



1/4-Inch VGA CMOS Digital Image Sensor Die

MT9V011 Die Data Sheet

For the product data sheet, refer to Aptina's Web site: www.aplina.com

Features

- Ultra low-power, low cost CMOS image sensor
- Superior low-light performance
- Simple two-wire serial interface
- Auto black level calibration
- Window size: VGA, programmable to any smaller format (QVGA, CIF, QCIF)
- Programmable controls: gain; frame rate; left-right and top-bottom image reversal; window size and panning

Applications

- Cellular phones
- PDAs
- PC cameras
- Toys and other battery-powered products

General Physical Specifications

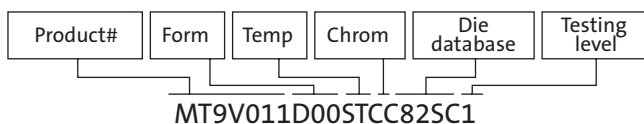
- Backside die bare silicon
- Typical metal 1 thickness: 3.1kÅ
- Typical metal 2 thickness: 3.1kÅ
- Typical metal 3 thickness: 6.1kÅ
- Metallization composition: 99.5 percent Al and 0.5 percent Cu over titanium
- Typical topside passivation: 2.2kÅ nitride over 6.0kÅ of undoped oxide
- Passivation openings (MIN): 75µm x 90µm

Order Information

2.8V Power Supply

MT9V011W00ST

MT9V011D00STC



- Die size (stepping interval): 4,819.80µm x 5,019.60µm
- Singulated die size (nominal dimension): 4,778µm ±25µm x 4,978µm ±25µm
- Bond Pad Location and Identification Tables, see pages 4–7

Option

Option	Designator
• Form	
– Die	D
• Testing	
– Standard (level 1) probe	C1

Notes: 1. Please consult die distributor or factory before ordering to verify long-term availability of these die products.

Key Performance Parameters

- Optical format: 1/4-inch (4:3)
- Active imager size: 3.58mm(H) x 2.69mm(V), 4.48mm diagonal
- Active pixels: 640H x 480V
- Oversize active pixels: 649H x 489V
- Total including dark pixels: 668H x 496V
- Pixel size: 5.6µm x 5.6µm
- Color filter array: RGB Bayer pattern
- Shutter type: electronic rolling shutter (ERS)
- Data rate/master clock: 13.5 Mp/s at 27 MHz
- Frame rate
 - VGA (640H x 480V) 30 fps at 27 MHz
 - CIF (352H x 288V) programmable up to 60 fps
 - QVGA (320H x 240V) programmable up to 90 fps
- ADC resolution: 10-bit, on-die
- Responsivity: 1.9V/lux-sec (550nm)
- Dynamic range: 60dB
- SNR MAX: 45dB
- Supply voltage: 2.8V ±0.25V
- Power consumption: 70mW at 2.8V
- Operating temperature: –20°C to +60°C

Die Database

- Die outline, see Figure 2 on page 8

General Description

The Aptina MT9V011 is a VGA-format ¼-inch CMOS active-pixel digital image sensor. The active imaging pixel array is 640H x 480V. It incorporates sophisticated camera functions on-die, such as windowing and column and row mirroring. It is programmable through a simple two-wire serial interface and has very low power consumption.

The MT9V011 features Aptina's breakthrough, low-noise CMOS imaging technology that achieves near-CCD image quality (based on signal-to-noise ratio and low-light sensitivity) while maintaining the inherent size, cost, and integration advantages of CMOS.

The sensor can be operated in its default mode or programmed by the user for frame size, exposure, gain setting, and other parameters. The default mode outputs a VGA-size image at 30 frames per second (fps). An on-die analog-to-digital converter (ADC) provides 10 bits per pixel. FRAME_VALID and LINE_VALID signals are output on dedicated bond pads, along with a pixel clock that is synchronous with valid data.

Die Testing Procedures

Aptina die products are tested with a standard probe (C1) test level. Wafer probe is performed at an elevated temperature to test product functionality in Aptina's standard package. Because the package environment is not within Aptina's control, the user must determine the necessary heat sink requirements to ensure that the die junction temperature remains within specified limits.

Image quality is verified through various imaging tests. The probe functional test flow provides test coverage for the on-die ADC, logic, serial interface bus, and pixel array. Test conditions, margins, limits, and test sequence are determined by individual product yields and reliability data.

