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SMBA-1000 BAROMETER MODULE

- Pressure range: 300 – 1100 mbar
- Temperature range: -20^{0}C – +70^{0}C
- Integrated pressure and temperature sensor
- Fully temperature compensated pressure reading, with automatically temperature compensated pressure output
- 3 coefficients for temperature and pressure calculation
- 2-wire synchronous serial interface
- Low power, low voltage
- Small dimension: 6.35 x 6.35 x 3.7mm
- Proprietary technology Mixed Substrate

Description

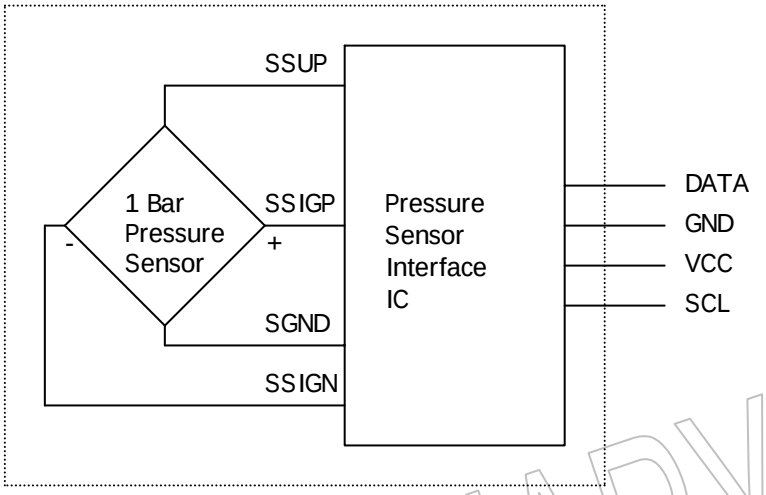
The SMBA-1000 is a SMD module including a piezo-resistive pressure sensor and a conditioning asic. It provides a 16-bit data word for pressure, temperature, supply voltage. Additionally, the module contains 3 readable coefficients for temperature and pressure calculation. SMBA-1000 is a low-power, low-voltage device with automatic power down. A 2-wires interface makes it easy to communicate with a low cost 4 bits microcontroller.

The small size of this module makes it easy to integrate in all watch and handheld applications.

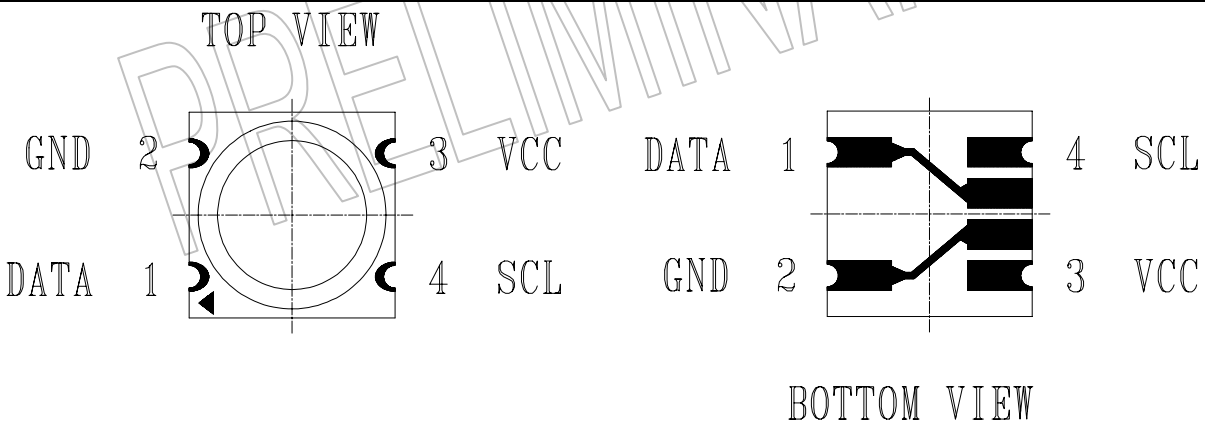
Application

- Weather station
- Barometer handheld device
- Altimeter watch
- GPS

Block Diagram



Pin Configuration



Pins Description

Name	In/Out	Pin No	Description
DATA	I/O	1	Serial Data Bi-Directional
GND	I	2	Ground
VCC	I	3	Power Supply Voltage
SCL	I	4	Serial Clock Input

