HOPERF
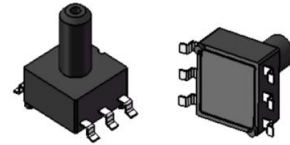
Pressure sensor HPS xxx GST-KO series

Features

- Compact size, MEMS technology
- Customizable measuring range $\pm$ 10kPa , $\pm$ 40kPa , $\pm$ 100 kPa
- High-speed I ^{2}C interface
- High-precision pressure monitor, wide temperature compensation
- SOP SMD package, easy to install and seal

Product Usage

- Intelligent electronic blood pressure monitors, oxygen concentrators, air wave therapy devices and other medical fields
- Massagers, massage chairs, air mattresses, sleep aid neck pillows and other sports and fitness equipment fields
- Smart vacuum cleaners, vacuum juicers and other small household appliances
- Beer machines, coffee machines, vacuum pumps, pressure instruments and other fields

Product Description

HPS xxx GST series sensors are integrated, digital output pressure sensors with the characteristics of miniaturization, high precision, high sensitivity and high reliability.

HPS xxx GST series sensors integrate the pressure sensor MEMS chip and signal conditioning chip to digitally compensate the zero point, sensitivity, temperature drift and nonlinearity of the sensor, output a calibrated and temperature compensated measurement data, and provide standard I2C Communication Interface.

HPS xxx GST series sensors are packaged in SOP and comply with RoHS standards, making it convenient for customers to weld, install and use. They are widely used in medical electronics, automotive electronics, sports and fitness equipment and other fields.

Maximum rated parameters

参数	符号	最小	典型	最大	单位	备注
VDD电压	VDD_{max}	−0.3		6.5	V	
过载压力	P_{proof}		3X		F.S	
爆破压力	P_{burst}		5X		F.S	
ESD防护	HBM		2		kV	
存储温度	T_{stg}	−40		100	˚C	

Recommended working conditions

参数	符号	最小	典型	最大	单位	备注
供电电压	VDD	3	3.3	3.6	V	VDD=3.3V
		4.5	5	5.5	V	VDD=5.0V
工作压力	P_{amb}	−200		200	kPaG	
工作温度	T_{opr}	−20		85	˚C	

Electrical parameters

参数	符号	最小	典型	最大	单位	备注
上电复位	VDD_{POR}		2		V	
工作电流	I_{avdd}		1.6		mA	
	$I_{standby}$			200	nA	
ADC分辨率	RES_{RAW}		24		Bits	
ADC转换时间	T_{ss}	-	1.54	-	ms	@OSR = 256X
		-	1.86	-	ms	@OSR = 512X
		-	2.5	-	ms	@OSR = 1024X
		-	3.78	-	ms	@OSR = 2048X
		-	6.34	-	ms	@OSR = 4096X
		-	11.46	-	ms	@OSR = 8192X
		-	21.7	-	ms	@OSR = 16384X
		-	42.18	-	ms	@OSR = 32768X
电源抑制比	PSRR	90	120		dB	
SCL/SDA上拉电阻	R_p		4.7		kOhm	
补偿温度范围	T_{COMP}	0		85	˚C	
综合精度	ACC		1.5%		%FS	−20˚C−85˚C

I2C Communication Electrical Characteristics

| 参数	标示	最小值	典型值	最大值	单位	备注
时钟频率	f_{SCL}	–	–	400	kHz	
时钟低脉冲维持时间	t_{LOW}	1.3	–	–	us	
时钟高脉冲维持时间	t_{HIGH}	0.6	–	–	us	
SDA建立时间	t_{SUDAT}	0.1	–	–	us	
SDA保持时间	t_{HDDAT}	0	–	–	us	
每次开始时的建立时间	t_{SUSTA}	0.6	–	–	us	
开始条件保持时间	t_{HDSTA}	0.6	–	–	us	
停止时间建立时间	t_{SUSTO}	0.6	–	–	us	
两次通讯之间间隔时间	t_{BUF}	1.3	–	–	us	

