

OV2640FSL Color CMOS 2.0 MegaPixel Camera Module with OmniPixel2™ Technology

General Description

The OV2640FSL is a sensor on-board camera and lens module designed for mobile applications where low power consumption and small size are of utmost importance.

Proprietary sensor technology utilizes advanced algorithms to cancel Fixed Pattern Noise (FPN), eliminate smearing, and drastically reduce blooming. All required camera functions are programmable through the serial SCCB interface.

The device can be programmed to provide image output in various fully processed and encoded formats.

The OV2640FSL features the OV2640 CAMERACHIP™ sensor. Refer to the [OV2640 Datasheet](#) for chip-specific information.



Caution: READ THIS FIRST!
Prior to finalizing any mechanical or electrical design for production, consult with OmniVision to confirm any final dimensional or electrical pinout data.

Features

- UXGA/SXGA and any size scaling down from SXGA to 40x30
- Output support for Raw RGB, RGB (RGB565/555), YUV (422/420), YCbCr (4:2:2) formats, and 8-bit compressed data
- 8mm x 8mm x 5.85mm module size
- Flex cable connector
- 2.8V operation, low power dissipation
- Serial Camera Control Bus (SCCB) interface
- Function controls:
 - Exposure control
 - Gain
 - White balance
 - Hue control
 - Windowing

Ordering Information

Product	Package
OV02640-FSL0	8mm x 8mm x 5.85mm Flex Cable

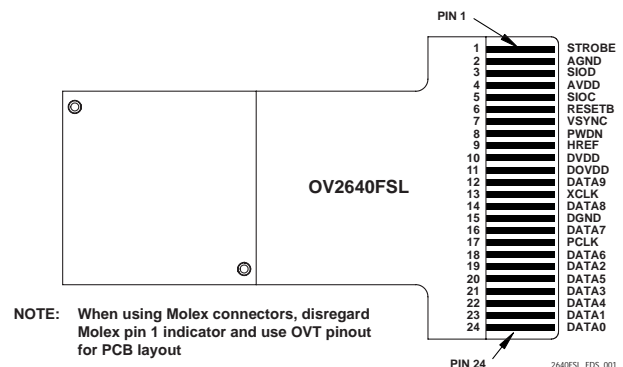
Applications

- Cell phones
- PDAs
- Picture phones
- Vision toys

Key Specifications

Array Size	UXGA	1600 x 1200
Power Supply	Core	1.3VDC \pm 5%
	Analog	2.5 ~ 3.0VDC
	I/O	1.7V to 3.3V
Power Requirements	Active	125 mW (for 15 fps, UXGA YUV mode)
		140 mW (for 15 fps, UXGA compressed mode)
	Standby	600 μ A
Output Formats (8-bit)	<ul style="list-style-type: none"> • YUV(422/420)/YCbCr422 • RGB565/555 • 8-bit compressed data • 8-/10-bit Raw RGB data 	
	Optical Format	1/4"
	Chief Ray Angle	25° non-linear
	Maximum Image Transfer Rate	UXGA/SXGA
SVGA		30 fps
CIF		60 fps
Sensitivity	0.6 V/Lux-sec	
S/N Ratio	40 dB	
Dynamic Range	50 dB	
Scan Mode	Progressive	
Maximum Exposure Interval	1247 x t_{ROW}	
Gamma Correction	Programmable	
Pixel Size	2.2 μ m x 2.2 μ m	
Dark Current	15 mV/s at 60°C	
Well Capacity	12 Ke	
Fixed Pattern Noise	<1% of $V_{PEAK-TO-PEAK}$	
Image Area	3590 μ m x 2684 μ m	
Package Dimensions	8mm x 8mm x 5.85mm	

Figure 1 OV2640FSL Pin Diagram

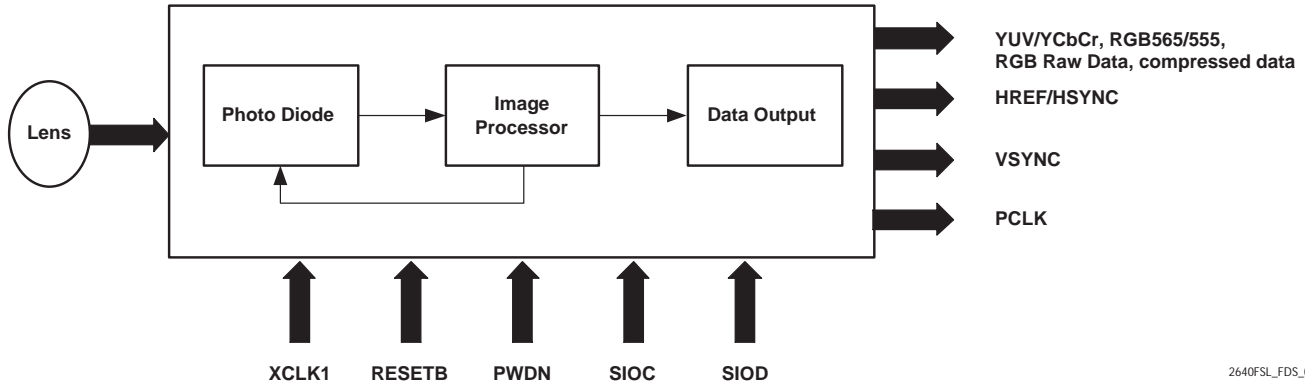


Functional Description

Figure 2 shows the functional block diagram of the OV2640FSL Camera Module. The OV2640FSL includes:

