1/4-Inch VGA CMOS Digital Image Sensor Die

MT9V011

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

Features

- Micron® DigitalClarity® CMOS imaging technology
- 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

- Wafer thickness:
  305μm ±12μm (available in die and wafer form)
  (Consult factory for die thickness other than 305μm)
- Backside wafer surface of polished 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

MT9V011W00STCC82SC1

MT9V011D00STCC82SC1

Product#	Form	Temp	Chrom	Die database	Testing level

MT9V011D00STCC82SC1
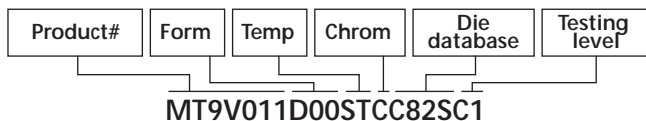
Die Database C82S

- Die outline, see Figure 2 on page 9
- 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

- Form
  – Die   D
  – Wafer – 200mm (8in)   W
- 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

General Description

The Micron Imaging 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 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 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

Micron Imager die products are tested with a standard probe (C1) test level. Wafer probe is performed at an elevated temperature to test product functionality in Micron's standard package. Because the package environment is not within Micron'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.

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 in this document are for reference only. For target functional and parametric specifications, refer to the product data sheet found on Micron'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 4, shows the MT9V011 typical die connections. For low-noise operations, the MT9V011 requires separate supplies for analog and digital power.

Wafer Saw

The die size (stepping interval) provided is measured from the center of the die street on one side of the die to the center of the die street on the other side of the die. A singulated die is approximately 42μm smaller in length and width. The dimensional tolerance of a singulated die is ±25μm. For example, if the die width (stepping interval) is 5,080μm and the die length (stepping interval) is 7,620μm, the dimensions of the singulated die will be 5,038μm ±25μm by 7,578μm ±25μm.

Wafer-Level Processing

Customers should choose the wafer form when post-processing of die is required. This includes adding extra passivation or metal layers or bumping of the bond pads. For these customers, the street widths are provided in the die outline. Also, a reference from the center of bond pad 1 to the center of the intersection of two streets is provided for easy alignment.

Storage Requirements

Micron 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. Micron 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.

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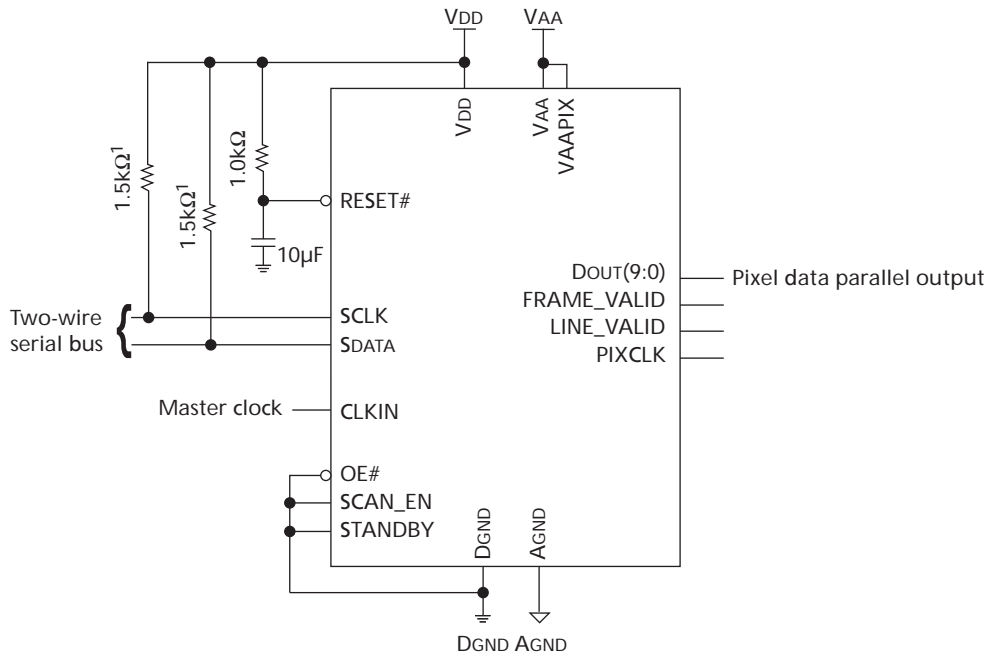
Notes: 1. A resistor value of 1.5kΩ is recommended, but may be greater for slower two-wire speed.

