Digital Infrared Temperature Sensor XL36

Features

- Accuracy: ≤1℃
- Resolution: ≤0.01℃
- Object temperature range:-20℃~120℃
- Output reading in ℃ unit directly
- Factory pre calibrated with user recalibration capability
- Built in dual MEMS thermopile chips
- Built in proprietary algorithm for enhanced noise immunity
- Built in over temperature alarm
- Built in temperature compensation module
- Available in DFN5*5-6 package

Applications

- Server
- Industrial temperature monitoring
- Intelligent household electrical appliance
- Mobile terminal equipment

General Description

XL36 is a non-contact temperature sensor based on MEMS technology, built in dual MEMS thermopile chips, high-precision environmental temperature compensation module, and dedicated signal processing ASIC chip, which adopts digital signal output. Housed in a DFN package, this device directly outputs processed temperature data via an I²C digital interface, delivering high measurement accuracy and rapid response characteristics. Its factory pre calibration design significantly reduces client side solution development cycles. Equipped with a built in over temperature alarm, the sensor supports an extended operating temperature range from -20℃ to 85℃. The compact form factor and low power consumption make it ideal for industrial controls, household appliances, and consumer electronics applications, substantially simplifying system design while enhancing temperature measurement reliability.

Typical application schematic

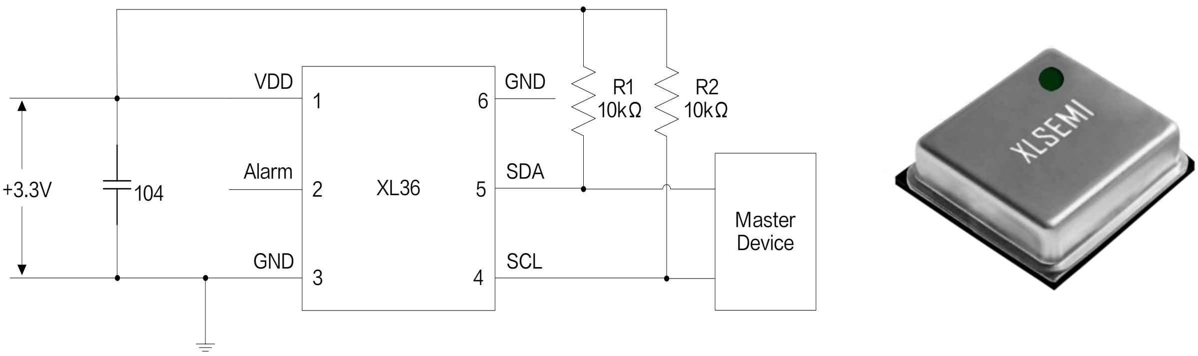


Figure1. XL36 Typical application schematic and Package Type

Pin Configurations

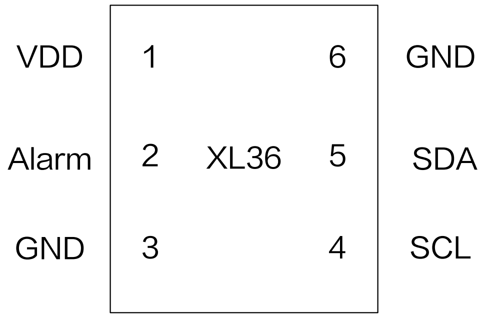


Figure2. Pin Configuration of XL36

Table1.Pin Description

Pin Number	Pin Name	Description
1	VDD	Supply Voltage Input Pin.
2	Alarm	Alarm Output Pin.
3,6	GND	Ground Pin.
4	SCL	I^2C Clock Line.
5	SDA	I^2C Data Line.

