

Operation and Maintenance Documentation

Kit for measuring and recording the amount of discharged sewage and rainwater

through open channels:

- KAMA series orifices***
- G 570 series level sensor***
- SM-03 monitoring station***
- G 923 converter***

(An open channel is also not fully filled sewage pipes)

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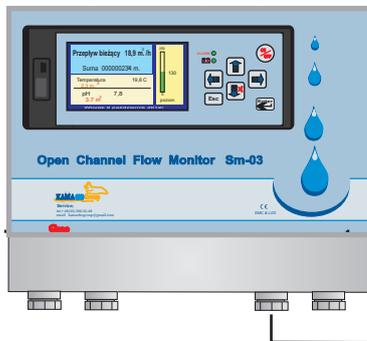
1. Introduction

This Operation and Maintenance Documentation is intended for users of the Sm-03 Station; it contains the necessary information to make it possible to operate and use the measuring system and Sm-03 station Sm-03 station is a version of Sm-01pH Station having the type approval of the Central Office of Measures - (type mark RP T 02 31 valid until 2006) Currently, there is no legal requirement for metrological control of this type of equipment. The device complies with the requirements of the Trade Metrology Act and provisions contained in: Journal of Laws no. 72 and Journal of Laws no. 62, Journal of Laws no. 115 of 2001, which entered into force at the beginning of 2002 and concerning: collective water supply and sewage disposal, environmental protection, Water Law. Sm-03 station meets the recommendations of the International Organization of Legal Metrology and the requirements of the EMC Directive LVD of the European Union. *The KAMA series orifices cooperating with the station have the status of the EU Community design No. OHIM 000988946 Both the station and the orifice are subject to copyright and patent protection no. P3558821 Indications and data recorded by the Sm-03 station can serve as the basis for financial settlements between the supplier and the recipient of sewage and water.*

2. Intended use of the sm-03 station

The sm-03 station together with the level sensor is designed to work with orifices of the KAMA, KAMA-euro KAMA euro R series and other types of primary elements of the Parshalla Venturi orifices of the KPV system, Thomson overflows, rectangular trapezoidal overflows, etc. A properly completed measuring system is used for measuring and recording the quantity and quality of discharged raw and treated sewage, rainwater, post-cooling water and drinking water flowing by gravitation through open channels and pipelines, ground trenches. It is used for measuring the amount of water and sewage discharged from housing estates, municipalities, cities, industrial plants, airports, large-surface facilities

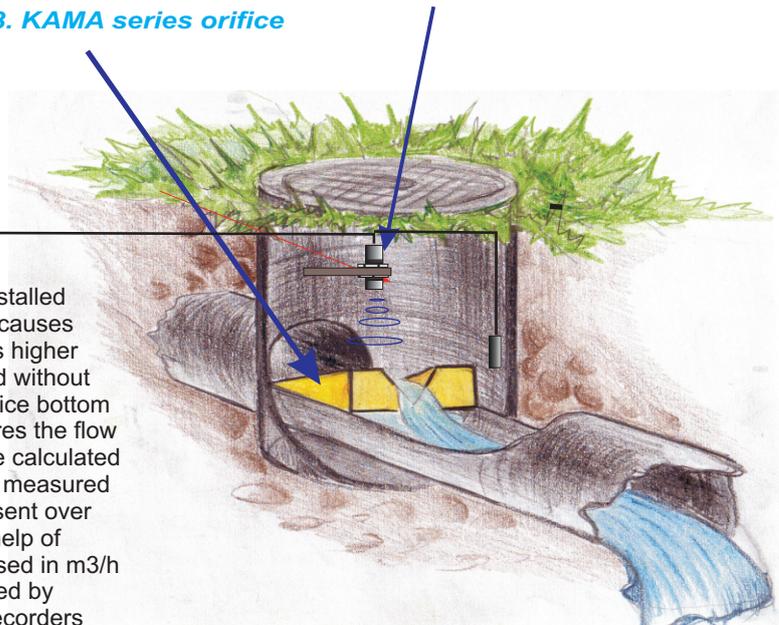
3. Construction of the basic measuring system and the principle of its operation



1. sm-03 flow monitoring station

2. Ultrasonic or hydrostatic level sensor

3. KAMA series orifice



Flow is measured as follows:

the flowing liquid hits resistance of the Kama orifice installed on its way. Appropriately selected shape of the orifice causes liquid damming at small sewage flows the damming is higher and higher as the level increases, damming is reduced without limiting the channel capacity and the speed at the orifice bottom increases, causing its self-cleaning, the orifice measures the flow from 0 to full filling of the collector. The damming value calculated from the zero of the sewage outflow from the orifice is measured by the level sensor. and the processed level signal is sent over the cable route to the Sm-03 station, where, with the help of a suitable algorithm, it is converted into a flow, expressed in m³/h on the station's display. The calculated flow is converted by the station electronics into data to the memory of its recorders and totaliser.

.Notices:

1. In case of the KAMA series orifices, the level is not measured from the bottom as in case of the Parshall Venturi orifices.
2. A detailed description of the measuring system completion is included in the completion sheet attached to the documentation of the particular measuring system.

Optionally, the measuring system can:

- be equipped with a backwater tkz sensor. data transmission module for the GPRS internet network, pH and temperature measurement, another type of level sensor, e.g. a hydrostatic level sensor used when sewage is foaming,
- work with any damming element of the Parshall, Venturi orifice, measuring overflows,
- be upgraded to the Sm-03 PB version more information www.kama-pomiary.pl. download tab, catalogue sheet sm-03 PB

3. KAMA orifices

Flow measurement in open channels is the most difficult measuring system to be made in water and sewage management.

