



Features

- Two and four channels of ESD protection
- Provides ESD protection to IEC61000-4-2
 - $\pm 8\text{kV}$ contact discharge
- Low loading capacitance of 2.0pF max.
- Low clamping voltage
- Channel I/O to I/O capacitance 1.5pF 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 RoHS-compliant, lead-free SOT and MSOP packages

Applications

- 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

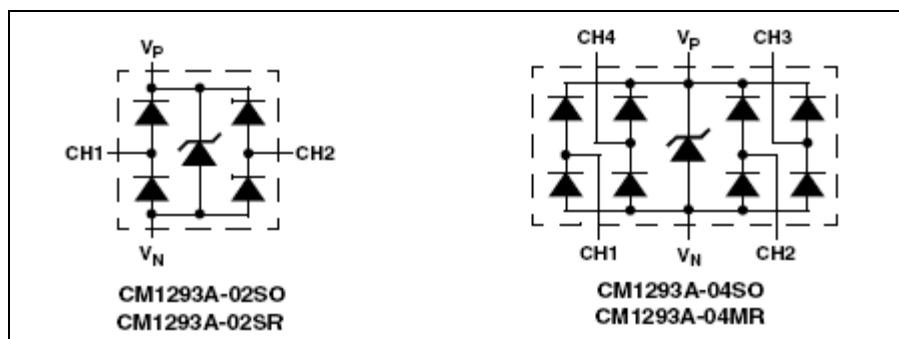
Product Description

The CM1293A family of diode arrays has been designed to provide ESD protection for electronic components or subsystems 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 that steer the positive or negative ESD current pulse to either the positive (V_P) or negative (V_N) supply rail. A Zener diode is embedded between V_P and V_N which helps protect the V_{CC} rail against ESD strikes. The CM1293A protects against ESD pulses up to $\pm 8\text{kV}$ contact discharge) per the IEC 61000-4-2 Level 4 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.

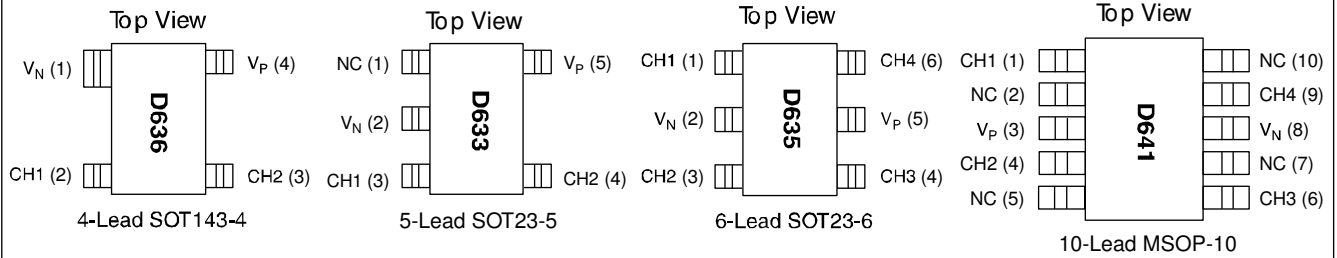
The CM1293A family of devices is available with RoHS-compliant, lead-free finishing.

Block Diagram



*Standard test condition is IEC61000-4-2 level 4 test circuit with each pin subjected to $\pm 8\text{kV}$ contact discharge for 1000 pulses. Discharges are timed at 1 second intervals and all 1000 strikes are completed in one continuous test run. The part is then subjected to standard production test to verify that all of the tested parameters are within spec after the 1000 strikes.

PACKAGE / PINOUT DIAGRAMS



Note: These drawings are not to scale.

