# 4-Channel Low Capacitance ESD Protection Array

# CM1293A-04SO

**SC-74**
**SO SUFFIX**
**CASE 318F**

### Product Description

CM1293A-04SO has been designed to provide ESD protection for electronic components or subsystems requiring minimal capacitive loading. This device is 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. This device 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

- 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*
- This Device is Pb-Free and is RoHS Compliant**

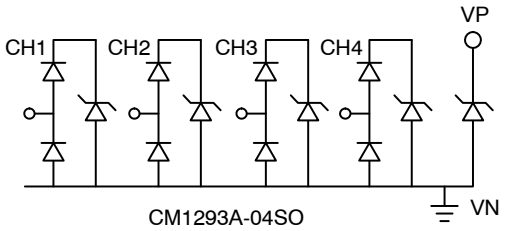
### Applications

- 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

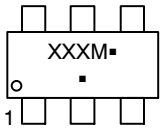
* Standard test condition is IEC61000-4-2 level 4 test circuit with each pin subjected to ±8 kV contact discharge for 1000 pulses. Discharges are timed at 1 second intervals and all 1000 strikes are completed in one continuous test run. The part is then subjected to standard production test to verify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

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

### BLOCK DIAGRAM




### 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-04SO | SC-74 (Pb-Free) | 3,000 / 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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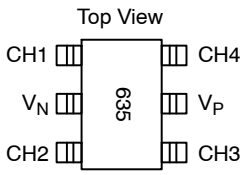
CM1293A–04SO/D

**Table 1. PIN DESCRIPTIONS**

| Pin | Name | Type | Description |
|---|---|---|---|
| 1 | CH1 | I/O | ESD Channel |
| 2 | $V_N$ | GND | Negative Voltage Supply Rail |
| 3 | CH2 | I/O | ESD Channel |
| 4 | CH3 | I/O | ESD Channel |
| 5 | $V_P$ | PWR | Positive Voltage Supply Rail |
| 6 | CH4 | I/O | ESD Channel |

**PACKAGE/PINOUT DIAGRAM**




4-Channel SC-74

## SPECIFICATIONS

**Table 2. ABSOLUTE MAXIMUM RATINGS**

| Parameter | Rating | Unit |
|---|---|---|
| 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 those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**Table 3. STANDARD OPERATING CONDITIONS**

| Parameter | Rating | Unit |
|---|---|---|
| Operating Temperature Range | –40 to +85 | °C |
| Package Power Rating | 225 | mW |

**Table 4. 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 | ($V_P$–$V_N$) = 3.3 V | | | 8.0 | μA |
| $V_F$ | Diode Forward Voltage | $I_F$ = 8 mA, $T_A$ = 25 °C | | 0.90 | | 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<br>Peak Discharge Voltage at any Channel Input, in System<br>Contact Discharge per IEC 61000-4-2 Standard | $T_A$ = 25°C (Notes 2 and 3) | ±8 | | | kV |
| $V_{CL}$ | Channel Clamp Voltage<br>Positive Transients<br>Negative Transients | $T_A$ = 25 °C, $I_{PP}$ = 1 A, $t_P$ = 8/20 μS (Note 3) | | +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 3) | | 0.96<br>0.5 | | Ω |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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. These measurements performed with no external capacitor on $V_P$.

