1/5-Inch, 1.3-Megapixel CMOS Digital Image Sensor Die

MT9M019

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

Features

- Micron® DigitalClarity® CMOS imaging technology
- Low dark current
- Simple two-wire serial interface
- Auto black level calibration
- Support for external LED or xenon flash
- High frame rate preview mode with arbitrary downsize scaling from maximum resolution
- Programmable controls: gain, frame size/rate, exposure, left-right and top-bottom image reversal, window size and panning
- SMIA-compatible
- Data interface: CCP2 compliant sub-low-voltage differential signaling (sub-LVDS)
- On-die phase-lock loop (PLL) oscillator
- Bayer pattern downsize scaler
- Superior low-light performance

General Physical Specifications

- Die thickness: 200µm ±12µm
  Wafer thickness: 750µm ±25µm
  (Consult factory for die thickness other than 200µm)
- Backside die 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

Wafer: MT9M019W00STCC14BC1

Die: MT9M019D00STCC14BC1

Product#	Form	Temp	Chrom	Die database	Testing level

MT9M019D00STCC14BC1

Die Database C14B

- Die outline, see Figure 2 on page 7
- Die size (stepping interval):
  4,622.05µm x 4,661.75µm
- Singulated die size:
  4,580µm ±25µm x 4,620µm ±25µm
- Bond Pad Location and Identification Tables, see pages 5–6

Options

• Form	
– Die	D
– Wafer – 200mm (8in)	W
• Testing	
– Standard (level 1) probe	C1

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

Key Performance Parameters

- Optical format: 1/5-inch SXGA (5:4)
- Active imager size: 2.83mm(H) x 2.27mm(V), 3.63mm diagonal
- Active pixels: 1288H x 1032V
- Pixel size: 2.2µm x 2.2µm
- Color filter array: RGB Bayer pattern
- Chief ray angle: 24.77° at 85 percent image height
- Shutter type: electronic rolling shutter (ERS)
- Maximum data rate: 64 Mp/s at 64 MHz internal clock
- Frame rate
  – SXGA (1280H x 1024V) programmable up to 30 fps
  – VGA (640H x 480V) programmable up to 60 fps
- ADC resolution: 10-bit, on-die (61dB)
- Responsivity: 1.14V/Lux-sec at 550nm
- Dynamic range: 67.2dB
- SNR_{MAX}: 36dB
- Supply voltage
  – Analog: 2.40–3.10V (2.80V nominal)
  – Digital: 1.70–1.90V (1.80V nominal)
- Power consumption: 190mW (nominal)
- Operating temperature: –30°C to +70°C

General Description

The Micron Imaging MT9M019 die is a 1/5-inch SXGA-format CMOS active-pixel digital image sensor with a pixel array of 1280H x 1024V (1288H x 1032V including border pixels). It incorporates sophisticated on-die camera functions such as windowing, mirroring, column and row skip modes, and snapshot mode. It is programmable through a simple two-wire serial interface and has very low power consumption.

The MT9M019 digital image sensor 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.

When operated in its default mode, the sensor generates a SXGA image at 30 frames per second (fps). An on-die analog-to-digital converter (ADC) generates a 10-bit value for each pixel.

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

Bonding Instructions

The MT9M019 imager die has 31 bond pads. Refer to Tables 1 and 2 on pages 5 and 6 for a complete list of bond pads and coordinates.

The MT9M019 imager die does not require the user to determine bond option features.

The die also has several pads defined as "do not use." These pads are used for engineering purposes and should not be used. Bonding these pads could result in a nonfunctional die.

Figure 1 on page 4 shows the MT9M019 typical die connections. For low-noise operation the MT9M019 die requires separate supplies for analog and digital power. Both power supply rails should be decoupled to ground using ceramic capacitors. Use of inductance filters is not recommended.

All DGND pads must be tied together, as must all AGND pads, all VDD pads, and all VAA pads.

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 in a cleanroom environment for shipping. 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.

