Heat and cold meter, evaluation unit of gas flow INMAT 59

PRODUCT MANUAL

Type 459

APPLICATION

- to measure the flow and heat transferred by steam
- to measure flow and heat in condensate
- to measure the flow and heat transferred by water
- to measure cold
- to measure the flow of liquids
- to measure gas flow
- as a separate meter for the construction of closed measuring units as well as for the construction of large-scale distributed systems

INMAT 59 allows the measurement of one to three separate circuits (taking into account the number of available inputs). It is possible to combine the measurement of different media and the use of different principles of flow measurement.
The design of the device, including the industrial protection IP 65, allows the use of the evaluation unit in the most demanding conditions. INMAT 59 is not designed for operation in the environment with a threat of explosion.
The devices Converters are rated products pursuant to the Directive 2014/30/EU of the European Parliament and the Council and EU Declaration of Conformity **EU-459000** is issued for them.

MEASUREMENT OF FLOW AND HEAT TRANSFERRED BY WATER STEAM

Evaluation unit of the meter of heat in the systems of steam measurement

INMAT 59 is designed for measurement of heat in the systems of measurement of water steam, as evaluation unit, which is a part of the heat meter. Furthermore, it can be used as meter of flown quantity of the condensate in the systems for steam measurement.

The meter INMAT 59 enables:

- Measurement of heat transferred by water steam with direct method (without measurement of the condensate) in combination with the substitute method
- Measurement of heat transferred by water steam with indirect method, i.e. with a calculation from the quantity of overheated water steam detected by the measurement of quantity of the condensate and temperature and pressure of overheated steam, in combination with the substitute method
- Measurement of heat in condensate
- Measurement of the average enthalpy of steam and condensate for a selected period of time
- Single and double circuit measurement by the above methods

INMAT 59 can also measure heat supply of up to 2,500 GJ/year by evaluating the amount of condensate in the place of consumption, steam enthalpy measured at the nearest reference point and technically determined condensate temperature in the place of consumption. A reference point is the place of steam enthalpy measurement. The meter, with the relevant SW version, measures the average steam enthalpy (for the selected time period) at the reference point and the average condensate enthalpy (for the selected time period).

Flow of water steam is measured with throttling units or speed probes with one pressure difference sensor with output current unified signal or volume flow meter (e.g. whirl) with linear output signal of frequency or unified current. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.

Condensate flow (indirect method) is measured with throttles or speed probes with one or two differential pressure sensors with output flow unified signal or volume flow meter (e.g. vortex) with linear output signal frequency or unified flow or water meter with output pulse signal. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.

Temperature of water steam in the piping is measured with a resistance temperature sensor with measuring resistor in four-wire connection or with a thermometer with converter to the unified current signal. Operating temperature of water steam in the transferring piping may be 600 °C as a maximum.
Temperature of the condensate (for indirect method) is measured with resistance temperature sensor with measuring resistor in four-wire connection or thermometer with converter to the unified current signal. Operating temperature of the condensate may be 200°C as a maximum.

Pressure of water steam is measured with the absolute pressure sensor or with the overpressure sensor with unified current signal. It is recommended to use the absolute pressure sensor for operating pressures lower than 1 MPa.
The meter INMAT 59 performs automatic correction of changes of density and enthalpy pursuant to IAPWS IF97 within the range of temperature from the limit of saturation to 600 °C and within the range of abs. pressure from 60 kPa to 18 MPa. The status of wet steam is signalled with the system of self-diagnostics. In case of a drop of the steam temperature under the limit of saturation, the measurement of flow and heat is switched over to the substitute method. The evaluation of flow and heat with both methods does not influence one another.

Heat, heat output, flown quantity and flow steam within the zone of overheated steam are displayed on independent meters.
The evaluation within the limited area of wet steam under the limit of saturation takes place on independent meters within the zone, the upper limit of which is the temperature of steam saturation (TS), the bottom limit is limited to 10°C under the temperature of saturation (TS - 10°C).

The quantities of flow and heat output in the wet steam area are indicated by an index **mp**. Heat and flow rate below the saturation limit are evaluated separately in two zones.
1st zone in the temperature range TS to TS - 2 ° C is marked by the index **mp**, 2nd zone in the temperature range TS - 2 ° C to TS - 10 ° C is marked by the index **mv**.

Data of the thermal output and heat in wet steam are multiplied with a coefficient Kh (0.5 to 1). In case of the direct method, data of flow and flown quantity in wet steam are multiplied with a coefficient Km (0.5 to 1). User adjustable coefficients Kh and Km are established contractually between the supplier and the customer of heat (implicitly Kh = Km = 1) and their change can be protected with a password.

The measurement methods are established in compliance with MPM 18-95 (Directive for permissible methods of measurement of heat in water steam and in condensate in business contact). The limit of saturation is established pursuant to “International formulation of thermodynamic properties of water and water steam for industrial purposes IAPWS-IF97.

Measurement in the area of overheated steam and measurement of the condensate has a nature of a rated operating meter. Measurement in the area of wet steam (so-called substitute method) has a nature of a non-rated operating meter. For billing purposes, it is necessary to use a measuring path for the measurement of flow that corresponds to the applicable standards or technical conditions of the used flow meter. The sensor pressure, thermometers and meters of the flown quantity of carrying medium, which are, together with the evaluation unit, elements of heat meters, shall be compatible with the evaluation unit INMAT 59.

FLOW AND HEAT MEASUREMENT IN CONDENSATE
Heat meter evaluation unit in steam measurement systems
INMAT 59 is designed for measurement of heat in the systems of measurement of water steam, as evaluation unit, which is a part of the heat meter. Furthermore, it can be used as meter of flown quantity of the condensate in the systems for steam measurement.

Condensate flow is measured with throttles or speed probes with one or two differential pressure sensors with output flow unified signal or volume flow meter (e.g. vortex) with linear output signal frequency or unified flow or water meter with output pulse signal. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.
The condensate temperature is measured by a resistance temperature sensor with a measuring resistance in a four-wire connection or by a thermometer with a converter to a unified current signal. The operating temperature of the condensate must not exceed 200 ° C.

The INMAT 59 meter automatically corrects changes of density and enthalpy according to IAPWS IF97. The measuring method has been determined in compliance with MPM 18-95 (Guidelines for permissible methods of measuring heat in water steam in supplier-customer relations). The measuring of condensate has the character of a determined meter. For invoicing purposes, a measuring route that complies with the applicable standards or technical conditions of the flowmeter must be used for measuring flow rate. The temperature sensor and the medium volume meters, which are parts of the temperature meters along with the evaluation unit, must be compatible with the INMAT 59 evaluation unit.

MEASUREMENT OF HEAT TRANSFERRED BY WATER AND MEASUREMENT OF COLD
Meter INMAT 59 evaluates flow of water and quantity of heat transferred by water or evaluates quantity of cold.

Flow is measured with throttling units or speed probes with one or two sensors of pressure difference with output current unified signal, volume flow meter (e.g. inductance, ultrasonic or whirl), weight flow meter with linear output signal of frequency or unified current and water meter with impulse signal. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.

Temperature of medium in the inlet and return piping is measured with paired resistance temperature sensors with the measuring resistor in four-wire connection. INMAT 59 can be used for a discretionary operating temperature difference from 3 to 200 K and for water temperature from 0 to 200 °C. For measurement of cold, the temperature range is max. from -50 to 200°C (depending on medium). After an agreement, at request, also in a different, smaller range.

The medium pressure for the flow calculation is considered to be constant 1.6 MPa abs. The pressure can be measured and displayed for other purposes. In this case, the pressure is measured by an absolute or relative pressure sensor with a unified flow signal. Pressure measurement in two-circuit versions is **only** possible in conjunction with a frequency or pulse flow signal.

Bidirectional flow
In connection with a bi-directional flow meter, INMAT 59 can evaluate both directions of flow of the medium. If a bidirectional flow meter is used, the evaluation flow direction signal switches between the first and second circuits. The flow direction can be switched by a logic signal applied to the pulse / frequency input (as contact or open collector, closed for direction 1, open for direction 2) or by a unified current signal (signal ≥ decision level = direction 1, signal <decision level for direction 2).

Bidirectional flow can also be measured using bidirectional orifices in conjunction with two anti-parallel pressure differential sensors. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.

MEASUREMENT OF FLOW OF LIQUID (can only be used as a working gauge not specified)
Flow of water and technical liquids is measured with throttling units or speed probes with one or two sensors of pressure difference with output current unified signal, volume flow meter (e.g. inductive, ultrasonic or whirl), weight flow meter with linear output signal of frequency or unified current and water meter with impulse signal. For two-circuit versions, the flow measurement options are limited by the number of meter inputs.

Temperature of medium in the piping is measured with resistance temperature sensor with measuring resistor in four-wire connection or resistance thermometer with converter to unified current signal. The meter INMAT 59 can be used for temperatures of water from 0 to 200 °C and temperature of technical liquids from -50 to 200°C (maximum -100 to 600 °C).
The medium pressure in the flow calculation pipe can be considered constant or measured by an absolute pressure sensor or an overpressure sensor with a unified flow signal. If a constant medium pressure is considered, the measured pressure can only be displayed for other purposes.

Bidirectional flow
In connection with a bidirectional flow flowmeter, INMAT 59 can evaluate both flow directions. If a bidirectional flow flowmeter is used, the evaluation flow direction signal switches between the first and the second circuit. The flow direction may be switched by a logical signal conducted to the impulse/frequency input (as a contact or open collector, connected for direction 1, disconnected for direction 2) or by a unified current signal (signal ≥ decision level= direction 1, signal < decision level for direction 2).
Bidirectional flow can also be measured by a bidirectional orifice plate in connection with two antiparallely connected pressure difference sensors. In two-circuit versions, the possibilities of measuring the flow rate are limited by the number of meter inputs.

