



### Features

- High bandwidth, high RF rejection filter array
- Six and eight 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
- Maintains signal integrity for signals that have a risetime and falltime as fast as 2ns
- Chip Scale Package (CSP) 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)
- 20-bump, 4.006mm x 1.376mm footprint Chip Scale Package (CM1451-08CS/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 computers
- Wireless handsets / cell phones
- Wireless Handsets
- Handheld PCs/PDAs
- LCD and camera modules

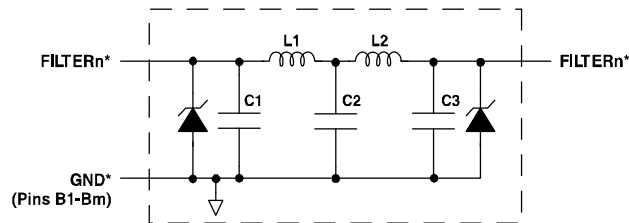
### Product Description

The CM1451 is an inductor-capacitor (L-C) based EMI filter array with integrated ESD protection in CSP. The CM1450-06 and CM1450-08 are configured in 6 and 8 channel formats respectively. Each channel is implemented as a 5-pole L-C filter with the component values 9.5pF-17nH-9.5pF-17nF-9.5pF. The CM1451's roll-off frequency at -10dB attenuation is 500MHz. It can be used in applications where the data rates are as high as 200Mbps while providing greater than 35dB attenuation over the 800MHz to 2.7GHz frequency range. The device has ESD protection diodes on every pin that 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 safely dissipate ESD strikes of •15kV, exceeding 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 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 while maintaining the integrity of signals that have rise/fall times as fast as 2ns.

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

**Electrical Schematic**

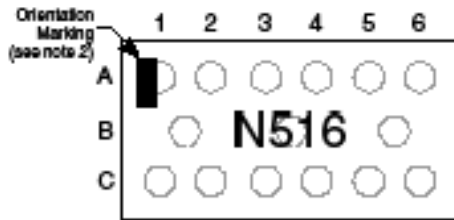


**1 of n EMI Filtering + ESD Channels**  
 (n = 6 for CM1451-06, 8 for CM1451-08, m=n/2)

\* See Package/Pinout Diagram for expanded pin information.

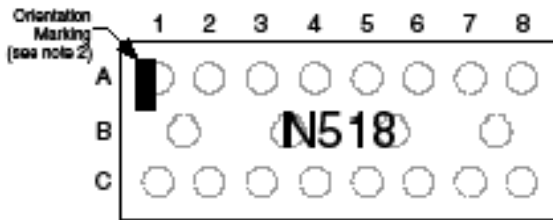
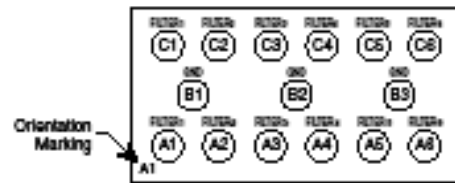
**PACKAGE / PINOUT DIAGRAMS**

**TOP VIEW**  
 (Bumps Down View)



CM1451-06CS/CP 15-Bump CSP Package

**BOTTOM VIEW**  
 (Bumps Up View)



CM1451-08CS/CP 20-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.

# CM1451

## PIN DESCRIPTIONS

CM1451-06	CM1451-08			CM1451-06	CM1451-08		
PIN(s)	PIN(s)	NAME	DESCRIPTION	PIN(s)	PIN(s)	NAME	DESCRIPTION
A1	A1	FILTER1	Filter Channel 1	C1	C1	FILTER1	Filter Channel 1
A2	A2	FILTER2	Filter Channel 2	C2	C2	FILTER2	Filter Channel 2
A3	A3	FILTER3	Filter Channel 3	C3	C3	FILTER3	Filter Channel 3
A4	A4	FILTER4	Filter Channel 4	C4	C4	FILTER4	Filter Channel 4
A5	A5	FILTER5	Filter Channel 5	C5	C5	FILTER5	Filter Channel 5
A6	A6	FILTER6	Filter Channel 6	C6	C6	FILTER6	Filter Channel 6
-	A7	FILTER7	Filter Channel 7	-	C7	FILTER7	Filter Channel 7
-	A8	FILTER8	Filter Channel 8	-	C8	FILTER8	Filter Channel 8
B1-B3	B1-B4	GND	Device Ground				

