TM601 Plus

Operating Manual

Read the user's manual carefully before starting to use the unit.
Producer reserves the right to implement changes without prior notice.

Table of Contents

Safety Information

Please always observe the following safety instructions!
Please pay attention to the safety instructions with the following pictograms and signal words in these operating instructions :

Warning | Caution | Danger
Indicates a potential hazard. Failure to follow all warnings may lead to equipment damage, injury, or death.

Do Not Use Tools
Use of tool(s) may damage produced beyond repair and potentially void product warranty.

Intended Use

- The Flow Meter should only be used for measuring the flow of pure liquids without particles and bubbles.
- The Flow Meter can be used for various applications
- The manufacturer is not liable for any injury, damage or harm due to inappropriate or unintended use or modifications of the flow meter. Conversions and/or changes to the flow meter may only be made, if they are expressly performed in accordance with the operating instructions in this operating manual.

Personnel for Installation, Commissioning and Operation

- Assembly, electrical installation, commissioning and maintenance of the flow meter must be carried out by qualified, trained personnel. The qualified personnel must have read and understood the operating instructions in this operating manual and must follow the operating instructions in this manual.
- The installer has to ensure that the flow meter is correctly connected according to the electrical connection diagrams in this operating manual.
- Serious injury or death from electric shock may occur if wiring, installation, disassembly or removal of wires is performed while electrical power is energized

Technological Progress

The manufacturer reserves the right to revise, alter, or modify the flow meter to the most current technology without special prior notice. Further information about the latest updates and potential additions to these operating instructions are available from Flo-Instruments.

Product Description

Convenience, Accuracy and Value in an Ultrasonic Flow Meter

The TM Series clamp-on ultrasonic flow meters are easy to install with exceptional long life performance and they require no alteration to current piping configurations.

The sensor sends many signals/sec in order to provide accurate measurement of liquid flow rates in full pipes and can be used in low pressure systems.

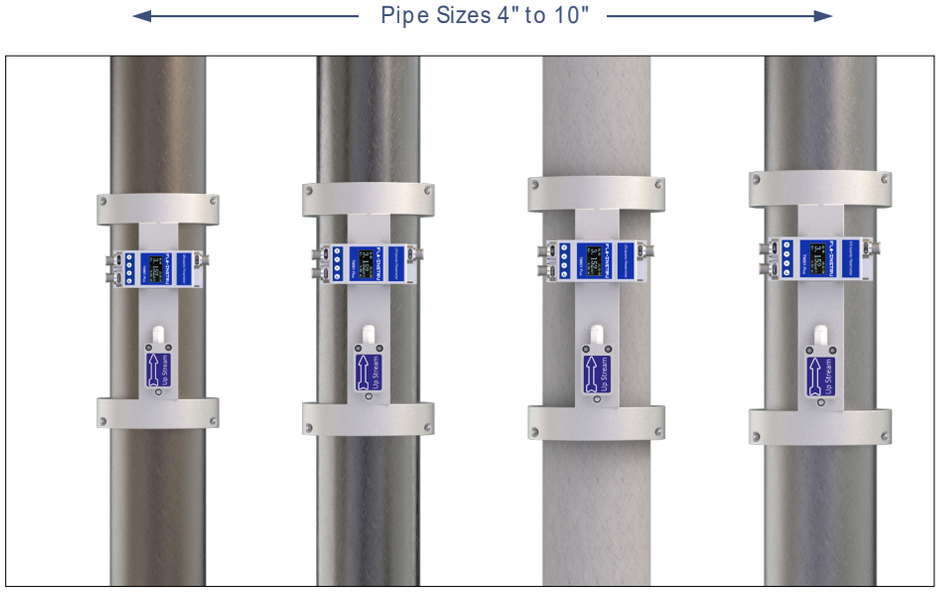
- Wide Dynamic Flow Range 0.328 ft/s ~ ±16ft/s (0.1m/s ~ ±5m/s)
- Light weight
- Aluminum alloy, CNC machined processing

