MT9M001-MONO-DIE

1/2-Inch Megapixel CMOS Active-Pixel Digital Image Sensor Die

ON Semiconductor's Imaging MT9M001 die is an SXGA-format 1/2-inch CMOS active-pixel digital image sensor with an active imaging pixel array of 1280 (H) × 1024 (V). It incorporates sophisticated on-die camera functions, such as windowing, column and row skip modes, and snapshot mode. It is programmable through a simple two-wire serial interface.

The MT9M001 digital image sensor die features ON Semiconductor'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 an SXGA-size image at 30 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.

Features

- CMOS Imaging Technology
- Array Format (5:4):
  - 1280 (H) × 1024 (V) (1,310,720 Active Pixels)
  - Total (Including Dark Pixels): 1312 (H) × 1048 (V) (1,374,976 Pixels)
- Frame Rate: 30 fps Progressive Scan, Programmable
- Shutter: Electronic Rolling Shutter (ERS)
- Window Size: SXGA; Programmable to Any Smaller Format (VGA, QVGA, CIF, QCIF, etc.)
- Programmable Controls: Gain, Frame Rate, Frame Size

Applications

- Digital Still Cameras
- Digital Video Cameras
- PC Cameras

General Physical Specifications

- Die Thickness: 200 μm ±12 μm (*Consult Factory for Other Die Thickness)*
- Backside Wafer Surface of Bare Silicon
- Typical Metal 1 Thickness: 3.1 kÅ
- Typical Metal 2 Thickness: 3.1 kÅ
- Typical Metal 3 Thickness: 6.1 kÅ
- Metallization Composition: 99.5% Al and 0.5% Cu over Ti
- Typical Topside Passivation: 2.2 kÅ Nitride over 6.0 kÅ of Undoped Oxide
- Passivation Openings (MIN): 75 × 90 μm

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Options	Designator
Form − Die	D
Testing − Standard (Level 1) Probe	C1

ORDERING INFORMATION

Die
MT9M001D00STMC84AC1−200

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

Die Database

- Die Outline (see Figure 2)
- Die Size (Stepping Interval): 7,863.80 μm × 7,863.60 μm
- Singulated Die Size: 7,821 μm ±25 μm × 7,821 μm ±25 μm
- Bond Pad Location and Identification Tables (see Tables 1 and 2)

Key Performance Parameters

- Optical Format: 1/2-inch (5:4)
- Active Imager Size: 8.52 mm Diagonal, 6.66 mm (H) × 5.32 mm (V)
- Active Pixels: 1,280 (H) × 1,024 (V)
- Pixel Size: 5.2 μm × 5.2 μm
- Shutter Type: Electronic Rolling Shutter (ERS)
- Maximum Data Rate/Master Clock: 48 Mp/S at 48 MHz
- Frame Rate: SXGA (1280 (H) × 1024(V)), 30 fps Progressive Scan; Programmable
- ADC Resolution: 10-bit, On-die
- Responsivity: 2.1 V/lux−sec
- Dynamic Range: 68.2 dB
- SNR_{MAX}: 45 dB
- Supply Voltage
  - Analog 3.6–3.0 V (3.3 V Nominal)
  - Digital 3.6–3.0 V (3.3 V Nominal)
- Power Consumption:
  - 363 mW at 3.3 V
  - Standby 294 μW
- Operating Temperature: 0°C to +70°C

Die Testing Procedures

ON Semiconductor 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 ON Semiconductor's standard package. Because the package environment is not within ON Semiconductor'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.

ON Semiconductor 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. ON Semiconductor 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 ON Semiconductor'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 our web site (www.onsemi.com).

Bonding Instructions

The MT9M001 imager die has 71 bond pads. Refer to Table 1 and Table 2 for a complete list of bond pads and coordinates.

The MT9M001 imager die does not require the user to determine bond option features.

The MT9M001 imager die also has several pads defined as "do not use." These pads are reserved for engineering purposes and should not be used. Bonding these pads could result in a nonfunctional die.

