A2TPMI ™

集成了信号处理电路的热电堆传感器

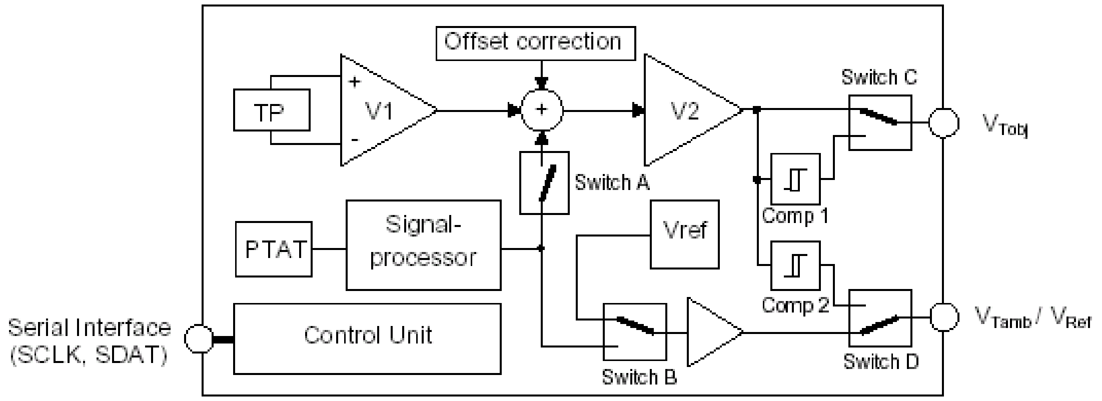
特点：

- 集成了信号处理电路的热电堆传感器
- 能适合特殊的测量工作
- 集成环境温度校准传感器
- 输出信号环境温度补偿
- 快速响应时间
- 有各种不同的光学系统和滤光片应用
- 数字接口用于校准和调节
- 模拟前端、后端，数字信号处理
- 内置E_2PROM用于数据存储
- 内置比较器，带高/低信号，用于远程温度极限控制
- TO－39，6脚封装

应用：

- 微型远程非接触温度测量（高温计）
- 独立的温度开关用于报警或温度调节
- 家庭，商用，汽车和工业温度控制
- 需要远程温度控制的家用电器产品，象微波炉， 电烤炉，电吹风等
- 激光打印机和复印机的温度控制
- 汽车内部温度通风控制

功能结构图



TP:热电堆
PTAT:温度传感器

V_{Tobj}:目标温度的输出电压
V_{Tamb}:环境温度的输出电压
V_{Ref}:1.225V 参考电压

描述：

PerkinElmer A2TPMI 是一种内部集成了专用信号处理电路以及环境温度补偿电路的多用途红外热电堆传感器，这种集成红外传感器模块将目标的热辐射转换成模拟电压。A2TPMI 完全由工厂通过串行接口，按照适合用户要求的规格进行校准。在预校准版本中，只有三个管脚是必须用到的：目标输出电压，5V电源电压和地。作为规格中的描述，由于A2TPMI具备偏置校准放大器和工厂校准环境温度传感器，与以前用分离元件做在一个印刷电路板上模块相比，集成化的模块更充分地调整好了输出特性的温度精度，这使它成为多用途，紧凑的，高精度器件。由于内部数字信号处理和内部8 bit分辨率控制寄存器，A2TPMI 改良了调节精度和特性，E_2PROM 技术允许无约束地改变配置。为了放大高灵敏热电堆微伏到毫伏级的信号，用了一个高分辨率的可编程，低噪声放大器。A2TPMI的两个内置比较器可以单独使用，增强了功能，它可以使A2TPMI 成为一个独立的温度开关，应用于温度报警。这两个比较器的极限温度值以及滞后回路是任

意可编程的设定的。一个带信号处理器的可调高精度环境温度传感器提供了与热电堆输出完美地匹配的精确环境温度补偿信号。在很宽的温度范围内，它使目标温度输出信号独立于环境温度。由于器件具有的灵活的偏置和增益调整，仍然适合用户的各种需要。由于传感器和相关电路集成在一个TO-39封装内，A2TPMI是一种高效的，不受环境影响的器件，例如PCB漏电流污染，潮湿以及电磁干扰环境等。

TPMI 定货信息

型号: **sn TPMI n3c xxx Gxx Oxx nnn Pnx MxGxx xxxx -xx**

sn: A2,模拟专用集成电路

TPMI: TO-39封装；5个隔离引脚，1个接管壳的地脚；内部信号处理专用集成电路

n3c: 芯片：n=3 ,0.7 x 0.7 mm2光敏面；数字3:包含温度参考，对TPMI是标准
外壳：c = 4 标准外壳，窗口直径, fov = 60°/也可以带多种长度的透镜；
c = 6 高外壳，带内部光学系统，例如内部反射镜；
c = 7 方孔 3.5 x 3.5 mm2, 低外壳fov = 120°

xxx: 传感器光学系统：空 带5.5um截断波长的标准滤光片；
L-x.y 带x.y mm长度焦距的硅透镜；
IR 带内部反射镜；
A 带内部光圈

Gxx: 传感器上红外滤光片：空 带5.5um截断波长的标准滤光片；
G9 带8..14 µm 带通高温滤光片；

Oxx: 输出配置：V_{Tobj}管脚 A 已经过环境温度补偿后的目标温度输出电压；
B 没有经过环境温度补偿的输出电压
V_{Tamb}管脚 A 环境温度输出电压；
V Vref = 1.225 V

nnn: 温度范围：-20 ... nnn°C

Pnx: 印刷电路板：P1 标准 pcb 17 x 33 mm2；
P3 微型 pcb 17 x 20 mm2；
L1 pcb板上带RC低通滤波器；
L2 pcb板上带放大器低通滤波器

MxGxx 外部光学系统和滤光片：ML / MR / MF 镜头向左/向右/向前
G 粘合在镜头上的标准滤光片
G12 粘合在镜头上的G12 (无覆盖硅)滤光片

xxxx 连接器：空 表示没有；
WTB 线到板连接；
JxT 上端插入，x = 4 or 6 脚；
JxS 侧面插入，x = 4 or 6 脚；
JxxC 带配对物

例如：

- A2TPMI 334-L5.5 OAA 300

  特点:标准TPS 334-L5.5传感器带集成A2TPMI专用集成电路以及5.5 mm硅透镜光学系统，5度视角，目标温度范围 –20…+300°C

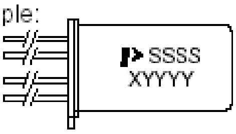
产品标记

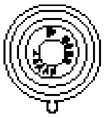
传感器类型:

SSSS 器件型号的最后四个数字

XYYYY X 是生产年份的最后一位数字，YYYY是产品序列号

Example:





PCB类型：
组装在PCB上的传感器，由打印在上面的一个字母和一串数字来标记
字母表示生产地点：
H 产品在德国生产
B 产品在印度尼西亚生产
E 工程样品在德国生产

最大绝对值：

参数	最小	最大
电源电压VDD	-0.3 V	+6.5V
存储温度范围（1）	-40 °C	100°C
工作温度范围	-25°C	100°C
所有的输入输出电压（1）	-0.3 V	VDD +0.3 V
输入脚电流（2）		+/- 5mA
管脚温度（焊接，10秒）		+300°C
ESD容量（3）		2.5 kV

Note 1: 在有限的几分钟内，可能延伸到 120°C
Note 2: 在输入电压超过最大绝对输入电压时，限制输入脚电流时必要的
Note 3: 人体模型, 1.5kW串联100pF. 所有的引脚符合 method 3015.7 of MIL-STD-883.

静电敏感器件，不用的器件必须存储在传导性材料中；不要将传感器暴露在氟里昂，三氯乙烯等清洁剂中；光学窗口（例如滤光片，透镜等）可以用酒精，棉花清洗。

电气特性：

除非特别说明，所限定的条件是T_A = 25°C, VDD = +5 V

符号	参数	最小	典型值	最大	单位	条件
电源						
VDD	电源电压	4.5	5	5.5	V	
I_{DD}	电源电流		1.5	2	mA	R_L > 1MΩ
VTobj / VTambESD输出						
V_O	输出电压幅度	0.25		VDD-0.25V	V	I_{out}: -100mA….+100mA
R_O	输出电阻			100	Ω	
R_L	阻性输出负载	50			kΩ	
		1			MΩ	
C_L	容性输出负载		100	500	pF	
I_{SC}	输出短路电流		6		mA	
			13		mA	

串行接口SDAT,SCLK						
ViL	低电平输入电压			0.3VDD	V	
ViH	高电平输入电压	0.7VDD			V	
I_{iL}	低电平输入电流	-600		-200	μA	
I_{iH}	高电平输入电流			1	μA	
V_{oL}	低电平输出电压			0.5	V	输出电流£2mA
V_{oH}	高电平输出电压	VDD-0.6V			V	输出电流32mA
参考电压						
V_{Ref}	参考电压	1.223	1.225	1.227	V	R_L > 1MΩ, T_A = 25°C
TC_{VRef}	参考电压温度数		±30	±100	ppm K^{-1}	

交流特性：

除非特别说明，所限定的条件是T_A = 25°C，VDD = +5 V

符号	参数	最小	典型值	最大	单位	条件
In_N	V1输入参考电压噪声			120	nV/√Hz	平均有效值
t_{Strt}	电源响应时间			1	s	
t_{lat}	V_{Tobj}反应时间			75	ms	
t_{resp}	响应时间		90	150	ms	

热电堆特性：

符号	参数	最小	典型值	最大	单位	条件
TPS33X 系列						
S	光敏面区域		0.7x0.7		mm^2	
N	噪声电压		38		nV/√Hz	
τ	持续时间		25		ms	

VTobj 特性：

A2TPMI的输出电压(V_{Tobj}) 特性，不仅依赖目标温度，而且和其它几种因素有关，例如目标尺寸，光学滤波特性等，因此我们不可能归纳出一个通用的 V_{Tobj} 特性，它只能根据用户的特殊应用规格来说明它的输出特性。

V_{tamb}特性：

除非特别说明，所限定的条件是T_A = 25°C, V_{ref} = +1.225

温度	Vtamb				Vtamb 典型值 (1)	单位
	最小	典型值	最大	倾斜度		
-20 °C		0.628		6,8 mV K^{-1}	-0.040	V
-10 °C		0.710		7,1 mV K^{-1}	-0.034	V
0 °C		0.821		12,6 mV K^{-1}	-0.027	V

10 °C	0.946	0.961	0.976	15,4 mV K^{-1}	-0.018	V
20 °C	1.111	1.130	1.148	18.3mV K^{-1}	-0.006	V
25 °C	1.205	1.225	1.245	19,8mV K^{-1}	0	V
30 °C	1.306	1.327	1.349	21,2mV K^{-1}	0.007	V
40 °C	1.530	1.554	1.578	24,1mV K^{-1}	0.022	V
50 °C	1.782	1.809	1.836	27,0mV K^{-1}	0.039	V
60 °C		2.093		29,9 mV K^{-1}	0.058	V
70 °C		2.406		32,7mV K^{-1}	0.079	V
80 °C		2.748		35,6 mV K^{-1}	0.102	V
90 °C		3.119		38,5mV K^{-1}	0.126	V
100 °C		3.518		41,4mV K^{-1}	0.153	V

1) V_{tamb}int是内部不缓冲的环境温度信号，由A开关加到V2放大器，这个信号被参考到V_{Ref} = 1.225 V.

