USB2.0 DCR Test Procedure

Revision 1.0

September 2025

Table of content

1. Reference

Standard	Description	Revision	Status
USB 2.0 Spec	USB 2.0 Specification with ECN	2.0	Released

2. Background

The USB2.0 specification include the USB ENGINEERING CHANGE NOTICE with title : USB 2.0 DC Resistance.

Reason:
The USB2.0 specification doesn't define the DC resistance (DCR) on the D+ and D- data path between the silicon and the connector. The lack of a DCR requirement in the USB2.0 specification may cause false disconnect events when high-speed capable USB2 Hosts and Devices are connected. The excessive DCR on the D+ and D- data path may be caused by multiples crossbar switches and/or passive components such as common-mode chokes. A false disconnect event may occur when a high EOP level is present due to 1) a high reflection by high DCR of D+ and D- line and 2) a large output swing (VHSOH) level being required to pass the eye diagram requirement at TP2.

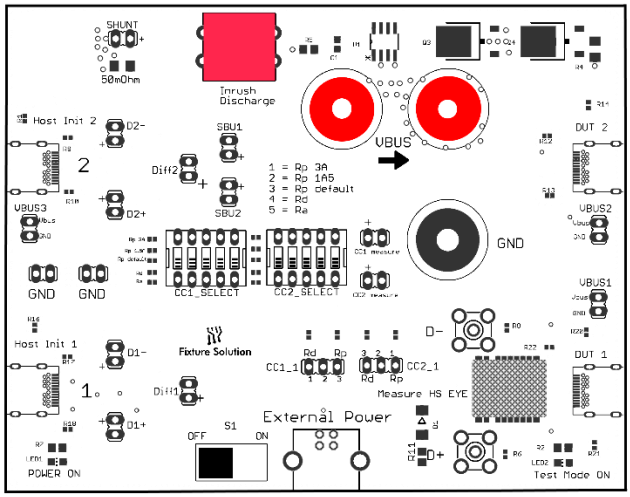
A maximum DCR limit should be defined in the specification along with an appropriate disconnect threshold voltage level in the Host design to ensure the interoperability in the USB2 eco-systems when the maximum DCR channel is present.

This test is required for all user accessible USB up and downstream ports supporting USB2.0 High Speed.

3. SETUP

3.1 Setup requirement for Device Upstream port

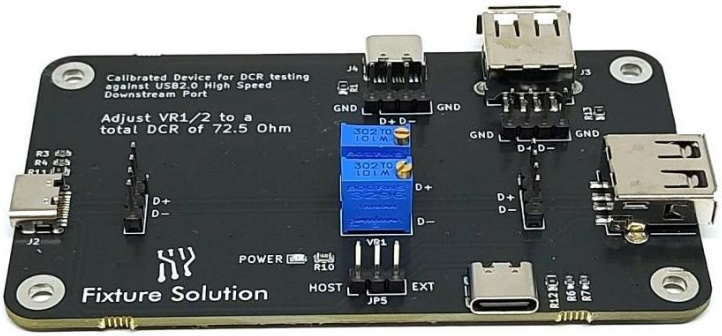
Description	Model
USB2.0 Type-C High Speed Signal Quality Test Fixture (Receptacle)	FS-HUCR
USB cable from fixture to DUT	Any
USB2.0 A-B cable to power FS-HUCR	Any
Multimeter to measure the resistance	Any
USB xHSETT to force DUT in SE0_NAK	-
MS Windows system running xHSETT	Any

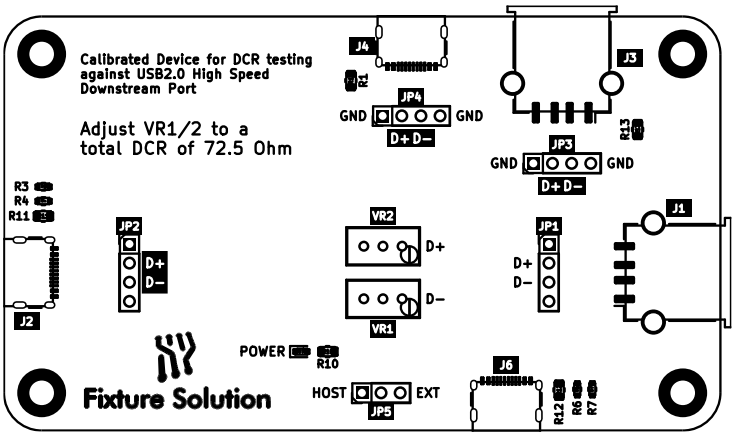


3.1 Setup requirements for Host / Hub Downstream port

Description	Model
Calibrated Device for DCR testing fixture	FS-DCR
USB-C cable to power the “EXT” power the FS-DCR fixture	**Any**
USB cable from fixture to DUT	**Any**
Known good device supporting High Speed and SE0_NAK (1)	**Any**

