# LCD & Camera EMI Filter Array with ESD Protection

## Features

- High bandwidth, high RF rejection filter array
- Six channels of EMI filtering
- Utilizes *Praetorian*™ inductor-based design technology for true L-C filter implementation
- *OptiGuard*™ coating for improved reliability
- ±15kV ESD protection on each channel (IEC 61000-4-2 Level 4, contact discharge)
- ±30kV ESD protection on each channel (HBM)
- Better than 40dB of attenuation at 1GHz
- Chip Scale Package features extremely low lead inductance for optimum filter and ESD performance
- 15-bump, 3.006mm x 1.376mm footprint Chip Scale Package (CM1451-06CS/CP)
- Lead-free version available

## Applications

- LCD and Camera data lines in mobile handsets
- I/O port protection for mobile handsets, notebook computers, PDAs, etc.
- EMI filtering for data phones in cell phones, PDAs or notebook computersWireless handsets / cell phones
- Wireless Handsets
- Handheld PCs/PDAs
- LCD and camera modules

## Product Description

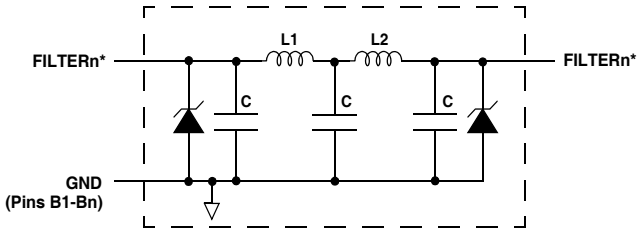
The CM1451 is an inductor-capacitor (L-C) based EMI filter array with integrated ESD protection in CSP form factor. The CM1451-06 is configured in a 6 channel format. Each EMI filter channel of the CM1451 is implemented as a 5-pole L-C filter where the component values are 10pF-17nH-10pF-17nF-10pF. The CM1451's roll-off frequency at -10dB attenuation is 400MHz and can be used in applications where the data rates are as high as 120Mbps while providing greater than 35dB over the 800MHz to 2.7GHz frequency range. The parts integrate ESD protection diodes on every pin, which provide a very high level of protection for sensitive electronic components that may be subjected to electrostatic discharge (ESD). The ESD protection diodes connected to the filter ports are designed and characterized to safely dissipate ESD strikes of ±15kV, beyond the Level 4 requirement of the IEC61000-4-2 international standard. Using the MIL-STD-883 (Method 3015) specification for Human Body Model (HBM) ESD, the pins are protected for contact discharges at greater than ±30kV.

This device is particularly well suited for portable electronics (e.g. wireless handsets, PDAs) because of its small package format and easy-to-use pin assignments. In particular, the CM1451 is ideal for EMI filtering and protecting data and control lines for the LCD display and camera interface in wireless handsets.

The CM1451 incorporates *OptiGuard*™ which results in improved reliability at assembly. The CM1451 is available in a space saving, low profile Chip Scale Package with optional lead-free finishing.

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### Electrical Schematic



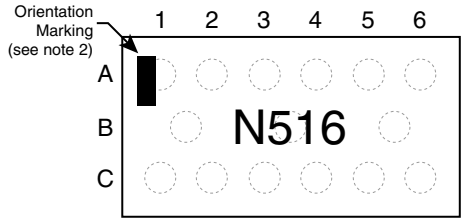

**1 of 6 EMI Filtering + ESD Channels**

* See Package/Pinout Diagram for expanded pin information.

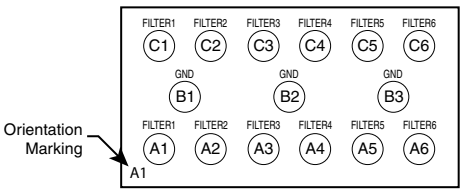
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## PACKAGE / PINOUT DIAGRAMS

TOP VIEW
(Bumps Down View)




BOTTOM VIEW
(Bumps Up View)




CM1451-06CS/CP 15-Bump CSP Package

Notes:
1) These drawings are not to scale.
2) Lead-free devices are specified by using a "**+**" character for the top side orientation mark.