For low-noise operation, the MT9M001 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

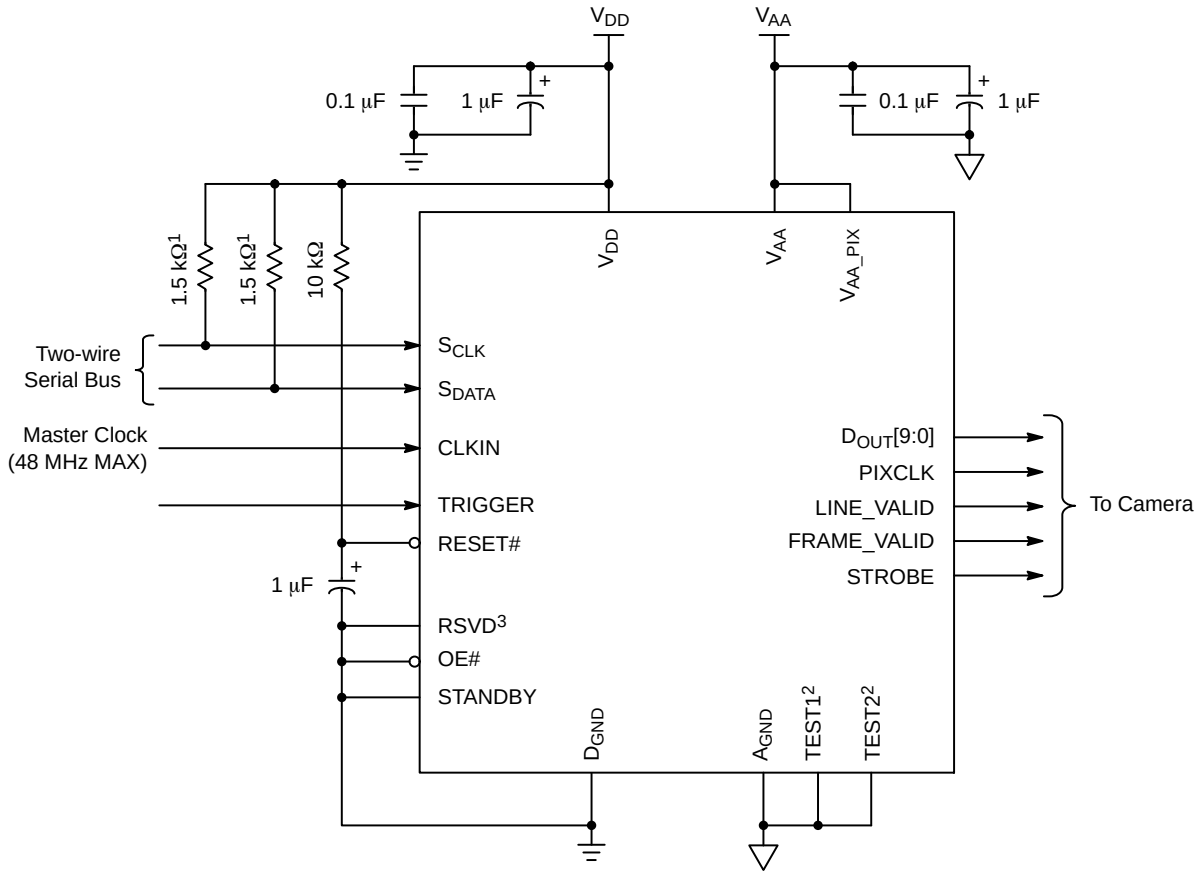
ON Semiconductor die products are packaged for shipping in a clean room environment. Upon receipt, the customer should transfer the die or wafers to a similar environment for storage. ON Semiconductor recommends the die or wafers be maintained in a filtered nitrogen atmosphere until removed for assembly. The moisture content of the storage facility should be maintained at 30% relative humidity ±10%. 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. ON Semiconductor'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.

Output Mode

Figure 1 shows typical configuration schematics for the MT9M001.



Notes:
1. A resistor value of 1.5 kΩ is recommended, but may be greater for slower two-wire speed.
2. TEST1 and TEST2 pads must be tied to A_{GND} for normal device operation.
3. The RSVD pad must be tied to D_{GND} for normal device operation.
4. All power supplies must be used.

