

TI USB Hubs: Adjusting USB_R1

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ABSTRACT

TUSB8020B, TUSB8041, TUSB8042, TUSB8043 and TUSB8044 are all USB-IF compliant USB 3.x hubs. They provide simultaneous SuperSpeed and High-speed connections on the upstream port and provide SuperSpeed, High-speed, Full-speed or Low-speed connections on the downstream ports. TUSB4041I and TUSB4020BI are a USB-IF compliant USB 2.0 hubs. They provide High-speed connection on the upstream port and provide High-speed, Full-speed or Low-speed connections on the downstream ports. This document describes and demonstrates the effects of adjusting the pull down resistor on USB_R1 ranging from a max of 10.85- k Ω \pm 1% to 8.25-k Ω \pm 1%, with a recommended value of 9.53-k Ω \pm 1%.

Contents

1	Introduction	2
2	Adjusting the USB_R1 Resistor.....	2
3	Test Setup	2
4	Results	4
5	References	7

List of Figures

1	TUSB8041 Demo Board Rev D Test Setup.....	3
2	EHSETT Tool Window Example Setup	3
3	USB_R1 = 10.95-k Ω (+15%)	4
4	USB_R1 = 10.45-k Ω (+10%)	5
5	USB_R1 = 10-k Ω (+5%)	5
6	USB_R1 = 9.53-k Ω	6
7	USB_R1 = 9.05-k Ω (-5%).....	6
8	USB_R1 = 8.55-k Ω (-10%)	7

List of Tables

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1 Introduction

The TI USB Hubs provide an external pin named USB_R1 to adjust the USB 2.0 High-speed drive strength of the driver. To configure USB_R1 pin correctly, connect a pull down resistor to GND. The value of this resistor directly affects the USB 2.0 eye height that can be measured on the downstream ports of the USB Hub. Adjusting this value may help to improve the USB 2.0 eye height when necessary. Adjusting this value only affects the downstream port USB 2.0 High-speed transmitters and not the USB 3.x SuperSpeed transmitters.

2 Adjusting the USB_R1 Resistor

TI recommends a 9.53-k Ω \pm 1% precision resistor to be connected between to the external pin named USB_R1 and GND. Changing the value of this resistor adjusts the output driver strength for USB 2.0 High-speed transmitters. Increasing the value of this resistor decreases the output driver strength for USB 2.0 High-speed transmitters, decreasing eye height. Decreasing the value of this resistor increases the output driver strength for USB 2.0 High-speed transmitters, increasing eye height.

- USB_R1 Range:
- MAX: 10.85- k Ω \pm 1%
- TYP (Recommended): 9.53-k Ω \pm 1%
- MIN: 8.25-k Ω \pm 1%

NOTE: The value of the USB_R1 resistor will set the same output driver strength for USB 2.0 High-speed transmitters on all the downstream ports and the upstream ports.

The following sections show the test setup and results of using different resistor values for USB_R1 and its effect on the USB 2.0 High-speed eye diagram of the TI USB Hub downstream ports.

3 Test Setup

In order to test the USB 2.0 High-speed eye diagram of TI USB Hub downstream ports the following set-up was used:

1. LeCroy digital scope, model SDA813Zi
2. [TUSB8041 Demo Board Rev D](#)
3. [USB.org Host Test Fixture](#)
4. [USB.org EHSETT Tool](#)
5. PC Dell XPS 8700

NOTE: [TUSB8044RGCEVM](#) can also be used for this test.

3.1 Test Procedure

1. Connect a +5V external power supply to the EVM.
2. Connect the EVM's upstream port to one of the any USB 3.0 ports (available in the Dell XPS PC).
3. Connect the USB.org Host Test Fixture to one of the EVM downstream port.
4. Connect the Scope to the Host Test Fixture USB2.0 lines using SMA matched cables.

