ON Semiconductor®

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

## CM1230

## Features

- Two, four, and eight channels of ESD protection
- Provides ESD protection to IEC61000-4-2 Level 4
  - ±8kV contact discharge
  - ±15kV air discharge
- Low loading capacitance of 0.8pF typical
- Minimal capacitance change with temperature and voltage
- Channel I/O to GND capacitance difference of 0.02pF typical is ideal for differential signals
- Channel I/O to I/O capacitance 0.15pF 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
- RoHS-compliant, lead-free version finishing

## Applications

- LCD and camera data lines in wireless handsets that use high-speed serial interfaces.
- I/O port protection for mobile handsets, notebook computers, DSCs, MP3 players, PDAs, etc. including USB, 1394 and serial ATA
- Wireless handsets
- Handheld PCs/PDAs
- LCD and camera modules

## 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 ±8kV, meeting the Level 4 requirement of the IEC61000-4-2 international standard as well as ±15kV 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 ±15kV.

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 1.5pF cannot be tolerated when high data rates are transferred between the baseband choppiest and the LCD driver/controller Is. 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.

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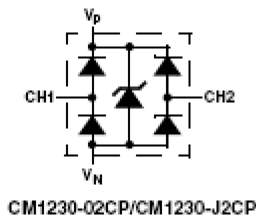
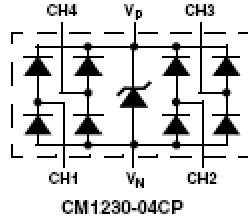
Publication Order Number:
**CM1230/D**

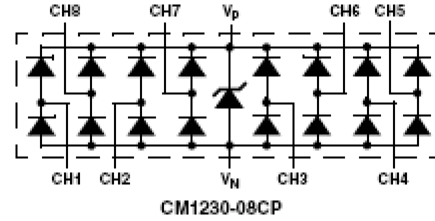
## Electrical Schematic



CM1230-02CP/CM1230-J2CP



CM1230-04CP



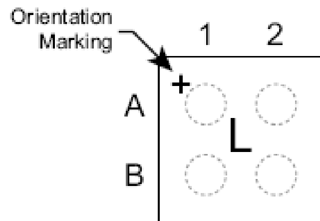
CM1230-08CP

*Standard test condition is IEC61000-4-2 level 4 test circuit with each ($A_{OUT}$/$B_{OUT}$) pin subjected to ±12kV contact discharge for 1000 pulses. Discharges are timed at 1 second intervals and all 1000 strikes are completed in one continuous test run.

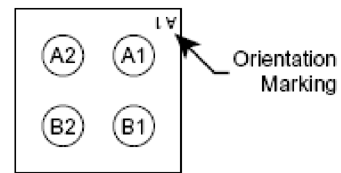
## PACKAGE / PINOUT DIAGRAMS

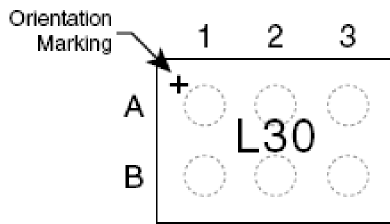
TOP VIEW (Bumps Down View)

BOTTOM VIEW (Bumps Up View)

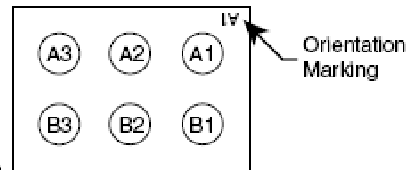


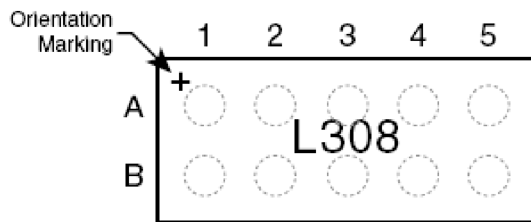

CM1230-02/J2
4-Bump CSP Package

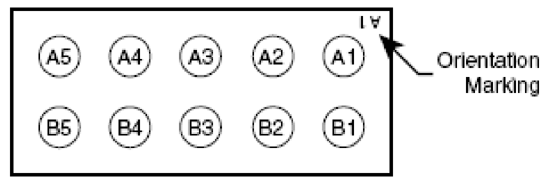



CM1230-04
6-Bump CSP Package




CM1230-08
10-Bump CSP Package

Notes:
1) These drawings are not to scale.

