Imaging Diagnostics
Total vision solutions

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.

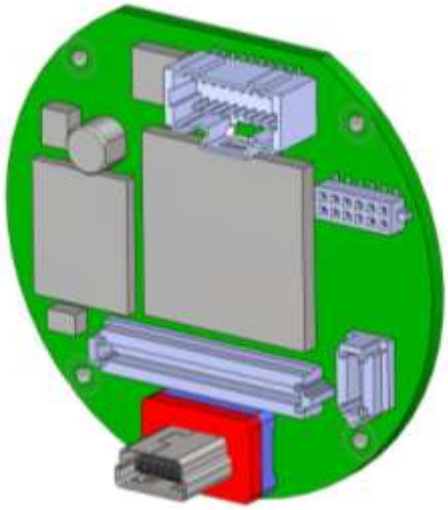
Camelot series features

- 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

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

Communications interface

- USB2 high speed (480Mbps)

Power source

- USB or 5VDC

Connectors

- JTAG–Female 12 pin (2x6) 1.27mm pitch
- Expansion connector–100 pin-0.4mm pitch 4mm board stacking-Samtec SS4
- Expansion connector–20 pin-0.4mm pitch 4mm board stacking-Samtec SS4
- Images sensor board connector-40 pin-0.5mm pitch 4mm board stacking-Hirose DF12
- USB–Cable connection (modified according to customer requirements)
- GPIO-20 pin Molex Pico-clasp 1mm Pitch board to wire connector ,Molex PN : 5011902017 , mating connector : 501189-2010 .
- Mini – USB Connector .
- DC Jack (for 5V Input only) .

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 20 pin Molex Pico-clasp 1mm Pitch board to wire connector ,Molex PN : 5011902017 , mating connector : 501189-2010 .

And crimp pins. PN: 501193-2000

Pin	Signal	Pin	Signal
1	GPIO1	**2**	VCC_IN
3	GPIO2	**4**	VCC_IN
5	GPIO3	**6**	PWM1
7	GPIO4- SPI1_SS	**8**	PWM2
9	GPIO5-SPI1_SCK	**10**	PWM3
11	GPIO6- SPI1_MISO	**12**	PWM4
13	GPIO7- SPI1_MOSI	**14**	PWM5
15	GPIO8- UART2-TX	**16**	PWM6
17	DGND	**18**	PWM7
19	DGND	**20**	GPIO9- UART2-RX

Each GPIO can be configured as strobe and trigger.

Interface connector 20 pin

The interface connector 20 pin on the Main board is a 20 pin Board to board connector from Samtec , PN : SS4-10-3.00-L-D-P-TR .

Pin	Signal	Pin	Signal
1	SD_D0	2	SP_TF0
3	SD_D1	4	SP_DT0SEC
5	SD_D2	6	SP_DT0PRI
7	SD_D3	8	SP_DTSCLK0
9	SD_CLK	10	SP_RFS0
11	SD_CMD	12	SP_DR0SEC
13	DSP_GPIO10	14	SP_DR0PRI
15	TMR9	16	SP_RSCLK0
17	TMR10	18	TMR8
19	DGND	20	VCC_IN

Interface connector 100 pin

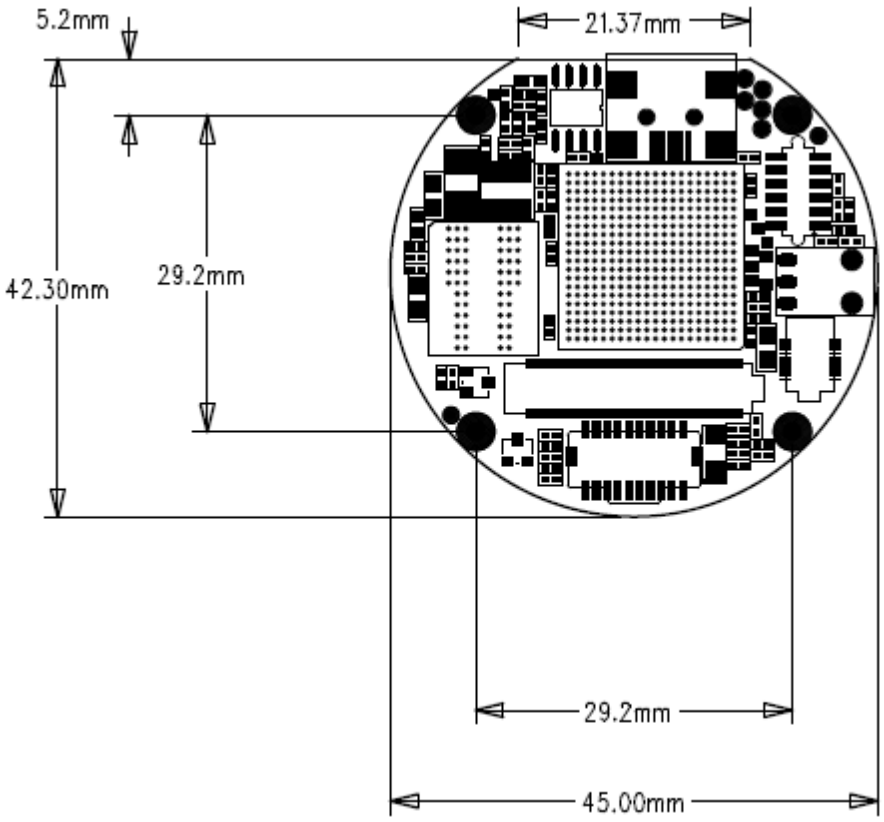
The Interface connector 100 pin on the Main board is a 100 pin Board to board connector from Samtec, PN: SS4-50-3.00-L-D-P-TR.