## PIN DESCRIPTIONS

| PIN(s) | NAME | DESCRIPTION | | PIN(s) | NAME | DESCRIPTION |
|---|---|---|---|---|---|---|
| A1 | FILTER1 | Filter Channel 1 | | C1 | FILTER1 | Filter Channel 1 |
| A2 | FILTER2 | Filter Channel 2 | | C2 | FILTER2 | Filter Channel 2 |
| A3 | FILTER3 | Filter Channel 3 | | C3 | FILTER3 | Filter Channel 3 |
| A4 | FILTER4 | Filter Channel 4 | | C4 | FILTER4 | Filter Channel 4 |
| A5 | FILTER5 | Filter Channel 5 | | C5 | FILTER5 | Filter Channel 5 |
| A6 | FILTER6 | Filter Channel 6 | | C6 | FILTER6 | Filter Channel 6 |
| B1-B3 | GND | Device Ground | | | | |

## Ordering Information

## PART NUMBERING INFORMATION

| | | Standard Finish | | Lead-free Finish[2] | |
|---|---|---|---|---|---|
| Bumps | Package | Ordering Part Number[1] | Part Marking | Ordering Part Number[1] | Part Marking |
| 15 | CSP | CM1451-06CS | N516 | CM1451-06CP | N516 |

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

Note 2: Lead-free devices are specified by using a "**+**" character for the top side orientation mark.

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## Specifications

| ABSOLUTE MAXIMUM RATINGS | | |
|---|---|---|
| **PARAMETER** | **RATING** | **UNITS** |
| Storage Temperature Range | -65 to +150 | °C |
| DC Power per Resistor | 100 | mW |
| DC Package Power Rating | 500 | mW |

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

| ELECTRICAL OPERATING CHARACTERISTICS (NOTE 1) | | | | | | |
|---|---|---|---|---|---|---|
| **SYMBOL** | **PARAMETER** | **CONDITIONS** | **MIN** | **TYP** | **MAX** | **UNITS** |
| $L_{TOT}$ | Total Channel Inductance ($L_1$ + $L_2$) | | | 34 | | nH |
| $L_1$, $L_2$ | Inductance | | | 17 | | nH |
| $C_{TOT}$ | Total Channel Capacitance ($C_1$+ $C_2$ + $C_3$ ) | At 2.5V DC, 1MHz, 30mV AC | 24 | 30 | 36 | pF |
| $C_1$, $C_2$, $C_3$ | Capacitance | At 2.5V DC, 1MHz, 30mV AC | 8 | 10 | 12 | pF |
| $f_C$ | Cut-off Frequency<br>$Z_{SOURCE}$=50Ω, $Z_{LOAD}$=50Ω | | | 200 | | MHz |
| $f_C$ | Roll-off Frequency at -10dB Attenuation<br>$Z_{SOURCE}$=50Ω, $Z_{LOAD}$=50Ω | | | 400 | | MHz |
| $V_{DIODE}$ | Diode Standoff Voltage | $I_{DIODE}$=10µA | 5.5 | | | V |
| $I_{LEAK}$ | Diode Leakage Current (reverse bias) | $V_{DIODE}$=±3.3V | | 100 | | nA |
| $V_{SIG}$ | Signal Voltage<br>Positive Clamp<br>Negative Clamp | $I_{LOAD}$ = 10mA | <br>5.6<br>-1.5 | <br>6.8<br>-0.8 | <br>9.0<br>-0.4 | <br>V<br>V |
| $V_{ESD}$ | In-system ESD Withstand Voltage<br>a) Human Body Model, MIL-STD-883, Method 3015<br>b) Contact Discharge per IEC 61000-4-2 Level 4 | Notes 2,4 and 5 | <br>±30<br>±15 | | | <br>kV<br>kV |
| $V_{CL}$ | Clamping Voltage during ESD Discharge MIL-STD-883 (Method 3015), 8kV<br>Positive Transients<br>Negative Transients | Notes 2,3,4 and 5 | | <br>+12<br>-7 | | <br>V<br>V |

Note 1: $T_A$=25°C unless otherwise specified.

Note 2: ESD applied to input and output pins with respect to GND, one at a time.

Note 3: Clamping voltage is measured at the opposite side of the EMI filter to the ESD pin. For example, if ESD is applied to Pin A1, then clamping voltage is measured at Pin C1.

Note 4: Unused pins are left open

Note 5: These parameters are guaranteed by design and characterization.

