Ultrasonic Flowmeter

M-2000 Series

Noncontact sensing for small line

The M-2000 Series is a flowmeter designed for low flow rates and small line applications. The flowmeter consists of a Flow Detector and a Signal Converter. All the wetted parts are of PFA. There are no mechanical seals or moving parts. The M-2000 has non-contact transducers and a flow through tube design without dead pockets. The M-2000 is an ideal choice for use in the semiconductor industry where extreme cleanliness and anti-corrosiveness is required.

Features

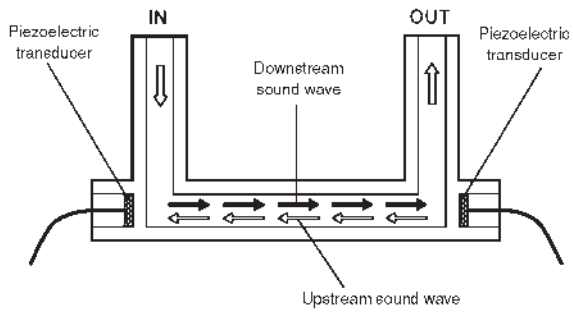
- Accuracy ±1% of Reading
- All wetted parts made of New PFA (AP-201SH) Contamination free from ions or particles
- Corrosion resistant, no metal parts
- Wide rangeability of 100:1 (Typical)
- Easy installation with compact meter body
- Measures viscous fluids up to 4.5 x 10^{-5} m^2/s (45cSt)
- Easy configuration in front panel with LCD display

Applications

- Pure water and ultra-pure water in semiconductor manufacturing plants.
- CMP slurries
- Chemical feeds
- Highly corrosive chemicals
- Very low flow measurement of liquid

Operating Principle

The fluid to be measured flows through the U-shaped tube. Two piezoelectric transducers, mounted at both ends of the measuring section, generate and receive an ultrasonic wave alternately. The wave traveling with the fluid is accelerated and the wave traveling against the fluid is slowed. The difference in transit time of the signals is proportional to the velocity of the fluid.



Corporate Headquarters
1060 S Rogers Cir Boca Raton, FL 33487
P: (561) 995-0595
F: (561) 995-0622

Western Office
3350 Scott Blvd, Suite #43 Santa Clara, CA 95054
P: (408) 970-3419
F: (408) 970-3426

http://www.malema.com

Specifications

Flow detector

Measurable Fluid : Liquids
Fluid Sound Speed : 100 to 2500 m/s
Fluid Temperature : 10 to 100^{0}C
Fluid Pressure : 0 to 70 psig
Fluid Kinematic Viscosity: 0.8x10^{-6} m^2/s to 4.5x10^{-5} m^2/s
Process Connection : PFA Tube End (Refer to Table1)
Enclosure Classification: IP65
Flow Range :Refer to Table1

Table1: Flow Range and Connecting Tube Size

Range Code	Flow Range (L/min)		Connecting Tube Size
	Min. Range	Max. Range	
10	0 - 1.0	0 - 20.0	1/2"
15	0 - 3.0	0 - 50.0	3/4"
20	0 - 4.0	0 - 80.0	1"

Table 2: Accuracy

Range Code	Flow Velocity < 1m/s		Flow Velocity > = 1m/s	
	Flowrate (L/min)	Accuracy (L/min)	Flowrate (L/min)	Accuracy (of Reading)
10	0 - 4.7	+/- 0.047	4.7 - 20	+/- 1%
15	0 - 10.6	+/- 0.106	10.6 - 50	+/- 1%
20	0 - 18.8	+/- 0.0188	18.8 - 80	+/- 1%

Note: Accuracy statement is based on a water calibration

Table 3: Materials of Flow Detector

Part Name		Material
Wetted Part	Body	New PFA
	Tube	New PFA
Housing		PTFE
Cable Fitting		PP
Signal Cable Sheath		PVC

Table 4: Pressure Loss Factor

Range Code	K
10	0.0625
15	0.0120
20	0.00377

Pressure Loss:
Pressure Loss for water(kPa) = K x Q^2
where K : Factor (refer table3)
Q : Flowrate (L/min)

Signal Converter

USC-291

Output:

1) 4 to 20 m A (Load resistance max.500 ohms)
   Time constant 0.1 ~ 99 seconds (programmable)
2) Flow rate alarm for High and Low flow rate
   Open collector / Max. 30 V, 20mA DC

Freely programmable (by digi tal I/O)
Alarm indication by 2 LED
Response time: 0.1s std. setting
(Programmable 0.1s, 0.3 ~ 25s in 0.1 s step)
Digital I/O: RS-485, MODBUS, Max. 32 devices
Low Cut-off: 2% F.S. std. setting
(Programmable 0 to 25%)
Linearization capability: Max. 15 points
(polygonal) programmable

Power Supply: 24V DC ± 10%,
Power Consumption: 3.6W / Approx. 150 mA
(running) Max. 0.25 A inrush current
Ambient Condition: 5 to 40°C / 30~80% RH
Installation: Plug-in type / DI N rail mounting
socket
Enclosure Class: IP20 (Indoor Use)
Materials: Housing & Socket / ABS
Color: Black
Data back up: by EEPROM
Weight: Approx. 200g
EMC: EMI / EN55011, CLASS A1, EMS / EN50082-2
Connection:
  Signal / BNC connector to M-2400
  Power supply / Screw terminal size M4
  RS-485 / Screw terminal size M2.6

USC-471

Specifications

Output:

1) a) 4 to 20mA (Load resistance 0 to 500 ohms)
   b) 0 to 10 VDC

   Damping Time Constant : 0.04 to 99 seconds

2) Scaled Pulse (Open collector / DC 30 V, 20mA Max.)
   Pulse width: 0.5ms (Max. 1000 Hz), 50ms (Max. 10 Hz), 100ms (Max. 5 Hz) (selectable depending on the pulse rate at full scale)
3) Flow rate alarm / Preset function
   2 points (Open collector / DC 30 V, 20mA Max.)
   Alarm: Relative method
   Relay Action: NO or NC (Alternative choice)
   Setting : Programmable (By parameter key switch)

Pulse Rate: 10 to 1000 pps
Low Cut-off: 0 to 30% of full scale
Display: LCD /2 line 16 digit alphanumeric (with illuminator)
Alarm indicator: 2 LED
Data Entry: By 4 key switches in front panel
Linearizer: 15 line-segment approximation
Power Supply: DC24V ± 10%
Power Consumption: 2.4W/100mA (running) (1.3A / starting)
Ambient Condition: 0 to 60°C/30 -80% RH
Installation: Panel Mounting
Enclosure Classification: IP20 (Indoor use)
Materials: Panel /Acryl, Housing/Aluminum
Color: Panel / Gray, Housing Black
Data back-up: Total count by EEPROM
Mass: Approx. 425 g
EMC: EMI: EN55011, CLASS A1
EMS: EN50082-2

USC-731 and USC-801 DSP Technology

The USC-731 and USC-771 utilize the latest **digital signal processing (DSP)** technology and features significant reduction of adverse influence of bubbles in measured fluids which is a common problem in semiconductor and chemical processes.

Features

- New signal processing has improved anti-bubbles capability of converter*.
  Normally, ultrasonic flowmeter has difficulty in measuring fluid containing bubbles, because the bubbles interfere with ultrasonic signal passage. In virtue of DSP and accumulated field experience, anti-bubbles capability has been remarkably improved.
- Compact converter package permits easy mounting onto space-valuable equipment housings for semiconductor manufacturing.
- Easy configuration with LCD display or RS485 connection

* Product cannot work with fluids having bubbles exceeding 10% by air volume and also other limitations as advised by our Applications engineers or factory.

USC-731
Specifications

Output:

1) a) 4 to 20mA (Load resistance 0 to 500 ohms)
   b) 0 to 10 VDC (24VDC required)
   c) 0 to 5 VDC

   Damping Time Constant : 0.2 to 10 seconds

2) Scaled Pulse (Open collector / DC 30 V, 20mA Max.)
   Pulse width: 0.5ms (Max. 1000 Hz),
   50ms (Max. 10 Hz),
   100ms (Max. 5 Hz)
   (selectable depending on the pulse rate at full scale)
3) Flow rate alarm / Preset function
   2 points (Open collector / DC 30 V, 20mA Max.)
   Alarm: Relative method
   Relay Action: NO or NC (Alternative choice)
   Low Cut-off: 0 to 30% of full scale
   Display: LCD /2 line 16 digit alphanumeric (with illuminator)
   Alarm indicator: 1 LED, LCD (high/low)
   Data Entry: By 4 key switches in front panel

