



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Features

1/3.2-Inch 2-Megapixel CMOS Digital Image Sensor Die

MT9D011

For the packaged product data sheet, refer to Micron's Web site: www.micron.com

Features

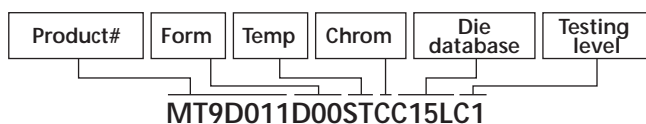
- Micron® DigitalClarity® CMOS imaging technology
- High frame rate
- Superior low-light performance
- Low dark current
- Simple two-wire serial interface
- Auto black level calibration
- Support for long integration times
- Anti-aliasing function and anti-eclipse function
- Operating modes: Snapshot (with flash control), high frame rate preview, 2 x 2 binning
- Programmable controls: Gain, frame size/rate, exposure, left-right and up-down image reversal, window size, panning, zoom and decimation
- 10-bit on-die ADC, with 3 external inputs
- Support for external mechanical shutter
- Internal master clock generated from on-die PLL
- Electronic rolling shutter (ERS)

General Physical Specifications

- Die thickness: 305µm ±12µm (12.0 mil ±0.5 mil)
(Consult factory for other die thickness)
- Backside wafer surface of 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 Ti
- Typical topside passivation:
2.2kÅ nitride over 6.0kÅ of undoped oxide
- Passivation openings (MIN): 75µm x 90µm

Order Information

MT9D011D00STCC15LC1



Die Database C15L

- Die outline, see Figure 2 on page 8
- Singulated die size:
6,374µm ±25µm x 6,445µm ±25µm
- Bond Pad Location and Identification Tables, see pages 4–7

Options

- Form
 - Die D
- Testing
 - Standard (level 1) probe C1

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

Key Performance Parameters

- Optical format: 1/3.2-inch (4:3)
- Active imager size: 4.48mm(H) x 3.36mm(V)
- Active pixels: 1,600H x 1,200V
- Pixel size: 2.8µm x 2.8µm
- Color filter array: RGB Bayer pattern
- Shutter type: Electronic rolling shutter
- Maximum data rate/master clock: 40 MPS/40 MHz
- Frame rate:
 - UXGA (full-frame, 1,600H x 1,200V) 15 fps at 36 MHz
 - SVGA (preview, 800H x 600V) 30 fps at 36 MHz
- ADC resolution: 10-bit, on-die
- Responsivity: 1.0 V/lux-sec (550nm)
- Dynamic range: >71.5dB
- SNR_{MAX}: 43.2dB
- Supply voltage:
 - I/O digital 1.7–3.1V
 - Core digital 1.7–1.9V (1.8V nominal)
 - Analog 2.5–3.1V (2.8V nominal)
- Power consumption:
 - <77mW at 30 fps, 36 MHz, preview mode
 - 130mW at 15 fps, 36 MHz, full-frame mode
- Operating temperature: –30°C to +70°C



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die General Description

General Description

The Micron[®] Imaging MT9D011 die is a UXGA-format 1/3.2-inch CMOS active-pixel digital image sensor with an oversized active imaging pixel array of 1,632H x 1,216V. It incorporates sophisticated camera functions on-die such as windowing, column and row skip mode, and snapshot mode. It is programmable through a simple two-wire serial interface and has low power consumption.

This 2-megapixel CMOS image sensor die features DigitalClarity—Micron's breakthrough, low-noise CMOS imaging technology that achieves 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 full resolution UXGA-size image at 15 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. A FLASH output signal is also available to synchronize external light sources with sensor exposure time.

Die Testing Procedures

Micron imager die products are tested with a standard probe (C1) test level. Wafer probe is performed at an elevated temperature to ensure product functionality in Micron's standard package. Since the package environment is not within Micron's control, the user must determine the necessary heat sinking 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.