Ordering Information

Order Information	Marking ID	Package Type	Eco Plan	Packing Type Supplied As
XL36	XL36	DFN5*5-6	RoHS	2500 Units Per Reel

Function Block

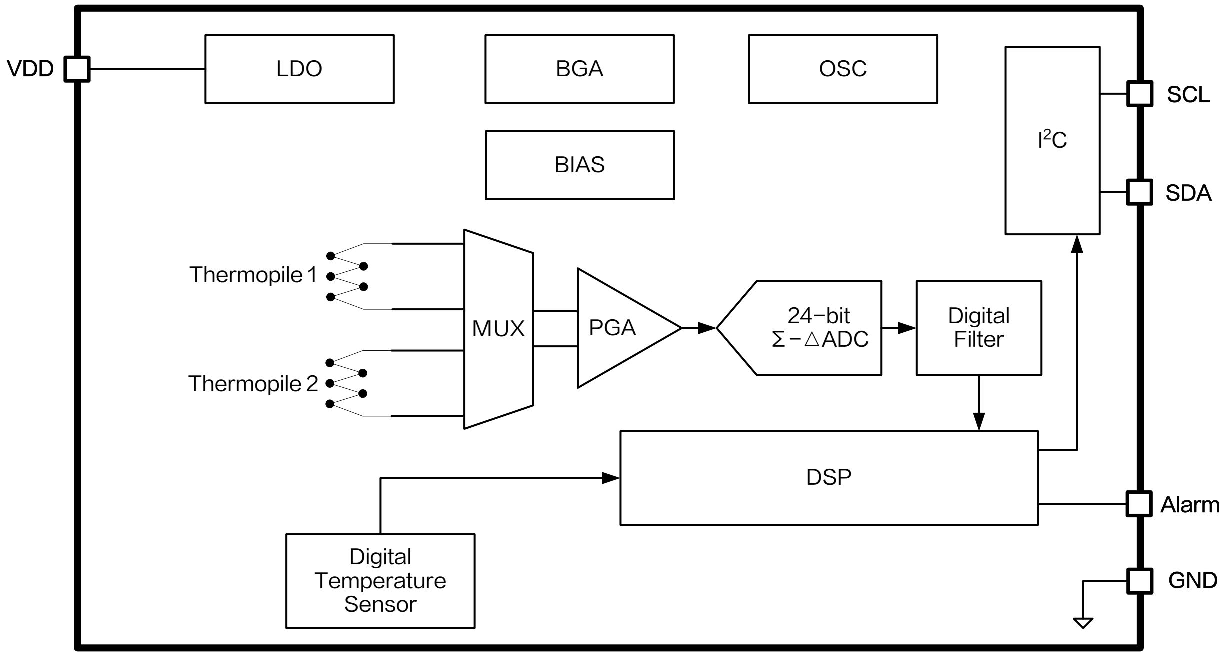


Figure3. Function Block Diagram of XL36

Absolute Maximum Ratings（Note1）

Parameter	Symbol	Value	Unit
Input Pin Voltage	V_{DD}	−0.3 ~ 5.5	V
I²C Pin Voltage	$V_{SCL/SDA}$	−0.3~V_{DD}	V
Thermal Resistance(DFN5*5−6) (Junction to Ambient，No Heatsink, Free Air)	R_{JA}	55	°C/W
Operating Temperature	T_A	−20 ~ 85	°C
Operating Junction Temperature	T_J	−40 ~ 105	°C
Storage Temperature	T_{STG}	−40 ~ 105	°C
Lead Temperature(Soldering,10sec)	T_{LEAD}	260	°C
ESD(HBM)	−	⩾8000	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.

Electrical Characteristics

T_{Amb} = 25℃, V_{DD}=3.3V, All other cases, unless otherwise specified.

Parameters	Symbol	Min.	Typ.	Max.	Unit
Operation Voltage	V_{DD}	3.2	3.3	3.4	V
Operation Current	I_{DD}	–	2	–	mA
Sleep Mode Current	I_S	–	3	–	μA
Wake up Time	T_{Wake}	–	1	–	s

Data Communication

Parameters	Typ.	Unit	Note
Electrical Interface	I^2C	–	–
Interface Clock Frequency	100	kHz	–
Data Refresh Rate	2	Hz	–
Slave Address	10H	–	7 bits addressing, customizable

Optical Characteristics

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Field of View	FOV	@50% target signal	–	90	–	°
Cut on Wavelength	–	@5% transmittance	5.1	5.5	5.9	μm

