

# TSEV01C Thermopile Sensor Module



- **Contact less Temperature Measurement**
- **High Accuracy**
- **Small Size**
- **Wide Supply Voltage Range**
- **Digital Interface Bus (I2C)**

## DESCRIPTION

TSEV01C is a contact-less temperature measuring system for OEM use based on the detection of infrared radiation.

TSEV01C is equipped with an infrared sensor (Thermopile) in front. The Thermopile Sensor has to be pointed at the target object of interest.

The basic working principle is:

- Detection of infrared radiation with a Thermopile sensor, which turns incoming radiation to an analogue voltage
- Determination of sensor temperature using a thermistor
- Further analogue signal processing and conditioning
- Calculation of ambient and object temperature using a processing unit
- Providing the ambient and objects temperature at digital output bus (I<sup>2</sup>C)

The TSEV01 is suitable for a wide range of application where non-contact temperature measurement and high accuracy are required.

## FEATURES

- 0°C – 50°C Measurement Range
- 4V – 16V Supply Voltage Range
- Up to 0.5°C Accuracy
- 2mA Current Consumption

## APPLICATIONS

- Contact less Temperature Measurement
- Climate Control
- Industrial Process Control
- Household Applications

# TSEV01C Thermopile Sensor Module

## ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are limiting values of permitted operation and should never be exceeded under the worst possible conditions either initially or consequently. If exceeded by even the smallest amount, instantaneous catastrophic failure can occur. And even if the device continues to operate satisfactorily, its life may be considerably shortened.

| Parameter             | Symbol | Conditions          | Min  | Typ | Max | Unit |
|-----------------------|--------|---------------------|------|-----|-----|------|
| Supply Voltage        | Vcc    | Measured versus GND | -0.3 |     | 16  | V    |
| Operating Temperature | Top    |                     | -10  |     | 85  | °C   |
| Storage temperature   | Tstor  |                     | -40  |     | 85  | °C   |

## OPERATING CONDITIONS

| Parameter            | Symbol     | Conditions          | Min  | Typ | Max | Unit |
|----------------------|------------|---------------------|------|-----|-----|------|
| Supply voltage       | Vcc        | Measured versus GND | 4    | 5   | 16  | V    |
| Emission Coefficient | $\epsilon$ |                     | 0.95 |     |     |      |

## OPERATING CONDITIONS

If not otherwise noted, 25°C ambient temperature, 5V supply voltage and object with  $\epsilon = 0.98$  were applied.

| Parameter                       | Symbol | Conditions                               | Min          | Typ | Max | Unit          |
|---------------------------------|--------|------------------------------------------|--------------|-----|-----|---------------|
| Field of View                   | FOV    |                                          |              | 70  |     | °             |
| Spectral Sensitivity            | S      |                                          | 5.5 (cut on) |     |     | $\mu\text{m}$ |
| Supply Current                  | I      | Full ambient temp. range, no output load | 1            | 2   | 4   | mA            |
| Digital Output Clock Rate (I2C) | FI2C   |                                          | 20           |     | 50  | kHz           |
| Data Output Rate                | Fout   |                                          |              | 1   |     | Hz            |

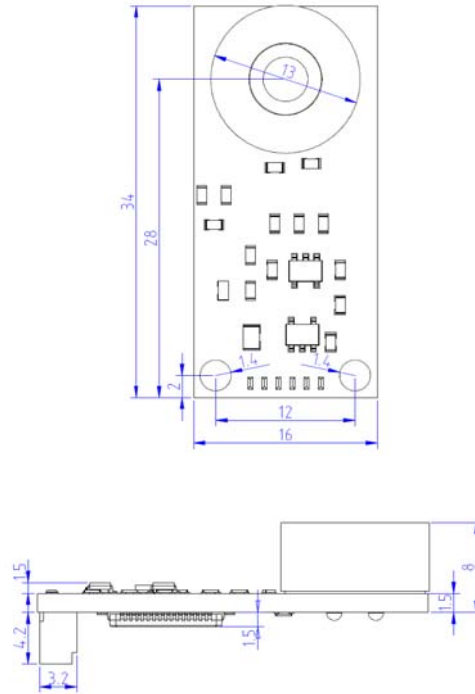
## OPERATIONAL CHARACTERISTICS

If not otherwise noted, 25°C ambient temperature, 5V supply voltage and object with  $\epsilon = 0.98$  were applied.