product description

The HPS xxx GST series pressure sensor integrates a MEMS pressure chip and a signal conditioning chip. It digitally compensates the zero point, sensitivity, temperature drift and nonlinearity of the sensor through a 2 4 -bit ADC , and outputs a signal that is linear with the applied pressure. After calibration Digital signals are accessible through the digital I2C interface .
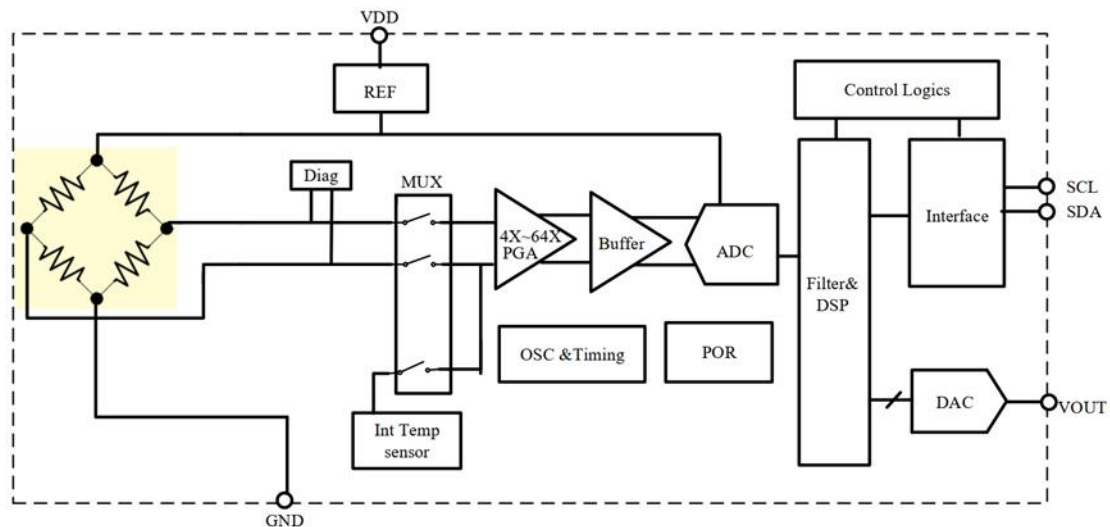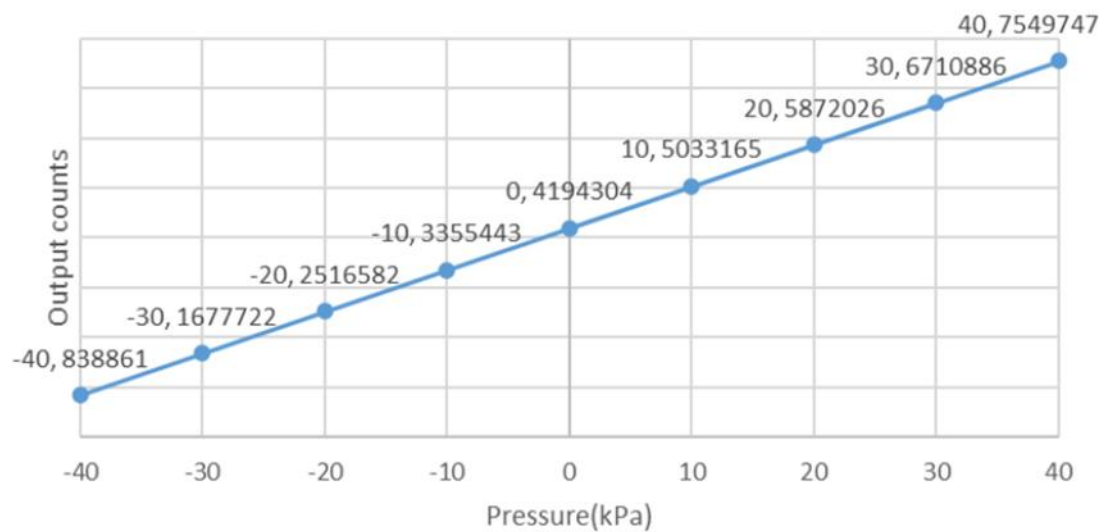

