CMOS OV5642 Camera Module
1/4-Inch 5-Megapixel Module Datasheet
Rev 1.1, Mar 2013
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1 Introduction

The OV5642 (color) image sensor is a low voltage, high-performance, 1/4-inch 5 megapixel CMOS image sensor that provides the full functionality of a single chip 5 megapixel (2592x1944) camera using OmniBSITM technology in a small footprint package. It provides full-frame, sub-sampled, windowed or arbitrarily scaled 8-bit/10-bit images in various formats via the control of the Serial Camera Control Bus (SCCB) interface or MIPI interface. The OV5642 has an image array capable of operating at up to 15 frames per second (fps) in 5 megapixel resolution with complete user control over image quality, formatting and output data transfer. All required image processing functions, including exposure control, gamma, white balance, color saturation, hue control, defective pixel canceling, noise canceling, etc., are programmable through the SCCB interface, MIPI interface or embedded microcontroller. The OV5642 also includes a compression engine for increased processing power. In addition, Omnivision image sensors use proprietary sensor technology to improve image quality by reducing or eliminating common lighting/electrical sources of image contamination, such as fixed pattern noise, smearing, etc., to produce a clean, fully stable, color image. The OV5642 has an embedded microcontroller, which can be combined with an internal autofocus engine and programmable general purpose I/O modules (GPIO) for external autofocus control. It also provides an anti-shake function with an internal anti-shake engine. For identification and storage purposes, the OV5642 also includes a one-time programmable (OTP) memory. Compared to its predecessor, the OV5642 has embedded TrueFocusTM Lite that enables extended depth of field (EDoF). The OV5642 supports both a digital video parallel port and a serial MIPI port. The MIPI and ISP interface can be used for a second camera sensor without requiring a dual serial port camera system.
2 Features

- ultra high performance
- automatic image control functions: automatic exposure control (AEC), automatic white balance (AWB), automatic band filter (ABF), automatic 50/60 Hz luminance detection, and automatic black level calibration (ABLIC)
- programmable controls for frame rate, AEC/AGC, 16-zone size/position/weight control, mirror and flip, scaling, cropping, windowing, and pan/tilt
- image quality controls: color saturation, hue, gamma, sharpness (edge enhancement), lens correction, defective pixel canceling, and noise canceling
- support for output formats: RAW RGB, RGB565/555/444, CCIR656, YUV422/420, YCbCr422, and compression
- support for images sizes: 5 megapixel, and any arbitrary size scaling down from 5 megapixel
- embedded TrueFocus™ light, enabling extended depth of field (EDoF)
- support for auto focus control (AFC)
- support for video or snapshot operations

3 Key Specifications

- active array size: 2592 x 1944
- power supply:
  - core: 1.5VDC ± 5% (internal regulator)
  - analog: 2.6 ~ 3.0V
  - I/O: 1.7 ~ 3.0V
- power requirements:
  - active: TBD
  - standby: TBD
- temperature range:
  - operating: -30°C to 70°C (see table 8-1)
  - stable image: 0°C to 50°C (see table 8-1)
- output formats (8-bit): YUV(422/420) / YCbCr422, RGB565/555/444, CCIR656, 8-bit compression data, 8/10-bit raw RGB data
- lens size: 1/4"
- lens chief ray angle: 24° non-linear (see table 10-1)
- input clock frequency: 6 ~ 27 MHz
- shutter: rolling shutter

- support for horizontal and vertical sub-sampling
- support for binning
- support for data compression output
- support for anti-shake
- support for external frame synchronization in frame exposure mode
- support for LED and flash strobe mode
- standard serial SCCB interface
- digital video port (DVP) parallel output interface
- MIPI serial input and output interface
- support for second camera chip-sharing ISP and MIPI interface
- embedded microcontroller
- embedded on-time programmable (OTP) memory for part identification, etc.
- on-chip phase lock loop (PLL)
- programmable I/O drive capability
- support for mechanical loop (PLL)
- built-in 1.5V regulator for core

- maximum image transfer rate:
  - 5 megapixel (2592x1944): 15 fps
  - (and any size scaling down from 5 megapixel)
  - 1080p (1920x1080): 30 fps
  - 720p (1280x720): 60 fps
  - VGA (640x480): 60 fps
  - QVGA (320x240): 120 fps
- sensitivity: TBD
- S/N ratio: TBD
- dynamic range: TBD
- scan mode: progressive
- maximum exposure interval: 1968 x f_tsec
- gamma correction: programmable
- pixel size: 1.4 μm x 1.4 μm
- well capacity: TBD
- dark current: TBD
- fixed pattern noise (FPN): TBD
- image area: 3673.6 μm x 2738.4 μm
- package dimensions: 6945 μm x 6695 μm
4 Block Diagram

Note: OV5642 camera module only support DVP interface, it doesn’t support MIPI interface.