## PERFORMANCE INFORMATION

### Input Channel Capacitance Performance Curves

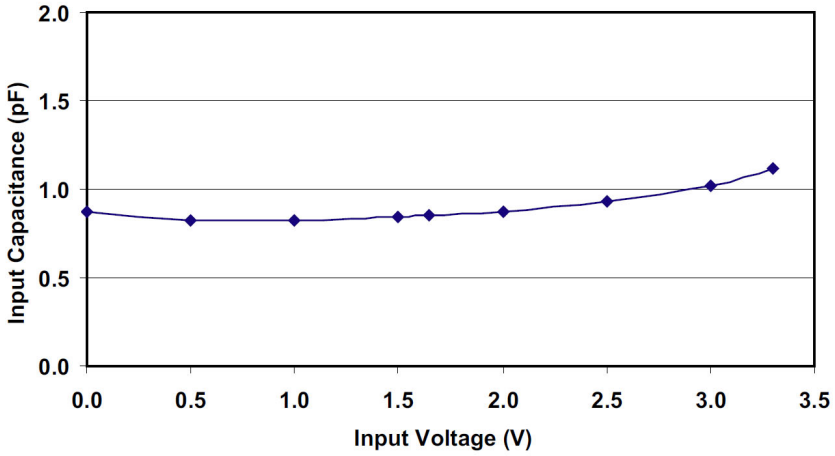



**Figure 1. Typical Variation of $C_{IN}$ vs. $V_{IN}$**
**(f = 1 MHz, $V_P$ = 3.3 V, $V_N$ = 0 V, 0.1 μF Chip Capacitor between $V_P$ and $V_N$, 25°C)**

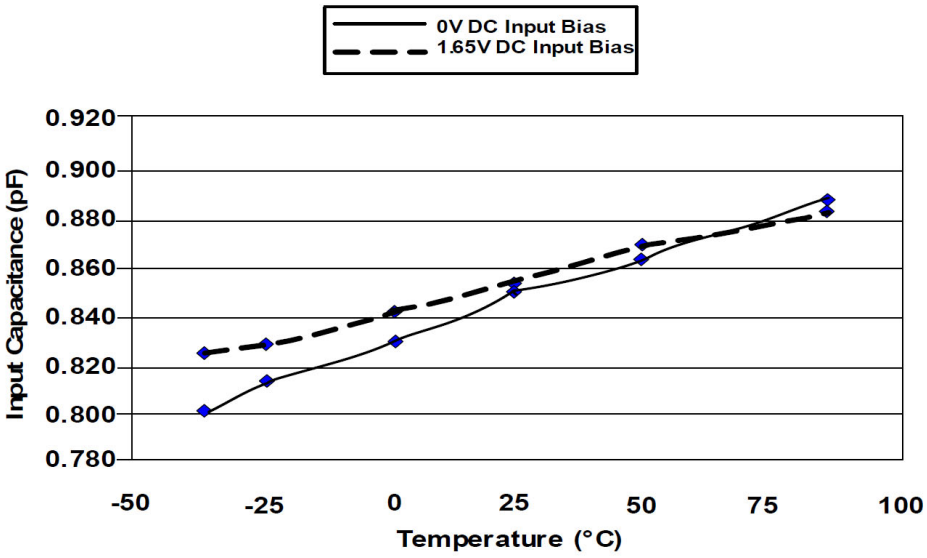



**Figure 2. Typical Variation of $C_{IN}$ vs. Temp**
**(f = 1 MHz, $V_{IN}$ = 30 mV, $V_P$ = 3.3 V, $V_N$ = 0 V, 0.1 μF Chip Capacitor between $V_P$ and $V_N$)**

