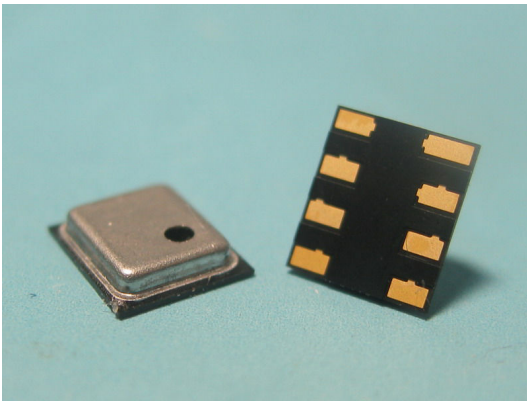


MIS-7300 series Intelligent Pressure Sensor

■ Features

- Supply Voltage 2.0 to 3.6V
- 300 to 1100 hPa pressure range
- Low standby current: <math><0.1\mu\text{A}</math>
- Factory calibrated and temperature compensated
- SPI and I2C digital signal output



The MIS-7300 is an intelligent pressure sensor which consists of a MEMS piezoresistive pressure sensor and a signal conditioning ASIC. The sensor is formed in an ultra-thin 8-pin LGA package. The package dimension is 4.5x4x1.1mm. The signal conditioning ASIC is a

■ Applications

- Digital barometer and altimeter
- Weather forecast station
- Mobile phones
- Personal navigation devices (PND)

16-bit AD converter with embedded 512 bits OTP memory. The sensor was calibrated and temperature compensated in factory. The factors for temperature compensation were stored in OTP memory. Users can implement temperature compensation via an external microprocessor. The external microprocessor reads the raw output data from MIS-7300 and does simple calculation according to the factors stored in OTP memory. Therefore using MIS-7300 series is easy to get rid of bothersome calibrations and temperature compensations. MIS-7300 provides SPI or I2C digital serial output interface to communicate with microprocessors. MIS-7300 series is specially designed for low voltage and low power consumption concerned applications.