PIN DESCRIPTIONS

| 2-CHANNEL, 4-LEAD SOT143-4 PACKAGE | | | | 2-CHANNEL, 5-LEAD SOT23-5 PACKAGE | | | |
|------------------------------------|----------------|------|------------------------------|-----------------------------------|----------------|------|------------------------------|
| PIN | NAME | TYPE | DESCRIPTION | PIN | NAME | TYPE | DESCRIPTION |
| 1 | V _N | GND | Negative voltage supply rail | 1 | NC | | No connect |
| 2 | CH1 | I/O | ESD Channel | 2 | V _N | GND | Negative voltage supply rail |
| 3 | CH2 | I/O | ESD Channel | 3 | CH1 | I/O | ESD Channel |
| 4 | V _P | PWR | Positive voltage supply rail | 4 | CH2 | I/O | ESD Channel |
| | | | | 5 | V _P | PWR | Positive voltage supply rail |
| 4-CHANNEL, 10-LEAD MSOP-10 PACKAGE | | | | 4-CHANNEL, 6-LEAD SOT23-6 PACKAGE | | | |
| PIN | NAME | TYPE | DESCRIPTION | PIN | NAME | TYPE | DESCRIPTION |
| 1 | CH1 | I/O | ESD Channel | 1 | CH1 | I/O | ESD Channel |
| 2 | NC | | No connect | 2 | V _N | GND | Negative voltage supply rail |
| 3 | V _P | PWR | Positive voltage supply rail | 3 | CH2 | I/O | ESD Channel |
| 4 | CH2 | I/O | ESD Channel | 4 | CH3 | I/O | ESD Channel |
| 5 | NC | | No connect | 5 | V _P | PWR | Positive voltage supply rail |
| 6 | CH3 | I/O | ESD Channel | 6 | CH4 | I/O | ESD Channel |
| 7 | NC | | No connect | | | | |
| 8 | V _N | GND | Negative voltage supply rail | | | | |
| 9 | CH4 | I/O | ESD Channel | | | | |
| 10 | NC | | No connect | | | | |

Ordering Information

PART NUMBERING INFORMATION

| # of Channels | Leads | Package | Lead-free Finish | |
|---------------|-------|----------|-----------------------------------|--------------|
| | | | Ordering Part Number ¹ | Part Marking |
| 2 | 4 | SOT143-4 | CM1293A-02SR | D636 |
| 2 | 5 | SOT23-5 | CM1293A-02SO | D633 |
| 4 | 6 | SOT23-6 | CM1293A-04SO | D635 |
| 4 | 10 | MSOP-10 | CM1293A-04MR | D641 |

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

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 |
| Package Power Rating | | |
| SOT143-4 Package (CM1293A-02SR) | 225 | mW |
| SOT23-5 Package (CM1293A-02SO) | 225 | mW |
| SOT23-6 Package (CM1293A-04SO) | 225 | mW |
| MSOP-10 Package (CM1293A-04MR) | 400 | mW |

Specifications (cont'd)**ELECTRICAL OPERATING CHARACTERISTICS¹**

| 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 Top Diode Bottom Diode | $I_F = 8mA; T_A = 25^\circ C$ | 0.60 0.60 | 0.80 0.80 | 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, $V_P = 3.3V, V_N = 0V, V_{IN} = 1.65V$ | | | 2.0 | pF |
| ΔC_{IO} | Channel I/O to I/O capacitance | | | 1.5 | | pF |
| V_{ESD} | ESD Protection Peak Discharge Voltage at any channel input, in system Contact discharge per IEC 61000-4-2 standard | Notes 3 and 4; $T_A = 25^\circ C$ | | ± 8 | | kV |
| V_{CL} | Channel Clamp Voltage Positive Transients Negative Transients | $I_{PP} = 1A, t_p = 8/20\mu s; T_A = 25^\circ C; \text{Notes 4}$ | | +9.9 -1.6 | | V V |
| R_{DYN} | Dynamic Resistance Positive Transients Negative Transients | $I_{PP} = 1A, t_p = 8/20\mu s; T_A = 25^\circ C; \text{Notes 4}$ | | 0.96 0.5 | | Ω Ω |

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

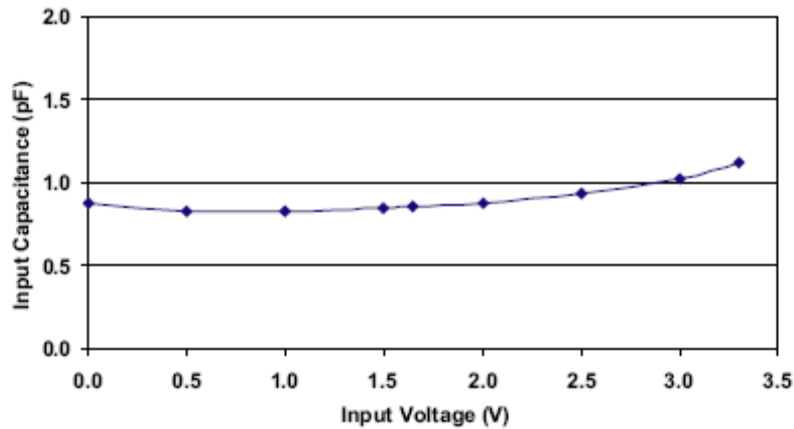
Note 2: Human Body Model per MIL-STD-883, Method 3015, $C_{Discharge} = 100pF, R_{Discharge} = 1.5K\Omega, V_P = 3.3V, V_N$ grounded.