## Ordering Information

| PART NUMBERING INFORMATION | | | | |
|---|---|---|---|---|
| # of Channels | Bumps | Package | Ordering Part Number[1] | Part Marking |
| 2 | 4 | CSP-4 | CM1230-02CP | L |
| 2 | 4 | CSP-4 | CM1230-J2CP | L |
| 4 | 6 | CSP-6 | CM1230-04CP | L30 |
| 8 | 10 | CSP-10 | CM1230-08CP | L308 |

Note 1: Parts are shipped in Tape and Reel form unless otherwise specified.

## Pin Descriptions

**2-CHANNEL, 4-BUMP CSP**

| PIN | NAME | TYPE | DESCRIPTION |
|---|---|---|---|
| A1 | $V_N$ | GND | Negative voltage supply rail |
| B1 | CH2 | I/O | ESD Channel |
| A2 | CH1 | I/O | ESD Channel |
| B2 | $V_P$ | 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 | $V_P$ | PWR | Positive voltage supply rail |
| B2 | $V_N$ | 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 | $V_P$ | PWR | Positive voltage supply rail |
| B3 | $V_N$ | 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 |

## Specifications

| 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 |

| STANDARD OPERATING CONDITIONS | | |
|---|---|---|
| PARAMETER | RATING | UNITS |
| Operating Temperature Range | -40 to +85 | °C |

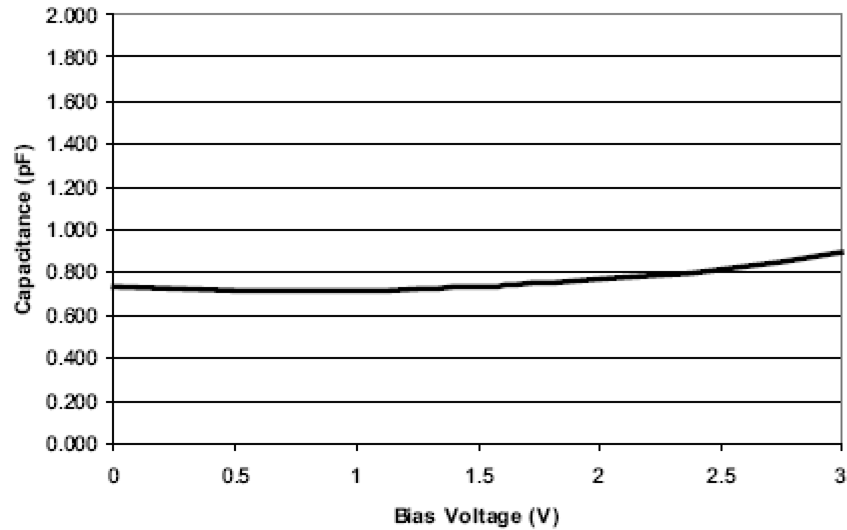
## ELECTRICAL OPERATING CHARACTERISTICS(SEE NOTE 1)