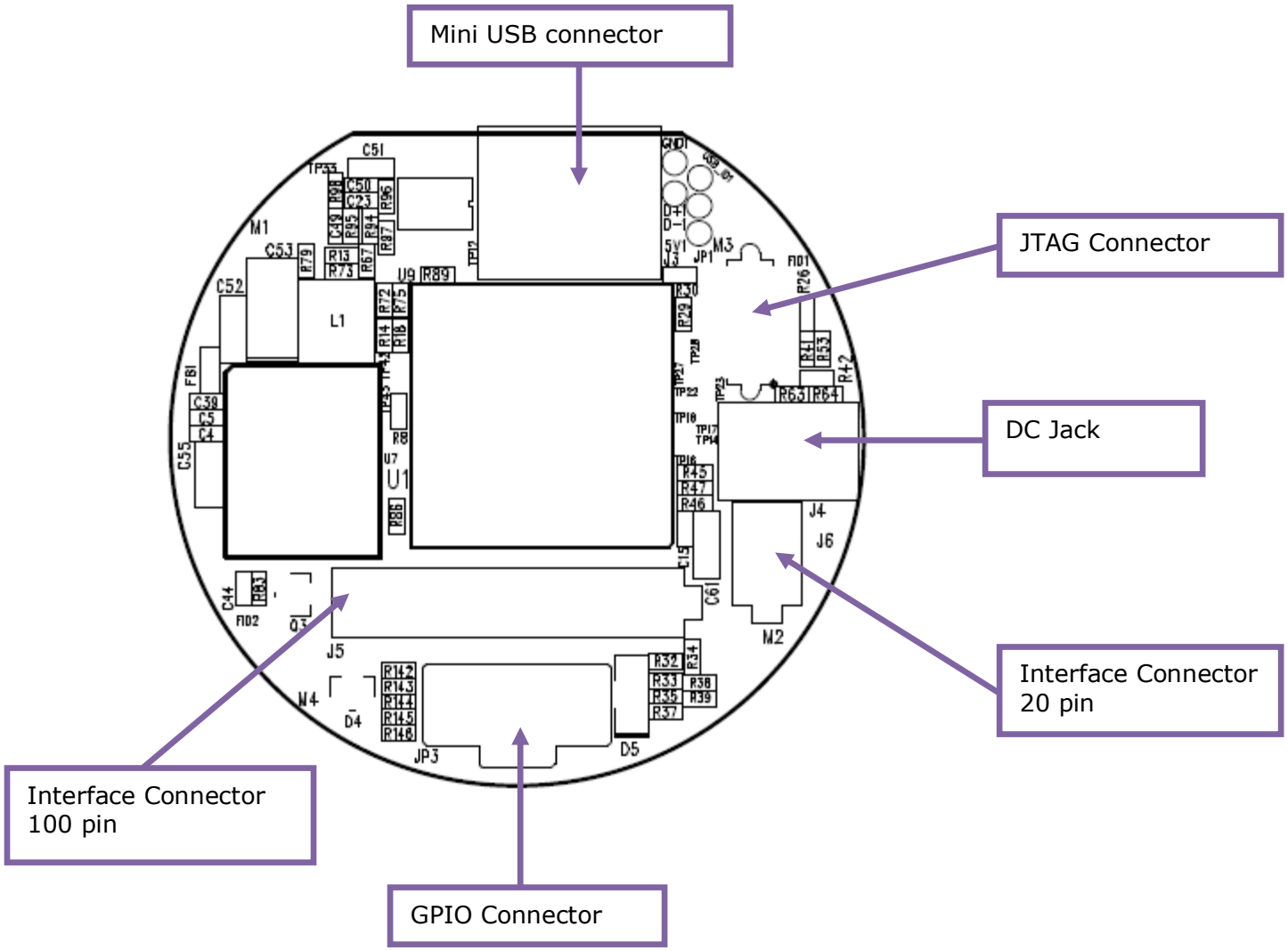
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	A1	2	VCC_IN	51	SCL1	52	PPI0_D9
3	A2	4	VCC_IN	53	SDA1	54	PPI0_D10
5	A3	6	PPI0_CLK	55	PB2	56	PPI0_D11
7	A4	8	PPI0_FS1	57	PB3	58	PPI0_D12
9	A5	10	PPI0_FS2	59	PB4	60	PPI0_D13
11	A6	12	SPI1_SCK	61	PB5	62	PPI0_D14
13	A7	14	SPI1_MISO	63	PB6	64	PPI0_D15
15	A8	16	SPI1_MOSI	65	PB7	66	PPI0_D6
17	A9	18	SPI1_SS#	67	PB9	68	PPI0_D17
19	A10	20	SPI1_SEL1#	69	PB10	70	D0
21	A11	22	SPI1_SEL2#	71	PB11	72	D1
23	A12	24	SPI1_SEL3#	73	PB12	74	D2
25	A13	26	UART0_TX	75	PB13	76	D3
27	A14	28	UART0_RX	77	PB14	78	D4
29	A15	30	UART1RTS#	79	AMS1#	80	D5
31	A16	32	UART1CTS#	81	AMS2#	82	D6
33	A17	34	PPI0_D0	83	AMS3#	84	D7
35	A18	36	PPI0_D1	85	AOE#	86	D8
37	A19	38	PPI0_D2	87	ARE#	88	D9
39	A20	40	PPI0_D3	89	AWE#	90	D10
41	A21	42	PPI0_D4	91	ABE0#	92	D11
43	A22	44	PPI0_D5	93	ABE1#	94	D12
45	A23	46	PPI0_D6	95	TMR7	96	D13
47	A24	48	PPI0_D7	97	DGND	98	D14
49	A25	50	PPI0_D8	99	DGND	100	D15

Physical Characteristics

- Circular design with a diameter of 45mm

Main board physical dimensions





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	WVGA	1.3 Mp	3 Mp	5 Mp	10 Mp
Max Resolution	752*480	1280*1024	2048*1536	2592*1944	3664*2748
Sensor Frame Rate	60FPS(1)	30FPS(1)	12FPS(1)	14FPS(1)	7.5FPS(1)
USB Frame rate	60FPS(1)(2)	30FPS(1)(2)	12FPS(1)(2)	8FPS(1)(2)	4 FPS(1)(2)
Optical Format	1/3”	1/2” (5:4)	1/2” (4:3)	1/2.5” (4:3)	1/2.3” (4:3)
Shutter	Global	Rolling	Rolling	Rolling	Rolling

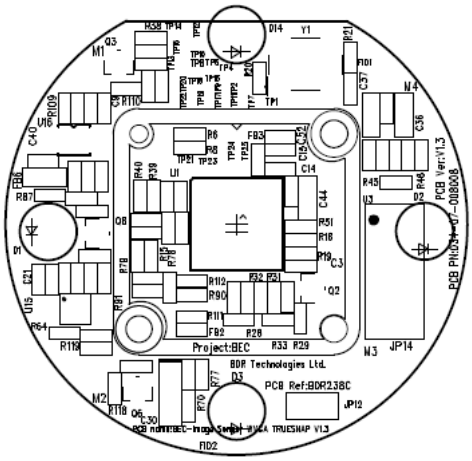
(1) Higher frame rates for region of interest or sub resolutions.
(2) Frame rate at maximum resolution, dependent on the PC. Frame rate for processing might be higher.

WVGA sensor board

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

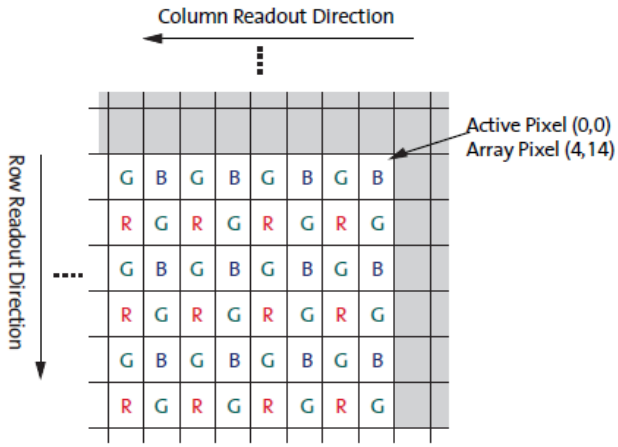
The sensor board can include 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

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

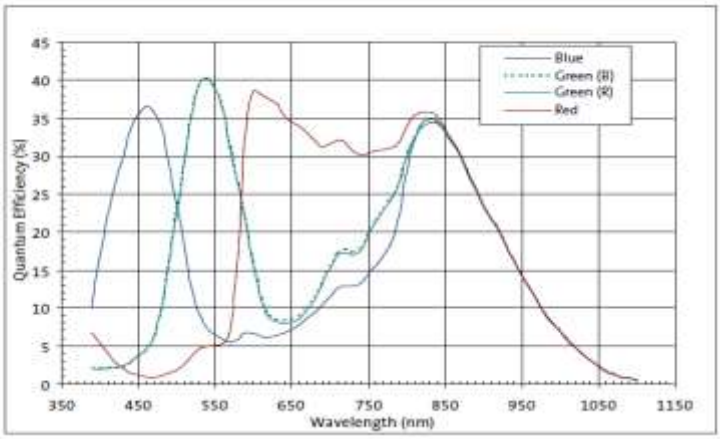


Item	Description or Value
Sensor	Aptina MT9V024
Resolution	WVGA
Optical Format	1/3-inch
Active Image Size	4.51mm (H) x 2.88mm (V) 5.35mm diagonal
Active Pixels	752H x 490V
Pixel Size	6.0 x 6.0µm
Color Filter Array	Monochrome or color RGB Bayer pattern
Shutter Type	TrueSNAP™ Global shutter
Maximum Data 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.

