MI0801 Camera Module
Product Brief

High-Definition, Cost-Effective and Compact Thermal Imaging Camera Module

Powered by SenXor™, Meridian Innovation's patented innovative CMOS hybrid architecture, MI0801 Camera Module is a Wafer Level Vacuum Packaged (WLVP) 80 x 62 Long Wavelength Infrared (LWIR) thermal array sensor from Meridian Innovation mounted in a custom housing. The MI0801 chip comprises of two CMOS wafers bonded together with a vacuum cavity in between. The base (active) wafer contains all the circuit and sensor elements; the top (cap) wafer is required to transfer the LWIR radiation and maintain a vacuum environment for optimum operation of the LWIR detectors. The MI0801 Camera Module comprises of WLVP chip, die attached to a PCB substrate and mounted in a custom housing, including lens assembly. It is designed to connect to Meridian Innovation's MI48A0 Thermal Image Processor Board via a simple flat strip cable. In this way multiple processing subsystems can be supported. The housing allows for the fitment of various lens assemblies, allowing fast adaptation within several application areas.

Features	
Resolution	80 (H) x 62 (V)
IR Wavelength	8 - 14µm (Thermal LWIR)
Temperature accuracy	up to +-1°C
Interface	USB
Data capture from standby	Less than TBD ms
TSP Processing	Non-uniformity, Environmental temperature, voltage correction Performs temporal and/or spatial filtering of thermal data
Power Consumption	Less than TBD mW
Calibration	Shutter-less, factory pre-calibrated
ITAR	No control and export compliance at 30Hz

Applications	
Appliances	Fridge | Microwave | HVAC
Automation	Occupancy | people counting - Lighting control Electrical faults Fire door control | security and safety camera
Industrial	Thermal measurement devices
Security	Surveillance | Fire Safety | Baby monitor
Automotive	Autonomous driving | Compartment occupancy
Medical	Thermography

Device Overview

MI0801 Camera Module has a digital interface and no shutter. The patented fabrication and WLVP packaging ensure low cost of ownership, enabling many new applications to exploit LWIR sensors.

It can be difficult to ascertain the "real world" performance of a thermal sensor from its device characteristics. Meridian Innovation believes it is important to set the correct user expectation. Our devices are designed to be able to measure temperature of a black body to accuracy of +/-TBD or with a maximum deviation amongst detectors of less than TBD%.

Key Specification

Detector	**MI0801**	**Thermal LWIR**
	IR Wavelength	8 - 14µm
	Array size	80 (H) x 62 (V)
	Detector pitch	45µm (H) x 45µm (V)
	Maximum frame rate	30 FPS
	Max scene temperature range*	-40°C to 1000°C
	NETD *(Ge Lens)	TBD
	Number of dead detectors	1%
	Accuracy*	TBD
Environmental	Operating temperature	-20 - 85°C
	Storage temperature	-40 - 85°C
	Altitude (pressure)	TBD kpa
	Relative Humidity	TBD %
	Shock	TBD
Interface	Power supply*	3.3V
	Power Consumption*	43mW
	Host interface	SPI interfaces supported
Mechanical	SenXor™ size	13mm x 17.025 mm x 10.68mm
	SenXor™ weight	TBD g

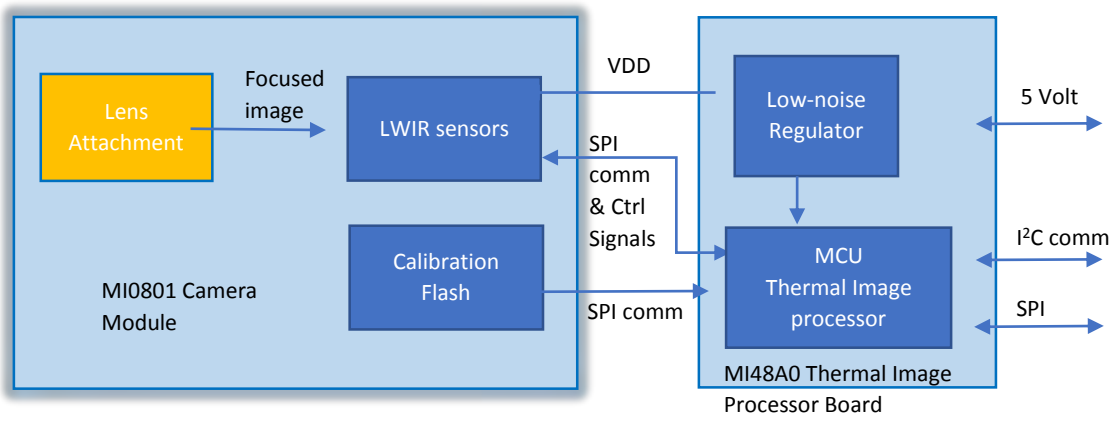
*Note: Number to be confirmed.