符号	参数	最小	典型值	最大	单位	条件
DT_{amb}	精度	-2		+2	°C	T_{amb} = 0 … 10°C
		-1		+1	°C	T_{amb} = 10 … 50°C
		-2		+2	°C	T_{amb} = 50 … 100°C

光学系统特性：

符号	参数	最小	典型值	最大	单位	条件
标准 Cap 类型(C4)						
FOV	可视区域		60	70	°	
OA	光轴		0	±10	°	
高 Cap类型带内部反射镜 (C6 IRA)						
FOV	可视区域		15	20	°	
OA	光轴		0	±2	°	
低 cap 类型 (C7)						
FOV	可视区域		95	105	°	
			125	135	°	
OA	光轴		0	±10	°	
Lens Cap 类型 (L5.5)						
FOV	可视区域		7	12	°	
OA	光轴		0	±3.5	°	
D:S	距离与目标尺寸比率		8：1			
外反射镜模块 (ML / MR / MF)						
FOV	可视区域		7	12	°	

滤光片特性：

参数	最小	典型值	最大	单位	条件
标准滤光片					
平均传输	70			%	波长从7.5 μm 到 13.5 μm
平均传输			0.5	%	波长从可见光 到 13.5 μm
截断频率	5.2	5.5	5.8	μm	25°C
无涂层硅透镜（G12）					
平均传输		52		%	波长从5.5 μm 到 13.5 μm

综合介绍：

热电堆传感器：

热电堆传感器产生的信号电压，通过一个8 bit分辨率的可编程放大器放大。根据热电堆温度测量原理，热电堆电压可能是正或者负，取决于目标温度是否高于或者低于A2TPMI的环境温度。为了使负电压信号能在单电源系统处理，所有的内部信号都连接到1.255 V内部电压参考(Vref)，作为虚拟模拟地信号。为了热电堆放大电路偏置电压的调整，放大器上带了一个能产生有8 bit分辨率偏置电压的可编程调整部分。热电堆电压显示了目标温度对应的非线性输出特性。

环境温度传感器：

A2TPMI的温度由一个集成的温度传感器来探测，这个信号被放大后，为了匹配热电堆放大信号曲线的反向特性，进行信号处理，两个信号相加，实现最适宜的环境温度补偿。环境温度传感器信号的特性是可调的，这个调节是专用集成电路生产过程的一部分，由工厂提供，因此A2TPMI 环境温度信号V_{tamb}的特性总是经过完全校准的 。

环境温度补偿：

电堆传感器根据热电效应，把目标表明的温度辐射转换成电信号，通过热辐射源与传感器紧密热接触的外壳之间的温度差异而产生输出电压。为了输出一个只与目标温度有关的信号，环境温度的任何改变必须进行适当的输出信号校准。为了温度补偿，放大的热电堆信号和温度参考信号(V_{Tamb}int)相加于一个放大器级。根据应用/用户的要求，这个放大器的增益在一个很宽的范围内可调。经过温度补偿放大后的信号输出到V_{Tobj}脚，温度参考信号或者参考电压输出到Vtamb脚，两个脚都是短路稳定的。

控制单元 /串行接口：

A2TPMI的工作特性由一个内部随机存取寄存器进行配置，所有的参数/配置永久地存在并行E2PROM内。控制单元提供的两线、双向同步串口(SDAT, SCLK) ，可以访问所有寄存器的A2TPMI内部参数。A2TPMI传感器通常在工厂进行了校准，因此在标准应用中，用户不需要使用串口。SDAT- / SCLK 引脚被内部连到VDD 。

输出结构：

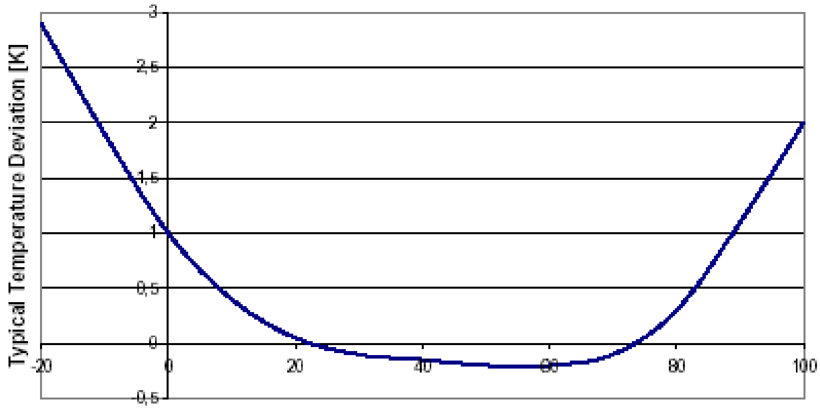
A2TPMI 提供多样的输出结构，依靠集成的模拟开关，通过串行通讯接口进行配置。对于每种输出，能够在‘模拟模式’或者‘比较器模式’之间独立进行选择。在‘模拟模式’，测量代表红外辐射的温度，输出一个模拟直流电压信号， ；在‘比较器模式’，测量红外辐射的温度，和一个设定的门限值做比较，对于缓慢变化的信号，附加的滞后特性可以被配置。如果测量信号高于门限值，输出+5V直流电压 (逻辑高)；低于门限值，输出0V直流电压 (逻辑低)。

应用信息：

环境温度补偿：

由于许多物理因素影响基于红外辐射的非接触温度测量，对于专门应用，进行最好的初调是很困难的，因此第一次测量中会发现有些差异。在所有的应用中，最优化的解决方案都要基于测量是的应用环境。我们很乐意提供帮助，发现这些条件，为你的应用提供最高的精确度。通过热电堆传感器和温度参考传感器的不同器件参数，在确定的环境温度范围内，环境温度补偿可以做的很好。下面的图表显示了一个典型特征，可以更好理解补偿曲线的原理。这个曲线表达了一个温度补偿模块校准偏差值。

VTobj的温度偏离 vs. 环境温度



环境温度 [°C]

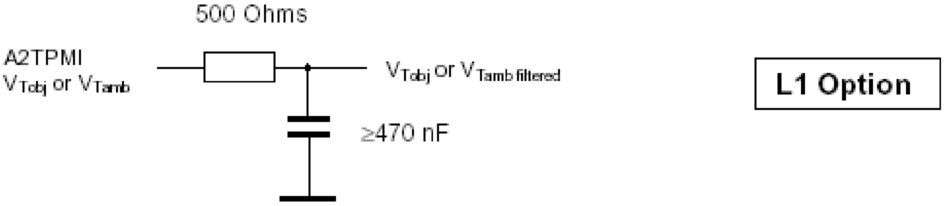
图表中，模块样品的补偿最适宜在20°C 到 80°C的环境温度，但是曲线能够移植到改变A2TPMI参数的整个环境温度范围。

测量误差：

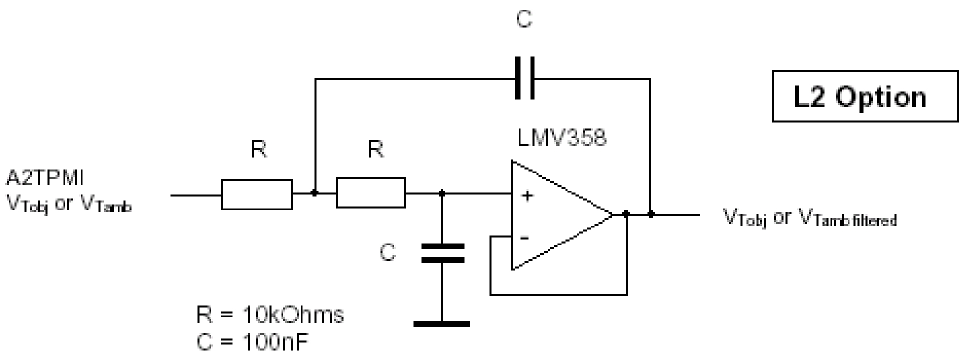
A2TPMI的温度误差依赖几种因素，象发射率 ，目标温度，与光斑尺寸有关的目标尺寸，环境温度梯度，器件公差以及理想的环境温度补偿调整。V_{Tamb} 和 V_{Tobj} 特性中说明的精度是基于理论计算以及统计计算结果的， PerkinElmer 质量系统承诺，所有的A2TPMI产品为了保证它们的规格，全部是经过校准和测试的。

输出信号：

A2TPMI放大器采用斩波放大器技术，由于这种技术本生具有的特性，输出信号 V_{Tobj} 和 V_{Tamb} 中包含了大约10 mV 峰值、250 kHz的交流信号。这些交流信号能被一个电子低通滤波电路或者类似的软件滤波抑制掉。在低阻抗负载(> 1Mohm)应用中，一个简单的RC低通滤波器电路用来消除这些信号。



在高阻抗负载(50kOhm … 1MOhm) 应用中，一个象LMV358这样的rail to rail 运算放大器电路，应该被用来作为输出信号的滤波器。



印刷电路板 (PCB) 版本：

两个不同尺寸的PCB 版本被提供：P1 版本是17 x 34 mm2 PCB 板，允许装配额外的外反射镜光学系统(ML / MR / MF)；P3 版本是17 x 20 mm2 PCB 板，适合有限制空间应用，不提供额外的外反射镜光学系统。每一种 PCB 版本既可以提供简单版本(传感器直接与连接器连接)，又可以提供低通滤波器版本（L1选项，RC 电路；L2选项，运算放大器电路）。

输出负载：

直接应用到输出的容性负载减少了环路稳定性，能容纳100 pF。
由于模块自身的发热，为了避免对温度信号的影响，输出阻抗负载应该保持尽可能小（例如，一个大的负载电阻，不得不用R_{load} > 50 kW）。

响应时间：

目标温度的响应时间依赖于热电堆的时间常数 t 和 A2TPMI的信号处理时间。热电堆信号的处理有一个最大75ms 的等待时间，它由A/D转换器，D/A转换器和信号处理要求的时间引起的。
下面的图表说明了它们之间的联系：

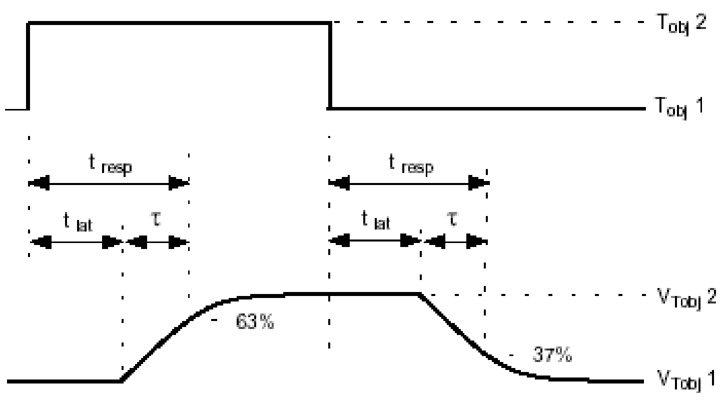


Figure 2: 响应时间的定义

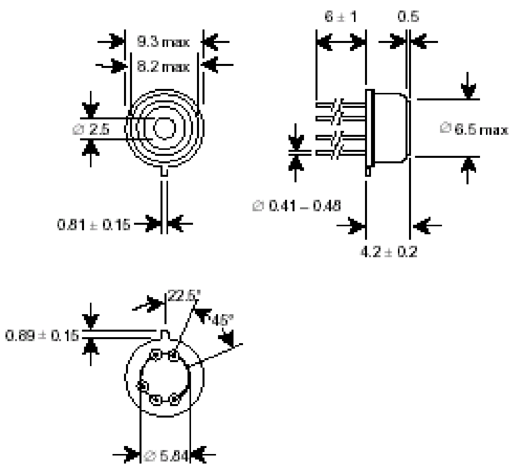
A2TPMI有每秒30次采样3的采样率，导致V_{Tobj} 的动态信号有大约30ms 的分辨率。