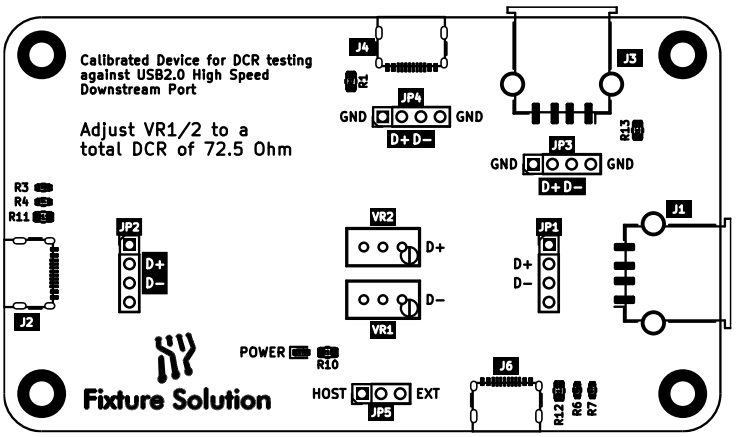
(1) It’s recommended but not mandatory using a USB Flash drive, that is typically supported by any USB Host or USB Embedded Host. Do however make sure the USB device is able to enter the SE0_NAK. The FS-DCR only route the USB2.0 data lines therefore USB3.2 / 4 devices can also be used.





3.2 Setup requirements for USB Cables

Description	Model
Calibrated Device for DCR testing fixture	FS-DCR
Multimeter to measure the resistance	Any

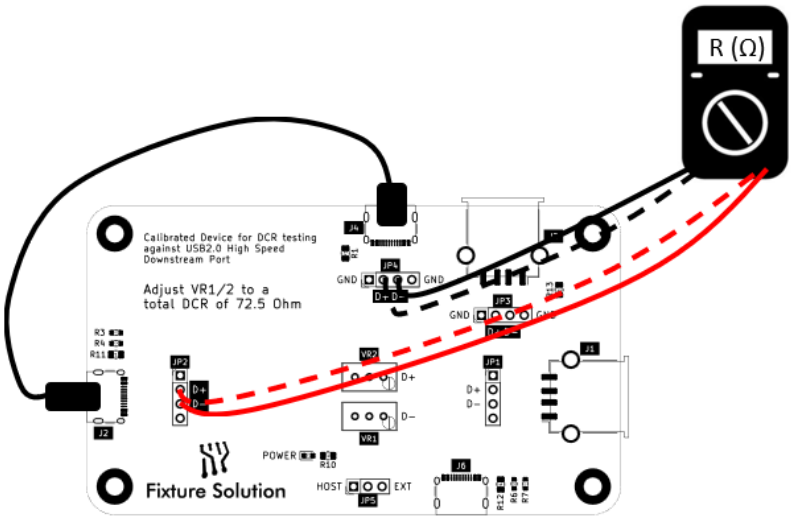


4. Test Procedure

4.1 Cable DCR

The DC resistance from plug shell to plug shell (or end of integrated cable) must be less than 3.5Ω.

Test setup



Test steps

	Test steps
C1	Connect Cable Under Test between J2 and J4 for a USB-C to USB-C cable or between J2 and J3 for a USB-C to USB-A cable.
C2	Measure the resistance between D+ JP2 and D+ JP4 for a USB-C to USB-C cable or between D+ JP2 and D+ JP3 for a USB-C to USB-A cable.
C3	Measure the resistance between D- JP2 and D- JP4 for a USB-C to USB-C cable or between D- JP2 and D- JP3 for a USB-C to USB-A cable.

The USB contact and PCB resistance is 100mΩ and shall be taken into account.