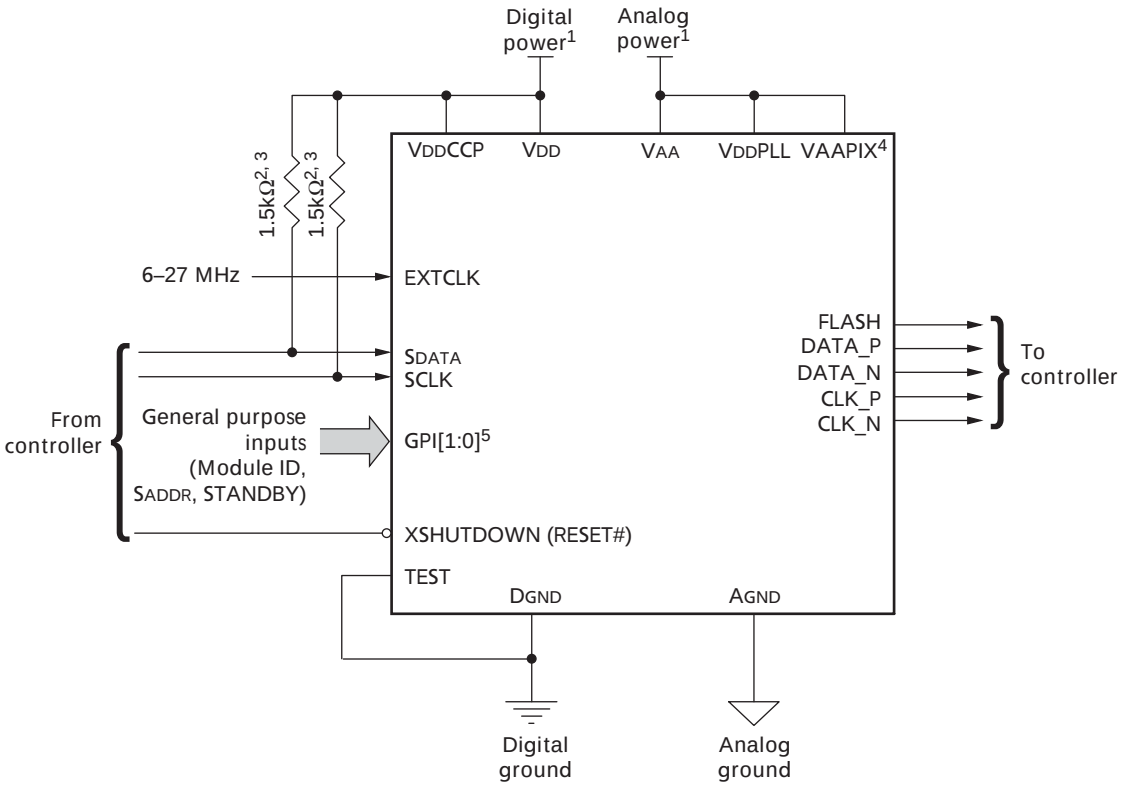
Product Reliability Monitors

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.

Operating Modes

By default, the MT9M019 powers up as a SMIA-compatible sensor with the serial pixel data interface enabled. A typical configuration in this mode is shown in Figure 1 on page 4.

Figure 1: Typical Configuration: Serial Pixel Data Interface



Notes:
1. All power supplies should be adequately decoupled.
2. A resistor value of 1.5kΩ is recommended, but may be greater for slower two-wire speed.
3. These pull-up resistors is not required if the controller drives a valid logic level on SCLK at all times.
4. VAA and VAAPIX must be tied together.
5. The GPI pins can either be statically pulled HIGH/LOW and used as module IDs, or they can be programmed to perform special functions (SADDR, STANDBY) and be dynamically controlled.

