

# CM1230

## 2, 4, and 8-Channel Low-Capacitance ESD Protection Array

### Product Description

The CM1230 is a family of 2, 4 and 8 channel, very low capacitance ESD protection diode arrays in a CSP form factor. It is ideal for protecting systems with high data and clock rates or for circuits that need low capacitive loading. Each channel consists of a pair of ESD diodes that act as clamp diodes to steer ESD current pulses to either the positive or negative supply rail. A Zener diode is integrated between the positive and negative supply rails. The  $V_{CC}$  rail is protected from ESD strikes and eliminates the need for a bypass capacitor to absorb positive ESD strikes to ground. Each channel can safely dissipate ESD strikes of  $\pm 8$  kV, meeting the Level 4 requirement of the IEC61000-4-2 international standard as well as  $\pm 15$  kV air discharges per the IEC61000-4-2 specification. Using the MIL-STD-883 (Method 3015) specification for Human Body Model (HBM) ESD, the pins are protected for contact discharges at greater than  $\pm 15$  kV.

This device is well-suited for next generation wireless handsets that implement high-speed serial interface solutions for the LCD display and camera interfaces. In these designs, a tolerance above 1.5 pF cannot be tolerated when high data rates are transferred between the baseband chip and the LCD driver/controller ICs. Higher capacitive loading normally causes the rise and fall times to slow which hampers the functionality of circuit and operation of the wireless handset. The CM1230 incorporates *OptiGuard*™ which results in improved reliability at assembly. The CM1230 is available in a space-saving, low profile Chip Scale Package with RoHS-compliant, lead-free finishing.

### Features

- Two, Four, and Eight Channels of ESD Protection
- Provides ESD Protection to IEC61000-4-2 Level 4  $\pm 8$  kV Contact Discharge &  $\pm 15$  kV Air Discharge
- Low Loading Capacitance of 0.8 pF Typical
- Minimal Capacitance Change with Temperature and Voltage
- Channel I/O to GND Capacitance Difference of 0.02 pF Typical is Ideal for Differential Signals
- Channel I/O to I/O Capacitance 0.15 pF Typical
- Zener Diode Protects Supply Rail and Eliminates the Need for External By-pass Capacitors
- Each I/O Pin Can Withstand Over 1000 ESD Strikes\*
- Available in 4, 6 and 10 Bump Chip Scale Packages (CSP)
- *OptiGuard*™ Coated for Improved Reliability at Assembly
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- I/O Port Protection for Mobile Handsets, Notebook Computers, DSCs, MP3 Players, PDAs, etc. Including USB, 1394 and Serial ATA
- LCD and Camera Data Lines in Wireless Handsets that use High-speed Serial Interfaces
- Wireless Handsets
- Handheld PCs/PDAs
- LCD and Camera Modules



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WLCSP4  
CP SUFFIX  
CASE 567CS



WLCSP6  
CP SUFFIX  
CASE 567BB

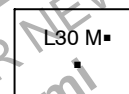


WLCSP10  
CP SUFFIX  
CASE 567BG

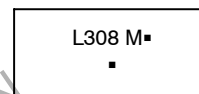
### MARKING DIAGRAM



CSP-4



CSP-6



CSP-10

Lxxx = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device               | Package          | Shipping†         |
|----------------------|------------------|-------------------|
| CM1230-02CP (Note 1) | CSP-4 (Pb-Free)  | 3,500/Tape & Reel |
| CM1230-J2CP (Note 1) | CSP-4 (Pb-Free)  | 3,500/Tape & Reel |
| CM1230-04CP          | CSP-6 (Pb-Free)  | 3,500/Tape & Reel |
| CM1230-08CP          | CSP-10 (Pb-Free) | 3,500/Tape & Reel |

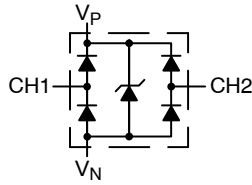
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

\*Standard test condition is IEC61000-4-2 level 4 test circuit with each (A<sub>OUT</sub>/B<sub>OUT</sub>) pin subjected to  $\pm 12$  kV contact discharge for 1000 pulses. Discharges are timed at 1 second intervals and all 1000 strikes are completed in one continuous test run.

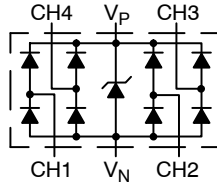
1. CM1230-02CP and CM1230-J2CP are the same mechanical package. Only difference is the Pin 1 orientation ('+' mark) on the tape and reel.