| 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 | ($V_P$-$V_N$)=3.3V | | | 8.0 | μA |
| $V_F$ | Diode Forward Voltage<br>Top Diode<br>Bottom Diode | $I_F$ = 8mA; $T_A$=25°C | <br>0.60<br>0.60 | <br>0.80<br>0.80 | <br>0.95<br>0.95 | <br>V<br>V |
| $I_{LEAK}$ | Channel Leakage Current | $T_A$=25°C; $V_P$=5V, $V_N$=0V, $V_{IN}$ = 0V to 5V | | ±0.1 | ±1.0 | μA |
| $C_{IN}$ | Channel Input Capacitance | At 1 MHz, $V_P$=3.3V, $V_N$=0V, $V_{IN}$=1.65V | | 0.8 | 1.20 | pF |
| $\Delta C_{IN}$ | Channel Input Capacitance Matching | At 1 MHz, $V_P$=3.3V, $V_N$=0V, $V_{IN}$=1.65V | | 0.02 | | pF |
| $C_{MUTUAL}$ | Mutual Capacitance between signal pin and adjacent signal pin | At 1 MHz, $V_P$=3.3V, $V_N$=0V, $V_{IN}$=1.65V | | 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 | <br><br>Notes 3 and 4; $T_A$=25°C<br>Notes 2 and 4; $T_A$=25°C | <br><br>±8<br>±15 | | | <br><br>kV<br>kV |
| $V_{CL}$ | Channel Clamp Voltage<br>Positive Transients<br>Negative Transients | $T_A$=25°C, $I_{PP}$ = 1A, $t_P$ = 8/20μS; Note 4 | | <br>+9.8<br>-1.8 | | <br>V<br>V |
| $R_{DYN}$ | Dynamic Resistance<br>Positive Transients<br>Negative Transients | $I_{PP}$ = 1A, $t_P$ = 8/20μS<br>Any I/O pin to Ground; Note 4 | | <br>0.76<br>0.56 | | <br>Ω<br>Ω |

Note 1: All parameters specified at $T_A$ = -40°C to +85°C unless otherwise noted.
Note 2: Human Body Model per MIL-STD-883, Method 3015, $C_{Discharge}$ = 100pF, $R_{Discharge}$ = 1.5KΩ, $V_P$ = 3.3V, $V_N$ grounded.
Note 3: Standard IEC 61000-4-2 with $C_{Discharge}$ = 150pF, $R_{Discharge}$ = 330Ω, $V_P$ = 3.3V, $V_N$ grounded.
Note 4: These measurements performed with no external capacitor on $V_P$.
Note 5: Measured under pulsed conditions, pulse width = 0.7ms, maximum current = 1.5A.

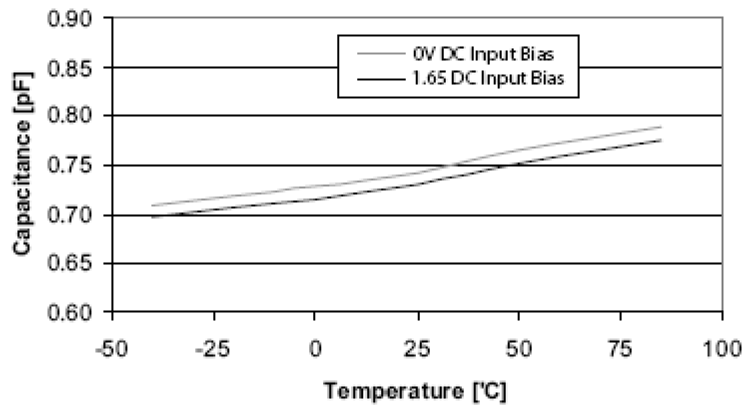
# Performance Information

## Input Channel Capacitance Performance Curves




**Typical Variation of $C_{IN}$ vs. $V_{IN}$**

(f=1MHz, $V_P$ = 3.3V, $V_N$ = 0V, 0.1 μF chip capacitor between $V_P$ and $V_N$, $T_A$ = 25°C)