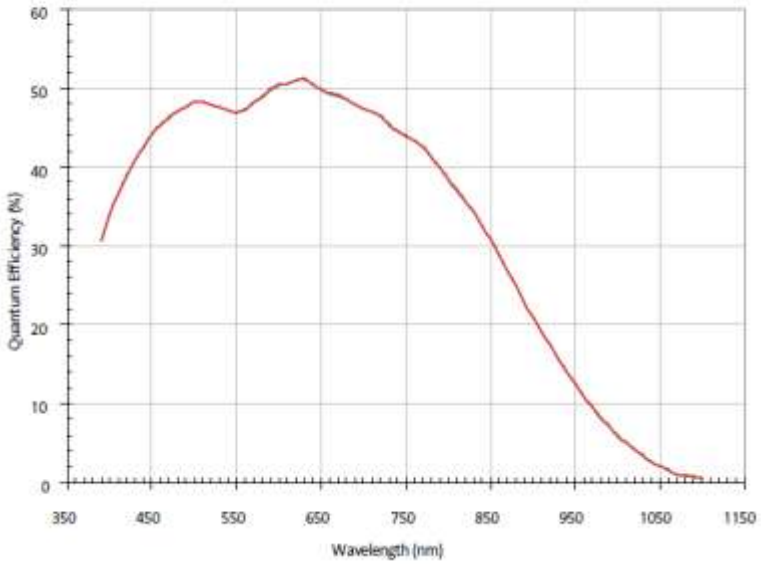
Pixel Color Pattern Detail (Top Right Corner)



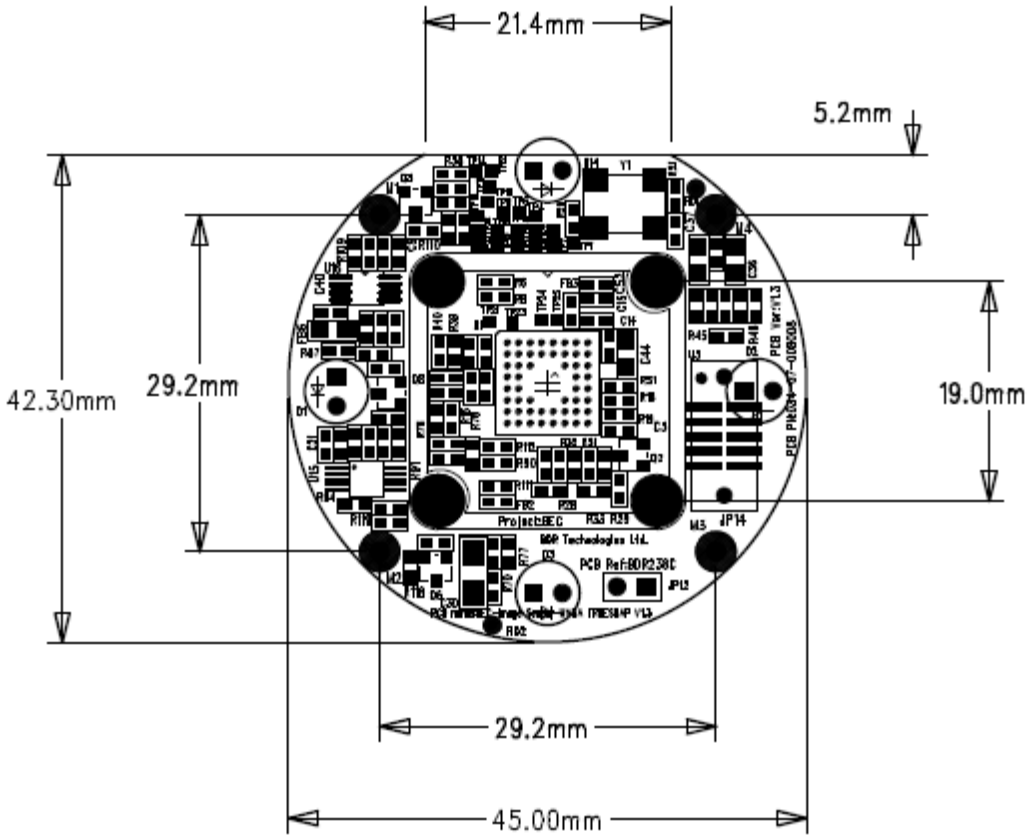
Typical Quantum Efficiency—Color



Typical Quantum Efficiency—Monochrome



Board dimensions



External illuminator connector

In order to use the external illuminator connector, use Samtec wire to board connector.
Mating wire to board connector PN: SFSD-05-28-H-10.00-DR-NDX

Change the PN according to cable length.

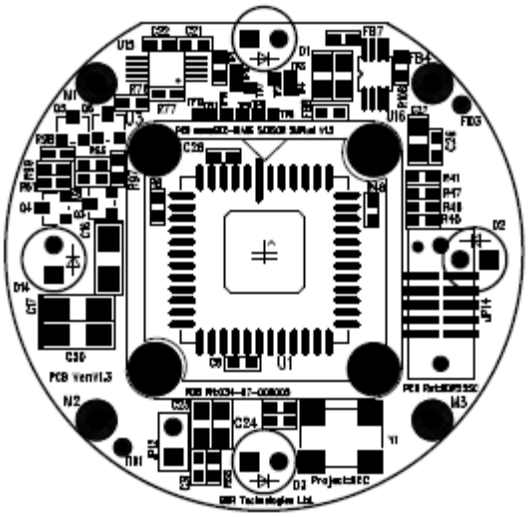
Pin	Signal Description	Pin	Signal Description
1	VCC_LIGHT	**2**	LED1
3	VCC_LIGHT	**4**	LED2
5	NC	**6**	LED3
7	LGND	**8**	LED4
9	LGND	**10**	NC

1.3Mpixel B&W sensor board

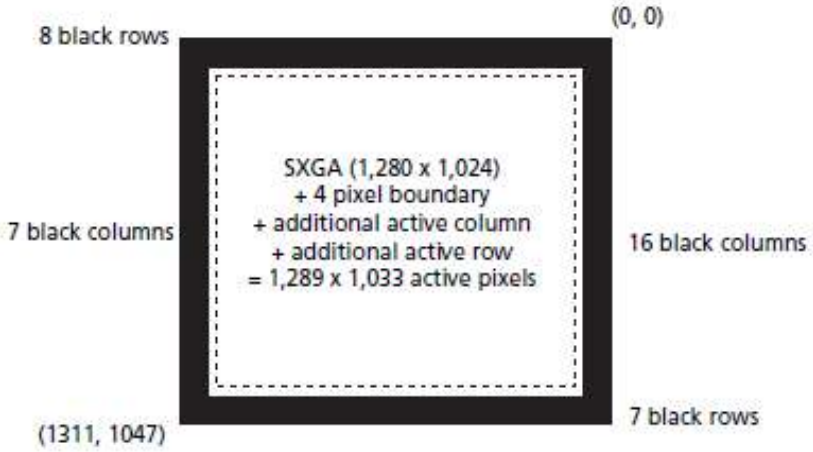
The 1.3Mpixel sensor board is based on the Aptina sensor MI-1300 B/W and is able to capture both continuous video and single frames.

