

1-, 2- and 4-Channel Low Capacitance ESD Arrays

Features

- 1, 2, and 4 channels of ESD protection
- Provides ± 15 kV ESD protection on each channel per the IEC 61000-4-2 ESD requirements
- Channel loading capacitance of 1.6 pF typical
- Channel I/O to GND capacitance difference of 0.04pF typical
- Mutual capacitance of 0.13pF typical
- Minimal capacitance change with temperature and voltage
- Each I/O pin can withstand over 1000 ESD strikes
- SOT packages
- Lead-free versions available

Applications

- IEEE1394 Firewire[®] ports at 400Mbps / 800Mbps
- DVI ports, HDMI ports in notebooks, set top boxes, digital TVs, LCD displays
- Serial ATA ports in desktop PCs and hard disk drives
- PCI Express ports
- General purpose high-speed data line ESD protection

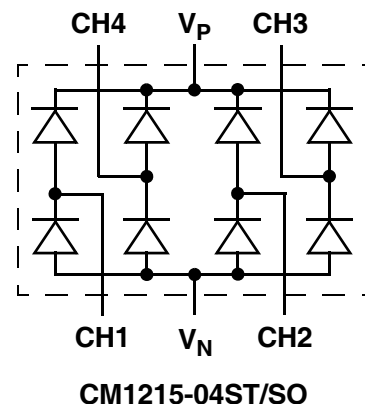
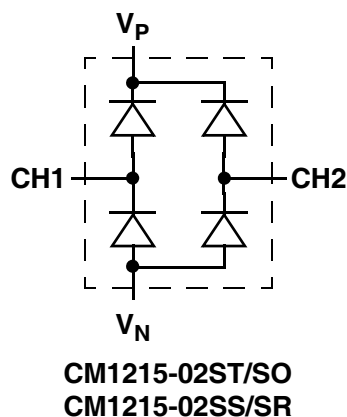
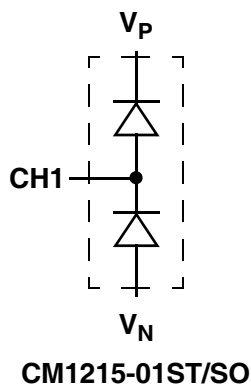
Product Description

The CM1215 family of diode arrays has been designed to provide ESD protection for electronic components or sub-systems requiring minimal capacitive loading. These devices are ideal for protecting systems with high data and clock rates or for circuits requiring low capacitive loading. Each ESD channel consists of a pair of diodes in series which steer the positive or negative ESD current pulse to either the positive (V_P) or negative (V_N) supply rail. The CM1215 will protect against ESD pulses up to ± 15 kV per the IEC 61000-4-2 standard.

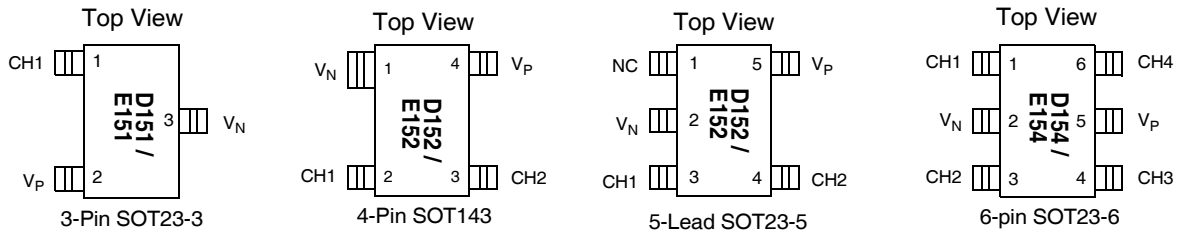
This device is particularly well-suited for protecting systems using high-speed ports such as USB2.0, IEEE1394 (Firewire[®], iLink[™]), Serial ATA, DVI, HDMI and corresponding ports in removable storage, digital camcorders, DVD-RW drives and other applications where extremely low loading capacitance with ESD protection are required in a small package footprint.