TM601 Plus
Compact Ultrasonic Flow Meter

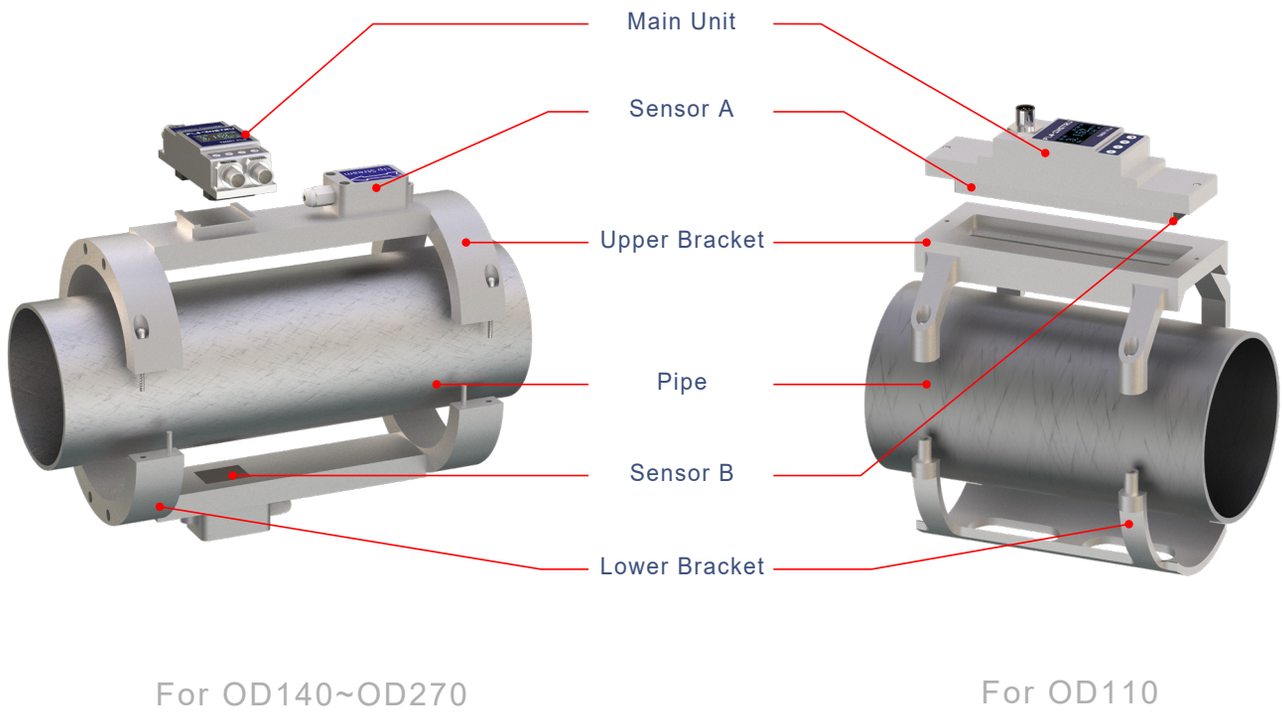
FLO-INSTRU

Features

- Under 2 Minute Installation Time
- No Contact with Liquid
- No Moving Parts
- Simple to Install-No Cutting of Pipe
- 4-20mA | RS485 Output
- Flow Rate + Totalizer | Resettable
- Simple Programming
- OLED Display
- Wide Dynamic Flow Range
  of 0.328 ft/s ~ ±16ft/s (0.1m/s ~ ±5m/s)
- ± 2.0% of Full Scale
- Pipe Sizes 4" - 10"
- Suitable for different applications



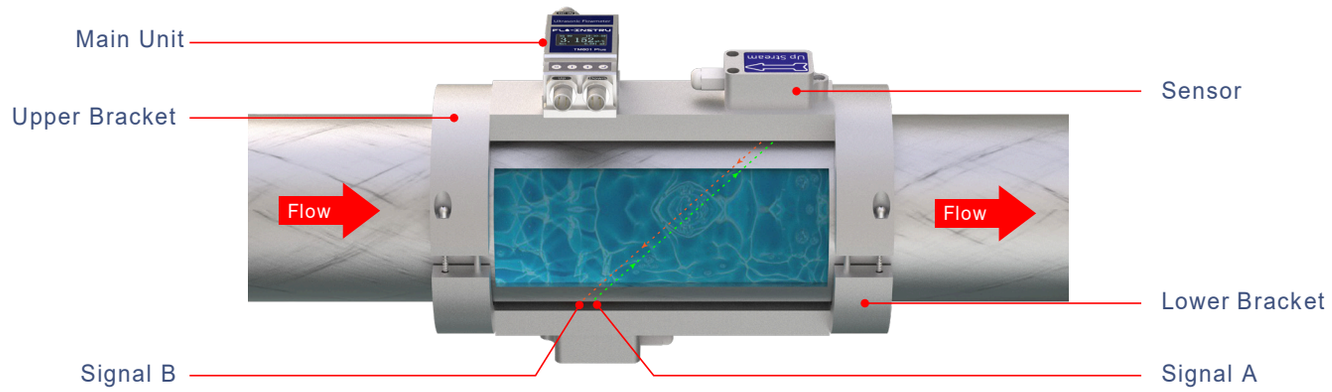
Exploded View



For OD140~OD270

For OD110

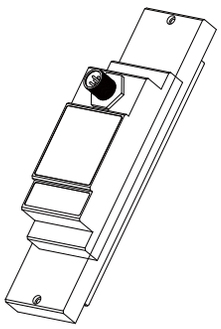
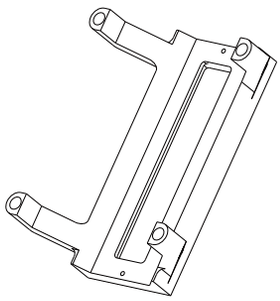
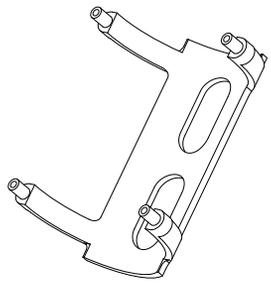
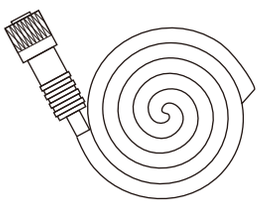
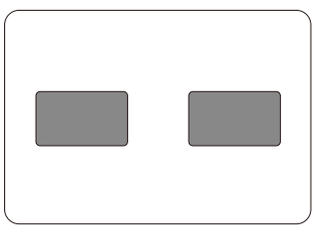
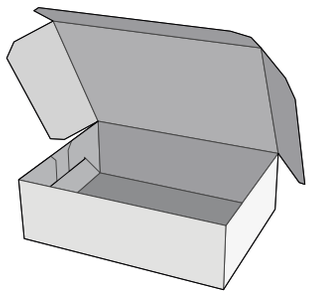
Working Principle



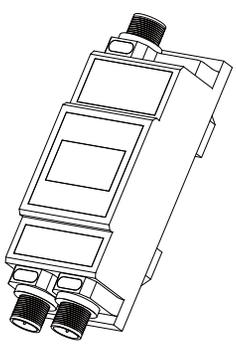
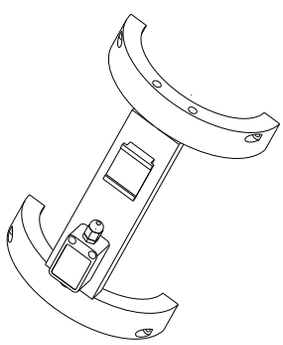
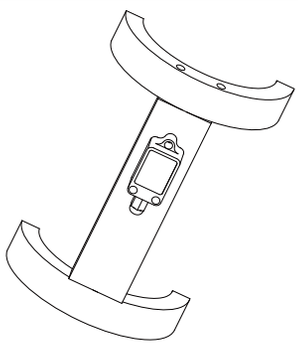
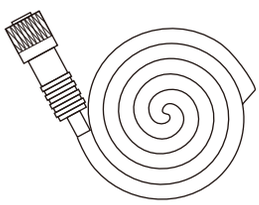
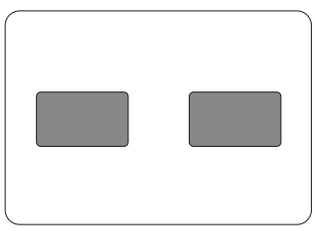
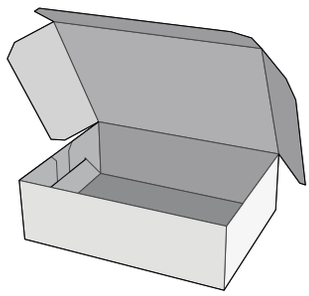
Technical Specifications