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## Performance Information

**Typical Filter Performance ($T_A$=25°C, DC Bias=0V, 50 Ohm Environment)**

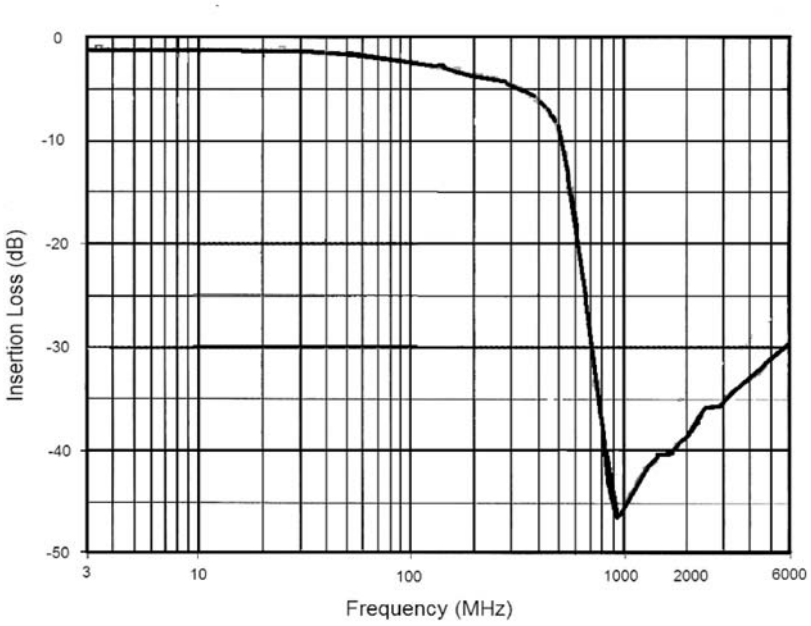



**Figure 1. Insertion Loss VS. Frequency (A1-C1 to GND B1)**

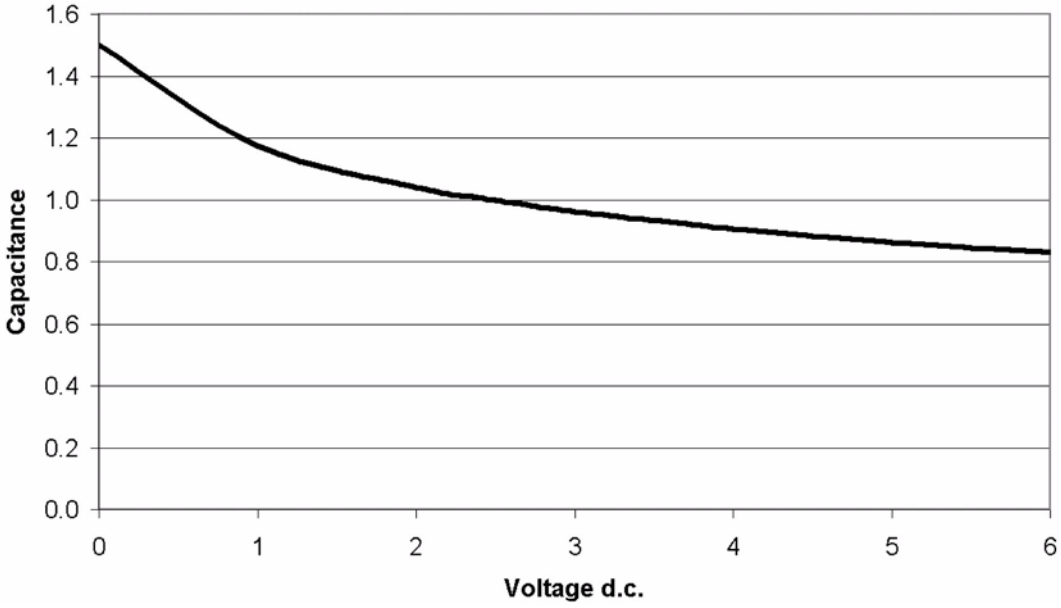



**Figure 2. Filter Capacitance vs. Input Voltage over Temperature (normalized to capacitance at 2.5VDC and 25°C)**

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## Performance Information (cont'd)

