100kPa I²C Digital Gauge Pressure Sensor XL253

Features

- Gauge Pressure Range: 0kPa~100kPa
- Typical Operation Voltage: 3.3V
- Built in 24-bit high-precision pressure ADC circuit
- The accuracy of measuring pressure can reach ± 0.5% FS
- Ambient Operating Temperature Range: -40℃ to 125℃
- Suitable for Non-corrosive Gases
- I²C digital interface
- SOP6 package

General Description

XL253 is a piezoresistive gauge pressure sensor made using MEMS technology. Built-in temperature sensor and signal conditioning chip, it digitally compensates for sensor offset, temperature drift, and nonlinearity, and can output high-precision pressure and temperature values. Provide I²C digital interface with strong anti-interference ability. XL253 adopts standard SOP6 package, which has excellent accuracy and reliability, and can be widely used in fields such as household appliances, consumer electronics, and industrial control.

Applications

- Pressure gauge
- Pipeline pressure monitoring
- Massage chair
- Oxygenator

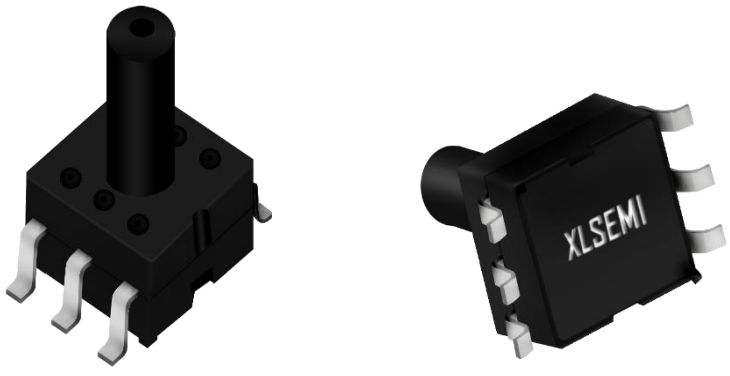

Figure1. Package Type of XL253

Pin Configurations

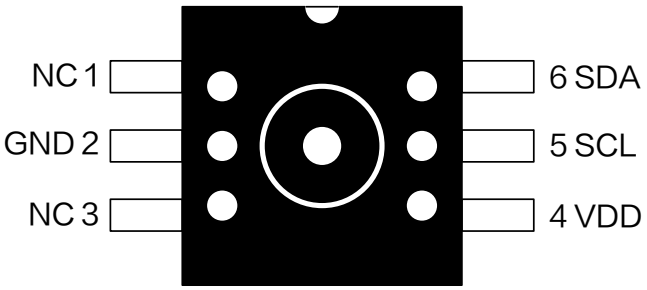

Figure2. Pin Configuration of XL253

Table 1 Pin Description

Pin Number	Pin Name	Description
1	NC	Floating Pin.
2	GND	Ground Pin.
3	NC	Floating Pin.
4	VDD	Supply Voltage Input Pin.
5	SCL	I²C serial clock.
6	SDA	I²C serial data.

Ordering Information

Order Information	Marking ID	Package Type	Eco Plan	Packing Type Supplied As
XL253	XL253	SOP6	RoHS & HF	70 Units Per Tube