General	
Velocity Rate	0.328 ft/s ~ ±16ft/s (0.1m/s ~ ±5m/s)
Accuracy	± 2.0%
Pipe Size	DN100 DN125 DN150 DN175 DN200 DN225 DN250
Liquid	Regular water, sea water, cooling/hot water, alcohol...
Pipe Material	PVC, stainless steel, carbon steel, copper...
Power Supply	24V DC, maximum 500mA
Communication	Support MODBUS protocol, RS485
Analog Output	4-20mA, Maximum 600Ω
Alarm Output	OCT upper and lower limit alarm function (optional)
Display	OLED 128*64 dot-matrix display screen
Key Panel	Four touch buttons
Flow Unit	Support metric unit selection, Cubic Meters(m^3), Liters(l), USA Gallons(gal).
Time Unit	/hour, /min, The factory default unit is cubic meters per hour.
	Daily, Monthly, and Annual Flow Totalizer
Temperature	Ambient: 32℉ ~ +122℉ (0℃ ~ +50℃)
	Liquid: 32℉ ~ +122℉ (0℃ ~ +50℃)
Ambient Humidity	RH 0~95%, No condensation
Housing Material	Aluminum alloy, CNC machined processing
Protection Rate	IP54
Cable Length	6.6ft (2m) standard

Components-For OD110

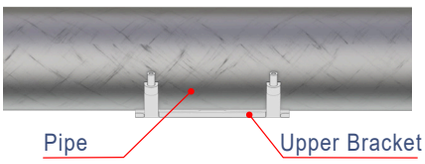
01  Main Unit	02  Upper Bracket	03  Lower Bracket
04  Cable	05  Coupling Pad	06  Box

Components-For OD140~OD270

01  Main Unit	02  Upper Bracket	03  Lower Bracket
04  Cable	05  Coupling Pad	06  Box

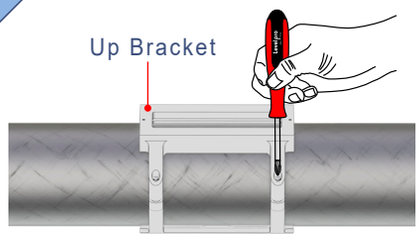
Installation and Connection-For OD110

01



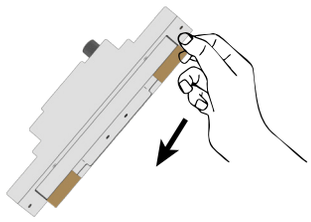
Make sure no dirt, paint, or other stains on the surface of the tube. If the surface of metal pipes is rough, it needs to be polished with tools. Then put the bottom parts on the side of the pipe.

02



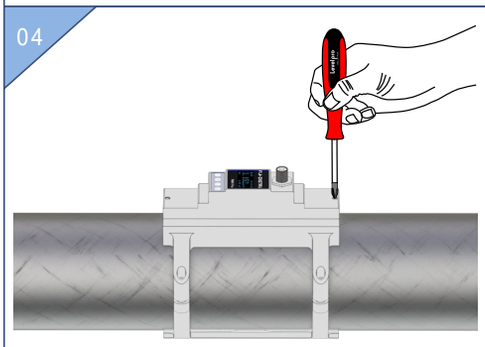
Align the bracket to the pipe position; Install screw on top part of the bracket, the bottom part of the bracket will automatically connect with the top part. Tighten all four M4 screws.

03



Take the cover off the sensor.

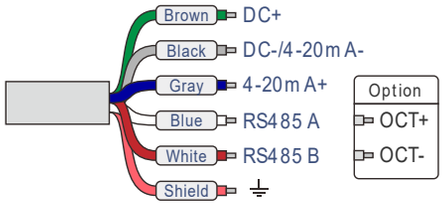
04



Attach the transmitter into the up bracket.

05

Wiring Diagram



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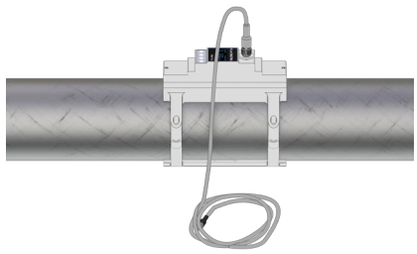
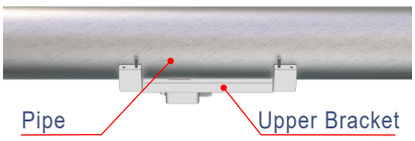


Connect the cable, then power on. The installation is finished.

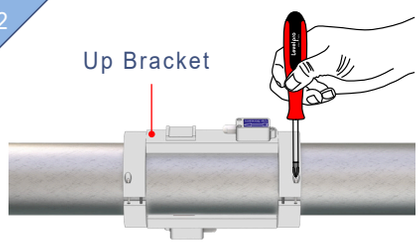
Installation and Connection-For OD140~OD270

01



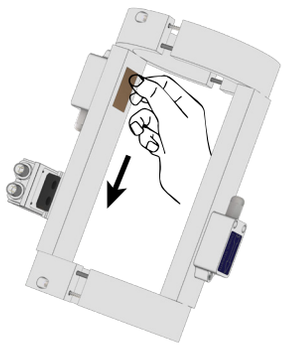
Align flow meter to the pipe position, Put the down bracket in place.

02



Put the up part into the bracket, and fasten the four screws.

03



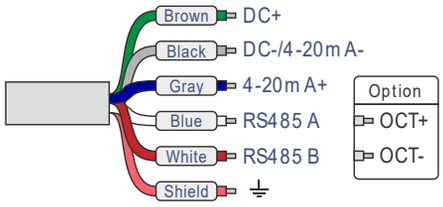
Take the cover off the sensor.

04

Attach the transmitter into the up bracket.