MEASUREMENT OF FLOW OF GASES - Evaluation unit of meter of flown-through quantity of gas
The meter INMAT 59 operates as an evaluation unit of flow and flown-through quantity of gases. The gas flow and volume are converted to reference conditions of pressure and temperature, or to weight.
The unit consists of INMAT 59, measuring pressure converter (absolute pressure or overpressure) and measuring temperature converter. The evaluation unit is used in connection with the meter of flown volume of gas or, as the case may be, flow of gas.
For billing measurement, it is necessary to use measuring converters with valid type approval and official certification identified in the Decision about gauge type approval. Measuring converters located on gas conduit with the use for heating, explosive and flammable gases shall have an approval for that particular environment. To ensure intrinsic safety of input and output signals of the evaluation unit, it is possible to use barriers approved for that particular environment.
Flow is measured:
- with throttling units or speed probes with one sensor of pressure difference with output current unified signal
- volume flow meter (e.g. whirl) with linear output signal of frequency, impulse or unified current
- mass flow meter with linear output signal of frequency, impulse or unified current
- gas meter with output signal of impulse, frequency or with unified current

Bi-directional flow can be measured by means of bi-directional orifices in connection with two anti-parallel connected sensors of pressure difference.

Temperature of gas is measured with resistance temperature sensor with measuring resistor in four-wire connection or with thermometer with converter to unified current signal.

Pressure of gas is measured with absolute pressure sensor or overpressure sensor with unified current signal. For heating gases, the sensor of relative pressure may be used only in case that the lower limit of the operating range of gas pressure is bigger than or equal to 2.1 MPa abs.
The contents of partial components in percent are entered to the evaluation unit with unified current signals.
Temperature range is:
- For heating gases from - 20 °C to 50 °C
- For technical gases from - 50 °C to 100 °C
- Other limits after an agreement with the manufacturer, max. - 100 °C to 600 °C

The pressure range of the evaluation unit is 5 to 100% of the measuring range of the pressure transducer used.
The calculation of the density correction or conversion factor takes into account the compressibility coefficient. Compressibility can be constant or variable. The calculation of compressible factors is realized for heating gases pursuant to AGA NX 19mod. or SGERG 88. For technical gases, the recalculation of compressibility factors is realized by means of the viration development or status equations (Van Der Waals, Redlich Kwong, Soave Redlich Kwong, Peng Robinson, Peng Robinson Gasem) pursuant to an agreement with the user.
INMAT 59 can re-calculate volume and volume flow for a discretionary relative conditions, e.g. to normal conditions (pn = 101.325 kPa, Tn = 288.15 K or pn = 98.0665 kPa, Tn = 293.15 K). Furthermore, it can evaluate mass and volume non-recalculated flow.

INMAT 59 is not designed for operation in the explosive environment.
Measuring converters in non-explosive design with fixed closure or in spark safe design can be used in the explosive environment, qualification of the environment pursuant to the used sensors.
Any changes of the parameters and constants related to the calculation programme and applicable meters are protected with an official mark. Permitted changes of the parameters (depending on design of dv, %CO2, %N2, %H2, Hs, Vc, Pc, Tc and ω) are efficiently protected with passwords and recording to memory that cannot be deleted.
Description of the function of passwords and use of the metrological password is described in the article OPERATION AND MAINTENANCE, USER AND METROLOGICAL PASSWORD.

DESCRIPTION

Access to the terminal block is blocked by a mounting seal. Access to the electronics is prevented by seals on the cover of the meter cassette (calibration seal or, in the case of a certified version, by an official mark), which make it impossible to influence the measurement by unprofessional or intentional intervention. The cassette is equipped with connector terminals and can be removed from the device without the need to disconnect the cabling and remove the device from the wall.
The official mark (sticker located on the measuring cassette) is visible through the window in the front plate of the device.

PRINCIPLE

The activity of the device is controlled with a one-chip micro-processor. Analogue input signals are transferred to the digital form with A/D converter and, with a possible impulse/ frequency input they are processed in the processor. On the basis of such data, INMAT 59 calculates instantaneous mass flow, flown quantity etc. The calculated quantities can be displayed on the backlit liquid crystal graphic display Quantities displayed on the display are updated cyclically. At the same time, it is evaluated if the quantities are within the pre-programmed limits. The second line of the display is used for displaying error messages as response to exceeding limits of some quantities and other internal tests.

The assessed quantities can be transmitted by means of the interface RS485 or RS232C or M-Bus to the master computer. The network interface RS485 and M-Bus enable the meter to operate in the local network. On the interface RS485, it is possible to connect to 30 equipments (e.g. meter INMAT 57, INMAT 51, INMAT 66, ...) with one computer. On the network, it is possible to transfer all values stored in the unit. Communication network possibilities of the interface enable access to individual quantities of the devices, without violating the activity of measurement. By means of the communication interface, it is possible to set-up real time, date, user constants, menu user, conduct of error messages etc.

The assessed quantities can be transferred to the following equipment in the form of a unified current signal 4 to 20 mA or impulse output signal. The selection of the output quantities and the range is adjustable by the user by means of communication interface and programme SWK45702.

TECHNICAL DATA

Construction requirements:
The device is made according to EN 61140 as electrical equipment of protection class II for use in networks with overvoltage category in installation III and pollution degree 2 according to EN 61010-1, internal output voltage source corresponds to Article 6.3 of this standard

Power supply:

Type of power supply:	1/N AC 230 V 50 Hz
Mains frequency tolerance:	48 ÷ 62 Hz
Coefficient of higher harmonics:	max. 10 %
Input current:	0,35A
power consumption:	max. 19 VA

The power consumption of the INMAT 59 meter is given including the power supply of the converters.

The electronics are powered from the built-in SELV source, the output of which corresponds to EN 61010-1, Article 6.8.3.

Type of supply mains:	DC 24 V
Supply voltage tolerance:	± 5 %

Internal fuse for electronics supply according to EN 60127-2: T3,15A L250V (not intended for user replacement)
Power supply fuse of converters according to EN 60127-2: F400L250V

The real-time clock is powered by a 3V Li CR2032 battery located in the holder - see FIGURE 2 - LABEL PLACEMENT ON THE DEVICE BOX, BATTERY LOCATION.
Ingress protection according to EN 60529: IP 65
Electrical insulation resistance:
power supply circuit against inputs, outputs and shielding against lid screws min. 5MΩ
circuit of inputs, outputs and shielding against lid screws min. 20 MΩ
Electrical strength of insulation according to EN 61010-1, Article. 6.8.3:
input, output and shielding circuit against the network circuit 5660 V DC
mains circuit against lid screws 3100 V DC
circuit of inputs, outputs and shielding against lid screws 750 V DC

Weight:	approx. 2 kg
Type of operation:	continuous
Used materials:	box: plastic PC
Display:	LCD with 240 × 128 dot backlight

Electrical connection:

clamps	screw for conductor cross section max. 2,5 mm2
bushings	12 x Pg7 according to DIN 40430 grey colour for cable diameter 2.5 to 6.5 mm
	10 x Pg9 according to DIN 40430 grey colour for cross section 4 to 8 mm

Service life of battery: typically 5 years
Discharge of the internal battery is signalled by the self-diagnostics on the display (during operation of the device) as well as the communication program in the menu Display / Diagnostics.

OPERATION CONDITIONS

Working environment:
The device is designed for the environment defined by the group of parameters and their degree of severity IE 36, but the minimum ambient temperature is only -20 ° C, according to EN 60721-3-3 and operating conditions according to technical conditions.

The device complies with environment class B and C according to EN 1434-1. The device complies with mechanical class M1 and environment class E2 according to EN 12405-1 + A2.

Ambient temperature: - 20 to + 55 °C
Relative ambient humidity:
5 to 100 % with condensation
Atmospheric pressure: 70 to 106 kPa
Operation position:
vertical, with the glands facing downwards
Settling time after turning on the power: 30 minute
Electromagnetic compatibility (EMC):
Radiation and resistance meet the requirements of standards EN 61326-1, EN 55011, EN 1434-4 and EN 12405-1+A2.

METROLOGICAL DATA

INPUT SIGNAL

a) current inputs - I1 to I12 (depending on version)
6x to 12x current loop 0 to 20mA or 4 to 20mA
The supply voltage at the terminals intended for supplying the converters from INMAT is approx. 1.5 V lower than the supply voltage of INMAT. Input resistance is approx. 50Ω.
b) resistive inputs - R1, R2, R5, R6, R9 and R10 (according to design)
0x to 6x resistance for resistance measurement in four-wire connection, eg for Pt 100 thermometer, according to EN 60751 (on special request Pt 200, Pt 500 or Pt 1000) in four-wire connection, loop resistance max. 20Ω.
c) pulse and frequency input - IMP1 / FR1 to IMP3 (5) / FR3 (5)
3x (5x) c) pulse and frequency input with/without vibration treatment (damping)
range:
without vibration treatment 0 Hz až 10 kHz
without vibration treatment 0 up to a maximum of 500Hz
the upper limit depends on the attenuation setting according to the flow meter used
Designed for REED contact or OK (open collector), DC 8.2 V supply. The maximum frequency is overloaded by 20 %.
Note: It can also function as a logic input.

INMAT 59 is standardly supplied in a combination of analogue inputs: 4x resistive + 8x current
after an agreement
- 0x resistance + 12x current
- 1x resistance + 11x current
- 2x resistance + 10x current
- 3x resistance + 9x current
- 6x resistance + 6x current
- 5x resistance + 7x current

The specific wiring diagram can be seen after removing the cover on the sticker located inside.

The temperature measurement range according to the used sensor and the measured medium can be maximum
0 to 200 °C for water
0 to600 °C for water steam
- 100 to 200 °C for gas
maximum - 100 to 600 °C for other uses *)
*) Other ranges are possible in agreement with the manufacturer.

INPUT SIGNAL

Measurement of heat and flow transferred by steam
a) from dp sensors (H and L) current:
0 to 20mA or 4 to 20mA
b) from the flow meter current:
0 to 20mA or 4 to 20mA
frequency: 0 to 10 kHz
impulse: max. 10 kHz
(with damping max. 500 Hz)
c) from a relative pressure or absolute pressure sensor
current:
0 to 20 mA or 4 to 20 mA
d) from temperature sensor resistance:
Pt 100, according to EN 60751
Pt 200, Pt 500 or Pt 1000 *)
current:
0 to 20 mA or 4 to 20 mA
e) flow direction control *) positive and negative flow direction
(>x ÷ ≤21) mA / (>3,6 ÷ ≤x) mA
for current input
(x=),
on / off for pulse input
*) It is possible in agreement with the manufacturer.

