

Universal Serial Bus 3.0 Connectors and Cable Assemblies Compliance Document

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1. Introduction

1.1 Purpose

This document describes the mechanical, electrical, environmental performance criteria and voluntary supplier compliance requirements for USB 3.0 connectors and cable assemblies.

1.2 Scope

The information provided in this document governs the voluntary compliance testing of USB 3.0 connectors and cables assemblies, as well as defining mechanical, electrical, environmental and performance characteristics. As such, it defines how USB 3.0 connectors and cables assemblies are to be tested and how manufacturers will interact with the voluntary compliance requirements.

1.3 Related Documents

American Society for Testing and Materials

ASTM-D-4565

Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable. This specification is available through the World Wide Web site <http://www.astm.org>

ASTM-D-4566

Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable. This specification is available through the World Wide Web site <http://www.astm.org>

ANSI/EIA 364-C

Electrical Connector/Socket Test Procedures Including Environmental Classifications, approved 1994. Available in hard copy – reference search site <http://www.nssn.org/information.html>

Underwriters Laboratories

UL STD-94

Test procedures used to classify polymeric materials 94HB, 94V-1, 94V-2, 94-5VA, 94-5VB, 94VTM-0, 94VTM-1, 94VTM-2, 94HBF, 94HF-1, and 94HF-2. This specification is available through the World Wide Web site <http://www.comm-2000.com>

UL Subject-444

Type CMP (plenum cable), Type CMR (riser cable), Type CM (commercial cable), and Type CMX (cable for restricted use. This specification is available through the World Wide Web site <http://www.comm-2000.com>

Electronics Industries Alliance

EIA-364-1000.01

Environmental Test Methodology for Assessing the Performance of Electrical Connectors and Sockets Used in Business Office Applications

Universal Serial Bus Implementers Forum

[USB 2.0]

Universal Serial Bus Specification, revision 2.0 (also referred to as the USB Specification). This specification is available on the World Wide Web site <http://www.usb.org>.

[USB 3.0]

Universal Serial Bus Specification, revision 3.0 (also referred to as the USB 3.0 Specification). This specification is available on the World Wide Web site <http://www.usb.org>

USB On-The-Go

On-The-Go Supplement to the USB 2.0 and 3.0 Specifications (also referred to as the USB On-The-Go Specification). This specification is available on the World Wide Web site <http://www.usb.org>.

1.4 Terms and Abbreviations

Term	Description
A2LA	<p>The American Association for Laboratory Accreditation (A2LA) is a non-profit, professional membership society. A2LA coordinates and manages a broad-spectrum, nationwide laboratory accreditation system and offers training and continuing education in laboratory practices and management.</p> <p>A2LA offers accreditation to private, independent (for hirer), in-house and government testing laboratories in the following fields: acoustics and vibration; biological; chemical; construction materials; electrical; environmental; geotechnical; mechanical; calibration; and, nondestructive and thermal.</p>
ANSI	American National Standards Institute
Approved Integrators List (AIL)	A listing available to USB-IF member companies at http://www.usb.org listing cable and connector products that have successfully completed a Voluntary Compliance Testing program conducted in accordance with the most current version of the USB Specification's Electrical, Mechanical and Environmental Performance Standards and this document.
ASTM	American Society for Testing and Materials.
ASUPS	The acronym for Application Specific USB Product Specification. An ASUPS describes the unique characteristics of a special purpose nonstandard USB connector or cable assembly specification.
C of C	Certificate of Compliance.
Characteristic	A physical, chemical, visual or any other measurable property of a product or material.
Contact Point	One electrical contact of a multi-contact connector.
Coplanarity	See ASTM definition
CTR	Conformance Test Report
Defect	Any nonconformance of the unit of product with specified requirements.
Defective Unit	A unit of product that contains one or more defects.
DWG	USB-IF Device Working Group
EIA	Electronic Industries Association.
EMI/RFI	Electro-magnetic Interference/Radio Frequency Interference.

