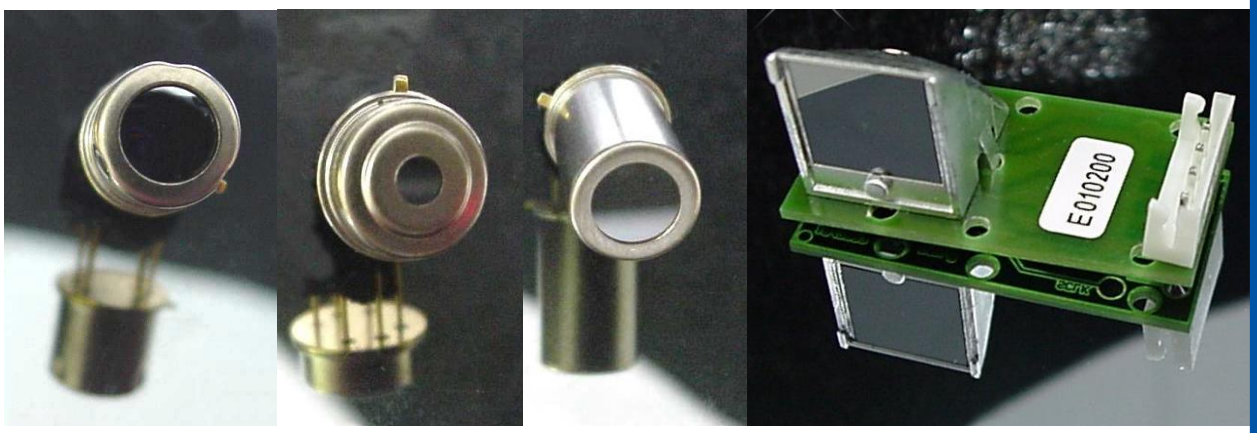
a2TPMI® Selection Guide

Sensor Solutions

GUIDE



Description

a2TPMI® thermopile sensors are the plug-and play solution for contact less temperature measurements.
The sensor modules are pre-amplified, pre-calibrated and ambient temperature compensated (unless otherwise noted).
After being connected to a 5 V DC power supply the object temperature and the ambient temperature are given out at the respective pins as analog voltages between 0.5 V and 4.5 V.

They are available in several standard configurations that cover most industrial applications.
This application note gives an overview over the standard configurations that are available in small quantities and at low cost.
At large quantities also custom configurations are available, which are not discussed in this application note.

Features and Benefits

- Integrated mixed signal ASIC performs all necessary signal pre-processing
- Ambient temperature compensation
- Calibrated output signal
- Internal instrumentation-grade
- pre-amplification **è** robust output signal even in presence of EMI and leakage currents on the application level
- “Plug-and-play” performance
- “Green” product: lead free and RoHS compliant
- Supply voltage 5 V,
  or 5 V – 15 V for respective types

Applications

Contact-less temperature measurement in consumer, industrial and automotive applications

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PerkinElmer® precisely.

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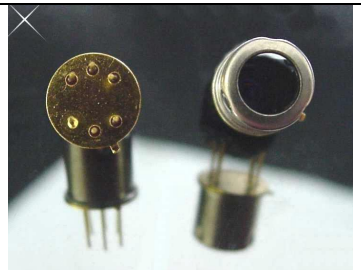
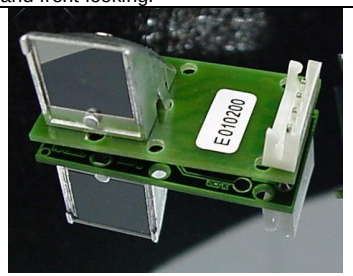
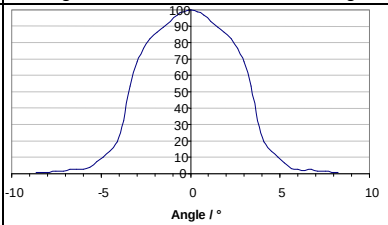
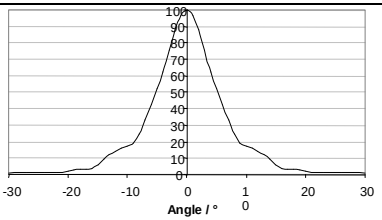
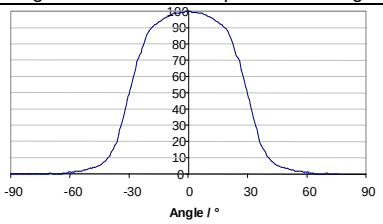
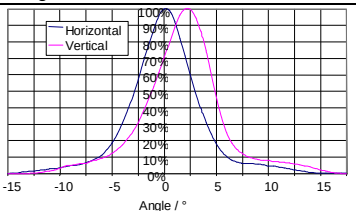
Standard Sensors

