Camelot

Fast USB2 digital camera
With stackable card design
& Embedded DSP Capability

INTRODUCTION

Camelot is a family of digital cameras for machine vision applications with fast USB2 connection and embedded digital signal processor capable of performing advanced image processing algorithms on the camera on the fly and capable of storing a buffer of images on the camera without the need to send all images to the PC. The cameras are intended for medical and industrial applications requiring superior image quality high performance and yet attractive pricing.

Camelot Series Features

- Compact design
- Board level option
- Micro lens support
- Internal / External LED support
- Various resolutions
- External trigger support
- Optional GPIO Board
- Optional Ethernet connection
- Sub resolutions
- Configurable ROI
- Electronic shutter
- Controllable Gain
- On board 64MByte DDR
- On board 8MByte Flash
- DirectShow Interface
- Software Development Kit
- Multiple camera support
- USB Powered or Self Powered
- Hi Sensitivity

PRELIMINARY

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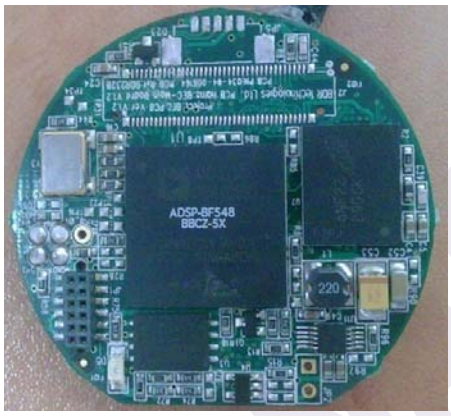
MAIN BOARD

The Camelot USB camera requires at least a main DSP board and an image sensor board.

The image sensor board is dependent on the type of sensor board required. The Camelot series is based on the Analog devices BF548 Blackfin DSP processor. The CM-BF548 Core Module is the most powerful Blackfin based single core processor module available, providing exceptional high performance (DDR RAM) and a large number of interfaces. This processor was chosen in order to perform advanced image processing algorithms in very limited space and power applications. It is therefore possible to run the camera on USB power without any need of adding an additional power supply.



Main Board Components

Analog Devices BF548 Processor Unit

Processor Specifications

- Up to 1066MMAC (533MHz)
- RISC-like register and instruction model
- Programmable on-chip voltage regulator
- DDR SDRAM Support
- Two 16-bit MACs, two 40-bit ALUs, four 8-bit video ALUs
- 4 DMA pairs
- High-speed USB On-the-Go (OTG) with integrated PHY
- On board RAM 64MByte DDR-167MHz-8 Meg x 16 x 4 Banks

Flash Memory

- 8MByte serial flash
- 32 sectors
- Page program (1024/1056 bytes)
- Sector erase (256Kbyte)
- Dual Interface Data Flash

PRELIMINARY

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Communications Interface

- USB2 high speed (480Mbps)

Power Source

- USB or 5VDC

Connectors

- JTAG–Female 12 pin (2x6) 1.27mm pitch
- Expansion connector–80 pin-0.5mm pitch 4mm board stacking-Hirose DF17A
- Images sensor board connector-40 pin-0.5mm pitch 4mm board stacking-Hirose DF12
- USB–Cable connection (modified according to customer requirements)
- GPIO-5 pin connector Cvilux CI44-05 board to wire connector

Interfaces Available

- USB2
- 4 x GPIO , 3.3V logic levels
- 2 x SPI (via expansion connector)
- PPI (via expansion connector)
- JTAG (via expansion connector)
- 3 x PWM (via expansion connector)
- 2 x UART (via expansion connector)
- I2C (via expansion connector)
- Image sensor board (via expansion connector)

GPIO Connector

The GPIO connector on the Main board uses a 5-pin plug.

In order to use GPIO, use Cvilux wire to board connector. PN: CI44-05S0000

And crimp pins. PN: CI44T011PP0

Pin	Signal
1	GPIO1
2	GPIO2
3	GPIO3
4	GPIO4
5	GND

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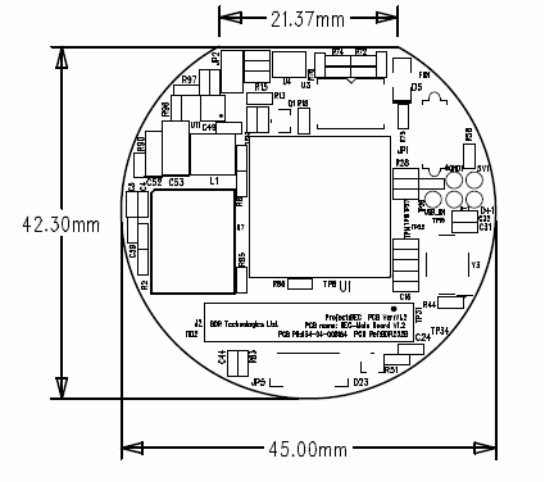
Physical Characteristics

- Circular design with a diameter of 45mm

Main Board Physical Dimensions



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SENSOR BOARDS

This section describes all the sensor boards.