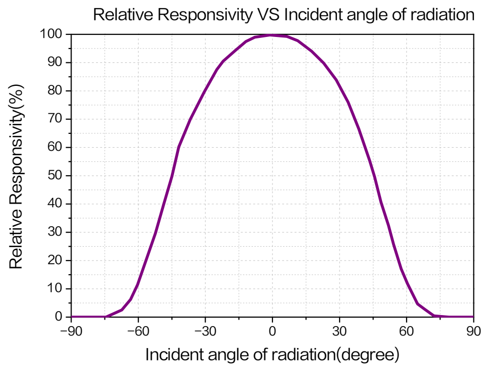


Figure4. FOV and Thermopile Relative Output

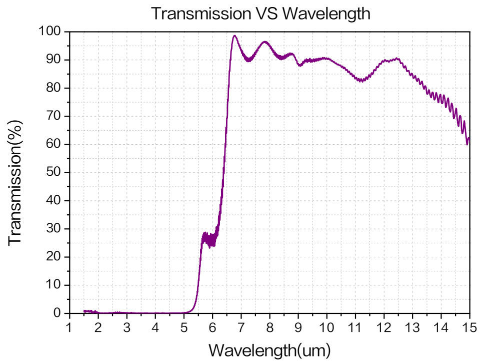


Figure5. Wavelength transmittance

Thermometer Sensing Characteristics (Note2)

Sensor to blackbody distance: 20 mm, Blackbody size: diameter 100 mm, Blackbody emissivity: ⩾0.98, T_{Amb} = 25℃, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Ambient Temperature Range	T_{Amb}	–	−20	–	85	℃
Object Temperature Range	T_{Obj}	–	−20	–	120	℃
Resolution of T_{Amb} Reading	T_{Res_Amb}	T_{Amb}=25℃	–	0.01	–	℃
Accuracy of T_{Amb} Reading	T_{Acc_Amb}	–	–	0.4	–	℃
Resolution of $_{TObj}$ Reading	T_{Res_Obj}	T_{Amb}=25℃	–	0.01	–	℃
Accuracy of T_{Obj} Reading	T_{Acc_Obj}	–	±1	±2	±3	℃

Note2： All accuracy specifications apply under settled isothermal conditions only. Furthermore, the accuracy is only valid if the object fills the FOV of the sensor completely.

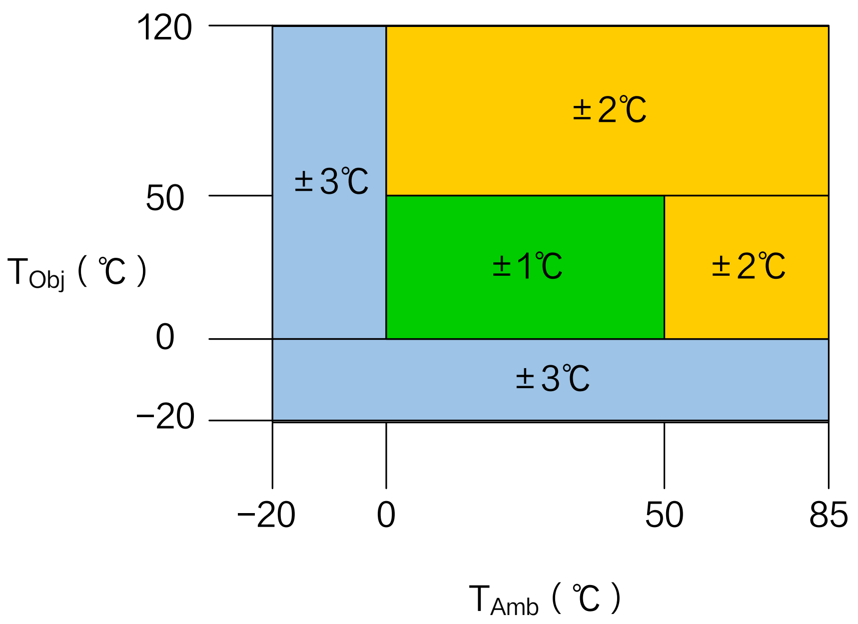


Figure6. Performance Curve of XL36

Temperature Data Readout Process (Master → Slave → Master)

The master has to send the following command set to read object temperature information from XL36. Send "20H", "80H", "21H", "Data_1", "Data_2", "Data_3", "Data_4", "Data_5" and "Data_6", as shown in Figure 7 and Table 2.