**AC Characteristics**

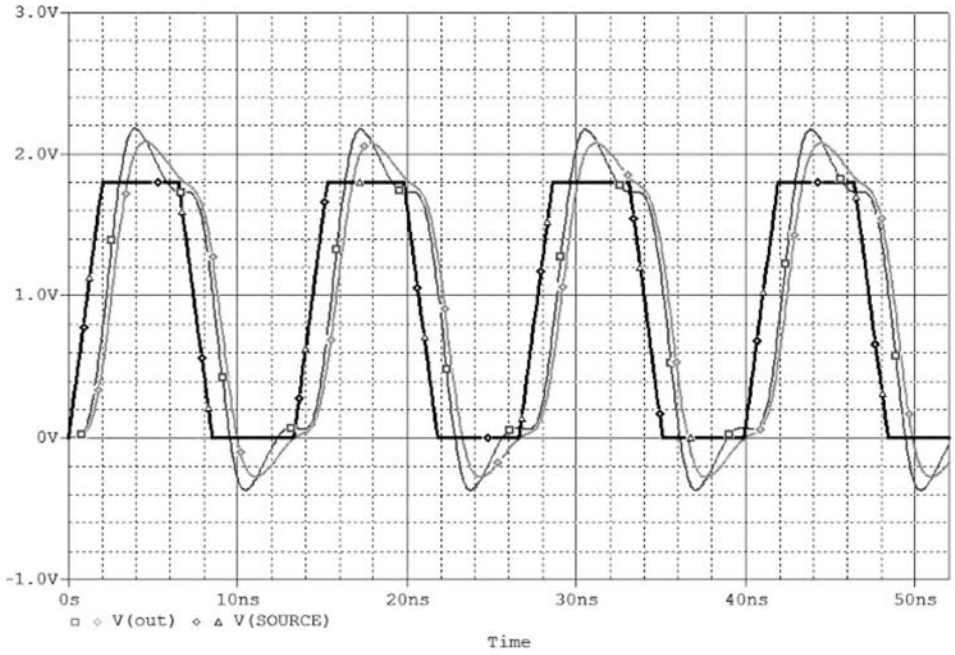



**Figure 3. 2ns Rise and Fall Times of Signals Clocked at 75MHz through CM1451 Filter Array (Simulation)**

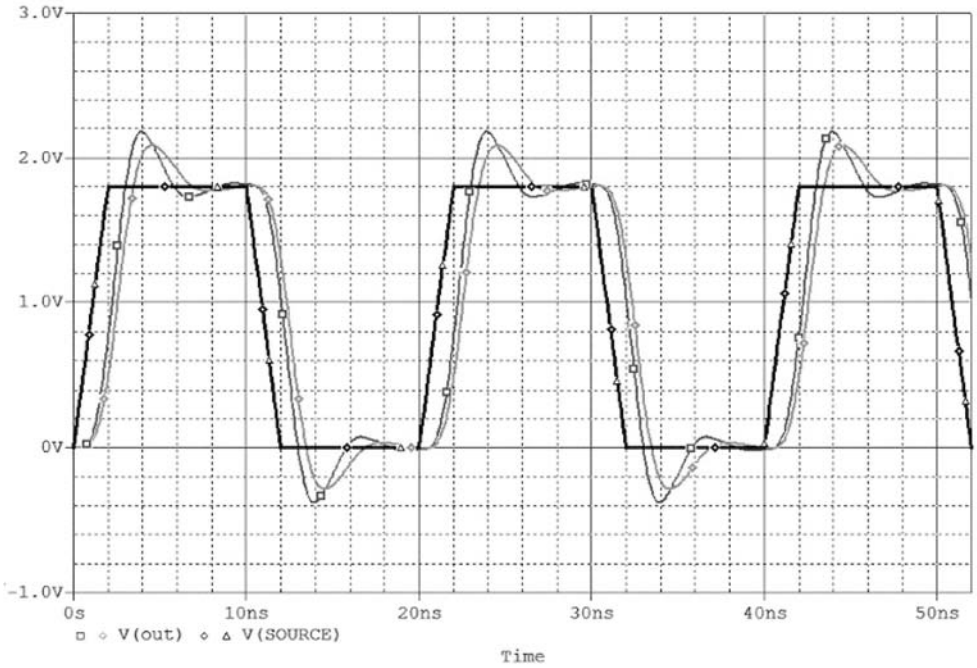



**Figure 4. 2ns Rise and Fall Times of Signals Clocked at 50MHz through CM1451 Filter Array (Simulation)**

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## Performance Information (cont'd)

