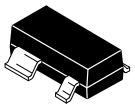
# CM1293A

# 2 and 4-Channel Low Capacitance ESD Protection Arrays

**ON Semiconductor®**

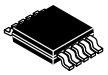
**http://onsemi.com**



**SOT−143**
**SR SUFFIX**
**CASE 318A**



**SC−74**
**SO SUFFIX**
**CASE 318F**



**MSOP−10**
**MR SUFFIX**
**CASE 846AE**

### 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 ±8 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®, i.LINK™), 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.

### Features

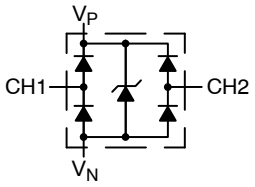
- Two and Four Channels of ESD Protection
- Provides ESD Protection to IEC61000−4−2
  - ♦ ±8 kV Contact Discharge
- Low Loading Capacitance of 2.0 pF Max
- Low Clamping Voltage
- Channel I/O to I/O Capacitance 1.5 pF Typical
- Zener Diode Protects Supply Rail and Eliminates the Need for External By−Pass Capacitors
- Each I/O Pin Can Withstand over 1000 ESD Strikes*
- These Devices are Pb−Free and are RoHS Compliant

### Applications

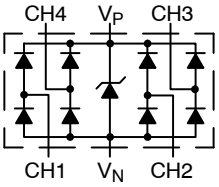
- DVI Ports, HDMI Ports in Notebooks, Set Top Boxes, Digital TVs, LCD Displays
- Serial ATA Ports in Desktop PCs and Hard Disk Drives
- PCI Express Ports
- General Purpose High−Speed Data Line ESD Protection

*Standard test condition is IEC61000−4−2 level 4 test circuit with each pin subjected to ±8 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.

### BLOCK DIAGRAM

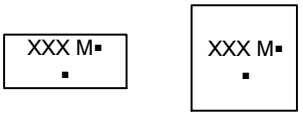



CM1293A−02SR
CM1293A−02SO




CM1293A−04MR

### MARKING DIAGRAM




XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(*Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| CM1293A−02SR | SOT143−4 (Pb−Free) | 3,000 / Tape & Reel |
| CM1293A−02SO | SC−74 (Pb−Free) | 3,000 / Tape & Reel |
| CM1293A−04MR | MSOP−10 (Pb−Free) | 4,000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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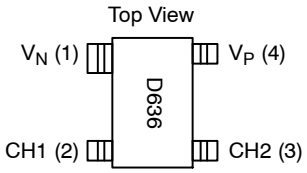
**Table 1. PIN DESCRIPTIONS**

| 2−Channel, 4−Lead SOT143−4 Package (CM1293A−02SR) | | | |
|---|---|---|---|
| **Pin** | **Name** | **Type** | **Description** |
| 1 | $V_N$ | GND | Negative Voltage Supply Rail |
| 2 | CH1 | I/O | ESD Channel |
| 3 | CH2 | I/O | ESD Channel |
| 4 | $V_P$ | PWR | Positive Voltage Supply Rail |

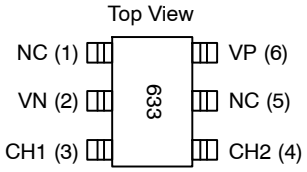
| 2−Channel, SC−74 Package (CM1293A−02SO) | | | |
|---|---|---|---|
| **Pin** | **Name** | **Type** | **Description** |
| 1 | NC | − | No Connect |
| 2 | VN | GND | Negative Voltage Supply Rail |
| 3 | CH1 | I/O | ESD Channel |
| 4 | CH2 | I/O | ESD Channel |
| 5 | NC | − | No Connect |
| 6 | VP | PWR | Positive Voltage Supply Rail |

| 4−Channel, 10−Lead MSOP−10 Package (CM1293A−04MR) | | | |
|---|---|---|---|
| **Pin** | **Name** | **Type** | **Description** |
| 1 | CH1 | I/O | ESD Channel |
| 2 | NC | − | No Connect |
| 3 | $V_P$ | PWR | Positive Voltage Supply Rail |
| 4 | CH2 | I/O | ESD Channel |
| 5 | NC | − | No Connect |
| 6 | CH3 | 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 |

