CAMERA MODULE SPECIFICATION

CUSTOMER NAME: Motorola Solution
CUSTOMER PRODUCT NAME: Futon
BYD PRODUCT NAME: BOCS9M114-MIC9074O

BYD PROJEC NAME: SMC9074O

Customer Service Unit
Division Ⅶ
BYD COMPANY LIMITED

Rev 1.3
Last update: Feb. 13th, 2014

BYD Co. Ltd.

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NOTICE

This document is a general product description and maybe changed basing on customer's requirement.

Revision History

Version	Date [D/M/Y]	Notes	Writer
1.0	Mar.6th.2013	Initial released	Zhao Xueming
1.1	Jul. 16th 2013	Update the Module consumption in P5.	Zhao Xueming
1.2	Nov. 06th 2013	Update the Sensor Pre-bake Recommendation	Zhao Xueming
1.3	Feb.13th 2014	Update date the Drawing	Zhao Xueming

APPROVALS		
PREPARED BY	CHECKED BY	APPROVED BY
Fang Zizheng	Ma Jingli	Zhao Xueming

Table of Contents

Abbreviations

CMOS	Complementary Metal-Oxide-Semiconductor Transistor
SVGA	Super Video Graphics Array (800x600)
SXGA	Super Extended Graphics Array (1280x1024)
SXVGA	Super Extended Video Graphics Array (1280x960)
UXGA	Ultra Extended Graphics Array (1600x1200)
VGA	Video Graphics Array (640x480)
SCCB	Serial Camera Control Bus
fps	Frames per second
FPN	Fixed Pattern Noise
AEC	Auto Exposure
AGC	Auto Exposure
AWB	Auto Exposure
ABF	Automatic Band Filter
ABLC	Automatic Black-Level Calibration
TTL	Total Track Length
EFL	Effective Focus Length
F/NO	F Number
FOV	Field Of View
CRA	Chief Ray Angle
I^2C	Inter IC bus IF Interface
ISP	Image Signal Processor
LSB	Least Significant Bit
APE	Application Processor Engine
bps	bit per second
CCP	Compact Camera Port
CCI	Camera Control Interface
DPCM	Differential Pulse Code Modulation
CDS	Correlated Double Sampling
I/O	Input/Output

General description

Aptina's MT9M114 is a 1/6-inch 1.26 Mp CMOS digital image sensor with an active-pixel array of 1296H x976V. It includes sophisticated camera functions such as auto exposure control, auto white balance, black level control, flicker avoidance, and defect correction. It is designed for low light performance. The MT9M114produces extraordinarily clear, sharp digital pictures, making it the perfect choice for a wide range of applications, including mobile phones, PC and notebook cameras, and gaming systems.

Table1.   Lens Specification

Composition	**3P+1Filter**
EFL	**2.23mm**
TTL	**2.8±0.1MM**
F/NO	**2.4±5%**
FOV	**70±3 DAGONAL**
TV-Distortion	**<2%**
Relative Illuminance	**45%**
CRA	**<29.6**

Tabel 2. Module Consumption

No.	Preview mode					Standby mode			
	DOVDD (mA)	DVDD (mA)	AVDD (mA)	Total Current (mA)	Total consumption (mW)	DOVDD (uA)	DVDD (uA)	AVDD (uA)	Total Current (uA)
1	0.3	20.2	35.7	56.2	137.16	218.5	23.2	0	241.7
2	0.3	20.7	35.4	56.4	137.22	221.6	16.5	0	238.1
3	0.3	20.4	35.5	56.2	136.96	222.2	15.3	0	237.5
4	0.3	20.5	35	55.8	135.74	219.7	16.5	0	236.2
5	0.3	20.2	35.6	56.1	136.88	220.9	12.8	0	233.7

Notes:
According to the MT9M114 sensor datasheet, the module's Max consumption is less than 200mW when work in the follow mode: full resolution, 24fps.

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MT9M114 Sensor Specification

Features

• Superior low-light performance
• Ultra-low-power
• 720p HD video at 30fps
• Internal master clock generated by on-chip phaselocked loop (PLL) oscillator
• Electronic rolling shutter (ERS), progressive scan
• Integrated image flow processor (IFP) for single-diecamera module
• Automatic image correction and enhancement
• Arbitrary image scaling with anti-aliasing
• Two-wire serial interface providing access to registers and microcontroller memory
• Selectable output data format: YCbCr, 565RGB, 555RGB, 444RGB, processed Bayer, BT656, RAW8- and RAW8+2-bit
• Parallel and MIPI data output
• Independently configurable gamma correction
• Adaptive Polynomial lens shading correction
• UVC interface
• Perspective correction
• Multi-camera synchronization

Table 3 Sensor Key Specification

Supply Voltage	Analog	2.5-3.1V
	I/O	1.75-1.95V or 2.5-3.1V
	Digital	1.7-1.95V
Temperature Range	Operation	-30°C to 70°C
Output Formats		YCbCr, 565RGB, 555RGB, 444RGB, processed Bayer, BT656, RAW8- and RAW8+2-bit
Optical format		1/6inch
Chief Ray Angle		27.7°
Frame rate		30 fps full res 30 fps 720p 60 fps VGA 120 fps QVGA2
Responsivity		2.25 V/lux-sec(9 V/lux-sec in summing mode)
S/N RatioMAX		36.8dB
Dynamic Range		68.7dB(pixel)
Data rate		MIPI: Up to 640 Mb/s and up to 85MHz parallel data Parallel: 80 Ms/s
Shutter type		Electronic rolling shutter
Pixel Size		1.9μm pixel