System functional block diagram

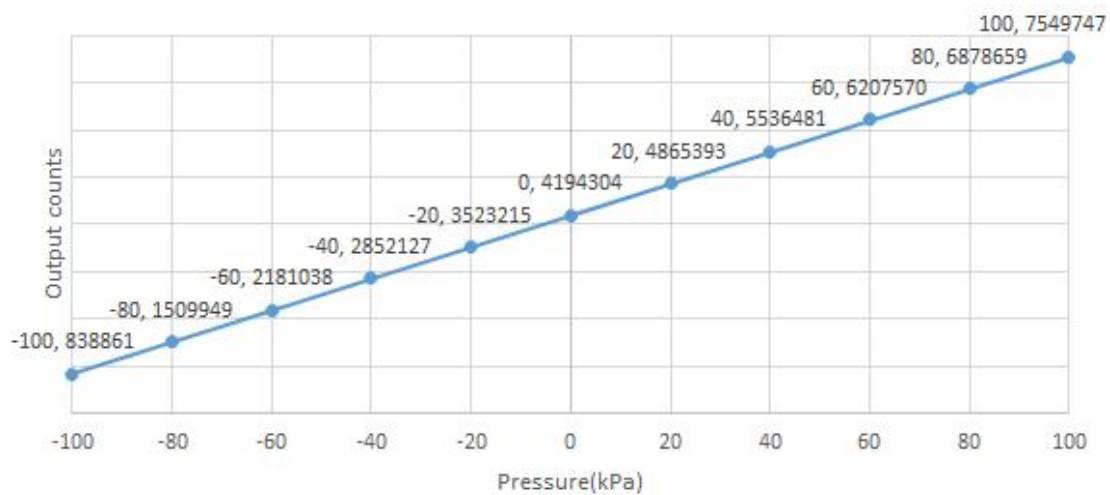## Digital output characteristic curve

HPS xxx GST series pressure sensors are calibrated within the specified pressure range from Pmin to Pmax. The following figure shows the relationship curve between AD value and pressure value.
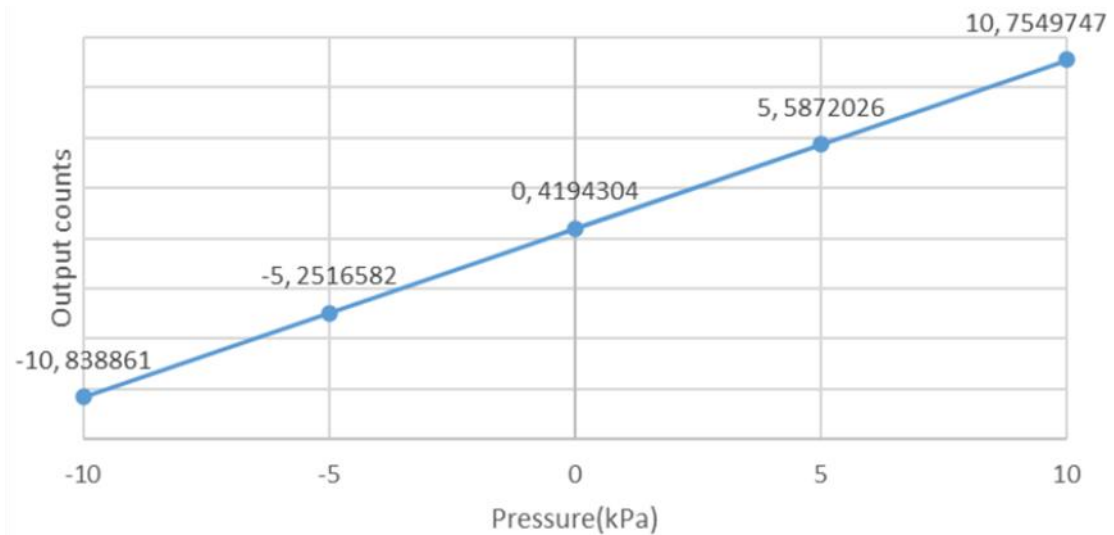
HPS010GST Counts VS Pressure (kPa)

HPS040GST Counts VS Pressure (kPa)

HPS100GST Counts VS Pressure (kPa)