| Parameter                                                                             | Symbol                   | Conditions            | Min | Typ  | Max | Unit |
|---------------------------------------------------------------------------------------|--------------------------|-----------------------|-----|------|-----|------|
| Object Temperature Range                                                              | Tobj                     |                       | 0   |      | 50  | °C   |
| Ambient Temperature Range                                                             | Tamb                     |                       | 0   |      | 85  | °C   |
| Standard Start-Up Time                                                                | tStart                   |                       |     | 5    |     | s    |
| Stabilization Time                                                                    | tStab                    |                       |     | 3    |     | min  |
| Accuracy offset – prior to thermal stability time                                     | $\Delta T_{\text{stab}}$ |                       |     | 2    |     | °C   |
| Accuracy tolerance when 10°C < Tambient < 40°C and after 3 minutes stabilization time | $\Delta T$               | 16°C < Tobject < 36°C |     | 0.55 |     | °C   |
|                                                                                       |                          | Outside above range   |     | 2    |     | °C   |

# TSEV01C Thermopile Sensor Module

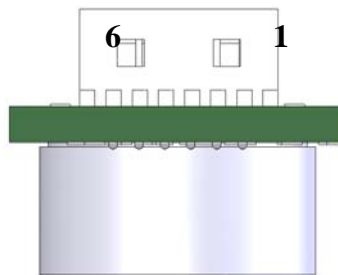
## MECHANICAL DIMENSIONS



## TERMINALS

Connector: Molex 51021-0600 (Farnell-In-One: 1012261, Digikey: WM1724-ND)

| Pin | Name  | Description                   | Type      |
|-----|-------|-------------------------------|-----------|
| 1   | TRES1 | Temperature Threshold         | Output    |
| 2   | TRES2 | Temperature Threshold         | Output    |
| 3   | SDA   | I <sup>2</sup> C Data (3.6V)  | Interface |
| 4   | SCL   | I <sup>2</sup> C Clock (3.6V) | Interface |
| 5   | GND   | Ground                        | Supply    |
| 6   | VCC   | Supply Voltage (5V)           | Supply    |



# TSEV01C Thermopile Sensor Module

## BLOCK DIAGRAM

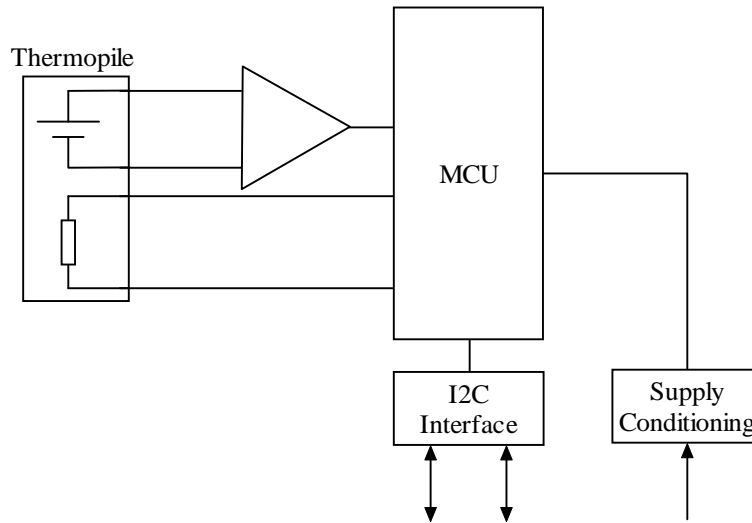


Figure n: Block diagram

## TYPICAL PERFORMANCE CURVES

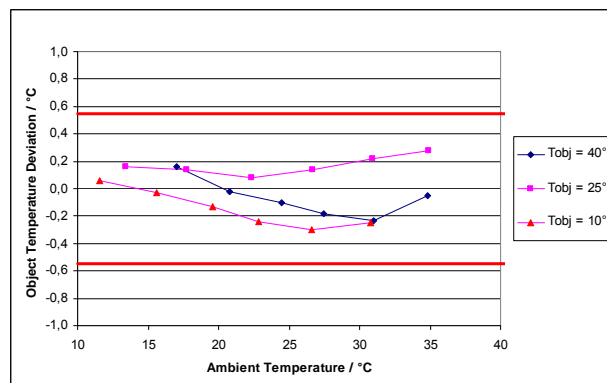


Figure n: typical performance curve

# TSEV01C Thermopile Sensor Module

## FUNCTION

### I<sup>2</sup>C INTERFACE

This module is always operating in pure slave modus of a two wire interface similar to I<sup>2</sup>C. The typical baud rate of this device is 20kBit/s. The supported address length is seven bits. The I<sup>2</sup>C slave address is 54h.