MT9M114 Module Specification

Table 4. Absolute Maximum Ratings

Supply Voltage (With Respect to Ground)	**AVDD(V_{DD-A})**	**2.8V**
	DVDD(V_{DD-C})	**1.8V**
	DOVDD(V_{DD-IO})	**1.8V or 2.8V**
Operating Temperature		**-30°C to 70°C**

Table 5. Module General Specification

No	Item		Specification
1	**Optical Format**		**1/6-inch**
2	**Pixel array number**		**1296 x 976**
3	**Power Supply**	**Analog**	2.5 to 3.1VDC
		I/O	**1.75-1.95V or 2.5-3.1V**
		Digital	**1.7-1.95V**
5	**Output format**		**YCbCr, 565RGB, 555RGB, 444RGB, processed Bayer, BT656, RAW8- and RAW8+2-bit**
7	**input clock range**		**6 – 54 MHz**
8	**Image processing**		**black level conditioning, shading correction, defect correction, color interpolation, edge detection, color correction, vertical perspective correction, aperture correction, and image formatting with cropping and scaling.**

Figure1. DC Characteristics (-30°C < T$_A$ < 70°C)

MIPI High-Speed Transmitter DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V$_{OD}$	HS transmit differential voltage	–	240	–	mV
CMTX	HS transmit static common mode voltage	–	201	–	mV
Δ V$_{OD}$	VOD mismatch when output is Differential-1 or Differential-0	–	2	–	mV
Δ VCMTX(1,0)	VCMTX mismatch when output is Differential-1 or Differential-0	–	1	–	mV
V$_{OHHS}$	HS output HIGH voltage	–	331	–	mV
Z$_{OS}$	Single-ended output impedance	–	46.97	–	Ω
Δ Z$_{OS}$	Single-ended output impedance mismatch	–	2.33	–	%

MIPI Low-Power Transmitter DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V$_{OL}$	Thevenin output low level	–	-0.25	–	mV
V$_{OH}$	Thevenin output high level	–	1.14	–	V
Z$_{OLP}$	Output impedance of LP transmitter	–	149	–	Ω

Figure2. AC Characteristics (-30°C < T$_A$ < 70°C)

MIPI High-Speed Transmitter AC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
	Data bit rate	–	–	768	Mb/s
t$_{rise}$	20–80% rise time	–	250	–	ps
t$_{fall}$	20–80% fall time	–	246	–	ps
VCMTX(LF)	Common-level variations between 50–450 MHz	–	15	–	mV peak

MIPI Low-Power Transmitter AC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Notes
t$_{rise}$	15–85% rise time	–	10.81	–	ns	
t$_{fall}$	15–85% fall time	–	13.12	–	ns	
Slew	Slew rate (CLOAD 20–70pF)	–	90.63	–	mV/ns	
t$_{rise}$ (Heavy Load)tRLP	15–85% rise time (Heavy Load)	–	8.78	–	ns	1
t$_{fall}$ (Heavy Load)tFLP	15–85% fall time (Heavy Load)	–	10.03	–	ns	1
Slew (Heavy Load)	Slew rate (CLOAD 20–70pF)(Heavy Load)	–	114.52	–	mV/ns	1

