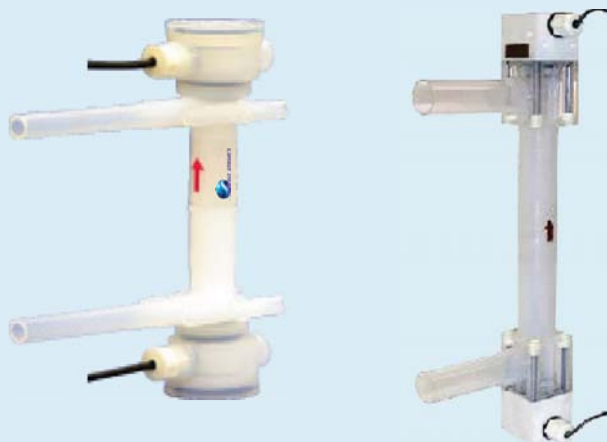


Key Features

- Accuracy $\pm 1\%$ of reading
- Repeatability $\pm 0.5\%$ 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
- Low flow measurements down to 2 mL/min
- Measures viscous fluids
- Ease of parameter configuration through front panel LCD and Keypad, or PC communication software



Applications

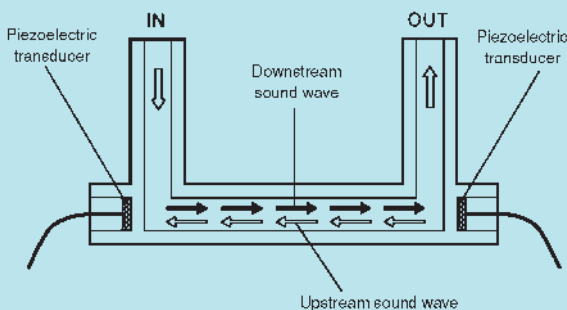
- CMP, ECD, Electroless Deposition, Wet Clean and Track tools in semiconductor manufacturing
- Solar PV equipment
- Medical Devices
- Wet process / Chemical distribution systems
- Laser equipment
- Cooling systems

Description

The M-2001 Series handles a wide range of flow rates and connection sizes. The flow meter consists of a Flow Detector and a Signal Converter. All the wetted parts are made of PFA. There are no mechanical seals or moving parts. The flow detector has non-contact transducers and a flow tube design without dead pockets. The M-2001 is an ideal choice for use in the semiconductor industry where extreme cleanliness and anti-corrosiveness are required.

Operating Principle

The fluid to be measured flows through the U or Z 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 wave signals is proportional to the velocity of the fluid.



Flow Detector Specifications

Measurable Fluid : Liquids
 Speed of Sound in Fluid: 1000 to 2200 m/s
 Fluid Temperature : 10°C to 60°C *
 Fluid Pressure : 0 to 70 psig
 Fluid Kinematic Viscosity : 0.8×10^{-6} m²/s to 4.5×10^{-5} m²/s **
 Process Connection : PFA Tube End (Refer to Table1)
 Enclosure Classification : IP65
 Flow Range : Refer to Table1

* Consult Malema for higher temperature applications.
 **Consult Malema for higher viscosity applications.

Table 1. Flow Range and Connecting Tube Size

Range Code	Flow Range (L/min)		Connecting Tube Size
	Min. Range	Max. Range	
04	0 - 0.05	0 - 3.0	3/8"
06	0 - 0.4	0 - 8.0	3/8"
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 and Repeatability

Range Code	Accuracy	Repeatability
04	± 5 ccm below 500 ccm* ± 1% of reading above 500 ccm	± 0.5 ccm below 100 ccm ± 0.5% of reading above 100 ccm
06	± 12 ccm below 1200 ccm ± 1% of reading above 1200 ccm	± 3 ccm below 600 ccm ± 0.5% of reading above 600 ccm
10	± 0.047 LPM below 4.7 LPM ± 1% of reading above 4.7 LPM	± 0.024 LPM below 4.7 LPM ± 0.5% of reading above 4.7 LPM
15	± 0.106 LPM below 10.6 LPM ± 1% of reading above 10.6 LPM	± 0.053 LPM below 10.6 LPM ± 0.5% of reading above 10.6 LPM
20	± 0.188 LPM below 18.8 LPM ± 1% of reading above 18.8 LPM	± 0.094 LPM below 18.8 LPM ± 0.5% of reading above 18.8 LPM

* Flow meter specified with 100 ccm full scale or less can be provided with ± 2 ccm accuracy.
 Please consult the factory for special requirements.
 Note: Accuracy statement is based on a room temperature DIW calibration.

