

Ultraflo U1000MKII-WM-HM

Clamp-on ultrasonic transducer on a guide rail at the pipe, connected by 5m cables to an IP68 wall- or panel-mounted electronics unit with display and keypad. The separate interface puts readings and set-up at an accessible height while the transducers sit on pipes from 25 mm to 225 mm OD carrying water up to 135 °C. Nothing is cut, there is no pressure loss and no drain-down. A matched pair of clamp-on PT100 Class B 4-wire sensors measures flow and return temperature, and the meter calculates thermal power and energy for heating and chilled-water circuits to EN 1434 section 6.

25–225 mm

Pipe outside diameter, two size versions

0.3 °C

Minimum ΔT ; 0.1 °C temperature resolution

±1–3%

Of flow reading, velocity > 0.3 m/s

0–135 °C

Water temperature range

IP68

Wall-mounted electronics enclosure

EN 1434

Heat calculation designed to comply with section 6



SIZE VERSIONS

Version	Pipe size	Pipe range
MC904-2000 14xx	Up to 4"	25–115 mm OD
MC904-2000 48xx	Up to 8"	125–225 mm OD (105–215 mm ID)

Output and communication options and full part numbers: see Ordering information.

KEY TECHNICAL FEATURES

- Cross-correlation transit-time measurement, 1 s measurement period
- Factory-built guide rail; transducer separation set from a displayed code
- Opto-isolated MOSFET pulse output: volume, energy, frequency or alarm
- Options: Modbus RTU, M-Bus or BACnet MS/TP over RS485
- Repeatability $\pm 0.15\%$ of measured value
- Glycol/water and ethanol/water mixtures selectable at set-up
- Optional isolated 4–20 mA (flow), 620 Ω max load
- Live signal %, gain, SNR and Δt diagnostics on the display

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01 Principle of operation and performance

The U1000MKII uses a cross-correlation transit-time algorithm. A pulsed ultrasonic signal is sent from the downstream transducer to the upstream transducer, then in the reverse direction. Liquid velocity speeds up the signal travelling with the flow and slows the one travelling against it, and the resulting time difference is directly proportional to the flow velocity. Cross-correlating the two received waveforms, rather than timing a single threshold crossing, improves timing resolution and noise immunity at low velocities. On heat-meter models the temperature difference between flow and return is combined with the measured volume to calculate the energy transferred to or from the water.

$$t_{\text{down}} = L / (c + v \cdot \cos \theta) \quad t_{\text{up}} = L / (c - v \cdot \cos \theta)$$

$$v = [L / (2 \cdot \cos \theta)] \times (t_{\text{up}} - t_{\text{down}}) / (t_{\text{up}} \cdot t_{\text{down}})$$

$$Q = K \times v \times A$$

L acoustic path length in the liquid · θ angle between path and pipe axis · c speed of sound in the liquid · v mean velocity along the path · A internal cross-sectional area, from the entered pipe ID · K flow-profile factor.

Reflex (V) path, both transducers in one guide rail

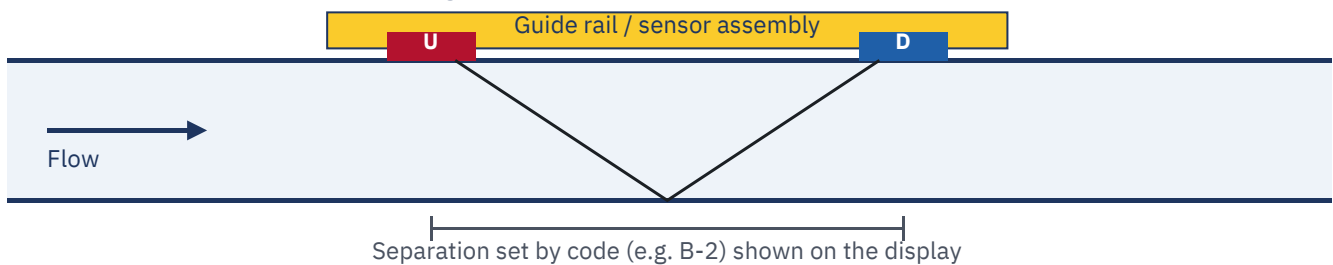


Figure 1. Acoustic path between upstream (U) and downstream (D) transducers in the U1000MKII sensor assembly.
PERFORMANCE

