Product Change Notification

PCN

TPiS 1T 1086 L5.5 / 7452 – 16.10.2019

Dear Customer,

This letter is to inform you about the change of calibration conditions for the thermopile sensor TPiS 1T 1086 L5.5 / 7452. In the context of product performance improvement, we decided to change the calibration conditions from a hollow black body type to a flat surface plate type, which reflects typical applications better and improves the part-to-part behavior. We demonstrate the influence on the temperature reading of this part below and we provide a counter measure to be adapted on your system level, in order to keep the behavior of this part as close as possible to the condition before the change. The change takes place for production parts from week 01 / 2020 onwards.

We apologize for any inconvenience.

Related Change Information

Affected Bau number: **9638 7452**

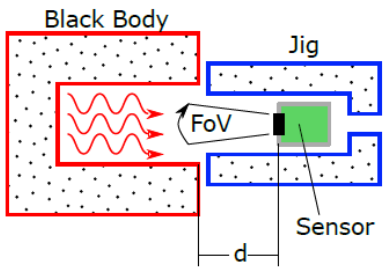
Content of Change

Calibration conditions before change (extracted from specifications)

8.1 Calibration Conditions

The thermopile output is related to the net IR-radiation. The net IR-radiation can be correlated with the object temperature for a specific fixed set-up. The set-up valid for the factory calibration constants is shown in sketch 19.

Figure 19: Calibration conditions



A silicon-oil immersed hollow black body with an inner diameter of 55 mm and an emissivity of better than 99 % has a temperature T_{obj}. A temperature controlled jig with a inner diameter of 35 mm has a temperature T_{amb} and is coated with a black paint for an emissivity of better than 96 %. The jig contains the TPiS 1T 1086 L5.5 sensor at a distance d to the black body.Numbers are specified in table 8. Conditions other than described in this document generally require a customized object calibration. Otherwise sensor performance may be different than specified here. Please contact our local representative for more details.

Table 8: Calibration Conditions and Temperature Measurement Specifications

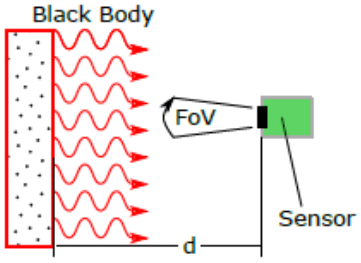
Parameter	Symbol	Min	Typ	Max	Unit	Remarks / Conditions
Distance to black body (BB)	d		30		mm	
Calib. Temp. $T_{BB=Obj}$			100		°C	
Calib. Temp. T_{Amb}			25		°C	
Accuracy T_{Obj}			±0.5		°C	@ Calib. Temp.
Precision T_{Obj}			< 0.1		°C	
Accuracy T_{Obj}			±3		°C	$40 < T_{Obj}[°C] < 250$
Precision T_{Amb}			< 0.1		°C	
Accuracy T_{Amb}			±1		°C	$10 < T_{Amb}[°C] < 80$

Calibration conditions after change (extracted from specifications)

8.1 Calibration Conditions

The thermopile output is related to the net IR-radiation. The net IR-radiation can be correlated with the object temperature for a specific fixed set-up. The set-up valid for the factory calibration constants is shown in sketch 19.

Figure 19: Calibration conditions



A fluid heated plane black body with an outer dimension covering at least 4 times the sensors field-of-view (FoV) and an emissivity of better than 95% has a surface temperature T_{obj}. The surface temperature uniformity is better than 0.2 °C. The ambient temperature T_{amb} is at 25 °C ± 3 °C. The TPiS 1T 1086 L5.5 sensor is mounted at a distance d to the black body. Numbers are specified in table 8.
Conditions other than described in this document generally require a customized object calibration. Otherwise sensor performance may be different than specified here. Please contact our local representative for more details.

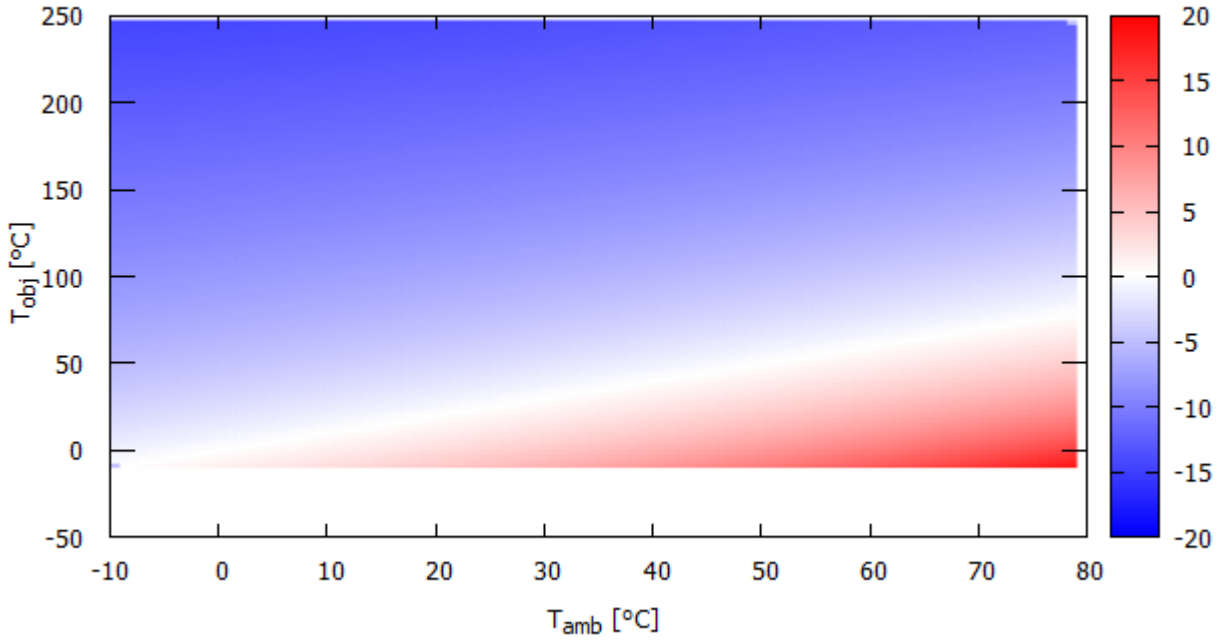
Table 8: Calibration Conditions and Temperature Measurement Specifications