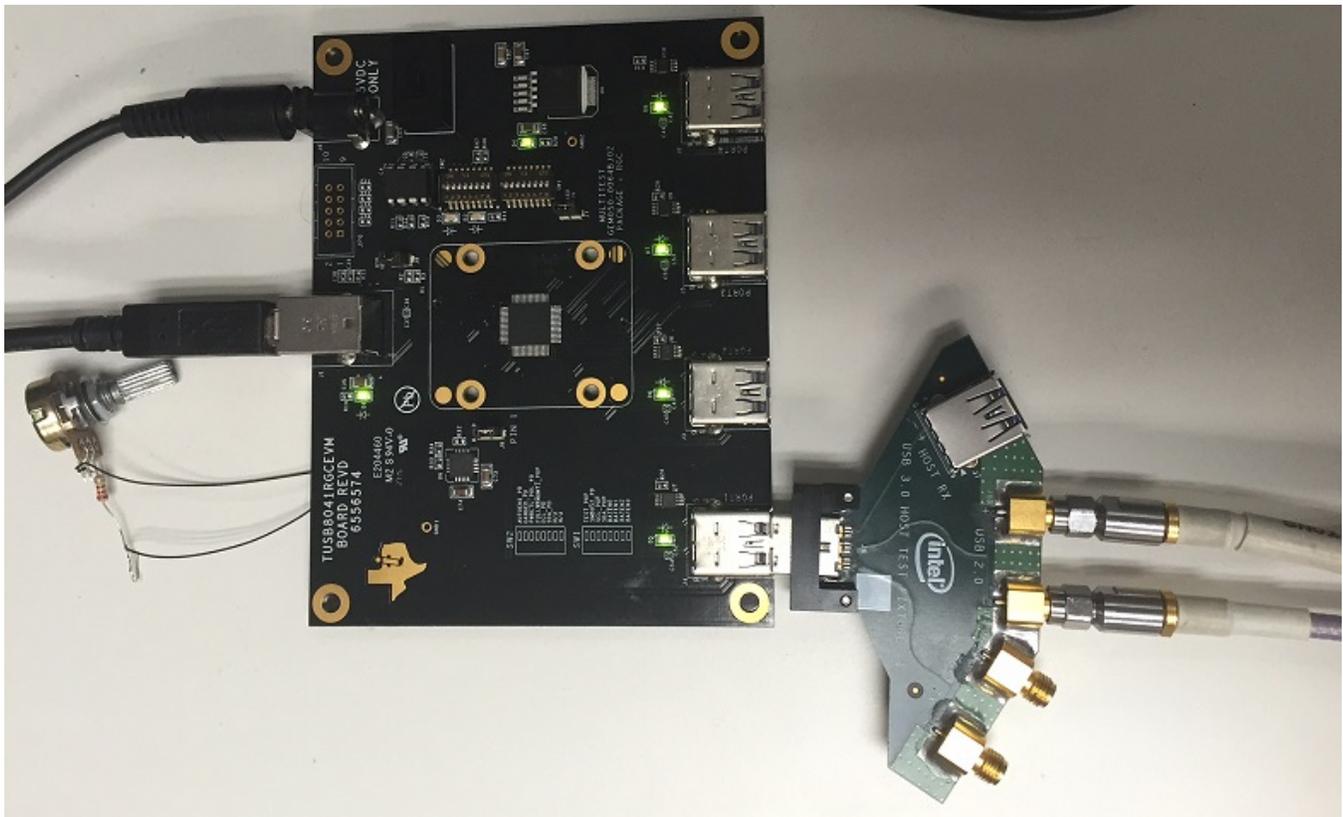


Figure 1. TUSB8041 Demo Board Rev D Test Setup

- Run the EHSETT tool and select “test Hub”, verify that the TUSB8041 is shown in the windows, then select Downstream TEST_PACKET for the downstream port to be tested.

