Quadrant VGA Camera Module
QMVGAMYUV-FP03-57-20F

Preliminary Datasheet

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1. Overview

This document describes the specifications to a camera module which incorporates a color CMOS image sensor, a signal processor and an optical system in a single package. This unit manifests VGA-size (640H x 480V pixels) color image input functions while being compact in size and consuming minimal power. This camera module is optimal as an image capturing device to meet the demands of battery-powered products such as cellular phones and PDAs.

This camera module performs a number of sophisticated processing functions, including color recovery, color correction, sharpening, programmable gramma correction, auto black reference (ABR) clamping, auto exposure (AE), automatic 50Hz/60Hz flicker avoidance, auto white balance (AWB), and on the fly defect identification and correction. Additional features include day/night mode configuration, 2x fixed zoom, decimation to arbitrary image size with continuous, smooth zoom and pan, and support for both Xenon and LED-type flash light sources.

2. Features

- Ultra low-power, low cost CMOS image module; 70mW at 15 frames per second, at 12MHz
- VGA size resolution (640H x 480V) with 1/4-inch optical format
- Up to 30fps at 27MHz
- Superior low-light performance
- Up to 30fps progressive scan for high-quality video
- Color-signal processing function:
  - Automatic exposure control (AE)
  - Automatic white balance control (AWB)
  - Gamma correction (LUT)
  - Color conversion (RGB-YCbCr)
  - Color correction
  - Image quality correction filtering
  - Flicker detection and elimination
  - Lens shading correction
- Digital image output functions:
  - Multiple picture format: VGA, CCIR556 (YCbCr), 565RGB, and 444RGB
  - Signal output format: Y:Cb:Cr = 4:2:2 8-bits.
- Module operation and storage temperature: -30°C ~ +70°C
- Module weight: 0.534g

