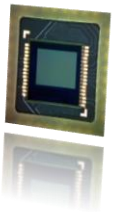

datasheet

PRODUCT SPECIFICATION

CMOS analog NTSC/PAL image sensor
with OmniPixel3-HS™ technology for automotive applications

SD07959

applications

- security and surveillance cameras

ordering information

- OV07959 (color, NTSC and PAL, Lead-free)
  32-Pin PLCC

features

- NTSC and PAL output (see **sidebar note**)
- high sensitivity
- automatic exposure/gain with 16-zone control
- horizontal and vertical windowing capability
- auto white balance control
- aperture/gamma correction
- slave compatible serial camera control bus (SCCB) control interface for register programming
- low power consumption
- low dark current
- overlay with single layer and color
- 32 bytes of one time programmable memory (OTP)
- SPI master for single static overlay and loading setting
- dynamic overlay controls
- defective pixel correction

note
Since it is impossible to check compatibility with all displays, check the interoperability before committing to mass production.

key specifications (typical)

- active array size:
  NTSC: 648 x 488
- power supply:
  core: 1.5V
  analog: 3.3V
  I/O: 1.8 ~ 3.3V
- power requirements:
  active: 220 mA
  standby: 28 µA
- temperature range:
  operating: -20°C to 70°C junction temperature
  stable image: 0°C to 50°C junction temperature
- optical size:
  NTSC: 1/3.6"
  PAL: 1/3.6"
- **chief ray angle:** 0° (no microlens shift)
- **output formats:** NTSC/PAL
- **maximum image transfer rate:**
  NTSC: 60 fields per second
  PAL: 50 fields per second
- **sensitivity:** 12V/Lux-sec
- **shutter:** rolling shutter (see **sidebar note**)
- **max S/N ratio:** 46 dB
- **dynamic range:** 72 dB @ 8x gain
- **scan mode:** interlaced
- **pixel size:** 6.0 µm x 6.0 µm
- **dark current:** 15.6 mV/sec @ 50°C junction temperature
- **image area:** 4008 µm x 3024 µm
- **package dimensions:** 10.0mm x 10.0 mm

note
Sensors with rolling shutter and high sensitivity can produce images with banding under certain fluorescent lighting conditions.

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1 signal descriptions

table 1-1 lists the signal descriptions and their corresponding pin numbers for the OV5653 image sensor. The package information is shown in **section 4**.

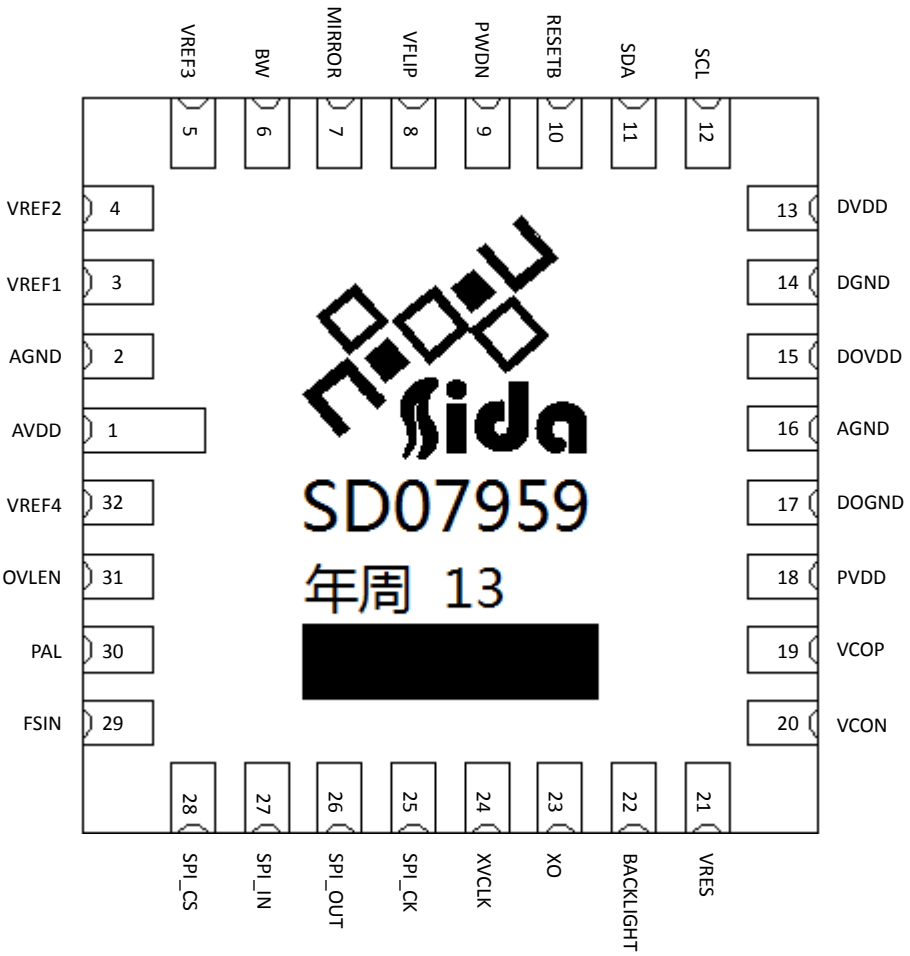
table 1-1 signal descriptions (sheet 1 of 2)

