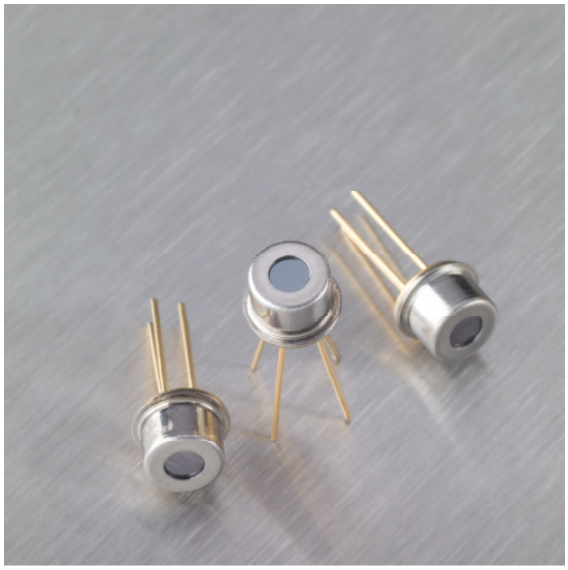
SENSOR SOLUTIONS

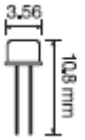
DATASHEET

# Thermopile Sensor

## TPS 230 / 3365

Revision - Date: 2007/11/12






## Introduction

PerkinElmer introduces the new TPS 230 as part of the TPS 23x family for low-cost remote temperature measurement applications. It consists of a silicon (Si) based thermopile chip in a metal housing with IR transmissive filter. The Si-chip carries a series of thermoelements, forming a sensitive area covered by an IR absorbing material.
With its optimized output signal, the TPS 23x family replaces the TPS 43x series by offering better performance at a lower cost.
The thermopile sensing principle allows for broadband IR measurements. PerkinElmer Optoelectronics thermopile sensors are equipped with a MEMS / MOEMS state-of-the art sensing element and an optical filter that defines the sensitive spectral range of the sensor and at the same time serves as device window.

## Properties of TPS 230

The TPS 230 is a miniature thermopile sensor in the extremely small TO-41 (3.5 mm cap diameter) housing. It is especially suited for compact ear thermometer solutions. The sensor employs a very small thermopile chip with a 0.5 mm round active area allowing small spot sizes in pyrometer applications. The chip is optimized for a large output signal.
The round window is equipped with an PerkinElmer's standard IR longpass filter with 5.5 µm cut-on wavelength. The frequency behavior corresponds to a low pass characteristic.
A 100 kΩ thermistor inside the TO-housing serves as the ambient temperature reference.

### Features and Benefits

- Miniature TO-41 housing (3.5 mm Ø)
- Small and perfectly round measurement spot
- Large output voltage
- High signal to noise ratio
- 5.5 µm IR longpass filter
- Stable signal in the case of ambient thermal shock due to the small TO-41 housing
- RoHS compliant – Si-chip made by standard CMOS processes

### Applications

- Compact ear thermometer
- High precision remote temperature sensing
- Infrared pyrometry



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# 1 General Characteristics

## 1.1 Absolute Maximum Ratings

### Table 1: Absolute Maximum Ratings

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| TA | Ambient temperature range | -20 | | 100 | °C | Operation |
| TA | Ambient temperature range | -40 | | 100 | °C | Storage |

## 1.2 Handling Requirements

Stresses above the absolute maximum ratings may cause damages to the device. Do not expose the sensor to aggressive detergents such as Freon, Trichloroethylene, etc. Windows may be cleaned with alcohol and cotton swab. Hand soldering and wave soldering may be applied by a maximum temperature of 260 °C for a dwell time less than 10 s. Avoid heat exposure to the top and the window of the detector. Reflow soldering is not recommended.

# 2 Type Characteristics

## 2.1 Design Characteristics

The Sensor TPS 230 is a lead-free component and fully complies with the RoHS regulations.