## PERFORMANCE INFORMATION (CONTINUED)

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

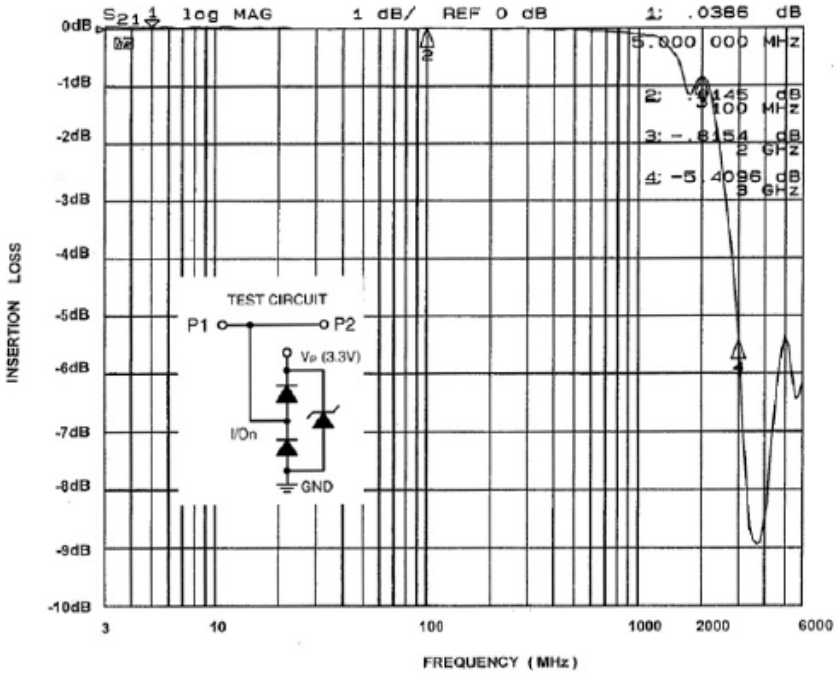



**Figure 3. Insertion Loss (S21) vs. Frequency (0 V DC Bias, $V_P$ = 3.3 V)**

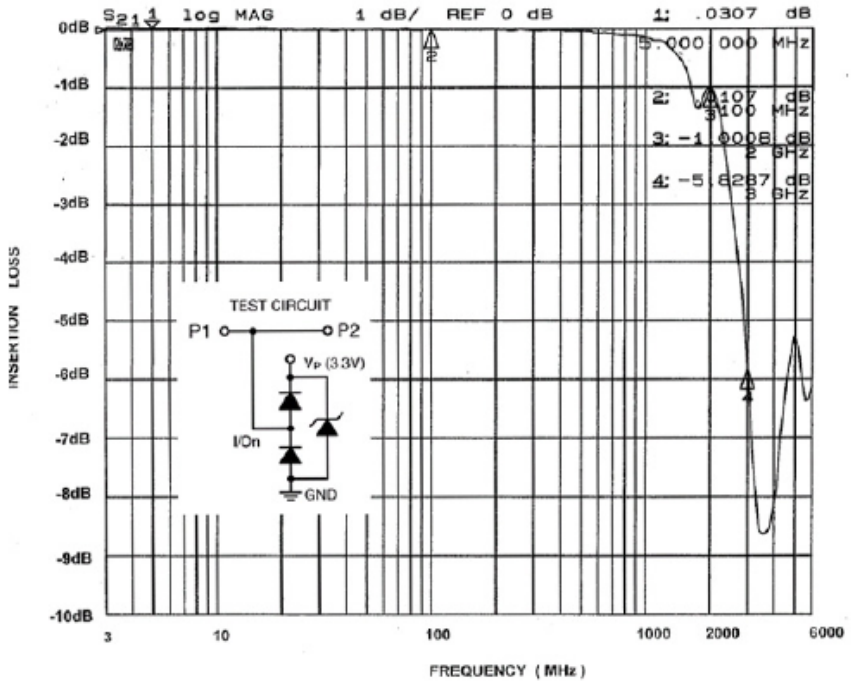



**Figure 4. Insertion Loss (S21) vs. Frequency (2.5 V DC Bias, $V_P$ = 3.3 V)**

## 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.

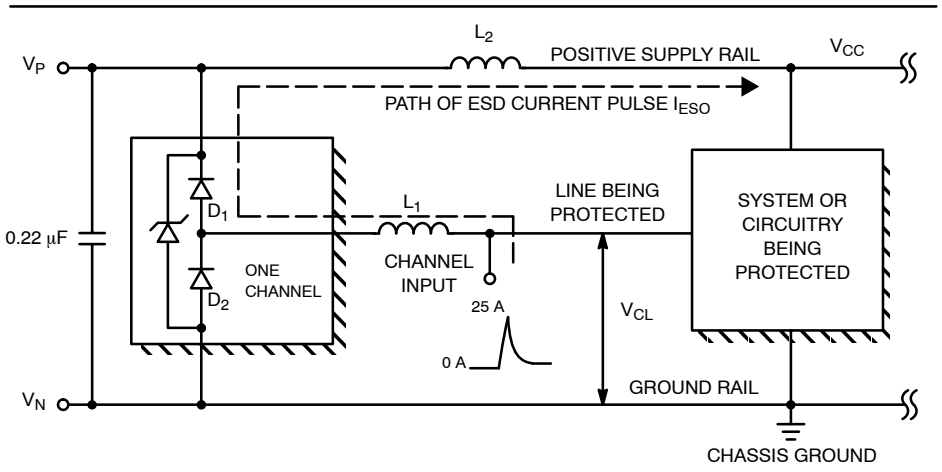



**Figure 5. Application of Positive ESD Pulse between Input Channel and Ground**

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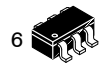
i.LINK is a trademark of Sony Corporation.



**SCALE 2:1**

**SC−74**
CASE 318F
ISSUE P

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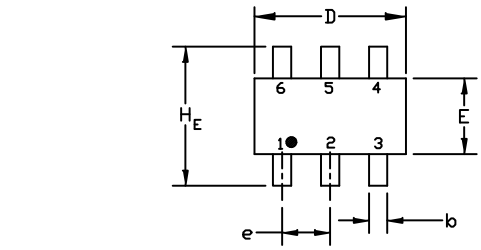
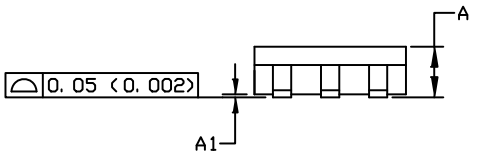
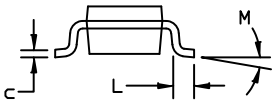



TOP VIEW




SIDE VIEW

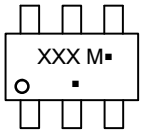



END VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCHES
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.

| | 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 |
| $H_E$ | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| M | 0° | --- | 10° | 0° | --- | 10° |

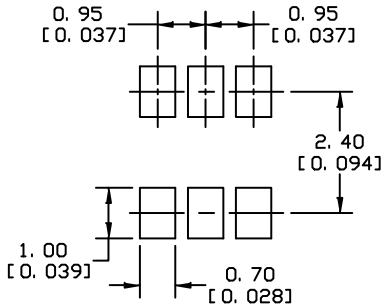
