

OV7670MFSL Color CMOS VGA (640 x 480) Concept Camera Module with OmniPixel® Technology

General Description

The OV7670MFSL 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 OV7670MFSL features the OV7670 CAMERACHIP™ sensor. Refer to the [OV7670/OV7171 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

- 307,200 pixels, VGA, CIF, and resolutions lower than CIF, 1/6" lens
- 6.0 mm x 6.0 mm x 4.60 mm module size, flex cable
- 2.5V operation, low power dissipation
- Serial Camera Control Bus (SCCB) interface
- Function controls:
 - Exposure control
 - Gamma
 - Gain
 - White balance
 - Color matrix
 - Color saturation
 - Hue control
 - Windowing

Ordering Information

Product	Package
OV07670-MFSL	6.0mm x 6.0mm x 4.60mm Flex Cable

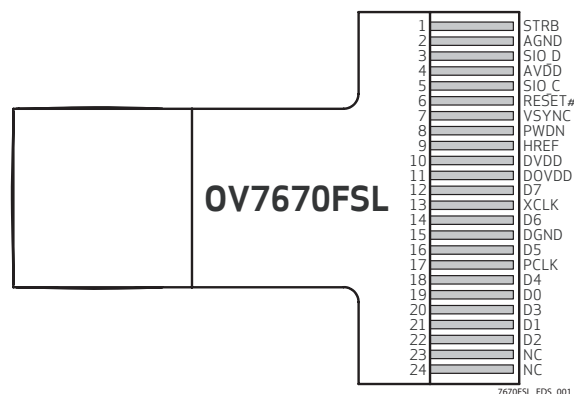
Applications

- Cell phones
- PDAs
- Picture phones
- Vision toys

Key Specifications

Array Element (VGA)		640 x 480
Power Supply	Digital Core	1.8VDC \pm 10%
	Analog	2.45V to 3.0V
	I/O	1.7V to 3.0V
Power Requirements	Active	60 mW typical (15fps VGA YUV format)
	Standby	< 20 μ A
Temperature Range	Operation	-30°C to 70°C
	Stable Image	0°C to 50°C
Output Formats (8-bit)		<ul style="list-style-type: none"> • YUV/YCbCr 4:2:2 • RGB565/555/444 • GRB 4:2:2 • Raw RGB Data
Lens Size		1/6"
Chief Ray Angle		25°
Maximum Image Transfer Rate		30 fps for VGA
Sensitivity		1.3 V/(Lux • sec)
S/N Ratio		46 dB
Dynamic Range		52 dB
Scan Mode		Progressive
Electronics Exposure		Up to 510:1 (for selected fps)
Pixel Size		3.6 μ m x 3.6 μ m
Dark Current		12 mV/s at 60°C
Well Capacity		17 K e ⁻
Image Area		2.36 mm x 1.76 mm
Package Dimensions		6.0 mm x 6.0 mm x 4.60 mm