Figure 1. Typical Configuration (Connection)

Bond Pad Location and Identification Tables

Table 1. BOND PAD LOCATION AND IDENTIFICATION FROM CENTER OF PAD 1

Pad Number	MT9M001	“X” Microns (Note 1)	“Y” Microns (Note 1)	“X” Inches (Note 1)	“Y” Inches (Note 1)
1	DNU (Note 2)	0.00	0.00	0.0000000	0.0000000
2	DGND1	277.98	0.00	0.0109441	0.0000000
3	DGND2	510.99	0.00	0.0201177	0.0000000
4	DGND3	744.00	0.00	0.0292913	0.0000000
5	VDD1	1077.01	0.00	0.0424020	0.0000000
6	VDD2	1310.02	0.00	0.0515756	0.0000000
7	VDD3	1543.03	0.00	0.0607492	0.0000000
8	DNU	1896.04	0.00	0.0746472	0.0000000
9	DNU	2139.96	0.00	0.0842504	0.0000000
10	VAAPIX1	2645.98	0.00	0.1041724	0.0000000
11	VAAPIX2	2878.99	0.00	0.1133461	0.0000000
12	VAAPIX3	3112.00	0.00	0.1225197	0.0000000
13	AGND1	3477.98	0.00	0.1369283	0.0000000
14	AGND2	3710.99	0.00	0.1461020	0.0000000
15	AGND3	3944.00	0.00	0.1552756	0.0000000
16	TEST1 (Note 3)	4290.08	0.00	0.1689008	0.0000000
17	SCLK	4910.99	0.00	0.1933461	0.0000000
18	SDATA	5510.99	0.00	0.2169681	0.0000000
19	DNU	6110.99	0.00	0.2405902	0.0000000
20	RSVD (Note 4)	6710.99	0.00	0.2642122	0.0000000
21	DNU	7083.65	–469.56	0.2788837	–0.0184864
22	FRAME_VALID	7083.65	–1069.56	0.2788837	–0.0421085
23	LINE_VALID	7083.65	–1669.56	0.2788837	–0.0657305
24	STROBE	7083.65	–2269.56	0.2788837	–0.0893526
25	DGND4	7083.65	–2607.52	0.2788837	–0.1026581
26	DGND5	7083.65	–2840.53	0.2788837	–0.1118317
27	DGND6	7083.65	–3073.54	0.2788837	–0.1210053
28	VDD4	7083.65	–3306.55	0.2788837	–0.1301789
29	VDD5	7083.65	–3539.56	0.2788837	–0.1393526
30	VDD6	7083.65	–3772.57	0.2788837	–0.1485262
31	DOUT9	7083.65	–4139.56	0.2788837	–0.1629746
32	DOUT8	7083.65	–4739.56	0.2788837	–0.1865967
33	DOUT7	7083.65	–5339.56	0.2788837	–0.2102187
34	DOUT6	7083.65	–5939.56	0.2788837	–0.2338407
35	DOUT5	7083.65	–6539.56	0.2788837	–0.2574628
36	PIXCLK	7083.65	–7139.56	0.2788837	–0.2810848
37	DNU	6584.09	–7432.21	0.2592161	–0.2926067
38	CLKIN	6024.09	–7432.21	0.2371689	–0.2926067
39	DOUT4	5424.09	–7432.21	0.2135469	–0.2926067
40	DOUT3	4914.09	–7432.21	0.1934681	–0.2926067
41	DOUT2	4424.09	–7432.21	0.1741768	–0.2926067
42	DOUT1	3924.09	–7432.21	0.1544917	–0.2926067
43	DOUT0	3374.09	–7432.21	0.1328382	–0.2926067

Table 1. BOND PAD LOCATION AND IDENTIFICATION FROM CENTER OF PAD 1 (continued)

