

PI3USB10LP-A/102

Solution for USB 2.0 Short Circuit Stress Test with Pericom's PI3USB10LP-A/102

Introduction

Pericom's PI3USB10LP-A and PI3USB102 USB switches are small package, low I/O capacitance, and low R-on single differential channel 2:1 multiplexer/demultiplexer USB 2.0 solutions. Both Product characteristics are excellent for USB applications and they have excellent signal quality performance. Please refer to PI3USB10LP-A User Guide and PI3USB102 evaluation report. However, in order to comply with USB 2.0 specification, good signal quality is only one part of the equation. The second part is the USB switch must be able to withstand a Vbus short circuit. The USB 2.0 specification is stated as below (ref. P.124 of USB 2.0 specification):

Short Circuit Withstand

A USB transceiver is required to withstand a continuous short circuit of D+ and/or D- to VBUS, GND, and other data line, or the cable shield at the connector, for a minimum of 24 hours without degradation. It is recommended that transceivers be designed to withstand such short-circuits indefinitely. The device must not be damaged under the short-circuit condition when transmitting 50% of the time and receiving 50% of the time (in all supported speeds). The transmit phase consists of a symmetrical signal that toggles between drive HIGH and drive LOW. This requirement must be met for max value of VBUS (5.25V).

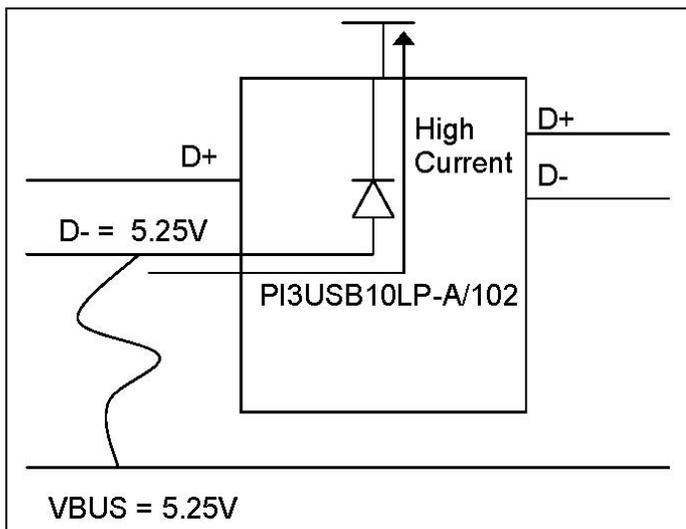


Figure 1. USB 2.0 Short Circuit Stress Test

Analysis

From figure 1, we can conclude that neither PI3USB10LP-A or PI3USB102 can comply with the USB 2.0 Short Circuit Stress since there will be a high current conduct through the path from D- to VCC. The excessive current will damage the device and it will become malfunction. The current is caused by the parasitic PMOS bulk diode and the I/V relationship is exponential. The current can be exceeded very quickly when voltage at D+/D- is above one diode drop which is around 0.5V to 0.7V.

Recommendation Solution for Short circuit Stress Test

In order to limit the current drawn, a Schottky diode can be placed at the VCC pin. This Schottky diode, IRF30BQ015 for our evaluation, can be used to block the current conducting through the device. Please refer to figure 2. In our evaluation, there is about 0.6mA of current drawn at D- during the stress test. This minimal amount of current does not damage the device and the device remains function without degradation after the stress test for 24 hours.

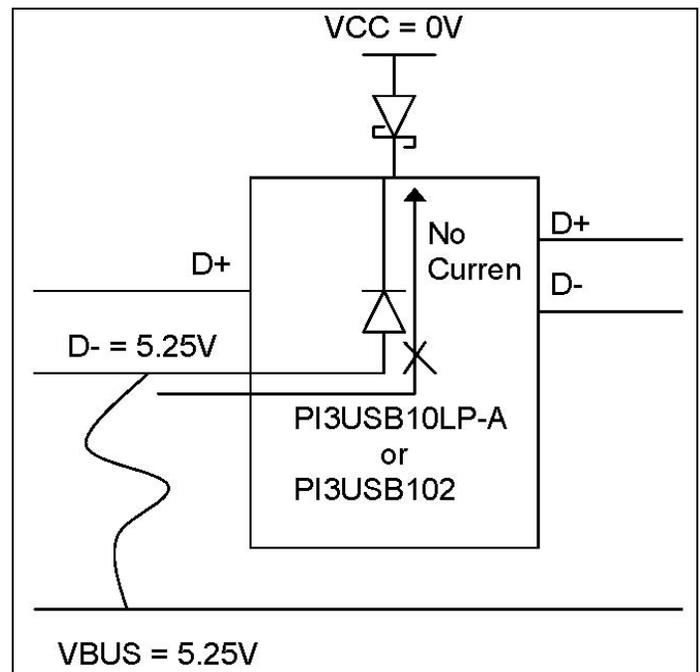


Figure 2. Recommended Solution for Short circuit Stress Test

Recommendation Solution II for Short circuit Stress Test

For the customers that have cost concern, the Schottky diode can be replaced by a 100 ohm resistor. Please refer to figure 3. In our evaluation, there is about 80mA of current conducting through the device during the stress test. This small amount of current does not damage the device and the device remains function without degradation after the stress test for 24 hours.

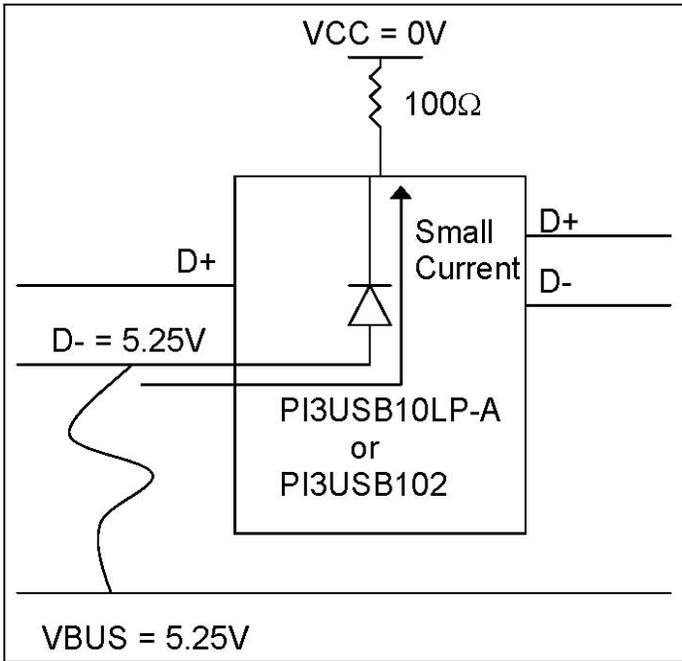


Figure 2. Recommended Solution II for Short circuit Stress Test