Table 1: Sensor Board Component

Component	Description
Lens	▪ C-mount or CS-Mount ▪ M12 micro lens adaptor
LEDs	▪ Four LED controlled LED Drivers ▪ Four on-board LEDs ▪ External connector for LED camera illuminator

Table 2: Sensor Technical Information

Sensor	1.3 Mp	3 Mp	5 Mp	9 Mp	WVGA
Max Resolution	1280*1024	2048*1536	2592*1944	3488X2616	752*480
Sensor Frame Rate	30FPS(1)	12FPS(1)	14FPS(1)	9.7FPS(1)	60FPS(1)
USB Frame rate	30FPS(1)(2)	12FPS(1)(2)	8FPS(1)(2)	3FPS(1)(2)	60FPS(1)(2)
Optical Format	1/2" (5:4)	1/2" (4:3)	1/2.5" (4:3)	1/2.3"(4:3)	1/3"
Shutter	Rolling	Rolling	Rolling	Rolling	Global

(1) Higher frame rates for region of interest or sub resolutions.
(2) Frame rate at maximum resolution, dependent on the PC. Frame rate for processing might be higher.

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WVGA Sensor Board

The WVGA sensor board is based on the Aptina sensor MT9V024 True-Snap with global shutter capability.

The sensor board can include 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

There is also an optional connector for an external illumination source instead of the on-board LED's.

Item	Description or Value
Sensor	Aptina MT9V024
Resolution	WVGA
Optical Format	1/3-inch
Active Image Size	4.51mm (H) x 2.88mm (V) 5.35mm diagonal
Active Pixels	752H x 490V
Pixel Size	6.0 x 6.0µm
Color Filter Array	Monochrome or color RGB Bayer pattern
Shutter Type	TrueSNAP™ Global shutter
Maximum Data Rate	27 MHz
Frame Rate	60 fps
Full Resolution	752 x 480
ADC Resolution	10-bit-on-chip. Board can work in either 10 bit or 8 bit.
Responsivity	4.8V/lux-sec (550nm)
Dynamic Range	>55dB Linear >100dB in HDR mode
Power Consumption	160mW
LEDs	Four 5mm LEDs on board.
LED Drivers	Four separated controlled LED Drivers-programmable current source up to 30mA.
External Illumination	Connector for external illumination using the four LED drivers.

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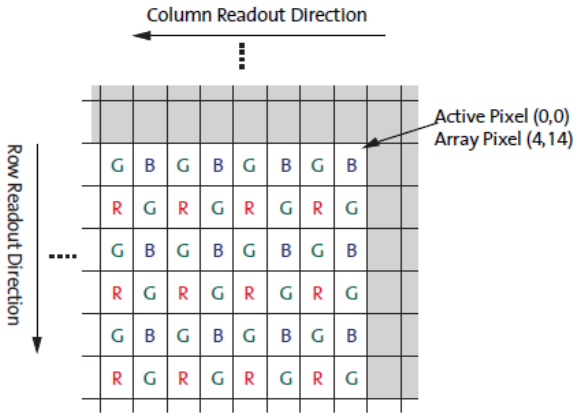
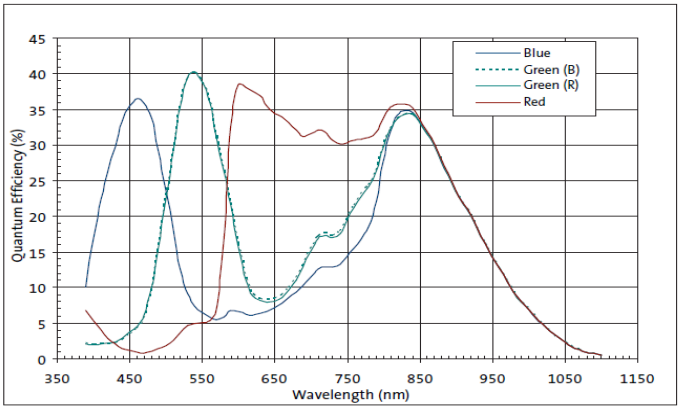
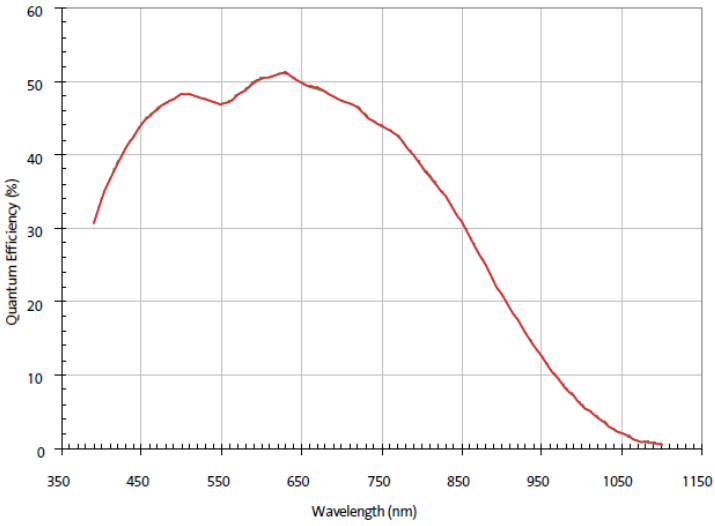
Pixel Color Pattern Detail (Top Right Corner)