Figure 1 OV7670MFSL Pin Diagram

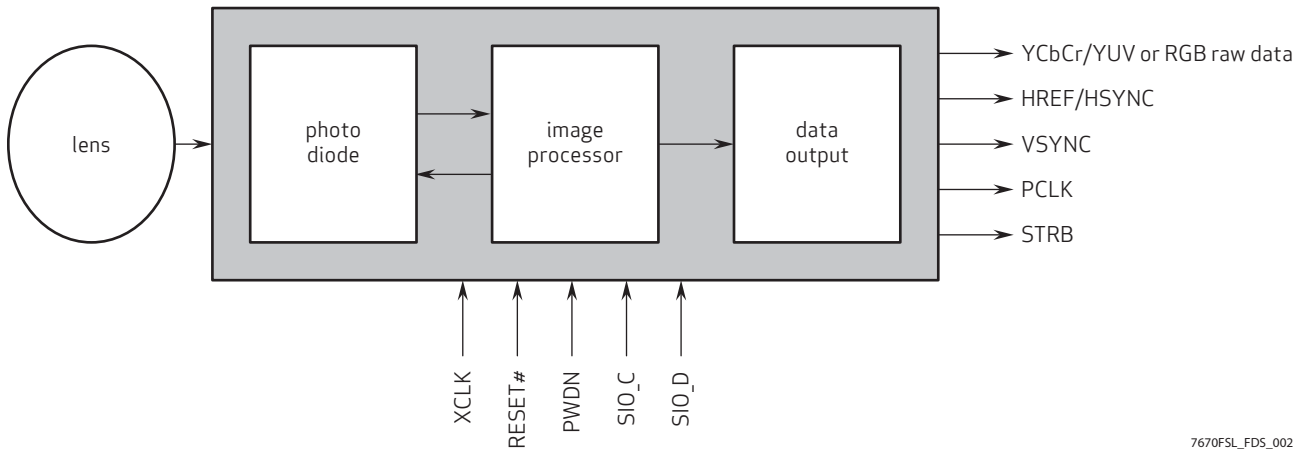


Functional Description

Figure 2 shows the functional block diagram of the OV7670MFSL Camera Module. The OV7670MFSL includes:

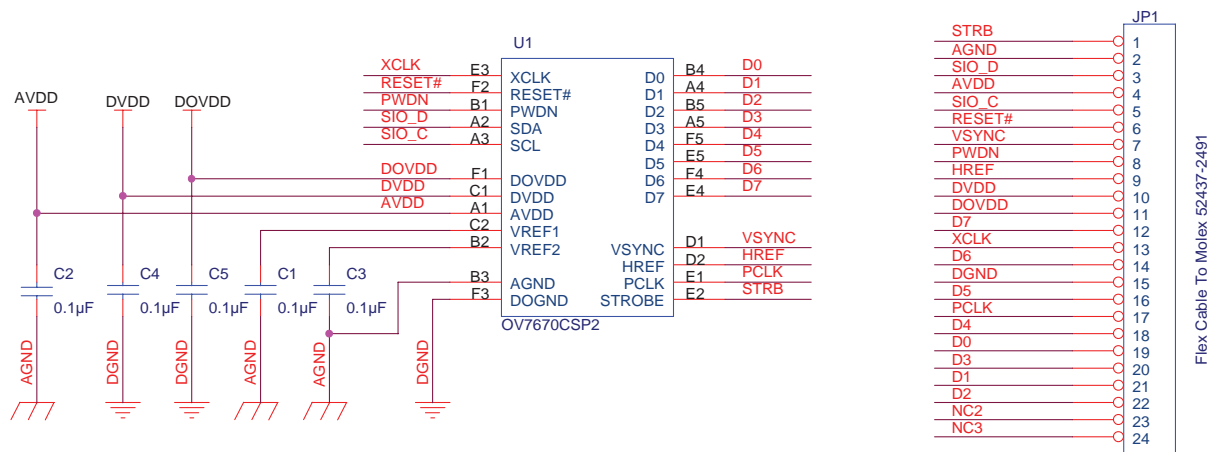
- 1/6" lens
- OV7670 CAMERACHIP image sensor
- Flex cable

Figure 2 Functional Block Diagram



7670FSL_FDS_002

Figure 3 Module Schematic



Flex Cable To Molex 52437-2491

Note:

Connector PWDN and RESET# should be connected to ground if unused.
 AVDD is 2.7V sensor analog power.
 DVDD is 1.8V sensor digital power.
 DOVDD is 1.7V 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 should be close to sensor VREF1 and AGND.
 C2 should be close to sensor AVDD and AGND.
 C3 should be close to sensor VREF2 and AGND.
 C4 should be close to sensor DVDD and DGND.
 C5 should be close to sensor DOVDD and DGND.
 D7:D0 is module YUV and RGB 8-bit output.

