MIS-3600 Series

■ Application Information

General

The MIS-3600 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 have to be 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 C13 have to be read from OTP memory via serial interface. This can be done once reset the MIS-3600. 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 C13. The general flow for temperature compensation calculation was listed as fig. 3.

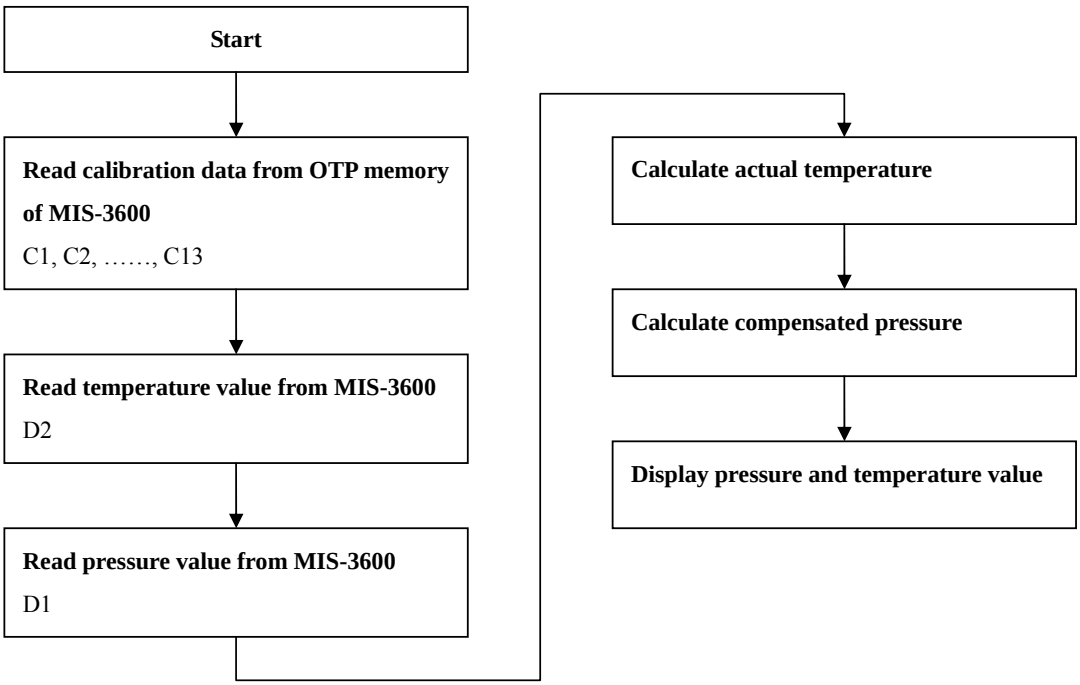


Fig. 1

Decoupling Capacitor

The decoupling capacitors, 0.1µF ceramic plus 1µF tantalum capacitor, have to be placed as close as possible to the MIS-3600 VDD and GND pin. This capacitor will stabilize the power supply during data conversion and thus, provide the highest possible accuracy.

Application Circuit example

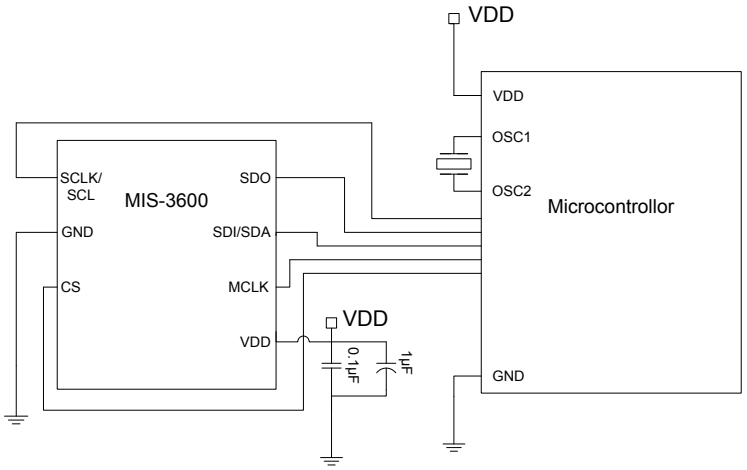


Fig. 2 Typical application circuit of MIS-3600 in SPI mode

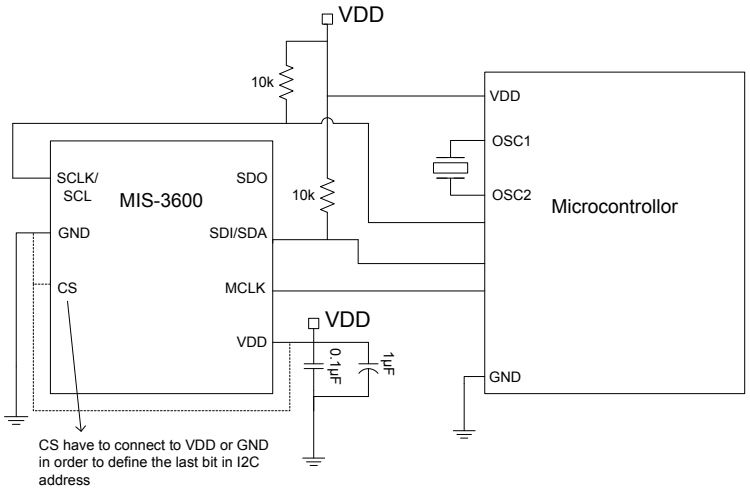


Fig. 3 Typical application circuit of MIS-3600 in I2C mode

■ Serial Interface

The MIS-3600 can provide two types of serial interfaces as SPI or I2C. The type of serial interface is defined as the device manufactured. The user can`t choose the type of serial interface by hardware wiring. So the user have to decide the type of serial interface as ordering the device.

■ SPI Interface

The MIS-3600 have a SPI（Serial Peripheral Interface）bus to communicate with the microprocessor and other digital systems. The functional block diagram of MIS-3600 was shown as fig.1. The SPI bus consists of four wires as SCLK, SDI, SDO, CS.

Serial Clock Input

The SCLK is the serial clock input for the device, and all data transfers (either on SDI or SDO) occur with respect to the SCLK signal. Each bit is shifted out of the SDO pin on the falling edge of SCLK and data is shifted into the SDI pin on the rising edge of SCLK. The SCLK-signal is generated by the microprocessor's system.

