AFD4XXX Datasheet

Vortex Liquid Flow Meter

- Excellent repeatability, high precision
- Low pressure loss, resistant to pollution
- Vortex measurement principle, no moving parts

Product Summary

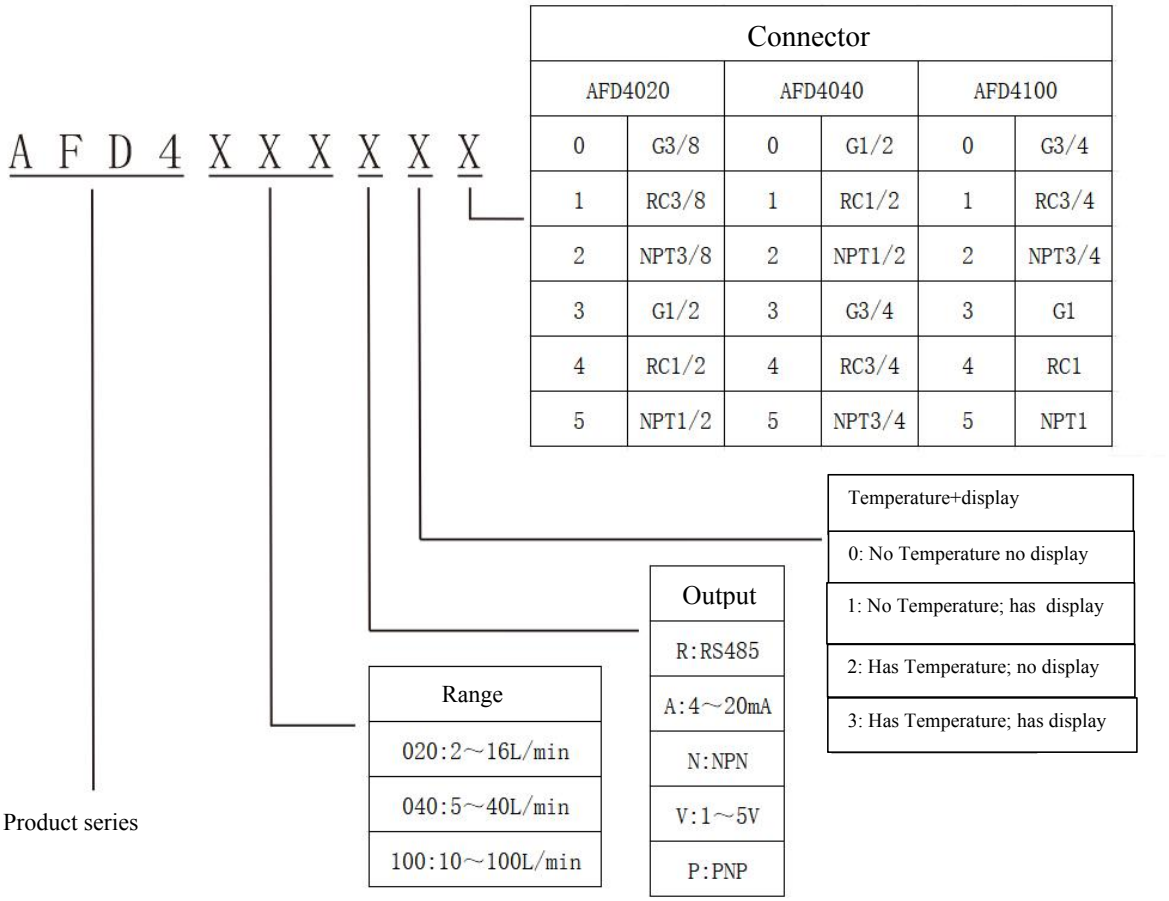
The AFD4 series is a vortex water flow sensor based on the principle of Von Karman vortices. When a certain volume of fluid flows around the spoiler column under certain conditions, double row linear vortices with opposite rotating directions and regular arrangement will periodically form on both sides of the spoiler column, forming a Karman vortex street. The sensor senses the frequency of the vortex flow through the internal chip, thereby measuring the liquid flow rate flowing through the pipe. The sensor features long life, resistance to contamination, high accuracy, fast response and no drift, making it ideal for demanding and cost-sensitive applications.