Measurement of flow and heat in condensate
a) from dp sensors (H and L) current:
0 to 20mA or 4 to 20mA
b) from the flow meter current:
0 to 20mA or 4 to 20mA
frequency: 0 to 10 kHz
c) from the water meter impulse 0÷500 Hz/0÷10 kHz
d) from temperature sensor resistance:
Pt 100, according ti EN 60751
Pt 200, Pt 500 or Pt 1000 *)
current:
0 to 20 mA or 4 to 20 mA
optionally:
e) from a relative pressure or absolute pressure sensor
current:
0 to 20 mA or 4 to 20 mA
f) flow direction control *) positive and negative flow direction
(>x ÷ ≤21) mA / (>3,6 ÷ ≤x) mA
for current input
(x= decision level),
on / off for pulse input
*) It is possible in agreement with the manufacturer.

Measurement of flow and heat transferred by water, measurement of cold
a) from dp sensors (H and L) current:
0 to 20mA or 4 to 20mA
b) from the flow meter current:
0 to 20mA or 4 to 20mA
frequency: 0 to 10 kHz
impulse: max. 500 kHz
c) from the water meter impulse: max. 500 Hz
d) from temperature sensor resistance:
Pt 100, according to EN 60751
Pt 200, Pt 500 or Pt 1000 *)
current:
0 to 20 mA or 4 to 20 mA
e) pressure current:
0 to 20 mA or 4 to 20 mA *)
f) flow direction flow direction control*)
positive and negative flow direction
(>x ÷ ≤21) mA / (>3,6 ÷ ≤x) mA
for current input
(x= decision level),
on / off for pulse input
*) It is possible in agreement with the manufacturer.

Liquid flow measurement
a) from dp sensors (H and L) current :
0 to 20mA or 4 to 20mA
b) from the flow meter current :
0 to 20mA or 4 to 20mA
frequency: 0 to 10 kHz
impulse: max. 500 Hz
c) from the water meter impulse: max. 500 Hz
d) from temperature sensors resistance:
Pt 100, according to EN 60751
Pt 200, Pt 500 or Pt 1000 *)
current:
0 to 20 mA or 4 to 20 mA
e) flow direction control *) positive and negative flow direction
(>x ÷ ≤21) mA / (>3,6 ÷ ≤x) mA
for current input
(x= decision level),
on / off for pulse input
*) It is possible in agreement with the manufacturer.

Gas flow measurement
a) from dp sensors (H and L) current :
0 to 20mA or 4 to 20mA
b) from the flow meter current :
0 to 20mA or 4 to 20mA

		frequency:	0 až 10 kHz
		impulse:	max. 500 Hz
c)	from gas meter	impulse:	max. 500 Hz
d)	from a relative pressure or absolute pressure sensor	current:	0 to 20 mA or 4 to 20 mA
e)	from temperature sensor	resistance:	Pt 100, according to EN 60751 Pt 200, Pt 500 or Pt 1000 *)
		current:	0 to 20 mA or 4 20 mA
f)	flow direction control *)	positive and negative flow direction	(>x ÷ ≤21) mA / (>3,6 ÷ ≤x) mA for current input (x= decision level), on / off for pulse input
g)	from the subcomponent sensor	current :	0 to 20mA or 4 to 20mA

*) It is possible in agreement with the manufacturer.

OUTPUTS

The evaluated quantities are displayed on a graphic LCD display with backlight. INMAT 59 it is also equipped with four analogue current outputs and four pulse outputs.

Display

Meaning of special symbols:

Σ	= symbol for the sum of the given quantity
Max	= indication of the maximum in the current period
max-1	= marking the maximum for the previous period
work time	= indication of operating time
	= symbol for quarter-hour maximum, (maximum floating quarter-hour average)
^	= symbol for maximum value, (maximum floating minute average)

The evaluated quantities are given with the index "1" for the first circuit. The quantities of the second circuit have the index "2", etc..

Assessed quantities - flow and heat transferred by water steam:
in the menu Operation (and User 1 to 3)

P	- heat output (steam)	[GJ/h] or [MW]
E	- heat quantity (steam)	[GJ] or [MWh]
Qm	- instantaneous flow (steam)	[t/h]
M	- quantity of water steam (steam)	[t]
Pmp	- heat output outside parameters	[GJ/h] or [MW]
Emp	- heat quantity outside parameters	[GJ] or [MWh]
Emv	- heat quantity outside parameters	[GJ] or [MWh]
Qmmp	- flow of water steam outside parameters	[t/h]
Mmp	- quantity of water steam outside parameters	[t]
Mmv	- quantity of water steam outside parameters	[t]
Pc	- instantaneous heat output (steam + wet steam)	[GJ/h] or [MW]
Ec	- heat quantity (steam + wet steam)	[GJ] or [MWh]
Qmc	- instantaneous flow of water steam (steam + wet steam)	[t/h]
Mc	- quantity of water steam (steam +wet steam)	[t]
t	- steam temperature	[°C]
dt	- overheating = steam temperature-temperature of saturation *)	[°C]
pa	- absolute static pressure	[MPa]
pg	- relative static pressure	[MPa]
Ec	- quarter-hour heat maximum	[GJ/h], [MW]
Mc	- quarter-hour maximum quantity of steam	[t/h]
^Pc	- maximum thermal output	[GJ/h], [MW]
^Qmc	- maximum of flow	[t/h]
^t	- maximum temperature	[°C]
^p	- maximum pressure (abs. /rel. according to sensor type)	[MPa]
time	- time outside parameters(wet steam)	[dd hh mm]
	- operating time	[dd hh mm]
	- real time (according to setup CET or SCET)	[hh:mm:ss]
	- date	[day month year]

For measurement by means of throttling units:

dp	- difference pressure	[kPa]
tq	- temperature before throttling unit	[°C]
paq	- abs. pressure before throttling unit	[MPa]

*) The steam temperature is considered temperature before the throttling unit

For indirect method also:

Pk	- heat output - condensate	[GJ/h] or [MW]
Ek	- heat quantity - condensate	[GJ] or [MWh]
Qmk	- flow of condensate	[t/h]
Mk	- quantity of condensate	[t]
Vk	- flown volume of condensate	[m^3]
tk	- temperature of condensate	[°C]
PD	- heat output steam-condensate	[GJ/h] or [MW]
ED	- heat quantity 0steam-condensate	[GJ] or [MWh]
PDmp	- heat output wet steam-condensate	[GJ/h] or [MW]
EDmp	- heat quantity wet steam - condensate	[GJ] or [MWh]
EDmv	- heat quantity wet steam - condensate	[GJ] or [MWh]
▲tk	- maximum temperature	[°C]]

In menu Service

hp	- steam enthalpy	[kJ/kg]
TS	- temperature of saturation	[°C]
v	- specific volume of steam (only for direct method)	[m^3/kg]

according to design

ix	- value of current on input x	[mA]
rx	- value of resistance on input x	[Ω]
imp	- number of impulses per 1s	[imp/s]
or		
fx	- frequency value	[Hz]

User-adjustable sums for fast inspection of compliance with the mechanical counter on the water meter or the gas meter, adjustable by means of SWK45702.
imp – sum of impulses, which came to impulse input [1]
Qp – Status on the flow meter (number of impulses *imp. number) [m^3]

For indirect method also:

vk	- specific volume of condensate	[m^3/t]
hk	- enthalpy of condensate	[kJ/kg]

Resetting quarter-hour maxima is realized by means of control push-buttons in the menu Setup or by software by means of communication interface and SWK45702.

Note: for indirect method, if flow meter with impulse output is used, instantaneous values P, Qm, Pmp, Qmmp, Pc, Qmc, Pk, Qmk, PD and PDmp are only informative..

Assessed quantities - flow and heat in the condensate:
in the menu Operation (and User)

User-defined string, e.g. name of circuit 2x16 characters

P	- heat output	[GJ/h] or [MW]
E	- heat quantity	[GJ] or [MWh]
Qm	- instantaneous mass flow	[t/h]
M	- flown quantity	[t]
Q	- instantaneous volume flow	[m^3/h]
V	- flown volume	[m^3]]
t	- condensate temperature	[°C]
h	- condensate enthalpy	[kJ/kg]
v	- specific volume of steam condensate	[m^3/kg]
E	- quarter-hour heat maximum	[GJ], [MWh]
M	- quarter-hour maximum quantity of steam	[t]
▲P	- maximum thermal output	[GJ/h], [MW]

^Qm	- maximum of flow	[t/h]
^t	- maximum temperature	[°C]
time	- time out of parameters (wet steam)	[dd hh mm]
	- operating time	[dd hh mm]
	- real time (according to setup CET or SCET)	[dd:hh:mm]
	- date	[day month year]

for measurement by means of throttling units:

dp	- difference pressure	[kPa]
tq	- temperature before throttling unit	[°C]
paq	- abs. pressure before throttling unit	[MPa]

In menu Service

according to design

ix	- value of current on input x	[mA]
rx	- value of resistance on input x	[Ω]
imp	- number of impulses per 1s	[imp/s]

or

fx	- frequency value	[Hz]

User-adjustable sums for fast inspection of compliance with the mechanical counter on the water meter or the gas meter, adjustable by means of SWK45702.

imp - sum of impulses, which came to the impulse input [1]

Qp – Status on the flow meter (number of impulses *imp. number) [m^3]

Resetting quarter-hour maxima is realized by means of control push-buttons in the menu Setup or by software by means of communication interface and SWK45702.

