

2SMPB-01-01

Absolute Pressure Sensor

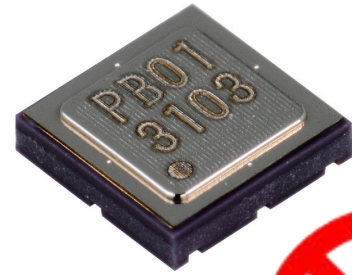
This announcement is based on product catalogue information previously shown before its discontinuation
Product information of the existing product may be different from the previous version

High accuracy and small size absolute pressure sensor with low current consumption

- Measure absolute pressure and temperature with high accuracy.
- Built in low noise 24 bits ADC.
- Digital control and output via I2C interface
- Automatically power down non working circuit to minimize current consumption
- Individual calibration parameters stored in OTP *

* One Time Programmable Non Volatile Memory

RoHS compliant



Application Example

- Smart Phone
- Activity monitor
- Wearable device

Ordering Information

■ Standard Models with Surface Mounting Terminals

| Structure | Packaging | Model | Minimum Order Quantity | Minimum Packing Unit |
|-----------|-----------------------|----------------|------------------------|----------------------|
| 8-pin QFN | Tape and Reel | 2SMPB-01-01-TR | 1,000 | 1,000 |
| | Embossed Carrier Tape | 2SMPB-01-01 | 10 | 10 |

2SMPB-01-01

Ratings, Specifications, and Function

■ Use conditions and recommended operating conditions

| | |
|--------------------------|-------------------|
| Type of Pressure | Absolute pressure |
| Medium | Air * |
| Operating Pressure Range | 30 kPa to 110 kPa |

* Never use corrosive gases.

■ Absolute Maximum Ratings

| Item | Symbol | Rating | Unit | Remark |
|----------------------------------|--------|------------------|------|-------------------------------|
| Power Supply Voltage | Vddmax | 4.0 | V | |
| Input Voltage (other than power) | Vmax | -0.2 to Vopr+0.2 | V | |
| Maximum Pressure | Pmax | 160 | kPa | |
| Storage Temperature | Tstr | -40 to 85 | °C | with no condensation or icing |
| Storage Humidity | Hstr | 10 to 95 | %RH | with no condensation |

■ Operating Ratings

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-----------------------|--------|------|------|------|------|--------|
| Operating Voltage | Vopr | 2.25 | 2.5 | 3.6 | V | VDD |
| | Vddio | 1.62 | 2.5 | 3.6 | V | VDDIO |
| Operating Temperature | Topr | -40 | - | 85 | °C | |

■ Electrical Characteristics (At Ta = 25°C, VDD = 2.5 V, unless otherwise noted)

| Item | Name | Min. | Typ. | Max. | Unit | Remarks |
|--------------------------------|--------|------|--------|------|------|------------------------------------|
| Average Current * | Ihp | - | 9 | - | μA | 1 sample/s High accuracy mode |
| Current Consumption | Idd | - | 500 | 610 | μA | |
| Sleep Mode Current Consumption | Isleep | - | 0.3 | 0.6 | μA | |
| Measureable Pressure Range | Popr | 30 | - | 110 | kPa | |
| Absolute Pressure Accuracy * | Pabs1 | -750 | - | 750 | Pa | 70 k to 110 kPa High accuracy mode |
| Relative Pressure Accuracy * | Prel1 | - | 6 | - | Pa | 70 k to 110 kPa High accuracy mode |
| rms Noise * | Pnois | - | 2 | - | Pa | 70 k to 110 kPa High accuracy mode |
| Absolute Temperature Accuracy | Tab | -2 | - | 2 | °C | |
| Pressure Resolution * | Pres | - | 0.06 | - | Pa | High accuracy mode |
| Temperature Resolution * | Tres | - | 0.0002 | - | °C | High accuracy mode |
| Discharge time of VDD * | Toff | - | 60 | - | sec | Time@ VDD From 2.5 V to 0.01 V |

* These characteristics are guaranteed by design.

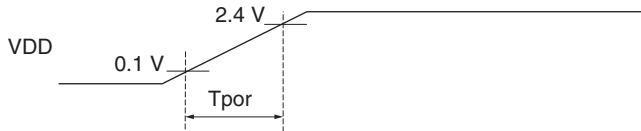
Note: Above table shows the characteristics without mounting board.

Please confirm performance of this sensors in your application and use your own judgment to determine the appropriateness of using them in such application.

■ I2C Characteristics (At Ta = 25°C, VDD = 2.5 V, unless otherwise noted)

| Item | Name | Standard Mode | | Fast Mode | | Unit | Remark |
|--------------------------------------|---------|---------------|---------|-----------|---------|------|--------|
| | | MIN. | MAX. | MIN. | MAX. | | |
| SCLK Clock Frequency | fsc1 | - | 100 | - | 400 | kHz | |
| Digital Input L (I2C) | Vil2 | -0.2 | VDD×0.2 | -0.2 | VDD×0.2 | V | |
| Digital Input H (I2C) | Vih2 | VDD×0.8 | VDD+0.2 | VDD×0.8 | VDD+0.2 | V | |
| Digital Output L (I2C) | Vol2 | 0 | 0.4 | 0 | 0.4 | V | |
| Pull-up Resister | Rpullup | 2.2 | 10 | 2.2 | 10 | kΩ | |
| Capacitive Load | Cb | - | 400 | - | 400 | pF | |
| Power On Supply Startup Waiting Time | Tpor | - | 0.8 | - | 0.8 | msec | |
| Power On Start Up Time | tstart | - | 2 | - | 2 | msec | |
| Pulse Width of Asynchronous Reset | trar | 100 | - | 100 | - | μsec | |

Power On Reset



Note 1: When the power is turned on, please activate power on reset.

For more information, please refer to the section of "Power on Reset" (p. 8).

Note 2: About detailed I2C bus information, please refer to the I2C-bus specification and user manual presented by NXP.