Applications

The AFD4 series flow sensor is a commonly used measuring instrument with a sturdy housing and compact structure. It can provide multi-functional sensing for harsh industrial production environments, energy measurement, environmental protection, laboratory environments, transportation and other application scenarios.

Figure 1. AFD4 series flow sensor photos

1. Product SN



2. Technical Parameters

Table 1. Technical Paramters

Parameter	Value
Measure range	2 ~ 16 L/min、5 ~ 40 L/min、10 ~ 100 L/min
Liquid temperature range	0 ~ 90℃
Flow accuracy	< ±3.0%F.S(flow)
Temperature accuracy	±5%F.S.max.(0 ~ 90℃,25℃)
Repeatability	< 2.0%
Liquid contact material	PPS/SUS304(Stainless steel)
Pressure	10bar(Max 16bar)
Working temperature	-10 ~ 65℃
Connector	Thread type: G or RC or NPT
Power supply	18 ~ 28VDC
Output signal	Three-wire system 4 ~ 20mA or RS485 or NPN or PNP or 1 ~ 5V

3. Pin Definition

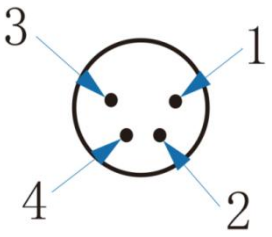


Figure 2. RS485, 4~20mA, NPN, 1~5V output, PNP output pin

Figure 3. AFD4 series wiring diagram

The flow sensor has five output modes, RS485, 4~20mA, NPN output, 1~5V output, and PNP output, but the interface is the same. The pin definitions corresponding to different outputs are shown in Table 2.

Table 2. Output pin description table

	1 brown	2 white	3 blue	4 black
RS485 output	Power+	485A	Power-	485B
4 ~ 20m Asingle current output	Power+	Empty	Power-	Flow analog output
4 ~ 20mA double current output	Power+	Temperature output	Power-	Flow analog output
NPN output	Power+	NPN1	Power-	NPN2
1 ~ 5V single voltage output	Power+	Empty	Power-	Flow analog output
1 ~ 5V double voltage output	Power+	Temperature output	Power-	Flow analog output
PNP output	Power+	PNP1	Power-	PNP2

4. Communication Protocol

RS485 communication

The digital output communication method of AFD4 series vortex liquid flowmeter is RS485 communication, and the communication parameters are shown in Table 3.

Table 3. RS485 communication parameters

Communication protocol	Description
Protocol format	Modbus RTU
Baud rate	9600bps
Start byte	1
Data byte	8
Stop byte	1
parity check	NO

The communication protocol is standard Modbus RTU. The host can be a computer, RS485 receiver, MCU controller, etc. As a slave, the AFD4 series has a default address of 0x01 and can be connected to the bus of multiple slaves.

The Modbus RTU communication register definition of the AFD4 series is shown in Table 4:

Table 4. Modbus RTU communication register definition

Register address	Range	read or write	Function code	multiple	Register info	Note
0x0000	0-65535	Read only	03	10	instantaneous traffic	Example:10.0L/min 0x0064
0x0001	0-65535	Read only	03	1	temperature	Example:10.0℃ 0x0064
0x0002	0-65535	Read only	03	1	Reserve	No
0x0003	0-65535	Read only	03	1	Reserve	No
0x0004	0-65535	Read only	03	1	Reserve	No
0x0028	1-32	Read and write	03/06	1	485 address	Example: 1 0x0001
0x0029	480 960 1920 11520	Read and write	03/06	0.1	baud rate	Example: Actual baud rate 9600 This address data is 9600/10=960 0x03C0

When the host reads the instantaneous flow value of the AFD4 series (slave address is 0x01), the host sends a command to the AFD4 series. The data format is shown in Table 5.

