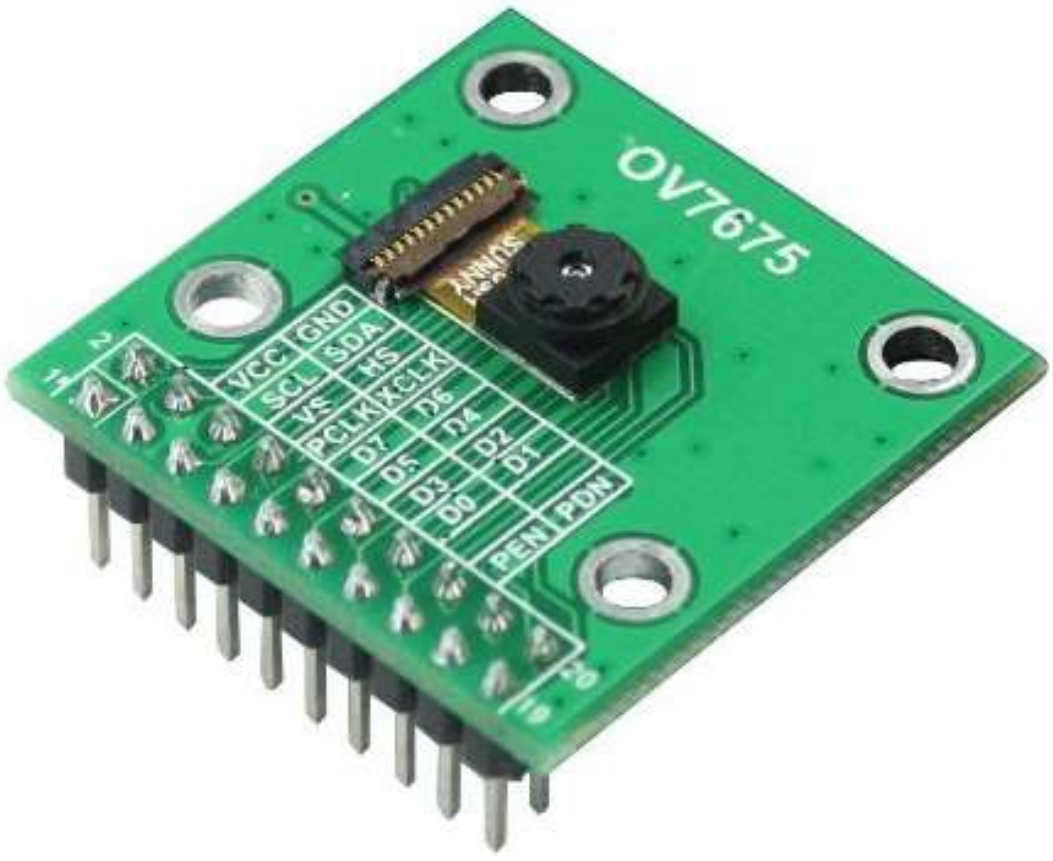
CMOS OV7675 Camera Module

1/9-Inch 0.3-Megapixel Module Datasheet

Rev 3.0, May 2015



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1 Introduction

The OV7675 (color) and OV7175 (b&w) image sensors are low voltage, high-performance 1/9-inch VGA CMOS image sensors that provides the full functionality of a single chip VGA (640x480) camera using OmniPixel3-HS™ technology in a small footprint package. They provide full-frame, sub-sampled, windowed and images in VGA, QVGA and QQVGA formats via the control of the Serial Camera Control Bus (SCCB) interface. The OV7675/OV7175 has an image array capable of operating at up to 30 frames per second (fps) in VGA 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. 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.

2 Features

- support for image sizes: VGA (640x480), QVGA (320x240) and QQVGA (160x120)
- support for output formats: YUV4:2:2, Raw RGB, ITU656, RGB565
- digital video port (DVP) parallel output interface
- on-chip phase lock loop (PLL)
- built-in 1.5V regulator for core
- capable of maintaining register values at power down
- programmable controls for frame rate, mirror and flip, AEC/AGC, and windowing
- support for horizontal and vertical sub-sampling
- automatic image control functions: automatic exposure control (AEC), automatic white balance, (AWB) and automatic black level calibration (ABLC), image quality controls: defect pixel correction and lens shading correction
- support for black sun cancellation
- standard serial SCCB interface
- parallel I/O tri-state configurability and programmable polarity
- module size: 6 mm x 6 mm