Chip Select Input

The CS (Chip Select Input) is an active low logic input used to select the MIS-3600. The CS can be used to select the MIS-3600 in systems with more than one device on the serial bus or as a frame synchronization signal in communicating with the device. CS can be hard-wired low, allowing the MIS-3600 to operate in 3-wire mode with SCLK, SDI, and SDO used to interface with the device.

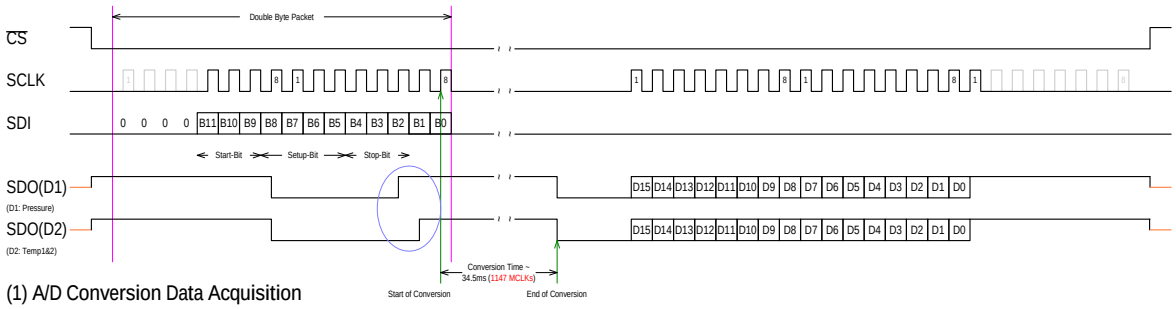
Serial Data Output (SDO)

The SDO pin provides the result of the last conversion as a serial bit stream during the data output state. In addition, the SDO pin is used as an end of conversion indicator during the conversion. When CS is HIGH, the SDO driver is switched to a high impedance state in order to share the data output line with other devices. If CS is brought LOW during the conversion phase, the SDO pin will be driven HIGH. Once the conversion is complete, if CS is brought 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-3600 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)

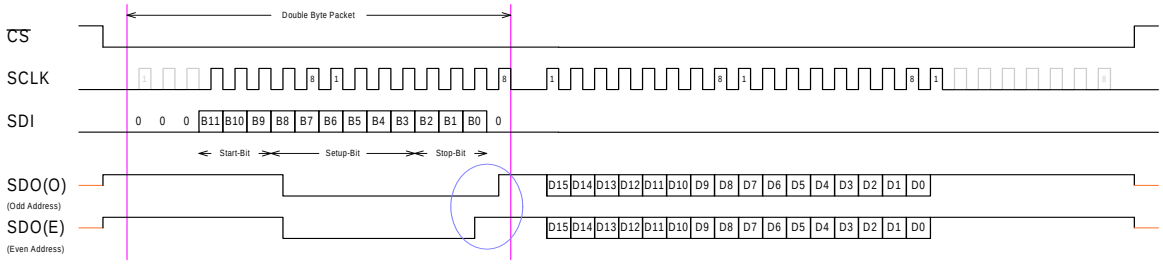
The SDI pin is used to select the input channel (Pressure or Temperature) and to access the OTP memory. Data is shifted into the device during the data output/input state on the rising edge of SCLK while CS is low