Linearizer: 15 line-segment approximation
Power Supply: 12-15VDC ± 10% or 24VDC ± 10%
Power Consumption: 2.4W/100mA (running) (1.3A / starting)
Ambient Condition: 0 to 50°C/30 -80% RH
Installation: Panel Mounting
Enclosure Classification: IP20 (Indoor use)
Materials: Panel /Acryl, Housing/Aluminum
Color: Panel: blue and yellow
Housing: Black
Mass: Approx. 530 g

USC-801 - Blind Type Converter

Output:

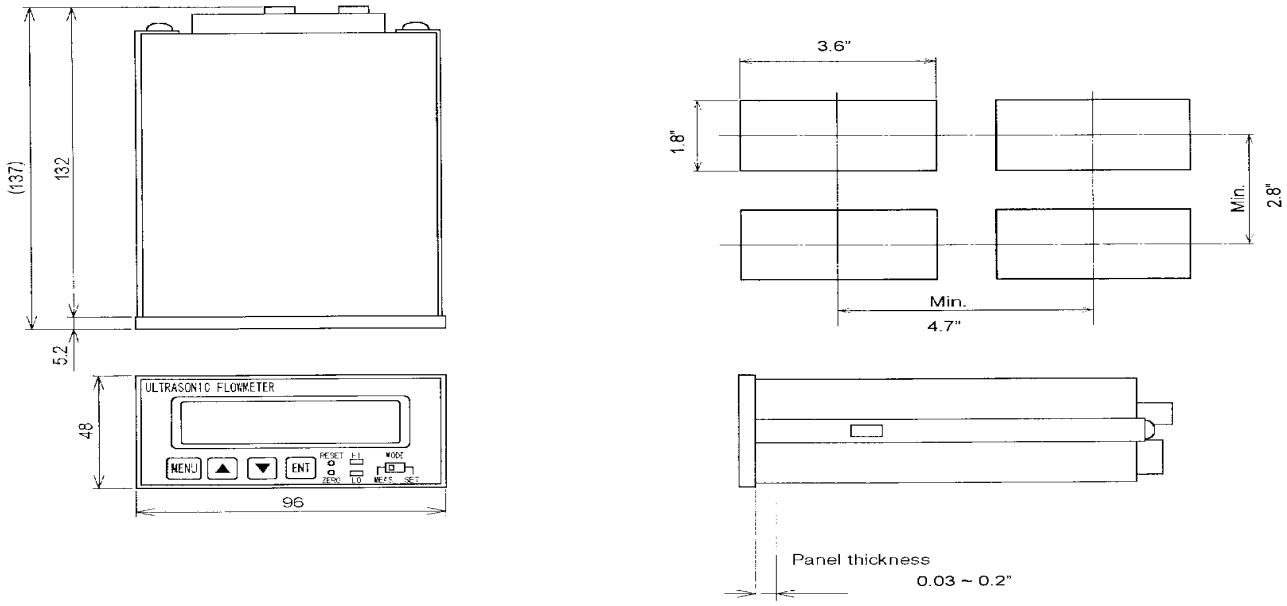
1) 4 to 20 m A (Load resistance max.500 ohms)
   Time constant 0.1 ~ 99 seconds (programmable)
2) Flow rate alarm for High and Low flow rate
   Open collector / Max. 30 V, 20mA DC

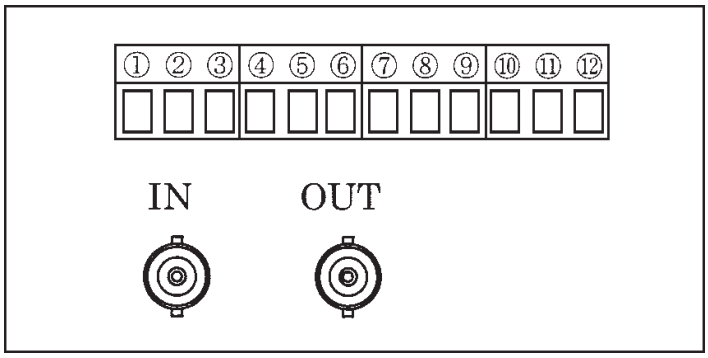
Freely programmable (by digi tal I/O)
Alarm indication by 2 LED
Response time: 0.1s std. setting
(Programmable 0.1s, 0.3 ~ 25s in 0.1 s step)
Digital I/O: RS-485, MODBUS, Max. 32 devices
Low Cut-off: 2% F.S. std. setting
(Programmable 0 to 25%)
Linearization capability: Max. 15 points
(polygonal) programmable
Power Supply: 24V DC ± 10%,

