Digital Barometer

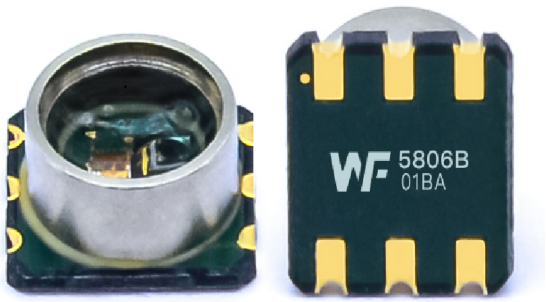
Key parameters

- Pressure range： 1… 1 7 00 h Pa
- Package: 6 -pin LGA metal-lid
  Footprint: 6 .2× 6 .8mm ^{2}

  Height: 3 .3mm
- Relative accuracy: ±0.03 hPa(±0.25m)
- Absolute accuracy: typ. ±3 0 hPa
- Temperature coefficient offset: 1.5 Pa/K, (12.6 cm/K)
- Digital interface: I^{2}C
- Current consumption: 3.5μA @1Hz sampling rate
- Temperature range: -40~+125°C
- RoHs compliant, halogen-free

Typical applications

- Barometer and altimeter for portable devices
- Indoor and outdoor navigation
- Weather station equipment
- Sport watches
- Flying toys



Technical advantages

- Wide compensate temperature -40~+125 °C
- Small package, height only 3 .3mm
- Excellent performance and cost

Brief Description

WF5806 is a high precision barometer and altimeter especially designed for consumer applications. It measures the pressure based on piezo-resistive MEMS pressure sensor.

The ultra-low power, low voltage electronics of the WF5806 is optimized for use in mobile phones, smart watches, PDAs, GPS navigation devices and outdoor equipment. The sensor module is housed in a compact 4-pin metal-lid LGA package with a footprint of only 6 .2× 6 .8 mm^2 and 3 .3mm package height. Its small dimensions and its low power consumption allow the implementation in battery driven devices. With a low altitude noise of merely 0.08m and very low offset temperature coefficient(TCO), the WF5806 offers superior performance and cost are perfectly suitable for applications like flying toys and sport watches. The I^{2}C interface allows for easy system integration with a microcontroller.

1 Specification

VDD = 3.3V, T=25°C, unless otherwise noted.

Table 1 Parameter specification

Parameter	Symbol	Condition	Min	Typ	Max	Units
Operating temperature range	T_A	operational	-40	25	+125	°C
		full accuracy	0		65	
Operating pressure range	P	full accuracy	1		1700	hPa
Sensor supply voltage	V_{DD}		1.8		3.6	V
Interface supply voltage	V_{DDIO}		1.8		3.6	V
Supply current	$I_{DD,\ LP}$	1Hz, ultra low power		3.4		μA
Peak current	I_{peak}	during pressure measurement		1950		μA
Current at temperature measurement	I_{DDT}			900		μA
Sleep current	I_{DDSL}	25°C		0.1	0.3	μA
Relative accuracy VDD=3.3V	A_{rel}	700...900hPa		±0.03		hPa
		25...40°C		±0.25		m
Offset temperature coefficient	TCO	900hPa		±1.5		Pa/K
		25...40°C		±12.6		cm/K
Absolute accuracy pressure		10 ... 9 0 0 hPa -20...0°C 60...80 ℃		±2		hPa
		10 ... 9 0 0 hPa 0...60℃		±1.5		hPa
Resolution of output data in ultra high resolution mode		Pressure		0.025		Pa
		Temperature		0.01		°C
Noise in pressure	$V_{P,full}$	Full bandwidth, ultra high resolution		1		Pa
				8		cm
	$V_{P,filtered}$	Lowest bandwidth, ultra high resolution		0.2		Pa
				1.7		cm
Absolute accuracy temperature	A^T	@25℃		±0.1		°C
		0...+65℃		±1.0		°C
PSRR (DC)	PSSR	Full V_{DD} range			±0.005	Pa/mV
Long term stability	ΔPstab	12 months		TBD		hPa
Solder drifts			-0.5		+2	hPa
Possible sampling rate	f_{sample}		587	649	TBD	Hz