Measurement technique	Ultrasonic transit time with cross-correlation signal processing
Flow velocity range	0.1 m/s to 10 m/s (0.3 ft/s to 32 ft/s)
Turndown ratio	100:1
Accuracy	±1% to ±3% of flow reading, for velocity > 0.3 m/s (1 ft/s); application dependent
Repeatability	±0.15% of measured value
Measurement period	1 s
Flow direction	Set at power-up; reverse flow is displayed (!) but not totalised
Damping	10, 20, 30, 50 or 100 s (default 20 s)
Zero cut-off	0 to 0.50 m/s (default 0.10 m/s)
Calibration factor	0.500 to 1.500 (default 1.000)
Volume totaliser	Rollover at 1 km ³ (10 ⁹ m ³) or the imperial equivalent; up to 10 rollovers indicated as R + digit

Accuracy applies with at least 10 pipe diameters of straight pipe upstream and 5 downstream, the sensor assembly mounted at 45° to the top of the pipe, correct pipe and fluid data entered, and a signal strength of 40% or more.

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02 Application envelope

PIPES

Pipe outside diameter	25–115 mm OD or 125–225 mm OD (105–215 mm ID), by model
Pipe materials	Stainless steel, mild steel, copper and plastic (selectable at set-up). Other materials: contact Micronics
Galvanised pipe	Surface roughness can reduce accuracy and in some cases prevent a valid flow signal
Composite pipe	Multi-layer composite pipes have limited compatibility: the construction creates multiple signal paths
Pipe condition	Full pipe. Corrosion or internal deposits distort the signal and may prevent correct operation

FLUIDS

Fluid condition	Clean water with less than 3% particulate (air or solids)
Water	Select COLD ($\leq 40\text{ °C}$) or HOT ($> 40\text{ °C}$) at set-up
Glycol / water	Ethylene glycol 30/70, 35/65, 40/60 or 50/50 mix. Not for propylene glycol
Ethanol / water	10%, 20%, 30%, 40% or 50% ethanol in water
Mixture temperature entry	-20 °C to $+135\text{ °C}$ (-4 °F to 275 °F), for glycol and ethanol mixtures
Water temperature range	0 °C to $+135\text{ °C}$ (32 °F to 275 °F)
Additives	Corrosion inhibitors and other additives change the speed of sound and are an unknown factor that can vary as systems are topped up
Other liquids	Contact the Micronics technical team

SELECTABLE UNITS

Velocity	m/s, ft/s
Flow rate	l/s, l/min, m ³ /min, m ³ /h, gal/min, gal/h, US gal/min, US gal/h
Volume	litres, m ³ , gallons, US gallons
Temperature	°C, °F
Power	kW, BTU/s
Energy total	kWh, kBTU; rollover at 10^9 kWh or the imperial equivalent

TYPICAL APPLICATIONS

Heat and cooling energy metering for LTHW and chilled-water circuits, including glycol systems · tenant and plant-room sub-metering · aM&T and BEMS energy monitoring. Industries: building services and energy management.

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03 Installation



The transducers are factory-fitted in an adjustable guide rail that clamps to the pipe. The separation code shown on the wall unit after the pipe, material and fluid data are entered sets the transducer positions. All connections are made inside the wall unit on screw-terminal plugs.

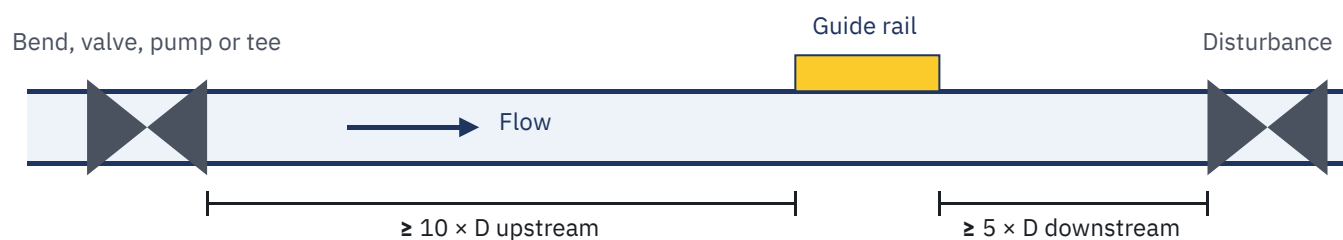


Figure 2. Minimum straight pipe run either side of the guide rail (D = pipe diameter).