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3. Product Description

3.1 Sensor Core Block Diagram

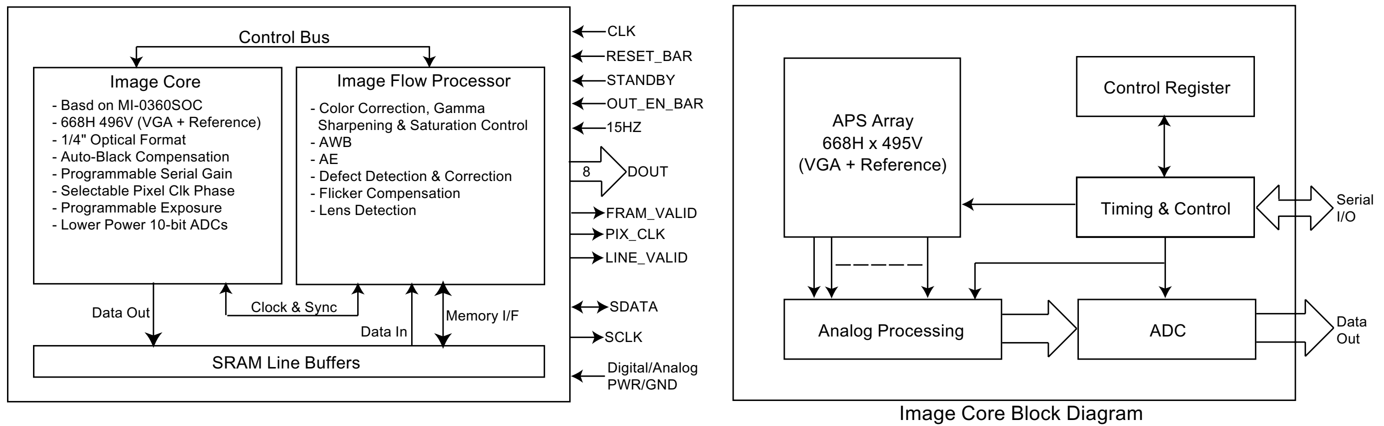

Image Core Block Diagram

3.2 Image Sensor Description

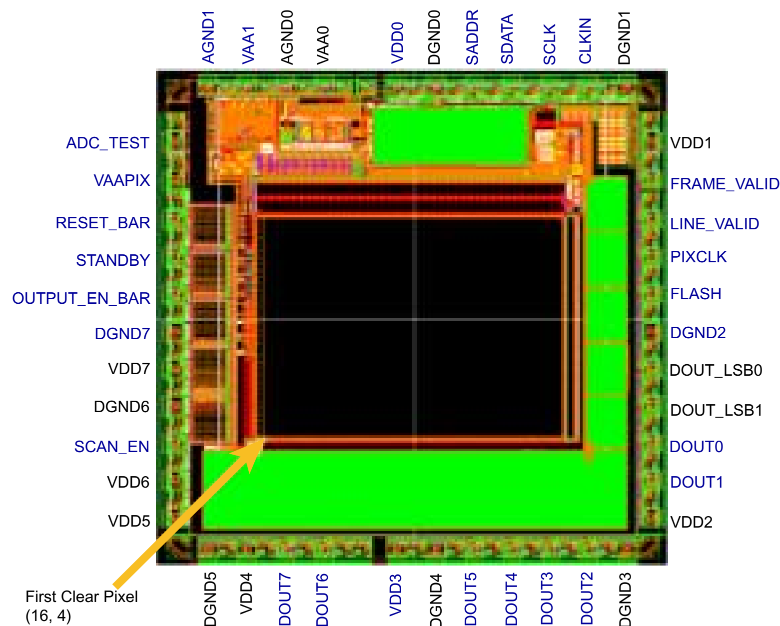

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Table 1.0 Pad Description

PIN / PACKAGE NUMBER	SYMBOL NAME	TYPE	DESCRIPTION
1	FLASH	Output	Flash strobe.
2	PIXCLK	Output	Pixel clock out. Pixel data output are valid during rising edge of this clock. Frequency = 1/2 (Master Clock).
3	LINE_VALID	Output	Active HIGH during line of selectable valid pixel data (see Reg0x20 for options).
4	FRAME_VALID	Output	Active HIGH during frame of valid pixel data.
5	CLKIN	Input	Master clock into sensor or (27MHz Maximum).
6	SCLK	Input	Serial clock.
7	SDATA	Bi-directional	Serial data I/O.
8	SADDR	Input	Serial interface address select: Reg0xB8 when HIGH, Reg0x90 when LOW.
9	VDD0	Power	Digital power (2.8V).
10	VAA1	Power	Analog power (2.8V).
11	AGND1	Ground	Analog ground.
12	ADC_TEST	Input	Input voltage for ADC testing (tie to VAAPIX for nominal usage).
13	VAAPIX	Power	Pixel power (2.8V).
14	RESET_BAR	Input	Asynchronous reset of sensor when LOW. All registers assume factory defaults.
15	STANDBY	Input	When HIGH disables the imager.
16	OUTPUT_EN_BAR	Input	When HIGH tri-state all output (tie LOW for normal operation).
17	DGND7	Ground	Digital ground.
18	SCAN_EN	Input	Internal Scanchain test pin (ground for normal operation).
19	DOUT7	Output	CCIR656/RGB data bit 7.
20	DOUT6	Output	CCIR656/RGB data bit 6.
21	VDD3	Power	Digital power (2.8V).
22	DOUT5	Output	CCIR656/RGB data bit 5.
23	DOUT4	Output	CCIR656/RGB data bit 4.
24	DOUT3	Output	CCIR656/RGB data bit 3.
25	DOUT2	Output	CCIR656/RGB data bit 2.
26	DOUT1	Output	CCIR656/RGB data bit 1.
27	DOUT0	Output	CCIR656/RGB data bit 0.
28	DGND2	Ground	Digital ground.

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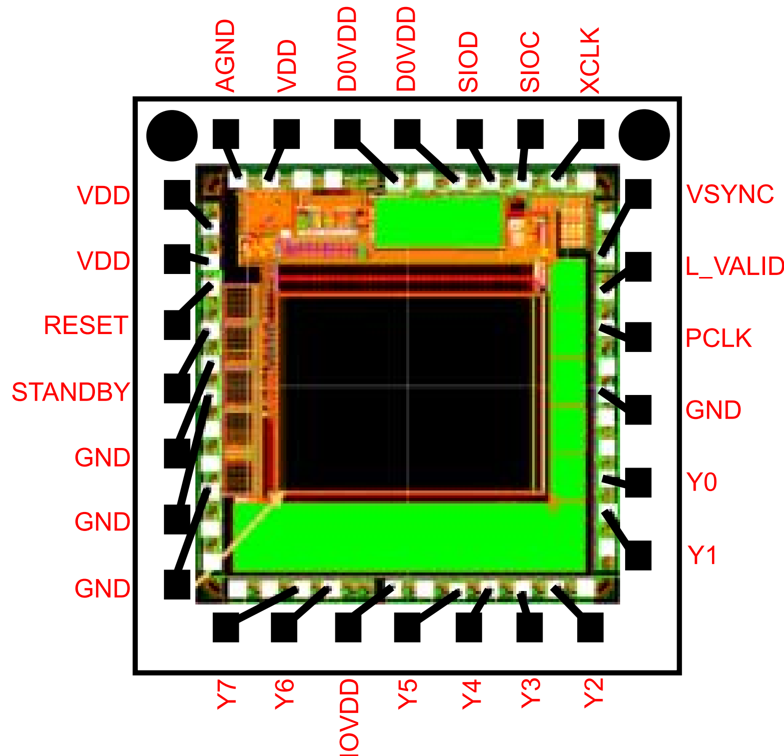
3.3 Image Sensor Bonding Diagram

The sensor bonding diagram hereafter shows the electrical interconnection between the image sensor and the substrate of the module.



