MT9M131-DIE

1/3-Inch 1.3 Megapixel SOC Digital Image Sensor Die

The MT9M131 die from ON Semiconductor is an SXGA-format single-chip camera with a one-third-inch CMOS active-pixel digital image sensor. This device combines the MT9M011 image sensor core with fourth-generation digital-image-flow processor technology from ON Semiconductor. It captures high-quality color images at SXGA resolution.

The MT9M131 die features DigitalClarity® − 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 is a complete camera-on-a-chip solution designed specifically to meet the demands of surveillance cameras. It incorporates sophisticated camera functions on-die and is programmable through a simple two-wire serial interface.

The MT9M131 die performs sophisticated processing functions including color recovery, color correction, sharpening, programmable gamma correction, auto black reference clamping, auto exposure (AE), automatic 50 Hz/60 Hz flicker avoidance, lens-shading correction, auto white balance (AWB), and on-the-fly defect identification and correction. Additional features include day/night mode configurations; special camera effects, such as sepia tone and solarization; and interpolation to arbitrary image size with continuous filtered zoom and pan. The device supports both xenon and LED flash light sources in several snapshot modes.

The MT9M131 die can be programmed to output progressive-scan images up to 30 frames per second (fps) in preview power-saving mode, and 15 fps in full-resolution (SXGA) mode. In either mode, the image data can be output in any one of six 8-bit formats:

- Progressive ITU−R BT.656
  (Formerly CCIR656, Progressive Scan Only) YcbCr
- 565RGB
- 555RGB
- 444RGB
- Raw Bayer
- "Processed" Bayer

The FRAME_VALID and LINE_VALID signals are output on dedicated pins, along with a pixel clock that is synchronous with valid data.

Features

- DigitalClarity CMOS Imaging Technology
- System-on-a-chip (SOC) − Completely Integrated Camera System
- Ultra Low-power, Low-cost, Progressive-scan CMOS Image Sensor

ON Semiconductor®

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

ORDERING INFORMATION

Die
MT9M131D00STCK14LC1

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

Features (Continued)

- On-die Image Flow Processor (IFP) Performs Sophisticated Processing: Color Recovery and Correction, Sharpening, Gamma, Lens Shading Correction, and On-the-fly Defect Correction
- Filtered Image Downscaling to Arbitrary Size with Smooth, Continuous Zoom and Pan
- Automatic Features: Auto Exposure, White Balance (AWB), Black Reference (ABR), Flicker Avoidance, Color Saturation, and Defect Identification and Correction
- Fully Automatic Xenon and LED Flash Support, Including Fast Exposure Adaptation
- Multiple Parameter Contexts for Easy/Fast Mode Switching
- Camera Control Sequencer that Automates Snapshots, Snapshots with Flash, and Video Clips
- Simple Two-wire Serial Programming Interface
- Progressive ITU−R BT.656 (YCbCr), 565RGB, 555RGB, or 444RGB
- Output FIFO and Integer Clock Divider: "Uniform" Pixel Clocking

General Physical Specifications

- Die Thickness: 305 μm ±12 μm (12.0 mil ±0.5 mil) (*Consult Factory for Die Thickness Other than 305 μm)*
- Backside Die 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

Die Database

- Die Outline (see Figure 2)
- Singulated Die Size: 7,440 μm ±25 μm × 7,328 μm ±25 μm
- Bond Pad Location and Identification Tables (see Tables 1 and 2)

Key Performance Parameters

- Optical Format: 1/3-inch (5:4)
- Active Imager Size: 4.61 mm (H) × 3.69 mm (V), 5.90 mm Diagonal
- Active Pixels: 1,280 (H) × 1,024 (V)
- Pixel Size: 3.6 μm × 3.6 μm
- Color Filter Array: RGB Bayer Pattern
- Shutter Type: Electronic Rolling Shutter (ERS)
- Maximum Data Rate/Maximum Master Clock:
  - 27 Mp/s at 54 MHz
- Frame Rate:
  - SXGA (1,280 (H) × 1,024 (V)) 15 fps at 54 MHz
  - QSXGA (640 (H) × 512 (V)) 30 fps at 54 MHz
- ADC Resolution: 10-bit, Dual On-die
- Responsivity: 1.0 V/lux−sec (550 nm)
- Dynamic Range: 71 dB
- SNR_{MAX}: 44 dB
- Supply Voltage:
  - I/O Digital: 1.7–3.1 V
  - Core Digital: 2.5–3.1 V (2.8 V Nominal)
  - Analog: 2.5–3.1 V (2.8 V Nominal)
- Power Consumption:
  - 170 mW SXGA at 15 fps (54 MHz CLKIN)
  - 90 mW QSXGA at 30 fps (54 MHz Low-power Mode)
- Operating Temperature, T_A: –30°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 test 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 analog-to-digital converter (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 MT9M131 imager die has 51 bond pads. Refer to Tables 1 and 2 for a complete list of bond pads and coordinates.

