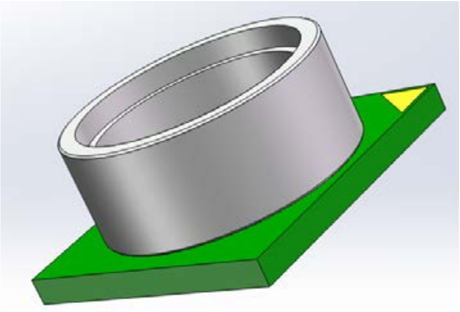
6862I

HIGH-PRECISION BAROMETER AND ALTIMETER SENSOR

Features

- Supply voltage: 1.7V–3.6V
- Pressure range: 300mBar~1200mBar
- Pressure absolute accuracy: ±1.0mBar
- Pressure relative accuracy: ±0.1mBar
- Temperature range: -40℃–+85℃
- Temperature accuracy: ±0.5℃ (Typ.)
- Standby current: 0.5μA (Typ.)
- Size: 6.8 x 6.2 x 3.1mm
- Waterproof design
- I2C digital interface



6.8 x 6.2 x 3.1mm

Applications

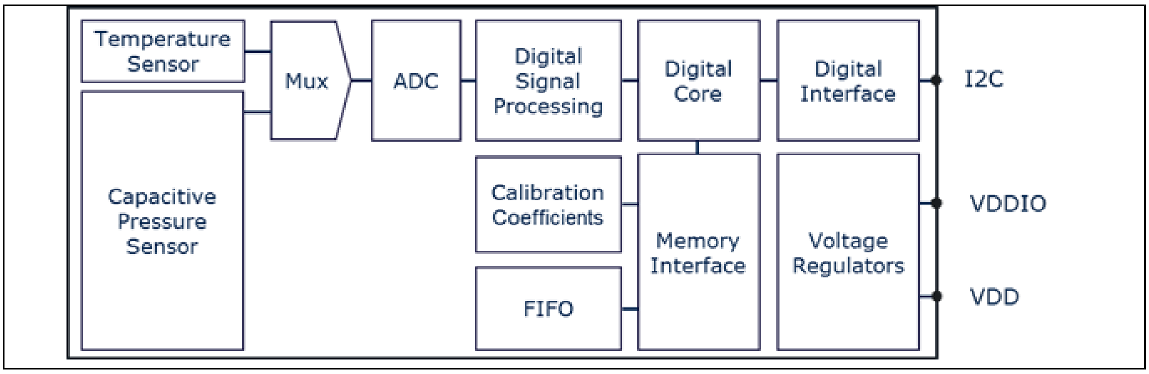
- Mobile barometer or altimeter
- Industrial pressure and temperature monitoring system
- Smart gas meter
- Outdoor sports equipment
- Weather station equipment
- Data logger for pressure and temperature

Descriptions

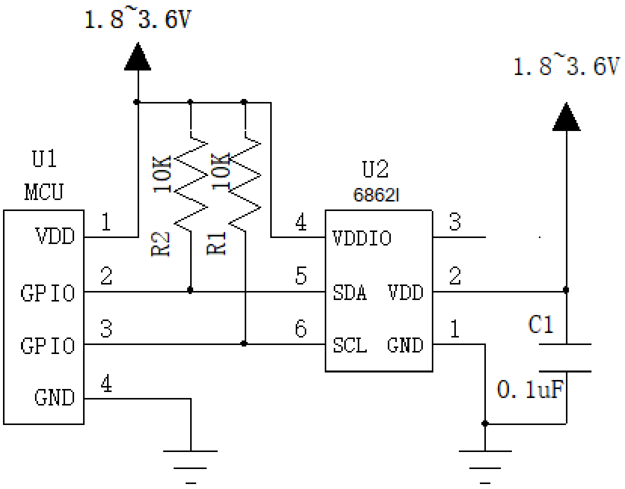
The 6862I is a digital absolute barometric pressure sensor with a high accuracy and a low current consumption, capable of measuring both pressure and temperature. The pressure sensor element is based on a capacitive principle which guarantees high precision during temperature changes. The waterproof design makes the 6862I ideal for mobile applications and outdoor devices.

The 6862I's internal signal processor converts the output from the pressure and temperature sensor elements to 24-bit results. Each unit is individually calibrated. The calibration coefficients calculated during this process are stored in the calibration registers. The coefficients are used in the application to convert the measurement results to high accuracy pressure and temperature values. The 6862I's internal FIFO can store up to 32 measurement results, allowing for a reduced host processor polling rate.

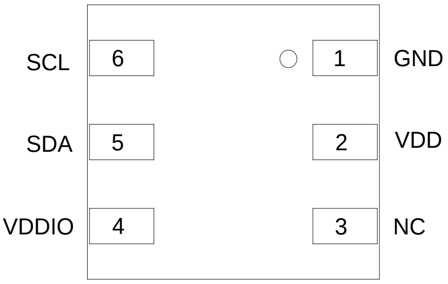
1. Block Diagram


Temperature Sensor
Capacitive Pressure Sensor
Mux
ADC
Digital Signal Processing
Calibration Coefficients
FIFO
Digital Core
Memory Interface
Digital Interface
Voltage Regulators
I2C
VDDIO
VDD

2. Application Circuit


1.8~3.6V
1.8~3.6V
U1
MCU
VDD
GPIO
GPIO
GND
1
2
3
4
R2
10K
R1
10K
U2
6862I
VDDIO
SDA
SCL
VDD
GND
4
5
6
3
2
1
C1
0.1uF

3. Pin Configuration and Description


SCL
6
SDA
5
VDDIO
4
1
GND
2
VDD
3
NC

Bottom View

Table 1 Pin Description

Pin	Name	Function
1	GND	Ground
2	VDD	Supply voltage for analog blocks
3	NC	No Connection
4	VDDIO	Digital supply voltage for digital blocks and I/O interface
5	SDA	I2C serial bi-directional data pin
6	SCL	I2C serial input clock pin

4. Definitions, Acronyms and Abbreviations

An explanation of terms and definitions used in this datasheet.

Table 2 Definitions

Term	Definitions/Explanation
Absolute accuracy	The absolute measurement accuracy over the entire measurement
Digital bit depth	The total bit depth used for conversion of the sensor input to the digital output. Measured in bits.
Digital resolution	The pressure value represented by the LSB change in output. This value should be much smaller than the sensor noise.
Full Scale Range (FSR)	The peak-to-peak measurement range of the sensor.
LSB	Least Significant Bit
Measurement time	The time required to acquire one sensor output result. This value determines the maximum measurement rate.
MSB	Most Significant Bit
Non-linearity	The deviation of measured output from the best-fit straight line, relative to 1000mBar and 25℃.
Output compensation	The process of applying an algorithm to the sensor output to improve the absolute accuracy of the sensor across temperature and to minimize unit to unit output variation. This algorithm makes use of both the temperature sensor readings and the individual calibration
Precision (noise)	The smallest measurable change, expressed as rms, after sensor oversampling.
Pressure temperature coefficient	The pressure measurement deviation, after compensation, from expected measurement value due to temperature change from 25℃. Measured in Pa/K.
Sensor calibration	The process, during the production test, where the sensor's measurement results are compared against reference values, and a set of calibration coefficients are calculated from the deviation. The coefficients are stored in the sensor's memory and are used in the
Sensor Over Sampling Rate (OSR)	Specifies the number of sensor measurements used internally to generate one sensor output result.

5. Specifications

5.1 Operating Range

The following operating conditions must not be exceeded in order to ensure correct operation of the device. All parameters specified in the following sections refer to these operating conditions, unless noted otherwise.

Table 3 Operating Range

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Pressure	Pa	300		1200	mBar	
Temperature	Ta	-40		85	℃	
Supply voltage	VDD	1.7		3.6	V	
Supply voltage of IO	VDDIO	1.2		3.6	V	
Ramp-up time of supply voltage	tvddup	0.001		5	ms	Time for supply voltage to reach 90% of final value.
Solder drift			0.8		mBar	
Long term stability			1.0		mBar	Depending on environmental conditions.

5.2 Absolute Maximum Ratings

Maximum ratings are absolute ratings. Exceeding any one of these values may cause irreversible damage to the integrated circuit.

Table 4 Absolute Maximum Ratings

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
VDD and VDDIO	VDDxx_ma			4	V	
Voltage on any pin	Vmax			4	V	
Storage temperature	Ts	-40		125	℃	
Pressure	Pmax			10	Bar	
ESD	VESD_HB	-2		2	KV	HBM

Attention: Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. Exposure to maximum rating conditions for extended periods may affect device reliability.