3.4 Lens & Optical Properties Description

The optical lens for this module is 2P construction with IR cut-off filter embedded inside the lens.

The main features are as below:

- Thread diameter: M6 x 0.35P
- Lens elements: 2Plastic
- IR cut-off filter specification T50% = 650±10nm
- TTL (optical) = Distance from the image plane to the top surface of the lens barrel after the focus is 5.02mm

The drawing details and optical parameters of the lens are shown in Appendix 1.

3.5 Module Geometrical Description

The camera head outline size is as: 8 x 8 x 5.7mm. The configuration details are shown in Appendix 2. Although the image sensor sensitive center is not on the die center, die location shift is used to make the module optics center be the same as the geometrical center. The module outline dimensions can be changed according to the customer's requirement.

3.5.1 Flexible PCB Description

The flexible PCB is a double-layer design, with one layer for signal routing and the other for GND, and with mesh copper layer shield to reduce the signal noise. The FPC connection pattern, which is given in the appendix, is done in accordance with the data sheet of Kyocera Zif connector 00-6299-020 000 800.

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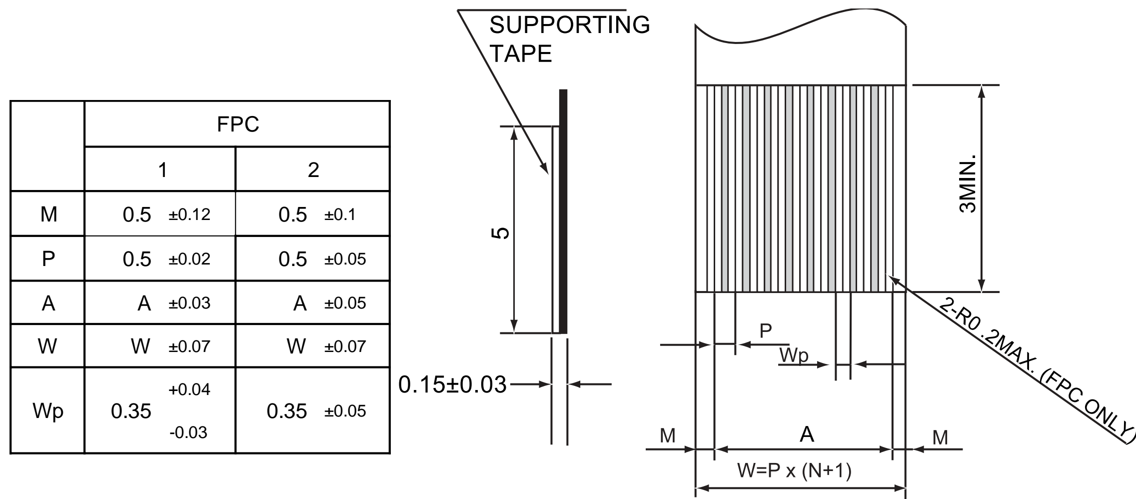
The flexible PCB recommended connection pattern is as below:



	FPC	
	1	2
M	0.5 ±0.12	0.5 ±0.1
P	0.5 ±0.02	0.5 ±0.05
A	A ±0.03	A ±0.05
W	W ±0.07	W ±0.07
Wp	0.35 +0.04 -0.03	0.35 ±0.05

Note 1: Polyamide and a themally hardened adhesive is recommended as the materials for the stiffener.
Note 2: Y dimension should be 1.5mm min. and X dimension should be 0.5mm for improved flexibility of FPC.

The FPCB mechanical drawing and routing details are shown in Appendix 3.

3.5.2 SMD-Passive Components Description

In order to achieve the minimal module outline size, 0201 components are used whenever possible to release routing and assembly constraints. However, 0402 components are also used if the 0201 components cannot be obtained, and such changes will not be informed.

3.5.3 Substrate Description

The substrate outline size is 8 x 8 x 0.4mm. The PCB thickness can be changed according to customer's design as long as the total height of the module is kept unchanged.