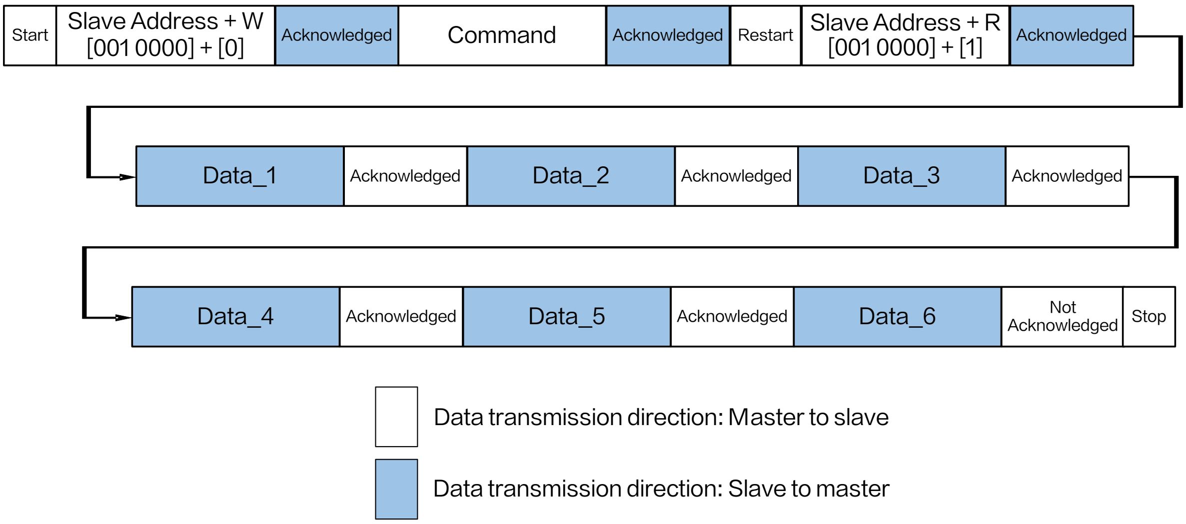


Figure7. Temperature Data Readout Process

Table 2. Description of Byte and Syntax

Byte sequence	Syntax	Value	Description
Byte 1	ADR	20H	Write data to I^{2}C slave address 10H
Byte 2	CMD	80H	Readout command
Byte 3	ADR	21H	Read data from I^{2}C slave address 10H
Byte 4	Data_1	xxH	Ambient Temperature Low Byte Data (Ambient_L)
Byte 5	Data_2	xxH	Ambient Temperature Middle Byte Data (Ambient_M)
Byte 6	Data_3	xxH	Ambient Temperature High Byte Data (Ambient_H)
Byte 7	Data_4	xxH	Object Temperature Low Byte Data (Object_L)
Byte 8	Data_5	xxH	Object Temperature Middle Byte Data (Object _M)
Byte 9	Data_6	xxH	Object Temperature High Byte Data (Object _H)

Temperature Calculation

Ambient Temperature Calculation (T_{Amb})

If "Data_3" is smaller than 80H,

$$T_{Amb}=\frac{Data\_1+Data\_2*256+Data\_3*65536}{200} \quad (1)$$

Otherwise,

$$T_{Amb}=\frac{(Data\_1+Data\_2*256+Data\_3*65536)-16777216}{200} \quad (2)$$

Object temperature calculation (T_{Obj})

If "Data_6" is smaller than 80H,

$$T_{Obj}=\frac{Data\_4+Data\_5*256+Data\_6*65536}{200} \quad (3)$$

Otherwise,

$$T_{Obj}=\frac{(Data\_4+Data\_5*256+Data\_6*65536)-16777216}{200} \quad (4)$$

Calculation Example 1

Assuming the return 6 bytes data are "EC 14 00 F8 15 00", we check and get that either the "Data_3" or the "Data_6" is smaller than 80H. Therefore, the Equation (1) and the Equation (3) shall be applied.