Term	Description
FEXT	Far End Crosstalk - interference between two pairs of a cable, measured at the end of the cable furthest from the transmitter
SuperSpeed (SS)	The USB 'Super speed' data signal rate is 5Gb/s
Full-speed	The USB 'Full-speed' data signaling rate is 12Mb/s.
High-speed	The USB 'High-speed' data signaling rate is 480Mb/s.
Low-speed	The USB 'Low-speed' data signaling rate is 1.5Mb/s.
NIST	National Institute of Standards and Technology.
NEXT	Near End Crosstalk - interference between two pairs of a cable, measured at the same end of the cable as the transmitter
Power Pair	The non-twisted pair of electrical conductors in a USB cable used to carry power from the 'host controller' and/or a 'self-powered hub' to the device. Where the 'Red' conductor is Vbus and the 'Black' conductor is Ground.
Signal Pair (s)	<p>The UTP (unshielded twisted pair) of electrical conductors in a USB cable used to carry USB2.0 data from the 'host controller' and/or a 'self-powered hub' to the device. Where the 'Green' conductor is Dplus (D+) and the 'White' conductor is Dminus (D-).</p> <p>The SDP (shielded differential pairs, twist or twinax) of electrical conductors in a USB 3.0 cable are required for the Super Speed data lines.</p>
TID	Test Identification Number
TDR	Time Domain Reflectometry - a measurement technique used to determine the characteristics of electrical lines by observing reflected waveforms.
Universal Serial Bus	Universal Serial Bus is a serial interconnect bus that supports transfer rates up to 5 Gbps for a maximum of 127 USB devices.
USB Devices	USB devices can be: 'Hubs' that provide attachment points for USB; or, 'Functions' that provide capabilities to the system, such as an ISDN connection, a digital joystick, a printer, speakers, et cetera.
CNLA	Chinese National Laboratory Accreditation

Term	Description
USB Host	The USB interface to the host computer system is referred to as the Host Controller. The Host Controller may be implemented in a combination of hardware, firmware or software. A 'root hub' is integrated within the host system to provide one or more attachment points. Additional information concerning the 'USB host' may be found in Section 4.9 and Chapter 10 of the USB Specification USB 2.0.
USB Topology	The USB connects USB devices with the USB host. The USB physical interconnection is a tiered star topology. A 'hub' is at the center of each star. Each wire segment is a point-to-point connection between the 'host' and a 'hub' or 'function,' or a 'hub' connected to another 'hub' or 'function.'
USB	The acronym for Universal Serial Bus. (Please see Universal Serial Bus.)
USB-IF	USB Implementers Forum is a nonprofit industry organization made up of original equipment manufacturers (OEMs), component manufacturers and firmware/software developers who are actively involved in the advancement of USB technology. (Please see http://www.usb.org)
VNA	Vector Network Analyzer - for measuring S parameters of RF and microwave transmissions.

2 Management Overview

This section is an overview of the contents of this document and provides a brief summary of each of the subsequent sections. It does not establish any requirements or guidelines.

Section 3 describes USB 3.0 Electrical, Mechanical and Environmental Compliance Standards.

Section 4 describes the acceptance testing criteria and test procedures for USB 3.0 connectors and cable assemblies.

Section 5 describes the Certification, Acceptance and Submission processes.

Appendices provide necessary supporting information for this document.

3 USB 3.0 Electrical, Mechanical and Environmental Compliance Standards

USB 3.0 connectors and cable assemblies must meet or exceed the requirements specified by the most current version of Chapter 5 of the USB 3.0 Specification and applicable Supplements. *See Table 3-1, USB 3.0 Electrical, Mechanical and Environmental Compliance Standards.*