Absolute Maximum Ratings

Parameter	Rating	Unit
Operating Temperature	-20 to +70	^{o}C
Storage Temperature	-40 to +100	^{o}C
Maximum overpressure	(*)	Bar
Maximum water resistance	(**)	m

Note:

(*) 6 Bar for SMBA-1000A.
11 Bar for SMBA-1000B.

(**) 50 meter for SMBA-1000A.
100 meter for SMBA-1000B.

DC Characteristic (VCC = 3V, Ta = 25^{o}C)

Parameter	Symbol	Conditions	Min	Typical	Max	Unit
Recommended Operating Voltage	VCC		2.3	3.0	3.6	V
Supply Current		VCC = 3V				
Temperature Mode Average (1)	I_{avgT}		(*)	47	62	µA
Pressure Mode Average (1)	I_{avgP}		(*)	70	95	µA
Voltage Mode Average (1)	I_{avgV}		(*)	10	15	µA
Sleep Mode	I_{slp}		(*)	2	(*)	µA
Peak Current						
Read Temperature	I_{pT}		(*)	1200	(*)	µA
Read Pressure	I_{pP}		(*)	1800	(*)	µA
Read Voltage	I_{pV}		(*)	1200	(*)	µA
Conversion Time		VCC = 3V				
Temperature mode	T_cvT		(*)	40	60	ms
Pressure mode	T_cvP		(*)	50	70	ms
Voltage mode	T_cvV		(*)	10	15	ms
Operating pressure range	P		300		1100	mbar
Operating temperature range	T_a		-20^{o}C		+70	°C
Synchronous serial clock	SCL				400	KHz

Notes:

1. Average current consumption for one reading per second.

(*) Not yet defined.

Pressure and Temperature Output Characteristics

Parameter	Test conditions	Min	Typ.	Max	Unit	Notes
Pressure resolution			0.1		mbar	
Absolute pressure accuracy	P = 500 … 1000 mbar T = 25°C	-1.5		+1.5	mbar	1
Relative pressure accuracy	P = 500 … 1000 mbar	-0.5		+0.5	mbar	2
Maximum pressure error over temperature	Ta = 0 ... +50°C	-1.5		+1.5	mbar	3
Maximum error over supply voltage	VCC = 2.6V ... 3.3V	-1		+1	mbar	4
Temperature accuracy	T = -20°C … +70°C	-1		+1	°C	5
Temperature resolution	T = -20°C … +70°C		0.1		^{o}C	
Long-term stability	One year		(*)			

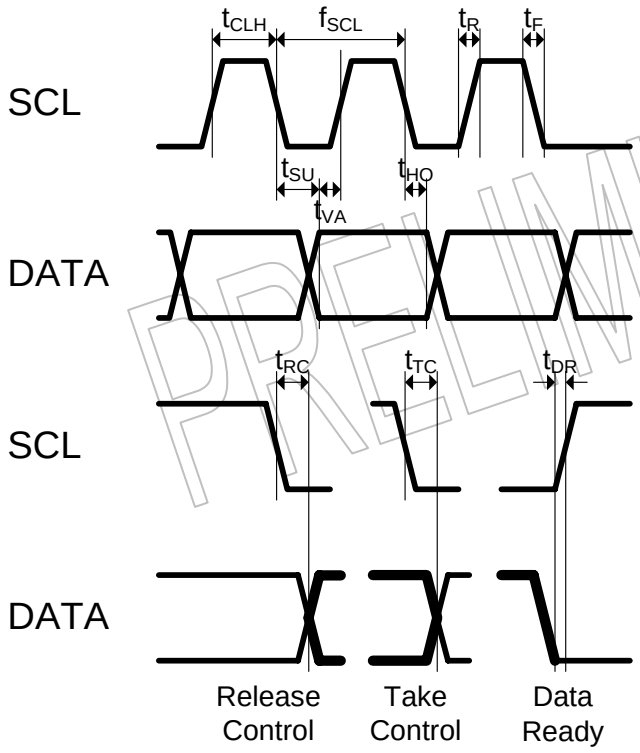
Notes:

(*) Not yet defined.