2 Absolute maximum ratings

Table 2 Absolute maximum ratings

Parameter	Symbol	Condition	Min	Max	Units
Supply voltage	V_{DD}		-0.3	+3.6	V
Voltage at all IO Pins	V_{DDIO}	all pins	-0.3	V_{DD}+0.3	V
Overpressure	P		0	18,000	hPa
Storage temperature	T_{STOR}		-45	+125	°C
ESD rating	ESD	HBM		±2	kV

3 Operation

3.1 Brief description

The WF5806 is designed to be connected directly to an external microcontroller of a mobile device via the I²C bus. The pressure and temperature data has to be compensated by the calibration data of the on-chip Non-Volatile Memory (NVM) which is individually factory calibrated for each device.

3.2 Function description

The WF5806 consists of a piezo-resistive micro-machined pressure sensor, an analog to digital converter and a control unit with Non-Volatile Memory (NVM) and a serial I²C interface. The WF5806 delivers the uncompensated values of the pressure and the temperature. The individual calibration data are stored in NVM. This is used to compensate sensitivity, offset, temperature dependence and other parameters of the sensor.

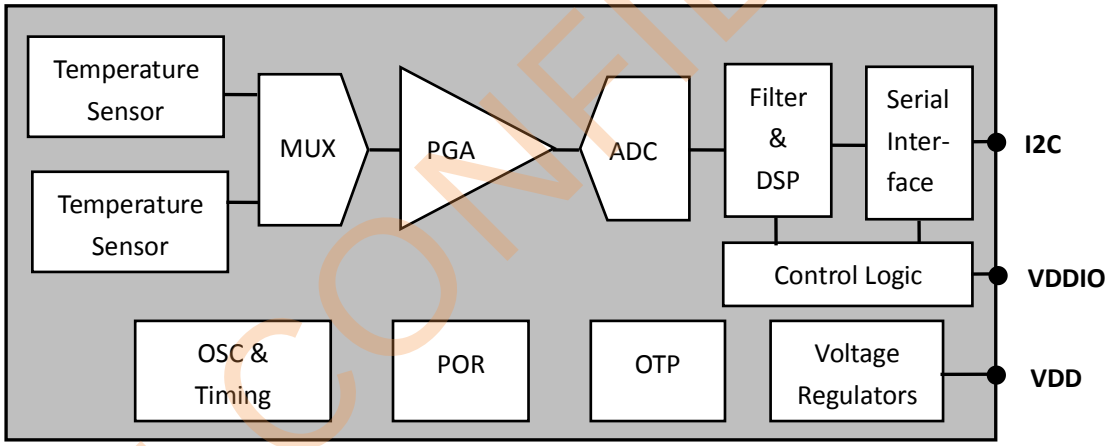


Figure 1 Block diagram of WF5806

3.3 Measurement of pressure and temperature

The microcontroller sends I²C write register to start a pressure or temperature measurement. After converting time or checking status via the I²C, the result value (raw pressure data and raw temperature data) can be read via the I²C interface. For pressure and temperature calibration calculation in microcontroller, the calibration data in NVM has to be used. The constants can be read out from the WF5806 's NVM via the I²Cinterface at software initialization.