Function Block

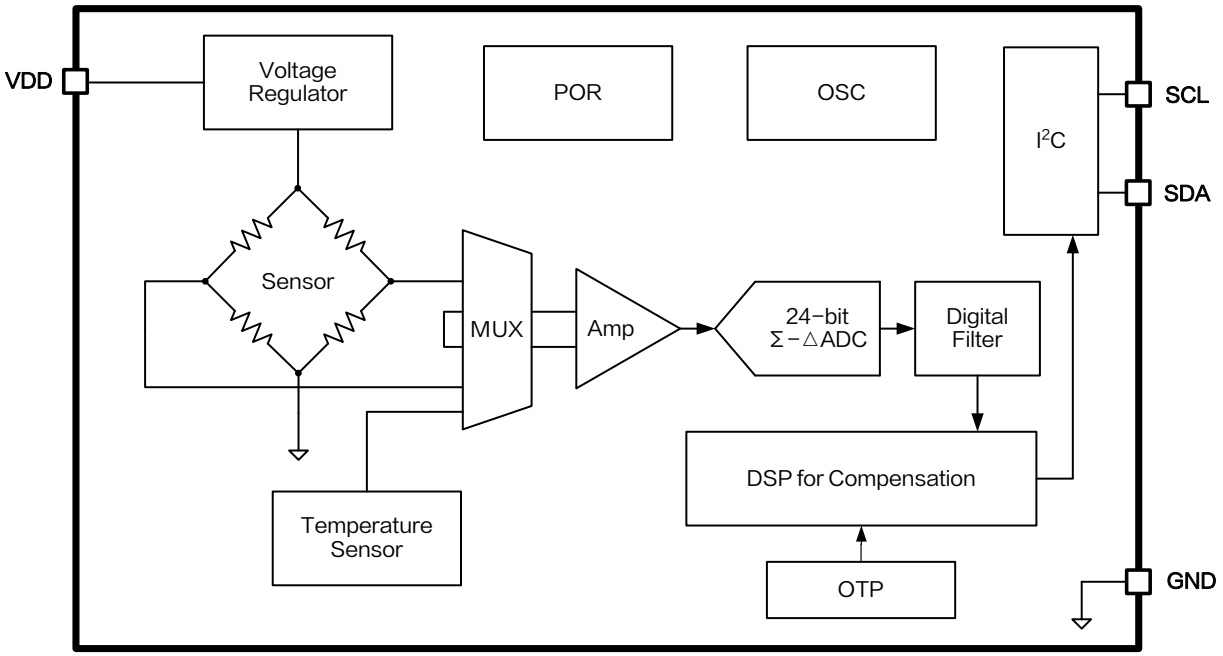

Figure3. Function Block Diagram of XL253

Absolute Maximum Ratings（Note1）

Parameter	Symbol	Value	Unit
Input Voltage	V_{DD}	−0.3 ~ 3.6	V
SCL/SDA Pin Voltage	V_{SCL}/V_{SDA}	−0.3 ~ V_{DD}+0.3	V
Operating Temperature	T_A	−40 ~ 125	°C
Operating Junction Temperature	T_J	−40 ~ 150	°C
Storage Temperature	T_{STG}	−65 ~ 150	°C
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	°C
ESD (HBM)		>3000	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

XL253 Characteristics

T_A = 25℃, V_{DD}=3.3V, measurement medium: air, system parameters test circuit figure4, unless otherwise specified.

Parameters	Test Condition	Min.	Typ.	Max.	Unit
Operation Voltage		1.8	3.3	3.6	V
Pressure Range		0		100	kPa
SCL/SDA Pull-up Resistor			4.7		kΩ
Quiescent Current			50		nA
Operation Current			500		uA
ADC Resolution of Pressure			24		Bits
Pressure Measurement Accuracy			±0.5		%FS
Zero Temperature Drift			±0.03		%FS/℃
Full Scale Temperature Drift			±0.03		%FS/℃
ADC Resolution of Temperature			16		Bits
Temperature Measurement Accuracy			±0.5		℃
Clock Pulse Frequency	I²C communication			3.4	MHz
Measurement Frequency		5		100	Hz
Overload Pressure			3x		Rated
Burst Pressure			5x		Rated

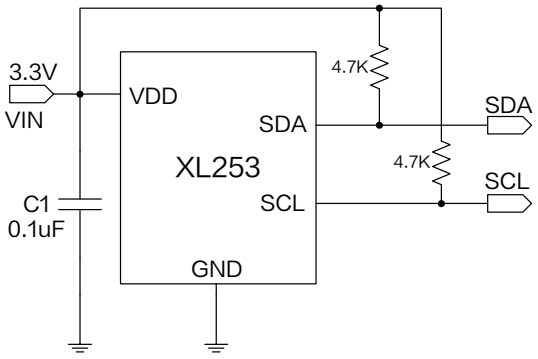

Figure4. XL253 Typical application schematic

I²C Communication Protocol

XL253 communicates with external devices using I²C protocol. All communication data starts from MSB, and the default 7bit I²C device address is 0x78.