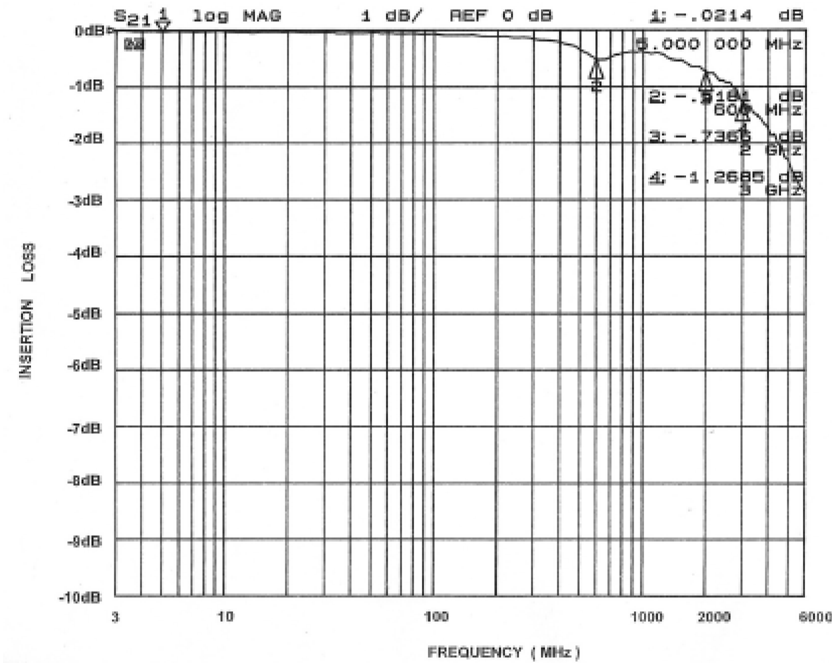



**Typical Variation of $C_{IN}$ vs. Temp**

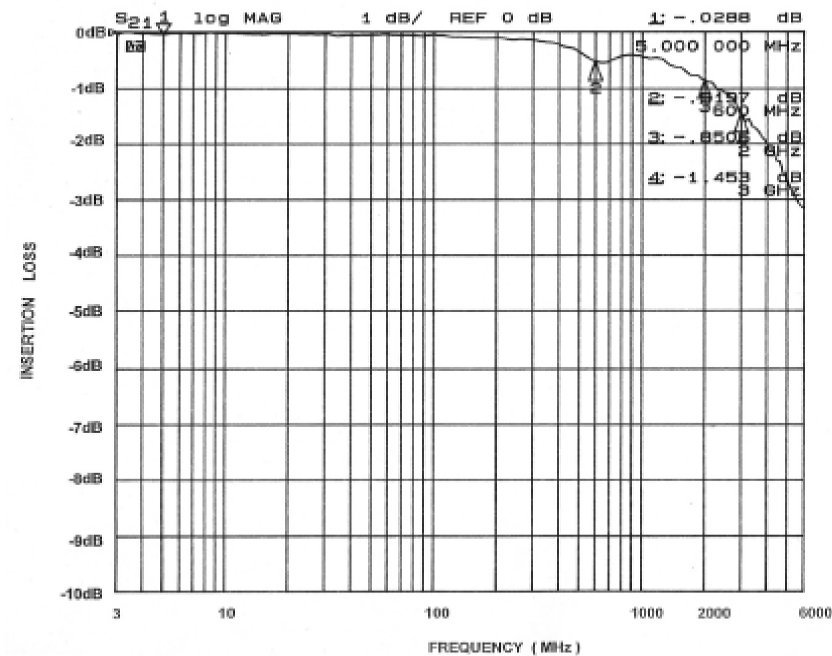
(f=1MHz, $V_{IN}$=30mV, $V_P$ = 3.3V, $V_N$ = 0V,
0.1 μF chip capacitor between $V_P$ and $V_N$)