5.3 Current Consumption

Test conditions (unless otherwise specified in the table): VDD= 1.8V and VDDIO=1.8V.

Typ. values (PA=1000mBar and TA=25℃). Max./Min. values (PA=950-1050mBar and TA=0-65℃).

Table 5 Current Consumption

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Peak Current Consumption	Ipeak		345		µA	During Pressure measurement
			280		µA	During Temperature measurement
Stand by Current Consumption	Istb		0.5		µA	
Current Consumption. (1measurementper second.)	I1Hz		2.1		µA	Low precision
			11			Standard precision
			38			High precision

Note: The current consumption depends on both pressure measurement precision and rate. Please refer to the Pressure Configuration (PRS_CFG) register description for an overview of the current consumption in different combinations of measurement precision and rate.

5.4 Temperature Transfer Function

Test conditions (unless otherwise specified in the table): VDD=1.8V and VDDIO=1.8V.

Typ. values (PA=1000mBar and TA=25℃). Max./Min. values (PA=950-1050mBar and TA=0-65℃)

Table 6 Temperature Transfer Function

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Temperature accuracy	At		+/-0.5		℃	@25℃
Temperature data resolution	At_res		0.01		℃	
Temperature measurement rate	f	1		128	Hz	

5.5 Pressure Transfer Function

Table 7 Pressure Transfer Function

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Absolute pressure accuracy	Ap_abs		±1.0		mBar	PA=400-1050mBar TA=0...+60°C
			±1.7		mBar	PA=400-1050mBar TA=-40...+85°C
Relative pressure accuracy	Ap_rel		±0.1		mBar	PA=400-1050mBar TA=25...+60°C
Pressure precision	Ap_prc		5.0		Pa RMS	Low Power
			1.5			Standard
			0.5			High Precision

Note: Pressure precision is measured as the average standard deviation. Please refer to the Pressure Configuration (PRS_CFG) register description for all precision mode options.

Power supply rejection	Ap_psr			0.063	Pa RMS	Measured with 217Hz square wave and broad band noise,100mVpp
Pressure temperature sensitivity of calibrated measurements	Ap_tmp		0.5		Pa/K	1000mBar, +25...+40°C.
Pressure data resolution	Ap_res			0.06	Pa RMS	
Pressure measurement rate	f	1		128	Hz	
Pressure measurement time	t		5.2		ms	Low Power
			27.6			Standard
			105			High Precision

Note: The pressure measurement time (and thus the maximum rate) depends on the pressure measurement precision. Please refer to the Pressure Configuration (PRS_CFG) register description for an overview of the possible combinations of measurement precision and rate.

5.6 Timing Characteristics

Table 8 Timing Characteristics

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Start-up timing						
Time to sensor ready	TSensor_rdy			12	ms	The SENSOR_RDY bit in the Measurement Configuration register will be set when the sensor is ready.
Time to coefficients are available	TCoef_rdy			40	ms	The COEF_RDY bit in the Measurement Configuration register will be set when the coefficients can be read out.
Note: Start-up timing is measured from VDD > 1.2V & VDDIO > 0.6V or Soft Reset.						
I2C Clock.	fI2C			3.4	MHz	

6. Functional Description

6.1 Operating Modes

The 6862I supports 3 different modes of operation: Standby, Command, and Background mode.

Standby Mode

Default mode after power on or reset. No measurements are performed.

All registers and compensation coefficients are accessible.

Command Mode

One temperature or pressure measurement is performed according to the selected precision.

The sensor will return to Standby Mode when the measurement is finished, and the measurement result will be available in the data registers.

Background Mode

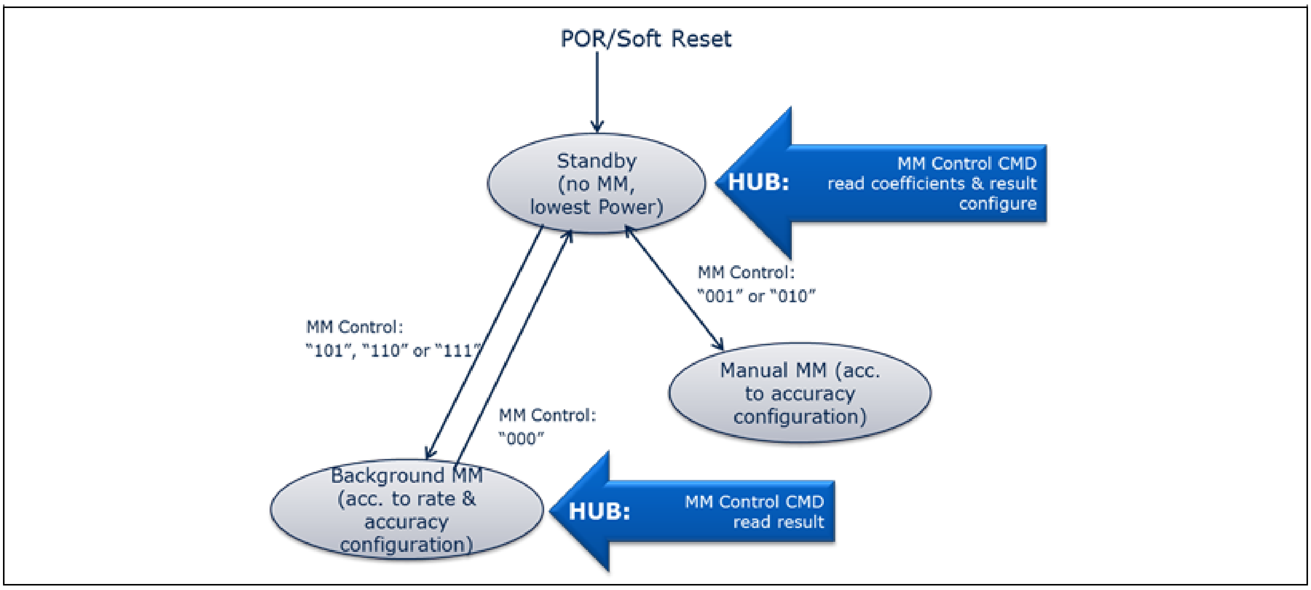
Pressure and/or temperature measurements are performed continuously according to the selected measurement precision and rate. The temperature measurement is performed immediately after the pressure measurement.

The FIFO can be used to store 32 measurement results and minimize the number of times the sensor must be accessed to read out the results.

Note: Operation mode and measurement type are set in the Sensor Operating Mode and Status (MEAS_CFG) register.

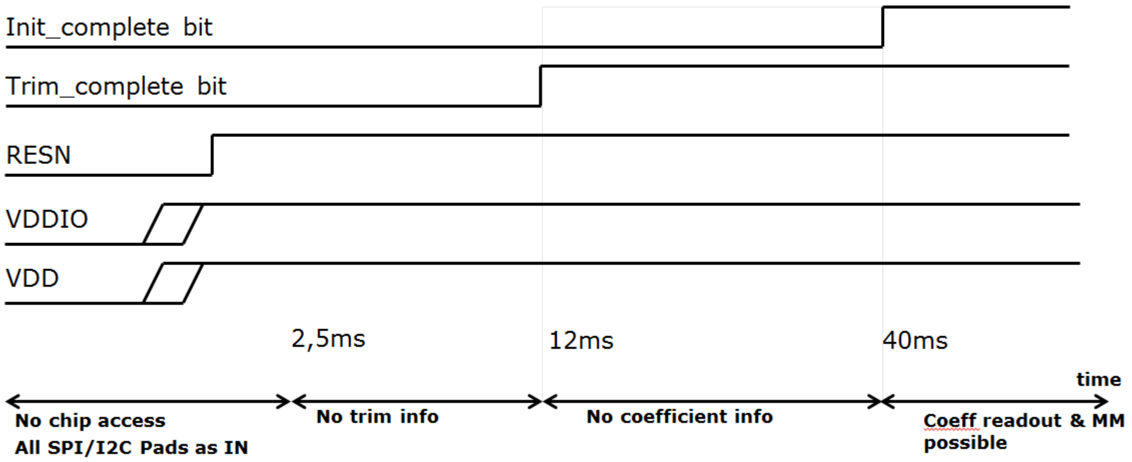
6.2 Mode Transition Diagram

The mode transition diagram is shown below.