The MT9M131 imager die does not require the user to determine bond option features.

The MT9M131 imager 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.

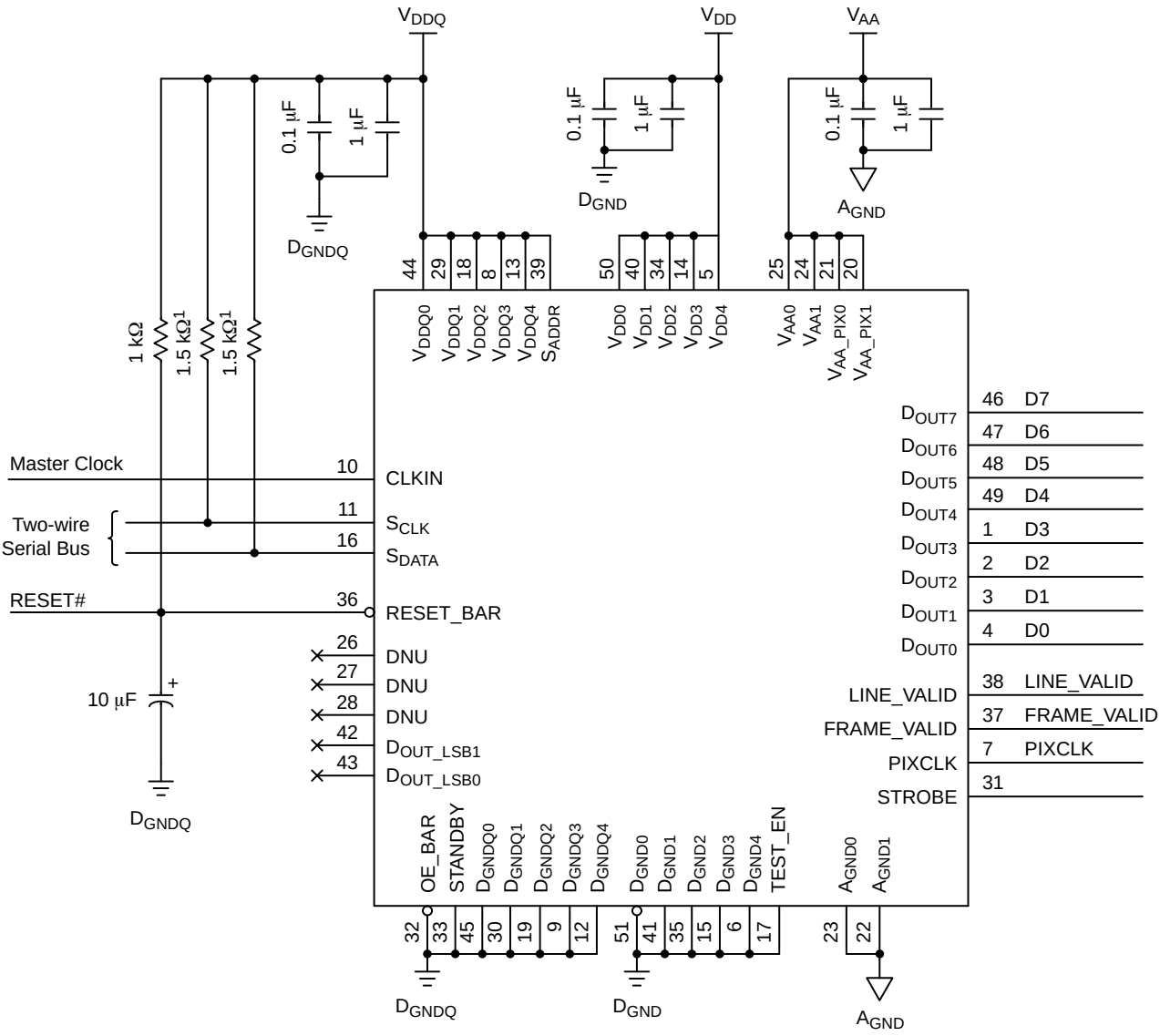
Figure 1 shows the MT9M131 typical die connections. For low-noise operation, the MT9M131 die requires separate supplies for analog and digital power. Incoming digital and analog ground conductors can be tied together right next to the die. Both power supply rails should be decoupled to ground using ceramic capacitors. The use of inductance filters is not recommended.