The basic difficulty with the changing amount of sewage and rainfall is selection of an orifice and its measuring range. The orifice should enable measurement of very small amounts of sewage during a dry season, during night hours, when people are asleep and maximum amounts during the hours of the highest water intake or rainfall.

type	width	measurement range	assembly possibilities
KAMA-1	400 mm	from 0 to 250 m ³ /h	catch pit > 1,000 mm, channel width 400 mm, diameter of the collector from 100 to 400 mm
KAMA 2	600 mm	from 0 to 800 m ³ /h	catch pit > 1,200 mm, channel width 600 mm, diameter of the collector from 100 to 600 mm
KAMA 3	800 mm	from 0 to 7,200 m ³ /h	catch pit > 1,600 mm, channel width 800 mm, diameter of the collector from 100 to 800 mm
KAMA 4	1,500 mm	from 0 to 10,000 m ³ /h	catch pit > 2,400 mm, channel width 1,500 mm, diameter of the collector from 100 to 1,200 mm
KAMA -euro		from 0 to 60,000 m ³ /h	concrete canals, trenches with a width of 2,500 mm to 6,000 mm



zero point
of sewage flow



Segment orifices for rainwater and sewage collectors

KAMA euro orifice	applicable to collectors with a diameter	measurement range
R U 300	from 100 to 350 mm	from 0 to 330 m ³ /h
R 500	from 400 to 500 mm	from 0 to 540 m ³ /h
R 800	from 700 to 880 mm	from 0 to 890 m ³ /h
R 1000	from 900 to 1,000 mm	from 0 to 2,400 m ³ /h
R 1200	from 1,100 to 1,200 mm	from 0 to 4,200 m ³ /h
R 1400	from 1,300 to 1,600 mm	from 0 to 6,100 m ³ /h
R 2000	from 2,000 to 2,400 mm	from 0 to 9,800 m ³ /h



Table of manufactured KAMA orifices - we also make orifices for egg-shaped collectors and orifices with other dimensions and measurement ranges

The measurement ranges given above are the maximum ranges of measuring orifices. These ranges can be progressively reduced in the sm-O3 station depending on the specific conditions of a given sewage system



KAMA euro R orifice

All of our KAMA orifices are already measuring the flow from 0 m³/h, with measurement accuracy. The largest ones measure the flow in the range from 0 to 60,000 m³/h, the smallest measure of the water barrier foundations from 0 to 0.5 m³/h. Both a 300 mm or 4,000 mm wide orifice will measure the flow of several hundred litres of sewage per hour

Orifices, which are specially shaped in the underwater part, play the role of the wing fence and increase the speed of the sewage, which allows sucking up the sediment that accumulates in front of the orifice and obtaining a laminar flow. During operation, the orifices do not require any service except for possible cleaning.

Zwężki wykonywane są z laminatów szklanych na bazie chemoodpornych żywic poliestrowych, winyloestrowych metoda ręcznego laminowania na mokro. Przy dużych zwężkach stosowane są oprócz tkanin i mat szklanych stosowane są lotnicze materiały przekładkowe, wzmocnienia z tkanin węglowych, bazaltowo kevlarowych.

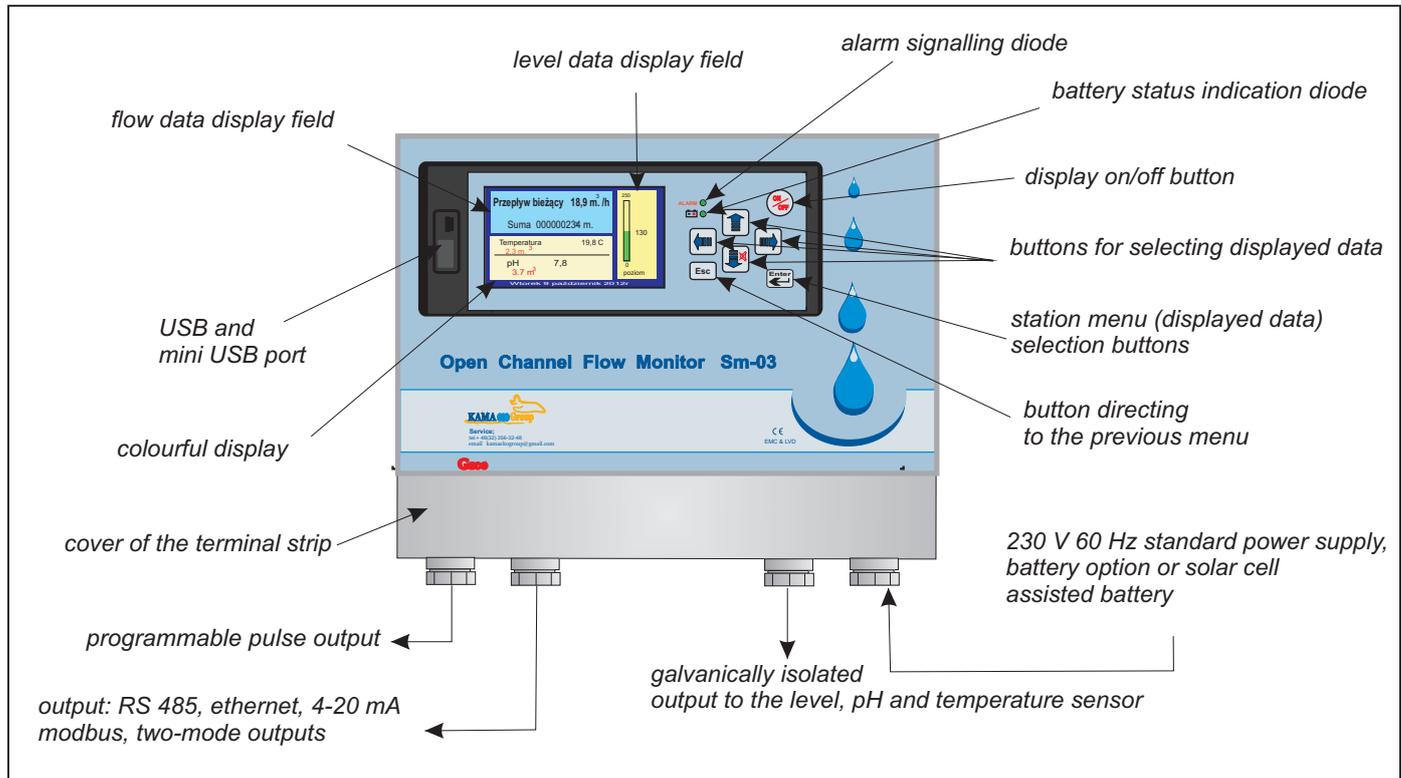
The orifices are made of glass laminates based on chemically resistant polyester-vinyl ester vines by manual wet-lamination. In case of large orifices, apart from fabrics and glass mats, the aviation sandwich materials are used together with reinforcements from carbon, basalt and Kevlar fabrics.