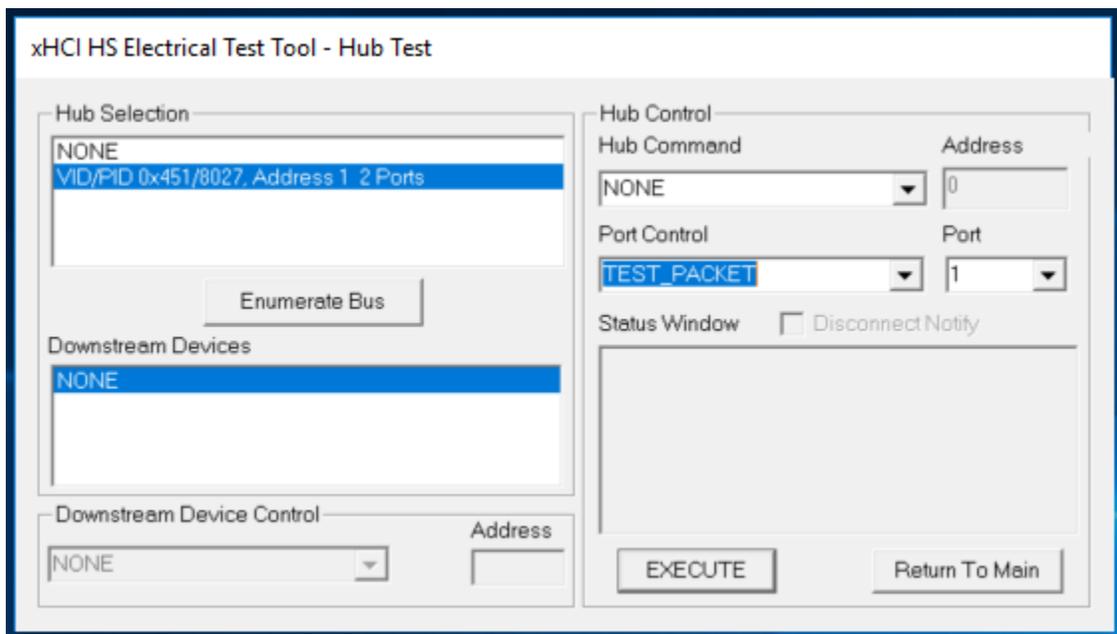


Figure 2. EHSETT Tool Window Example Setup

4 Results

Following figures show the High-Speed eye-diagram of the Hub downstream ports using different values of USB_R1. Values used are centered around TI recommend resistor value of 9.53-k Ω \pm 1%.

NOTE: Increasing or decreasing the value of the USB_R1 resistor by large margins may cause violations for the USB 2.0 High-speed Eye Mask during testing.

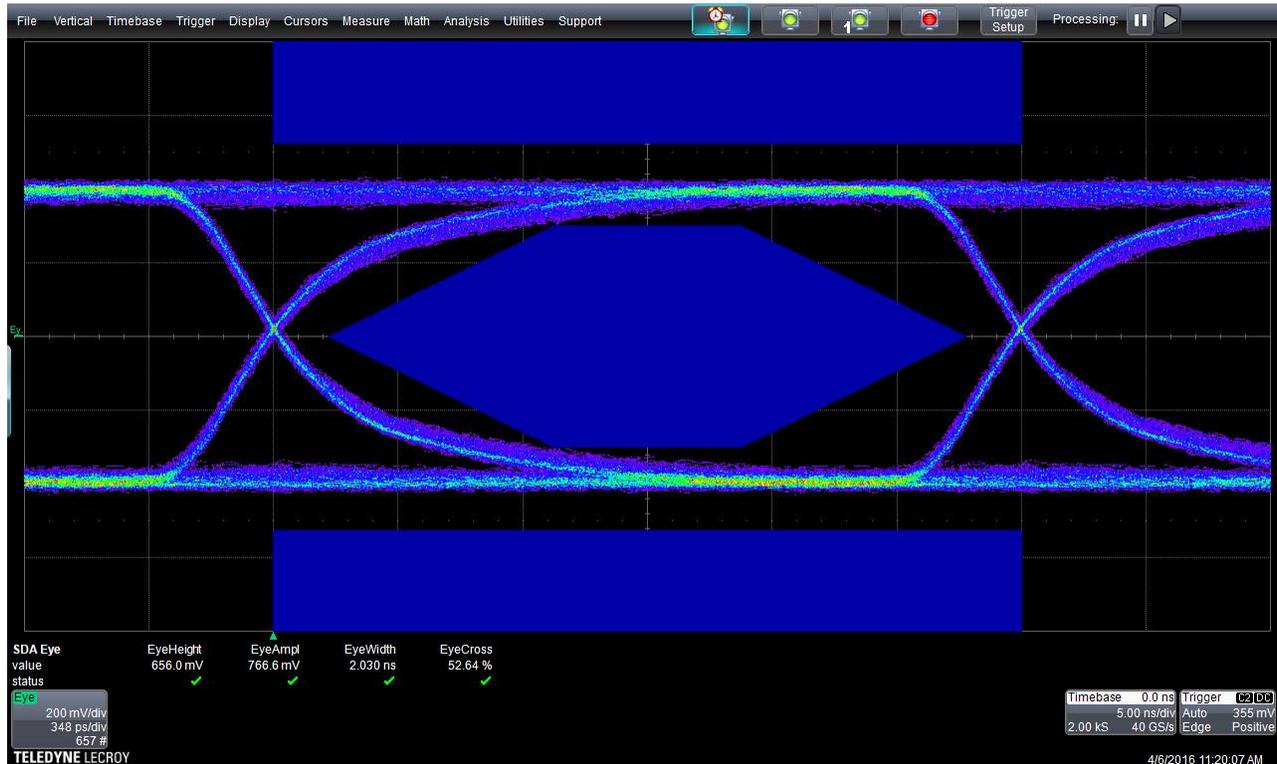


Figure 3. USB_R1 = 10.95-k Ω (+15%)