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

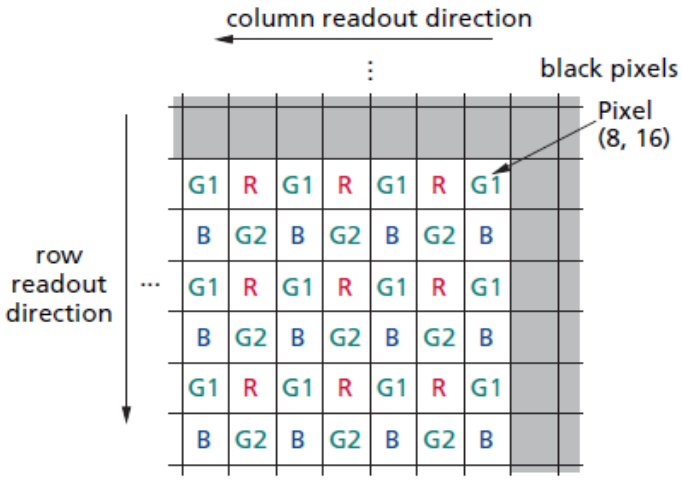
There is an optional connector for an external illumination source instead of the on-board LED's.



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.



Pixel Pattern Detail (Top Right Corner)



Quantum Efficiency—Monochrome

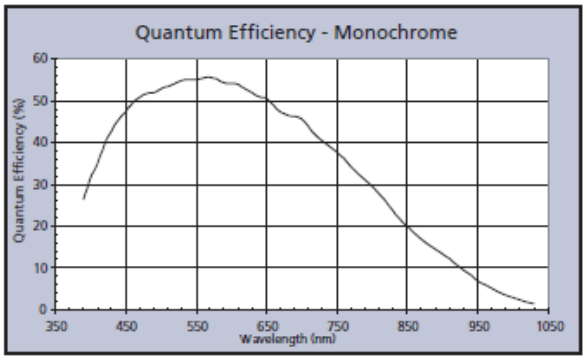
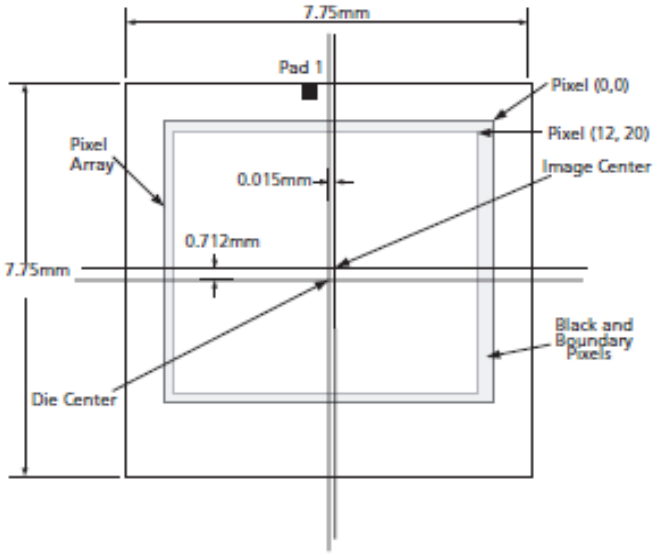
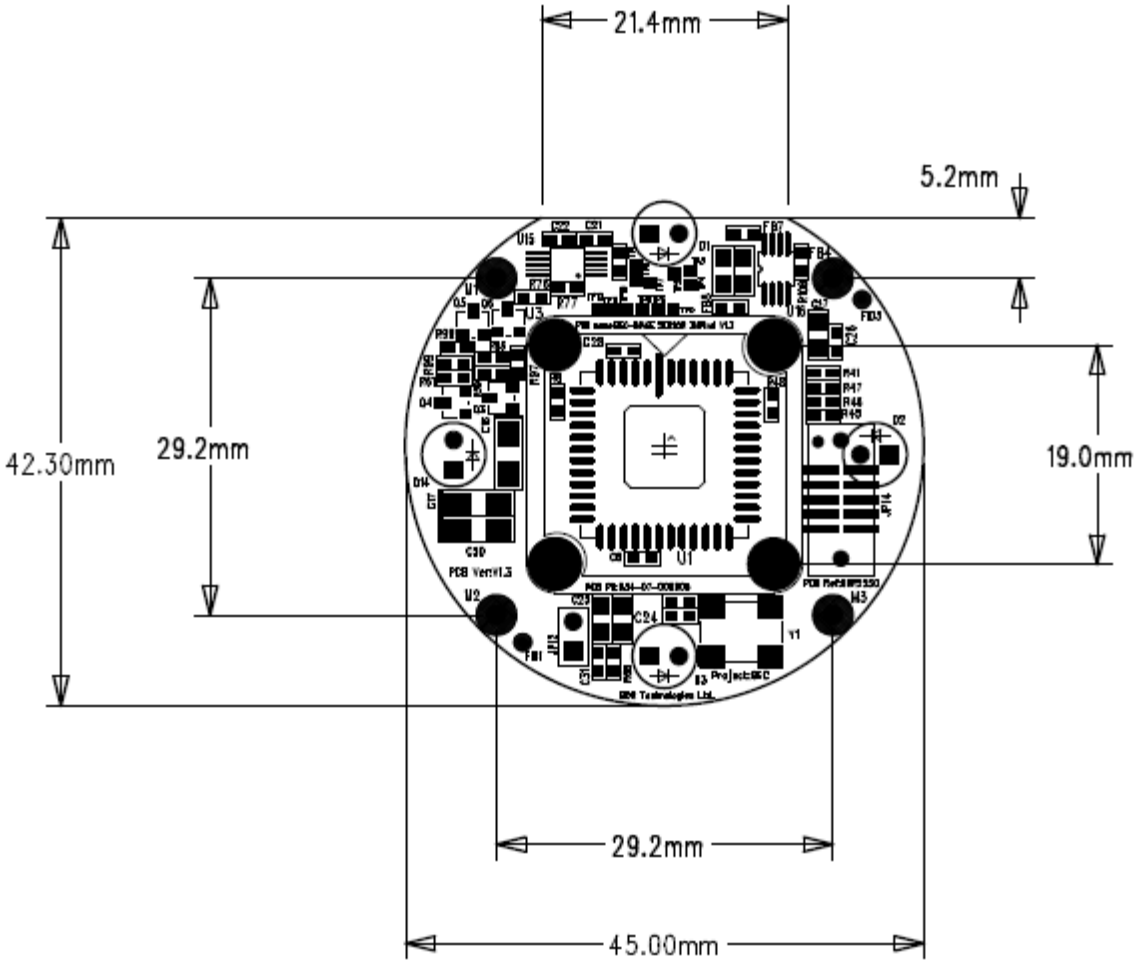


Image Center Offset



Board dimensions



External illuminator connector

In order to use the external illuminator connector, use Samtec wire to board connector.
PN (of mating wire to board connector): SFSD-05-28-H-10.00-DR-NDX

Change the PN according to cable length.

