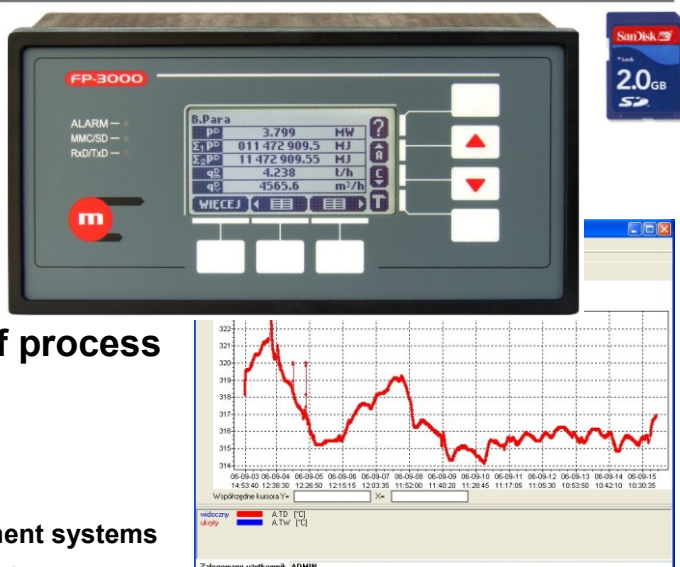# FP-3000

Flow computer of compensated Flow and heat rate of steam, water, other liquid media and compensated flow of technical gases with electronic recording of process values

- **Servicing of up to 3 independent measurement systems**
- **Balancing of flowrates – sum, difference, ratio**
- **Alarm / control functions, 4 output relays**
- **Advanced recording of process values based on removable MMC card**
- **Graphical LCD display with white backlight**
- **RS-485 communication port, ASCII and Modbus RTU protocołs**

APPLICATION:

- **Measurement and computation of steam and water in balancing systems**
- **Measurements of compensated technical gases and other liquid media flow rates (glicol, water) in industrial systems of generation or reception, in heat exchange systems with possibility of local alarming or simple control implementation**
- **Measurement systems of dispersed points with possibility of work in computerized systems**
- **Measurements with values recording and local readout of values or periodic readout of recorded data with use of removable MMC card.**

The FP-3000 flow computer is a modern universal device for compensated mass flowrate measurements. In this device can be configured up to three independent measurement systems (A, B, C) to calculate heat of steam, water and other liquid media and technical gases. Math functions allow to make balances of flows and energy (systems X, Y, Z). Flow computer is designed for industrial applications in independent measurement systems as an element of computerized measurement and control systems.
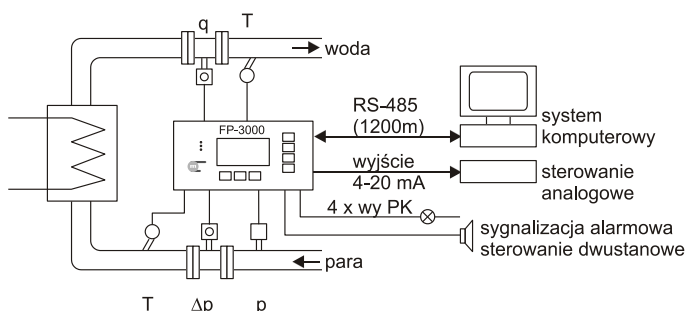
RANGE OF STEAM AND WATER PARAMETERS COMPENSATION

Flow computer allows for measurement of flowrate and heat of superheated steam or saturated as well as water according to IAPWS-IF97 recommendations within operating range of temperature from 0 ° C to 800º C and absolute pressure from 0,05 MPa to 16,52 MPa. In case of other liquids flowrate and heat

measurement systems computations are performed in the range of tabular values entered by user with both density and specific enthalpy being temperature functions.

FLOW RATE MEASUREMENT

Flow computer can cooperate with:
- mass flowmeters,
- volume flowmeters,
- differential pressure flowmeters with square root approximation,
- differential pressure flowmeters – orifices and nozzles according to iteration algorythm by PN-EN ISO 5167 standard (only for water and steam).