Table 3. Materials of Flow Detector

Part Name		Material
Wetted Part	Body	PFA
	Tube	PFA
Housing (Size 10 / 15 / 20)		PTFE
End Cap (Size 04 / 06)		PP
Cable Fitting		PP
Cable Jacket		PVC

Table 4. Pressure Loss Factor

Range Code	K
04	3.04
06	0.537
10	0.0625
15	0.0120
20	0.00377

Pressure Loss for water(kPa) = $K \times Q^2$
 Where K : Factor and Q : Flowrate (L/min)

Signal Converter Options

Depending on the application, the signal converter can be selected between a **NON-DSP** version or **DSP** version.

DSP (Digital Signal Processing) Technology

Conventional ultrasonic flow meters encounter difficulty in measuring fluids containing bubbles because the bubbles interfere with the ultrasonic signal transmission. Digital signal processing has improved the bubble immunity of this series of flow meters by virtue of sampling the entire wave signal and proven its advantage.

NON-DSP Version

USC-291

Power & I/O Interface	24 Vdc \pm 10%
Power Consumption	3.6 W / Approx. 150 mA (Continuous) Max. 0.25 A, surge current
Ambient Condition	5°C to 40°C / 30~80% RH
Installation	Plug-in type / DIN rail mounting socket
Enclosure Class	IP20 (Indoor use)
Materials	Housing & Socket / ABS
Weight	Approx. 200g
EMC	EN61326
Electrical Connection	Detector Signal - BNC connector to M-2001 Power & I/O Interface - Screw terminal size M4 RS-485 - Screw terminal size M2.6
Analog Output	4 to 20 mA (Load resistance less than 500 Ohms) 0 to 10 Vdc 0 to 5 Vdc 1 to 5 Vdc
Pulse Output	Open Collector/ Max. 30 Vdc, 20 mA 0-1000 Hz (Corresponds to 0 - 100 % full scale)
Flow Rate Alarm	High and Low flow rate alarm programmable Open Collector / Max. 30 Vdc, 20mA Alarm indication by 2 LED
Response Time	Programmable 0.1s, 0.3s ~ 25s in 0.1s step
Digital I/O	RS-485, MODBUS, Max. 32 devices
Low Flow Cut-off	Programmable 0 to 25% of full scale
Linearization	Max. 15 points (Programmable)
Display	None

NON-DSP Version

USC-471

Power & I/O Interface	24 Vdc \pm 10%
Power Consumption	2.4 W / Approx. 100 mA (Continuous) Max. 1.3 A, surge current
Ambient Condition	0°C to 60°C / 30~80% RH
Installation	Panel mounting
Enclosure Class	IP20 (Indoor use)
Materials	Panel-Acrylic Housing-Aluminum
Weight	Approx. 425g
EMC	EMI / EN5501, CLASS A 1 EMS / EN50082-2
Electrical Connection	Detector Signal - BNC connector to M-2001 Power & I/O Interface - Pluggable screw terminals
Analog Output	4 to 20 mA (Load resistance less than 500 Ohms) 0 to 10 Vdc 0 to 5 Vdc 1 to 5 Vdc
Scaled Pulse Output	Open Collector/ Max. 30 Vdc, 20 mA Pulse width: 0.5 mS (Max. 1000 Hz) 50 mS (Max. 10 Hz) 100 mS (Max. 5 Hz) (Select table depending on the pulse rate at full scale)
Flow Rate Alarm	High and Low flow rate alarm programmable Open Collector / Max. 30 Vdc, 20 mA Alarm indication by 2 LED
Response Time	Programmable 0.04s ~ 99s in 0.1s step
Digital I/O	None
Low Flow Cut-off	Programmable 0 to 30% of full scale
Linearization	Max. 15 points (Programmable)
Display	LCD/ 2 line 16 digits alpha numeric (with illuminator)