The CM1215 family of devices is available with optional lead-free finishing.

Simplified Electrical Schematic



PACKAGE / PINOUT DIAGRAM



Note: These drawings are not to scale.

Pin Configuration

PACKAGE PIN DESCRIPTIONS

| PIN NAMER | SOT23-3 | SOT143 | SOT23-5 | SOT23-6 | TYPE | DESCRIPTION |
|----------------|---------|---------|---------|---------|------|------------------------------|
| | PIN NO. | PIN NO. | PIN NO. | PIN NO. | | |
| CH1 | 1 | 2 | 3 | 1 | I/O | ESD Channel |
| V _N | 3 | 1 | 2 | 2 | GND | Negative voltage supply rail |
| CH2 | – | 3 | 4 | 3 | I/O | ESD Channel |
| CH3 | – | – | – | 4 | I/O | ESD Channel |
| V _P | 2 | 4 | 5 | 5 | PWR | Positive voltage supply rail |
| CH4 | – | – | – | 6 | I/O | ESD Channel |
| N/C | – | – | 1 | – | – | No Connection |

Ordering Information

PART NUMBERING INFORMATION

| Pins | Package | Standard Finish | | Lead-free Finish | |
|------|---------|-----------------------------------|--------------|-----------------------------------|--------------|
| | | Ordering Part Number ¹ | Part Marking | Ordering Part Number ¹ | Part Marking |
| 3 | SOT23-3 | CM1215-01ST | D151 | CM1215-01SO | E151 |
| 4 | SOT143 | CM1215-02SS | D152 | CM1215-02SR | E152 |
| 5 | SOT23-5 | CM1215-02ST | D152 | CM1215-02SO | E152 |
| 6 | SOT23-6 | CM1215-04ST | D154 | CM1215-04SO | E154 |

Specifications

| ABSOLUTE MAXIMUM RATINGS | | |
|--|----------------------------|-------|
| PARAMETER | RATING | UNITS |
| Operating Supply Voltage (V_P-V_N) | 6 | V |
| Diode Forward DC Current (Note 1) | 20 | mA |
| DC Voltage at any Channel Input | $(V_N-0.5)$ to $(V_P+0.5)$ | V |
| Operating Temperature Range | | |
| Ambient | -40 to +85 | °C |
| Junction | -40 to +125 | °C |
| Storage Temperature Range | -40 to +150 | °C |

| STANDARD OPERATING CONDITIONS | | |
|----------------------------------|------------|-------|
| PARAMETER | RATING | UNITS |
| Temperature Range (Ambient) | -40 to +85 | °C |
| Package Power Rating | | |
| SOT23-3 Package (CM1215-01ST/SO) | 225 | mW |
| SOT143 Package (CM1215-02SS/SR) | 225 | mW |
| SOT23-5 Package (CM1215-02ST/SO) | 225 | mW |
| SOT23-6 Package (CM1215-04ST/SO) | 225 | mW |

Specifications (cont'd)