Ordering Information

Order Number	Lens f/No.	Diagonal FOV	NETD**
MI0801M0G	0.8	55	TBD

** NETD quoted @1FPS ambient 25 degree and scene temperature 10-70 degree.

Recommended System Architecture



It is recommended that the MI0801 Camera Module is paired with the Meridian Innovation's MI48A0 Thermal Image Processor Board. The MI0801 Camera Module can conveniently be clipped to the MI48A0 Thermal Image Processor Board which takes care of all calibration and image optimization. The camera module may be unclipped and remotely mounted if required. The camera module is factory calibrated and the calibration information is stored in the 64 kByte flash that is mounted on it.

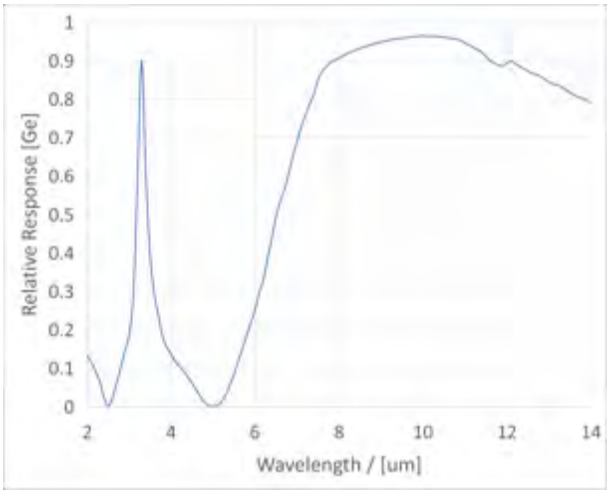
The MI48A0 Thermal Image Processor performs all the low-level computations required to process the raw data from the MI0801 Camera Module, completely removing this burden from the customer CPU. This results in a very clean and streamline interface that is simple to implement and maintain.

I^2C and SPI communications are provided in the MI48A0 Image Processor Board to facilitate connection to a customer CPU.

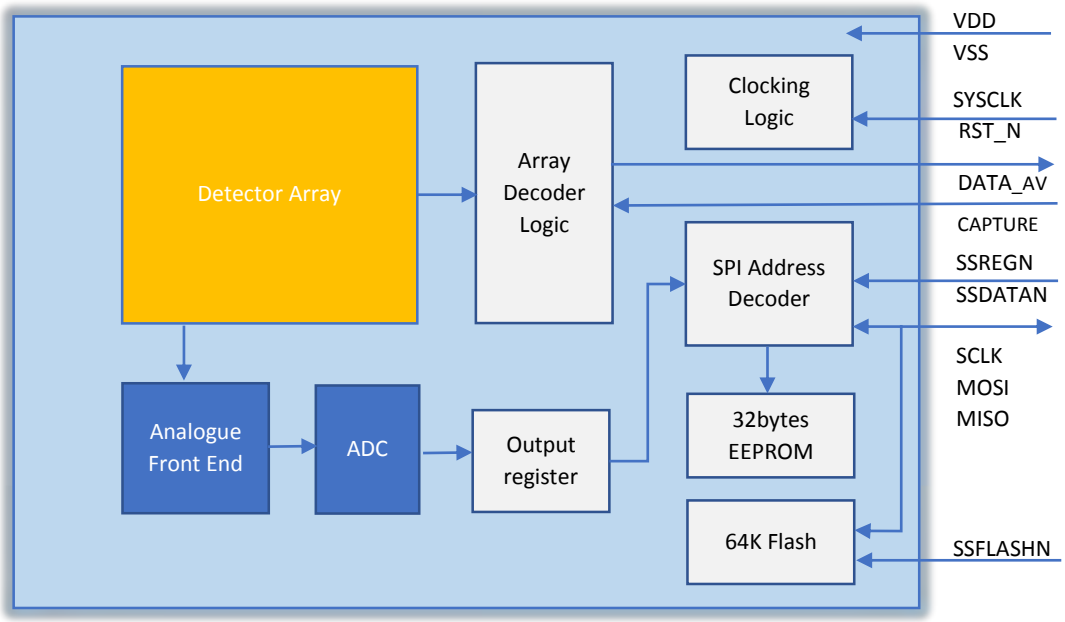
Meridian is also providing implemented evaluation kit with processor board. Please refers to Camera Module Evaluation Kit for further information if interested.