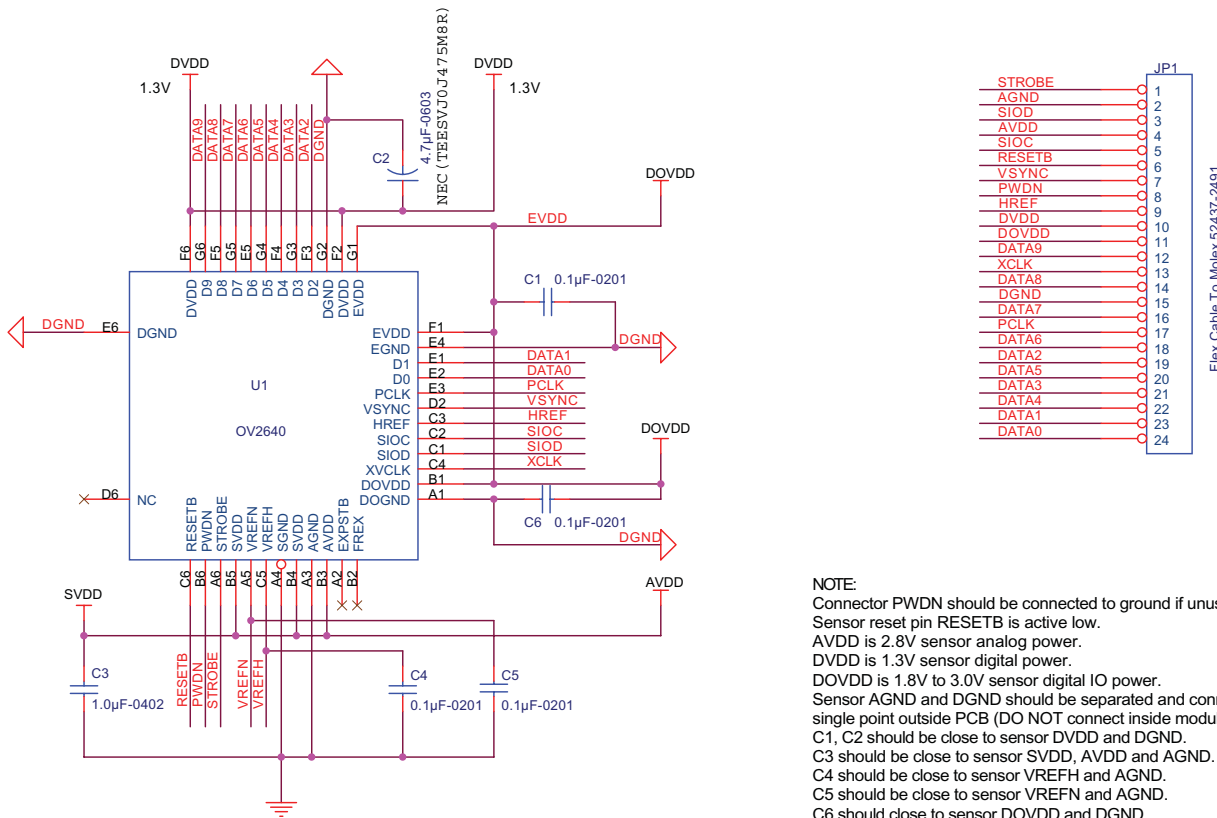
- 1/4" lens
- OV2640 CAMERACHIP image sensor
- Flex cable

Figure 2 Functional Block Diagram



2640FSL_FDS_002

Figure 3 Module Schematic



NOTE:
 Connector PWDN should be connected to ground if unused.
 Sensor reset pin RESETB is active low.
 AVDD is 2.8V sensor analog power.
 DVDD is 1.3V sensor digital power.
 DOVDD is 1.8V to 3.0V sensor digital IO power.
 Sensor AGND and DGND should be separated and connected to a single point outside PCB (DO NOT connect inside module).
 C1, C2 should be close to sensor DVDD and DGND.
 C3 should be close to sensor SVDD, AVDD and AGND.
 C4 should be close to sensor VREFH and AGND.
 C5 should be close to sensor VREFN and AGND.
 C6 should close to sensor DOVDD and DGND.
 C7 should close to sensor EVDD and DGND.
 D[9:2] is module YUV and RGB 8-bit output (D9: MSB, D2: LSB).
 D[9:0] is module raw RGB 10-bit output (D9: MSB, D0: LSB).