## Ordering Information

### PART NUMBERING INFORMATION

Bumps	Package	Standard Finish		Lead-free Finish <sup>2</sup>	
		Ordering Part Number <sup>1</sup>	Part Marking	Ordering Part Number <sup>1</sup>	Part Marking
15	CSP	CM1451-06CS	N516	CM1451-06CP	N516
20	CSP	CM1451-08CS	N518	CM1451-08CP	N518

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.

## Specifications

### ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNITS
Storage Temperature Range	-65 to +150	°C
Current per Inductor	30	mA
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
$R_{DC\ IN-OUT}$	DC Channel Resistance			18		$\Omega$
$C_{TOT}$	Total Channel Capacitance ( $C_1 + C_2 + C_3$ )	At 2.5V DC, 1MHz, 30mV AC	22.8	28.5	34.2	pF
$C_1, C_2, C_3$	Capacitance	At 2.5V DC, 1MHz, 30mV AC	7.6	9.5	11.4	pF
$f_c$	Cut-off Frequency $Z_{SOURCE}=50\Omega, Z_{LOAD}=50\Omega$			260		MHz
$f_{RO}$	Roll-off Frequency at -10dB Attenuation $Z_{SOURCE}=50\Omega, Z_{LOAD}=50\Omega$			500		MHz
$V_{DIODE}$	Diode Standoff Voltage	$I_{DIODE}=10\mu A$		6.0		V
$I_{LEAK}$	Diode Leakage Current	$V_{DIODE}=+3.3V$		0.1	1	$\mu A$
$V_{SIG}$	Signal Voltage Positive Clamp Negative Clamp	$I_{LOAD} = 10mA$	5.6 -1.5	6.8 -0.8	9.0 -0.4	V V
$V_{ESD}$	In-system ESD Withstand Voltage a) Human Body Model, MIL-STD-883, Method 3015 b) Contact Discharge per IEC 61000-4-2 Level 4	Note 2	30 15			kV kV
$R_{DYN}$	Dynamic Resistance Positive Negative			2.30 0.90		$\Omega$ $\Omega$

Note 1:  $T_A=25^\circ C$  unless otherwise specified.

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

## Performance Information

Typical Filter Performance ( $T_A=25^\circ\text{C}$ , DC Bias=0V, 50 Ohm Environment)