Table 3-1 USB 3.0 Electrical, Mechanical and Environmental Compliance Standards

Test Description	Test Procedure	Performance Requirement
Low Level Contact Resistance	EIA 364-23b The object of this test is to detail a standard method to measure the electrical resistance across a pair of mated contacts under a low voltage/current condition. Measurement to use the Kelvin 4-wire method.	30 mΩ maximum initial for the Power (VBUS) and Ground (GND) contacts and 50 mΩ maximum initial for all other contacts when measured at 20 mV maximum open circuit at 100 mA. Mated contacts under test must be in a connector housing. 10 mΩ maximum change for post test LLCR Test shall be done in sequences defined in EIA 364-1000.01.
Dielectric Withstanding Voltage	EIA 364-20 The object of this test procedure is to detail a test method to prove that a USB 3.0 connector can operate safely at its rated voltage and withstand momentary over potentials due to switching, surges and/or other similar phenomena.	The dielectric must withstand 100 VAC (RMS) for one minute at sea level after the environmental stress defined in EIA 364-1000.01. Test shall be done in sequences defined in EIA 364-1000.01.
Cable Assembly Voltage Drop	5V nominal. The purpose of this test is to verify the voltage drop across the mated cable assembly. A minimum voltage is required for a USB device to function appropriately.	At 900mA: 225mV maximum drop across power pair (VBUS and GND) from pin to pin (mated cable assembly)
Insertion Force	EIA 364-13 The object of this test is to detail a standard method for determining the mechanical forces that are required for inserting a USB 3.0 connector.	35 Newtons maximum at a maximum rate of 12.5 mm (0.492") per minute.
Extraction Force	EIA 364-13 The object of this test is to detail a standard method for determining the mechanical forces that are required for extracting a USB 3.0 connector.	10 N minimum initial and 8 N minimum after the specified insertion/extraction, or durability cycles (at a maximum rate of 12.5mm/0.492" per minute). No burs or sharp edges are allowed on top of locking latches (hook surfaces which will rub against receptacle shield).
Durability	EIA 364-09 The object of this test procedure is to detail a uniform test method for determining the effects caused by subjecting a USB 3.0 connector to the conditioning action of insertion and extraction, simulating the expected life of the connector. Durability cycling with a gauge is intended only to produce mechanical stress. Durability performed with mating components is intended to produce both mechanical and wear stress.	Standard-A, Standard-B and Powered-B series: <ul style="list-style-type: none"> ○ Standard Durability Class: 1500 cycles ○ High Durability Class: 5000 cycles Micro Connector Family: <ul style="list-style-type: none"> ○ 10,000 cycles Cycle rate of 200 cycles per hour manually or 500 maximum

Test Description	Test Procedure	Performance Requirement
		per hour automatically Test shall be done in sequences defined in EIA 364-1000.01.
Cable Flexing	EIA 364-41, Condition I Dimension X=3.7 x cable diameter and 100 cycles in each of two planes 120 degree arc	No physical damage. No discontinuity over 1 microsecond during flexing.
Cable Pull-Out	EIA 364-38 Test Condition A The object of this test procedure is to detail a standard method for determining the holding effect of a USB 3.0 plug cable clamp without causing any detrimental effects upon the cable or connector components when the cable is subjected to inadvertent axial tensile loads.	After the application of a steady state axial load of 40 Newtons for one minute. No physical damage or discontinuity allowed
4-Axes Continuity	See Appendix C for detailed test fixture and procedures. This test checks the mating interface electrical connection robustness.	Subject the mating interface to an 8N tensile force for at least 10 seconds. No discontinuities greater than 1 microsecond duration in any of the four orientations tested. Micro connector family only.
Solderability	EIA 364-52 The object of this test procedure is to detail a uniform test method for determining USB 3.0 connector solderability. The test procedure contained herein utilizes the solder dip technique. It is not intended to test or evaluate solder cup, solder eyelet, other hand-soldered type or SMT type terminations.	Solder shall cover a minimum of 95% of the surface being immersed, when soldered at temperature 255°C+/-5°C for in immersion duration 5s.
Visual & Dimensional Inspection	EIA 364-18 Visual, dimensional and functional inspection in accordance with the USB 3.0 quality inspection plans	Must meet the minimum requirements specified by the most current version of Chapter 5 of the USB 3.0 Specification.
Temperature Life	EIA 364-17, Method A. The object of this test procedure is to detail a standard method to assess the ability of a USB 3.0 connector to withstand temperature.	105° C without applied voltage for 120 hours. 105° C without applied voltage for 72 hours when used as preconditioning in EIA 364-1000.01. Test shall be done in sequences defined in EIA 364-1000.01.
Vibration	EIA 364-28 Test Condition VII, Test Letter D This test procedure tests the ability of USB 3.0 connectors to withstand conditions involving vibration.	No evidence of physical damages. Test shall be done in sequences defined in EIA 364-1000.01.
Cyclic Temperature and Humidity	EIA 364-31 The object of this test procedure is to detail a standard test method for the evaluation of the designs and materials used in USB 3.0 connectors as the effects of high humidity and heat influences them.	24 cycles as defined in Test Group 2 of EIA 364-1000.01. Test shall be done in sequences defined in EIA 364-1000.01.
Thermal Shock	EIA 364-32 Test Condition I The object of this test is to determine the resistance of a USB 3.0 connector to exposure at extremes of high and low temperatures and to the shock of alternate exposures to these	10 Cycles -55°C and +85°C. The USB 3.0 connectors under test must be mated. There shall be no evidence of any physical damage. Test shall be done in sequences defined in EIA 364-1000.01.