Micron 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. Micron 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 Micron's data sheets. This is due to differences in package capacitance, inductance, resistance, and trace length.

Functional Specifications

The specifications provided here are for reference only. For functional and parametric specifications, refer to the packaged product data sheet found on Micron's Web site.

Bonding Instructions

The MT9D011 Imager die has 53 bond pads. Refer to Tables 1 and 2, on pages 4–7, for a complete list of bond pads and coordinates.

The MT9D011 Imager die does not require the user to determine bond option features.



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Storage Requirements

Figure 1 on page 3, shows the MT9D011 typical die connections. For low-noise operation the MT9D011 die requires separate supplies for analog and digital power. Power supply rails should be decoupled to ground using capacitors. Use of inductance filters is not recommended.

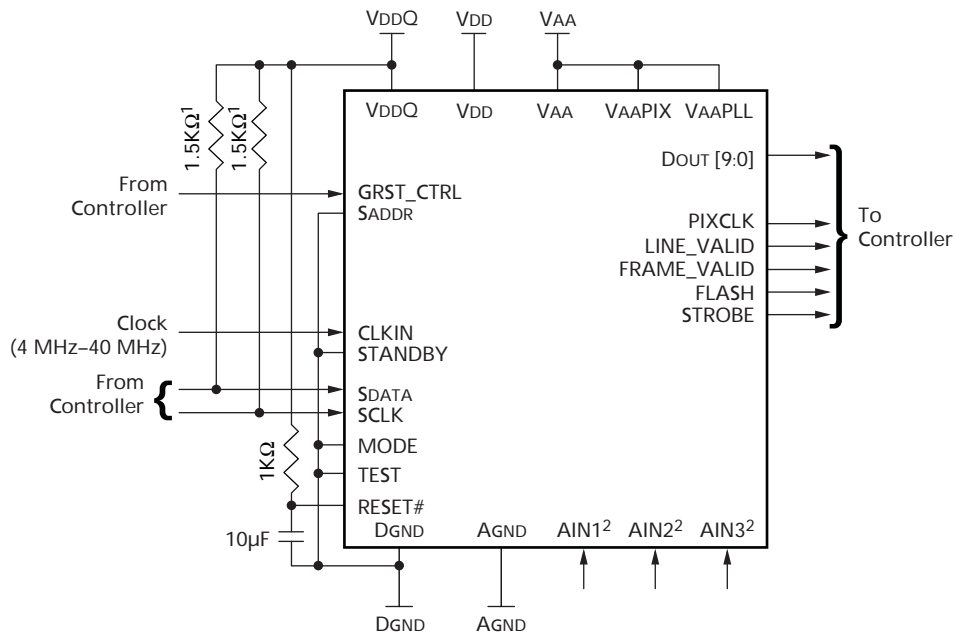
Storage Requirements

Micron die products are packaged in a cleanroom environment for shipping. Upon receipt, the customer should transfer the die to a similar environment for storage. Micron recommends the die 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.

Product Reliability Monitors

Reliability of all packaged products is monitored by ongoing reliability evaluations. Micron's QRA department continually samples product families for reliability studies. These samples are subjected to a battery of tests known as the "Accelerated Life" and "Environmental Stress" tests. During these tests, devices are stressed for many hours under conditions designed to simulate years of normal field use. A summary of these product family evaluations is published on a regular basis.

Figure 1: Typical Configuration (Connection)



- Notes:
1. A Resistor value of 1.5kΩ is recommended, but may be greater for slower two-wire speed.
 2. If not used, leave unconnected.