Do not use metal wire brushes, scrapers, etc. for cleaning.

Correct operation of the orifice is conditioned by ensuring gravitational inflow of sewage and their free outflow behind the orifice

4. stacja monitoringu przepływu ścieków

The Sm-03 station is a specialized measuring device designed for measuring and recording the amount of discharged sewage and rainwater, as well as their pH and temperature, intended for cooperation with orifices of the Kama series. The electronics used in the station allows registering flow data from every three minutes of the last 370 days. The data is stored in both the station and sensor memory. Data reading is possible directly on the station's display; it can also be copied via the USB port or sent via GPRS modem (option) to the computer system. The station and the sensor have a built-in interchangeable security system against the surge input system, signal output and cable route from the sensor. In addition, the station has a glass fuse on the motherboard under the terminal block cover securing the 230 V power supply circuit.



The station is prepared for cooperation with the converter of output signals with full galvanic isolation and may also have a built-in module for GPRS data transmission, information gathered in the station with the option of analyses, charts can be read on any computer connected to the Internet. The measuring system can be operated by our dedicated MONSTREAM H2O application (sewage network analysis system, reporting, emergency alarms, chamber cover opening, cabinets, sending notifications to a mobile phone). The station is also adapted to work through 4-20mA and Modbus RTU converter and outputs to cooperate also with other data transmission systems via the GPRS system and Scada I other systems via available outputs from the converter and sm-03 stations

Notice:

After 30 seconds of not using the operating system (push-buttons), the energy saving system switches off the station display. Pressing the on/off button turns it on - switching off the display does not turn off the operation of the measuring system

5. Basic technical data of the Sm-03 station and the G 570 level sensor

Power parameters

1. external 230 V 50 Hz power supply of the station protected by a fuse on the main board of the station; optional station 24 V DC or 12 V DC power supply
2. sensor power supply, data transmission station sensor - 24V DC secure voltage through three independent power packs built into the Sm-03 station in the form of a removable electronics module

Basic technical data of the Sm-03 station

The main elements of the station are: a housing, a front panel with a built-in control panel (buttons) and a graphic display of TFT type with a diagonal of 4.5 inches and a resolution of 480 x 272 pixels, a motherboard with processor and electronics and a module of independent galvanically isolated power supplies.

Reporting system on the station display

- daily flow in a form of a linear graph on the coordinate system with a resolution of 3 minutes with automatic scaling of the vertical axis according to the maximum flow; horizontal axis daily memory of min. 370 days; browsing after selecting an option in the main "measurements" menu and then "daily", using the buttons ◀ ▶
- monthly flows in a form of a three-colour bar graph on the coordinate system; horizontal axis of days, automatically scaled vertical axis with maximum daily flow in m³; colours: green flow, red flow from exceeded pH, yellow flow with exceeded temperature; memory of min. 24 months browsing after selecting options in the main "measurements" menu and then "monthly", using the buttons ◀ ▶
- annual flows in a form of a bar graph on the coordinate system; horizontal axis of months, automatically scaled vertical axis with maximum monthly flow; colours: green flow, red flow from exceeded pH, yellow flow with exceeded temperature; memory of min. 24 months browsing after selecting options in the main "measurements" menu and then "monthly", using the buttons ◀ ▶
- alarm states, turn-off times displayed in the main menu option "information"

Data transmission

- between the sensor and the station properly matched to the field conditions with a twisted pair cable 4x2x0.8 min.
- after equipping the sm-03 station with a GPRS modem, data can be sent remotely to the Internet
- the output signals can also be sent by properly selected signal cables to the akpia systems

Output signals from the station and converter

- programmable pulse output in the range from 1 to 1,000 m³
- programmable alarm output exceeding the thresholds pH, temperature, level
- signals of station faceplate opening, well cover and signals with galvanic isolation and 4-20 mA filters, Modbus RTU (frame description further in the operation and maintenance documentation)

Measurement ranges of the Sm-03 station and the conditions of its operation,

- flow in m³/h, programmable depends on the used orifice
- sewage temperature from 0 to 100 C, Pt 100 sensor
- pH measurement from 2 to 14
- level from 0 to 1,200 mm measurement resolution 0.1 mm
- the station cooperates as standard with a dedicated level sensor G 570, it can also work with other level sensors: hydrostatic one, radar one
- the station can be operated at -15 C to 40C
- Sm-03 station housing - FIBOX Cardmaster Pc 25/30 has IP 67 protection class and second protection class. However, it is recommended to install the station in a cabinet or a closed room (max. distance from sensor to sm-03 station 1,200 m without amplifier)