Bond Pad Location and Identification Tables

Table 1: MT9M019 Bond Pad Location From Center of Pad 1

Pad	MT9M019	"X"[1] Microns	"Y"[1] Microns	"X"[1] Inches	"Y"[1] Inches
1	DGND3	0.00	0.00	0.0000000	0.0000000
2	VDD2	150.48	0.00	0.0059244	0.0000000
3	RESET# (XSHUTDOWN)	303.90	0.00	0.0119644	0.0000000
4	SCLK	473.82	0.00	0.0186541	0.0000000
5	SDATA	683.12	0.00	0.0268945	0.0000000
6	GPI0[2]	871.15	0.00	0.0342970	0.0000000
7	FLASH	1086.32	0.00	0.0427685	0.0000000
8	TEST[3]	1274.35	0.00	0.0501711	0.0000000
9	GPI1[2]	1450.14	0.00	0.0570919	0.0000000
10	VAA4	2144.88	0.00	0.0844441	0.0000000
11	VAA3	2295.36	0.00	0.0903685	0.0000000
12	AGND4	2445.84	0.00	0.0962929	0.0000000
13	AGND3	2596.32	0.00	0.1022173	0.0000000
14	DNU[4]	2746.80	0.00	0.1081417	0.0000000
15	DNU	2897.28	0.00	0.1140661	0.0000000
16	VAAPIX2	3047.76	0.00	0.1199906	0.0000000
17	VAAPIX1	3198.24	0.00	0.1259150	0.0000000
18	AGND2	3198.24	–4338.53	0.1259150	–0.1708083
19	AGND1	3047.76	–4338.53	0.1199906	–0.1708083
20	VAA2	2897.28	–4338.53	0.1140661	–0.1708083
21	VAA1	2746.80	–4338.53	0.1081417	–0.1708083
22	VDDCCP	2291.76	–4338.53	0.0902268	–0.1708083
23	DGND2	2141.28	–4338.53	0.0843024	–0.1708083
24	CLK_N	1923.04	–4338.53	0.0757102	–0.1708083
25	CLK_P	1633.04	–4338.53	0.0642929	–0.1708083
26	DATA_N	1266.40	–4338.53	0.0498583	–0.1708083
27	DATA_P	976.40	–4338.53	0.0384409	–0.1708083
28	VDDPLL	613.44	–4338.53	0.0241512	–0.1708083
29	EXTCLK	–601.04	–4338.53	–0.0236630	–0.1708083
30	VDD1	–783.36	–4338.53	–0.0308409	–0.1708083
31	DGND1	–918.72	–4338.53	–0.0361701	–0.1708083

Notes:
1. Reference to center of each bond pad from center of bond pad 1.
2. The GPI pins can either be statically pulled HIGH/LOW and used as module IDs, or they can be programmed to perform special functions (TRIGGER, OE#, STANDBY) and be dynamically controlled.
3. Must be connected to DGND. Used for manufacturing tests only.
4. DNU = do not use. See "Bonding Instructions" on page 2.