$$T_{Amb}=\frac{236+20*256+0*65536}{200}=26.78℃$$

$$T_{Obj}=\frac{248+21*256+0*65536}{200}=28.12℃$$

Calculation Example 2

Assuming the return 6 bytes data is "70 FD FF 30 F6 FF", we check and get that either the "Data_3" or the "Data_6" is greater than 80H. Therefore, the Equation (2) and the Equation (4) shall be applied.

$$T_{Amb}=\frac{(112+253*256+255*65536)-16777216}{200}=-3.28℃$$

$$T_{Obj}=\frac{(48+246*256+255*65536)-16777216}{200}=-12.56℃$$

User Recalibration Process (Note3)

In certain application scenarios, precision performance may require fine-tuning to adapt to specific working environments. Users can adjust parameters using the following formula "$T_{Obj\_After}=T_{Obj\_Before}*k+b$", by default, k=1 and b=0. When fine-tuning is needed, the master device must send the following commands to the slave device (XL36) for recalibration of the target object temperature. Data transmission follows little-endian byte order.

To adjust k:

Send the sequence: 20H, A4H, Data_1, Data_2 and Data_3;

To adjust b:

Send the sequence: 20H, A5H, Data_1, Data_2 and Data_3;

As shown in Figure 8.

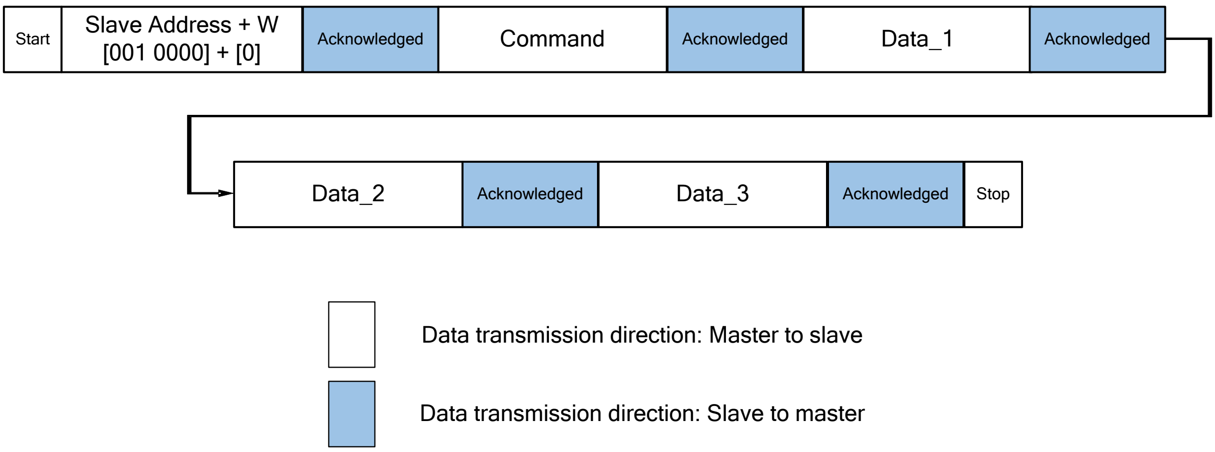


Figure8. Recalibration Process Diagram

Note3: "Data_1", "Data_2" and "Data_3" constitute a three-byte floating-point number that complies with the format specified in Table 3. This value can be interpreted as a single-precision floating-point format (binary 32) with the least significant byte discarded.

Table 3. Data Format

Sign Bit	Index	Base Number
23	22~15	14~8 7~0
←1-bit →	← 8-bit →	← 15-bit →
Data_3	Data_2	Data_1

User Address Modification Procedure

In certain application scenarios, the chip address may require reconfiguration. Users can reset the address using the following command sequence.

Send "20H", "A7H" and "Data_1" to reset the address. The I^{2}C address is 7-bit, when transmitting "Data_1", a "0" must be padded to the Most Significant Bit (MSB) as illustrated in Figure 9. A power cycle is required for the new address to take effect after modification.