POR/Soft Reset
Standby (no MM, lowest Power)
HUB:
MM Control CMD
read coefficients & result
configure
MM Control:
"001" or "010"
MM Control:
"101", "110" or "111"
Manual MM (acc. to accuracy configuration)
MM Control:
"000"
Background MM (acc. to rate & accuracy configuration)
HUB:
MM Control CMD
read result

6.3 Start-up Sequence

The star-up sequence of the 6862I is shown below. This diagram shows when the registers are accessible for read and/or write and also when the Pressure/Temperature measurements can start.


Init_complete bit
Trim_complete bit
RESN
VDDIO
VDD
2,5ms
12ms
40ms
time
No chip access
All SPI/I2C Pads as IN
No trim info
No coefficient info
Coeff readout & MM possible

6.4 Measurement Precision and Rate

Different applications require different measurement precision and measurement rates. Some applications, such as weather stations, require lower precision and measurement rates than for instance indoor navigation and sports applications.

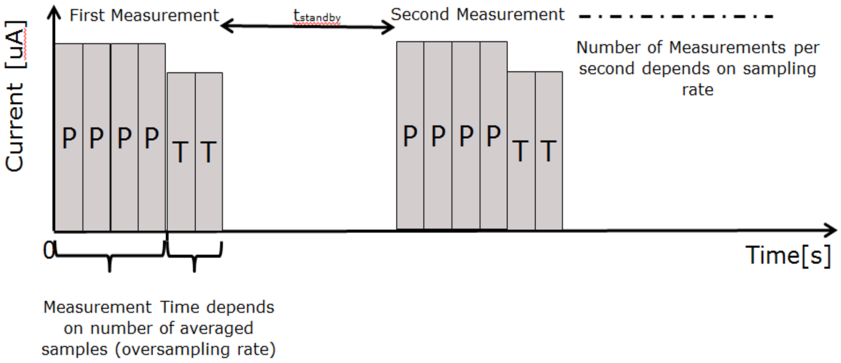
When the 6862I is in Background Mode, the measurement precision and rate can be configured to match the requirements of the application. This reduces current consumption of the sensor and the system.

In order to achieve a higher precision, the 6862I will read the sensor multiple times (oversampling), and combine the readings into one result. This increases the current consumption and also the measurement time, reducing the maximum possible measurement rate. It is necessary to balance the accuracy and data rate required for each application with the allowable current consumption.

The measurement precision, rate and time is set in the Pressure Configuration (PRS_CFG) and Temperature Configuration(TMP_CFG) registers. The register descriptions contain information about the current consumption and the possible combinations of measurement precision, time, and rate.

Enabling temperature measurements allows for compensation of temperature drift in the pressure measurement. The rates of these measurements can be set independently, but temperature compensation is more accurate when temperature and pressure measurements are taken together. This reduces the maximum pressure measurement rate, since: Rate_temperature * Time_temperature + Rate_pressure * Time_pressure < 1 second. Measurement Settings and Use Case Examples contains a table with examples of combinations of pressure and temperature precision and rates for different use cases.

In the figure below is described the Temperature and Pressure measurements sequence in background mode.


Current [uA]
First Measurement
$t_{standby}$
Second Measurement
Number of Measurements per second depends on sampling rate
P P P P T T
P P P P T T
0
Time[s]
Measurement Time depends on number of averaged samples (oversampling rate)

6.5 Sensor Interface

The 6862I can be accessed as a slave device through I2C serial interface.

- I2C interface
  - The sensor's default interface.
  - The sensor's address is 0x77 (default).

More details about digital interfaces are available in the Digital interfaces.

6.6 Result Register Operation

After starting the measurements, the latest pressure and temperature raw data will be available in their respective result registers. Temperature measurement can be skipped. The temperature measurements can be disabled if there is a requirement to measure pressure rapidly, but it will make accurate temperature drift compensation impossible.

All measurement data can be read in a single command using auto-increment read. When FIFO is disabled, reading the result register will not affect the register value, it will only be updated when a new measurement is completed. When FIFO is enabled, the pressure result register will update to the next value in the FIFO after each read. When all of the FIFO values have been read, the result register will be set to 0x800000.

6.7 FIFO Operation

The FIFO can store the last 32 measurements of pressure or temperature. This reduces the overall system power consumption as the host processor does not need to continuously poll data from the sensor but can go into standby mode for longer periods of time.

The FIFO can store any combination of pressure and temperature results, according to the background mode measurement rate settings. The pressure rate can for instance be set 4 times higher than the temperature rate and thus only every fifth result will be a temperature result. The measurement type can be seen in the result data. The sensor will set the least significant bit to:

- '1' if the result is a pressure measurement.
- '0' if it is a temperature measurement.

- The sensor uses 24 bits to store the measurement result. Because this is more bits than is needed to cover the full dynamic range of the pressure sensor, using the least significant bit to label the measurement type will not affect the precision of the result.

The FIFO can be enabled in the Interrupt and FIFO configuration register. The data from the FIFO is read out from the Pressure Data (PRS_Bn) registers regardless of whether the next result in the FIFO is a temperature or a pressure measurement.

When a measurement has been read out, the FIFO will auto increment and place the next result in the data register. A flag will be set in the FIFO Status register when the FIFO is empty and all following reads will return0x800000.

If the FIFO is full, the FIFO_FULL bit in the FIFO Status (FIFO_STS)will be set. If the INT_FIFO bit in the Interrupt and FIFO configuration register (CFG_REG) is set, an interrupt will also be generated when the FIFO is full.

The FIFO will stop recording measurements results when it is full.

6.8 Calibration and Measurement Compensation

The sensor is a calibrated sensor and contains calibration coefficients. These are used in the application (for instance by the host processor) to compensate the measurement results for sensor non-linearities. The sections that follow describe how to calculate the compensated results and convert them into Pa and ℃ values.

6.8.1 How to Calculate Compensated Pressure Values

Read the pressure calibration coefficients (c00, c10, c20, c30, c01, c11, and c21) from the calibration Coefficient register.

Note:

c00 and c10, read from the coefficient register are 20bit 2's complement numbers.

c20, c30, c01, c11, and c21, read from the coefficient register are 16bit 2's complement numbers.

Choose scaling factors kT (for temperature) and kP (for pressure) based on the chosen precision rate. The scaling factors are listed in Table 9.

Read the pressure and temperature result from the registers or FIFO.

Note:

The measurements read from the result registers (or FIFO) are 24bit 2´s complement numbers.

Depending on the chosen measurement rates, the temperature may not have been measured since the last pressure measurement.

Calculate scaled measurement results.

Traw_sc = Traw/kT

Praw_sc = Praw/kP

Calculate compensated measurement results.

Pcomp(Pa) = c00 + Praw_sc*(c10 + Praw_sc*(c20 + Praw_sc*c30)) + Traw_sc*c01 + Traw_sc*Praw_sc*(c11 + Praw_sc*c21)

6.8.2 How to Calculate Compensated Temperature Values

Read the temperature calibration coefficients (c0 and c1) from the Calibration Coefficients (COEF) register.

Note: The coefficients read from the coefficient register are 12 bit 2´s complement numbers.

Choose scaling factor kT (for temperature) based on the chosen precision rate. The scaling factors are listed in Table 9.

Read the temperature result from the temperature register or FIFO.

Note: The temperature measurements read from the temperature result register (or FIFO) are 24bit 2´s complement numbers.

Calculate scaled measurement results.

Traw_sc = Traw/kT

Calculate compensated measurement results.

