3) should be pressed and after some time (in older versions of the detector even after a few minutes), the device shall ‘find’ the end of the detection cable. After the procedure is finished, the LMI05 device screen will show the voltage run for the whole detection cable. If necessary, the location of K2 cursor should be adjusted, so that it is located at the beginning of the measurement impulse reflected from

the end of the detection cable. Next one should remove the shorting at the end of the cable, enter option "1- Zakres L =" in Kalibracja / Długość Pętli menu and enter the exact length of the detection cable.

If for any reason LIM05 is not able to 'find' the end of the cable automatically, a calibration described in point 8 of this manual should be performed.

METHOD 2

"2-Zakres (range) L+AL=" - Usually the entered value of the detection cable length is by 20 to 30% higher than the actual value. For the VOP ratio, a known value is entered or a default length of 0,92 is left. So established measurement range guarantees that the actual length of the detection cable will be shown on the display near x axis, especially, when only an estimated value is known. At the same time it is a prerequisite for the next part of the calibration.

"1-Zakres (range) L=" - Precisely at the end of the heat network a fault is simulated (shorting, break) and then the measurement is enforced with 7-Ping key. Next, K1 cursor is set at the beginning of the x axis ($x=0$), and K2 cursor at the beginning of the image of the reflected measurement impulse. Location of K2 cursor shows not only the location of simulated fault, but the end of the detection cable as well. If an exact length is known, its value should be entered to *1-Zakres L =*. The device will calculate the exact value of the VOP and put it in *6-VOP= entry*. It shall be used for all the calculations for the calibrated network section. If the length of the detection cable is unknown, one should put the value shown next to K2 cursor into *1-Zakres L =*. For this calculation, the default value of $VOP=0.92$ is entered, or the one set by the user. (Detailed description - see calibration procedure, point 8)

Important: After any change of the length value of the detection cable, reference run should be made and recorded (see point 6 and 8).

6.2 „Napięcie progowe $Up=$ ” entry

Input signals, the amplitude of which is within the range of $\pm Up$ values, are not analyzed. This limitation makes it possible to eliminate some part of low-amplitude 'noise' which occurs in the alarm system of the heat distribution network. Range of $\pm Up$ voltages can be set individually for each of the channels.

6.3 „Liczba kanałów=" entry

The device can monitor no more than four detection loops. Entered digit (1÷4) defines the number of monitored sections of the heat distribution network with an alarm system. (See point 8). If there are less loops connected, a condition applies, that they should be connected with each measurement sockets of the unit, starting with extreme left. (channel 1).

6.4 „Przebieg odniesienia” entry

Activation of *Przebieg odniesienia* function enforces the execution of a given set of measurement cycles in the selected measurement channel. Then, the average value of received measurements is calculated and stored as the reference run. (see point 8)

6.5 „Czas martwy=" entry

Automatically performed cycle of detector's measurement consists of measurement data gathered for each of the heat distribution networks. They are made

one after another. Between the measurement cycles there is a break, called 'dead time'. It can be set from 1 ÷ 255min. (see point 8).

6.6 „VOP=” entry

This entry makes it possible to establish the VOP ratio values for all measurement channels used. It can be a fraction from 0.3 ÷ 1.0 or the value shown in %, from 30 to 100%. (see point 8). Default value: VOP=0,92.

6.7 „Parametry impulsu>” entry

For each of the measurement channels one can set a value of amplitude in [V] and time of duration in [ns] of the measurement impulse. The length of the monitored network (length of monitored detection cable) influences the choice of the two above mentioned values "1-czas trwania =" – time of measurement impulse is changed with keys „▲”(increase) and „▼”(decrease). Changes occur in leaps, each 12.5ns in 12,5 ÷ 75ns range.

"2-amplituda impulsu =" – the value of the measurement impulse amplitude can be changed within the range of 2.3÷7.8V (4,8 ÷ 14,6V for the amplitude of voltage for the measurement impulse generator) with keys „▲”(increase) and „▼”(decrease).

Important: After a change of time or amplitude of the measurement impulse a reference run should be created and stored. (see point 6 and 8).

6.8 „Zakres pomiarowy Uzak=” entry

The range of voltages measured by the detector is ±2047mV. Entering 100mV value sets the voltage measurement range at ±100mV. Optimal setting is: ± 500mV. It allows for a clear image of a leak just after it occurs (is registered) and in the initial stages of development. The shape of a reflected measurement impulse will be morphed to the level of voltage values which limit the measurement range. Extending the measurement voltage range influences the time of a measurement cycle.

Important: After a change of time or amplitude of the measurement impulse a reference run should be created and stored. (see point 6 and 8).

6.9 („Display set”) „Wyświetlenie nastaw” function

Activation of *Wyświetlenie nastaw* function results in displaying a list of all calibration options entries with all the set values .

6.10 „Kod PIN=” entry

Entering *Kalibracja* option requires a PIN code authentication. „Kod PIN=” entry serves as a way of setting and recording of the code. (see point 8).