■ Characteristics by Power Mode

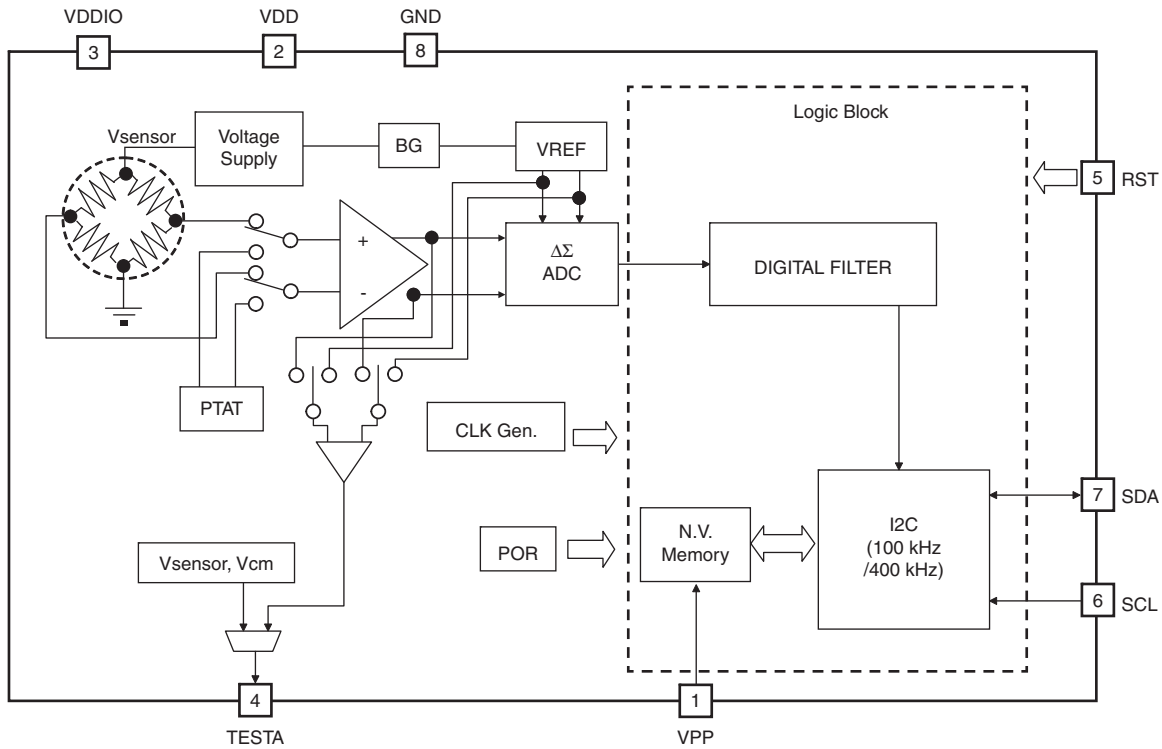
| Mode *1 | Waiting Time [msec] *2 | Average Current @1 sample/s [μA] *2 | rms Noise [Pa] *2 |
|--------------------|------------------------|-------------------------------------|-------------------|
| Low power mode | 7 | 4 | 6 |
| Standard mode | 9 | 5 | 3 |
| High accuracy mode | 17 | 9 | 2 |

*1. Please see "I2C_SREQ: Sensor Request Register" (p. 13) for setting up power mode.

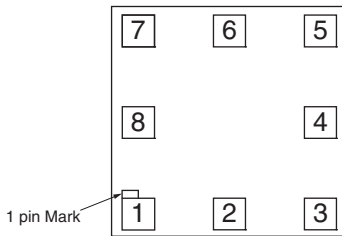
*2. Please see "Execute timing chart" (p. 6) for meaning of waiting time. These characteristics are guaranteed by design.

Connection

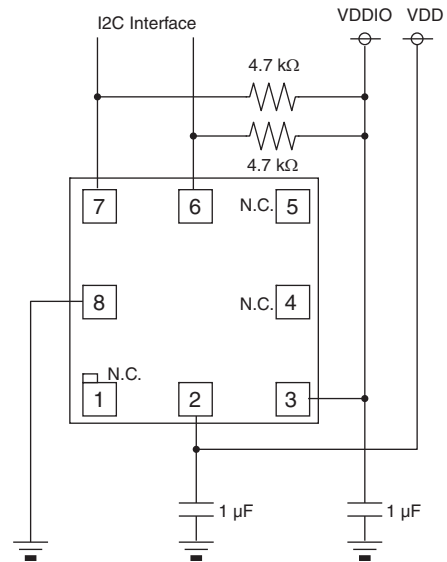
■ Block Diagram



■ Pin Description and Layout (Top view)



■ Typical Connection



| Pin No. | Symbol | Description |
|---------|--------|-----------------------|
| 1 | VPP | OTP write enable * |
| 2 | VDD | Power |
| 3 | VDDIO | Digital I/O Power |
| 4 | TESTA | Analog out for test * |
| 5 | RST | Asynchronous reset |
| 6 | SCL | I2C clock |
| 7 | SDA | I2C data |
| 8 | GND | Ground |

* These pins are for test purpose only.
Please leave open (Non-connect) while operating.

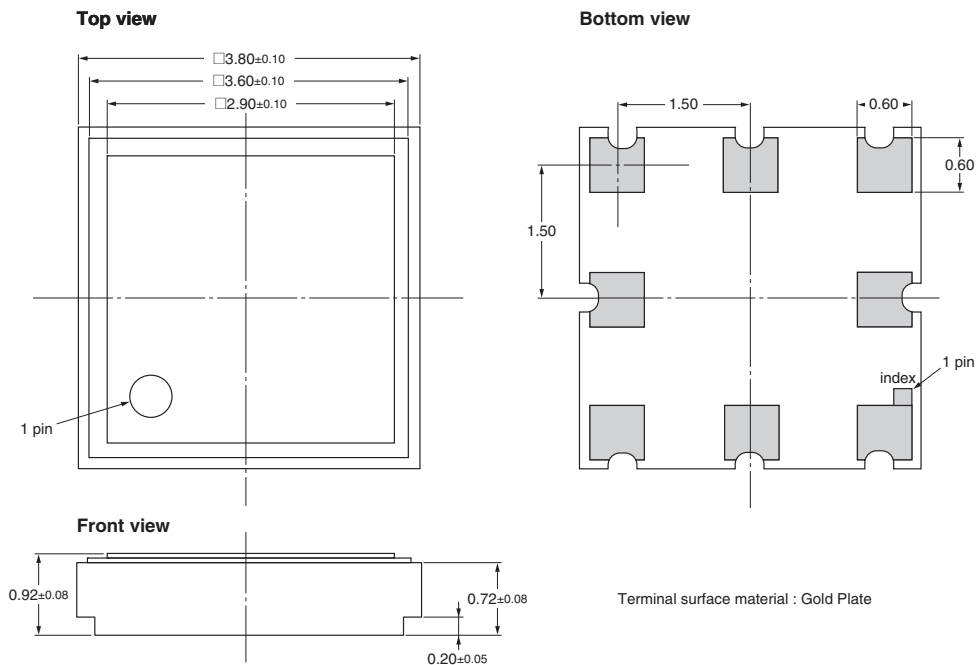
Dimensions (Unit: mm)

■ Package

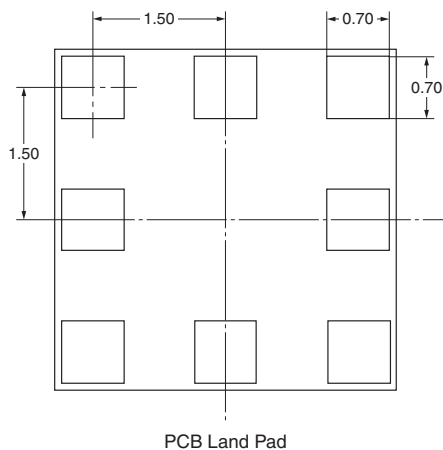
Package Type: QFN (Quad Flat No-lead package) 8 pin

Package Size: 3.8 mm × 3.8 mm × 1.0 mm (max.)