2640FSL_FDS_003

Imaging Specifications

Table 1 Sensor Image Functions

Sensor Imaging Functions	Description
Auto Exposure	Module automatically sets correct exposure time.
Auto Exposure ON/OFF	Auto exposure can be turned off so the exposure can be set manually.
Auto White Balance (AWB)	AWB without companion processor interaction.
Auto White Balance OFF	AWB can be turned off.
Electrical Illumination Flicker Elimination	Interference from 50Hz or 60Hz illumination can be suppressed with manually set frame rate divider.
Image Size Decimation	Size can be altered using the windowing registers. Quarter-format sub-sampling is also provided.
Image ON/OFF	Image ON/OFF can be controlled by register settings.
Vertical Flip	Transposes the top and bottom sides of the image.
RGB Output	RGB raw data output available.
AGC Gain	Automatic Gain Control (AGC)
White Balance	Automatic White Balance

NOTE: OV2640FSL features the OV2640 CAMERACHIP sensor. Refer to the [OV2640 Datasheet](#) for chip-specific information.

Table 2 Output Specifications

Output Image Formats	Description
Output Formats	UXGA (1600 x 1200 pixels)
	SXGA (1280 x 1024)
	SVGA (800 x 600 pixels)
	CIF (400 x 292 pixels)
RGB Raw Format	8-bit or 10-bit
YUV Format	4:2:0 or 4:2:2 compliant with CCIR656
YUV Order	YUYV or UYVY
Embedded Sync Codes	Sync signals coded in with data output (CCIR656) or output separately.
Data Clipping	According to CCIR656 or no clipping.
Format in Decimation Mode	PCLK verifies whether or not there is data on every cycle.

Pin Description

Table 3 Module Pin Description

Pin Number	Name	Pin Type	Function/Description
01	STROBE	I/O	Flash control output
02	AGND	Power	A/D converter ground, array decoder ground
03	SIOD	I/O	SCCB serial interface data I/O
04	AVDD	Power	2.8 V supply for A/D converter and array decoder
05	SIOC	Input	SCCB serial interface clock input
06	RESETB	Input (0)	Chip reset, active low
07	VSYNC	Output	Vertical synchronization output when chip is in master mode
08	PWDN	Input (0) ^a	Power down mode enable, active high
09	HREF	Output	Horizontal reference output
10	DVDD	Power	1.3 V supply for digital circuits
11	DOVDD	Power	2.8 V supply for digital video port
12	DATA9	Output	Video port output bit[9]
13	XCLK1	Input	Crystal clock input
14	DATA8	Output	Video port output bit[8]
15	DGND	Power	Digital video port ground
16	DATA7	Output	Video port output bit[7]
17	PCLK	Output	Pixel clock output
18	DATA6	Output	Video port output bit[6]
19	DATA2	Output	Video port output bit[2]
20	DATA5	Output	Video port output bit[5]
21	DATA3	Output	Video port output bit[3]
22	DATA4	Output	Video port output bit[4]
23	DATA1	Output	Video port output bit[1]
24	DATA0	Output	Video port output bit[0]

a. Input (0) represents an internal pull-down low resistor.

Electrical Characteristics

Table 4 Absolute Maximum Ratings

Ambient Storage Temperature		-40°C to +95°C
Supply Voltages (with respect to Ground)	V_{DD-A}	4.5V
	V_{DD-C}	3V
	V_{DD-IO}	4.5V
All Input/Output Voltages (with respect to Ground)		-0.3V to V _{DD-IO} +1V

NOTE: Exceeding the Absolute Maximum ratings shown above invalidates all AC and DC electrical specifications and may result in permanent device damage.

Table 5 DC Characteristics (-30°C < T_A < 70°C)

Symbol	Parameter	Min	Typ	Max	Unit
Supply					
V _{DD-A}	Supply voltage	2.5	2.8	3.0	V
V _{DD-D}	Supply voltage	1.24	1.3	1.36	V
V _{DD-IO}	Supply voltage ^a	1.71	2.8	3.3	V
I _{DDA-A}	Active (Operating) Current ^b		30	40	mA
I _{DDA-D}	Active (Operating) Current ^b		25 (YUV) 35 (Compressed)	35 (YUV) 50 (Compressed)	mA
I _{DDA-IO}	Active (Operating) Current ^b		6	10	mA
I _{DDS-SCCB}	Standby Current ^b		1	2	mA
I _{DDS-PWDN}			600	1200	μA
Digital Inputs					
V _{IL}	Input voltage LOW			0.54	V
V _{IH}	Input voltage HIGH	1.26			V
C _{IN}	Input capacitor			10	pF
Digital Outputs (standard loading 25 pF)					
V _{OH}	Output voltage HIGH	1.62			V
V _{OL}	Output voltage LOW			0.18	V
Serial Interface Inputs					
V _{IL}	SIO_C and SIO_D	-0.5	0	0.54	V
V _{IH}	SIO_C and SIO_D	1.26	1.8	2.3	V