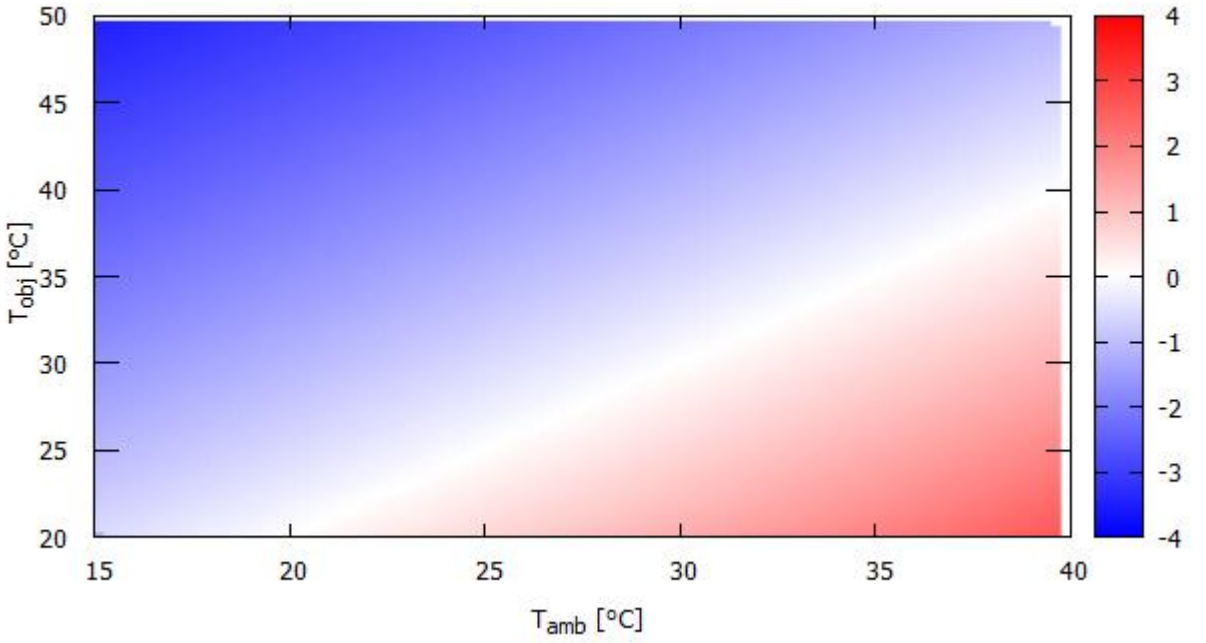
Parameter	Symbol	Min	Typ	Max	Unit	Remarks / Conditions
Distance to black body (BB)	d		26		mm	
Calib. Temp. $T_{BB=Obj}$			100		°C	
Calib. Temp. T_{Amb}			25		°C	
Accuracy T_{Obj}			±1		°C	@ Calib. Temp.
Precision T_{Obj}			< 0.1		°C	
Accuracy T_{Obj}			±3		°C	$40 < T_{Obj}[°C] < 250$
Precision T_{Amb}			< 0.1		°C	
Accuracy T_{Amb}			±1		°C	$10 < T_{Amb}[°C] < 80$

Effects of change

Despite having a black body covering the full field of view with a controlled surface temperature, stray light is affecting this part. The contribution of stray light is visible in the signal. The signal of the thermopile is stronger for a plate type black body as compared to a hollow tube black body. This in turn will likely lead in the application to temperatures, which are displayed lower as previously in case the object temperature is higher than the sensor temperature.

Based on a two-point measurement in front of a flat black body for a set of 6 samples, we demonstrate the following expected mean deviation (T object before change) – (T object after change) = ΔT[°C] for two different object and temperature ranges:





Countermeasures

In order to keep the behavior for the parts after change comparable to the behavior before the change, you must scale the calibration factor as given by the component EEPROM by a factor of

$$\mathbf{k \rightarrow k / 1.127}$$

This is described in the product specifications in section 8.5. If your code is foreseeing an emissivity correction, you may alternatively scale the emissivity by the factor of

$$\boldsymbol{\varepsilon \rightarrow \ \varepsilon / 1.127}$$

8.5 Calculation of the Object Temperature

The thermopile output signal TP_{object} is not only depending on the objects temperature but also on the ambient temperature T_{amb} as demonstrated in figure 4. To obtain the object temperature T_{obj} calculate

$$T_{object}[\mathrm{K}] = F\left[\frac{TP_{object} - U_0}{k} + f(T_{amb})\right]$$

where T_{amb} is obtained as discussed in section 8.4. k is a scaling/calibration factor given by

$$k = \frac{U_{out1} - U_0}{f(T_{obj1}[^\circ\mathrm{C}] + 273.15) - f(25 + 273.15)}$$

and contains the emissivity ϵ of the object as well as the field-of-view coverage factor Θ. Since our devices are calibrated for a full FOV coverage ($\Theta = 1$) and an object emissivity of nearly $\epsilon = 1$, this factor has to be scaled properly to adjust for a different object property in the application by

$$k \longmapsto k \cdot (\epsilon \cdot \Theta)$$

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