避免锁住：

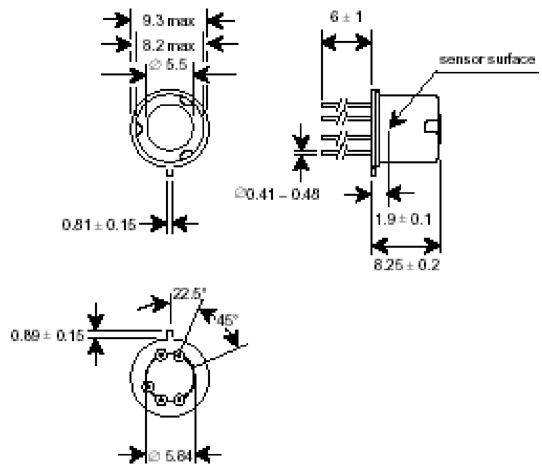
连接点隔离 CMOS 电路固有的一个寄生 4 层 (PNPN) 结构，有一个类似于半岛体闸流管(SCR)的特性。在某一特定环境下，连接点可能被触发到一个低阻抗状态，导致额外的电源电流，破坏电路。为了避免这种情况，没有任何超过0.3 V的电压被加到管脚上。通常 A2TPMI 电源必须同时或者在信号输入前建立，如果不可能的化，驱动电路必须限制输入电流，最大不超过 5mA ，避免锁住。通常器件工作时，电源并联上一个100 nF 电容。

封装信息：

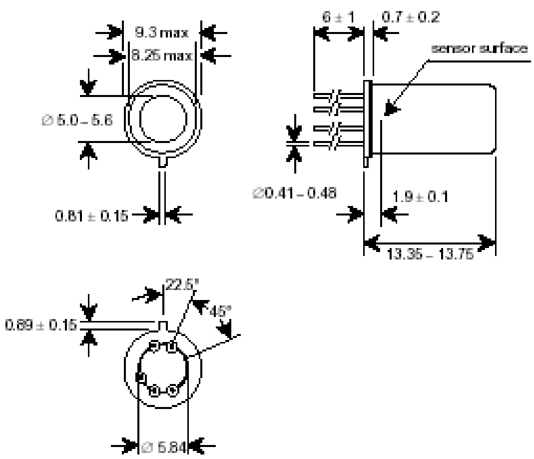
TO39 with Standard cap (C4):
A2TPMI 334



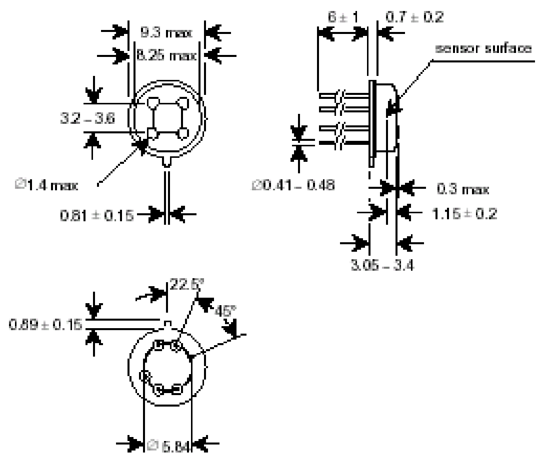
TO 39 with 5.5mm focal length Si lens (L5.5):
A2TPMI 334-L5.5



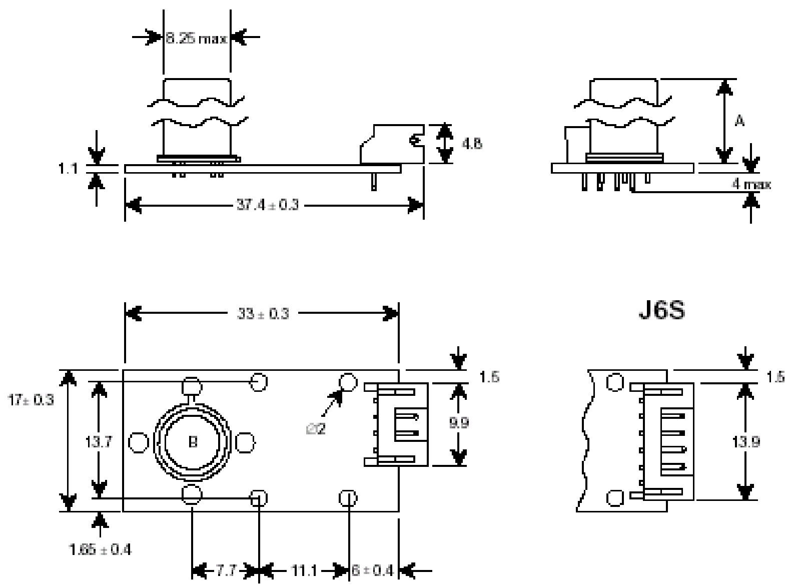
TO39 with high cap and int. reflector (C6 IRA):
A2TPMI 336 IRA



TO39 with low cap and square hole (C7)
A2TPMI 337



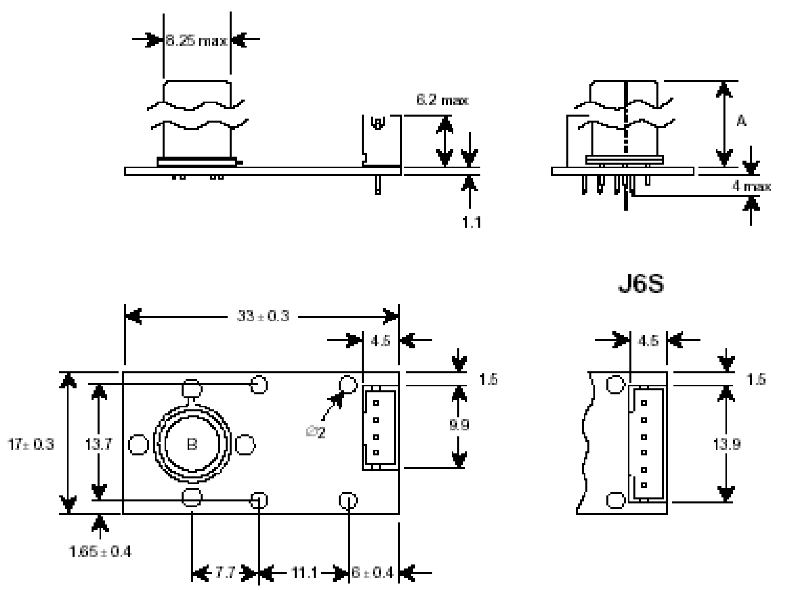
PCB Version P1 J4S



Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

Dimensions B
Refer to sensor drawings

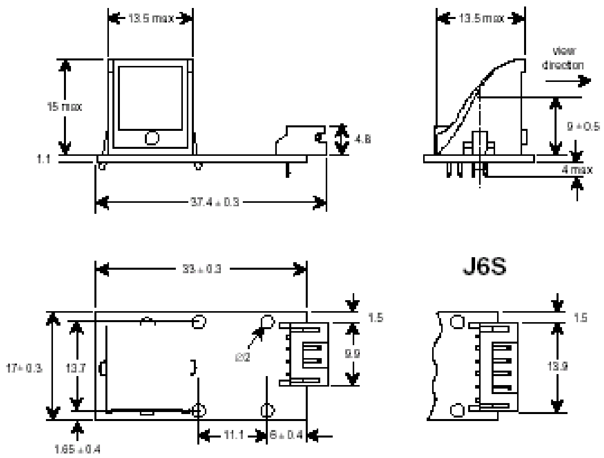
PCB Version P1 J4T



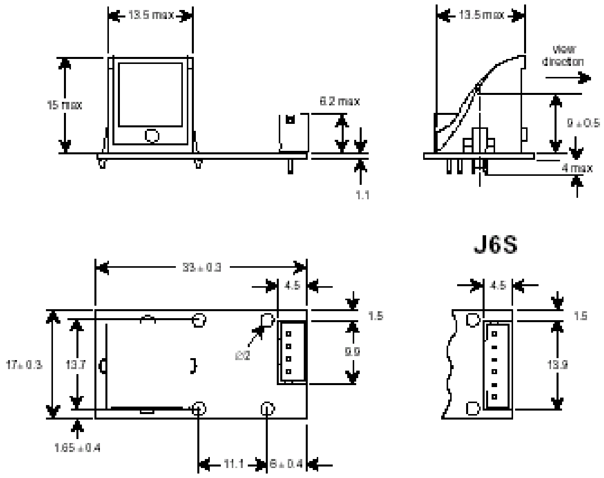
Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