Report

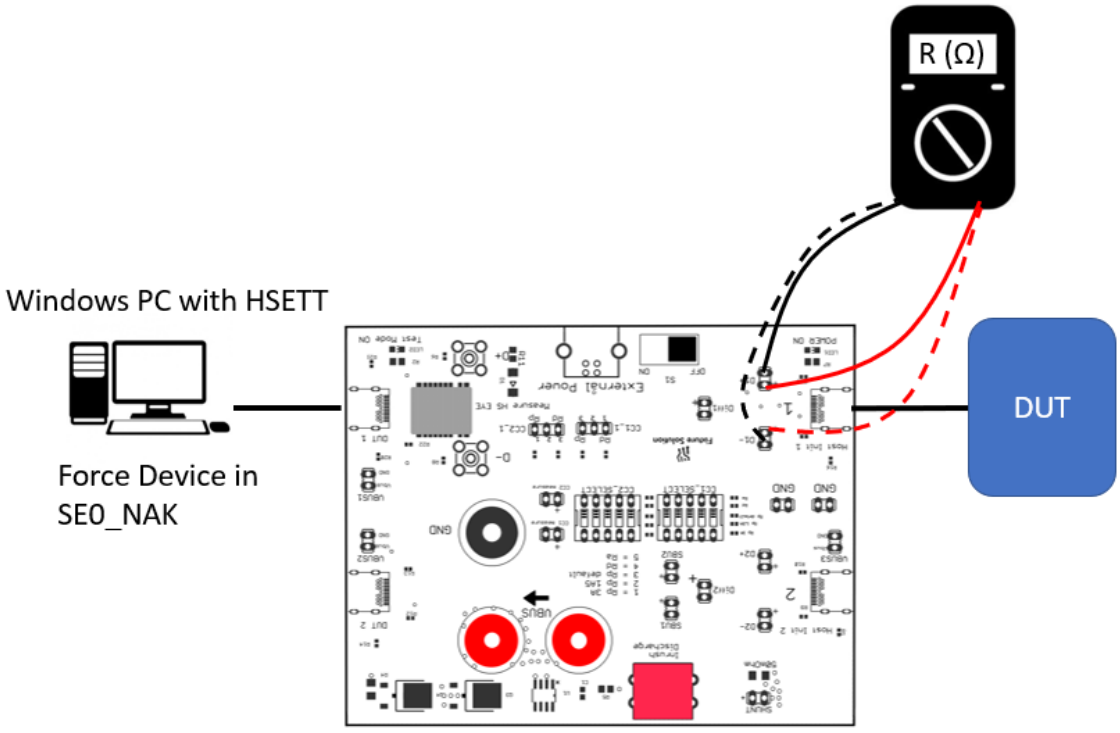
ID	Test	Requirement	Measured Value	Status
Cable_DCR_1	D+ Cable Resistance	< 3.6Ω	Ω	Pass/Fail
Cable_DCR_2	D- Cable Resistance	< 3.6Ω	Ω	Pass/Fail

4.2 Upstream Device and Hub DCR

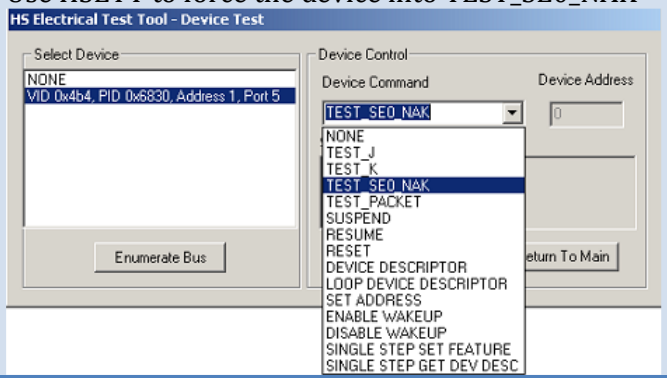
The maximum allowed DC resistance for a device including the worst termination resistance is as followed:

	DCR Max Host/Hub DS/DRD	**DCR Max Device/Hub UP**	**DCR Max Captive device**
DCR	13Ω	17Ω	23Ω
Max DCR + Rterm worst	62.5Ω	66.5Ω	72.5Ω

Test setup



Test steps

	Test steps
U1	Power the FS-HUCR fixture by connecting a USB cable to 'External Power' and a USB port that is powered and see that "POWER ON" LED is on.
U2	Flip switch S1 to off and see that "Test Mode ON" LED is off.
U3	Connect DUT to USB port "Host Init 1" port
U4	Connect Host with xHSETT installed on to "DUT1" port
U5	Use HSETT to force the device into TEST_SE0_NAK 
U6	Once the DUT is in SE0_NAK mode flip the S1 switch to on and see that the "Test Mode ON" LED is on.
U7	Measure the resistance between D1+ and GND and D1- and GND.
U8	For non-captive cable DUT subtract the cable DCR from the measurement at U7.