Pad Number	MT9M001	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
44	DGND7	3020.05	–7432.21	0.1188996	–0.2926067
45	DGND8	2787.04	–7432.21	0.1097260	–0.2926067
46	DGND9	2554.03	–7432.21	0.1005524	–0.2926067
47	VDD7	2300.11	–7432.21	0.0905555	–0.2926067
48	VDD8	2067.10	–7432.21	0.0813819	–0.2926067
49	VDD9	1834.09	–7432.21	0.0722083	–0.2926067
50	AGND4	1271.82	–7432.21	0.0500717	–0.2926067
51	AGND5	1038.81	–7432.21	0.0408980	–0.2926067
52	VAA1	805.80	–7432.21	0.0317244	–0.2926067
53	VAA2	551.88	–7432.21	0.0217276	–0.2926067
54	VAA3	318.87	–7432.21	0.0125539	–0.2926067
55	DNU	12.84	–7432.21	0.0005055	–0.2926067
56	AGND6	–323.57	–7059.66	–0.0127388	–0.2779392
57	AGND7	–323.57	–6826.65	–0.0127388	–0.2687656
58	AGND8	–323.57	–6593.64	–0.0127388	–0.2595919
59	AGND9	–323.57	–6360.63	–0.0127388	–0.2504183
60	VAA4	–323.57	–6088.67	–0.0127388	–0.2397112
61	VAA5	–323.57	–5855.66	–0.0127388	–0.2305376
62	VAA6	–323.57	–5622.65	–0.0127388	–0.2213640
63	TEST23	–323.57	–5286.69	–0.0127388	–0.2081372
64	DNU	–323.57	–4547.66	–0.0127388	–0.1790415
65	OE#	–323.57	–3947.66	–0.0127388	–0.1554195
66	DNU	–323.57	–3347.66	–0.0127388	–0.1317974
67	DNU	–323.57	–2747.66	–0.0127388	–0.1081754
68	RESET#	–323.57	–2147.66	–0.0127388	–0.0845533
69	DNU	–323.57	–1547.66	–0.0127388	–0.0609313
70	TRIGGER	–323.57	–947.66	–0.0127388	–0.0373093
71	STANDBY	–323.57	–397.66	–0.0127388	–0.0156557

1. Reference to center of each bond pad from center of bond pad 1.
2. DNU = "do not use". See "Bonding Instructions".
3. TEST1 and TEST2 pads must be tied to A_{GND} for normal device operation.
4. The RSVD pad must be tied to D_{GND} for normal device operation.

Table 2. BOND PAD LOCATION AND IDENTIFICATION FROM CENTER OF DIE (0,0)

Pad Number	MT9J003	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
1	DNU (Note 2)	–3380.04	3716.11	–0.1330724	0.1463033
2	DGND1	–3102.06	3716.11	–0.1221283	0.1463033
3	DGND2	–2869.05	3716.11	–0.1129547	0.1463033
4	DGND3	–2636.04	3716.11	–0.1037811	0.1463033
5	VDD1	–2303.03	3716.11	–0.0906705	0.1463033
6	VDD2	–2070.02	3716.11	–0.0814969	0.1463033
7	VDD3	–1837.01	3716.11	–0.0723232	0.1463033
8	DNU	–1484.00	3716.11	–0.0584252	0.1463033
9	DNU	–1240.08	3716.11	–0.0488220	0.1463033
10	VAAPIX1	–734.06	3716.11	–0.0289000	0.1463033
11	VAAPIX2	–501.05	3716.11	–0.0197264	0.1463033
12	VAAPIX3	–268.04	3716.11	–0.0105528	0.1463033
13	AGND1	97.94	3716.11	0.0038559	0.1463033
14	AGND2	330.95	3716.11	0.0130295	0.1463033
15	AGND3	563.96	3716.11	0.0222031	0.1463033
16	TEST1 (Note 3)	910.04	3716.11	0.0358283	0.1463033
17	SCLK	1530.95	3716.11	0.0602736	0.1463033
18	SDATA	2130.95	3716.11	0.0838957	0.1463033
19	DNU	2730.95	3716.11	0.1075177	0.1463033
20	RSVD (Note 4)	3330.95	3716.11	0.1311398	0.1463033
21	DNU	3703.61	3246.55	0.1458112	0.1278169
22	FRAME_VALID	3703.61	2646.55	0.1458112	0.1041949
23	LINE_VALID	3703.61	2046.55	0.1458112	0.0805728
24	STROBE	3703.61	1446.55	0.1458112	0.0569508
25	DGND4	3703.61	1108.59	0.1458112	0.0436453
26	DGND5	3703.61	875.58	0.1458112	0.0344717
27	DGND6	3703.61	642.57	0.1458112	0.0252980
28	VDD4	3703.61	409.56	0.1458112	0.0161244
29	VDD5	3703.61	176.55	0.1458112	0.0069508
30	VDD6	3703.61	–56.46	0.1458112	–0.0022228
31	DOUT9	3703.61	–423.45	0.1458112	–0.0166713
32	DOUT8	3703.61	–1023.45	0.1458112	–0.0402933
33	DOUT7	3703.61	–1623.45	0.1458112	–0.0639154
34	DOUT6	3703.61	–2223.45	0.1458112	–0.0875374
35	DOUT5	3703.61	–2823.45	0.1458112	–0.1111594
36	PIXCLK	3703.61	–3423.45	0.1458112	–0.1347815
37	DNU	3204.05	–3716.11	0.1261437	–0.1463033
38	CLKIN	2644.05	–3716.11	0.1040965	–0.1463033
39	DOUT4	2044.05	–3716.11	0.0804744	–0.1463033
40	DOUT3	1534.05	–3716.11	0.0603957	–0.1463033
41	DOUT2	1044.05	–3716.11	0.0411043	–0.1463033
42	DOUT1	544.05	–3716.11	0.0214193	–0.1463033
43	DOUT0	–5.95	–3716.11	–0.0002343	–0.1463033
44	DGND7	–359.99	–3716.11	–0.0141728	–0.1463033