Dimensions B
Refer to sensor drawings

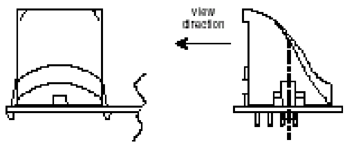
PCB Version P1 J4S with external Mirror



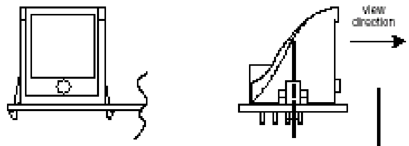
PCB Version P1 J4T with external Mirror



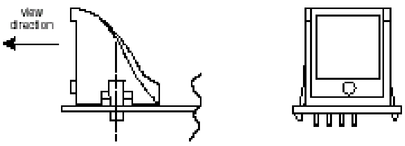
MR Type



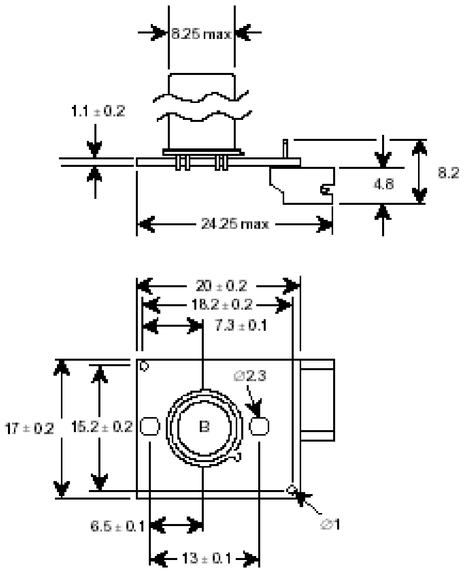
ML Type

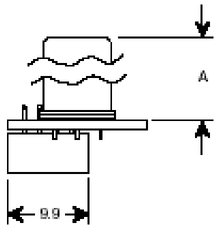


MF Type

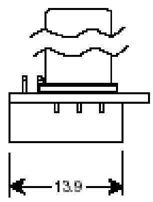


PCB Version P3 J4S





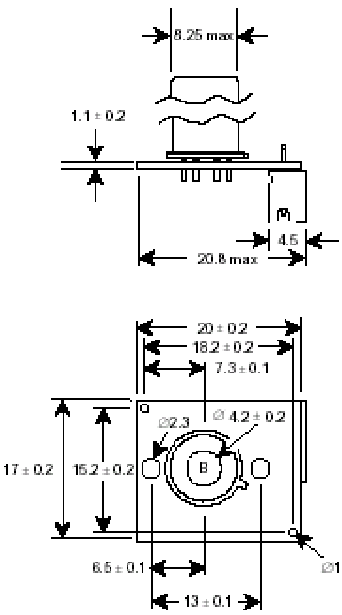
J6S

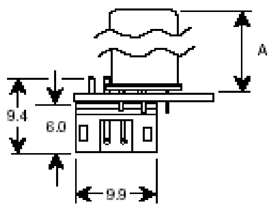


Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

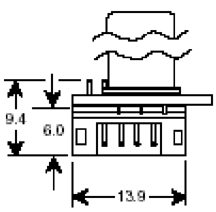
Dimensions B
Refer to sensor drawings

PCB Version P3 J4T





J6T

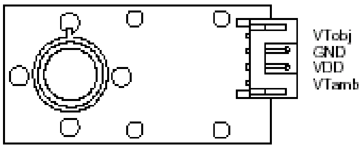


Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

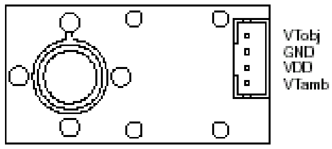
Dimensions B
Refer to sensor drawings

连接器信息：

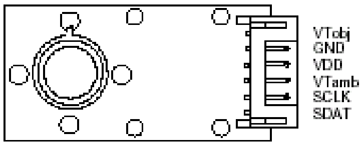
PCB Version P1 J4S



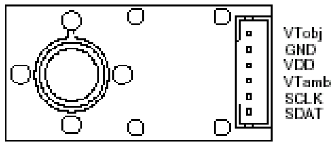
PCB Version P1 J4T



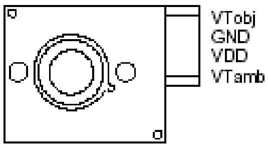
PCB Version P1 J6S



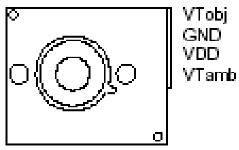
PCB Version P1 J6T



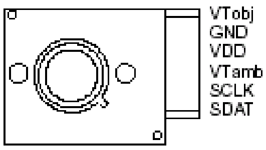
PCB Version P3 J4S



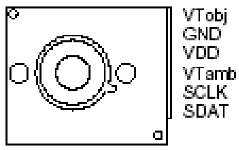
PCB Version P3 J4T



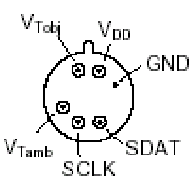
PCB Version P3 J6S



PCB Version P3 J6T



Non PCB Version



Bottom view

Thermopile with integrated signal processing circuit

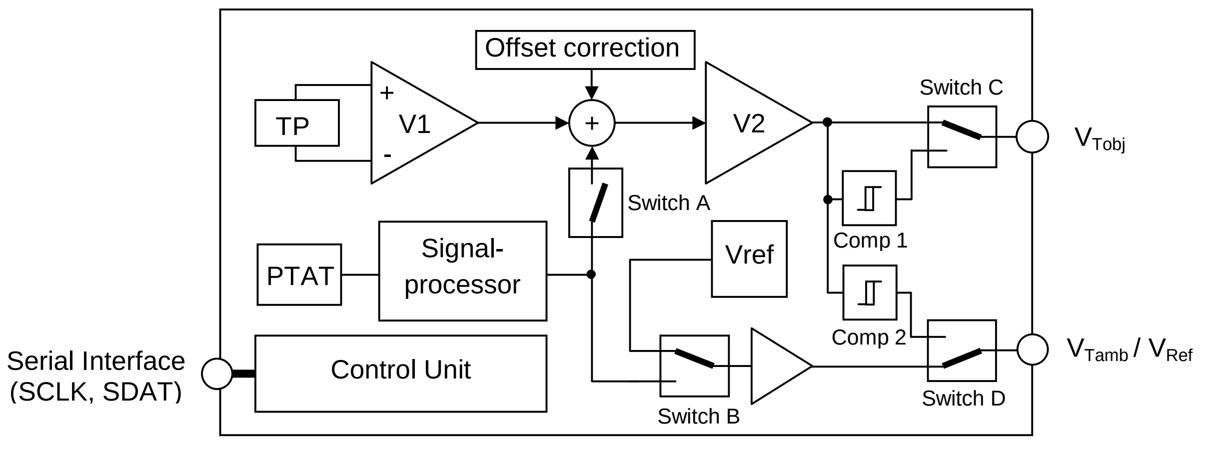
FEATURES

- Smart thermopile sensor with integrated signal processing.
- Can be adapted to your specific measurement task.
- Integrated, calibrated ambient temperature sensor.
- Output signal ambient temperature compensated.
- Fast reaction time.
- Different optics and IR filters available.
- Digital serial interface for calibration and adjustment purposes.
- Analog frontend/backend, digital signal processing.
- E^2PROM for configuration and data storage.
- Configurable comparator with high/low signal for remote temperature threshold control.
- TO 39 6 pin housing.

APPLICATIONS

- Miniature remote non contact temperature measurement (pyrometer).
- Temperature dependent switch for alarm or thermostatic applications
- Residential, commercial, automotive, and industrial climate control.
- Household appliances featuring a remote temperature control like microwave oven, toaster, hair dryer.
- Temperature control in laser printers and copiers.
- Automotive climate control.

FUNCTIONAL DIAGRAM



TP: Thermopile
PTAT: Temperature Sensor

V_{Tobj} : Output voltage object temperature
V_{Tamb} : Output voltage ambient temperature
V_{Ref} : 1.225 V reference voltage

DESCRIPTION

The PerkinElmer A2TPMI is a versatile infrared thermopile sensor with an integrated configurable ASIC for signal processing and ambient temperature compensation. This integrated infrared module senses the thermal radiation emitted by objects and converts this to a analog voltage.

The A2TPMI can be delivered fully factory calibrated and adapted to the customer specification, as well as customer programmable via the serial interface. In the pre-calibrated version, only three pins are necessary for operation: object output voltage, 5V supply voltage, and ground.

As described in this specification, the temperature accuracy of the fully adjustable integrated circuit outperforms that of the previous PerkinElmer thermopile modules with discrete components on pcb, because the A2TPMI features an offset correction of the amplifier and a factory calibrated ambient temperature sensor. This makes the A2TPMI a versatile, compact and high precision device.

Due to the internal digital signal processing and 8 bit resolution of the internal control registers the A2TPMI has improved accuracy for adjustment and improved performance. E^2PROM technology allows unlimited changing of the configuration.

For amplification of the highly sensitive thermopile signal in the micro- to millivolt range, a high resolution programmable low noise chopper amplifier is provided. An adjustable high precision ambient temperature sensor followed by a signal processor, offers an accurate compensation signal with polynomial characteristics that perfectly matches to that of the thermopiles output. Adding of these signals results in an ambient independent object temperature signal over a large temperature range, which still can be adapted / scaled to customer needs due to flexible offset and postgain adjustment facilities of the device.

The two configurable comparators of the A2TPMI, that can alternatively be used, enhance the functionality. This allows to employ the A2TPMI as an temperature dependent switch for alarm purposes. Threshold temperatures and the hysteresis is free programmable for both comparators.

Due to integration of sensor and electronic in a compact TO 39 housing, the A2TPMI is robust and insensitive to environmental influences like pcb contamination (leakage currents), humidity and electromagnetic interference.

TPMI Ordering Information

Part code: sn TPMI n3c xxx Gxx Oxx nnn Pnx MxGxx xxxx -xx

Series (sn)

A2	analog ASIC - version 1

TPMI

- TO 39 housing
- 5 isolated pins, 1 ground pin to housing
- internal ASIC for signal conditioning

Sensor chip and cap (n3c)

chip:

n = 3	0.7 x 0.7 mm^2 absorber (standard)
digit "3":	temperature reference included (standard for TPMI)

cap:

c = 4	standard cap, window diameter 2.5 mm^2, fov = 60° / lens cap of various lengths
c = 6	high cap, additional internal optics, e.g. internal reflector (IR)
c = 7	square hole 3.5 x 3.5 mm^2, low cap, large fov = 100°

Sensor optics (xxx)

blank	standard filter with 5.5 µm cut-on wavelength
L-x.y	silicon lens with x.y mm focal length
IRA	internal reflector (mirror)
A	internal aperture

Infrared filter on sensor (Gxx)

blank	standard filter with 5.5 µm cut-on wavelength
G9	pyrometry filter, 8..14 µm bandpass
Gxx	PerkinElmer specified broadband or (narrow) bandpass filter

Output configuration (Oxx)

Pin V_{Tobj}

A	ambient temperature compensated output voltage representing object temperature
B	not compensated output voltage
C	comparator 1 enabled

Pin V_{Tamb}

A	output voltage representing ambient (sensor) temperature
V	V_{ref} = 1.225 V
C	comparator 2 enabled

Temperature sensing range (n)

nnn	-20 ... nnn°C (remark: for object T range < 100°C the min. T-range may be >20°C)

Option: Printed circuit board (pcb)

P1	standard pcb 17 x 33 mm^2
P3	mini pcb 17 x 20 mm^2
L1 or L2	electrical low pass filter on pcb (L1 = 1st order with RC; L2 = 2nd order with OpAmp)

Option: External optics and filter

ML / MR / MF	mirror left / right / front looking
G	standard filter glued to mirror
G12	G12 (uncoated silicon) filter glued to mirror

Option: Connector

blank	none
WTB	wire to board
JxT	top entry, x = 4 or 6 pin
JxS	side entry, x = 4 or 6 pin
JxxC	with counterpart

Optional customer suffix

Examples:

- A2TPMI 334-L5.5 OAA 100 and A2TPMI 334-L5.5 OAA 250

  are standard configurations of the PerkinElmer TPS 334 sensor with integrated A2TPMI ASIC and lens optics with 7° field of view adapted to an object temperature range –20…+100°C and -20…250°C, respectively.

- A2TPMI 334 OAA 100 P1L1 MLG12 J4T

  features the PerkinElmer TPS 334 sensor with integrated A2TPMI ASIC on a standard pcb (P1). An RC circuit serves as a low pass filter to block the chopper frequency. The optics is the standard left looking mirror with attached protection filter. A 4 pin JST connector with top entry is used. The object temperature range is set to –20…100°C. (Typical module for microwave oven application.)

- A2TPMI 334 OAA 75 P1L1 J4S

  features the PerkinElmer TPS 334 sensor with integrated A2TPMI ASIC on a standard pcb (P1). An RC circuit serves as a low pass filter to block the chopper frequency. No additional optics – the sensor looks with full field of view into the surrounding. The connector is a 4 pin side entry connector and the temperature range is –10…75°C. (This is a typical module for air conditioner application.)

- A2TPMI 334 L5.5 OAA 250 P3L2 J6S

  features the PerkinElmer TPS 334-L5.5 sensor with integrated A2TPMI ASIC and build-in 5.5 mm lens on a miniature pcb. It has an additional 2nd order low pass filter with operation amplifier to block the chopper frequency. The connector is a 6 pin side entry connector and the temperature range is –20…250°C. This is a high performance module for industrial applications. The 6 pin connector gives access to the serial interface of the module.

- For data visualization and for configuration changes a versatile application kit with PC software is available. Please ask for details.

Labeling

Sensor:

SSSS Last four digits of the device part number
XYYYY X is the last digit of the calendar year and YYYY are the serial nr. of the production lot

Example:

PCB Version:

Sensors assembled on a PCB are labeled with a sticker having a letter and a serial number printed on. The letter describes the manufacturing site as follows:

H	Production parts made in Germany
B	Production parts made in Indonesia
E	Engineering samples made in Germany

Absolute Maximum ratings

Parameter	Min	MAX
Supply Voltage VDD	-0.3 V	+6.5 V
Storage Temperature Range (Note 1)	-40 °C	100°C
Operating Temperature Range	-25°C	100°C
Voltage at all inputs and outputs (Note 1)	-0.3 V	VDD +0.3 V
Current at input pins (Note 2)		+/- 5mA
Lead temperature (Soldering, 10sec)		+300°C

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

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.