1. Maximum error of pressure reading over the pressure range.
2. Maximum error of pressure reading at one pressure point.
3. Maximum error of pressure reading over the temperature range.
4. Maximum error of pressure reading / temperature reading over supply voltage range.
5. Maximum error of temperature reading over the temperature range.

AC Characteristic

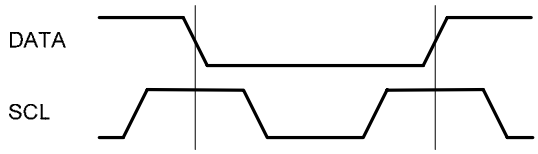
Parameter	Symbol	Conditions	Min	Typical	Max	Unit
SCL frequency	f_{SCL}				400	Khz
SCL hi/low Time	t_{CLH}, t_{CLL}		100	-	-	ns
DATA Set Up Time	t_{SU}		50	-	-	ns
DATA Valid Time	t_{VA}		-	250	-	ns
DATA Hold Time	t_{HO}		0	10	-	ns
SCL Rise/Fall Time	t_R, t_F		-	250	-	ns
Release Control Time	t_{RC}		0	10	-	ns
Take Control Time	t_{TC}		50	-	-	ns
Data Ready Time	t_{DR}		10	-	-	ns



Serial communication

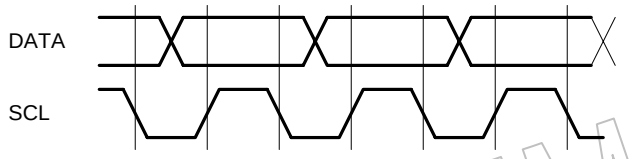
1. Transmission Start Serial Interface

To initiate a transmission, a "transmission start" sequence has to be issued. It consists of a negative clock edge of the DATA line while SCL is high, followed by a low pulse on SCL and a rising clock edge on the DATA while SCL is high again.



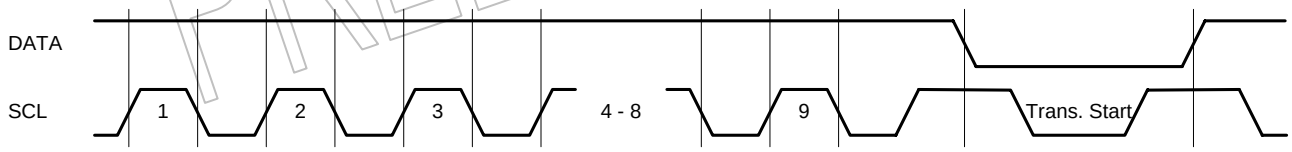
2. Bit Transfer Serial Interface

DATA line changes its state when serial clock SCL is low.



3. Connection Reset Serial Interface

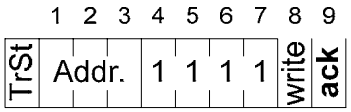
If communication with the SMBA-1000 is lost, following signal sequence will reset the serial interface. While DATA high, SCL is toggled 9 or more times. This sequence must be followed by a "transmission start" sequence preceding the next command. This sequence resets the interface.



4. Commands Timing

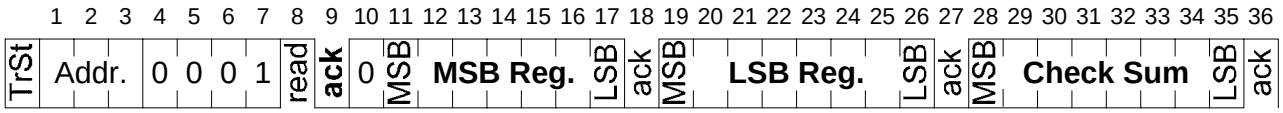
After initiation of a transmission with the "transmission start" sequence, a command can be transmitted. Following, the timing sequences of all commands are given (*general comment:* **bold** → the SMBA-1000 controls the data line).