3 Key Specifications

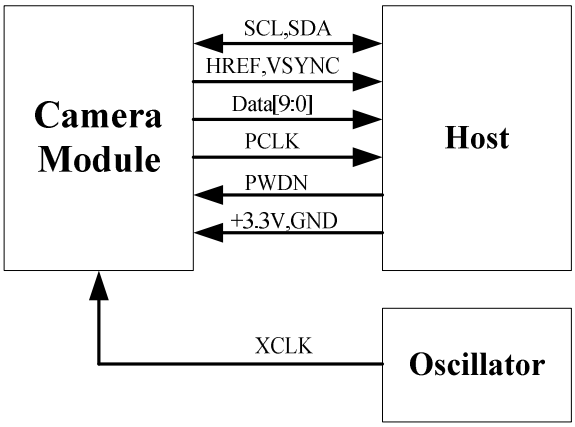
- **active array size:** 640x480
- **power supply:**
  analog: 2.6 ~ 3.0V
  core: 1.5V DC ± 5% (internal regulator)
  I/O: 1.71 ~ 3.0V
- **power requirements:**
  active: 98 mW
  standby: 60 µW
- **temperature range:**
  operating: -30°C to 70°C (see table 8-2)
  stable image: 0°C to 50°C (see table 8-2)
- **output formats:** YUV422, Raw RGB, ITU656, RGB565
- **lens size:** 1/9"
- **lens chief ray angle:** 21° (see figure 10-2)
- **input clock frequency:** 1.5 ~ 27 MHz (see table 8-5)
- **scan mode:** progressive
- **maximum image transfer rate:** (see table 2-1 for details)
- **sensitivity:** 1800 mV/(Lux-sec)
- **shutter:** rolling shutter
- **S/N ratio:** 38 dB
- **dynamic range:** 71 dB
- **maximum exposure interval:** 510 x t_{ROW}
- **pixel size:** 2.5 µm x 2.5 µm
- **dark current:** 10 mV/sec @ 60°C
- **well capacity:** 12 Ke^-
- **fixed pattern noise (FPN):** 1% of $V_{PEAK-TO-PEAK}$
- **image area:** 1640 µm x 1220 µm
- **package dimensions:** 2815 x 2825 µm

4 Application

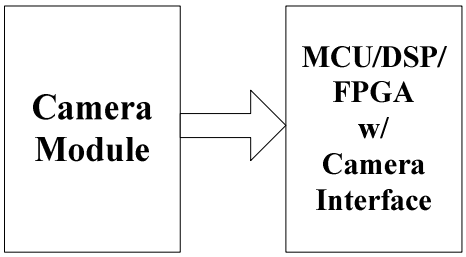
- Cellular phones
- PDAs
- Toys
- Other battery-powered products
- Can be used in Arduino, Maple, ChipKit, STM32, ARM, DSP, FPGA platforms

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,

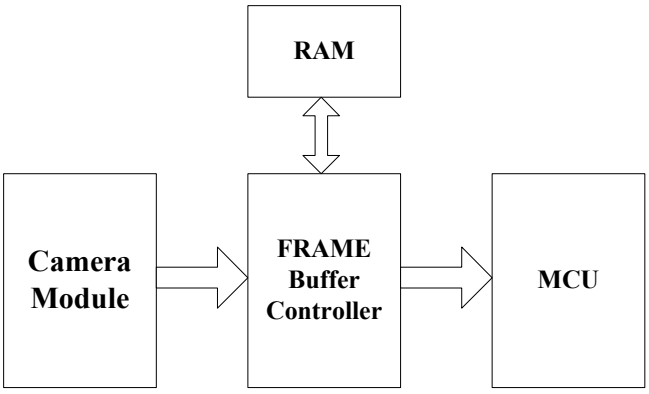
then the camera supply pixel clock (PCLK) and camera data (Data[9:0]) back to the host with synchronize signal like HREF and VSYNC.



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.



5 Pin Definition

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	DOUT7	Output	Pixel Data Output 7
10	DOUT6	Output	Pixel Data Output 6
11	DOUT5	Output	Pixel Data Output 5
13	DOUT4	Output	Pixel Data Output 4
14	DOUT3	Output	Pixel Data Output 3
15	DOUT2	Output	Pixel Data Output 2 (LSB)
16	DOUT1	Output	Pixel Data Output 1(10bit mode)
17	DOUT0	Output	Pixel Data Output 0 (10bit mode)
18	NC	-	No connect
19	NC	-	No connect
20	PEN	Input	Power enable
21	PDN	Input	Power down