Note: If flow meter is used with impulse output, instantaneous values P1, Qm and Q are only informative

Assessed quantities - flow and heat transferred by water, measurement of cold:
in the menu Operation (and User)

User-defined string, e.g. name of circuit 2x16 characters

P	- instantaneous heat output	[GJ/h] or [MW]
E	- heat quantity	[GJ] or [MWh]
Qm	- instantaneous mass flow	[t/h]
M	- flown quantity	[t]
Q	- instantaneous volume flow	[m^3/h]
V	- flown volume	[m^3]
tp	- water temperature in the transferring piping	[°C]
tv	- water temperature in return piping	[°C]
∆t	- water temperature difference in transferring and return piping	[°C]
↗E	- quarter-hour heat maximum	[GJ], [MWh]
↗M	- quarter-hour maximum quantity of steam	[t]
▲P	- maximum thermal output	[GJ/h], [MW]
▲Qm	- maximum of flow	[t/h]
▲tp	- maximum of temperature in the transferring piping	[°C]
▲tv	- maximum temperature in return piping	[°C]
▲dt	- maximum temperature difference	[°C]
time	- operating time	[dd hh mm]
	- real time (according to setup CET or SCET)	[dd:hh:mm]
	- date	[day month year]

if pressure is measured

pa	- abs. pressure of medium	[MPa]
pg	- overpressure of medium	[MPa]

for measurement by means of throttling units:

dp	- difference pressure	[kPa]
tq	- temperature before throttling unit	[°C]
paq	- abs. pressure before throttling unit	[MPa]

In menu Service

hp	- enthalpy in the transferring piping	[kJ/kg]
hv	- enthalpy in return piping	[kJ/kg]
v	- specific volume in the transferring piping	[m^3/t]

according to design

ix	- value of current on input x	[mA]
rx	- value of resistance on input x	[Ω]
imp	- number of impulses per 1s	[imp/s]

or

frx	- frequency value	[Hz]

User-adjustable sums for fast inspection of compliance with the mechanical counter on the water meter or the gas meter, adjustable by means of SWK45702.

imp - sum of impulses, which came to the impulse input [1]

Qp – Status on the flow meter (number of impulses *imp. number) [m^3]

Resetting quarter-hour maxima is realized by means of control push-buttons in the menu Setup or by software by means of communication interface and SWK45702.

Note: If flow meter is used with impulse output, instantaneous values P1, Qm and Q are only informative.

Assessed quantities - flow of fluids:
in the menu Operation (and User)

User-defined string, e.g. name of circuit 2x16 characters

Qm	- instantaneous mass flow	[t/h]
M	- flown quantity	[t]
Q	- instantaneous volume flow	[m^3/h]
V	- flown volume	[m^3]
t	- temperature of liquid	[°C]
pa	- abs. pressure of liquid	[MPa]
pg	- rel. pressure of liquid	[MPa]
↗M	- quarter-hour maximum quantity	[t]
↗V	- quarter-hour maximum of volume	[m^3]
▲Qm	- maximum weight of flow	[t/h]
▲Q	- maximum volume of flow	[m^3/h]
▲t	- maximum of temperature in the transferring piping	[°C]
▲p	- maximum pressure	[MPa])
time	- operating time	[dd hh mm]
	- real time (according to setup CET or SCET)	[dd:hh:mm]
	- date	[day month year]

if pressure is measured

pa	- abs. pressure of medium	[MPa]
pg	- overpressure of medium	[MPa]

for measurement by means of throttling units:

dp	- difference pressure	[kPa]
tq	- temperature before throttling unit	[°C]
paq	- abs. pressure before throttling unit	[MPa]

In menu Service

v	- specific volume in the transferring piping	[m^3/t]

according to design

ix	- value of current on input x	[mA]
rx	- value of resistance on input x	[Ω]
imp1	- number of impulses per 1s	[imp/s]

or

frx	- frequency value	[Hz]

User-adjustable sums for fast inspection of compliance with the mechanical counter on the water meter or the gas meter, adjustable by means of SWK45702.

imp - sum of impulses, which came to the impulse input [1]

Qp – Status on the flow meter (number of impulses *imp.number) [m^3]

Resetting quarter-hour maxima is realized by means of control push-buttons in the menu Setup or by software by means of communication interface and SWK45702.

Note: If flow meter is used with impulse output, instantaneous values Qm1 and Q1 are only informative.

Assessed quantities - measurement of flow of gases:
in the menu Operation (and User)

User-defined string, e.g. name of circuit 2x16 characters

Qn	- standardized flow of gases	[m^3/h]
Vn	- standardized volume	[m^3]
Q	- operating flow of gases	[m^3/h]
V	- operating volume	[m^3]
Qm	- instantaneous mass flow	[t/h]
M	- flown quantity of gas	[t]
Qnmp	- standardized flow of gases outside parameters	[m^3/h]
Vnmp	- standardized volume outside parameters	[m^3]
Qmp	- operating flow of gases outside parameters	[m^3/h]

Vmp	- operating volume outside parameters	[m^3]
Qmmp	- instantaneous mass flow outside parameters	[t/h]
Mmp	- flown quantity of gas outside parameters	[t]
K	- compressibility grade	
Z	- re-calculating number	
t	- temperature of gas	[°C]
pa	- absolute pressure of gas	[MPa]
pg	- relative pressure of gas	[MPa]
↯Vn	- quarter-hour maximum of re-calculated volume	[m^3]
↯M	- quarter-hour maximum quantity	[kg]
▲Qn	- maximum of flow	[m^3/h]
▲Qm	- maximum of flow	[kg/h]
▲t	- maximum of temperature in the transferring piping	[°C]
▲p	- maximum pressure (abs. /rel. according to sensor type)	[MPa]
time	- time outside parameters	[dd hh mm]
	- operating time	[dd hh:mm]
	- real time (according to setup CET or SCET)	[dd:hh:mm]
	- date	[day month year]

for measurement by means of throttling units:

dp	- difference pressure	[kPa]
tq	- temperature before throttling unit	[°C]
paq	- abs. pressure before throttling unit	[MPa]

In menu Service
according to design

ix	- value of current on input x	[mA]
rx	- value of resistance on input x	[Ω]
imp	- number of impulses per 1s	[imp/s]
or		
frx	- frequency value	[Hz]

User-adjustable sums for fast inspection of compliance with the mechanical counter on the water meter or the gas meter, adjustable by means of SWK45702.
imp - sum of impulses, which came to the impulse input [1]
Qp – Status on the flow meter (number of impulses *imp.number) [m^3]

Resetting quarter-hour maxima is realized by means of control push-buttons in the menu Setup or by software by means of communication interface and SWK45702.

Note: If flow meter is used with impulse output, instantaneous values of flow (Qn, Q, Qm, Qnmp, Qmp and Qmmp) are only informative.

Current output 4x
INMAT 59 can be equipped with the current output module with passive galvanic separation with the unified current signal 4 to 20 mA. The selection of the output quantity and the range are user-adjustable by means of communication interface and the programme SWK45702. When the range is exceeded, the value of the output signal remains on the maximum value (typically 21 mA).

Parameters:

output signal:	4 to 20 mA
power supply output:	24V DC (10 to 36V DC)
galvanic separation:	500V

Impulse output 4x will be added later
INMAT 59 it is equipped with galvanically separated pulse outputs of the open collector type. The function of the module, the selection of output quantities and the range are user-adjustable by means of communication interface and the programme SWK45702.
Parameters:

output with galvanic separation with open collector	
function:	*impulse output or signalling of errors and alarms*
length of pulse:	*adjustable 100 ms to 900 ms*
frequency of pulses:	*max. 3000 imp per hour (overload capacity 20%)*
external source:	*max. 70 V DC, max. 20 mA (type 5 mA)*
galvanic separation:	*500V*
logical levels:	*1 - transistor connected, 0 - transistor disconnected*

COMMUNICATION INTERFACE
INMAT 59 is equipped with four communication interfaces. As standard it is 1x optical interface (line A), 1x RS485 (line B) and another 2 interfaces (lines C and D) **optionally (see Table 1)** RS485 or M-Bus**)**. The meter also uses the ZPA communication protocol based on M-Bus (M-Bus +), the M-Bus protocol and the Modbus protocol.. A more detailed description of the interface and communication protocol is given in a separate appendix – **Description of communication protocols INMAT 59**, which can be downloaded at www.zpanp.cz.
Implicit setup of the parameters from the manufacturer: address 0, transmission speed 9600 Bd, without parity.

Optical line - M-Bus serial line - input / output
A two-way communication line is used to communicate one unit with a computer using an optical head. The baud rate is optional, maximum 9600 Bd. The optical head can be ordered as an accessory (see Table 4).
The line is galvanically isolated.

Serial line RS485 - input/output
Bi-directional communication line is used for communication of one or more units with the computer (max. 30 equipments without repeater). By means of RS485, it is possible to read the measured and assessed data. It is also possible to set-up some parameters (date, time, user constants, parameters of the communication interface RS485, ...).
The connection is realized with the structure of the type of bus. Twisted wire (twist) is used as the connecting medium most often with the maximum recommended length 1200 m.
Transmission speed is optional, maximum 1152000 Bd
The terminating resistor is connected (at the end station) with the switchover DIP over the right part of the terminal board – by switching over to the position ON (refer to FIGURE 1 – MEASURING CARTRIDGE INMAT 59, DIMENSIONS AND LOCATION OF BATTERY).
The line has galvanic separation.

Serial line M-Bus - input/output
Bi-directional communication line is used for communication of one or more units with the computer.
Transmission speed is optional, maximum 9600 Bd.
The line has galvanic separation.

SELF-DIAGNOSTICS - ERROR MESSAGES
The meter INMAT 59 has a built-in self-diagnostics in its firmware, which controls the limits of the measured quantity, assessed quantities and internal battery. Data of the diagnostics can be displayed on the bottom line of the display and in the menu Diagnostics; they are also available on the communication interface.
The test results are only displayed in case of a detected error. It means that in case of a successful test, no message is displayed. The message can be reset in the menu Diagnostics or with the communication programme SWK45702.
A more detailed description of setup of the error messages is identified in the Article OPERATION AND MAINTENANCE.