The MT9M131 imager die also supports different digital core (V_{DD}/D_{GND}) and I/O power (V_{DDQ}/D_{GNDQ}) power domains that can be at different voltages.

Storage Requirements

ON Semiconductor die products are packaged for shipping in a clean room environment. Upon receipt, the customer should transfer the die to a similar environment for storage. ON Semiconductor 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% 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.

Typical Connection



Notes:

1. A 1.5 kΩ resistor value is recommended, but may be greater for slower two-wire speed.
2. V_{DD}, V_{AA}, and V_{AA_PIX} must all be at the same potential; though if connected, care must be taken to avoid excessive noise injection into the V_{AA}/V_{AA_PIX} power domains.

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	Name	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
1	DOUT3	0.00	0.00	0.0000000	0.0000000
2	DOUT2	466.56	0.00	0.0183685	0.0000000
3	DOUT1	933.12	0.00	0.0367370	0.0000000
4	DOUT0	1399.68	0.00	0.0551055	0.0000000
5	VDD4	2099.52	0.00	0.0826583	0.0000000
6	DGND4	2566.08	0.00	0.1010268	0.0000000
7	PIXCLK	3265.92	0.00	0.1285795	0.0000000
8	VDDQ3	3965.76	0.00	0.1561323	0.0000000
9	DGNDQ3	4432.32	0.00	0.1745008	0.0000000
10	CLKIN	5132.16	0.00	0.2020535	0.0000000
11	SCLK	5598.72	0.00	0.2204220	0.0000000
12	DGNDQ4	6065.28	0.00	0.2387906	0.0000000
13	VDDQ4	6707.19	–715.45	0.2640624	–0.0281671
14	VDD3	6707.19	–1182.01	0.2640624	–0.0465356
15	DGND3	6707.19	–1648.57	0.2640624	–0.0649041
16	SDATA	6707.19	–2115.13	0.2640624	–0.0832726
17	TEST_EN	6707.19	–2581.69	0.2640624	–0.1016411
18	VDDQ2	6707.19	–3048.25	0.2640624	–0.1200096
19	DGNDQ2	6707.19	–3514.81	0.2640624	–0.1383781
20	VAA_PIX 1	6707.19	–4082.17	0.2640624	–0.1607152
21	VAA_PIX 0	6707.19	–4548.73	0.2640624	–0.1790837
22	AGND1	6707.19	–5283.13	0.2640624	–0.2079970
23	AGND0	6707.19	–5749.69	0.2640624	–0.2263656
24	VAA1	6707.19	–6216.25	0.2640624	–0.2447341
25	VAA0	6707.19	–6682.81	0.2640624	–0.2631026
26	DNU (Note 2)	5948.40	–7019.11	0.2341890	–0.2763429
27	DNU	5481.84	–7019.11	0.2158205	–0.2763429
28	DNU	5015.28	–7019.11	0.1974520	–0.2763429
29	VDDQ1	4344.80	–7019.11	0.1710551	–0.2763429
30	DGNDQ1	3878.24	–7019.11	0.1526866	–0.2763429
31	STROBE	3178.40	–7019.11	0.1251339	–0.2763429
32	OE_BAR	2711.84	–7019.11	0.1067654	–0.2763429
33	STANDBY	2245.28	–7019.11	0.0883969	–0.2763429
34	VDD2	1778.72	–7019.11	0.0700283	–0.2763429
35	DGND2	1312.16	–7019.11	0.0516598	–0.2763429
36	RESET_BAR	845.60	–7019.11	0.0332913	–0.2763429
37	FRAME_VALID	379.04	–7019.11	0.0149228	–0.2763429
38	LINE_VALID	–87.52	–7019.11	–0.0034457	–0.2763429
39	SADDR	–423.83	–6595.29	–0.0166860	–0.2596569
40	VDD1	–423.83	–6128.73	–0.0166860	–0.2412884
41	DGND1	–423.83	–5662.17	–0.0166860	–0.2229199
42	DOUT_LSB1	–423.83	–5195.61	–0.0166860	–0.2045514
43	DOUT_LSB0	–423.83	–4729.05	–0.0166860	–0.1861829