6 Block Diagram

figure 2-1 OV7675 block diagram

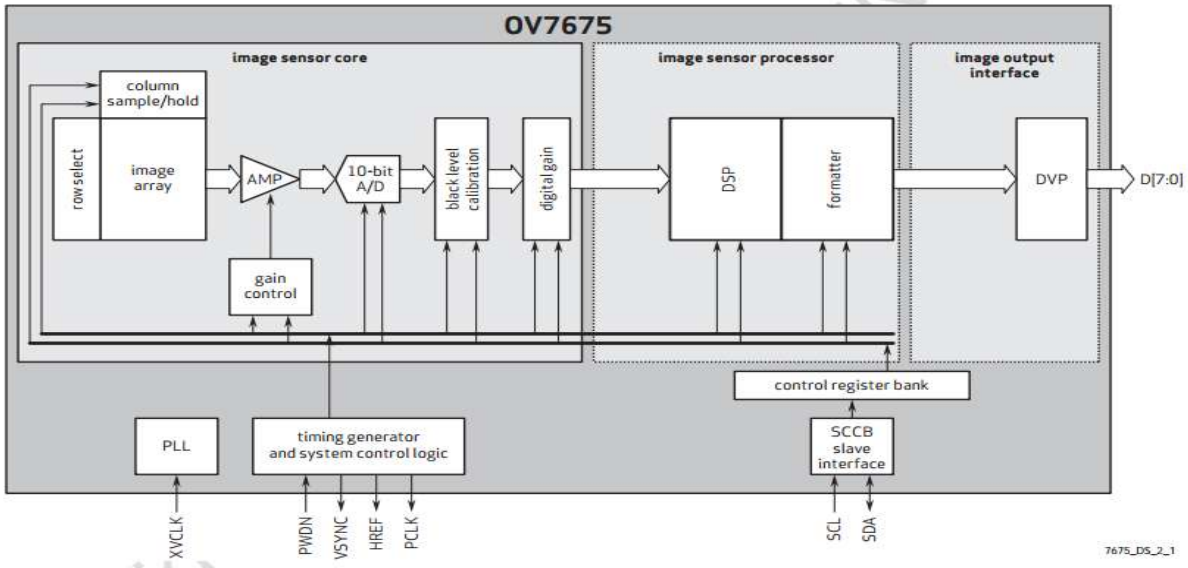
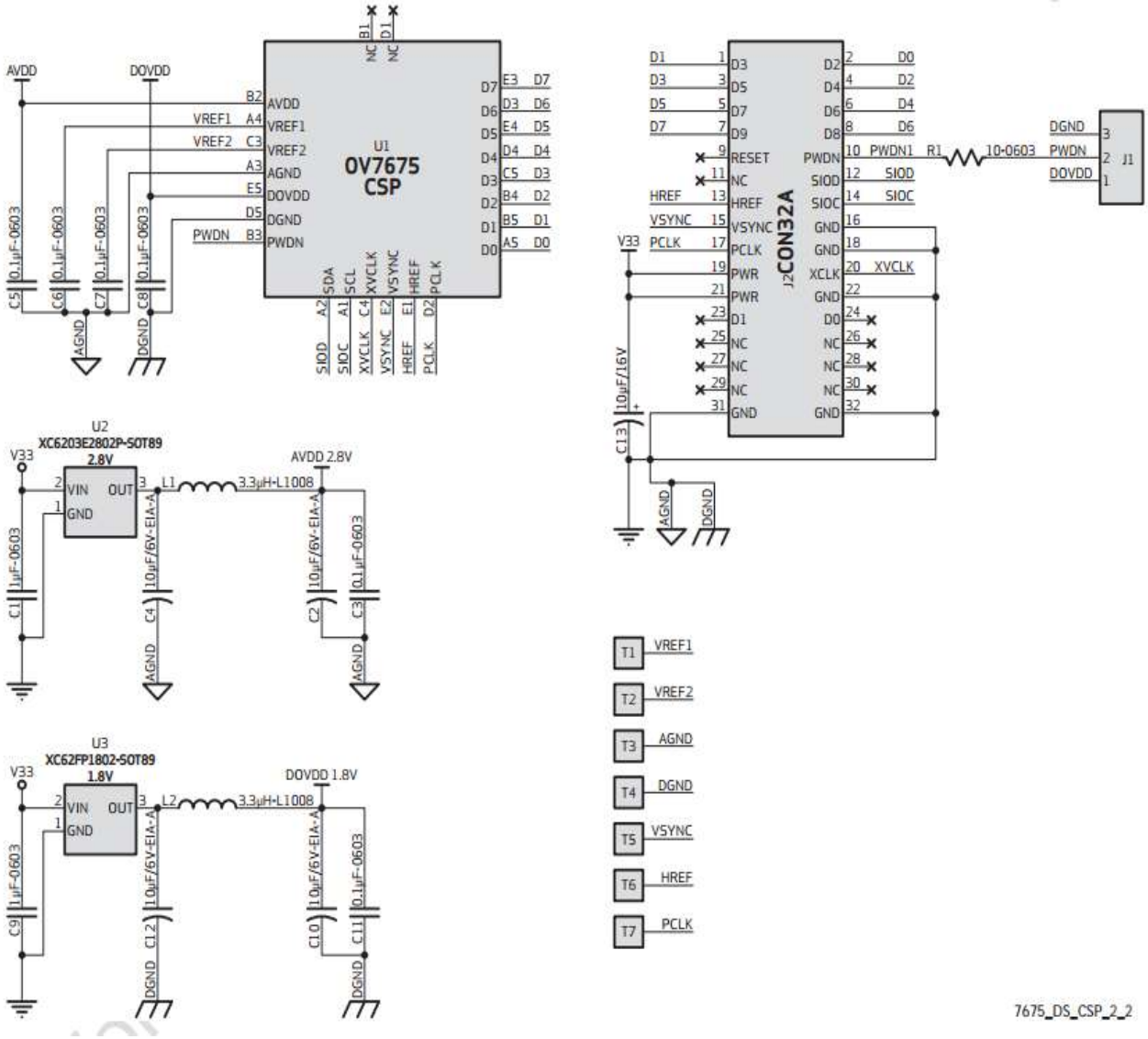


figure 2-2 reference design schematic (CSP)



7 Mechanical Dimension