7670FSL_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.
Color Correction	It is possible to adjust for the color filter response of the image sensor as well as for human eye sensitivity.
Bayer Pattern Interpolation	(Mosaic or equivalent) The interpolation must be done prior to downsizing the image to avoid artifacts due to incorrect interpolation.
Electrical Illumination Flicker Elimination	Interference from 50Hz or 60Hz illumination can be suppressed with manually set frame rate divider.
Gamma Correction	Built-in 0.45/1.0
Color Space Conversion	Bayer raw RGB is converted to YCbCr/YUV color space.
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.
Horizontal Flip (Mirror)	Transposes the left and right sides of the image.
RGB Output	RGB raw data output available.
AGC Gain	Automatic Gain Control (AGC)
White Balance	Automatic White Balance

NOTE: OV7670MFSL features the OV7670 CAMERACHIP sensor. Refer to the [OV7670/OV7171 Datasheet](#) for chip-specific information.

Table 2 Output Specifications

Output Image Formats	Description
Output Formats	VGA (640 x 480 pixels)
	QVGA (320 x 240 pixels)
YUV Format	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 Pin Description

Pin Number	Name	Pin Type	Function/Description
01	STRB	Output	LED/strobe control output
02	AGND	Power	Analog ground
03	SIO_D	I/O	SCCB serial interface data input and output
04	AVDD	Power	Analog power ($V_{DD-A} = 2.45$ to 3.0 VDC)
05	SIO_C	Input	SCCB serial interface clock input
06	RESET#	Function (default = 1)	Chip reset, active low <i>NOTE: This is for REV4 and REV5 of the OV7670 sensor. For previous REV of the sensor, this pin is RESET (high for reset). In other words, if register 0x0B = 70 or 71, this pin is active high. If register 0x0B = 72 or higher, this pin is active low.</i>
07	VSYNC	Output	Vertical sync output
08	PWDN	Function (default = 0)	Power Down Mode Selection 0: Normal mode 1: Power down mode
09	HREF	Output	HREF output
10	DVDD	Power	Digital core power ($V_{DD-C} = 1.8$ VDC $\pm 10\%$)
11	DOVDD	Power	Digital power I/O ($DOV_{DD} = 1.7$ V to 3.0 V)
12	D7	Output	Video component output bit[7]
13	XCLK	Input	Clock input
14	D6	Output	Video component output bit[6]
15	DGND	Power	Digital ground
16	D5	Output	Video component output bit[5]
17	PCLK	Output	Pixel clock output
18	D4	Output	Video component output bit[4]
19	D0	Output	Video component output bit[0]
20	D3	Output	Video component output bit[3]
21	D1	Output	Video component output bit[1]
22	D2	Output	Video component output bit[2]
23	NC	–	No connection
24	NC	–	No connection

Electrical Characteristics

Table 4 Operating Conditions

Parameter	Min	Max	Unit
Operating temperature (guaranteed performance)	0	40	°C
Operating temperature (chip functional) ^a	-10	70	°C
Storage, transportation temperature	-40	85	°C

- a. Exceeding the stresses listed may permanently damage the device. This is a stress rating only and functional operation of the sensor at these and any other condition above those indicated in this specification is not implied. Exposure to absolute maximum rating conditions for any extended period may affect reliability.

Table 5 DC Characteristics (-20°C < T_A < 70°C, Voltages referenced to GND)

Symbol	Parameter	Min	Typ	Max	Unit
Supply					
V _{DD-A}	DC supply voltage - Analog	2.45	2.5	3.0	V
V _{DD-C}	DC supply voltage - Digital Core	1.62	1.8	1.98	V
DOV _{DD}	Sensor I/O power	1.7		3.0	V
I _{DD2}	Supply current (1.8V V _{DD-C} , 2.5V V _{DD-A} , 2.5V DOV _{DD} at 7.5 fps YUV without digital I/O loading)		18		mA
I _{DD3}	Standby supply current		10		μA
Digital Inputs					
V _{IL}	Input voltage LOW			0.3 x DOV _{DD}	V
V _{IH}	Input voltage HIGH	0.7 x DOV _{DD}			V
C _{IN}	Input capacitor			10	pF
Digital Outputs (standard loading 25 pF, 1.2 KΩ to 2.5 V)					
V _{OH}	Output voltage HIGH	0.9 x DOV _{DD}			V
V _{OL}	Output voltage LOW			0.1 x DOV _{DD}	V
SCCB Inputs					
V _{IL}	SIO_C and SIO_D (DOV _{DD} = 2.5V)	-0.5	0	1	V
V _{IH}	SIO_C and SIO_D (DOV _{DD} = 2.5V)	2.5	3	DOV _{DD} + 0.5	V