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

Pad Number	Name	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
44	VDDQ0	–423.83	–4029.21	–0.0166860	–0.1586301
45	DGNDQ0	–423.83	–3562.65	–0.0166860	–0.1402616
46	DOUT7	–423.83	–2862.81	–0.0166860	–0.1127089
47	DOUT6	–423.83	–2396.25	–0.0166860	–0.0943404
48	DOUT5	–423.83	–1929.69	–0.0166860	–0.0759719
49	DOUT4	–423.83	–1463.13	–0.0166860	–0.0576033
50	VDD0	–423.83	–996.57	–0.0166860	–0.0392348
51	DGND0	–423.83	–530.01	–0.0166860	–0.0208663

1. Reference to center of each bond pad from center of bond pad 1.
2. DNU = "do not use".

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

Pad Number	Name	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
1	DOUT3	–3141.68	3509.56	–0.1236882	0.1381715
2	DOUT2	–2675.12	3509.56	–0.1053197	0.1381715
3	DOUT1	–2208.56	3509.56	–0.0869512	0.1381715
4	DOUT0	–1742.00	3509.56	–0.0685827	0.1381715
5	VDD4	–1042.16	3509.56	–0.0410299	0.1381715
6	DGND4	–575.60	3509.56	–0.0226614	0.1381715
7	PIXCLK	124.24	3509.56	0.0048913	0.1381715
8	VDDQ3	824.08	3509.56	0.0324441	0.1381715
9	DGNDQ3	1290.64	3509.56	0.0508126	0.1381715
10	CLKIN	1990.48	3509.56	0.0783654	0.1381715
11	SCLK	2457.04	3509.56	0.0967339	0.1381715
12	DGNDQ4	2923.60	3509.56	0.1151024	0.1381715
13	VDDQ4	3565.51	2794.11	0.1403742	0.1100043
14	VDD3	3565.51	2327.55	0.1403742	0.0916358
15	DGND3	3565.51	1860.99	0.1403742	0.0732673
16	SDATA	3565.51	1394.43	0.1403742	0.0548988
17	TEST_EN	3565.51	927.87	0.1403742	0.0365303
18	VDDQ2	3565.51	461.31	0.1403742	0.0181618
19	DGNDQ2	3565.51	–5.25	0.1403742	–0.0002067
20	VAA_PIX 1	3565.51	–572.61	0.1403742	–0.0225437
21	VAA_PIX 0	3565.51	–1039.17	0.1403742	–0.0409122
22	AGND1	3565.51	–1773.57	0.1403742	–0.0698256
23	AGND0	3565.51	–2240.13	0.1403742	–0.0881941
24	VAA1	3565.51	–2706.69	0.1403742	–0.1065626
25	VAA0	3565.51	–3173.25	0.1403742	–0.1249311
26	DNU (Note 2)	2806.72	–3509.56	0.1105008	–0.1381715
27	DNU	2340.16	–3509.56	0.0921323	–0.1381715
28	DNU	1873.60	–3509.56	0.0737638	–0.1381715
29	VDDQ1	1203.12	–3509.56	0.0473669	–0.1381715
30	DGNDQ1	736.56	–3509.56	0.0289984	–0.1381715
31	STROBE	36.72	–3509.56	0.0014457	–0.1381715

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

Pad Number	Name	"X" Microns (Note 1)	"Y" Microns (Note 1)	"X" Inches (Note 1)	"Y" Inches (Note 1)
32	OE_BAR	–429.84	–3509.56	–0.0169228	–0.1381715
33	STANDBY	–896.40	–3509.56	–0.0352913	–0.1381715
34	VDD2	–1362.96	–3509.56	–0.0536598	–0.1381715
35	DGND2	–1829.52	–3509.56	–0.0720283	–0.1381715
36	RESET_BAR	–2296.08	–3509.56	–0.0903969	–0.1381715
37	FRAME_VALID	–2762.64	–3509.56	–0.1087654	–0.1381715
38	LINE_VALID	–3229.20	–3509.56	–0.1271339	–0.1381715
39	SADDR	–3565.51	–3085.73	–0.1403742	–0.1214854
40	VDD1	–3565.51	–2619.17	–0.1403742	–0.1031169
41	DGND1	–3565.51	–2152.61	–0.1403742	–0.0847484
42	DOUT_LSB1	–3565.51	–1686.05	–0.1403742	–0.0663799
43	DOUT_LSB0	–3565.51	–1219.49	–0.1403742	–0.0480114
44	VDDQ0	–3565.51	–519.65	–0.1403742	–0.0204587
45	DGNDQ0	–3565.51	–53.09	–0.1403742	–0.0020902
46	DOUT7	–3565.51	646.75	–0.1403742	0.0254626
47	DOUT6	–3565.51	1113.31	–0.1403742	0.0438311
48	DOUT5	–3565.51	1579.87	–0.1403742	0.0621996
49	DOUT4	–3565.51	2046.43	–0.1403742	0.0805681
50	VDD0	–3565.51	2512.99	–0.1403742	0.0989366
51	DGND0	–3565.51	2979.55	–0.1403742	0.1173051