05

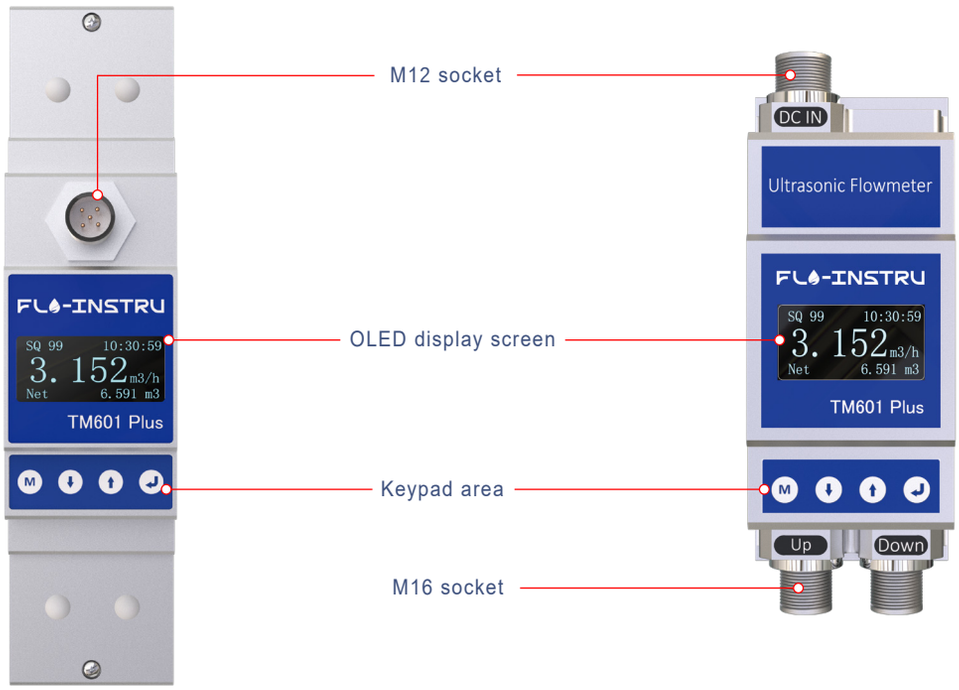
Wiring Diagram



06

Connect the cable, then power on. The installation is finished.

Panel Function



(For OD110) (For OD140~OD270)

Keypad Functions

Follow these Guide Lines when using the Flow Meter Keypad:

Press (M) to Enter the Programming Mode or to return to the previous menu during programming.
Press (↓)(↑) to Scroll Up or Down
Press (↓) to move to the Next Digit
Press (↑) to Select Digits (0-9)
Press (↵) to Confirm.

Powering ON

When connected to a VDC Power Supply the flowmeter will begin to run self-diagnosis program.

Signal Quality (SQ value)

SQ value is short for Signal Quality. It indicates the level of the signal detected. SQ value is indicated by numbers from 0~99 is the minimum signal could be detected and 99 represents the maximum. Normally, the transducer position should be adjusted repeatedly and coupling compound should be checked frequently until the signal quality detected is as strong as possible.

Display Description

STEPS	DISPLAY	OPERATION
Main screen Press Key Totalizer Press Key Flow Rate / S.TOT Totalizer Press Key Flow Rate / Velocity / Net Totalizer Press Key Velocity / Net Totalizer	SQ99 12:30:18 3.368 m³/h Net 768.89m³	When power is on, The meter will display Flow Rate/Net Totalize. Display signal quality. Time, flow rate and net totalize.
	Runtime 216h Day 79.068m³ Mth. 3839.8m³ Year 3768 m³	Press ▼ will display Run time/Daily Totalizer /Month Totalize /Year Totalize, press ▲ will return to previous menu. Display Run time, Date, Month and Year net totalize.
	SQ99 12:30:18 3.368 m³/h S.ToT 23.89m³	Press ▼ will display Flow Rate/ S.TOT Totalize, press ▲ will return to previous menu. Display signal quality. Time, flow rate and S.ToT totalize.
	SQ99 12:30:18 Vel 1.068m/s Flow 3.339m³/h Net 768.89m³	Press ▼ will display Flow Rate/ Velocity/Net Totalize, press ▲ will return to previous menu. Display signal quality. Time, velocity, flow rate and net totalize.
	20-03-18 12:30 1.868 m/s Net 768.89m³	Press ▼ will display Velocity/Net Totalize. Press ▲ will return to previous menu. Display date and time,velocity and net totalize.

Setup Menu

STEPS	DISPLAY	OPERATION
Main screen Press M Key Setup Menu	SQ99 12:30:18 3.368 m³/h Net 768.89m³	Power on Main Display shows Flow Rate & Net Totalizer
	Setup menu 0.Pipe parameter 1.System setting 2.Calibration	Press M to display Setup Menu. The following options are available (using the ▲ or ▼ buttons) 0. Pipe parameter 1. System setting 2. Calibration 3. Output setting 4. History data

Pipe Parameter Setup Menu

STEPS	DISPLAY	OPERATION
Setup Menu Press ↓ to ↵ Key Pipe Parameter	Pipe Setting 0.Outer diameter 1.Wall thickness 2.Material	Press ↓ , select 0. pipe parameter, then ↵ to display. The following options are available (using the ↓ or ↑ buttons) 0. Outer diameter 1. Wall thickness 2. Material: Press ↓ or ↑ can option PVC, Carbon steel, Steel, Copper, PVDF, PFA, PTFE, PU pipe etc. 3. Fluid type: Press ↓ or ↑ to choose between Water, Sea Water, Oil etc.