## GENERIC MARKING DIAGRAM*




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

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.




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

SOLDERING FOOTPRINT

STYLE 1:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. ANODE
6. CATHODE

STYLE 2:
PIN 1. NO CONNECTION
2. COLLECTOR
3. EMITTER
4. NO CONNECTION
5. COLLECTOR
6. BASE

STYLE 3:
PIN 1. EMITTER 1
2. BASE 1
3. COLLECTOR 2
4. EMITTER 2
5. BASE 2
6. COLLECTOR 1

STYLE 4:
PIN 1. COLLECTOR 2
2. EMITTER 1/EMITTER 2
3. COLLECTOR 1
4. EMITTER 3
5. BASE 1/BASE 2/COLLECTOR 3
6. BASE 3

STYLE 5:
PIN 1. CHANNEL 1
2. ANODE
3. CHANNEL 2
4. CHANNEL 3
5. CATHODE
6. CHANNEL 4

STYLE 6:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE

STYLE 7:
PIN 1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

STYLE 8:
PIN 1. EMITTER 1
2. BASE 2
3. COLLECTOR 2
4. EMITTER 2
5. BASE 1
6. COLLECTOR 1

STYLE 9:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 10:
PIN 1. ANODE/CATHODE
2. BASE
3. EMITTER
4. COLLECTOR
5. ANODE
6. CATHODE

STYLE 11:
PIN 1. EMITTER
2. BASE
3. ANODE/CATHODE
4. ANODE
5. CATHODE
6. COLLECTOR

| | | |
|---|---|---|
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| **DESCRIPTION:** | **SC−74** | **PAGE 1 OF 1** |

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