Pad number	signal name	pad type	description
01	AVDD	power	3.3V power
02	AGND	ground	analog ground
03	VREF1	analog	internal reference
04	VREF2	analog	internal reference
05	VREF3	analog	internal reference
06	BW	input	BW enable (active high) / DVP data bit 7
07	MIRROR	input	mirror enable (active high) / DVP data bit 6
08	VFLIP	input	vertical flip enable (active high) / DVP data bit 5
09	PWDN	input	power down input (active high with pull down resistor)
10	RESETB	input	reset input (active low with pull up resistor)
11	SDA	I/O	SCCB interface data pin
12	SCL	input	SCCB interface input clock
13	DVDD	power	1.5V power reference
14	DGND	ground	digital ground
15	DOVDD	power	1.8~3.3V power
16	AGND	ground	analog ground
17	DOGND	ground	digital ground
18	PVDD	power	TV encoder power
19	VCOP	output	TV positive output
20	VCON	output	TV negative output
21	VRES	analog	internal reference (connected to AGND and 1.62KΩ resistor)
22	BACKLIGHT	I/O	backlight enable DVP PCLK output
23	XO	output	clock output
24	XVCLK	input	system clock input
25	SPI_CK	output	SPI clock output / DVP data bit 0

table 1-1 signal descriptions (sheet 2 of 2)

Pad number	signal name	pad type	description
26	SPI_OUT	output	SPI data output / DVP data bit 1
27	SPI_IN	input	SPI data input / DVP data bit 2
28	SPI_CS	output	SPI chip select output / DVP data bit 3
29	FSIN	input	frame sync signal / DVP data bit 4
30	PAL	input	PAL switch / DVP HREF output
31	OVLEN	input	overlay enable / DVP VSYNC output
32	VREF4	analog	internal reference

figure 1-1 pin diagram



2 system level description

2.1 overview

The OV7959 color image sensor is low voltage, high performance CMOS image analog sensor that provides the full functionality of a single chip digital/analog NTSC/PAL image sensor using OmniPixel3-HS™ technology in a small footprint package. The image processing circuit also features black level calibration, lens correction, advanced auto white balance, auto exposure control, white/black pixel correction, color matrix and interpolation. It provides full-frame images via the control of the Serial Camera Control Bus (SCCB) interface.This product is ideal for applications requiring a small footprint, low voltage, low power and low cost color video camera.

2.2 architecture

The OV7959 sensor core generates streaming pixel data at a constant frame rate with analog output.

The timing generator outputs clocks to access the rows of the imaging array, precharging and sampling the rows of array sequentially. In the time between precharging and sampling a row, the charge in the pixels decrease with exposure to incident light. This is the exposure time in rolling shutter architecture.