| ELECTRICAL OPERATING CHARACTERISTICS NOTE 1 | | | | | | |
|--|---|--|------------|----------------------------|--------------|----------------------|
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
| 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 | μA |
| V_F | Diode Forward Voltage Top Diode Bottom Diode | $I_F = 20mA$; $T_A = 25^\circ C$ | 0.6 0.6 | 0.8 0.8 | 0.95 0.95 | V V |
| I_{LEAK} | Channel Leakage Current | $T_A = 25^\circ C$; $V_P = 5V$, $V_N = 0V$ | | ± 0.1 | ± 1.0 | μA |
| C_{IN} | Channel Input Capacitance | At 1 MHz, $V_P = 3.3V$, $V_N = 0V$, $V_{IN} = 1.65V$; Note2 | | 1.6 | 2.0 | pF |
| ΔC_{IN} | Channel I/O to GND Capacitance Difference | Note 2 | | 0.04 | | pF |
| C_{MUTUAL} | Mutual Capacitance | $(V_P-V_N) = 3.3V$; Note 2 | | 0.13 | | pF |
| V_{ESD} | ESD Protection Peak Discharge Voltage at any channel input, in system, contact discharge per IEC 61000-4-2 standard | Notes 2, 3, and 4; $T_A = 25^\circ C$ | ± 15 | | | kV |
| V_{CL} | Channel Clamp Voltage Positive Transients Negative Transients | $I_{PP} = 1A$, $t_P = 8/20\mu S$; $T_A = 25^\circ C$; Notes 2 | | $V_P + 1.5$ $V_N - 1.5$ | | V V |
| R_{DYN} | Dynamic Resistance Positive transients Negative transients | $I_{PP} = 1A$, $t_P = 8/20\mu S$; $T_A = 25^\circ C$; Notes 2 | | 0.4 0.4 | | Ω Ω |

Note 1: All parameters specified at $T_A = -40^\circ C$ to $+85^\circ C$ unless otherwise noted.

Note 2: These parameters guaranteed by design and characterization.

Note 3: Standard IEC 61000-4-2 with $C_{Discharge} = 150pF$, $R_{Discharge} = 330\Omega$, $V_P = 3.3V$, V_N grounded.

Note 4: From I/O pins to V_P or V_N only. V_P bypassed to V_N with low ESR 0.2 μF ceramic capacitor.

Performance Characteristics

Input Channel Capacitance Performance Curve

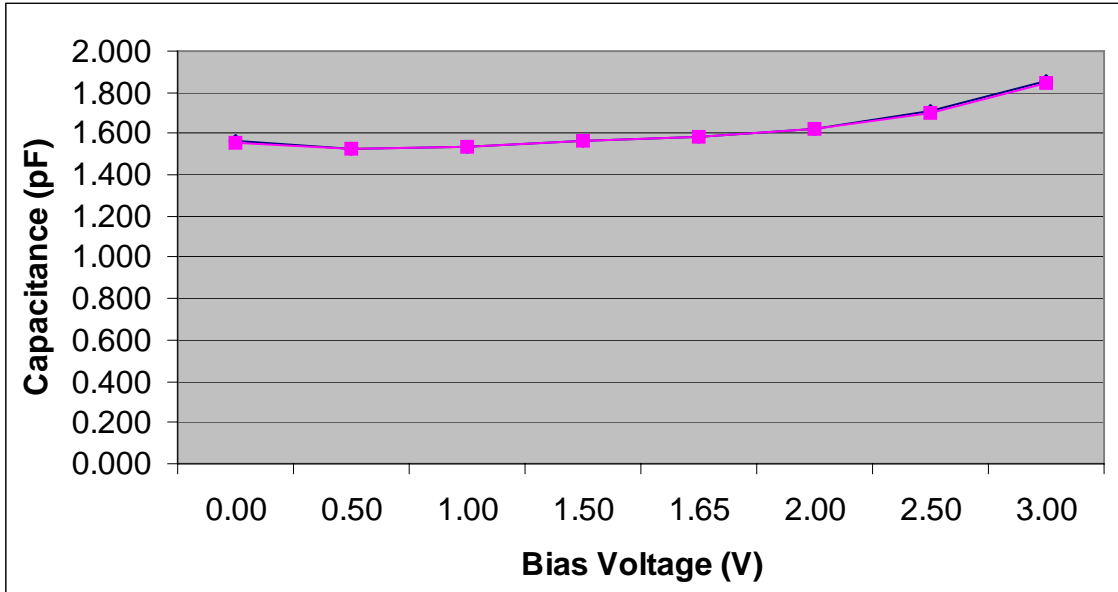


Figure 1. Typical Variation of C_{IN} vs. V_{IN}
 (f = 1MHz, V_P= 3.3V, V_N = 0V, 0.1μF chip capacitor between V_P and V_N, T_A = 25°C)