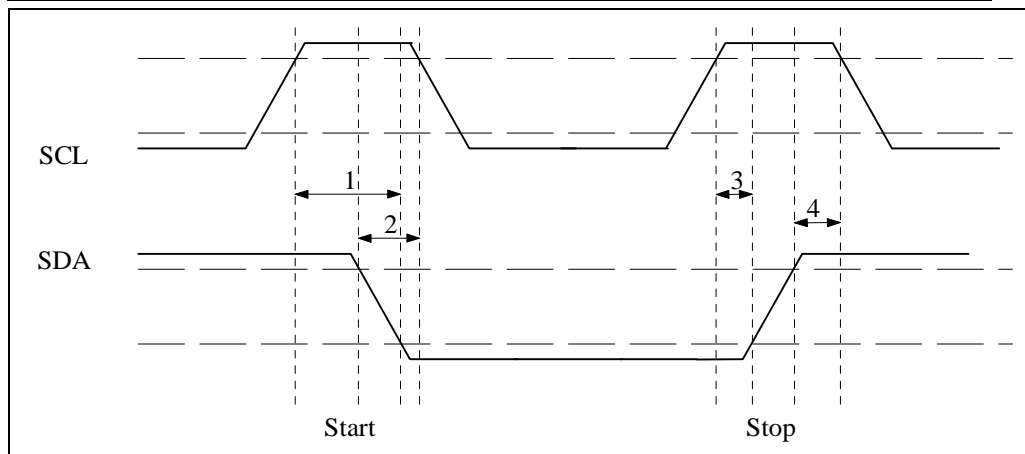
#### PHYSICAL INTERFACE PARAMETERS

| Parameter          | Min | Typical | Max | Unit   |
|--------------------|-----|---------|-----|--------|
| Baudrate           | 10  | ---     | 50  | kBit/s |
| Address length     | --- | 7       | --- | Bit    |
| Address (standard) | --- | 54h     | --- | ---    |
| Input High Level   | 2   | ---     | 3.6 | V      |
| Input Low Level    | --- | ---     | 1   | V      |
| Output High Level  | 2.5 | ---     | --- | V      |
| Output Low Level   | --- | ---     | 1   | V      |

#### TIMING PARAMETERS

##### START/STOP

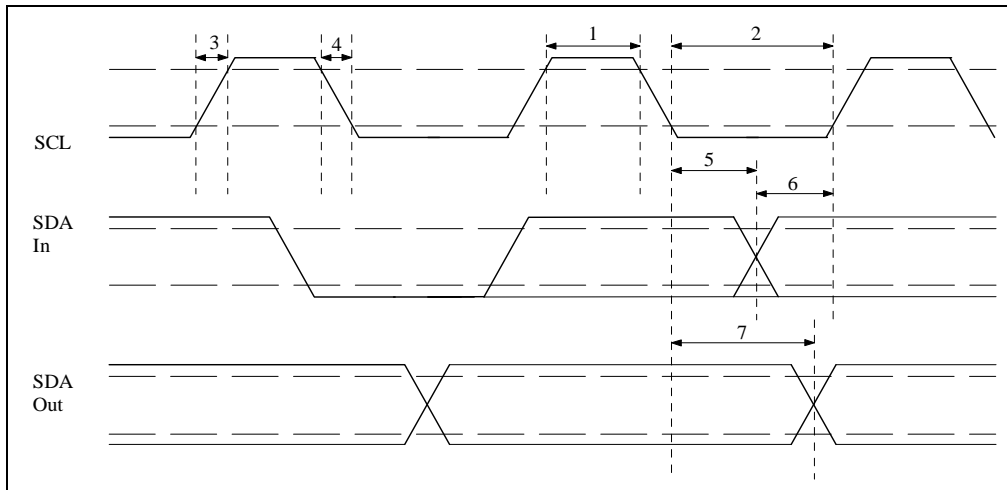
| No. | Parameter | Description      | Min | Typ | Max | Unit |
|-----|-----------|------------------|-----|-----|-----|------|
| 1   | TSU:STA   | Start Setup Time | 4.7 | --- | --- | μs   |
| 2   | THD:STA   | Start Hold Time  | 4.0 | --- | --- | μs   |
| 3   | TSU:STO   | Stop Setup Time  | 4.0 | --- | --- | μs   |



