Model PFLOW2001 Series

MEMS Mass Flow Sensors

(VA.0)

CE

MEMS Mass Flow Sensor

The PFLOW2001 series of mass flow sensors are made with the micromachined (MEMS) sensing elements that offer an innovative thermal sensing principle with excellent linearity and removal of gas sensitivity of some common gases.

This PFLOW2001 Series mass flow sensor series offer a fully customizable flow dynamic range of 100:1 with the full-scale flowrate from 10 sccm to 5000 sccm.
The sensors are opted with digital and analog interface, bi-directional sensing capability with an operational temperature range of -25 to 85 °C (-13 to 185 °F).

SPECIFICATIONS

Performance characteristics

(Test conditions: Vcc = 8-15VDC, Ta = 20°C, RHa = 30…70%)

Parameter	Value	Unit
Flow range, full scale (1)	10, 30, 50, 100, 200, 500, 1000, 2000, 3000, 4000, 5000(2)	sccm
Dynamic range (3)	100:1	n.a.
Accuracy (4)	± (1.5%RD + 0.15%FS)	%
Temperature error coefficient (5)	0.03	%RD/°C
Maximum common mode pressure	50 (3.5)	psi (bar)
Maximum overflow	10 x full scale flowrate	sccm
Maximum flowrate change	2.5 x full scale flowrate	sccm/sec
Compensated temperature range	0 ~ 60	°C
Operating temperature range	-25 ~ 85	°C
Storage temperature	-40 ~ 90	°C
Humidity	0~100 (no condensation)	%RH
Gas compatibility	Non-corrosive/non-explosive	
Shock	100 (MIL-STD-883)	g
Compliance	RoHS, REACH, CE: IEC 6100-4-2;4;8	
Wetted materials	Polycarbonate, silicon nitride, FR4 and epoxy	

Electrical Characteristics

(Test conditions: Vcc = 8-15VDC, Ta = 20°C, RHa = 30…70%)

Item	Condition	Rating			Unit
		Min.	Typ.	Max.	
Supply voltage		8		15	VDC
	Low voltage option	2.7		5.5	
Supply current		10	15	50	mA
	Low voltage option	5	7	10	
Warmup time (6)			500		Msec
Minimum Output load (analog & digital version)			5		kΩ
Response time (digital, analog)			2.0		Msec
Output (analog) (7)		1		5	VDC
	Low voltage option	0.2		2	VDC
Analog null voltage		0.98		1.02	VDC
	Low voltage option	0.18		0.22	VDC
Analog null drift			0.05		%FSS/year
Maximum output (8)				1.2	FSS
Output (digital)			I2C		--
I2C bus voltage		3.0		5.5	VDC
I2C frequency		10		400	kHz
Resolution digital output			15		bit
Digital null offset			0		
Digital null drift (9)				0.05	%FSS/year

Note:

1. sccm denotes standard cubic centimeters per minute.
   Standard conditions: 20°C, 101.325kPa, dry and clean air
2. For 5000 sccm version there can be expected effects of installation related errors, or the flow conditioning is not as good as the other flow ranges. Because of the channel size, there is also difficult to add an external flow conditioning.
3. For 10sccm full scale model, the dynamic range is 50:1
4. Accuracy is the combined error from offset and span calibration, linearity, hysteresis, and repeatability over the entire calibrated flow range. For bi-directional sensors accuracy is defined for total absolute range, i.e. ±200 sccm sensor has absolute range of 400
5. For compensated temperature range
6. Warm-up time is the time from power on to the first stable reading.
7. Output not ratio metric
8. Refer to Typical Output chapter for details
9. Digital offset can be reset using I2C command (see chapter: Digital I^2C Communication)