■ Outline Dimension



■ Mounting PAD Dimensions (Top View) : recommended



■ Marking structure

P B 0 1 (Type : Fixed)

× × × ×

- Sequence number (from 0 to 9, from A to Z (without O, Q, I))
- Week of manufacture (from 01 to 5*)
- Year of manufacture (One digit at the end of the year)

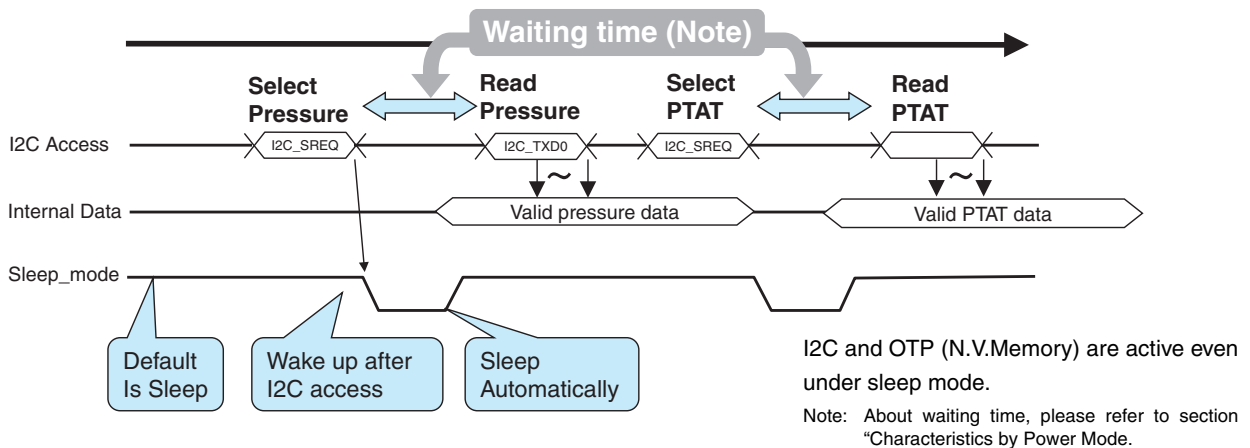
Operations

■ Outline of Sensor Operation

This page describes the typical operation after power on.

1. Wait until OTP initialization. (waiting for OTP automatically initialize finish)
2. Start-up ADC by setting up I2C_SETUP register
 - Write 02h in I2C_SETUP register.
3. Access COE_* registers and get calibration parameters.
 - Write 25h in I2C_AADJ register to enable OTP read operation.
 - Access COE_* registers and get calibration data.
 - After completion of read operation, write 65h to I2C_AADJ register.
4. Set up I2C_SREQ register to enable temperature measurement.
5. Get temperature data from I2C_TXD0 register after waiting time.
6. Set up I2C_SREQ register to enable pressure measurement.
7. Get pressure data from I2C_TXD0 register after waiting time.
8. Correct measured data with calibration data got at step 3.
9. Repeat 6 to 8. May need step 4, 5, and 8 when ambient temperature is changed.

Execute timing chart

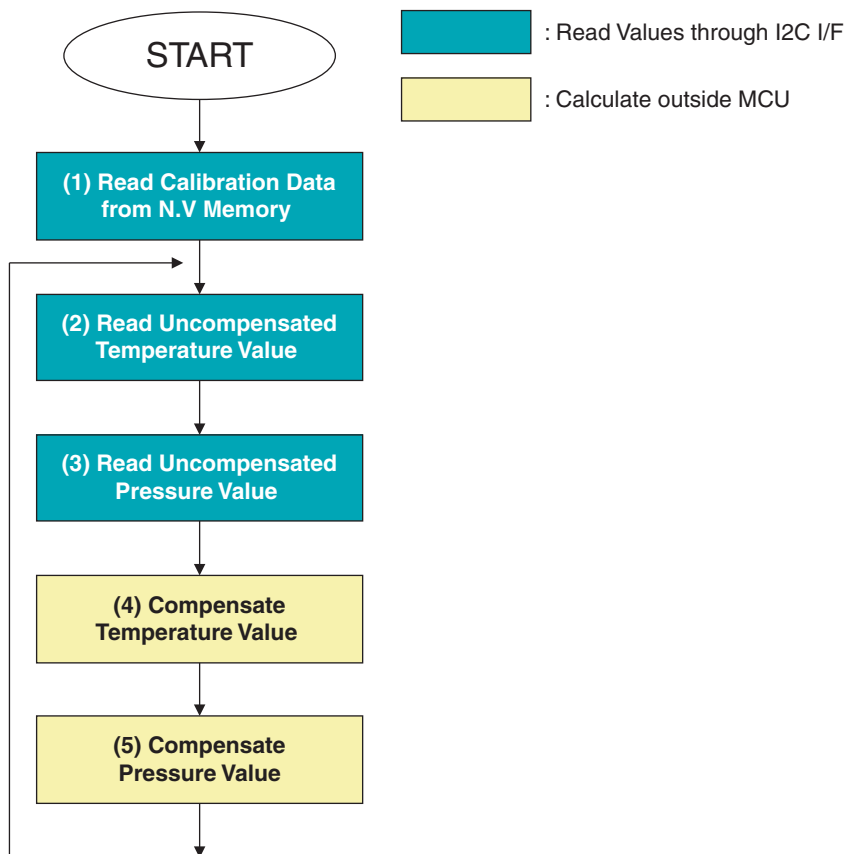


■ Outline of Sleep Operation

Sleep operation of this sensor is controlled by start/stop internal clock.

- System will automatically stop clock and sleep after completion of analog to digital conversion.
- ADC and Digital Filter Block are powered down while sleeping.
- Other part such as OTP (N.V.Memory) and I2C continue working during sleep, then can communicate outside via I2C interface.
- ADC and Digital Filter Block can be awoken by I2C_SREQ bit 4 (ACTBIT) = "1".

■ Compensation of pressure and temperature



- Read calibration data which are contained in internal NVM through I2C.
These coefficients are used at compensation calculation below step (4) or step (5).
- Read temperature data which are output by absolute pressure sensor through I2C.
This temperature data is used at step (4) using coefficients of step (1) for compensation.
- Read pressure data which are output by absolute pressure sensor through I2C.
This pressure data is used at step (5) using coefficients of step (1) for compensation.
- Using coefficients of step (1) and temperature data of step (2), the operator corrects temperature data by using following temperature compensation formula.

$$\begin{aligned}
 Tr &= (Dt - ca) \times ba0 \\
 &= (Dt - ca) \times ba \times 2^{-19}
 \end{aligned}$$

- Tr: Calculation result [1/256°C]
 Dt: 2SMPB-01 digital output of temperature (internal) [digit]
 ba: 2SMPB-01 calibration coefficient (16 bits read value of COE_PTAT2 Reg)
 ca: 2SMPB-01 calibration coefficient (24 bits read value of COE_PTAT3 Reg and COE_CEX Reg)

- Using coefficients of step (1) and pressure data of step (3), the operator corrects pressure data by using following pressure compensation formula.

$$PI = (Dp - cp) \times bp0$$

$$= (Dp - cp) \times bp \times 2^{-19}$$

- PI: Calculation result. This result is a relative value from 90 kPa. [Pa]
 Dp: 2SMPB-01 digital output of pressure [digit]
 bp: 2SMPB-01 calibration coefficient (16 bits read value of COE_PR2 Reg)
 cp: 2SMPB-01 calibration coefficient (24 bits read value of COE_PR3 Reg and COE_CEX Reg)

The next by using the result data of step (4), the operator corrects pressure data temperature compensation.

$$Ta \geq 25 [^{\circ}C]$$

$$Po = PI + 90000 + (PI + 90000) (ct0 + bt0 \times Tr) - 90000$$

$$= PI + 90000 + (PI + 90000) (ct \times 2^{-18} + bt \times 2^{-31} \times Tr) - 90000$$

$$Ta < 25 [^{\circ}C]$$

$$Po = PI + 90000 + (PI + 90000) (ct20 + bt20 \times Tr) - 90000$$

$$= PI + 90000 + (PI + 90000) (ct2 \times 2^{-18} + bt2 \times 2^{-31} \times Tr) - 90000$$

Note: Temperature calibration of the pressure is calculated after converting to absolute pressure value because PI is a relative value from 90 [kPa].

