1 Introduction

This application note provides information on Printed Circuit Board layout for High-Speed Secure-Digital (SD) media sockets with USB22XX and USB260X.

2 Overview

Successful High-Speed operation of Secure-Digital media with USB22XX and USB260X requires special consideration for Printed Circuit Board (PCB) layout. This application note describes the important items to consider for layout of PCB.

3 PCB Layout Guidelines

The guidelines presented are applicable to all SMSC card-reader products that support High-Speed Secure-Digital operation. Guidelines for both two-layer and four-layer PCBs are presented here.

3.1 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 SMSC card-reader.

- SD socket VDD supply trace from card-reader should be 20 mils wide, 0.5 oz or thicker for a length up to 3000 mils.
- 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.

3.2 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 trace requires two grounded guard-traces, one on each side spaced, at 3 times minimum spacing.
- SD_CLK guard traces must have a via connecting to the ground plane at both ends and every 500 mils along the path.
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.

### 3.3 Signal Trace Length

Trace length for SD signals must be less than the maximum length specified in Table 3.1 and Table 3.2. An external buffer is required for SD_CLK when trace lengths exceed 1000 mils (800 mils excluding the socket itself). Table 3.1 provides the trace length when the unbuffered SD_CLK is driven directly by the SMSC card-reader. Table 3.2 provides the trace length when an external clock buffer is used. The buffer must be connected with a trace shorter than 50 mils to the card-reader SD_CLK pin. Skew control between data lines is not critical within the limits given in the tables.

Figure 4.1 and Figure 4.2 show the suggested placement of a series termination resistor. Figure 4.3 shows the series termination resistor when an external buffer is used with a long SD_CLK trace. The details for guarding of the SD_CLK are shown in Figure 5.1.

<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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<thead>
<tr>
<th>Signal</th>
<th>Maximum Trace Length (including socket) [mils]</th>
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<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>3000</td>
<td>80 - 150</td>
<td>&gt; 55</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>SD_DAT[0:3]</td>
<td>3500</td>
<td>80 - 150</td>
<td>&gt; 50</td>
<td>+/- 750</td>
<td>-500 to +500</td>
</tr>
<tr>
<td>SD_CMD</td>
<td>3500</td>
<td>80 - 150</td>
<td>&gt; 50</td>
<td>N/A</td>
<td>-500 to +500</td>
</tr>
</tbody>
</table>

**Note:** Trace length includes 200 mils for trace inside the socket.
4 Placement of Series Termination Resistor and Buffer

**PCB: 2 layers, signal trace with adjacent guard traces**

**Figure 4.1** Place series termination resistor close to card-reader pin SD_CLK for two layer PCBs.

**PCB: 4 layers, signal trace with adjacent guard traces**

**Figure 4.2** Place series termination resistor close to media socket pin SD_CLK for four layer PCBs.

**PCB: 2 or 4 layers when SD_CLK trace is longer than 800 mils**

**Figure 4.3** Place buffer and series termination resistor close to card reader pin SD_CLK when SD_CLK trace is longer than 800 mils not including the socket.
5 Guarding of SD_CLK

![Diagram of guard trace for SD_CLK signal. Either flood or trace can be used.](image)

Figure 5.1 Detailed view of guard trace for SD_CLK signal. Either flood or trace can be used.
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