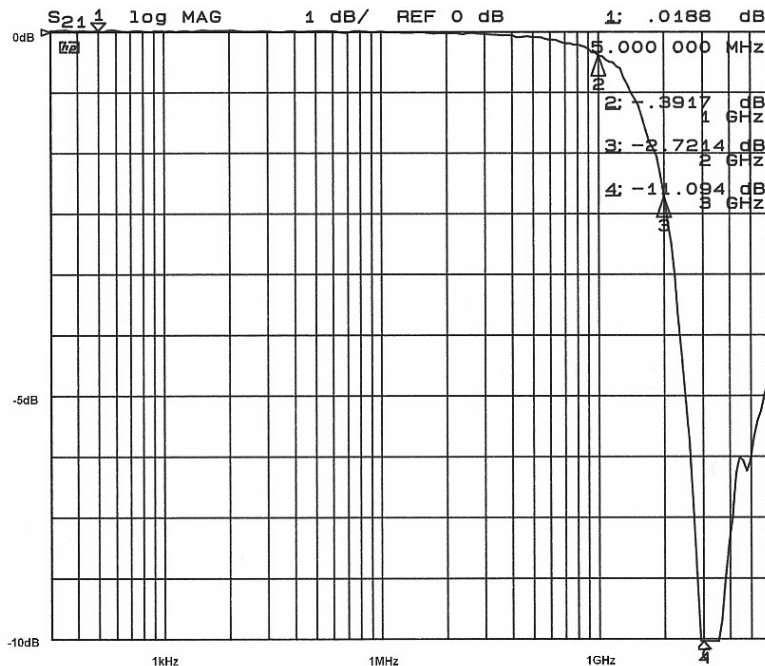


Figure 2. Typical Filter Performance (nominal conditions unless specified otherwise, 50 Ohm Environment)

APPLICATION INFORMATION

Design Considerations

In order to realize the maximum protection against ESD pulses, care must be taken in the PCB layout to minimize parasitic series inductances on the Supply/Ground rails as well as the signal trace segment between the signal input (typically a connector) and the ESD protection device. Refer to Figure 1, which illustrates an example of a positive ESD pulse striking an input channel. The parasitic series inductance back to the power supply is represented by L1 and L2. The voltage VCL on the line being protected is:

$$V_{CL} = \text{Fwd voltage drop of } D_1 + V_{\text{SUPPLY}} + L_1 \times d(I_{\text{ESD}}) / dt + L_2 \times d(I_{\text{ESD}}) / dt$$

where IESD is the ESD current pulse, and VSUPPLY is the positive supply voltage.

An ESD current pulse can rise from zero to its peak value in a very short time. As an example, a level 4 contact discharge per the IEC61000-4-2 standard results in a current pulse that rises from zero to 30 Amps in 1ns. Here d(IESD)/dt can be approximated by d(IESD)/dt, or 30/(1x10-9). So just 10nH of series inductance (L1 and L2 combined) will lead to a 300V increment in VCL!

Similarly for negative ESD pulses, parasitic series inductance from the VN pin to the ground rail will lead to drastically increased negative voltage on the line being protected.

As a general rule, the ESD Protection Array should be located as close as possible to the point of entry of expected electrostatic discharges. The power supply bypass capacitor mentioned above should be as close to the VP pin of the Protection Array as possible, with minimum PCB trace lengths to the power supply, ground planes and between the signal input and the ESD device to minimize stray series inductance.

Additional Information

See also California Micro Devices Application Note AP-209, "Design Considerations for ESD Protection", in the Applications section at www.calmicro.com.