INSTALLATION REQUIREMENTS

Straight pipe run	At least 10 pipe diameters upstream and 5 downstream of bends, tees, valves, pumps and other obstructions; shorter runs give unpredictable errors
Orientation	Mount the guide rail at 45° to the top of the pipe, clear of air at the top and sludge at the bottom
Flow measurement side	Boiler systems: measure flow on the cold (return) side. Chiller systems: measure on the warmer (return) side
Surface preparation	Degrease and remove loose or flaking paint so the transducer faces sit on a smooth surface
Transducer cables	5 m between guide rail and wall unit; 5 m extension cable available
Coupling	Gel pads, or ultrasonic grease as an alternative

WALL-UNIT TERMINALS

Block	Terminals	Function
Power	+VIN, -VIN, Screen	12–24 V AC/DC supply; earth the cable screen
RTD A, RTD B	V+, I+, I-, V- (each)	4-wire PT100 temperature sensors
Pulse	PULSE A, PULSE B	Opto-isolated MOSFET contact
IO0	1/01–1/04; 4–20 mA RET, OUT	Option module position 0
IO1 (Modbus)	1/01 -ve Out_B · 1/02 Gnd isolated · 1/03 +ve Out_A · 1/04 Gnd isolated	RS485, SELV only
IO1	4–20 mA RET, OUT	Option module position 1
J1, J3	Coaxial connectors	Flow transducer cables

Designations as on the wall-unit board (U1000 Modbus supplement). Fitted modules depend on the options ordered.

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04 Commissioning and diagnostics

SET-UP SEQUENCE AT FIRST POWER-UP

Step	Screen	Entry
1	Enter Pipe ID	Internal diameter in mm or inches
2	Pipe Material	Plastic, S/Steel, M/Steel or Copper
3	Instrument Type	Heating or Chiller (default Heating)
4	Instrument Side	Flow or Return (default Flow)
5	Instrument Fluid	Water, Glycol or Ethanol; mixture % and temperature where applicable
6	Temperature	Water only: COLD ($\leq 40\text{ }^{\circ}\text{C}$) or HOT ($> 40\text{ }^{\circ}\text{C}$)
7	Set Separation	Separation code, e.g. B-2: set the transducers to this position on the rail
8	Checking Signals	Signal search, then the flow reading screen

The configuration is retained for all subsequent start-ups and can be changed from the password-protected menus. With the liquid stationary, set the zero offset for best accuracy.

DISPLAY AND DIAGNOSTICS

Display	Two-line backlit LCD; four-key keypad; LEDs for Energy and Pulse
Flow screen	Signal %, flow rate, units and direction (* forward, ! reverse); also ΔT , energy, power and total flow screens
Signal strength	40% or more for reliable operation
Gain	5 dB to 80 dB; around 50 dB or below is normal; above 60 dB check the installation
Signal-to-noise ratio	0 dB to 80 dB; below 20 dB check the installation
Δt and transit times	Up/downstream time difference in ns; estimated and actual TA (9999.99 = no usable signal)
Error code	1–255 bit-coded value, or None; firmware versions and serial number

ERROR CODE / MODBUS STATUS BITS

Bit (value)	Meaning	Bit (value)	Meaning
0 (1)	RTD I ² C failed	4 (16)	Flow board failed
1 (2)	RTD T _{hot} failed	5 (32)	Flow window failed
2 (4)	RTD T _{cold} failed	6 (64)	Flow sensor type failed
3 (8)	Flow signal lost	7 (128)	Flow board I ² C failed

The displayed error code and Modbus register 1 are the sum of the active bit values, e.g. 8 = no flow signal.

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05 Heat and energy measurement

The matched PT100 pair measures flow and return temperature at the pipe surface. Thermal power is calculated continuously from the measured volumetric flow, the fluid properties and the temperature difference, and integrated into an energy total, for heating or chilled-water circuits.

$$P = q_v \times \rho \times c_p \times \Delta T \quad \Delta T = T_{\text{hot}} - T_{\text{cold}}$$

$$E = \int P \, dt$$

q_v volumetric flow rate · ρ , c_p density and specific heat capacity of the selected fluid (together, the heat coefficient k of EN 1434) · T_{hot} , T_{cold} temperatures from the clamp-on PT100 pair.

