



# CMOS OV3640 Camera Module

## 1/4-Inch 3-Megapixel Module Datasheet

Rev 1.3, July 2016

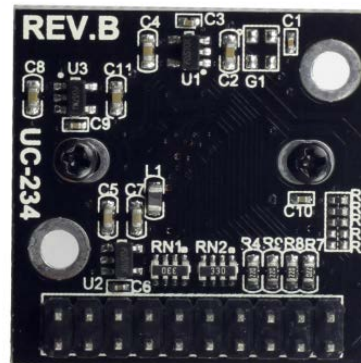


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# 1 Introduction

The OV3640 (color) CameraChip™ sensor is a low voltage, high-performance 1/4-inch 3.1 megapixel CMOS image sensor that provides the full functionality of a single chip QXGA (2048x1536) camera using OmniPixel3™ 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. The OV3640 has an image array capable of operating at up to 15 frames per second (fps) in QXGA 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 OV3640 also includes a compression engine for increased processing power. In addition, Omnivision CameraChip 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 OV3640 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.



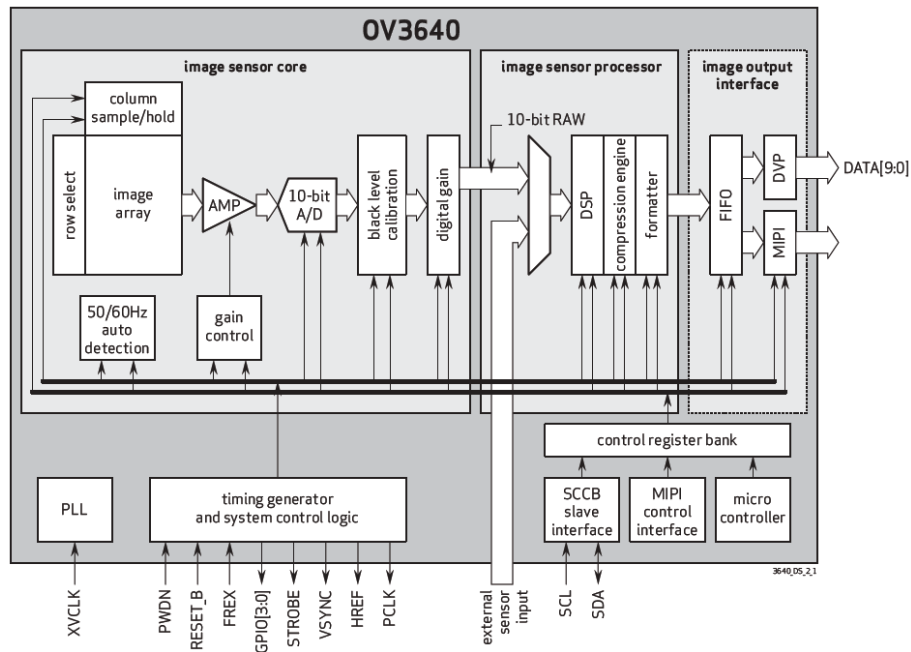
## 2 Features

- ultra low power and low cost
- 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 (ABLC)
- programmable controls for frame rate, AEC/AGC 16-zone size/position/weight control, mirror and flip, scaling, cropping, windowing, and panning
- 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, YUV422/420, YCbCr422, and compression
- support for images sizes: QXGA, and any arbitrary size scaling down from QXGA
- support for video or snapshot operations
- support for horizontal and vertical sub-sampling
- support for data compression output
- support for auto focus control (AFC)
- support for anti-shake
- support for internal and external frame synchronization
- support for LED and flash strobe mode
- standard serial SCCB interface
- digital video port (DVP) parallel output interface
- MIPI serial output interface
- support for second camera chip-sharing ISP and MIPI interface
- embedded microcontroller
- embedded one-time programmable (OTP) memory
- on-chip phase lock loop (PLL)
- programmable I/O drive capability