Table 2. BOND PAD LOCATION AND IDENTIFICATION FROM CENTER OF DIE (0,0) (continued)

Pad Number	MT9J003	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
45	DGND8	–593.00	–3716.11	–0.0233465	–0.1463033
46	DGND9	–826.01	–3716.11	–0.0325201	–0.1463033
47	VDD7	–1079.93	–3716.11	–0.0425169	–0.1463033
48	VDD8	–1312.94	–3716.11	–0.0516906	–0.1463033
49	VDD9	–1545.95	–3716.11	–0.0608642	–0.1463033
50	AGND4	–2108.22	–3716.11	–0.0830008	–0.1463033
51	AGND5	–2341.23	–3716.11	–0.0921744	–0.1463033
52	VAA1	–2574.24	–3716.11	–0.1013480	–0.1463033
53	VAA2	–2828.16	–3716.11	–0.1113449	–0.1463033
54	VAA3	–3061.17	–3716.11	–0.1205185	–0.1463033
55	DNU	–3367.20	–3716.11	–0.1325669	–0.1463033
56	AGND6	–3703.61	–3343.55	–0.1458112	–0.1316358
57	AGND7	–3703.61	–3110.54	–0.1458112	–0.1224622
58	AGND8	–3703.61	–2877.53	–0.1458112	–0.1132886
59	AGND9	–3703.61	–2644.52	–0.1458112	–0.1041150
60	VAA4	–3703.61	–2372.56	–0.1458112	–0.0934079
61	VAA5	–3703.61	–2139.55	–0.1458112	–0.0842343
62	VAA6	–3703.61	–1906.54	–0.1458112	–0.0750606
63	TEST23	–3703.61	–1570.58	–0.1458112	–0.0618339
64	DNU	–3703.61	–831.55	–0.1458112	–0.0327382
65	OE#	–3703.61	–231.55	–0.1458112	–0.0091161
66	DNU	–3703.61	368.45	–0.1458112	0.0145059
67	DNU	–3703.61	968.45	–0.1458112	0.0381280
68	RESET#	–3703.61	1568.45	–0.1458112	0.0617500
69	DNU	–3703.61	2168.45	–0.1458112	0.0853720
70	TRIGGER	–3703.61	2768.45	–0.1458112	0.1089941
71	STANDBY	–3703.61	3318.45	–0.1458112	0.1306476

1. Reference to center of each bond pad from center of die (0,0).
2. DNU = "do not use". See "Bonding Instructions".
3. TEST1 and TEST2 pads must be tied to A_{GND} for normal device operation.
4. The RSVD pad must be tied to D_{GND} for normal device operation.