DSP Version

USC-801 (DSP equivalent of USC-291)

Power & I/O Interface	24 Vdc \pm 10%
Power Consumption	3.6 W / Approx. 150 mA (Continuous) Max. 0.25 A, surge current
Ambient Condition	5°C to 40°C / 30~80% RH
Installation	Plug-in type / DIN rail mounting socket
Enclosure Class	IP20 (Indoor Use)
Materials	Housing & Socket / ABS
Weight	Approx. 200g
EMC	EN61326
Electrical Connection	Detector Signal - BNC connector to M-2001 Power & I/O Interface - Screw terminal size M4 RS-485 - Screw terminal size M2.6
Analog Output	4 to 20 mA (Load resistance less than 500 ohms) 0 to 10 Vdc 0 to 5 Vdc 1 to 5 Vdc
Pulse Output	Open Collector/ Max. 30 Vdc, 20 mA 0-1000 Hz (Corresponds to 0 - 100 % full scale)
Flow Rate Alarm	High and Low flow rate Alarm Programmable Open Collector / Max. 30 Vdc, 20 mA Alarm indication by 2 LED
Response Time	Programmable 0.1s, 0.3s ~ 25s in 0.1s step
Digital I/O	RS-485, MODBUS, Max. 32 devices
Low Flow Cut-off	Programmable 0 to 25% of full scale
Linearization	Max. 15 points (Programmable)
Display	None

DSP Version

USC-731

Power & I/O Interface	24 Vdc \pm 10%
Power Consumption	3.6 W / Approx. 150 mA (Continuous) Max. 0.25 A, surge current
Ambient Condition	0°C to 50°C / 30~80% RH
Installation	Panel mounting
Enclosure Class	IP20 (Indoor use)
Materials	Panel-Acrylic Housing-Aluminum
Weight	Approx. 530g
EMC	EN61326
Electrical Connection	Detector Signal - SMB connector with lock to M-2001 Power & I/O Interface - Pluggable screw terminals
Analog Output	4 to 20 mA (Load resistance less than 500 Ohms) 0 to 10 Vdc 0 to 5 Vdc 1 to 5 Vdc
Scaled Pulse Output	Open Collector/ Max. 30 Vdc, 20 mA Pulse width: 0.5 mS (Max. 1000 Hz) 50 mS (Max. 10 Hz) 100 mS (Max. 5 Hz) (Select table depending on the pulse rate at full scale)
Flow Rate Alarm	High and Low flow rate Alarm Programmable Open Collector / Max. 30 Vdc, 20 mA Alarm indication by 1 LED, LCD (High / Low)
Response Time	Programmable 0.2s, 0.3s ~ 25s in 0.1s step
Digital I/O	None
Low Flow Cut-off	Programmable 0 to 30% of full scale
Linearization	Max. 15 points (Programmable)
Display	LCD/ 2 line 16 digits alpha numeric (With illuminator)

