MI0801 Camera Module
Evaluation Kit
User Manual

Contents

1. Overview

This user manual is aimed to give users a fast introduction to the use of the MI0801 Camera Module Evaluation Kit (EVK) and its accompanying software.

## 1.1. MI0801 Camera Module Evaluation Kit (EVK)

The EVK contains two circuit boards, the MI48A0 Thermal Image Processor and the External Interface Processor Board. This kit contains:

- MI0801 Camera Module
- MI48A0 Thermal Image Processor (TIP) Board
- External Interface Processor Board
- Graphical User Interface (GUI) software

Together, these components combine to form a thermal camera system capable of capturing 80-by-62 thermal images. This kit is designed to be connected via USB to a host PC and controlled using the provided GUI software.

1.2. EVK Internal Connections

The following diagram provides a high-level view of the physical and electrical connections within components of the EVK.
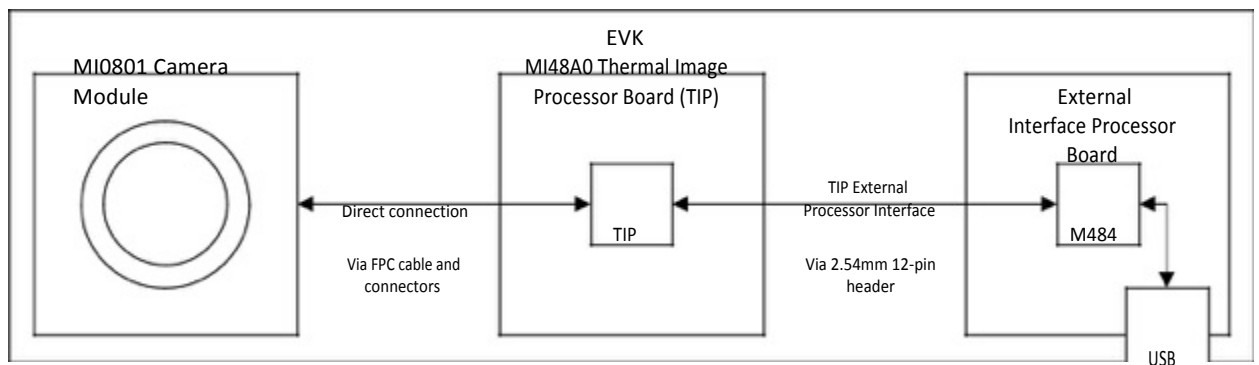
1.3. MI0801 Camera Module - Bobcat

The MI0801 Camera Module is a thermal imaging sensor, capable of capturing 80x62 (4,960)-pixel images of long wave infrared radiation (LWIR). It is factory calibrated and has a completely digital interface. No mechanical shutter is employed nor required. Its patented fabrication and wafer-level vacuum packaging ensures low cost of ownership, enabling many new applications to employ LWIR thermal imaging technology.
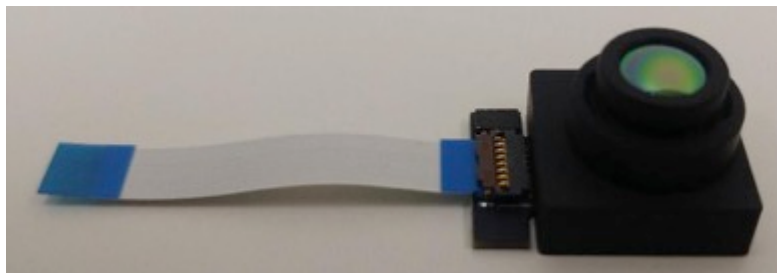
1.4. MI48A0 Thermal Image Processor (TIP)

The MI48A0 TIP is a Meridian Innovation product made specifically to interface with the MI0801 Camera Module as a companion chip. It is a 5mm by 5mm QFN32 chip with a bottom thermal pad and is expected to be electronically connected to the corresponding signal pins of the MI0801 Camera Module. This companion chip performs all the low-level computations and signal timing required to process the raw data from the MI0801 Camera Module, thus removing this burden from any external processors.

The MI48A0 TIP also provides the external interface which is made up of common electrical buses and interfaces. The serial peripheral interface (SPI) bus is provided to transfer thermal image data with the MI48A0 TIP as a SPI slave device. The Inter-Integrated Circuit (I^2C) bus is provided to control MI0801 module parameters. The DATA_READY Interrupt is a digital signal output from the MI48A0 TIP to alert the external processor of available image data for reading.