Spectral Response

The graph below is indicating the relative spectral response of each sensor within the array using a germanium lens.



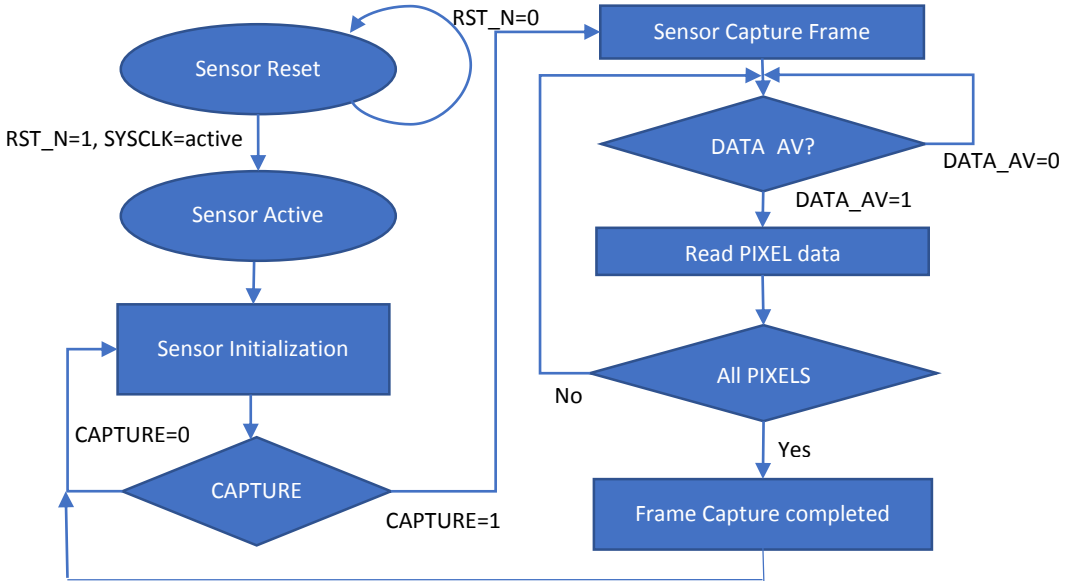
MI0801 Camera Module Block Diagram



Detector Array	**An array of 80 x 62 LWIR detectors, each of which produces a voltage dependent on the difference in temperature between the incident IR energy it absorbs (via a lens) and the temperature of the die substrate**.
Clocking Logic	The clocking logic is responsible for all the timing signals supplied to the Array decode logic. It allows the MI48A0 Thermal Image Processor to reset the MI0801 Camera Module; start and stop capture of frame data and control the frame rate.
SPI Address Decoder	This logic decodes data on the SPI Slave bus and selects the correct registers within the MI0801 Camera Module. Three SPI select pins are supported. The 1st register decode section (which has an address associated with each transfer). The 2nd one is for the ADC data section, this has no address associated with the transfer and only supports data from the MI0801 Camera Module to the Host. The 3rd one is for the 64Kbyte flash section.
Array decode logic	Comprising row and column decode logic, this block is responsible for accessing each detector in sequence and routing its output via the Analogue Front End to the ADC.
Analogue Front End	The AFE stage is responsible for amplifying and filtering the Detector and Sensor signals so they are suitable for digitization by the Analogue Digital Converter. This stage includes gain controls and signal conditioning which is selected depending on the scene temperature and frame rate.
ADC	The Analogue to Digital Converter digitizes the output signal from the Analogue Front end and passes it to the SPI interface where it can be read by the MI48A0 Thermal Image Processor.
Output Register	The output register stores the converted digitized signal.
32bytes EEPROM	Embedded EEPROM has 32 bytes that is mainly used to hold the unique device ID field (read only).
64K Flash	On board Flash memory has 64Kbytes that is mainly used to hold the calibration information.