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Bond Pad Location and Identification Tables

Bond Pad Location and Identification Tables

Table 1: MT9D011 Bond Pad Location From Center of Pad 1

Pad	MT9D011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
1	DOUT9	0.00	0.00	0.0000000	0.0000000
2	DOUT8	233.28	0.00	0.0091843	0.0000000
3	DOUT7	466.56	0.00	0.0183685	0.0000000
4	DOUT6	699.84	0.00	0.0275528	0.0000000
5	DOUT5	933.12	0.00	0.0367370	0.0000000
6	VDDQ3	1333.60	0.00	0.0525039	0.0000000
7	VDDQ2	1475.44	0.00	0.0580882	0.0000000
8	DGND4	1606.48	0.00	0.0632472	0.0000000
9	DGND3	1737.52	0.00	0.0684063	0.0000000
10	DOUT4	1930.32	0.00	0.0759969	0.0000000
11	DOUT3	2163.60	0.00	0.0851811	0.0000000
12	DOUT2	2396.88	0.00	0.0943654	0.0000000
13	DOUT1	2630.16	0.00	0.1035496	0.0000000
14	DOUT0	2863.44	0.00	0.1127339	0.0000000
15	LINE_VALID	3096.72	0.00	0.1219181	0.0000000
16	FRAME_VALID	3330.00	0.00	0.1311024	0.0000000
17	PIXCLK	3563.28	0.00	0.1402866	0.0000000
18	VDDQ1	3745.60	0.00	0.1474646	0.0000000
19	VDDQ0	3887.44	0.00	0.1530488	0.0000000
20	DGND2	4018.48	0.00	0.1582079	0.0000000
21	DGND1	4149.52	0.00	0.1633669	0.0000000
22	CLKIN	4302.94	0.00	0.1694069	0.0000000
23	VDD1	4679.44	0.00	0.1842299	0.0000000
24	VDD0	4821.28	0.00	0.1898142	0.0000000
25	VAAPLL	5183.44	0.00	0.2040724	0.0000000
26	DGND0	5314.48	0.00	0.2092315	0.0000000
27	AGND2	5660.08	-6137.81	0.2228378	-0.2416461
28	AGND1	5529.04	-6137.81	0.2176787	-0.2416461
29	AGND0	5398.00	-6137.81	0.2125197	-0.2416461
30	VAA2	5256.16	-6137.81	0.2069354	-0.2416461
31	VAA1	5114.32	-6137.81	0.2013512	-0.2416461
32	VAA0	4972.48	-6137.81	0.1957669	-0.2416461
33	AIN3 ²	4841.44	-6137.81	0.1906079	-0.2416461
34	AIN2 ²	4710.40	-6137.81	0.1854488	-0.2416461
35	AIN1 ²	4579.36	-6137.81	0.1802898	-0.2416461
36	VAAPIX2	4217.20	-6137.81	0.1660315	-0.2416461
37	VAAPIX1	4075.36	-6137.81	0.1604472	-0.2416461
38	VAAPIX0	3933.52	-6137.81	0.1548630	-0.2416461



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Bond Pad Location and Identification Tables

Table 1: MT9D011 Bond Pad Location From Center of Pad 1 (continued)

Pad	MT9D011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
39	VDD2	2529.52	-6137.81	0.0995874	-0.2416461
40	DGND6	2180.32	-6137.81	0.0858394	-0.2416461
41	DGND5	2049.28	-6137.81	0.0806803	-0.2416461
42	MODE ³	1895.87	-6137.81	0.0746404	-0.2416461
43	VDDQ5	1737.52	-6137.81	0.0684063	-0.2416461
44	VDDQ4	1595.68	-6137.81	0.0628220	-0.2416461
45	SCLK	1442.27	-6137.81	0.0567821	-0.2416461
46	SDATA	1232.96	-6137.81	0.0485417	-0.2416461
47	GRST_CTRL	1039.07	-6137.81	0.0409081	-0.2416461
48	SADDR	869.15	-6137.81	0.0342183	-0.2416461
49	TEST ³	699.22	-6137.81	0.0275285	-0.2416461
50	STANDBY	529.30	-6137.81	0.0208388	-0.2416461
51	RESET#	359.38	-6137.81	0.0141490	-0.2416461
52	FLASH	150.08	-6137.81	0.0059087	-0.2416461
53	STROBE	-83.20	-6137.81	-0.0032756	-0.2416461

- Notes:
1. Reference to center of each bond pad from center of bond pad number 1.
 2. If not used, leave unconnected.
 3. Must be connected to DGND.