7. Settings requiring a PC type computer

Conducting of some LIM05 detector settings requires the usage of a PC with (for instance) Hyperterminal type software. Both devices should be connected via a transmission cable RS232 (tri-core with interleave). The cable has to end with female plugs on both ends. The entry RS323 port is on the front cover of the detector. In order to ensure the best connection the following parameters should be set in the computer:

57600,8,N,2

- Transmission speed = 57600 bps
- Number of bits = 8
- No parity control
- Stop bits number = 2

After entering the settings, press ENTER on a computer keyboard. A notice shall appear on the computer screen:

LIM05>

No notice means that there is no connection between the detector and the computer. In such case, check the connection as well as the status of a chosen COM port. When „LIM05>“ notice appears proceed to the settings.

7.1 Time setting

Time setting requires entering the following command on the terminal screen:

czas hh:mn:ss

Where :

hh – hours

mn – minutes

ss – seconds

Example: set the time: 12 hours, 33 minutes and 30 seconds.

On the computer screen, enter the following command: **czas 12:33:30** Then press ENTER on the computer keyboard. LCD of the detector should show the correct time.

7.2 Date setting

Date setting requires entering the following command on the terminal screen:

data rrrr/mm/dd

Where:

rrrr – year

mm – month

dd – day

Example: set date 2006.10.11.

On the computer screen, enter the following command: **data 2006/10/11**
Then press ENTER on the computer keyboard. LCD of the detector should show the correct date

7.3 Detector signature setting

Very often a device is distinguished by a code, name or measuring station address. In order to check or change the existing signature, enter the Main Menu (FN key) and then use Info option (key 8). The recent name shall appear. It will be displayed in the first line on the LCD.

Setting a new signature requires entering the following command on the terminal screen:

Nazwa = ..treść oznaczenia..

Where: ..treść oznaczenia.. – set of no more than 20 alphanumerical signs
(no Polish letters; „Backspace” key can be used)

Example: set a signature for a measuring station by entering site address: **ul. Poleczki 5** (5 Poleczki Street)

On the computer screen, enter: **Nazwa = Poleczki 5**, then press ENTER on the computer keyboard. In order to check the correctness of a new entry, enter the Main Menu, then „Info” option. If a name is longer than 20 signs, the signature will consist of the first 20 signs entered.

8. Examples of procedures

Below are a few examples which shall serve as practical guides for some procedures described in this manual. All operations should be initiated only when the detector's screen shows a run.

8.1 Calibration Procedure: Calibration; Loop length entry

Important: Detector calibration should be done after 30 minutes from turning the device on. This time is required to establish equal thermal conditions inside of the device.

The way of describing of the below procedures makes them appear as separate instructions. Therefore, the beginning of almost all of them starts with entering the Main Menu (**FN**) and ends with exit by multiple pressing of the ESC key. In practice, when a few sequential options to be used are located in Calibration option, there is no reason to exit this set after each of them is finished. Just use one after another and exit only after the last one is done. The same applies to the Main Menu **FN**. We think, that during the actual device usage all these issues shall be easily explained. During the calibration it may turn out that the amplitude of the reflected measurement impulse is too small in order to perform the procedure correctly. In such case, use the *Kalibracja/Parametry impulsu*> option and increase the amplitude of the impulse or try to increase the time of the impulse instead. Remember that the default PIN code is 123.

1. On the ends of the monitored alarm loops place 67LV23 zero terminals in 67LV15 boxes.
2. Disable automatic measurements.
FN-> (2)
3. Set the number of monitored alarm systems.

FN->(3)-> enter PIN-> (3)-> enter number of monitored alarms [1...4] -> ENT-> wait 2s->ESC->ESC

IMPORTANT: If the number of monitored alarm systems is less than 4, they should be connected with the device starting from the extreme left port (channel 1).

4. Choose measurement channel number to be calibrated.

FN-> (1) -> enter channel number [1...4] -> ENT

5. Enter known VOP value (see 8) or leave default: VOP=0,92.

FN -> (3)-> enter PIN -> (6)-> enter VOP value as % (number 30...100) or fraction value (0.300...1.0) -> ENT-> wait 2s -> ESC -> ESC

6. Establish approximate length of alarm loop:

1) Enter length)* of the detection cable increased by 20 to 30% in relation to the actual value.

FN-> (3)-> enter PIN-> (1)-> (2)-> enter length-> -> ENT -> wait 2s -> ESC -> ESC-> ESC

*)*In technical documentation there should be an actual length of the alarm loop given. However, sometimes this value is only approximate. Therefore always enter the length value increased by 20-30% in relation to the actual length.*

2) Create and record a reference run.

FN -> (3) -> enter PIN -> (4)

A straight line will appear on the display (x axis).

3) At the end of the heat network simulate a break in alarm system

In order to do that, remove the zero terminal 67LV23 from 67LV15 box. Take measurements by pressing „PING” key. An image of reflected measurement impulse (from the end of the network) will appear (site of simulated fault).

The length of the visible section of x axis does not portray the actual length of the alarm cable. In point 3, larger value has been entered so that the image of the reflected impulse 'fits' the display during calibration. We should always try to make x axis length correspond with the actual length of alarm cable if we want to achieve the best measurement resolution for the monitored network. Besides if there is any fault present near the end of the network, it should be shown near the end of the chart (x axis) and not somewhere in the middle, so that there is a certain compliance between the image and reality.