# CM1230

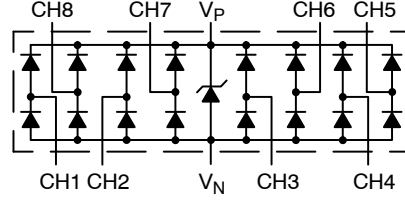
## ELECTRICAL SCHEMATIC



CM1230-02CP/  
CM1230-J2CP



CM1230-04CP



CM1230-08CP

Table 1. PIN DESCRIPTIONS

| 2-Channel, 4-Bump CSP |                |      |                              |
|-----------------------|----------------|------|------------------------------|
| Pin                   | Name           | Type | Description                  |
| A1                    | V <sub>N</sub> | GND  | Negative Voltage Supply Rail |
| B1                    | CH2            | I/O  | ESD Channel                  |
| A2                    | CH1            | I/O  | ESD Channel                  |
| B2                    | V <sub>P</sub> | PWR  | Positive Voltage Supply Rail |

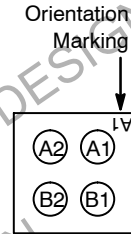
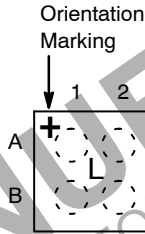
| 4-Channel, 6-Bump CSP |                |      |                              |
|-----------------------|----------------|------|------------------------------|
| Pin                   | Name           | Type | Description                  |
| A1                    | CH1            | I/O  | ESD Channel                  |
| B1                    | CH2            | I/O  | ESD Channel                  |
| A2                    | V <sub>P</sub> | PWR  | Positive Voltage Supply Rail |
| B2                    | V <sub>N</sub> | GND  | Negative Voltage Supply Rail |
| A3                    | CH3            | I/O  | ESD Channel                  |
| B3                    | CH4            | I/O  | ESD Channel                  |

| 8-Channel, 10-Bump CSP |                |      |                              |
|------------------------|----------------|------|------------------------------|
| Pin                    | Name           | Type | Description                  |
| A1                     | CH1            | I/O  | ESD Channel                  |
| B1                     | CH2            | I/O  | ESD Channel                  |
| A2                     | CH3            | I/O  | ESD Channel                  |
| B2                     | CH4            | I/O  | ESD Channel                  |
| A3                     | V <sub>P</sub> | PWR  | Positive Voltage Supply Rail |
| B3                     | V <sub>N</sub> | GND  | Negative Voltage Supply Rail |
| A4                     | CH5            | I/O  | ESD Channel                  |
| B4                     | CH6            | I/O  | ESD Channel                  |
| A5                     | CH7            | I/O  | ESD Channel                  |
| B5                     | CH8            | I/O  | ESD Channel                  |

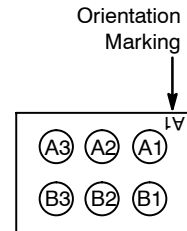
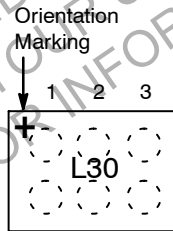
## PACKAGE / PINOUT DIAGRAMS

Top View  
(Bumps Down View)

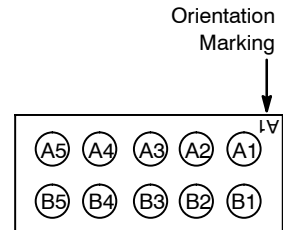
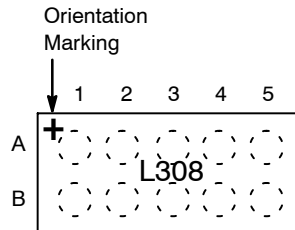
Bottom View  
(Bumps Up View)



CM1230-02/J2  
4-bump CSP Package



CM1230-04  
6-bump CSP Package



CM1230-08  
10-bump CSP Package

## SPECIFICATIONS

Table 2. ABSOLUTE MAXIMUM RATINGS

| Parameter                                | Rating                         | Units |
|------------------------------------------|--------------------------------|-------|
| Operating Supply Voltage ( $V_P - V_N$ ) | 6.0                            | V     |
| Operating Temperature Range              | -40 to +85                     | °C    |
| Storage Temperature Range                | -65 to +150                    | °C    |
| DC Voltage at any Channel Input          | $(V_N - 0.5)$ to $(V_P + 0.5)$ | V     |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 3. STANDARD OPERATING CONDITIONS

| Parameter                   | Rating     | Units |
|-----------------------------|------------|-------|
| Operating Temperature Range | -40 to +85 | °C    |