INPUTS

In the device there are ten measuring inputs enabling connection of sensors and transmitters of various type:
- two inputs are designed for direct connection of resistive temperature sensors Pt-100, Pt-200, Pt-500, Pt-1000 or Ni-100, Ni-200,Ni-1000,
- six inputs enable connection of transmitters and sensors in 0-20 mA or 4-20 mA current loop standard,
- two inputs enable flow rate measurement from a pulse transmitter in the range from 0,001 Hz to 10 kHz or implementation of binary inputs functions (e.g. flow direction).

Within the framework of available ten measuring inputs up to three different measurement systems A, B, C can be installed.
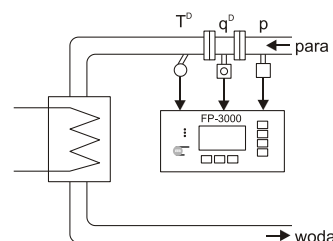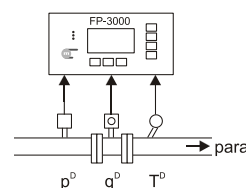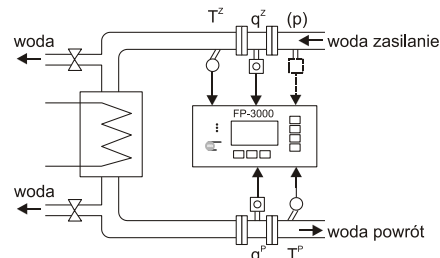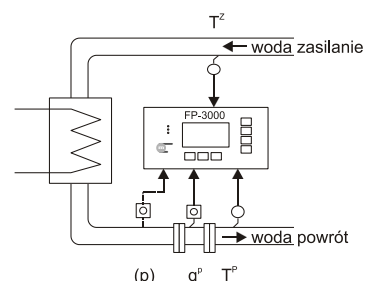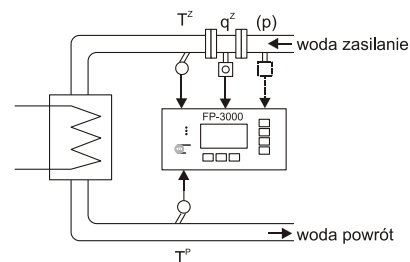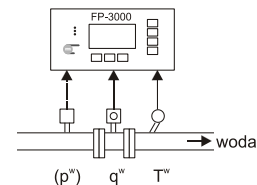
AUXILIARY MEASUREMENTS AND COMPUTATIONS

In the flow computer there are available 8 additional channels. Each of them allow to implement measurement of auxiliary quantities or calculations. Auxiliary quantities do not take part in computations linked with flow measurement system but these are only auxiliary quantities entered to the device. Computed quantities are result of math calculations based on other measured quantities or earlier computed and can be used directly in measurement systems.

TYPES OF STEAM AND WATER MEASUREMENT SYSTEMS

During flow computer configuration with help of creator one of available types of measurement systems is selected. Other systems can be built as a group of measurement systems A,B or C and X, Y or Z. List of system types includes all applied in practice main configurations for water, steam or other liquids:
- Flow and heat rate of liquid measurement system
- Flow and delta heat rate of liquid measurement in closed system-flow rate measurement „at supply"
- Flow and delta heat rate of liquid measurement in closed system-flow rate measurement „at return"
- Flow and delta heat rate of liquid measurement with partial return of medium
- Flow and heat rate of steam measurement system
- Flow and heat rate of steam measurement system for steam condensation conditions
- Flow and delta heat rate of steam-condensate measurement in closed system

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- Flow and delta heat rate of steam-condensate measurement system with partial condensate return
- Flow and delta heat rate measurement in steam generation system with water flow rate measurement
- Technical gases flow rate measurement system.
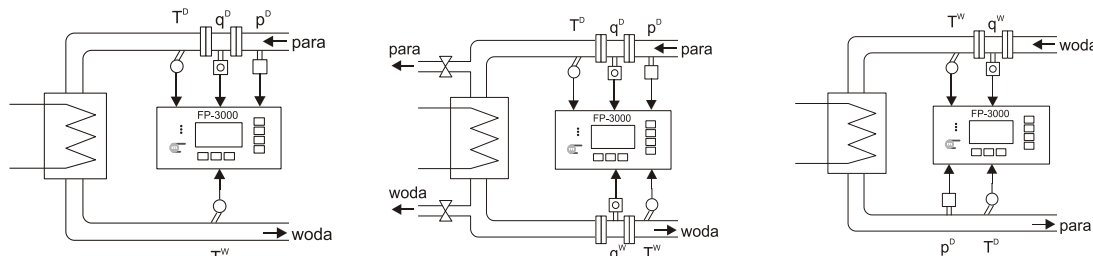
PROCESS VALUES DISPLAYING