### Table 2: Design Characteristics

| Parameter | Description |
|---|---|
| Cap | Metal cap with integrated IR window |
| Header | TO 41 |
| Leads | (3 isolated + 1 ground) pins with solderable gold coating |
| Filter type | Si-based interference IR longpass filter |
| Temperature reference | Thermistor 100 kΩ |
| Insulation gas sealing | The sensor is sealed in a dry nitrogen environment and gross leak proof |
| Device marking | PerkinElmer Logo “P” + device number xxxx + 3 digits date code YWW |

## 2.2 Electrical Characteristics

### Table 3: Thermopile sensor characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| | Sensitive Area | | 0.2 | | $mm^2$ | Absorber Ø0.5 mm (round) |
| $R_{TP}$ | Resistance | 85 | | 135 | kΩ | |
| $S_V$ | Responsivity | | 42 | | V/W | $T_{obj}$ = 500 K (=227 °C), $T_{amb}$ = 298 K (=25 °C) 1Hz, |
| ΔU / ΔT | Average sensitivity | | 28 | | µV/K | $T_{obj}$ = 313 K (=40 °C), $T_{amb}$ = 298 K (=25 °C) |
| ΔU / ΔT | Average sensitivity | | 36 | | µV/K | $T_{obj}$ = 373 K (=100 °C), $T_{amb}$ = 298 K (=25 °C) |
| τ | Time constant | | 15 | | ms | |
| $V_{RMS}$ | Noise voltage | | 40 | | nV/√Hz | |
| | TC of resistance | | 0.03 | | %/K | |
| | TC of sensitivity | | -0.05 | | %/K | |

