TECH
BRIEF

ESD Protection IEEE 1394 Data Lines

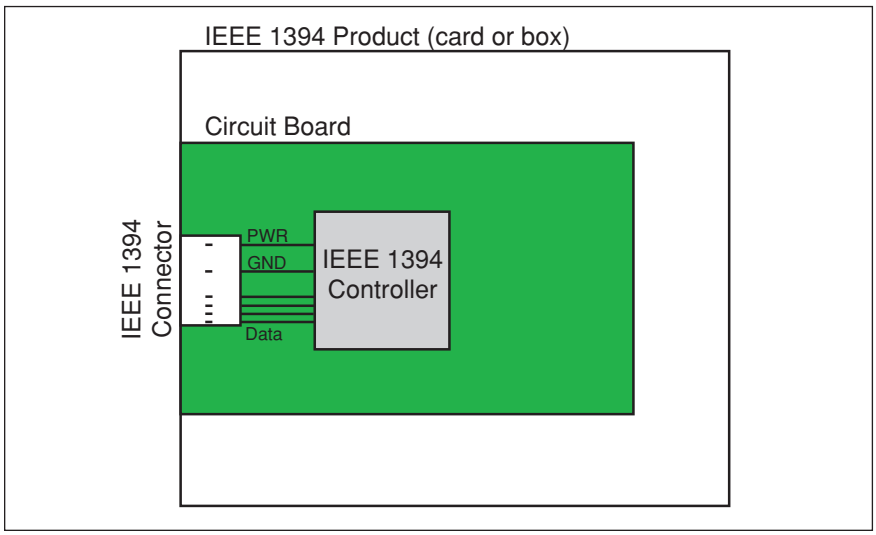

Figure 1. Simple IEEE1394 circuit diagram (ESD suppressors protect the data lines which have exposure to the outside world. The 1394 protocol uses 4 high-speed data lines).

Background

IEEE 1394 products (PCI adapter cards, hubs/routers, etc.) can be susceptible to ESD events when the cable is disconnected from the data port. The ESD pulse can be introduced directly into the open port, or into the disconnected end of the cable. Either way, the integrated circuitry that controls the IEEE 1394 functionality can be compromised.

The Problem

After the ESD pulse is introduced into the data port, it will travel through the connector to the PC board. Once on the PC board, it will propagate down the data lines toward the integrated circuitry. Specifically, the IC of concern is the **IEEE 1394 Controller**. Without sufficient protection, the Controller chip can be rendered inoperable.

The Solution

In order to provide the IC with protection against ESD transients, the use of suppression products is recommended. The suppressors are installed between the data line and the chassis ground (parallel connection) and shunt the ESD transient from the data line to the ground.

For high-speed protocols like IEEE 1394a (400 Mbps) and the upcoming IEEE 1394b (800 - 1,600 Mbps), suppressors with extremely low capacitance levels should be used. Suppressors with high capacitance can affect the data stream by distorting the data waveforms

Littelfuse offers PulseGuard® ESD suppressors as a solution for IEEE 1394 data line ESD protection. These products are surface mount devices with 0.050 pF of capacitance. They will provide ESD protection and maintain the integrity of the data signals.

Examples of IEEE 1394 products which can benefit from ESD protection include:

- Computers (desktops and laptops)
- PCI adapter cards
- Repeaters and hubs
- External hard drives
- Digital video recorders
- Digital still cameras
- Recordable CD ROM drives





Littelfuse®
Circuit Protection Specialists

Capacitance and Signal Integrity

In previous generations of I/O protocols (RS232, USB 1.1, 10BaseTEthernet, etc.), the signal speed (rise/fall time of logic states) was sufficiently slow that the parasitic components of circuit protection devices was of minimal concern.

However, as data rates have increased, the capacitive loading that is presented to the data circuitry by the protection device becomes more of a concern. For example, the diagrams to the right show the effect capacitive loading has on various IEEE 1394 waveforms.

In the first set of diagrams, data is shown for the 400 Mbps data rate. The first diagram shows the eye diagram for a control board which only contain traces for the data lines. The second diagram shows the response of a data line which has a PulseGuard® ESD (0.050 pF) suppressor installed. The third diagram is included for reference, and shows the response when a 3 pF capacitor is installed on a data line. The PulseGuard device and capacitor were referenced to ground. The second set of diagrams replicates the same tested devices, but raises the data rate to 1,600 Mbps.