Soft Reset:



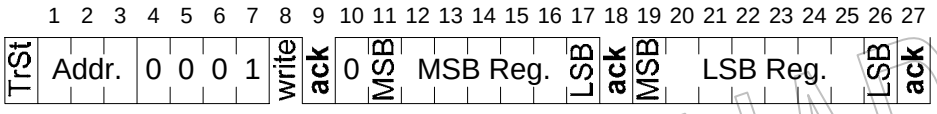
(Add 200 us delay after ACK)

Read User Register:



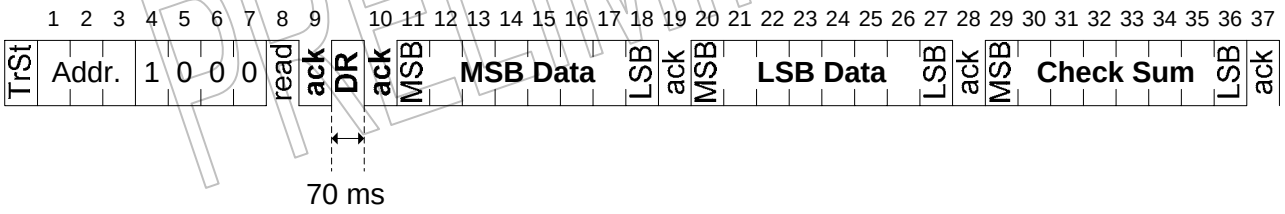
After sending transmission header (including Transmission Start, the Address, the Command and read/write bit) and receiving a proper acknowledgement, the SMBA-1000 transmits the register MSB. Transmission must be terminated by an acknowledgement by pulling down DATA while clocking SCL, where a high value of DATA ends the sequence. A low value for the acknowledgement initiates transmission of the register LSB. Again, the acknowledgement decides, whether a CRC checksum is transmitted. If CRC checksum is not needed, the controller may terminate communication after register LSB by pulling the DATA line high for acknowledgement.

Write User Register:

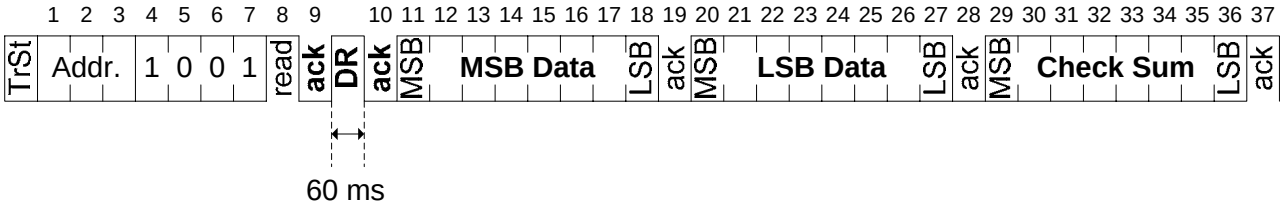


After a transmission header, the register MSB and LSB transmitted and terminated by a corresponding acknowledgement issued by the SMBA-1000.

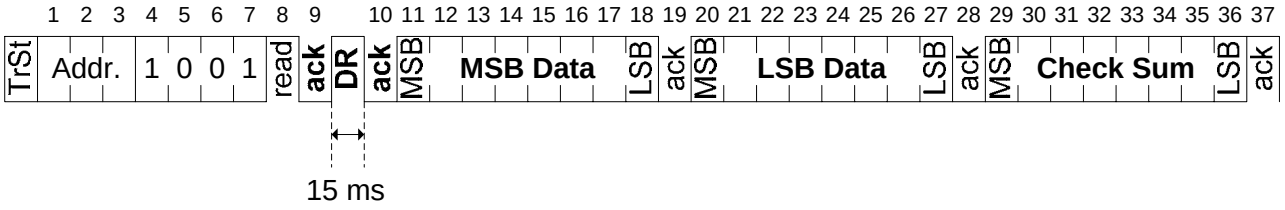
Measure SOP:



Measure SOT:



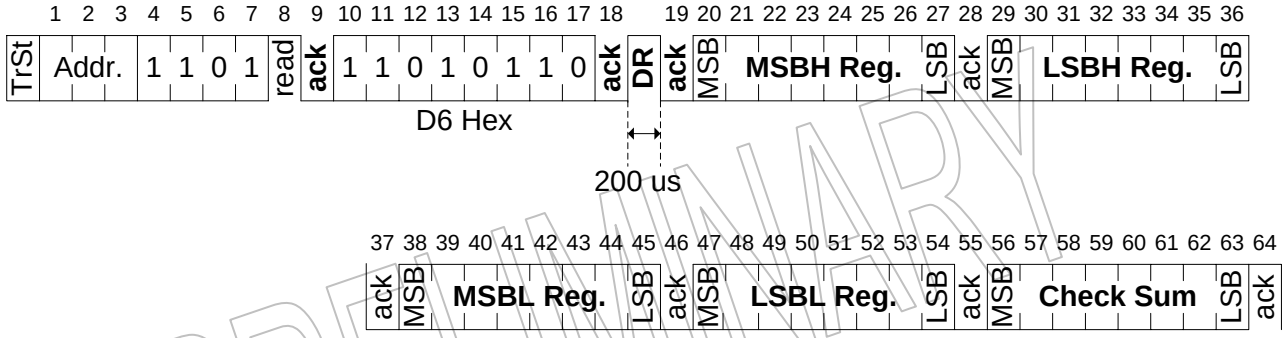
Measure SOV:



After issuing a transmission start for measurement SOP, SOT or SOV, the controller has to wait for the measurement to be completed. To signal completion, the SMBA-1000 pulls down DATA line. The controller must wait for this “Data Ready” signal before starting to output SCL again and receiving an ACK. Two bytes of measurement data and one byte of CRC checksum will be then transmitted. The controller must acknowledge each byte by pulling down the DATA line low while clocking SCL.

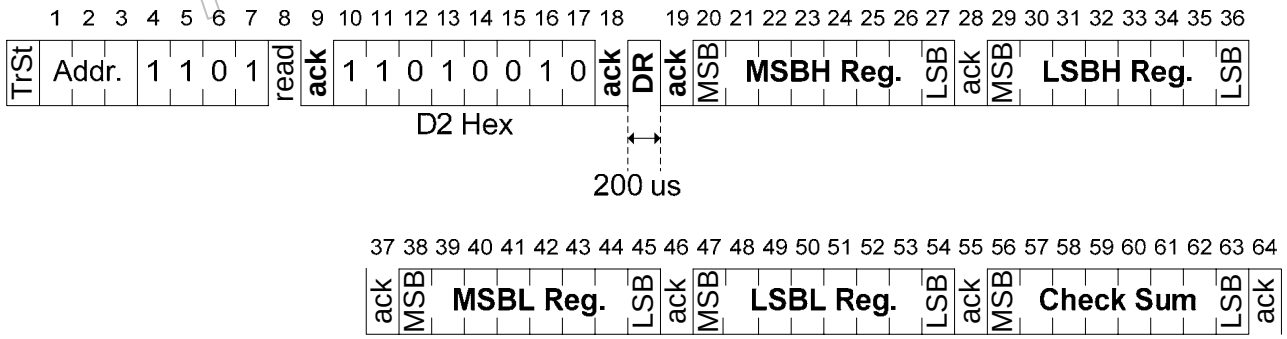
Communication terminates after the acknowledgement bit of the CRC data. If CRC checksum is not needed, the controller may terminate communication after measurement LSB by pulling the DATA line high for acknowledgement. The SMBA-1000 goes into sleep mode after measurement and communication has terminated.

Read C_temp_sens and SOT15:



SOT15 = High Register 16 bit.
C_temp_sens = Low Register 16 bit.

Read CVDD:



CVDD = LSBL Reg. 8 bit.