TEMPERATURE MEASUREMENT

Sensor type	Clamp-on PT100, Class B, 4-wire
Measurement range	0 °C to +135 °C (32 °F to 275 °F)
Resolution	0.1 °C (0.18 °F)
Minimum ΔT	0.3 °C
Sensor accuracy	±0.725 °C (±1.305 °F) per sensor; the pair is balanced at commissioning with the zero temperature offset
Cable length	5 m, matched pair. Do not extend or shorten: this negates the sensor calibration
Fixing	Stainless steel cable ties; thermal compound recommended; lag over the sensor
Connection	RTD A and RTD B terminal blocks in the wall unit

ENGINEERING NOTES

Thermal contact

The pipe under each sensor must be free of grease and insulating coatings. Use thermal compound and lag over the sensor so ambient air does not bias the reading.

Glycol mixtures

Mixture settings assume ethylene glycol only. Concentration is often uncertain and additives vary, so energy values for glycol systems should be treated as estimates.

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06 Outputs and diagnostics

PULSE OUTPUT (STANDARD)

Type	SPNO/SPNC MOSFET relay; opto-isolated, volt-free contact
Maximum load	500 mA; 24 V AC when driving external equipment, 24 V DC for electronic pulses and switching
Modes	Volume, energy, frequency, low-flow alarm or signal-loss alarm
Pulse width	3 ms to 99 ms (default 50 ms)
Volume per pulse	User-set (default 10 litres)
Energy per pulse	1, 10 or 100 kWh, or 1 MWh (1, 10 or 100 kBTU, or 1 MBTU)
Frequency mode	1 Hz to 200 Hz, proportional to flow; flow at maximum frequency user-set
Low-flow alarm	0 to 9999 in the flow units in use; 2.5% hysteresis; N/O or N/C
Signal-loss alarm	Triggers when no usable signal (flow shown as -----); N/O or N/C
Reverse flow	No pulses generated
Circuit	SELV circuits only

Sizing the volume per pulse

$$V_{\text{pulse}} \geq Q_{\text{max}} \text{ [l/min]} \times 2 \cdot t_w \text{ [s]} / 60 \rightarrow \text{at } t_w = 50 \text{ ms: } V_{\text{pulse}} \geq Q_{\text{max}} / 600$$

Example: $Q_{\text{max}} = 500 \text{ l/min}$ gives $V_{\text{pulse}} \geq 0.833 \text{ l}$, so set 1 litre per pulse. A 50 ms width suits most mechanical counters; use a larger volume or energy per pulse, or a shorter width, for higher flows.

4–20 MA OUTPUT (OPTION)

Type	Isolated current source, optional, flow rate only
Maximum load	620 Ω
Resolution	0.1% of full scale
Isolation	1 M Ω at 100 V
Scaling	Flow at 4 mA and at 20 mA user-set (default 4 mA = 0)
Alarm current	3.5 mA when flow exceeds the 20 mA setting, flow is negative or no signal is detected
Calibration	Factory calibrated; default OFF

07 Communications: Modbus RTU

MODBUS RTU

Protocol	Modbus RTU slave to Modbus Application Protocol V1.1b; function 03, read holding registers
Physical layer	Isolated RS485, 2-wire plus ground; 1/8 unit load; SELV circuits only
Baud rate / address	1200 to 38,400 baud; slave address 1 to 247
Timing	Minimum polling interval 1 s; response under 1 s; time-out after 5 s
Data format	IEEE 754 float, big-endian ABCD (high word first); totals also as unsigned 64-bit integers in 0.1 l and 0.1 kWh
Data handling	Invalid flow reads 0. Negative flow: flow and power reported, totals not incremented;
Cabling	temperature out of range reads -99 °C (-146.2 °F) Installer-supplied screened cable to terminals IO1 1/01 (B-) and 1/03 (A+), isolated

MODBUS REGISTER MAP ground 1/02 and 1/04

Offset	Parameter	Type	Units / content
0	Device ID	Int 16	0xAC = U1000MKII
1	Status	Int 16	0x0000 = OK
2	System type	Int 16	0x04 heating, 0x0C chiller
6-7	Measured velocity	IEEE 754	m/s
8-9	Measured flow	IEEE 754	m³/h (US gal/min)
10-11	Calculated power	IEEE 754	kW (BTU/s)
12-13	Calculated energy	IEEE 754	kWh (kBTU)
14-15	Temperature, hot	IEEE 754	°C (°F)
16-17	Temperature, cold	IEEE 754	°C (°F)
18-19	Temperature difference	IEEE 754	°C (°F)
20-21	Volume total	IEEE 754	m³ (US gal)
22	Instrument units	Int 16	0 metric, 1 imperial
23	Gain	Int 16	dB
24	SNR	Int 16	dB
25	Signal	Int 16	%
26-27	Δt difference	IEEE 754	ns
28-29	Estimated TA	IEEE 754	μs
30-31	Actual TA	IEEE 754	μs
32-35	Volume total	UInt64	0.1 litre
36-39	Energy total	UInt64	0.1 kWh

Imperial units in brackets. Full description in the U1000 Modbus supplement. M-Bus (option 03): see the U1000 M-Bus supplement.