- 1.8V I/O is supported. Contact your local OmniVision FAE for further details.
- V_{DD-A} = 2.8V, V_{DD-D} = 1.3V, and V_{DD-IO} = 1.8V for 15 fps in UXGA mode
I_{DDS-SCCB} refers to SCCB-initiated Standby, while I_{DDS-PWDN} refers to PWDN pin-initiated Standby

Table 6 AC Characteristics (T_A = 25°C, V_{DD-A} = 2.8V)

Symbol	Parameter	Min	Typ	Max	Unit
ADC Parameters					
B	Analog bandwidth		20		MHz
DLE	DC differential linearity error		0.5		LSB
ILE	DC integral linearity error		1		LSB
	Settling time for hardware reset			<1	ms
	Settling time for software reset			<1	ms
	Settling time for UXGA/SVGA mode change			<1	ms
	Settling time for register setting			<300	ms

Table 7 Timing Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
Oscillator and Clock Input					
f _{osc}	Frequency (XCLK)	6	24		MHz
t _r , t _f	Clock input rise/fall time			5	ns
	Clock input duty cycle	45	50	55	%

Timing Specifications

Figure 4 SCCB Interface Timing Diagram

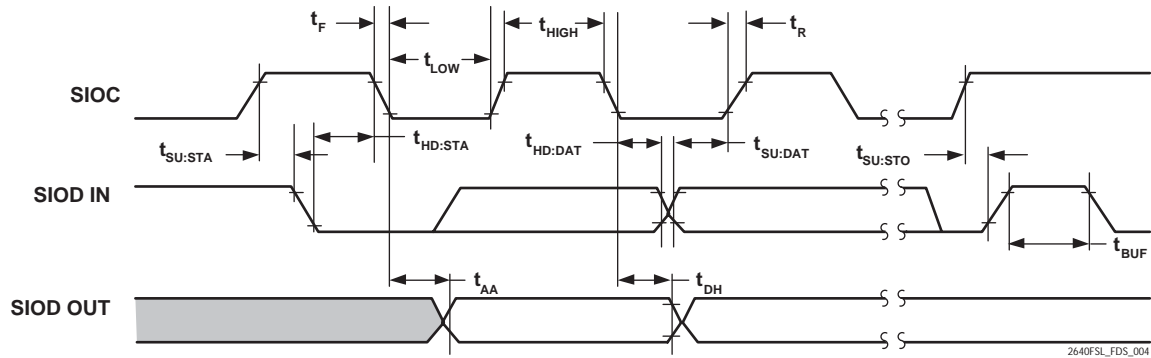
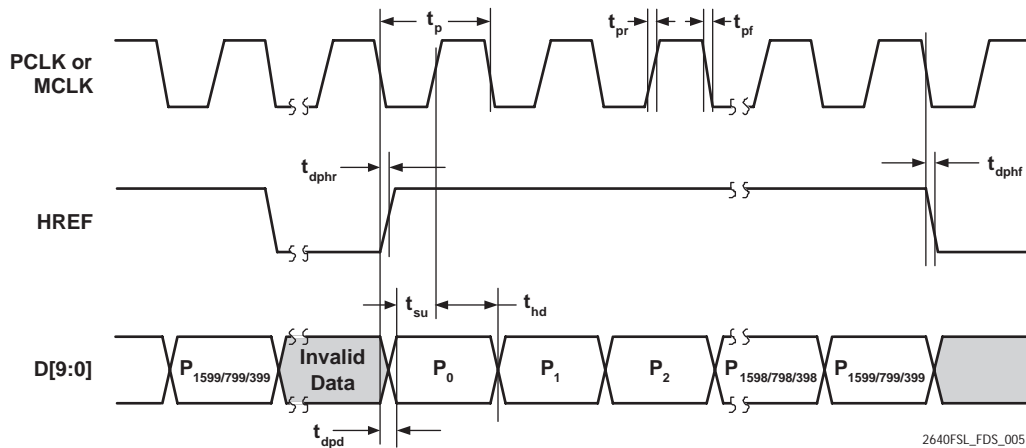


Table 8 SCCB Interface Timing Specifications

Symbol	Parameter	Min	Typ	Max	Unit
f_{SIO_C}	Clock Frequency			400	KHz
t_{LOW}	Clock Low Period	1.3			μ s
t_{HIGH}	Clock High Period	600			ns
t_{AA}	SIOC low to Data Out valid	100		900	ns
t_{BUF}	Bus free time before new START	1.3			μ s
$t_{HD:STA}$	START condition Hold time	600			ns
$t_{SU:STA}$	START condition Setup time	600			ns
$t_{HD:DAT}$	Data-in Hold time	0			μ s
$t_{SU:DAT}$	Data-in Setup time	100			ns
$t_{SU:STO}$	STOP condition Setup time	600			ns
t_R, t_F	SCCB Rise/Fall times			300	ns
t_{DH}	Data-out Hold time	50			ns