Timing Waveform Diagrams



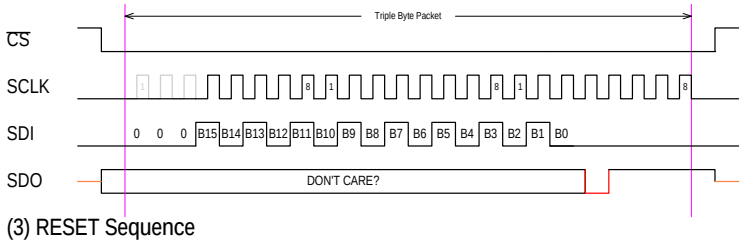
(1) A/D Conversion Data Acquisition

Fig.4



(2) OTP Data Acquisition

Fig.5



(3) RESET Sequence

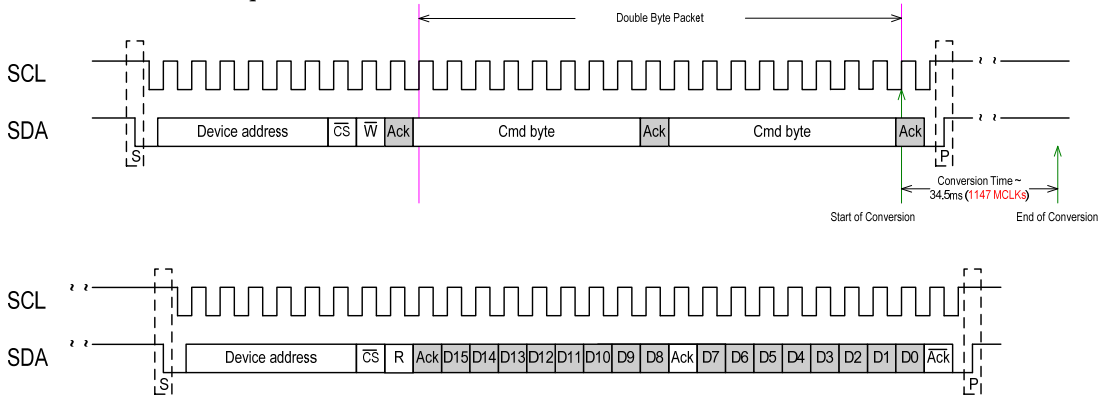
Fig. 6

■ 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

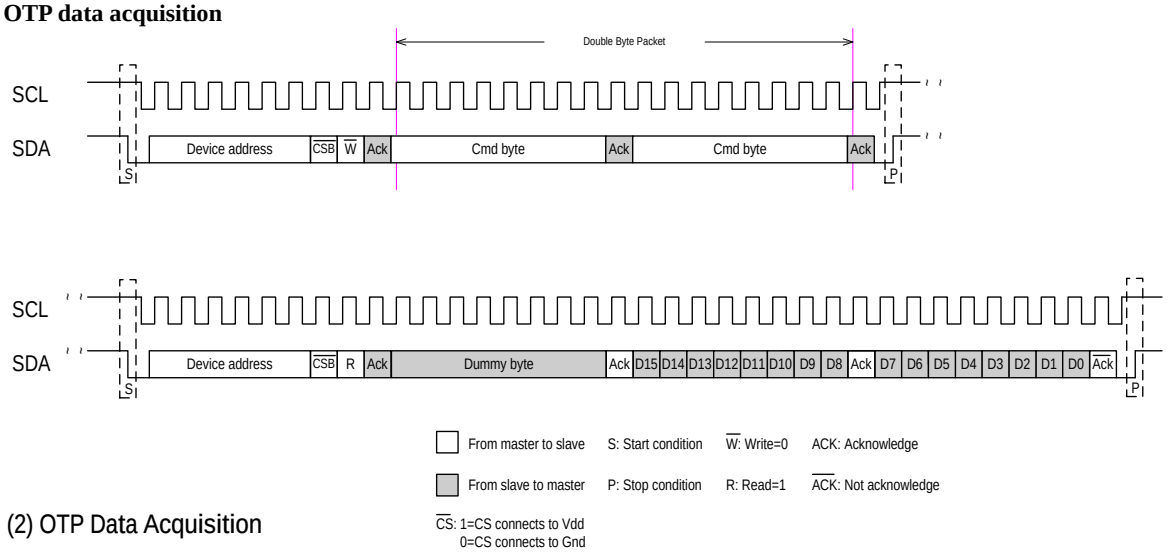
A/D conversion data acquisition



(1) A/D Conversion Data Acquisition

Fig. 7

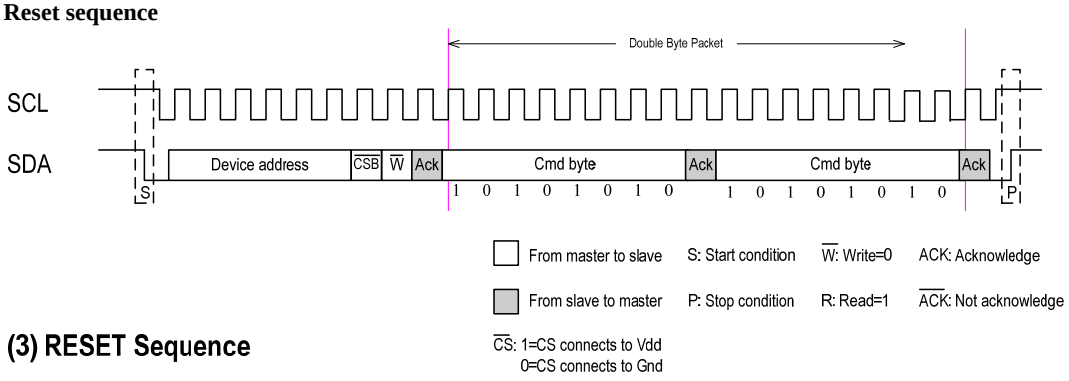
OTP data acquisition



(2) OTP Data Acquisition

Fig. 8

Reset sequence



(3) RESET Sequence

Fig. 9

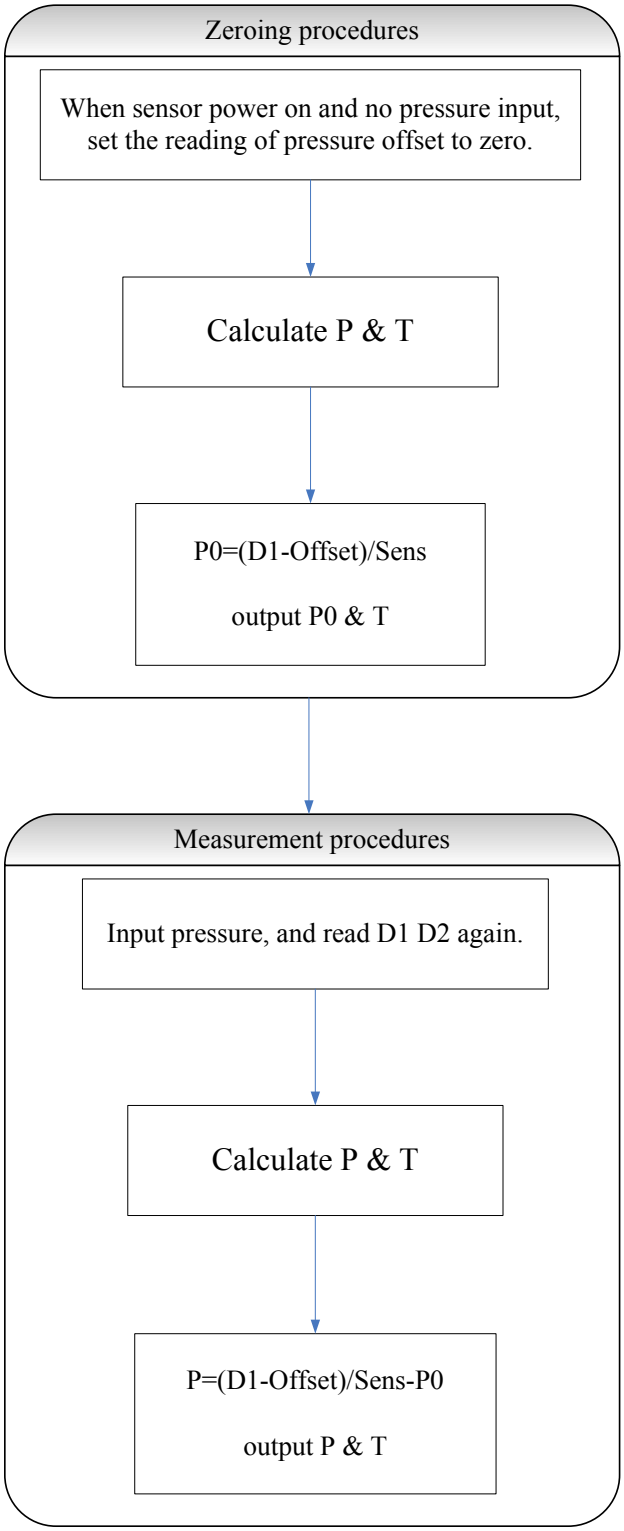
■ Pressure and temperature reading instructions

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）		
For 5.8 & 15 psi	0Fh & 49h	0Fh & 49h
For 0.5 & 1 psi	0Fh & 59h	0Fh & 59h
Conversion start for temperature measurement（D2）	0Fh & 21h	0Fh & 21h
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
Reading coefficient C11	1Ch & E0h	0Eh & 70h
Reading coefficient C12	1Ch & F0h	0Eh & 78h
Reading coefficient C13	1Dh & 00h	0Eh & 80h