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Bond Pad Location and Identification Tables

Table 2: MT9D011 Bond Pad Location from center of die (0, 0)

Pad	MT9D011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
1	DOUT9	-2768.20	3068.91	-0.1089843	0.1208230
2	DOUT8	-2534.92	3068.91	-0.0998000	0.1208230
3	DOUT7	-2301.64	3068.91	-0.0906157	0.1208230
4	DOUT6	-2068.36	3068.91	-0.0814315	0.1208230
5	DOUT5	-1835.08	3068.91	-0.0722472	0.1208230
6	VDDQ3	-1434.60	3068.91	-0.0564803	0.1208230
7	VDDQ2	-1292.76	3068.91	-0.0508961	0.1208230
8	DGND4	-1161.72	3068.91	-0.0457370	0.1208230
9	DGND3	-1030.68	3068.91	-0.0405780	0.1208230
10	DOUT4	-837.88	3068.91	-0.0329874	0.1208230
11	DOUT3	-604.60	3068.91	-0.0238031	0.1208230
12	DOUT2	-371.32	3068.91	-0.0146189	0.1208230
13	DOUT1	-138.04	3068.91	-0.0054346	0.1208230
14	DOUT0	95.24	3068.91	0.0037496	0.1208230
15	LINE_VALID	328.52	3068.91	0.0129339	0.1208230
16	FRAME_VALID	561.80	3068.91	0.0221181	0.1208230
17	PIXCLK	795.08	3068.91	0.0313024	0.1208230
18	VDDQ1	977.40	3068.91	0.0384803	0.1208230
19	VDDQ0	1119.24	3068.91	0.0440646	0.1208230
20	DGND2	1250.28	3068.91	0.0492236	0.1208230
21	DGND1	1381.32	3068.91	0.0543827	0.1208230
22	CLKIN	1534.74	3068.91	0.0604226	0.1208230
23	VDD1	1911.24	3068.91	0.0752457	0.1208230
24	VDD0	2053.08	3068.91	0.0808299	0.1208230
25	VAAPLL	2415.24	3068.91	0.0950882	0.1208230
26	DGND0	2546.28	3068.91	0.1002472	0.1208230
27	AGND2	2891.88	-3068.91	0.1138535	-0.1208230
28	AGND1	2760.84	-3068.91	0.1086945	-0.1208230
29	AGND0	2629.80	-3068.91	0.1035354	-0.1208230
30	VAA2	2487.96	-3068.91	0.0979512	-0.1208230
31	VAA1	2346.12	-3068.91	0.0923669	-0.1208230
32	VAA0	2204.28	-3068.91	0.0867827	-0.1208230
33	AIN3 ²	2073.24	-3068.91	0.0816236	-0.1208230
34	AIN2 ²	1942.20	-3068.91	0.0764646	-0.1208230
35	AIN1 ²	1811.16	-3068.91	0.0713055	-0.1208230
36	VAAPIX2	1449.00	-3068.91	0.0570472	-0.1208230
37	VAAPIX1	1307.16	-3068.91	0.0514630	-0.1208230
38	VAAPIX0	1165.32	-3068.91	0.0458787	-0.1208230



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Bond Pad Location and Identification Tables

Table 2: MT9D011 Bond Pad Location from center of die (0, 0) (continued)