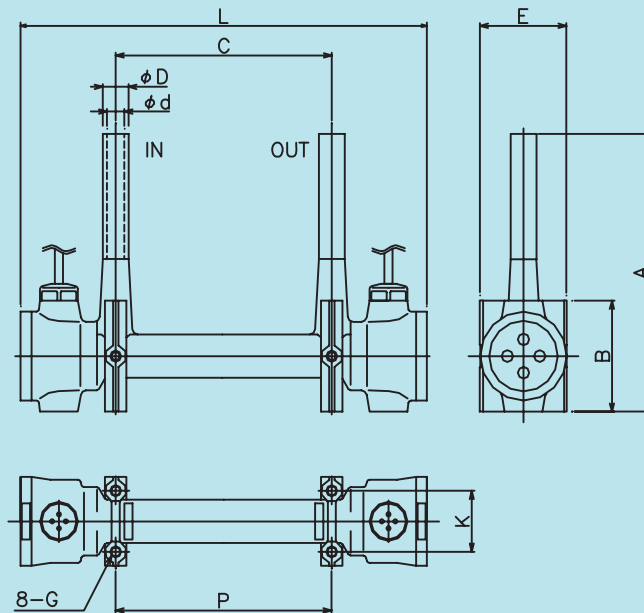
DSP Version

USC-741

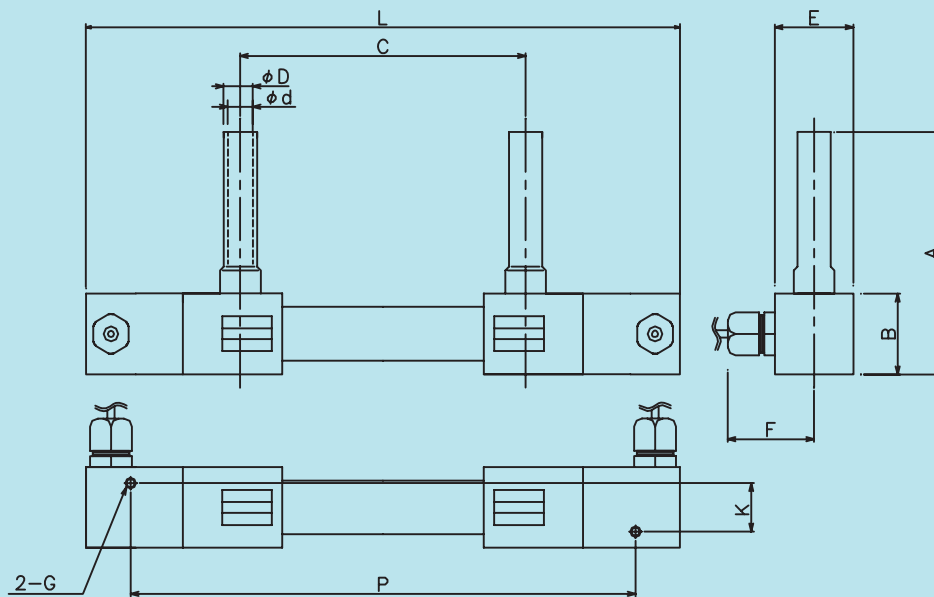
Power & I/O Interface	24 Vdc \pm 10%
Power Consumption	2.4 W / Approx. 100 mA (Continuous) Max. 1.3 A, surge current
Ambient Condition	0°C to 50°C / 30~80% RH
Installation	Panel mounting
Enclosure Class	IP20 (Indoor use)
Materials	Panel-Acrylic Housing-Aluminum
Weight	Approx. 530g
EMC	EN61326
Electrical Connection	Detector Signal - BNC connector to M-2001 Power & I/O Interface - Pluggable screw terminals
Analog Output	4 to 20 mA (Load resistance less than 500 Ohms) 0 to 10 Vdc 0 to 5 Vdc 1 to 5 Vdc
Scaled Pulse Output	Open Collector/ Max. 30 Vdc, 20 mA Pulse width: 0.5 mS (Max. 1000 Hz) 50 mS (Max. 10 Hz) 100 mS (Max. 5 Hz) (Select table depending on the pulse rate at full scale)
Flow Rate Alarm	High and Low flow rate alarm programmable Open Collector / Max. 30 Vdc, 20 mA Alarm indication by 2 LED
Response Time	Programmable 0.2s, 0.3s ~ 25s in 0.1s step
Digital I/O	None
Low Flow Cut-off	Programmable 0 to 30% of full scale
Linearization	Max. 15 points (Programmable)
Display	LCD/ 2 line 16 digits alpha numeric (With illuminator)

Dimensions (Flow Detectors)