The exposure time is controlled by adjusting the time interval between precharging and sampling. After the data of the pixels in the row has been sampled, it is processed through analog circuitry to correct the offset and multiply the data with corresponding gain. Following analog processing is the ADC which outputs 10-bit data for each pixel in the array.

figure 2-1 OV7959 block diagram

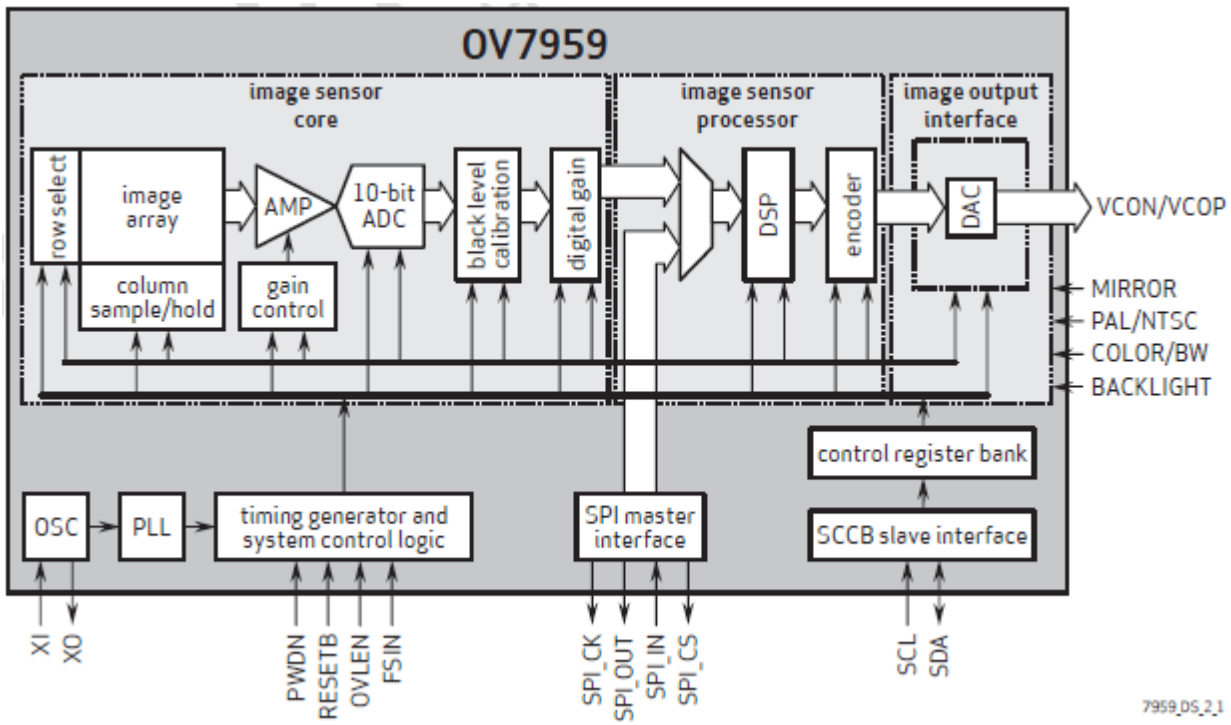
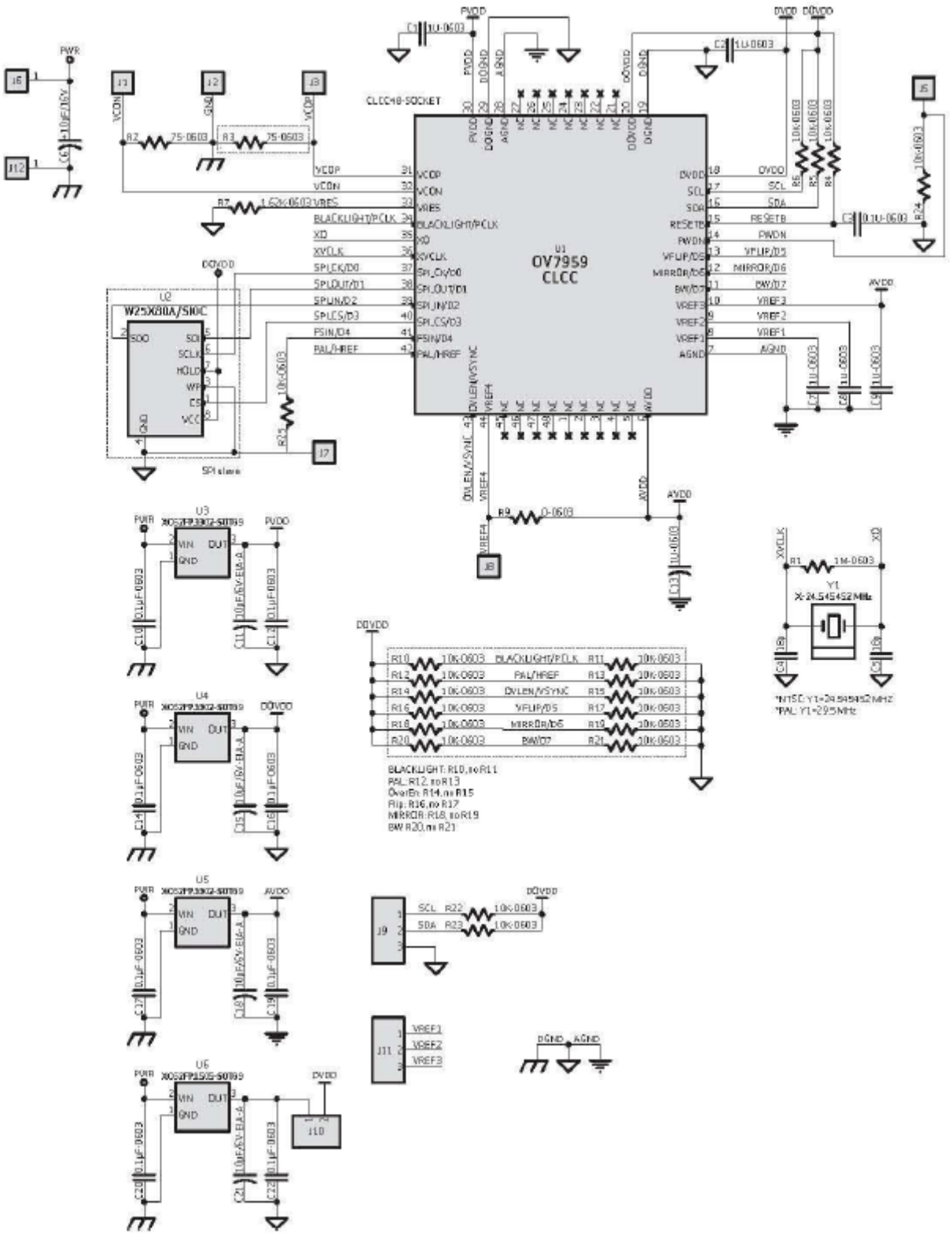