Typical Quantum Efficiency—Color



Typical Quantum Efficiency—Monochrome



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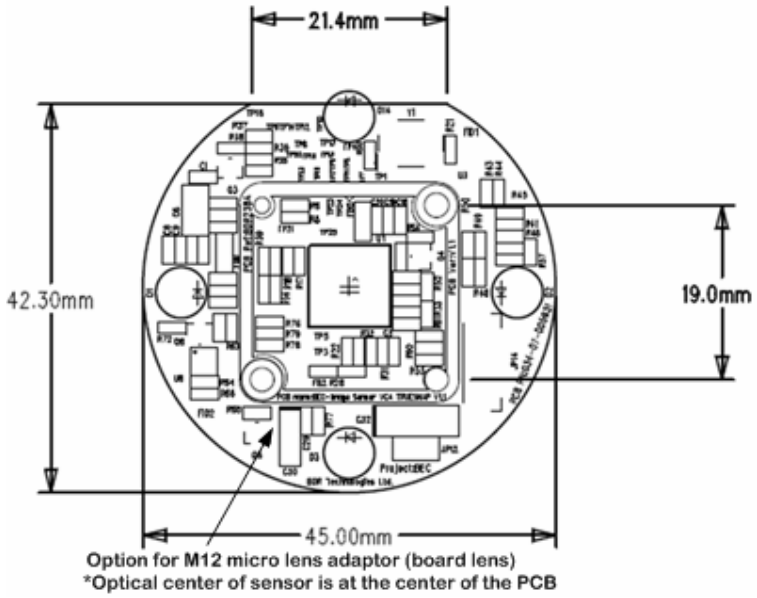
Board Dimensions



External Illuminator Connector

In order to use the external illuminator connector, use Cvilux wire to board connector. PN: CI44-05S0000 and crimp pins. PN: CI44T011PP0

Pin	Signal Description
1	Vcc_Light
2	LED1
3	LED2
4	LED3
5	LED4
6	GND

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1.3Mpixel B&W Sensor Board

The 1.3Mpixel sensor board is based on the Aptina sensor MI-1300 B/W and is able to capture both continuous video and single frames.

The sensor board can include 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

There is an optional connector for an external illumination source instead of the on-board LED's.

Item	Description or Value
Sensor	Aptina MT9M001C12
Resolution	1.3Mpixel
Optical Format	1/2-inch (4:3)
Active Image Size	6.66mm(H) x 5.32mm(V)
Active Pixels	1,280H x 1,024V
Pixel Size	5.2 x 5.2µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS)
Maximum Data Rate	48 Mp/s at 48 MHz
Frame Rate	30 fps
ADC Resolution	10-bit-on-chip. Board can work in either 10 bit or 8 bit.
Responsivity	2.1V/lux-sec (550nm)
Pixel Dynamic Range	68.2db
SNR Max	45db
Power Consumption	363mW
LEDs	Four 5mm LEDs on board.
LED Drivers	Four separately controlled LED Drivers-programmable current source up to 30mA (current sink).
External Illumination	Connector for external illumination using the four LED drivers.

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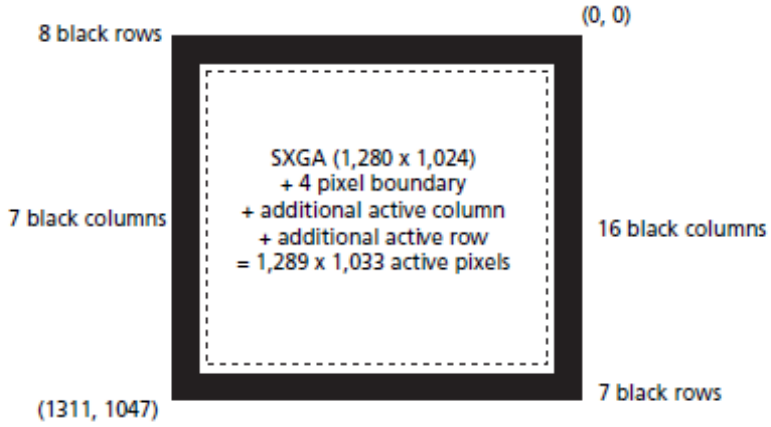
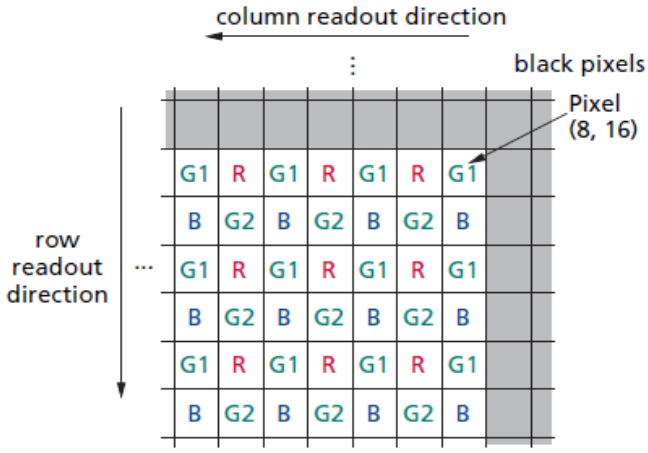