Report

ID	Test	Requirement	Measured Value	Status
U_1	D+ Device Rterm + DCR	< 66.5Ω (non-captive(*)) < 72.5Ω (captive)	Ω	Pass/Fail
U_2	D- Device Rterm + DCR	< 66.5Ω (non-captive(*)) < 72.5Ω (captive)	Ω	Pass/Fail

(*) For non-captive cable devices subtract the cable DCR.

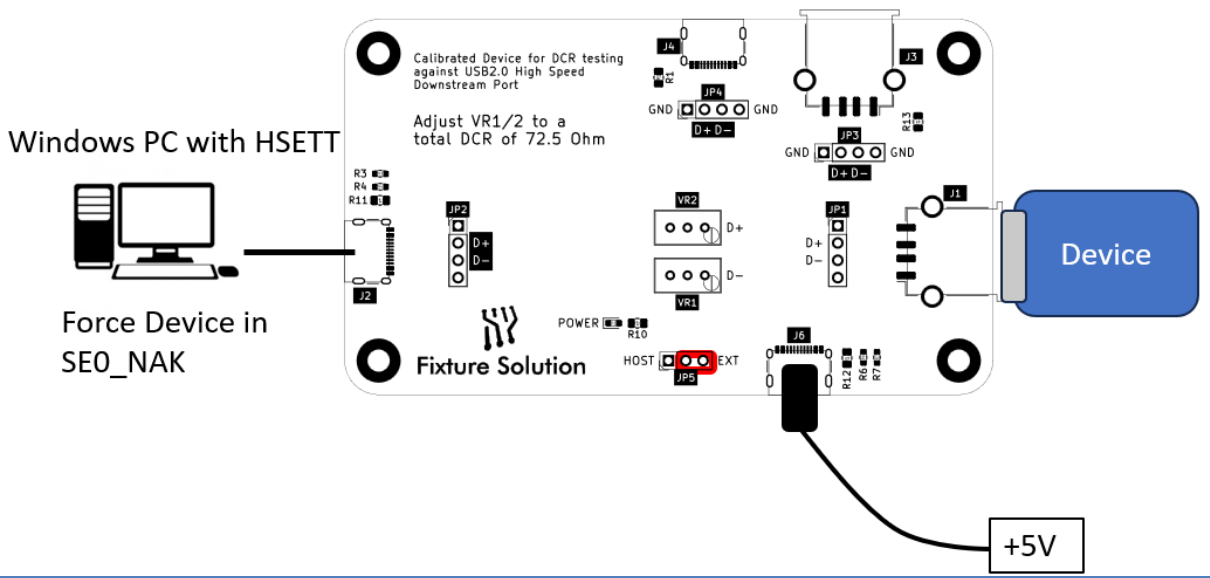
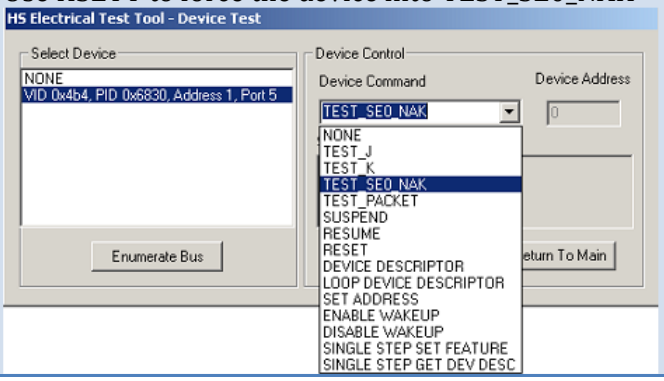
4.3 Downstream Host DCR