■ Calculation of pressure and temperature

For 0.5psi range sensor：MIS-3600-C50DI、MIS-3600- C50SI、MIS-3600- C50DS、MIS-3600- C50SS



Please refer to the procedure in fig.13

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Fig.10

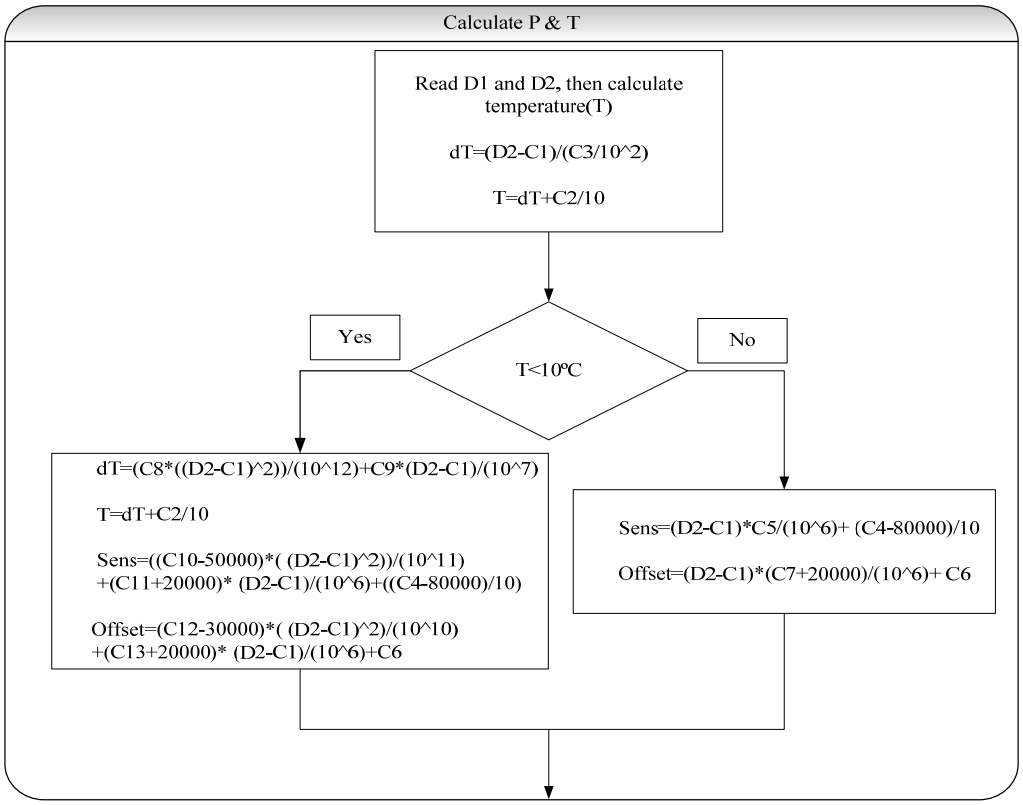
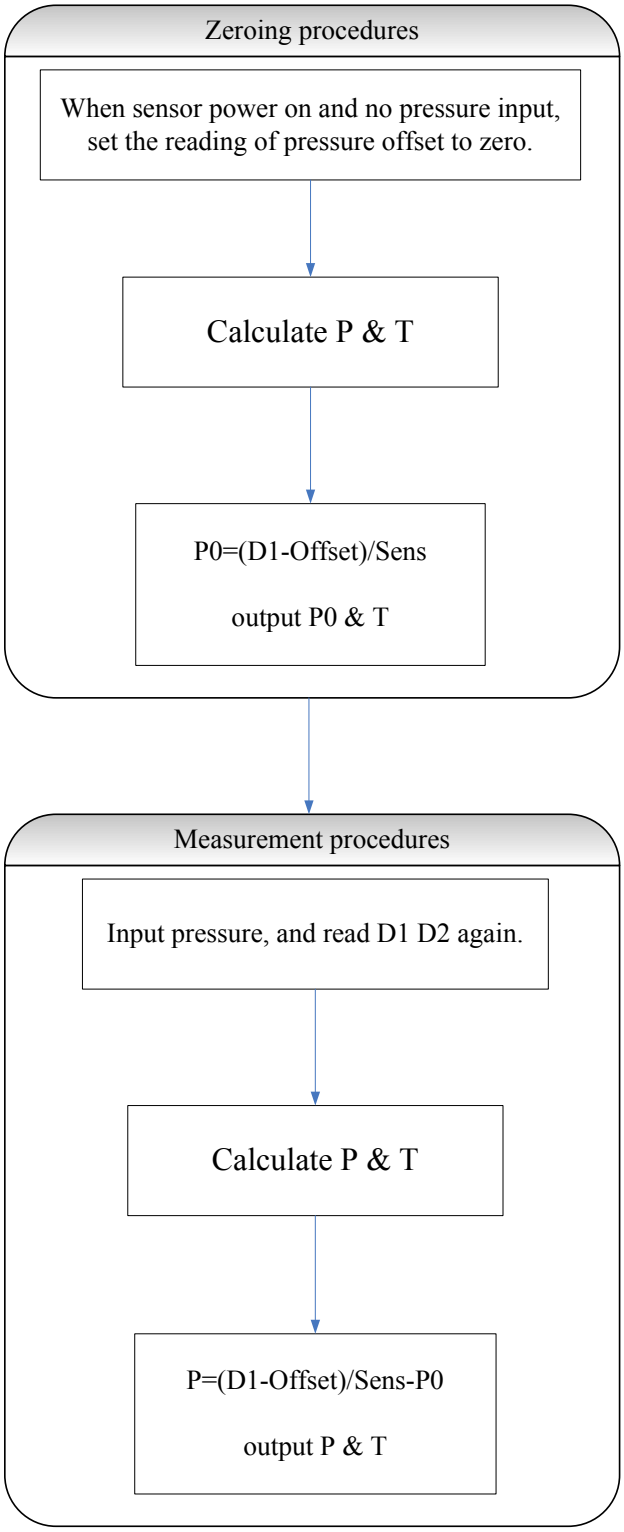