Pad	MT9D011	"X" ¹ Microns	"Y" ¹ Microns	"X" ¹ Inches	"Y" ¹ Inches
39	VDD2	-238.68	-3068.91	-0.0093969	-0.1208230
40	DGND6	-587.88	-3068.91	-0.0231449	-0.1208230
41	DGND5	-718.92	-3068.91	-0.0283039	-0.1208230
42	MODE ³	-872.34	-3068.91	-0.0343439	-0.1208230
43	VDDQ5	-1030.68	-3068.91	-0.0405780	-0.1208230
44	VDDQ4	-1172.52	-3068.91	-0.0461622	-0.1208230
45	SCLK	-1325.94	-3068.91	-0.0522022	-0.1208230
46	SDATA	-1535.24	-3068.91	-0.0604425	-0.1208230
47	GRST_CTRL	-1729.14	-3068.91	-0.0680762	-0.1208230
48	SADDR	-1899.06	-3068.91	-0.0747659	-0.1208230
49	TEST ³	-2068.98	-3068.91	-0.0814557	-0.1208230
50	STANDBY	-2238.90	-3068.91	-0.0881455	-0.1208230
51	RESET#	-2408.82	-3068.91	-0.0948352	-0.1208230
52	FLASH	-2618.12	-3068.91	-0.1030756	-0.1208230
53	STROBE	-2851.40	-3068.91	-0.1122598	-0.1208230

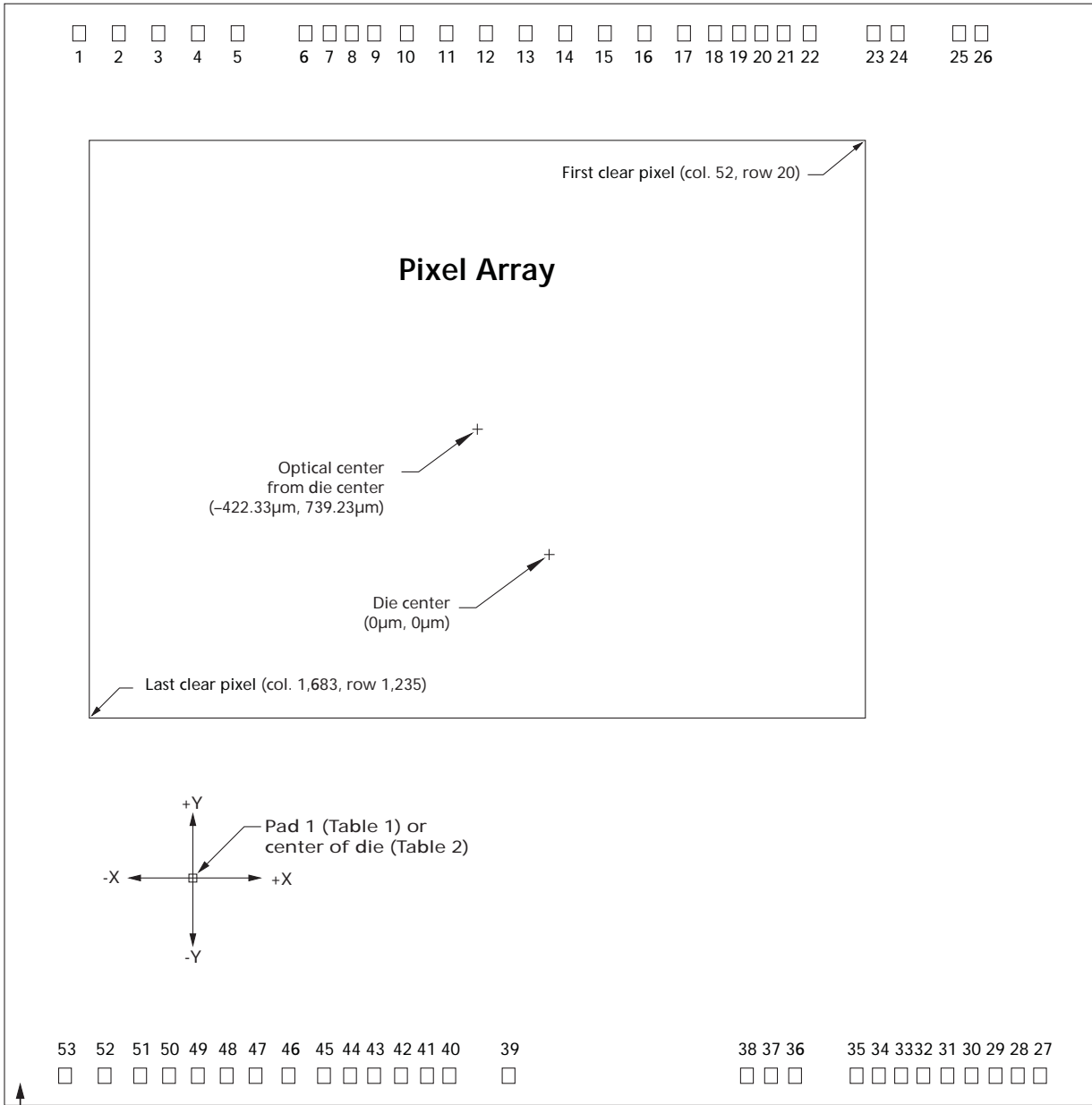
- Notes:
1. Reference to center of each bond pad from center of die (0, 0).
 2. If not used, leave unconnected.
 3. Must be connected to DGND.