Standard sensors				
Field of view	7° (lens optics)	15° (internal mirror optics)	60° (aperture optics)	7° (external mirror optics)
Special features, Typical properties:	- Narrow field of view - Warning: The sensor is (in particular for low temperature measurements) not immune against intense direct unfiltered sun or halogen light. - Warning: Low intrinsic stability at changing ambient temperatures (Thermal shock stability). [1]	- Immune against intense direct unfiltered sun or halogen light on the object or on the sensor - narrow field of view - Low to medium intrinsic stability at changing ambient temperatures (Thermal shock stability) [1]	- Immune against intense direct unfiltered sun or halogen light on the object or on the sensor - large field of view - Certain intrinsic stability at changing ambient temperatures (Thermal shock stability) [1]	- Supply voltage: 4.5 V – 15 V - Very high intrinsic stability at changing ambient temperatures (Thermal shock stability) - Immune against intense direct unfiltered sun or halogen light on the object or on the sensor - Mirror can be oriented left (picture), right and front looking.
Product picture	 Figure 1: module with L5.5 housing	 Figure 2: module with IRA housing	 Figure 3: module with aperture housing	 Figure 4: module with external mirror
Field of view character-ristics Maximum object temperature	 Figure 5: Field of view/ Relative Angular Sensitivity of L5.5 housing	 Figure 6: Field of view/ Relative Angular Sensitivity of IRA housing	 Figure 7: Field of view/ Relative Angular Sensitivity of aperture housing	 Figure 8: Field of view/ Relative Angular Sensitivity of aperture housing
60°C	a2TPMI 334 L5.5 OAA 060	a2TPMI 336 OAA 060 IRA	a2TPMI 334 OAA 060	a2TPMI 334 OAA060 P9L1V MLG12 J4S
120°C	a2TPMI 334 L5.5 OAA 120			a2TPMI 334 OAA120 P9L1V MLG12 J4S
180°C	a2TPMI 334 L5.5 OAA 180	a2TPMI 336 OAA 180 IRA	a2TPMI 334 OAA 180	a2TPMI 334 OAA180 P9L1V MLG12 J4S
250°C	a2TPMI 334 L5.5 OAA 250	a2TPMI 336 OAA 250 IRA		
300°C	a2TPMI 334 L5.5 OAA 300			
350°C				a2TPMI 334 OAA350 P9L1V MLG12 J4S
600°C	a2TPMI 334 L5.5 OBA 600 [2]		a2TPMI 334 OBA 600 [2]	

[1] If good thermal shock stability is not an intrinsic property of the specific sensor, it can be obtained by application design measures.

[2] Note: Not ambient temperature compensated. Compensation can be done by external software. See respective application note.

Special Standards

In the past, it showed that some versions that were originally developed to cater for some very specific applications were useful for a large number of customers. For that reason, the devices are made available as additional a2TPMI special standard sensors.
Special standard modules can for example be mounted on a PCB (Figure 11), have an external focusing mirror (Figure 12) or have for example an additional G9 filter.

The G9 filter is an optical band pass (Figure 9), that allows for a measurement that is independent from several influences that otherwise can disturb the measurement.
Influences are:

- the presence of water vapor
- external IR radiation from direct unfiltered sun light, halogen bulbs, etc
- warm or cold air flow that could lead to temperature gradients over the sensor