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

Note 4: These measurements performed with no external capacitor on V_P .

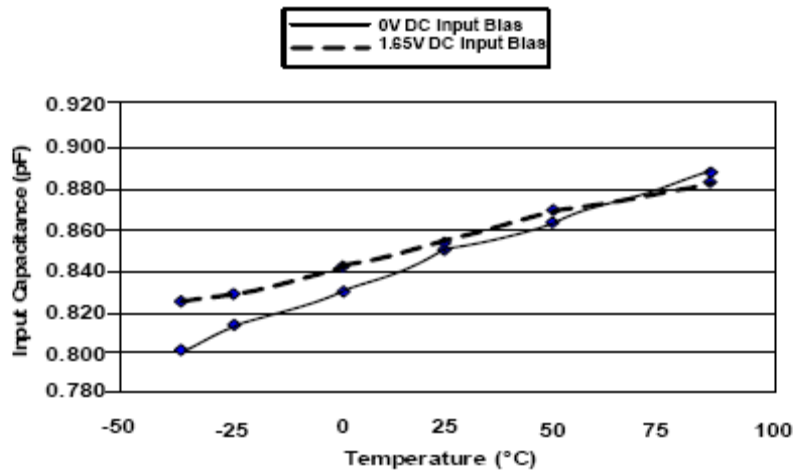
Performance Information

Input Channel Capacitance Performance Curves



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

($f=1\text{MHz}$, $V_P = 3.3\text{V}$, $V_N = 0\text{V}$, $0.1\ \mu\text{F}$ chip capacitor between V_P and V_N , 25°C)



Typical Variation of C_{IN} vs. Temp

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

Performance Information (cont'd)

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

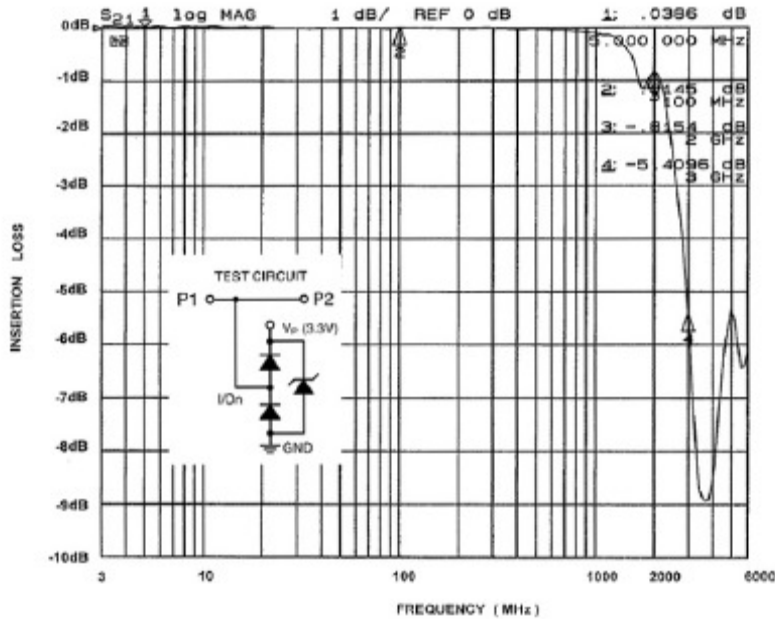


Figure 1. Insertion Loss (S21) VS. Frequency (0V DC Bias, $V_p=3.3V$)