The reading operation C_temp_sens, SOT15 and CVDD is of similar timing as for measurement operation. After a transmission header, a “Data Ready” sequence indicates the transmission of the value (MSB and LSB).

Notes:

- Addr. = 001
- read = 1
- write = 0
- DR: Data Ready
- TrSt: Transmission Start

Application Measurement

Read C_temp_sens, SOT15 and CVDD only one time after power on.

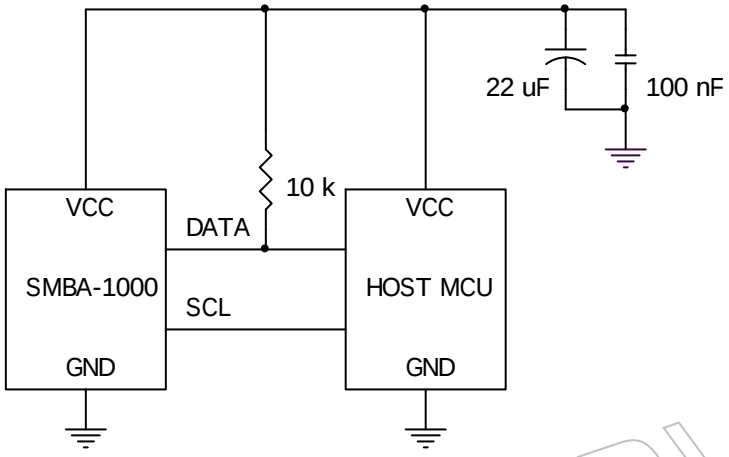
1. **Temperature measurement:**
   - Read User Register.
   - Clear bit 12 of User Register and write into User Register.
   - Measure SOT by using Measure SOT command.
   - Temperature = 200 + C_temp_sens*(SOT – SOT15)/2^16 (units of 0.1^{o}C)

2. **VCC measurement:** the unit of the VCC reading SOV is mV
   - Read User Register.
   - Set bit 12 of User Register and write into User Register.
   - Measure SOV by using Measure SOV command.
3. **Pressure measurement** [2]**:** with voltage compensation
   - Measure SOV by using VCC measurement [1].
   - Read User Register.
   - Clear bit 12 of User Register and write into User Register.
   - Measure SOP.
   - SOP_V = SOP + (CVDD – 2^7) * (3000 – SOV) / 2^7
   - Pressure = 10000 + SOP_V * 1000 / 512 (units of 0.01 mbar)

Note:
(1): It is recommended that SOV is updated once before entering barometer/altimeter mode or once per hour to reduce current consumption.

(2): The pressure output is temperature compensated, no need to read temperature before reading pressure

