MERIDIAN
Innovation

Performance Verification MI0802M5S

Application Note MI.AN42

Revision 0.0.3 – Jan 2023

1. INTRODUCTION

The MI0802 is factory calibrated, so that all pixels report the same temperature value subject to some tolerance, when the field of view is flooded with uniform temperature target. This is referred to as *factory level calibration*. When the MI0802 is used in an application where not just thermal contrast is needed, but absolute temperature values are important, it may be useful to verify and fine tune the performance either per product (*product level calibration*), or per individual module (*unit level calibration*).

Below we describe a simplified approach that allows one to check the performance of an individual module by using the standard evaluation kit hardware and software, and available calibrated blackbody with known emissivity.

By radiometrically calibrated blackbody we mean that its radiance at a given temperature set by the user must correspond to the radiance of a perfect blackbody (with emissivity 1.0) at that temperature. This should be valid at least at room temperature of operation.

2. METHODOLOGY

The accuracy of the readout temperature is affected by the *distance* between the reference heat source and the thermal imager, and by the *size of the emitter* of the reference heat source (blackbody). The best accuracy is achievable for an optimal combination of *distance* and *emitter size*.

The basic setup is illustrated in Fig. 1. The ambient temperature, in the range of 21 – 25 °C must remain constant, and no forced ventilation should be applied to the blackbody or the thermal imaging sensors. There should be no moisture on the lens of the module.

2.1. Physical Setup

- *Distance*: 10 to 15 cm between thermal imager and blackbody emitter
- *Emitter size*: between 10 cm x 10 cm and 20 cm x 20 cm square emitter, or a circular emitter of 12 to 17 cm diameter.

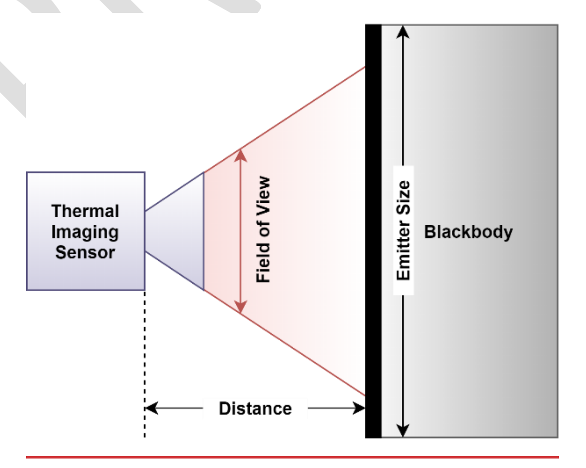


Fig. 1. Physical setup for module verification. The emitter size of the blackbody must nearly fill or exceed the field of view of the sensor in each direction.

2.2. Verification Results

Typical results are shown in Fig. 2, for 10 different module samples. The left plots presents the temperature readout $T_{readout}$ from the sensor versus the reference blackbody temperature T_{bb}. The temperature readout is obtained by averaging 50 frames, acquired at 10 FPS and then taking the average value of the 9 pixels at the centre of the array. The averaging establishes with sufficient accuracy the mean readout value at a given target temperature in a relatively short time, 5 seconds, in this case. The right plot depicts the readout error, defined as $T_{error} = T_{readout} - T_{bb}$. For each module, data is acquired at the conditions specified in the title of Fig. 2. During the acquisition, the MI48 thermal imaging processor has been configured with the default gain of 1.0, a sensitivity factor of 1.0, and frame offset of 0.0. No firmware or software filtering has been used during the acquisition. Fig. 2 combines data acquired from two different blackbodies. For the range $5\ to\ 95$ ℃, HGH Infra PCN-7 radiometric blackbody is used. Accordingly, the MI48 emissivity register has been set to 1.0. This data is represented with squares. Another data acquisition was performed in the range from $30\ to\ 250$ ℃ and is presented with disks in Fig. 2. In this case, BR400 blackbody was used, and the MI48 emissivity register was set to the advertised emissivity of the blackbody, 0.97.