## 3 Key Specifications

- **active array size:** 2048 x 1536
- **power supply:**
  - core: 1.5VDC  $\pm$  5%
  - analog: 2.5 ~ 3.0V
  - I/O: 1.7 ~ 3.0V (1.8V is strongly recommended)
- **power requirements:**
  - active: 75 mA (without MIPI)
  - standby: 20  $\mu$ A
- **temperature range:**
  - operating: -20°C to 70°C
  - stable image: 0°C to 50°C
- **output formats (8-bit):** YUV(422/420) / YCbCr422, RGB565/555/444, 8-bit compression data, 8/10-bit raw RGB data
- **lens size:** 1/4"
- **lens chief ray angle:** 25° non-linear (see [Table 10-1](#))
- **input clock frequency:** 6 ~ 54 MHz
- **maximum image transfer rate:**
  - QXGA (2048x1536): 15 fps for QXGA and any size scaling down from QXGA
  - XGA (1024x768): 30 fps for XGA and any size scaling down from XGA
- **sensitivity:** 490 mV/(Lux • sec)
- **S/N ratio:** 36 dB
- **dynamic range:** 60 dB
- **shutter:** rolling shutter
- **scan mode:** progressive
- **maximum exposure interval:** 1560 x t<sub>ROW</sub>
- **gamma correction:** programmable
- **pixel size:** 1.75  $\mu$ m x 1.75  $\mu$ m
- **well capacity:** 7.2 Ke<sup>-</sup>
- **dark current:** <3 mV/sec @ 60°C
- **fixed pattern noise (FPN):** 1% of V<sub>PEAK-TO-PEAK</sub>
- **image area:** 3626  $\mu$ m x 2709  $\mu$ m
- **package dimensions:** 6285  $\mu$ m x 6125  $\mu$ m

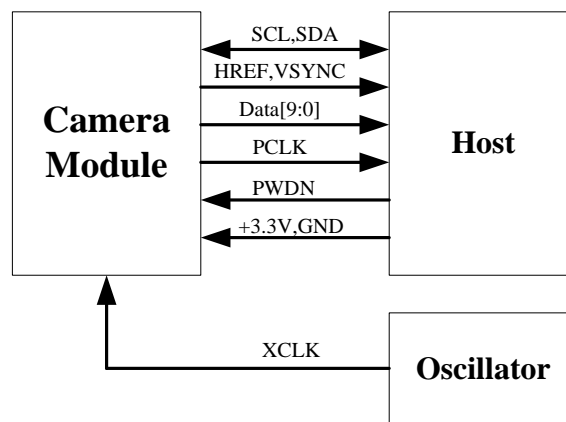
## 4 Block Diagram



## 5 Application

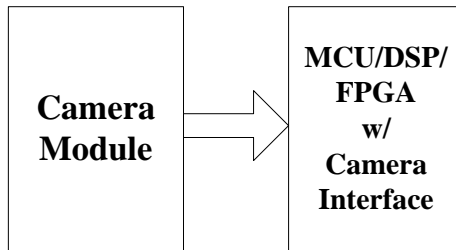
- Cellular phones
- PDAs
- Toys
- Other battery-powered products
- Can be used in Arduino, Maple, ChipKit, STM32, ARM, DSP, FPGA platforms

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.

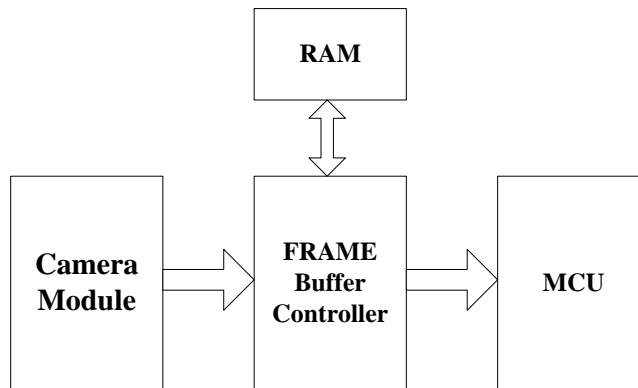


The host may have integrate camera interface like STM32F2 or STM32F4 series MCUs, or ARM9/11 which has dedicate camera port, and DPS like TI TMS320DM series, as well as FPGAs

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

The OV3640 module uses standard ArduCAM camera pin out. The pin number is listed as belows.



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

## 7 Mechanical Dimension