Basic technical data of the G 570 level sensor

- ultrasonic measurement in the range from 0 to 1,200 mm, insensitivity zone min. 300 mm
- temperature to compensate for level measurement - 30 to 80C
- 24 V DC power supply from the Sm-03 station
- the sensor housing has an IP 67 protection class
- data transmission, encrypted digital transmission to the Sm-03 station
- distance of the sensor installation in front of the orifice, limited by a horizontal sewage mirror

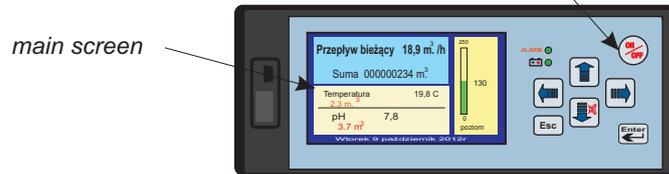
Pooled error of measurement system:

processing of the damming characteristic, level measurement, influence of the supply voltage, temperature in accordance with the applicable law, no more than 5%

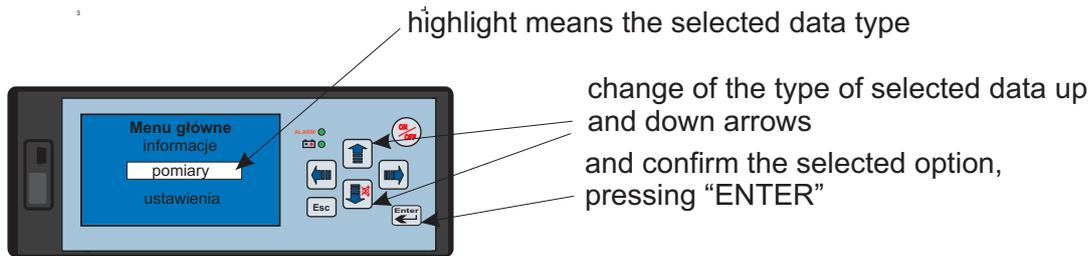
6. Operation of the station display panel

The station has an intuitive operating system. The general rule is to use "ENTER" and "ESC". "ENTER" confirms a choice, while "ESC" cancels it

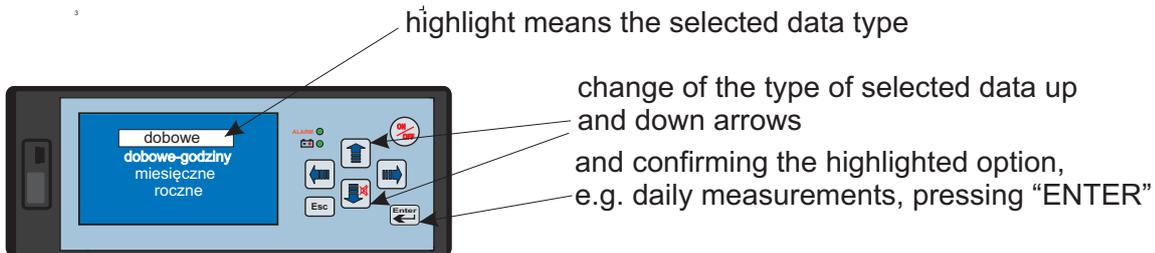
status of the display panel after pressing on/off button



panel view after pressing "ENTER" while displaying the main screen

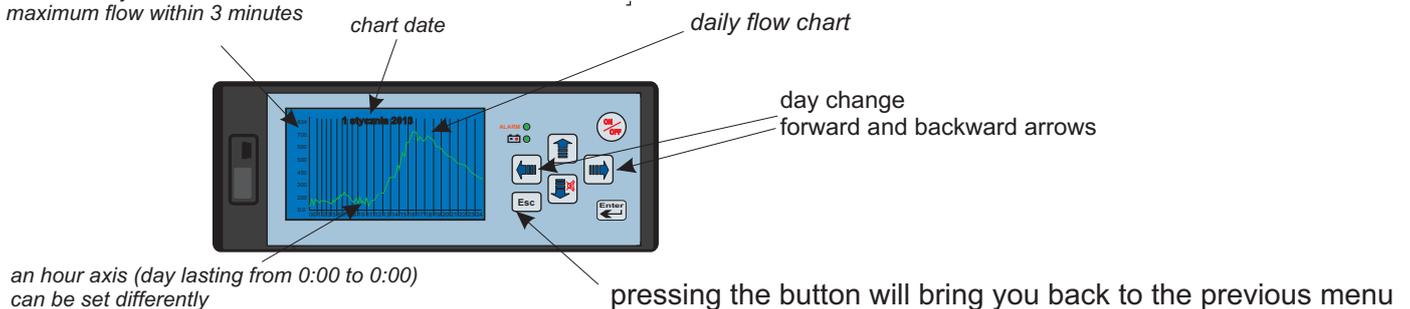


view of the display panel after confirming the "measurements" option with "ENTER" in the main menu



