Auto Focus Camelot Camera

- High Resolution 5Mp Sensor
- Manual/Auto Focus Option
- Superior Image Quality
- Uses Standard Commercial M12 lens
- Unlimited Auto Focus Repeatability
- Embedded DSP Capability
- Available With USB or IP Interface

INTRODUCTION

Camelot’s Auto Focus Camera is part of a family of digital cameras for machine vision applications with fast USB2.0 or Ethernet connection and embedded Digital Signal Processor capable of performing advanced image processing algorithms on the camera. The cameras are intended for medical and industrial applications requiring superior image quality, high performance and yet attractive pricing.

Camera Features

- Motorized Focus Module
- Auto/Manual focus with 3000 positions
- Supports standard M12 lens
- Configurable ROI
- External trigger support
- 6 Programmable PWM Timers
- 9 Programmable GPIOs
- USB 2.0 or Ethernet connection
- Electronic shutter
- Controllable Gain
- On board 64MByte DDR
- On board 16MByte Flash
- DirectShow Interface
- Software Development Kit
- Multiple camera support
- Standalone mode
The Auto Focus Camelot Camera consists of

- Digital Signal Processing board with USB connector, and optional Ethernet extension board
- 5Mp image sensor board (other sensors will be available in future and/or per demand)
- Motorized focus mechanism, enabling movement of M12 lens

**USB DSP Board**

The Camelot series is based on the Analog devices BF548 Blackfin DSP processor, providing high performance and a large number of interfaces. This processor was chosen in order to perform advanced image processing algorithms in limited space and power limitations. It is therefore possible to run the camera on USB power without any need of adding an additional power supply.

**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**

- 16MByte serial flash
- 32 sectors
- Page program (1024/1056 bytes)
- Sector erase (256Kbyte)
Communications interface

- USB2 high speed (480Mbps)

Power source

- USB / Via 20 pin Molex connector

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

- USB2.0
- 9 x GPIO , 3.3V logic levels
- 2 x SPI ( via expansion connector )
- PPI ( via expansion connector )
- JTAG ( via expansion connector )
- 6 x PWM ( via expansion connector )
- 2 x UART ( via expansion connector )
- I2C ( via expansion connector )
- Image sensor board ( via expansion connector )
USB 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
Each GPIO can be configured as strobe or trigger.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin name</th>
<th>Pin description</th>
<th>Remarks</th>
<th>Pin</th>
<th>Pin name</th>
<th>Pin description</th>
<th>Remarks</th>
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<tbody>
<tr>
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<td>PB0</td>
<td>GPIO-Open-drain</td>
<td>10K Pull-Up</td>
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<td>5V</td>
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<td>PC7</td>
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<td>5V</td>
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<td>PC8</td>
<td>GPIO</td>
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<td>PB9</td>
<td>TMR1 (PWM)</td>
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<td>SPI1_SEL2#</td>
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<td>8</td>
<td>PB10</td>
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<td>SPI1_SS#</td>
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<td>SPI1_MISO</td>
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<td>12</td>
<td>PC9</td>
<td>GPIO</td>
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<td>13</td>
<td>PG10</td>
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<td>PC10</td>
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<td>PB4</td>
<td>UART2-TX</td>
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<td>PC11</td>
<td>GPIO</td>
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<tr>
<td>17</td>
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<td>PH3</td>
<td>TMR9 (PWM)</td>
<td>10K Pull-Up</td>
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<tr>
<td>19</td>
<td>GND</td>
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<td></td>
<td>20</td>
<td>PB5</td>
<td>UART2-RX</td>
<td>10K Pull-Up</td>
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</table>

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. It connects the sensor board to the main board.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
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<tbody>
<tr>
<td>1</td>
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<td>SP_TF0</td>
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<td>SP_DT0SEC</td>
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<td>5</td>
<td>SD_D2</td>
<td>6</td>
<td>SP_DT0PRI</td>
</tr>
<tr>
<td>7</td>
<td>SD_D3</td>
<td>8</td>
<td>SP_DT0SCLK0</td>
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<tr>
<td>9</td>
<td>SD_CLK</td>
<td>10</td>
<td>SP_RFS0</td>
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<td>11</td>
<td>SD_CMD</td>
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<tr>
<td>15</td>
<td>TMR9</td>
<td>16</td>
<td>SP_RSCLK0</td>
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<td>TMR10</td>
<td>18</td>
<td>TMR8</td>
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<tr>
<td>19</td>
<td>DGND</td>
<td>20</td>
<td>VCC_IN</td>
</tr>
</tbody>
</table>
Physical Characteristics

- Circular design with a diameter of 45mm

Main board physical dimensions
The 5Mpixel sensor board is based on the Aptina sensor MT9P031, which incorporates sophisticated camera functions on-chip.

### 5MP Sensor Board

#### Sensor Board Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Focus Module</td>
<td>M12 micro lens adaptor</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Item</th>
<th>Description or Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>Aptina MT9P031</td>
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<tr>
<td>Resolution</td>
<td>5Mpixel</td>
</tr>
<tr>
<td>Optical Format</td>
<td>1/2.5-inch (4:3)</td>
</tr>
<tr>
<td>Active Image Size</td>
<td>5.7mm (H) x 4.28mm (V) 7.13mm diagonal</td>
</tr>
<tr>
<td>Active Pixels</td>
<td>2,592H x 1,944V</td>
</tr>
<tr>
<td>Pixel Size</td>
<td>2.2 x 2.2µm</td>
</tr>
<tr>
<td>Color Filter Array</td>
<td>RGB Bayer pattern</td>
</tr>
</tbody>
</table>
| Shutter Type          | Electronic rolling shutter (ERS)  
                         | Snapshot only  
                         | Global reset release (GRR)                                                       |
| Maximum Data Rate     | 96 Mp/s at 96MHz                                                                    |
| Sensor 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

Active Image

2,592 x 1,944 active pixels

(0,0)

50 black rows

134 black columns

10 black columns

(2751, 2003)

2 black rows

Pixel Color Pattern Detail (Top Right Corner)

column readout direction

black pixels

First Clear Pixel (10,50)

Typical Spectral Characteristics

Quantum Efficiency vs. Wavelength

Wavelength (nm)

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.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Description</th>
<th>Pin</th>
<th>Signal Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>VCC_LIGHT</td>
<td>2</td>
<td>LED1</td>
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<tr>
<td>3</td>
<td>VCC_LIGHT</td>
<td>4</td>
<td>LED2</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>6</td>
<td>LED3</td>
</tr>
<tr>
<td>7</td>
<td>LGND</td>
<td>8</td>
<td>LED4</td>
</tr>
<tr>
<td>9</td>
<td>LGND</td>
<td>10</td>
<td>NC</td>
</tr>
</tbody>
</table>
AUTO FOCUS MECHANISM

Features

- Precision lens control; superior image quality
- Single-lens focus solution with minimal external processing requirements
- Precise lens position control (0.5 micron resolution),
- Best-in-class bi-directional repeatability
- No hysteresis enabling you to capture the sharpest images from your camera
- High performance that is not susceptible to temperature or power variations.
CAMERA HOUSING

Camera housing physical dimensions and locations
HOW TO CONTACT US

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