Pixel Pattern Detail (Top Right Corner)



Quantum Efficiency—Monochrome

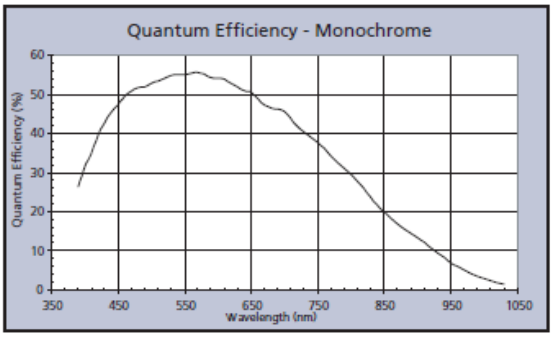


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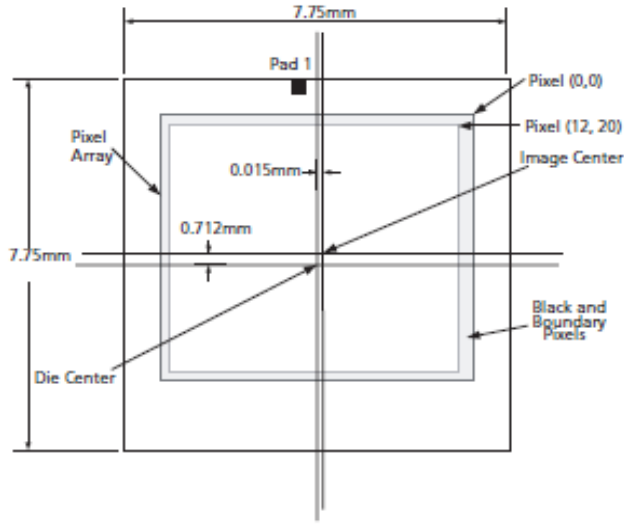
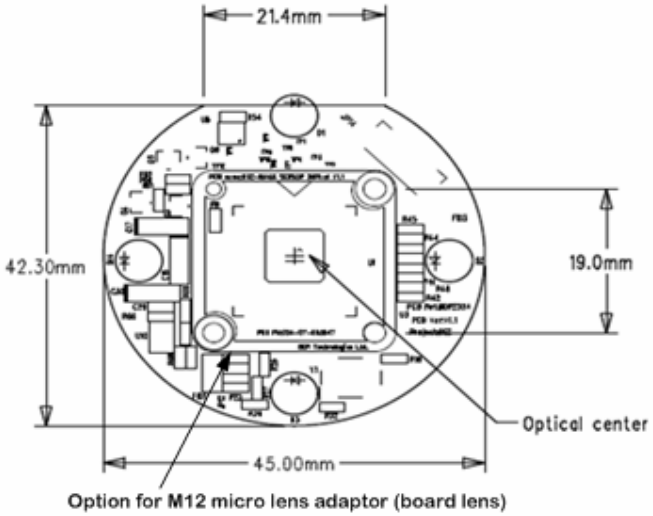
Image Center Offset



Board Dimensions



External Illuminator Connector

In order to use the external illuminator connector, use Cvilux wire to board connector. PN: CI44-05S0000 and crimp pins. PN: CI44T011PP0

Pin	Signal Description
1	Vcc_Light
2	LED1
3	LED2
4	LED3
5	LED4
6	GND

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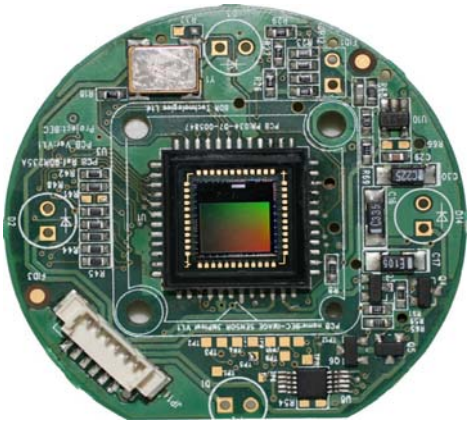
3Mpixel Sensor Board

The 3Mpixel sensor board is based on the Aptina sensor MI3000 and is able to capture both continuous video and single frames.