Figure 5 UXGA, SVGA, and CIF Line/Pixel Output Timing



2640FSL_FDS_005

Table 9 Pixel Timing Specifications

Symbol	Parameter	Min	Typ	Max	Unit
t_p	PCLK period		27.78		ns
t_{pr}	PCLK rising time		3.5		ns
t_{pf}	PCLK falling time		2.2		ns
t_{dphr}	PCLK negative edge to HREF rising edge	0		5	ns
$t_{dp hf}$	PCLK negative edge to HREF negative edge	0		5	ns
$t_{dp d}$	PCLK negative edge to data output delay	0		5	ns
t_{su}	Data bus setup time	15			ns
t_{hd}	Data bus hold time	8			ns

Figure 6 UXGA Frame Timing

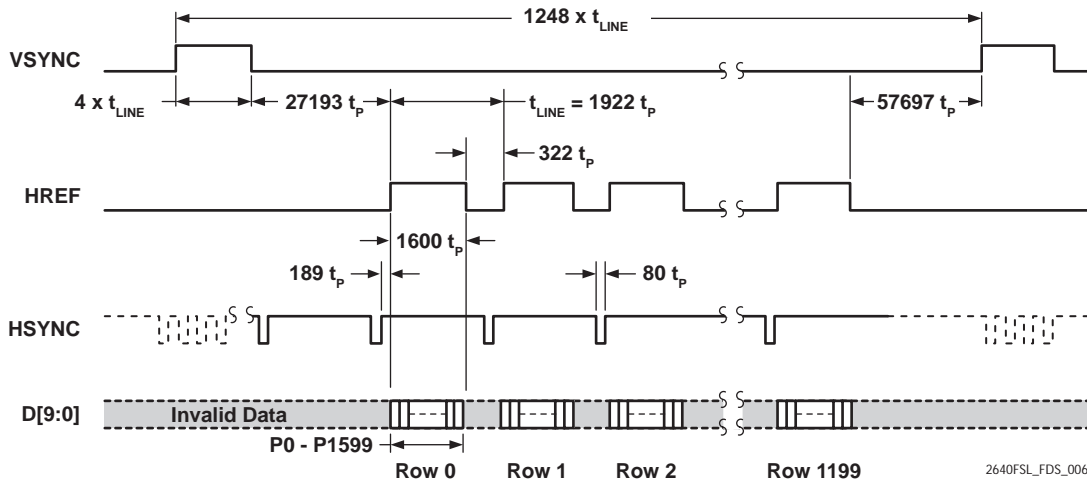


Figure 7 SVGA Frame Timing

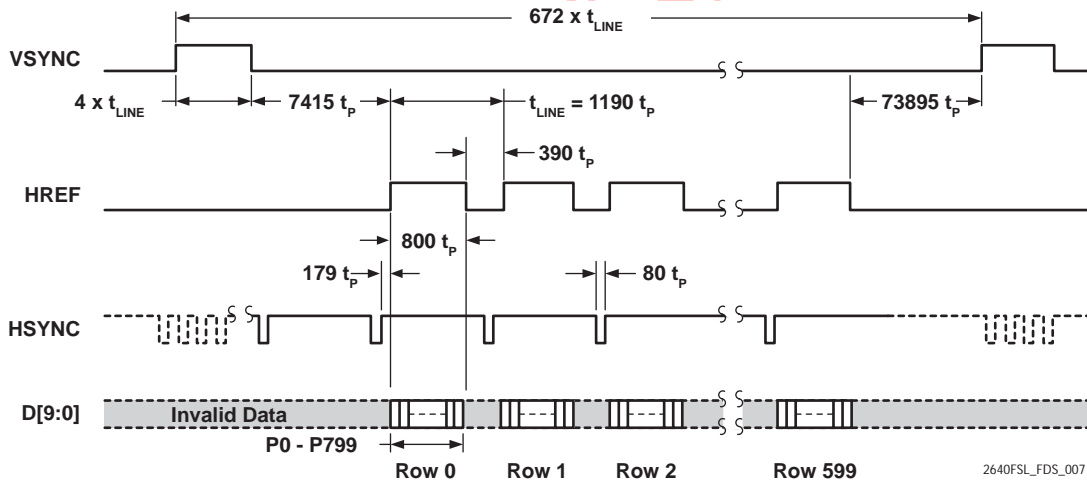


Figure 8 CIF Mode Frame Timing

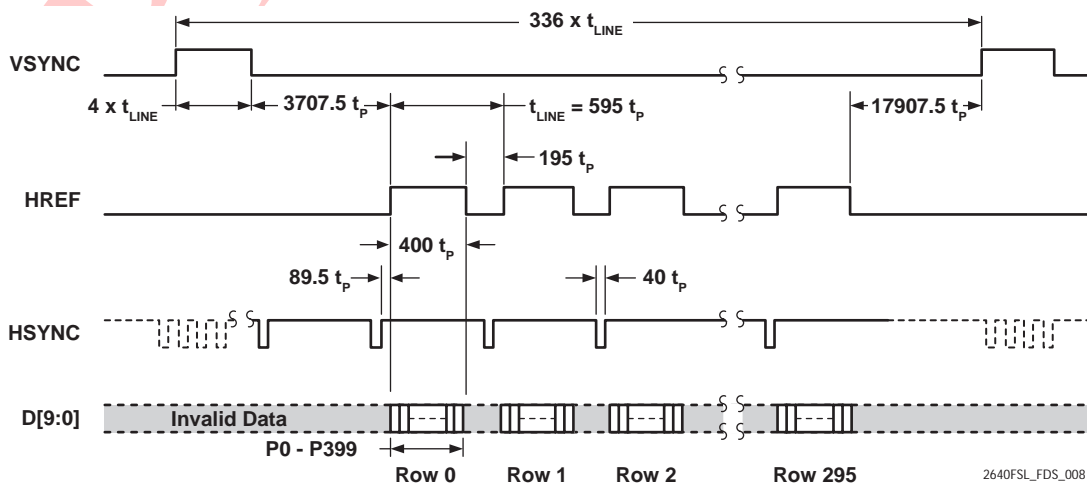
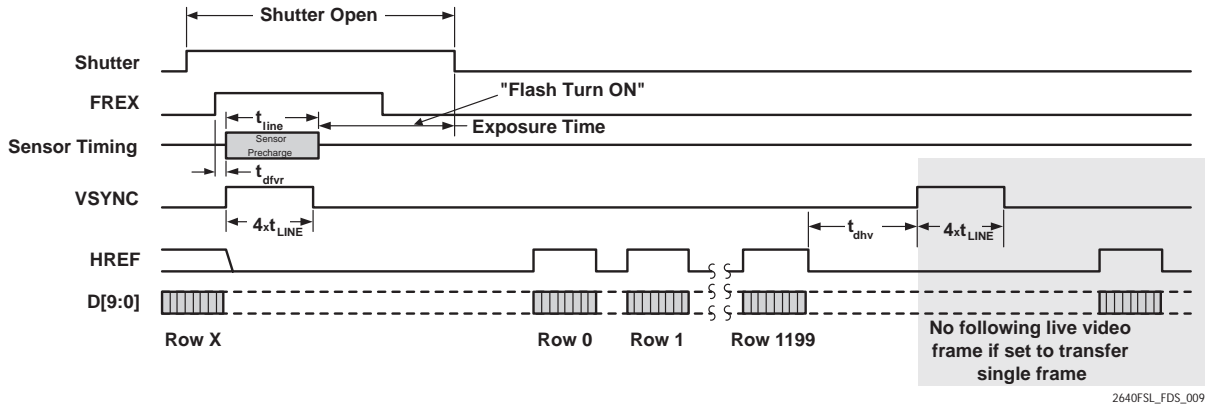
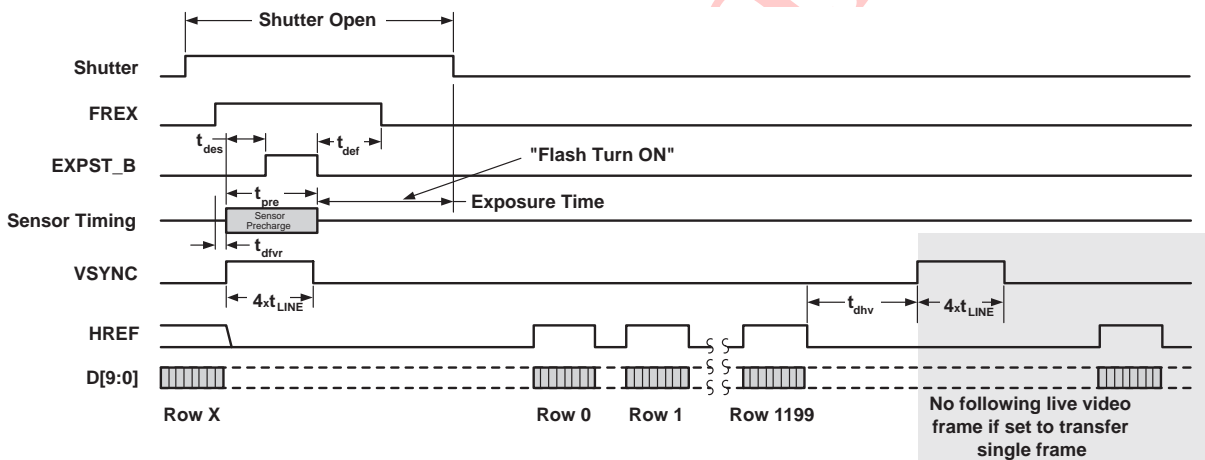