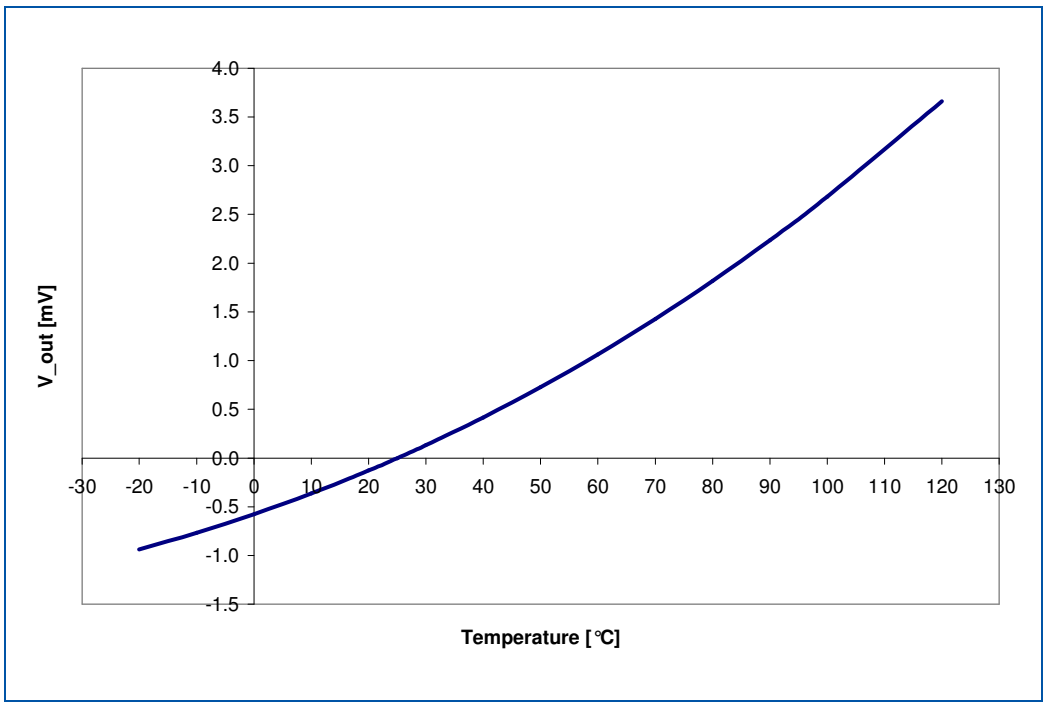


**Figure 1: Typical output voltage versus object temperature with sensor at 25° C.**

**Table 4: Typical numerical data of Thermopile's output voltage (sensor at 25° C)**

| Temp. | V_out |
|---|---|
| °C | mV |
| -20 | -0.94 |
| -10 | -0.77 |
| 0 | -0.58 |
| 10 | -0.36 |
| 20 | -0.13 |
| 25 | 0.00 |
| 30 | 0.13 |
| 40 | 0.42 |
| 50 | 0.73 |
| 60 | 1.06 |
| 70 | 1.43 |
| 80 | 1.82 |
| 90 | 2.24 |
| 100 | 2.68 |
| 120 | 3.66 |

## Table 5: Thermistor 100 kΩ

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| R25 | Base resistance | 95 | 100 | 105 | kΩ | Tamb = 25 °C |
| ß | BETA -value | | 3964 | | K | Defined at 25 °C/100 °C |
| ß | BETA - tolerance | | | ± 0.3 | % | |

## Table 6: Tabulated Thermistor Data

| Temp. | $R_{min1}$ | $R_{min2}$ | $R_{nom}$ | $R_{max2}$ | $R_{max1}$ |
|---|---|---|---|---|---|
| °C | Ω | Ω | Ω | Ω | Ω |
| -20 | 862756 | 909418 | 915479 | 921581 | 968201 |
| -15 | 655207 | 690548 | 694575 | 698625 | 733944 |
| -10 | 501697 | 528693 | 531349 | 534018 | 561001 |
| -5 | 387196 | 407985 | 409715 | 411452 | 432234 |
| 0 | 301098 | 317232 | 318336 | 319444 | 335574 |
| 5 | 235852 | 248468 | 249149 | 249832 | 262445 |
| 10 | 186038 | 195972 | 196369 | 196767 | 206701 |
| 15 | 147731 | 155608 | 155815 | 156022 | 163900 |
| 20 | 118070 | 124357 | 124439 | 124521 | 130808 |
| 25 | 95000 | 100000 | 100000 | 100000 | 105000 |
| 30 | 76707 | 80791 | 80843 | 80895 | 84978 |
| 35 | 62328 | 65649 | 65732 | 65815 | 69137 |
| 40 | 50926 | 53643 | 53743 | 53843 | 56559 |
| 45 | 41833 | 44067 | 44175 | 44283 | 46516 |
| 50 | 34541 | 36387 | 36497 | 36608 | 38453 |
| 55 | 28662 | 30195 | 30303 | 30412 | 31944 |
| 60 | 23898 | 25176 | 25280 | 25385 | 26663 |
| 65 | 20017 | 21089 | 21187 | 21286 | 22357 |
| 70 | 16842 | 17744 | 17836 | 17928 | 18830 |
| 75 | 14231 | 14994 | 15079 | 15165 | 15927 |
| 80 | 12075 | 12721 | 12800 | 12879 | 13526 |
| 85 | 10286 | 10838 | 10910 | 10983 | 11534 |
| 90 | 8796 | 9268 | 9334 | 9401 | 9872 |
| 95 | 7550 | 7956 | 8016 | 8077 | 8481 |
| 100 | 6504 | 6853 | 6908 | 6964 | 7313 |

$R_{min1}$ : Minimum Thermistor Resistance resulting from the Total Tolerance
$R_{min2}$ : Minimum Thermistor Resistance resulting from the BETA-Tolerance
$R_{nom}$ : Typical Thermistor Resistance
$R_{max1}$ : Maximum Thermistor Resistance resulting from the Total Tolerance
$R_{max2}$ : Maximum Thermistor Resistance resulting from the BETA-Tolerance