For communication with operator there are designed graphical LCD display with dimensions 66 x 35 mm, 7-button keyboard and 3 two-colour signalling diodes.   Process values are displayed in the form of screens. During programming of the device settings the user configures sets of process values and the method of their displaying. For each of A, B, C, X, Y and Z systems there is a separate set of screens. The main screen is a table with most important values. With help of „More" button the user gets access to detailed data on values: trend, totalisers states, minimum, maximum and average values and bargraph. There are also available auxiliary screens which present alarm-control thresholds states, relay outputs states, information on archive (number of saved records, forecasted overflow date etc.) as well as current date and time. Unnecessary screens may be deactivated from displaying what simplifies browsing of values to indispensable information.
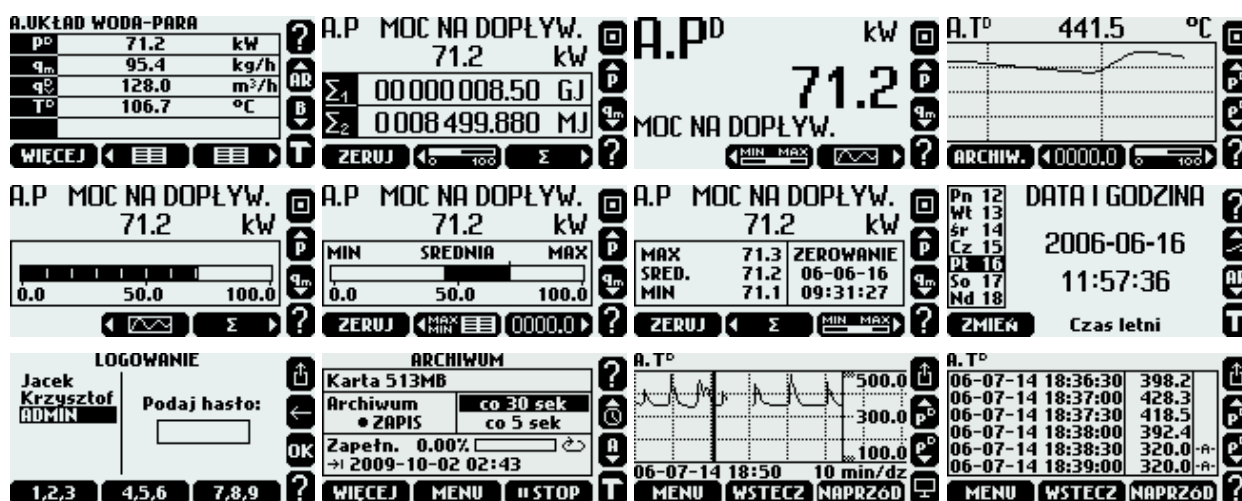
PROCESS VALUES ARCHIVIZATION ON MMC/SD CARD

The FP-3000 flow computer has got extended functions of measured and computed quantities. The archived data are saved on the MMC/SD card which then can be read on computer with help of reader or RS-485 communication port.

An „Archiving" function allows for recording of all momentary values with a selected interval (from 3 sec). Values are saved in text files, data from the current file can be viewed on the device display in graphic or tabular form.

In totalisers and average values archive („hourly archive") there are saved records containing states of selected totalisers and the following values: hourly average, minimum and maximum of a given value. Up to 15 totalisers and 15 average values can be archived simultaneously.

![metronic logo] **metronic**
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LOGS

The flow computer has got four logs recording various types of measurement events and commands executed by the user. These are: totalisers log, event log, authorization log and calibration log. The logs contents is stored in an internal nonvolatile memory of the device. The contents can be copied to a text file on MMC card (except of totalisers and calibration logs). Logs can be read on the display via RS-485 port (with use of FP-3000_Raport program) and directly from the card in MMC card reader.

Totalisers log contains states of all totalisers active at the end of the nominal month with operation time of the device in a given month. This log can be browsed exclusively on the device display, data of 12 last months are available. The nominal month beginning does not have to be the beginning of the calendar month and is adjusted by the user together with hour beginning the (nominal) day.