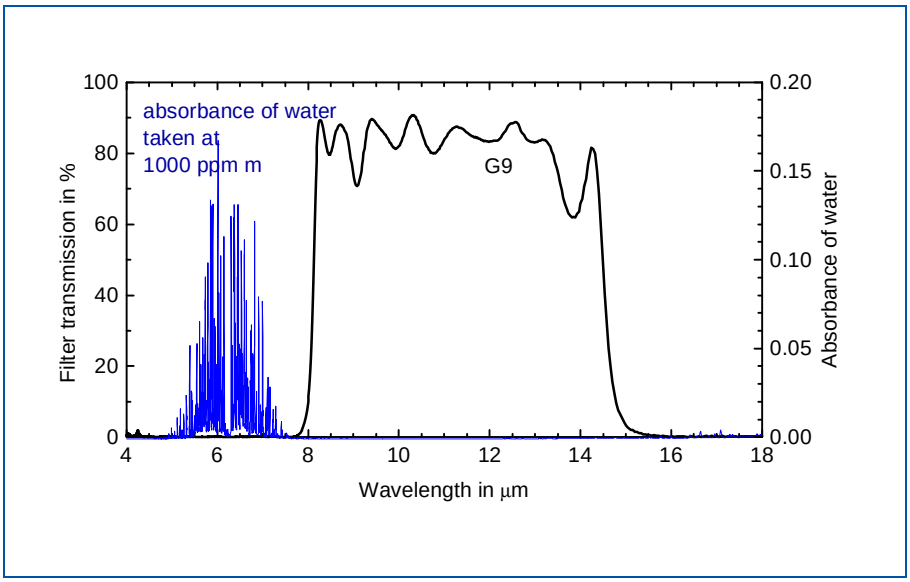
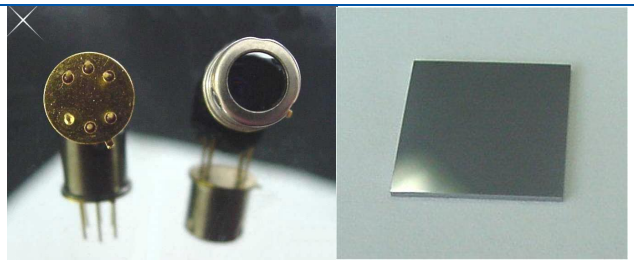


Figure 9
Spectral properties of a G9 filter, shown together with the absorption bands of water vapor.

a2TPMI334-L5.5 OAA150 eG9

Name:	a2TPMI334-L5.5 OAA150 eG9
Max. object temperature:	150° C
Description:	Thermopile sensor for contact less temperature measurement for a maximum object temperature of 150° C, calibrated with a “married” external G9 filter. For maximum accuracy, each sensor is designed to be used only in conjunction with its respective piece of G9 filter.
Product picture:	 **Figure 10:** Lens type sensor with additional G9 filter
Field of view characteristics:	7°; see Figure 5
Filter characteristics:	See Figure 14

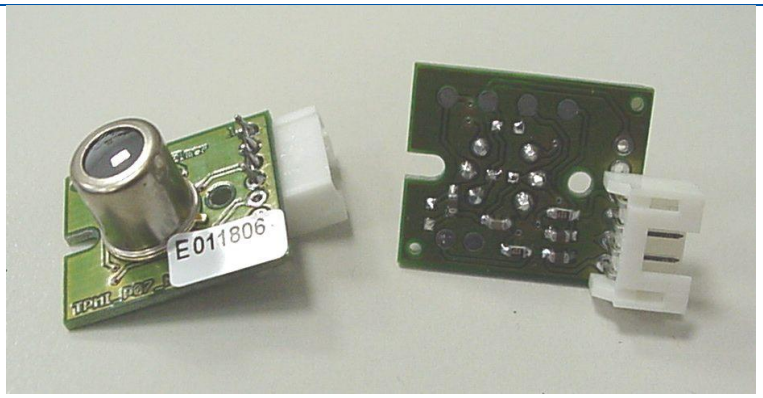
a2TPMI336-IRA-G9 OBA 1200

Name:	a2TPMI336-IRA-G9 OBA 1200
Max. object temperature:	1200° C
Description:	Thermopile sensor for contact less temperature measurement for a maximum object temperature of 1200° C. Sensor contains an integrated G9 filter.
Product picture:	See Figure 2
Field of view characteristics:	15°; compare Figure 5
Filter characteristics:	See Figure 9