The data register value can be converted into a pressure value using the following equation:

$$P(kPa) = A \times code + B$$

where $code$ is the normalized value of the data register P data /8388608 ; P is the actual pressure value, the unit is k P a;

Register description

地址	位地址	寄存器名称	默认值	描述
0x30	7-4	Reserve<7:4>	4'b 0000	
	3	Sco<3>	1'b 0	1: 开始采集数据，采集结束时自动返回0
	2-0	Measurement_ctrl<2:0>	3'b 000	000b: 单次温度信号采集模式 001b: 单次压力信号采集模式 010b: 组合采集模式（进行一次温度信号采集后立即进行一次压力信号采集）
0x06	7-0	PDATA<23:16>	0x00	24-bit有符号数，存储经过校准的压力传感器数据
0x07	7-0	PDATA<15:8>	0x00	若最高位为0， Pdata=PDATA$_{0x06}$*65536+PDATA$_{0x07}$*256+PDATA$_{0x08}$
0x08	7-0	PDATA<7:0>	0x00	若最高位为1， Pdata=PDATA$_{0x06}$*65536+PDATA$_{0x07}$*256+PDATA0$_{x08}$-16777216
0x09	7-0	TEMP_MSB<7:0>	0x00	存储经过校准的温度数据，1 LSB = 1/256 ℃
0x0A	7-0	TEMP_LSB<7:0>	0x00	
0xA5	1	Raw_data_on<1>	1'b 0	1：输出ADC原始数据（仅在单次压力信号采集模式和单次温度信号采集模式下有效） 0：输出校准数据；
	0	Reserve<0>	1'b 0	
0xA6	2-0	OSR_P<2:0>	3'b 000	采集压力信号时的过采样率 000: 256X; 001: 512X; 010: 1024X; 011: 2048X; 100: 4096X; 101: 8192X; 110: 16384X; 111: 32768X
0xA7	2-0	OSR_T<2:0>	3'b 000	采集温度信号时的过采样率 000: 256X; 001: 512X; 010: 1024X; 011: 2048X; 100: 4096X; 101: 8192X; 110: 16384X; 111: 32768X

Ordering Information

订货料号	输出模式	压力量程（kPa）		数字归一化		传递函数系数		工作电压（V）
		P_L	P_H	O_L	O_H	A	B	
HPS010GST	I2C数字接口	-10	10	0.1	0.9	25	-12.5	3.3V
HPS040GST	I2C数字接口	-40	40	0.1	0.9	100	-50	3.3V
HPS100GST	I2C数字接口	-100	100	0.1	0.9	250	-125	3.3V

Pressure value calculation process

Taking HPS 010 GST as an example, the conversion process of pressure value is as follows:

When the values of the 0x 06 , 0x 07 , and 0x 08 registers are 0x 4F , 0x5C , and 0x29 respectively ,

Pdata = 79*65536+92*256+41 = 5200937,

The pressure value P(k P a) = 25 * Pdata / 8388608 – 12.5 = 3 k P a is obtained.

Data reading

1) Set the value of the lower 3 bits of the 0 xA 6 and 0 xA 7 registers.
   Note: You cannot directly write an 8-bit value. You need to read the value of the 0 xA 6 and 0 xA 7 registers first, only modify the lower 3-bit value, and then write 0xA 6 , 0xA 7 register ! _

2) Read 0xA5 The value of the register, "bitwise AND" the read value 0xFD After that, write 0xA5 register.

3) Send command 0x0A to register 0x30 to collect temperature data and pressure data.

4) Read the value of the 0x30 register. If the Sco bit is 0, it means that the

acquisition is completed and the data can be read; otherwise, wait for 10 ms . (When the OSR configuration value is 1 024 X).

5) Read the values of the three registers 0x06, 0x07, and 0x08 to form the 24-bit pressure data AD value.

The 24-bit AD that will be read value, and calculate the final pressure output according to the transfer function characteristics:

$$P(kPa) = A \times code + B.$$

I 2 C communication protocol

The I ^{2}C bus uses SCL and SDA as signal lines. Both lines are connected to VDD through pull-up resistors and remain high when not communicating. The I ^{2}C device addresses of this series of products are as follows:

A7	A6	A5	A4	A3	A2	A1	W/R
1	1	1	1	1	1	1	0/1

The I ^{2}C communication protocol has special start (S) and stop (P) conditions. When SCL is high, the falling edge of SDA marks the start of data transfer.