Table 6 AC Characteristics ($T_A = 25^\circ\text{C}$, $V_{DD} = 2.5\text{V}$)

Symbol	Parameter	Min	Typ	Max	Unit
RGB/YCbCr Output					
I_{SO}	Sourcing current		15		mA
V_Y	DC level at zero signal		0.4		V
	YPP 100% amplitude (without sync)		0.7		V
	Sync amplitude		0.4		V
ADC Parameters					
DLE	DC differential linearity error		0.5		LSB
ILE	DC integral linearity error		1		LSB

Table 7 Timing Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
Oscillator and Clock Input					
f_{OSC}	Frequency (XCLK)	10	24	48	MHz
t_r, t_f	Clock input rise/fall time			5	ns
	Clock input duty cycle	45	50	55	%
SCCB Timing					
f_{SIO_C}	Clock Frequency			400	KHz
t_{BUF}	Bus free time between STOP and START	1.3			μs
$t_{HD:SAT}$	SIO_D change after START status	0.6			μs
t_{LOW}	SIO_D low period	1.3			μs
t_{HIGH}	SIO_D high period	0.6			μs
$t_{HD:DAT}$	Data hold time	0			μs
$t_{SU:DAT}$	Data setup time	0.1			μs
$t_{SU:STP}$	Setup time for STOP status	0.6			μs
Digital Timing					
t_{PCLK}	PCLK cycle time		41.7		ns
t_r, t_f	PCLK rise/fall time			5	ns
t_{PDD}	PCLK to data valid			5	ns
t_{PHD}	PCLK to HREF delay	0	5	10	ns