Figure 3: Two-wire Serial Control Bus Timing

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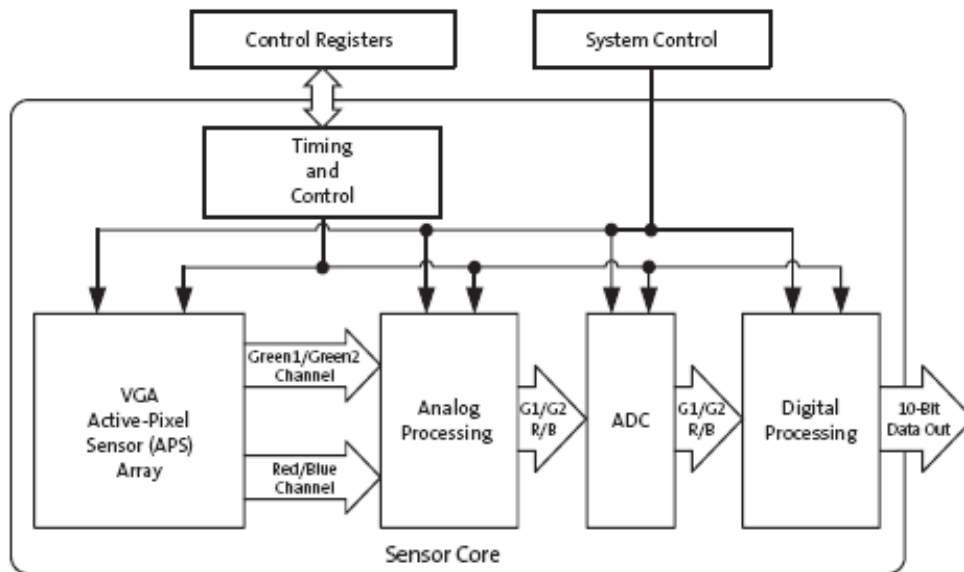|	
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Pixel Data Timing Example
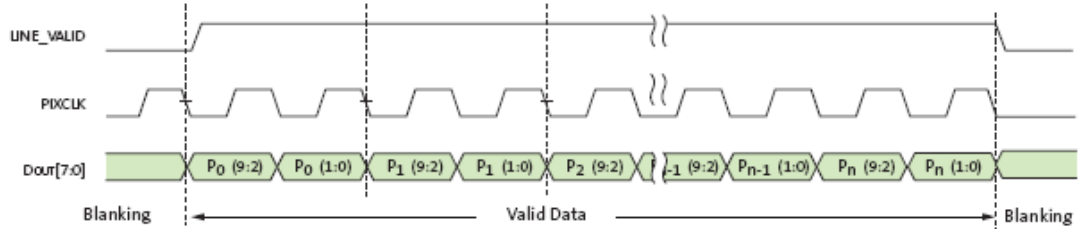
Row Timing, FV, and LV Signals
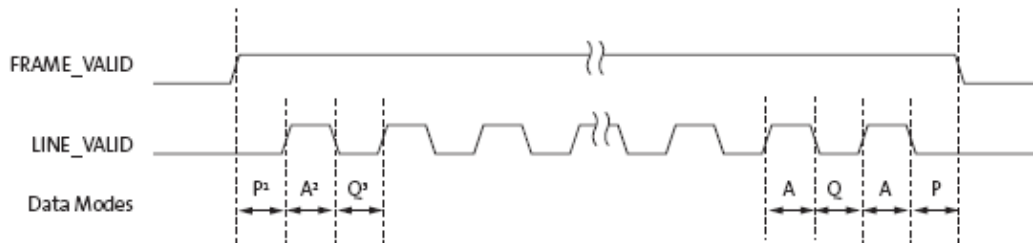
Notes: 1. P: Frame start and end blanking time.
          2. A: Active data time.
          3. Q: Horizontal blanking time.

Figure 2. Sensor Core Block Diagram

Figure 3. Pixel Color Pattern Detail (Bottom Left Corner)
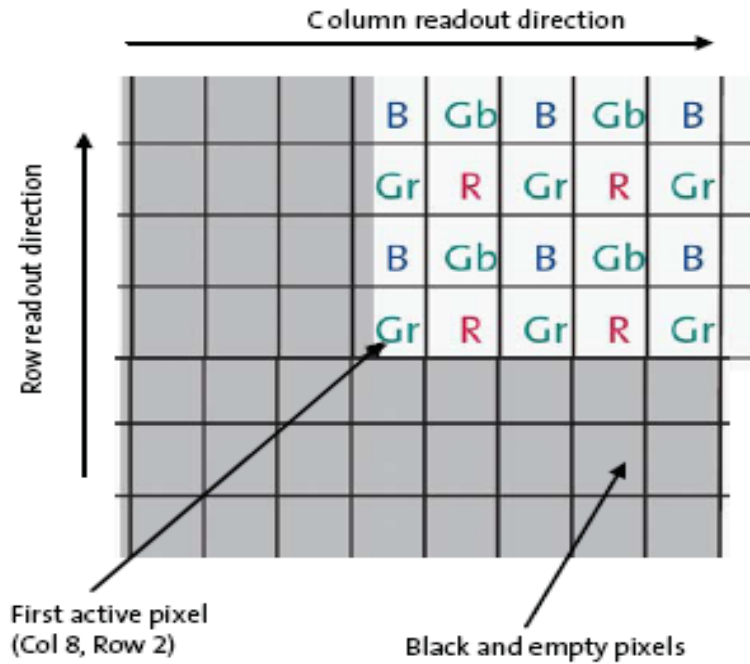
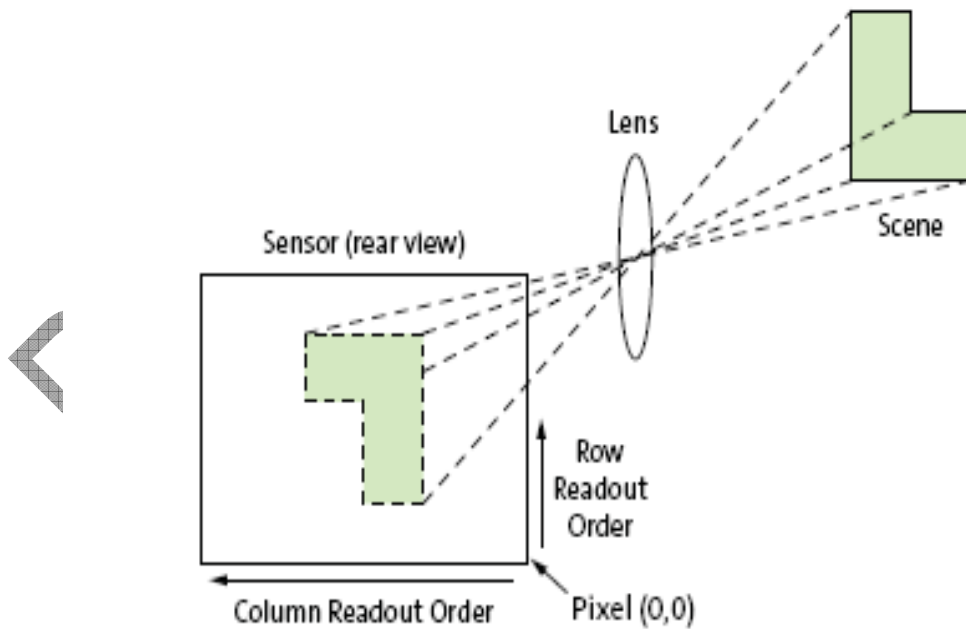**Figure 4 Imaging a Scene**