**AC Characteristics**

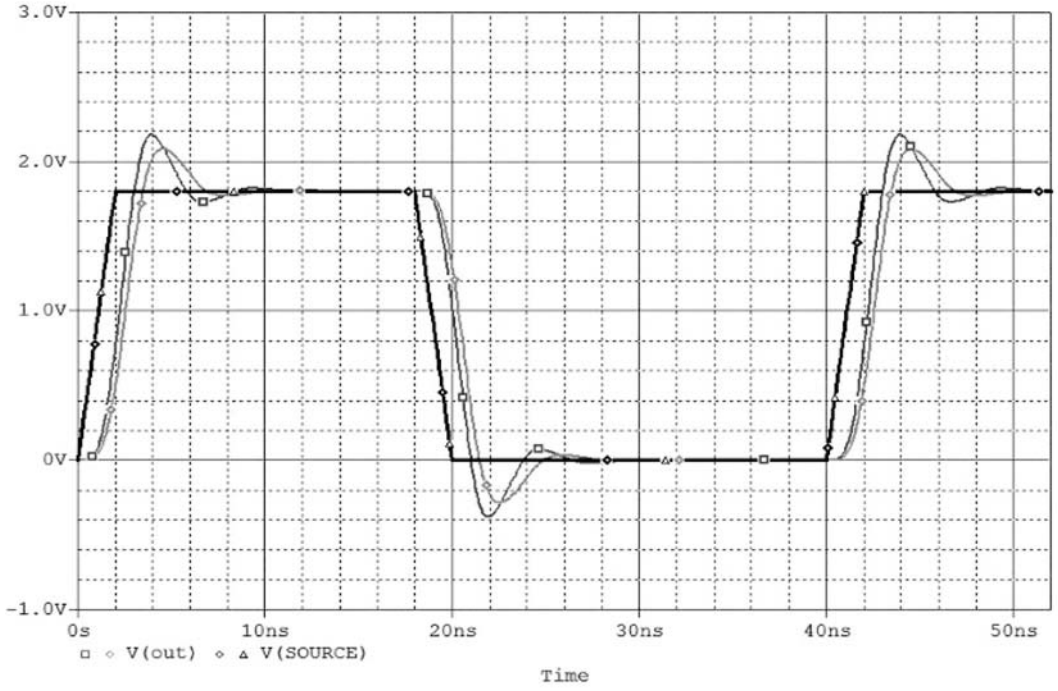



**Figure 5. 2ns Rise and Fall Times of Signals Clocked at 25MHz through CM1451 Filter Array (Simulation)**

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## Application Information

Refer to Application Note AP-217, "The Chip Scale Package", for a detailed description of Chip Scale Packages offered by California Micro Devices.

| PRINTED CIRCUIT BOARD RECOMMENDATIONS | |
|---|---|
| **PARAMETER** | **VALUE** |
| Pad Size on PCB | 0.275mm |
| Pad Shape | Round |
| Pad Definition | Non-Solder Mask defined pads |
| Solder Mask Opening | 0.325mm Round |
| Solder Stencil Thickness | 0.125mm - 0.150mm |
| Solder Stencil Aperture Opening (laser cut, 5% tapered walls) | 0.330mm 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 | ±50µm |
| Solder Ball Side Coplanarity | ±20µm |
| Maximum Dwell Time Above Liquidous (183°C) | 60 seconds |
| Soldering Maximum Temperature | 260°C |

