

ESD Protection Cradles and Docking Stations

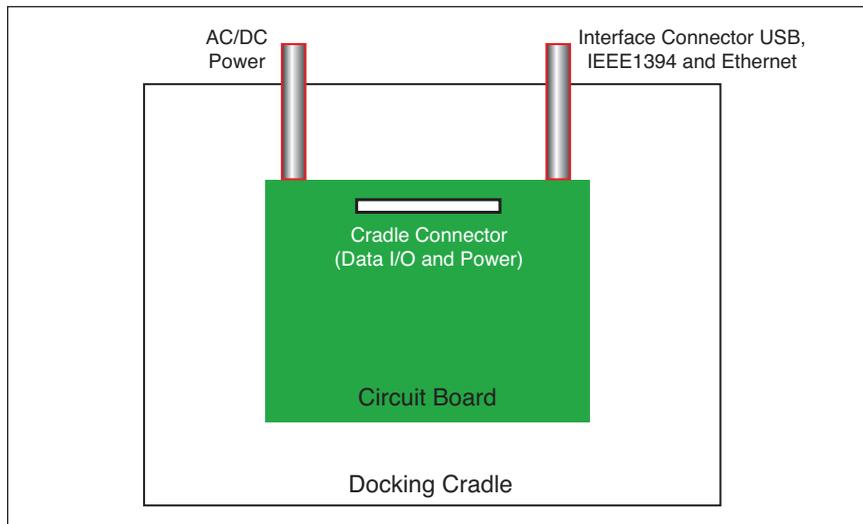


Figure 1. Simple Docking Cradle circuit diagram (The cradle/docking station connector provides DC power as well as high-speed data/clock lines to connect to a PC or host).

Background

Docking Cradles are becoming commonplace with the increase in portable devices such as PDA's, digital camera's, Internet appliances and laptop computers. The cradle is the primary connection for file transfer between the portable device and the host computer or printer. In addition, the cradle also provides charging capabilities for the device batteries.

The Problem

ESD pulses can be introduced directly into the host computer or printer from the docking cradle.

The ESD pulse is introduced at the docking cradle and travels through the cradle connector to the host PC or printer, causing damage to the interface circuitry. Without sufficient ESD protection, the interface chip can be rendered inoperable.

The Solution

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

High-speed protocols for USB 2.0, IEEE 1394, and Ethernet require ESD suppressors with extremely low capacitance. Slower speed interfaces such as RS 232, 1284 and audio still require ESD protection, but capacitance is not a main concern.

Littelfuse offers a complete line of ESD suppressors suitable for high and low speed interfaces.

Examples of docking cradle based portable products which can benefit from ESD protection include:

Computing

- PDA's and accessories
- Laptop/handheld computers
- "Smart" mobile phones
- Portable
- Instrumentation/scanners

Consumer Electronics

- Digital still cameras
- Digital video cameras

Capacitance and Signal Integrity

Today's docking cradles are using high speed I/O such as USB 2.0, IEEE 1394 and Ethernet to connect to host computers and printers. As the data rates for these protocols have increased, the capacitive loading that is presented to the



interface circuitry by the protection device becomes more of a concern. For example, the diagrams to the right show the effect capacitive loading has on a high-speed (480 Mbps) data waveform.

The first diagram shows the eye diagram for a control board which only contains a the data lines. The second diagram shows the response of the data line which has a PulseGuard[®] ESD suppressor installed. The third diagram is included for reference, and shows the response when a 3 pF capacitor is installed on the data line. The PulseGuard device and capacitor were referenced to ground. The signals are representative of high speed data signals used for data communication. The data stream was created on Agilent BERT system and measured with an Agilent Infinium DCA.

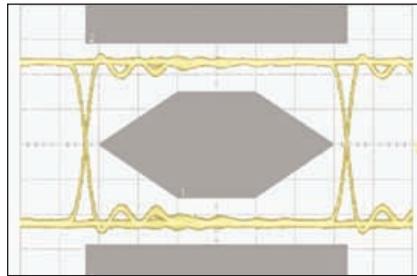


Figure 2. Control Signal (No devices added)

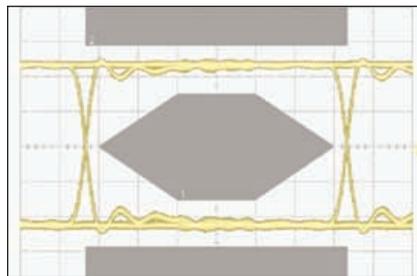


Figure 3. PulseGuard[®] suppressor (0.050pF)

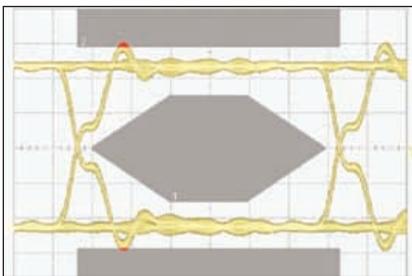


Figure 4. Surface mount capacitor (3pF)

Power Line Protection

Docking cradles also provide power to charge the batteries of the portable device. The AC/DC power line is susceptible to line transients caused by lightning strikes or power cross events. These transients can also cause damage to the host PC or printer via the docking cradle circuitry. These transients can be suppressed by over-voltage and over-current suppressors in the power circuit as show below.

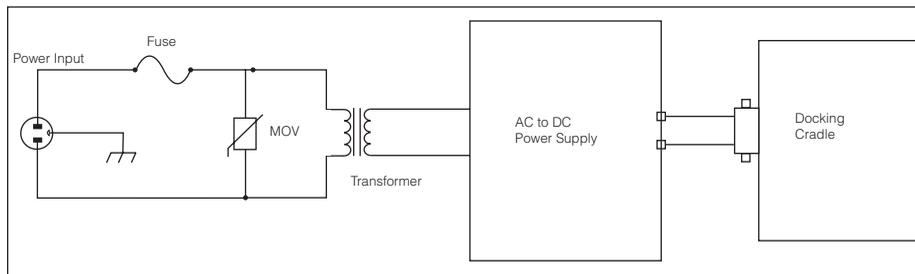


Figure 5. Power Line Protection Circuit

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