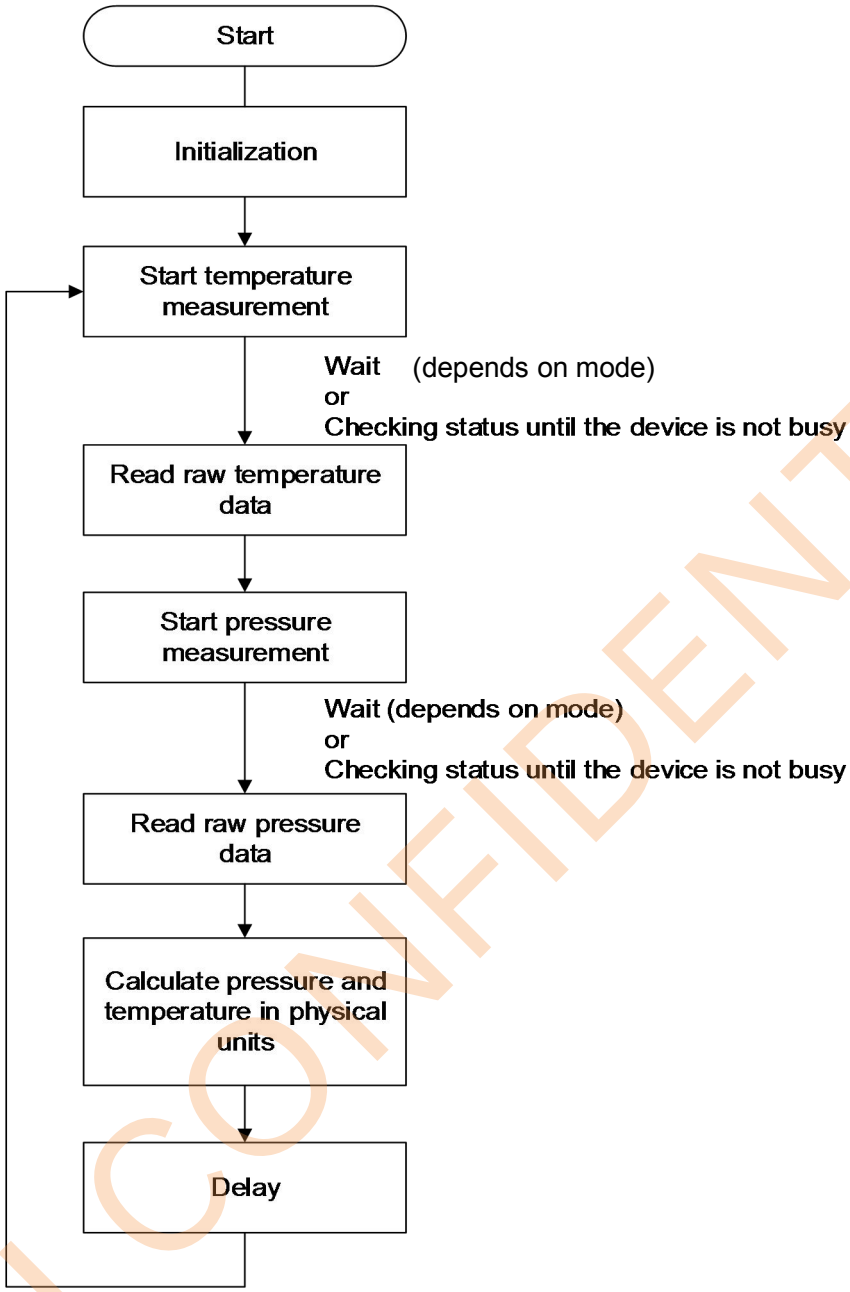


Figure 2 Measurement flow of WF5806

3.4 Timing of the measurements

The output data rate (ODR) of the measurements is controlled by the external microcontroller. A single measurement is performed according to the received I^2C register value. When the measurement is finished, the sensor returns to sleep mode and the measurement results can be obtained via I^2C interface.

The ODR can be increased to more than 500 samples per second for dynamic measurement. For application with high ODR, constant t_{delay} is recommended as the

self-heating of the pressure sensor and heat dissipation are in the balance if sampling rate is constant, which helps reducing the noise caused by irregular heat exchange between the sensor and the ambient environment. The recommended working timing diagram is shown in Figure 3.