In the event log there may be recorded turn on and turn off of the power supply, settings change, date or time change, resetting (i.e. resumption of monitoring) of maximum, minimum and average values, clear of totalizers, start and end of chosen thresholds crossing and releasing, closing and opening of selected binary inputs, start and end of emergency state at selected analog inputs.

In authorization log there is recorded execution of each command requiring authorization. These are creation of a new archive, resumption or stopping of archiving, resetting (i.e. resumption of monitoring) of maximum, minimum and average values, date and hour change, totalisers clearing, change of main settings (i.e. all except of listed below), change of level and hysteresis settings of thresholds, change of display settings (screens configuration and backlight and contrast of display), archivization settings change (recording interval, set of archived values and recording mode).

RELAY OUTPUTS, ALARM AND CONTROL THRESHOLDS

Device is equipped with 4 semiconductor output relays with loading ability 0,1 A / 60 V. The outputs cooperate with alarm and control thresholds and also may be used for signaling of a failure of sensors connected to analog inputs.

For each measurement channel up to 4 alarm and control thresholds may be defined. Each threshold has its own level, hysteresis and direction of crossing (if it should be active below or above chosen level). Crossing of the threshold may cause the following reactions of the device:

- alarm signalization – red diode flashes, a message is displayed, also a chosen relay output may be activated; signalization is active until the message is acknowledged;
- control – selected relay output is active for the whole time of the threshold crossing;
- archivization interval change - more about it in „Archivization …" section;
- recording in the event log.

For each relay output active state can individually be chosen as closed or opened. For outputs designed for signalling an active state may also be pulsing. One relay output can be assigned to any number of thresholds.

COMMUNICATION WITH THE MASTER SYSTEM IN RS-485 STANDARD

Recorder is equipped with galvanic separated serial port RS-485 enabling transmission with a speed up to 115,2 kb/s. Communication can be implemented in two protocols: character ASCII or Modbus RTU. Character protocol is designed mainly for communication with FP-3000_Raport program. Modbus RTU protocol makes available current process values what enables use of universal visualization programs.

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HOUSING AND POWER SUPPLY

Flow computer is installed in an non-flammable housing of NORYL type plastic designed for panel surface mounting in control cabinets. The housing ensures protection degree P54 from the front panel and IP30 from the rear panel. The device can be supplied with 24V AC or DC.
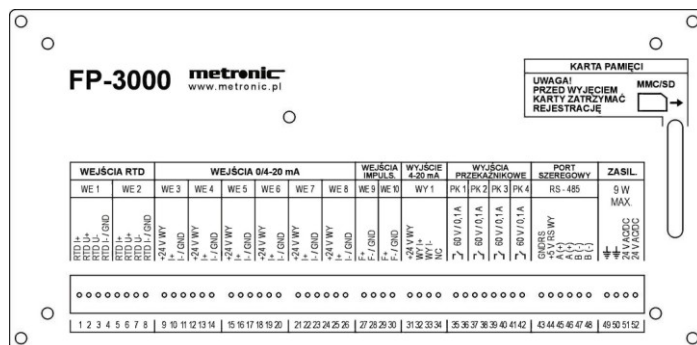
TECHNICAL DATA

Analog inputs RTD (WE1, WE2)	
Number	2 electronically multiplexed
Sensor type	Pt-100 x K, Ni-100 x K (K = 1..11) K – multiplier, e.g..: for Pt-200 K = 2
Measurement range	-200 .. +850 °C for Pt100 x K 0 .. +150 °C for Ni100 x K
Sensor connection	2- or 4-wire
Leads resistance compensation	Constant in range -99.99 Ω - +99.99 Ω
Maximum resistance of leads	50 Ω
Galvanic separation between channels	No, common potential GND for inputs WE1 .. WE10
Galvanic separation from supply voltage	400 VAC
Main error (for T_a = +20 °C)	± 0,5 °C (typically ± 0,3 °C)