Timing Specifications

Figure 4 SCCB Timing Diagram

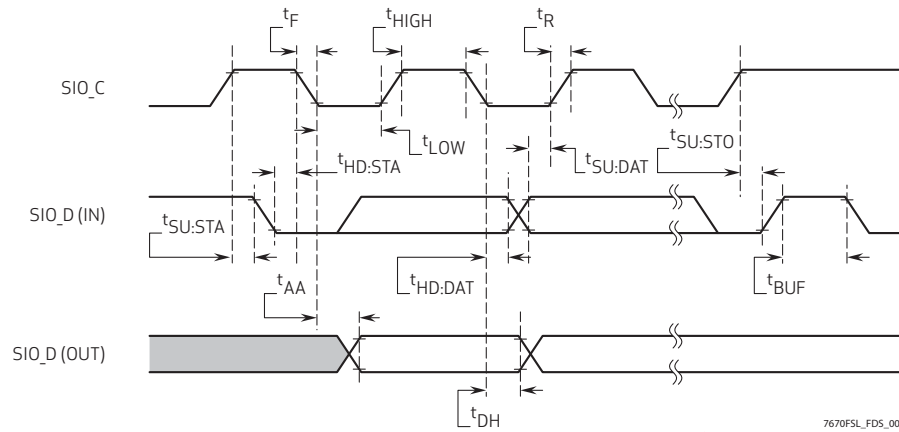


Figure 5 Horizontal Timing

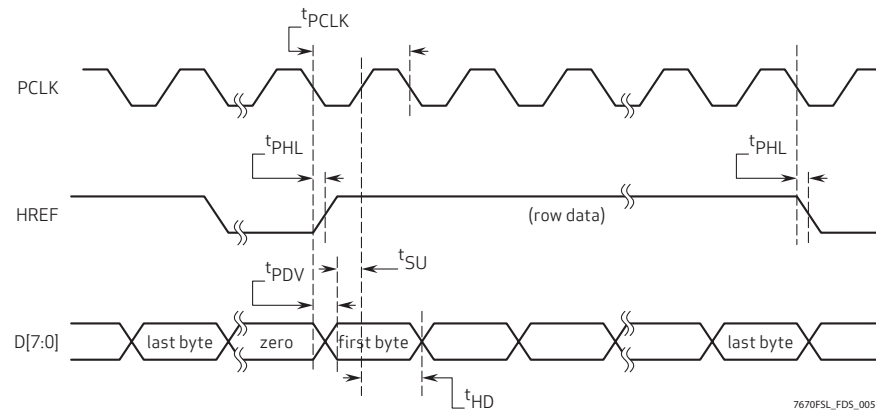
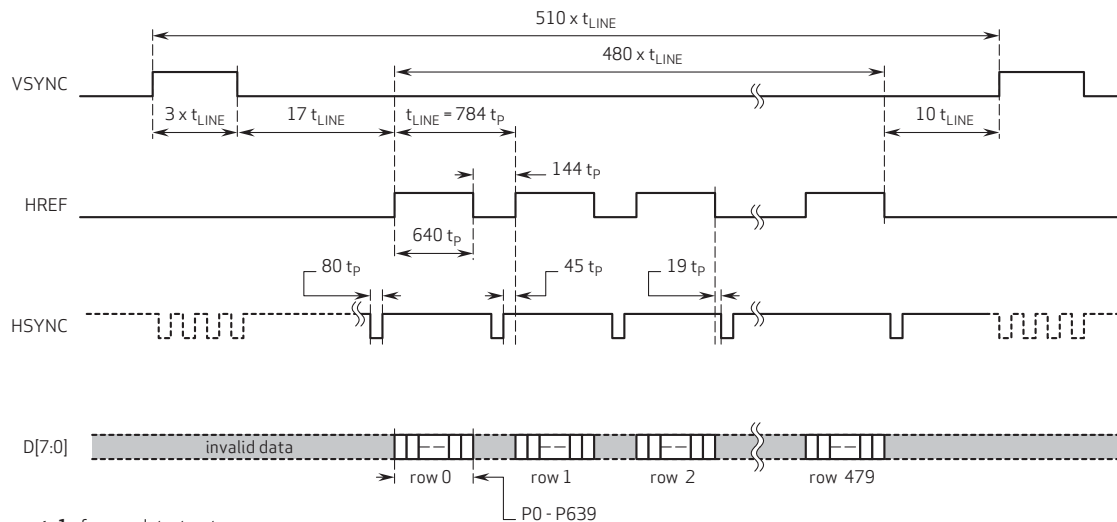