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Die Features

Die Features

Figure 2: Die Outline (Top View)



Die ID: MI-2010 and logo location



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Physical Specifications

Physical Specifications

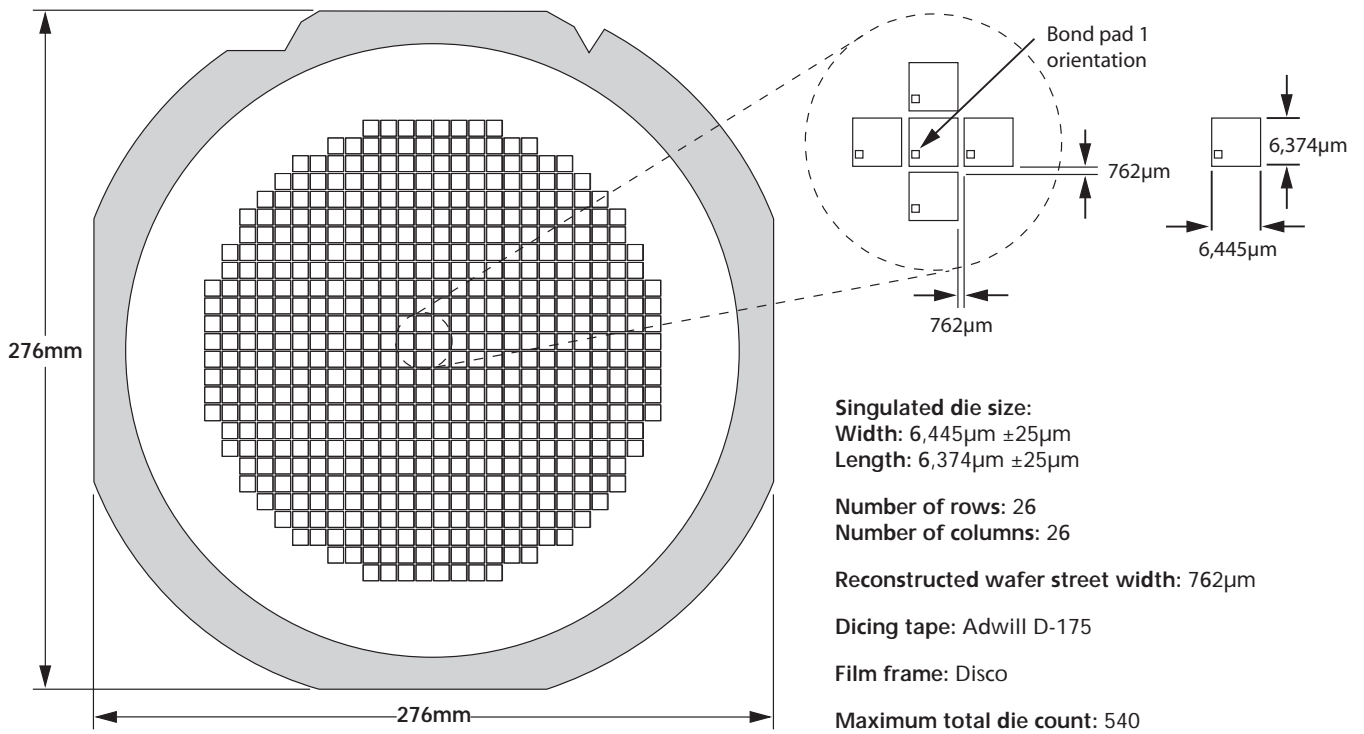
Table 3: Physical Dimensions

Feature	Dimensions
Wafer diameter	200mm (8in)
Die thickness	305 μ m \pm 12 μ m
Singulated die size Width: Length:	6,374 μ m \pm 25 μ m 6,445 μ m \pm 25 μ m
Bond pad size (MIN)	85 μ m x 100 μ m (3.35 mil x 3.94 mil)
Passivation openings (MIN)	75 μ m x 90 μ m (2.95 mil x 3.54 mil)
Minimum bond pad pitch	131.04 μ m (5.159 mil)
Optical array <i>Optical center from die center:</i> <i>Optical center from center of pad 1:</i>	X = -422.33 μ m, Y = 739.23 μ m X = 2,345.87 μ m, Y = 2,329.68 μ m
First clear pixel (col. 52, row 20) <i>From die center:</i> <i>From center of pad 1:</i>	X = 1,861.08 μ m, Y = 2,440.23 μ m X = 4,629.28 μ m, Y = -628.68 μ m
Last clear pixel (col. 1,683, row 1,235) <i>From die center:</i> <i>From center of pad 1:</i>	X = -2,705.73 μ m, Y = -961.71 μ m X = 62.48 μ m, Y = -4,030.68 μ m



MT9D011: 2-Megapixel CMOS Digital Image Sensor Die Physical Specifications

Figure 3: MT9D011 Die Orientation in Reconstructed Wafer



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



**MT9D011: 2-Megapixel CMOS Digital Image Sensor Die
Revision History**

Revision History