Table 4. ELECTRICAL OPERATING CHARACTERISTICS (Note2)

| Symbol          | Parameter                                                                                                                                                                              | Conditions                                                                           | Min          | Typ          | Max          | Units |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------|--------------|--------------|-------|
| $V_P$           | Operating Supply Voltage ( $V_P - V_N$ )                                                                                                                                               |                                                                                      |              | 3.3          | 5.5          | V     |
| $I_P$           | Operating Supply Current                                                                                                                                                               | $(V_P - V_N) = 3.3$ V                                                                |              |              | 8.0          | μA    |
| $V_F$           | Diode Forward Voltage<br>Top Diode<br>Bottom Diode                                                                                                                                     | $I_F = 8$ mA; $T_A = 25^\circ\text{C}$                                               | 0.60<br>0.60 | 0.80<br>0.80 | 0.95<br>0.95 | V     |
| $I_{LEAK}$      | Channel Leakage Current                                                                                                                                                                | $T_A = 25^\circ\text{C}$ ; $V_P = 5$ V, $V_N = 0$ V, $V_{IN} = 0$ V to 5 V           |              | ±0.1         | ±1.0         | μA    |
| $C_{IN}$        | Channel Input Capacitance                                                                                                                                                              | At 1 MHz, $V_P = 3.3$ V, $V_N = 0$ V, $V_{IN} = 1.65$ V                              |              | 0.80         | 1.2          | pF    |
| $\Delta C_{IN}$ | Channel Input Capacitance Matching                                                                                                                                                     | At 1 MHz, $V_P = 3.3$ V, $V_N = 0$ V, $V_{IN} = 1.65$ V                              |              | 0.02         |              | pF    |
| $C_{MUTUAL}$    | Mutual Capacitance between signal pin and adjacent signal pin                                                                                                                          | At 1 MHz, $V_P = 3.3$ V, $V_N = 0$ V, $V_{IN} = 1.65$ V                              |              | 0.15         |              | pF    |
| $V_{ESD}$       | In-system ESD Protection<br>Peak Discharge Voltage at any channel input, in system<br>a) Contact discharge per IEC 61000-4-2 standard<br>b) Human Body Model, MIL-STD-883, Method 3015 | $T_A = 25^\circ\text{C}$ (Notes 4 and 5)<br>$T_A = 25^\circ\text{C}$ (Notes 3 and 5) | ±8<br>±15    |              |              | kV    |
| $V_{CL}$        | Channel Clamp Voltage<br>Positive Transients<br>Negative Transients                                                                                                                    | $T_A = 25^\circ\text{C}$ , $I_{PP} = 1$ A, $t_P = 8/20$ μS (Note 5)                  |              | +9.8<br>-1.8 |              | V     |
| $R_{DYN}$       | Dynamic Resistance<br>Positive Transients<br>Negative Transients                                                                                                                       | $I_{PP} = 1$ A, $t_P = 8/20$ μS<br>Any I/O pin to Ground (Note 5)                    |              | 0.76<br>0.56 |              | Ω     |

2. All parameters specified at  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  unless otherwise noted.

3. Human Body Model per MIL-STD-883, Method 3015,  $C_{Discharge} = 100$  pF,  $R_{Discharge} = 1.5$  KΩ,  $V_P = 3.3$  V,  $V_N$  grounded.