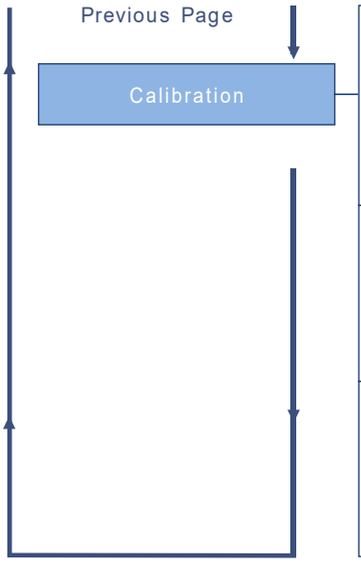
System Setting Setup Menu

STEPS	DISPLAY	OPERATION
Setup Menu Press ↓ to ↵ Key System Setting	System setting 0.System unit 1.Flow rate unit 2.Total unit	Press ↓ , select 1. System setting, then ↵ to display. The following options are available (using the ↓ or ↑ buttons) 0. System unit: Press ↓ or ↑ to choose between Metric, English 1. Flow rate unit: Press ↓ or ↑ to choose between m^3h, LPM, GPM 2. Total unit: Press ↓ or ↑ to choose between m^3, L, GAL. 3. Total RESET: Press ↵ then Parameters will be reset.
	yy-mm-dd hh:mm 20-03-18 12:30	4. Time set: When modifying, the default is 30 seconds. Generally, it is unnecessary to modify date & time as the system is equipped with a highly reliable perpetual calendar chip.
Press ↓ Key Next Page		5. System lock: Once the system is locked, any modifications to the system are prohibited, but the parameter is readable. "Unlock" using your designated password. The password is composed of 1 to 4 numbers. System lock / System unlocked → System lock / ENT to lock → ENT key word / 0000 → System lock / System locked OK System lock / System locked → System lock / ENT to unlock → ENT key word / 0000 → System lock / System unlocked OK 6. System INFO: Display serial number (SN) of the meter. This SN is the only one assigned to each flow meter ready to leave the factory. The factory uses it for files setup and for management by the user. Press ↵ 5 times to enter Manual Totalizer: The manual totalizer is a separate totalizer. Press ↵ to start, and press ↵ to stop it. It is used for flow measurement and calculation. System INFO / Flowmeter / SN:30001399 / V1.00 → Manual Totalizer / ENT To Start → Manual Totalizar / ENT To Stop / 1.239 m3/h / SQ 99 1.056L → Manual Totalizer / ENT TO Restart / 1.239 m3/h / SQ 99 1.056L

STEPS	DISPLAY	OPERATION
Previous Page System Setting	Display dir 0.Normal 1.Inversion	7. Display dir.: Select the display direction of the screen, which can be rotated by 180 degrees.
	Damping 003	8. Damping: When the flow regime is unstable and the display value changes greatly, damping can be set to adjust the measurement response speed of the product. The unit is in seconds.
	Display format 0. x0.001 1. x0.01 2. x0.1	9. Display format: The display digit of the measured value can be set through the zoom function. It is displayed after the decimal point by default 3 digits. You can choose to display 2 digits after the decimal point, 1 digit after the decimal point and 0 digit after the decimal point.

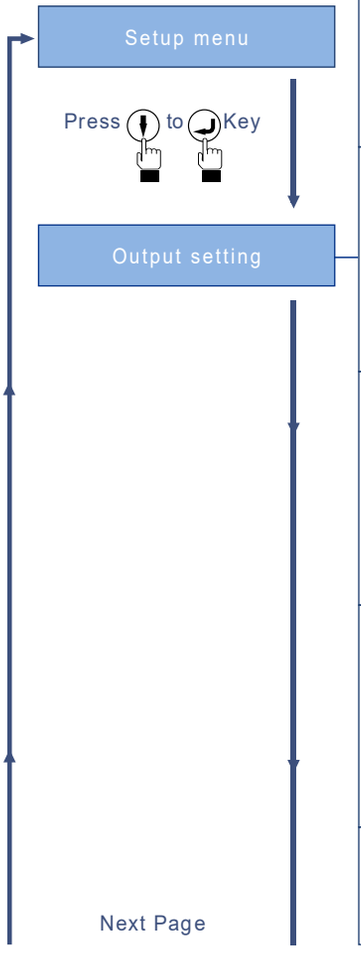
Calibration Setup Menu

STEPS	DISPLAY	OPERATION
Setup menu Press ↓ to ↵ Key Calibration	Calibration 0.Scale factor 1.4-20mA CAL 2.Set zero	Press ↓, select 2.Calibration, then ↵ to display. The following options are available (using the ↓ or ↑ buttons)
	Scale factor 1.000	0. Scale facetor: Refers to the ratio between "actual value" and "reading value". For example, when the measurement is 2.00, and it is indicated at 1.98 on the instrument, the scale factor reading is 2/1.98 This means that the best scale factor constant is 1.01.
	4mA Calibrate 25492 20mA Calibrate 4555	1. 4-20mA CAL: Check if the current loop has been calibrated before leaving the factory. Press ↓ move ↑ to display 4mA or 20mA, and at The same time, check with an ammeter to verify that Current Loop output displayed values. It is necessary to re-calibrate the current loop, if over the permitted tolerance. The displayed value has no meaning, but is only used for Internal records. Correct only by up and down Key operation, check the displayed value of ammeter (multimeter).
	Set zero Ent To set zero Reset zero	2. Set zero: Press ↵ reset "Zero Point" which was set by the user. After setting, return to the main interface and the flow is "0". If you return to the main interface, the flow is not "0", the setting is unsuccessful. Check whether the installation is correct or not.
Next Page	Low flow cut 0.0500 m/s	3. Lowflow cut: Flow rate falls below the low flow cutoff value. This function can prevent that when the pump stops working and the liquid flows at a low speed in the pipe, data accumulation error caused by continuous reading of flow meter. Input is generally recommended 0.05m/s as the low flow cut-off point.The low flow



Low flow cut 0.0500 m/s	cut-off value is independent of the measurement results. Generally, pipes made of SS304 or SS316 are with wall thickness of more than 2mm.In practical use, it will receive false signals due to the interference of pipe wall signals, It is recommended that the low flow rate should be cut off at 0.08m/s or above.
Manual zero 0.0000 m3/h	4. Manual zero: This method is not commonly used and is only suitable for experienced operators. It is not suitable for other parties, Manually input the value and add it to the measured value to obtain the actual value.
Hi AGC 0. OFF	5. Hi AGC: High gain switch do not needs to be set generally. could try to switch on for special pipes with weak signal detected.

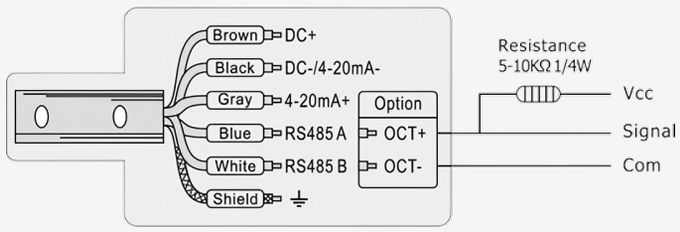
Output Setting Setup Menu



STEPS	DISPLAY	OPERATION
	Output setting 0.RS485 Setup 1.4-20mA range 2.Alarm value	Press , select 3.Output setting, then to display. The following options are available (using the or buttons)
	RS485 Setup 0.Network addr 1.RS485 Baudrate	0. RS485 Setup: The window is used to set serial port. Its connection with the equipment of its serial port set of parameters must match. Firstly to choose baud rate: 2400, 4800, 9600, 19200.Secondly to choose: None. Data digit length is 8, Stop bit for a fixed length; Factory serial port parameters default is"9600, 8, None,1".
		1. 4-20mA rang: Set the Current Loop output value according to the flow value at 4mA, and 20mA. The flow unit is m3/h. 4mA value 0.00 m3/h 20mA value 15.00 m3/h
	Alarm value 0.Low value 1.High value	2. Alarm value(Option): Enter the low alarm value; any measured flow lower than the low value. will activate the alarm in the OCT hardware or relay output signal. Enter the high alarm value; any measured flow higher than the high value, will activate the alarm in the OCT hardware or relay output signal.
		3. OCT output(Applicable to OCT output model): The OCT output in the flow meter is a kind of isolated collector open circuit output with programmable open and close qualifications. The user can