Aptina retains a wafer map of each wafer as part of the probe records, along with a lot summary of wafer yields for each lot probed. Aptina reserves the right to change the probe program at any time to improve the reliability, packaged device yield, or performance of the product.

Die users may experience differences in performance relative to Aptina's data sheets. This is due to differences in package capacitance, inductance, resistance, and trace length.

Functional Specifications

The specifications provided in this document are for reference only. For target functional and parametric specifications, refer to the product data sheet found on Aptina's Web site.

Bonding Instructions

The MT9V011 Imager die has 43 bond pads. Refer to Tables 1 and 2 for a complete list of bond pads and coordinates.

The MT9V011 Imager die does not require the user to determine bond option features.

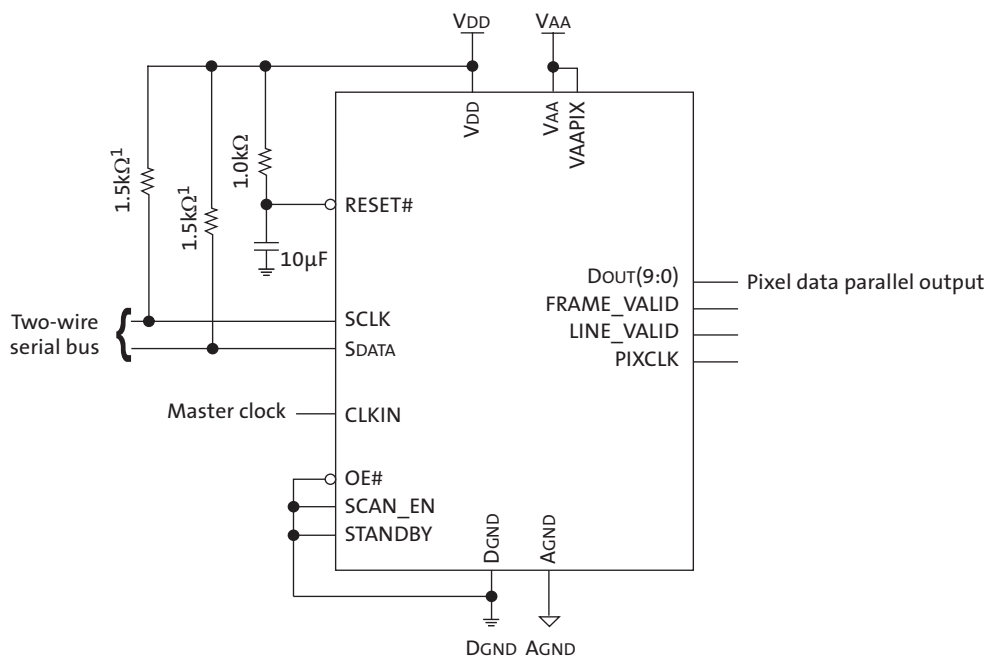
The MT9V011 Image die also has several pads defined as "do not use." These pads should not be used. Bonding these pads could result in a nonfunctional die.

Figure 1 on page 3, shows the MT9V011 typical die connections. For low-noise operations, the MT9V011 requires separate supplies for analog and digital power.

Storage Requirements

Aptina die products are packaged for shipping in a cleanroom environment. Upon receipt, the customer should transfer the die or wafers to a similar environment for storage. Aptina recommends the die or wafers be maintained in a filtered nitrogen atmosphere until removed for assembly. The moisture content of the storage facility should be maintained at 30 percent relative humidity ± 10 percent. ESD damage precautions are necessary during handling. The die must be in an ESD-protected environment at all times for inspection and assembly.

Figure 1: Typical Configuration (Connection)



Notes: 1. A resistor value of 1.5kΩ is recommended, but may be greater for slower two-wire speed.