## Performance Information (Cont’d)

### Typical Filter Performance (nominal conditions unless specified otherwise, 50 Ohm Environment)




**Insertion Loss VS. Frequency (0V DC Bias, $V_P$=3.3V)**




**Insertion Loss VS. Frequency (2.5V DC Bias, $V_P$=3.3V)**

# Application Information

| PARAMETER | VALUE |
|---|---|
| Pad Size on PCB | 0.240mm |
| Pad Shape | Round |
| Pad Definition | Non-Solder Mask defined pads |
| Solder Mask Opening | 0.290mm Round |
| Solder Stencil Thickness | 0.125mm - 0.150mm |
| Solder Stencil Aperture Opening (laser cut, 5% tapered walls) | 0.300mm 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 | $\pm 50\mu m$ |
| Solder Ball Side Coplanarity | $\pm 20\mu m$ |
| Maximum Dwell Time Above Liquidous | 60 seconds |
| Maximum Soldering Temperature for Lead-free Devices using a Lead-free Solder Paste | 260°C |

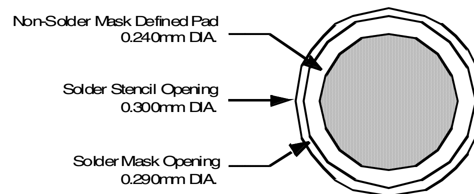



**Figure 8. Recommended Non-Solder Mask Defined Pad Illustration**

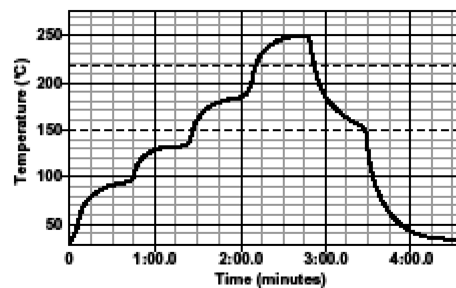


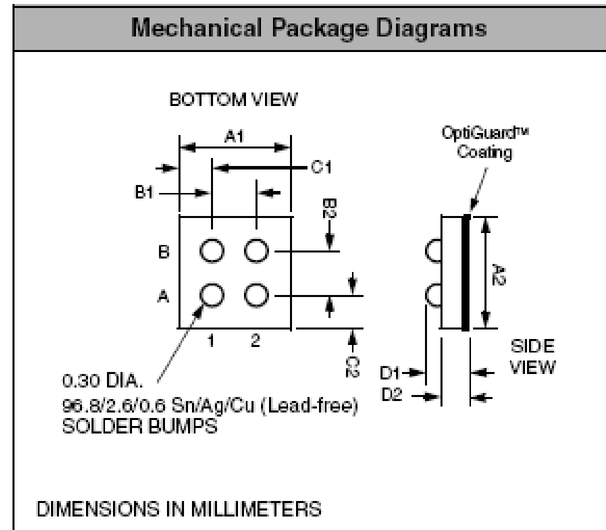

**Figure 9. Lead-free (SnAgCu) Solder Ball Reflow Profile**

# Mechanical Details

### CSP-4 Mechanical Specifications (CM1230-02CP)

The CM1230-02CP is supplied in a 4 bump Chip Scale Package (CSP). Dimensions are shown below. For complete information on the CSP, see the California Micro Devices CSP Package Information document.

| PACKAGE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| **Package** | Custom CSP | | | | | |
| **Bumps** | 4 | | | | | |
| **Dim** | **Millimeters** | | | **Inches** | | |
| | **Min** | **Nom** | **Max** | **Min** | **Nom** | **Max** |
| **A1** | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| **A2** | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| **B1** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **B2** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **C1** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **C2** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **D1** | 0.575 | 0.644 | 0.714 | 0.0226 | 0.0254 | 0.0281 |
| **D2** | 0.368 | 0.419 | 0.470 | 0.0145 | 0.0165 | 0.0185 |
| **# per tape and reel** | 3500 pieces | | | | | |
| Controlling dimension: millimeters | | | | | | |




**Package Dimensions for CM1230-02CP Chip Scale Package**

**CSP Tape and Reel Specifications**

| PART NUMBER | CHIP SIZE (mm) | POCKET SIZE (mm) $B_0$ X $A_0$ X $K_0$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | $P_0$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| CM1230-02CP* | 0.96 x 0.96 x 0.644 | 1.14 x 1.00 x 0.70 | 8mm | 178mm (7") | 3500 | 4mm | 4mm |