Table 5. Host to send read register command

Host send info	Byte	send info example（Hex）	Description
Slave address	1	01	Communication slave address
Function code	1	03	Read multiple registers
Register start address	2	0000	Register 0x0000 stores the instantaneous flow value
Read register quantity	2	0001	Read 1 register
CRC	2	840A	CRC code is used for verification

When the host receives the data returned by the AFD4 series, the data format is shown in Table 6.

Table 6. Format table for host to receive AFD4 series register data

Slave send info	Byte	Receive info example（Hex）	Description
Slave address	1	01	Communication slave addres
Function code	1	03	Read multiple registers
Receive data bytes	1	02	Number of data bytes received = Number of read registers × 2
Register data	2	062A	Read 1 register
CRC	2	3A3B	CRC code is used for verification

5. Flow /output

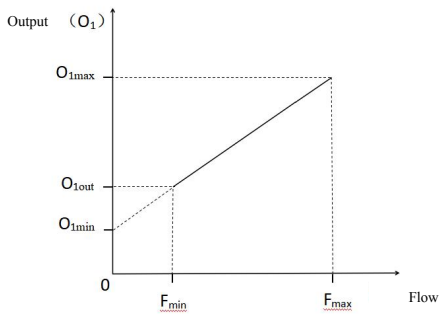


Figure 4. Corresponding linear graph of flow rate and output of AFD4 series

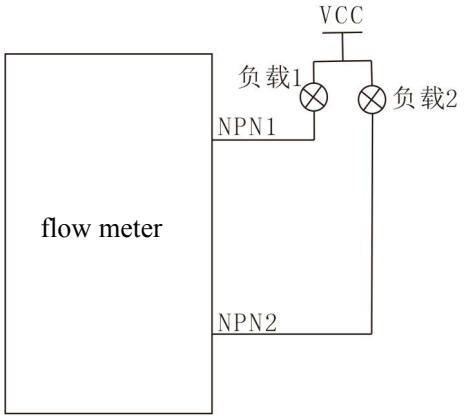


Figure 5. NPN output typical circuit diagram

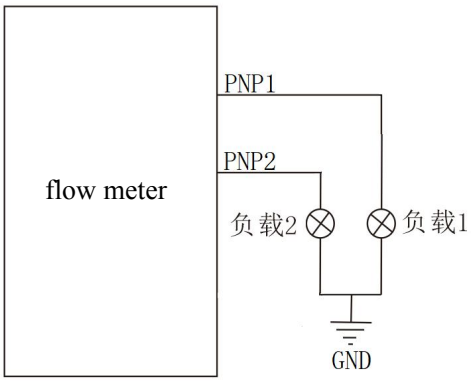


Figure 6. PNP output typical circuit diagram

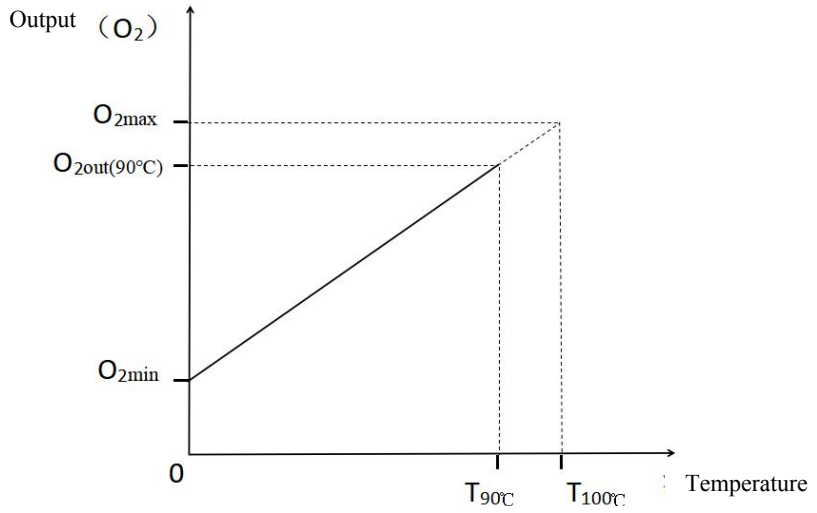