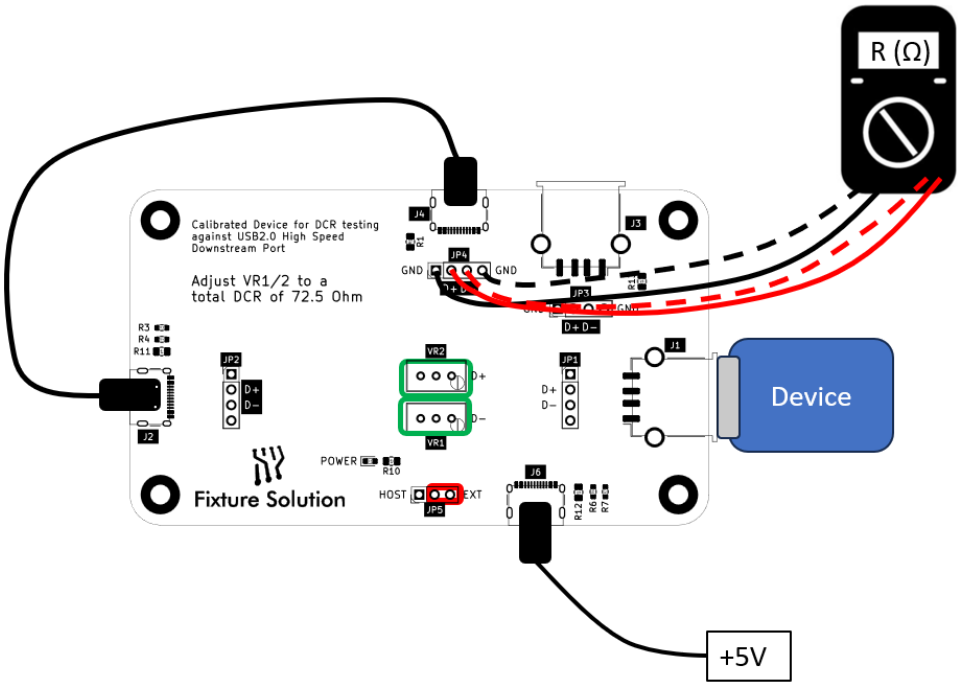
For high-speed capable downstream facing ports to check for “False Connect” and “False Disconnect” events.

4.3.1 False Host Disconnect

Prove functionality without disconnects on host under test by stressing the for example the Mass Storage Device (e.g. play music, file transfer,…) after the “*Calibrated Device”* is calibrated with the worst DCR of 72.5 Ω. All downstream ports accessible by the user shall be tested.

4.3.1.1 Calibration steps

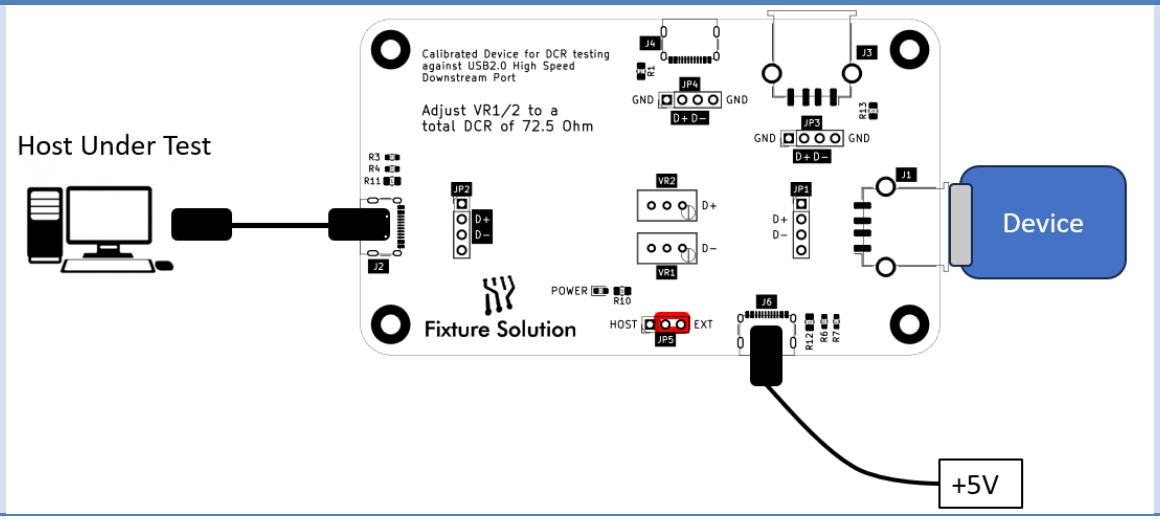
	Test steps
H1	Power the FS-DCR fixture by connecting a USB cable to ‘External Power’ and a USB port that is powered and see that “POWER ON” LED is on. (*) 
H2	Connect Device to J1
H3	Use HSETT to force the device into TEST_SE0_NAK 
H4	When the Device successfully is placed in TEST_SE0_NAK disconnect USB connection from the Host and place it to J4 if the USB Plug is Type-C and to J3 if the USB Plug is A.