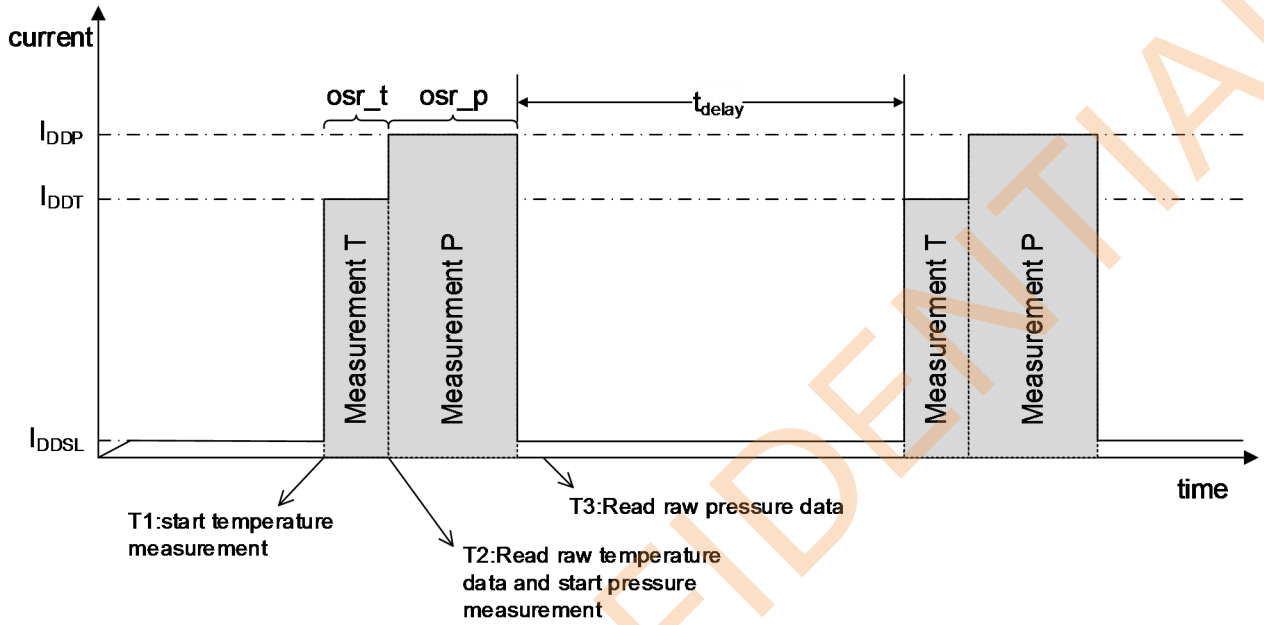


Figure 3 Recommended working timing diagram

For applications which require low ODR or host-based synchronization, the t_{delay} can be set with any value larger than 0.5ms. The optimum compromise between power consumption, speed and resolution can be selected.

3.5 Output compensation

The WF5806 output consists of the ADC output values include raw temperature and pressure data. Due to different characteristic of each sensing element, the actual pressure and temperature must be calculated using a set of calibration coefficients. These coefficients are individually factory calibrated and stored in the NVM. The NVM is organized with 16-bit data type.

3.6 Compensation formula

The ODR and OSR can be selected by selected by the oversampling_setting in the C code. Using the driver C code provided by WF Tech. Inc. is strongly recommended. Please contact with WF Tech. Inc. for details.

4 Registers

All the WF5806 registers can be departed into normal registers and OTP registers. The normal registers are used to send a conversion command to the WF5810M, read back the conversion data and perform the OTP blowing. The OTP registers are used to store the configurations and calibration coefficients for the WF5806 , whose default values can be programmed by the inside OTP banks.

4.1 Normal Registers

The WF5806 is designed to be connected directly to an external microcontroller of a mobile device via the I^2C bus. The pressure and temperature data has to be compensated by the calibration data of the on-chip Non-Volatile Memory (NVM) which is individually factory calibrated for each device.