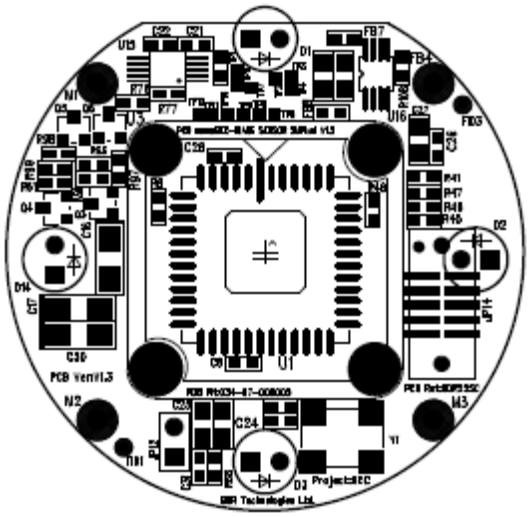
Pin	Signal Description	Pin	Signal Description
1	VCC_LIGHT	**2**	LED1
3	VCC_LIGHT	**4**	LED2
5	NC	**6**	LED3
7	LGND	**8**	LED4
9	LGND	**10**	NC

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.

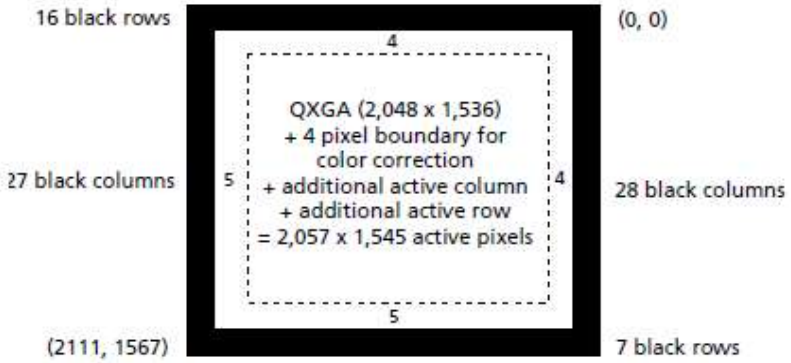
The sensor board can include 4 LEDs, each with a separately controlled programmable current source up to 30mA (current sink).

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

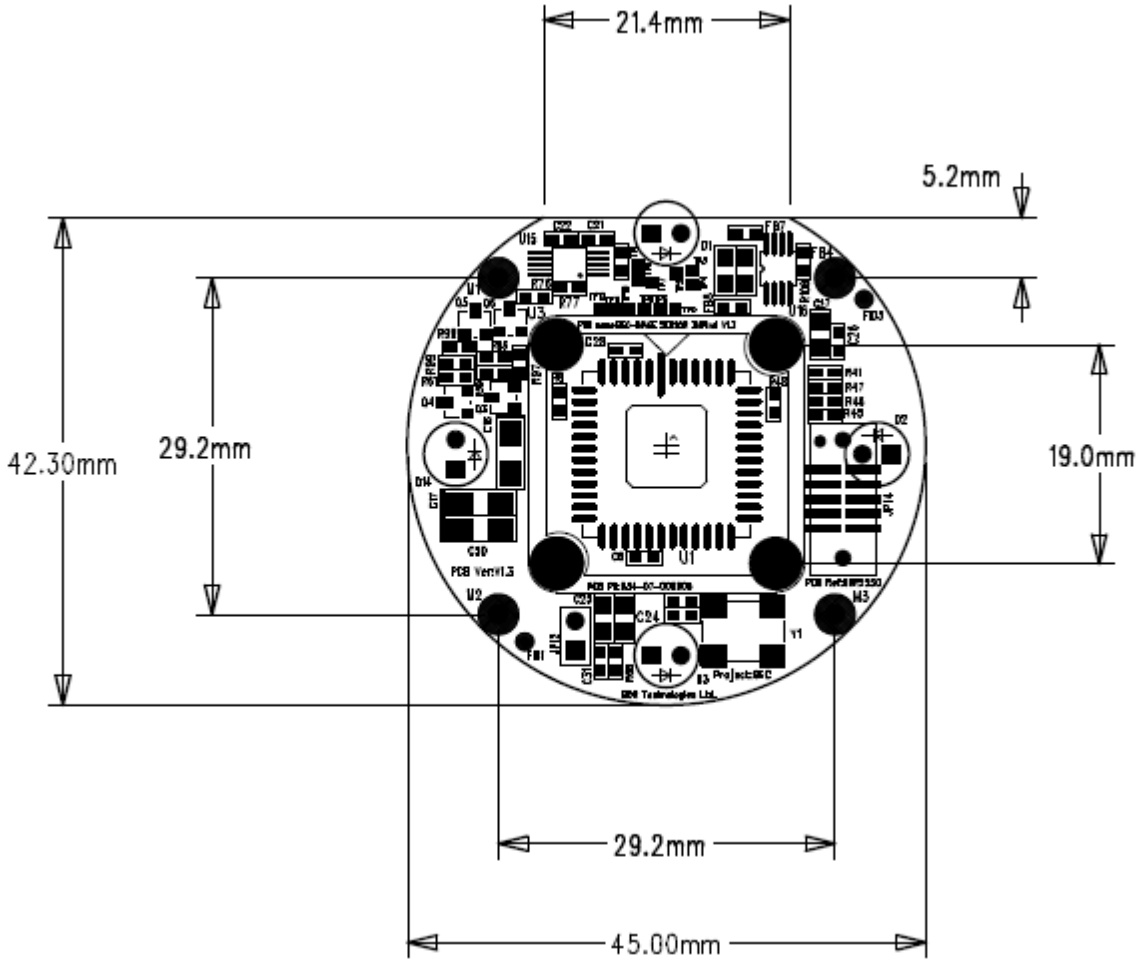


Item	Description or Value
Sensor	Aptina MT9T001
Resolution	3Mpixel
Optical Format	1/2-inch (4:3)
Active Image Size	6.554mm(H) x 4.915mm(V) 8.192 (Diagonal)
Active Pixels	2,048H x 1,536V
Pixel Size	3.2 x 3.2µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS) Global reset 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.

Pixel array description



Board dimensions



External illuminator connector

In order to use the external illuminator connector, use Samtec wire to board connector.
PN (of mating wire to board connector): SFSD-05-28-H-10.00-DR-NDX

Change the PN according to cable length.

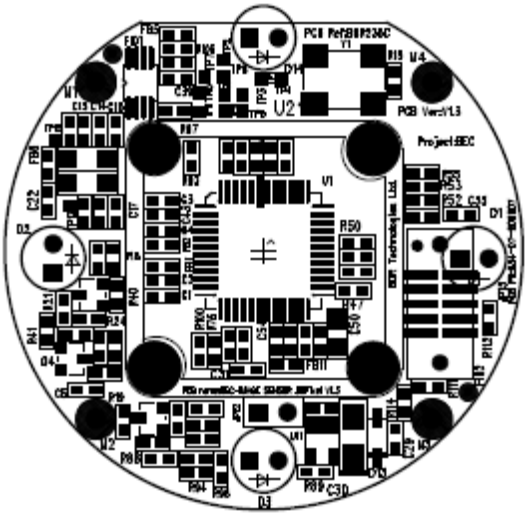
Pin	Signal Description	Pin	Signal Description
1	VCC_LIGHT	**2**	LED1
3	VCC_LIGHT	**4**	LED2
5	NC	**6**	LED3
7	LGND	**8**	LED4
9	LGND	**10**	NC