Tcomp (℃) = c0*0.5 + c1*Traw_sc

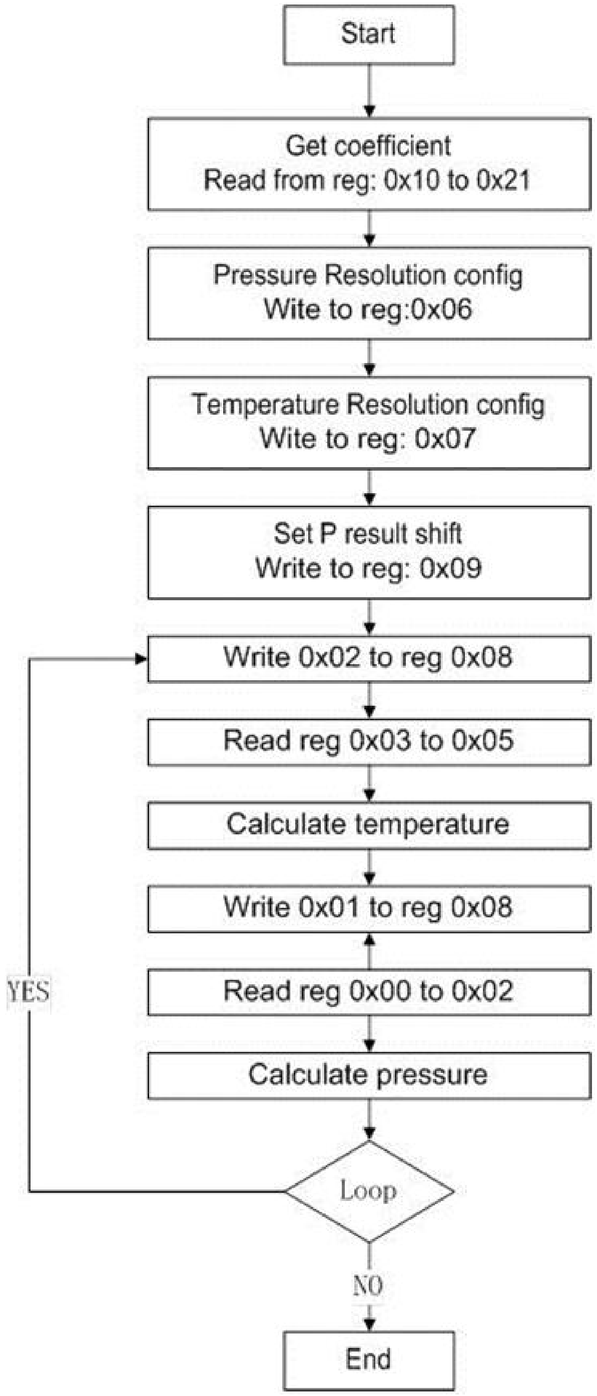
6.8.3 Compensation Scale Factors

Table 9 Compensation Scale Factors

Oversampling Rate	Scale Factor (kP or kT)	Result Shift (bit 2 and 3 address 0x09)
1 (single)	524288	0
2 times (Low Power)	1572864	0
4 times	3670016	0
8 times	7864320	0
16 times (Standard)	253952	enable pressure or temperature shift
32 times	516096	enable pressure or temperature shift
64 times (High Precision)	1040384	enable pressure or temperature shift
128 times	2088960	enable pressure or temperature shift

6.9 Pressure and Temperature Calculation Flow

The flow chart below describes the Pressure and Temperature calculate.


Start
Get coefficient
Read from reg: 0x10 to 0x21
Pressure Resolution config
Wite to reg:0x06
Temperature Resolution config
Wite to reg: 0x07
Set P result shift
Write to reg: 0x09
Write 0x02 to reg 0x08
Read reg 0x03 to 0x05
Calculate temperature
Write 0x01 to reg 0x08
Read reg 0x00 to 0x02
Calculate pressure
Loop
YES
NO
End

See also How to Calculate Compensated Pressure Values and How to Calculate Compensated Temperature Values.

7. Applications

7.1 Measurement Settings and Use Case Examples

Table 10 Measurement Settings and Use Case Examples

Use Case	Performance	Pressure Register Configuration Address: 0x06	Temperature Register Configuration Address: 0x07	Other
Weather Station (Low power)	5 Pa precision. 1 pr sec. 3 uA	0x01	0x80	Start background measurements (addr 0x08)
Indoor navigation (Standard precision, background mode)	10 cm precision. 2 pr sec. 22 uA	0x14	0x90	Enable P shift (addr 0x09) Start background measurements (addr 0x08)
Sports (High precision, high rate, background mode)	5 cm precision 4 pr sec. 200 uA	0x26	0xA0	Enable P shift (addr 0x09) Start background measurements (addr 0x08)

7.2 IIR Filtering

The air pressure is slowly changing due to weather conditions or short term changing like air turbulence created by a fan, slamming a door or window. All these disturbances can be suppressed or triggered on the software application level by implementing different IIR filtering.

Same sensor can be used by different software applications applying different IIR filtering to the raw data like low pass, high pass or band pass filtering.

8. Digital Interfaces

The measurement data, calibration coefficients, and configuration registers can be accessed through the I2C serial interfaces.

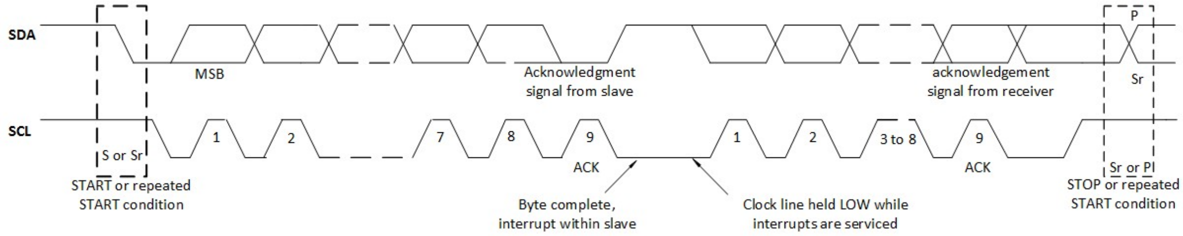
The following commands are supported: single byte write, single byte read and multiple byte read using auto increment from a specified start address.

8.1 I2C Interface

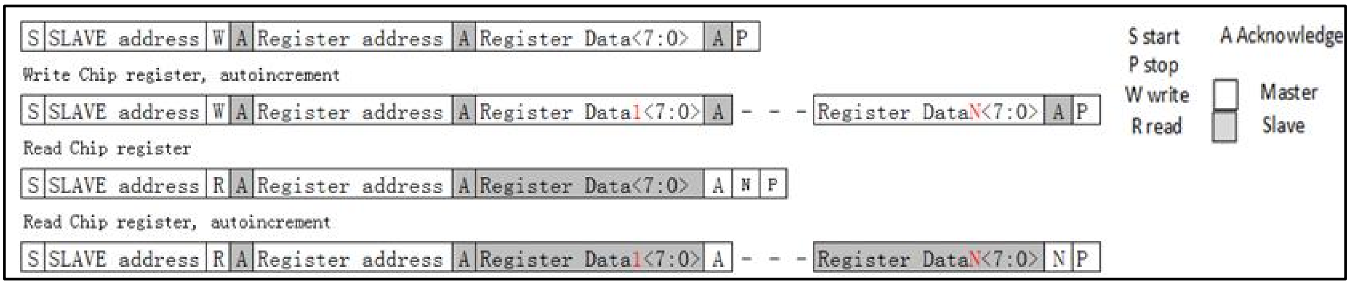
The I2C slave interface is compatible with Philips I2C Specification version 2.1. The I2C interface supports standard, fast and high speed mode.

The sensor's address is 0x77.

The basic timing is shown in the diagram below:


SDA
SCL
MSB
Acknowledgment signal from slave
acknowledgement signal from receiver
P
Sr
S or Sr
START or repeated START condition
1
2
7
8
9
ACK
Byte complete, interrupt within slave
Clock line held LOW while interrupts are serviced
1
2
3 to 8
9
ACK
Sr or P
STOP or repeated START condition

In one access, without stop, incremental read (address is auto increment) and auto-incremental write is supported. The read and write access is described below:


S SLAVE address W A Register address A Register Data<7:0> A P
Write Chip register, autoincrement
S SLAVE address W A Register address A Register Data1<7:0> A - - - Register DataN<7:0> A P
Read Chip register
S SLAVE address R A Register address A Register Data<7:0> A N P
Read Chip register, autoincrement
S SLAVE address R A Register address A Register Data1<7:0> A - - - Register DataN<7:0> N P
S start
P stop
W write
R read
A Acknowledge
Master
Slave

8.2 Interface Parameters Specification

8.2.1 General Interface Parameters

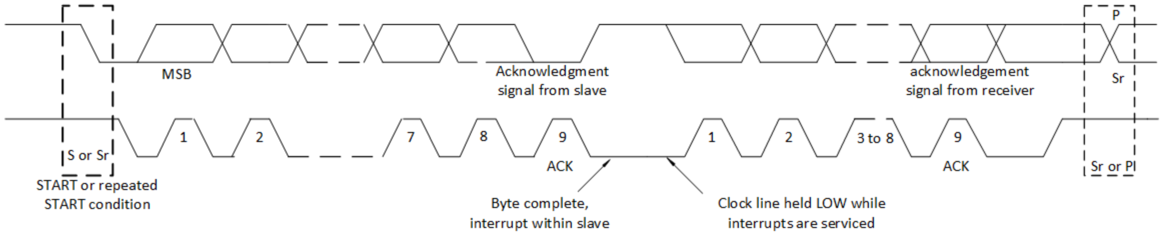
The general interface parameters are given in the table below:

Table 11 Interface Parameters

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Input voltage for low logic level at input pins	Vlow_in			0.3 * VDDIO	V	VDDIO=1.2V to 3.6V
Input voltage for high logic level at input pins	Vhigh_in	0.7 * VDDIO			V	VDDIO=1.2V to 3.6V
Output - low level for I2C	Vlow_SDA			0.1 * VDDIO	V	VDDIO=1.8V, iol=2mA
Output voltage for low level at pin SDA for I2C	Vlow_SDA_1.2			0.2* VDDIO	V	VDDIO=1.20V, iol=1.3mA
Output voltage for high level at pins SDA	Vhigh_out	0.8 * VDDIO			V	VDDIO=1.8V, iol=1mA (SDA)
Output voltage for high level at pins SDA	Vhigh_out_1.2	0.6 * VDDIO			V	VDDIO=1.2V, iol=1mA (SDA)
Pull-up resistor	Rpull	60	120	180	kohm	Internal pull-up resistance to VDDIO
I2C bus load capacitor	Cb			400	pF	On SDA and SCK

8.2.2 I2C Timings

The I2C timing is shown in the diagram below and corresponding values are given in the table below. The naming refers to I2C Specification version 2.1,the abbreviation sused "S&F mode" = standard and fast mode, "HS mode" = high speed mode, Cb = bus capacitance on SDA line.


MSB
Acknowledgment signal from slave
acknowledgement signal from receiver
P
Sr
S or Sr
START or repeated START condition
1
2
7
8
9
ACK
1
2
3 to 8
9
ACK
Sr or P
Byte complete, interrupt within slave
Clock line held LOW while interrupts are serviced

Data transfer on the I2C-bus

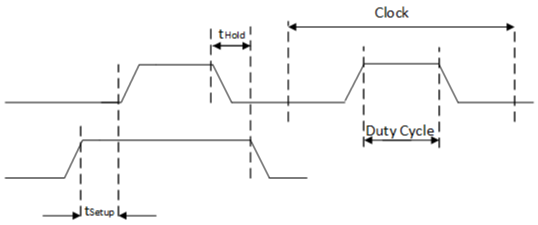

Clock
tHold
Duty Cycle
tSetup

Table 12 I2C Timings

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Data setup time on SDA pin	tSetup	20			ns	S&F mode
		5			ns	HS mode
Data hold time on SDA pin	tHold	0			ns	S&F&HS mode,
Duty Cycle	DC			70	%	S&F mode,
				55	%	HS mode,

9. Register Map

Table 13 Register Map

Register Name	Addr.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Reset State
PSR_B2	0x00	PSR[23:16](r)								00h
PSR_B1	0x01	PSR[15:8](r)								00h
PSR_B0	0x02	PSR[7:0](r)								00h
TMP_B2	0x03	TMP[23:16](r)								00h
TMP_B1	0x04	TMP[15:8](r)								00h
TMP_B0	0x05	TMP[7:0](r)								00h
PRS_CFG	0x06	-	PM_RATE[2:0](rw)			PM_PRC[3:0](rw)				00h
TMP_CFG	0x07	TMP_ EXT(rw)	TMP_RATE[2:0](rw)			TM_PRC[3:0](rw)				00h
MEAS_CFG	0x08	COEF_ RDY(r)	SENSOR _RDY(r)	TMP_ RDY(r)	PRS_ RDY(r)	-	MEAS_CRTL[2:0](rw)			C0h
CFG_REG	0x09	-	-			TMP_ SHIFT_ EN(rw)	PRS_ SHIFT_ EN(rw)	FIFO_ EN(rw)	SPI_ MODE (rw) (rw)	00h
FIFO_STS	0x0B	-	-	-	-	-	-	FIFO_ FULL(r)	FIFO_ EMPTY(r)	00h
RESET	0x0C	FIFO_ FLUSH (w)	-	-	-	SOFT_RST[3:0](w)				00h
COEF	0x10-0x21	<see register description>								xxh
Reserved	0x22-0x27	Reserved								xxh

10. Register Description

10.1 Pressure Data (PRS_Bn)

The Pressure Data registers contains the 24bit (3 bytes) 2's complement pressure measurement value. If the FIFO is enabled, the register will contain the FIFO pressure and/or temperature results (please see FIFO operation). Otherwise, the register contains the pressure measurement results and will not be cleared after read.

10.1.1 PRS_B2

The highest byte of the three bytes measured pressure value.

PRS_B2	Address:	00H
Pressure (MSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
PRS23	PRS22	PRS21	PRS20	PRS19	PRS18	PRS17	PRS16

r

Field	Bits	Type	Description
PRS[23:16]	7:0	r	MSB of 24bit 2´s complement pressure data.

10.1.2 PRS_B1

The middle byte of the three bytes measured pressure value.

PRS_B1	Address:	01H
Pressure (LSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
PRS15	PRS14	PRS13	PRS12	PRS11	PRS10	PRS9	PRS8-

r

Field	Bits	Type	Description
PRS[15:8]	7:0	r	LSB of 24bit 2´s complement pressure data.

10.1.3 PRS_B0

The lowest byte of the three bytes measured pressure value.

PRS_B0	Address:	02H
Pressure (XLSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
PRS7	PRS6	PRS5	PRS4	PRS3	PRS2	PRS1	PRS0

r

Field	Bits	Type	Description
PRS[7:0]	7:0	r	XLSB of 24bit 2´s complement pressure data.

10.2 Temperature Data (TMP_Tn)

The Temperature Data registers contain the 24bit (3 bytes) 2's complement temperature measurement value (Unless the FIFO is enabled, please see FIFO operation) and will not be cleared after the read.

10.2.1 TMP_B2

The highest byte of the three bytes measured temperature value.

TMP_B2	Address:	03H
Temperature (MSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
TMP23	TMP22	TMP21	TMP20	TMP19	TMP18	TMP17	TMP16

r

Field	Bits	Type	Description
TMP[23:16]	7:0	r	MSB of 24bit 2´s complement temperature data.

10.2.2 TMP_B1

The middle byte of the three bytes measured temperature value.

TMP_B1	Address:	04H
Temperature (LSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
TMP15	TMP14	TMP13	TMP12	TMP11	TMP10	TMP9	TMP8

r

Field	Bits	Type	Description
TMP[15:8]	7:0	r	LSB of 24bit 2´s complement temperature data.

10.2.3 TMP_B0

The lowest part of the three bytes measured temperature value.

TMP_B0	Address:	05H
Temperature (XLSB data)	Reset value:	00H

7	6	5	4	3	2	1	0
TMP7	TMP6	TMP5	TMP4	TMP3	TMP2	TMP1	TMP0

r

Field	Bits	Type	Description
TMP[7:0]	7:0	r	XLSB of 24bit 2´s complement temperature data.

10.3 Pressure Configuration (PRS_CFG)

Configuration of pressure measurement rate (PM_RATE) and resolution (PM_PRC)

PRS_CFG	Address:	06H
Pressure measurement configuration	Reset value:	00H

7	6	5	4	3	2	1	0
-	PM_RATE[2:0]			PM_PRC[3:0]			
-	rw			rw			

Field	Bits	Type	Description
-	7	-	Reserved.
PM_RATE[2:0]	6:4	rw	Pressure measurement rate: 000-1 measurements pr.sec. 001-2 measurements pr.sec. 010-4 measurements pr.sec. 011-8 measurements pr.sec. 100-16 measurements pr.sec. 101-32 measurements pr.sec. 110-64 measurements pr.sec. 111-128 measurements pr.sec. Applicable for measurements in Background mode only
PM_PRC[3:0]	3:0	rw	Pressure oversampling rate: 0000-Single (Low Precision) 0001-2 times (Low Power). 0010-4 times 0011-8 times 0100*)-16 times (Standard). 0101*)-32 times 0110*)-64 times (High Precision). 0111*)-128 times 1xxx*)-Reserved

*) Note: Use in combination with a bit shift. See Interrupt and FIFO configuration (CFG_REG) register.