M-2001 -04,-06



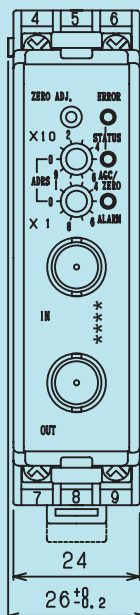
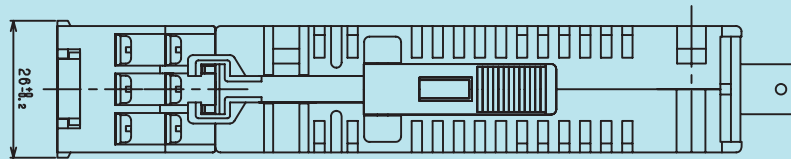
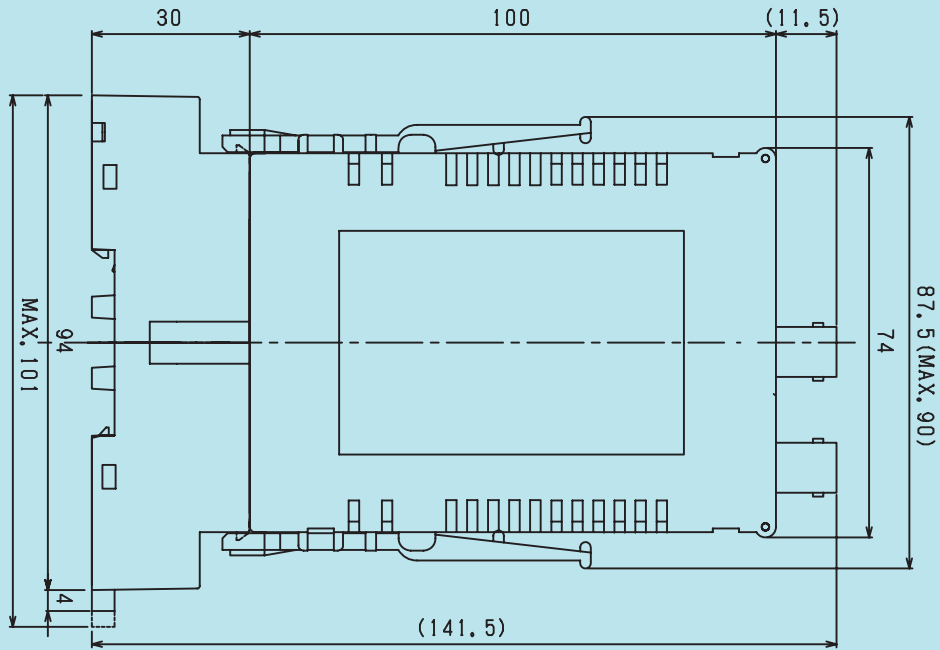
M-2001 -10,-15,-20



Range Code	Connecting tube Size	Dimensions(mm)											Mass(g)		
		D	d	C	L	A	B	E	F	G	K	P	Detector	Cable(16ft)	Total
04	3/8"	9.53	6.38	80±1	150±1	100	40	32	-	M4	22	80±1	160	140	300
06	3/8"	9.53	6.38	100±1	170±1	100	40	32	-	M4	22	100±1	200	140	340
10	1/2"	12.70	9.55	110±1	209±1	90	30	40	35	M4	18	193±1	420	140	560
15	3/4"	19.05	15.90	165±1	271±1	100	40	50	40	M5	26	253±1	760	140	900
20	1"	25.40	22.25	220±2	328±1	120	40	50	40	M5	26	310±2	880	140	1020

Dimensions (Converter USC 291/801)