Table 7. AFD4 series flow meter

Model	**Flow F[L/min]**	
	MINI	**MAX**
AFD4020	2	16
AFD4040	5	40
AFD4100	10	100

Table 8. AFD4 series flow and output relationship table

Output / **Description**	**O_{1min}**	**AFD4020: 2L/min**	**AFD4040: 5L/min**	**AFD4100: 10L/min**	**O_{1max}**
		O_{1out}			
Current output(I)	4mA	6mA	6mA	5.6mA	20mA
Voltage output(V)	1V	1.5V	1.5V	1.4V	5V

Flow output calculation formula: $F = F_{max} * (O_{1out} - O_{1min}) / (O_{1max} - O_{1min})$



Note: Fluid temperature range: 0~90, fluid temperature 90~100 can be measured, but its accuracy is not guaranteed.

Figure 7. Corresponding linear graph of temperature and output of AFD4 series

Table 9. AFD4 series temperature and output relationship table

Temperature output / Description	0℃	30℃	60℃	90℃	100℃
	O_{2min}	O_{2out}			O_{2max}
Current output(I)	4mA	8.8mA	13.6mA	18.4mA	20mA
Voltage output(V)	1V	2.2V	3.4V	4.6V	5V

Temperature output calculation formula:$T = (O_{2out}-O_{2min})/((O_{2max}-O_{2min})/T_{100℃})$

6. Dimension

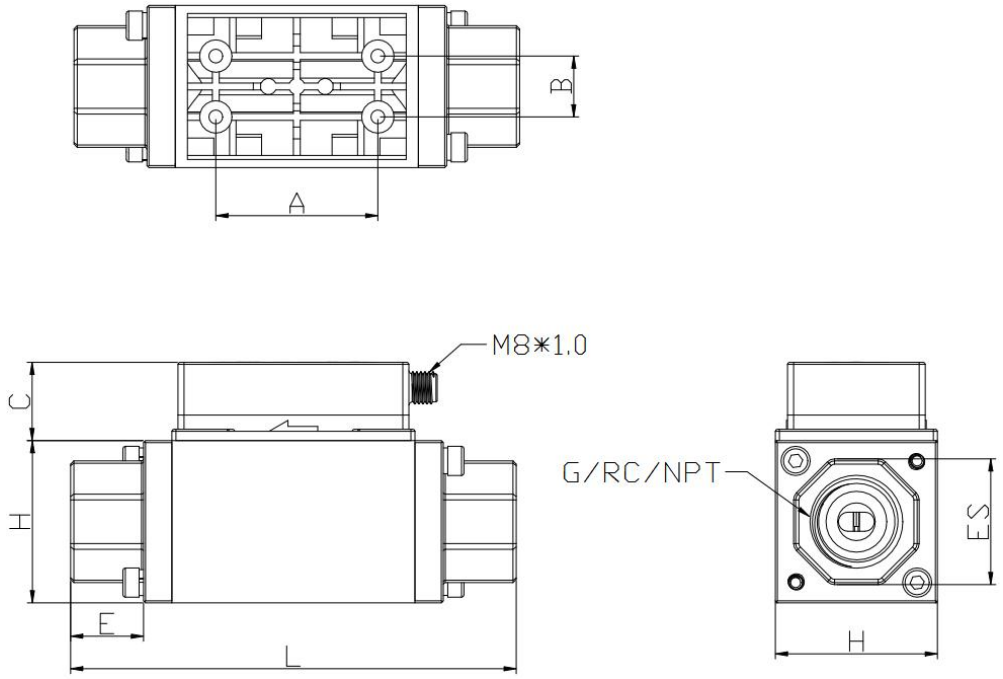


Figure 8. AFD4 series overall dimensions (unit: mm, L tolerance: ±1mm, other unmarked tolerances: ±0.5 mm)

Table 10. Dimensions (unit: mm)