Previous Page

Output setting

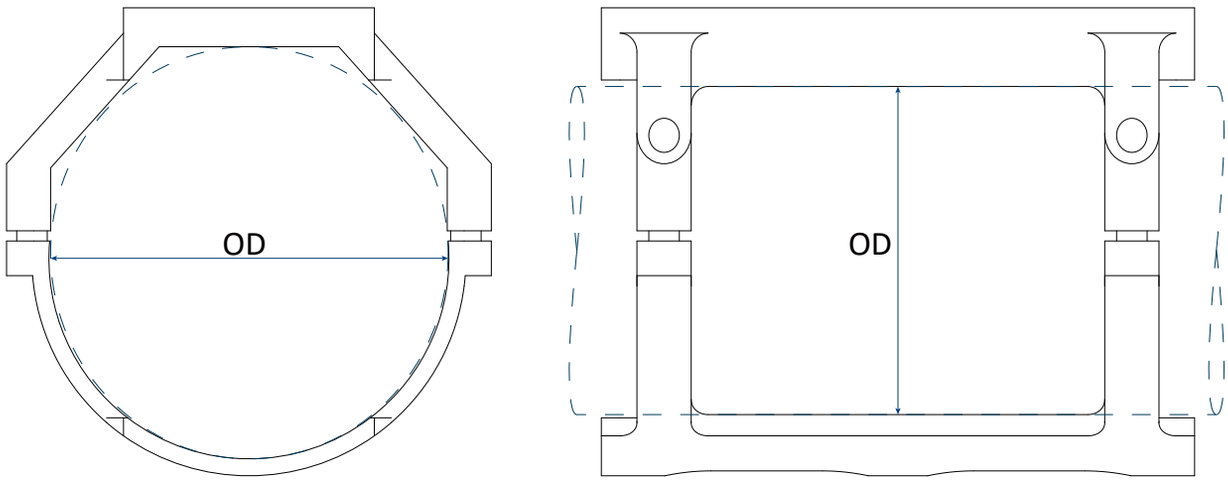
OCT output 0.Total Pulse 1.Alarm output 2.No Signal	program the open and close functions under the following conditions: the system alarm signals are being activated or the totalizer pulse is being transmitted. Pulses are cumulative output, and the equivalent of each pulse is 0.01L~ 100m3, It can be set through the menu. The maximum number of pulses output per second is 40. OCT wiring diagram: To select OCT output, an external 5-10K pull-up resistor shall be connected at the OCT + end; Add a 5-24V DC power supply at VCC and com ends, as shown in the figure: 
OCT output 0.Total Pulse 1.Alarm output 2.No Signal	4. OCT multiplier (Applicable to OCT output model): Select OCT pulse output multiple.

History data Setup Menu

STEPS	DISPLAY	OPERATION
History data	OCT output 0.Total Pulse 1.Alarm output 2.No Signal	Press ↓, select 4.History data, then ↵ to display. The following options are available (using the ↓ or ↑ buttons) 0. By Day: Display Totalizer flow for days 1. By Month: Display Totalizer flow for months. 2. By Year: Display Totalizer flow for years.