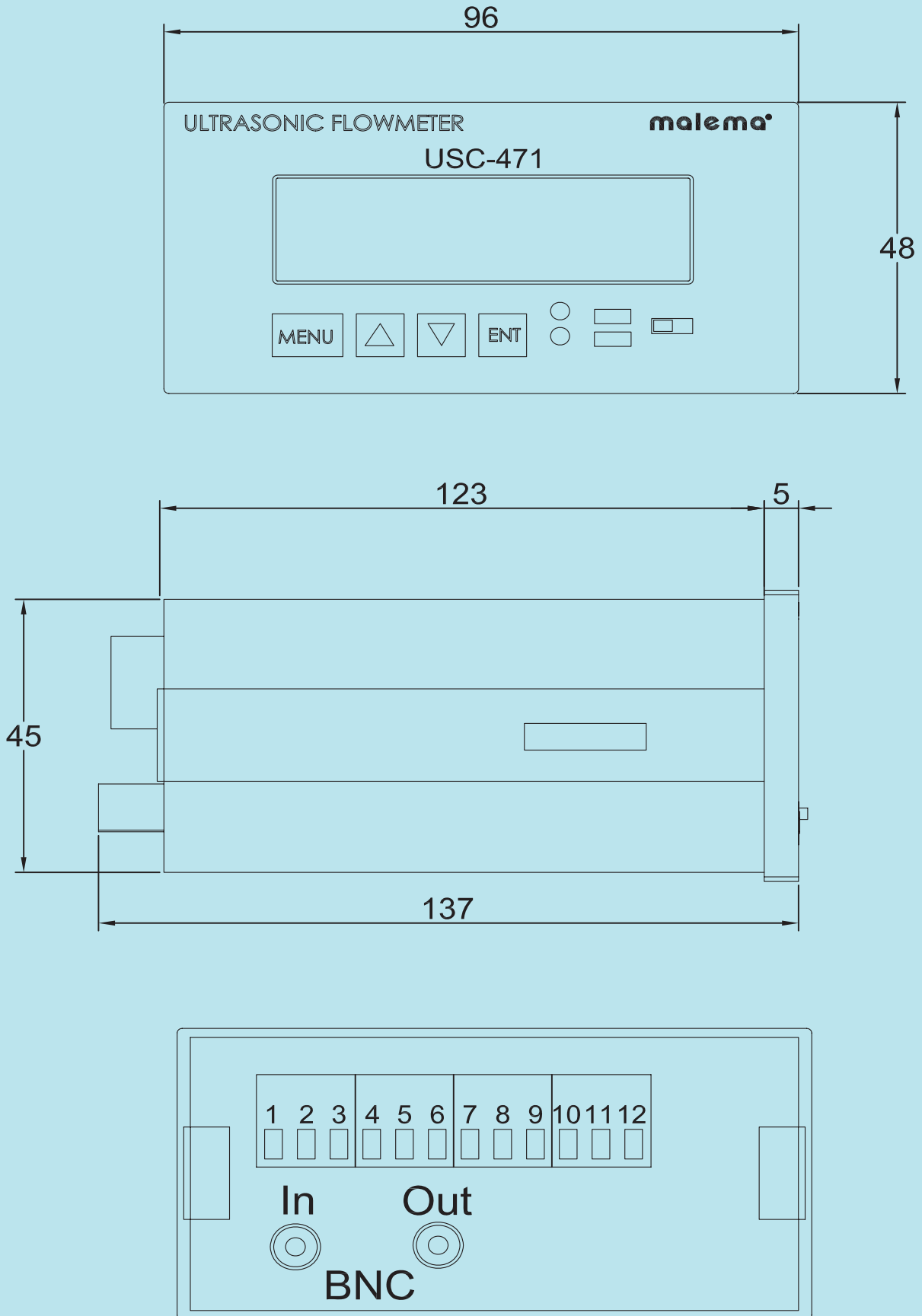
Dimensions in mm



BNC
Connectors