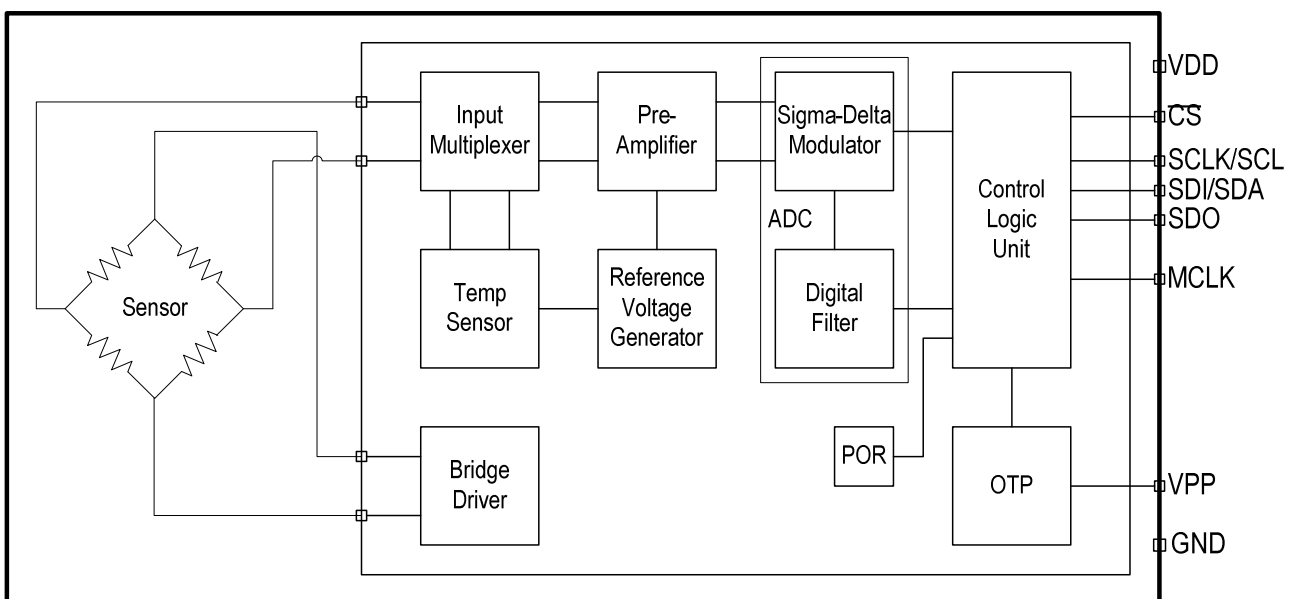


Fig. 1 Functional Block Diagram of MIS-7300

■ Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Units	Notes
1. Absolute Maximum Ratings							
Supply Voltage	VDD		-0.3		4	V	
Inputs voltage to VSS			-0.3		VDD+0.3	V	
Storage Temperature Range			-40		125	°C	
Maximum Overpressure					2X	Rated pressure	
ESD Rating							
HBM			4000			V	
MM			400				
2. Recommended Operating Conditions							
Pressure Range			300		1100	hPa	mbar
Operating Temperature Range			-40		85	°C	
Humidity			0		95	%RH	
Supply Voltage	VDD		2.0	3	3.6	V	
Supply Current		VDD=3V					
Peak Current During Conversion	I _{sc}			600		μA	
Standby	I _{ss}			0.1	0.5	μA	
Average	I _{avg}	1 conversion/s		21.6	30.5	μA	
Conversion Time	t _{conv}	MCLK=32.768kHz		34.5		ms	
External clock signal	MCLK		30000	32768	35000	Hz	
Duty cycle of MCLK			40	50	60	%	
Serial data clock	SCLK				500	kHz	
3. Electrical Parameters							
Analog to Digital Converter							
Resolution				16		Bits	
Output Code Range			2048		63487		
Integral Nonlinearity			-4		+4	LSB	TBD
Differential Nonlinearity			-1		+1	LSB	TBD
Digital Interface							
Digital Inputs							
Serial data clock					500	kHz	
Input High Voltage	V _{IH}	I _{IH} < 5μA	80%VDD		VDD		
Input low Voltage	V _{IL}	I _{IL} < 5μA	0		20%VDD		
Input leakage current					0.1	μA	
Rise time	t _r				200	nS	
Fall time	t _f				200	nS	
Digital Outputs							
Output High Voltage	V _{OH}	SDO, I _{source} =0.6mA	80%VDD				
Output low Voltage	V _{OL}	SDO, I _{sink} =0.6mA			20%VDD		
Output low Voltage	V _{OL}	SDI, I _{sink} =1.0mA			20%VDD		
Rise time	t _r	C _{load} = 50pf			200	nS	
Fall time	t _f	C _{load} = 50pf			200	nS	
Pressure Output Characteristics							
Resolution				0.045		hPa	
Absolute Pressure Accuracy		p = 700~1100 hPa Ta = 0~65°C	-2.5		2.5	hPa	2
		p = 300~1100 hPa Ta = 0~65°C	-3		3	hPa	
Relative Pressure Accuracy		p = 700~1100 hPa Ta = 25°C	-0.5		0.5	hPa	3
Noise in pressure				0.035		hPa	RMS noise ⁴
Soldering drift		After solder reflow	-2		2	hPa	

Long term stability		12 months	-1		1	hPa	
Recovery time after reflow				7		days	5
Temperature Output Characteristics							
Resolution				0.1		°C	
Accuracy		-40 to 85°C	-2		2	°C	
Notes :							
1. Unless otherwise specified, measurements were taken with a supply voltage of 3 Vdc at a temperature of 25±3°C and humidity ranging from 0~95% RH. 2. Maximum error of pressure reading over the pressure range. 3. Maximum error of pressure reading over the pressure range after offset adjustment at one pressure point. 4. The noise data was calculated as standard deviation of 25 data points. 5. Time to recovering >66% impact of solder reflow							
Metrodyne Microsystem Corp. reserves the right to make changes to the product specification in this publication.							

■ Pin Configuration and Function Descriptions

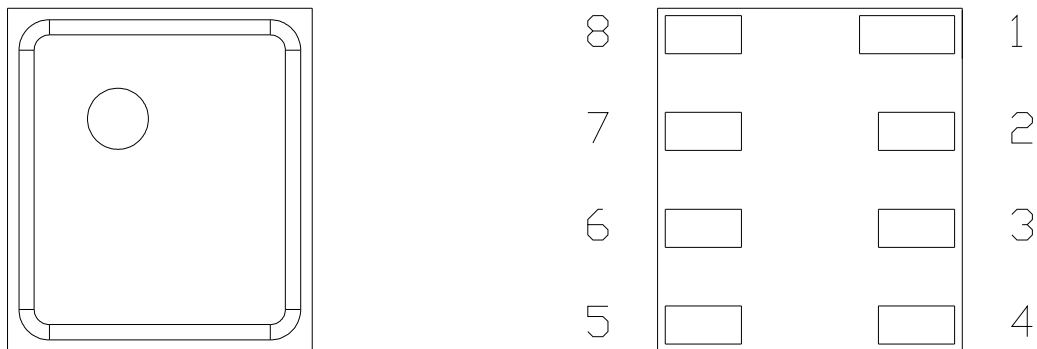
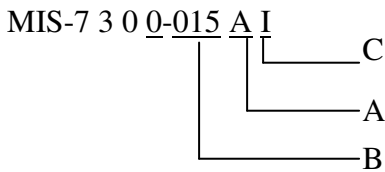


Fig. 2 Pin configuration of MIS-7300

Pin No.	Pin Name	Description
1	SCLK/SCL	External Clock Input. This clock synchronizes serial data I/O.
2	GND	Ground.
3	$\overline{\text{CS}}$	Chip Select Input. Control data conversion timing and enables the serial input/output register.
4	VPP	OTP Programming Voltage.
5	VDD	Power Supply.
6	MCLK	External Clock Input. This clock runs the A/D conversion process.
7	SDI/SDA	SPI Serial Data Input I2C data I/O
8	SDO	SPI Serial Data Output. Data is shifted on the RISING edge of SCLK. This output is high impedance when CS_ is HIGH.
Note! Pin4 was used only for calibration by the manufacturer and should not be connected.		