MECHANICAL DIMENSIONS

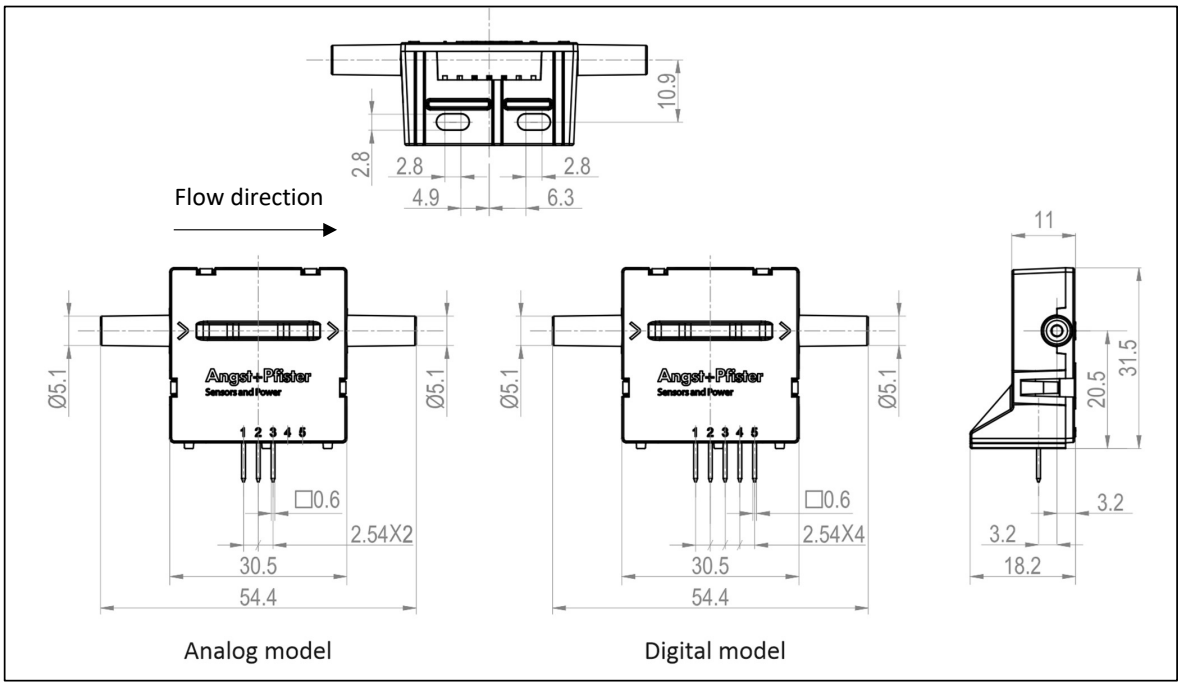


Figure 1 PFLOW2001. All units are in mm

Flow direction from left to right for uni-directional sensors.

ELECTRICAL INTERFACE

Digital and analog version pinout

Pin#	Definition	Notes
1	Vout	Output ref. to GND
2	Vcc	Supply
3	Vss	GND
4	SDA	I^2C data
5	SCL	I^2C clock

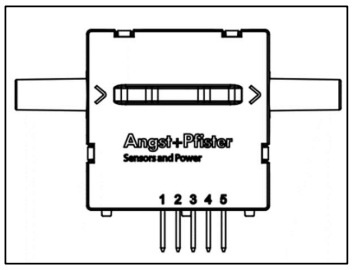


Figure 2 Digital and analog version (VI2C) pin assignment

Analog only version pinout

Pin#	Definition	Notes
1	Vout	Output ref. to GND
2	Vcc	Supply
3	Vss	GND

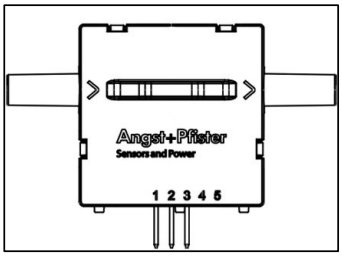


Figure 3 Analog only version pin assignment

GAS CORRECTION FACTORS

To be confirmed after the tests

Gas type	Correction factor
Air	1.0
Oxygen (O2)	1.0
Nitrogen (N2)	1.0
Argon (Ar)	1.0
Hydrogen (H2)	*
Carbon dioxide (CO2)	0.545

To obtain the real flow rates in a specific gas, multiply the readings from the sensor by the gas correction factor in the table. The factors are approximate and should be used as guidelines only. Sensor performance strongly depends on gas dynamics and has to be evaluated in the respective application.

For Hydrogen applications, the actual H2 calibration is performed whenever possible.

TYPICAL OUTPUT

Table 1: PFLOW2001, typical analog output.

