

# **USB Interoperability Testing for Intel® RealSense™ Cameras**

## ***USB Interoperability Testing***

---

***Intel® RealSense™ Depth Camera D415, Intel® RealSense™ Depth Camera D435, Intel® RealSense™ Depth Camera D435i, Intel® RealSense™ Depth Camera D455, Intel® RealSense™ LiDAR Camera L515***

***Revision 001***

***March 2021***

Intel products described herein. You agree to grant Intel a non-exclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein.

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at [intel.com](http://intel.com).

Intel technologies may require enabled hardware, specific software, or services activation. Check with your system manufacturer or retailer.

The products described may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Intel product specifications and roadmaps.

Copies of documents which have an order number and are referenced in this document may be obtained by calling 1-800-548-4725 or visit [www.intel.com/design/literature.htm](http://www.intel.com/design/literature.htm).

Intel and the Intel logo, Intel® Core™, Intel® Atom™, trademarks of Intel Corporation in the U.S. and/or other countries.

\*Other names and brands may be claimed as the property of others.

© 2021 Intel Corporation. All rights reserved.

# Contents

---

1	Introduction .....	5
	1.1 Purpose and Scope of this Document.....	5
	1.2 Terminology .....	6
	1.3 Equipment List .....	7
2	Topologies and Tests.....	9
	2.1 Basic Topology .....	9
	2.2 Tests Performed .....	10
	2.3 Conclusion .....	11

## Figures

Figure 2-1. Basic Topology .....	9
Figure 2-2. Basic Topology Change 1 .....	9
Figure 2-3. Basic Topology Change 2 .....	10

## Tables

Table 1-1: Terminology .....	6
Table 1-2: Equipment List.....	7
Table 2-1: Tests Performed.....	10

# Revision History

---

Revision Number	Description	Revision Date
001	Initial release	March 2021

§ §

# **1 Introduction**

---

## **1.1 Purpose and Scope of this Document**

This document captures the testing equipment and topology that is used when testing the Intel® RealSense™ Cameras for USB interoperability. The equipment, topology, and testing are done in accordance with the specification outlined here:

<https://www.usb.org/document-library/xhci-interoperability-test-procedures-peripherals-hubs-and-hosts>.

## 1.2 Terminology

**Table 1-1: Terminology**

Acronym	Term	Description
xHCI	Extensible Host Controller Interface	USB 3.1 host controller specification
SSP	SuperSpeedPlus	USB 3.1 Gen 2 (10Gbps)
SS	SuperSpeed	USB 3.1 Gen 1 (5Gbps)
HS	HighSpeed	USB 2 (480Mbps)
HS MTT	HighSpeed Hub w/MTT	HighSpeed Hub with multiple translation translator
HS STT	HighSpeed Hub w/STT	HighSpeed Hub with single translation translator
FS	FullSpeed	USB 1.1 (12Mbps)
DUT	Device Under Test	
U0/U1/U2/U3	USB 3 Power States	U0 – Active current U1 – Standby with fast exit U2 – Standby with slower exit U3 – Suspend current
LPM	Link Power Management	Link – A USB connection between two USB ports LPM Transaction – USB transaction to transaction a link to a specific link power state L0/L1 – USB 2 Link power states
Driver Verifier	Driver Verifier Tool	Microsoft Windows tool for catching device driver bugs

## 1.3 Equipment List

**Table 1-2: Equipment List**

Device	Description
SSP Host	Dell XPS 8930 Desktop
USB Gen2 PCI Express Card	PCI Express Card with ASM3142 Chipset (ASMedia Technology Inc)
SSP Hub USB3.1 (Self-Powered)	Realtek RTS5423 (FW Version 103)
SS Hub USB3.0 Gen1 (Self-Powered)	Via VL811+ B2 step (FW Version 0982)
HS-MTT Hub (Self-Powered)	Belkin F5U237
HS-STT Hub (Self-Powered)	EVB-USB2422
FS Hub (Self-Powered)	Belkin Economy USB 1.1 7-Port Hub F5U027
SSP Cable 1M	Cables included with Realtek RTS5423
SS Cable 3M	
HS Cable 5M	
SSP Low Power Drive	Via VL716 Evaluation Board (USB-C 3.1 Gen2) (FW Version 95.c0.41.b0)
SS/SSP Video Camera	Logitech Brio
SS Display Adapter	DisplayLink: DisplayLink DL-P002 Development Board
HS Drive	Verbatim Store 'n' Go USB2.0 64GB
FS Drive	
Keyboard	Microsoft Natural Keyboard Pro
HS/FS Camera	Microsoft LifeCam HD-3000
Mouse	Microsoft Classic Intellimouse