■ Ordering information



A	Pressure type	B	Pressure range
A	Absolute	015	300-1100hPa
C	Interface		
I	I2C		
S	SPI		

Part No.	Pressure type	Pressure range	Digital interface	Note
MIS-7300-015AI	Absolute	300-1100hPa	I2C	
MIS-7300-015AS	Absolute	300-1100hPa	SPI	

■ Application Information

General

The MIS-7300 is SIP device consisted of a MEMS pressure sensor and a signal conditioning ASIC. A 16-bits ADC is used to convert analog pressure and temperature signal to a 16-bits digital data. Due to the strong temperature coefficient of sensor output voltage, it is necessary to be compensated for practical applications. By a dedicated program running at an external microcontroller, this compensation will be performed.

Factory calibration

Each sensor was individually calibrated in the factory. There are several coefficients stored in OTP memory for compensation. Resulted from process variation and temperature variation of sensor, the coefficients are read by microcontroller and calculated by software to correct temperature drift of sensor.

Pressure and Temperature Measurement

The sequence of reading pressure and temperature as well as software compensation is shown as fig. 3.

First the coefficients C1 to C10 have to be read from OTP memory via serial interface. This can be done once reset the MIS-7300. The data format of coefficient is unsigned 16-bit. In order to measure pressure, the microcontroller have to read the 16 bit data for pressure (D1) and temperature (D2). Then, the microcontroller calculate the compensated pressure by D1, D2, and coefficients C1 to C10. The general flow for temperature compensation calculation was listed as fig. 3.

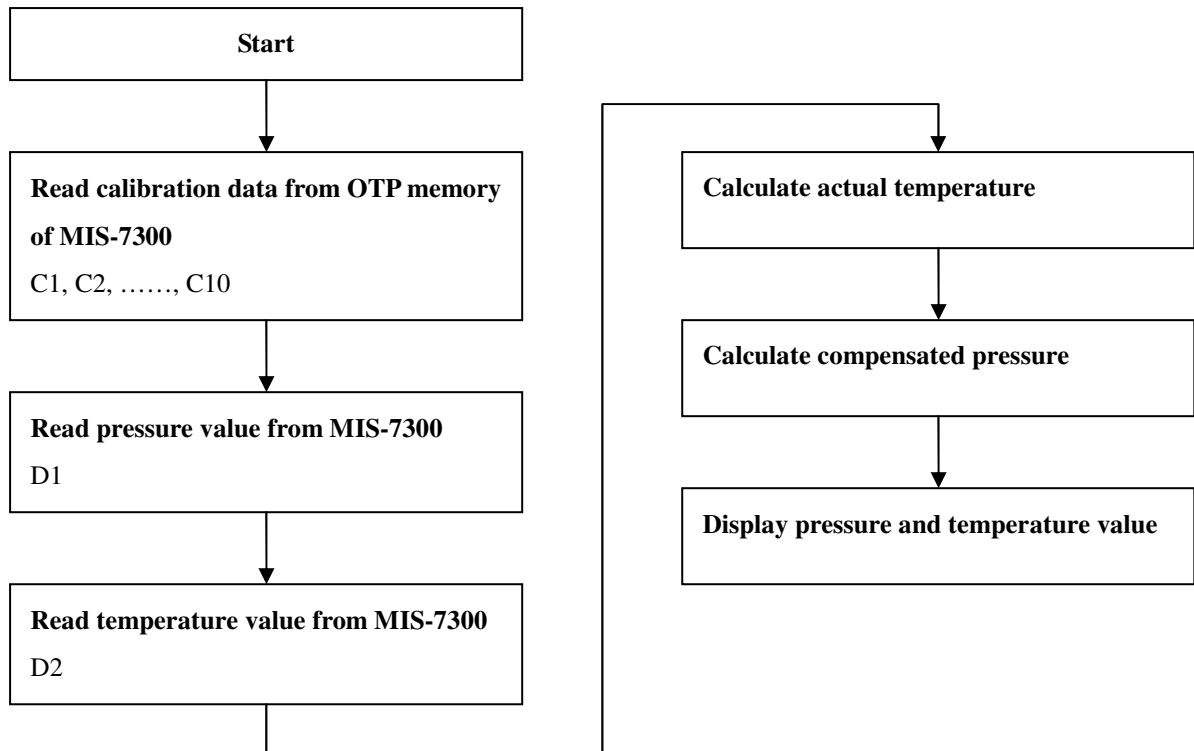


Fig. 3

Decoupling Capacitor

The decoupling capacitors, 0.1µF ceramic plus 1µF tantalum capacitor, have to be placed as close as possible to the MIS-7300 VDD and GND pin. This capacitor will stabilize the power supply during data conversion and thus, provide the highest possible accuracy.