Fig.11

For 1psi bipolar range sensor：MIS-3600-001DI、MIS-3600-001DS



Please refer to the procedure in fig.15

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Fig.12

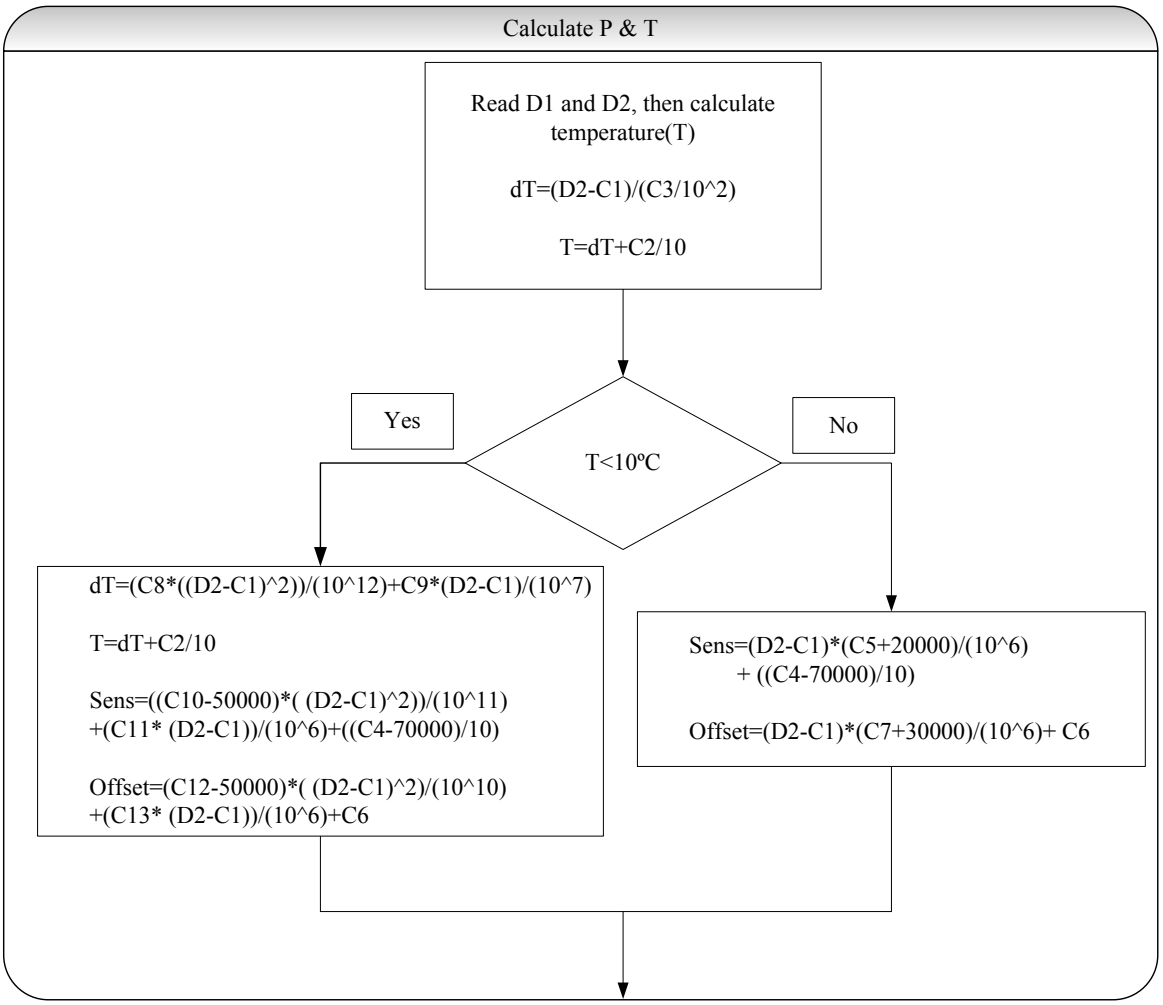
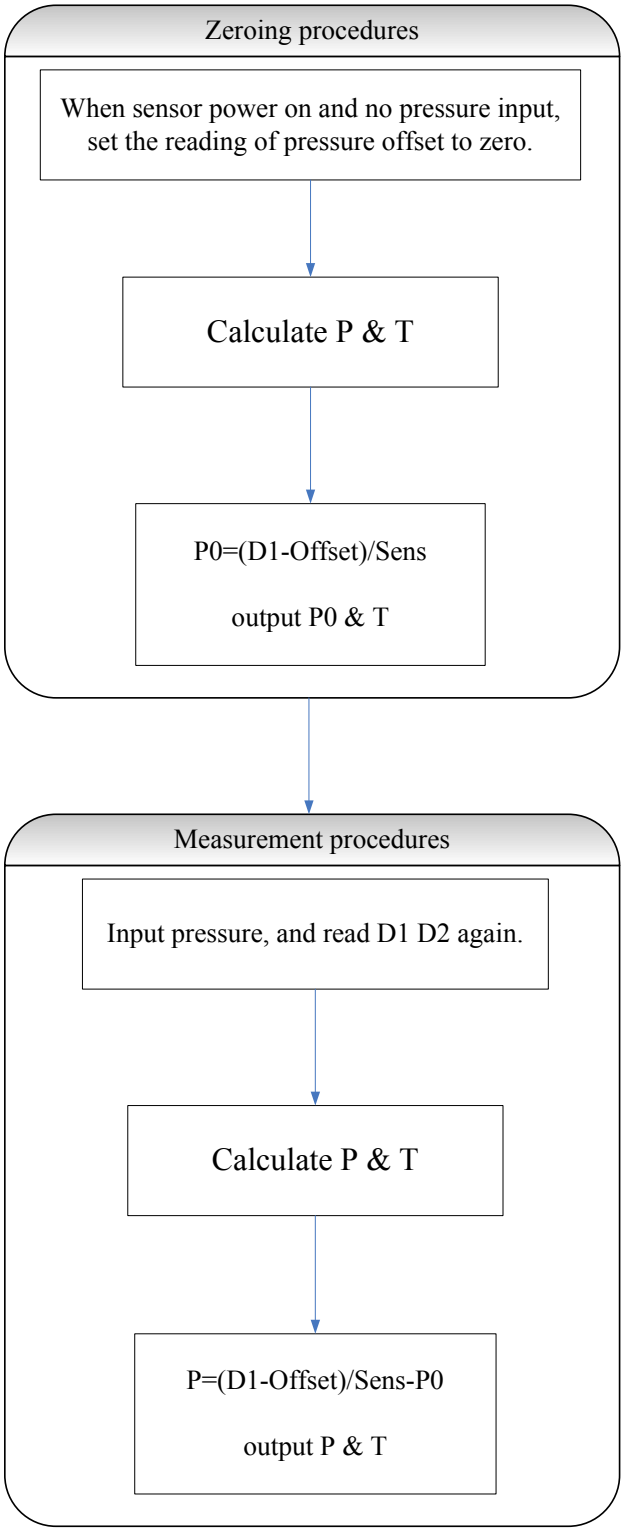