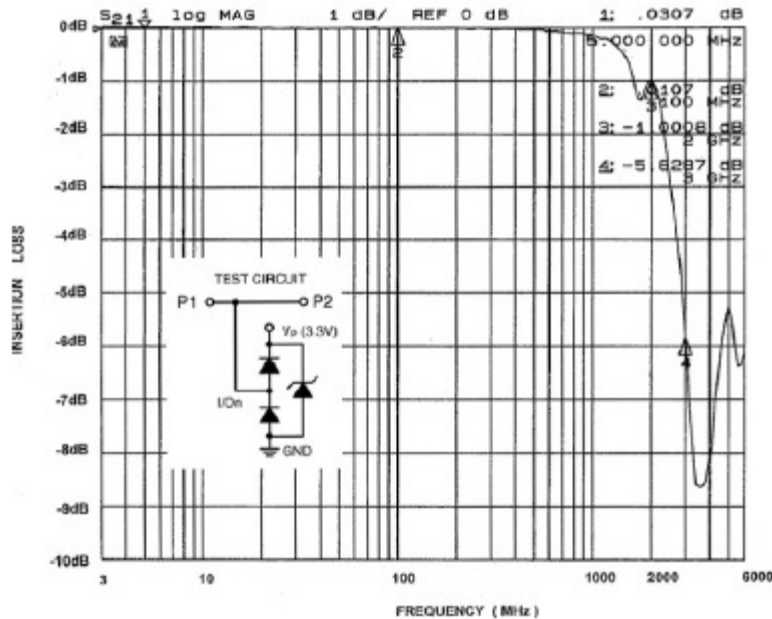


Figure 2. Insertion Loss (S21) VS. Frequency (2.5V DC Bias, $V_p=3.3V$)

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 3](#), 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 L_1 and L_2 . The voltage V_{CL} on the line being protected is:

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

where I_{ESD} is the ESD current pulse, and V_{SUPPLY} 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 $d(I_{ESD})/dt$ can be approximated by $\Delta I_{ESD} / \Delta t$, or $30 / (1 \times 10^{-9})$. So just 10nH of series inductance (L_1 and L_2 combined) will lead to a 300V increment in V_{CL} !

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

The CM1293 has an integrated Zener diode between V_P and V_N . This greatly reduces the effect of supply rail inductance L_2 on V_{CL} by clamping V_P at the breakdown voltage of the Zener diode. However, for the lowest possible V_{CL} , especially when V_P is biased at a voltage significantly below the Zener breakdown voltage, it is recommended that a 0.22µF ceramic chip capacitor be connected between V_P and the ground plane.

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 V_P 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.

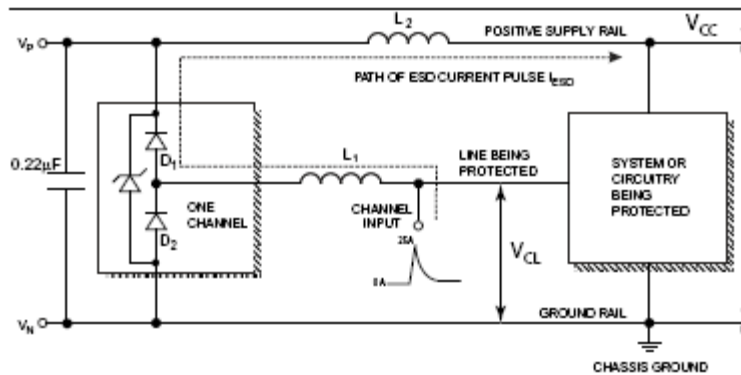


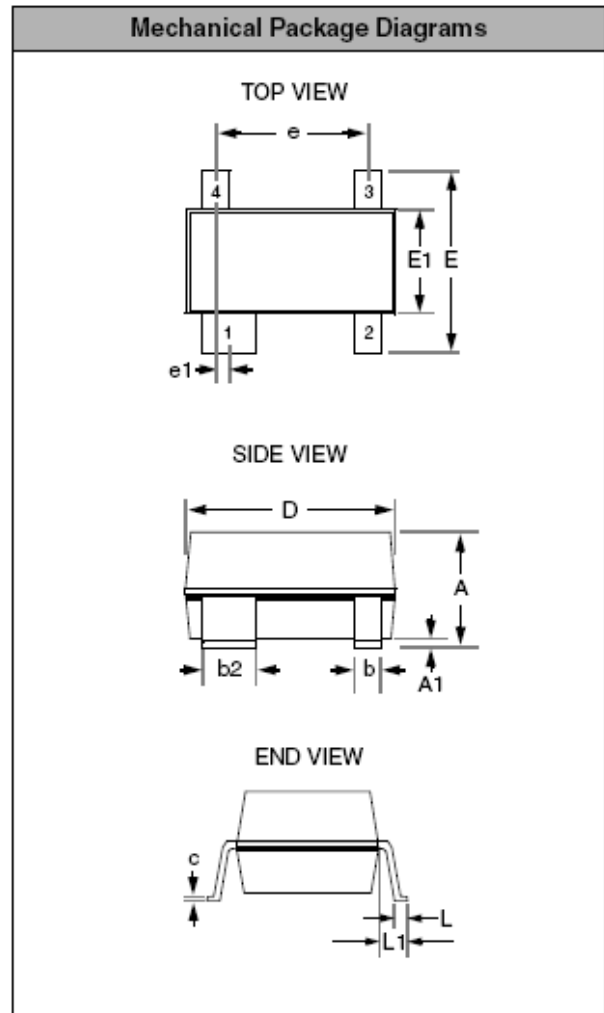
Figure 3. Application of Positive ESD Pulse between Input Channel and Ground