The PCB mechanical drawing and routing details are shown in Appendix 4.

3.5.4 Lens Holder Description

In order to guarantee the holder's rigidity characteristics, complex plastic material PC+ 30% glass fiber is the first choice. Furthermore, a holder surface roughness of 35 charmilles is required.

The lens holder mechanical drawing details shown in Appendix 5.

4. Assembly Process

4.1 General Specification Description

- Assembly environmental: Class 10/10k clean room assembly
- Maximum dust size on image matrix: 5μm
- ESD protections at all steps

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4.2 Process Specification Description

4.2.1 Wafer Saw and Grinding
- Wafer grinding thickness: 250±10μm
- Wafer roughness: 0.3μm
- Wafer warpage: 1000μm
- Wafer saw chipping: <40μm

4.2.2 SMD Placement
- Component location: ±50μm

4.2.3 Die Mount and Wire Bonding
- Die X,Y position shift: ±50μm
- Die attached epoxy: non-conductive epoxy
- Die tilt: 1mil
- Die rotation: θ_{Max} ˜1°
- Die shear strength: >2Kg
- Bonding wire: 1.0mil gold wire
- Bond wire pull strength: >4g

4.2.4 Optics Position Accuracy
- Tilt: 10mil Max
- Rotation: θ_{Max} ˜2°
- Lens holder shear: >4Kg
- Lens holder torque (stress to fail): 0.4Kgf*cm

4.2.5 Flexible PCB Attachment
- FPCB side pull (destructive): >1Kg
- FPCB side pull test (non destructive, worst case): >0.5Kg
- FPCB pull test (destructive) linear: >2Kg
- FPCB pull test (non destructive): >1Kg

4.3 Packing Procedure Description
All the finished goods are placed in anti-static black PS tray and packaged in box with EPE foam protection to withstand shock.

5. Environmental Specification

5.1 Temperature & Humidity
- Ambient operating: -30°C to +60°C
- Storage and shipping: -40°C to +85°C
- Humidity for operating: 3% to 95%
- Storage and shipping relative humidity: 0% to 100%

5.2 Temperature Shock
100 cycles of temperature change between -40°C and +85°C. The temperature change shall last no longer than 30 sec. Therefore, a 2 Chamber Climate system is necessary.

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5.3 Pressure

- Operating altitude: -150m to 3050m above mean sea level
- Storage and shipping altitude: -300m to 15250m above mean sea level

5.4 Mechanical Shock & Vibration

Test conditions for the vibration testing are 20g peak from 20 to 2000Hz at 0.4 decade per minute, with endurance testing at each resonant frequency of 5g for 150 minutes. Test time is at least 2 hours per axis. These measurements are applied to all 3 axis (X,Y,Z).

The condition for mechanical shock testing is half shine, 0.5ms duration, 1500g, 3 shocks for each direction of each axis. The conditions for continuing shock testing are 6ms duration, 250g, 500 shocks for each direction of each axis.

The tests are in accordance with Mil-STD-883E.

5.5 Static Pressure

The housing should withstand a partial pressure, applied by a spherical die of 20mm in diameter.

- Pressure feed rate: 1.3mm/Min
- Pressure stress: Force 150N, Appl. time 30sec

5.6 Heat with Sunlight

The optical system have passed a testing of being placed at a temperature of 55°C, a radiant light exposure with 1120W/m^2 for at least 3 cycles of 8 hours, followed by a dark space storage phase of 16 hours, and will not lose 100% functionality.

5.7 Material Declaration

All components (Parts, Elements, etc) which affect the safety of the device are listed in “Yellow Books” and in “List of Certified Equipment” of the Canadian Standard Association. In addition, all parts fulfill the DIN 9004 and the UL Supervision program UL746D.