5 Application

- Cellular phones
- PDAs
- Toys
- Other battery-powered products
- Can be used in Arduino, Maple, ChipKit, STM32, ARM, DSP, FPGA platforms

The following schematic diagram show a basic camera based system. The camera module is powered from a single +3.3V power supply. An external oscillator provide the clock source for camera module XCLK pin. With proper configuration to the camera internal registers via I2C bus, then the camera supply pixel clock (PCLK) and camera data (Data[9:0]) back to the host with synchronize signal like HREF and VSYNC.
The host may have integrate camera interface like STM32F2 or STM32F4 series MCUs, or ARM9/11 which has dedicate camera port, and DPS like TI TMS320DM series, as well as FPGAs that user can design special logic for camera application. The typical connection between these system and camera module would show like following diagram.

For the host that doesn’t have a dedicate camera interface, additional hardware is needed. User need to buffer a entire frame before read them out with low speed MCUs. For example ArduCAM shield is a additional hardware that can be connected to Arduino UNO/Mega board, user can take a photo or something like that easily. The following diagram show the system without dedicate camera interface.
## 6 Pin Definition

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>PIN NAME</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>POWER</td>
<td>3.3v Power supply</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
<td>Power ground</td>
</tr>
<tr>
<td>3</td>
<td>SCL</td>
<td>Input</td>
<td>Two-Wire Serial Interface Clock</td>
</tr>
<tr>
<td>4</td>
<td>SDATA</td>
<td>Bi-directional</td>
<td>Two-Wire Serial Interface Data I/O</td>
</tr>
<tr>
<td>5</td>
<td>VSYNC</td>
<td>Output</td>
<td>Active High: Frame Valid; indicates active frame</td>
</tr>
<tr>
<td>6</td>
<td>HREF</td>
<td>Output</td>
<td>Active High: Line/Data Valid; indicates active pixels</td>
</tr>
<tr>
<td>7</td>
<td>PCLK</td>
<td>Output</td>
<td>Pixel Clock output from sensor</td>
</tr>
<tr>
<td>8</td>
<td>XCLK</td>
<td>Input</td>
<td>Master Clock into Sensor</td>
</tr>
<tr>
<td>9</td>
<td>DOUT9</td>
<td>Output</td>
<td>Pixel Data Output 9 (MSB)</td>
</tr>
<tr>
<td>10</td>
<td>DOUT8</td>
<td>Output</td>
<td>Pixel Data Output 8</td>
</tr>
<tr>
<td>11</td>
<td>DOUT7</td>
<td>Output</td>
<td>Pixel Data Output 7</td>
</tr>
<tr>
<td>12</td>
<td>DOUT6</td>
<td>Output</td>
<td>Pixel Data Output 6</td>
</tr>
<tr>
<td>13</td>
<td>DOUT5</td>
<td>Output</td>
<td>Pixel Data Output 5</td>
</tr>
<tr>
<td>14</td>
<td>DOUT4</td>
<td>Output</td>
<td>Pixel Data Output 4</td>
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<tr>
<td>15</td>
<td>DOUT3</td>
<td>Output</td>
<td>Pixel Data Output 3</td>
</tr>
<tr>
<td>16</td>
<td>DOUT2</td>
<td>Output</td>
<td>Pixel Data Output 2 (LSB)</td>
</tr>
<tr>
<td>17</td>
<td>PWDN</td>
<td>Input</td>
<td>Power down</td>
</tr>
<tr>
<td>18</td>
<td>RSV</td>
<td>NC</td>
<td>Reserved</td>
</tr>
<tr>
<td>19</td>
<td>DOUT1</td>
<td>Output</td>
<td>Pixel Data Output 1(10bit mode)</td>
</tr>
<tr>
<td>20</td>
<td>DOUT0</td>
<td>Output</td>
<td>Pixel Data Output 0 (10bit mode)</td>
</tr>
</tbody>
</table>
7 Mechanical Dimension