Flow Rate (sccm)	Typical Analog Output (Vdc)
0	1.0
0.2FS	1.8
0.4FS	2.6
0.6FS	3.4
0.8FS	4.2
1.0FS	5.0
1.2FS	5.8
1.4FS	5.8

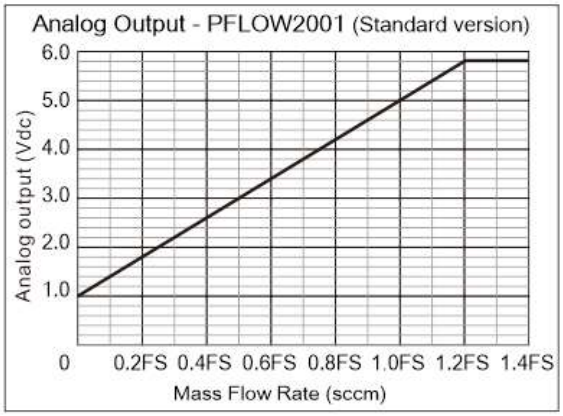


Figure 1: typical analog output curve of PFLOW2001.

Table 2: PFLOW2001L, typical analog output.

Flow Rate (sccm)	Typical Analog Output (Vdc)
0	0.20
0.2FS	0.56
0.4FS	0.92
0.6FS	1.28
0.8FS	1.64
1.0FS	2.00
1.2FS	2.36
1.4FS	2.36

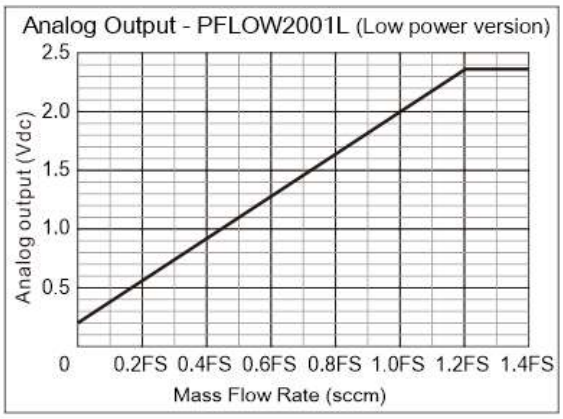


Figure 2: typical analog output curve of PFLOW2001L.

Table 3: Typical digital output.

Flow Rate (sccm)	Typical Digital Output (sccm)
0	0
0.2FS	0.2FS
0.4FS	0.4FS
0.6FS	0.6FS
0.8FS	0.8FS
1.0FS	1.0FS
1.2FS	1.2FS
1.4FS	1.2FS

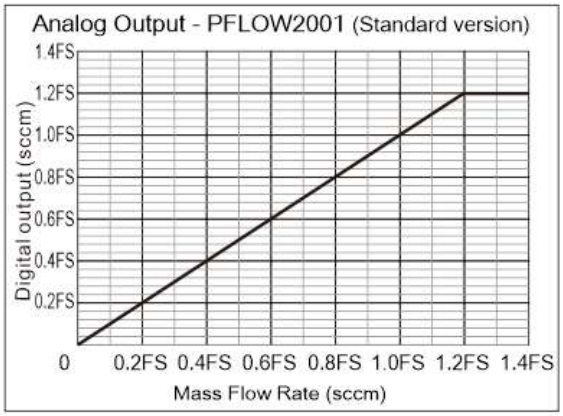
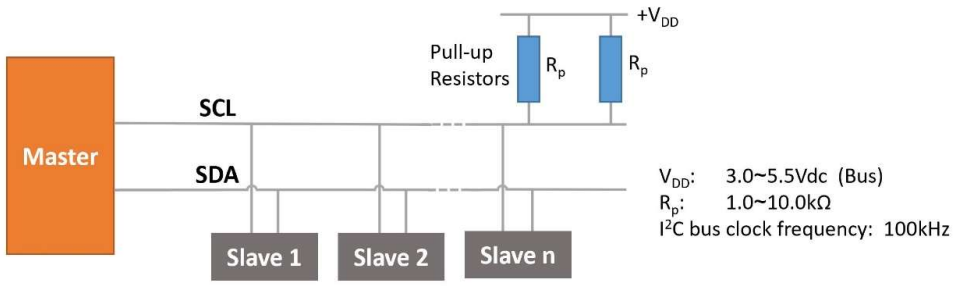


Figure 3: typical digital output curve.

DIGITAL I²C COMMUNICATION

I²C interface connection diagram



I²C interface command description

Command	Width (Byte)	Command Name	Read/Write	Notes
0x00A4	2	I²C address	Read/Write	Bit 0 is R/W flag bit; Bit 1~ Bit 7 are available.
0x00F0	2	Flowrate offset reset	Write	1 byte, ensure no-flow conditions
0x0030	12	Serial number	Read	ASCII
0x003A	4	Flow rate	Read	Measured value (2-Byte) / (1000 LSB/sccm) + CRC (2-Byte) CRC=(Byte1)xOR(Byte2)x(OR(Byte3)XOR(byte4)

Notes:

I2C is an onboard protocol. It is not intended for usage with cables. If the sensor is used connected via cables, it is recommended to check the system carefully for electromagnetic disturbances.