4. Standard IEC 61000-4-2 with  $C_{Discharge} = 150$  pF,  $R_{Discharge} = 330$  Ω,  $V_P = 3.3$  V,  $V_N$  grounded.

5. These measurements performed with no external capacitor on  $V_P$ .

6. Measured under pulsed conditions, pulse width = 0.7 ms, maximum current = 1.5 A.

## PERFORMANCE INFORMATION

## Input Channel Capacitance Performance Curves

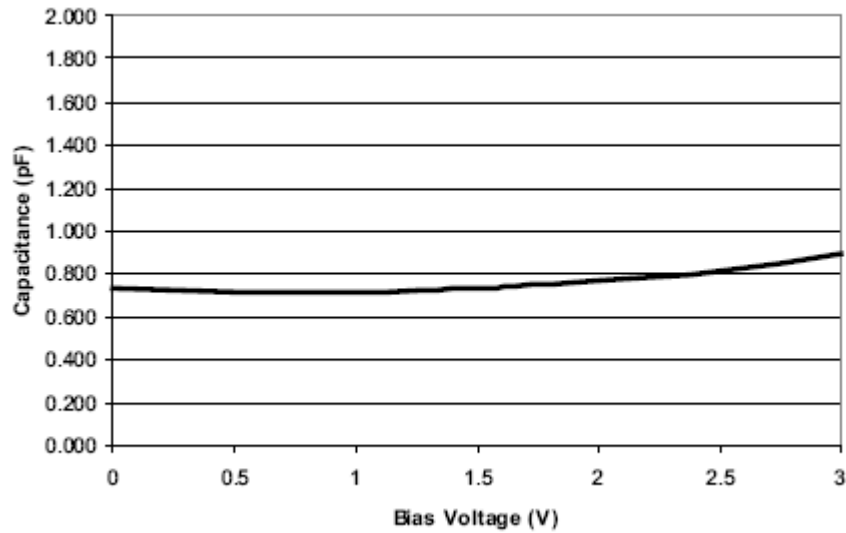


Figure 1. Typical Variation of  $C_{IN}$  vs.  $V_{IN}$   
 ( $f = 1\text{ MHz}$ ,  $V_P = 3.3\text{ V}$ ,  $V_N = 0\text{ V}$ ,  $0.1\text{ }\mu\text{F}$  chip capacitor between  $V_P$  and  $V_N$ ,  $T_A = 25^\circ\text{C}$ )

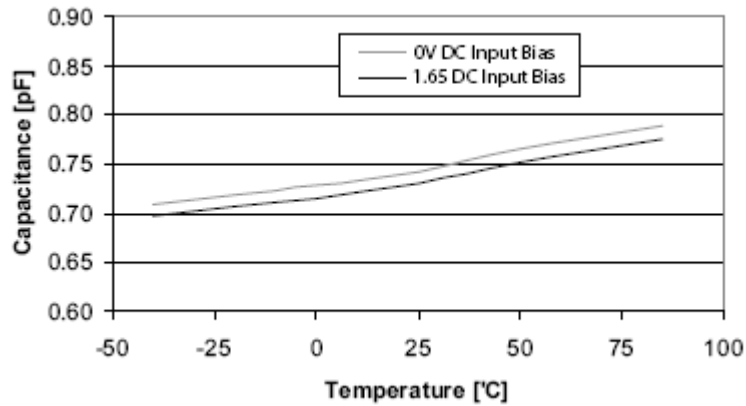


Figure 2. Typical Variation of  $C_{IN}$  vs. Temp  
 ( $f = 1\text{ MHz}$ ,  $V_{IN} = 30\text{ mV}$ ,  $V_P = 3.3\text{ V}$ ,  $V_N = 0\text{ V}$ ,  $0.1\text{ }\mu\text{F}$  chip capacitor between  $V_P$  and  $V_N$ )

521.1 log MAG 1 dB/ REF 0 dB 1: -.0288 dB

|           |    |
|-----------|----|
| 2: -.8197 | dB |
| 3: -.8505 | dB |
| 4: -1.453 | dB |

5.000 000 MHz  
2.000 MHz  
2.000 MHz  
3.000 GHz

INSERTION LOSS

FREQUENCY (MHz)

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## APPLICATION INFORMATION

Table 5. PRINTED CIRCUIT BOARD RECOMMENDATIONS

| Parameter                                                                          | Value                        |
|------------------------------------------------------------------------------------|------------------------------|
| Pad Size on PCB                                                                    | 0.275 mm                     |
| Pad Shape                                                                          | Round                        |
| Pad Definition                                                                     | Non-Solder Mask defined pads |
| Solder Mask Opening                                                                | 0.325 mm Round               |
| Solder Stencil Thickness                                                           | 0.125 – 0.150 mm             |
| Solder Stencil Aperture Opening (laser cut, 5% tapered walls)                      | 0.330 mm Round               |
| Solder Flux Ratio                                                                  | 50/50 by volume              |
| Solder Paste Type                                                                  | No Clean                     |
| Pad Protective Finish                                                              | OSP (Entek Cu Plus 106A)     |
| Tolerance – Edge To Corner Ball                                                    | $\pm 50\ \mu\text{m}$        |
| Solder Ball Side Coplanarity                                                       | $\pm 20\ \mu\text{m}$        |
| Maximum Dwell Time Above Liquidous                                                 | 60 seconds                   |
| Maximum Soldering Temperature for Lead-free Devices using a Lead-free Solder Paste | 260°C                        |