figure 2-2 OV7959 reference schemetic



2.3 PLL control

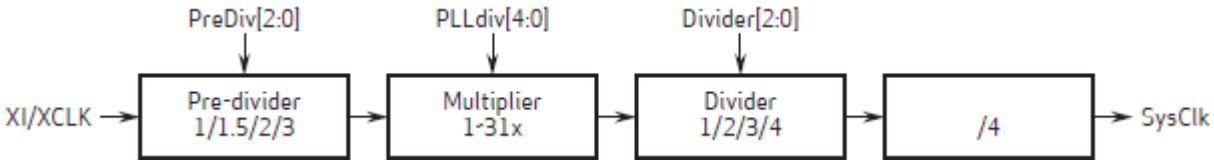
The OV7959 PLL allows input clock frequencies ranging from 6~27 MHz and has a maximum VCO frequency of 60 MHz. For NTSC output, the input clock frequency should be 24.545452 MHz. For PAL output, the input clock frequency should be 29.5 MHz.

PreDiv[2:0] (0x0305[2:0]) 1:1/1, 2:1/2, 3:1/3, others:1/1.5

PLLdiv[4:0] (0x0307[4:0]) is the multiplier parameter: multiplier 0:32x, 1:1x, 2:2x...31:31x

Divider[2:0] (0x0303[2:0]) is the system divider 1:/1, 2:/2, 3:/3, 4:/4

figure 2-3 OV7959 block diagra



2.4 system control

2.4.1 external components

An external 3.14 ~ 3.47V power supply is used for array power. DOVDD, power for IO pad, can be from 1.7 to 3.47V. 1.5V core power is converted from DOVDD power by the internal regulator.

A resistor is required for TV out DAC power reference.