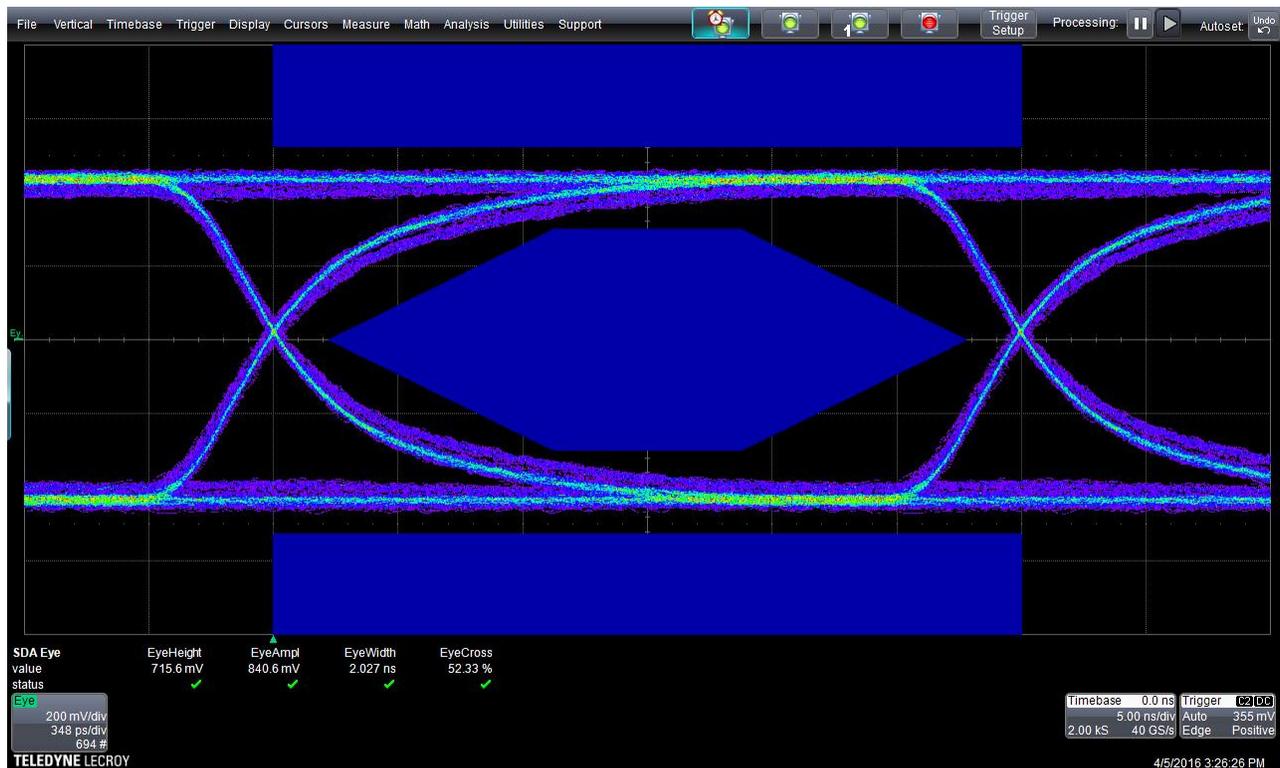


Figure 4. USB_R1 = 10.45-kΩ (+10%)