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	D$_{OUT}$4	0.00	0.00	0.0000000	0.0000000
2	D$_{OUT}$5	486.02	0.00	0.0191346	0.0000000
3	D$_{OUT}$6	972.04	0.00	0.0382693	0.0000000
4	D$_{OUT}$7	1458.06	0.00	0.0574039	0.0000000
5	D$_{OUT}$8	1944.08	0.00	0.0765386	0.0000000
6	D$_{OUT}$9	2430.10	0.00	0.0956732	0.0000000
7	OE#	2916.12	0.00	0.1148079	0.0000000
8	STANDBY	3757.89	−343.85	0.1479482	−0.0135374
9	RESET#	3757.89	−606.86	0.1479482	−0.0238921
10	SCAN_EN	3757.89	−869.87	0.1479482	−0.0342469
11	VAAPIX0	3757.89	−1405.89	0.1479482	−0.0553500
12	VAAPIX1	3757.89	−1638.90	0.1479482	−0.0645236
13	VAAPIX2	3757.89	−1871.91	0.1479482	−0.0736972
14	A$_{GND}$8	3757.89	−2124.92	0.1479482	−0.0836583
15	A$_{GND}$7	3757.89	−2357.93	0.1479482	−0.0928319
16	A$_{GND}$6	3757.89	−2590.94	0.1479482	−0.1020055
17	A$_{GND}$5	3757.89	−3056.96	0.1479482	−0.1203528
18	A$_{GND}$4	3757.89	−3289.97	0.1479482	−0.1295264
19	A$_{GND}$3	3757.89	−3522.98	0.1479482	−0.1387000
20	V$_{AA}$2	3757.89	−3755.99	0.1479482	−0.1478736
21	V$_{AA}$1	3757.89	−3989.00	0.1479482	−0.1570472
22	V$_{AA}$0	3757.89	−4222.01	0.1479482	−0.1662209
23	A$_{GND}$2	3347.11	−4695.01	0.1317760	−0.1848429
24	A$_{GND}$1	3114.10	−4695.01	0.1226024	−0.1848429
25	A$_{GND}$0	2881.09	−4695.01	0.1134287	−0.1848429
26	S$_{DATA}$	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	D$_{OUT}$0	−737.13	−3656.65	−0.0290207	−0.1439626
34	D$_{OUT}$1	−737.13	−3190.63	−0.0290207	−0.1256154
35	V$_{DD}$1	−737.13	−2916.61	−0.0290207	−0.1148272
36	V$_{DD}$0	−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

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

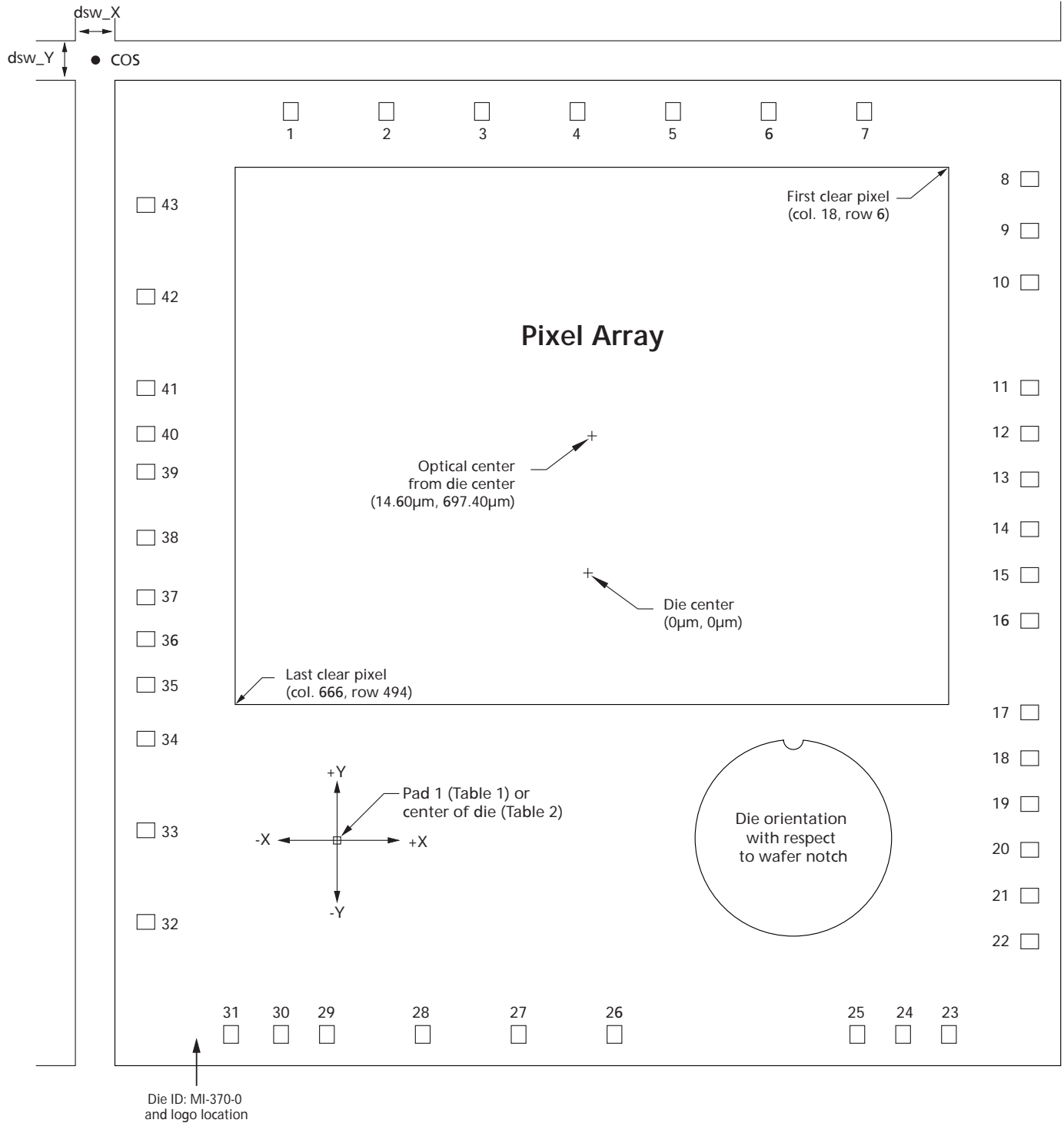| PAD	MT9V011	"X"[1] Microns	"Y"[1] Microns	"X"[1] Inches	"Y"[1] Inches
39	DNU	−737.13	−1832.54	−0.0290207	−0.0721470
40	D$_{GND}$1	−737.13	−1640.06	−0.0290207	−0.0645691
41	D$_{GND}$0	−737.13	−1407.05	−0.0290207	−0.0553955
42	D$_{OUT}$2	−737.13	−942.04	−0.0290207	−0.0370880
43	D$_{OUT}$3	−737.13	−476.02	−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.