Model NO.	AFD4020				AFD4040				AFD4100			
Display	-	●	-	●	-	●	-	●	-	●	-	●
Temperature	-	-	●	●	-	-	●	●	-	-	●	●
Length	110		121		110		121		120		131	
Hole (A)	40				40				40			
Hole (B)	15				15				20			
Height(C)	19.3				19.3				19.3			
Height(H)	40x40				40x40				45x45			
Fix(E)	18				18				23			
Connector hex (ES)	30				30				41			
Process connection (G/RC/NPT)	3/8 or 1/2				1/2 or 3/4				3/4 or 1			

Note: ●means with display or temperature, - means without display or without temperature.

7. Alarm, screen function and communication setting instructions

(a) (b) (c)

Figure 9. Alarm function description diagram (taking AFD4040 with temperature band display as an example)

After powering on, the sensor enters the main interface, as shown in Figure 9(a), and can then be set according to the following table.

Press and hold the middle blue button for 2 seconds to enter the setting menu page, and press the left and right triangle buttons to set parameters.

There are four levels in the setting menu page, and the function introduction of each level is shown in Table 11.

Table 11. Function description

Main menu	Sub menu	Sub menu	Sub menu	Function
Parameter settings	Alarm settings	Alarm switch	ON	Alarm function on or off
			OFF	
		Upper Alarm	0~999	Set the flow upper limit value. When the alarm function is turned on, an alarm will occur if the flow rate exceeds the upper limit value.
		Lower Alarm	0~999	Set the flow lower limit value. When the alarm function is turned on, an alarm will occur if the flow rate is lower than the lower flow limit value.
		Exit	/	Back to last menu
	Exit	/	/	Back to last menu
System	Screen	Rotate Right	/	Screen rotate right 90 ˚

Main menu	Sub menu	Sub menu	Sub menu	Function
		Rotate Left	/	Screen rotate left 90 °
		Exit	/	Back to last menu
	Restore Factory	Confirm	/	Restore Factory setting
		Cancellation	/	Back to last menu
	Exit	/	/	Back to last menu
Communication settings	BAUD	4800	/	baud rate 4800
		9600	/	baud rate 9600
		19200	/	baud rate 19200
		115200	/	baud rate 115200
	485 address	1~32	/	Set 485 address
	Exit	/	/	Back to last menu
Exit	/	/	/	Back to last menu

Note:
1. When the alarm switch is turned on, an alarm bell will appear on the main interface, as shown in Figure 9(b).
2. The upper limit value of the flow setting must be greater than the lower limit value of the flow setting, and the lower limit value of the flow setting must also be less than the upper limit value of the flow setting, otherwise the set value will turn red.
3. When the traffic exceeds the set upper or lower flow limit, a bell with an upward or downward arrow will appear on the main interface, and the font color will also change to red, as shown in Figure 9(c).

8. Piping precautions

When piping the product, use a wrench and a metal part (pipe fitting) that is integrated with the piping part. If the wrench is used in other parts, the flow switch may be damaged. In particular, you cannot use a wrench on an M8 connector. Otherwise, the connector may be damaged.

Table 12. Safety torque table

Screw (G/RC/NPT)	3/8	1/2	3/4	1
Applicable torque range	22 ~ 24 N·m	28 ~ 30 N·m	28 ~ 30 N·m	28 ~ 30 N·m
Torque safety range	<200N·m	<200N·m	<200N·m	<200N·m

Note: When installing piping, please do not let the sealing tape get mixed into the pipe. When connecting piping, be sure not to loosen it and cause liquid leakage. Tightening beyond the tightening torque range may cause damage to the switch. If assembled with insufficient tightening torque, the connecting thread may become loose.