Fig.13

For 1psi unipolar range sensor：MIS-3600-001SI、MIS-3600-001SS



Please refer to the procedure in fig.17

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Fig.14

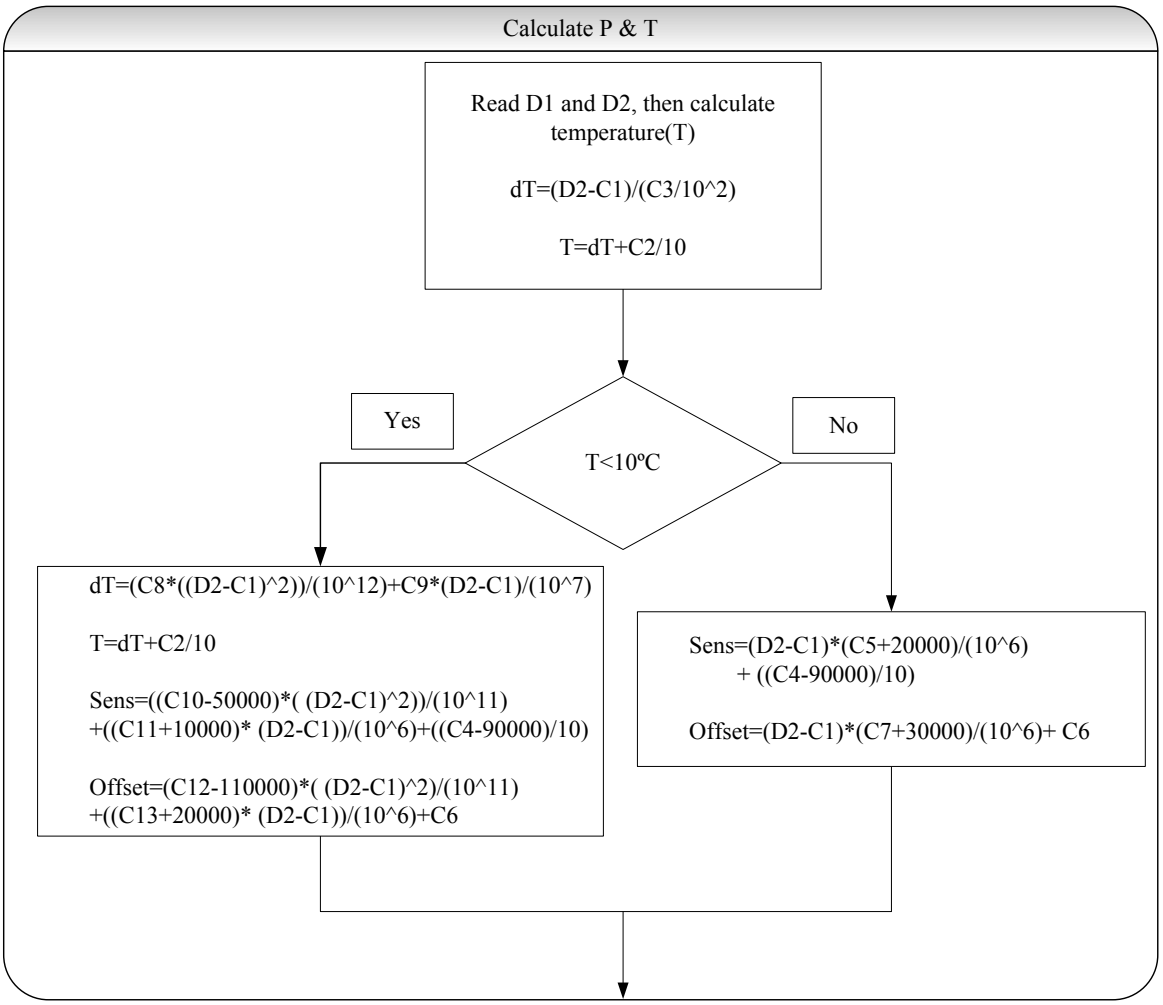

Fig.15

For 5.8psi range sensor：MIS-3600-006DI、MIS-3600-006SI、MIS-3600-006DS、MIS-3600-006SS