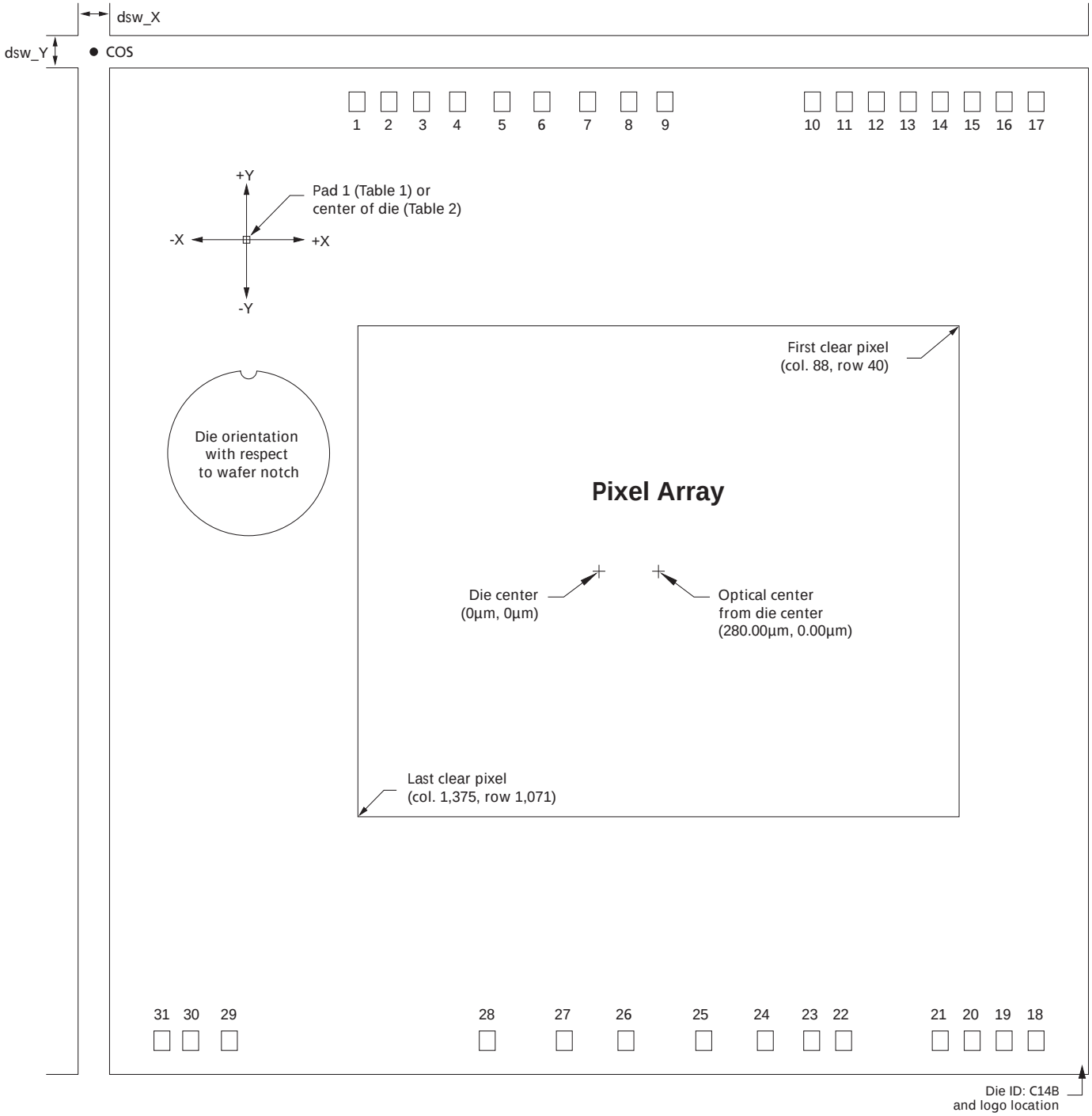
Table 2: MT9M019 Bond Pad Location From Center of Die (0, 0)