	
H5	Measure the resistance between D+/GND & D-/GND at JP4 for Type-C Plug and at JP3 for A-Plug.
H6	Adjust the **trimpots VR2 and VR2** resistance till you get 72.5Ω for both D+ & D-

When using a bus powered Device JP5 shall be set EXT to keep the device powered after the device is placed in TEST_SE0_NAK and the cable is detached from the Host.

When using a self- powered Device you may place the JP5 to HOST instead of EXT and not connect an external 5V, there a typical self-powered Device remains in TEST_SE0_NAK till power cycling the Device.

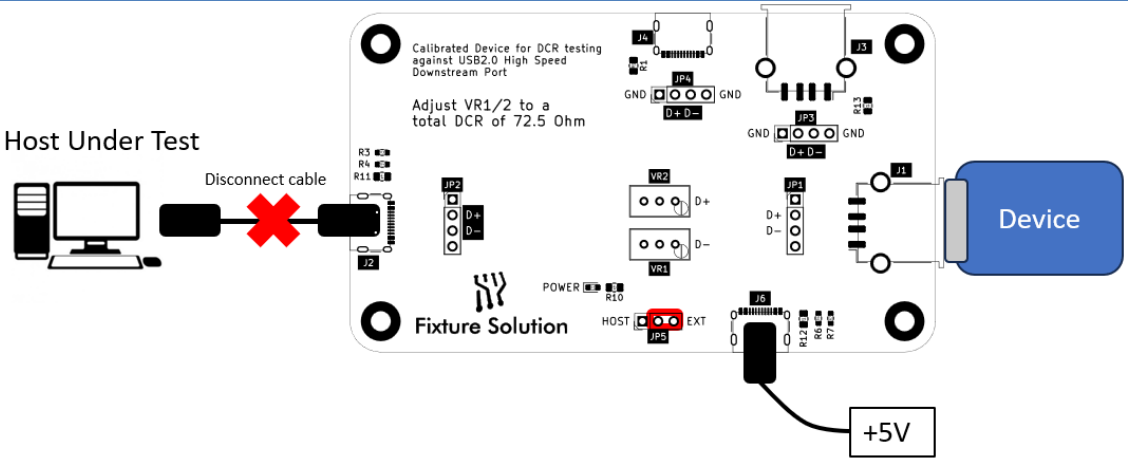
4.3.1.1 Test steps

H7	After the setup is set to 72.5Ω connect the USB cable from J2 to the Host Under Test. Make sure using the same cable used during the calibration.
H8	
H9	Prove functionality of the Device against the Host Under Test by stressing the USB communication for more than 2 minutes. For example when Device is a mass storgae device do large file transer of 5Gb file.
H10	Observer there is no USB disconnetion and USB communication proceed for at least 2 minutes.

Report

ID	Test	Requirement	Measured Value	Status
H_1	Stress the USB communication between host and calibrated Device	No USB disconnection is allowed		Pass/Fail

4.3.1 False Host Connect

	Test steps
H11	Disconnect the USB cable between calibrated device and Host Under Test
	
H12	Observer that the USB calibrated device diconnect from the host under test. For example verify that the device is not listed anymore in Windows device manager or is not listed anymore when doing *'lusb'* on a Linux based system.

Report

ID	Test	Requirement	Measured Value	Status
H_1	Disconnect calibrated device	USB device shall disconnect and not be visible in the OS		Pass/Fail

4.4 Downstream Hub DCR

For high-speed capable downstream facing ports to check for “False Connect” and “False Disconnect” events.