The I²C address is set to Bit 7~Bit 1. e.g., if the I²C address is 1 (0000 001x), the write address will be 0x02 (0000 0010) and the read address will be 0x03 (0000 0011).

The highest significant byte is transmitted first; the lowest significant byte is transmitted last.

In order to obtain the measured flow in the predefined unit, the measured flow value read from the result register needs to be converted according to the following formula:

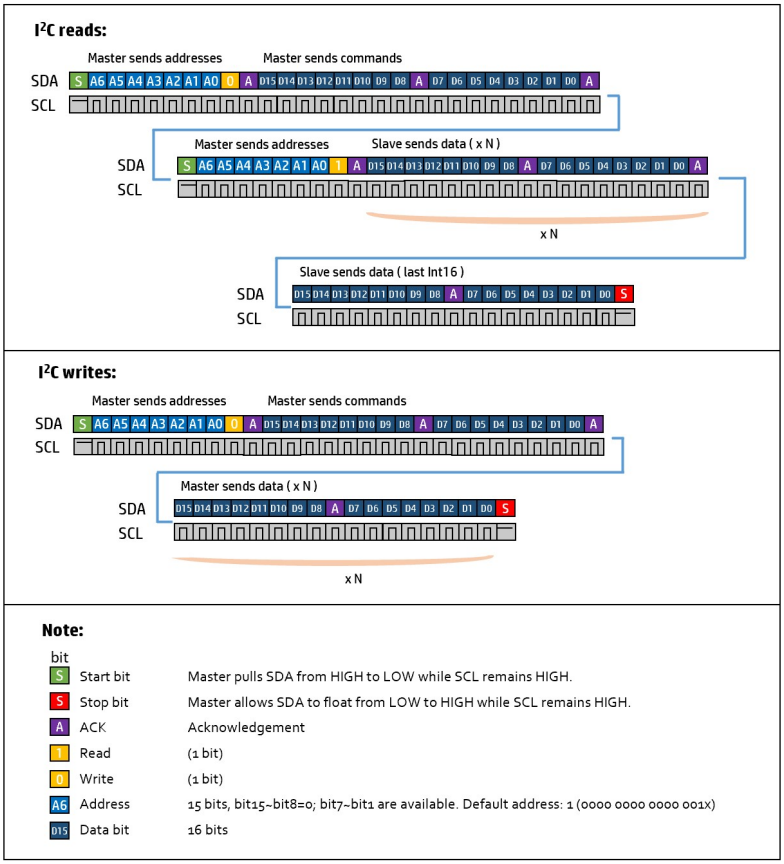
flow in sccm unit = (measured value – offset flow) / (scale factor flow)
Offset Flow: 0 LSB
Scale Factor Flow: 1000 LSB / sccm

CRC checksum calculation

The 8-bit CRC checksum transmitted after each two data bytes (int 16) is generated by a CRC algorithm. Its properties are listed in the following table. To calculate the checksum, only these two previously transmitted data bytes are used.

Property	Value
Name	CRC-8
Protected data	I²C read and write
Width	8 bits
Polynomial	0x07 (x8 + x2 + x + 1)
Initialization	0x00
Reflect input	False
Reflect output	False
Final XOR	0x00
Example	CRC (0x4E20) = 0x6D

I²C interface read/write sequences



ORDERING INFORMATION

The product part number is composed of the product model number and suffix indicating the full-scale flow rate, mechanical connection, output format as well as the applicable gas. Refer to the following for the product order:

PFLOW2001□–□–□–□–□

- Gas (A: air, N_2, O_2, Ar; C: CO_2; X: other gas, please contact the manufacturer)
- Output[2] (V: analog model; VI2C: digital + analog model)
- Option: U-unidirectional, B-bidirectional
- Full scale forward flowrate[1] (10, 30, 50, 100, 200, 500, 1000, 2000, 3000, 4000 and 5000)
- Model (Null: standard model; L: low power model; XX-custom version)

Note:
(1) Full flowrate default unit is sccm
(2) VI2C model consist of both outputs digital and analog

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