4) Place K2 cursor at the beginning of the image of the reflected measurement impulse.

Press „6 K2” key -> move cursor K2 with „▲” (left) or „▼” (right) keys

8) Enter the actual length of the alarm cable taking into account the ‘electrical length’ of the connection cable. If the actual length is unknown - enter value shown at the K2 cursor. The device will automatically calculate the value of VOP ratio for the actual length. It will be stored in the memory. For the approximate length value, a default value of VOP=0.92 shall be used or value set by the operator.

FN-> (3)-> enter PIN-> (1)-> (1)-> enter known length value with regard to the cable length or copy the approximate value shown at the K2 cursor -> ENT-> wait 2s-> ESC-> ESC-> ESC

The measurement length range will cover the length of the monitored detection cable. In this case the best possible measurement resolution will be reached. Both the measurement range and the length of the monitored detection cable will be imaged.

- 9) Place the zero terminal 67LV23 in 67LV15 box at the end of the heat distribution network.
- 10) Stop measurements. Create and record a reference run.
FN-> 2 -> FN -> (3) -> enter PIN -> (4)
7. Repeat points 1) to 10) for all measurement channels used (see point 6 and 8)
8. Set 'dead time' value (break between measurement cycles). Suggested value: 10min.
**FN-> (3)-> enter PIN-> (5)-> enter dead time value:
 1...255min.-> ENT-> wait 2s.-> ESC-> ESC-> ESC**
9. Start automatic measurements.
FN -> (2)
 długość -> ENT ->(czekać 2s)-> ESC -> ESC

8.2 Channel number entry

FN -> (1) -> enter channel number [digit from 1 to 4] -> ENT

8.3 Start or stop of automatic measurements

FN -> (2)

Start of automatic measurements is signaled with >AUTO< notice. It appears in the right lower corner of the display. Stop of automatic measurements will result in the notice no longer being displayed. Change of setting happens after each pressing of the key (2).

8.4 Create and register a reference run

FN -> (3) -> enter PIN -> ENT-> (4)

8.5 New length of alarm loop entry

FN -> (3) -> enter PIN -> ENT-> (1) -> (2) -> enter new

After this operation create and record a reference run.

(FN-> (3) -> enter PIN -> ENT-> (4))

8.6 Change of alarms number

FN -> (3) -> enter PIN -> ENT-> (3) -> enter the number of channels [1...4] ->ENT->(wait 2s)->ESC->ESC

8.7 VOP change

FN -> (3) -> enter PIN -> ENT-> (6) -> enter VOP as a per cent value (number 30...100) or fraction (number 0.30 ... 1.0) -> ENT ->(wait 2s)-> ESC -> ESC

8.8 PIN change

FN -> (3) -> enter PIN -> ENT-> (0) -> enter new PIN -> ENT->(wait 2s)-> ESC -> ESC

8.9 Input run display

FN -> (6)

8.10 Display of the differential run

FN -> (5)

8.11 Change of value of 'dead time'FN -> (3) -> enter PIN-> ENT-> (5) -> enter 'dead time'
value: 1...255 min ->ENT ->wait 2s->ESC ->ESC

9. Technical data

Number of monitored alarm loops	4
Maximal length of alarm wire	$3518\text{m} \cdot \text{VOP})^1$
Measurement resolution of the detection	$\pm 0,23\text{m} \cdot \text{VOP}$
VOP values changes range	$0,300 \div 1,000$ (30 ÷ 100%)
Localization error range	$\pm 1\text{m}$
Unit's output impedance	200 Ω
Fault detected notification	red LED (each channel)

Measuring impulse characteristic:

Time	12.5ns, 25ns, 50ns, 75ns
Voltage amplitude (unloaded exit)	regulated: $4.8 \div 14.6\text{V}$

Method of presenting measurement data	LCD screen 128 x 240 pixels
Way of presenting measurement results	described chart
Device programming method	16 numerical-function keys
Measurement voltage range	$\pm 2047\text{mV}$
Maximal measurement sensitivity	1mV/pixel
Range of alterations of sensitivity threshold voltage values.....	$1 \div 1024 \text{ mV}$
Range of alterations of „dead time” length	$1 \div 255 \text{ min}$

Methods of outside communication:

Alarm output	non-potential contacts of the relay (load 1A/60V)
Digital transmission	RS232C
Radio transmission (optional)	GSM transmission module

Supply Voltage	230V 50Hz
Supply Power from mains	max 6 VA

Operating temperature range	$0 \div 50^\circ\text{C}$
Case tightness class	IP54 (IP65 if ordered)
Electrical protection of measurement input entries	250V(ac+dc)
Insulation class.....	B

Dimensions	262mm x 235mm x 143mm
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¹ – (VOP) ratio between the speed of measurement impulse in the alarm cable and the speed of light in vacuum.
Value given in % (0 to 100%) or in relative values (from 0.00 to 1.00)

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