Electrical Characteristics

Unless otherwise indicated, all limits specified for T_A = 25°C, V_{DD} = +5 V

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 > 1MΩ
Outputs V_{Tobj} / V_{Tamb}						
V_O	Output Voltage Swing	0.25		V_{DD} – 0.25V	V	I_{out}: -100µA … +100µA
R_O	Output Resistance			100	Ω	
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
Serial Interface SDAT, SCLK						
V_{iL}	Low level input voltage			0.3 V_{DD}	V	
V_{iH}	High level input voltage	0.7V_{DD}			V	
I_{iL}	Low level input current	-600		-200	µA	
I_{iH}	High level input current			1	µA	
V_{oL}	Low level output voltage			0.5	V	output current ≤ 2mA
V_{oH}	High level output voltage	V_{DD}- 0.6V			V	output current ≥ 2mA

Electrical Characteristics (continued)

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
Reference Voltage						
V_{Ref}	Reference voltage	1.215	1.225	1.235	V	R_L > 1MΩ, T_A = 35°C
TC_{VRef}	Temperature coefficient of reference voltage			±100	ppm K^{-1}	

AC Characteristics

Unless otherwise indicated, all limits specified for T_A = 25°C, V_{DD} = +5V

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	

Thermopile Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
3-type chip (TPS 33x)						
S	Sensitive (absorber) area		0.7x0.7		mm^2	
N	Noise voltage		38		nV/√Hz	
τ	Time constant		25		ms	

V_{Tobj} Characteristics

The V_{Tobj} characteristic of thermopile sensors depends not only on object temperature but on several other factors like object size to spot size relation or optical filter characteristics. Therefore it is not possible to specify a general V_{Tobj} characteristic. The V_{Tobj} characteristic will be specified application specific in a separate customer specification.

There are some standard types in preparation whose characteristic will be available in the next datasheet revision.

V_{Tamb} Characteristics

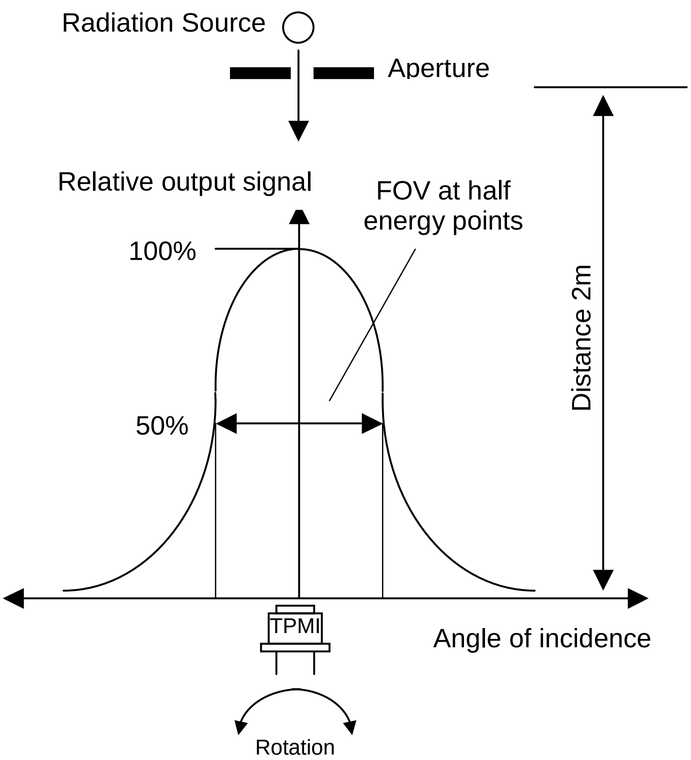
Unless otherwise indicated, all limits specified for V_{DD} = +5 V, V_{ref} = +1.225 V

Temperature	V_{Tamb}				V_{Tamb}int [1)]	Unit
	Min	Typ	Max	Gradient	Typ	
-20 °C		0.628		6.8 mV K^{-1}	-0.040	V
-10 °C		0.710		7.1 mV K^{-1}	-0.034	V
0 °C		0.821		12.6 mV K^{-1}	-0.027	V
10 °C	0.946	0.961	0.976	15.4 mV K^{-1}	-0.018	V
20 °C	1.111	1.130	1.148	18.3 mV K^{-1}	-0.006	V
25 °C	1.205	1.225	1.245	19.8 mV K^{-1}	0	V
30 °C	1.306	1.327	1.349	21.2 mV K^{-1}	0.007	V
40 °C	1.530	1.554	1.578	24.1 mV K^{-1}	0.022	V
50°C	1.782	1.809	1.836	27.0 mV K^{-1}	0.039	V
60 °C		2.093		29.9 mV K^{-1}	0.058	V
70 °C		2.406		32.7 mV K^{-1}	0.079	V
80 °C		2.748		35.6 mV K^{-1}	0.102	V
90 °C		3.119		38.5 mV K^{-1}	0.126	V
100°C		3.518		41.4 mV K^{-1}	0.153	V

Note 1) V_{Tamb}int is the internal unbuffered ambient temperature signal, that is fed via Switch A into the adding amplifier V2. This signal is referenced to V_{Ref} = 1.225 V.

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
ΔT_{amb}	Accuracy	-2		+2	°C	T_{amb} = -10 … 10°C
		-1		+1	°C	T_{amb} = 10 … 50°C
		-2		+2	°C	T_{amb} = 50 … 100°C

Optical Characteristics



The A2TPMI is available with different standard optical cap assemblies with and without an infrared lens or mirror.

The optics defines 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 setup shown.

Figure 1: FOV definition

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
Standard Cap Type (C4)						
FOV	Field of view		60	70	°	
OA	Optical axis		0	± 10	°	
High cap type with internal reflector (C6 IRA)						
FOV	Field of view		15	20	°	
OA	Optical axis		0	±2	°	
Low cap type (C7)						
Field of view			95	105	°	
			125	135	°	10% rel. output signal
Optical axis			0	±10	°	
Lens Cap Type (L5.5)						
FOV	Field of view		7	12	°	
OA	Optical axis		0	± 3.5	°	
D:S	Distance to spot size ratio		8:1			
Mirror Module (ML / MR / MF)						
Field of view			7	12	°	

Filter Characteristics

Parameter	Min	Typ	Max	Unit	Conditions
Standard Filter					
Average Transmission	70			%	Wavelength range from 7.5 µm to 13.5 µm
Average Transmission			0.5	%	Wavelength range from visual to 5 µm
Cut On	5.2	5.5	5.8	µm	At 25°C
Uncoated Silicon Lens (G12)					
Average Transmission		52		%	Wavelength range from 5.5 µm to 13.5 µm

PerkinElmer offers a wide range of Infrared Filters available in many different filter characteristics. Please contact PerkinElmer if you have special requirements or need further information.

General Description

THERMOPILE SENSOR

The signal voltage, generated by the infrared radiation-sensitive thermopile sensor, is preamplified by a programmable choppered amplifier with 8 bit resolution.

Due to the principle of thermopile temperature measurements, the thermopile voltage can be positive or negative depending if the object temperature is higher or lower than the ambient temperature of the A2TPMI. In order to allow signal processing of negative voltages with a single supply system, all internal signals are related to an internal voltage reference (Vref) of nominal 1.225 V, which serves as a virtual analog ground.

For offset voltage trimming of the thermopile amplification path, the preamplifier is followed by a programmable trimming stage generating an offset voltage with a resolution of 8 bit.

The thermopile voltage shows a non-linear output characteristic versus the object temperature.

AMBIENT TEMPERATURE SENSOR

The temperature of the A2TPMI, respectively the thermopile sensor, is detected by an integrated temperature sensor. This signal will be amplified and signal processed in order to match the reverse characteristics of the amplified thermopile curve, to realize an optimum of ambient temperature compensation after adding the two signals. The characteristics of the temperature sensor signal is adjustable. This adjustment is part of the ASIC production process and will be provided by PerkinElmer. Thus the characteristics of the A2TPMI ambient temperature signal V_{Tamb} is always provided fully calibrated.

AMBIENT TEMPERATURE COMPENSATION

The thermopile sensor converts the temperature radiation of an object surface to an electrical signal by means of thermocouples (Seebeck effect). The sensor output voltage is caused by the temperature difference between radiation heated (hot) junctions and cold junctions with a good thermal contact to the housing.

In order to deliver an output signal which is only dependent on the object temperature, any change of housing (ambient) temperature has to lead to an appropriate output signal correction.

For temperature compensation, the amplified thermopile- and temperature reference signals (V_{Tamb}int) are added in an adding amplifier stage. The amplification is adjustable in a wide range according to application / customer requirements.

The ambient temperature compensated and amplified signal is supplied to the output V_{Tobj}. The temperature reference signal or alternatively the bandgap reference voltage is available on a second output pin V_{Tamb}. Both outputs are short circuit stable .

CONTROL UNIT / SERIAL INTERFACE

The operation characteristics of the A2TPMI have to be configured with a set of internal random access registers. All parameters / configurations are permanently stored in E2PROM in parallel.

The control unit offers via serial interface access to all the registers, i.e. the internal parameters of the A2TPMI. The serial interface is a two wire bi-directional synchronous (SDAT, SCLK) type. A2TPMI sensors are in general factory calibrated and therefore there is no need to use the serial interface for standard applications.

The SDAT- / SCLK pins are internally pulled up to VDD and can be left unconnected.

For detailed information about the serial interface refer to application note: *A2TPMI Serial Interface description*, or contact PerkinElmer application support.

OUTPUT CONFIGURATION

The A2TPMI offers various output configurations, which can be configured via the serial communication interface by means of integrated analog switches. For each output it can be individually selected whether the output operates in 'Analog mode' or in 'Comparator mode'.

In 'Analog mode' the output signal represents the measured IR radiation, respectively the temperature as an analog DC voltage.

In 'Comparator mode' the measured IR radiation, respectively the temperature is compared to a programmed threshold. For slowly changing signals an additional hysteresis can be configured. If the measured signal is above the threshold, +5VDC (logical high) is applied to the output. If the measured signal is below the threshold, 0VDC (logical low)is applied to the output.

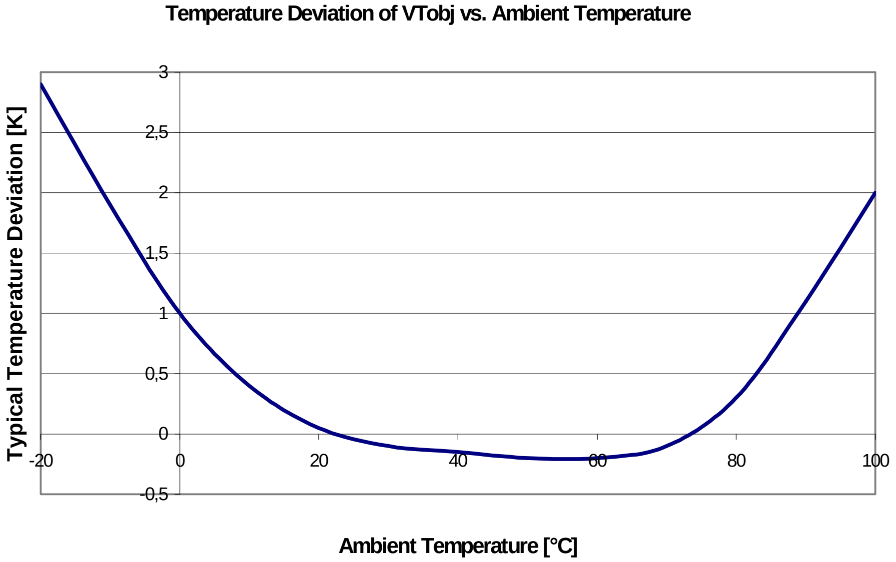
For detailed information about the output configuration refer to application note: *A2TPMI Serial Interface description*, or contact PerkinElmer application support.

Application Information

AMBIENT TEMPERATURE COMPENSATION

Because of many physical effects, that influence the non-contact temperature measurement based on infrared radiation, it is difficult to meet the best initial adjustment for a specific application. Therefore some deviations might be found at first measuring. For all applications the optimized solution can be prepared and fixed based on the measurement in the application environment. PerkinElmer is pleased in providing you assistance to find the conditions, which deliver the highest accuracy in your application.

The temperature compensation is only working well within a certain ambient temperature range, limited by different device parameters of the thermopile sensor and the temperature reference sensor. The following diagram shows a typical characteristics and is only an example for better understanding of the principle compensation curve. The curve shows the deviation for a correct working of a compensated module.