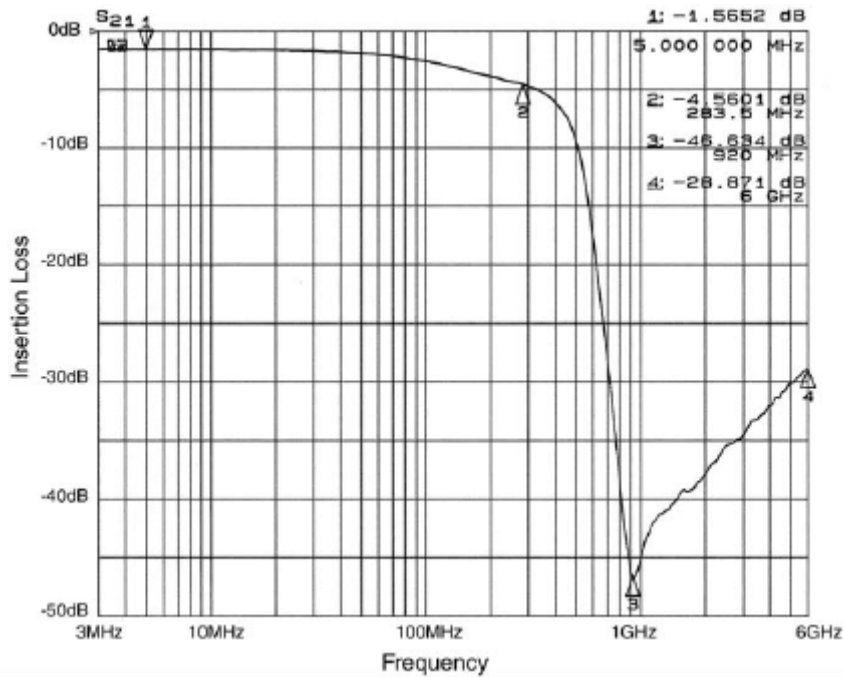


Figure 1. Insertion Loss vs. Frequency (A1-C1 to GND B1)

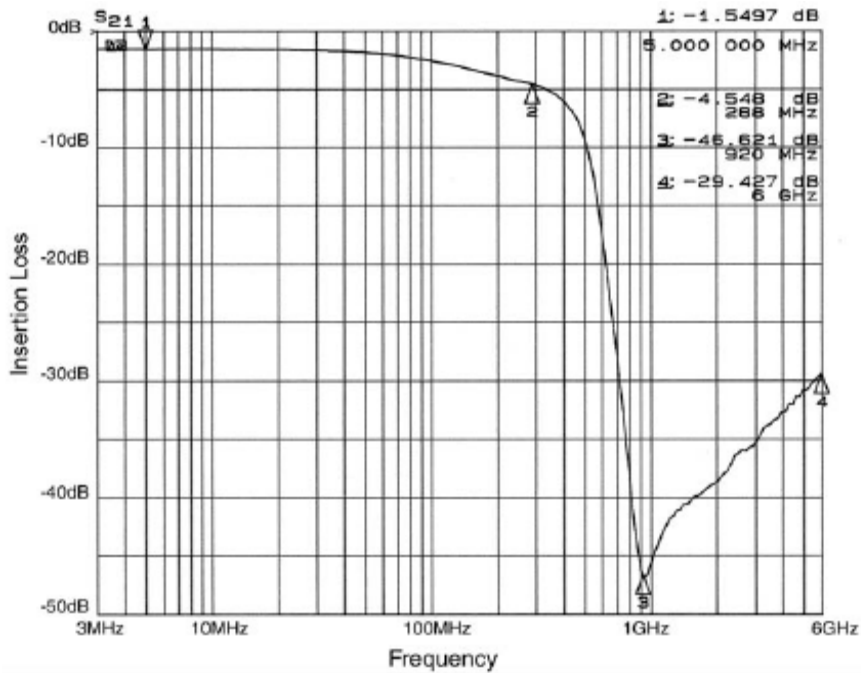


Figure 2. Insertion Loss vs. Frequency (A2-C2 to GND B1)

## Performance Information (cont'd)

Typical Filter Performance ( $T_A=25^\circ\text{C}$ , DC Bias=0V, 50 Ohm Environment)