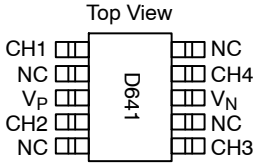
**PACKAGE/PINOUT DIAGRAM**




4−Lead SOT143−4




2−Channel SC−74




10−Lead MSOP−10

## SPECIFICATIONS

**Table 2. 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 |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**Table 3. STANDARD OPERATING CONDITIONS**

| Parameter | Rating | Units |
|---|---|---|
| Operating Temperature Range | –40 to +85 | °C |
| Package Power Rating<br>SOT143–4 Package (CM1293A–02SR)<br>SC–74 Package (CM1293A–02SO)<br>MSOP–10 Package (CM1293A–04MR) | <br>225<br>225<br>400 | mW |

**Table 4. ELECTRICAL OPERATING CHARACTERISTICS** (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 | ($V_P$–$V_N$) = 3.3 V | | | 8.0 | μA |
| $V_F$ | Diode Forward Voltage<br>Top Diode<br>Bottom Diode | $I_F$ = 8 mA, $T_A$ = 25°C | <br>0.60<br>0.60 | <br>0.80<br>0.80 | <br>0.95<br>0.95 | V |
| $I_{LEAK}$ | Channel Leakage Current | $T_A$ = 25°C, $V_P$ = 5 V, $V_N$ = 0 V | | ±0.1 | ±1.0 | μA |
| $C_{IN}$ | Channel Input Capacitance | At 1 MHz, $V_P$ = 3.3 V, $V_N$ = 0 V, $V_{IN}$ = 1.65 V | | | 2.0 | pF |
| $\Delta C_{IO}$ | Channel I/O to I/O Capacitance | | | 1.5 | | pF |
| $V_{ESD}$ | ESD Protection – Peak Discharge Voltage at any Channel Input, in System<br>Contact Discharge per IEC 61000–4–2 Standard<br>Human Body Model, MIL–STD–883, Method 3015 | <br>$T_A$ = 25°C (Notes 2 and 4)<br>$T_A$ = 25°C (Notes 3 and 4) | <br>±8<br>±15 | | | kV |
| $V_{CL}$ | Channel Clamp Voltage<br>Positive Transients<br>Negative Transients | $T_A$ = 25°C, $I_{PP}$ = 1A, $t_P$ = 8/20 μS (Note 4) | | <br>+9.9<br>–1.6 | | V |
| $R_{DYN}$ | Dynamic Resistance<br>Positive Transients<br>Negative Transients | $T_A$ = 25°C, $I_{PP}$ = 1A, $t_P$ = 8/20 μS (Note 4) | | <br>0.96<br>0.5 | | Ω |

1. All parameters specified at $T_A$ = –40°C to +85°C unless otherwise noted.
2. Standard IEC 61000–4–2 with $C_{Discharge}$ = 150 pF, $R_{Discharge}$ = 330 Ω, $V_P$ = 3.3 V, $V_N$ grounded.
3. Human Body Model per MIL–STD–883, Method 3015, $C_{Discharge}$ = 100 pF, $R_{Discharge}$ = 1.5 kΩ, $V_P$ = 3.3 V, $V_N$ grounded.
4. These measurements performed with no external capacitor on $V_P$.

## PERFORMANCE INFORMATION

### Input Channel Capacitance Performance Curves

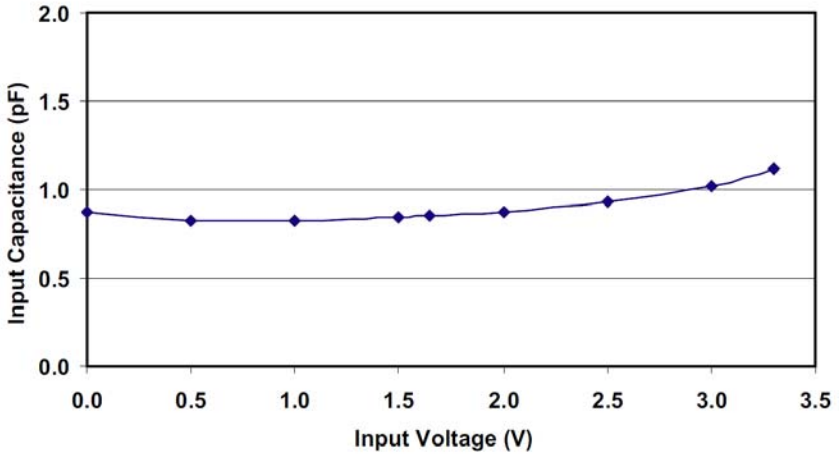



**Figure 1. Typical Variation of $C_{IN}$ vs. $V_{IN}$**
**(f = 1 MHz, $V_P$ = 3.3 V, $V_N$ = 0 V, 0.1 μF Chip Capacitor between $V_P$ and $V_N$, 25°C)**