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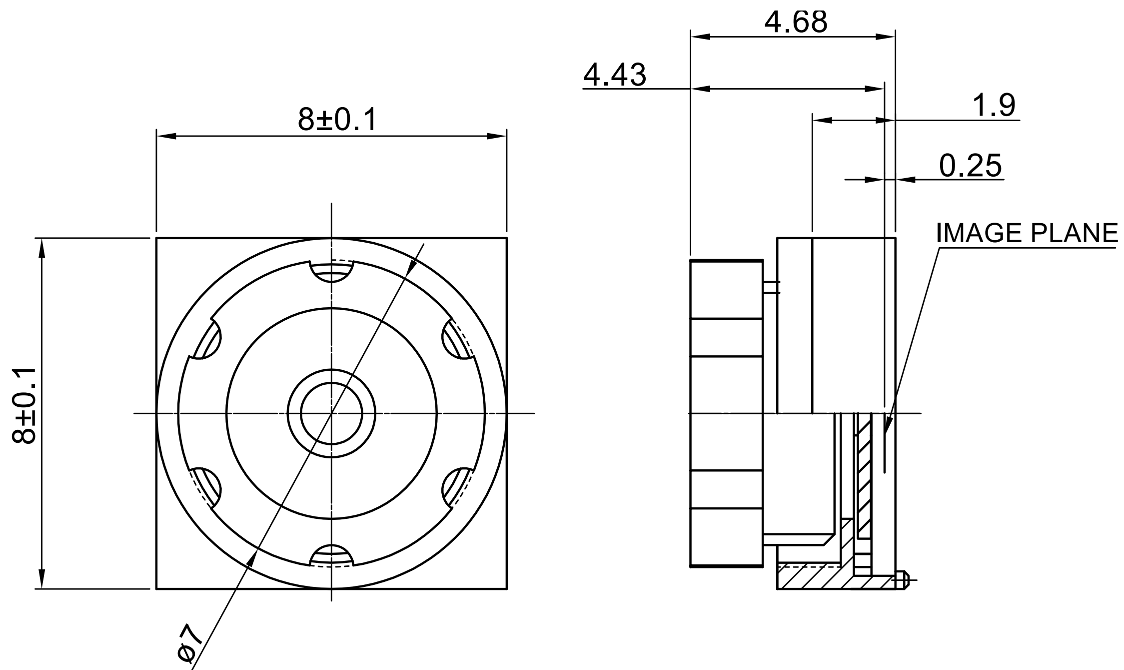
Appendix 1: Lens Specifications



	Specifications
1.	For 1/4" Sensor
2.	EFL = 3.8mm
3.	BFL = 1.28mm
4.	F/NO = 2.8
5.	FOV = 61°
6.	TV-Distortion < 1%
7.	Relative Illumination = 55.8%
8.	Construction: 2P
9.	Thread: M6 x 0.35P

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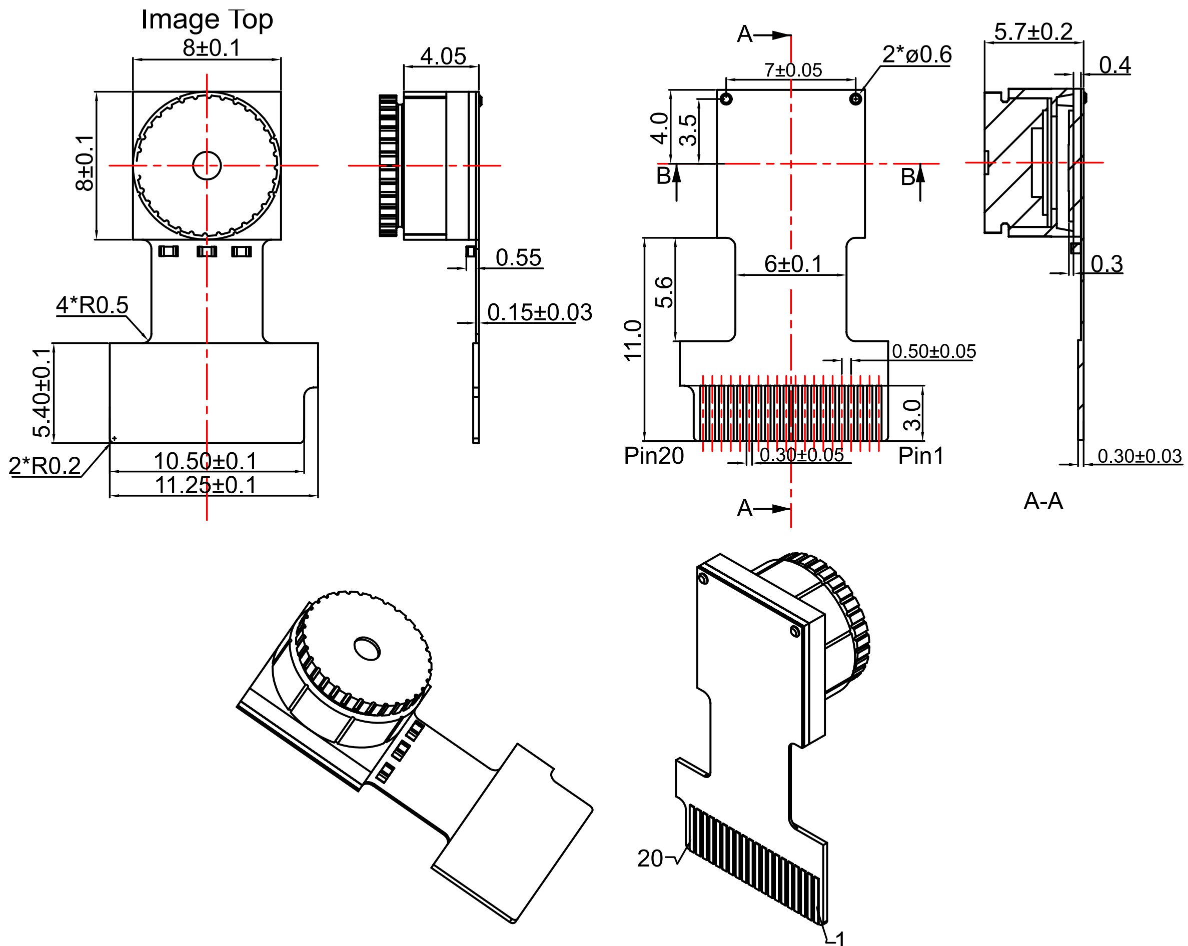
Appendix 2: Mechanical Specifications