1. Reference to center of each bond pad from center of die (0,0).
2. DNU = "do not use".

Die Features

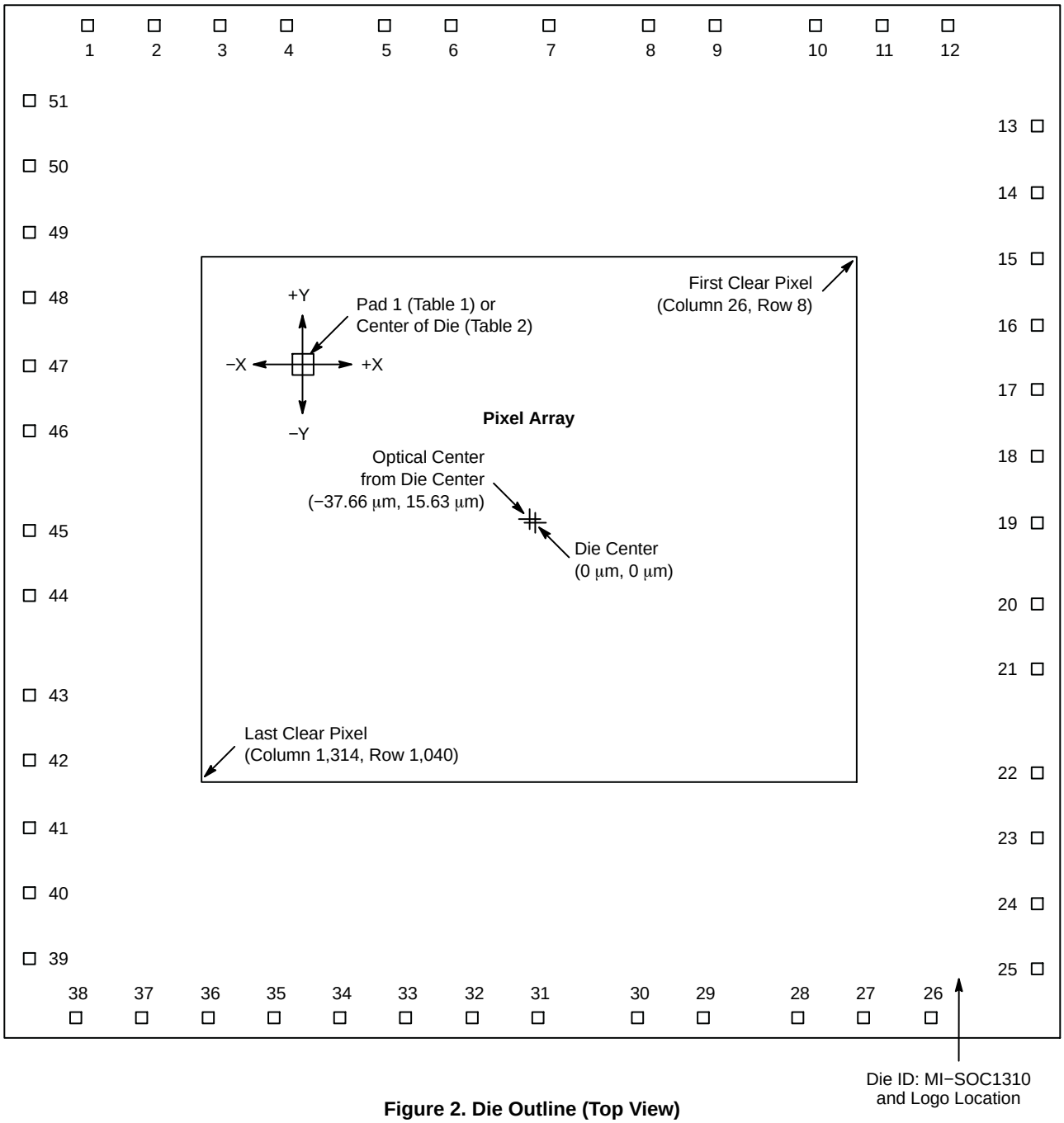


Figure 2. Die Outline (Top View)