1.5. MI48A0 Thermal Image Processor Board

The MI48A0 Thermal Image Processor Board demonstrates how the MI0801 Camera Module and MI48A0 TIP are connected and provides a standard 2.54mm 12-pin header containing the external interface for easy integration into any external processor or system. The External Interface Processor board is an example of such an external system.
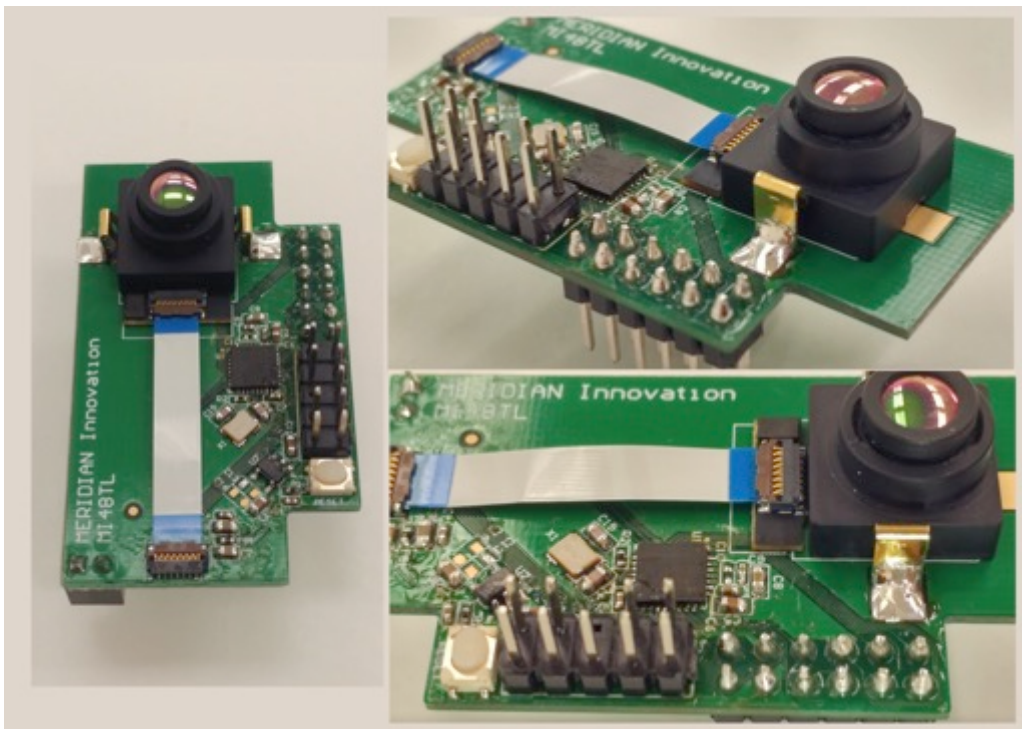
1.6. External Interface Processor Board

The External Interface Processor Board is an example of an external system that interfaces with the MI48A0 TIP using the TIP External Interface. The external processor is the Nuvoton M484SIDAE. This External Processor Board is shipped pre-loaded with Meridian Innovation's firmware to demonstrate the TIP External Interface communication protocol.

The External Processor Board also features a USB Micro B connector plug, and should be connected to a host PC via a USB 2.0 High-speed (HS) port for power and communication.

1.7. EVK Graphical User Interface (GUI) Software

The EVK GUI software is a computer program that allows a computer user to control the External Interface Processor board, view the thermal images captured, and more. The GUI currently only supports computers with Windows-based operating systems.