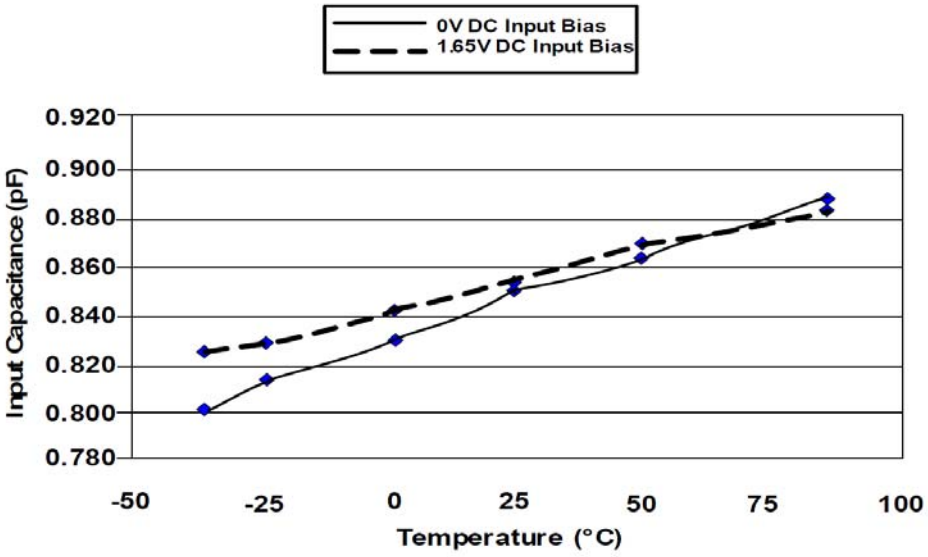



**Figure 2. Typical Variation of $C_{IN}$ vs. Temp**
**(f = 1 MHz, $V_{IN}$ = 30 mV, $V_P$ = 3.3 V, $V_N$ = 0 V, 0.1 μF Chip Capacitor between $V_P$ and $V_N$)**