- Po: Final compensated result. This result is a relative value from 90 kPa. [Pa]
 bt: 2SMPB-01 calibration coefficient (16 bits read value of COE_TEMP2 Reg)
 ct: 2SMPB-01 calibration coefficient (16 bits read value of COE_TEMP3 Reg)
 bt2: 2SMPB-01 calibration coefficient (16 bits read value of COE_TEMP22 Reg)
 ct2: 2SMPB-01 calibration coefficient (16 bits read value of COE_TEMP23 Reg)

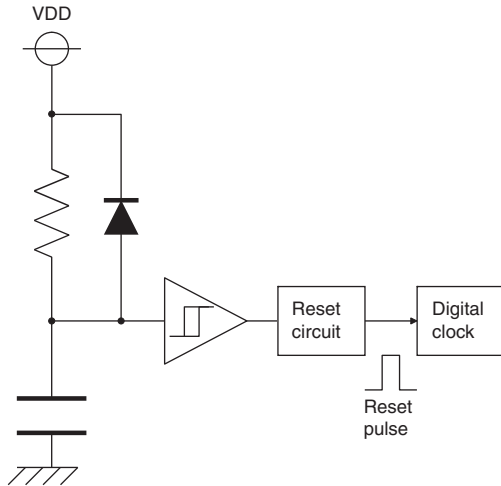
Power on Reset

Power-on reset circuit of 2SMPB-01 is using the CR delay. Therefore power-on reset is not working properly on below situations. At the time of the following circumstances when power is switched on again:

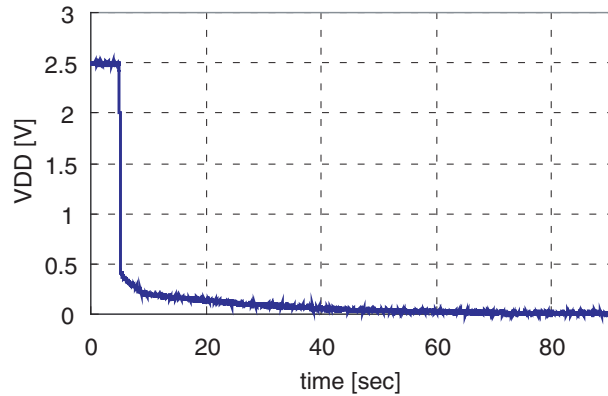
- The potential of the VDD pin is not 0 volt.
- The instantaneous voltage drop occurs in the VDD pin.

Circuit diagram of a power-on reset and discharge characteristics of the VDD pin are as follow.

Power On Reset Circuit



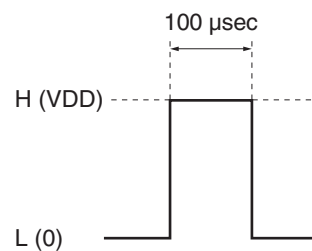
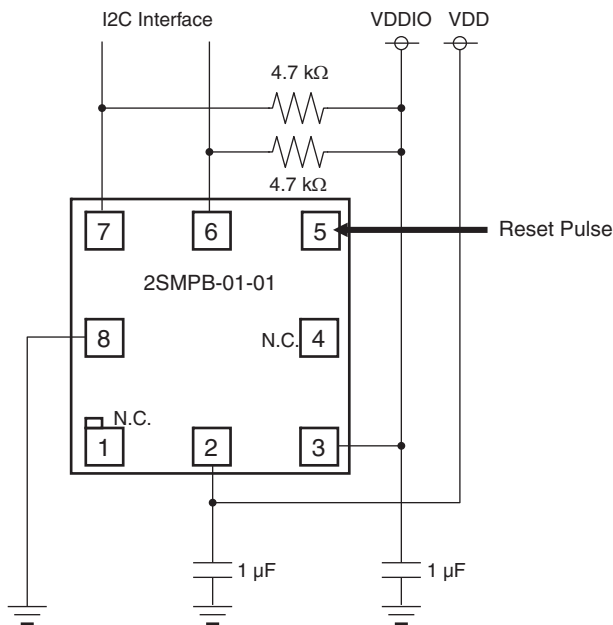
Discharge characteristic of VDD Terminal (VDD Terminal OPEN at OFF)



When the power is turned on, the power-on reset should be activated. If the power-on reset is not working properly, it can be returned to normal operation by executing reset using the asynchronous reset pin, hardware reset or software reset.

Example of reset using the asynchronous reset pin

Note: Please fix the No.5 pin into Low during normal operation.

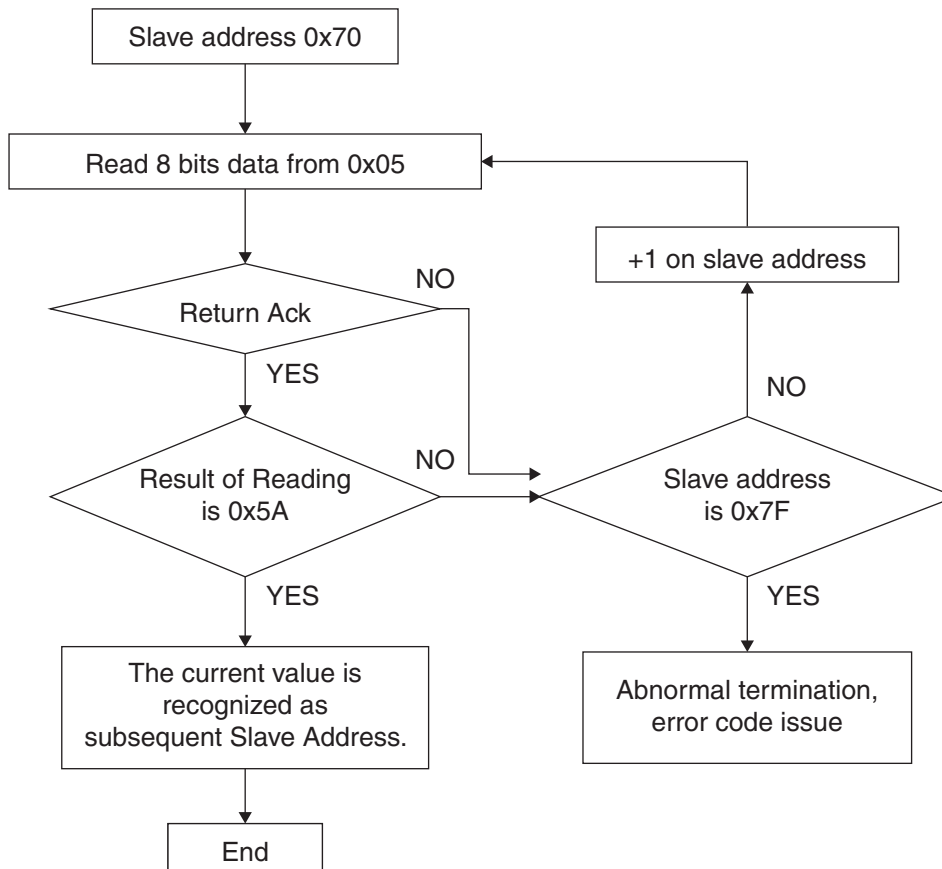


Examples of the reset pulse
(reset at the potential of High)
Pulse width : 100 µsec. or more