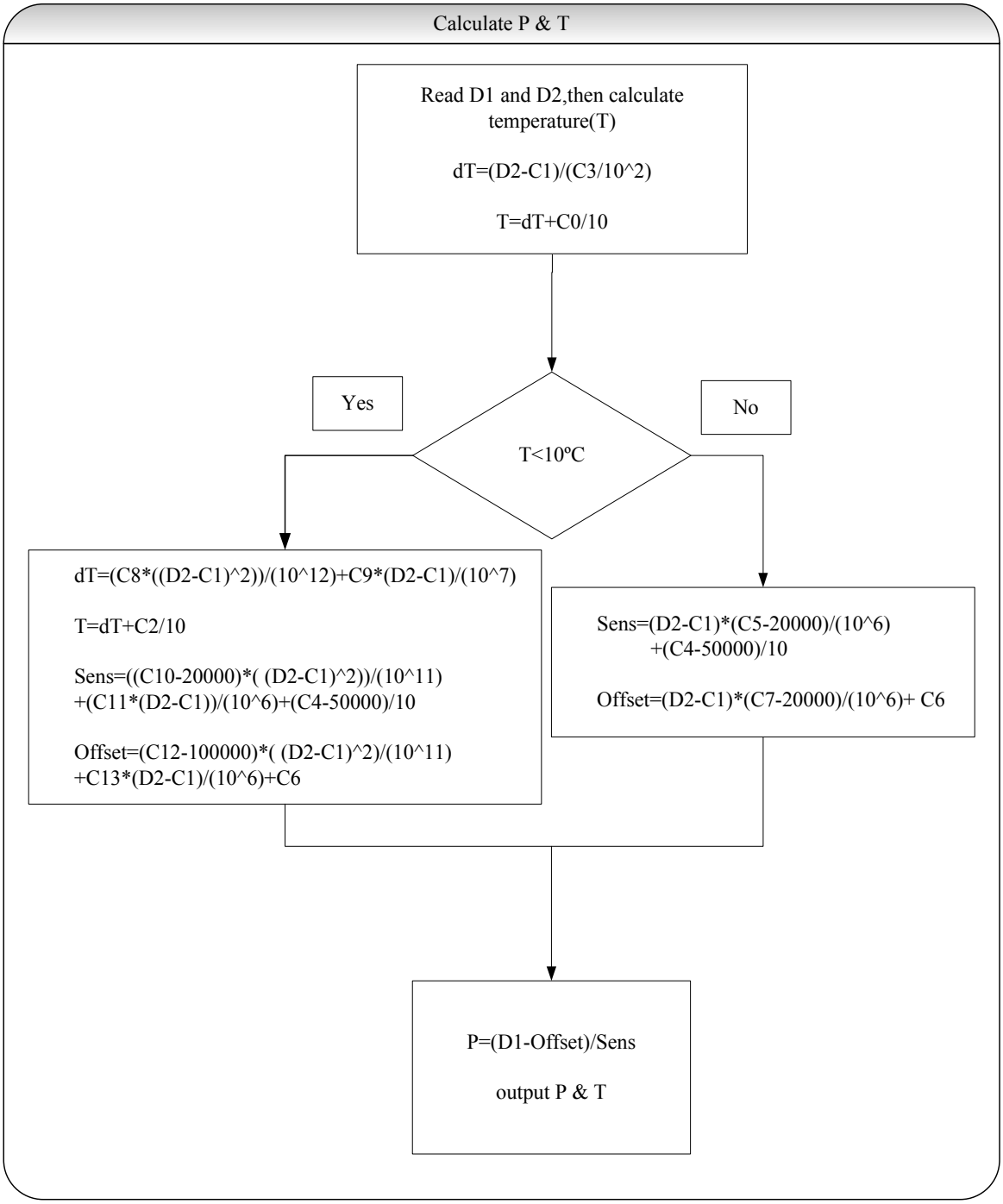

Fig.16

For 15psi range sensor：MIS-3600-015DI、MIS-3600-015SI、MIS-3600-015DS、MIS-3600-015SS

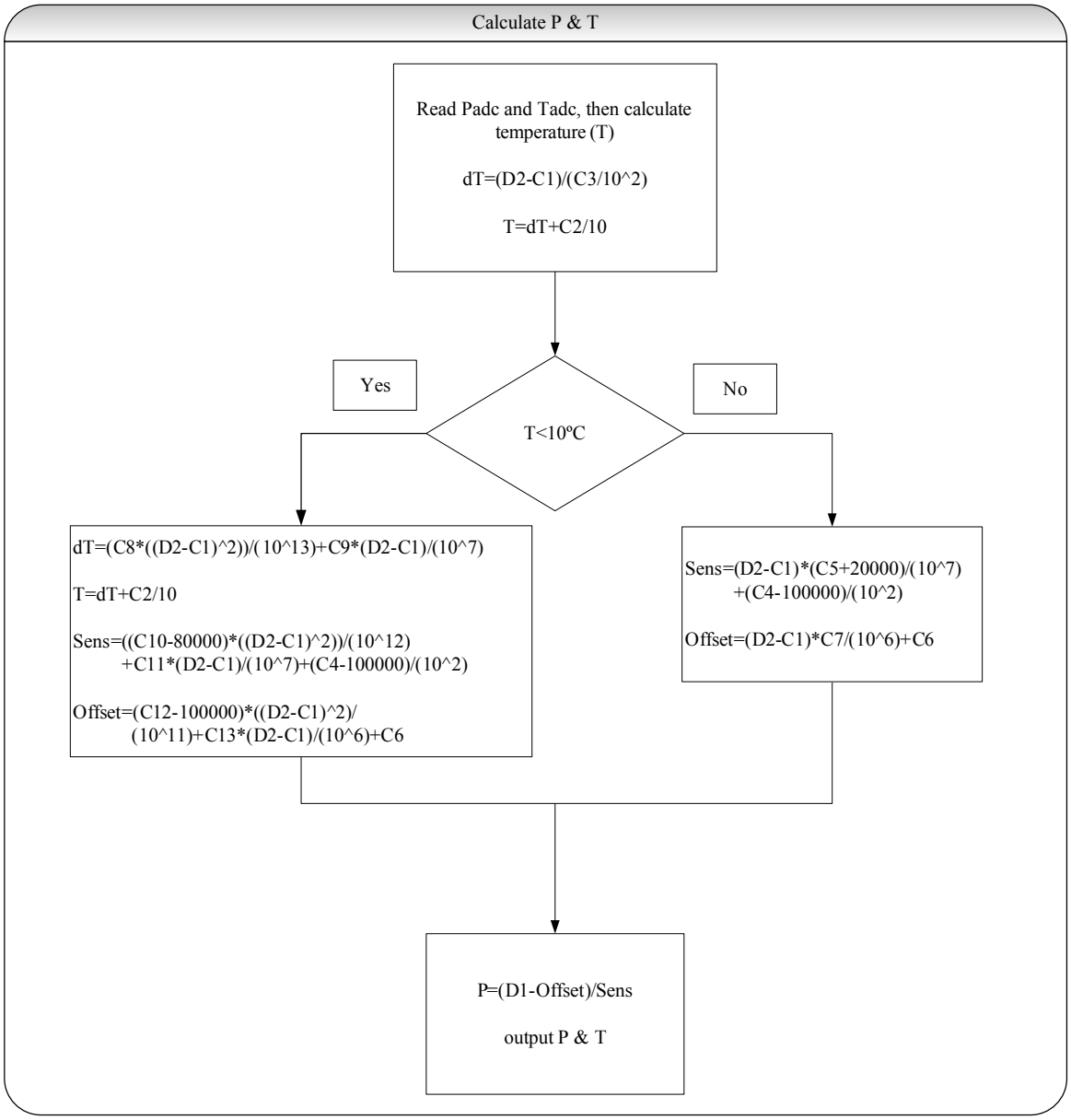

Fig.17

For 30psi range sensor：MIS-3600-030DI、MIS-3600-030SI、MIS-3600-030DS、MIS-3600-030SS