Power Consumption: 3.6W / Approx. 150 mA
(running) Max. 0.25 A inrush current
Ambient Condition: 5 to 40°C / 30~80% RH
Installation: Plug-in type / DI N rail mounting
socket
Enclosure Class: IP20 (Indoor Use)
Materials: Housing & Socket / ABS
Color: Black
Data back up: by EEPROM
Weight: Approx. 200g
EMC: EMI / EN55011, CLASS A1, EMS / EN50082-2
Connection:
Signal / BNC connector to M-2400
Power supply / Screw terminal size M4
RS-485 / Screw terminal size M2.6

Dimensions (Converter USC 471)

Panel Cutout

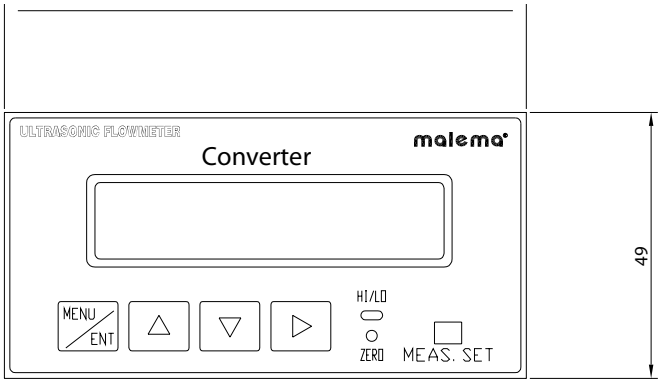


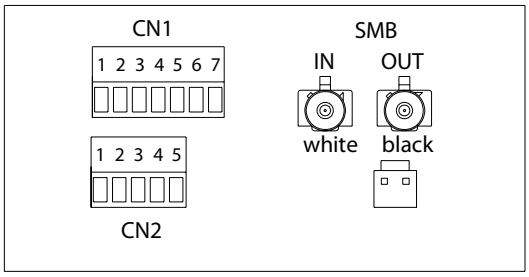


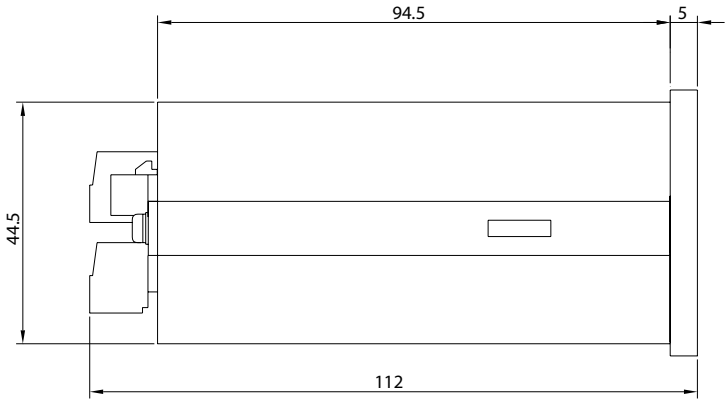
Terminal	Polarity	Description
IN	Inlet side	Sensor signal (BNC Connector)
OUT	Outlet side	
①	+	Current output (DC 4~20mA)
②	−	
③	+	Scaled pulse output (Open collector)
④	−	
⑤	+	H alarm (H) or Total H Alarm (HH) (Open collector)
⑥	−	L Alarm (L) or Total H Alarm (HH) (Open collector)
⑦	+	
⑧	+	Reset input (Totalizer)
⑨	−	
⑩	⏚	FG (Grounding)
⑪	0V	Power supply (DC24V)
⑫	24V	