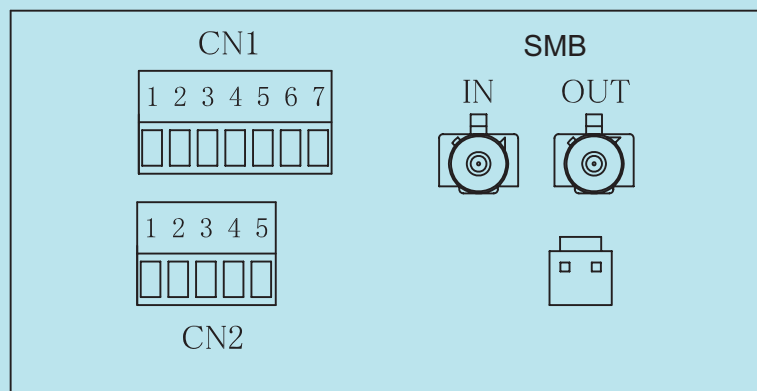
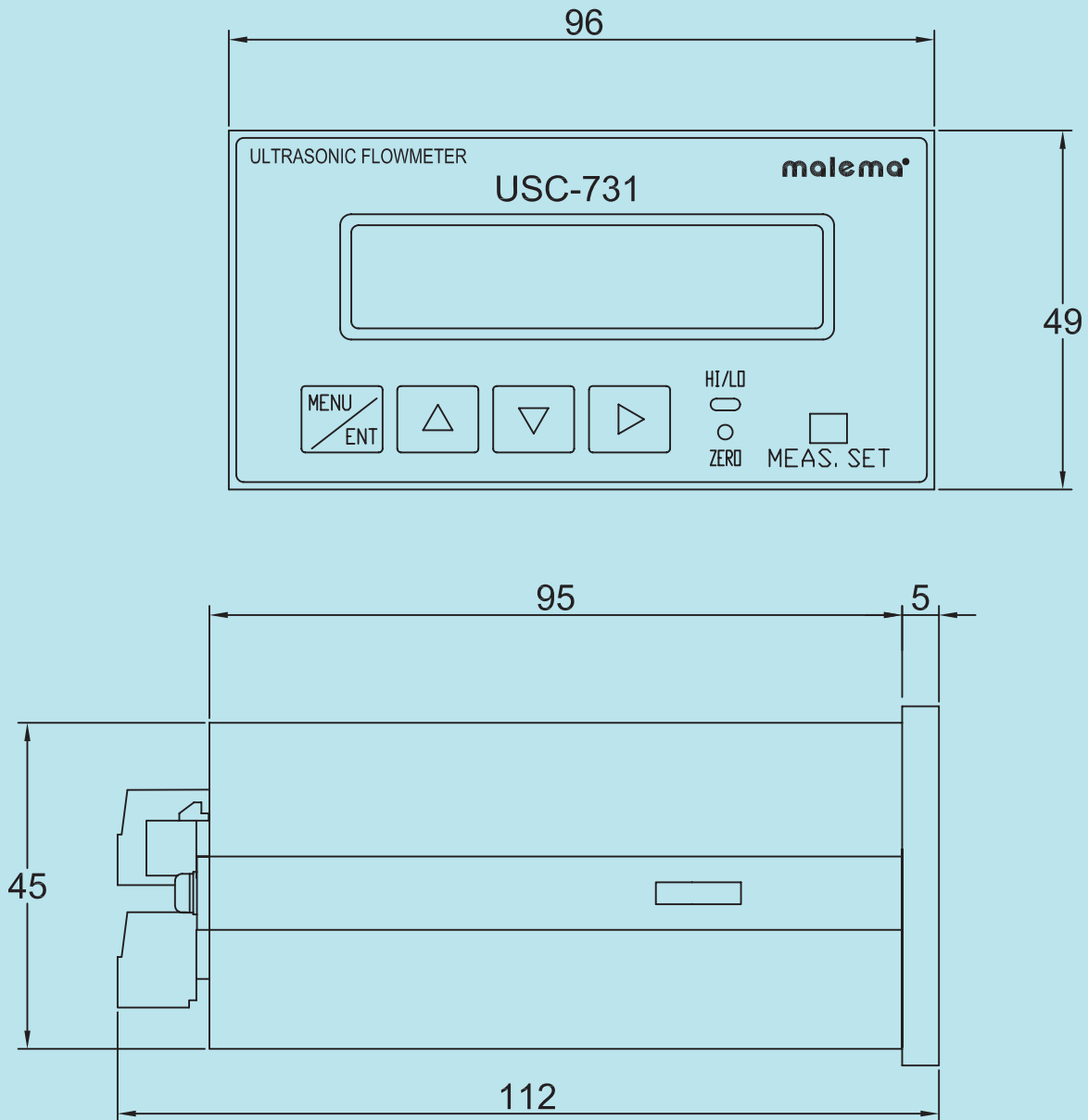
Dimensions (Converter USC 471)