Table 3 Normal registers

Addr	Description	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Default
0x00	SYS _ RST	RW			Softreset			Softreset			0x00
0x01	Part_ID	R	PartID<7:0>								0x00
0x02	Status		Error_code<3:0>						1'b0	DRDY	
0x06	DATA_MSB	R	Data out<23:16>								0x00
0x07	DATA_CSB	R	Data out<15:8>								0x00
0x08	DATA_LSB	R	Data out<7:0>								0x00
0x09	TEMP_MSB	R	Temp out<15:8>								0x00
0x0A	TEMP_LSB	R	Temp out<7:0>								0x00
0x30	CMD	RW	Sleep_time<3:0>				Sco	Measurement<2:0>			0x00

Reg0x 00

Soft_reset: 1: Reset all the WF5806 registers (except 'margin'), automatically come back to 0 after reset complete.

Reg0x01

PartID: OTP programmed 8 bits Part ID .

Reg0x02

DRDY： 1,indicates once conversion complete, and the output data is ready for reading.

Error_code: When diagnostic function enabled, These bits stores the error information.

Error_code[3]: VINP short to VDD

Error_code[2]: VINP short to GND

Error_code[1]: VINN short to VDD

Error_code[0]: VINN short to GND

Reg0x06-Reg0x08

Data_out: 24 bits ADC output data .

Reg0x09-Reg0x0a

Temp_out: Temperature output with an LSB equals to (1/256)℃.

Reg0x30

Sleep_time<3:0>: 0000:0ms, 0001:62.5ms, 0010:125ms ... 1111: 1s, only active during sleep mode conversion.

Measurement_control<1:0>: 000b, indicate a single shot temperature signal conversion. 001b, indicate a single shot sensor signal conversion. 010b: indicate a combined conversion (once temperature conversion immediately followed by once sensor signal conversion). 011b: indicate a sleep mode conversion (periodically perform once combined conversion with an interval time of ‘sleep_time’) .

Sco: 1, Start of conversion, automatically come back to 0 after conversion ends (except sleep mode conversion).

5 I2C INTERFACE

WF5806 's I2C bus uses SCL and SDA as signal lines. Both lines are connected to VDD externally via pull-up resistors so that they are pulled high when the bus is free The I2C device address of WF5806 is shown below.

Table 4 I2C Address

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

Table 5 Electrical specification of the I2C interface pins

Symbol	Parameter	Condition	Min	Max	Unit
f_{scl}	Clock frequency			400	kHz
t_{LOW}	SCL low pulse		1.3		us
t_{HIGH}	SCL high pulse		0.6		us
t_{SUDAT}	SDA setup time		0.1		us
t_{HDDAT}	SDA hold time		0.0		us
t_{SUSTA}	Setup Time for a repeated start condition		0.6		us
t_{HDSTA}	Hold time for a start condition		0.6		Us
t_{SUSTO}	Setup Time for a stop condition		0.6		Us
t_{BUF}	Time before a new transmission can start		1.3		Us