The screen shots below show example images from the GUI. In the descriptions that follow items shown in "*quotes and italics*" refer to the corresponding elements of the GUI.
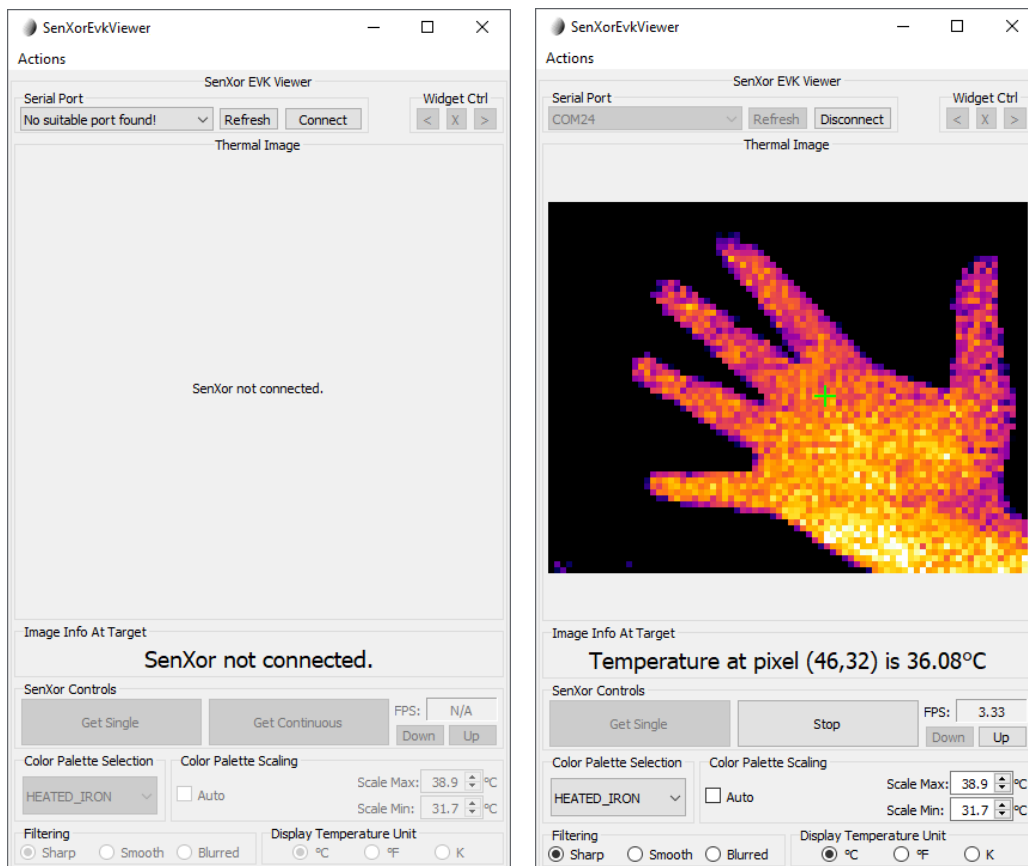
2. GUI Software

The following sections describe how to obtain, run and operate the GUI on a Windows-based computer with a USB 2.0 High-Speed connector socket.

2.1. Minimum System Requirements

The GUI currently only supports computers running Windows 7, 8/8.1, 10. It also requires at least one USB 2.0 port supporting USB High-speed mode.

2.2. Obtaining and Launching GUI

Please contact us to obtain the GUI software in a ZIP file.

After obtaining and downloading the ZIP file, extract (a.k.a. unzip) the contents into a convenient directory.

Inside the directory with the extracted files, run the file in .exe.

Note that most GUI controls are disabled upon launch.

2.3. Connecting via USB

Connect the EVK to a computer using a USB 2.0 A-Male to Micro B cable.

The EVK should enumerate as a "*USB Serial Device (COMx)*" in Windows' "*Device Manager*" window, where x is an integer. The EVK is a USB Communications Device Class (CDC) device and has a USB Vendor ID of 0416 (hex) and a USB Product ID of B002 (hex).
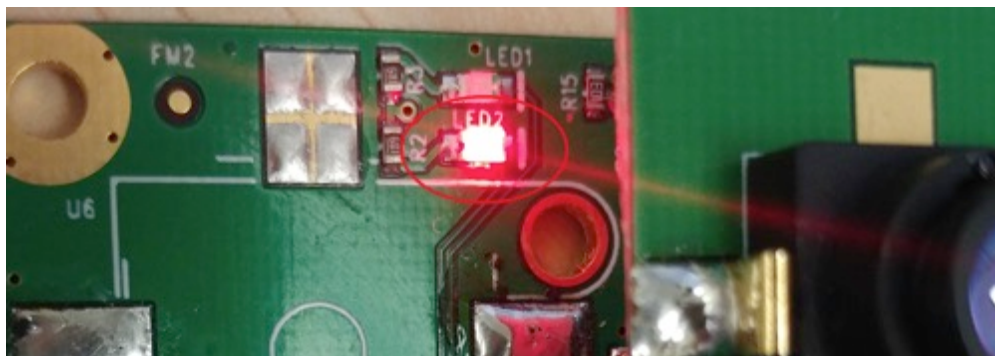

Note that upon connecting the USB cable to the computer and EVK, the latter is powered on. This is indicated by the LED2 on the EVK.

After launching the GUI software and physically connecting the USB cable, press "*Refresh*" on the GUI under the "*Serial Port*" section. The "*Serial Port*" selection drop-down should change from "*No suitable port found!*" to "*COMx*" if the EVK is detected properly.