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	D$_{OUT}$4	–1510.38	2347.51	–0.0594638	0.0924215
2	D$_{OUT}$5	–1024.36	2347.51	–0.0403291	0.0924215
3	D$_{OUT}$6	–538.34	2347.51	–0.0211945	0.0924215
4	D$_{OUT}$7	–52.32	2347.51	–0.0020598	0.0924215
5	D$_{OUT}$8	433.70	2347.51	0.0170748	0.0924215
6	D$_{OUT}$9	919.72	2347.51	0.0362094	0.0924215
7	OE#	1405.74	2347.51	0.0553441	0.0924215
8	STANDBY	2247.51	2003.66	0.0884844	0.0788841
9	RESET#	2247.51	1740.65	0.0884844	0.0685293
10	SCAN_EN	2247.51	1477.64	0.0884844	0.0581746
11	VAAPIX0	2247.51	941.62	0.0884844	0.0370715
12	VAAPIX1	2247.51	708.61	0.0884844	0.0278978
13	VAAPIX2	2247.51	475.60	0.0884844	0.0187242
14	A$_{GND}$8	2247.51	222.59	0.0884844	0.0087632
15	A$_{GND}$7	2247.51	–10.43	0.0884844	–0.0004104
16	A$_{GND}$6	2247.51	–243.44	0.0884844	–0.0095841
17	A$_{GND}$5	2247.51	–709.46	0.0884844	–0.0279313
18	A$_{GND}$4	2247.51	–942.47	0.0884844	–0.0371049
19	A$_{GND}$3	2247.51	–1175.48	0.0884844	–0.0462785
20	V$_{AA}$2	2247.51	–1408.49	0.0884844	–0.0554522
21	V$_{AA}$1	2247.51	–1641.50	0.0884844	–0.0646258
22	V$_{AA}$0	2247.51	–1874.51	0.0884844	–0.0737994
23	A$_{GND}$2	1836.73	–2347.51	0.0723122	–0.0924215
24	A$_{GND}$1	1603.72	–2347.51	0.0631386	–0.0924215
25	A$_{GND}$0	1370.71	–2347.51	0.0539650	–0.0924215
26	S$_{DATA}$	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	D$_{OUT}$0	–2247.51	–1309.15	–0.0884884	–0.0515411
34	D$_{OUT}$1	–2247.51	–843.13	–0.0884884	–0.0331939
35	V$_{DD}$1	–2247.51	–569.11	–0.0884884	–0.0224057
36	V$_{DD}$0	–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

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	$D_{GND}1$	–2247.51	707.45	–0.0884884	0.0278524
41	$D_{GND}0$	–2247.51	940.46	–0.0884884	0.0370260
42	$D_{OUT}2$	–2247.51	1405.47	–0.0884884	0.0553335
43	$D_{OUT}3$	–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)

Physical Specifications

Table 3:   Die Dimensions

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

MT9V011: 1/4-Inch VGA CMOS Image Sensor Die
Physical Specifications

Figure 3: **MT9V011 Die Orientation in Reconstructed Wafer**

276mm

276mm

Bond pad 1 orientation

762μm

7620μm

Singulated die size:
Width: 4,778μm ±25μm
Length: 4,978μm ±25μm

Reconstructed wafer street width : 762μm

Number of rows: 32
Number of columns: 32

Dicing tape: Adwill D-175

Film frame: Disco

Maximum total die count: 820

PDF: 09005aef81709f37/Source: 09005aef81709ef4
MT9V011_dds.fm - Rev. C; Pub. 9/07 EN

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Revision History

- Updated template
- Added singulated die size and die offset dimensions

- Applied new template
- Changed Responsivity from 2.0V/lux-sec to 1.9V/lux-sec on page 1
- Updated "Wafer Saw" on page 3
- Updated Figure 3 on page 11

- Initial release