## 2.3 Optical Characteristics

### Table 7: Optical Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| | Field of view | | 82 | | degree | At 50% target signal |
| | Optical axis | | 0 | +/- 10 | degree | |

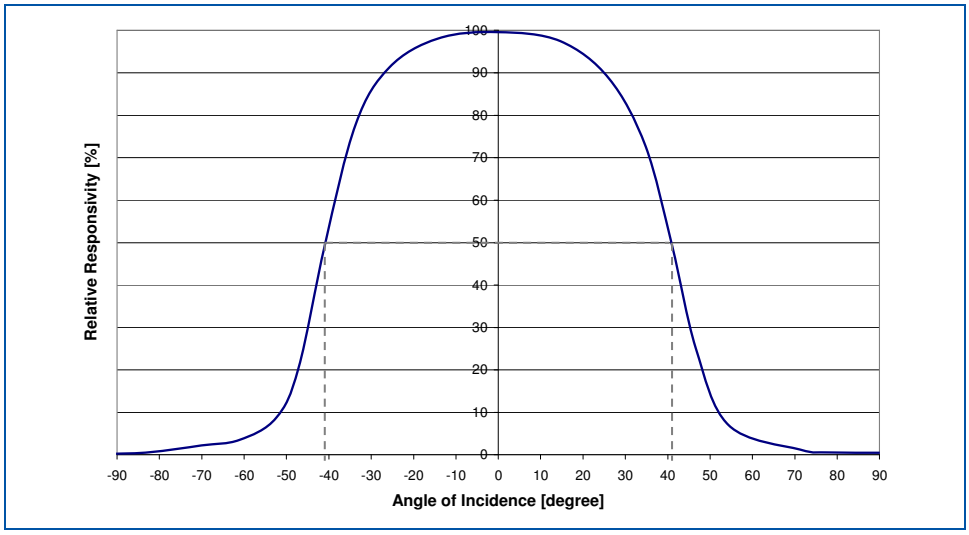


**Figure 2:Field of View Curve**

### Table 8: Filter Parameters

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| TA | Average transmittance | 75 | > 77 | | % | Wavelength range from 7.5 µm to 13.5 µm |
| TA | Average transmittance | | | < 0.5 | % | Wavelength range < 5 µm |
| λ (5 %) | Cut on wavelength | 5.2 | 5.5 | 5.8 | µm | At 25°C |