Figure 9 Frame Exposure Mode Timing with EXPST_B Staying Low



2640FSL_FDS_009

Figure 10 Frame Exposure Mode Timing with EXPST_B Asserted



2640FSL_FDS_010

Table 10 Frame Exposure Timing Specifications

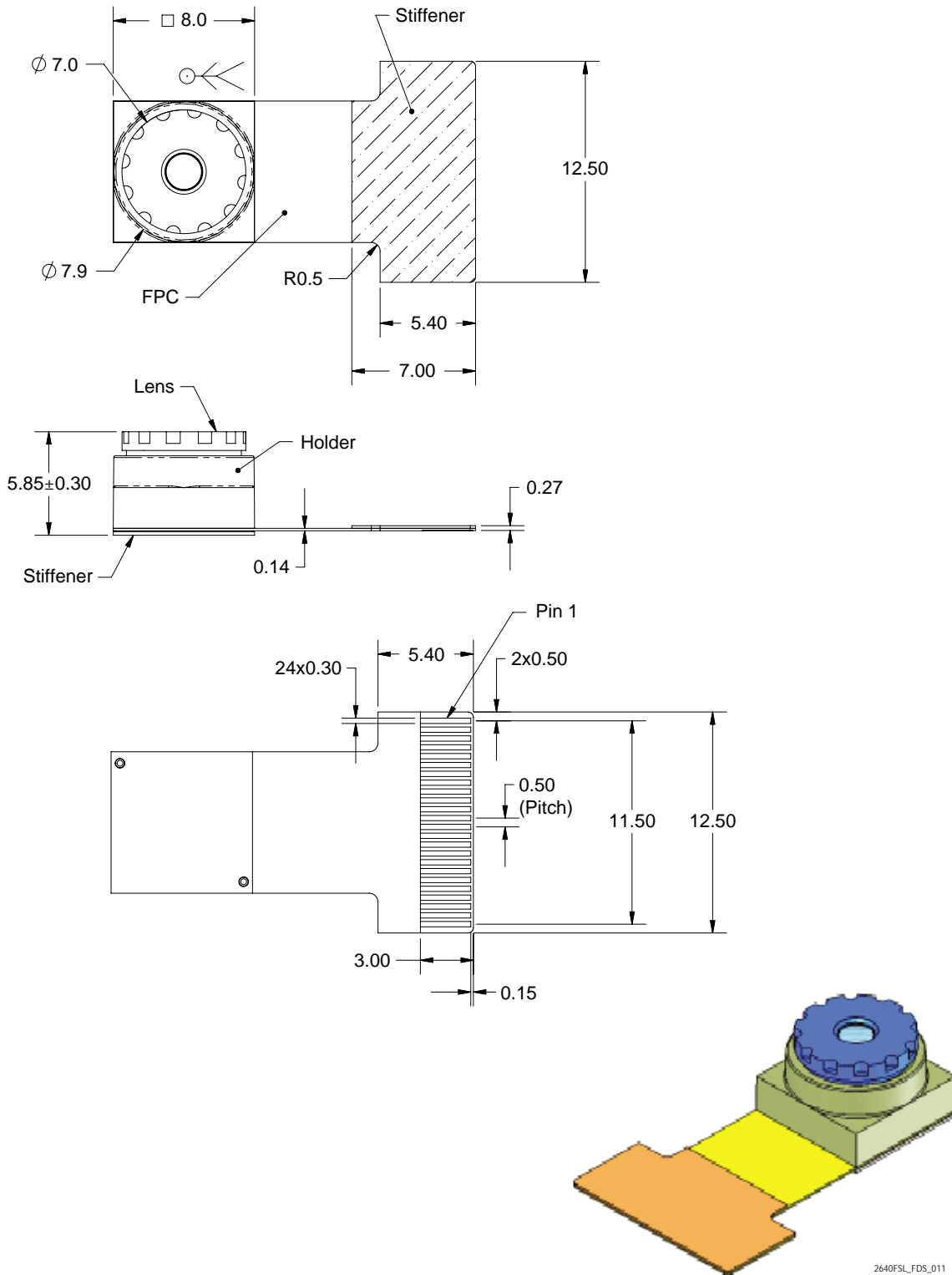
Symbol	Min	Typ	Max	Unit
tline		1922 (UXGA)		tp
tvS		4		tline
tdfvr	8		9	tp
tdfvf			4	tline
tdvsc			2	tline
tdhv		38964 (UXGA)		tp
tdvh		15928 (UXGA)		tp
tdhso	0			ns
tdef	20			tp
tDes	8		1900 (UXGA)	tp

NOTE 1) FREX must stay high long enough to ensure the entire sensor has been reset.
 2) Shutter must be closed no later than 3896 tp after VSYNC falling edge.

Package Specifications

Refer to [Figure 11](#) for package information on the OV2640FSL module.

Figure 11 OV2640FSL Package Specifications



2640FSL_FDS_011

Mechanical Specifications

Table 11 Mechanical Dimensions

Parameter	Specification	Comments
Sensor	6.30 mm x 6.32 mm	CMOS in housing
Lens	Plastic	
Connection Type	24 x 0.5 mm	Flex cable
Housing	8.0 mm x 8.0 mm x 5.85 mm	Excluding mushroom

Connector Information

The OV2640FSL uses a 24-pin, 0.5 mm pitch flex cable connector. [Table 12](#) shows a listing of some recommended connectors.