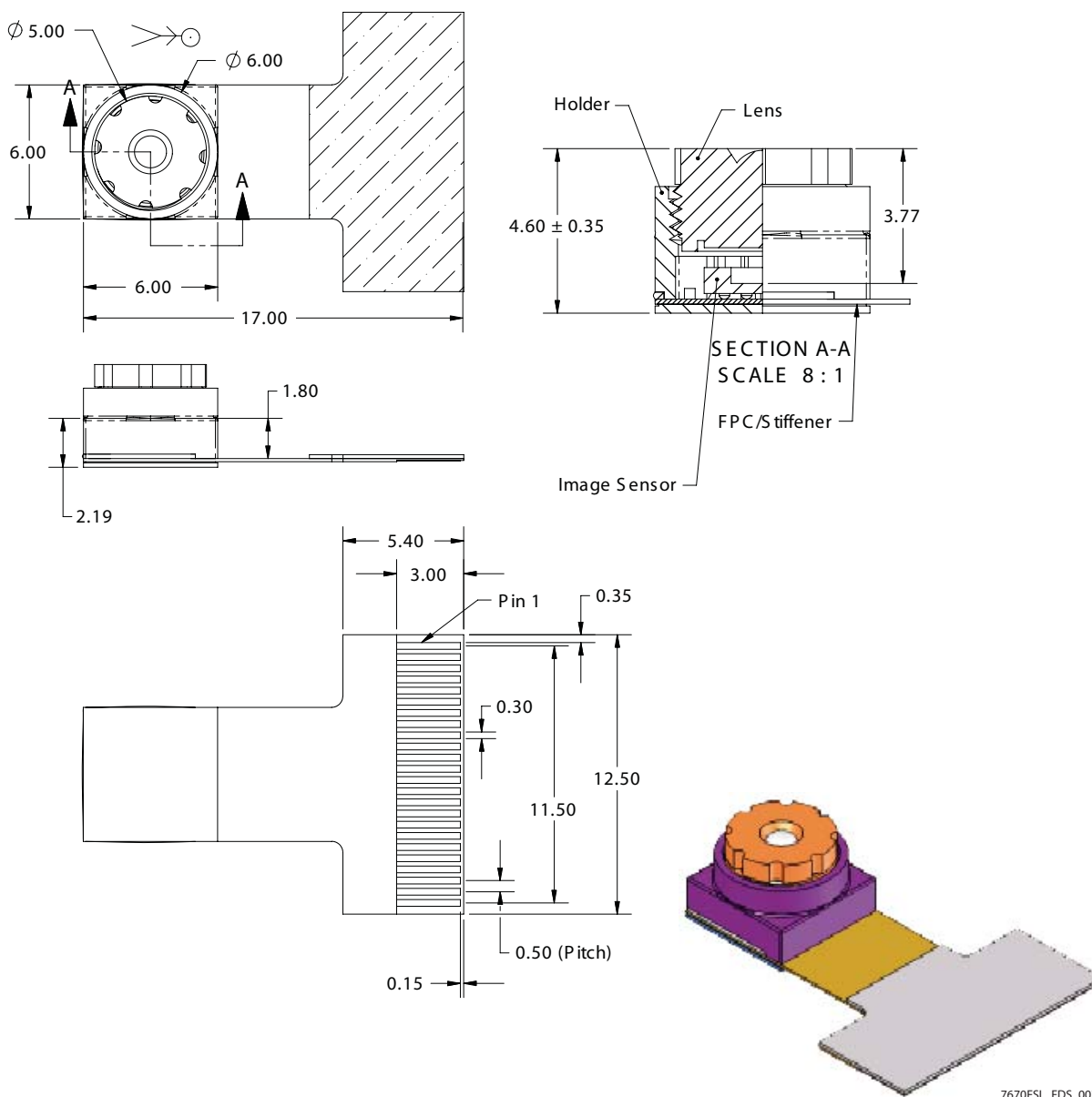
Figure 6 VGA Frame Timing



Package Specifications

Refer to Figure 7 for package information on the OV7670MFSL module.

Figure 7 OV7670MFSL Package Specifications



7670FSL_FDS_007

Mechanical Specifications

Table 8 Mechanical Dimensions

Parameter	Specification	Comments
Sensor	4.95 mm x 4.78 mm	CMOS in housing
Lens	Plastic	
Connection Type	24 x 0.5 mm	Flex cable
Housing	6.0 mm x 6.0 mm x 4.60 mm	Excluding mushroom

Connector Information

The OV7670MFSL uses a 24-pin, 0.5 mm pitch flex cable connector. [Table 9](#) shows a listing of some recommended connectors.

Table 9 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 10 Optical Specifications

Parameter	Specification	Comments
Lens Elements	Plastic	3-element
Viewing Angle	58° diagonal	
Focal Length	2.56 mm	
F Number	2.8	
Focus Range	30 cm → ∞	
Filter	IR cut	Included in the barrel
Mount Description	M5 x 0.35P	
TV Distortion	<1%	
Focus Adjustment	Fixed	

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.