9. Precautions for pipeline installation

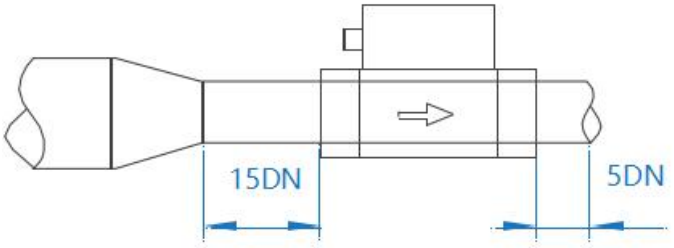
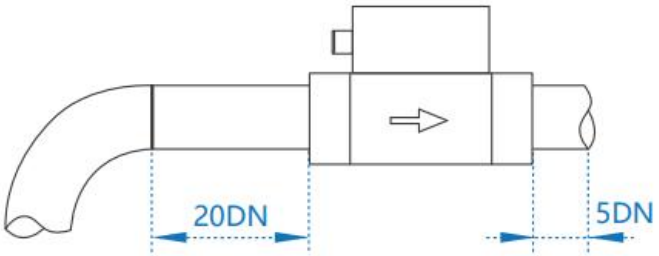
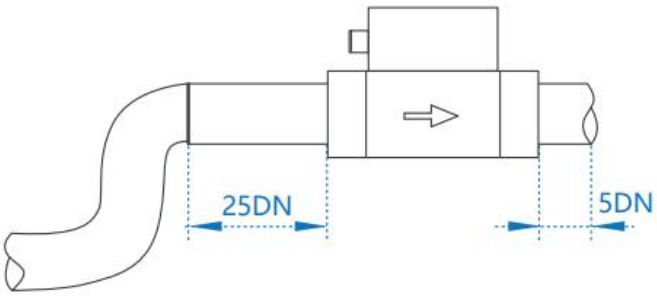
For the sensor to work properly, the following instructions must be observed:

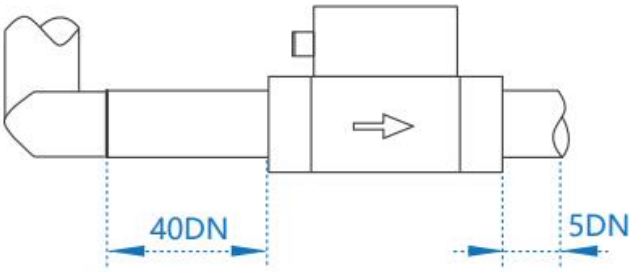
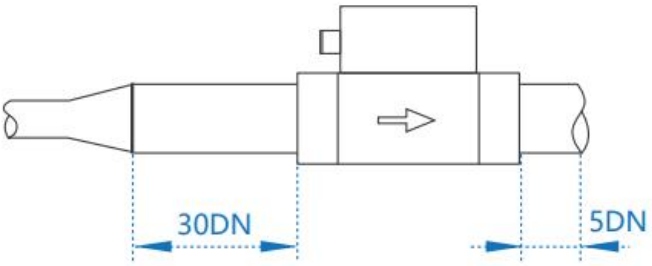
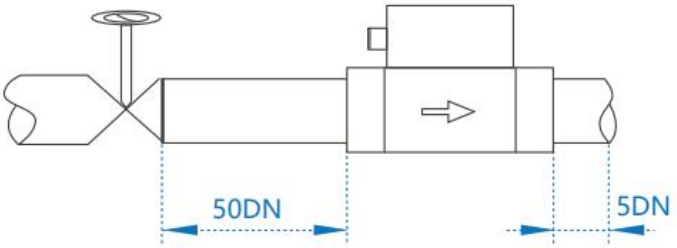
a. Multiple bends that are not on the same level immediately before the entrance (bend pipe) should be avoided.

b. The inner diameter of the tube cannot be smaller than the inner diameter of the measuring tube.

Table 13 shows the pipeline installation requirements under different circumstances.

Table 13. Pipe type upstream of the sensor and length of straight pipe sections before and after the sensor

Sensor upstream pipeline type	Front and rear straight pipe length
Concentric contraction fully open valve	
A 90 degree elbow	
Two 90 degree elbows on the same plane	

Two 90-degree elbows on different planes	
Concentric expansion	
Regulating valve half-open valve (not recommended)	

Note: DN represents the nominal diameter or nominal diameter of the pipeline.