Application Circuit example

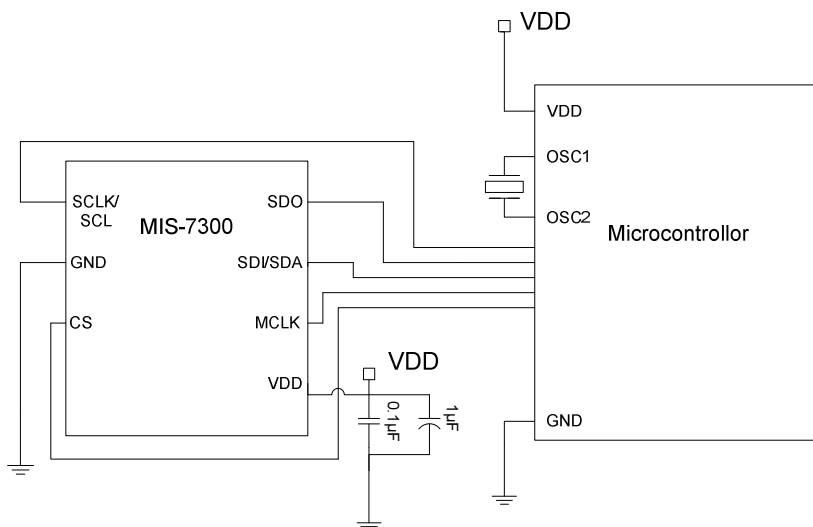


Fig. 4 Typical application circuit of MIS-7300 in SPI mode

LOW, SDO pin will be driven LOW indicating the conversion is complete and the result is ready to be shifted out of the device. The digital data sent by MIS-7300 SDO pin is either the conversion results or the calibration data stored in OTP. The selection of the output data is done by sending the corresponding instruction on the SDI pin.

Serial Data Input (SDI)

The SDI pin is used to select the input channel (Pressure or Temperature) and to access the OTP memory. Data is shifted into the device during the data output/input state on the rising edge of SCLK while CS is low.