2.4.2 power management

Suspend mode is controlled by the PWDN pin. In suspend mode, the internal clocks are stopped, sensor modules are powered off, and logic control blocks clock input from internal circuitry by logic control. Register values are saved while the sensor is in suspend mode.

Sleep mode can be controlled by register. During sleep mode, the SCCB clock keeps running. Register values can still be accessed while the sensor is in this mode.

In both suspend and standby modes, the TV output pin state is turned OFF and the 75 ohm termination is connected to GND.

2.4.3 system clock

The on-chip PLL takes 24.545452 MHz (NTSC) or 29.5 MHz (PAL) clock signals from an external crystal. A clock divider is provided to generate different system frequencies.

2.5 SCCB interface

The Serial Camera Control Bus (SCCB) interface controls the image sensor operation. Refer to the *OmniVision Technologies Serial Camera Control Bus (SCCB) Specification* for detailed usage of the serial control port.

2.6 hardware and software standby

Two suspend modes are available for the OV7959:

- hardware standby
- software standby

2.6.1 hardware standby

To initiate hardware standby mode, the PWDN pin must be tied to high. When this occurs, the OV7959 internal device clock is halted and all internal counters are reset and registers are maintained.

2.6.2 software standby

Executing a software standby through the SCCB interface suspends internal circuit activity but does not halt the device clock. All register content is maintained in standby mode.

2.7 analog format

table 2-1 analog format and frame rate

function	format	field rate	input clock
analog output	NTSC	60 fields/sec	24.545452 MHz
	PAL	50 fields/sec	29.5 MHz

3 block level description

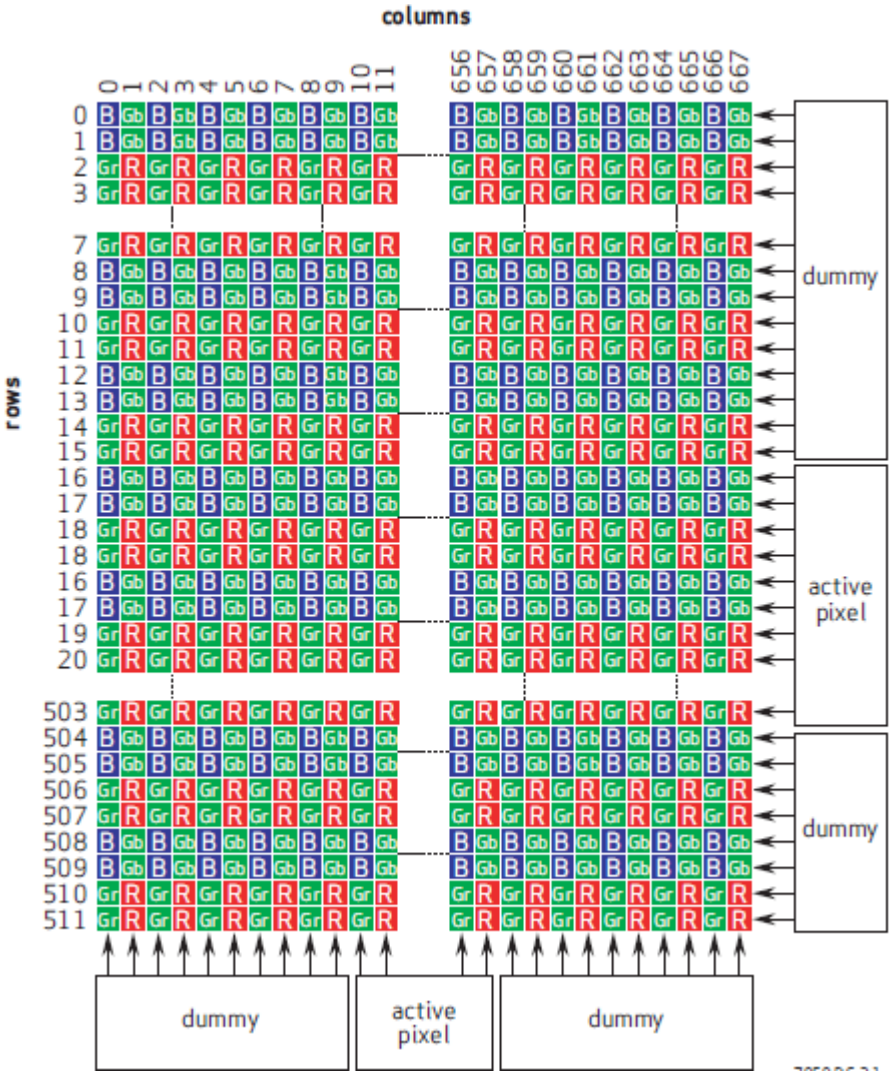
3.1 pixel array structure

The OV7959 sensor has an image array of 668 columns by 512 rows (342,016 pixels).