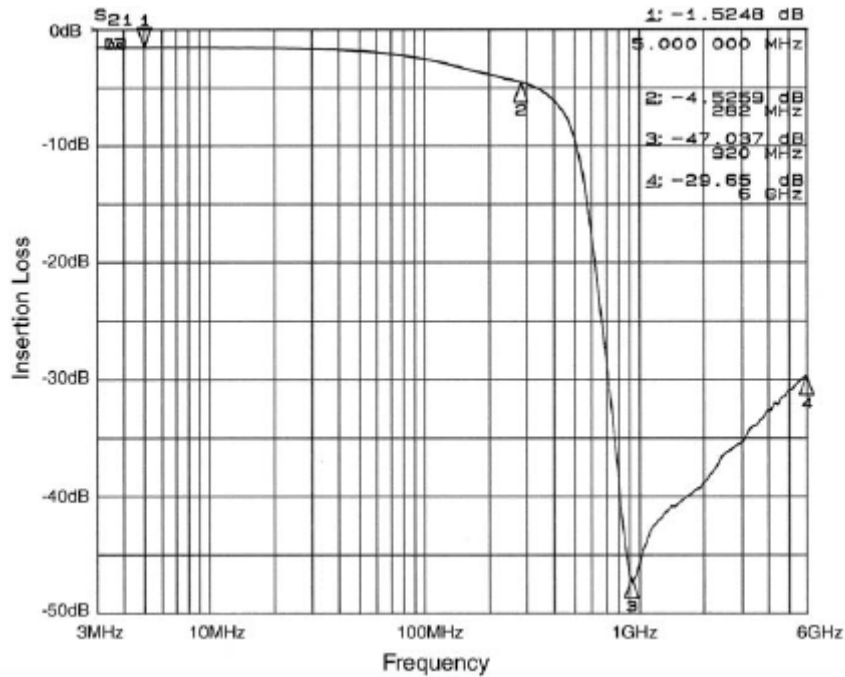


Figure 3. Insertion Loss vs. Frequency (A3-C3 to GND B2)

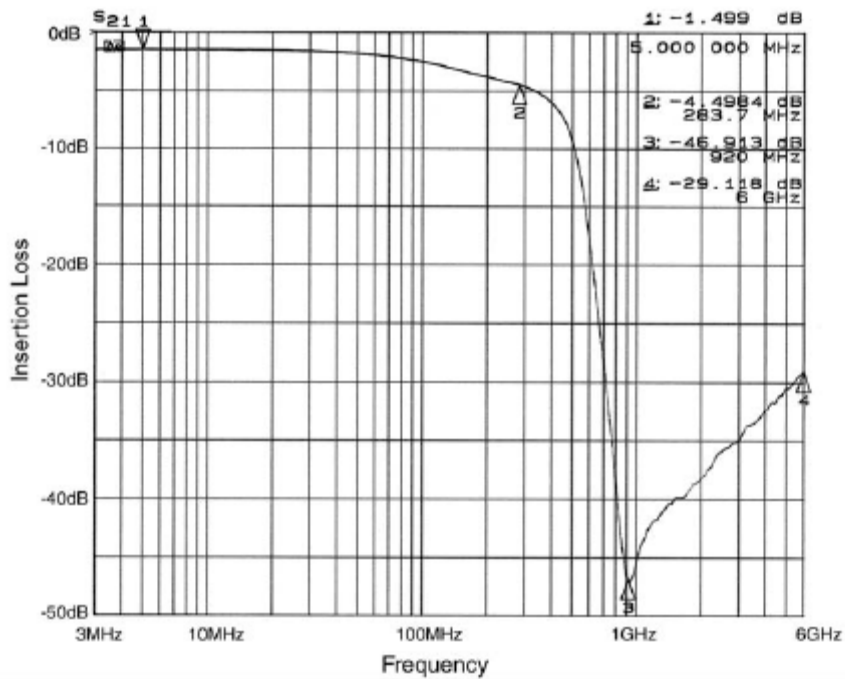


Figure 4. Insertion Loss vs. Frequency (A4-C4 to GND B2)

Performance Information (cont'd)

Typical Filter Performance ( $T_A=25^\circ\text{C}$ , DC Bias=0V, 50 Ohm Environment)