Pin Assignment			
No.	Name	No.	Name
1	GND	11	Y0
2	HREF	12	Y`
3	VSYNC	13	Y1
4	STANDBY	14	Y3
5	PCLK	15	GND
6	VDD	16	Y4
7	DOVDD	17	Y5
8	SIOD	18	Y6
9	XCLK	19	Y7
10	SIOC	20	RESET

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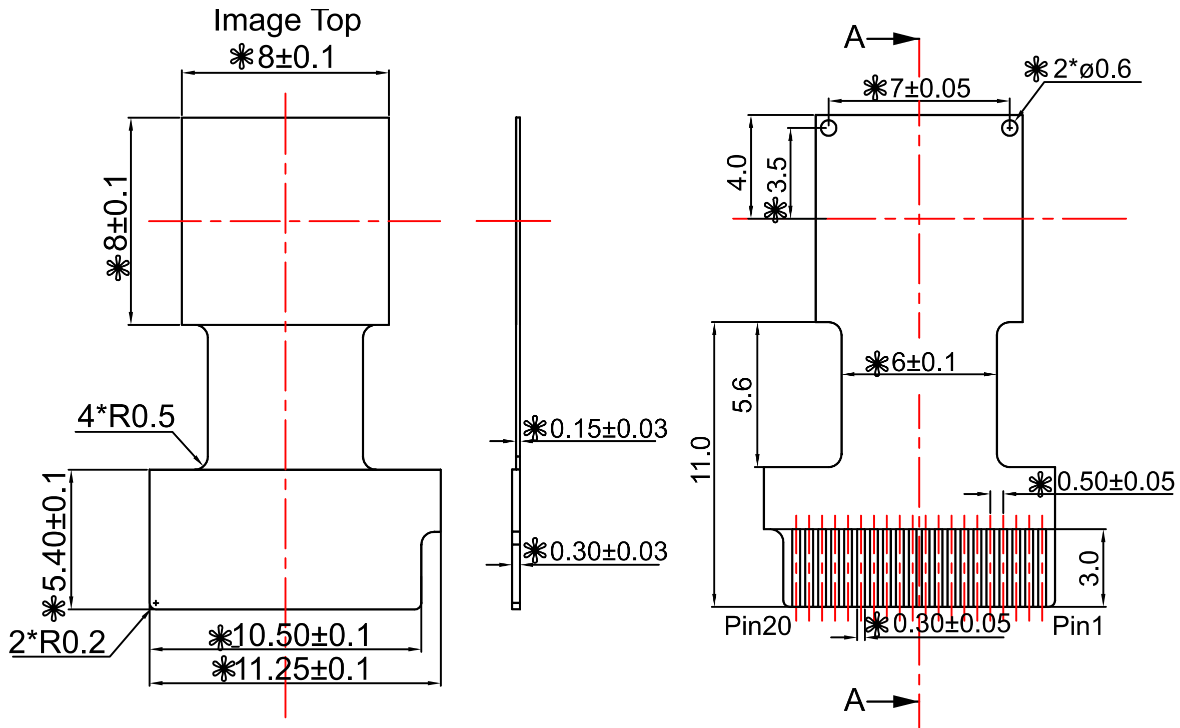
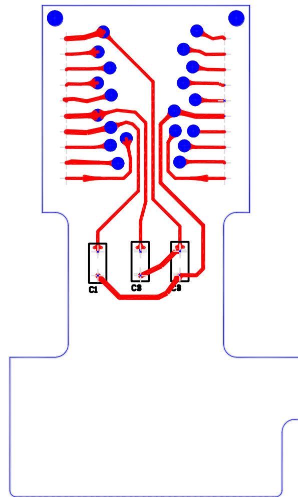
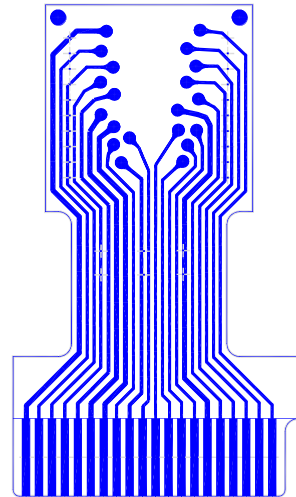
Appendix 3: FPCB Mechanical Drawings