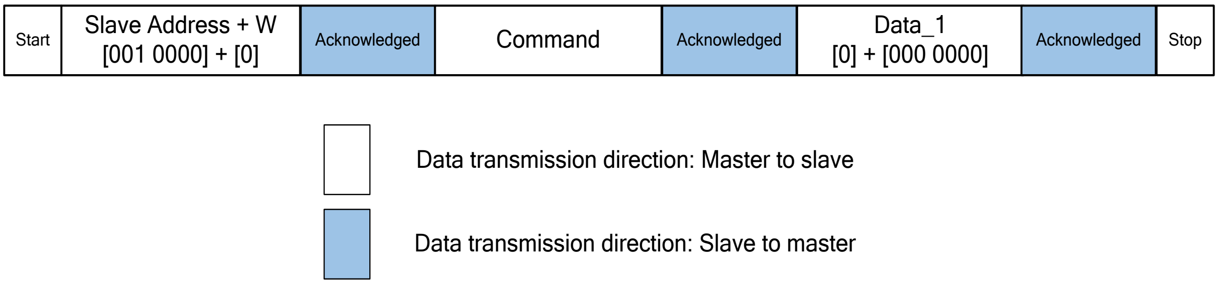
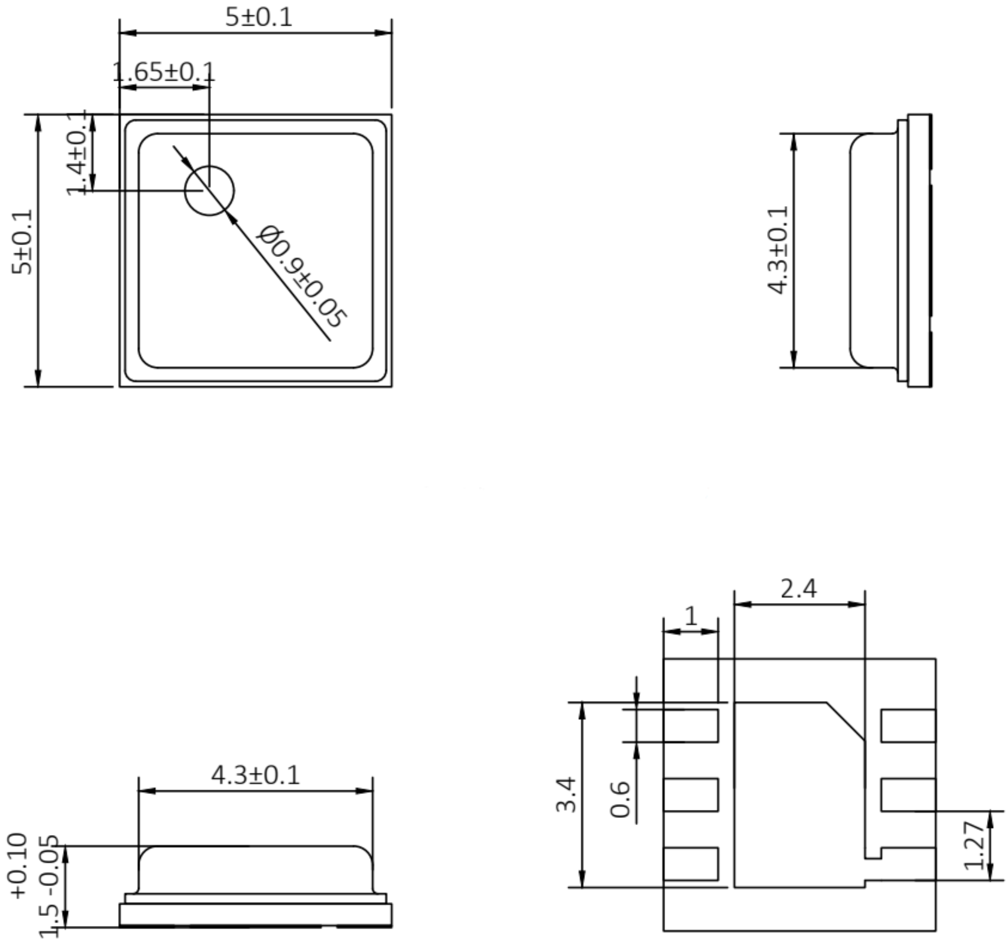


Figure9. Address Remapping Flowchart

Package Information

DFN5*5-6



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