Timing Waveform Diagrams

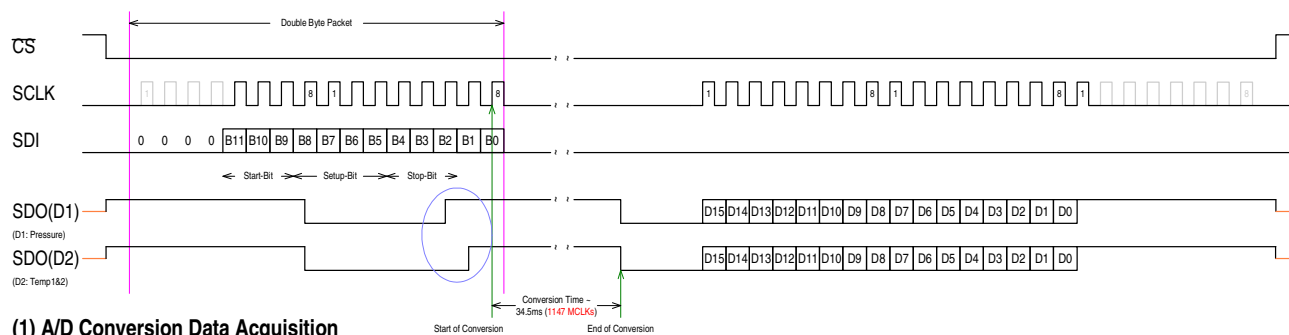


Fig.6

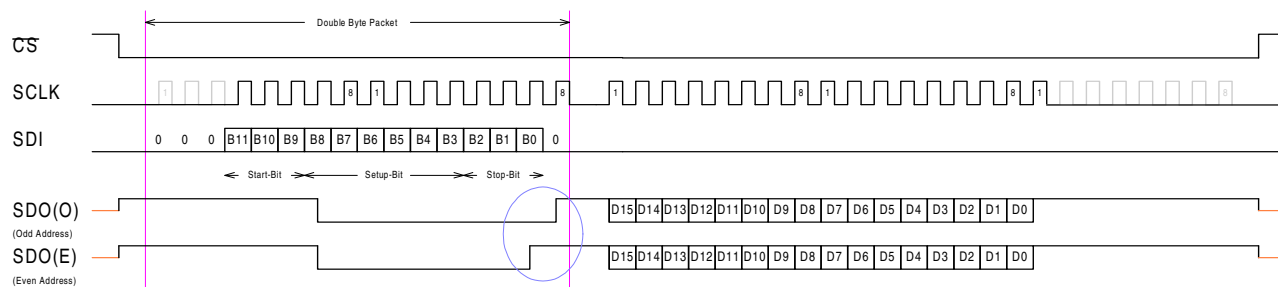


Fig.7

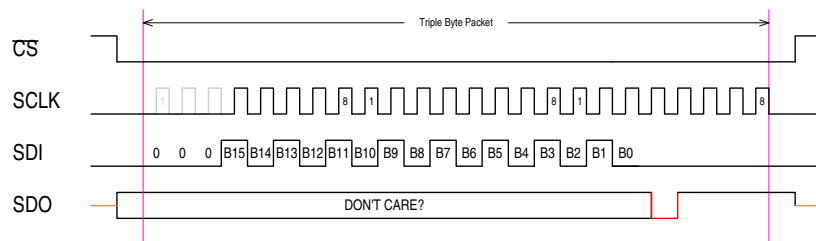


Fig. 8

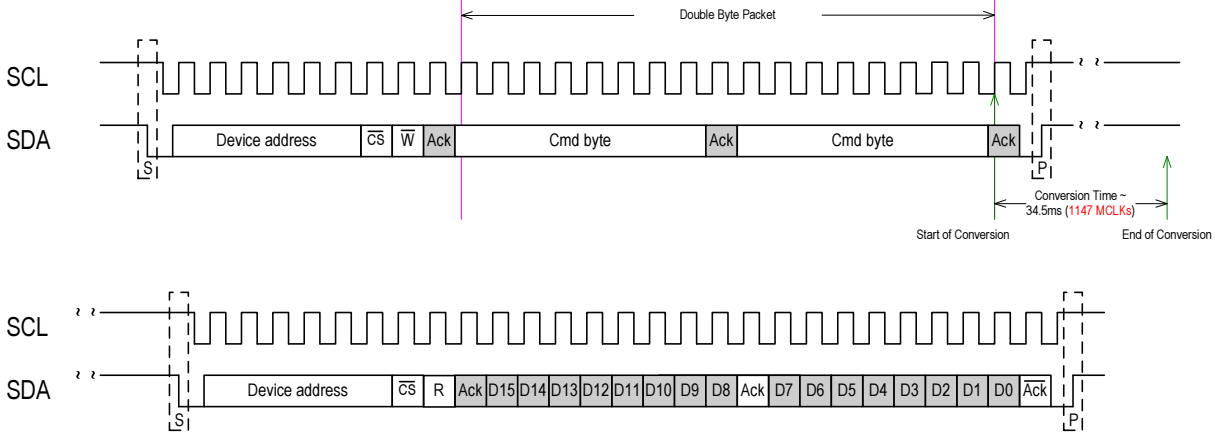
I2C Interface

Typical I2C communication starts with the start condition and is ended with the stop condition. The device address consisted of six pre-defined bits plus a pin defined bit. The device address is 111011C. The value of C is determined by the \overline{CS} pin connected with VDD or GND.

\overline{CS} connected to	Device address
------------------------------	----------------

VDD	1110111
GND	1110110

A/D conversion data acquisition

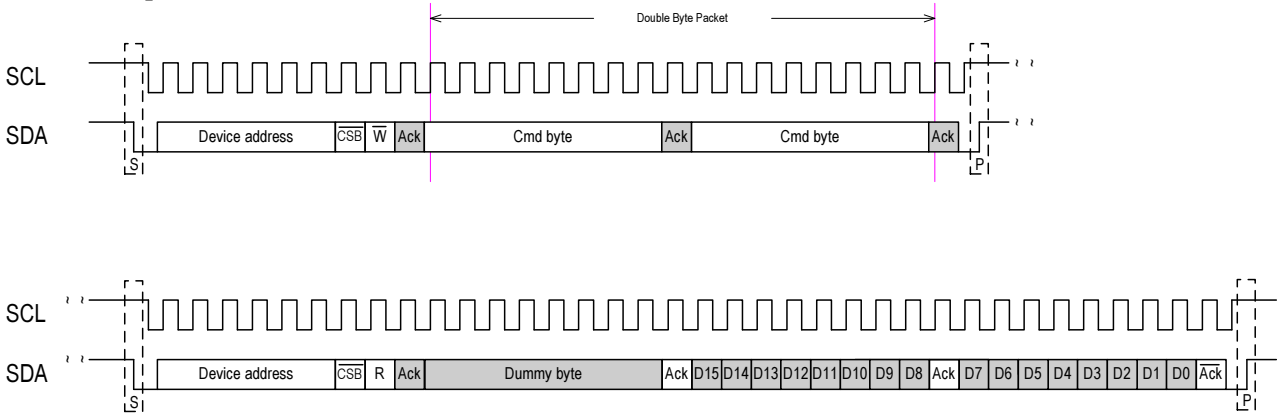


From master to slave S: Start condition \overline{W} : Write=0 ACK: Acknowledge
 From slave to master P: Stop condition R: Read=1 \overline{ACK} : Not acknowledge
 \overline{CS} : 1=CS connects to Vdd
 0=CS connects to Gnd