Mechanical Details

SOT143 Mechanical Specifications

Dimensions for CM1293A-02SR devices supplied in 4-pin SOT143 packages are presented below.

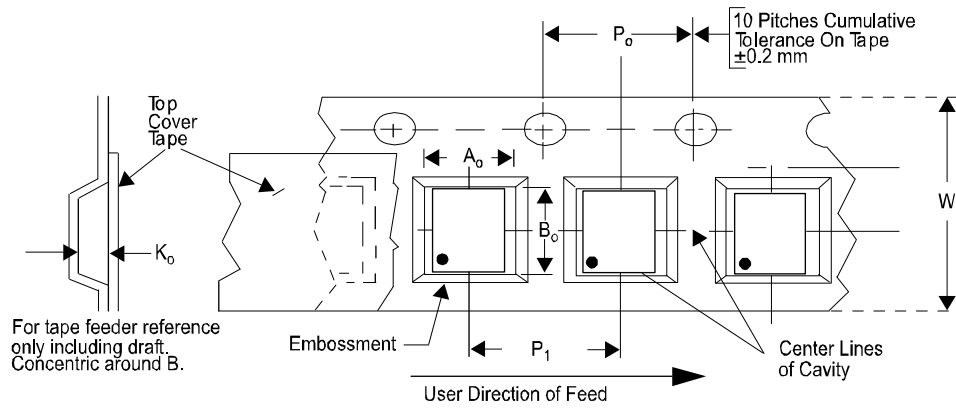
| PACKAGE DIMENSIONS | | | | |
|------------------------------------|-------------|------|-----------|-------|
| Package | SOT143 | | | |
| Pins | 4 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.80 | 1.22 | 0.031 | 0.048 |
| A1 | 0.05 | 0.15 | 0.002 | 0.006 |
| 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

Tape and Reel Specifications

| PART NUMBER | PACKAGE SIZE (mm) | POCKET SIZE (mm) $B_o \times A_o \times K_o$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | P_o | P_1 |
|--------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1293A-02SR | 2.92 X 2.37 X 1.01 | 2.60 X 3.15 X 1.20 | 8mm | 178mm (7") | 3000 | 4mm | 4mm |