The sensor board can include 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

There is an optional connector for an external illumination source instead of the on-board LED's.



Item	Description or Value
Sensor	Aptina MT9T001
Resolution	3Mpixel
Optical Format	1/2-inch (4:3)
Active Image Size	6.554mm(H) x 4.915mm(V) 8.192 (Diagonal)
Active Pixels	2,048H x 1,536V
Pixel Size	3.2 x 3.2µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS) Global reset release (GRR)
Maximum Data Rate	48 Mp/s at 48 MHz
Frame Rate	12 fps
ADC Resolution	10-bit-on-chip. Board can work in either 10 bit or 8 bit.
Responsivity	>1.0V/lux-sec (550nm)
Pixel Dynamic Range	61db
SNR Max	43db
Power Consumption	240mW
LEDs	Four 5mm LEDs on board.
LED Drivers	Four separately controlled LED Drivers-programmable current source up to 30mA (current sink).
External Illumination	Connector for external illumination using the four LED drivers.

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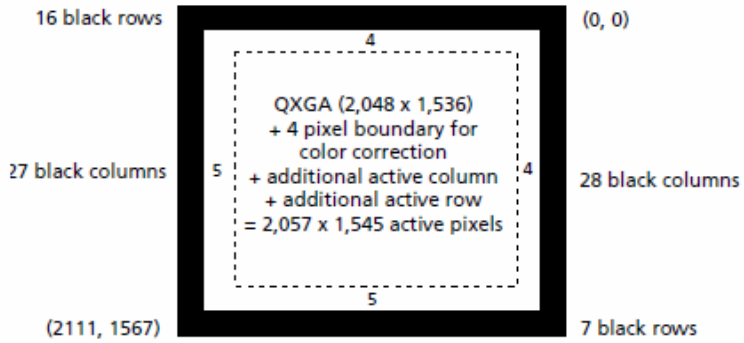
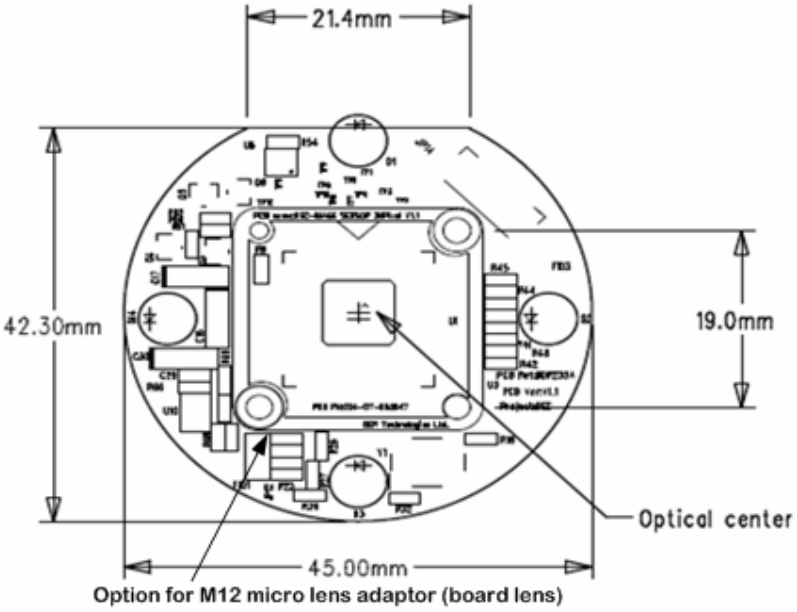
Pixel Array Description



Board Dimensions



External Illuminator Connector

In order to use the external illuminator connector, use Cvilux wire to board connector. PN: CI44-05S0000 and crimp pins. PN: CI44T011PP0

Pin	Signal Description
1	Vcc_Light
2	LED1
3	LED2
4	LED3
5	LED4
6	GND

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5Mpixel Sensor Board

The 5Mpixel sensor board is based on the Aptina sensor MT9P031, which incorporates sophisticated camera functions on-chip, with snapshot mode.

The sensor board can include four LEDs each with a separately controlled programmable current source up to 30mA (current sink).

There is an optional connector for external illumination instead of the on board LED's.