Rev G, Preliminary **4/07**

- Updated Figure 3 on page 10

Rev F, Preliminary..... **2/06**

- Updated template

Rev E, Preliminary **5/05**

- From 1/3-inch to 1/3.2-inch.

Rev F, Pub. 4/05, Preliminary..... **4/05**

- Added Optical Center from Center of Pad 1: X = 3,855.68µm, Y = -3,767.05µm to Table 3
- Changed wafer thickness to 305µm from 200µm on pages 1 and 9
- Updated “Key Performance Parameters” on page 1
- Updated Table 3 to correct singulated die size dimensions

Rev E, Pub. 2/05, Preliminary **2/05**

- Added Optical Center from Center of Pad 1: X = 3,855.68µm, Y = -3,767.05µm to Table 3
- Changed wafer thickness to 305µm from 200µm on pages 1 and 9

Rev D, Pub. 1/05, Preliminary **1/05**

- Updated first and last clear pixel information on page 8 and page 9
- Added singulated die size to Figure 3, MT9D011 Die Orientation in Reconstructed Wafer, on page 10

Rev C, Pub. 11/04, Preliminary **11/04**

- Went to Preliminary
- Under Key Performance Parameters on page 1:
 - Revised Active Imager Size: 4.48mm(H) x 3.36mm(V)
 - Active Pixels: 1,600H x 1,200V
 - Power Consumption:
 - <85mW at 30 fps, 36 MHz, Preview mode
 - 130mW at 15 fps, 36 MHz, Full-frame mode
- Added 675µm ±12µm wafer thickness, page 1

Rev B, Pub. 11/04, Advance **11/04**

- Removed (MI-2010) from title bar

Rev B, Pub. 8/04, Advance..... **8/04**

- Revised X coordinates in Table 1

Rev A, Pub. 8/04, Advance..... **8/04**

- Initial release