Test Description	Test Procedure	Performance Requirement
	extremes, simulating the worst case conditions for storage, transportation and application.	
Mixed Flowing Gas	EIA 364-65 Class II A The object of this test procedure is to produce environmentally related corrosive atmospheres to determine the reaction to plated or un-plated surfaces when exposed to different concentrations of flowing industrial gas mixtures. USB 3.0 connector evaluation samples should be placed in an environmentally controlled 'test chamber' that is monitored by a gas analyzing system for controlled concentrations of the specified gas mixture. Test coupons shall also be used and the weight gain reported.	7-days, Options #1A and #1B as specified in EIA 364-1000.01. Test shall be done in sequences defined in EIA 364-1000.01.
Contact Capacitance	EIA 364-30 The object of this test is to detail a standard method to determine the capacitance between conductive elements of a USB 3.0 connector.	2 pF maximum unmated, per contact. D+/D- contacts only.
Propagation Delay	EIA 364 -103 The purpose of the test is to verify the end-to-end propagation of the D+/D- lines of the cable assembly.	10ns maximum for a cable assembly attached with one or two Micro connectors and 26ns maximum for a cable assembly attached with no Micro connector. 200ps rise time. D+/D-lines only.
Propagation Delay Intra-pair Skew	EIA 364 – 103 This test ensures that the signal on both the D+ and D- lines of cable assembly arrive at the receiver at the same time.	Test condition: 200ps rise time . D+/D- lines: 100ps Maximum
D+/D- Pair Attenuation	EIA 364 – 101 This test ensures the D+/D- pair of a cable assembly can provide adequate signal strength to the receiver in order to maintain a low error rate.	-0.67 dB Maximum @ 12 MHz -0.95 dB Maximum @ 24 MHz -1.35 dB Maximum @ 48 MHz -1.90 dB Maximum @ 96 MHz -3.20 dB Maximum @ 200.0 MHz -5.80 dB Maximum @ 400.0 MHz
Mated Connector Impedance (Differential)	EIA 364 – 108 This test ensures that the signal conductors of the USB 3.0 connectors have the proper impedance.	75 Ω minimum, 105 Ω maximum. 50ps (20-80%) rise time of a differential TDR. (Mated connector includes cable termination areas). SuperSpeed pairs only.
Differential Insertion Loss of SS Pairs of Mated Cable Assembly	EIA-360-101 Normalized with a 90-ohm differential impedance. See Appendix C.	The measured differential insertion loss of a mated cable assembly must not exceed the limit defined by the following vertices: (100 MHz, -1.5 dB), (1.25 GHz, -5.0 dB), (2.5 GHz, -7.5 dB), and (7.5 GHz, -25 dB). See Appendix C. SuperSpeed pairs only.
Differential Near End Crosstalk between SS Pairs of Mated Cable Assembly	EIA-360-90. See Appendix C.	Must not exceed the limit defined below: <ul style="list-style-type: none"> • USB 3.0 Standard-A connector: 0.9% • USB 3.0 Standard-B connector: 1.8% • USB 3.0 Micro connector family: 1.2% 50ps (20-80%) rise time of a differential TDT SuperSpeed pairs only.
Differential Near and	EIA-360-90.	Must not exceed the limit defined below:

Test Description	Test Procedure	Performance Requirement
Far End Crosstalks between SS Pairs and D+/D- pair of Mated Cable Assembly	See Appendix C.	<ul style="list-style-type: none"> • USB 3.0 Standard-A connector: 2% • USB 3.0 Standard-B connector: 2% • USB 3.0 Micro connector family: 2% <p>500ps (10-90%) rise time of a differential TDT</p>
Differential to Common Mode Conversion	<p>Measure the single-ended S-parameters of the mated cable assembly and derive the Differential to Common Mode Conversion. See Appendix C.</p> <p>Normalized with a 90-ohm differential impedance.</p> <p>The main purpose of this requirement is to limit the cable assembly EMI emission.</p>	<p><= -20 dB from 100 MHz to 7.5 GHz.</p> <p>SuperSpeed pairs only.</p>

4 Acceptance Criteria, Test Methods and Test Procedures

For a USB 3.0 connector or cable assembly product to be listed on the USB-IF Integrators List, the manufacturer must show satisfactory completion of all qualification tests specified in the most current version of the USB 3.0 Specification and the USB-IF USB 3.0 Connectors and Cable Assemblies Compliance Document.

Cable assemblies must implement certified USB 3.0 connectors in order to submit the cable assembly for certification testing.

Stand-alone captive cable assemblies with vendor specific connectors are not eligible for USB certification. A captive cable is considered to be electrically part of its target USB 3.0 device and will participate in the device's compliance program.

IMPORTANT NOTICE: USB 3.0 connectors and cable assemblies must successfully pass all inspection procedures and compliance testing at the intervals defined in this document before listing on the USB-IF Integrators List will be granted.

4.1 Integrators List (IL)

USB-IF maintains a current listing of 'IL manufacturers and/or fabricators' who have been authorized to use the trademarked 'USB3.0 logo' in conjunction with or on their connector and/or cable assembly products. The USB-IF's listing of approved manufacturers is periodically updated and is available to all USB-IF member companies.

4.2 USB Logo Usage

Only products that meet or exceed the compliance test requirements identified in this document at the time of testing are eligible to display the certified logo provided the product vendor has signed the USB IF logo trademark license agreement.

4.3 Compliance Test Report

The testing laboratory performing the compliance testing will issue a certified test report concisely detailing the tests performed. The certified test report must contain complete test results (inclusive of the raw data). Upon completion of compliance testing, the certified laboratory shall be responsible for notifying the USB IF with the products test results. Upon acceptance of the test results confirming compliance to this document the product will be added to the integrators list.

4.4 Connector and Cable Assembly Physical Certification

In case of conflict between the requirements of this document and the USB 3.0 Specification, the most current revision of the USB 3.0 Specification & applicable USB 3.0 Supplements shall take precedence.

Unless otherwise specified, all tests shall be performed at the following standard test conditions.

Table 4-1 Standard Test Conditions

Temperature	15° C to 35° C
Air Pressure	86 to 106 kPa
Relative Humidity	25% to 85%

Table 4-2 Performance Levels

Performance Level	EIA Certification	Temperature Degrees C	Humidity % RH	Marine Atmosphere	Harsh Environment
1	G1.1	25° C to 65° C	40% to 75%	No	No

Note: Testing details are described in Sections 4.8 to 4.10.

4.5 General Information

This document shows minimum compliance tests to be performed, the order in which they shall be performed and the performance requirements for each test.

4.5.1 Mated Pairs

See table 5-1 of the USB 3.0 standard for a listing of mated pairs. See section 4.8 of this document for required specimens.

An example of mated pairs consists of one USB 3.0 Receptacle and one USB 3.0 Plug and will be tested as such unless otherwise specified. Typically in most tests, the USB 3.0 Receptacle is 'fixed' and the USB 3.0 Plug is 'free.' Each 'receptacle' and 'plug' shall be clearly and individually identified.

Note: 'Mated connectors' MUST remain together for the duration of the testing sequence. For example, when 'un-mating' is required by a test, the same 'receptacle and plug pair' as before shall be mated for the subsequent tests.

4.5.2 Before Testing

Before testing commences, the specimens shall have been stored for at least 24 hours in the non-inserted state under standard test conditions, unless otherwise specified.