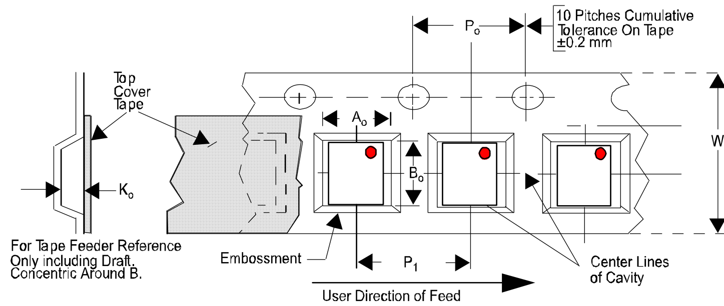



**Figure 3. Tape and Reel Mechanical Data***

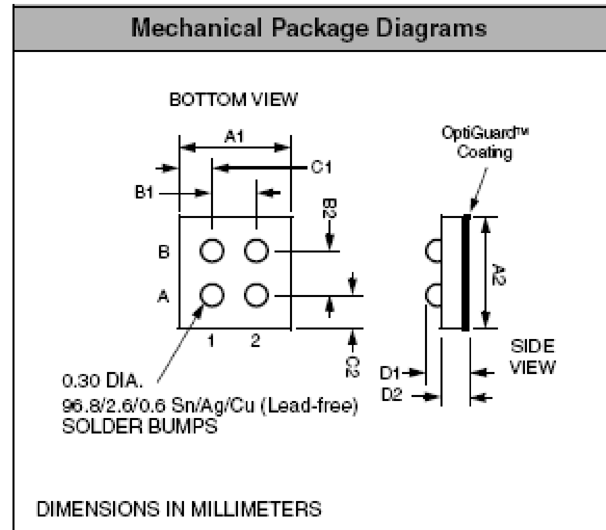
* CM1230-02CP and CM1230-J2CP are the same mechanical package. The only difference is the Pin 1 orientation (red dot) on the tape and reel.

## Mechanical Details (cont'd)

### CSP-4 Mechanical Specifications (CM1230-J2CP)

The CM1230-J2CP is supplied in a 4 bump Chip Scale Package (CSP). Dimensions are shown below. For complete information on the CSP, see the California Micro Devices CSP Package Information document.

| PACKAGE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Package | Custom CSP | | | | | |
| Bumps | 4 | | | | | |
| Dim | Millimeters | | | Inches | | |
| | Min | Nom | Max | Min | Nom | Max |
| A1 | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| A2 | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| B1 | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| B2 | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| C1 | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| C2 | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| D1 | 0.575 | 0.644 | 0.714 | 0.0226 | 0.0254 | 0.0281 |
| D2 | 0.368 | 0.419 | 0.470 | 0.0145 | 0.0165 | 0.0185 |
| # per tape and reel | 3500 pieces | | | | | |
| Controlling dimension: millimeters | | | | | | |




**Package Dimensions for CM1230-J2CP Chip Scale Package**

### CSP Tape and Reel Specifications

| PART NUMBER | CHIP SIZE (mm) | POCKET SIZE (mm) $B_0$ X $A_0$ X $K_0$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | $P_0$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| CM1230-J2CP* | 0.96 x 0.96 x 0.644 | 1.14 x 1.00 x 0.70 | 8mm | 178mm (7") | 3500 | 4mm | 4mm |