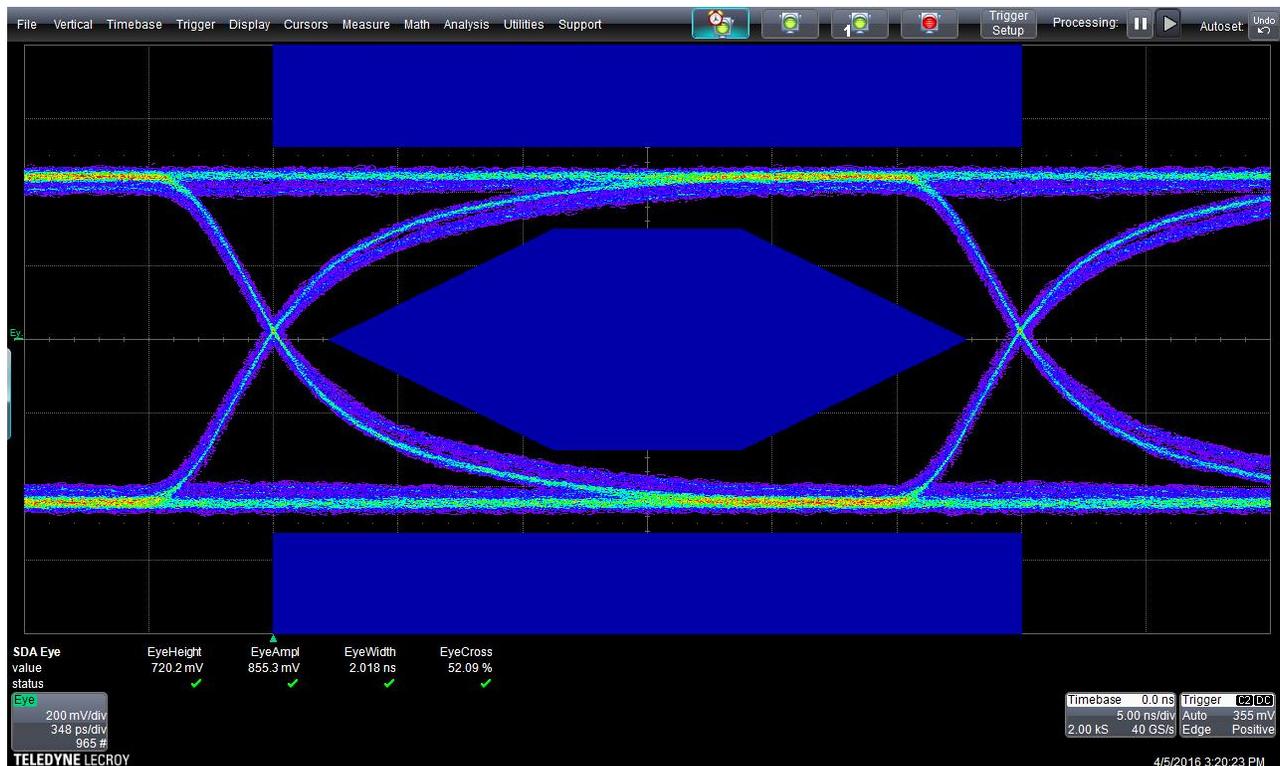


Figure 5. USB_R1 = 10-kΩ (+5%)