Analog inputs 0/4-20 mA (WE3 .. WE8)	
Number	6 electronically multiplexed
Measurement signal	0-20 mA or 4-20 mA
Transmitter connection	Passive (supplied from the measurement loop) or active transmitter (supplied from the field or from the FP-3000 supply unit)
Input resistance	100 Ω ±10%
Transmitters supply	24 V DC/max 22 mA, but in total max 0,125 A for all inputs WE3 .. WE8
Galvanic separation between channels	No, common potential GND for inputs WE1 .. WE10
Galvanic separation from supply voltage	400 VAC
Main error (for T_a = +20 °C)	±0,1% of the range (typically ±0,05% of the range)

Binary/pulse inputs (WE9, WE10)	
Number	2
Input maximum voltage	±28 VDC

Frequency measurement	
Measurement range	0,001 Hz to 10 kHz (0,001 Hz to 1 kHz with connected filtering condenser)
Minimum pulse width	20 μs (0,5 ms with connected filtering condenser)

Main error (T$_a$ = 20 °C)	0,02%
Configuration: OC/contact	**Jumper in OC position**
Voltage in open contact position	+5 V
Current in closed contact position	5 mA
Configuration: current input	**Jumper in PR position**
Input resistance	220 Ω
On / off threshold	Approx. 12,3 mA / 11 mA
Configuration: voltage input	**No jumper**
Input resistance	>10 kΩ
On/off threshold	2,7 V / 2,4 V
Galvanic separation between channels	No
Galvanic separation from supply voltage	400 VAC

Uncertainty of compensated measurement	
Uncertainty of compensated steam, water, other liquid or technical gas measurement	< 2% (typically < 0,5%)

Analog output 4-20 mA (WY1 - optionally)	
Output signal	4-20 mA
Maximum voltage between I+ and I-	28 VDC
Loop resistance (for U$_{supply}$ = 24 V)	0 .. 500 Ω
Current loop circuit supply	From outside or internal supply unit 24 V DC / 22 mA
Galvanic separation from supply voltage	400 VAC

Binary outputs	
Number	4
Outputs type	Semiconductor relays
Maximum load current	100 mA DC/AC
Maximum voltage	60 V DC/AC
Galvanic separation	400 VAC

Serial port RS-485	
Maximum load	32 receivers / transmitters
Maximum line length	1200 m
Minimum impedance of data transmission line	27 Ω
Internal terminating resistor	No
Short-circuit protection / thermal	Yes
Transmission protocol	ASCII Modbus RTU (actual readout and totalisers)
Transmission speed	1.2, 2.4, 4.8, 9.6 ,19.2, 38.4, 57.6, 115.2 kbps
Parity control	Even, Odd, None
Frame	1start bit, 8 data bits, 1stop bit
Galvanic separation	400 VAC

Supply	
Supply voltage	24 VAC (15 .. 26,5 VAC) or 24 VDC (15 .. 35 VDC)
Power consumption	Max 9 VA / 9 W

Dimensions – housing	
Housing type	For panel surface mounting, „Noryl" non-flammable plastic
Dimensions (height x width x depth)	96 mm x 192 mm x 63,5 mm
Housing depth with junction boxes	approx. 80 mm
Panel cut-out dimensions	186 $^{+1,1}$ mm X 92 $^{+0,6}$ mm
Maximum panel thickness	5 mm
Mass	ok. 1,4 kg

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QUALITY MANAGEMENT
ISO 9001:2000

Protection degree from the front panel	IP-54
Protection degree from the rear panel	IP-30
Climatic conditions	
Operating temperature	0 .. +50 °C
Relative humidity	0 .. 75% (without steam condensation)
Storage temperature	-20 .. +80 °C

DEVICE VERSIONS

The FP-3000 device is offered in two versions:
- main with only one measurement system (available only system A),
- full with three measurement systems A, B, C and three auxiliary systems X, Y, Z.

Main version can be later supplemented by user by buying an appropriate license.

Apart from that the device may be equipped with current loop 4-20 mA analog signal output. The output can be installed only at the manufacturer's service.

The device option is described by a code:

FP-3000	- x	- x	
	- 0		- version with one measurement system A
	- 1		- version with systems A, B, C, X, Y, Z
		- 0	- version without analog output 4-20 mA
		- 1	- version with analog output 4-20 mA

ACCESSORIES

CONV485USB-I, CONV485USB converter, MMC/SD card and MMC/SD card reader

*PSS30 230V /24V , PSS10 230V/24V transformers manufactured by BREVE
and PI6-1P 24VAC/DC relay by Relpol SA
(all elements for TS-35 rail mounting)*