4-Channel Low Capacitance ESD Protection Array
CM1213A-04SO, SZCM1213A-04SO

SCHEMATIC

Product Description

CM1213A–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 which 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, offering two advantages. First, it protects the V_{CC} rail against ESD strikes, and second, it eliminates the need for a bypass capacitor that would otherwise be needed for absorbing positive ESD strikes to ground. This device will protect against ESD pulses up to 8 kV per the IEC 61000−4−2 standard.

This device is particularly well-suited for protecting systems using high-speed ports such as USB 2.0, 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.

MARKING DIAGRAM

Features

- Four Channels of ESD Protection
- Provides ESD Protection to IEC61000−4−2 Level 4
  - ±8 kV Contact Discharge
- Low Channel Input Capacitance of 0.85 pF Typical
- Minimal Capacitance Change with Temperature and Voltage
- Channel Input Capacitance Matching of 0.02 pF Typical is Ideal for Differential Dignals
- Zener Diode Protects Supply Rail and Eliminates the Need for External By-pass Capacitors
- Each I/O Pin Can Withstand Over 1000 ESD Strikes*
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and RoHS Compliant

ORDERING INFORMATION

Device	Package	Shipping†

Applications

- USB2.0 Ports at 480 Mbps in Desktop PCs, Notebooks and Peripherals
- IEEE1394 Firewire® Ports at 400 Mbps/800 Mbps
- 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.

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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 DIAGRAMS

Top View

CH1 ▯ 1   6 ▯ CH4
V_N ▯ 2 234 5 ▯ V_P
CH2 ▯ 3   4 ▯ CH3

6−Lead SC−74
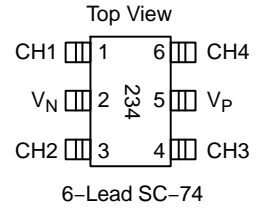
SPECIFICATIONS

Table 2. ABSOLUTE MAXIMUM RATINGS

Parameter

PERFORMANCE INFORMATION

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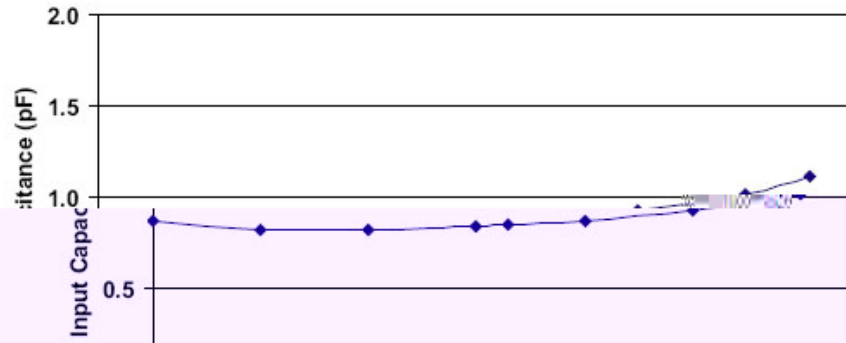
Figure 1. Typical Variation of C_{IN} vs. V_{IN}
(f = 1 MHz, V_P = 3.3 V, V_N = 0 V, 0.1 μF Chip Capacitor between V_P and V_N, 25°C)