Press "*Connect*" to establish a connection between the GUI and the EVK.

Note that most GUI controls are now enabled and start continuous capturing by default.

2.4. Capturing Image
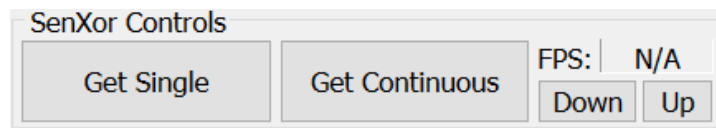
Press the "*Get Single*" button under "*SenXor Controls*". The EVK will capture a thermal image, which will be transmitted to and displayed on the GUI. Note that LED1 on the EVK may blink multiple times. LED1 indicates that frame(s) are being captured and processed by the EVK.

Press the "*Get Continuous*" button under "*SenXor Controls*". The EVK will begin to continuously capture thermal images, and the GUI display will be continuous updated. Note that LED1 will blink continuously, and the "*FPS*" counter under "*SenXor Controls*" on the GUI will also continuously update to report the framerate of the EVK. "*FPS*" here stands for Frames Per Second. The FPS is mainly affecting the internal frame averaging.

The EVK always captures raw sensor data at 30 frames per second (FPS), which is then processed by the TSP companion chip into images of dense temperature data. The TSP also features various post-processing functions.

One such function is internal frame averaging. Depending on the application, it may be desirable to sacrifice framerate for higher accuracy and lower image noise. Internal frame averaging controls the number of frames (N) captured and averaged before output from the TSP. The resulting framerate is 30/N frames per second. Lower FPS means more frames are taking for internal averaging. By default, the range of FPS is set between 1 to 15.

Human hand under different internal frame averaging
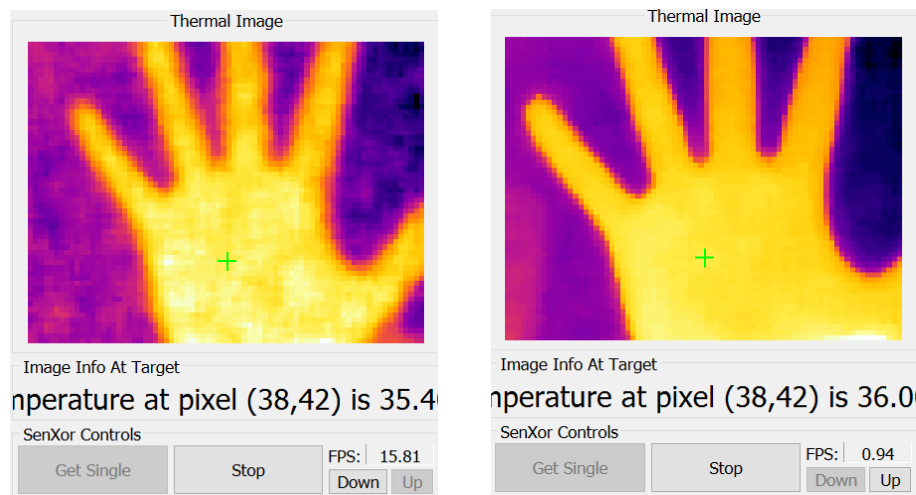
2.5. Display & Cursor Interactions

While there is an image displayed on the "*Thermal Image*" display area, it accepts cursor clicks on the displayed image to place a "*crosshair*" on a pixel. The array coordinates and temperature reading for that pixel is shown in the "*Image Info at Target*" area.

Note that the crosshair persists with new frames from "*Get Single*" or "*Get Continuous*" and the information for the target pixel will update correspondingly.

2.6. Color Palette and Scaling

The GUI performs its own post-processing functions (i.e. processing down on the host PC) before displaying the thermal data received over USB. One such function is to apply color to pixel values so that temperature differences are more visually significant.
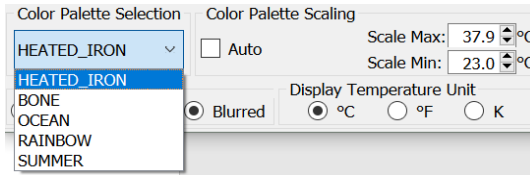

Under "*Color Palette and Scaling*", there are a drop-down control to select different pre-set color palette mapping to the temperature value.