Data of self-diagnostics
- **Measurement of flow and heat transferred by steam**
  The following is signalled on the display:
  - Wet steam
  - Interrupted thermometer t1
  - Error of pressure sensor p1
  - Error of flow sensor
  - Errors of probes-blocked calculation of flow
  - Exceeded temperature t1
  - Input 1 is outside limits
  - Input 2 is outside limits
  - Input 3 is outside limits

- **Measurement of flow and heat in condensate**
  The following is signalled on the display:
  - Interrupted thermometer t
  - Error of pressure sensor p
  - Error of flow sensor
  - Errors of probes-blocked calculation of flow
  - Exceeded temperature t1Input 1 is outside limits
  - Input 2 is outside limits
  - Input 3 is outside limits

- **Measurement of flow and heat transferred by water, measurement of cold**
  The following is signalled on the display:
  - o Interrupted thermometer tp1 - transferring piping
  - o Interrupted thermometer tv1 - return piping
  - o Error of pressure sensor p1
  - o Error of flow sensor
  - o Errors of probes-blocked calculation of flow
  - o Exceeded temperature tp1 - transferring piping
  - o Exceeded temperature tv1 - return piping
  - o Input 1 is outside limits
  - o Input 2 is outside limits
  - Input 3 is outside limits

- **Measurement of flow of fluids**
  The following is signalled on the display:
  - o Interrupted thermometer t
  - o Error of pressure sensor p
  - o Error of flow sensor
  - o Errors of probes-blocked calculation of flow
  - o Exceeded temperature t1
  - o Input 1 is outside limits
  - o Input 2 is outside limits
  - o Input 3 is outside limits

- **Measurement of flow of gases**
  The following is signalled on the display:
  - o Substitute parameters
  - o Interrupted thermometer t
  - o Error of pressure sensor p
  - o Error of flow sensor
  - o Errors of probes-blocked calculation of flow
  - o Exceeded temperature t
  - o Input 1 is outside limits
  - o Input 2 is outside limits
  - o Input 3 is outside limits

INMAT 59 can also display other error messages according to the specific application.

LIMITS OF PERMITTED BASIC ERROR
- current loop 0 to 20mA or 4 to 20mA: error 0.1 % from the measured value; 0.02 % from the range *)
- resistance in four-wire connection: error 0.1 % from the measured value; 0.02 % from the range *)
- frequency / impulse input: error 0.1 % from the measured value; 0.02 % from the range *)
- operating and real time: 3.5 PPM (2 min/year)
- current/impulse output : error 0.2 % from the measured value; 0.04 % from the range *)

*) during the assessment, the bigger value of the highest permitted error established by the applicable specifications is used

Limits of permitted basic error
- **Flow and heat transferred by steam**
  The device operates in accuracy class 4 and 5.
  Maximum permitted error of calculation of the thermal output, heat, flow and flown quantity:
  0.1 % from the measured value within the range 5 to 100 %
  for volume and mass flow meters and cascade connection of two differential pressure sensors in the range 2 to 100 %

- **Flow and heat in the condensate**
  Maximum permitted error of calculation of the thermal output, heat, flow and flown quantity:
  0.1 % from the measured value within the range 5 to 100 %
  for volume and mass flow meters and cascade connection of two differential pressure sensors in the range 2 to 100 %

- **Flow and heat transferred by water, cold**
  Maximum permitted error of calculation of the thermal output, heat, flow and flown quantity for a temperature difference in the range 3 K to 200 K:
  0.1 % from the measured value within the range 5 to 100 %
  for volume and mass flow meters and cascade connection of two differential pressure sensors in the range of 2 to 100%

- **Flow of fluids**
  Maximum permitted error of calculation of flow and flown quantity:
  0.1 % from the measured value within the range 5 to 100 %
  for volume and mass flow meters and cascade connection of two differential pressure sensors in the range of 2 to 100%

- **Meter INMAT 59 of status re-calculator of gases**
  Maximum permitted error of calculation of the instantaneous re-calculated flow of gases:
  0.1 % from the measured value within the range 5 to 100 of flow of gases, for volume and mass flow meters
  within the range 2 to 100 %
  Maximum permitted error of the used temperature meter:
  - o resistance of the temperature sensor: class A and B pursuant to ČSN EN 60751
  - o converters of temperature with converter R/I: 0.25 % from measuring range of the output signal

  Maximum permitted error of the used pressure meter (overpressure, absolute pressure):
  - o - measuring converter of overpressure: 0.20 % from measuring range of the output signal
  - o - measuring converter of absolute pressure: 0.25 % from measuring range of the output signal
- Maximum permitted error of the used pressure difference meter: 0.2 % from measuring range of the output signal

HYSTERESIS: max. 0.01 %
REPRODUCTION ERROR: max. 0.01 %
INSENSITIVITY ZONE: max. 0.01 %
LONG-TERM DRIFT FOR 4800 HOURS: max. 0.05 %

ADDITIONAL ERRORS
For a change of ambient temperature: max. ± 0.1 % / 10 °C

Evaluation of output signals
Evaluation of output signals: All quantities displayed on the displaying unit digitally correspond to the relevant units without the re-calculation constant. Also a scientific notation can be used (e.g. 7654321 is displayed as 8E6).

D E S I G N A T I O N

Data on the product can be divided into several groups.
1) Data on the manufacturing label on the cover of the device:
- Trademark
- Text: Made in Czech Republic
- Product number
- Serial number
- Type of power supply network
- Maximum power input
- Ingress Protection
- degree of rigor of the working environment
- CE mark

2) Data displayed on the display of the device in the menu CONFIG, labels of the device or on the front panel:
- Product number
- Manufacturing number with year and month of manufacture
- Calculated (referential) values of the throttling unit or the flow meter
- Used principle of measurement of flow
- Calculated flow of the throttling unit or the range of the flow meter Mv
- Calculated temperature of the throttling unit or reference temperature of the flow meter tv
- Calculated pressure of the throttling unit or reference pressure of the flow meter pv (for steam and gases)
- Signal of flow
- Type of thermometer (e.g. Pt100 4-wire)
- Range of the pressure sensor (e.g. 0-1.6 MPa rel.)
- Signal of the pressure sensor

DELIVERY

Unless agreed otherwise with the customer, each delivery includes

- Delivery note
- Products pursuant to the purchase order
- Optional accessories
  - o fuse F500L250V according EN 60127-2 – 2Pcs
  - o Program communication SWK 459 02
  - o Optical head OH USB-1
- Accompanying technical documentation in Czech:
  - o Product quality and completeness certificate, which also serves as the warranty certificate
  - o Calibration sheet (for non-certified design)
  - o Product manual

If it is established in the purchase contract or agreed otherwise, the following documentation can be also delivered with the product:

- EU Declaration of Conformity

PACKING

The products and accessories are delivered in a packing ensuring resistance to the impact of thermal effects and mechanical effects pursuant to controlled packing regulations.

TRANSPORT

The products may be transported on conditions corresponding to the set of combinations of classes IE 21 pursuant to EN 60721-3-2 (i.e. by airplanes and trucks, in premises that are ventilated and protected against atmospheric conditions; in case of the air transport, only heated overpressure cargo areas of airplanes are considered).

STORAGE

The products may be stored on conditions corresponding to the set of combinations of classes IE 12 pursuant to EN 60721-3-1 (i.e. in places continuous temperature control from 0 to 55 °C and humidity of surrounding air 45% and max. content of 29g H_2O/m^3 of dry air, without a special threat of an attack with biological agents, with vibrations of small significance and not situated close to sources of dust and sand).

The shelf life is max. 12 months. After this period, control piece tests shall be performed on the product according to technical conditions.

RELIABILITY

Indicators of reliability in operation conditions and conditions of the environment specified herein

- Mean time of operation between failures 96 000 hours (inf. value)
- Expected service life 10 years

ORDERING

The purchase order shall specify

- Name
- Product ordering number
- Filled-in questionnaire (essential annex to the purchase order)
- Calculation of a throttling unit (essential annex to the purchase order)
- For measurement of flow by means of a throttling unit
- Number of pieces
- Questionnaires can be downloaded at www.zpanp.cz.

PURCHASE ORDER EXAMPLE

Meter INMAT 59
459 S11 316/xxxxx
5 Pcs
Filled-in questionnaires enclosed

ORDERING ACCESSORIES

The purchase order shall specify:

- Name
- Product ordering number
- Number of pieces

PURCHASE ORDER EXAMPLE

1. Program communication for INMAT 59
   SWK 457 02
   1 Pcs
2. Optical head
   OH USB-1
   1 Pcs

TABLE 1 - DESIGN OF METERS INMAT 59

SPECIFICATIONS		ORDERING NUMBER						
		459	x	x	x	x	x	x
Design	Standard design (box IP65)		S					
Outputs	4x Current output 4 to 20 mA + 4x Impulse output			1				
Communication	3x RS485 + OPTICS				1			
	2x RS485 + 1x M-Bus + OPTICS				2			
	1x RS485 + 2x M-Bus + OPTICS				3			
Use	#1 Circuit application 1 #2 Circuit application 2 #3 Circuit application 3 See table for application codes 2.					#1	#2	#3

TABLE 2 – APPLICATION CODE

Applications	Questionnaire + annex to questionnaire no.:	Application code (for #1, #2 and #3]
No application - unused circuit	-	0
Measurement of flow and heat transferred by steam - direct method	1	1
Measurement of flow and heat transferred by steam - indirect method	2	2
Measurement of flow and heat transferred by water and cold	3	3
Measurement of fluid flow	4	4
Measurement of gas flow **)	5	5
Measurement of flow and heat in the condensate	6	6
Measurement of flow and heat transferred by steam up to 2500GJ / year	7	7
Measurement of gas flow with measurement of the component content **)	8	8
Special applications *)	-	9

*) Special applications and other combinations are supplied in agreement with the manufacturer.
**) These applications can only be two-circuit

Note: For each measured circuit, it is necessary to attach a completed appendix to the questionnaire according to the application.

TABLE 3 - ACCESSORIES - to be ordered separately

SPECIFICATIONS		ORDERING NUMBER
Communication program for INMAT 59 Description of archiving for INMAT 59 Communication protocol for INMAT 59 Questionnaires	Placed on a CD (or free download at www.zpanp.cz)	SWK45702
Optical head USB-1		OH USB-1

INMAT 59 is provided with the manufacturer's marks.
For the location of the manufacturer's and official marks, see FIGURE 2 - LOCATION OF THE MANUFACTURING LABEL ON THE INSTRUMENT CASE, LOCATION OF THE BATTERY, FIGURE 3 - LOCATION OF THE OFFICIAL MARKS AND THE PRODUCTION LABEL ON THE CASSETTE.

CALIBRATION

The devices are delivered with the initial calibration, including the calibration sheet.

Subsequent calibration is ordered in the department AMS ZPA N. Paka, a.s (ams@zpanp.cz).