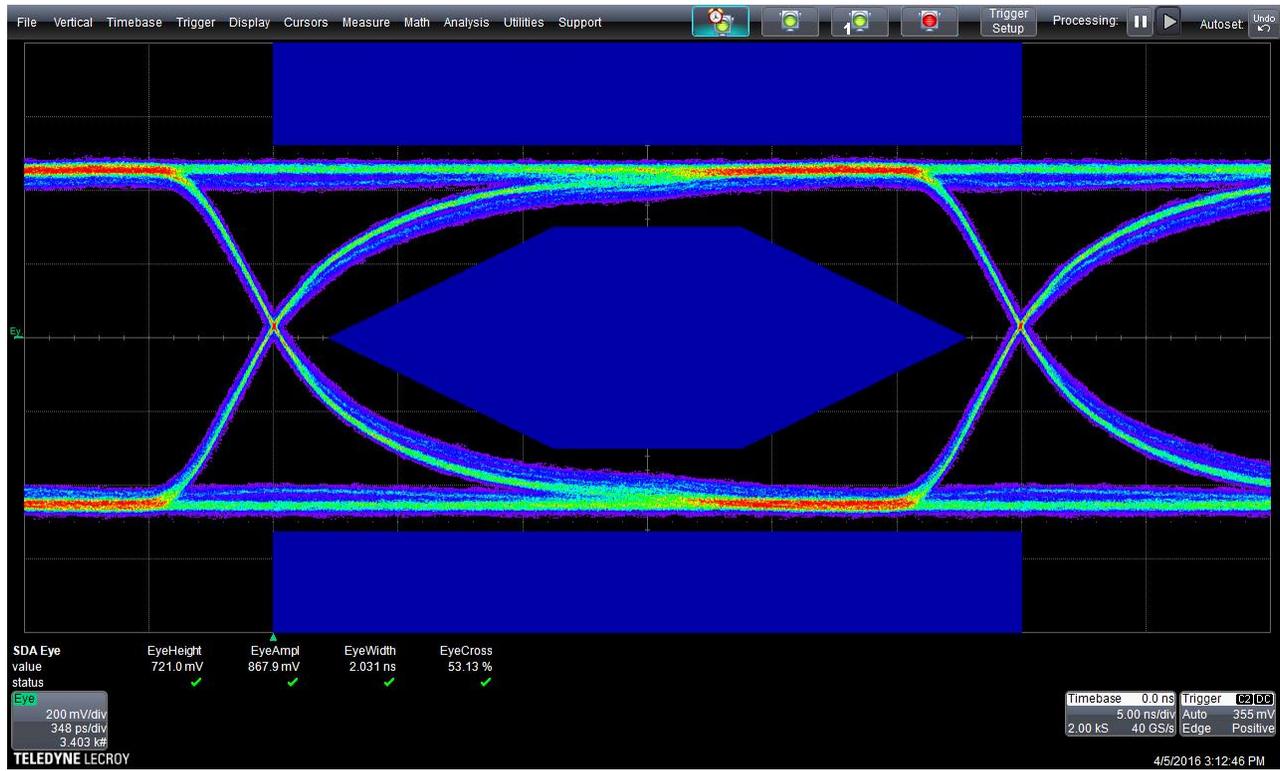


Figure 6. USB_R1 = 9.53-kΩ

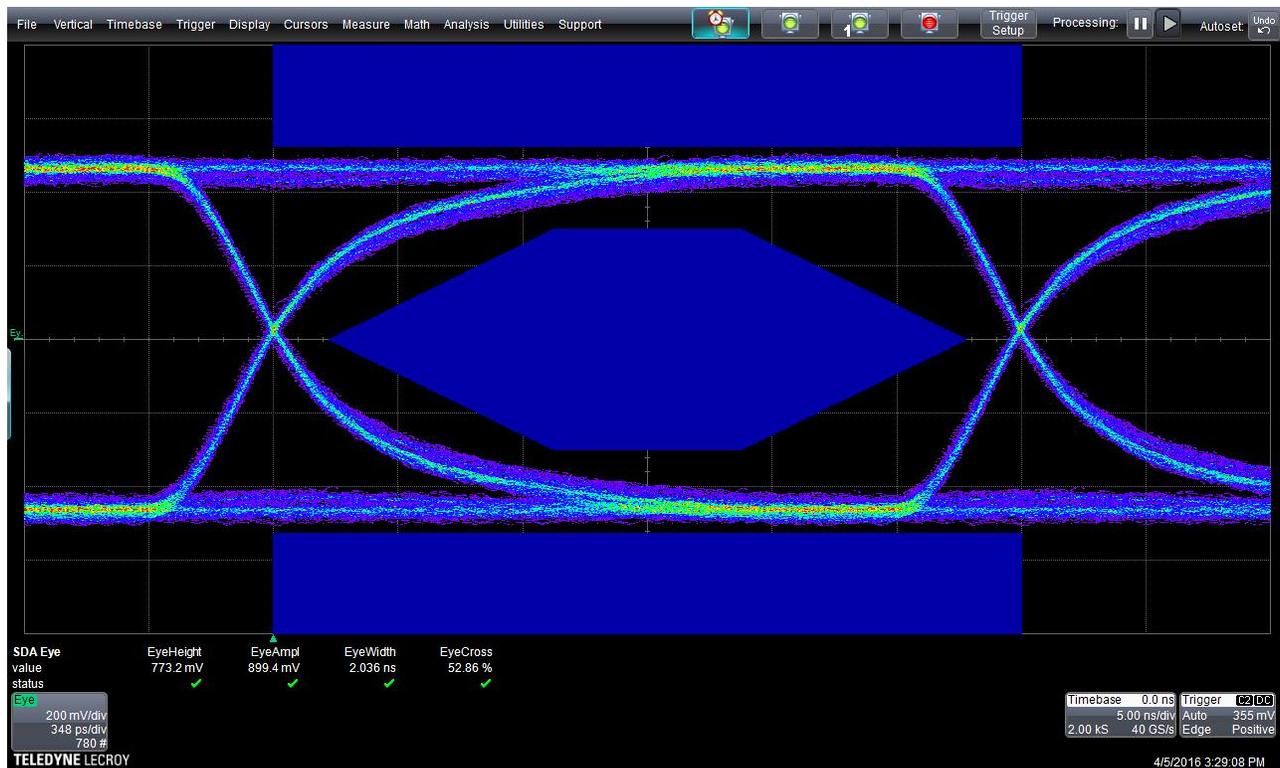


Figure 7. USB_R1 = 9.05-kΩ (-5%)