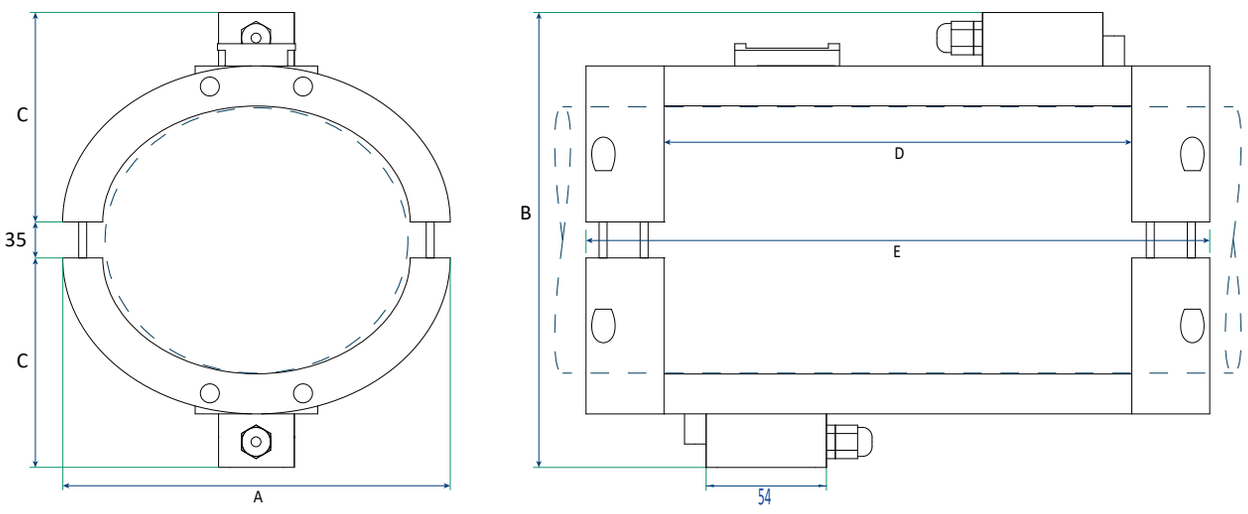
Product Dimension-For OD110

Model	Min OD	Max OD
Φ110	Φ108	Φ116



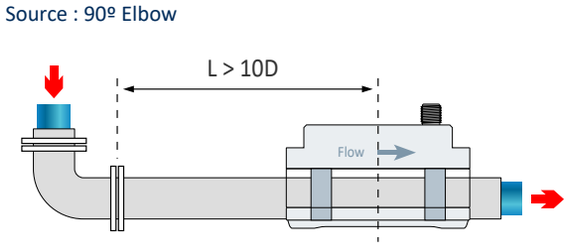
Product Dimension-For OD140~OD270

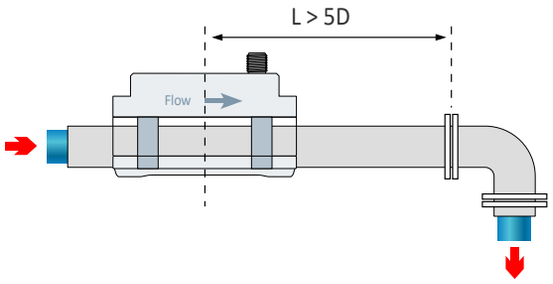
Model	A(mm)	B(mm)	C(mm)	D(mm)	E(mm)	Min OD(mm)	Max OD(mm)
DN125	172.0	185.0	75.0	148.0	212.0	115.0	142.0
DN150	199.0	212.0	88.5	163.0	227.0	142.0	169.0
DN175	226.0	239.0	102.0	176.0	240.0	169.0	196.0
DN200	253.0	266.0	115.5	188.0	252.0	196.0	223.0
DN225	280.0	293.0	129.0	199.0	263.0	223.0	250.0
DN250	307.0	320.0	142.5	212.0	276.0	250.0	277.0



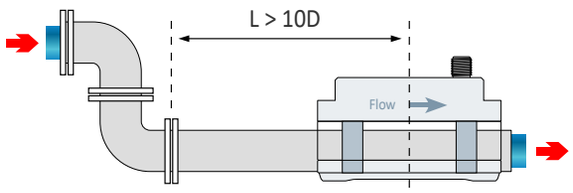
Installation Positions

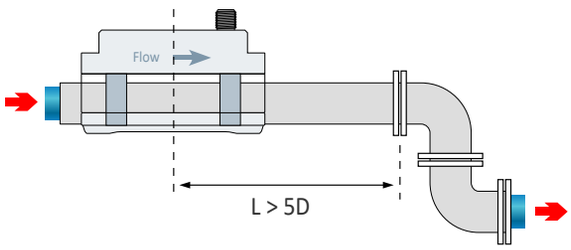
Source : 90º Elbow



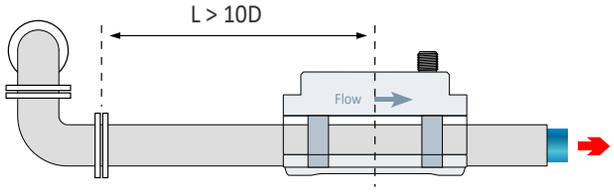


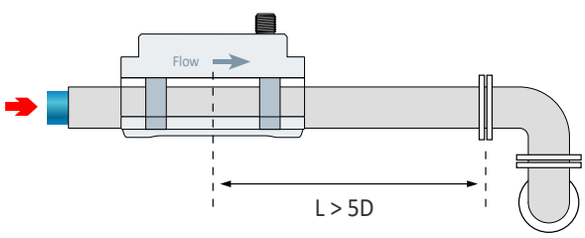
Source : 2 x 90º Elbow in One Plane



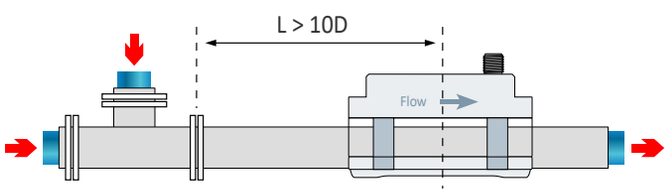


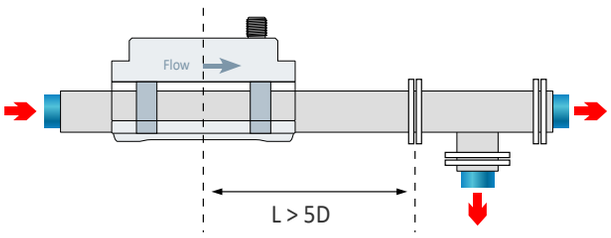
Source : 2 x 90º Elbow in Different Plane