<b>Device</b>	<b>Description</b>
Intel® RealSense™ Cameras	Intel® RealSense™ Depth Camera D415 Intel® RealSense™ Depth Camera D435 Intel® RealSense™ Depth Camera D435i Intel® RealSense™ Depth Camera D455 Intel® RealSense™ LiDAR Camera L515

**§ §**



# 2 Topologies and Tests

## 2.1 Basic Topology

Figure 2-1. Basic Topology

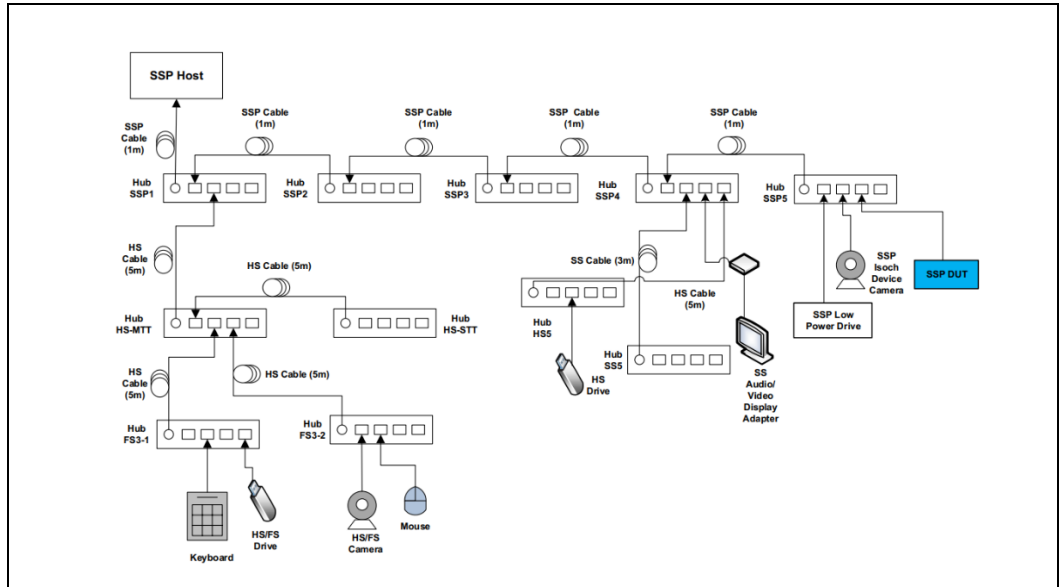


Figure 2-2. Basic Topology Change 1

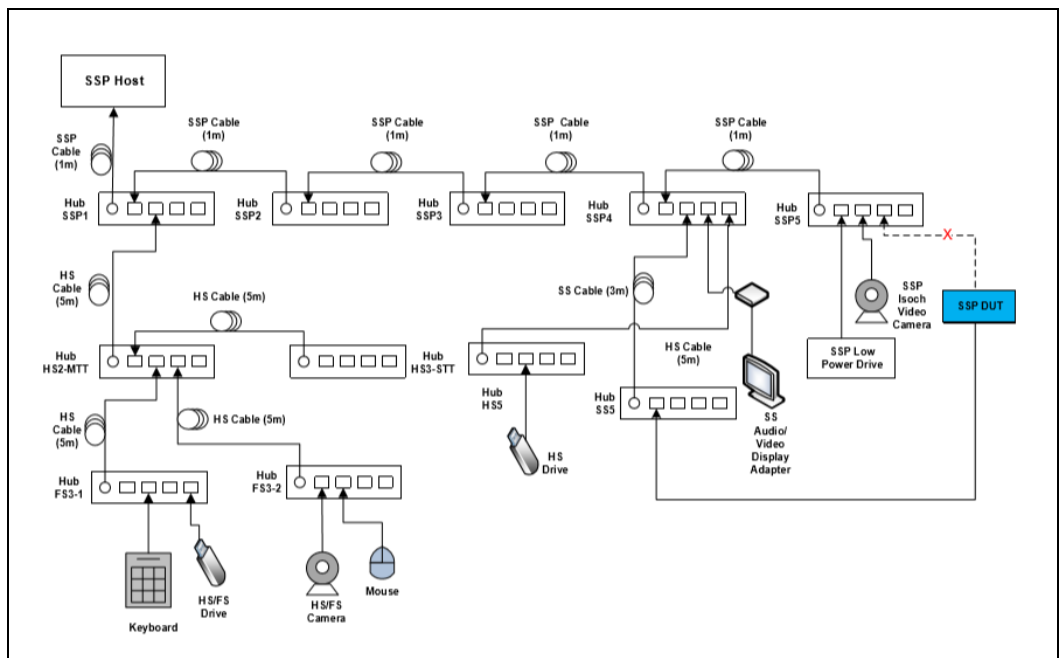
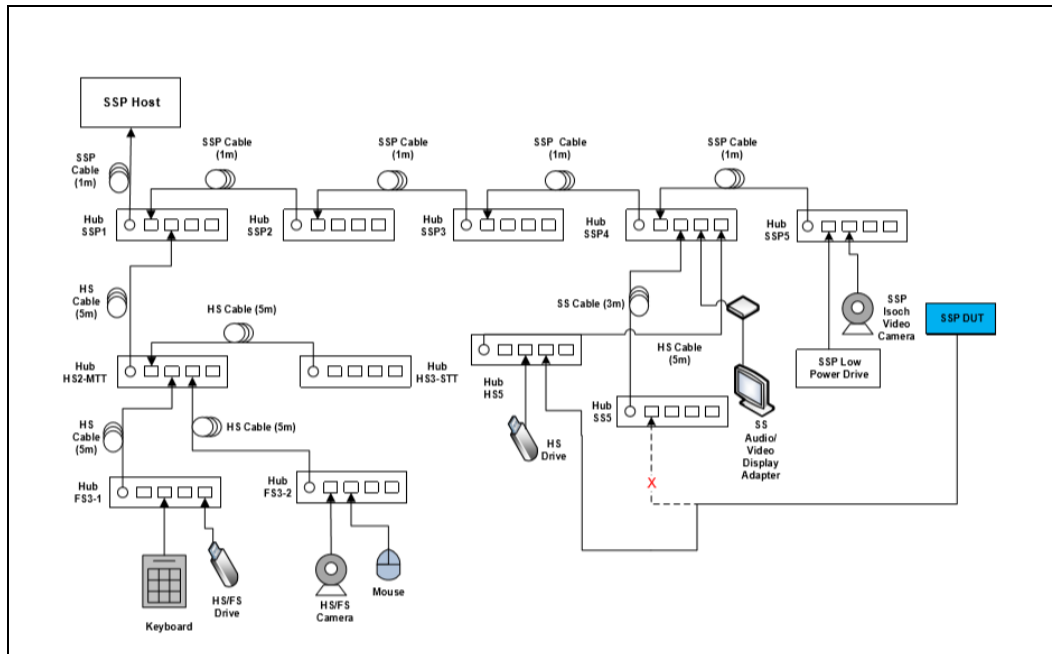


Figure 2-3. Basic Topology Change 2



## 2.2 Tests Performed

Table 2-1: Tests Performed

Test Chapter	Description
Chapter 2: USB Peripheral Interoperability Test Steps	Section 2.1: Peripheral Interoperability Tests
	Section 2.2: Peripheral Current Measurement
	Section 2.3: Peripheral U1/U2 Test Steps
	Section 2.4: Peripheral L1 (USB2 compliance) Test Steps
Chapter 7: All Devices – Interoperability Test Steps	Repeats at: <ul style="list-style-type: none"> <li>- All Devices Tests</li> <li>- All Devices Tests (After topology change 1)</li> <li>- All Devices Tests (After topology change 2)</li> <li>- Root Port Testing</li> </ul>

## **2.3 Conclusion**

The Intel® RealSense™ Cameras outlined in this document has gone through the extensive tests outlined in the interoperability test procedures and performed by in-house validation teams, which can be found at [usb.org](http://usb.org). With the equipment list provided here, the peripheral cameras have passed all tests.

**§ §**