The signals replicate the P1394b (Draft 1.11 - section 6.2) protocol (± 0.625V, 400 and 1,600 Mbps); created on Agilent 81250 ParBERT equipment and measured with an Agilent Digital Communications Analyzer.

400Mbps

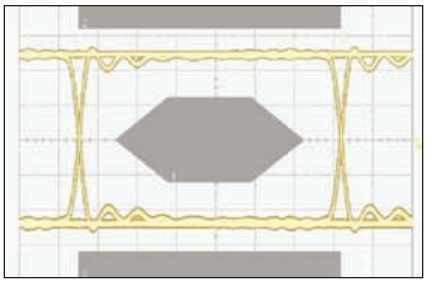

Figure 2. Test board traces (No Devices) for 400Mbps IEEE 1394 data line

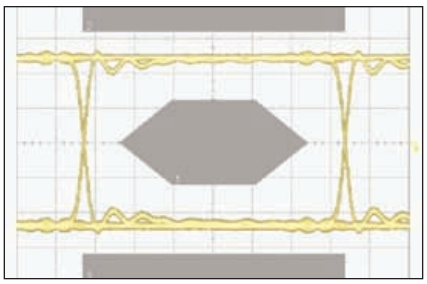

Figure 3. PulseGuard® suppressor (0.05pF) traces for 400Mbps IEEE 1394 data line

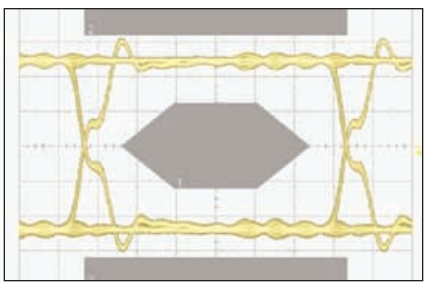

Figure 4. Surface mount capacitor (3pF) traces for 400Mbps IEEE 1394 data line

1,600Mbps

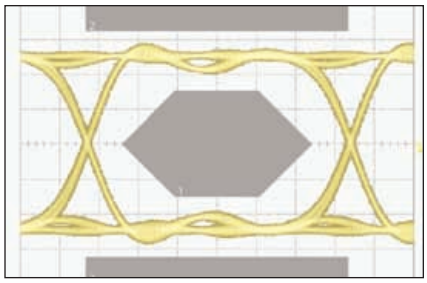

Figure 5. Test board traces (No Devices) for 1600Mbps IEEE 1394 data line

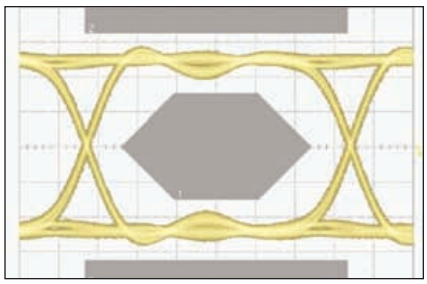

Figure 6. PulseGuard® suppressor (0.05pF) traces for 1600Mbps IEEE 1394 data line

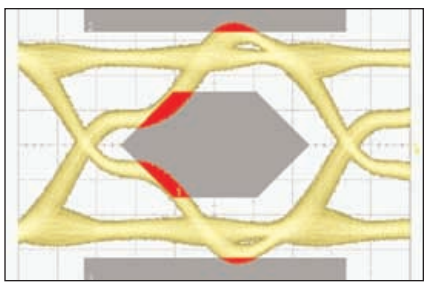

Figure 7. Surface mount capacitor (3pF) traces for 1600Mbps IEEE 1394 data line

Littelfuse, Inc.
800 E. Northwest Highway
Des Plaines, IL 60016
(847) 824-1188
www.littelfuse.com/esd

Specifications, descriptions and illustrative material in this literature are as accurate as known at time of publication, but are subject to change without notice. Littelfuse is a registered trademark of Littelfuse Incorporated.

Copyright © 2001 Littelfuse, Inc., All Rights Reserved. Printed in U.S.A. JANUARY 2002

Littelfuse®
Circuit Protection Specialists