INTRODUCTION

This application note provides information on Printed Circuit Board layout for High-Speed Secure-Digital (SD) media sockets with USB225x/USB224x/USB264x/USB266X.

OVERVIEW

Successful High-Speed operation of Secure-Digital media with USB225x/USB224x/USB264x/USB266X requires special consideration for Printed Circuit Board (PCB) layout. This application note describes the important items to consider for layout of PCB.

PCB LAYOUT GUIDELINES

The guidelines presented are applicable to all Microchip card-reader products that support High-Speed Secure-Digital operation. Guidelines for both two-layer and four-layer Microchip PCBs are presented here. This is for the SD signals only.

Power and Ground Distribution to SD Socket

Ground connection between the card-reader and the media socket is important, both for supply return current and signal return currents. The ground should be solid, have low impedance and few constrictions between the card-reader and the socket. The card-reader supplies the power to the socket in most applications since the power-FET is built-in to the Microchip card-reader.

- MEC163x / MEC164x PCS, TBD
- SD socket ground connection: plane, 0.5 oz or thicker, between socket and card-reader.

Note: No constrictions or cuts allowed in the ground between card-reader and socket.
Signal Traces to SD Socket

The Secure-Digital interface has a total of seven signals to the card-reader. Six of these signals are critical for high-speed operation: SD_DAT[0:3], SD_CMD and SD_CLK and require special considerations.

• Signal traces must be above a solid and continuous ground plane along the path from card-reader to socket.
• SD_CLK termination resistor must be placed close, within 400 mils to the SD_CLK pin on card-reader for two layers PCB.
• SD_CLK termination resistor must be placed close, within 400 mils to socket for four layers PCB.
• SD_CLK must be buffered when trace length exceeds 1000 mils. A 74AHC1G125 or equivalent buffer can be used that has less than 2.5 ns propagation delay.

Signal Trace Length

Trace length for SD signals must be less than the maximum length specified in Table 1. An external buffer is required for SD_CLK when trace lengths exceed 1000 mils (800 mils excluding the socket itself). Table 1 provides the trace length when the unbuffered SD_CLK is driven directly by the Microchip card-reader. Skew control between data lines is not critical within the limits given in the tables.

Figure 2 and Figure 3 show the suggested placement of a series termination resistor.

### TABLE 1: TRACE LENGTH AND TOLERANCE FOR UNBUFFERED SD_CLK

<table>
<thead>
<tr>
<th>Signal</th>
<th>Maximum Trace Length (including socket) [mils]</th>
<th>PCB Trace Impedance 2-layer PCB [Ohm]</th>
<th>PCB Trace Impedance 4-layer PCB [Ohm]</th>
<th>Trace Length Tolerance [mils]</th>
<th>Maximum Trace Length difference to SD_CLK [mils]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD_CLK</td>
<td>1000</td>
<td>100 - 130</td>
<td>&gt; 55</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>SD_DAT[0:3]</td>
<td>2500</td>
<td>80 - 150</td>
<td>&gt; 50</td>
<td>+/- 750</td>
<td>-250 to +1500</td>
</tr>
<tr>
<td>SD_CMD</td>
<td>2500</td>
<td>80 - 150</td>
<td>&gt; 50</td>
<td>N/A</td>
<td>-250 to +1500</td>
</tr>
</tbody>
</table>

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**Card Detect and Write Protect**

The card detect switch and the write protect switch behavior can vary between different socket models. Table 2 provides suggestions of routing sockets with different types of card detect and/or write protect switch behaviors.

**TABLE 2: SOCKET SWITCH CONFIGURATIONS**

<table>
<thead>
<tr>
<th>Socket Circuit Diagram:</th>
<th>CARD DETECT/WRITE PROTECT switch behavior when card is INSERTED/UNLOCKED respectively:</th>
<th>Appropriate circuit connections:</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram 1" /></td>
<td>The switch closes to digital GROUND (most common).</td>
<td>Connect the socket pin to the input of the card reader.</td>
</tr>
<tr>
<td><img src="image2" alt="Diagram 2" /></td>
<td>The switch closes to a signal pin.</td>
<td>Connect one pin to input of the card reader and the other to digital ground.</td>
</tr>
<tr>
<td><img src="image3" alt="Diagram 3" /></td>
<td>The switch closes to the socket shield.</td>
<td>Connect the socket pin to input of the card reader and the chassis to ground with galvanic isolation.</td>
</tr>
<tr>
<td><img src="image4" alt="Diagram 4" /></td>
<td>The switch opens from a signal pin.</td>
<td>Connect strong pull up to one pin of the socket. Connect the input of the card reader and weak pull down on the other pin of the socket.</td>
</tr>
<tr>
<td><img src="image5" alt="Diagram 5" /></td>
<td>The switch opens from a power rail.</td>
<td>Connect the socket pin to input of the card reader with a series resistor and a weak pull down.</td>
</tr>
</tbody>
</table>
For microSD card applications, the SD_WP input of the card reader should be pulled low with a 1K Ohm resistor to enable writing to the media, or pulled high for read-only applications.

In microSD card applications where the card is not removable, the SD_nCD input of the card reader should be pulled low with a 1k Ohm resistor.

**Placement of Series Termination Resistor and Buffer**

**FIGURE 2:** PLACE SERIES TERMINATION RESISTOR CLOSE TO CARD-READER PIN SD_CLK FOR TWO LAYER PCBs.

**FIGURE 3:** PLACE SERIES TERMINATION RESISTOR CLOSE TO MEDIA SOCKET PIN SD_CLK FOR FOUR LAYER PCBs.
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