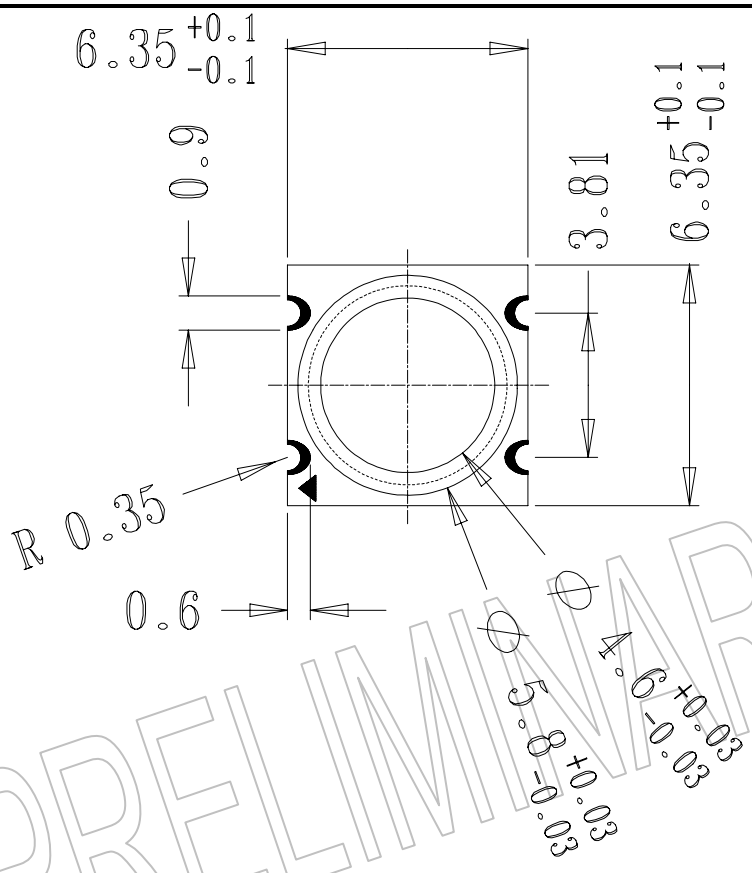
Application Schematic

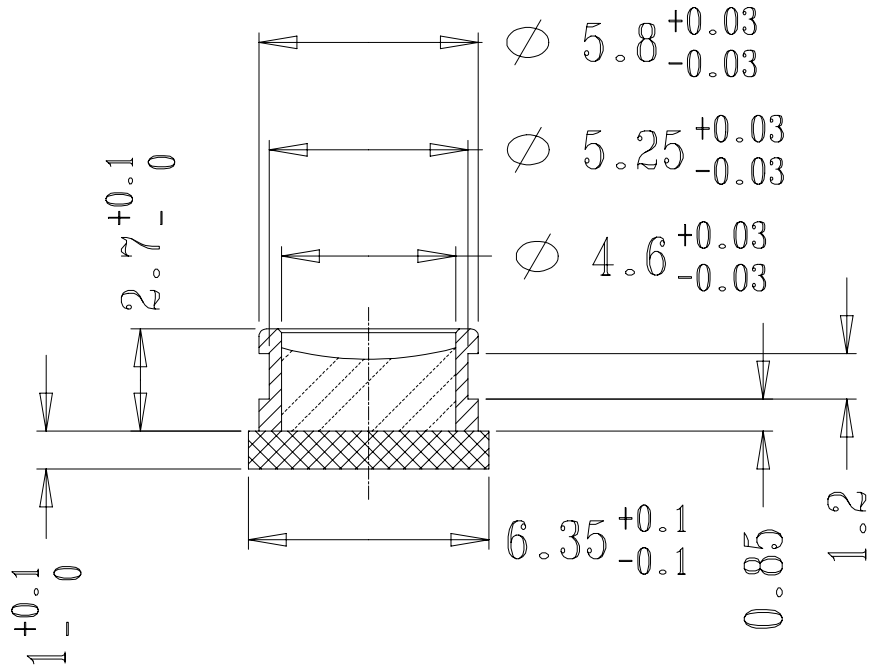


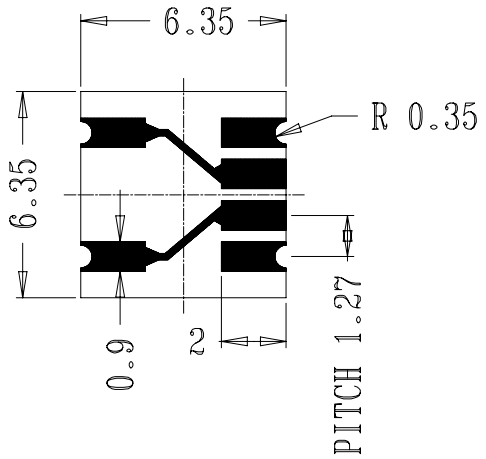
Recommendations

- **The module SMBA-1000 is not designed for reflow soldering.** Hand soldering is recommended. The temperature of the solder tip must be lower than 300 ^{o}C.
- Take all necessary ESD protections when handling this device.

Package Dimensions







ORDERING INFORMATION:

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History of Document

1. Rev00: First version.
2. Rev01: Add Serial communication and AC characteristic.
3. Rev02: Update company's address
   Change temperature calculation formula on page 8.
4. Rev03: Modify Maximum overpressure on page 3.
5. Rev04: Separate 2 versions SMBA-1000A and SMBA-1000B on page 3.
   Add Maximum water resistance on page 3.
   Modify Product Code on page 13.