Operation Overview

State diagram of MI0801 Camera Module in Single Capture operation



The sequence of operation is as follows:

- The host processor should hold the MI0801 Camera Module in reset (**RST_N** = 0) until required.
- The host should apply **SYSCLK** and then de-assert **RST_N**, making sure the clock and reset timings are met.
- Next the MI0801 Camera Module should be configured using the SPI register interface.
- Now the host can assert **CAPTURE** to start acquiring frame data. Continuous and single frame modes are supported (see “Capture” section for the modes available).
- Data should now be transferred on the SPI ADC data interface, a positive edge on **DATA_AV** signals to the host that the next word is ready for transfer.
- The MI48A0 Image Processor is responsible for calculating the scene temperature from the SPI ADC data.
- If required the MI48A0 Thermal Image Processor may stop capturing – align to a complete frame boundary, and then change any of the MI0801 registers using the SPI register interface.
- It may then continue to capture new frames.

Single frames capture and power down modes allow for very versatile and low power capture regimes to be implemented.

Interfaces

The MI0801 Camera Module has a very simple interface with a MI48A0 Thermal Image Processor. This consists of clocking and handshake signals and 2 SPI channels, one for register access and one for ADC data access.

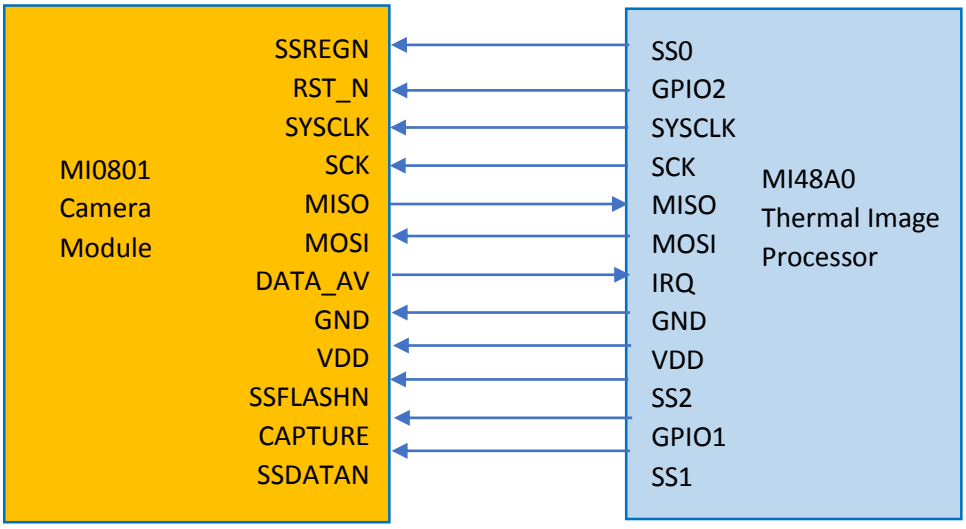
The clocking and handshake signals are:

Signal	Type	Description
SYSCLK	In	Master clock from host
RST_N	In	Reset from Host (active low)
CAPTURE	In	Host signal to acquire frame data
DATA_AV	Out	Next data sample available signal to host

The SPI interface signals are:

Signal	Type	Description
SSREGN	In	SPI register space select signal from host (active low)
SSDATAN	In	SPI ADC Data select signal from host (active low)
SSFLASHN	In	SPI FLASH data select signal from host (active low)
MOSI	In	Serial data from host to MI0801
MISO	Out	Serial data from MI0801 to host
SCK	In	Serial clock from host

Wire connection between MI0801 Camera Module and a Host processor



In addition to the signals above, the MI0801 Camera Module also requires a single regulated 3.3V supply.