* Specification subject to change without notice

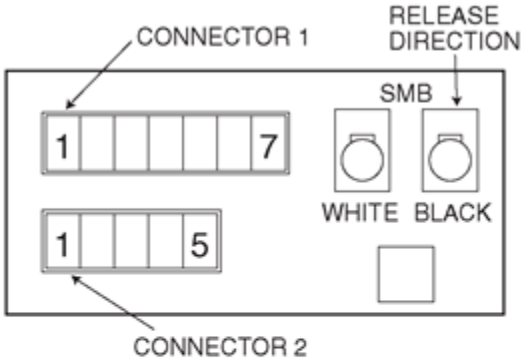
Dimensions (Converter USC 731)







Units in mm



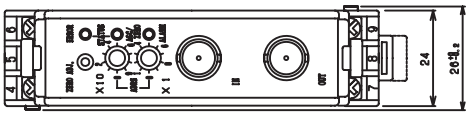
CONNECTOR 1 (Removable)

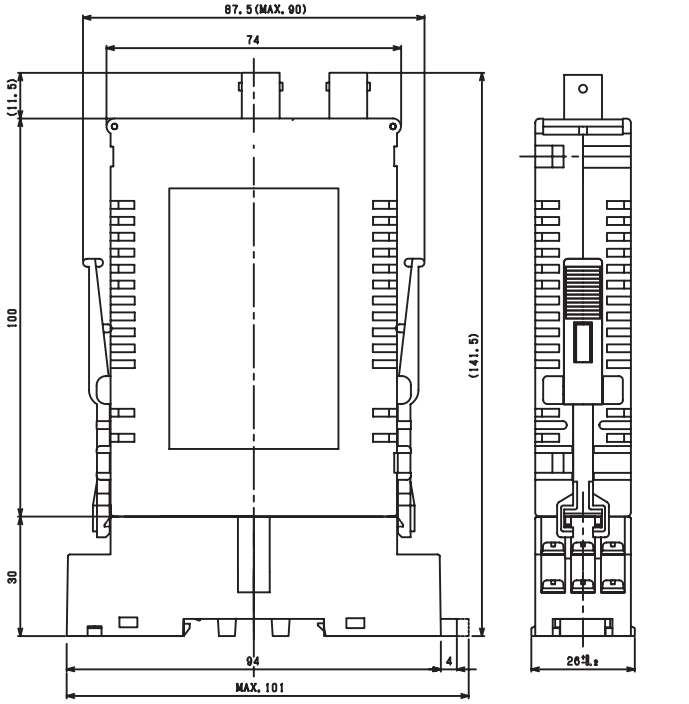
Terminal	Polarity	Description
White	Inlet side	Sensor Signal (Coaxial cable connector)
Black	Outlet side	
1	+	Power supply (DC24V)
2	–	
3	⏚	FG (Grounding)
4	+	Output current 4-20mA or voltage 0-10V
5	–	
6	+	Reset pulse input for totalizer
7	–	

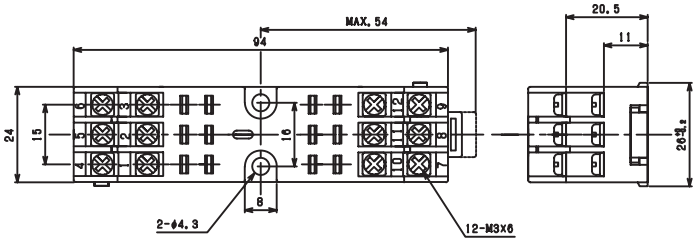
CONNECTOR 2 (Removable)

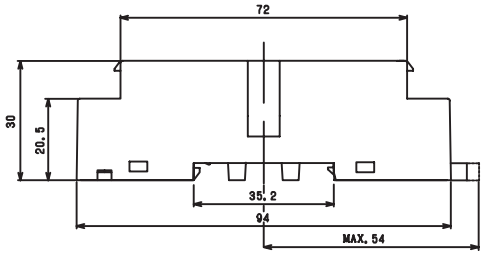
1	+	Pulse Output
2	–	
3	+	Alarm Hi
4	–	Alarm Common
5	+	Alarm Lo

Dimensions (Converter USC 291/801)