Table 14 Precision (Pa RMS) and Pressure Measurement Time (ms) versus Oversampling Rate

Oversampling (PRC[3:0])	Single (0000)	2 times (0001)	4 times (0010)	8 times (0011)	16 times (0100)	32 times (0101)	64 times (0110)	128 times (0111)
Measurement time (ms)	3.6	5.2	8.4	14.8	27.6	53.2	104.4	206.8
Precision(Pa RMS)	5		2.5		1.5		0.5	

Table15 Estimated Current Consumption (uA)

Oversampling (PRC[3:0])	Single (0000)	2 times (0001)	4 times (0010)	8 times (0011)	16 times (0100)	32 times (0101)	64 times (0110)	128 times (0111)
Measurements pr sec. (PM_RATE([2:0])								
1 (000)	2.1	2.7	3.8	6.1	11	20	38	75
2 (001)								
4 (010)								
8 (011)	Note: The current consumption can be calculated as the Measurement Rate* Current Consumption of 1 measurement per. sec.							n.a.
16 (100)							n.a.	n.a.
32 (101)						n.a.	n.a.	n.a.
64 (110)					n.a.	n.a.	n.a.	n.a.
128 (111)			n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Note: The table shows the possible combinations of Pressure Measurement Rate and oversampling when no temperature measurements are performed. When temperature measurements are performed the possible combinations are limited to Rate temperature x Measurement Time temperature + Rate pressure x Measurement Time pressure < 1 second. The temperature measurement time versus temperature oversampling rate is similar with pressure measurement time versus pressure oversampling rate.								

10.4 Temperature Configuration (TMP_CFG)

Configuration of temperature measurement rate (TMP_RATE) and resolution (TMP_PRC)

TMP_CFG	Address:	07H
Temperature measurement configuration	Reset value:	00H

7	6	5	4	3	2	1	0
TMP_EXT	TMP_RATE[6:4]			-	TMP_PRC[2:0]		
rw	rw			-	rw		

Field	Bits	Type	Description
TMP_EXT	7	rw	Temperature measurement 0-Internal sensor (in ASIC) 1-External sensor (in pressure sensor MEMS element) Note: It is highly recommended to use the same temperature sensor as the source of the calibration coefficients. Please see the Coefficient Source register
TMP_RATE[2:0]	6:4	rw	Temperature measurement rate: 000-1 measurement pr. sec. 001-2 measurements pr. sec. 010-4 measurements pr. sec. 011-8 measurements pr. sec. 100-16 measurements pr. sec. 101-32 measurements pr. sec. 110-64 measurements pr. sec. 111-128 measurements pr. sec. Applicable for measurements in Background mode only
-	3	-	Reserved.
TMP_PRC[2:0]	2:0	rw	Temperature oversampling (precision): 000-single. (Default)-Measurement time 3.6ms. Note: Following are optional, and may not be relevant: 001-2 times. 010-4 times. 011-8 times. 100-16 times. 101-32 times. 110-64 times. 111-128 times.

10.5 Sensor Operating Mode and Status (MEAS_CFG)

Setup measurement mode

MEAS_CFG	Address:	08H
Measurement configuration	Reset value:	C0H

7	6	5	4	3	2	1	0
COEF_RDY	SENSOR_RDY	TEM_RDY	PRS_RDY	-	MEAS_CTRL		
r	r	r	r	-	rw		

Field	Bits	Type	Description

COEF_RDY	7	r	Coefficients will be read to the Coefficients Registers after start-up: 0-Coefficients are not available yet. 1-Coefficients are available.
SENSOR_RDY	6	r	The pressure sensor is running through self-initialization after start-up. 0-Sensor initialization not complete 1-Sensor initialization complete It is recommended not to start measurements until the sensor has completed the self-initialization.
TMP_RDY	5	r	Temperature measurement ready 1-New temperature measurement is ready. Cleared when temperature measurement is read.
PRS_RDY	4	r	Pressure measurement ready 1-New pressure measurement is ready. Cleared when pressure measurement is read.
-	3	-	Reserved.
MEAS_CTRL	2:0	rw	Set measurement mode and type: Standby Mode 000-Idle/Stop background measurement Command Mode 001-Pressure measurement 010-Temperature measurement 011-na. 100-na. Background Mode 101-Continuous pressure measurement 110-Continuous temperature measurement 111-Continuous pressure and temperature measurement

10.6 FIFO Configuration (CFG_REG)

Configuration of interrupts, measurement data shift, and FIFO enable.

CFG_REG	Address:	09H
Configuration register	Reset value:	00H

7	6	5	4	3	2	1	0
_				T_SHIFT	P_SHIFT	FIFO_EN	_
_				rw	rw	rw	_

Field	Bits	Type	Description
_	7-4	_	Reserved
T_SHIFT	3	rw	Temperature result bit-shift 0-no shift. 1-shift result right in data register. Note: Must be set to '1' when the oversampling rate is > 8 times.
P_SHIFT	2	rw	Pressure result bit-shift 0-no shift. 1-shift result right in data register. Note: Must be set to '1' when the oversampling rate is > 8 times.
FIFO_EN	1	rw	Enable the FIFO: 0-Disable. 1-Enable.
_	0	_	Reserved

10.7 FIFO Status (FIFO_STS)

FIFO status register

FIFO_STS	Address:	0BH
FIFO status register	Reset value:	00H

7	6	5	4	3	2	1	0
-						FIFO_FULL	FIFL_EMPTY
-						r	r

Field	Bits	Type	Description
-	7:2	-	Reserved.
FIFO_FULL	1	r	0-The FIFO is not full 1-The FIFO is full
FIFO_EMPTY	0	r	0-The FIFO is not empty 1-The FIFO is empty

10.8 Soft Reset and FIFO Flush (RESET)

Flush FIFO or generate soft reset.

RESET	Address:	0CH
FIFO flush and soft reset	Reset value:	00H

7	6	5	4	3	2	1	0
FIFO_FLUSH	-			SOFT_RST			
w	-			w			

Field	Bits	Type	Description
FIFO_FLUSH	7	w	FIFO flush 1-Empty FIFO After reading out all data from the FIFO, write '1' to clear all old data.
-	6:4	-	Reserved.
SOFT_RST	3:0	w	Write '1001' to generate a soft reset. A soft reset will run through the same sequences as in power-on reset.

10.9 Calibration Coefficients (COEF)

The Calibration Coefficients register contains the 2´s complement coefficients that are used to calculate the compensated pressure and temperature values.

Table16 Calibration Coefficients

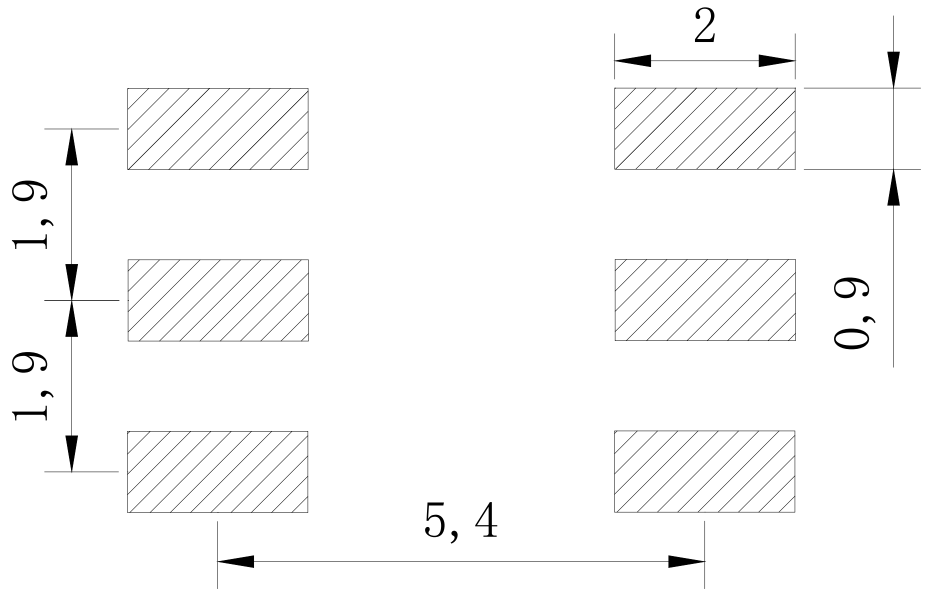
Coefficient	Addr.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
c0	0x10	c0[11:4]							
c0/c1	0x11	c0[3:0]				c1[11:8]			
c1	0x12	c1[7:0]							
c00	0x13	c00[19:12]							
c00	0x14	c00[11:4]							
c00/c10	0x15	c00[3:0]				c10[19:16]			
c10	0x16	c10[15:8]							
c10	0x17	c10[7:0]							
c01	0x18	c01[15:8]							
c01	0x19	c01[7:0]							
c11	0x1A	c11[15:8]							
c11	0x1B	c11[7:0]							
c20	0x1C	c20[15:8]							
c20	0x1D	c20[7:0]							
c21	0x1E	c21[15:8]							
c21	0x1F	c21[7:0]							
c30	0x20	c30[15:8]							
c30	0x21	c30[7:0]							