The compensation of the module sample in the diagram is adjusted to the best fitting at 20°C to 80°C ambient temperature, but the curve can be shifted in the whole ambient temperature range through the change of A2TPMI parameters.

MEASUREMENT TOLERANCE

The temperature error of the A2TPMI depends on several factors like the emissivity, object temperature, object size to spot size relation, temperature gradients over the sensor housing in the environment, device tolerances and the optimal adjustment of the ambient temperature compensation.

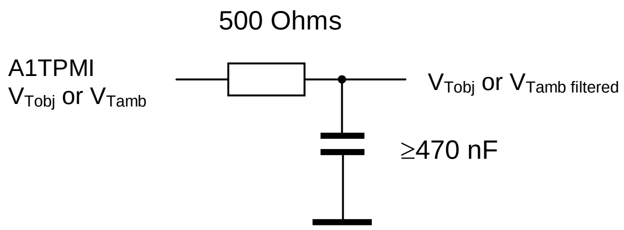
The accuracy as specified under V_{Tamb} and V_{Tobj} characteristics is based on theoretical calculation as well as on statistical evaluation results. The PerkinElmer quality system ensures that all A2TPMIs are calibrated and tested under a certain test conditions in order to guarantee these specifications.

However, due to the nature of infrared remote temperature measurements there might occur limits exceeding or deviations in specific application environments. In this case please contact the PerkinElmer application support to help you solving the problem.

OUTPUT SIGNAL

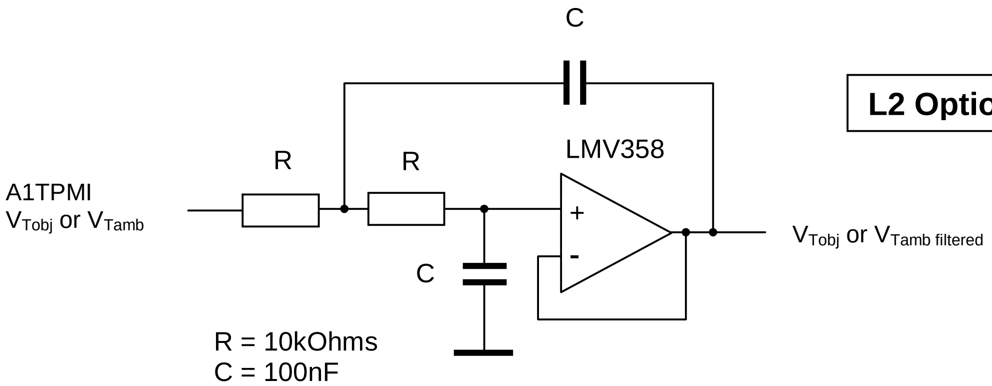
The A2TPMI amplifiers are realized in chopper amplifier technology. Due to the nature of this technology the output signals V_{Tobj} and V_{Tamb} incorporate an AC signal of approximately 10 mV peak to peak in the range of 250 kHz. This AC voltage can be suppressed either by an electrical low pass filter or via an additional software filtering.

In applications with low resistive load (> 1Mohm) a simple RC low pass filter as follows can be used to smooth the signal:



L1 Option

In applications with high resistive load (50kOhm … 1MOhm) filtering can be achieved with the following circuit. A rail to rail OPAmp like the LMV358 should be used so that the full sensing range will be available on the output of the filter circuit.



L2 Option

PRINTED CIRCUIT BOARD (PCB) VERSION

Two different sizes of standard PCB versions are available. P1 version is a 17 x 34 mm^2 PCB which allows assembly of additional external mirror optics (M options). P3 version is 17 x 20 mm^2 PCB suitable for applications with restricted space. P3 version is not available with mirror (M option).

Each PCB version is available either as plain version (sensor directly wired to connector), or with 1st order (RC-circuit, L1 option) or 2nd order (active OpAmp circuit, L2 option) low pass filter, in order to provide attenuation of the AC portion on the output signal as described in chapter Output Signal.

The PCB versions are available with following connector assemblies:

Connection type	Manufacturer: Model No. Header	Manufacturer: Model No. Connector
4 pin top entry	JST: B 4B-PH-K-S	Housing: PHR 4 Contact: SPH-004T-P0.5S
4 pin side entry	JST: S 4B-PH-K-S	
6 pin top entry	JST: B 6B-PH-K-S	Housing: PHR 6 Contact: SPH-004T-P0.5S
6 pin side entry	JST: S 6B-PH-K-S	

Contact Material: Phosphor bronze ; tin-plated,
Applicable wire: 0,032 to 0,08mm^2
Insulation O.D.: 0.5 to 0.9 mm

Note: Engineering samples will be delivered only with a 6 pin header and counterpart connector with 350 mm cable.

OUTPUT LOAD

Capacitive loads which are applied directly to the outputs reduce the loop stability margin. Values of 100 pF can be accommodated. Resistive load for the outputs should be held as small as possible (i.e. a large load resistance, R_{load} > 50 kΩ has to be used) in order to avoid an impact on the temperature signal due to self heating of the module.

RESPONSE TIME

The response time to an object temperature jump depends on the time constant τ of the thermopile and the signal processing time of the A2TPMI. The processing of the thermopile signal has a latency time (t_{lat}) of max. 75ms caused by the time required for AD-conversion, DA conversion and signal processing. The following diagram explains the connection of these events

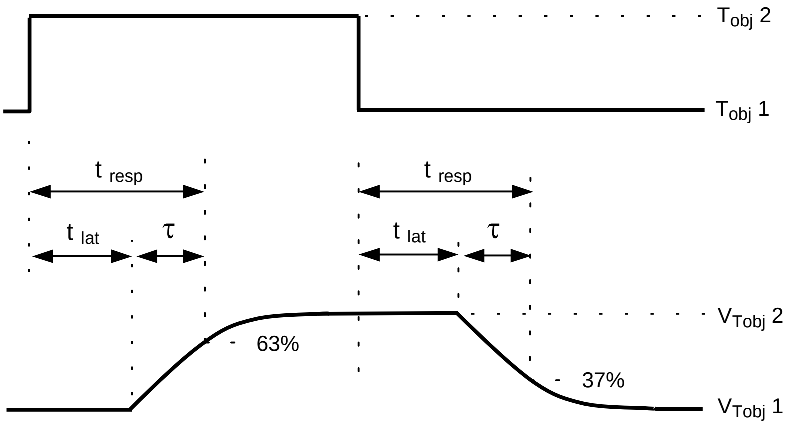


Figure 2: response time definition

The A2TPMI has a sampling rate of 30 samples / second which results in a resolution of approx. 30ms for dynamic signals at V_{Tobj}.

LATCHUP AVOIDANCE

Junction isolated CMOS circuits inherently include a parasitic 4 layer (PNPN) structure which has characteristics similar to a thyristor (SCR). Under certain circumstances this junction may be triggered into a low impedance state, resulting in excessive supply current, which can thermally destroy the circuit.

To avoid this condition, no voltage greater than 0.3 V beyond the supply rails should be applied to any pin. In general the ATPMI supplies must be established either at the same time or before any signals are applied to the inputs. If this is not possible the drive circuits must limit the input current flow to maximum 5mA to avoid latchup. In general the device has to be operated with a 100 nF capacitor in parallel to the power supply.

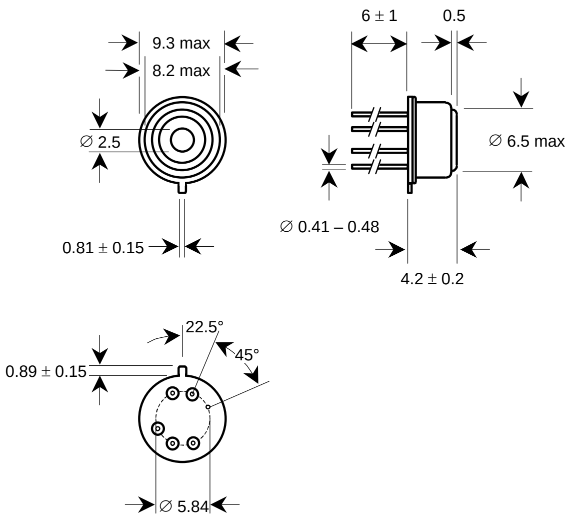
SOLDERING

The TPMI is a lead-free component and fully complies with the existing roadmaps of lead-free soldering. The terminations of the TPMI sensor consist of nickel plated Kovar and gold finish. Hand soldering is recommended.

Packaging Information

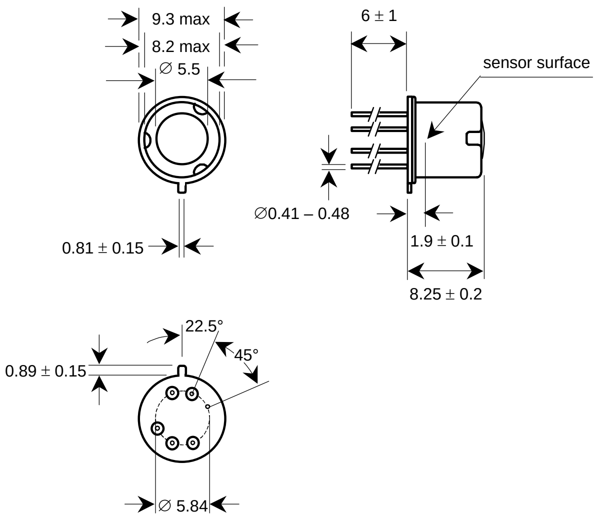
TO39 with Standard cap (C4):

A2TPMI 334



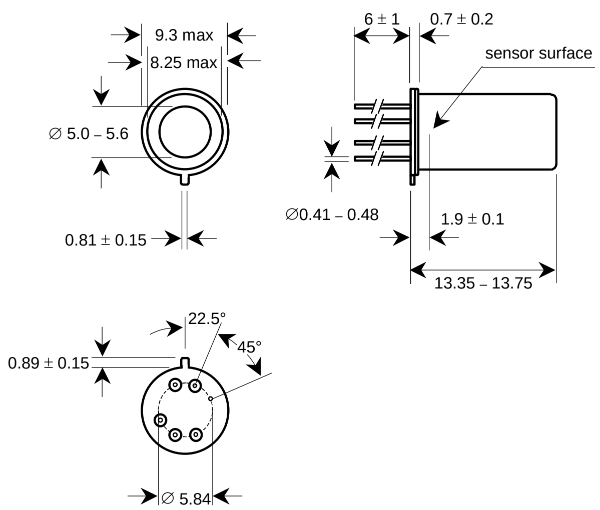
TO 39 with 5.5mm focal length Si lens (L5.5):

A2TPMI 334-L5.5



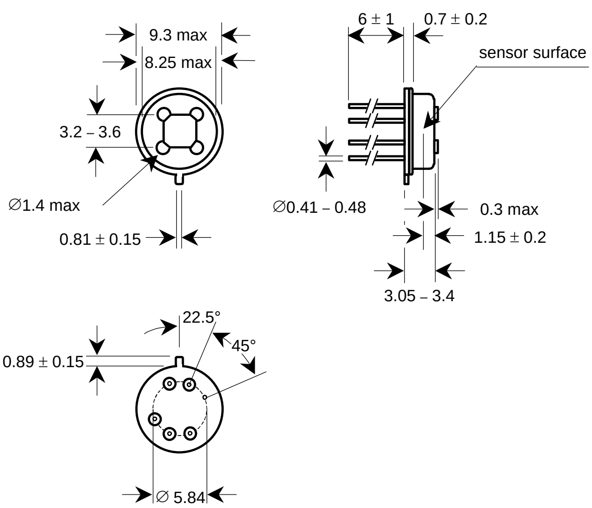
TO39 with high cap and int. reflector (C6 IRA):