Top Layer Routing



Bottom Layer Routing

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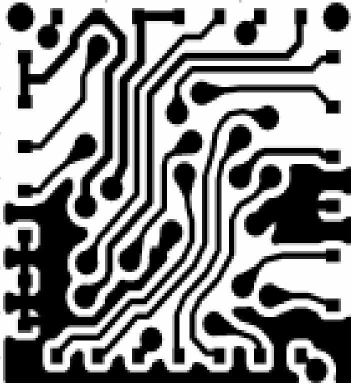
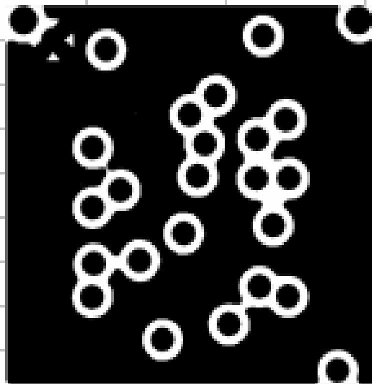
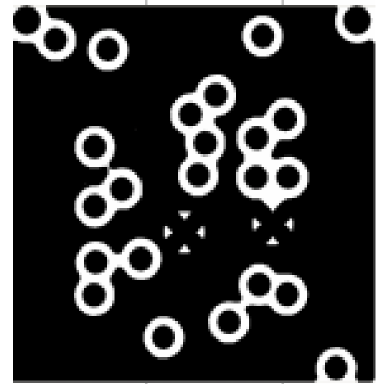
Appendix 4: PCB Mechanical Drawings