Note: Generate the decimal numbers out of the calibration coefficients registers data:

```
C20 = reg0x1D + reg0x1C*2^8
if(C20>(2^15-1))
C20 = C20 - 2^16
endif

C0 = (reg0x10*2^4) + ((reg0x11/2^4)&0x0F)
if(C0>(2^11-1))
C0 = C0 - 2^12
endif
```

11. Recommended Pad Layout (Unit: mm)



12. Cautions

Operating Temperature Range：-40°C～+85°C

Storage Temperature Range：-40°C～+125°C

The sensor is a highly sensitive component that must be stored in vacuum packaging. If the sensor is directly exposed to the external environment (Remove product from vacuum packaging) for more than 48 hours, the sensor needs to be baked at 150°C for 2 hours before reflow soldering. Care needs to be taken to ensure that the plastic housing (tray, tape) can withstand the corresponding baking temperature.

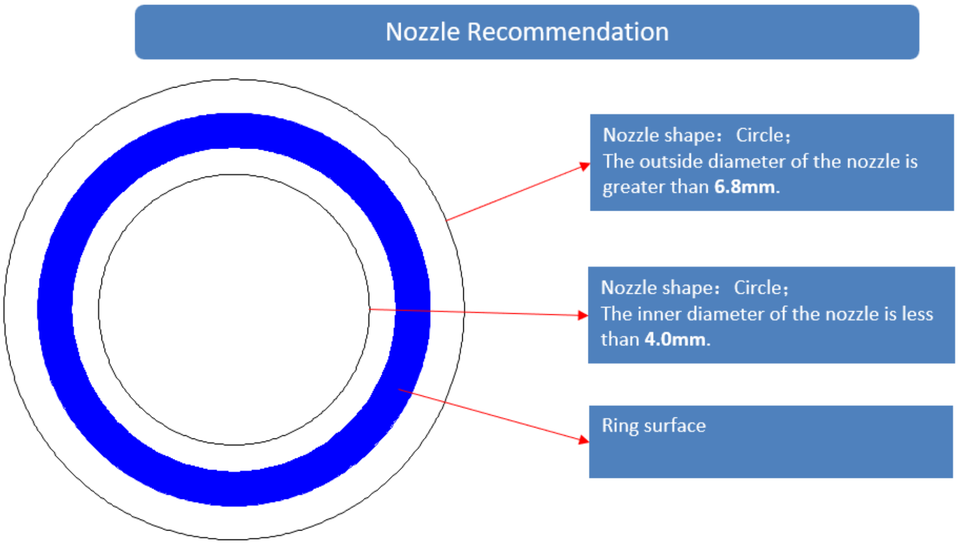
Keep in warehouse with less than 75% humidity and without sudden temperature change, acid air, any other harmful air or strong magnetic field.

The sensor with vacuum packaging can be transported by ordinary conveyances. Please protect products against moist, shock, sunburn and pressure during transportation.

Because the high temperature of reflow soldering will produce thermal shock to the sensor, the sensor will have a certain pressure drift in the initial stage after reflow soldering, which is a normal phenomenon. It is recommended that customers leave the sensor for 48 hours after reflow soldering, and then test it again. Under normal circumstances, the pressure drift will automatically disappear.

The inner area of the steel ring is a jelly-like waterproof glue covering the sensing element, and it is strictly forbidden to cause physical damage to it due to all external forces and sharp objects, otherwise it will affect the measurement accuracy of the sensing element or directly damage the sensing element. It is strictly prohibited to carry out ultrasonic cleaning or ultrasonic welding on the sensor, otherwise it will directly damage the sensor.

The recommended SMT nozzle sizes for reflow soldering are as follows.



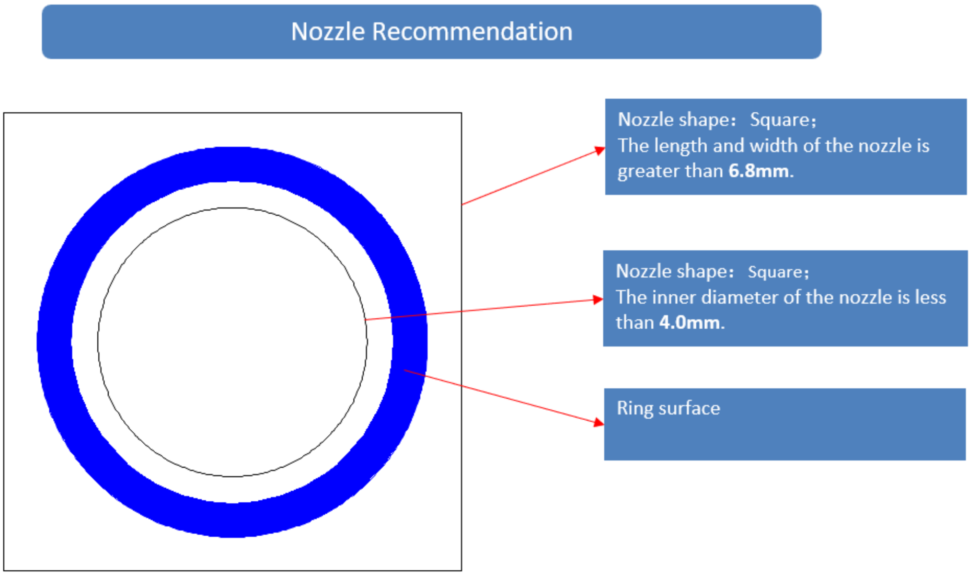
Nozzle Recommendation

Nozzle shape：Circle；
The outside diameter of the nozzle is greater than **6.8mm**.

Nozzle shape：Circle；
The inner diameter of the nozzle is less than **4.0mm**.

Ring surface

Circle Nozzle



Nozzle Recommendation

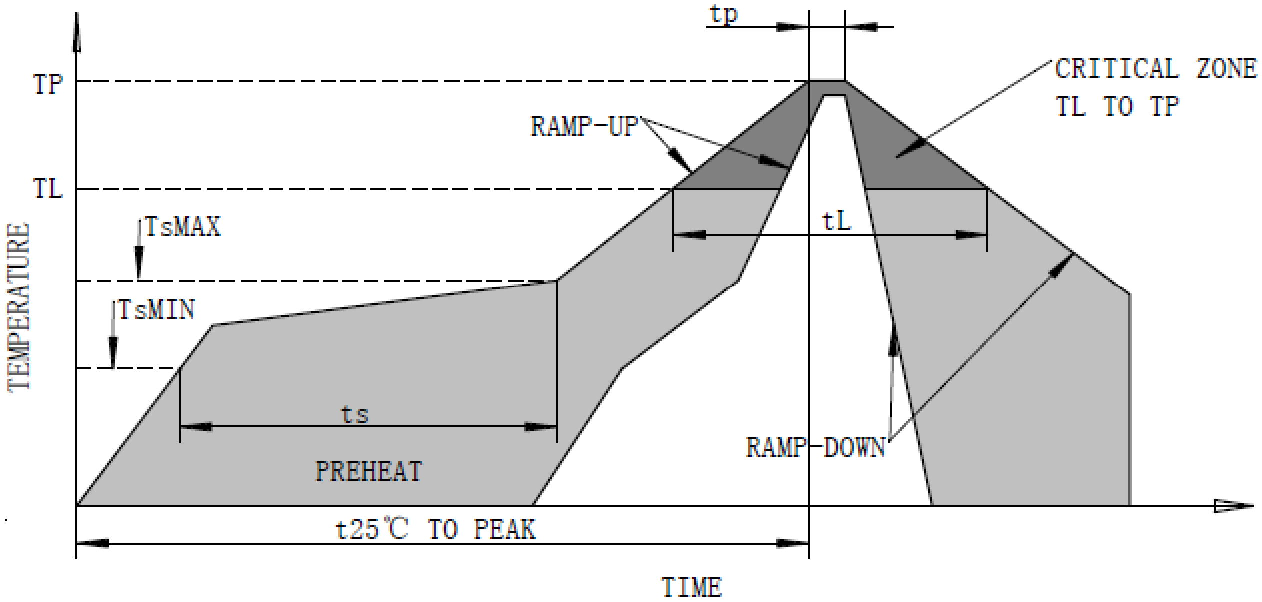
Nozzle shape：Square；
The length and width of the nozzle is greater than **6.8mm**.