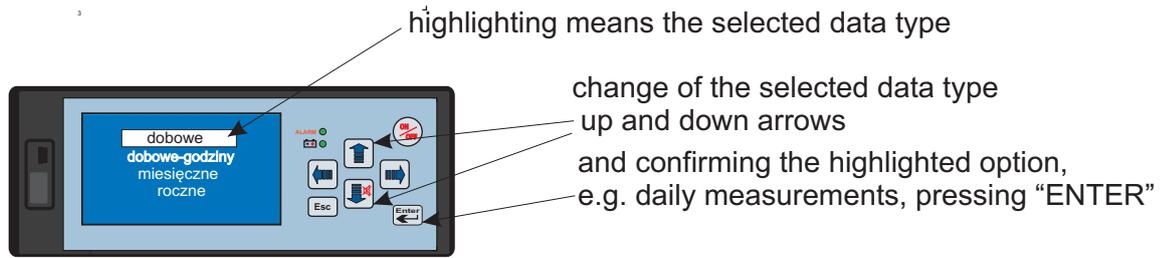
status of the display panel after selecting "daily measurements" with "ENTER"

automatically scaled flow axis
maximum flow within 3 minutes

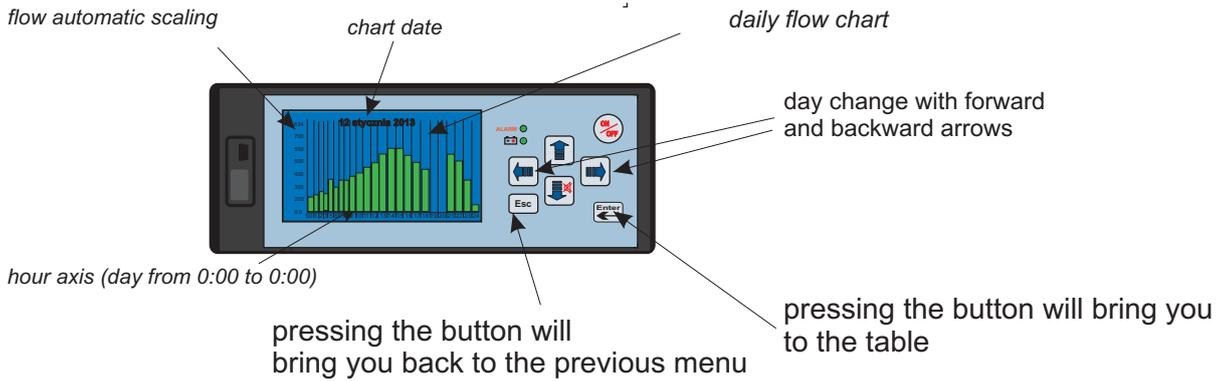


Procedure in case of data selection of **daily - hours, monthly, annual measurements** are the same; charts are available in the bar system additionally after pressing Enter during displaying The bar chart will display data in the form of a table scrolling with the up and down buttons

view of the display panel after confirming the “measurements” option with “ENTER” in the main menu



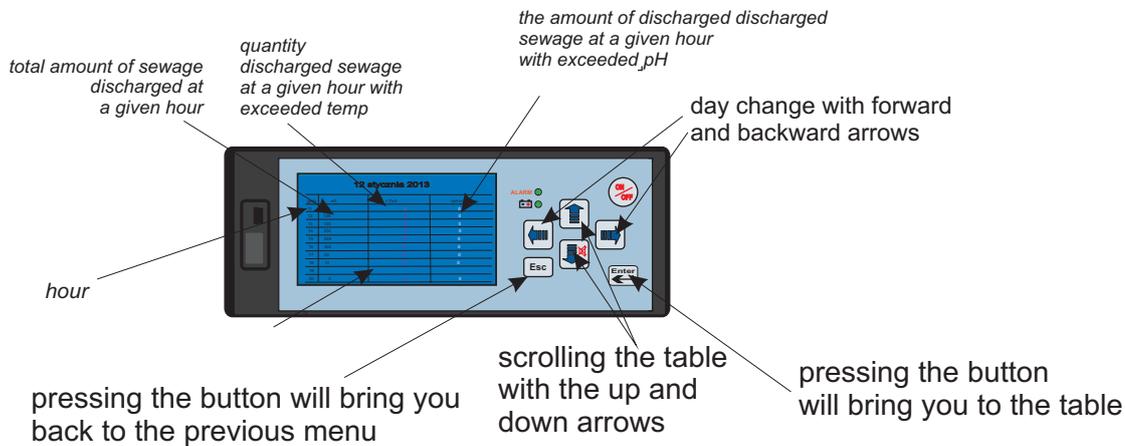
status of the display panel after selecting “daily-hours” measurements with “ENTER”



Notice:

1.no data in the bar graph may indicate zero flow or device turn-off; status verification is data in the table (the table is displayed after pressing “enter” while displaying the bar graphs).

status of the display panel after pressing “ENTER” while displaying bar graphs

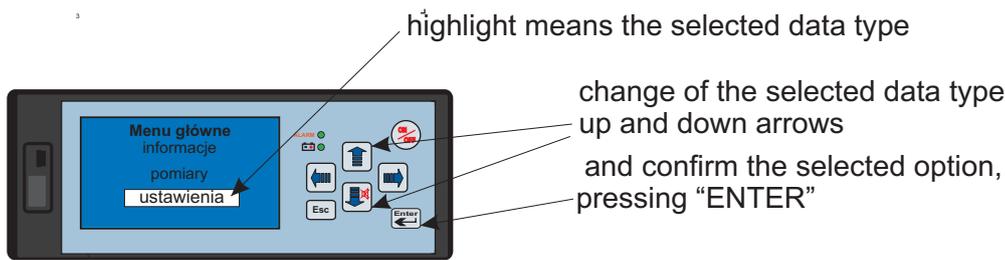


Notice:

1. no data in the table indicates the device is turned off at a given time

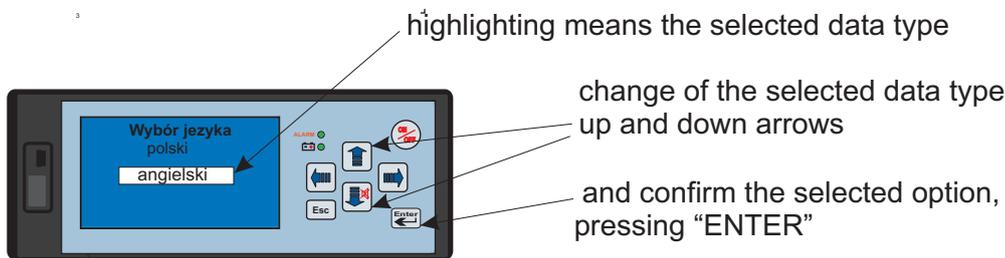
The procedure in case of data selection of “monthly” “annual” measurements is the same

status of the display panel after pressing “ENTER” while the main screen is displayed (current flow, level, counter, pH, temperature) and selecting a setting option with a down arrow



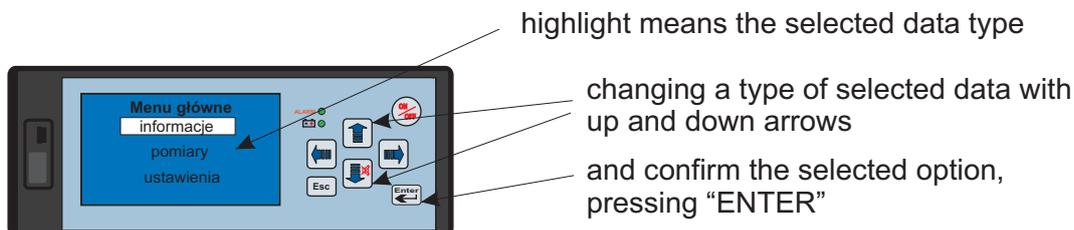
after confirming the option with ENTER, the station will move forward to the screen with the language selection

status of the display panel after selecting a setting option and selecting the English language with a down arrow



after choosing the English language option (confirmation with “ENTER”), descriptions of all data, options will be displayed in English, return to previous menu (language selection) with “ESC” button, if no buttons are used, the station will return to the output operating mode:
- switched off main screen with saved selected Polish or English language.

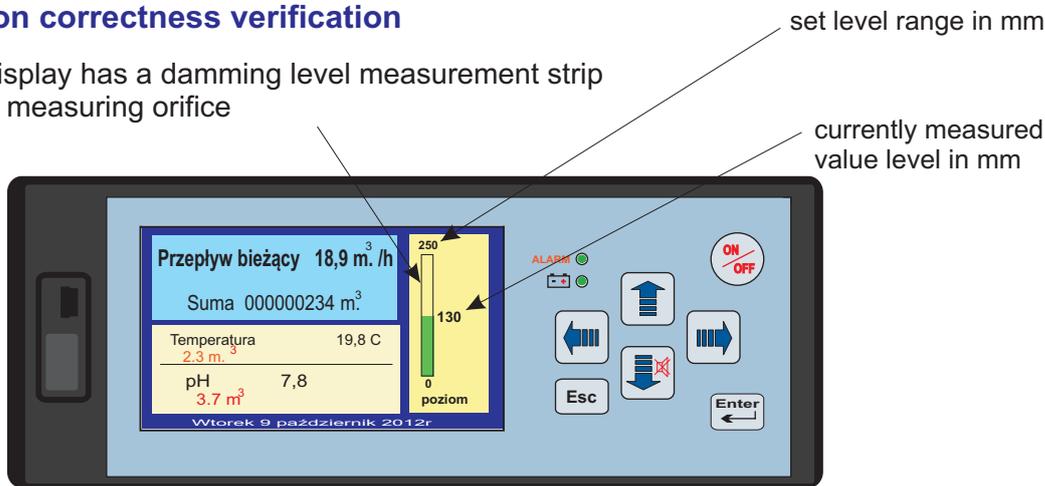
panel view after pressing “ENTER” during main screen display and selecting the information with an up arrow



after confirming the option with ENTER, the information will be displayed on the station screen:
- the date of station commissioning, zeroing the counter, software options, registered alarms, times of turning off the station

8. Calibration correctness verification

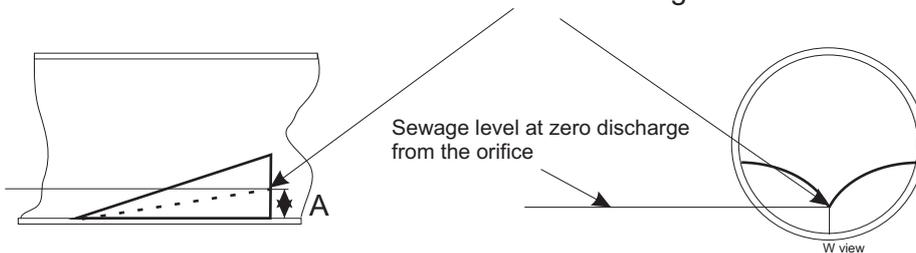
The station display has a damming level measurement strip in front of the measuring orifice



set level range in mm

currently measured value level in mm

Verification of correct indications by the user consists in comparing the value of the level displayed on the display with the current damming level in front of the measuring orifice. The best method is to check the zero. With zero outflow from the measuring orifice.



An example of an orifice installed in the collector in the as-built documentation is the zero point for a specific mounted orifice

Another way is to measure a damming level in front of the orifice, generally at the place of mounting the level sensor from its front to the sewage level.

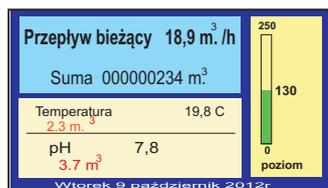
Note: the sensor does not measure the level from the bottom, but from the dammed sewage level at the zero outflow of sewage from the orifice.