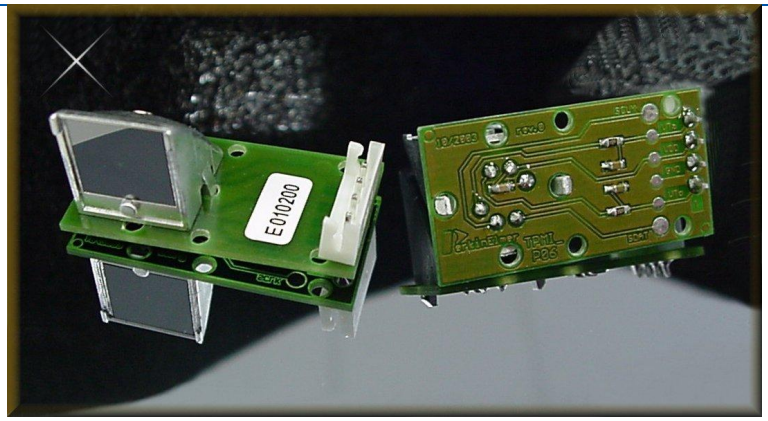
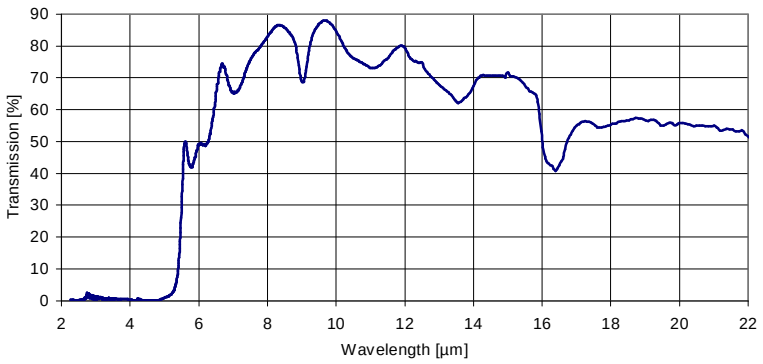
a2TPMI336-IRAG9 OAA250 / 6274

Name:	a2TPMI336-IRAG9 OAA250 / 6274
Max. object temperature:	250° C
Description:	Thermopile sensor for contact less temperature measurement for a maximum object temperature of 250° C. Sensor contains an integrated G9 filter.
Product picture:	See Figure 2
Field of view characteristics:	15°; compare Figure 5
Filter characteristics:	See Figure 9

A2TPMI 334-L5.5 OAA250 P7L1 J4S / 6290

Name:	A2TPMI 334-L5.5 OAA250 P7L1 J4S / 6290
Max. object temperature:	250° C
Description:	Thermopile module A2TPMI 334-L5.5 OAA250 (please refer to the previous section [standard sensors] for details on this module) mounted on PCB with connector.
Product picture:	 **Figure 11:** Module mounted on PCB
Field of view characteristics:	See figure 5
Filter:	Silicon. Flat characteristics for aR radiation of wavelengths above 1.2 µm

a2TPMI334 OAA140 P6L1 MLG12 J4T / 6261

Name:	a2TPMI334 OAA140 P6L1 MLG12 J4T / 6261
Max. object temperature:	140° C
Description:	Thermopile sensor module with external focusing mirror on PCB with connector. As compared to other modules, this module is particularly stable in conditions with rapidly changing ambient temperatures.
Product picture:	 **Figure 12:** Module with external focusing mirror (left looking).
Field of view characteristics:	7°; See Figure 8
Filter characteristics:	The module is equipped with a standard filter (internally) that makes it immune against unfiltered daylight. The external G12 filter serves for mechanical protection.  **Figure 13:** Transmission characteristics of standard filter

Appendix A: Ambient Temperature Compensation

All thermopile sensor measure an object temperature based on the radiation energy exchanged between the object and the sensor. Since the infrared radiation emitted by the sensor is a function of the sensor's own temperature (which is approximately the ambient temperature), the output voltage of the thermopile sensor must be ambient temperature compensated in order to give an accurate object temperature measurement. This effect is of particular importance for low object temperatures.
For ambient temperature compensation, all a2TPMI modules have an integrated ambient temperature sensor. Its signal is available as analog voltage.
a2TPMI sensors are available in two versions:

- OAA: with internal ambient temperature compensation of the object temperature signal. For temperatures up to 350° C all standard sensors are OAA types.

- OBA: without internal ambient temperature compensation. The user can compensate the object temperature (if necessary) using the ambient temperature signal and his own circuitry or algorithms. For temperatures above 300° C, all sensors are OBA types.

Appendix B: Integrated ASIC

Sensor modules of the a2TPMI series have an integrated ASIC that performs tasks such as compensation of ambient temperature, instrumentation grade pre-amplification, calibration etc.