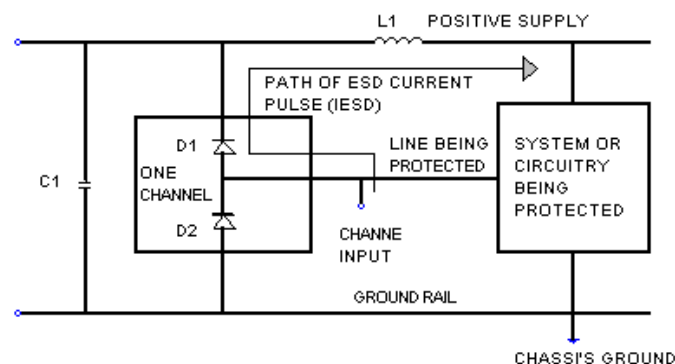


Figure 3. Application of Positive ESD Pulse between Input Channel and Ground

Mechanical Details

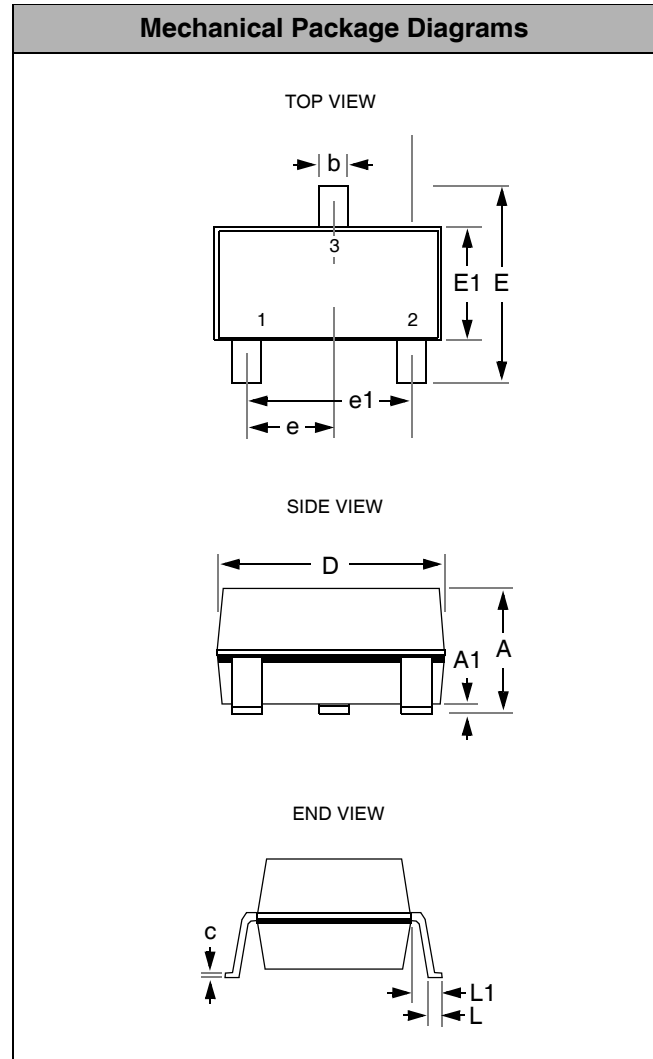
The CM1215 is supplied in SOT23-3, SOT143-4, SOT23-5 and SOT23-6 packages with a lead-free finishing option. These package drawings are presented on the following pages.

SOT23-3 Mechanical Specifications

CM1215-01ST/SO devices are packaged in 3-pin SOT23 packages. Dimensions are presented below.