Inspections should be carried out once a year or after finding incorrect operation of the measuring system. Such inspection can be carried out by the manufacturer's service at the request of the user.

In the event of non-compliance, notify the manufacturer of the measuring KAMA system manufacturer. Calibration of the measuring system is carried out only by the manufacturer or its authorized representative

Interpretation of level indications

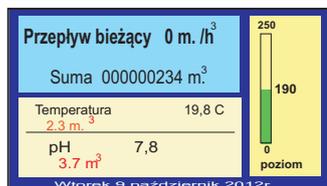
1. normal operation of the measuring system displays the current flow data and the green strip of the level status



2. red strip of the level status, indicated flow value means exceeded level range

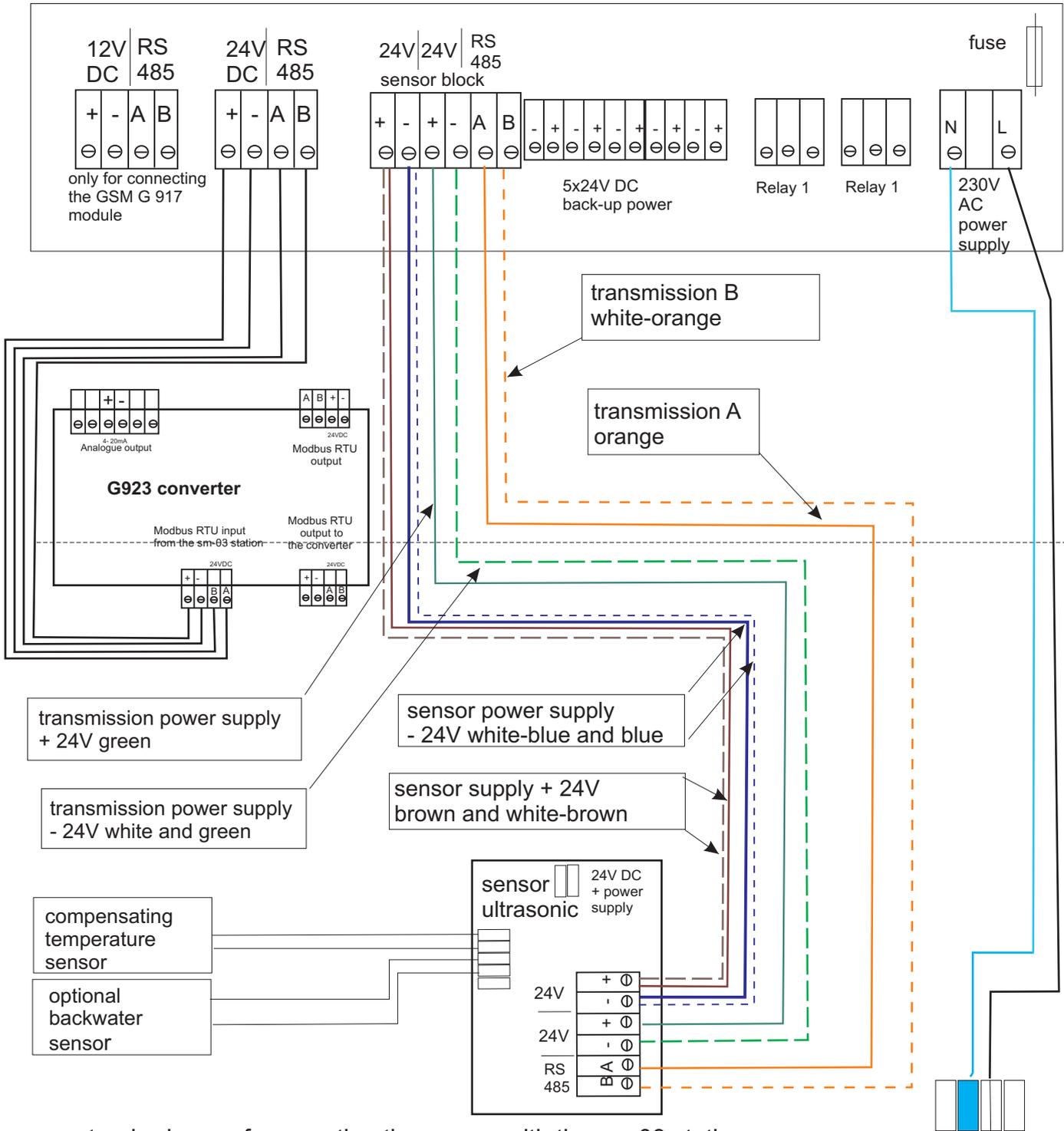


3. Green strip - zero flow value means the operation of the backwater sensor the backwater sensor is not always mounted



9. The wiring diagram of the sm-03 sensor

terminal block of the sm-03 station



a standard way of connecting the sensor with the sm-03 station

Notice:

Due to frequent damage to the Modbus output port by external factors in December 2015, we introduced an additional element of the measuring system - a fully insulated converter of output signals of the sm-03 4-20 mA and Modbus RTU station; the converter is adapted to the installation on a DIN rail or can have a discreet casing