Figure 5. 3 Three Pixels in Normal and Column Mirror Readout Mode

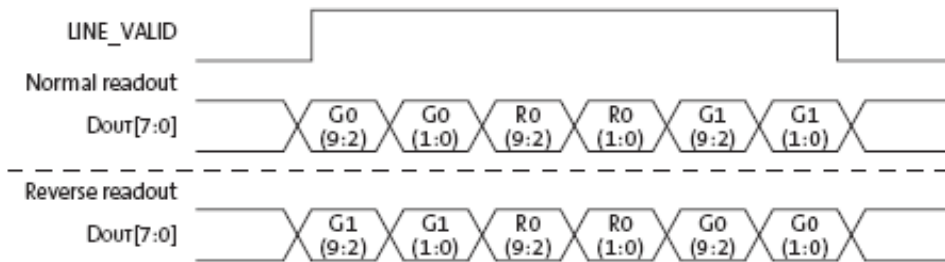| BOCS9M114-MIC9074O Camera Module Product Specification	Division Ⅶ Revision 1.3

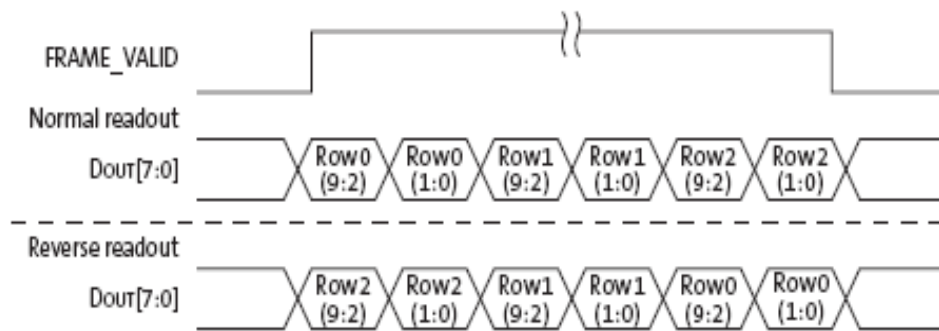**Figure 6．Three Rows in Normal and Row Mirror Readout Mode**

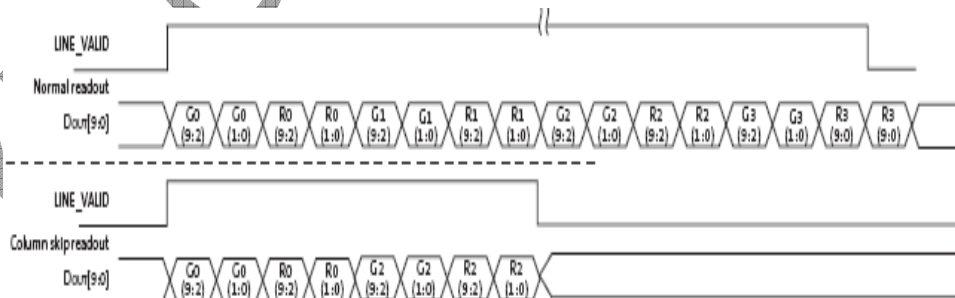**Figure 7．Eight Pixels in Normal and Column Skip 2X Readout Mode**