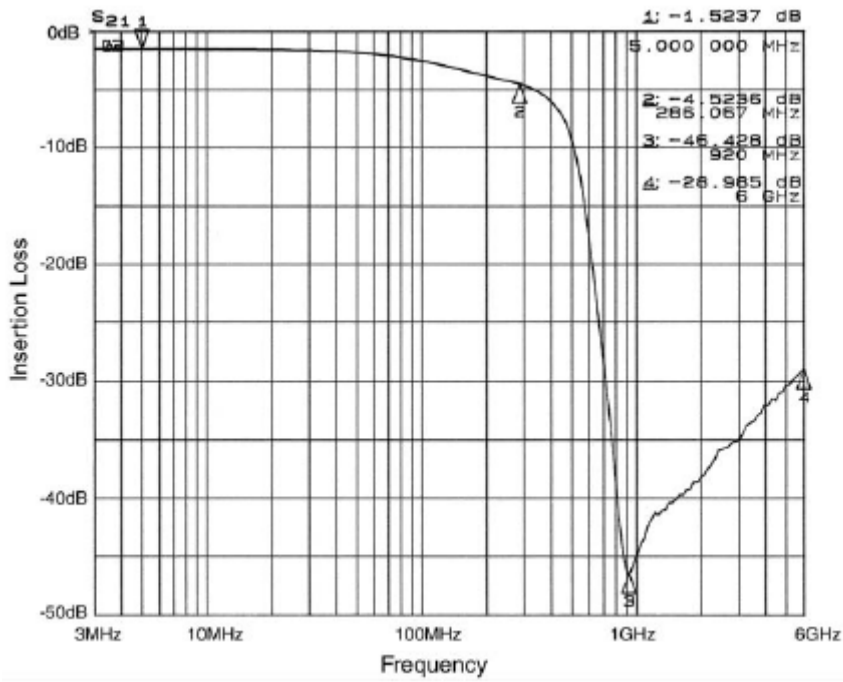


Figure 5. Insertion Loss vs. Frequency (A5-C5 to GND B3)

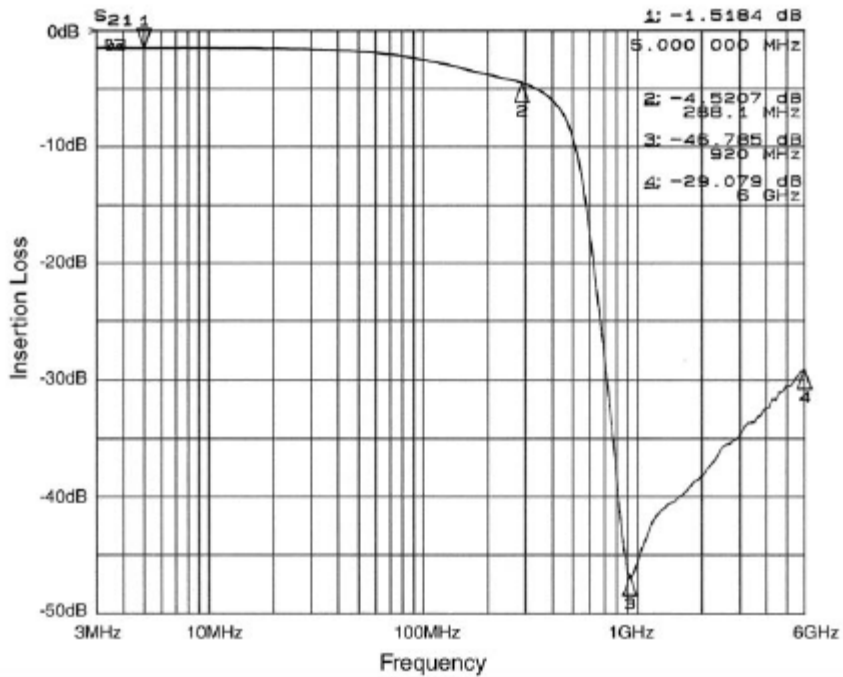
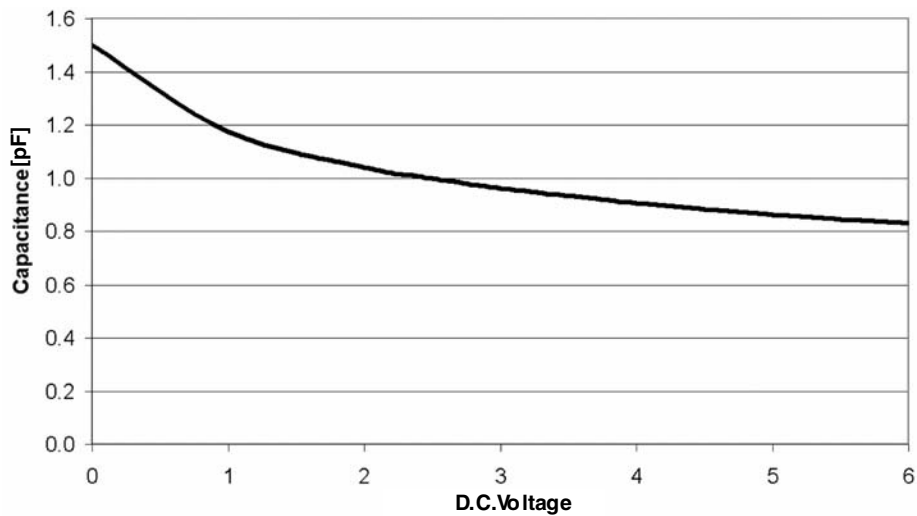