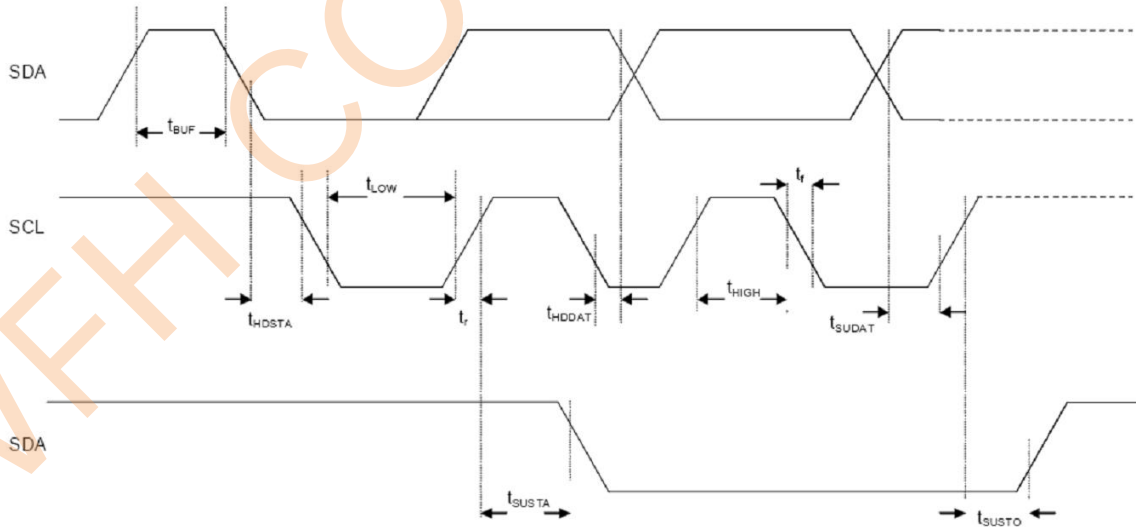


Figure 4 I2C Timing Diagram

The I2C interface protocol has special bus signal conditions. Start (S), stop (P) and binary dataconditions are shown below. At start condition,SCL is high and SDA has a falling edge. Then theslave address is sent. After the 7 address bits,the direction control bit R/ W selects the read or

write operation. When a slave device recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle.

At stop condition, SCL is also high, but SDA has a rising edge. Data must be held stable at SDA when SCL is high. Data can change value at SDA only when SCL is low.