Item	Description or Value
Sensor	Aptina MT9P031
Resolution	5Mpixel
Optical Format	1/2.5-inch (4:3)
Active Image Size	5.7mm (H) x 4.28mm (V) 7.13mm diagonal
Active Pixels	2,592H x 1,944V
Pixel Size	2.2 x 2.2µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS) Snapshot only Global reset release (GRR)
Maximum Data Rate	96 Mp/s at 96MHz
Frame Rate	14 fps
ADC Resolution	12-bit-on-chip. Board can work in either 12 bit or 8 bit.
Responsivity	1.4V/lux-sec (550nm)
Pixel Dynamic Range	70.1db
SNR Max	38.1db
Power Consumption	381mW
LEDs	Four 5mm LEDs on board.
LED Drivers	Four separately controlled LED Drivers-programmable current source up to 30mA (current sink).
External Illumination	Optional connector for external illumination using the four LED drivers.

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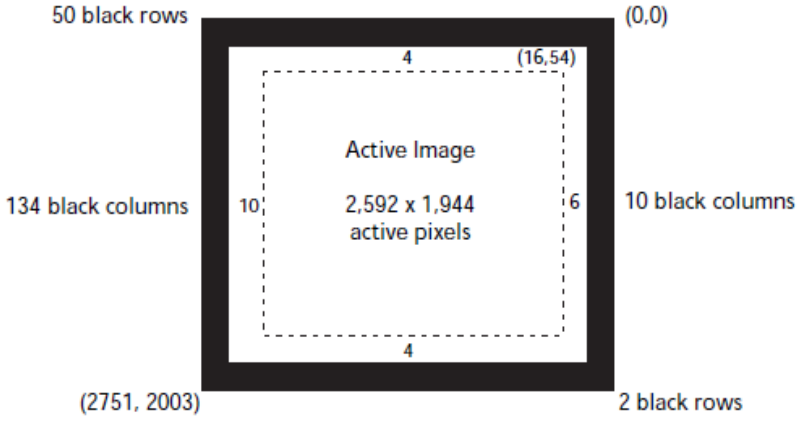
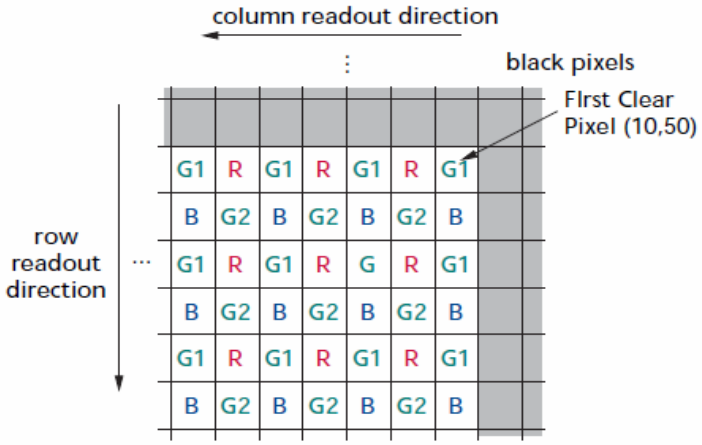
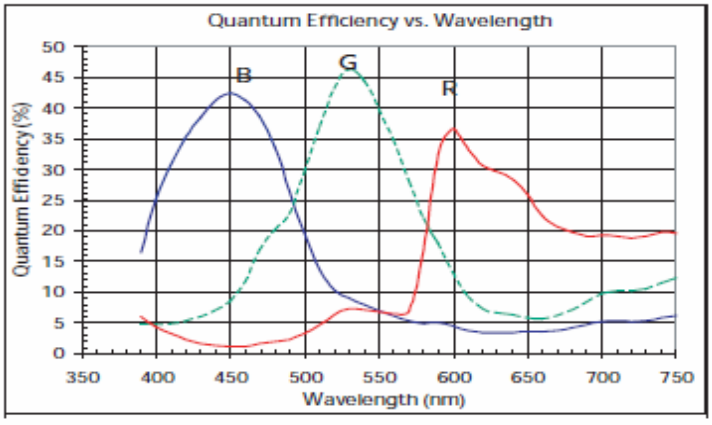
Pixel Array Description



Pixel Color Pattern Detail (Top Right Corner)



Typical Spectral Characteristics



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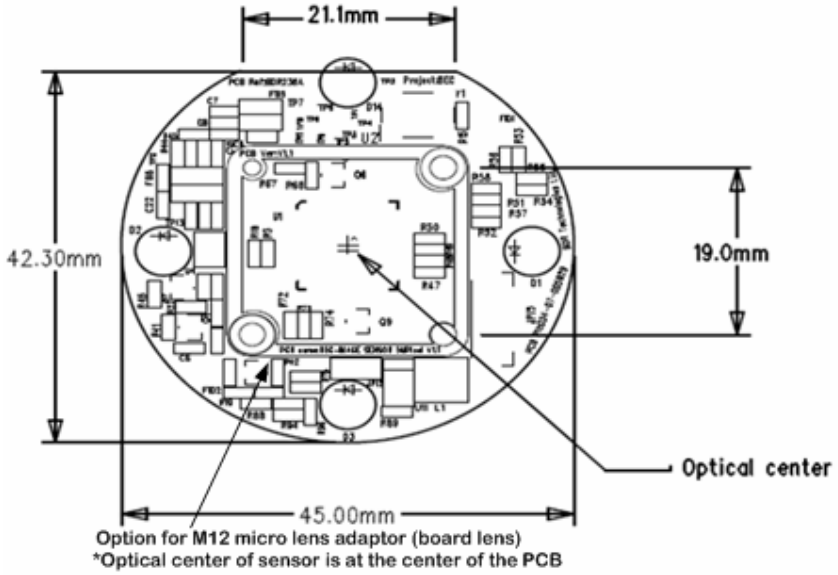
Board Dimensions