Terminal

No.	Description	No.	Description
1	AL2	7	(+) : RS485
2	AL1	8	(+) : P OUT
3	COM: (AL1/AL2用)	9	(+) : ANALOG OUT
4	Ground	10	(-) : RS485
5	Input : 0V	11	(-) : P OUT
6	Input : DC24V	12	(-) : ANALOG OUT

Units in mm

Outline Dimensions (Sensor)

M-2000 -10, -15, -20

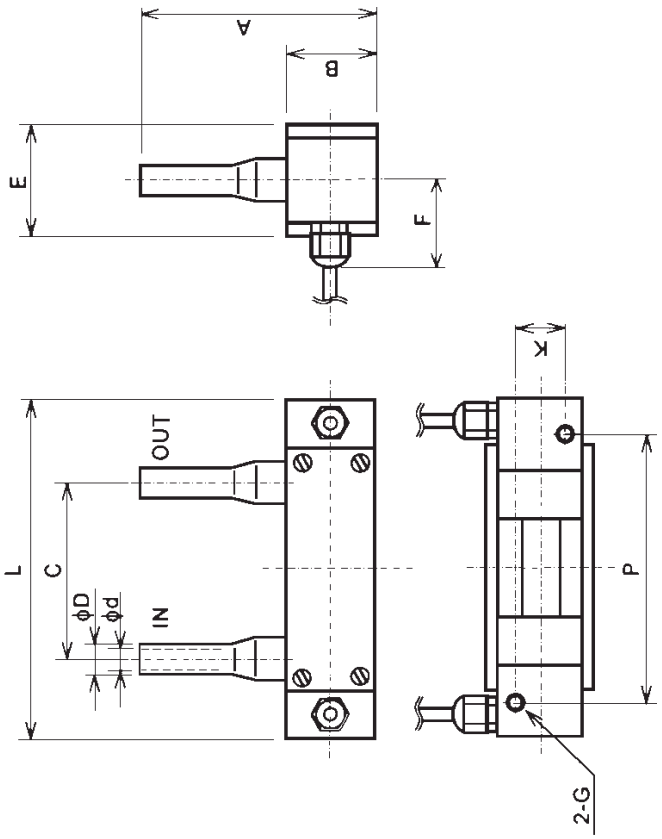


Table 7. Flow Detector Dimensions and Mass

Range Code	Connecting Tube Size	Dimensions(inches)											Mass(oz)		
		D	d	C	L	A	B	E	F	G	K	P	Detector	Cable(16ft)	Total
10	1/2”	1/2	3/8	4.33	8.94	3.54	1.18	1.57	1.38	M4	0.71	7.60	15	5	20
15	3/4”	3/4	5/8	6.50	11.30	3.94	1.57	1.97	1.57	M5	1.02	9.96	27	5	32
20	1”	1	7/8	8.66	13.54	4.72	1.57	1.97	1.57	M5	1.02	12.20	31	5	36

Cautions On Installation

- Installation Area for Flow Detector: Select the area of pipe where no air or gas bubbles exist in the flow.
- Mounting of flow detector: Recommend to install detector vertically with upward flow, in order to prevent deposit of slurry or bubbles in low flowrate conditions.
- Location of control valve: If a flow control valve is installed in the piping, it should be located on the downstream side of the flow detector to keep the fluid pressure high. The high fluid pressure will prevent the formation of bubbles in the flow.
- Noise Suppression: All electrical noise sources near the flowmeter, such as power relays or solenoid valves, should be fitted with a surge suppressor.
- Signal Cable Wiring: Keep signal cables away from high voltage or high current power cables to avoid induced electrical noise.

Ordering Information

M	-	Model	-	Tube Material	Tube Size	Tube Ends	Range Code	-	Converter Model	Analog Output Type	-	Geometry	-	XXX
M	-	2000	-	T	X	1	XX	-	X	X	-	X	-	XXX
M	-	2000	-	T - PFA	4 - 1/2" 6 - 3/4" 8 - 1"	1 - Tube end	10 0 - 20 lpm 15 0 - 50 lpm 20 0 - 80 lpm	-	1 - USC 471 5 - USC 731 9 - USC-291 A - USC-801	1 - 0 to 10 VDC 2 - 4 to 20 mA 3 - 0 to 5 VDC 4 - 1 to 5 VDC	-	U - U shape	-	Unique PN identifier