For complete information on the SOT23-3 package, see the California Micro Devices SOT23 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|------------------------------------|--------------------------------|------|------------|--------|
| Package | SOT23-3 (JEDEC name is TO-236) | | | |
| Pins | 3 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.89 | 1.12 | 0.0350 | 0.0441 |
| A1 | 0.01 | 0.10 | 0.0004 | 0.0039 |
| b | 0.30 | 0.50 | 0.0118 | 0.0197 |
| c | 0.08 | 0.20 | 0.0031 | 0.0079 |
| D | 2.80 | 3.04 | 0.1102 | 0.1197 |
| E | 2.10 | 2.64 | 0.0827 | 0.1039 |
| E1 | 1.20 | 1.40 | 0.0472 | 0.0551 |
| e | 0.95 BSC | | 0.0374 BSC | |
| e1 | 1.90 BSC | | 0.0748 BSC | |
| L | 0.40 | 0.60 | 0.0157 | 0.0236 |
| L1 | 0.54 REF | | 0.0213 REF | |
| # per tape and reel | 3000 pieces | | | |
| Controlling dimension: millimeters | | | | |



Package Dimensions for SOT23-3.

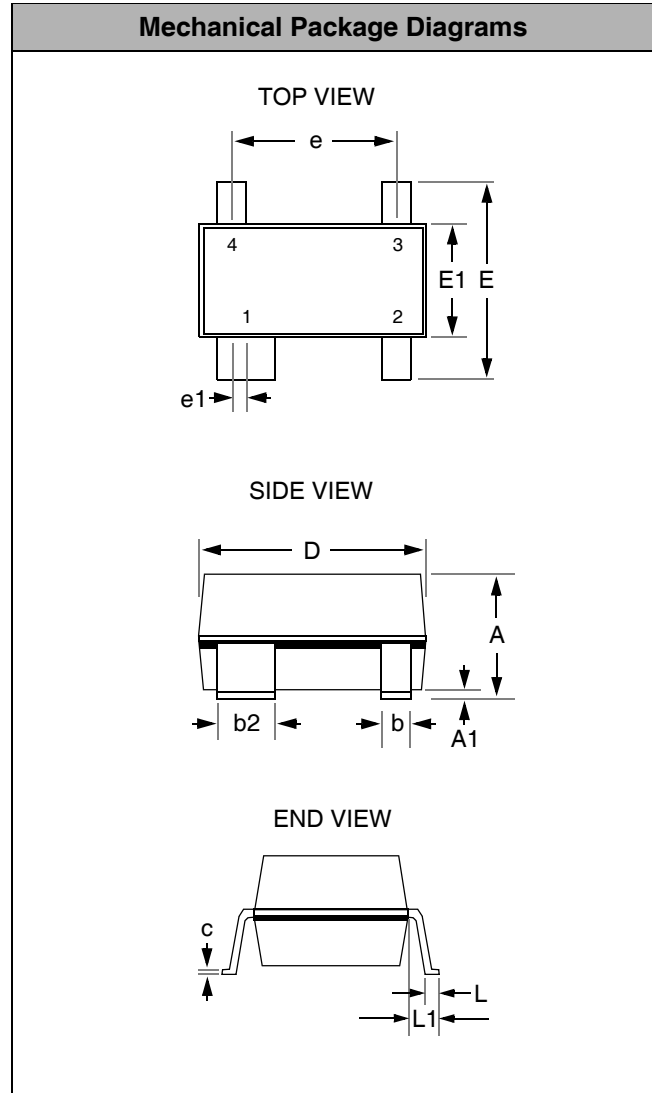
Mechanical Details (cont'd)

SOT143 Mechanical Specifications

CM1215-02SS/SR devices are supplied in 4-pin SOT143 packages. Dimensions are presented below.

For complete information on the SOT143 package, see the California Micro Devices SOT143 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|------------------------------------|-------------|------|-----------|-------|
| Package | SOT143 | | | |
| Pins | 4 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.80 | 1.22 | 0.031 | 0.048 |
| A1 | 0.05 | 0.15 | 0.002 | 0.006 |
| b | 0.30 | 0.50 | 0.012 | 0.019 |
| b2 | 0.76 | 0.89 | 0.030 | 0.035 |
| c | 0.08 | 0.20 | 0.003 | 0.008 |
| D | 2.80 | 3.04 | 0.110 | 0.119 |
| E | 2.10 | 2.64 | 0.082 | 0.103 |
| E1 | 1.20 | 1.40 | 0.047 | 0.055 |
| e | 1.92 BSC | | 0.075 BSC | |
| e1 | 0.20 BSC | | 0.008 BSC | |
| L | 0.4 | 0.6 | 0.016 | 0.024 |
| L1 | 0.54 REF | | 0.021 REF | |
| # per tape and reel | 3000 pieces | | | |
| Controlling dimension: millimeters | | | | |



Package Dimensions for SOT143.