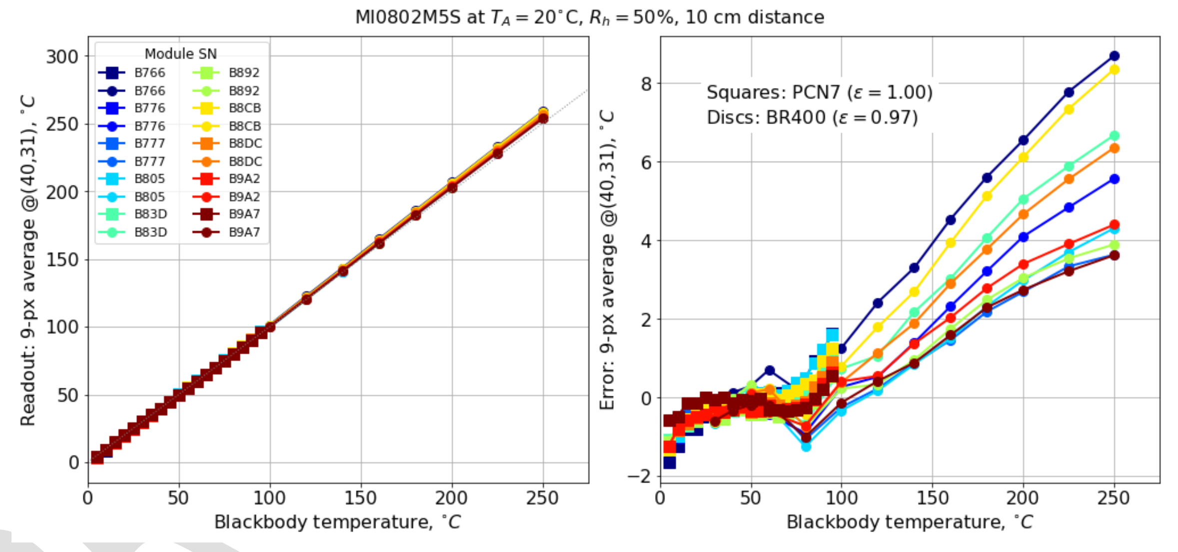


Fig. 2. Measured temperature (left) and temperature error (right) versus reference blackbody temperature. Dashed line on the left plot is the ideal relation of blackbody and measured temperature, for visual reference. The actual deviation of the readout from the reference temperature is shown in the right plot, using corresponding symbols and colours. For each module

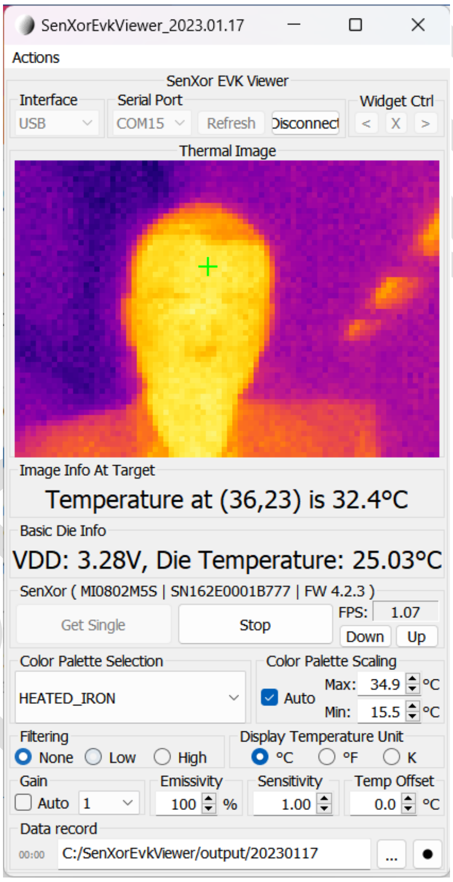
The deviation of the temperature readout from the reference blackbody temperature is shown for each datapoint on the right plot in Fig. 2. The magnitude of the error is within specification.

Since the error exhibits systematic character, it is in principle possible to compensate for it at system level, accounting for other potential sources of error, e.g. due to different supply voltage reference to the sensor and nominal enclosure temperature.

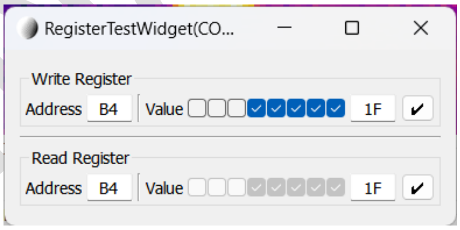
2.3. EVK Software Setup

One can reproduce the above results following the setup of Section 2.2 and the following example settings of the MI48.

1. Ensure you have SenXor EVK Viewer version 2022.04.06 or later.
2. Connect to the thermal imaging module and start continuous transfer.
3. Wait for the die temperature to reach steady state – very slow or no change at all.
4. Set **Filtering** to **Low or None**, after connecting to the sensor, as seen in Fig. 3.
5. If using GUI release 2023-01-17 or later, set Gain to 1, Emissivity to 100 %, Sensitivity to 1.0 and Temperature Offset to 0.0, as shown in Fig. 3—a). Alternatively, use the Register Read/Write Action (from Actions drop-down menu) to set several registers according to the table shown in Fig. 3—c).
6. Record data for 10 seconds and then extract the 9-pixel average from the centre of the average frame (across all recorded data frames), assuming the centre pixels represents the centre of your reference heat source.



a)



b)

Register Address	Register Value
0xB4	0x19
0xCA	0x64
0xC2	0x64
0xCB	0x00
0xB9	0x00

c)

Fig. 3. a)—EVK GUI showing **Filtering** level is **None**, **Emissivity** 100%, **Sensitivity** 1.0, **Offset 0.0** ℃ and **FPS** 1. b)—The RegisterTestWidget, selected from *Actions →Registers Read/Write*. c)—Table of the registers addresses and corresponding values that must be set for the performance check of the module.

3. Revision History

Revision	Date	Notes
0.0.1	Jan 2023	Initial Version
0.0.2	Jan 2023	Updated GUI interface pictures as per GUI release 230117
0.0.3	Jan 2023	Fixed Typos in section 2

4. Legal Information

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5. Contacts Information

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