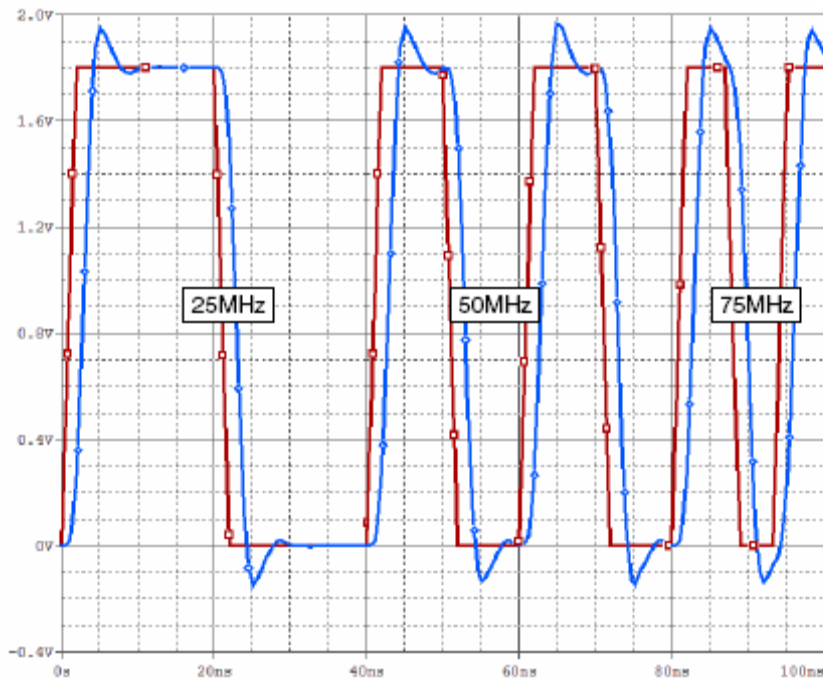
Figure 6. Insertion Loss vs. Frequency (A6-C6 to GND B3)

### Performance Information (cont'd)



**Figure 9. Filter Capacitance vs. Input Voltage over Temperature (normalized to capacitance at 2.5VDC and 25°C)**

### Transient Response Characteristics



**Figure 10. Simulated Transient Response (input signal risetime and falltime= 2ns, clocked at 25, 50 and 75 MHz, 15Ω Source Resistance, 5pF Load)**



## 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	$\pm 50\mu\text{m}$
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