The I ^{2}C master device in turn sends the slave device's address (7 bits) and the read/write control bit (1 bit). When the slave device recognizes this address, it generates a response signal and pulls SDA low in the 9th cycle. After getting the response from the slave device, the master device continues to send the 8-bit register address. After getting the response from the slave device, the master device continues to send or read data.

When SCL is at high level, the rising edge of SDA marks the end of data transfer.

In addition to the start and end flags, data transferred by SDA must remain stable when SCL is high. When SCL is low, the data transmitted by SDA can change.

All data transmission in I $^{2 C \text{ communication is based on 8 bits, and every 8 bits}}$ After a bit of data is transmitted, an acknowledge signal is required to keep the transmission going.

The I ^{2}C communication timing is as follows:
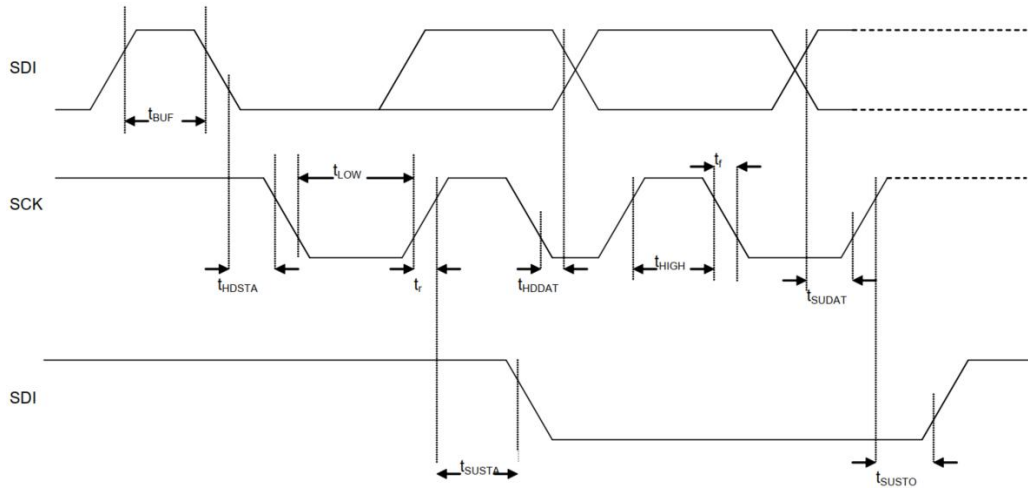
I²C read and write timing

The I²C interface protocol has special bus signal conditions. I²C communication begins with a START condition sent by the master and ends with a STOP condition sent by the master.

START condition: When SCL is high level, the level on SDA changes from high to low.

STOP condition: When SCL is high, the level on SDA changes from low to high.

When the slave is addressed, the master should release SDA in the 9th clock cycle, and the slave should pull the SDA level low as a response signal. When SDA remains high in the 9th clock cycle, it is regarded as a non-acknowledge signal.
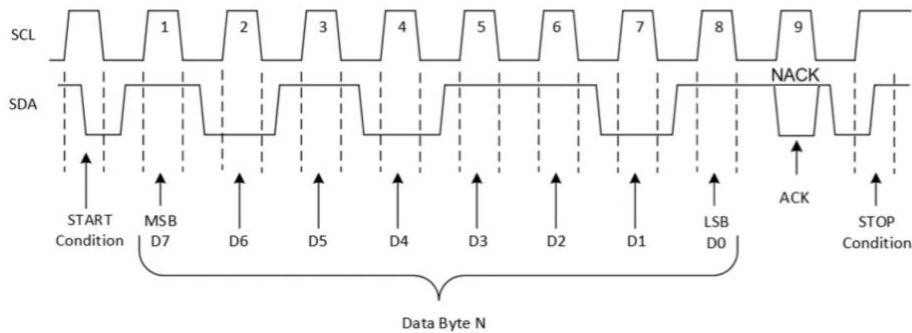
I²C communication protocol

I²C write timing

The write operation is accomplished by sending the slave address in write mode (read and write bits are 0), resulting in the slave write address 11111110b. The host then sends pairs of register addresses and corresponding values. The write operation is terminated with a STOP condition.