Bond Pad Location and Identification Tables

Table 1: Bond Pad Location and Identification From Center of Pad 1

PAD	MT9V011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
1	DOUT4	0.00	0.00	0.0000000	0.0000000
2	DOUT5	486.02	0.00	0.0191346	0.0000000
3	DOUT6	972.04	0.00	0.0382693	0.0000000
4	DOUT7	1458.06	0.00	0.0574039	0.0000000
5	DOUT8	1944.08	0.00	0.0765386	0.0000000
6	DOUT9	2430.10	0.00	0.0956732	0.0000000
7	OE#	2916.12	0.00	0.1148079	0.0000000
8	STANDBY	3757.89	-343.85	0.1479482	-0.0135374
9	RESET#	3757.89	-606.86	0.1479482	-0.0238921
10	SCAN_EN	3757.89	-869.87	0.1479482	-0.0342469
11	VAAPIX0	3757.89	-1405.89	0.1479482	-0.0553500
12	VAAPIX1	3757.89	-1638.90	0.1479482	-0.0645236
13	VAAPIX2	3757.89	-1871.91	0.1479482	-0.0736972
14	AGND8	3757.89	-2124.92	0.1479482	-0.0836583
15	AGND7	3757.89	-2357.93	0.1479482	-0.0928319
16	AGND6	3757.89	-2590.94	0.1479482	-0.1020055
17	AGND5	3757.89	-3056.96	0.1479482	-0.1203528
18	AGND4	3757.89	-3289.97	0.1479482	-0.1295264
19	AGND3	3757.89	-3522.98	0.1479482	-0.1387000
20	VAA2	3757.89	-3755.99	0.1479482	-0.1478736
21	VAA1	3757.89	-3989.00	0.1479482	-0.1570472
22	VAA0	3757.89	-4222.01	0.1479482	-0.1662209
23	AGND2	3347.11	-4695.01	0.1317760	-0.1848429
24	AGND1	3114.10	-4695.01	0.1226024	-0.1848429
25	AGND0	2881.09	-4695.01	0.1134287	-0.1848429
26	SDATA	1646.04	-4695.01	0.0648047	-0.1848429
27	SCLK	1158.54	-4695.01	0.0456118	-0.1848429
28	LINE_VALID	671.04	-4695.01	0.0264189	-0.1848429
29	FRAME_VALID	183.54	-4695.01	0.0072260	-0.1848429
30	DNU ²	-49.74	-4695.01	-0.0019583	-0.1848429
31	PIXCLK	-303.96	-4695.01	-0.0119669	-0.1848429
32	CLKIN	-737.13	-4122.67	-0.0290207	-0.1623098
33	DOUT0	-737.13	-3656.65	-0.0290207	-0.1439626
34	DOUT1	-737.13	-3190.63	-0.0290207	-0.1256154
35	Vdd1	-737.13	-2916.61	-0.0290207	-0.1148272
36	Vdd0	-737.13	-2683.60	-0.0290207	-0.1056535
37	DNU	-737.13	-2471.60	-0.0290207	-0.0973071
38	DNU	-737.13	-2168.16	-0.0290207	-0.0853604



MT9V011: 1/4-Inch VGA CMOS Image Sensor Die Bond Pad Location and Identification Tables

Table 1: Bond Pad Location and Identification From Center of Pad 1 (continued)

PAD	MT9V011	"X"1 Microns	"Y"1 Microns	"X"1 Inches	"Y"1 Inches
39	DNU	-737.13	-1832.54	-0.0290207	-0.0721470
40	DGND1	-737.13	-1640.06	-0.0290207	-0.0645691
41	DGND0	-737.13	-1407.05	-0.0290207	-0.0553955
42	DOUT2	-737.13	-942.04	-0.0290207	-0.0370880
43	DOUT3	-737.13	-476.02	-0.0290207	-0.0187407

- Notes:
1. Reference to center of each bond pad from center of bond pad number.
 2. DNU = do not use. See Bonding Instructions on page 2.



MT9V011: 1/4-Inch VGA CMOS Image Sensor Die Bond Pad Location and Identification Tables

Table 2: Bond Pad Location and Identification From Center of Die (0, 0)