# TSEV01C Thermopile Sensor Module

## DATA

| No | Parameter | Description           | Min  | Max | Unit |
|----|-----------|-----------------------|------|-----|------|
| 1  | THIGH     | Clock High Time       | 4.0  | 50  | μs   |
| 2  | TLOW      | Clock Low Time        | 4.7  | --- | μs   |
| 3  | TR        | SDA & SCL Rise Time   | ---  | 1   | μs   |
| 4  | TF        | SDA & SCL Fall Time   | ---  | 0.3 | μs   |
| 5  | THD:DAT   | Data Input Hold Time  | 0.3  | --- | μs   |
| 6  | TSU:DAT   | Data Input Setup Time | 0.25 | --- | μs   |
|    | TBUF      | Bus Free Time         | 4.7  | --- | μs   |



## I2C COMMAND REFERENCE

### AMBIENT AND OBJECT MEASUREMENT

Please refer following table for I<sup>2</sup>C commands to read object temperature and ambient temperature. Both values are transmitted in hundredth of degrees.

| Command | Description              | Reply                                      | Bytes |
|---------|--------------------------|--------------------------------------------|-------|
| 0xB6    | Read object temperature  | Object temperature in hundredth of degree  | 2     |
| 0xB5    | Read ambient temperature | Ambient temperature in hundredth of degree | 2     |

### EXAMPLE OF TEMPERATURE CALCULATION

For reading object temperature send: 0xB6

Return values i.e.: Byte(0) = 0x0E, Byte(1) = 0xAA

Temperature  $T_{obj} = (256 * \text{Byte}(0) + \text{Byte}(1)) / 100 = (256 * 14 + 170) / 100 = 37.54^{\circ}\text{C}$

### OUT OF RANGE INDICATION

In case of ambient or object temperature over exceeding specified temperature ranges temperature outputs showing following data:

| Command | Description                | Reply  | Bytes |
|---------|----------------------------|--------|-------|
| 0xB6    | Object temperature > 50°C  | 0xFFF0 | 2     |
| 0xB6    | Object temperature < 0°C   | 0xFFF1 | 2     |
| 0xB5    | Ambient temperature > 85°C | 0xFFFF | 2     |
| 0xB5    | Ambient temperature < 0°C  | 0xF000 | 2     |

# TSEV01C Thermopile Sensor Module

---

## ORDERING INFORMATION

---

### NORTH AMERICA

Measurement Specialties, Inc.  
910 Turnpike Road  
Shrewsbury, MA 01545  
Tel: 1-508-842-0516  
Fax: 1-508-842-0342

Sales email:  
[temperature.sales.amer@meas-spec.com](mailto:temperature.sales.amer@meas-spec.com)

### EUROPE

MEAS Deutschland GmbH  
Hauert 13  
44227 Dortmund  
Tel: +49 (0) 231/9740-0  
Fax: +49 (0) 231/9740-20

Sales email:  
[info.de@meas-spec.com](mailto:info.de@meas-spec.com)

### ASIA

Measurement Specialties (China) Ltd.  
No. 26 Langshan Road  
Shenzhen High-Tech Park (North)  
Nanshan District, Shenzhen 51807  
China  
Tel: +86 (0) 755 33305088  
Fax: +86 (0) 755 33305099

Sales email:  
[temperature.sales.asia@meas-spec.com](mailto:temperature.sales.asia@meas-spec.com)

The information in this sheet has been carefully reviewed and is believed to be accurate; however, no responsibility is assumed for inaccuracies. Furthermore, this information does not convey to the purchaser of such devices any license under the patent rights to the manufacturer. Measurement Specialties, Inc. reserves the right to make changes without further notice to any product herein. Measurement Specialties, Inc. makes no warranty, representation or guarantee regarding the suitability of its product for any particular purpose, nor does Measurement Specialties, Inc. assume any liability arising out of the application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. Typical parameters can and do vary in different applications. All operating parameters must be validated for each customer application by customer's technical experts. Measurement Specialties, Inc. does not convey any license under its patent rights nor the rights of others.