Table 12 Recommended Connectors

Manufacturer	Part No.	Description
Molex	52437-2427 (Bulk) 52437-2491 (Tape reel)	0.5 FPC Connector ZIF for SMT, R/A (bottom contact)

Optical Specifications

Table 13 Optical Specifications

Parameter	Specification	Comments
Lens Elements	4-element plastic	Fixed focus
Viewing Angle	59.9° diagonal	
Focal Length	3.78 mm	
F Number	2.8	
Focus Range	60 cm → ∞	Allowable blur size: 4.4 μm
Filter	IR cut	Included
Mount Description	M7 x 0.35P	
TV Distortion	<1%	
Focus Adjustment	Fixed	At 1.2 m

Handling Precautions

**WARNING: READ THIS FIRST!**

Prior to handling any OmniVision flex camera module, read the following precautions.

- DO NOT try to open the unit enclosure as there is no user-serviceable component inside.
- To prevent damage to the camera module by electrostatic discharge, handle the camera module ONLY after discharging ALL static electricity from yourself and ensuring a static-free environment for the camera module.
- DO NOT touch the top surface of the lens.
- DO NOT press down on the lens.
- DO NOT try to focus the lens.
- DO NOT put the camera module in a dusty environment.
- To reduce the risk of electrical shock and damage to the camera module, turn OFF the power before connect and disconnect the camera module.
- DO NOT bend the flex cable in a sharp angle.
- DO NOT twist the flex cable.
- DO NOT peel the flex cable when you install and uninstall the camera module.
- DO NOT drop the camera module more than 60 cm onto any hard surface.
- To prevent fire or shock hazard, DO NOT expose camera module to rain or moisture.
- DO NOT expose camera module to direct sunlight.
- DO NOT put camera module in a high temperature environment.
- DO NOT use liquid or aerosol cleaners to clean the lens.
- DO NOT make any changes or modifications to camera module.
- DO NOT subject camera module to strong electromagnetic field.
- DO NOT subject the camera module to excessive vibration or shock.

Note:

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For further information, please feel free to contact OmniVision at info@ovt.com.

**OmniVision Technologies, Inc.
1341 Orleans Drive
Sunnyvale, CA USA
(408) 542-3000**



REVISION CHANGE LIST

Document Title: OV2640FSL Flex Module Datasheet

Version: 1.0

DESCRIPTION OF CHANGES

Initial release



REVISION CHANGE LIST

Document Title: OV2640FSL Flex Module Datasheet

Version: 1.1

DESCRIPTION OF CHANGES

The following changes were made to version 1.0:

- In Table 5 on page 5, made the following changes:
 - Added “40 mA” for Maximum specification of I_{DDA-A}
 - Added “35 mA (YUV)” and “50 mA (Compressed)” for Maximum specification of I_{DDA-D}
 - Added “10 mA” for Maximum specification of I_{DDA-IO}
 - Added “2 mA” for Maximum specification of $I_{DDS-SCCB}$
 - Added “1200 μ A” for Maximum specification of $I_{DDS-PWDN}$
- Changed module schematic in Figure 3 on page 2.



REVISION CHANGE LIST

Document Title: OV2640FSL Flex Module Datasheet

Version: 1.2

DESCRIPTION OF CHANGES

The following changes were made to version 1.1:

- Under Key Specifications on page 1, changed specification for Core Power Supply from “1.2VDC \pm 5%” to “1.3VDC \pm 5%”
- In Figure 3 on page 2, changed DVDD voltage callouts (2 places) from “1.2V” to “1.3V”
- In Figure 3 on page 2, changed 4th line under Notes from “DVDD is 1.2V sensor digital power” to “DVDD is 1.3V sensor digital power”
- In Table 3 on page 4, changed description of pin 10 (DVDD) from “1.2V supply for digital circuits” to “1.3V supply for digital circuits”
- In Table 5 on page 5, changed Min, Typ, and Max for Supply voltage (V_{DD-D}) from “1.14”, “1.2”, and “1.26” to “1.24”, “1.3”, and “1.36”
- In Table 5 on page 5, changed table footnote b from “ $V_{DD-A} = 2.8V$, $V_{DD-D} = 1.2V$, ...” to “ $V_{DD-A} = 2.8V$, $V_{DD-D} = 1.3V$, ...”



REVISION CHANGE LIST

Document Title: OV2640FSL Flex Module Datasheet

Version: 1.3

DESCRIPTION OF CHANGES

The following changes were made to version 1.2:

- In Figure 1 on page 1, added “Note: When using Molex connectors, disregard Molex pin 1 indicator and use OVT pinout for PCB layout.”
- In Table 12 on page 12, added table footnote a “When using Molex connectors, disregard Molex pin 1 indicator and use OVT pinout for PCB layout.”
- In Table 13 on page 12, changed Lens Elements specification from “3-element plastic” to “4-element plastic”
- In Table 13 on page 12, changed Focus Range specification from “80 cm \rightarrow ∞ ” to “60 cm \rightarrow ∞ ” and added “Allowable blur size: 4.4 μ m” under Comments
- In Table 13 on page 12, added “At 1.2 m” under Comments for the Focus Adjustment specification