The graphic table is written with 0x30 Register as an example:

Start	Slave Address							RW	ACKS	Control byte Register Address(30h)								ACKS	Data byte Register Data								ACKS	Stop
S	1	1	1	1	1	1	1	0		0	0	1	1	0	0	0	0		bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0		P

I²C read timing

Before starting the read operation, the register address is first sent in write mode (slave address 11111110b), then the start signal is regenerated, and then the slave is addressed in read mode with the I2C address (11111111b). The slave starts sending the register value from the register address until a NOACK signal and a stop condition are generated, and the read operation ends.

The table in the figure takes reading 0x06, 0x07, and 0x08 registers as an example:

Start	Slave Address							RW	ACKS	Control byte Register Address(06h)								ACKS
S	1	1	1	1	1	1	1	0		0	0	0	0	0	1	1	0	

Start	Slave Address							RW	ACKS	Data byte Register Data(06h)								ACKM
S	1	1	1	1	1	1	1	1		bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
										Data byte Register Data(07h)								ACKM
										bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
										Data byte Register Data(08h)								NOACKM	Stop
										bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0		P

Dimensional drawings
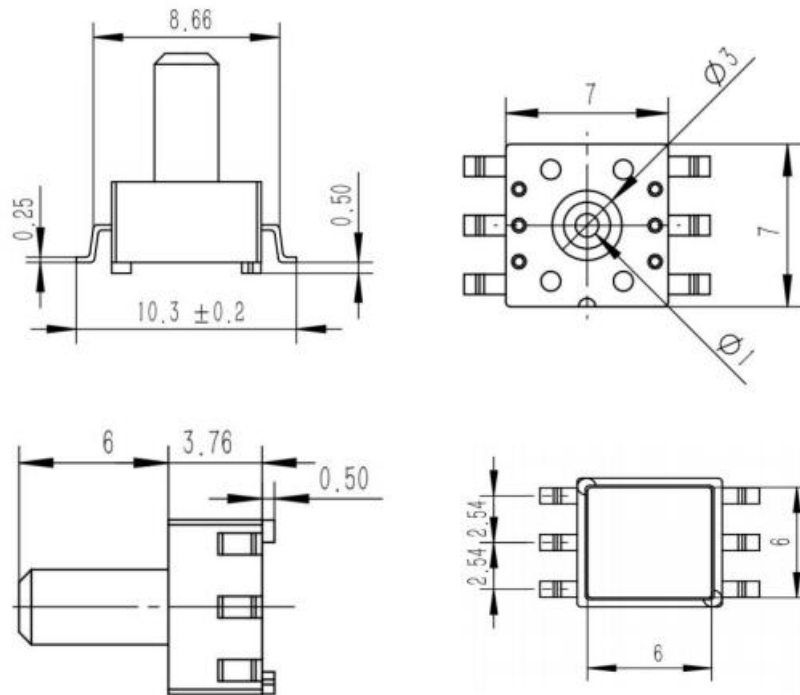
Pin definition description
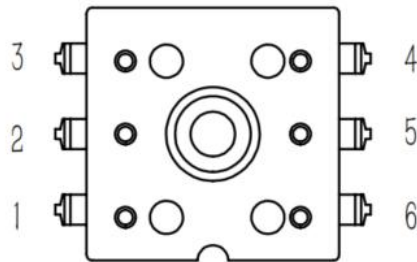
管脚标号
(俯视图，从气孔方向)

Pin	Name	I/O Type	Description
1	GND	Supply	land
2	NC	– –	– –
3	SCL	In	clock
4	SDA	In/Out	data
5	VDD_	Supply	power supply
6	NC	– –	– –