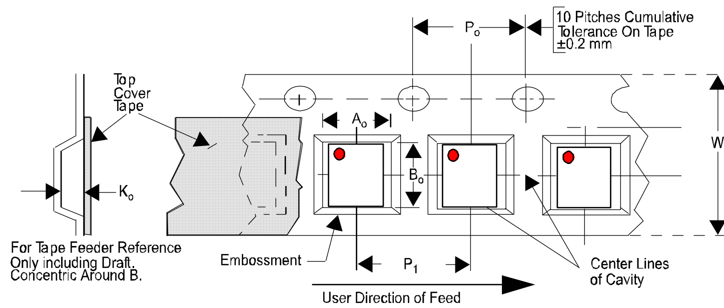



**Figure 4. Tape and Reel Mechanical Data***

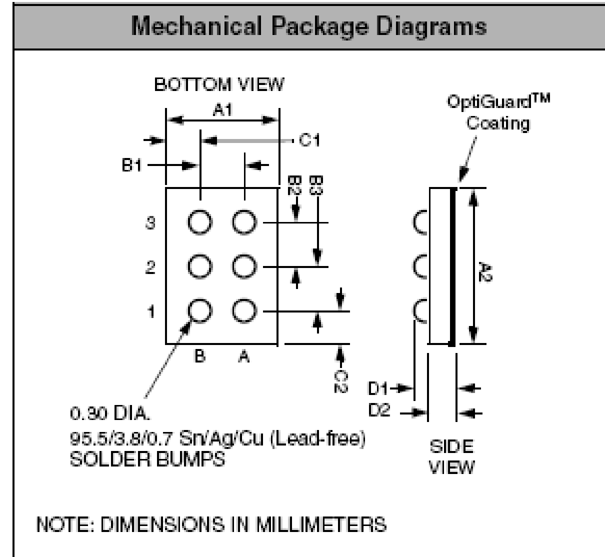
*CM1230-02CP and CM1230-J2CP are the same mechanical package. Only difference is the Pin 1 orientation (red dot) on the tape and reel.

## Mechanical Details (cont'd)

### CSP-6 Mechanical Specifications

The CM1230-04CP is supplied in a 6 bump Chip Scale Package (CSP). Dimensions are shown below. For complete information on the CSP, see the California Micro Devices CSP Package Information document.

| PACKAGE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| **Package** | Custom CSP | | | | | |
| **Bumps** | 6 | | | | | |
| **Dim** | **Millimeters** | | | **Inches** | | |
| | **Min** | **Nom** | **Max** | **Min** | **Nom** | **Max** |
| **A1** | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| **A2** | 1.415 | 1.460 | 1.505 | 0.0557 | 0.0575 | 0.0593 |
| **B1** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **B2** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **C1** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **C2** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **D1** | 0.575 | 0.644 | 0.714 | 0.0226 | 0.0254 | 0.0281 |
| **D2** | 0.368 | 0.419 | 0.470 | 0.0145 | 0.0165 | 0.0185 |
| **# per tape and reel** | 3500 pieces | | | | | |
| Controlling dimension: millimeters | | | | | | |




**Package Dimensions for CM1230-04CP Chip Scale Package**

### CSP Tape and Reel Specifications

| PART NUMBER | CHIP SIZE (mm) | POCKET SIZE (mm) $B_0$ X $A_0$ X $K_0$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | $P_0$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| CM1230-04CP | 1.46 x 0.96 x 0.644 | 1.72 x 1.17 x 0.73 | 8mm | 178mm (7") | 3500 | 4mm | 4mm |