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08 Communications: BACnet MS/TP and RS485 wiring

BACNET MS/TP

Network	BACnet MS/TP over RS485, 8N1; full master node state machine; ANSI/ASHRAE 135-2016
Device profile	B-SS BACnet Smart Sensor
BIBBs	DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB-B
Identification	Vendor ID 1009; default device instance 1037129; model name U1000-WM-HM
Set-up	MAC address, device ID and baud rate in the BACnet Setup menu
Limits	Max APDU 128 octets; no segmentation; COV subscription not supported

BACNET OBJECTS

Object	Description	Unit	Object	Description	Unit
AI 0	Measured velocity	m/s	AI 10	SNR	dB
AI 1	Measured flow	m ³ /h	AI 11	Signal strength	dB
AI 2	Calculated power	kW	AI 12	Δt difference	ms
AI 3	Calculated energy	kWh	AI 13	Estimated TA	ms
AI 4	Temperature, hot	°C	AI 14	Actual TA	ms
AI 5	Temperature, cold	°C	BI 0	Alarm relay state	
AI 6	Temperature difference	°C	BV 1	Reset totals	
AI 7	Measured total	m ³	PIV 0	Flow total (integer)	m ³
AV 8	Meter units	0 metric, 1 imperial	PIV 1	Energy total (integer)	kWh
AV 9	Gain	dB			

All measured-value objects are read-only.

RS485 WIRING

Topology	Daisy chain preferred; spurs up to 5 m permitted
Termination	120 Ω at both ends of the segment; bias resistors at the master (270 Ω for +5 V, 1 kΩ for +12 V)
Cable	Screened twisted pair, screen earthed; segment length up to 1,200 m

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09 General specifications and dimensions

ELECTRICAL		WALL UNIT	
Supply	12–24 V AC/DC $\pm 10\%$	Protection	IP68
Consumption	7 W / 7 VA per unit	Dimensions	215 × 125 × 90 mm (8.46 × 4.92 × 3.54 in)
Supply rating	Class 2 external supply; optional plug-in 12 V supply	Mounting	Wall or panel
ENVIRONMENTAL		SENSORS	
Pipe temperature	0 °C to +135 °C	Flow transducers	IP54, in adjustable guide rail
APPROVALS		Transducer cables	5 m
Marking	CE approved	Coupling	Gel pads or grease
		PT100 cables	5 m, matched pair