Nozzle shape：Square；
The inner diameter of the nozzle is less than **4.0mm**.

Ring surface

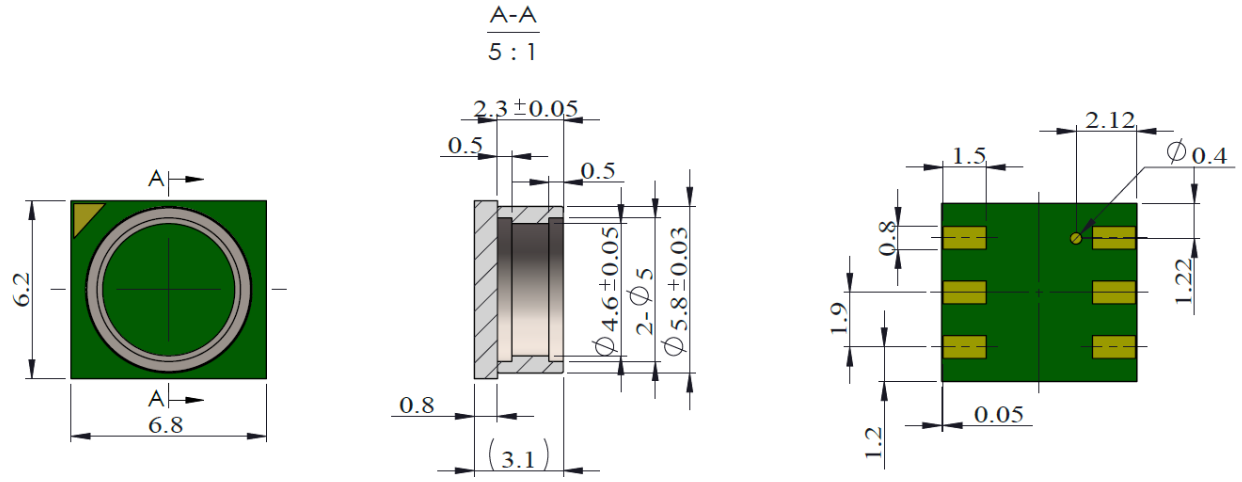
Square Nozzle

13. Soldering Recommendation


tp
CRITICAL ZONE
TL TO TP
TP
RAMP-UP
TL
TsMAX
tL
TsMIN
ts
PREHEAT
RAMP-DOWN
TEMPERATURE
t25℃ TO PEAK
TIME

Profile Feature	Pb-Free Assembly
Average ramp-up rate(TsMAX to TP)	2℃/seconds max
Preheat -Temperature Min.(TsMIN) - Temperature Max.(TsMAX) -Time (TsMIN to TsMAX)(Ts)	 130℃ 200℃ 90~110 seconds
Time maintained above: -Temperature(TL) -Time(tL)	 217℃ 50~60 seconds
Ramp time of Ts to TL	15-25 seconds
Time 25℃ to peak temperature	300 seconds max
Peak temperature(TP)	235~240℃
Ramp-down rate(peak to 217℃)	2~4℃/seconds

14. Mechanical Dimension (Unit: mm)

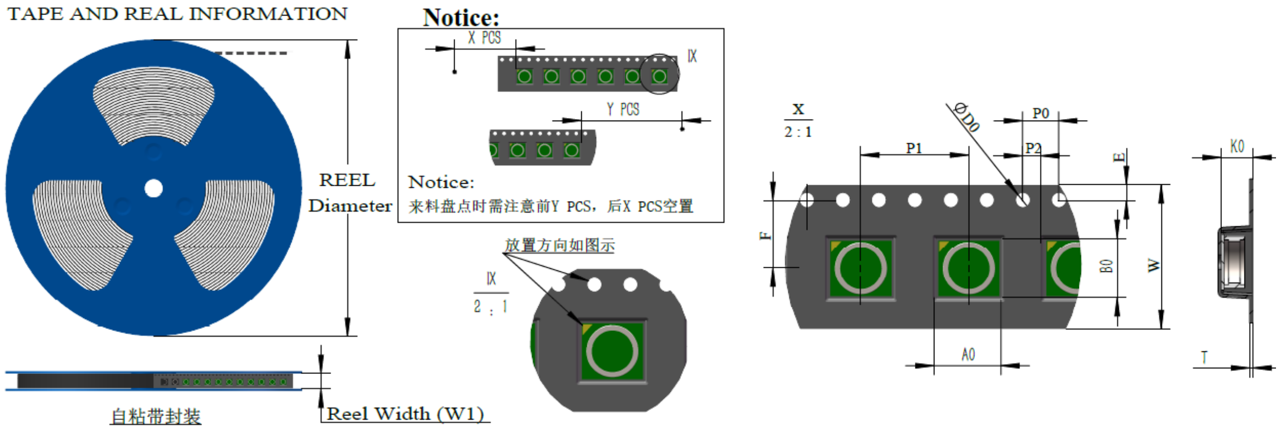

A-A
5 : 1
A
A
6.2
6.8
2.3 ±0.05
0.5
0.5
∅4.6±0.05
2-∅5
∅5.8±0.03
0.8
(3.1)
2.12
1.5
∅0.4
0.8
1.22
1.9
1.2
0.05

Notes: General Tolerance: ±0.10mm

15. Package Specification

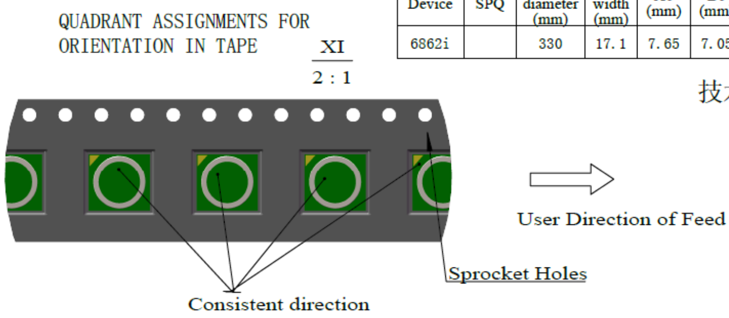
Carrier Tape Dimension (Unit：mm).

Quantity per Reel: 1000 pcs.


TAPE AND REAL INFORMATION
REEL
Diameter
自粘带封装
Reel Width (W1)
Notice:
X PCS
IX
Y PCS
放置方向如图示
IX
2 : 1
X
2 : 1
ØD0
P0
P1
P2
E
F
B0
W
A0
K0
T

Notice:
来料盘点时需注意前Y PCS，后X PCS空置

Device	SPQ	Reel diameter (mm)	Reel width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	D0 (mm)	F (mm)	T (mm)	E (mm)	P0 (mm)	P2 (mm)	Pin1 Quad
6862i		330	17.1	7.65	7.05	3.5	12	16	1.5	7.5	0.35	1.75	4	2	


QUADRANT ASSIGNMENTS FOR
ORIENTATION IN TAPE
XI
2 : 1
User Direction of Feed
Sprocket Holes
Consistent direction

技术要求：

1. 每10个型腔间距的累积公差为±0.2mm；
2. 表面摩擦电压<100V，10*10^4欧姆<表面电阻<1*10^9欧姆；
   产品使用自粘带封装。
3. 所有尺寸符合EIA-481-3国际标准；
4. 每13寸盘载带长度20.8M；
5. 材料：黑色；
6. 未注公差为±0.2mm；
7. 载带弯曲每100mm不超过1mm；
8. A0，B0测量以型腔上表面为基准，其公差为±0.3mm；K0值测量为型腔内底部为基准至载带上表面测量值。

16. Publication History

Version	Date	Description
V1.0	2021.4.27	New release
V1.1	2021.6.24	Update package specification
V1.2	2021.10.23	Update application circuit
V1.3	2024.2.6	1. Update mechanical dimension and package specification 2. Add the caution information
V1.4	2024.8-20	1. Update register list