10. Description of the MODBUS RTU data frame of the sm-03 station with the factory setpoint of transmission parameters

MODBUS data structure

Address 8

Speed 9600

1b stop frame, 8b data, no parity, 1b stop

Address Contents/read only

40001 Total flow [litres] 64 bits (b0-b15)
40002 Total flow [litres] 64 bits (b16-b31)
40003 Total flow [litres] 64 bits (b32-b47)
40004 Total flow [litres] 64 bits (b48-b63)
40005 Current flow [litres/ hour] 32 bits (b0-b15)
40006 Current flow [litres/ hour] 32 bits (b16-b31)
40007 Level [mm] 16 bits (b0-b15)
40008 Year 8 bits (b0-b7) / Month 8 bits (b8-b15)
40009 Day 8 bits (b0-b7) / Hour 8 bits (b8-b15)
40010 Minute 8 bits (b0-b7) / Second 8 bits (b8-b15)
40011 Working time [seconds] 32 bits (b0-b15)
40012 Working time [seconds] 32 bits (b16-b31)
40013 Down time [seconds] 32 bits (b0-b15)
40014 Down time [seconds] 32 bits (b16-b31)
40015 Total flow [m3] 32 bits (b0-b15)
40016 Total flow [m3] 32 bits (b16-b31)
40017 Flow temp [m3] 32 bits (b0-b15)
40018 Flow temp [m3] 32 bits (b16-b31)
40019 Flow pH [m3] 32 bits (b0-b15)
40020 Flow pH [m3] 32 bits (b16-b31)
40021 Sewage temp [°C x 10] 16 bits (b0-b15)
40022 Sewage pH [pH x 10] 16 bits (b0-b15)
40023 Backwater 16 bits (b0-b15); 0x0000-no; 0xFFFF-yes

11. Maintenance and repair

Sm-03 station and sensors of temperature pH level

After proper installation and programming of the SM-03 station, the station does not require any maintenance work, apart from dusting off. It is recommended to periodically inspect the level sensor, at least once a year. The inspection covers comparison with a displayed level value at the SM-03 station above the damming element, and a damming value with a physically measured gauge in the orifice (p. 10 of this Operation and Maintenance Documentation In the event of any discrepancies, please notify the service. The service data can be found on the front panel of the Sm-03 station, the Operation and Maintenance Documentation of the as-built documentation and on the Internet at www.kama-pomiary.pl

During operation, do not exceed the maximum measuring range given in the documentation, as it may damage the sensors. Additional elements of the measuring system, such as pH, temperature probes, require periodic inspection, cleaning of the calibration, replacement of pH electrodes in accordance with the manufacturer's recommendations. KAMA uses Elmentron's electrodes. The working time of the pH probe depends on a type of sewage; the probe is not covered by the warranty. Detailed description, operating rules are always attached to the as-built documentation in case of the extension of the measuring system by pH or temperature measuring system. Each Sm-03 station can be extended to the Sm-03 PB version; for more information, see www.kama-pomiary.pl

KAMA orifices

The KAMA series orifices are made of reinforced polyester and vinyl ester resins - using a wet method. After being laminated, they are painted with chemically resistant polyurethane paints - blue RAL 5017, RAL 5015 or yellow RAL 1003. Orifices can also be additionally protected with anti-fouling paints. The orifices do not require any special service except possible cleaning. Do not use sharp steel brush tools or other tools that may scratch the surface of the protective coatings; after cleaning the orifice should be covered with a layer of car polish paste, which will protect the orifice from contamination. If the orifice or its protective layer is damaged, please contact us. The address and telephone number of the orifice manufacturer can be found on the front panel of the station, warranty card and Operation and maintenance documentation. The orifice will work properly in case of constant outflow of the sewage and no solid parts on its overflow edge (e.g. paper rags, paper towels, etc.).

12. Warranty

The manufacturer warrants correct operation of the SM-03 station together with the level sensor within 24 or 36 months from the date of measuring system commissioning. The measuring system can only be installed and commissioned under supervision of the manufacturer or its representative.

The KAMA orifices supplied and installed by the manufacturer are covered by a 50-month warranty.

Using the measuring system not in accordance with the manufacturer's instructions contained in the warranty cards, operation and maintenance documentation and as-built documentation deprive the purchaser of the right to claims under the warranty granted by the manufacturer. The warranty does not cover random events, flooding the sensor, floods, lightning, atmospheric breakage of pH probe and normal wear and tear of the pH probe.

13. Storage, packaging and transport

Devices: the station and sensor transported must be covered by means of transport in the packaging provided by the manufacturer, it should be protected against impacts and shocks. Before installation, the Sm-03 station and sensor should be stored at a temperature of 5 to 35°C, and the air should be free of corrosive agents. Dimension of the station packaging 320 mm x 260 mm x 120 mm; weight about 2 kg; G570 sensor 190mm x 140mm x 100mm weight 700g Dimensions of the orifice, depending on particular completion for a specific recipient.

14. Legal aspects

Currently, there is no legal requirement for metrological control of this type of equipment.

The predecessor of Sm-03 station, SM-01 pH station had type approval of the Central Office of Measures - type mark RPT 02 31; the construction of Sm-03 station meets the requirements of the Trade Metrology Act and provisions contained in: Journal of Laws no. 72 and Journal of Laws no. 62, Journal of Laws no. 115 of 2001, which entered into force at the beginning of 2002 concerning: collective water supply and sewage disposal, environmental protection, Water Law; it also meets the recommendations of the International Organization of Legal Metrology and requirements EMC LVD Directive of the European Union.

The KAMA series orifices cooperating with the station have the status of the EU Community design No. OHIM 000988946 Both the station and the orifice are subject to copyright and patent protection no. P3558821

Indications and data recorded by the Sm-03 station can serve as the basis for financial settlements between the supplier and the recipient of sewage and water. Moreover, the measuring system meets the requirements of integrated quality and environmental management systems compliant with ISO. At the request of the customer, a sewage recipient, the system can be calibrated with the volumetric method, control measurement performed by a hydrometric current meter or another agreed method. After commissioning of the measuring system, the user receives the Operation and maintenance documentation, a completion sheet, a protocol, a declaration of conformity and is trained together with the representative of the sewage receiver in the scope of operating the measuring system.