DIMENSIONS

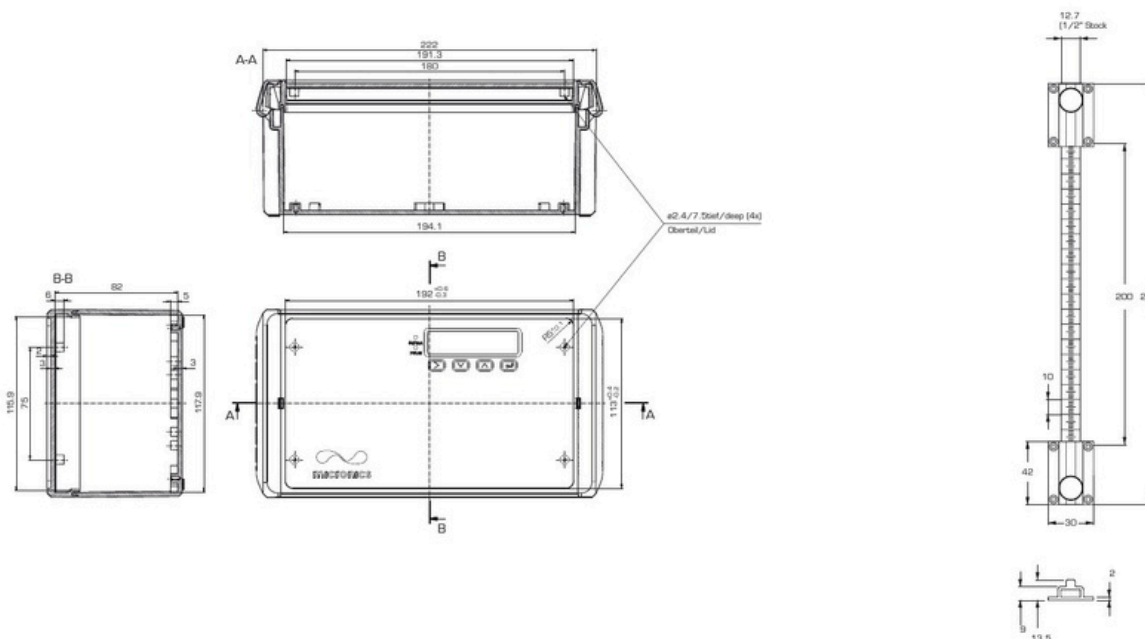


Figure. Wall-mount unit (left: section A-A, front and section B-B) and guide rail (right). Dimensions in mm.

PACKAGE CONTENTS

- IP68 wall-mounted electronics unit with display and keypad
- Adjustable guide rail with two IP54 flow transducers
- 5 m transducer cables
- Gel pads and all pipe-mounting hardware
- Pair of PT100 temperature sensors with 5 m cables

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10 Ordering information

MC904-2000

① Model and mounting

14

② Pipe size

07

③ Outputs

Example shown: MC904-20001407. Every part number is the base code followed by a two-digit pipe-size code and a two-digit output code.

② PIPE SIZE

Code	Version	Pipe range
14	Up to 4"	25–115 mm OD
48	Up to 8"	125–225 mm OD (105–215 mm ID)

③ OUTPUTS AND COMMUNICATIONS

Code	Fitted
00	Pulse output only
01	Pulse + 4–20 mA (flow)
02	Pulse + Modbus RTU
03	Pulse + M-Bus
06	Pulse + BACnet MS/TP
04	Pulse + 4–20 mA (flow) + Modbus RTU
05	Pulse + 4–20 mA (flow) + M-Bus
07	Pulse + 4–20 mA (flow) + BACnet MS/TP

PART NUMBERS

Part number	Configuration
MC904-20001400	Up to 4": pulse only
MC904-20001401	Up to 4": + 4–20 mA (flow)
MC904-20001402	Up to 4": + Modbus RTU
MC904-20001403	Up to 4": + M-Bus
MC904-20001406	Up to 4": + BACnet MS/TP
MC904-20001404	Up to 4": + 4–20 mA (flow) + Modbus RTU
MC904-20001405	Up to 4": + 4–20 mA (flow) + M-Bus
MC904-20001407	Up to 4": + 4–20 mA (flow) + BACnet MS/TP

Part number	Configuration
MC904-20004800	Up to 8": pulse only
MC904-20004801	Up to 8": + 4–20 mA (flow)
MC904-20004802	Up to 8": + Modbus RTU
MC904-20004803	Up to 8": + M-Bus
MC904-20004806	Up to 8": + BACnet MS/TP
MC904-20004804	Up to 8": + 4–20 mA (flow) + Modbus RTU
MC904-20004805	Up to 8": + 4–20 mA (flow) + M-Bus
MC904-20004807	Up to 8": + 4–20 mA (flow) + BACnet MS/TP

OPTIONAL EXTRAS

Part number	Description
MC126-5002	U1000 12 V wall power supply
MCU1000CAL	U1000 calibration certificate

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11 Accessories and spares

Part numbers for replacement and optional items. For pricing and availability see the current Micronics price list or contact sales.

Part number	Description
MC223-5009	Gel pads, pair
MC225-5007	Quick-release clamp 25–70 mm (up to 50 mm OD), 2 off
MC225-5001	Quick-release clamp 51–127 mm (up to 110 mm OD), 2 off
MC225-5009	Very small circle pipe clamp, 2 off
MC225-5005	Small pipe V clamp, 2 off
MC292-5000	Omega 38 grease, food grade
MC292-0002	Omega 71 universal non-melt grease
MC194-5040	Modbus / M-Bus cable, 1 m (-5M: 5 m; -10M: 10 m)
MC803A5047	Wall-mount guide rail assembly, complete with sensors
MC230-5029	Pair of U1000 WM B34" sensors
MC194-5047	Sensor extension cable, 5 m
MC231-5004	RTD PT100 surface-mount probe, open end, 3 m (/5M, /10M, /20M)
MC231-5005	RTD PT100 probe with binder fitted, 3 m (/5M, /10M, /12M, /15M, /20M)
MC223-5008	RTD PT100 stainless steel cable tie

Micronics reserve the right to alter any specification without notification.

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