The "*Auto?*" checkbox selects whether the color palette is scaled automatically to cover the minimum and maximum temperatures of the currently displayed image. While this is checked, "*Scale Min*" and "*Scale Max*" controls display the minimum and maximum temperature values. While this is unchecked, the "*Scale Min*" and "*Scale Max*" controls allow the user to manually adjust the minimum and maximum temperatures of the color scale.

Note that if a pixel on the image exceed the maximum temperature of the color palette scale, that pixel will be applied the color corresponding to the maximum value on the color palette scale, similar to a pixel below minimum temperature. On the other words, the scaling affects how the color palette spreading in between minimum and maximum temperature boundary. Please adjust the scaling range according to the target object and environment temperature to optimize visualization.

Take a human hand as example, under HEATED_IRON color palette:

MERIDIAN Innovation
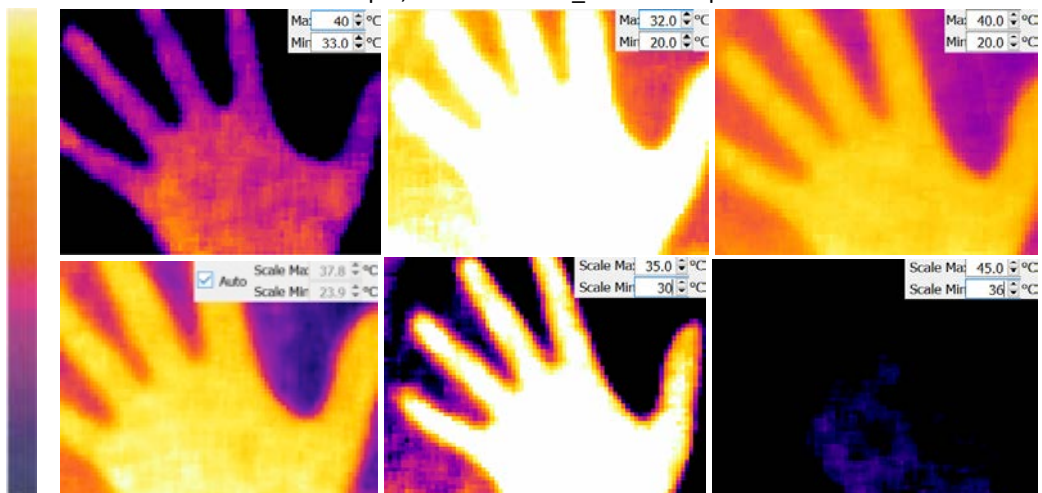
2.7. Pixel Filter

Another GUI post-processing function is the pixel filter. In traditional image processing terms, this function is equivalent to apply a 2D convolution to the thermal image with a NxN mask, where N is set to be 0, 3 or 5 corresponding to Sharp, Smooth and Blurred currently. The GUI controls for these parameters are available under the "*Pixel Filter*" sections of the GUI. A pixel filter performs spatial filtering of the image, in order to reduce noise and effective in removing "salt and pepper noise" in temperature images.
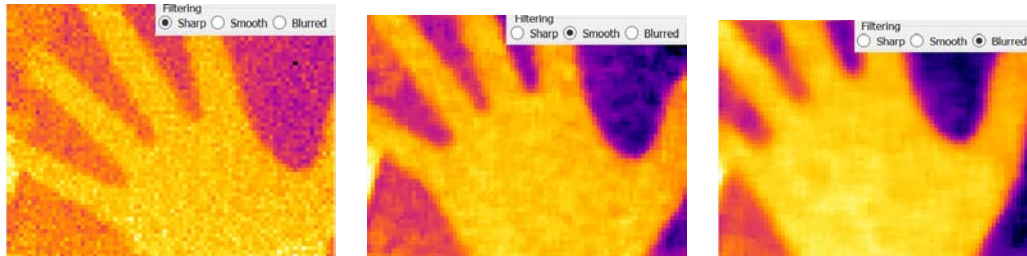
Note that the effective image size is reduced when a pixel filter is applied. For a mask of size 3, the top, left, right and bottom image border pixels are disregarded and hence the effective image size is reduced by 2 rows and 2 columns. For a mask of size 5, the effective image size is reduced by 4 rows and 4 columns.

2.8. Temperature Unit

By default, all temperatures values displayed on the GUI is in degrees Celsius. This can be modified to degree Fahrenheit or Kelvin.

2.9. Multiple EVK connection

If there are more than one EVK connecting to the device, the GUI can expand to multiple widgets for different EVK. Under "Action" -> "Add New Viewer" tag and new widget can be added on the left or right to the main window. Widget Ctrl controls the corresponding widget swap with left, close or swap with right widget.