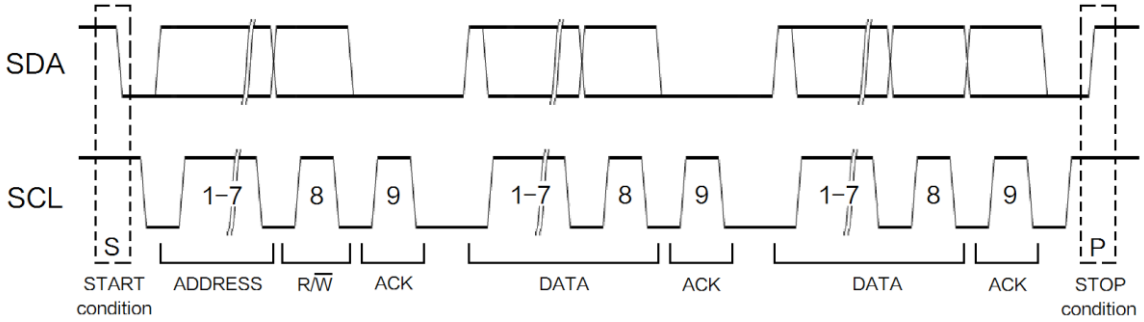

Figure5. I²C timing diagram

START Condition

SDA transitions from idle high state to low state, during which SCL remains high. This can also repeatedly send the start condition during transmission, indicating that the transmission will restart without an intermediate stop bit.

Address Bits

During the first byte transfer process, the first 7-bits provide the specified address of the device, which defaults to 0x78. The device at this address will acknowledge this communication.

Read/Write Direction Bit

During the first byte transfer process, the last 1 bit Indicating the read or write of the communication. 0 represents the main device write operation, and 1 represents the main device read operation. If the main device requests a read operation, the main device will control the SDA line to output data in subsequent bytes.

Data Byte

All other bytes, except for the address and read/write bits, are considered communication data bytes transmitted on SDA.

Acknowledge or Not Acknowledge Bit

The acknowledge bit is used to inform the sender that the byte has been received. The device needs to acknowledge each byte, including the address byte, when receiving data. At this moment, the bus device that sends data stops driving the SDA line and the SDA line is pulled up. Not acknowledge a byte, the receiving device does not need to do anything. Acknowledge a byte, the receiving device needs to lower the SDA. A receiving slave device does not need to acknowledge if the slave device is not an addressing device or cannot process the received bytes. The main device does not respond if it is receiving and wants to end communication. If there is no response, the device needs to generate a stop bit for data transmission.

STOP Condition

SDA transitions from low state to high state, and SCL remains high. This ends I²C communication.

I²C Digital Interface

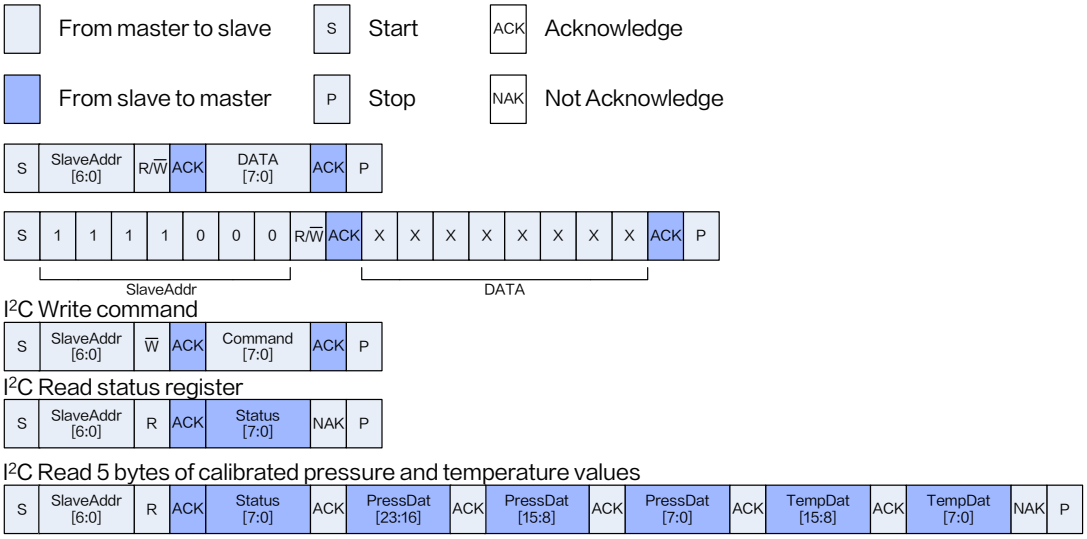

Figure6. I²C Interface Operation

Any response from the XL253 I²C interface should start with the status byte, followed by data, and the returned data content is based on the previous command. If the I²C read command is repeated, the same data will be read multiple times. If the next command is not an I²C read command, the previous data will be invalid.