Pad	MT9M019	"X"[1] Microns	"Y"[1] Microns	"X"[1] Inches	"Y"[1] Inches
1	DGND3	–1139.76	2169.27	–0.0448724	0.0854041
2	VDD2	–989.28	2169.27	–0.0389480	0.0854041
3	RESET# (XSHUTDOWN)	–835.87	2169.27	–0.0329081	0.0854041
4	SCLK	–665.95	2169.27	–0.0262183	0.0854041
5	SDATA	–456.64	2169.27	–0.0179780	0.0854041
6	GPI0[2]	–268.62	2169.27	–0.0105754	0.0854041
7	FLASH	–53.44	2169.27	–0.0021039	0.0854041
8	TEST[3]	134.59	2169.27	0.0052986	0.0854041
9	GPI1[2]	310.38	2169.27	0.0122195	0.0854041
10	VAA4	1005.12	2169.27	0.0395717	0.0854041
11	VAA3	1155.60	2169.27	0.0454961	0.0854041
12	AGND4	1306.08	2169.27	0.0514205	0.0854041
13	AGND3	1456.56	2169.27	0.0573449	0.0854041
14	DNU[4]	1607.04	2169.27	0.0632693	0.0854041
15	DNU	1757.52	2169.27	0.0691937	0.0854041
16	VAAPIX2	1908.00	2169.27	0.0751181	0.0854041
17	VAAPIX1	2058.48	2169.27	0.0810425	0.0854041
18	AGND2	2058.48	–2169.27	0.0810425	–0.0854041
19	AGND1	1908.00	–2169.27	0.0751181	–0.0854041
20	VAA2	1757.52	–2169.27	0.0691937	–0.0854041
21	VAA1	1607.04	–2169.27	0.0632693	–0.0854041
22	VDDCCP	1152.00	–2169.27	0.0453543	–0.0854041
23	DGND2	1001.52	–2169.27	0.0394299	–0.0854041
24	CLK_N	783.28	–2169.27	0.0308378	–0.0854041
25	CLK_P	493.28	–2169.27	0.0194205	–0.0854041
26	DATA_N	126.64	–2169.27	0.0049858	–0.0854041
27	DATA_P	–163.36	–2169.27	–0.0064315	–0.0854041
28	VDDPLL	–526.32	–2169.27	–0.0207213	–0.0854041
29	EXTCLK	–1740.80	–2169.27	–0.0685354	–0.0854041
30	VDD1	–1923.12	–2169.27	–0.0757134	–0.0854041
31	DGND1	–2058.48	–2169.27	–0.0810425	–0.0854041

Notes:
1. Reference to center of each bond pad from center of die (0, 0).
2. The GPI pins can either be statically pulled HIGH/LOW and used as module IDs, or they can be programmed to perform special functions (TRIGGER, OE#, STANDBY) and be dynamically controlled.
3. Must be connected to DGND for proper device functionality.
4. DNU = do not use. See "Bonding Instructions" on page 2.

Die Features

Figure 2: Die Outline (Top View)



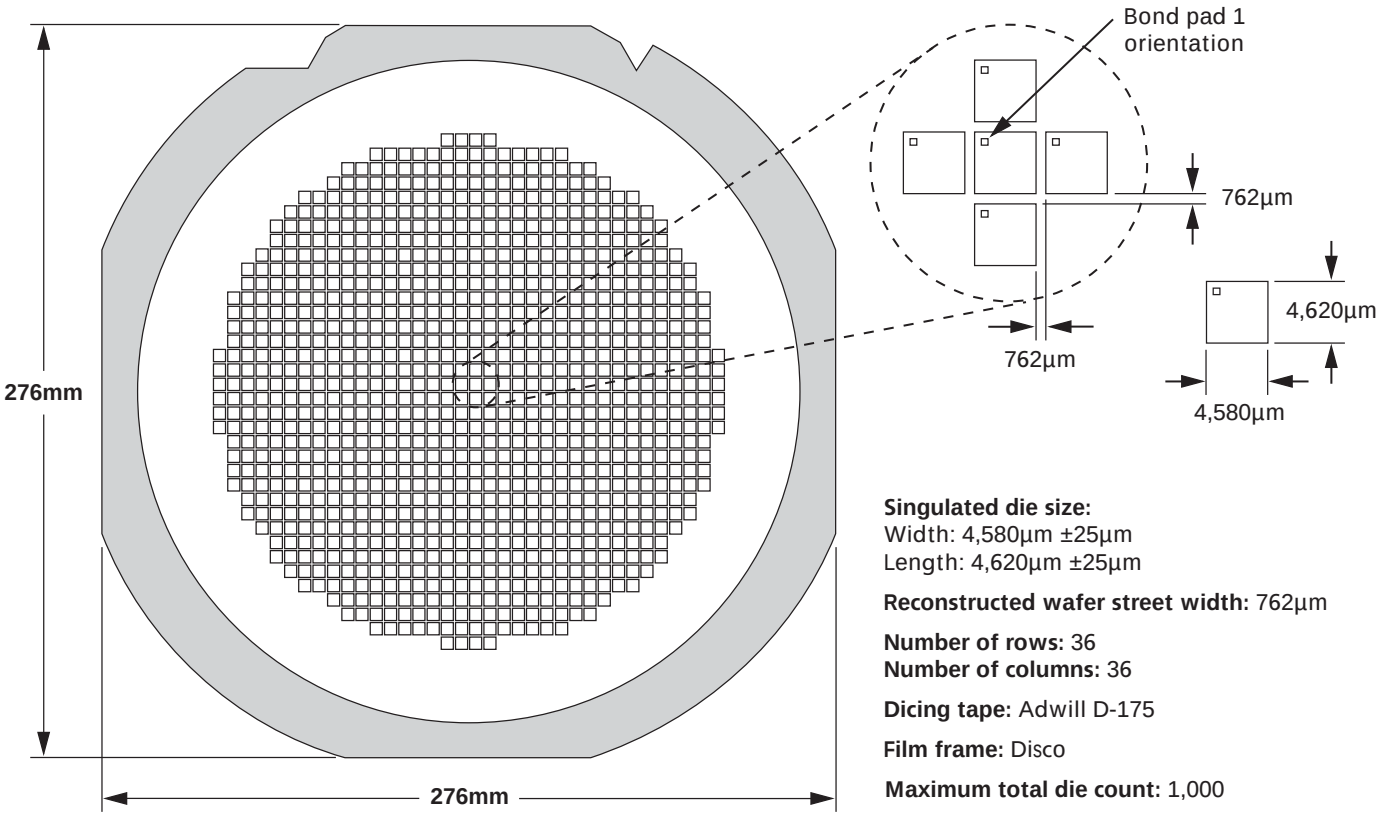
Notes: 1. Die street widths are not drawn to scale.