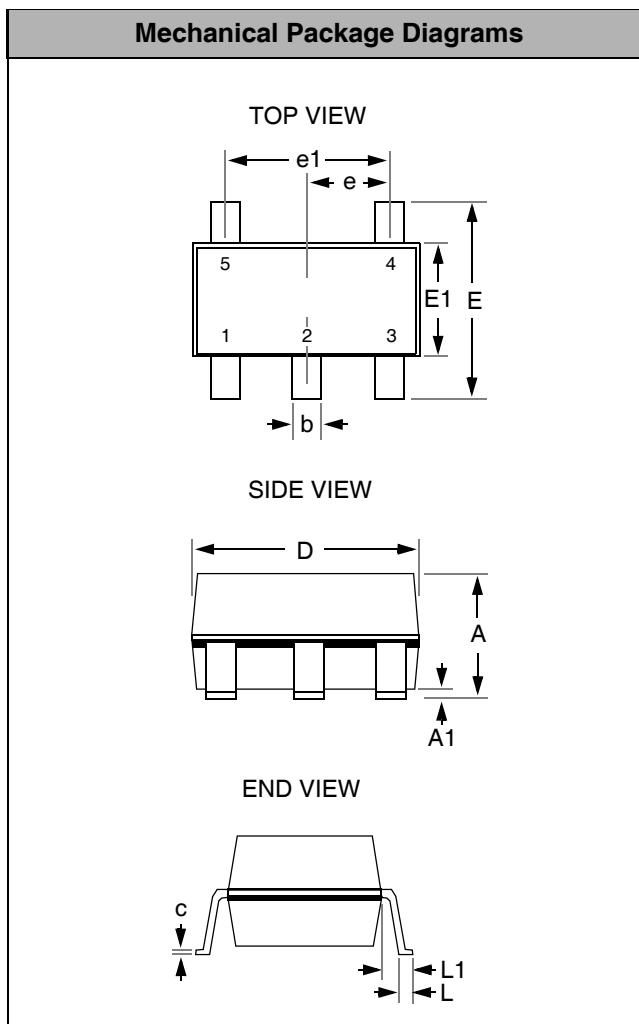
Mechanical Details (cont'd)

SOT23-5 Mechanical Specifications

CM1215-02ST/SO devices are supplied in 5-pin SOT23 packages. Dimensions are presented below.

For complete information on the SOT23-5 package, see the California Micro Devices SOT23 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|------------------------------------|--------------------------------|------|------------|--------|
| Package | SOT23-5 (JEDEC name is MO-178) | | | |
| Pins | 5 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | -- | 1.45 | -- | 0.0571 |
| A1 | 0.00 | 0.15 | 0.0000 | 0.0059 |
| b | 0.30 | 0.50 | 0.0118 | 0.0197 |
| c | 0.08 | 0.22 | 0.0031 | 0.0087 |
| D | 2.75 | 3.05 | 0.1083 | 0.1201 |
| E | 2.60 | 3.00 | 0.1024 | 0.1181 |
| E1 | 1.45 | 1.75 | 0.0571 | 0.0689 |
| e | 0.95 BSC | | 0.0374 BSC | |
| e1 | 1.90 BSC | | 0.0748 BSC | |
| L | 0.30 | 0.60 | 0.0118 | 0.0236 |
| L1 | 0.60 REF | | 0.0236 REF | |
| # per tape and reel | 3000 pieces | | | |
| Controlling dimension: millimeters | | | | |



Package Dimensions for SOT23-5.