Table 2 Status Byte Description

Bits	Significance	Description
Bit7	Reserved	Fixed to 0
Bit6	Power indication	1 Power On; 0 Power Off
Bit5	Busy indication	1 The device is busy, indicating that the data requested to be read by the last I²C command is not yet valid. If the device is busy, new command will not be processed. 0 Indicating that the data requested by the most recent I²C command is ready to be read.
Bit4	Reserved	Fixed to 0
Bit3	Mode status	0 Only start the measurement once after receiving the I²C command. 1 Used for testing and calibration, always in a powered on state.
Bit2	Memory integrity/ error flag	0 Indicating that the OTP memory data integrity test (CRC) has passed; 1 Indicating that the integrity test has failed. The test for data integrity id only calculated once during the power on process (POR), and the new CRC value written can only be used after the following POR.
Bit1	Reserved	Fixed to 0
Bit0	Reserved	Fixed to 0

I²C Command

Command (byte)	Return	Description	NOR	CMD
0xAC	24bits pressure value after calibration 16bits temperature value after calibration	Get_Cal Use the configuration in OTP for overall measurement and write the calibrated pressure and temperature values into the interface.	✓	✓
0xB0~0xBF	24bits pressure value after calibration 16bits temperature value after calibration	Get_Cal_S It is almost the same as Get_Cal, but the oversampling rate is not specified by OTP, but directly by the command. Refer to the following table.	✓	✓

Get_ Cal_S Command

Command 0xBX (HEX)	Function	Description	
Bit [3] of X	The oversampling rate OSR_T of ADC when measuring temperature	0:4xOversampling rate	1:8xOversampling rate
Bit [2:0] of X	The oversampling rate OSR_P of ADC when measuring pressure	000:128xOversampling rate 001:64xOversampling rate 010:32xOversampling rate 011:16xOversampling rate	100:8xOversampling rate 101:4xOversampling rate 110:2xOversampling rate 111:1xOversampling rate

XL253 only starts measuring pressure and temperature once after receiving the corresponding I²C command, and automatically enters deep sleep mode to save power consumption after completing the measurement.

Example of Operation

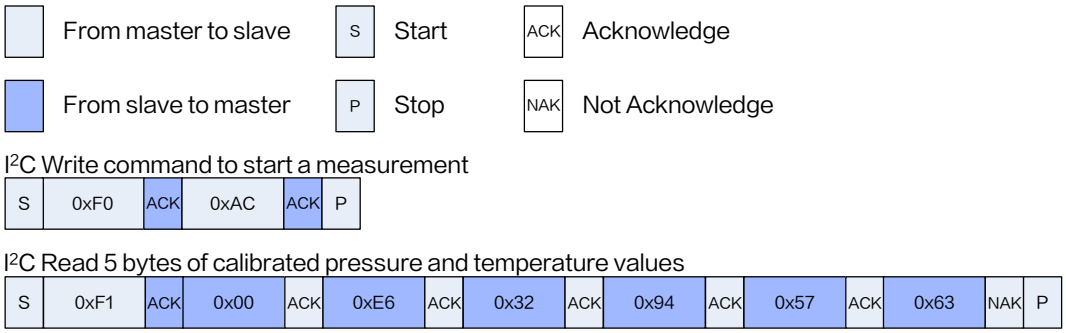

Figure7. I²C Example of Operation

0xF0 represents the default 7bits I²C sensor slave device address 0x78, and the last bit is 0 Indicating that the master device is performing a write operation. 0xAC is the command byte, which starts the slave sensor to start a measurement.

After sending the command, wait for the slave sensor to complete the measurement before sending the command to read the measurement data. 0xF1 represents the default 7bits I²C sensor slave device address 0x78, and the last bit is 1, indicating that the master device is performing a read operation. The first byte read is the status byte, the next three bytes are the pressure value, and the last two bytes are the temperature value.

Data Conversion

After reading the calibration data, it is necessary to perform a simple conversion of unsigned numbers represented in the form of AD values.

According to figure7, the calibration data read is: 0x00 0xE6 0x32 0x94 0x57 0x63

0x00 is the status byte, and bit5 is 0, indicating that the device is not busy and can read data. Other bit descriptions are shown in Table 2.

0xE6 0x32 0x94 Three bytes are pressure calibration values.

0x57 0x63 Two bytes are temperature calibration values.

Pressure calibration value conversion:

The calibration range used is 0kPa~100kPa, and the corresponding AD output is 1677722~15099494 (10% AD~90% AD).

$$\text{Actual pressure value}=(100-0)*\frac{(X-1677722)}{(15099494-1677722)}-0$$

By substituting 0xE6 0x32 0x94, the actual pressure value can be calculated to be 99.90kPa.

