



Instruction Manual

for

gRAY Thermal PSD

1. Equipment needed

1 gRAY Thermal PSD

Optional: 4 analog voltage amplifiers

1 Differential voltage read-out unit (1 mV resolution or better)

1 Heat sink for thermal integration (e.g. aluminum block)

2. Structure of the position sensitive device

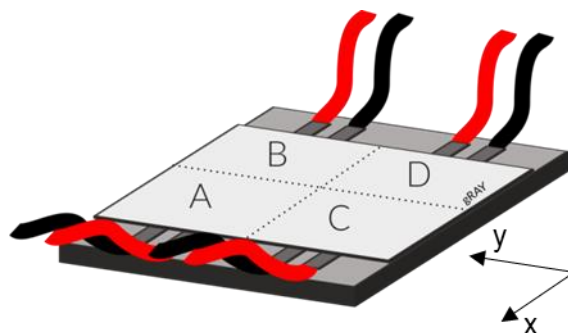
The gRAY Thermal PSD is based on a thermopile detector. For a standard power sensor, all thermocouples comprised in the module would be connected in series for the signal read-out. To form the PSD, only the thermocouples in each quadrant are electrically connected to divide the total area into four electrically separated regions (as depicted below). Due to the common mechanical integration, a thermal coupling is still provided between all segments. The latter is the reason for the remarkable sensitivity for relative position changes of an incident laser beam.

When illuminating one of the sections (e.g. section A) with a laser spot, the output signal of this segment increases, whereas the other segments will show a low signal output. If the beam is moved towards the center, the signal of section A starts to decrease. The other three signals increase on the other hand, since the power detected in those sections is higher when the beam is closer to the center of the PSD.

As is explained below, the x and y position of the incident laser beam can be determined by relating the recorded signal for all four segments. Hence, a direct read-out of the laser beam position is possible.

Comment: The determined position indicates the center of power density for the laser beam. For a symmetric beam, this corresponds to the geometric center as well. However, for asymmetric beam shapes, the geometric center might differ from the center of power density.

3. Set up the x-y read-out by following these steps:



1. Mount the sensor onto a thermal stabilizer like an aluminum profile heat sink. As mounting substances, either a thermally conductive paste or a thermally conductive glue is suitable.



2. Connect each of the four PSD segments to a channel of your voltage read-out unit (A=channel1; B=channel2; C=channel3; D=channel4). The polarization is indicated in the figure above, where “red” marks the positive and “black” indicates the negative pole of the respective sensor element.
3. Record the voltage signals for each segment A, B, C and D while illuminating the sensor surface with a laser beam.
4. To determine the normalized x and y position of the laser beam, use the following equations:

$$X = \frac{(A+C) - (B+D)}{(A+B+C+D)}$$

$$Y = \frac{(A+B) - (C+D)}{(A+B+C+D)}$$

5. A coordinate of (X , Y) = (0 , 0) corresponds to the center position.
6. In order to obtain the absolute position of the laser beam, multiply the normalized coordinates by the edge length of one segment (half the total sensor edge length “a”, given in the datasheet). Please note that this absolute position is only valid close to X = Y = 0 and increasing deviations occur towards the edge of the position sensor due to intrinsic nonlinearity.

Disclaimer

The above restrictions, recommendations, materials, etc. do not cover all possible cases and items. This document is not to be considered to be complete and it is subject to change without prior notice.

Revision History

Date	Revision	Changes
16. October 2014	1.0	Initial revision
04. August 2015	1.1	Changed polarity in drawing
27. June 2016	1.2	Add axes to drawing, fixed typos
22. May 2017	1.3	Add note to nonlinearity