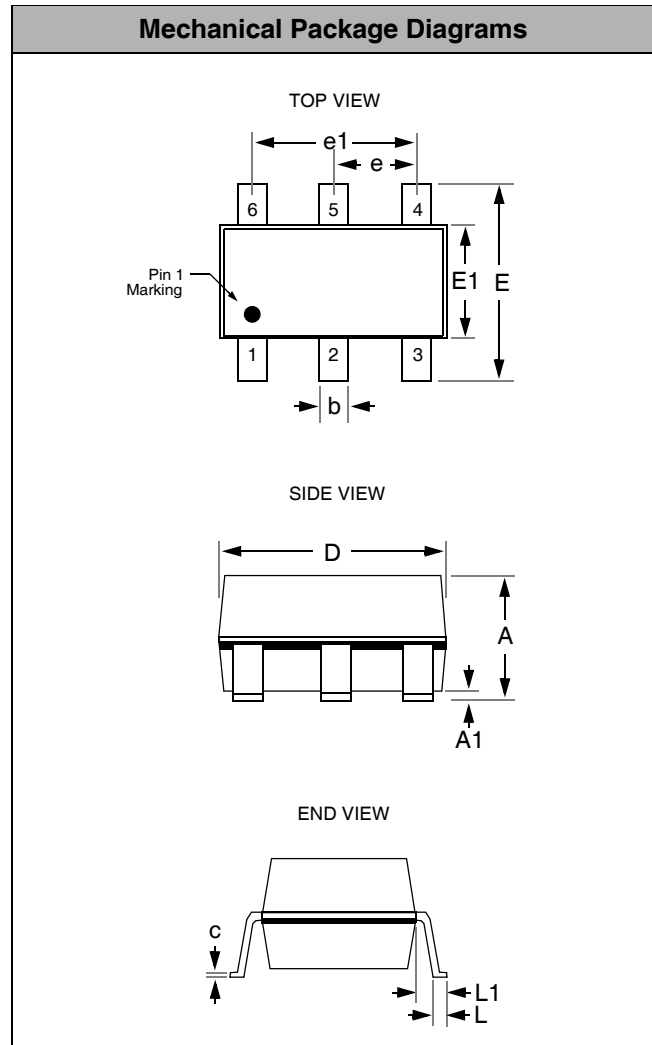
Mechanical Details (cont'd)

SOT23-6 Mechanical Specifications

CM1215-04ST/SO devices are supplied in 6-pin SOT23 packages. Dimensions are presented below.

For complete information on the SOT23-6 package, see the California Micro Devices SOT23 Package Information document.

| PACKAGE DIMENSIONS | | | | |
|------------------------------------|--------------------------------|------------|---------------|------------|
| Package | SOT23-6 (JEDEC name is MO-178) | | | |
| Pins | 6 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | -- | 1.45 | -- | 0.0571 |
| A1 | 0.00 | 0.15 | 0.0000 | 0.0059 |
| b | 0.30 | 0.50 | 0.0118 | 0.0197 |
| c | 0.08 | 0.22 | 0.0031 | 0.0087 |
| D | 2.75 | 3.05 | 0.1083 | 0.1201 |
| E | 2.60 | 3.00 | 0.1024 | 0.1181 |
| E1 | 1.45 | 1.75 | 0.0571 | 0.0689 |
| e | 0.95 BSC | | 0.0374 BSC | |
| e1 | 1.90 BSC | | 0.0748 BSC | |
| L | 0.30 | 0.60 | 0.0118 | 0.0236 |
| L1 | 0.60 REF | | 0.0236 REF | |
| # per tape and reel | 3000 pieces | | | |
| Controlling dimension: millimeters | | | | |



Package Dimensions for SOT23-6.