Example of the software reset

| No. | Register | Operation | Write address | I2C Order MCU Operation | Explanation |
|-----|----------|-----------|---------------|--|--|
| 1 | 0x05 | Read | | (search slave address of module by I2C_FIND0) Note: Refer to the next section of sequence for searching the slave address | Run for the searched slave address below. The searched slave address is shown as Y. |
| 2 | 0x03 | Write | 0x10 | Write 0x10 to slave address Y, resister address 0x03 | Single operation Setting low power mode for for clear early |
| 3 | | | | Waiting 20 msec or more | |
| 4 | 0x05 | Read | | Find the slave address of the module using the I2C_FIND0 register Note: For details, see sequence for searching the slave address in next section | Run for the slave address that searched, slave address is Y |
| 5 | 0x04 | Write | 0x50 | Write 0x50 to slave address Y, resister address 0x04 | To ASIC forced mode of operation (internal clock starts oscillating) => It is required for writing to 0x07 address |
| 6 | 0x0A | Write | 0x02 | Write 0x02 to slave address Y, resister address 0x0A | Normal initialization of Setup register |
| 7 | 0x0C | Write | 0x00 | Write 0x00 to slave address Y, resister address 0x0C | Normal initialization of IOTEST register |
| 8 | 0x08 | Write | 0x25 | Write 0x25 to slave address Y, resister address 0x08 | Change AADJ resister, transision to OTP read mode |
| 9 | | | | Waiting 10 msec or more | Waiting of transission to OTP read mode (Waiting time can afford) |
| 10 | 0x09 | Write | 0x22 | Write 0x22 to slave address Y, resister address 0x09 | Normal initialization of WAKEUP register |
| 11 | 0x30 | Read | | Read 16 bit from slave address Y, resister address 0x30, and save as Z upper 8 bits. | Trimming value of W/T results acquisition Note: It is required OTP read mode on 8 Address of Z are 0x01, 0x02, 0x03...0x0F. |
| 12 | 0x07 | Write | | Write Z to slave address Y, resister address 0x07 | In particular, run the I2C communication less than 100 kHz. Henceforth, slave address return 0x70. |
| 13 | 0x04 | Write | 0x10 | Write 0x10 to slave address 0x70, resister address 0x04 | Normal initialization of MODESEL register ASIC ; sleep mode, DSP ; nomal mode |
| 14 | 0x08 | Write | 0x65 | Write 0x65 to slave address 0x70, resister address 0x08 | Normal initialization of AADJ register |
| 15 | 0x03 | Write | 0x16 | Write 0x16 to slave address 0x70, resister address 0x03 | Single operation on high accuracy mode |
| 16 | | | | Waiting 20 msec or more | |
| 17 | | | | Reset program of absolute pressure sensor module termination | |

Sequence for searching the slave address



I2C Protocol

About I2C Slave Address

The 2SMPB-01-01 module I2C slave address is shown below.

| Bit | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
|-------|---------|---------|---------|---------|---------|---------|---------|-------|
| | Add [6] | Add [5] | Add [4] | Add [3] | Add [2] | Add [1] | Add [0] | R/W |
| Value | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 / 0 |

Write Access : Please set LSB of slave address as "0", and this byte is E0h (1110_0000b). ($70h \ll 1 + WR(0)$)

Read Access : Please set LSB of slave address as "1", and this byte is E1h (1110_0001b). ($70h \ll 1 + RD(1)$)

I2C Access Protocol Examples

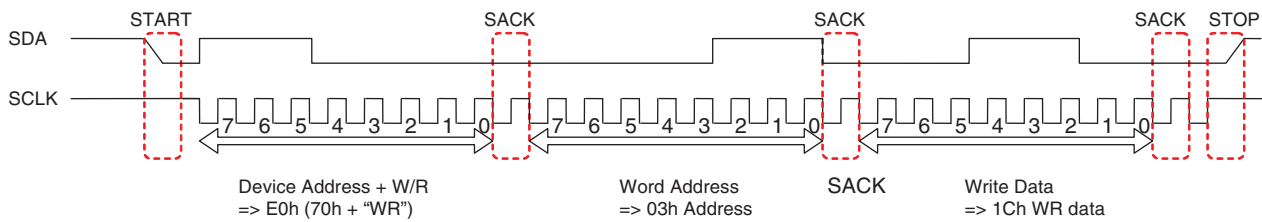
Symbol

- START : START condition
- STOP : STOP condition
- Re-START : Re-START condition for Read
- SACK : Acknowledge by Slave
- MACK : Acknowledge by Master
- MNACK : Not Acknowledge by Master

(1) Register Write Access Protocol

(Application: Addresses other than OTP Registers (20h - 34h))

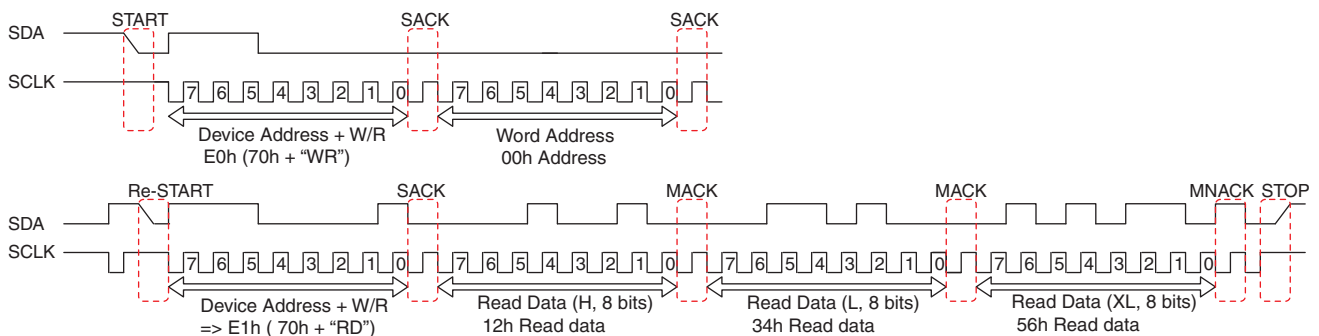
Example: Write data (8 bits) to address (03h)



(2) Register Read Access Protocol

(Application: Pressure/Temperature Data Register = I2C_TXD0)

Example: Read pressure data (24 bits) from I2C_TXD0=address (00h).



Pressure/Temperature data consists of 24 bits and output as three blocks of 8 bits.

Data will be output as H, L and XL order and each 8 bits also output as MSB first.

24 bits data format is below.

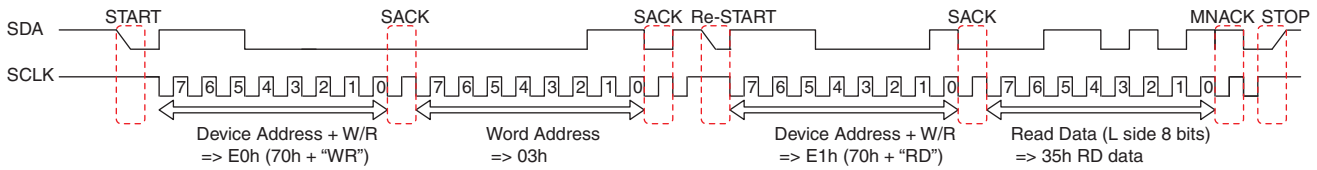
| Bit | Bit23 | ... | Bit16 | Bit15 | ... | Bit8 | Bit7 | ... | bit0 |
|------|-------------|-----|-------|-------------|-----|------|--------------|-----|------|
| Data | Read Data H | | | Read Data L | | | Read Data XL | | |

In order to read only data (L) or data (XL), use next protocol (3).

(3) Register Read Access Protocol

(Application: Addresses other than OTP Registers (20h - 34h), I2C_TXD0.)