Figure 8．Gamma Correction Curve

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Figure 9．Chief Ray Angle
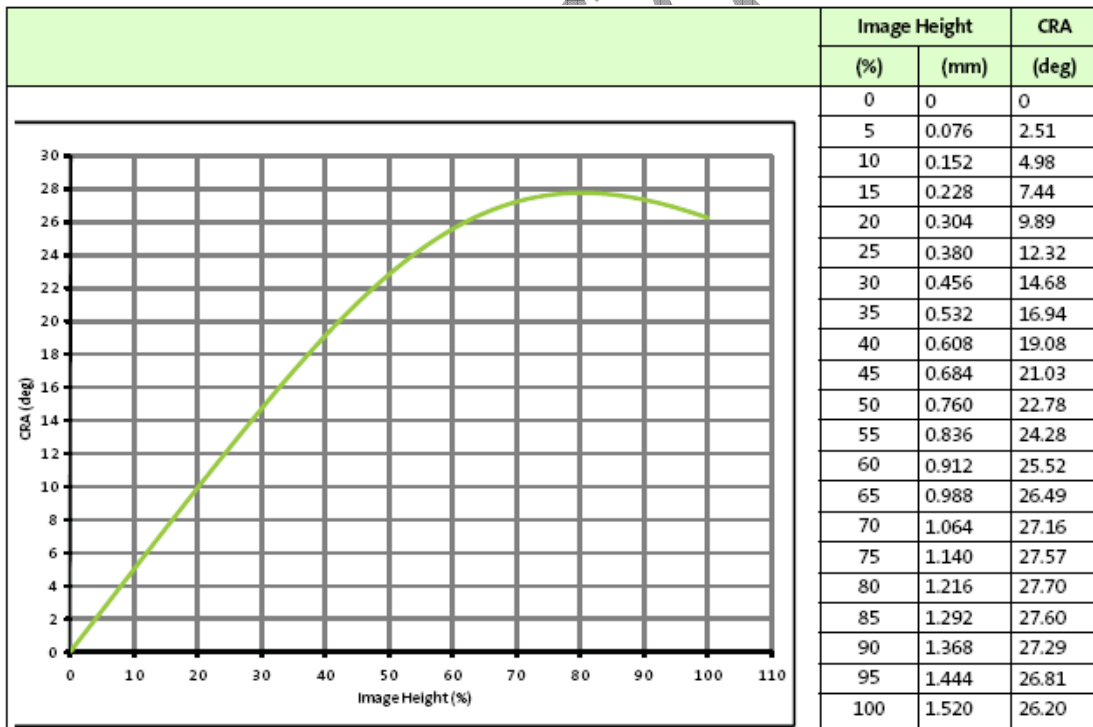
Image Height		CRA
(%)	(mm)	(deg)
0	0	0
5	0.076	2.51
10	0.152	4.98
15	0.228	7.44
20	0.304	9.89
25	0.380	12.32
30	0.456	14.68
35	0.532	16.94
40	0.608	19.08
45	0.684	21.03
50	0.760	22.78
55	0.836	24.28
60	0.912	25.52
65	0.988	26.49
70	1.064	27.16
75	1.140	27.57
80	1.216	27.70
85	1.292	27.60
90	1.368	27.29
95	1.444	26.81
100	1.520	26.20

Module Pin Description

Table 6.   Module Pin Description

PIN No.	NAME	Type	Description
1	AGND	Ground Input	Ground of Analog circuit block
2	DGND	Ground Input	Ground of digital circuit block
3	AVDD	Power	Power supply for sensor Analog
4	MCLK	Input	Master Input Clock
5	DGND	Ground Input	Ground of digital circuit block
6	DGND	Ground Input	Ground of digital circuit block
7	DOVDD	Power	Power supply for sensor digital circuit block Module data output
8	CLk-N	Clock	Clock
9	DVDD	Power	Power supply for sensor digital
10	CLk-P	Clock	Clock
11	PWDN	Output	NC
12	DGND	Ground Input	Ground of digital circuit block
13	RESET	Input	RESET
14	DN0	Output	Data output
15	ID2	ID	GND via a 0201 150kΩ resister
16	DP0	Output	Data output
17	ID1	ID	DOVDD
18	DGND	Ground Input	Ground of digital circuit block
19	SDA	IO	CCI data signal
20	NC	NC	NC
21	SCL	IO	CCI clock signal
22	NC	NC	NC
23	DGND	Ground Input	Ground of digital circuit block
24	DGND	Ground Input	Ground of digital circuit block

Testing

Optical testing

Table 7.　Optical testing

No	Test Item	Illumination Type	Distance	Intensity Range	Spec(1.3M)	
1	Field of View	DNP Light Box(5100K)	N/A	>200Lux	67 ° <FOV<73°	
2	TV-Distortion	DNP Light Box(5100K)	N/A	>200Lux	<1.5%	
3	Resolution	Daylight Fluorescent (6500K)	Take the picture for full chart	250±50Lux	Centre (0.1Field): >600	
					Corners (0.7Field):>500	
4	Shading	DNP Light Box(5100K)	Take the picture for full chart	>300Lux	>60%	
5	Sensitivity	Daylight Fluorescent (6500K)	Take the picture for full chart	250±50Lux	>30db	
6	Gray Scale	Daylight Fluorescent (6500K)	Take the picture for full chart	>200Lux	≥10 level	
7	Focal Range	Daylight Fluorescent (6500K)	N/A	>200Lux	Non-obvious area in the target<80	
8	Dark Noise	Daylight Fluorescent (6500K)	N/A	<1mLux	<10	
9	Color Rendition	Daylight Fluorescent (6500K)	Take the picture for full chart	>200Lux	Δ E < 25	
10	Inside Picture	Daylight Fluorescent (6500K)	40CM	>200Lux	N/A	