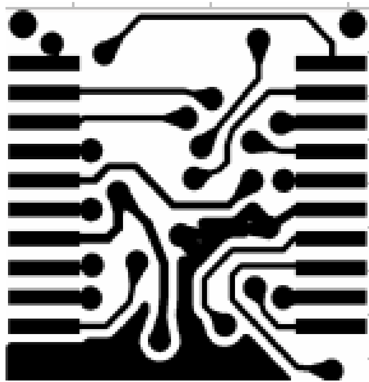
TOP



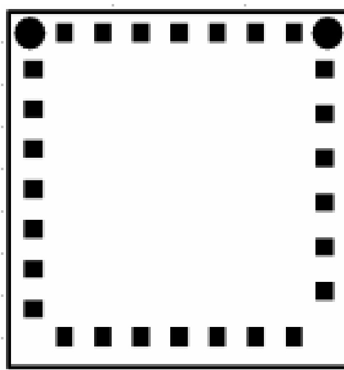
LAYER 2



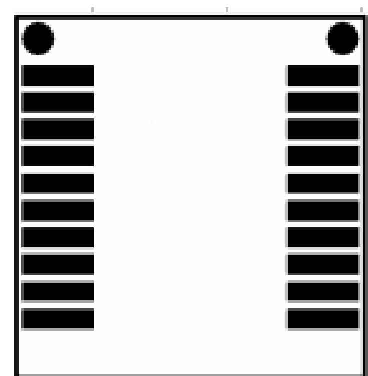
LAYER 3



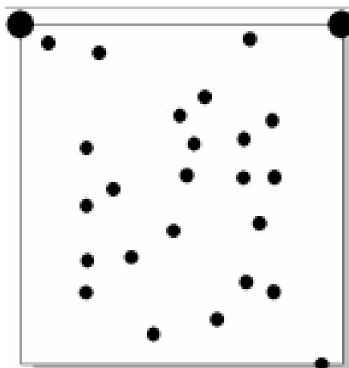
BOTTOM



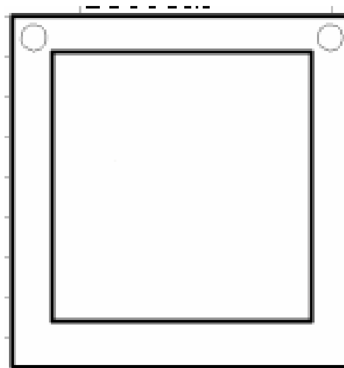
SOLDERMASK TOP



SOLDER MASK BOTTOM



NC DRILL



SILKSCREEN

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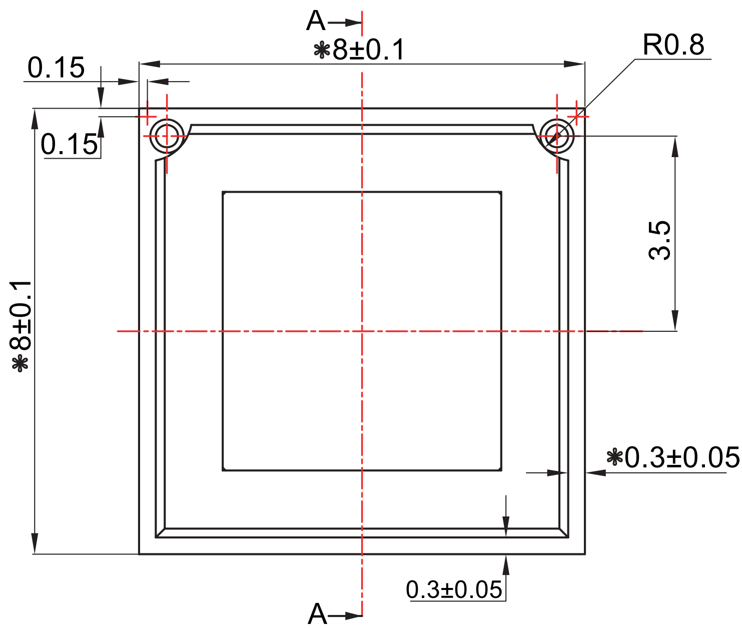
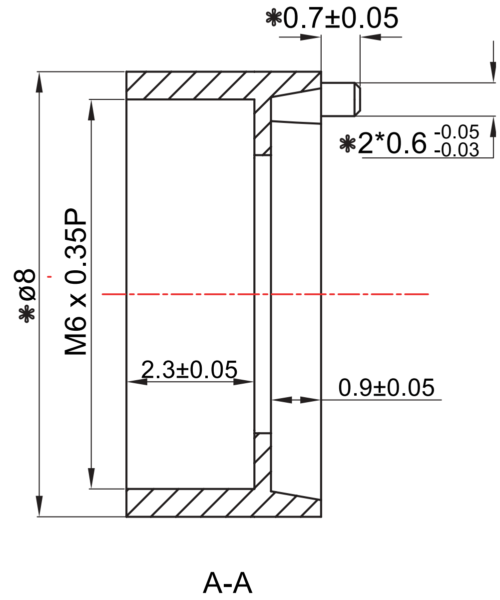
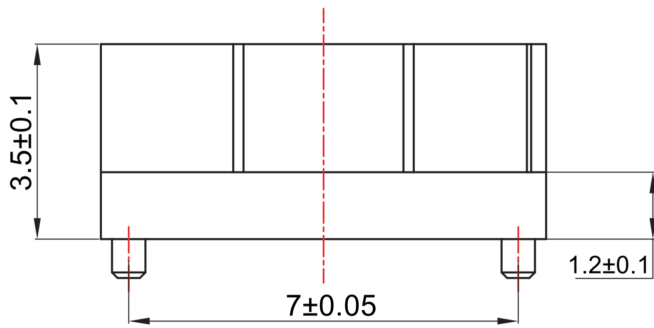
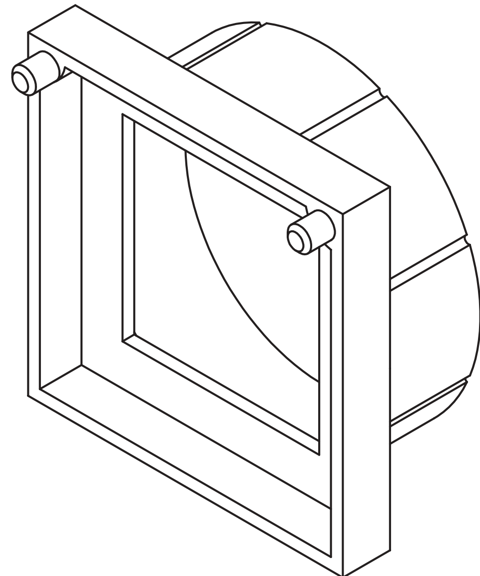
Appendix 5: Lens Holder Drawings









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