Of the 342,016 pixels, 648 x 488 (316,224) are active pixels and can be output. The other pixels are used for black level calibration and interpolation

The sensor array design is based on a field integration read-out system with line-by-line transfer and an electronic shutter with a synchronous pixel read-out scheme.

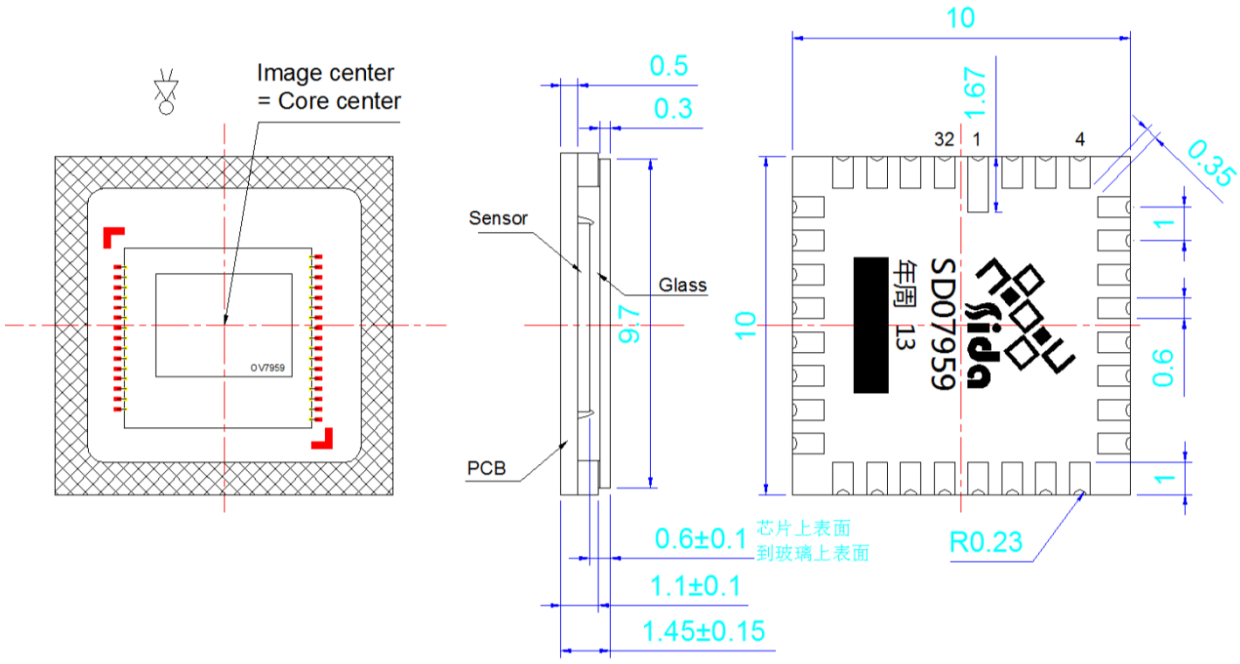
figure 3-1 sensor array region color filter layout



4 mechanical specifications

4.1 physical specifications

figure 4-1 package specifications



Note1 all exposed metallized areas shall be gold-plate 0.05um min. thickness over nickel plate unless otherwise specified in purchase order

Note2 seal area and die attach area shall be without metallization

table 4-1 package dimensions (sheet 1 of 2)