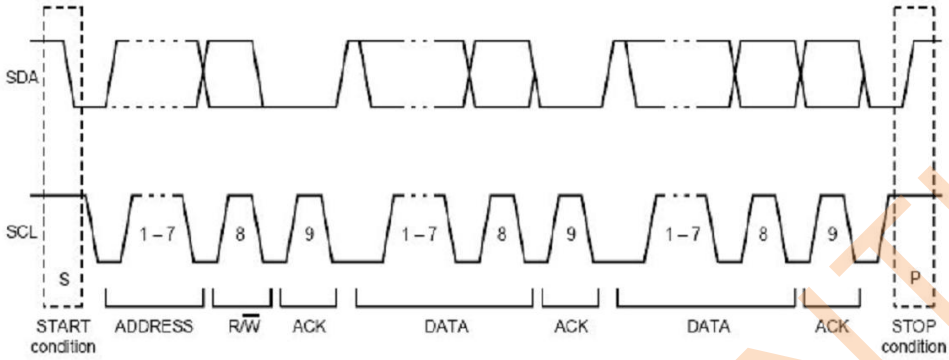


Figure 5 I2C Protocol

6 Connection diagram

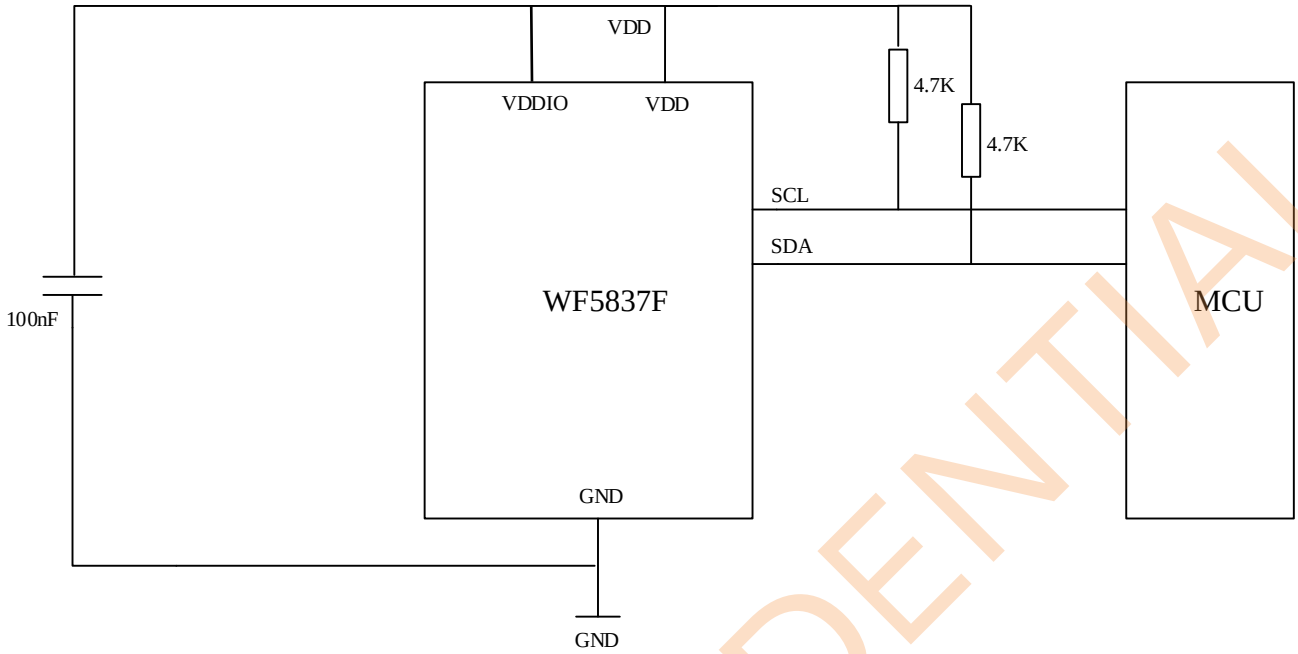


Figure 6 Typical Application (I2C Mode)

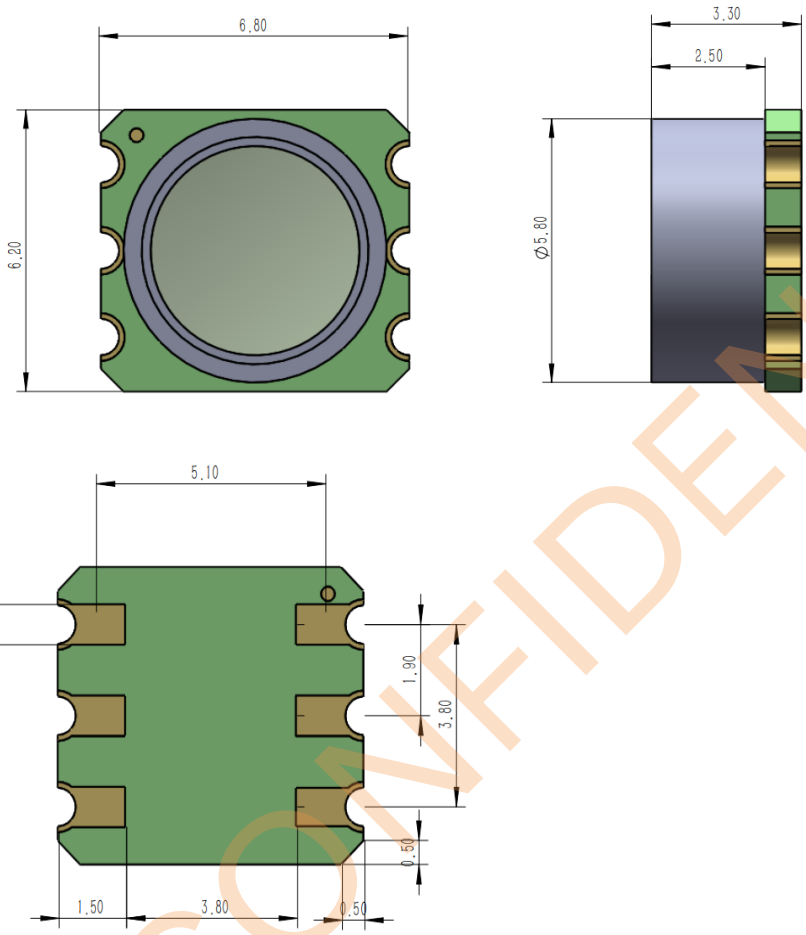
Notes:

- The recommended value for C1 is 100nF
- The value for the pull-up resistors R1, R2 should be based on the interface timing and the bus load; a normal value of R1 is 4.7kΩ, R2 is 4.7kΩ.