5Mpixel sensor board

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

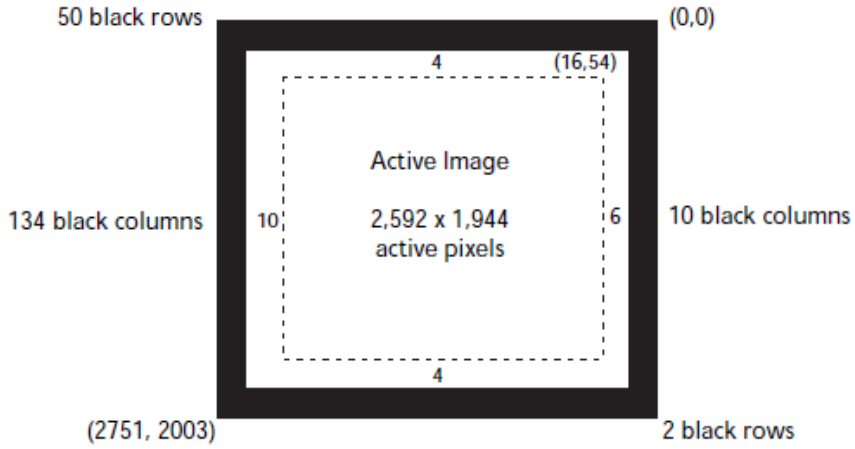
The sensor board can include four LEDs each with a separately controlled programmable current source up to 30mA (current sink).

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

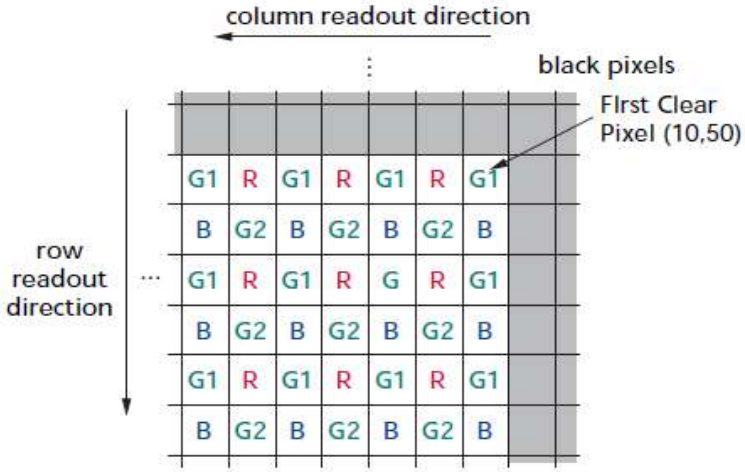


Item	Description or Value
Sensor	Aptina MT9P031
Resolution	5Mpixel
Optical Format	1/2.5-inch (4:3)
Active Image Size	5.7mm (H) x 4.28mm (V) 7.13mm diagonal
Active Pixels	2,592H x 1,944V
Pixel Size	2.2 x 2.2µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS) Snapshot 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.

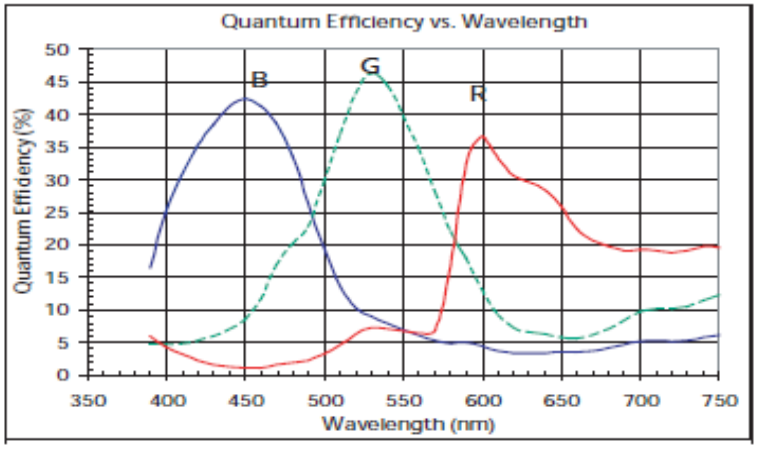
Pixel array description



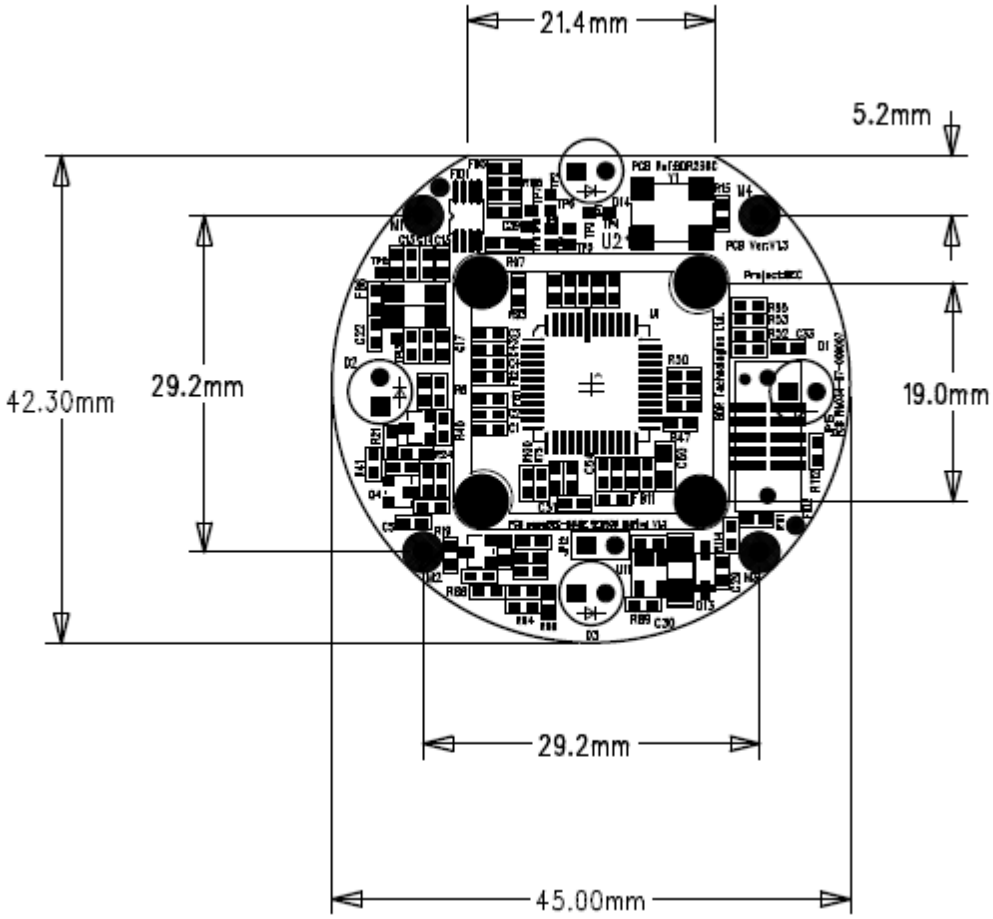
Pixel Color Pattern Detail (Top Right Corner)



Typical Spectral Characteristics



Board dimensions



External illuminator connector

In order to use the external illuminator connector, use Samtec wire to board connector.
PN (of mating wire to board connector): SFSD-05-28-H-10.00-DR-NDX

Change the PN according to cable length.