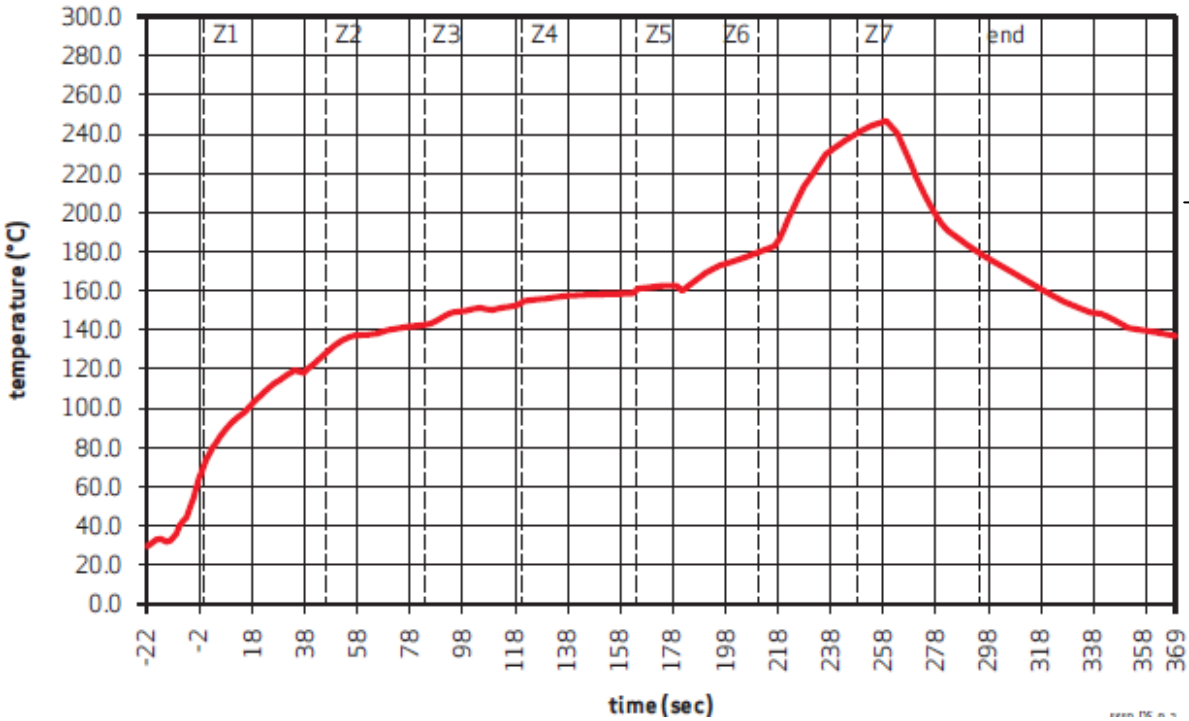
dimensions	millimeters	inches
Package size	10.0±0.10 sq	0.394±0.004 sq
Package height	1.45±0.15	0.057±0.006
Substrate base height	0.5±0.05	0.0197±0.002
Cavity size	8.10±0.20 sq	0.319±0.008 sq
Castellation height	0.52±0.05	0.021±0.002
Pin 1# pad size	0.60 x 1.70	0.024 x 0.067
Pad size	0.60 x 1.00	0.024 x 0.039
Pad pitch	1.00±0.05	0.039±0.002
Package edge to first lead center	0.85±0.10	0.034±0.004
End-to-end pad center-center	9.00±0.10	0.354±0.004

table 4-1 package dimensions (sheet 2 of 2)

dimensions	millimeters	inches
Glass size	9.70±0.10 sq	0.382±0.004 sq
Glass height	0.3±0.05	0.012±0.002
Die thickness	0.30±0.015	0.012±0.0006
Top of glass to image plane	0.6±0.10	0.024±0.004
Substrate height	1.1±0.10	0.043±0.004

4.2 IR reflow specifications

figure 4-2 IR reflow ramp rate requirements



note
The OV7959 uses a Lead free package

table 4-2 reflow conditions

zone	description	exposure
Ramp up	Heating from room temperature to 150℃	Temperature slope ≤3℃per second
soaking	Heating from 150℃ to 200℃	30 – 150 seconds
reflow	Temperature higher than 217℃	30 – 120 seconds
peak	Maximum temperature in SMT	245℃
cooling	Cooling from 217℃ to room temperature	Temperature slope ≤6℃ per second

a. Maximum number of reflow cycles = 3

b. N2 gas reflow or control O2 gas PPM < 500 as recommendation