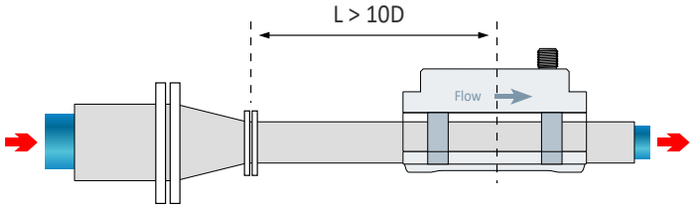


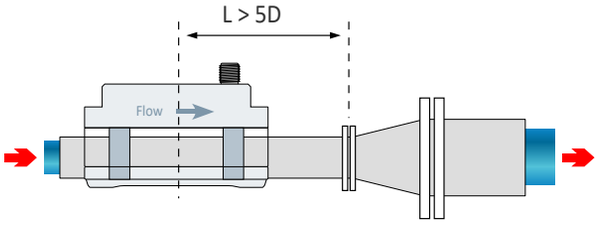
Source : T-Section





Source : Reducer

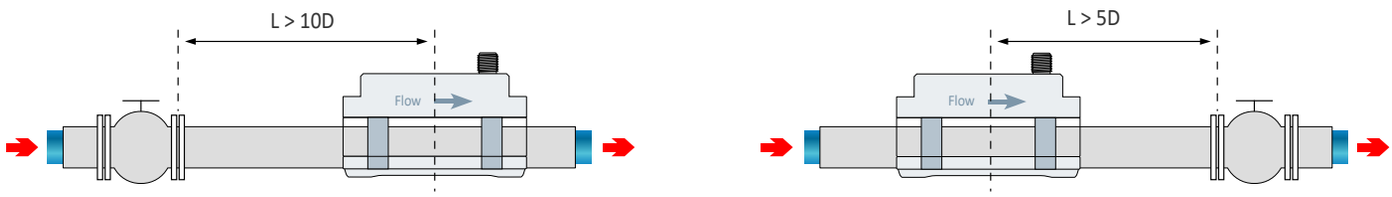




Installation Positions

Source : Diffuser

Source : Valve



Pipeline Specifications & Flow Range

DN	OD	OD Range	Inch	Flow Range
DN100	OD110	108mm-116mm	4"	2.917 ~ 145.858 m3/h 48.619 ~ 2430.963 l/min 12.844 ~ 642.194 gal/min
DN125	OD140	115mm-142mm	5"	4.558 ~ 227.903 m3/h 75.968 ~ 3798.380 l/min 20.069 ~ 1003.429 gal/min
DN150	OD160	142mm-169mm	6"	6.564 ~ 328.180 m3/h 109.393 ~ 5469.666 l/min 28.899 ~ 1444.938 gal/min
DN175	OD190	169mm-196mm	7"	8.934 ~ 446.689 m3/h 148.896 ~ 7444.824 l/min 39.334 ~ 1966.721 gal/min
DN200	OD220	196mm-223mm	8"	11.669 ~ 583.431 m3/h 194.477 ~ 9723.852 l/min 51.376 ~ 2568.778 gal/min
DN225	OD240	223mm-250mm	9"	14.768 ~ 738.405 m3/h 246.135 ~ 12306.750 l/min 65.022 ~ 3251.109 gal/min
DN250	OD270	250mm-277mm	10"	18.232 ~ 911.611 m3/h 303.870 ~ 15193.518 l/min 80.274 ~ 4013.715 gal/min

Communication protocol

This instrument protocol supports the following function codes of the MODBUS protocol:

Function code	Represents functional data
0x03	Read register

1.MODBUS Protocol function code 0x03 use

The host sends out the frame format of the read register information:

Slave	Operation function	Register header address	Register number	checkcode
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01~0xF9	0x03	0x0000~0xFFFF	0x0000~0x7D	CRC checkcode

Data frame format from the slave:

Slave address	Read operation	Number of bytes of	Data	checkcode
1 byte	1 byte	1 byte	N*x2 byte	2 byte
0x01~0xF9	0x03	2xN*	N*x2 data	CRC check code

N*＝Number of data registers.

The address of the meter (the address of the flow meter) ranges from 1 to 249 (hex: 0x01 to 0xF9). The address can be viewed in the Menu Network addr. If the decimal number displayed in Menu Network addr is 12, then the address of this meter in the MODBUS protocol is: 0x0C.

The CRC check code of this instrument is obtained by CRC-16-IBM (polynomial X16 + X15 + X2 + 1, mask word 0xA001) cyclic redundancy algorithm, the low byte of the check code is first, and the high byte is after.

2.MODBUS Register address list

The meter's MODBUS register contains a read-only register and a single write register。

a)Read-only register address list (read with 0x03 function code)

Register address	Register	Data description	Date Type	Number of registers	Description
0000	40001	Flow velocity-low byte	32 bits real	2	Unit: m/s
0001	40002	Flow velocity-high byte			
0002	40003	Instantaneous flow rate low byte	32 bits real	2	
0003	40004	Instantaneous flow rate high byte			
0004	40005	Flow totalizer low byte	32 bits real	2	
0005	40006	Flow totalizer high byte			
0006	40007	Flow totalizer integer Low byte	32 bits int.	2	
0007	40008	Flow totalizer integer high byte			
0008	40009	Flow totalizer decimal-low byte	32 bits real	2	
0009	40010	Flow totalizer decimal-low byte			
000A	40011	Today totalizer integer-low byte	32 bits int.	2	
000B	40012	Today totalizer integer high byte			
000C	40013	Today totalizer decimal-low byte	32 bits real	2	
000D	40014	Today totalizer decimal-high byte			
000E	40015	Monthly totalizer-low byte	32 bits real	2	
000F	40016	Monthly totalizer-low byte			
0010	40017	Yearly totalizer low byte	32 bits real	2	
0011	40018	Yearly totalizer-high byte			
0012	40019	4-20mA output value low byte	32 bits real	2	
0013	40020	4-20mA output value high byte			
0014	40021	Running time low byte	32 bits int.	2	Unit : s
0015	40022	Running time high byte			
0016	40023	Meter Serial Number Character 1,2	String	4	
0017	40024	Meter Serial Number Character 3,4			
0018	40025	Meter Serial Number Character 5,6			
0019	40026	Meter Serial Number Character 7,8			

001A	40027	Date and Time		3	Year,month, day,hour,minute,second
001B	40028				
001C	40029				
001D	40030	Signal Quality Q	16 bits int	1	
001E	40031	Running Status	16 bits int	1	
001F	40032	Meter Address (1-249)	16 bits int		
0020	40033	Communication baud rate 0 =2400, 1	16 bits int		
0021	40034	Flow velocity unit	String		m/s or f/s
0022	40035				
0023	40036	Instantaneous flow rate unit	String		
0024	40037				
0025	40038	Flow totalizer unit	String		

b) Single write register address list (write with 0x06 function code)

Register	Register	Data description	Read/write	Date Type	Number of
1003	44100	Meter Address (1-249)	R/W	16 bits int.	1
1004	44101	Communication baud rate 0 =2400, 1 =	R/W	16 bits int.	1
1005	44102	Instantaneous flow rate unit	R/W	16 bits int	1
1006	44103	Flow totalizer unit	R/W	16 bits int	1

Note:

1. The instantaneous flow unit has the following options:

0. 0x30 — m3/h	1. 0x31 — LPM	2. 0x32 — GPM

2. The flow totalizer unit has the following options:

0. 0x30 — m3	1. 0x31 — L	2. 0x32 — GAL

3. When changing the address or communication baud rate of the instrument, the instrument will work at the new address or communication baud rate immediately after the instrument returns a response at the original address or communication baud rate.

   16 bits int－Represents a short integer ， 32 bits int－Represents a long integer ， 32 bits real－Represents a floating point number ， String－Represents a string, BCD-Represents a decimal number

Warranty & Scope of warranty

Flo-Instruments' products have been strictly tested before leaving factory. If any malfunction occurs, please contact us or our agents immediately and provide details of the malfunction.

Warranty

The warranty period is one full year from date of shipment

Scope of warranty

- If any malfunction is caused by within the one-year warranty,we would repair the product free of charge.
- The following situations are not covered by the warranty.
- If product is not used properly in accordance to the manual or technical requirements (including unsuitable conditions, unsuitable environment, etc.).
- If the malfunction is caused by purchasers or purchasers' software.
- If product is amended or fixed without permission.