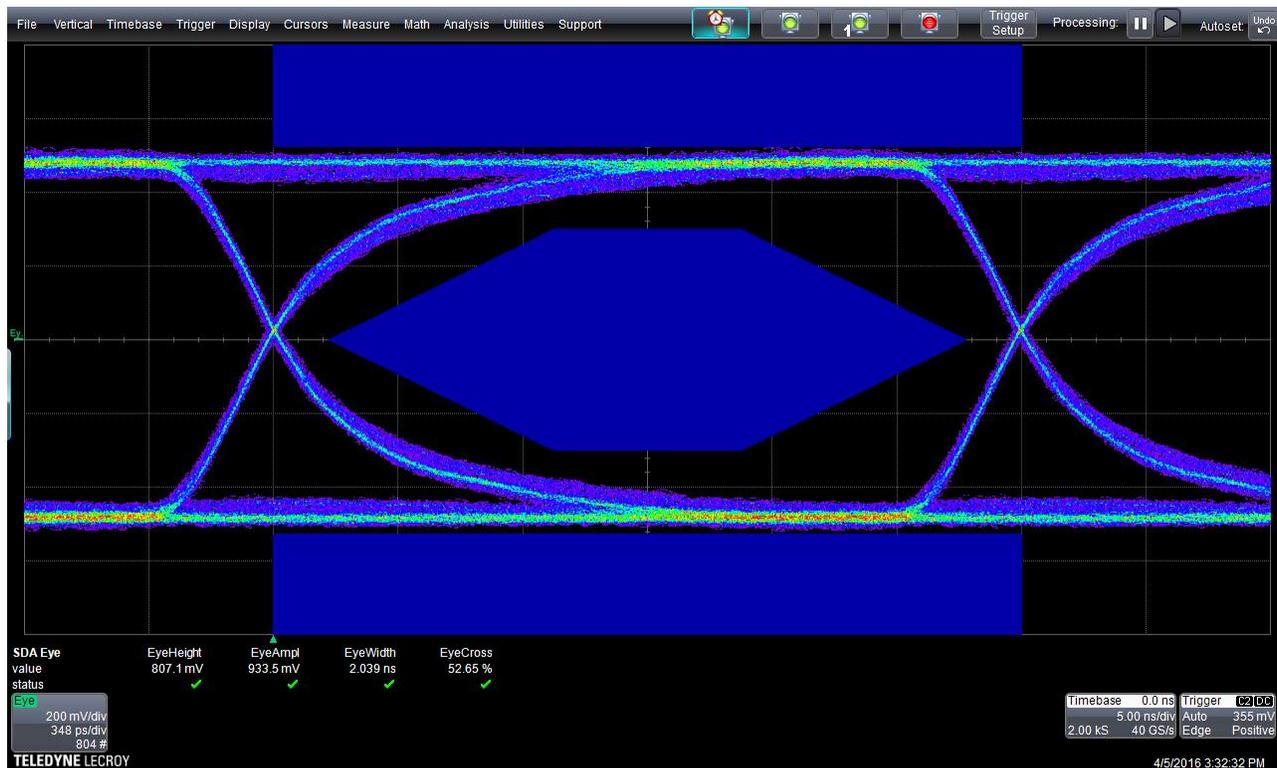


Figure 8. USB_R1 = 8.55-kΩ (-10%)

5 References

- [TUSB8020B](#)
- [TUSB8041](#)
- [TUSB8042](#)
- [TUSB8043](#)
- [TUSB8044](#)
- [TUSB8041EVM: Four-Port USB 3.0 SuperSpeed Hub Evaluation Module](#)
- [TUSB8044 Four-Port USB3.1 Gen1 Hub with USB Billboard Evaluation Module](#)
- [TUSB4020BI](#)
- [TUSB4041I](#)
- [TUSB4041PAPEVM Evaluation Module](#)

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