## PERFORMANCE INFORMATION (Cont'd)

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

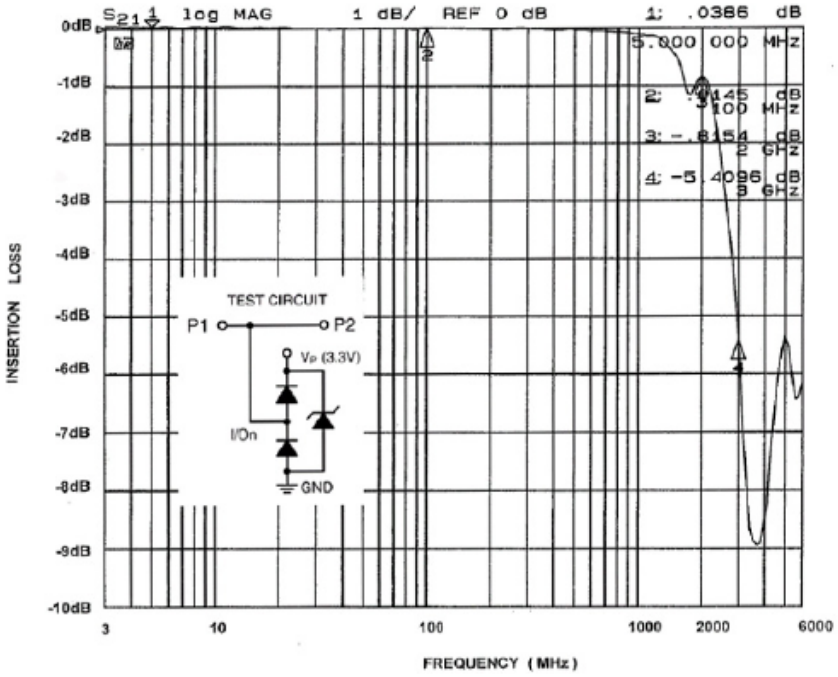



**Figure 3. Insertion Loss (S21) vs. Frequency (0 V DC Bias, $V_P$ = 3.3 V)**

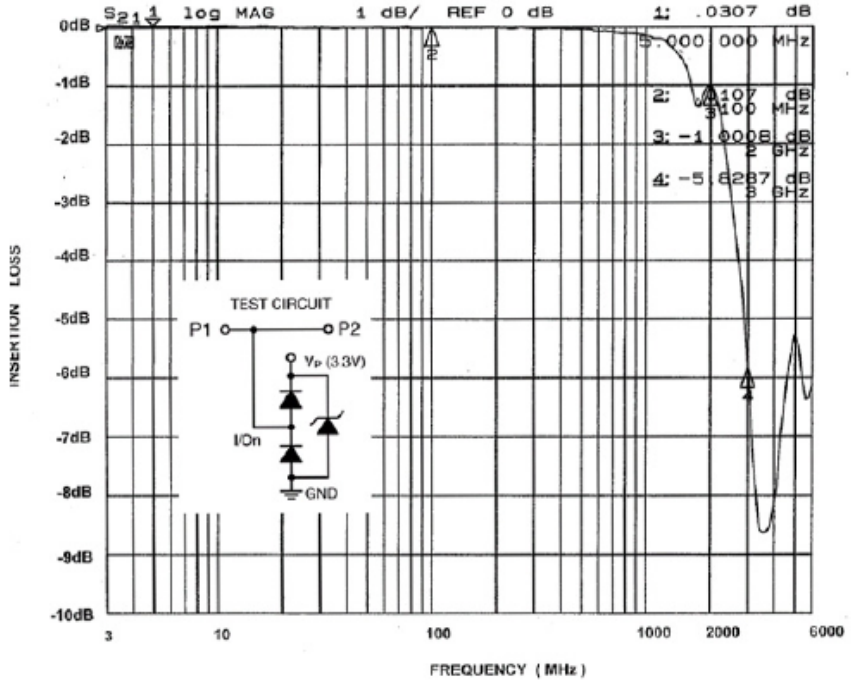



**Figure 4. Insertion Loss (S21) vs. Frequency (2.5 V DC Bias, $V_P$ = 3.3 V)**

## 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 5, 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:

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

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 1 ns. Here $d(I_{ESD})/dt$ can be approximated by $\Delta I_{ESD}/\Delta t$, or $30/(1x10^{-9})$. So just 10 nH of series inductance ($L_1$ and $L_2$ combined) will lead to a 300 V 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 0.22 μF 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.