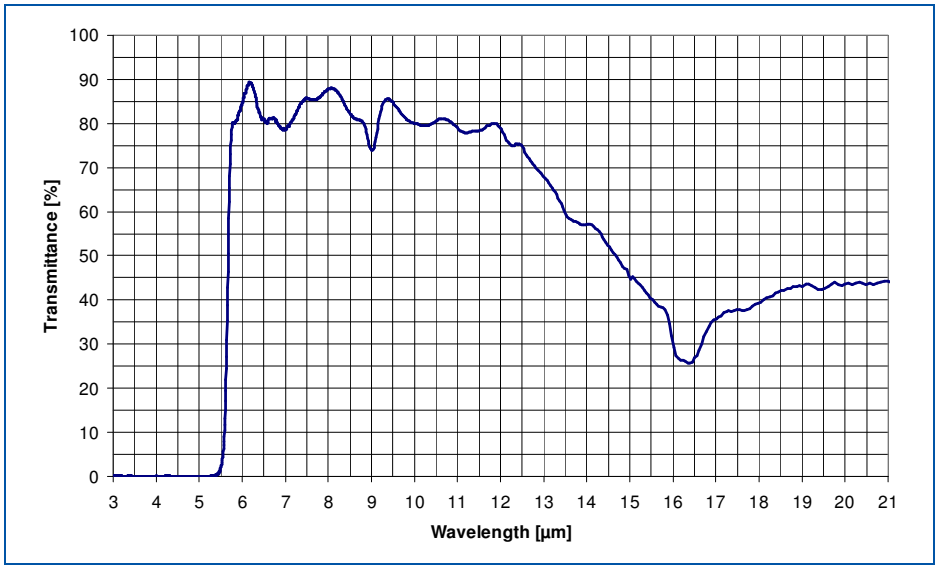


**Figure 3: Transmission Curve for PerkinElmer Standard Filter**

## 2.4 Mechanical Drawing

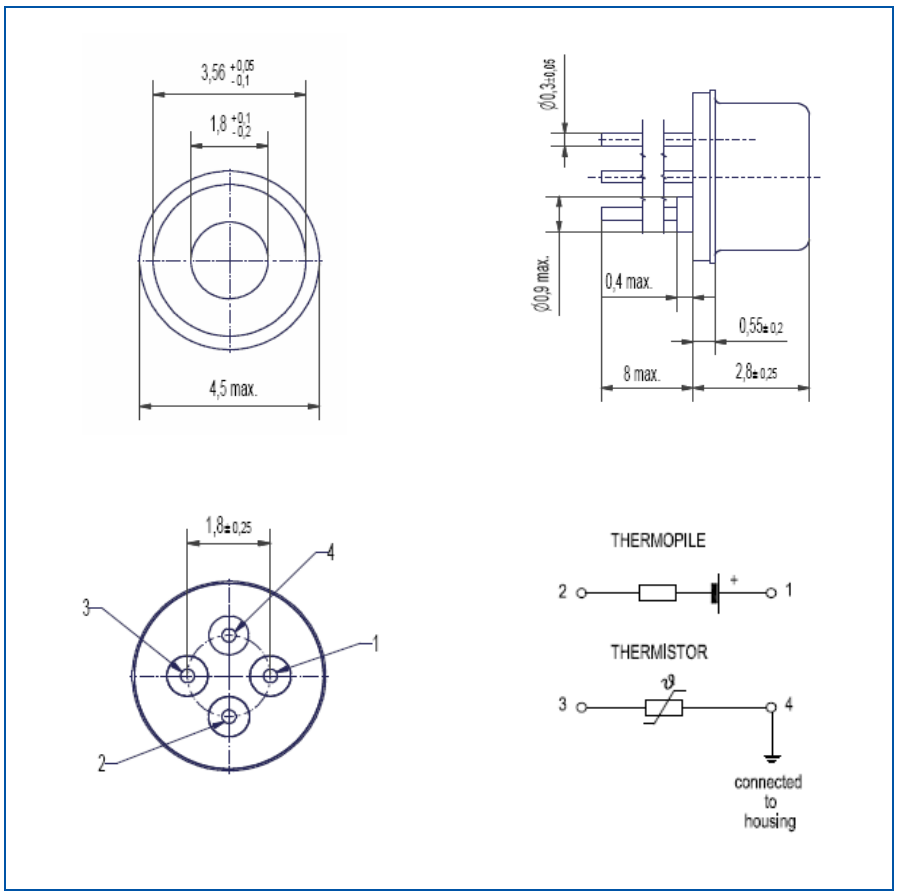


**Figure 4:Mechanical Drawing of the TPS 230**

# 3 Quality Statement

PerkinElmer Optoelectronics is an ISO 9001:2002 and ISO/TS 16949:2002 certified manufacturer. All devices employing PCB assemblies are manufactured according IPC-A-610 guidelines.

## 3.1 Liability Policy

The contents of this document are subject to change without notice and customers should consult with PerkinElmer Optoelectronics sales representatives before ordering. Customers considering the use of PerkinElmer Optoelectronics thermopile devices in applications where failure may cause personal injury or property damage, or where extremely high levels of reliability are demanded, are requested to discuss their concerns with PerkinElmer Optoelectronics sales representatives before such use. The Company's responsibility for damages will be limited to the repair or replacement of defective product. As with any semiconductor device, thermopile sensors or modules have a certain inherent rate of failure. To protect against injury, damage or loss from such failures, customers are advised to incorporate appropriate safety design measures into their product.

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