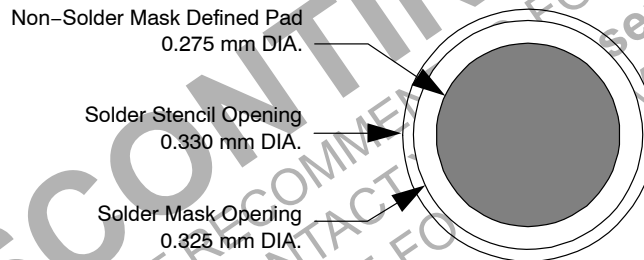


Figure 5. Recommended Non-Solder Mask Defined Pad Illustration

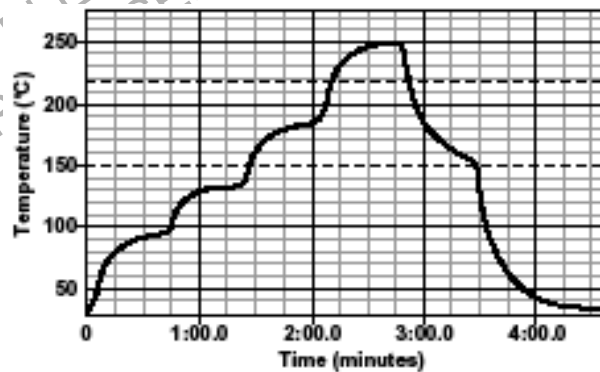
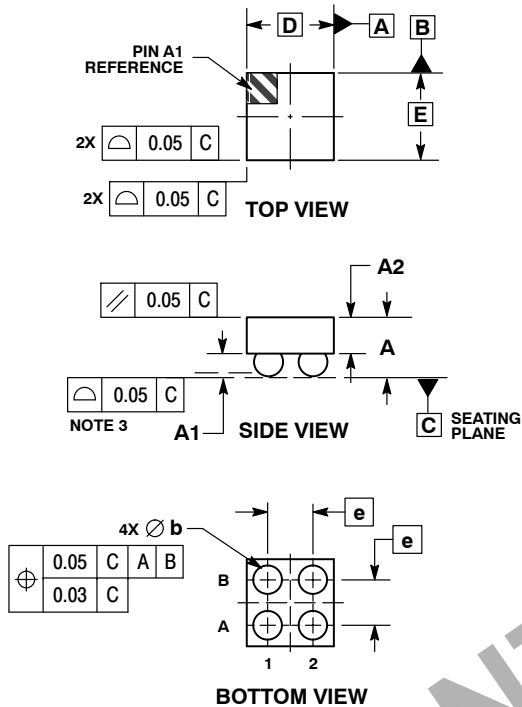