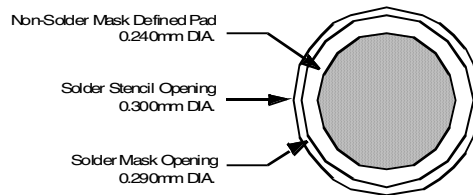


Figure 5. Recommended Non-Solder Mask Defined Pad Illustration

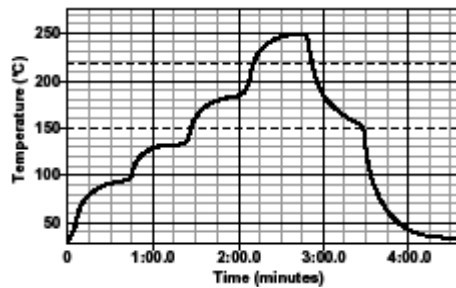


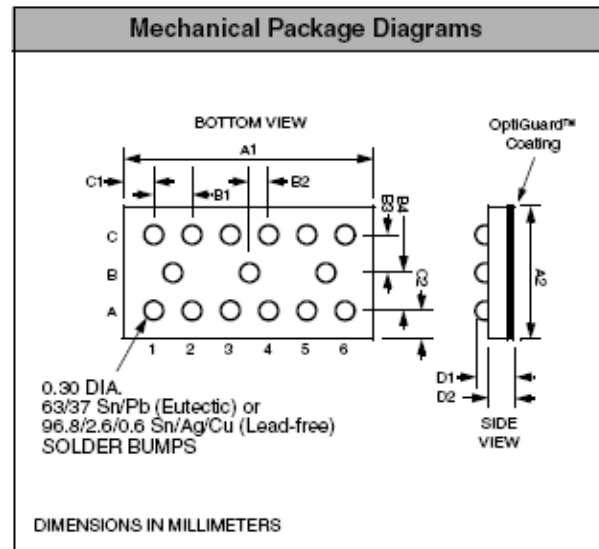
Figure 6. Lead-free (SnAgCu) Solder Ball Reflow Profile

## Mechanical Details

### CM1451-06CS/CP CSP Mechanical Specifications

CM1451-06CS/CP devices are supplied in a custom Chip Scale Package (CSP). Dimensions are presented below. For complete information on the CSP, 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	2.961	3.006	3.051	0.1166	0.1183	0.1201
A2	1.331	1.376	1.421	0.0524	0.0542	0.0559
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	0.203	0.253	0.303	0.0080	0.0100	0.0119
C2	0.203	0.253	0.303	0.0080	0.0100	0.0119
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						

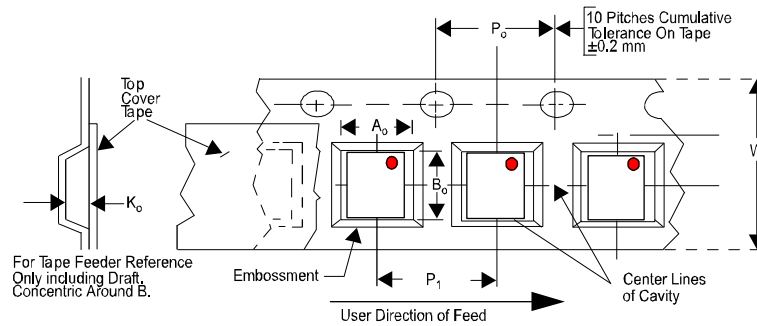


Package Dimensions for  
CM1451-06CS/CP Chip Scale Package

# CM1451

## CSP Tape and Reel Specifications

PART NUMBER	CHIP SIZE (mm)	POCKET SIZE (mm) $B_0 \times A_0 \times K_0$	TAPE WIDTH W	REEL DIAMETER	QTY PER REEL	$P_0$	$P_1$
CM1451-06	3.01 X 1.38 X 0.644	3.10 X 1.45 X 0.74	8mm	178mm (7")	3500	4mm	4mm



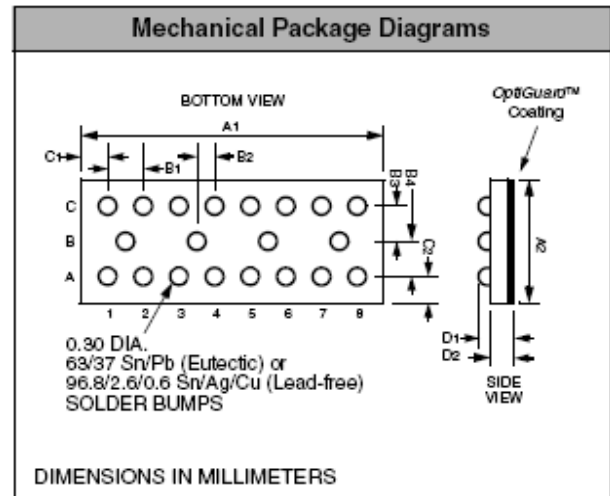
**Figure 12. Tape and Reel Mechanical Data**