A2TPMI 336 IRA

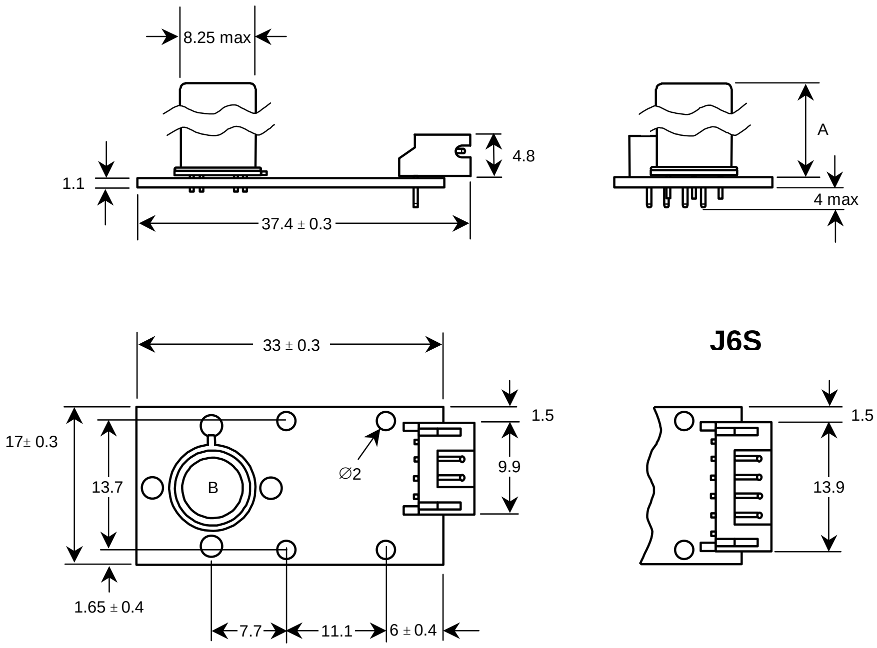


TO39 with low cap and square hole (C7)

A2TPMI 337



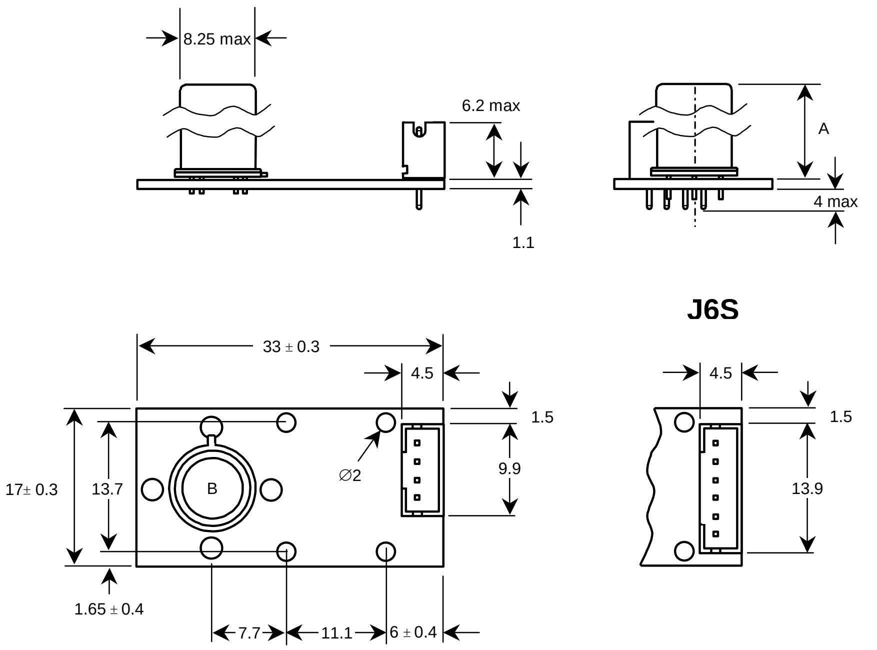
PCB Version P1 J4S



Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

Dimensions B
Refer to sensor drawings

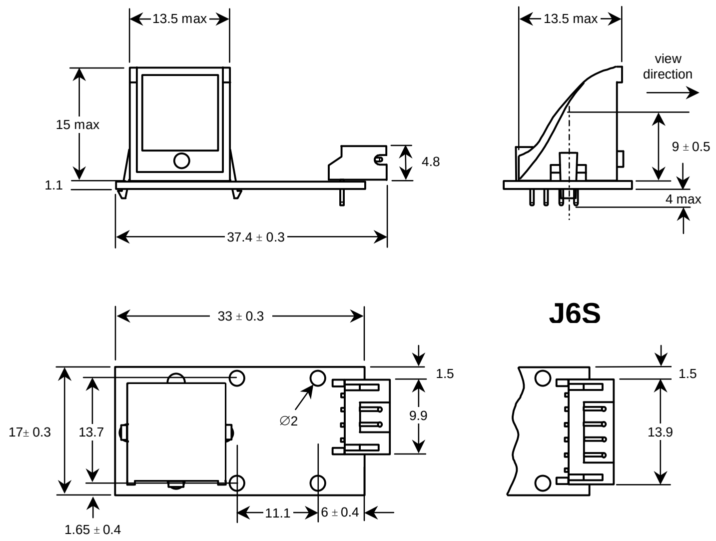
PCB Version P1 J4T



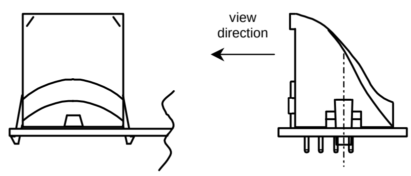
Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

Dimensions B
Refer to sensor drawings

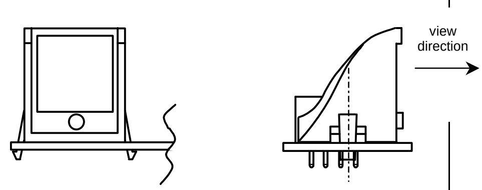
PCB Version P1 J4S with external Mirror



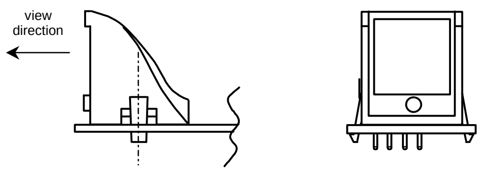
MR Type



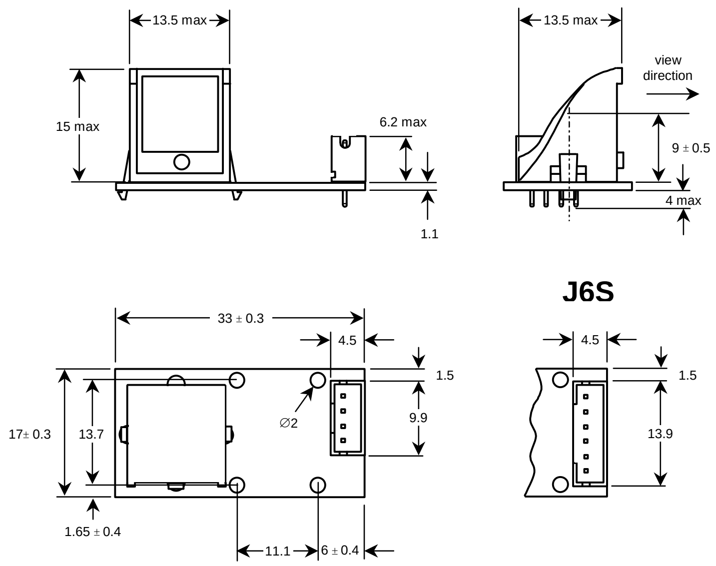
ML Type



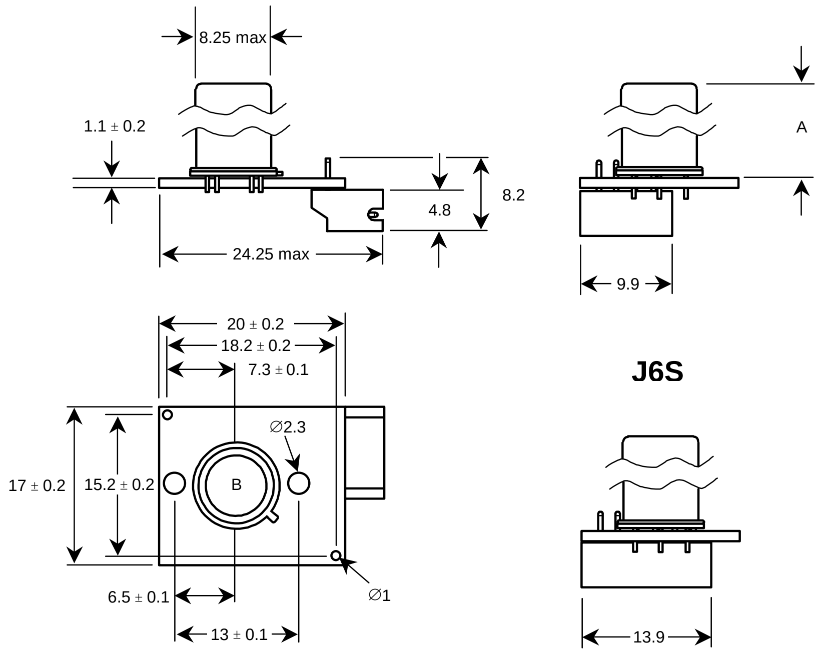
MF Type



PCB Version P1 J4T with external Mirror



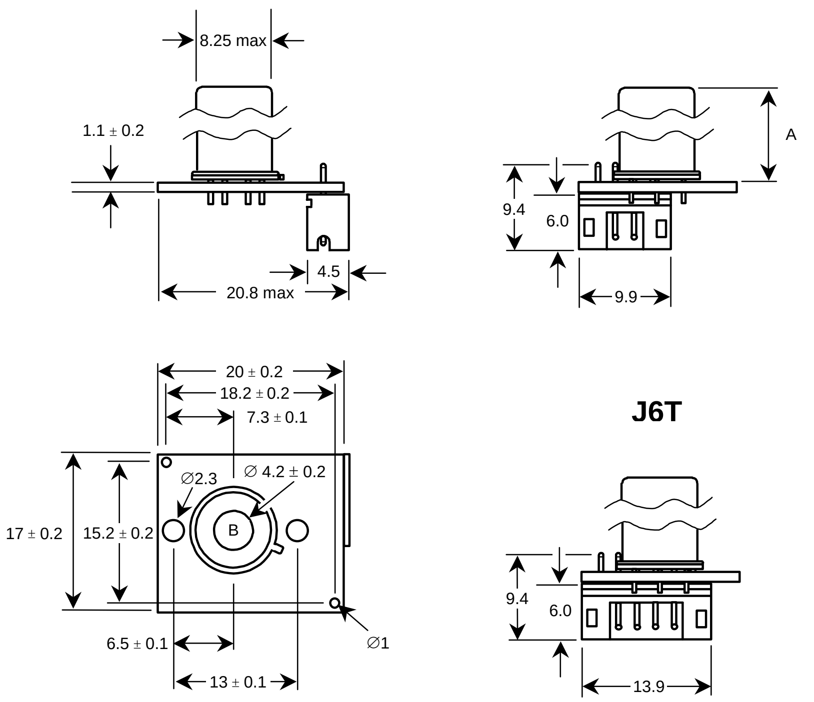
PCB Version P3 J4S



Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

Dimensions B
Refer to sensor drawings

PCB Version P3 J4T

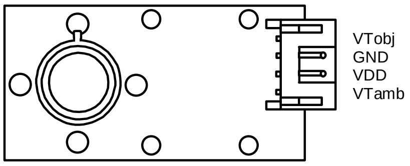


Dimensions A (Cap Type)	
C4	4.3 ± 0.3
C6IRA	13.6 ± 0.3
C7	3.5 ± 0.3
L5.5	8.3 ± 0.3