PAD	MT9V011	"X"1 Microns	"Y"1 Microns	"X"1 Inches	"Y"1 Inches
1	DOUT4	-1510.38	2347.51	-0.0594638	0.0924215
2	DOUT5	-1024.36	2347.51	-0.0403291	0.0924215
3	DOUT6	-538.34	2347.51	-0.0211945	0.0924215
4	DOUT7	-52.32	2347.51	-0.0020598	0.0924215
5	DOUT8	433.70	2347.51	0.0170748	0.0924215
6	DOUT9	919.72	2347.51	0.0362094	0.0924215
7	OE#	1405.74	2347.51	0.0553441	0.0924215
8	STANDBY	2247.51	2003.66	0.0884844	0.0788841
9	RESET#	2247.51	1740.65	0.0884844	0.0685293
10	SCAN_EN	2247.51	1477.64	0.0884844	0.0581746
11	VAAPIX0	2247.51	941.62	0.0884844	0.0370715
12	VAAPIX1	2247.51	708.61	0.0884844	0.0278978
13	VAAPIX2	2247.51	475.60	0.0884844	0.0187242
14	AGND8	2247.51	222.59	0.0884844	0.0087632
15	AGND7	2247.51	-10.43	0.0884844	-0.0004104
16	AGND6	2247.51	-243.44	0.0884844	-0.0095841
17	AGND5	2247.51	-709.46	0.0884844	-0.0279313
18	AGND4	2247.51	-942.47	0.0884844	-0.0371049
19	AGND3	2247.51	-1175.48	0.0884844	-0.0462785
20	VAA2	2247.51	-1408.49	0.0884844	-0.0554522
21	VAA1	2247.51	-1641.50	0.0884844	-0.0646258