Dimensions in mm



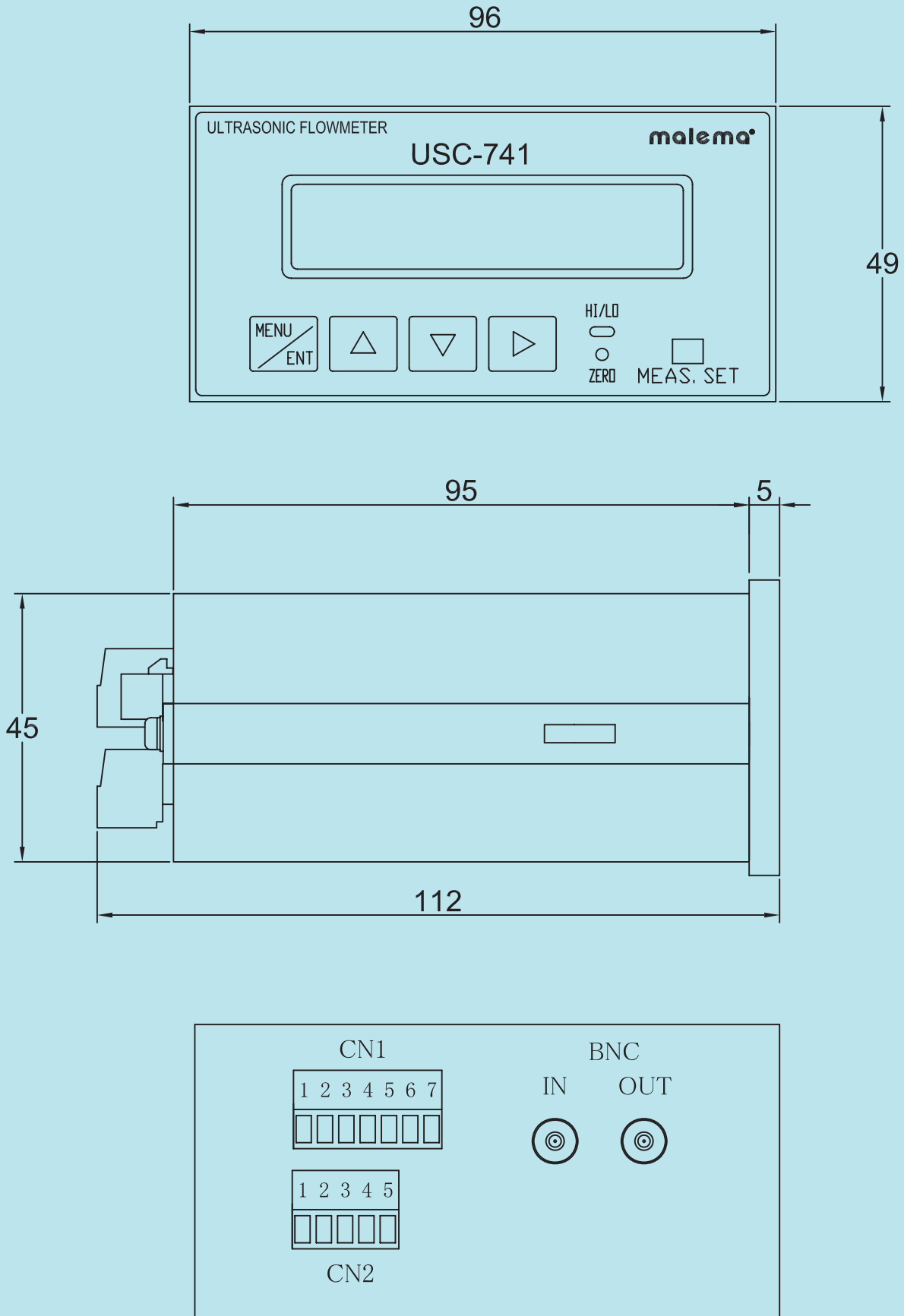
Dimensions (Converter USC 731)

Dimensions in mm



Dimensions (Converter USC 741)

Dimensions in mm



Ordering Information

Model Code											Description	
M-2001												
	-											
Tube Material	T											PFA
Tube Size	3											3/8" OD
	4											1/2"OD
	6											3/4"OD
	8											1"OD
Connection	1											Tube Ends
	2											Flare
	3											Pillar Super 300
Range Code	04											0 - 3 lpm
	06											0 - 8 lpm
	10											0 - 20 lpm
	15											0 - 50 lpm
	20											0 - 80 lpm
	-											
Converter Model	1											Standard w/Display (USC-471)
	5											DSP w/Display (USC-731)
	9											Standard w/ RS485 (USC-291)
	A											DSP w/ RS485 (USC-801)
	B											DSP w/Display (USC-741)
Analog Output Type	1											0 - 10 Vdc
	2											4 - 20 mA
	3											0 - 5 Vdc
	4											1 - 5 Vdc
	-											
Geometry	U											U - Shape
	Z											Z - Shape
	-											
										XXX		Unique PN Identifier