(1) A/D Conversion Data Acquisition

Fig. 9

OTP data acquisition

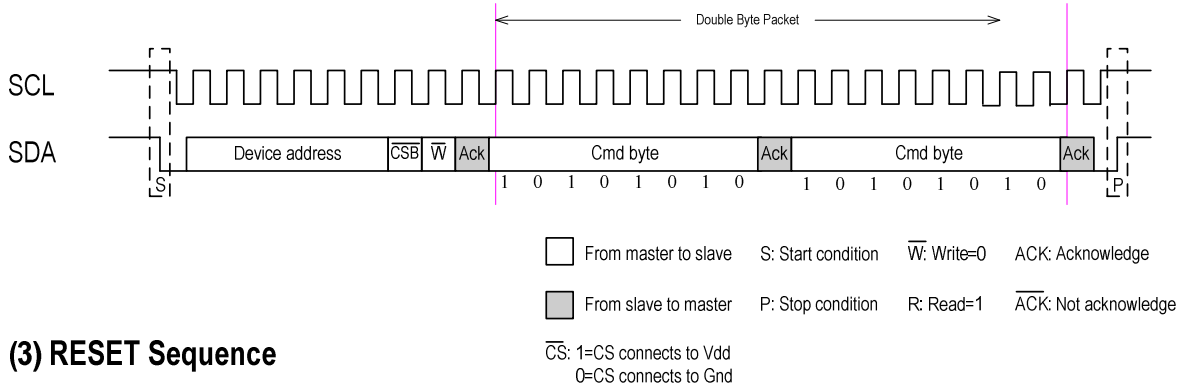


From master to slave S: Start condition \overline{W} : Write=0 ACK: Acknowledge
 From slave to master P: Stop condition R: Read=1 \overline{ACK} : Not acknowledge
 \overline{CS} : 1=CS connects to Vdd
 0=CS connects to Gnd

(2) OTP Data Acquisition

Fig. 10

Reset sequence



(3) RESET Sequence

Fig. 11

■ Pressure and temperature reading instructions

Here we will give several examples to introduce reading pressure, temperature and calibration coefficients. All the commands for pressure, temperature and coefficients reading is listed as following table.

Action	Instruction	
	SPI mode	I2C mode
Conversion start for pressure measurement (D1)	0Fh & 51h	0Fh & 51h
Conversion start for temperature measurement(D2)	0Fh & 21h	0Fh & 21h
Reset	0Ah & AAh & A0h	AAh & AAh
Reading coefficient C1	1Ch & 40h	0Eh & 20h
Reading coefficient C2	1Ch & 50h	0Eh & 28h
Reading coefficient C3	1Ch & 60h	0Eh & 30h
Reading coefficient C4	1Ch & 70h	0Eh & 38h
Reading coefficient C5	1Ch & 80h	0Eh & 40h
Reading coefficient C6	1Ch & 90h	0Eh & 48h
Reading coefficient C7	1Ch & A0h	0Eh & 50h
Reading coefficient C8	1Ch & B0h	0Eh & 58h
Reading coefficient C9	1Ch & C0h	0Eh & 60h
Reading coefficient C10	1Ch & D0h	0Eh & 68h