Temperature calibration value conversion:

The calibration range for temperature is specified as −40℃~150℃. As the calibration data read is expressed in percentage form, this percentage is numerically equal to the ratio of the maximum value of the converted decimal number to the 16 bits unsigned number (65535).

$$\text{Actual temperature value}=(150-(-40))*\frac{X}{65535}-40$$

By substituting 0x57 0x63, the actual temperature value can be calculated to be 24.86℃.

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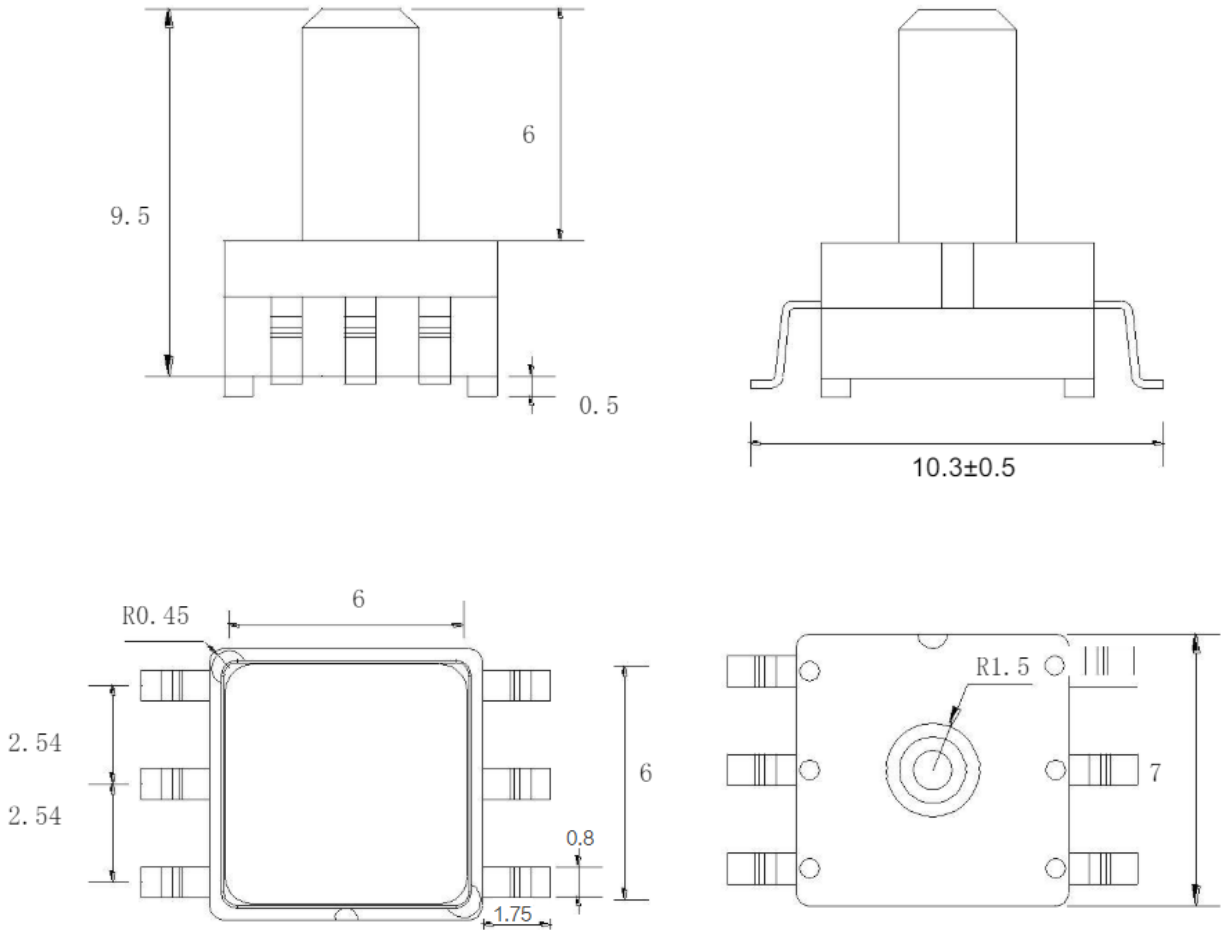
Package Information

SOP6



The above data has a tolerance of ± 0.05mm, unless otherwise specified.

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