External Illuminator Connector

In order to use the external illuminator connector, use Cvilux wire to board connector. PN: CI44-05S0000 and crimp pins. PN: CI44T011PP0

Pin	Signal Description
1	Vcc_Light
2	LED1
3	LED2
4	LED3
5	LED4
6	GND

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9Mpixel Sensor Board

The 9Mpixel sensor board is based on the Aptina sensor MT9N001 and is able to capture both continuous video and single frames.

The sensor board includes 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

There is an optional connector for an external illumination source instead of the on-board LED's.

Item	Description or Value
Sensor	Aptina MT9N001
Resolution	9Mpixel
Optical Format	1/2.3-inch (4:3)
Active Image Size	6.104mm (H) x 5.578mm (V) 7.63mm diagonal
Active Pixels	3,488H x 2,616V
Pixel Size	1.75 x 1.75µm
Color Filter Array	RGB Bayer pattern
Chief Ray Angle	0°, 25°
Shutter Type	Electronic rolling shutter (ERS) Global reset release (GRR)
Maximum Data Rate	96 Mp/s
Frame Rate	9.7 fps
ADC Resolution	12-bit-on-chip. Board can work in either 12 bit or 8 bit.
Responsivity	0.44V/lux-sec (550nm)
Dynamic Range	62.7db
SNR Max	37.4db
Power Consumption	485mW
LEDs	Four 5mm LEDs on board.
LED Drivers	Four separated controlled LED Drivers-programmable current source up to 30mA (current sink).
External Illumination	Connector for external illumination using the four LED drivers.

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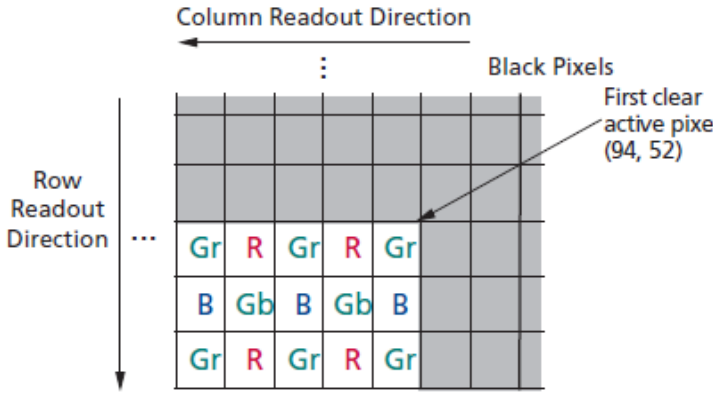
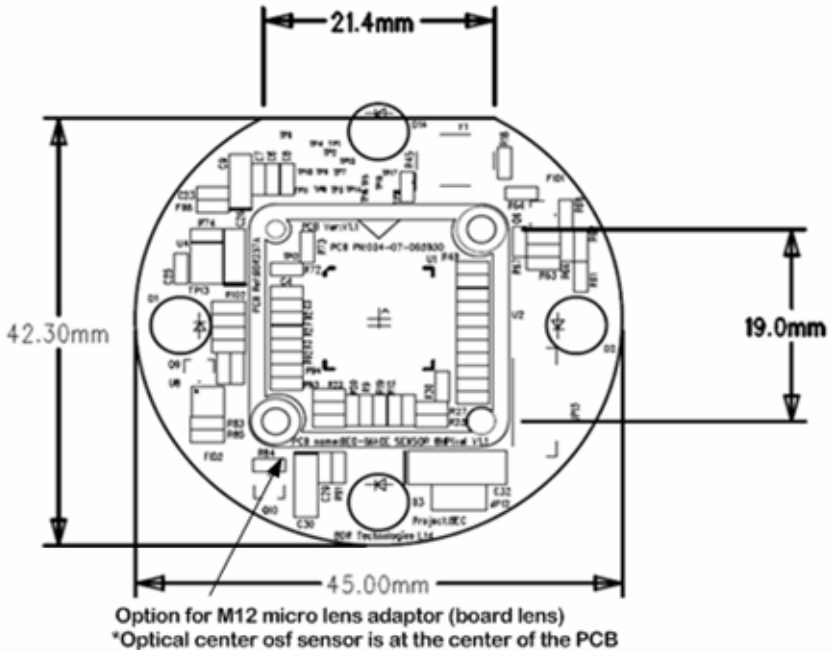
Pixel Color Pattern Detail (Top Right Corner)