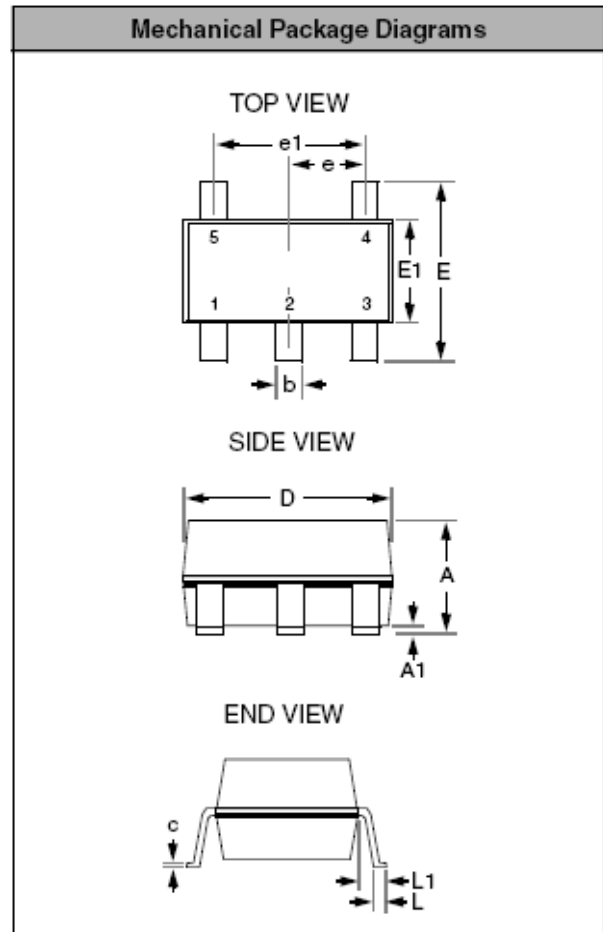


Mechanical Details (cont'd)

SOT23-5 Mechanical Specifications, 5 pin

The 5-pin SOT23 package dimensions are presented below.

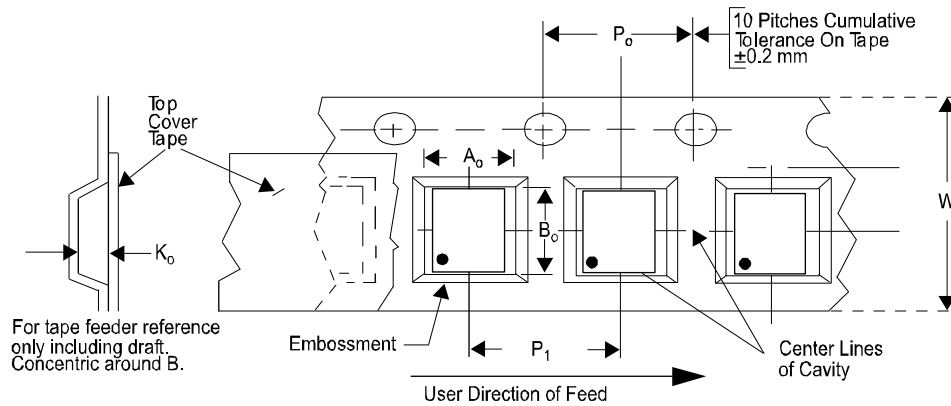
| PACKAGE DIMENSIONS | | | | | | |
|------------------------------------|------------------|------|------|-----------|-------|-------|
| Package | SOT23-5 | | | | | |
| JEDEC No. | MO-178 (Var. AA) | | | | | |
| Leads | 5 | | | | | |
| Dim. | Millimeters | | | Inches | | |
| | Min | Nom | Max | Min | Nom | Max |
| A | 1.14 | 1.24 | 1.35 | 0.045 | 0.049 | 0.053 |
| A1 | 0.05 | 0.10 | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 1.09 | 1.14 | 1.19 | 0.043 | 0.045 | 0.047 |
| b | 0.30 | 0.35 | 0.40 | 0.012 | 0.014 | 0.016 |
| c | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 2.87 | 2.92 | 2.97 | 0.113 | 0.115 | 0.117 |
| E | 2.67 | 2.79 | 2.92 | 0.105 | 0.110 | 0.115 |
| E1 | 1.55 | 1.63 | 1.68 | 0.061 | 0.064 | 0.066 |
| e | 0.95 REF | | | 0.037 REF | | |
| e1 | 1.90 REF | | | 0.075 REF | | |
| L | 0.35 | 0.40 | 0.45 | 0.014 | 0.016 | 0.018 |
| L1 | 0.53 | 0.58 | 0.64 | 0.021 | 0.023 | 0.025 |
| # per tape and reel | 3000 pieces | | | | | |
| Controlling dimension: millimeters | | | | | | |



Package Dimensions for SOT23-5

Tape and Reel Specifications

| PART NUMBER | PACKAGE SIZE (mm) | POCKET SIZE (mm) $B_o \times A_o \times K_o$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | P_o | P_1 |
|--------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1293A-02SO | 2.92 X 2.79 X 1.24 | 3.20 X 3.20 X 1.40 | 8mm | 178mm (7") | 3000 | 4mm | 4mm |