Environment testing

Table 9. Environment testing

| No	Test Item	Test Conditions	Judge standard
1	High Temp & Damp test	Temp.：85°C ± 2°C Damp：85% ± 3%RH Test duration：120h	No image distort and good color rendition. Not to be dewy
2	Low Temperature storage	Temp.：−40°C ± 3°C Test duration：96h	No image distort and good color rendition.
3	ESD(Electrostatic Discharge)	Air ：+/-10KV； contact：+/-2KV； 3 times	No image distort and good color rendition.
4	Thermal Shock Test	Temp.：85°C ± 3°C Temp.：−40°C ± 3°C 45min,30cycle	No image distort and good color rendition.
5	Vibration (Package State)	Frequency range：5—200 Hz amplitude：3.5mm, 2 hour for each position. Test all 3 axes (X, Y, Z)	No image distort，good color rendition，no white、black、colorful dot.
6	Mobile drop tes	6-faces, 3-edges and 1-corner Number of drops：3 Height：150cm	No image distort，good color rendition，no white、black、colorful dot.
7	FPC Bending test	Area: Head glue area; middle FPC and FPC near Connector Angle and Radius: 90° &0.8mm for Head glue area, 180°&0.8mm for middle, 180° 0.8mm near Connector Remarks: Head glue area:10pcs bend upwards for 20 times, downwards 5times; another 10pcs downwards 20, upwards Middle FPC:10 times FPC near Connector: The same as Head	No serious breaking and maintain fine electronic conductive features

Appendix 1: Packaging

The package must prevent damage to the components during transport and must be suitable for electrostatic-sensitive devices. The single camera modules shall be delivered in a reusable tray of antistatic plastic material. Several cameras shall be packed in one tray. The tray has separate holders for each camera-module.
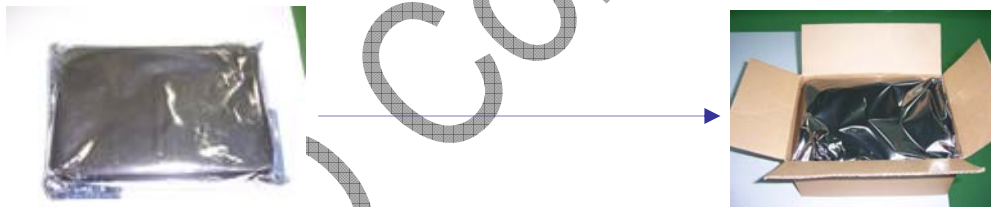
TRAY SPECIFICAITON:
Material: black antistatic PS   Resistance :< 1010 Ω
Dimension: 260 (W) x 180 (D) x 11.1 (H) mm (Top tray and bottom tray assembly)
Capacity: 1 unit(120PCS)

Example:
BOTTOM TRAY   **CAMERA**   **TOP**
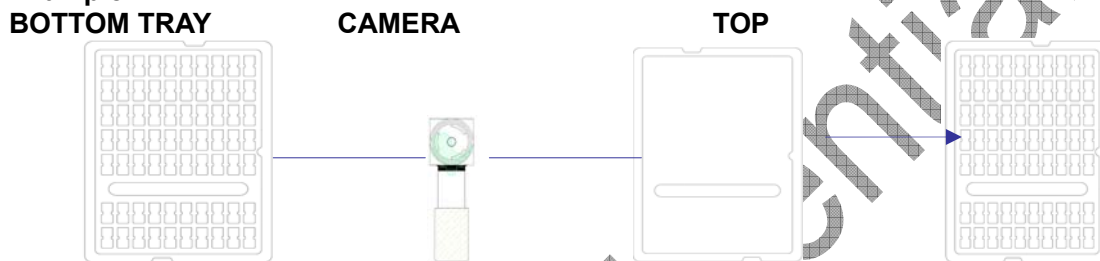
ESD SHIELDING BAG SPECIFICATION:
Resistance: 107~1010 Ω   Dimension:430 (W) x 380 (D) x 0.075 (T) mm
Capacity: 10 units(1200PCS)

CARTON SPECIFICAITON: **PAPER SHEET SPECIFICAITON:**
Dimension: 276 (W) x 198 (D) x 113 (H) mm   Capacity: 1 units (120pcs camera module)
Dimension: 270 (W) x 192 (D) x 2.5 (T) mm

PACKAGING:

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Appendix2: Module Drawing

CUSTOMER	
APPROVED	CHECKED

Engineering Drawing

RoHS

NOTE:
1.SENSOR.: MT9M114
2.LENS:30013A1D
2.CONNECTOR TYPE:BBR13-24K6J01
3.ID1 CONNECTS TO DOVDD,ID2 Connects to 0201 Package 150KΩ Resister
SADDR CONNECTS TO DGND
I2C address: 0X90(Write) 0X91(Read)
4.⊘⊗CRITICAL DEMENSIONS
5.TOLERANCE TABLE BELOW INDICATE THE LIMITS UNLESS OTHERWISE
NOTED
6.The steel stiffer should be connector with GND -FPC should be meet the
bending requirements

Front view

Side view

Back view

MODULE SPECIFICATION

Sensor	1/6inch
Pixel Size	1.9um
AVDD	2.8V
DVDD	1.8V
DOVDD	1.8/2.8V

LENS	3P+1R
TTL	2.6±0.1
F/NO	2.4±5%
FOV	70±3°
TV-Distortion	< 2%
Connector	BBR13-24K6J01