Figure 6. Lead-free (SnAgCu) Solder Ball Reflow Profile

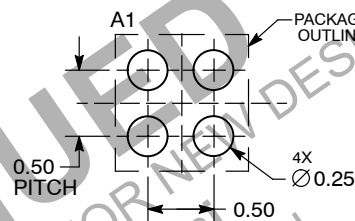
## PACKAGE DIMENSIONS

WLCSP4, 0.96x0.96  
CASE 567CS  
ISSUE O

## NOTES:

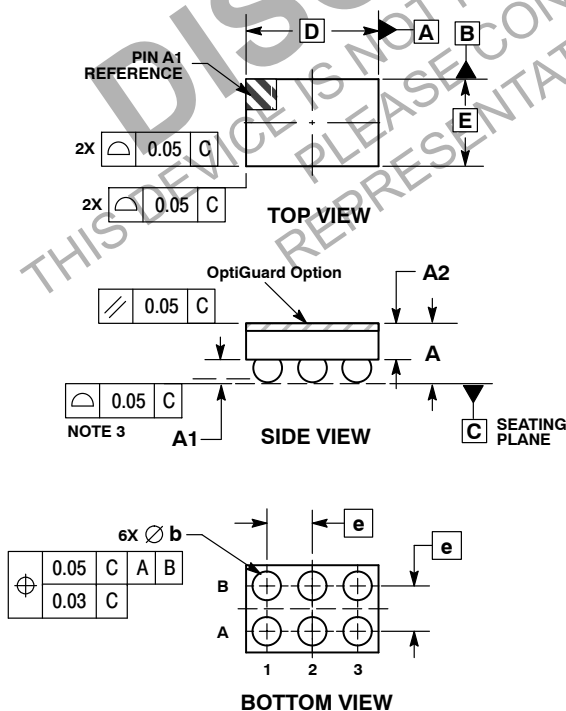
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.61 | 0.69 |
| A1          | 0.21 | 0.28 |
| A2          | 0.41 | REF  |
| b           | 0.29 | 0.34 |
| D           | 0.96 | BSC  |
| E           | 0.96 | BSC  |
| e           | 0.50 | BSC  |

RECOMMENDED  
SOLDERING FOOTPRINT\*

DIMENSIONS: MILLIMETERS

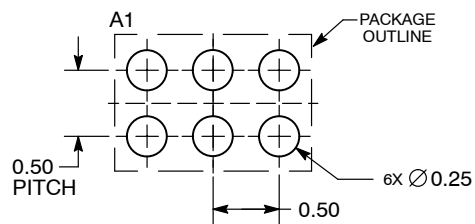
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

WLCSP6, 1.46x0.96  
CASE 567BB  
ISSUE O

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.56 | 0.72 |
| A1          | 0.21 | 0.27 |
| A2          | 0.42 | REF  |
| b           | 0.29 | 0.35 |
| D           | 1.46 | BSC  |
| E           | 0.96 | BSC  |
| e           | 0.50 | BSC  |

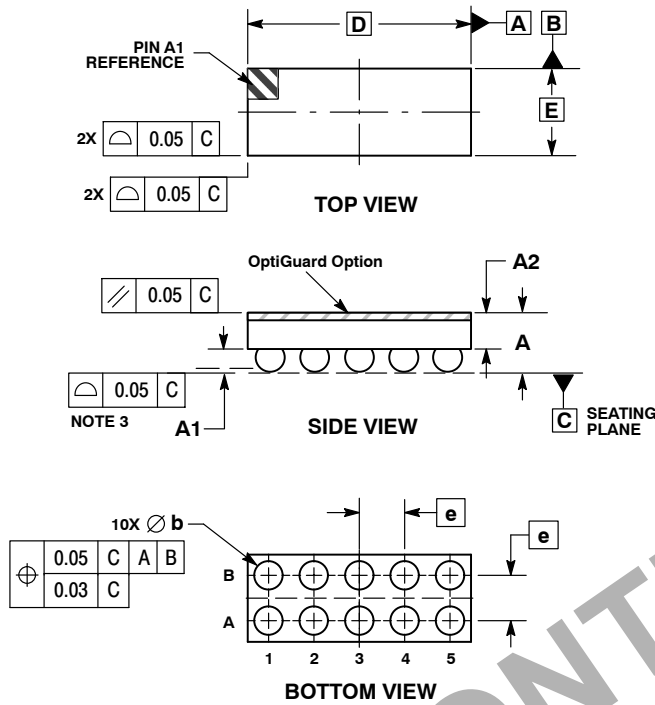
RECOMMENDED  
SOLDERING FOOTPRINT\*

DIMENSIONS: MILLIMETERS

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## PACKAGE DIMENSIONS

WLCSP10, 2.46x0.96  
CASE 567BG  
ISSUE O

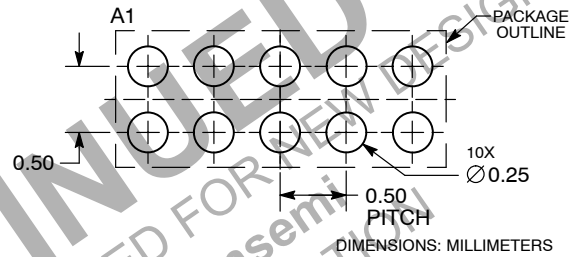


## NOTES:

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| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.56        | 0.72 |
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| A2  | 0.42        | REF  |
| b   | 0.29        | 0.35 |
| D   | 2.46        | BSC  |
| E   | 0.96        | BSC  |
| e   | 0.50        | BSC  |

## RECOMMENDED SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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