INSTALLATION AND CONNECTION

Warning!
Installation and uninstallation of the meter, connecting and disconnecting of wires including disconnecting and connecting of the display connector MUST be performed with switched off supply voltage.

INSTALLATION OF THE METER

Installation, commissioning, monitoring activity and maintenance are realized pursuant to ČSN EN 1434-6.
The device is connected on the wall or frame with four screws according to FIGURE 1 – DIMENSIONAL DRAWING.

Removal procedure for access to terminal block and battery holder:

1) Switch off the supply voltage
2) Remove the 2 cover mounting seals.
3) Loosen the cover by loosening the six screws on the front of the cover.
4) Carefully lift the lid and disconnect the connector connecting the lid to the meter cartridge from the cartridge
5) Remove the cover.

Procedure for removing and inserting the meter cartridge:

1) With the cover removed, disconnect the connector terminal block without disconnecting the wiring.
2) Remove and remove the 6 screws holding the meter cartridge in the chassis. Warning: Screws secured with seals must not be disassembled!
3) Remove the cassette from the box.
4) Close and secure the device box.

Install in reverse order.

ELECTRICAL CONNECTION

Electrical connection may only be realized by qualified workers
Scheme of connection of the terminal board is provided in FIGURE 4 - SCHEME OF CONNECTION AND TERMINAL BOARD. The terminal board is accessible after tilting the lid away.

To connect the device to the mains, insulated copper wires must be used, dimensioned according to ČSN 33 2000-4-43 ed.2 with a maximum cross-section of cores up to 2.5 mm^2. The installation of the device must include a switch that allows the device to be disconnected from the mains.

The device is connected with shielded cable with insulated Cu wires with total insulation resistance min. 10 MΩ, dimensioned according to ČSN 33 2000-4-43 ed.2 with maximum cross-section 2.5 mm^2. Shielding is connected only on one side of the cable, namely on the terminal board of the mathematical element.
The use of cables exceeding 10 m is possible.
Cable outlets are delivered in sealed conditions, before the application of the outlet, it is necessary to dismantle the plug. Unused cable outlets shall remain sealed with plugs.

The temperature sensor is used with four-wire connection and it is connected independently with a four-wire with shielded cable. Shielding is connected only on one side of the cable, namely on the terminal board of the mathematical element. Temperature sensor with converter is connected pursuant to article Installation of the sensors with output current loop. Resistance of individual loops including the inner resistance of wiring of the sensor may be max. 20 Ω.

Installation of the sensors with current loop output:
INMAT 59 enables to connect the sensors in two ways:

1) directly connected two-wire converter with output 4 to 20 mA, which is supplied from a common source with a mathematical element (power supply source shall be dimensioned also for power supply of the required number of the converters)
2) active current signal 0 to 20 mA or 4 to 20 mA

The sensors are connected with a shielded cable pursuant to own technical conditions. Shielding is connected only on one side of the cable, namely on the terminal board of the mathematical element.

Impulse signal from the flow meter/gas meter is connected to the device with the cable with shielded twisted pair. The shield is connected only on one side of the cable to the terminal block of the mathematical element.
Communication interface (RS485, M-Bus) is connected with shielded cable. Shielding is connected only on the side of the master equipment (PC).

Current/Impulse output is connected with shielded cable. Shielding is connected only on the side of the evaluation equipment.

Warning!
During the installation, this installation manual shall be complied with.

FIGURE 1 – DIMENSIONAL DRAWING

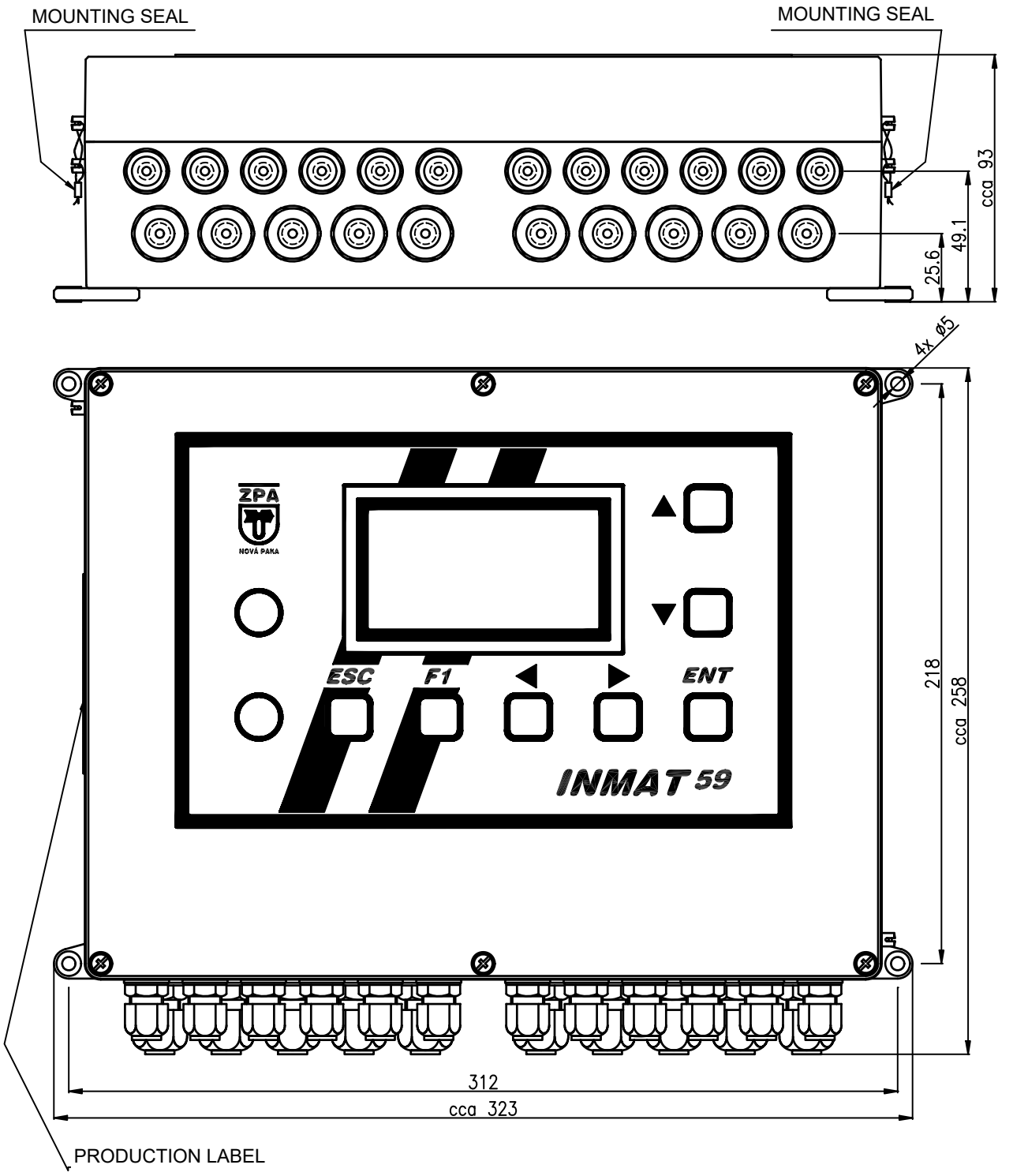
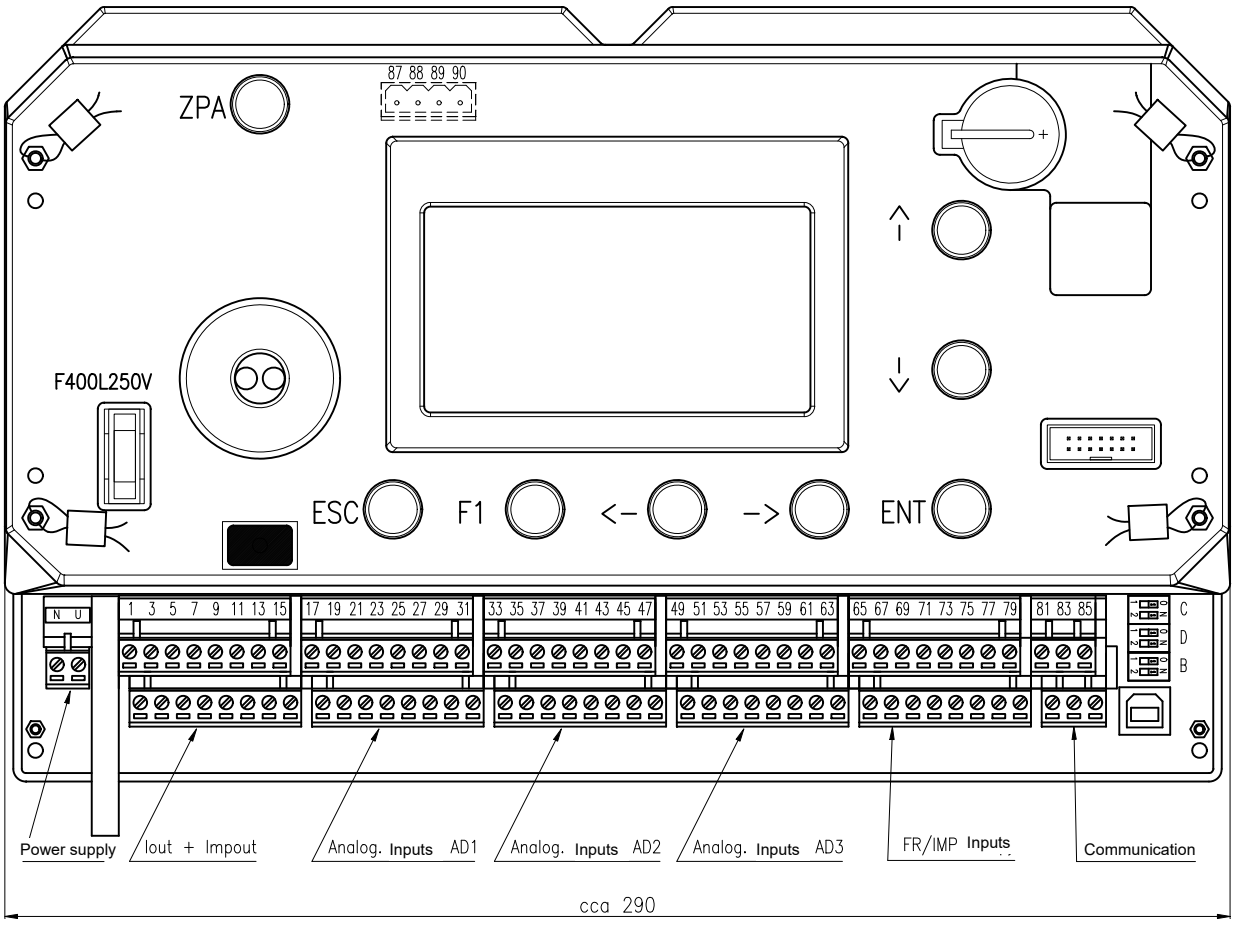