Properties of the ASIC

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
Power Supply						
V_{DD}	Supply voltage	4.5	5	5.5	V	
I_{DD}	Supply current		1.5	2	mA	R_L > 1 MΩ
Outputs V_{Tobj} / $V_{TambESD}$						
V_O	Output voltage swing	0.25		V_{DD} – 0.25 V	V	I_{out}: -100 µA ... +100 µA
R_O	Output resistance			10	Ω	I_{out}: -100 µA ... +100 µA
				100		otherwise
R_L	Resistive output load	50			kΩ	
C_L	Capacitive output load		100	500	pF	
I_{SC}	Output short circuit current		6		mA	Sourcing
			13		mA	Sinking
V_{oL}	Low level output voltage			0.5	V	output current ≤ 2 mA
V_{oH}	High level output voltage	V_{DD}-0.6			V	output current ≥ -2 mA

DC Characteristics. Unless otherwise indicated, all limits specified for Tamb = 25° C, V_{DD} = +5 V.

AC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
In_N	V1 Input referred voltage noise			120	nV/√Hz	rms value
t_{Strt}	Response time after power on			1	s	
t_{lat}	Latency time for V_{Tobj}			75	ms	
t_{resp}	Response time		90	150	ms	

AC characteristics. Unless otherwise indicated, all limits specified for Tamb = 25° C, V_{DD} = +5 V.

Absolute Maximum Ratings

Parameter	Min	Max
Supply Voltage V_{DD}	-0.3 V	+6.5 V
Storage Temperature Range Note 1)	-40° C	100° C
Operating Temperature Range	-40° C	100° C
Voltage at all inputs and outputs Note 2)	-0.3 V	V_{DD} +0.3 V
Current at input pins Note 2)		+/- 5 mA
Lead temperature (Soldering, 10 sec)		+300° C
ESD Tolerance Note 3)		2.5 kV

Note 1: Extension to 120° C for limited periods of several minutes possible.
Note 2: Limiting input pin current is only necessary for input voltages that exceed absolute maximum input voltage ratings.
Note 3: Human body model, 1.5 kΩ in series with 100 pF. All pins rated per method 3015.7 of MIL-STD-883.

Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
Precautions should be taken to avoid reverse polarity of power supply. Reversed polarity of power supply results in a destroyed unit.
Do not expose the sensors to aggressive detergents such as freon, trichlorethylen, etc.
Optical windows (e.g. filter, lens) may be cleaned with alcohol and cotton swab.

Appendix C: Definition of the Field-of-View

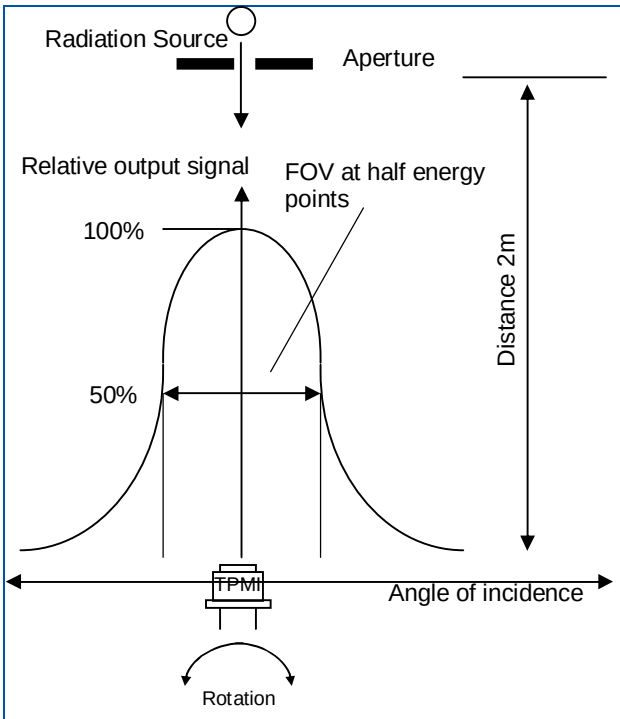


Figure 14: FOV definition

The a2TPMI is available with different standard optical cap assemblies with and without an infrared lens or mirror.

The optics define the view angle or field of view (FOV) of the sensor.

The FOV is defined as the incidence angle difference, where the sensor shows 50 % relative output signal according to the set-up shown.

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
Lens Cap Type (L5.5)						
FOV	Field of view		7	12	° Degrees	
OA	Optical axis		0	± 3.5	° Degrees	
D:S	Distance to spot size ratio		8:1			
Internal Reflector type						
FOV	Field of view		15	20	° Degrees	
OA	Optical axis		0	± 2	° Degrees	
Standard Cap Type (C4)						
FOV	Field of view		60	70	° Degrees	
OA	Optical axis		0	± 10	° Degrees	

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