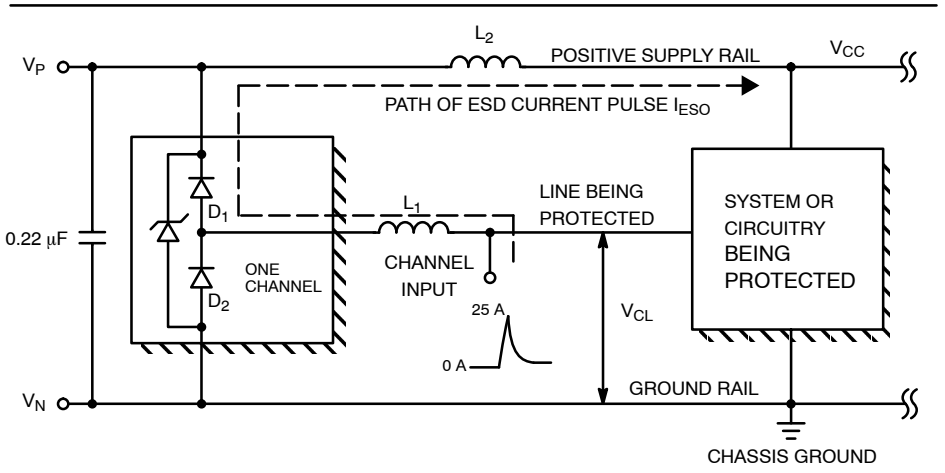
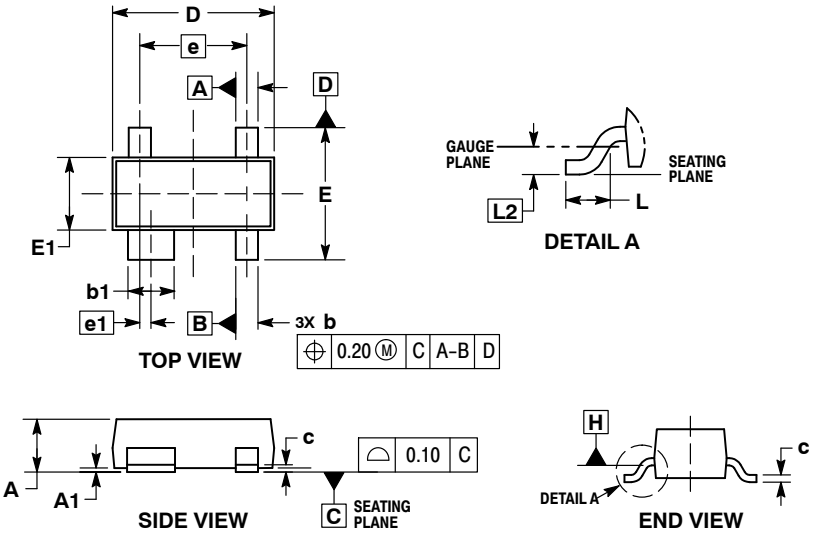



**Figure 5. Application of Positive ESD Pulse between Input Channel and Ground**

## PACKAGE DIMENSIONS

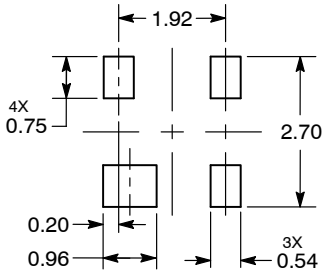
**SOT−143**
CASE 318A−06
ISSUE U




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, AND GATE BURRS SHALL NOT EXCEED 0.25 PER SIDE. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
6. DATUMS A AND B ARE DETERMINED AT DATUM H.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.80 | 1.12 |
| A1 | 0.01 | 0.15 |
| b | 0.30 | 0.51 |
| b1 | 0.76 | 0.94 |
| c | 0.08 | 0.20 |
| D | 2.80 | 3.05 |
| E | 2.10 | 2.64 |
| E1 | 1.20 | 1.40 |
| e | 1.92 BSC | |
| e1 | 0.20 BSC | |
| L | 0.35 | 0.70 |
| L2 | 0.25 BSC | |