4.4.1 False Hub Disconnect

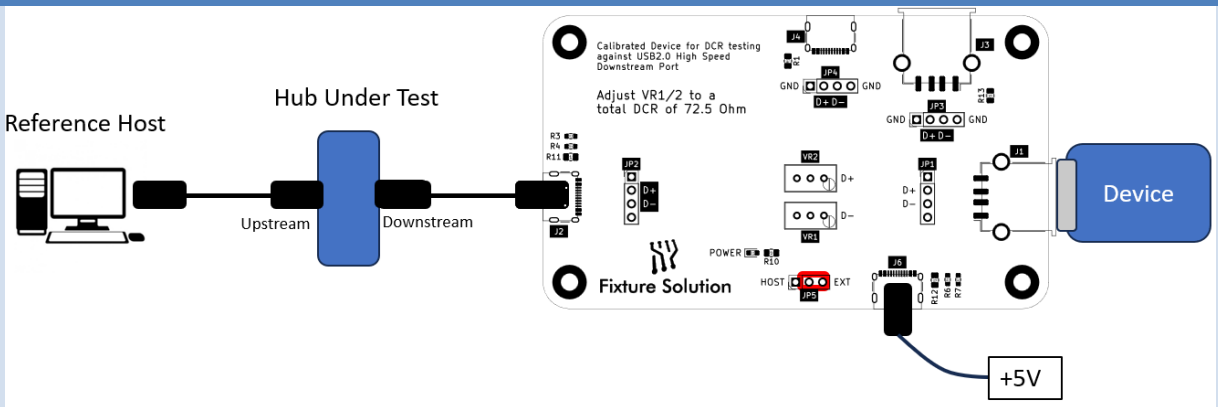
The requirements for Hub downstream ports are similar to the *4.3.1 False Host Disconnect*

4.4.1.1 Calibration steps

The calibration steps are similar as the *4.3.1.1 Calibration steps.*

4.3.1.1 Test steps

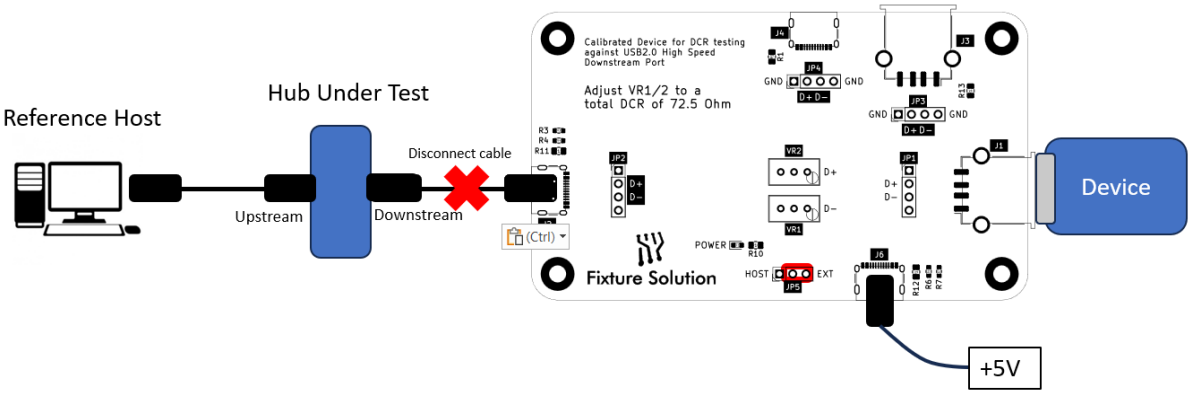
For a testing a Hub a known good Windows system (Reference Host) is needed to test the calibrated device against. It’s recommended using mass storage device as Device on the calibrated device.

Hu7	After the setup is set to 72.5Ω connect the USB cable from J2 to the Downstream port of the Hub Under Test. Make sure using the same cable used during the calibration. Connect the Upstream port to the Reference Host.
Hu8	
Hu9	Prove functionality of the Device on the Reference Host trough the Hub under Test by stressing the USB communication for more than 2 minutes. For example when Device is a mass storgae device do large file transer of 5Gb file.
Hu10	Observer there is no USB disconnetion and USB communication proceed for at least 2 minutes.

Report

ID	Test	Requirement	Measured Value	Status
Hu_1	Stress the USB communication between host and calibrated Device	No USB disconnection is allowed		Pass/Fail

4.3.1 False Host Connect

	Test steps
H11	Disconnect the USB cable between calibrated device and Host Under Test
	
H12	Observer that the USB calibrated device diconnect from the reference host. For example verify that the device is not listed anymore in Windows device manager or is not listed anymore when doing *'lusb'* on a Linux based system.

Report

ID	Test	Requirement	Measured Value	Status
Hu_2	Disconnect calibrated device	USB device shall disconnect and not be visible in the OS		Pass/Fail