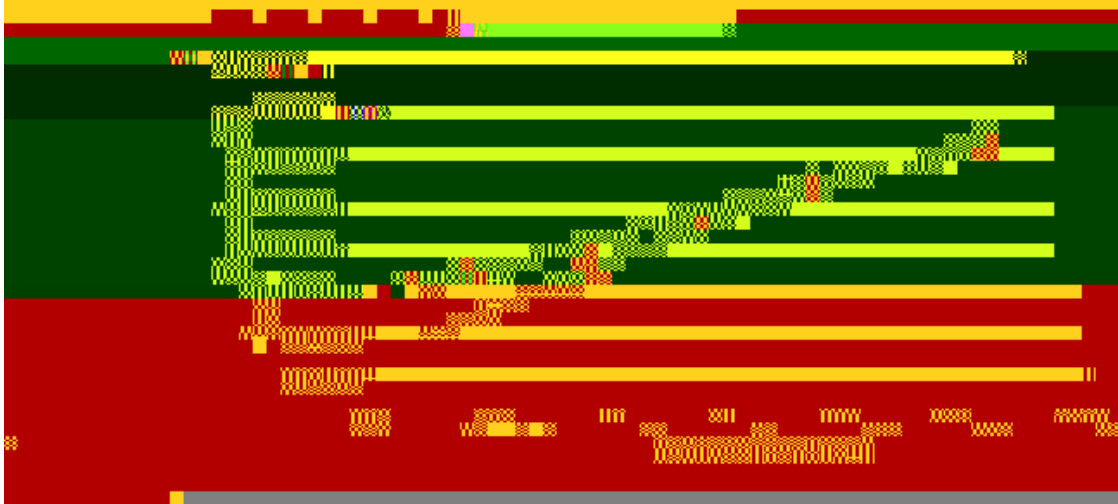**Figure 2. Typical Variation of C_{IN} vs. Temp**
(f = 1 MHz, V_{IN} = 30 mV, V_P = 3.3 V, V_N = 0 V, 0.1 μF Chip Capacitor between V_P and V_N)

PERFORMANCE INFORMATION (CONT'D)

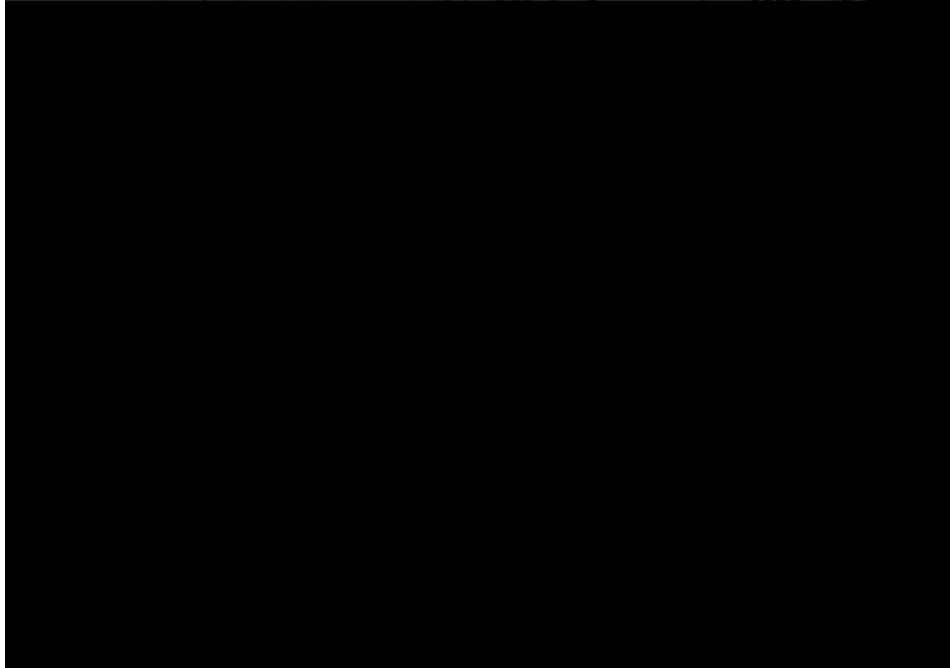**Typical Filter Performance (nominal conditions unless specified otherwise, 50 Ohm Environment)**

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)

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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 Application of Positive ESD Pulse between Input Channel and Ground, 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:

$$\mathbf{V_{CL} = Fwd\ Voltage\ Drop\ of\ D_1 + V_{SUPPLY} + L_1\ x\ d(I_{ESD})\ /\ dt + L_2\ x\ d(I_{ESD})\ /\ dt}$$

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 CM1213A 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.

Additional Information

See also ON Semiconductor Application Note "Design Considerations for ESD Protection", in the Applications section.

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