## Mechanical Details (cont'd)

### CM1451-08CS/CP Mechanical Specifications

CM1451-08CS/CP devices are supplied in a custom Chip Scale Package (CSP). Dimensions are presented below. For complete information on the CSP, see the California Micro Devices CSP Package Information document.

PACKAGE DIMENSIONS						
Package	Custom CSP					
Bumps	20					
Dim	Millimeters			Inches		
	Min	Nom	Max	Min	Nom	Max
A1	3.961	4.006	4.051	0.1559	0.1577	0.1595
A2	1.331	1.376	1.421	0.0524	0.0542	0.0559
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	0.203	0.253	0.303	0.0080	0.0100	0.0119
C2	0.203	0.253	0.303	0.0080	0.0100	0.0119
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						

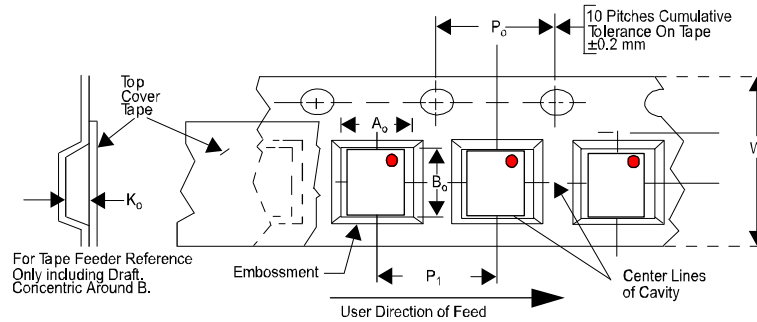


**Package Dimensions for  
CM1451-08CS/CP Chip Scale Package**

# CM1451

## CSP Tape and Reel Specifications

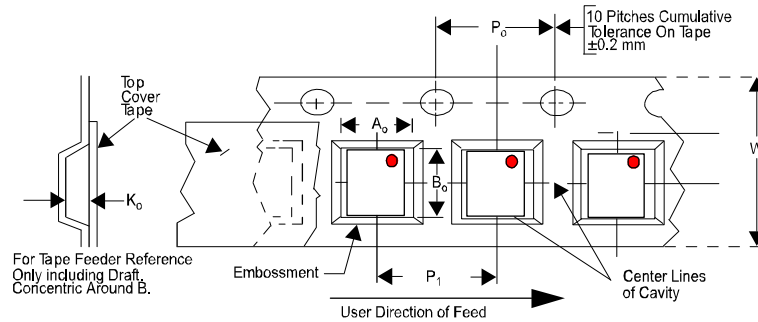
PART NUMBER	CHIP SIZE (mm)	POCKET SIZE (mm) $B_0 \times A_0 \times K_0$	TAPE WIDTH W	REEL DIAMETER	QTY PER REEL	$P_0$	$P_1$
CM1451-08	4.006 X 1.376 X 0.644	4.11 X 1.57 X 0.76	12mm	330mm (13")	3500	4mm	4mm




**Figure 13. Tape and Reel Mechanical Data**

**CSP Tape and Reel Specifications**

PART NUMBER	CHIP SIZE (mm)	POCKET SIZE (mm) $B_0 \times A_0 \times K_0$	TAPE WIDTH W	REEL DIAMETER	QTY PER REEL	$P_0$	$P_1$
CM1450-08	4.006 X 1.376 X 0.644	4.11 X 1.57 X 0.76	12mm	330mm (13")	3500	4mm	4mm



**Figure 15. Tape and Reel Mechanical Data**

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