FIGURE 2 – INMAT 59 MEASURING CARTRIDGE, BATTERY DIMENSIONS AND LOCATION



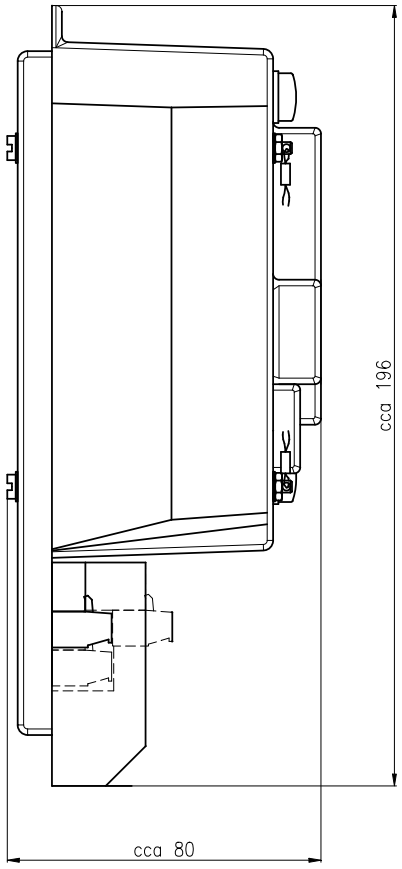


FIGURE 3 – MEASURING CARTRIDGE INMAT 59, FRONT

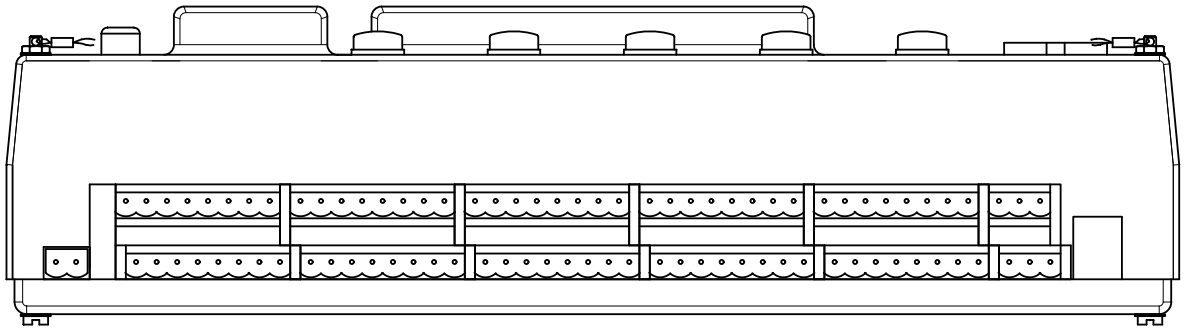
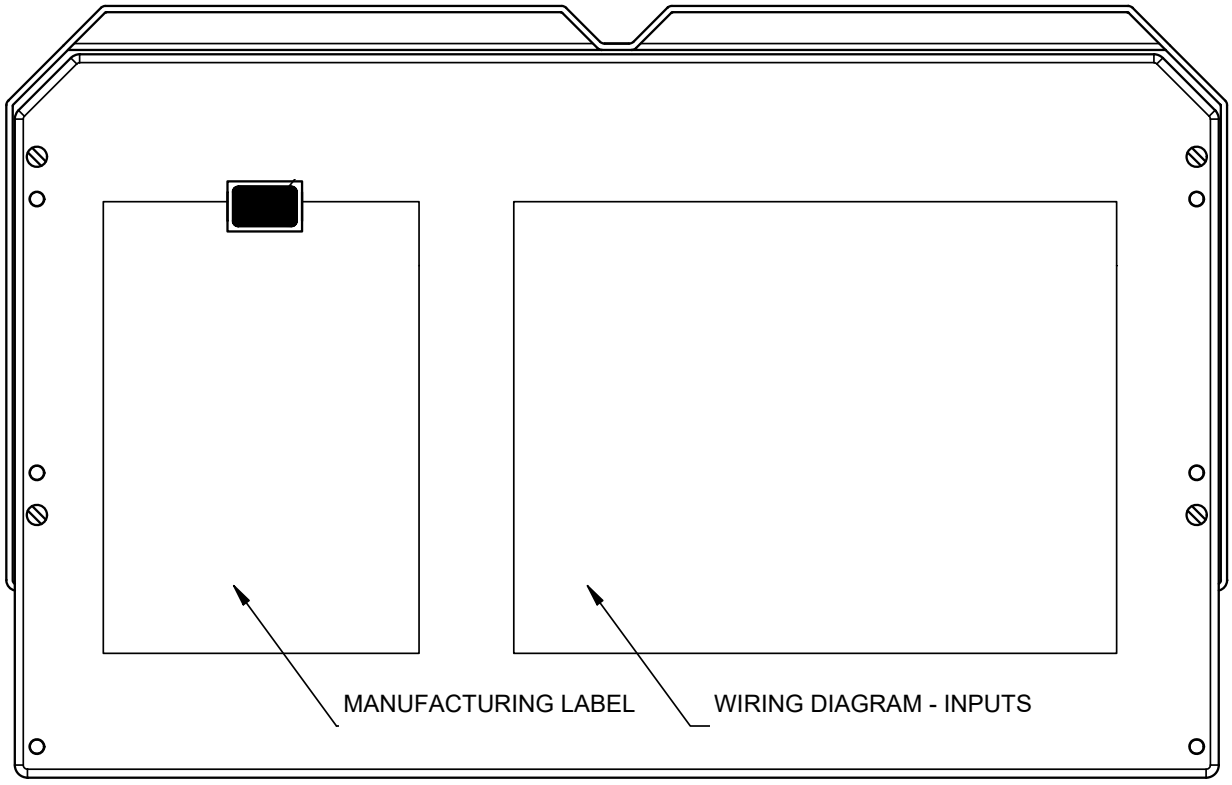


FIGURE 4 - PLACEMENT OF THE MANUFACTURING LABEL ON THE CASSETTE



COMMISSIONING

After the connection, the device is prepared for operation. If the RS485 communication line is used, one device is configured as a terminator by changing the setting of the terminating resistor switches to position 1 or ON, respectively.. The device is delivered in the configuration of the transient member of the network (switchovers in position 0, terminating resistors not connected). These switchovers are accessible after tilting the lid of the terminal board away.
If required, it is possible to set-up the date and time by means of communication interface.
Before the start of the operation, it is necessary to comply with the period of heating of 30 min.

For commissioning of the INMAT 59 without set metrological constants, the metrological constants must be set. In this case, INMAT 59 does not calculate the amount passed or the heat. This condition is strongly signaled by the flashing of the display backlight and the error message "**SET METROLOGICAL CONSTANTS !!!"**. In the SWK45702 program, in the Display / Identification menu, this status is signaled by the item **Summary: no**.
INMAT 59 allows **only one-time setting** of metrological constants. A typical use is, for example, to set the pulse number of a water meter or the diameter of an aperture. Metrological constants must be set for commissioning. This resets all amounts and balances and the INMAT 59 is ready for operation. The settings are made using SWK45702 in the menu Display / Metrological constants.. In the SWK45702 program, the **Summary: Yes** menu indicates this status in the Display / Identification menu

OPERATION AND MAINTENANCE

The device is operated using the buttons on the device cover or the device cassette.

DESCRIPTION OF BUTTON FUNCTION

▲ and ▼ button

These buttons allow the gradual selection of the display of the values of individual quantities from the selected menu. You can scroll through the view in both directions.
In the Settings menu, you can use the buttons to change the value of the set item.
In the Balance menu, this button selects the recording time.

► and ◄ button

They allow to switch between individual display modes USER1, USER2, USER3, OPERATION, SERVICE, CONFIG, BALANCE, SETTINGS, DIAGNOSTICS, INPUTS,

…. In the Settings menu, you can use the buttons to select the item to be set.
In the Balance menu, this button selects the recorded quantity.

ENT button
Used to reset error messages in the DIAGNOSTICS menu.

ESC button
A short press switches to the first menu item Operation.

F1 button
This is a function button with a user-adjustable function - it will be added later

„Logo ZPA“ button
This is a service button that is not used for normal operation of the device.

Note: The manufacturer reserves the right to make minor changes to the device menu without modification in the documentation.

MAINTENANCE
Replacement of the internal battery (CR2032) is realized at the latest after 5 years. If the internal battery is discharged sooner, it shall be replaced. Discharging of the internal battery is signalled by the diagnostics of the device. Status of the battery can be identified also in the menu SETUP/ BATTERY.
During the replacement of the battery, the stored data remain without damage. If power supply is switched off during the replacement of the battery, it is necessary to set-up date and time in the device.

Warning!
The battery voltage is checked after starting the device and once every day at 24:00. The diagnostic system warns of a possible bad battery condition.

SPARE PARTS
The design of the device does not require any delivery of spare parts.