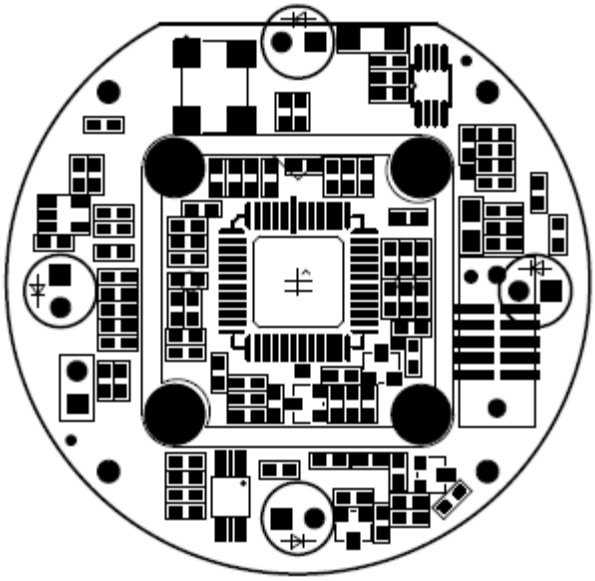
Pin	Signal Description	Pin	Signal Description
1	VCC_LIGHT	**2**	LED1
3	VCC_LIGHT	**4**	LED2
5	NC	**6**	LED3
7	LGND	**8**	LED4
9	LGND	**10**	NC

10Mpixel sensor board

The 10Mpixel sensor board is based on the Aptina sensor MT9J003, which incorporates sophisticated camera functions on-chip, with snapshot mode.

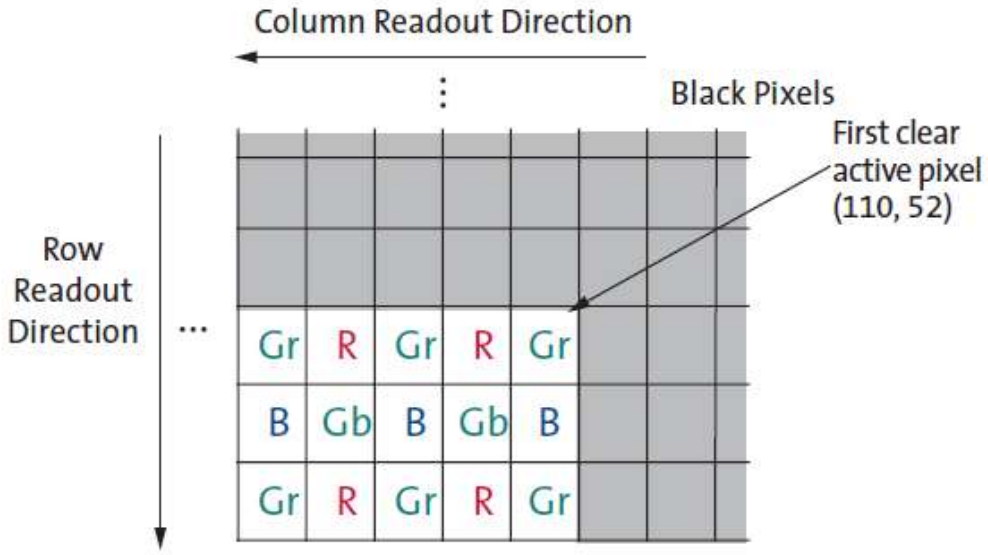
The sensor board can include four LEDs each with a separately controlled programmable current source up to 30mA (current sink).

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

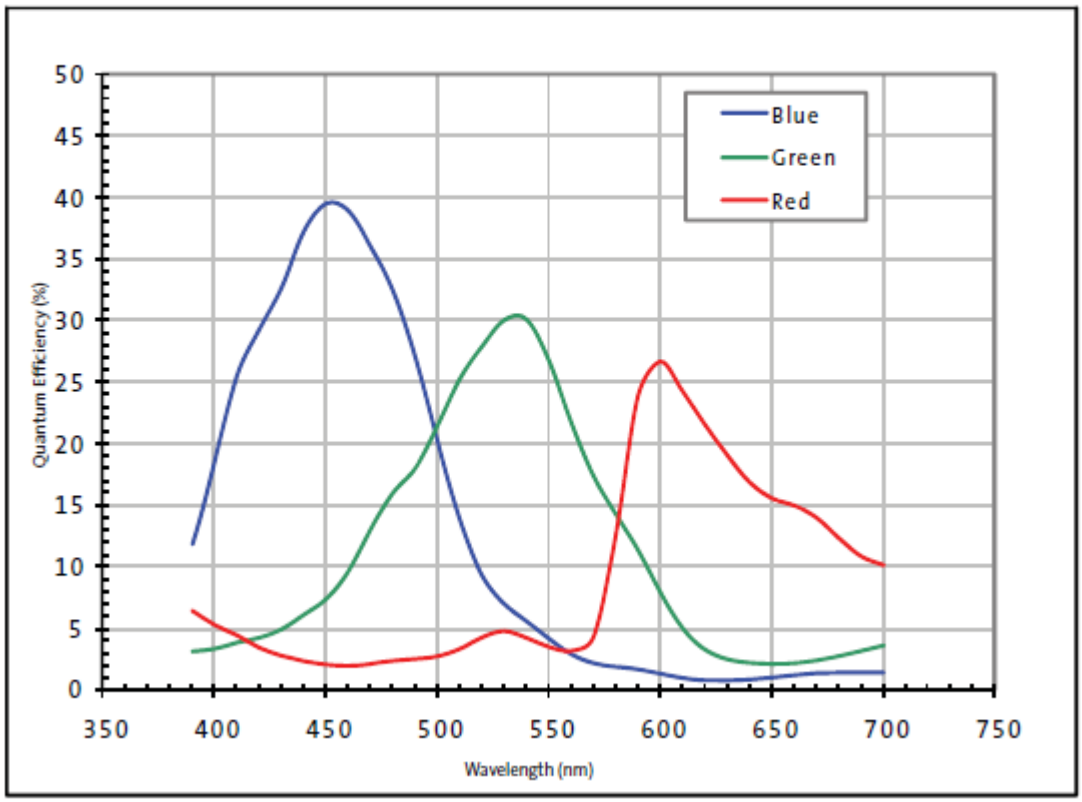


Item	Description or Value
Sensor	Aptina MT9J003
Resolution	10Mpixel
Optical Format	1/2.3-inch (4:3)
Active Image Size	6.119mm (H) x 4.589mm (V) 7.649mm diagonal
Active Pixels	3,664H x 2,748V
Pixel Size	1.67 x 1.67µm
Color Filter Array	RGB Bayer pattern
Shutter Type	Electronic rolling shutter (ERS) with Global reset release (GRR)
Maximum Data Rate	80 Mp/s at 80MHz
Frame Rate	7.5 fps
ADC Resolution	12-bit-on-chip. Board can work in either 12 bit or 10 bit or 8 bit.
Responsivity	0.31V/lux-sec (550nm)
Pixel Dynamic Range	65.2db
SNR Max	34 db
Power Consumption	388mW
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.