Example: Read data (8 bits) from I2C_SREQ = address (03h)

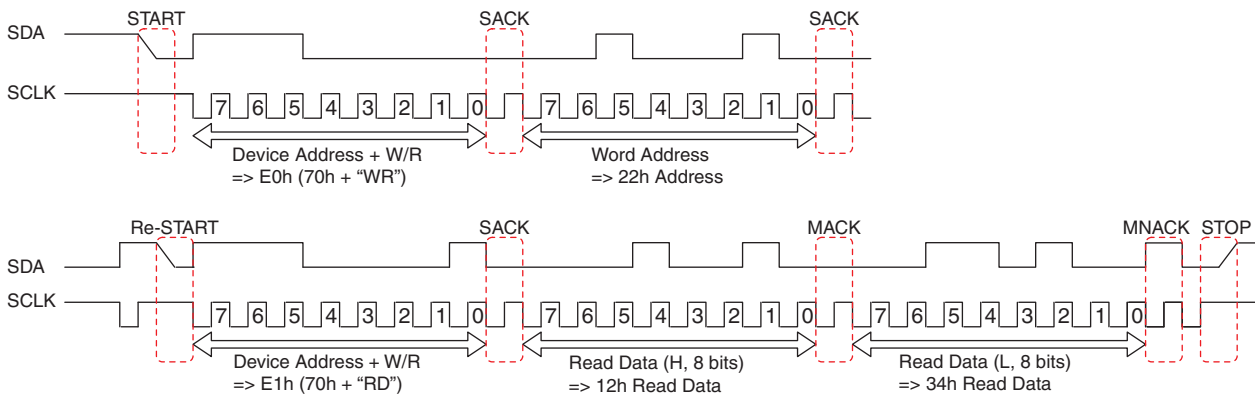


Each 8 bits data will be output as MSB first.

(4) Register Read Access Protocol

(Application: OTP Registers (20h - 34h))

Example: Read calibration data (16 bits) from COE_PR2 = address (22h).



Set VBGACT bit "L" of I2C_AADJ before this operation.

Each 8 bits data will be output as MSB first.

I2C Register

| Register Name | Address | Bits | R/W | Default | Contents |
|---------------|---------|---------|-----|---------|--|
| I2C_TXD0 | 00h | 8 bits | R/- | 00h | Data Register MSB (24-17 bits) |
| I2C_TXD1 | 01h | 8 bits | R/- | 00h | Data Register LSB (16-9 bits) |
| I2C_TXD2 | 02h | 8 bits | R/- | 00h | Data Register XLSB (8-1 bits) |
| I2C_SREQ | 03h | 8 bits | R/W | 00h | Sense Request |
| I2C_AADJ | 08h | 8 bits | R/W | 65h | OTP Read Register |
| I2C_SETUP | 0Ah | 8 bits | R/W | 00h | Setup Register |
| COE_PR2 | 22h | 16 bits | R/- | 00h | Pressure Linearity Calib.2: 1 st Coefficient |
| COE_PR3 | 24h | 16 bits | R/- | 00h | Pressure Linearity Calib.3: offset |
| COE_TEMP2 | 26h | 16 bits | R/- | 00h | Temp Calibration 2: 1 st Coefficient |
| COE_TEMP3 | 28h | 16 bits | R/- | 00h | Temp Calibration 3: offset |
| COE_TEMP22 | 2Ah | 16 bits | R/- | 00h | Temp Calibration 2-2: 1 st Coefficient-2 |
| COE_TEMP23 | 2Ch | 16 bits | R/- | 00h | Temp Calibration 2-3: offset-2 |
| COE_PTAT2 | 2Eh | 16 bits | R/- | 00h | PTAT Linearity Calib.2: 1 st Coefficient |
| COE_PTAT3 | 32h | 16 bits | R/- | 00h | PTAT Linearity Calib.3: offset |
| COE_CEX | 34h | 16 bits | R/- | 00h | Pressure & PTAT Linearity extend bits Bit [15:8] => COE_PR3 extend bit [23:16] Bit [7:0] => COE_PTAT3 extend bit [23:16] |

I2C_TXDx: Sensor Data TXD0 (Address = 00h), TXD1 (Address = 01h) or TXD2 (Address = 02h)

| | | | | | | | |
|---------|-------|-------|-------|-----|------|------|------|
| Bit | bit23 | bit22 | bit21 | ... | bit2 | bit1 | bit0 |
| R/W | R/- | R/- | R/- | ... | R/- | R/- | R/- |
| Initial | 0 | 0 | 0 | ... | 0 | 0 | 0 |

ADC output is stored with 22 to 24bit accuracy which depend on power mode.

Data can be retrieved as 24 bits by one operation. If data consists of less than 24 bits, additional "0" will be filled as shown in the table below. The data are read out in an unsigned.

I2C_TXD0 address can be accessed by memory map method.

| | | | | | | | | |
|--|-------|-------|-------|-----|-------|-------|-------|-------|
| Bit | 23 | 22 | 21 | ... | 3 | 2 | 1 | 0 |
| 22 bits data (Low power mode) | valid | valid | valid | ... | valid | valid | 0 | 0 |
| 24 bits data (Standard & High Accuracy mode) | valid | valid | valid | ... | valid | valid | valid | valid |

I2C_SREQ: Sensor Request Register (Address = 03h)

| | | | | | | | | |
|---------|------|------|------|------|------|------|------|------|
| Bit | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| R/W | Resv | Resv | R/- | -/W | R/W | R/W | R/W | R/W |
| Initial | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | |
|-----------|--------------------------|--|
| Bit7 | Reserved | Reserved. Set "0" when write register I2C_SREQ |
| Bit6 | Reserved | Reserved. Set "0" when write register I2C_SREQ |
| Bit5 | Sleep state (SLEEPST) | Indicate operation mode while reading. 1: sleep mode 0: operating mode Set "0" when write register I2C_SREQ |
| Bit4 | Wake up request (ACTREQ) | Control sleep mode. Set "1" when write register I2C_SREQ. 1: Awaken the system 0: Not awaken the system |
| Bit3 to 1 | Mode select | Select measurement mode. "0_0_0" Low power mode "0_1_0" Standard mode "0_1_1" High accuracy mode |
| Bit0 | Sensor select (PTATSEL) | Sensor Input Select 1: PTAT 0: Pressure (Default) |

Note: Proper operation will not be assured with bit combination not specified above.

I2C_AADJ: OTP Read Register (Address = 08h)

| | | | | | | | | |
|---------|------|------|------|------|------|------|------|------|
| Bit | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| R/W | Resv | R/W | Resv | Resv | Resv | Resv | Resv | Resv |
| Initial | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |

| | | |
|-----------|------------------------|---|
| Bit7 | Reserved | Reserved. Set "0" when write register I2C_ADDJ |
| Bit6 | OTP Read Mode (VBGACT) | 0: OTP Read Enabled 1: OTP Read Disabled (Default) |
| Bit5 to 4 | Reserved | Reserved. Set "1_0" when write register I2C_ADDJ. |
| Bit3 to 2 | Reserved | Reserved. Set "0_1" when write register I2C_ADDJ. |
| Bit1 to 0 | Reserved | Reserved. Set "0_1" when write register I2C_ADDJ. |

Note: Proper operation will not be assured with bit combination not specified above.

I2C_SETUP: Set Up Register (Address = 0Ah)

| Bit | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
|---------|------|------|------|------|------|------|------|------|
| R/W | Resv | Resv | Resv | Resv | Resv | Resv | R/W | R/W |
| Initial | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

| | | |
|-----------|----------|---|
| bit7 to 2 | Reserved | Reserved. Set "0" when write register I2C_SETUP |
| bit1 to 0 | Setup | ADC Power Up Mode "1_0": Start ADC Setup (Default) "0_0"/"0_1"/"1_1": Please DO NOT USE |

Note 1: This set-up is required to start ADC operation.