Physical Specifications

Table 3: Die Dimensions

Feature	Dimensions
Wafer diameter	200mm (8in)
Die thickness	200µm ±12µm
Wafer thickness	750µm ±50µm
Singulated die size *Width:* *Length:*	 4,580µm ±25µm 4,620µm ±25µm
Die size (stepping interval)	4,622.05µm x 4,661.75µm (181.9705 mil x 183.5335 mil)
Street width along X-axis (dsw_X)	102µm (4.02 mil)
Street width along Y-axis (dsw_Y)	102µm (4.02 mil)
Center of streets (COS) (relative to center of bond pad 1)	X = –1,171.27µm, Y = 161.61µm (X = 46.1128 mil, Y = 6.3626 mil)
Bond pad size (MIN)	85µm x 100µm (3.35 mil x 3.94 mil)
Passivation openings (MIN)	75µm x 90µm (2.95 mil x 3.54 mil)
Minimum bond pad pitch	135.36µm (5.329 mil)
Optical center *Optical center from die center:* *Optical center from center of pad 1:*	 X = 280.00µm, Y = 0.00µm X = 1,419.76µm, Y = –2,169.27µm
First clear pixel (col. 88, row 40) *From die center:* *From center of pad 1:*	 X = 1,695.90µm, Y = 1,133.95µm X = 2,835.66µm, Y = –1,035.32µm
Last clear pixel (col. 1,375, row 1,071) *From die center:* *From center of pad 1:*	 X = –1,135.51µm, Y = –1,134.25µm X = 4.26µm, Y = –3,303.52µm
Die offset *From center of wafer to center of die (wafer notch at bottom):*	 X = –3.02225 µm, Y = –1.54700µm

Figure 3: MT9M019 Die Orientation in Reconstructed Wafer



Singulated die size:
Width: 4,580µm ±25µm
Length: 4,620µm ±25µm

Reconstructed wafer street width: 762µm

Number of rows: 36
Number of columns: 36

Dicing tape: Adwill D-175

Film frame: Disco

Maximum total die count: 1,000

8000 S. Federal Way, P.O. Box 6, Boise, ID 83707-0006, Tel: 208-368-3900
prodmktg@micron.com www.micron.com Customer Comment Line: 800-932-4992

Revision History

Rev. B 6/07

- Updated part number.
- Added DigitalClarity to trademarks.

Rev. A 10/06

- Initial release.