PIN		
01	AGND	DGND
02	DGND	
03	AVDD	MCLK
04	MCLK	
05	DGND	DGND
06	DGND	
07	DOVDD	CLK-N
08	CLK-N	
09	DVDD	
10	CLK-P	
11	PWDN(NC)	
12	DGND	
13	RESET	
14	DATA0_N	
15		
16	DATA0_P	
17	ID1	
18	DGND	
19	SDA	
20	NC	
21	SCL	
22	NC	
23	DGND	
24	DGND	

TOLERANCE

	0-1	>1-10	>10-50	>50
	±0.1	±0.15	±0.2	±0.3

SHEET:1/1 UNIT:mm SIZE : A4 SCALE:1:1 REV V1.0

BYD COMPANY LTD
DRAWNED CHECKED APPROVED
PROJECTION

REMARK
CUSTOM NAME：: Motorola Solution
CUSTOM PROJECT: Futon
PROJECT NUM: MMM13005
BYD PROJECT: SMC9074O
Module Part No: BOCS9M114-MIC9074

Items	Name	Qty
1	Lens	1
2	Hoder	1
3	Sensor	1
4	FPCA	1
5	Stifer	1
6	Connector	1

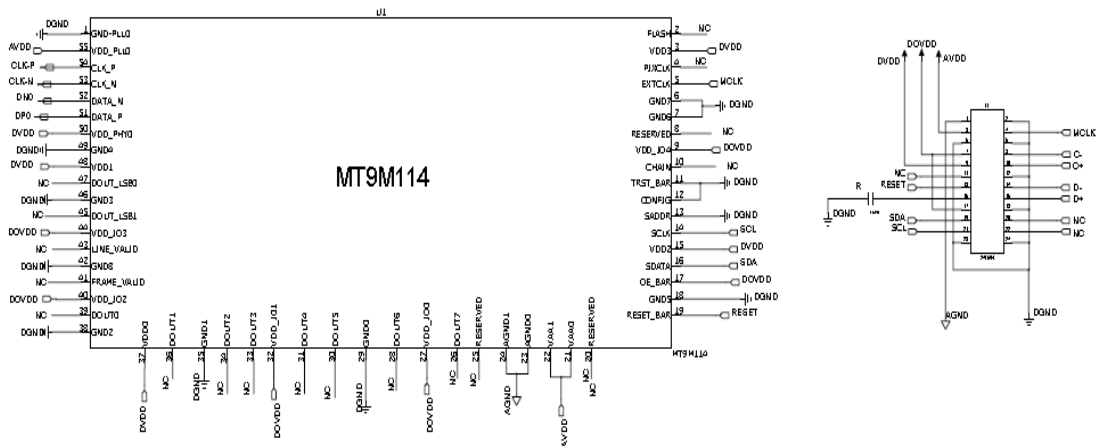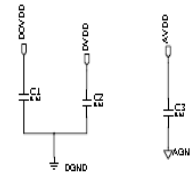| REV	DESCRIPTION	BY	DATE
1.0	Initial Release	Zhao Xueming	2013-02-12
1.1	Add the part No	Zhao Xueming	2013-04-08
1.1	Change the Stiffener & FPC thickness	Zhao Xueming	2014-02-08