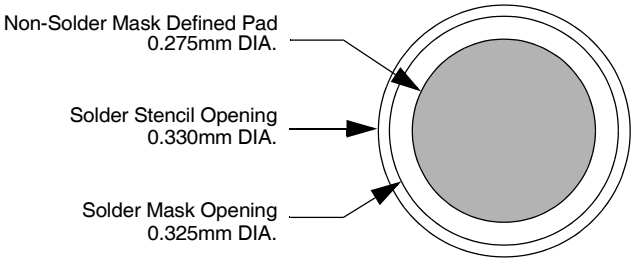



**Figure 6. Recommended Non-Solder Mask Defined Pad Illustration**

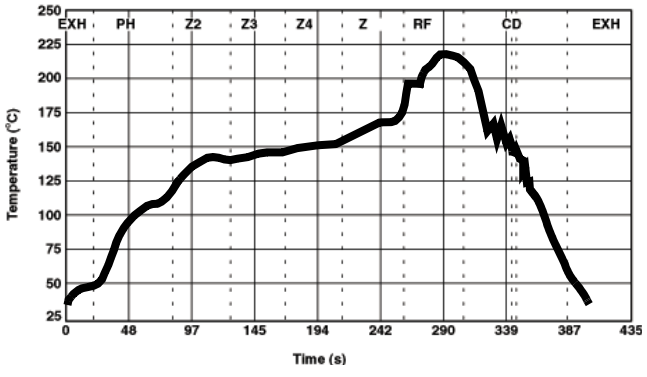



**Figure 7. Eutectic (SnPb) Solder Ball Reflow Profile**

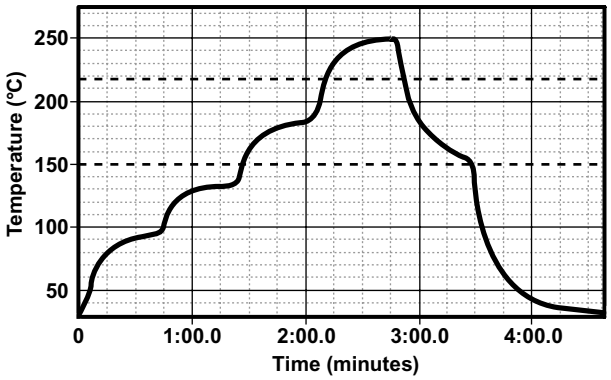



**Figure 8. Lead-free (SnAgCu) Solder Ball Reflow Profile**

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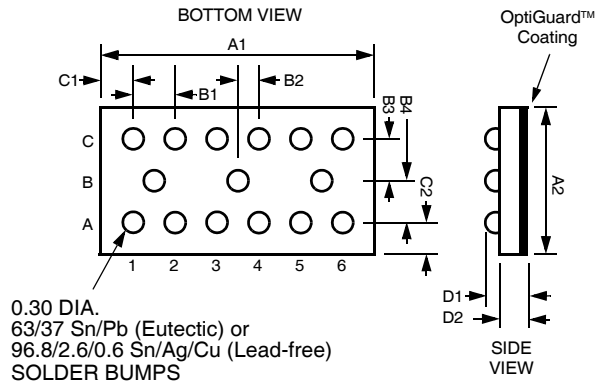
# Mechanical Details

### CM1450-06CS/CP CSP Mechanical Specifications

CM1451-06CS/CP devices are packaged in a custom Chip Scale Package (CSP). Dimensions are presented below. For complete information on CSP packaging, see the California Micro Devices CSP Package Information document.

| PACKAGE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| **Package** | Custom CSP | | | | | |
| **Bumps** | 15 | | | | | |
| **Dim** | **Millimeters** | | | **Inches** | | |
| | **Min** | **Nom** | **Max** | **Min** | **Nom** | **Max** |
| **A1** | 2.915 | 2.960 | 3.005 | 0.1148 | 0.1165 | 0.1183 |
| **A2** | 1.285 | 1.330 | 1.375 | 0.0506 | 0.0524 | 0.0541 |
| **B1** | 0.495 | 0.500 | 0.505 | 0.0195 | 0.0197 | 0.0199 |
| **B2** | 0.245 | 0.250 | 0.255 | 0.0096 | 0.0098 | 0.0100 |
| **B3** | 0.430 | 0.435 | 0.440 | 0.0169 | 0.0171 | 0.0173 |
| **B4** | 0.430 | 0.435 | 0.440 | 0.0169 | 0.0171 | 0.0173 |
| **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** | 0.600 | 0.670 | 0.739 | 0.0236 | 0.0264 | 0.0291 |
| **D2** | 0.394 | 0.445 | 0.495 | 0.0155 | 0.0175 | 0.0195 |
| **# per tape and reel** | 3500 pieces | | | | | |
| Controlling dimension: millimeters | | | | | | |

**Mechanical Package Diagrams**




**Package Dimensions for CM1451CS/CP 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 | $P_0$ | $P_1$ |
|---|---|---|---|---|---|---|---|
| CM1451-06 | 2.96 X 1.33 X 0.6 | 3.10 X 1.45 X 0.74 | 8mm | 178mm (7") | 3500 | 4mm | 4mm |

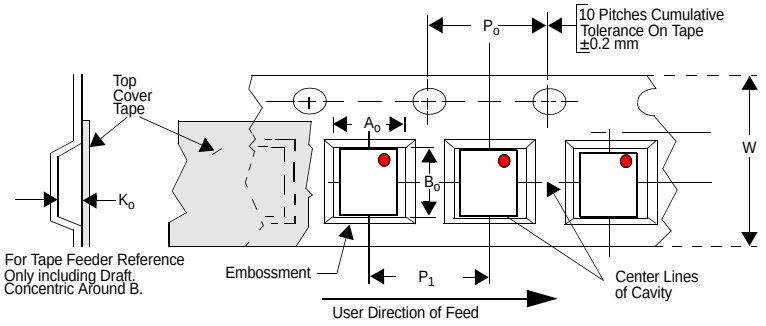



**Figure 9. Tape and Reel Mechanical Data**

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