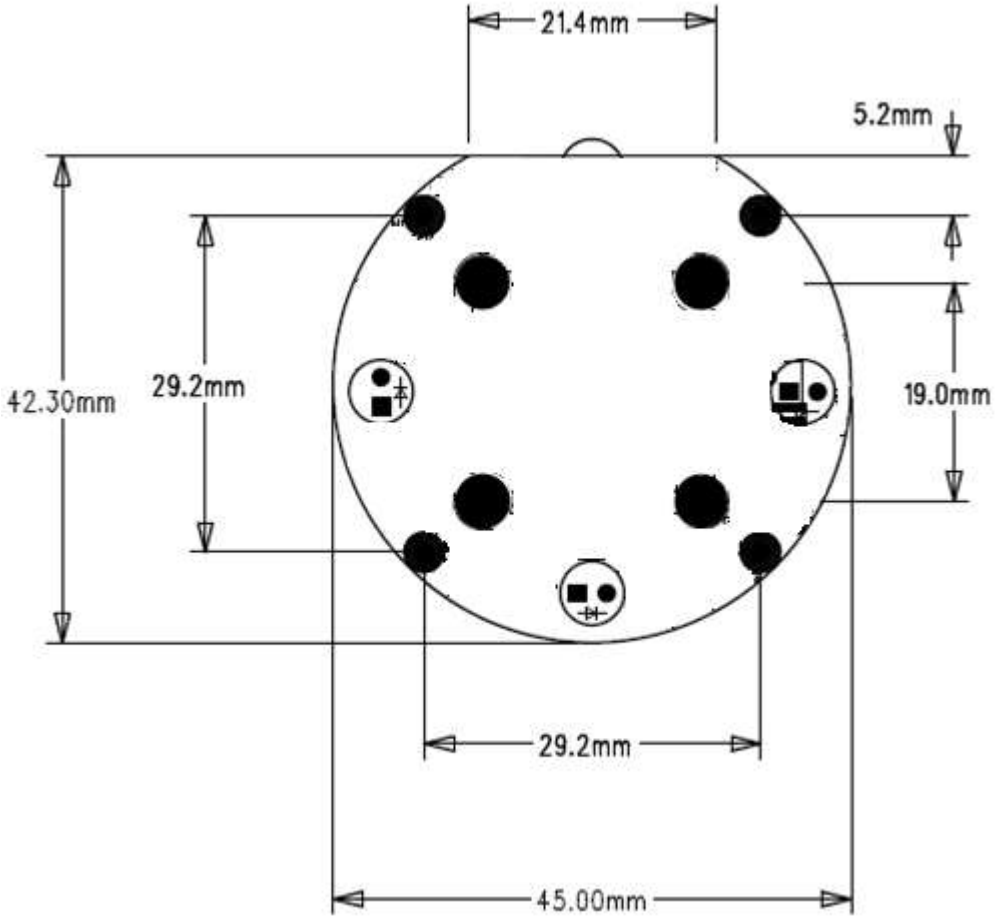
Pixel Color Pattern Detail (Top Right Corner)



Quantum Efficiency



Board dimensions



External illuminator connector

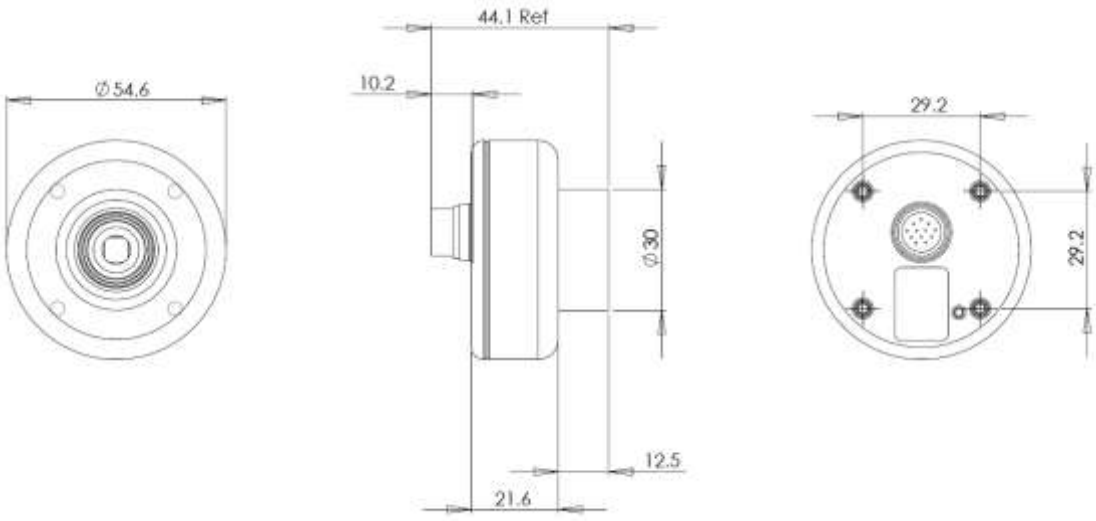
In order to use the external illuminator connector, use Samtec wire to board connector.
PN (of mating wire to board connector): SFSD-05-28-H-10.00-DR-NDX

Change the PN according to cable length.

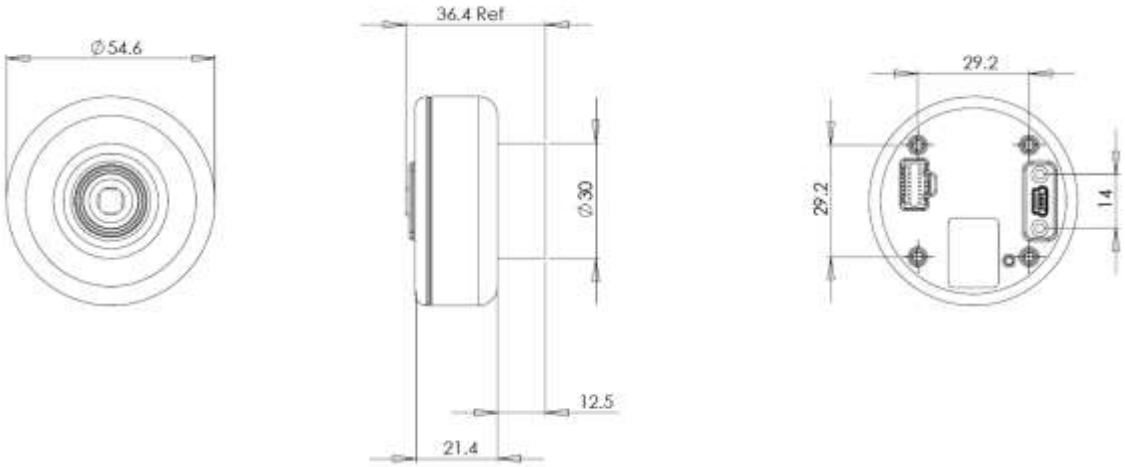
Pin	Signal Description	Pin	Signal Description
1	VCC_LIGHT	**2**	LED1
3	VCC_LIGHT	**4**	LED2
5	NC	**6**	LED3
7	LGND	**8**	LED4
9	LGND	**10**	NC

CAMERA HOUSING

Camera housing physical dimensions and locations Option1



Option2



HOW TO CONTACT US

Kane Computing Ltd
7 Theatre Court, London Road,
Northwich, Cheshire, CW9 5HB, UK.
Tel: +44(0)1606 351006
Fax: +44(0)1606 351007/8
Email: sales@kanecomputing.com
Web: www.kanecomputing.co.uk

Disclaimer

The information in this manual was accurate and reliable at the time of its release. However, we reserve the right to change the specifications of the product described in this manual without notice at any time.

Registered Trademarks

All other proprietary names mentioned in this manual are the trademarks of their respective owners.

August 2010

Imaging Diagnostics
Total vision solutions

BDR GROUP