Note 2: Proper operation will not be assured with bit combination not specified above.

COE_PR*: Calibration Data Register for Pressure Linearity (OTP Register) (Address = 22h to 24h)

| Bit | bit15 | bit14 | bit13 | ... | bit3 | bit2 | bit1 | bit0 |
|---------|-------|-------|-------|-----|------|------|------|------|
| R/W | R/- | R/- | R/- | ... | R/- | R/- | R/- | R/- |
| Initial | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 |

Read only. Calibration data is stored.

The data are read out in an unsigned.

I2C_AADJ bit6 (VBGACT bit) should be set to "0" to enable read operation of these OTP registers.

COE_TEMP*: Calibration Data Register for Temperature Correction of Pressure (OTP Register) (Address = 26h to 2Ah)

| Bit | bit15 | bit14 | bit13 | ... | bit3 | bit2 | bit1 | bit0 |
|---------|-------|-------|-------|-----|------|------|------|------|
| R/W | R/- | R/- | R/- | ... | R/- | R/- | R/- | R/- |
| Initial | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 |

Read only. Calibration data is stored.

The data are read out in an unsigned.

I2C_AADJ bit6 (VBGACT bit) should be set to "0" to enable read operation of these OTP registers.

COE_PTAT*: Calibration Data Register for PTAT Linearity (OTP Register) (Address = 2Ch to 32h)

| Bit | bit15 | bit14 | bit13 | ... | bit3 | bit2 | bit1 | bit0 |
|---------|-------|-------|-------|-----|------|------|------|------|
| R/W | R/- | R/- | R/- | ... | R/- | R/- | R/- | R/- |
| Initial | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 |

Read only. Calibration data is stored.

The data are read out in an unsigned.

I2C_AADJ bit6 (VBGACT bit) should be set to "0" to enable read operation of these OTP registers.

COE_CEX: Calibration Data Register for Extend Bits for PR3 & PTAT3 (OTP Register) (Address = 34h)

| Bit | bit15 | bit14 | bit13 | ... | bit3 | bit2 | bit1 | bit0 |
|---------|-------|-------|-------|-----|------|------|------|------|
| R/W | R/- | R/- | R/- | ... | R/- | R/- | R/- | R/- |
| Initial | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 |

Read only. Calibration data is stored.

The data are read out in an unsigned.

Bit15 to 8: These bits are extend bits of COE_PR3 register.

Bit7 to 0: These bits are extend bits of COE_PTAT3 register.

I2C_AADJ bit6 (VBGACT bit) should be set to "0" to enable read operation of these OTP registers.

Packaging

| Model | Packaging | Minimum Order Quantity | Minimum Packing Unit |
|----------------|-----------------------|------------------------|----------------------|
| 2SMPB-01-01-TR | Tape and Reel | 1,000 | 1,000 |
| 2SMPB-01-01 | Embossed Carrier Tape | 10 | 10 |