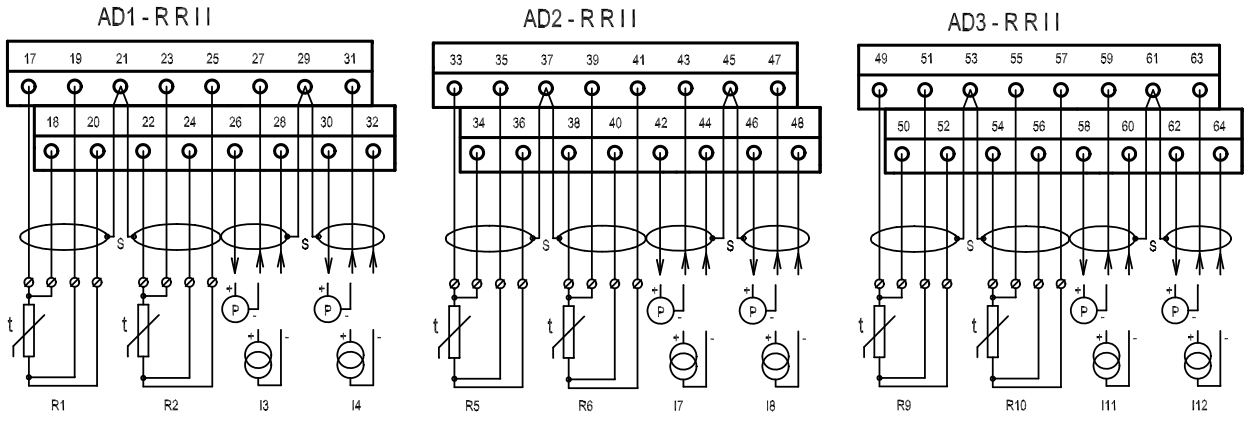
WARRANTY
The warranty period is 24 months from the receiving of the product by the customer, unless established otherwise in the contract. Rejection of defects shall be enforced in writing at the manufacturer within the warranty period. The rejecting side shall identify the product name, ordering and manufacturing numbers, date of issue and number of the delivery note, clear description of the occurring defect and the subject of the claim. If the rejecting side is invited to send the device for repair, it shall do so in the original package of the manufacturer and/or in another package ensuring safe transport.
The warranty shall not apply to defects caused by unauthorized intervention into the device, its forced mechanical damage or failure to comply with operation conditions of the product and the product manual.

REPAIRS
The devices shall be repaired by the manufacturer. They shall be sent for repair in the original or equal package marked pursuant to EN ISO 780: HANDLE WITH CARE – FRAGILE.

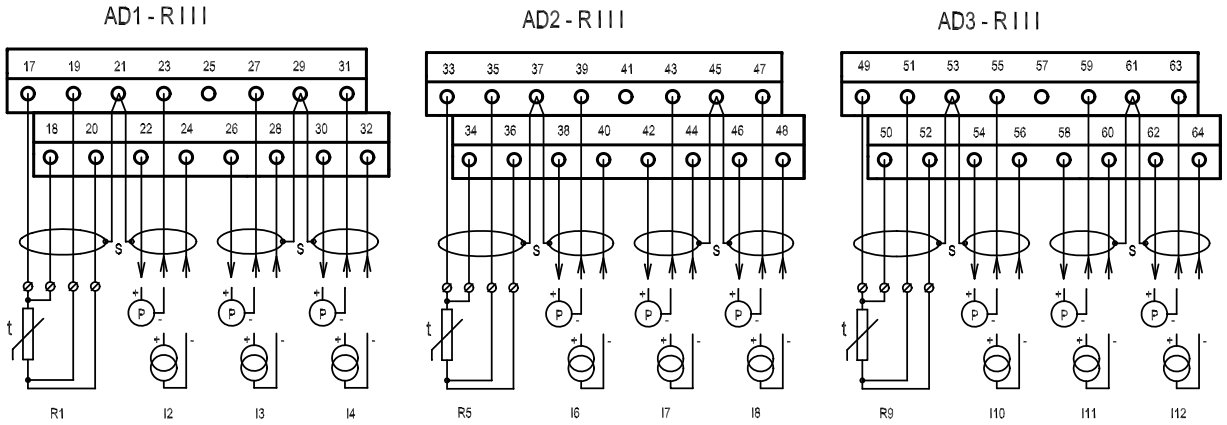
DISABLING AND LIQUIDATION
The product and its package do not include any parts that could impact the environment.
Products that are withdrawn from operation, including their packages (with the exception of products marked as electrical equipment for the purposes of return withdrawal and separate salvage of electrical waste and battery), may be disposed of to sorted or unsorted waste pursuant to the type of waste.
The manufacturer realizes free return withdrawal of marked electrical equipment (from 13.8.2005) and batteries from the consumer and points out the danger connected with their illegal disposal.
The package of the device can by recycled completely.
Metal parts of the products are recycled, non-recyclable plastic materials, electrical waste and the battery shall be disposed of in accordance with applicable legislation.

FIGURE 5 - WIRING DIAGRAMS INCLUDING TYPE VARIANTS WIRING OF ANALOG INPUTS
The specific connection of individual devices is part of the accompanying documentation for the device

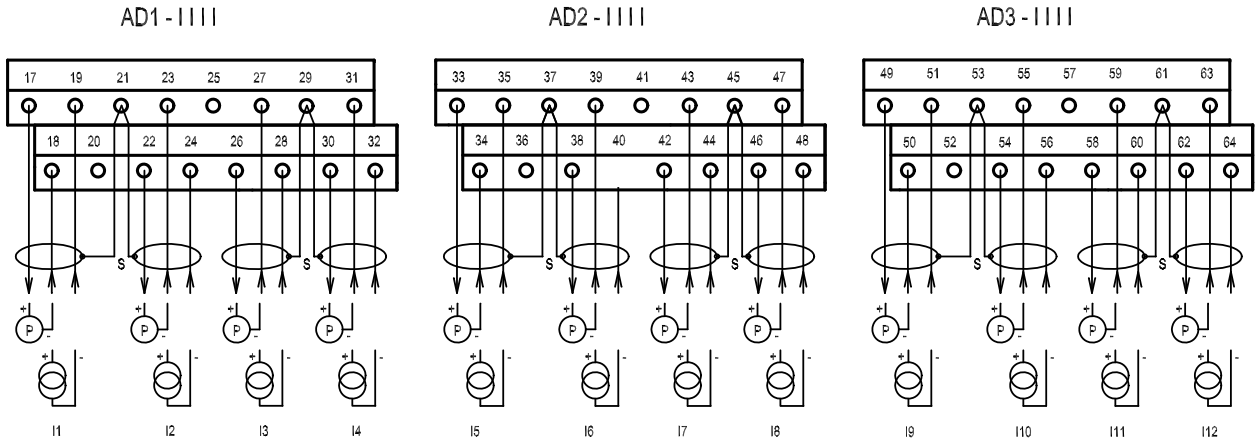
a) **R R I I** - 2x resistance input



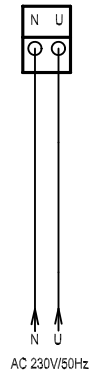
b) **R I I I** - 1x resistance input



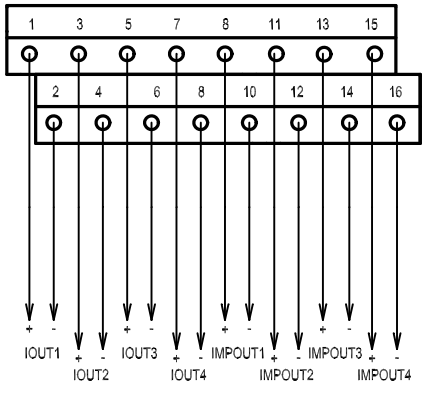
c) **I I I I** – without resistance inputs



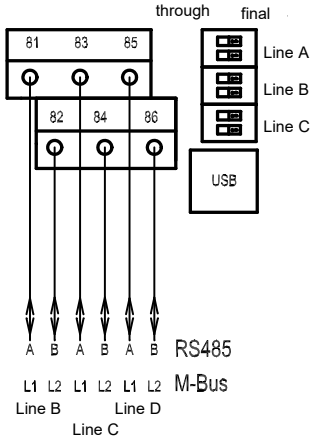
POWER SUPPLY



IOUT - IMPOUT



COMMUNICATION



FR/IMP

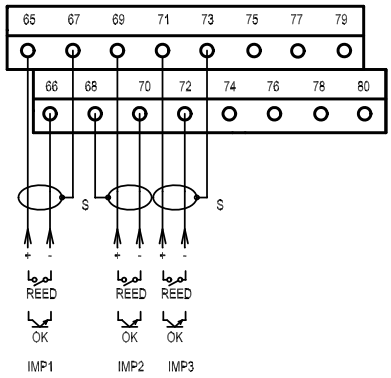


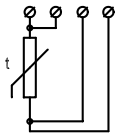
TABLE 4 - MEANING OF SYMBOLS USED

Two-wire converter 4 to 20 mA (power supplied from INMAT)
e.g.: pressure sensor, pressure difference sensor, flow meter

Source of current 0/4 to 20 mA

REED contact (5 V / 10 mA)

Open collector (5 V / 10 mA)



Thermometer Pt100 – four-wire connection

Shielding

Ix	Current input x
Rx	Resistance input x
R2	Resistance input 2
IMP/FR	Pulse / frequency input
IOUT/IMPOUT	Current / Pulse output
S	Shielding
RS485	RS485 communication interface
A, B	RS485 interface signals
through	Switch position for pass-through device on RS485 interface
final	Position of the switch for the terminal device on the RS485 interface
M-Bus	M-Bus communication interface
L1, L2	M-Bus interface signals

TABLE 5 - SOFTWARE VERSION NUMBERING

The application version is displayed in the form: "*Name X.XX / XXXX*"

Name:

	Liquid
Mass	Mass flow meter without correction for temperature and pressure
Steam	Steam by direct method
ISteam	Steam by indirect method
Cond	Condensate
Gas	Gas
GasE	Gas with partial component measurement
Water	Water - heat / cold in water
WaterB	Water - heat / cold in water, two-way flow meter
Glycol	Antifreeze mixtures - heat / cold
GlycolB	Antifreeze mixtures - heat / cold, two-way flow meter
-.XX/----	application repair - (display errors, text editing in the application, etc.)
-.--/XXXX	non-metrological modifications - customer requirements (addition of temperature measurement, addition of description on the display, etc..)

Example: "Gas 1.00/CMi0"

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ZPA Nová Paka, a.s.
Pražská 470
509 01 Nová Paka

tel.: spojovatel: 493 761 111
e-mail: obchod@zpanp.cz
www.zpanp.cz

bankovní spojení: ČSOB HK
číslo účtu: 271 992 523/300

IČO: 46 50 48 26
DIČ: CZ46504826