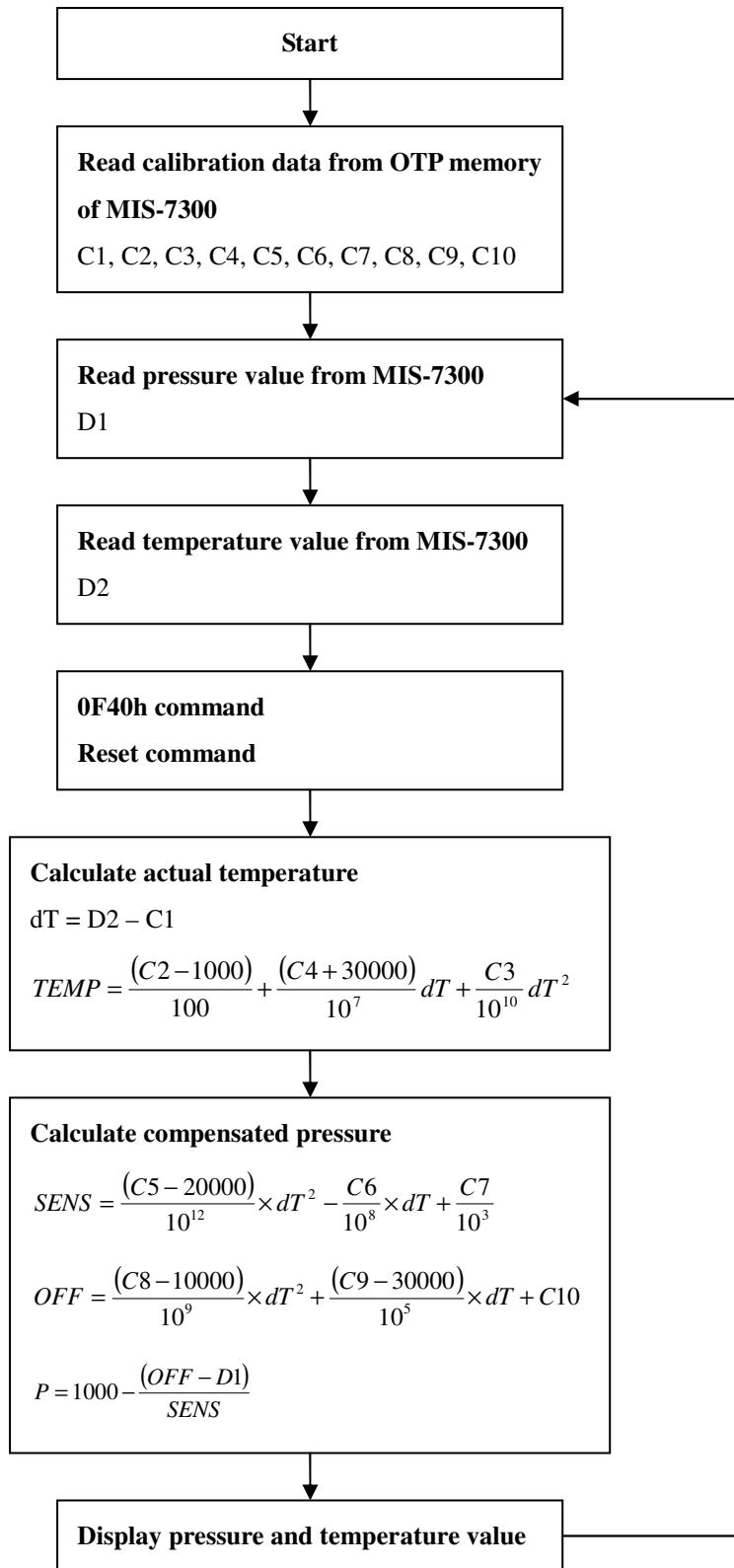
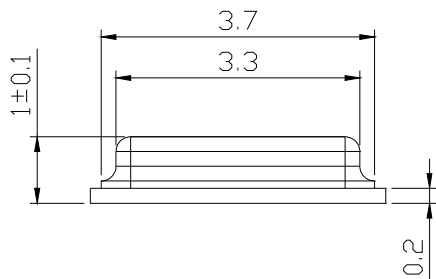
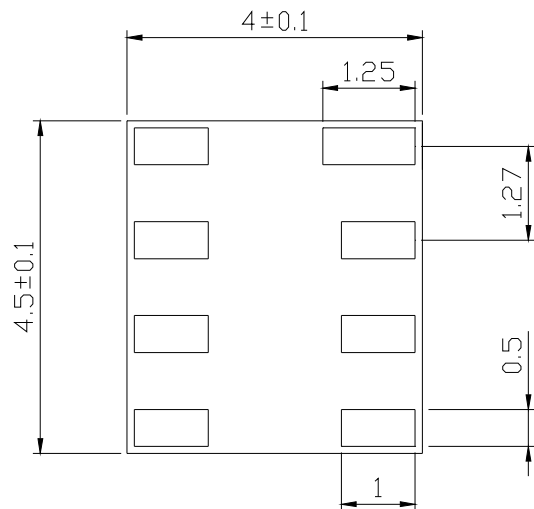
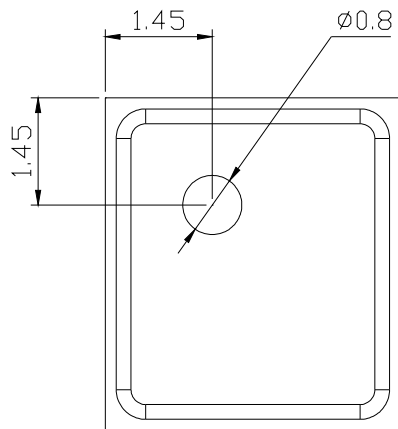