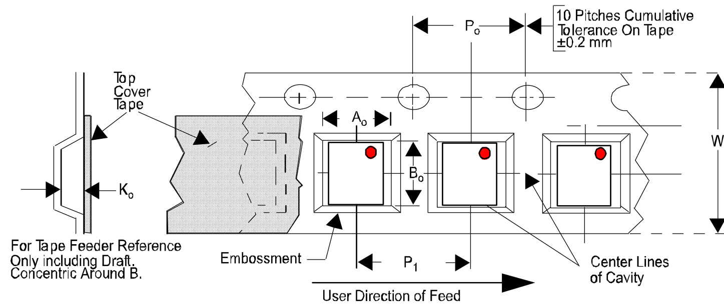



**Figure 5. Tape and Reel Mechanical Data**

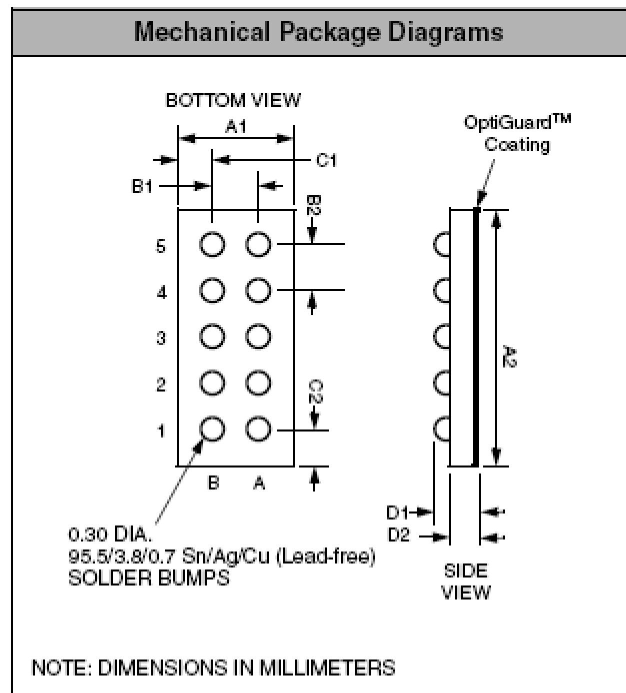
## Mechanical Details (cont'd)

### CSP-10 Mechanical Specifications

The CM1230-08CP is supplied in a 10 bump Chip Scale Package (CSP). Dimensions are shown below. For complete information on the CSP, see the California Micro Devices CSP Package Information document.

| PACKAGE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| **Package** | Custom CSP | | | | | |
| **Bumps** | 10 | | | | | |
| **Dim** | **Millimeters** | | | **Inches** | | |
| | **Min** | **Nom** | **Max** | **Min** | **Nom** | **Max** |
| **A1** | 0.915 | 0.960 | 1.005 | 0.0360 | 0.0378 | 0.0396 |
| **A2** | 2.415 | 2.460 | 2.505 | 0.0951 | 0.0969 | 0.0986 |
| **B1** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **B2** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **C1** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **C2** | 0.180 | 0.230 | 0.280 | 0.0071 | 0.0091 | 0.0110 |
| **D1** | 0.575 | 0.644 | 0.714 | 0.0226 | 0.0254 | 0.0281 |
| **D2** | 0.368 | 0.419 | 0.470 | 0.0145 | 0.0165 | 0.0185 |
| **# per tape and reel** | 3500 pieces | | | | | |

Controlling dimension: millimeters




**Package Dimensions for CM1230-08CP Chip Scale Package**

## CSP Tape and Reel Specifications

| PART NUMBER | CHIP SIZE (mm) | POCKET SIZE (mm) $B_0$ X $A_0$ X $K_0$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | $P_0$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| CM1230-08CP | 2.46 x 0.96 x 0.644 | 2.62 x 1.12 x 0.76 | 8mm | 178mm (7") | 3500 | 4mm | 4mm |

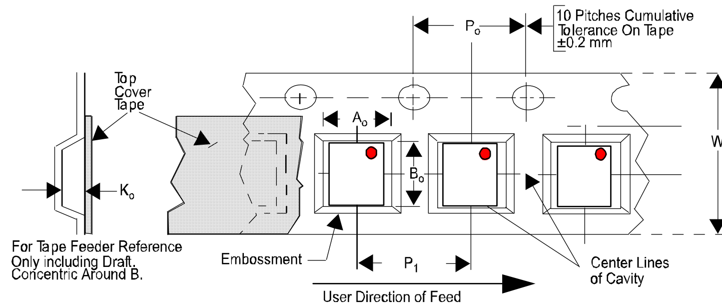



**Figure 6. Tape and Reel Mechanical Data**

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