22	VAA0	2247.51	-1874.51	0.0884844	-0.0737994
23	AGND2	1836.73	-2347.51	0.0723122	-0.0924215
24	AGND1	1603.72	-2347.51	0.0631386	-0.0924215
25	AGND0	1370.71	-2347.51	0.0539650	-0.0924215
26	SDATA	135.66	-2347.51	0.0053409	-0.0924215
27	SCLK	-351.84	-2347.51	-0.0138520	-0.0924215
28	LINE_VALID	-839.34	-2347.51	-0.0330449	-0.0924215
29	FRAME_VALID	-1326.84	-2347.51	-0.0522378	-0.0924215
30	DNU ²	-1560.12	-2347.51	-0.0614220	-0.0924215
31	PIXCLK	-1814.34	-2347.51	-0.0714307	-0.0924215
32	CLKIN	-2247.51	-1775.17	-0.0884884	-0.0698884
33	DOUT0	-2247.51	-1309.15	-0.0884884	-0.0515411
34	DOUT1	-2247.51	-843.13	-0.0884884	-0.0331939
35	VDD1	-2247.51	-569.11	-0.0884884	-0.0224057
36	VDD0	-2247.51	-336.10	-0.0884884	-0.0132321
37	DNU	-2247.51	-124.10	-0.0884884	-0.0048856
38	DNU	-2247.51	179.35	-0.0884884	0.0070610



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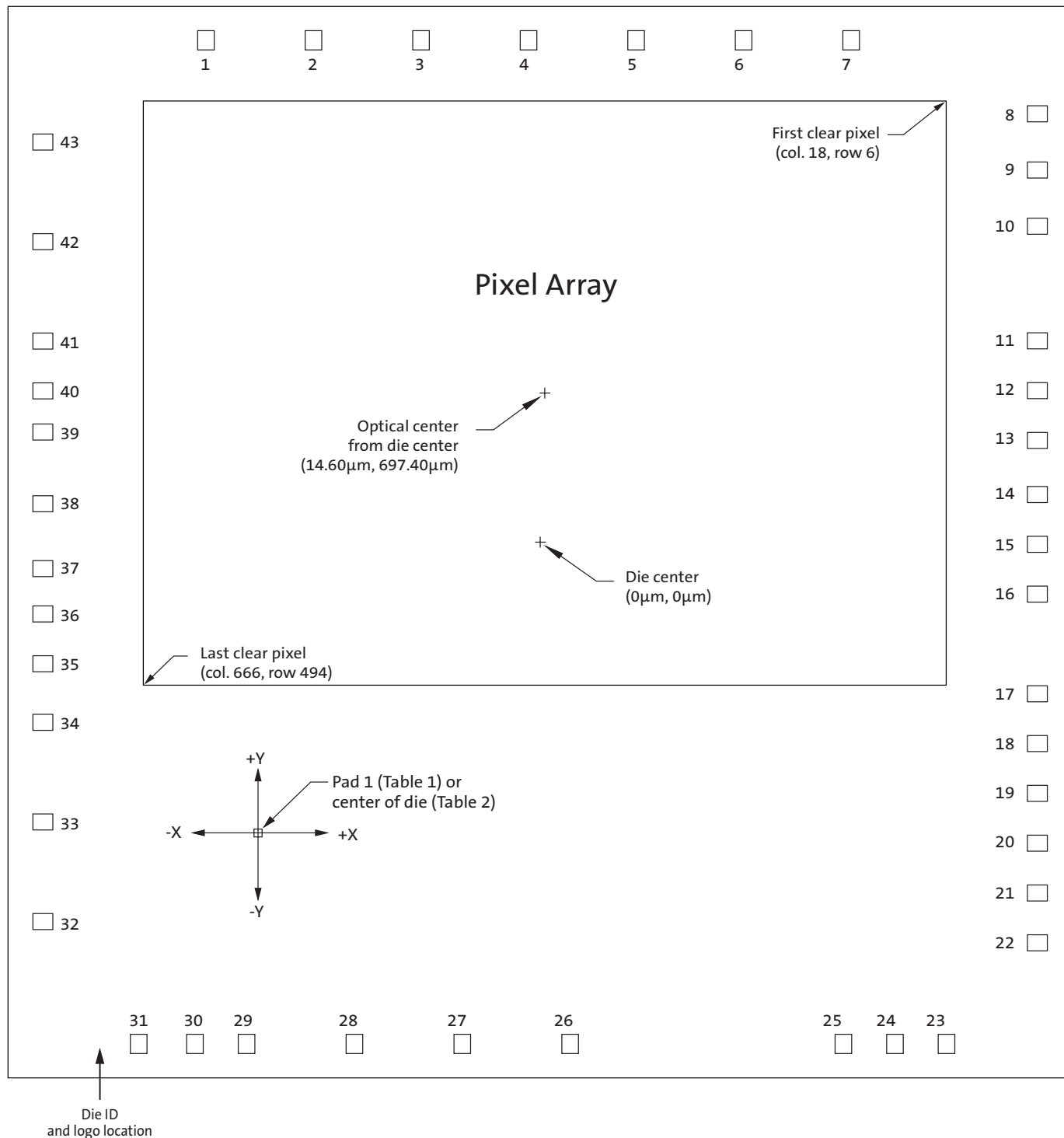
Table 2: Bond Pad Location and Identification From Center of Die (0, 0) (continued)