Application circuit

HOPERF
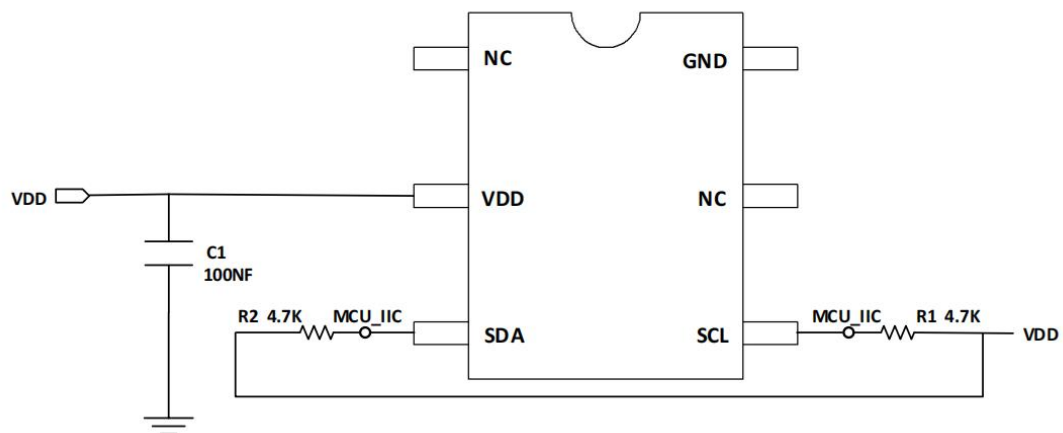
Note:

Recommended value of C filter capacitor is 100 nF

R_P pull-up resistor recommended value is 4.7 KΩ

Selection guide

编号	HPS	xxx	G	S	T
说明	HOPE Pressure Sensor	量程范围	压力类型	封装形式	包装方式
规格		010：±10 kPa 040：±40 kPa 100：±100 kPa	A：绝压 G：表压 D：差压	S：SMT	T：Tube R：Reel & Tape

Product packaging

Tube packaging, each tube is 70EA, 20 tubes per box, minimum order quantity (MOQ) 1400EA

HOPERF

Precautions for use

■ Install

Please use printed board pads so that the product can be adequately fixed

■ welding

Since this sensor has a small structure with a small heat capacity, please try to reduce the influence of heat from the outside . Otherwise , it may cause damage due to thermal deformation and affect the characteristics ; please use non-corrosive rosin-type flux , and pay attention Do not allow flux to enter the inside of this sensor.

1) soldering iron welding

♦ Please use a soldering iron with a temperature of 260 ~ 300 ℃ to complete the work within 5 seconds .

♦ soldering on the pins , it should be left for a while before use.

♦ Clean the soldering iron tip regularly to keep it clean

2) reflow soldering

The recommended setting conditions for reflow soldering are as follows:
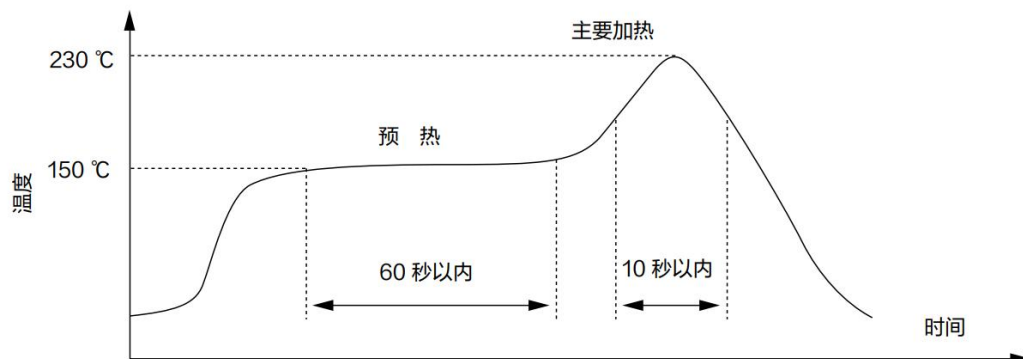
3) Applying excessive external force to the pins can cause deformation and impair solderability, so please avoid dropping the sensor or performing complicated use.

4) Try to keep the curvature of the PCB board relative to the entire sensor. Below 0.05mm.

HOPERF

update record

Version	update content	Updated
1.0 _	Officially released	2 019.08.13
1.1 _	revised edition	2 019.10.24
1.2	Add custom range	2022.03.12