DOC.NO WIH12-A8-0561

★机密★

Appendix 3: Lens Optical Specifications


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COMPOSITION:4 ELEMENTS,3 PLASTIC + 1 FILTER
SENSOR:MI1040-1/6" CMOS(2.432x1.824,DIAGONAL=3.04)
EFLm=2.22
FB=2.67±0.1 (AIR,INFINITY)
   =2.8±0.1 (INFINITY,WITH 0.4mm COVER GALSS)
FNO=2.4±5% (INFINITE)
FIELD OF VIEW
   VERTICAL:45°(Y'=0.912)
   HORIZONTAL:58°(Y'=1.216)
   DIAGONAL:69.6°(Y'=1.52)
   L=0.78 RIGHT TO FACE OF BARREL(DIAGONAL)
ENTRANCE PUPIL
   P=0.11 RIGHT FROM THE FIRST SURFACE
   D=∅0.89
EXIT PUPIL
   P=1.81 LEFT FROM THE IMAGE PLANE
   D=∅0.72
TV-DISTORTION (Traditional*2) <1.5%
RELATIVE ILLUMINANCE=45%(@Y'=1.52)(Ref.)
CHIEF RAY ANGLE < 29.6°
MAXIMUM IMAGE CIRCLE:∅3.4
IR-CUT COATING FILTER:T50%=650±10nm
BARREL MATERIAL:PC(BLACK)
HOLDER MATERIAL:PC(BLACK)
TORQUE SPEC.:20~140gf-cm
PATENT NO.:US8000033,US7974014
```

Appendix 4: Schematic Drawing

NOTE:

1. The SADDR pad of mt9m114 sensor connect to DGND, It define I2C write address is 0x90 and read address is 0x91

2. ID1 of Connector pin connect to DOVDD,This is customer's requirement
   ID2 Connect to 150K of 0201 Package Resister

3. power supply:DOVDD:1.8V OR 2.8V;AVDD:2.8V;DVDD:1.8V

4. PWDN of Connector pin is NC,Beause the mt9m114 can't accomplish hardware pwdn function
   It's accomplished by software
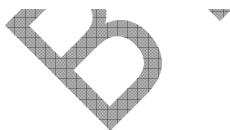
Appendix 5: Sensor Package datasheet

Figure 40: Package Mechanical Drawing

Note: The orientation of the figure is with the lens.

Top View

Bottom View

Cross-section View (E - E)
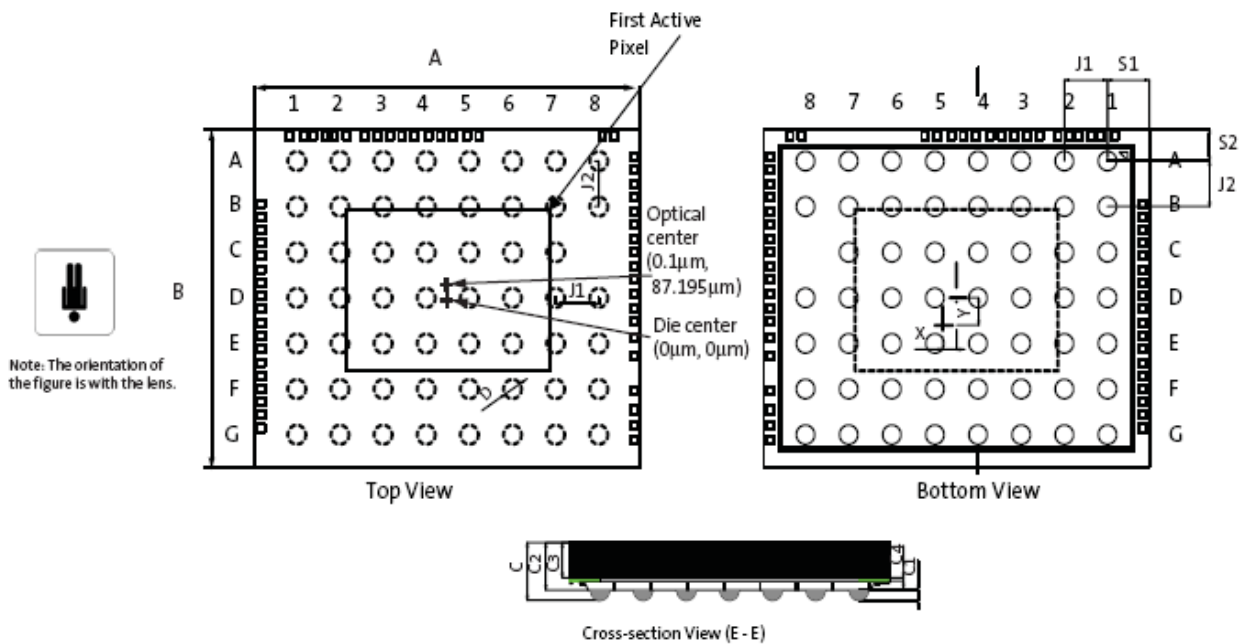
Table 32: Ball Matrix

	1	2	3	4	5	6	7	8
A	VAA	Reserved[1]	DOUT[6]	DOUT[4]	DOUT[2]	VDD	DOUT[1]	VDD
B	GND	VAA	VDD_IO	DOUT[5]	DOUT[3]	GND	DOUT[0]	VDD_IO
C	VDD	OE_BAR	AGND	GND	VDD_IO	FV	LV	
D	CONFIG	SCLK	SDATA	DOUT[7]	Reserved[1]	DOUT_LSB1	GND	VDD
E	VDD_IO	CHAIN	Reserved[1]	SADDR	RESET_BAR	DOUT_LSB0	GND	VDD_PHY
F	EXTCLK	PIXCLK	GND	TRST_BAR	DATA_N	DATA_P	CLK_P	CLK_N
G	VDD	FLASH	VDD	PGND[2]	PGND[2]	VDD_PLL	GND_PLL	GND_PLL

Notes: 1. Do not use.
              2. To be used for EMI shielding.

Sensor Pre-Bake before SMT

Pre-Bake Recommendation (before SMT)

Recommendation: Prebake at 125°C for 4 hours is recommended. If floor life exceeds the MSL requirement, then refer to TN-09-233 for bake conditions. The bake time can be reduced depending on the package size and floor exposure time. The baking temperature can be limited by the packing material.

Caution needs to be taken when CSP component is baked with Protective Film attached. A certain level of residual adhesive may be visible after bake, and cleaning may be required.

Reflow Recommendation

Refer to Aptina Technical Note TN-09-03. For CSP packages, the MAX peak temperature is recommended to be below 240°C, and the MAX dwell time above 220°C is 40 seconds.

CSP Packaging Handing Recommendations

Recommendations:
- Store material in N2 cabinet after removal from ESD bag.
- Use vacuum pen only to handle the package.
- Use ionizing air blower at every working station to ensure electrostatic voltage smaller than 0.5KV.
- The maximum mechanical normal force applied to the CSP top and bottom surface should be less than 5N (blunt point load). Any applied normal force to the top or bottom CSP surfaces should uniformly distributed with a maximum pressure of 3MPa and the BGA should be supported with a minimum contact area of $3mm^2$.

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