### RECOMMENDED SOLDERING FOOTPRINT*



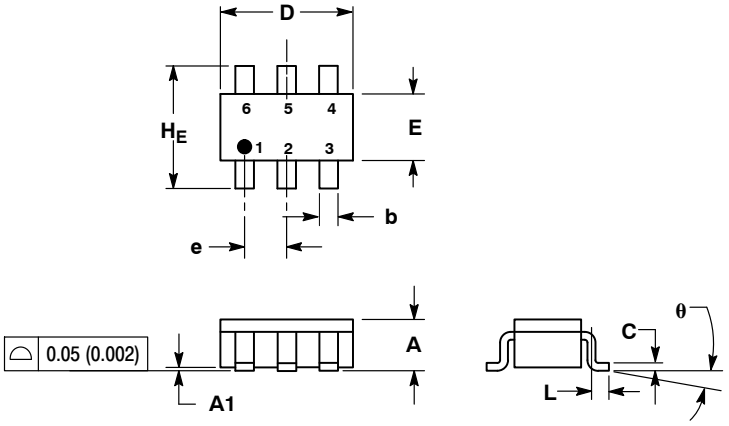

DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

**SC−74**
CASE 318F−05
ISSUE N

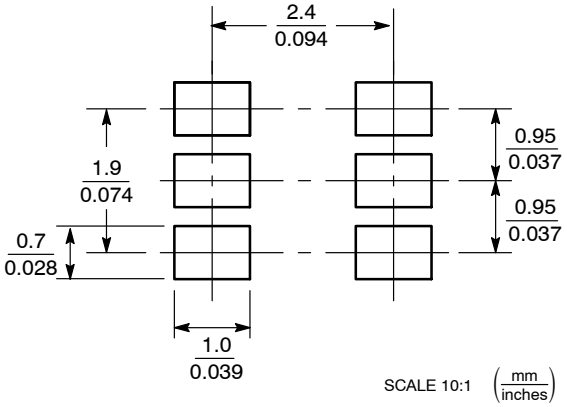
**SCALE 2:1**




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F−01, −02, −03, −04 OBSOLETE. NEW STANDARD 318F−05.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.90 | 1.00 | 1.10 | 0.035 | 0.039 | 0.043 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.25 | 0.37 | 0.50 | 0.010 | 0.015 | 0.020 |
| c | 0.10 | 0.18 | 0.26 | 0.004 | 0.007 | 0.010 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 0.85 | 0.95 | 1.05 | 0.034 | 0.037 | 0.041 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| $H_E$ | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| θ | 0° | – | 10° | 0° | – | 10° |

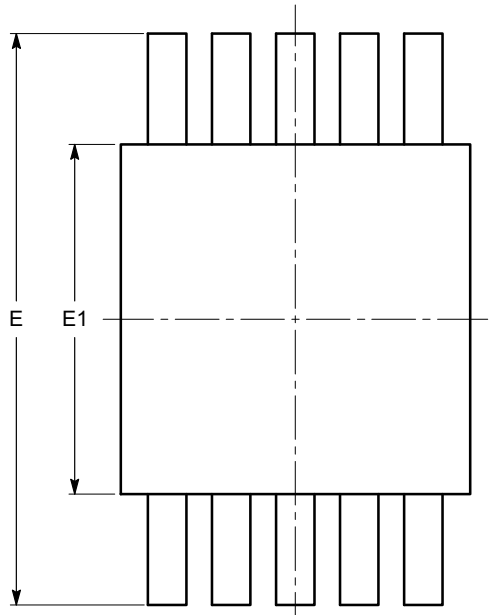
## SOLDERING FOOTPRINT*



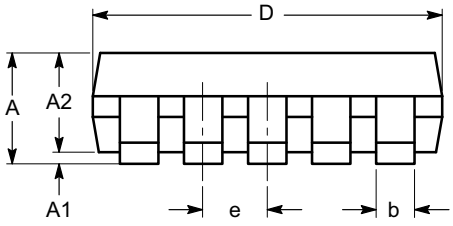

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

**MSOP 10, 3x3**
CASE 846AE−01
ISSUE O

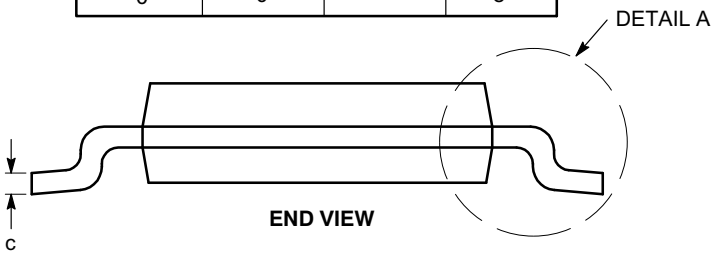



TOP VIEW

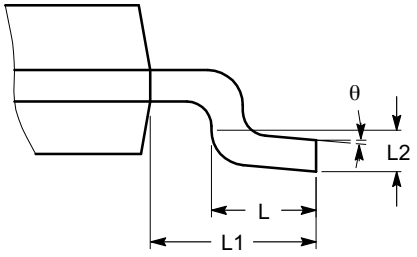



SIDE VIEW

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | | | 1.10 |
| A1 | 0.00 | 0.05 | 0.15 |
| A2 | 0.75 | 0.85 | 0.95 |
| b | 0.17 | | 0.27 |
| c | 0.13 | | 0.23 |
| D | 2.90 | 3.00 | 3.10 |
| E | 4.75 | 4.90 | 5.05 |
| E1 | 2.90 | 3.00 | 3.10 |
| e | 0.50 BSC | | |
| L | 0.40 | 0.60 | 0.80 |
| L1 | 0.95 REF | | |
| L2 | 0.25 BSC | | |
| θ | 0º | | 8º |




END VIEW




DETAIL A

**Notes:**
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MO-187.

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