Physical Specifications

Table 3. PHYSICAL DIMENSIONS

Feature	Dimensions
Die Thickness	305 μm ±12 μm (12.0 mil ±0.5 mil)
Singulated Die Size Width (X Dimension) Length (Y Dimension)	 7,440 μm ±25 μm 7,328 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	466.56 μm (18.369 mil)
Optical Array Optical Center from Die Center	X = –37.66 μm, Y = 15.63 μm
First Clear Pixel (Column 26, Row 8) From Die Center From Center of Pad 1	 X = 2,280.51 μm, Y = 1,873.39 μm X = 5,422.19 μm, Y = –1,636.17 μm
Last Clear Pixel (Column 1,314, Row 1,040) From Die Center From Center of Pad 1	 X = –2,356.16 μm, Y = –1,841.76 μm X = 785.52 μm, Y = –5,351.31 μm

Die Orientation in Reconstructed Wafer

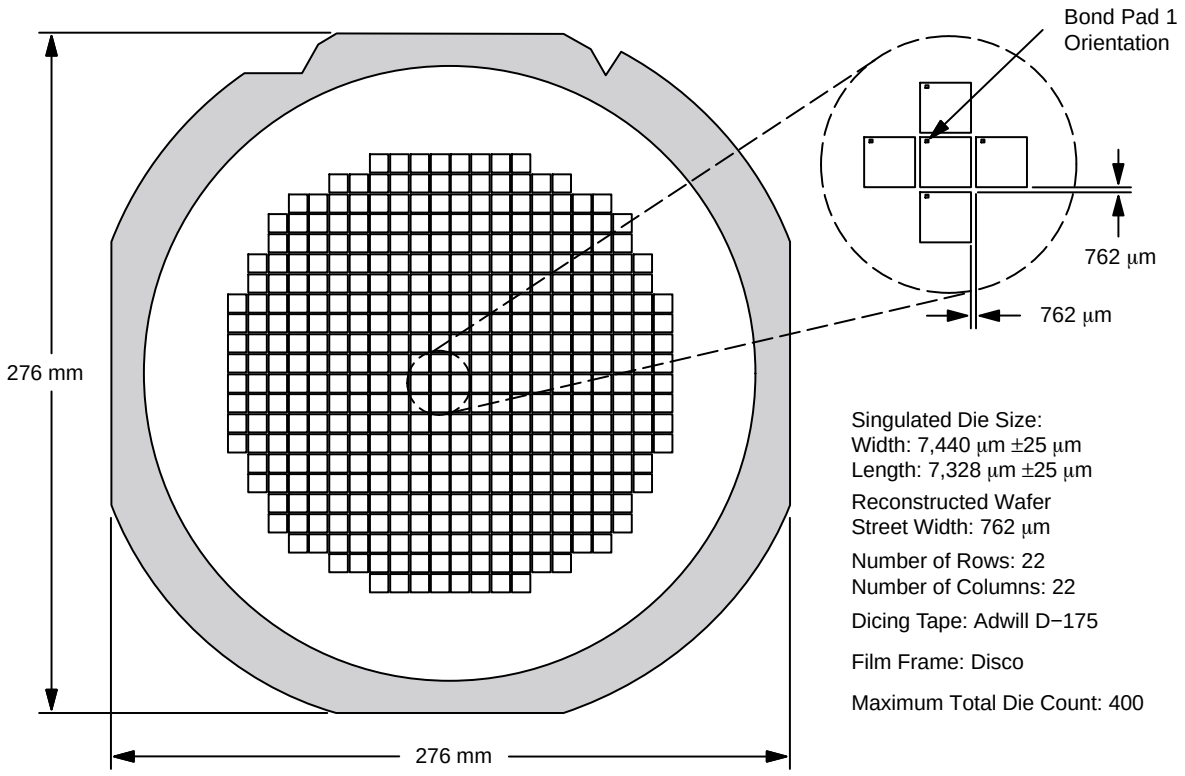


Figure 3. Die Orientation in Reconstructed Wafer

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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Phone: 81−3−5817−1050

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

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