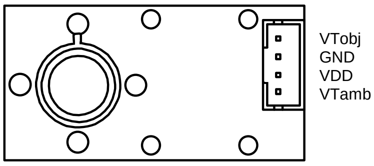
Dimensions B
Refer to sensor drawings

Connection Information

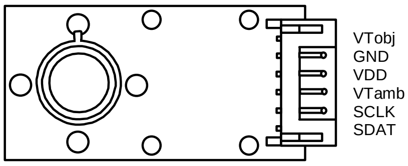
PCB Version P1 J4S



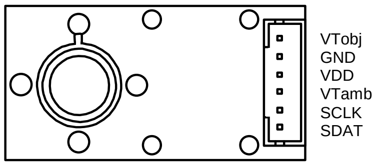
PCB Version P1 J4T



PCB Version P1 J6S



PCB Version P1 J6T



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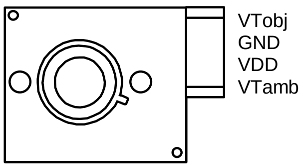
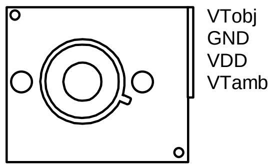
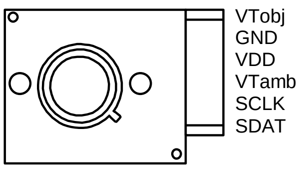


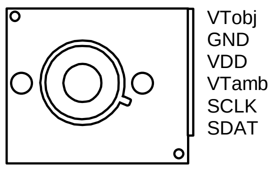
PCB Version P3 J4T



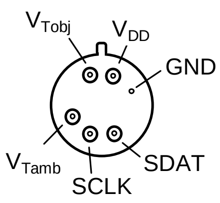
PCB Version P3 J6S



PCB Version P3 J6T



Non PCB Version



Bottom view

Liability Policy

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Customers considering the use of PerkinElmer Optoelectronics thermopile devices in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded, are requested to consult with PerkinElmer Optoelectronics sales representatives before such use. The company will not be responsible for damage arising from such use without prior approval.

As any semiconductor device, thermopile sensors or modules have inherently a certain rate of failure. It is therefore necessary to protect against injury, damage or loss from such failures by incorporating safety design measures into the equipment.

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基于 A2TPM I的电磁炉非接触式测温方案*

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(电子科技大学 成都 610054)

摘要: A2TPM I334是一种内部集成了专用信号处理电路以及环境温度补偿电路的多用途红外热电堆传感器,文中介绍了 A2TPM I334红外热电堆传感器的性能特征,同时提出了一种利用该传感器实现电磁炉的非接触式测温的方案。

关键词: A2TPM I334传感器; 红外; 传感器; 电磁炉; 测温
中图分类号: TP274·52 文献标识码: B 文章编号: 1672 - 4550(2006) 05 - 0120 - 04

Non - Touch Temperature Measurement Scheme of Induction Cooker Based on A2TPM I

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(University of Electronic Science and Technology of China Chengdu 610054)

Abstract: A2TPM I334 is a kind of infrared thermopile sensor, which integrates a special signal processing circuit and an environment temperature compensating circuit The performance and characteristics of the infrared thermopile sensor A2TPM I334 is introduced in this paper, and a Non - touch Temperature Measurement scheme of Induction Cooker adopting this sensor is put forward

Key words: A2TPM I334; infrared; sensor; induction cooker; temperature measurement

1 引 言

市面上现有的电磁炉产品,为了达到加热功率自动控制及实现保温等功能,都是在线圈盘中心上安置热敏电阻来间接获知锅的温度,这种检测方法检测的是从锅底向隔板的传导热,因锅底和隔板之间空隙的影响,误差很大。为了提高检测精度,为控制器提供准确的现场温度信息,使系统能够准确掌握烹饪火候,从而达到最佳烹饪状态,人们开始考虑直接检测从锅底放射的红外线的方法,于是我们就提出了本文的测温方案。

2 红外热电堆传感器介绍

热电堆传感器是根据热电效应,把目标的红外辐射转换成电信号,其频谱响应度均匀,广泛用来测量 - 180～+2 800℃范围内的温度。A2TPM I334是一种内部集成了专用信号处理电路以及环境温度补偿电路的多用途红外热电堆传感器,这种集成红外传感器模块将目标的热辐射转换成模拟电压。

2.1 特 性

集成信号处理电路; 集成环境温度校准传感器; 输出信号环境温度补偿; 快速响应时间; 有各种不同的光学系统和滤光片应用; 数字接口用于校准和调节。

2.2 引脚说明及功能介绍

本文选用型号为 A2TPM I334 - L5.5 OAA 300的传感器。它是由标准 TPS 334 - L5.5传感器带集成 A2TPM I专用集成电路以及 5.5 mm硅透镜光学系统构成,有 5视角,目标温度测量范围为 - 20～+300℃,正好适合电磁炉测温中 60～270℃的要求。

(1) 封装: A2TPM I334 - L5.5 OAA 300的封

* [收稿日期] 2006 - 07 - 28
** [作者简介] 许 雄(1985 -),男,本科生,就读于电子信息科学与技术专业。

装及引脚如图 1所示。

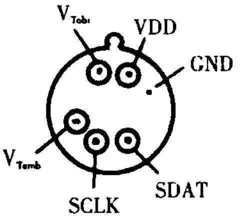

图 1 引脚说明

(2) 引脚功能:各引脚功能含义如表 1所示。

表 1 TLC7226引脚功能

引脚名称	功能	使用注意事项
GND	地	
V_{DD}	电源	通常接稳定的 5V直流电源
V_{Tobj}	目标温度输出电压	需接一个一阶或二阶低通滤波器
V_{Tamb}	环境温度输出电压	
SCLK	时钟线	一般不需要使用该串口
SDAT	数据线	

2.3 信号输出特征及测试数据

如图 2所示,传感器目标温度的输出电压与目标温度之间是非线性的,设 x为传感器目标温度的输出电压值,在室温 25°C时的典型值为 1.225 V,则关系式如下:

$$t/(℃) = -2.815\ 56x^6 + 51.719\ 67x^5 - 386.824\ 1x^4 + 1\ 510.241x^3 - 3\ 267.076x^2 + 3\ 820.25x - 1\ 792.6$$

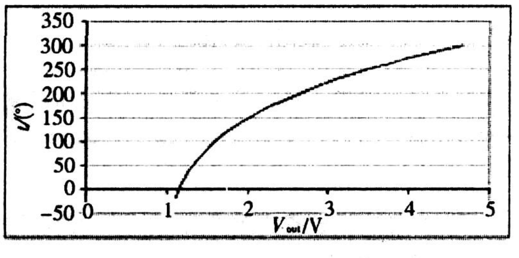

图 2 目标温度的输出电压与目标温度的关系

传感器环境温度的输出电压与环境温度之间也是非线性的,设 x为传感器环境温度的输出电压值,在室温 25°C时的典型值也为 1.225 V,关系式如下:

$$t/(℃) = -31.118x^6 + 390.89x^5 - 1\ 998.5x^4 + 5\ 321.1x^3 - 7\ 790.4x^2 + 6\ 006.5x - 1\ 895.6$$

在室温环境下,我们利用电烙铁对其无障碍物进行测试,所得到的数据与资料所给的数据吻合;当我们在传感器与电烙铁之间加入电磁炉的隔板时,目标温度的输出电压是从 1.302 V变化到 1.466 V,即只有 0.164 V的微小变化。环境温度的输出电压是从 1.236 V变化到 1.355 V,也是微小的变化。

3 电磁炉测温中的难点

障碍物(即承载锅的隔板)对信号的衰减比较大,透红外线的能力较差,通过传感器所测得的信号随锅温度变化的范围较小,要想放大微小的变化信号时,就不能用普通的运算放大器,而是考虑用仪表放大器。

障碍物本身也有一定的热传导的温度,也辐射出大量的红外线,导致传感器本身所处的环境温度也不断在变化,这样就需要对所测得的信号进行温度校正补偿。

4 方案实现

系统框图如图 3所示。

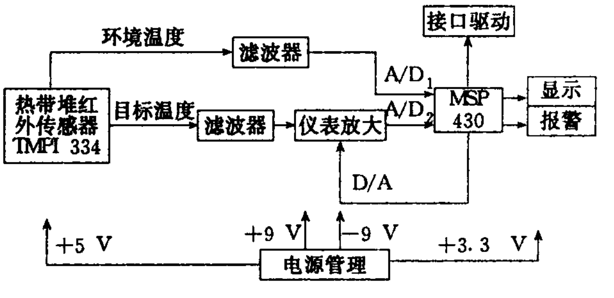

图 3 系统框图

针对上述测温中的难点,本系统中通过仪表放大器来放大微小的变化信号,同时用两路 A/D转换器即采集目标温度,又采集传感器所处环境的温度。在仪表放大器中,我们用高精度的 D/A转换器来产生基准电压,获得差动放大。

本系统中的微处理器选用的是 TI公司的 16位单片机 MSP430F169,它具有 8路 12位的 A/D转换器和 2路 12位的 D/A转换器,同时具有 16×16的硬件乘法器,能实现复杂的快速的数据处理。因为本系统中要实现非线性的温度补偿,所以要进行复杂的运算和数据处理。

本系统中还要注意电源的设计。传感器对电源的要求较高,需要比较稳定的、纹波系数较小的直流电源,因此设计时对其单独供电。而单片机系统是数字系统,且工作在 3.3 V,仪表放大又是模拟系统,所以它们的供电系统也要单独设计。

5 结束语

本文所提出的方案经过我们的测试是可行的，其他的测温方案还在继续深入研究之中，由于所使用的传感器的不同，所得信号的差异，系统设计也必然跟着变化，本文只是其中的一种实现方法，仅供参考。

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写借用人相关信息即可自动打印仪器设备借用表。添加一个命令按钮(CommandButton)控件，用于确认填写完成及打印借用登记表，打印登记表使用"Me. PrintOut 1, 1"语句可实现只打印当前工作表第一页(即借用登记表内容)。借用人核对所借仪器设备信息无误后签字即完成借用手续，实现了快速便捷的借用管理。在打印借用登记表的同时，自动将该条借用信息存入下面的仪器设备借用明细表中，同时更改"仪器设备汇总表"工作表中该仪器设备的"仪器现状"为"外借"。

3.4 实现归还

在归还所借仪器时，只需将"设备借用"工作表下面的仪器设备借用明细表中对应的"实际归还时间"一格填写当前时间即可。填写归还时间将触发工作表变化(Worksheet_Change)事件，程序通过有效性条件判断后，自动将"仪器设备汇总表"工作表中该仪器设备的"仪器现状"改为"可借用"。并同时根据借用时间和实际归还时间计算出该仪器设备的使用时间，以备综合分析需要。

3.5 实现仪器现状自动统计

为了实现仪器现状的自动统计，在"仪器设备汇总表"工作表上方插入三行，编写仪器设备现状统计表。在对应单元格内插入COUNTIF函数，该函数功能为计算指定区域中满足给定条件的单元格的个数，每次"仪器现状"发生改变，该函数都将自动统计处于不同状态的仪器设备数量，使管理者有一个总量的概念。

4 结束语

随着仪器设备管理人员的能力不断提高，实现仪器设备的信息化管理成为可能。本文以学校资产处提供的仪器设备明细账为基础，利用Excel和VBA技术自主开发仪器设备借用管理系统，突破传统管理模式，实现开放实验室条件下的仪器设备综合借用。该系统丰富了仪器设备借用登记表信息，加强了仪器设备的综合管理能力，可以更好地为在校师生及广大科研人员提供使用仪器设备的相关服务，有助于提升现有仪器设备的综合效益。

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