PAD	MT9V011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
39	DNU	-2247.51	514.97	-0.0884884	0.0202744
40	DGND1	-2247.51	707.45	-0.0884884	0.0278524
41	DGND0	-2247.51	940.46	-0.0884884	0.0370260
42	DOUT2	-2247.51	1405.47	-0.0884884	0.0553335
43	DOUT3	-2247.51	1871.49	-0.0884884	0.0736807

- Notes:
1. Reference to center of each bond pad from center of die (0, 0).
 2. DNU = do not use. See Bonding Instructions on page 2.

Die Features

Figure 2: Die Outline (Top View)



Notes: 1. Die street widths are not drawn to scale.

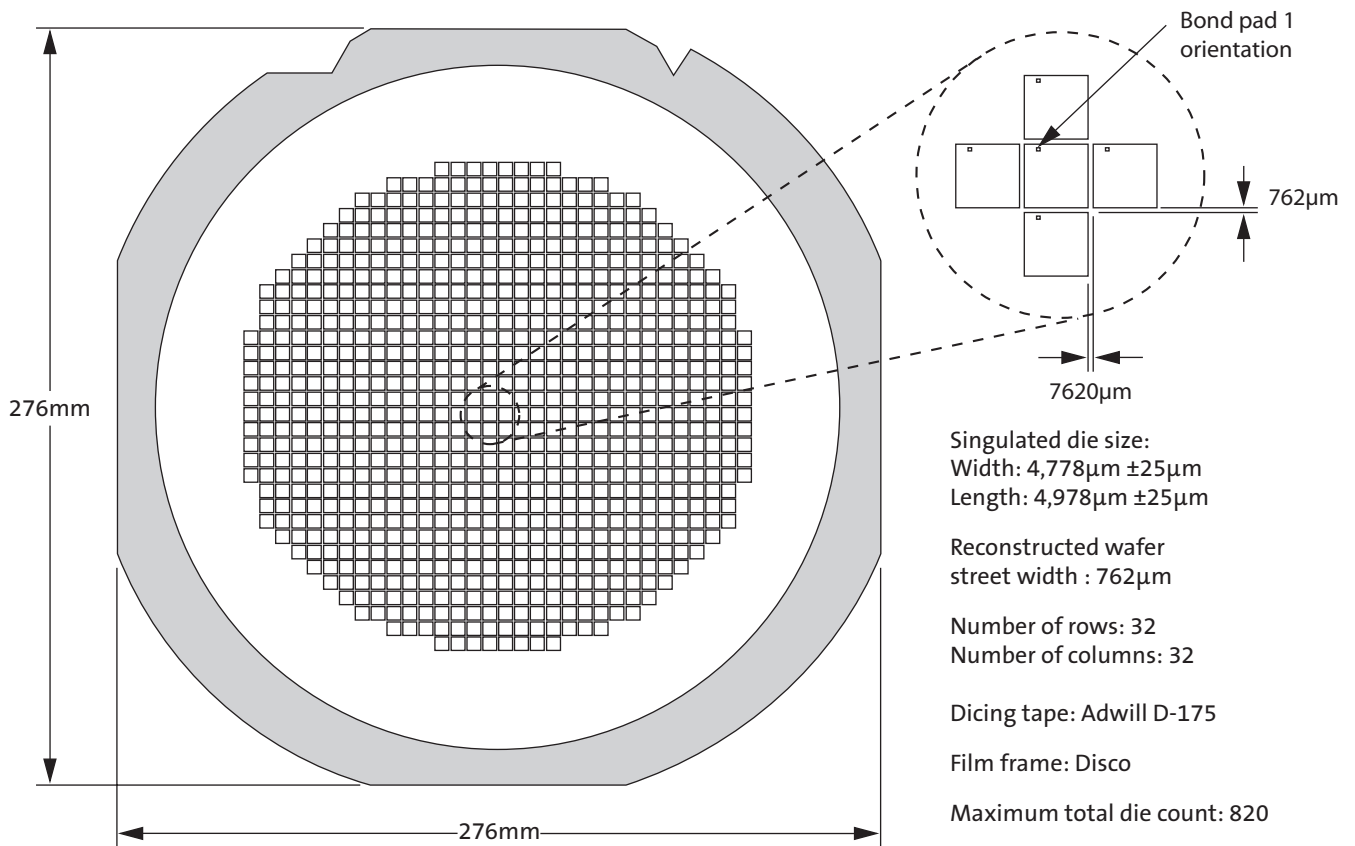


Physical Specifications

Table 3: Die Dimensions

Feature	Dimensions
Wafer diameter	200mm (8in)
Wafer thickness	305 μ m \pm 12 μ m
Die size (stepping interval)	4,819.80 μ m x 5,019.60 μ m
Singulated die size	
Width:	4,778 μ m \pm 25 μ m
Length:	4,978 μ m \pm 25 μ m
Street width along X-axis (dsw_X)	101.8 μ m
Street width along Y-axis (dsw_Y)	101.6 μ m
Center of streets (COS) (relative to center of bond pad 1)	X = -899.52 μ m, Y = 162.095 μ m
Bond pad size (MIN)	85 μ m x 100 μ m
Passivation openings (MIN)	75 μ m x 90 μ m
Minimum bond pad pitch	192.48 μ m
Optical array	
Optical center from die center:	X = 14.60 μ m, Y = 697.40 μ m
First clear pixel (col. 18, row 6)	
From die center:	X = 1,799.87 μ m, Y = 2,063.81 μ m
From center of pad 1:	X = 3,310.25 μ m, Y = -283.71 μ m
Last clear pixel (col. 666, row 494)	
From die center:	X = -1,828.93, Y = -669.00 μ m
From center of pad 1:	X = -318.55 μ m, Y = -3,016.51 μ m
Die offset	
From center of wafer to center of die:	X = 2.385400mm, Y = 2.478000mm

Figure 3: MT9V011 Die Orientation in Reconstructed Wafer





Revision History

Rev. E		9/10
	<ul style="list-style-type: none"> • Updated to non-confidential 	
Rev. D, Preliminary		6/10
	<ul style="list-style-type: none"> • Updated to Aptina template 	
Rev. C, Preliminary		9/07
	<ul style="list-style-type: none"> • Updated template • Added singulated die size and die offset dimensions 	
Rev. B, Preliminary		1/05
	<ul style="list-style-type: none"> • Applied new template • Changed Responsivity from 2.0V/lux-sec to 1.9V/lux-sec on page 1 • Updated "Storage Requirements" on page 3 • Updated Figure 3 on page 10 	
Rev. A, Preliminary		11/04
	<ul style="list-style-type: none"> • Initial release 	

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Preliminary: This data sheet contains initial characterization limits that are subject to change upon full characterization of production devices.