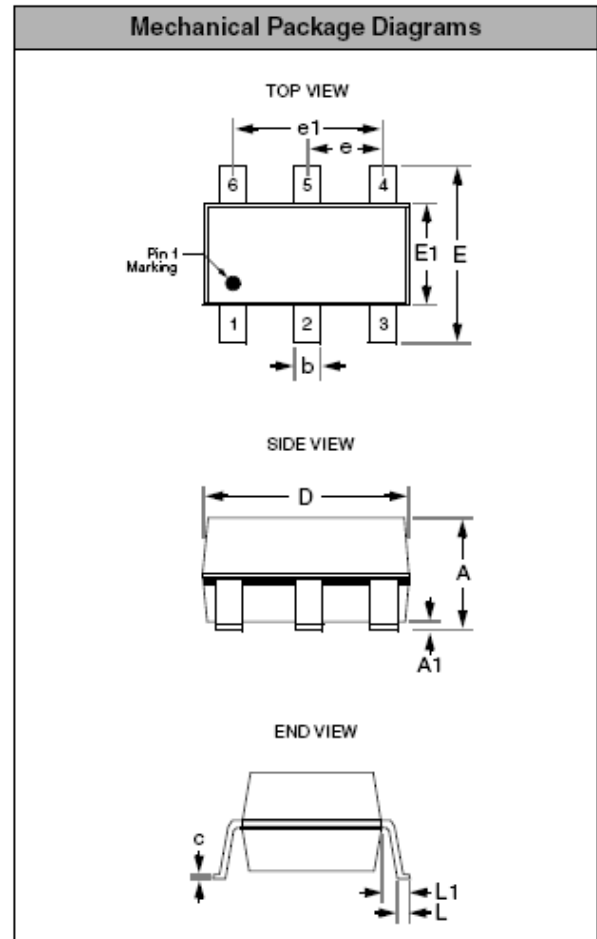


Mechanical Details (cont'd)

SOT23-6 Mechanical Specifications

The CM1293A-04SO is supplied in a 6-pin SOT23 package. Dimensions are presented below.

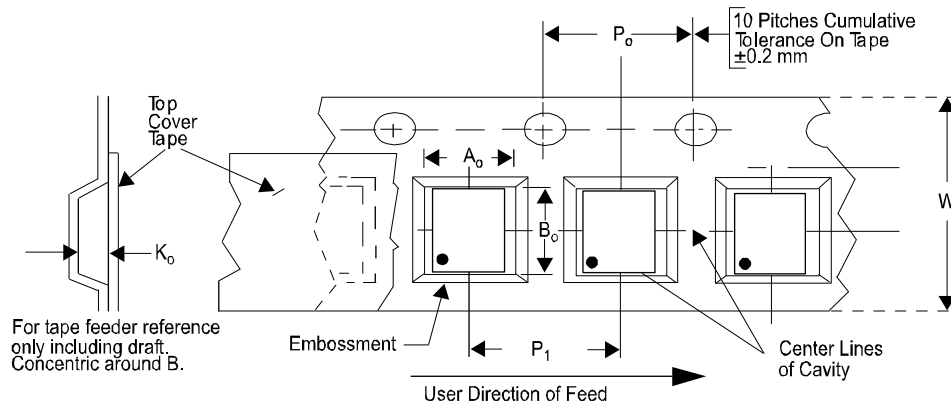
| PACKAGE DIMENSIONS | | | | |
|------------------------------------|--------------------------------|------|------------|--------|
| Package | SOT23-6 (JEDEC name is MO-178) | | | |
| Pins | 6 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | -- | 1.45 | -- | 0.0571 |
| 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

Tape and Reel Specifications

| PART NUMBER | PACKAGE SIZE (mm) | POCKET SIZE (mm) $B_o \times A_o \times K_o$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | P_o | P_1 |
|--------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1293A-04SO | 2.90 X 2.80 X 1.45 | 3.20 X 3.20 X 1.40 | 8mm | 178mm (7") | 3000 | 4mm | 4mm |