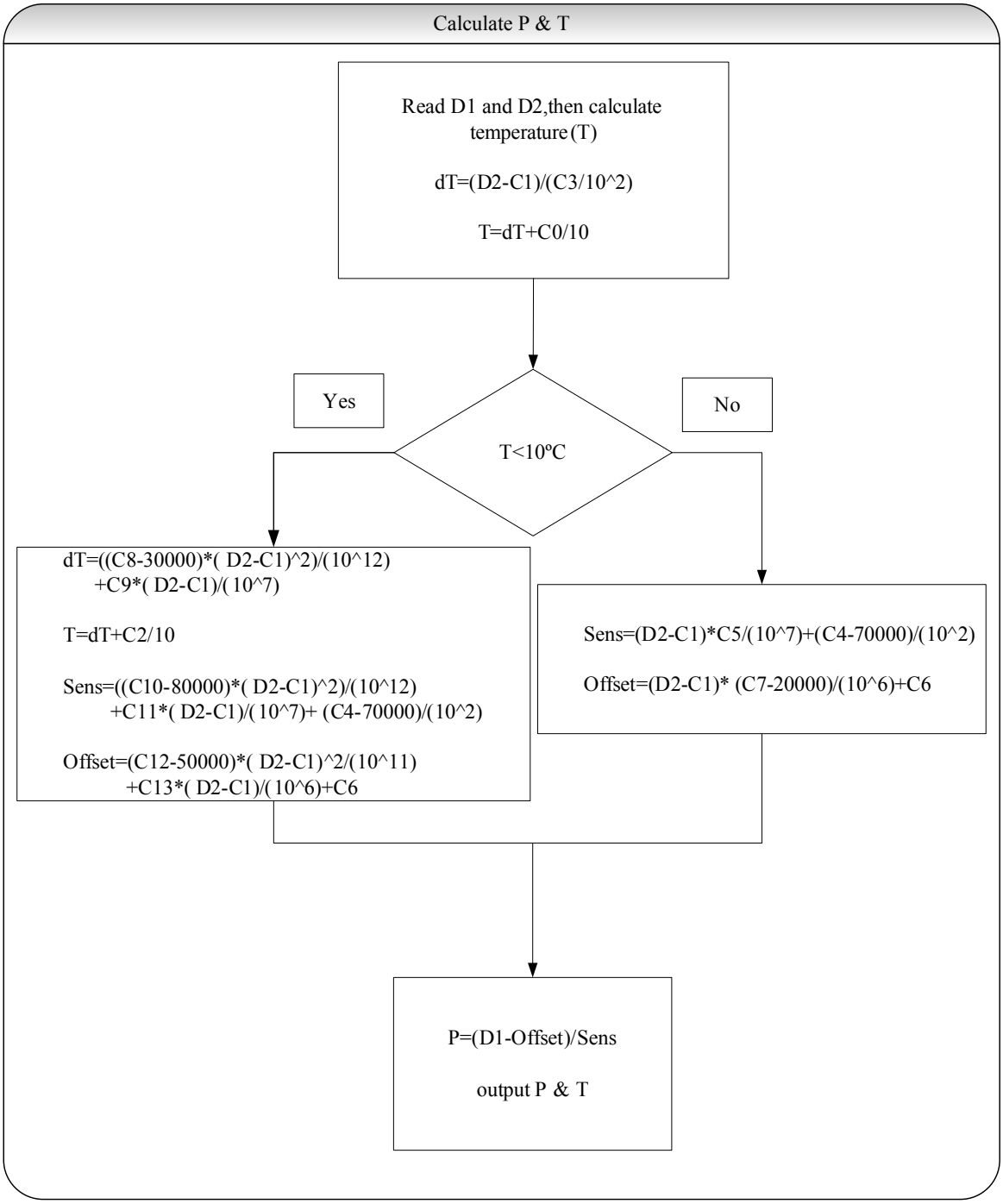

Fig.18

■ Package Outlines

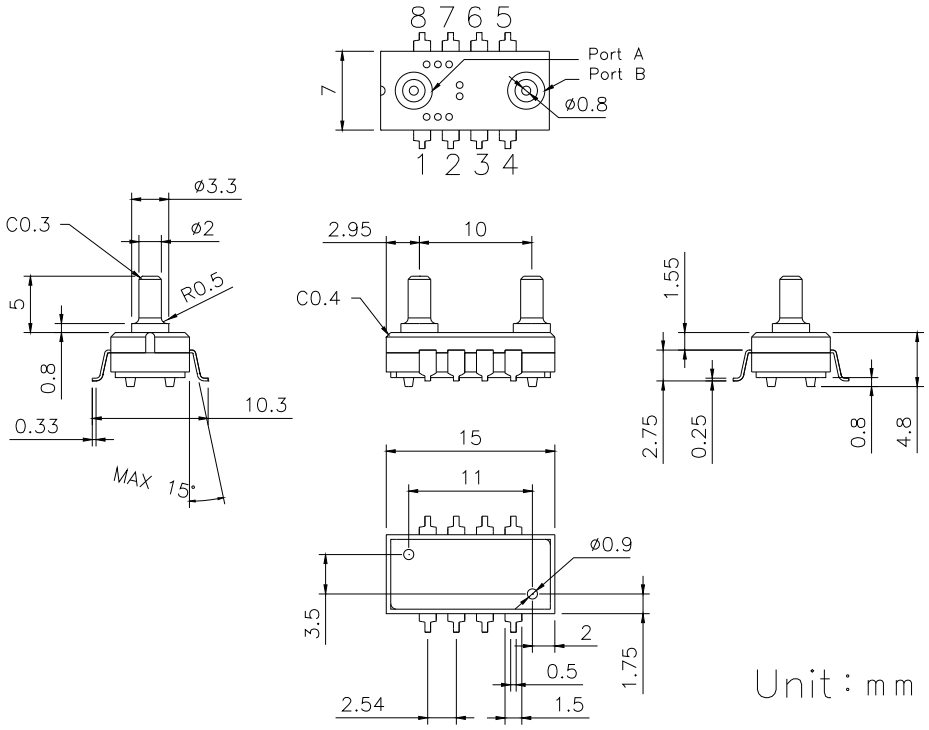

Fig. 19

■ Recommended footprint

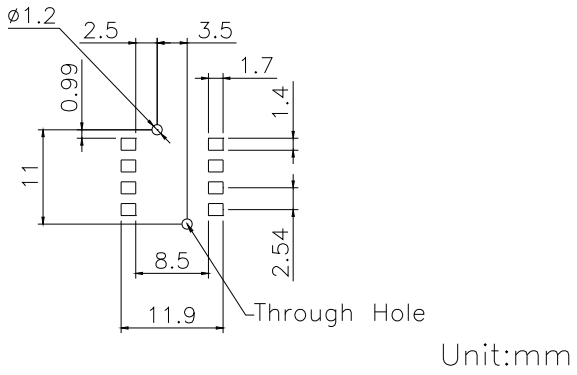

Fig. 20

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