Board Dimensions



External Illuminator Connector

In order to use the external illuminator connector, use Cvilux wire to board connector. PN: CI44-05S0000 and crimp pins. PN: CI44T011PP0

Pin	Signal Description
1	Vcc_Light
2	LED1
3	LED2
4	LED3
5	LED4
6	GND

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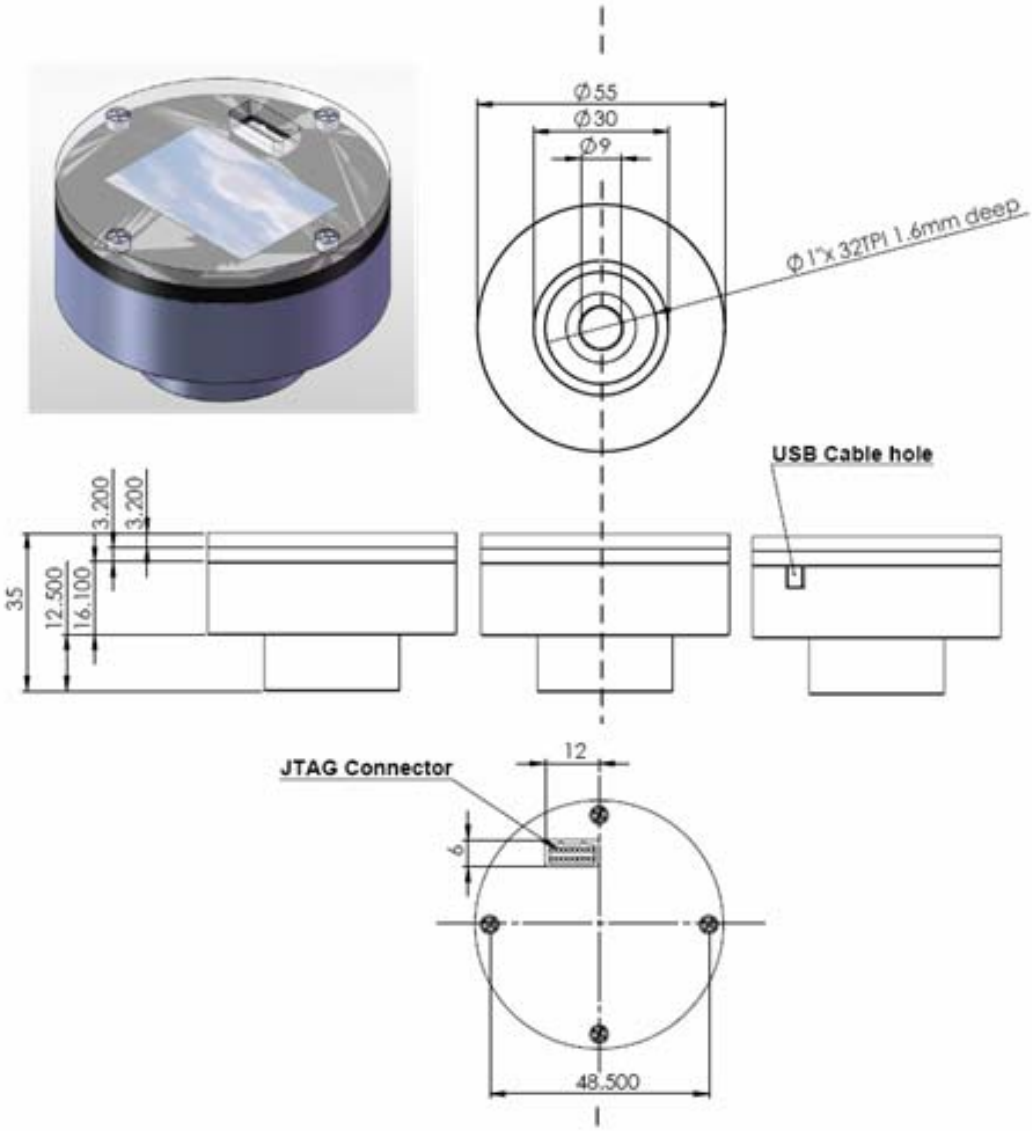
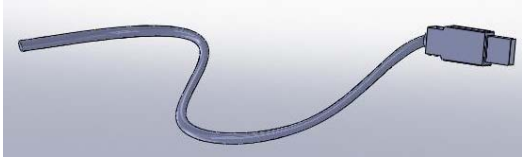
CAMERA HOUSING

Camera Housing Physical Dimensions and Locations



USB Communications Cable

The camera side of the USB cable is connected permanently to the camera. Connect the other end to a USB 2.0 port on your computer.



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