Fig. 12

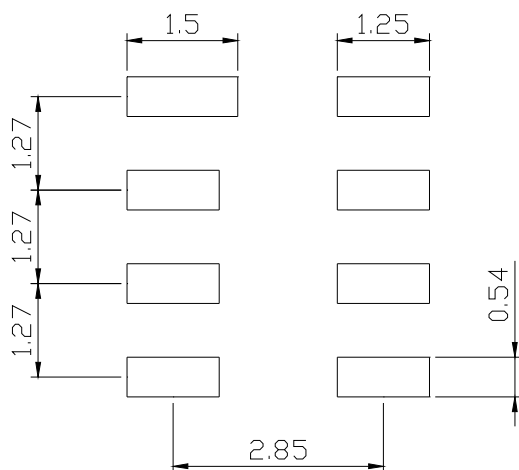
■ Package Outlines



Unit: mm

Fig. 13

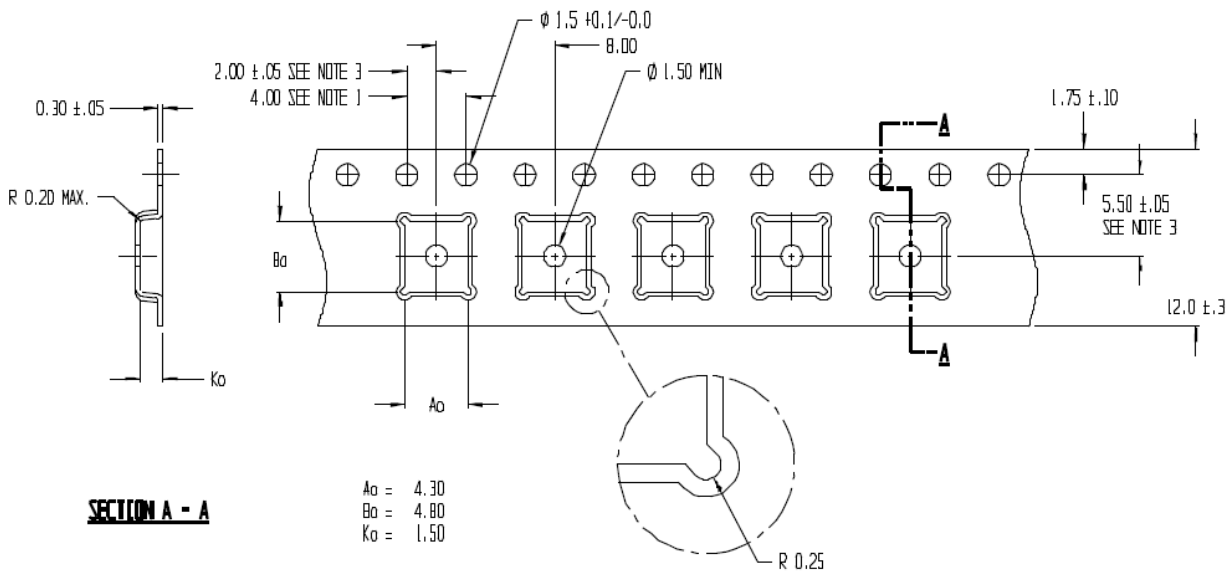
■ Recommended footprint



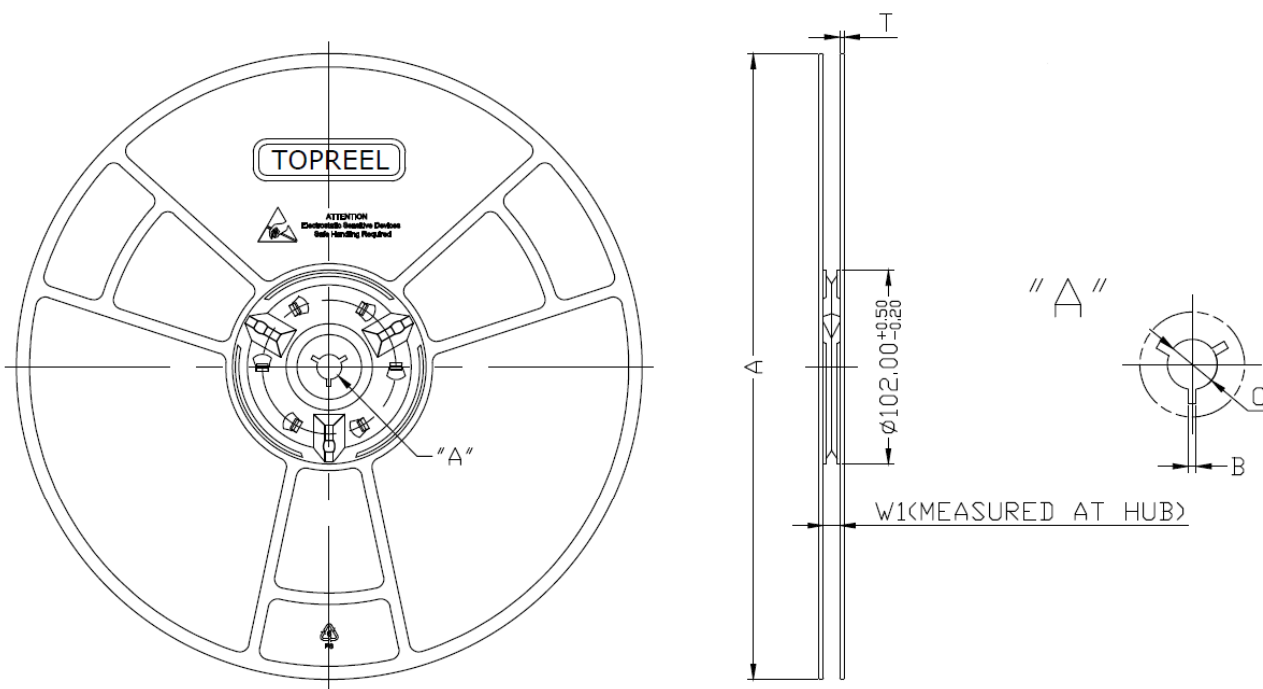
Unit: mm

Fig. 14

■ Tape specification



■ Reel specification



XX is for RB/SW/BK/BL/RC

Part Number	Nominal Hub Width	A +0.5mm -0.2mm	T +0.5mm -0.2mm	C +0.5mm -0.2mm	B +0.5mm -0.2mm	W1 +0.6mm -0.4mm
XX13412-A	12.0mm					12.8mm
		330.0mm	2.30mm	13.1mm	2.0mm	

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