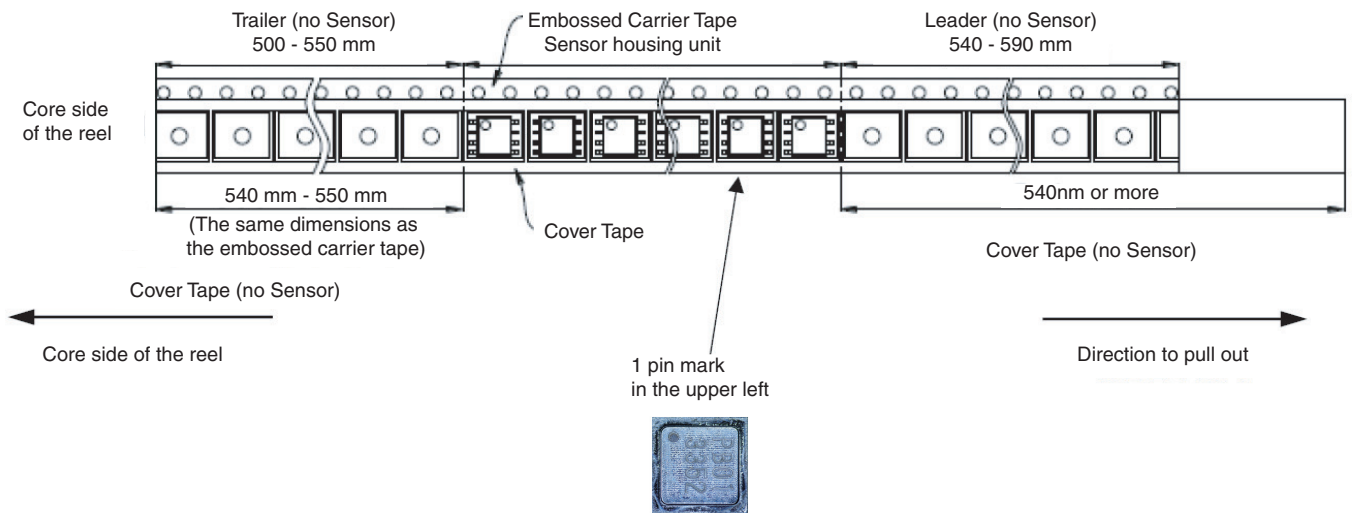
■ 2SMPB-01-01-TR / Tape and Reel

Configuration of shipment

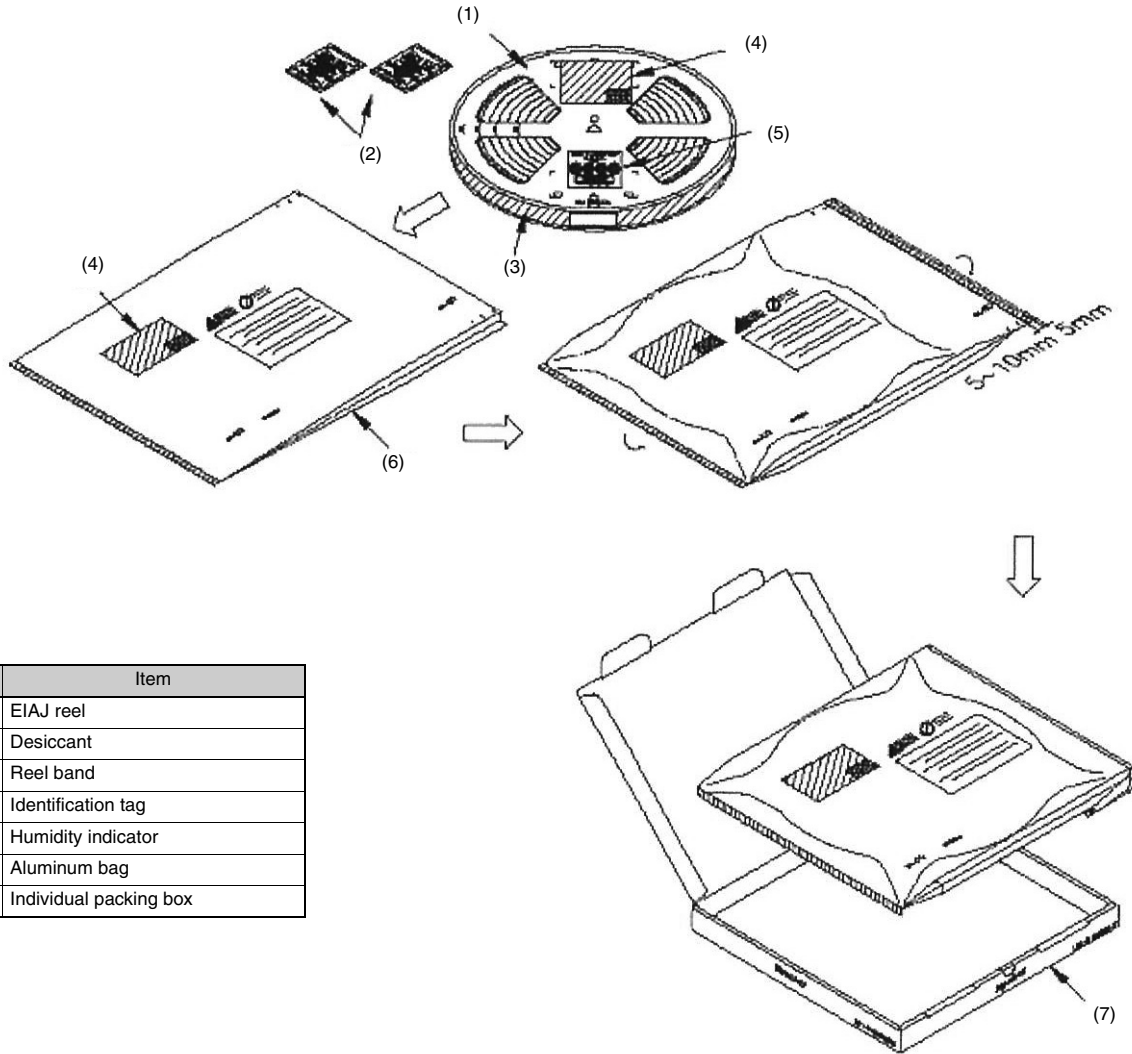
| | |
|---------------|---|
| Packaging | Embossed Carrier Tape |
| Quantity | SPQ 1,000 pcs Max. 5,000 pcs/reel 1 reel / 1 Interior box |
| Reel model | EIAJ reel (330 mm dia.) |
| Insert method | see below |

Taping

Emboss pitch 4 mm type & tape width 12 mm type



Individual packaging



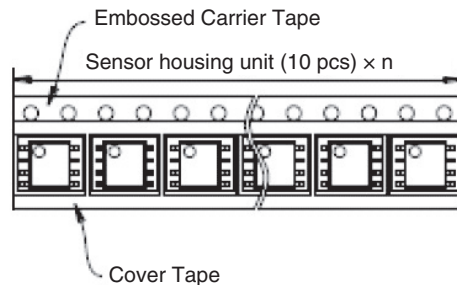
| No. | Item |
|-----|------------------------|
| (1) | EIAJ reel |
| (2) | Desiccant |
| (3) | Reel band |
| (4) | Identification tag |
| (5) | Humidity indicator |
| (6) | Aluminum bag |
| (7) | Individual packing box |

2SMPB-01-01

■ 2SMPB-01-01 / Embossed Carrier Tape

Taping

To ensure the reel for small shipment, the tape will be cut into multiple units of 10 pieces length.



Individual packing box

These are chosen the packaging box following two patterns.

- Packing small reel cut type in the box with air cap.
- Packing the reel cut products shaped ring in the box with air cap.

Recommended Soldering Method

■ Soldering method

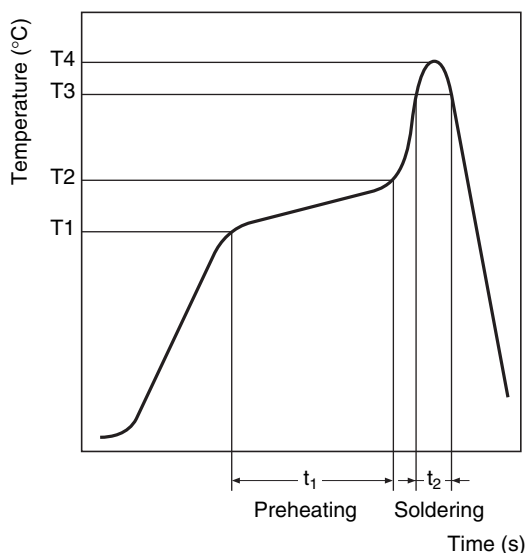
air reflow (Max. 2 times)

■ Condition of Temperature

Max. 260°C, within 10 seconds

■ Recommended Soldering Method

Temperature profile conditions of reflow soldering should be set as shown in the below table, and then confirm that actual conditions coincide with the conditions shown in the table.



| Item | Preheating (T1 to T2, t1) | Soldering (T3, t2) | Peak value (T4) |
|-----------------------|---------------------------|----------------------|-----------------|
| Terminal | 150°C to 180°C 120 s max. | 230°C min. 30 s max. | 250°C max. |
| Upper surface of case | - | - | 255°C max. |

- We recommend a thickness of 150 to 200 μm for the solder cream.
- Since the pressure sensor chip is exposed to atmosphere, cleaning fluid shall not be allowed to enter inside the sensor's case.
- We recommend that the recommended mounting PAD dimensions should be used for the land pattern.

Safety Precautions

Precautions for Correct Use

Handling

- (1) Only air can be used as pressure media on the product directly. It is prohibited to use pressure media including corrosive gases (e.g. organic solvents gases, sulfur dioxide and hydrogen sulfide gases), fluid and any other foreign materials.
- (2) The product are not water proof. The product shall be kept dry in use including the sensor port.
- (3) The product shall not be used under dew-condensing conditions. Frozen fluid on sensor chips may cause fluctuation of sensor output and other troubles.
- (4) The product shall be used within rated pressure. Usage at pressure out of the range may cause breakage.
- (5) The product may be damaged by static electricity. Charged materials (e.g. a workbench and a floor) and workers should provide measures against static electricity, including ground connection.
- (6) Overpowering pins may deform terminals and detract solder abilities of sensor terminals. The product shall not be dropped and handled roughly.
- (7) The product shall not be used under dusty or damp condition.
- (8) Please connect the sensor terminals according to the connection diagram.
- (9) The product shall not be used under high-frequency vibration including ultrasonic wave.
- (10) This product uses the elastic adhesive for bonding the lid, so do not add excessive stress to the lid.
- (11) If you use other conditions described in this document, please check yourself in advance.

Environmental conditions for transport and storage

- (1) The product shall not be kept with corrosive gases (e.g. organic solvents gases, sulfur dioxide and hydrogen sulfide gases).
- (2) The product are not water proof. The product shall be kept dry during storage.
- (3) By condition of the place and storage period, there are cases that strength of outer boxes may be degraded. Please use the product in order.
- (4) For this product, please keep away from direct sunlight or ultraviolet rays.
- (5) The product shall be kept in appropriate conditions of temperature and humidity.
- (6) Sometimes the color of terminals of the product may change depending on the conditions. It is not covered under warranty.
- (7) The product shall not be kept under dusty or damp condition.

Note: Specifications in this document are subject to change without notice.

• Application examples provided in this document are for reference only. In actual applications, confirm equipment functions and safety before using the product.
• Consult your OMRON representative before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems or equipment that may have a serious influence on lives and property if used improperly. Make sure that the ratings and performance characteristics of the product provide a margin of safety for the system or equipment, and be sure to provide the system or equipment with double safety mechanisms.

Note: Do not use this document to operate the Unit.