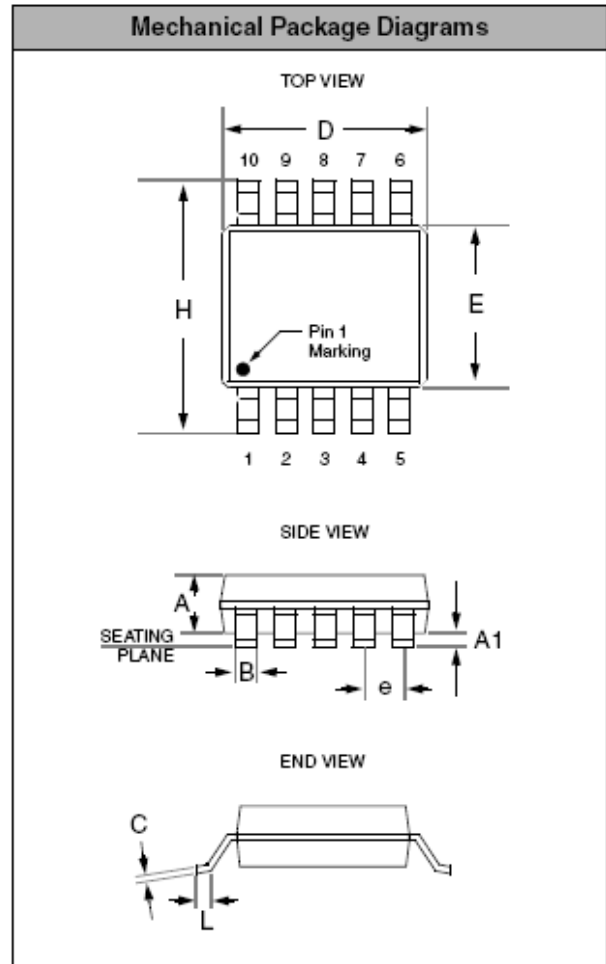


Mechanical Details (cont'd)

MSOP-10 Mechanical Specifications

The CM1293A-04MR is supplied in a 10-pin MSOP package. Dimensions are presented below.

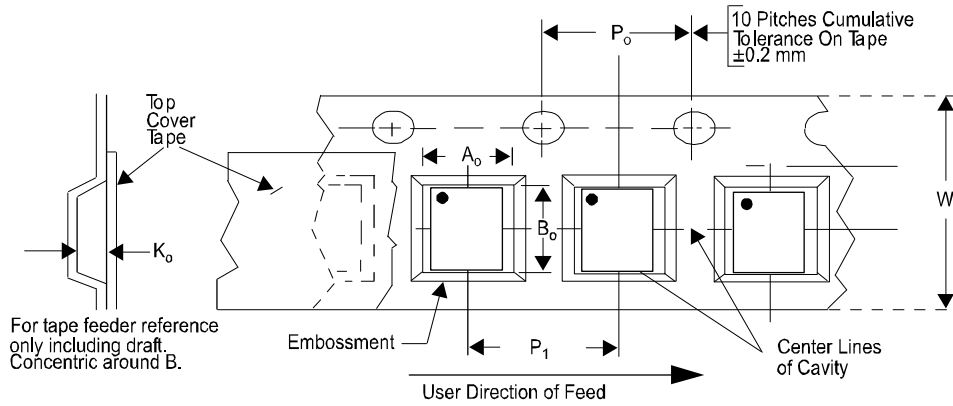
| PACKAGE DIMENSIONS | | | | |
|------------------------------------|-------------|------|------------|-------|
| Package | MSOP | | | |
| Pins | 10 | | | |
| Dimensions | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.75 | 0.95 | 0.028 | 0.038 |
| A1 | 0.05 | 0.15 | 0.002 | 0.006 |
| B | 0.17 | 0.27 | 0.007 | 0.013 |
| C | 0.13 | 0.23 | 0.005 | 0.009 |
| D | 2.90 | 3.10 | 0.114 | 0.122 |
| E | 2.90 | 3.10 | 0.114 | 0.122 |
| e | 0.50 BSC | | 0.0196 BSC | |
| H | 4.90 BSC | | 0.193 BSC | |
| L | 0.40 | 0.70 | 0.0137 | 0.029 |
| # per tape and reel | 4000 | | | |
| Controlling dimension: millimeters | | | | |




Package Dimensions for MSOP-10

Tape and Reel Specifications

| PART NUMBER | PACKAGE SIZE (mm) | POCKET SIZE (mm) $B_o \times A_o \times K_o$ | TAPE WIDTH W | REEL DIAMETER | QTY PER REEL | P_o | P_1 |
|--------------|--------------------|---|-----------------|---------------|--------------|-------|-------|
| CM1293A-04MR | 3.00 X 3.00 X 0.85 | 3.30 X 5.30 X 1.30 | 12mm | 330mm (13") | 4000 | 4mm | 8mm |



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