Die Features

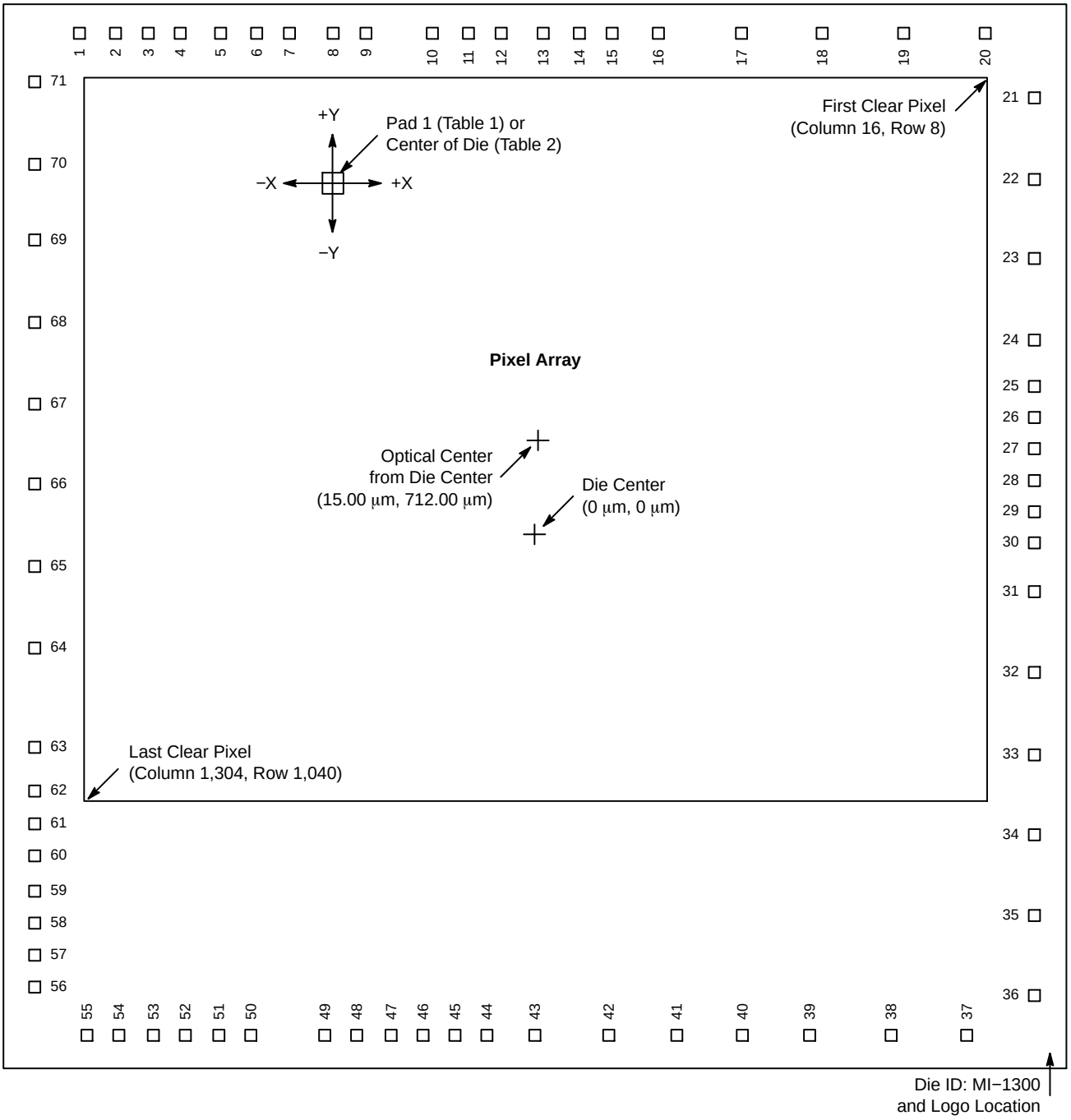


Figure 2. Die Outline (Top View)