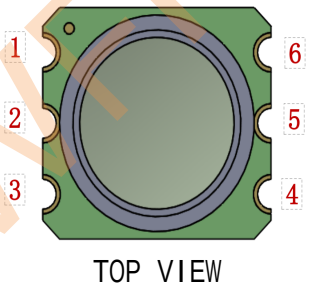
7 Package, reel and environment

7.1 Package Information

unit: mm
tol :0.1mm



7.2 Pin Configuration



TOP VIEW

NO	Name	Type	Function
1	GND	P	GROUND
2	VDD	P	POSITIVE SUPPLY
3	NC	N/A	NO CONNECTION
4	VDDIO	P	POSITIVE SUPPLY IO
5	SDA	I/O	IIC DATA
6	SCL	I	IIC CLOCK

8 Soldering recommendation

The recommended soldering profile is shown in Figure 12, followed by a description of the profile features in Table 10.

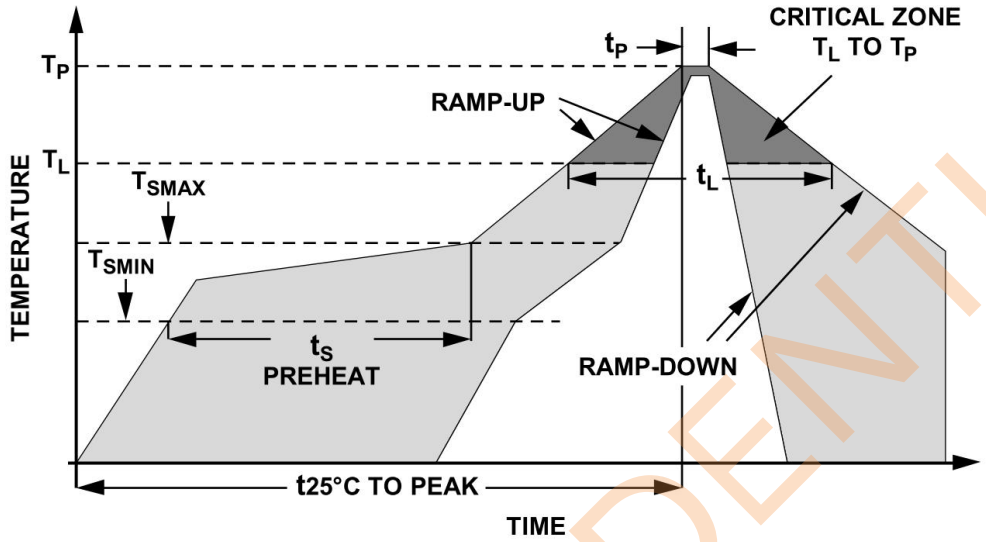


Figure 12 Recommended Soldering Profile

Table 10 Recommended Soldering Profile

Profile Feature	Pb-Free
Average ramp-up rate(TsMax to TP)	3℃/sec max.
Preheat: -Temperature Min.(TsMin) -Temperature Max.(TxMax) -Time.(TsMin to TsMax)(Ts)	 150℃ 200℃ 60 sec to 180 sec
Time maintained above: -Temperature(TL) -Time(tL)	217℃ 60 sec to 150 sec
Peak temperature(TP)	250℃
Time within 5℃ of actual peak temperature(TP)2	20 sec to 40 sec
Ramp-down rate	4℃/sec max.
Time 25℃ to peak temperature	8 minutes max.