Connector type

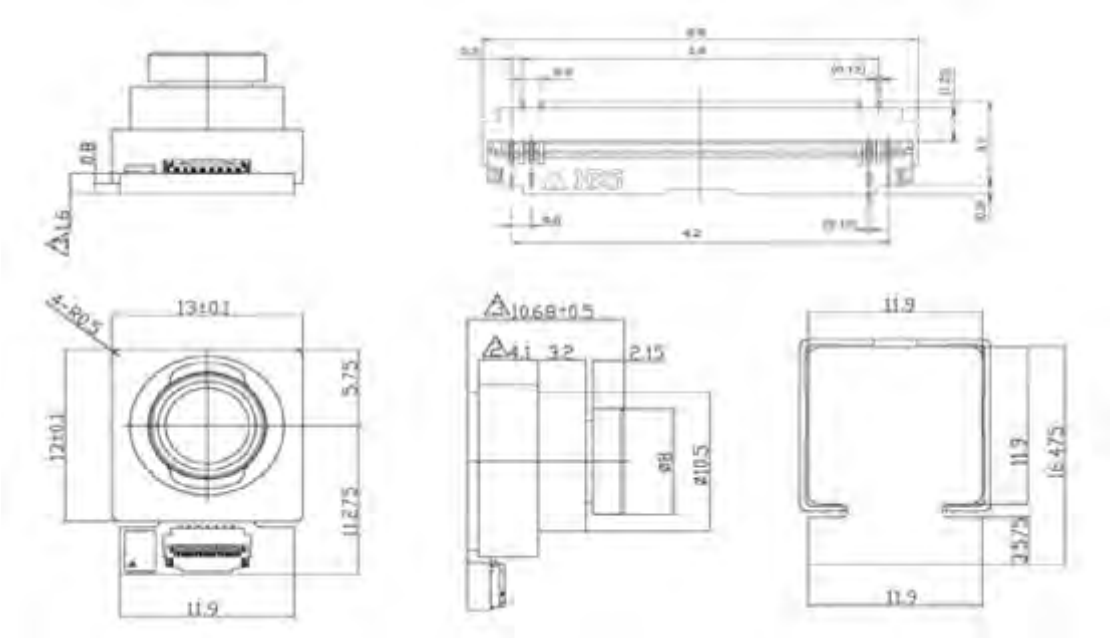
The connector used on the MI0801 Camera Module is from the HIROSE ELECTRIC CO., LTD FH26W range the part number is **FH26W-15S-0.3SHW(**)** – see dimensions below

Connector pinout

Signal	Pin Number
SYSCLK	1
VSS	2
RST_N	3
SSREGN	4
SSDATAN	5
MOSI	6
MISO	7
SCK	8
CAPTURE	9
SSFLASHN	10
DATA_AV	11
VDD	12
VDD	13
VSS	14
VSS	15

Mounting Specification

Mechanical drawing of MI0801 Camera Module



Note: All dimensions are in tolerance of +/-0.1mm unless specified

Electrical Specifications

DC and Logic level Specifications

Symbol	Parameter	Min	Typ	Max	Units
VDD	MI0801 Camera Module Supply voltage	-	3.3	-	Volts
IDD_{active}	Active current	-	12.2	-	mA
$IDD_{standby}$	Standby current	-	0.6	-	mA

AC Electrical Characteristics

Parameter	Min	TYP	Max	Units
SYSCLK	3	5	20	MHz
SCK,	3	5	20	MHz
SCK, duty cycle	-	50	-	%
SCK, t_r	--	--	TBD	ns
SCK, t_f	--	--	TBD	ns
Data in Setup Time,tdSU	2			ns
Data In Hold Time, tdH	5			ns

Absolute Maximum Ratings

Parameter	Max	Units
Supply voltage	3.6	Volts
I/O voltage	3.6	Volts

Environmental Specifications

Stress Parameter	Maximum Rating	Units
Operating Temperature Range*	-20 to 85	℃
Maximum Operating Temperature	85	℃
Storage Temperature*	-40 to 85	℃
Relative Humidity	TBD	%
Thermal Shock	TBD	
Mechanical Shock	TBD	G
Vibration	TBD	
ESD(HBM)*	2	KVolts
ESD(CDM)*	500	Volts

*Note: Number to confirm