Physical Specifications

Table 3. PHYSICAL DIMENSIONS

Feature	Dimensions
Wafer Diameter	200 mm (8″)
Die Thickness	200 μm ±12 μm
Singulated Die Size Width Length	 7,821 μm ±25 μm 7,821 μm ±25 μm
Bond Pad Size (MIN)	85 μm × 100 μm (3.35 mil × 3.94 mil)
Passivation Openings (MIN)	75 μm × 90 μm (2.95 mil × 3.54 mil)
Minimum Bond Pad Pitch	233 μm (9.17 mil)
Optical Array Offset Optical Center from Die Center Optical Center from Center of Pad 1	 X = 15.00 μm, Y = 712.00 μm X = 3,395.04 μm, Y = –3,004.11 μm
First Clear Pixel (Column 16, Row 8) From Die Center From Center of Pad 1	 X = 3,361.60 μm, Y = 3,380.60 μm X = 6,741.64 μm, Y = –327.51 μm
Last Clear Pixel (Column 1,304, Row 1,040) From Die Center From Center of Pad 1	 X = –3,336.00 μm, Y = –1,977.80 μm X = 44.04 μm, Y = –5,693.91 μm

Die Orientation in Reconstructed Wafer

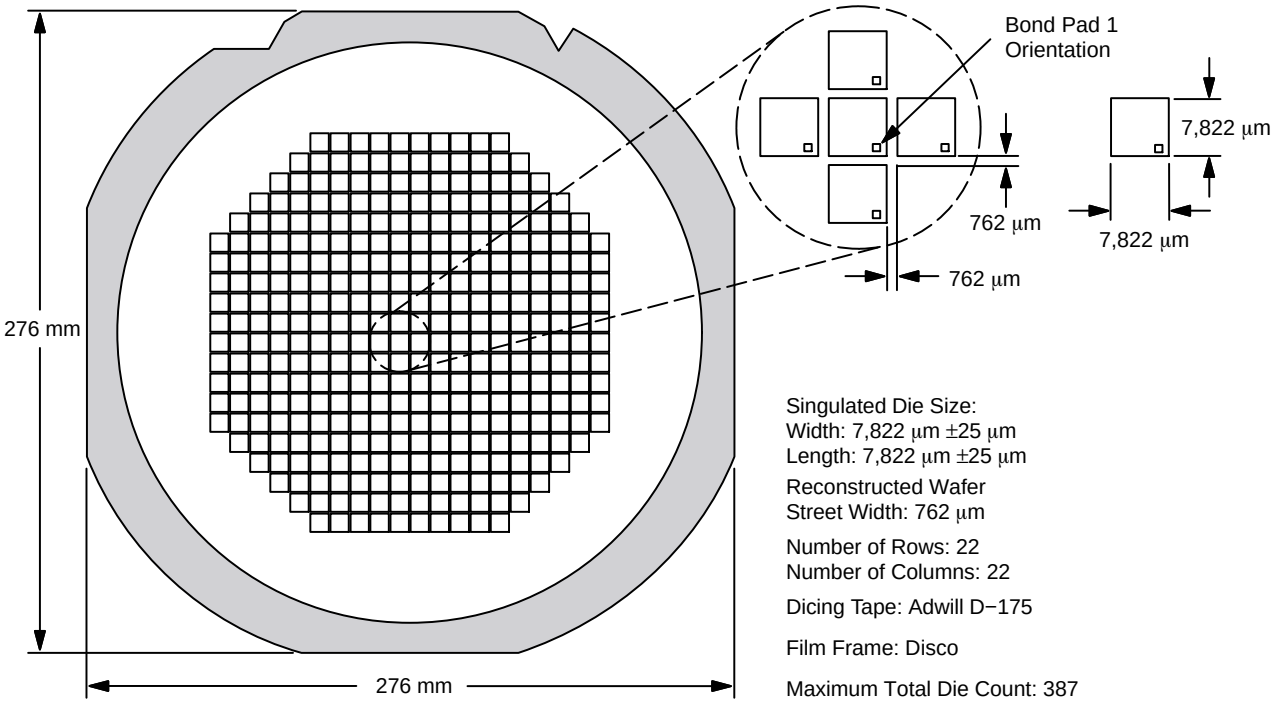


Figure 3. MT9M001 Die Orientation in Reconstructed Wafer

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

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For additional information, please contact your local Sales Representative