4.5.3 EIA Test Procedures

Where an EIA test is specified the latest approved revision of that test shall be used.

4.5.4 Test Sequences

All the tests in Table 3-1 that are marked with "Test shall be done in sequences defined in EIA 364-1000.01" must follow the sequences defined in EIA-364-1000.01.

4.6 Sample Selection

The samples to be tested for USB 3.0 Certification shall be from a production run of the product.

All acceptance tests shall be performed on the minimum number of samples specified in the appropriate table unless otherwise specified.

IMPORTANT Note: All compliance testing will be performed at the manufacturer's expense by a certified laboratory. The certified laboratory shall have direct traceability to a recognized standards organization, e.g., A2LA.

4.7 USB 3.0 Compliance Testing Interval

Once a connector or cable assembly has been certified it remains certified for the life of the product. However, any change to the materials, configuration or dimensions will void certification of that product. Any modification of the manufacturing process that results in a change to the product will void the certification. The USB offers a QbS program for re-certification requirements.

4.8 Primary Qualification Approval Testing

The following number of specimens shall be subjected to the tests under the conditions as specified in *Section 3 of this document*.

Table 4-3 Primary Qualification Approval Testing

Test Group	Number of Specimens		Performance Level 1
	Connectors	Cable Assemblies	Number of Permitted Defects
Inspection	92	25	0
Test Groups A	As required by EIA 364-1000.01	Only Group A-7	0
Test Group B-1	8	8	0
Test Group B-2	3	3	0
Test Group B-3	5	n/a	0
Test Group B-4	3	3	0
Test Group B-5	3	n/a	0

Primary Qualification Approval Testing Notes:

1. Critical Dimension Inspection of some connectors may require destructive disassembly of the part for complete dimensional inspection.
2. The vendor is responsible for providing additional plugs, as specified by the test lab, with a cable using an appropriate overmold and strain relief. The cable is to be at least 200mm long when measured from the strain relief and be properly terminated for the test lab's setup fixtures.
3. Plugs designed for PCB mounting (e.g. USB 3.0 flash memory drives) should be supplied with PCBs not mounted. The vendor is responsible for providing additional plugs mounted on PCBs as specified by the test lab. Traces that extend from the terminations of the plug to the end of the PCB may be required.

4. The vendor is responsible for providing additional receptacles (as specified by the test lab) properly mounted on a printed circuit board for the test lab's setup fixtures. Traces that extend from the receptacle's terminations to the end of the PCB may be required.
5. The USB-IF may require an inter-mate connector test using Certified USB 3.0 connectors from other manufacturers
6. Test Group B-4 is required for the certification of USB 3.0 connectors and cable assemblies. Plug vendors must submit, along with their plugs, a representative cable assembly for SuperSpeed electrical testing. The vendor is responsible for providing the receptacles to be tested mounted on test fixtures, designed for the high speed tests, per the requirements of **Design Guidelines for USB3.0 Super Speed Electrical Test Fixtures**. Test fixtures for the testing of cable assemblies are not required and are part of the test lab's setup.

4.9 Sustaining Qualification Approval Testing

USB IF does not require vendors to re-qualify certified products. Please see section 4.7

4.10 Compliance Test Sequences

The following tests shall be performed in the sequence shown.

4.10.1 Inspection EIA 364-18

Visual and Dimensional Inspection and Test Group B-5 Critical Dimension Inspection

Because of the inspection criteria similarities between test groups and the fact that data may be collected during inspections that can halt the subsequent test requirements, it is recommended they be conducted concurrently. Representative specimens should be subjected to the following tests to verify that a USB 3.0 connector and/or cable assembly demonstrates sufficient product integrity to be processed through the remaining product acceptance test procedures/groups.

4.10.1.1 Visual Inspection

The laboratory conducting the compliance testing is required to 100% visually inspect each lot of sample parts for obvious mechanical defects. Prohibited cable assemblies or connectors are not eligible for certification. Vendors should be informed of non-compliant configurations.

4.10.1.1.1 Connector

The number of contacts for the standard series USB 3.0 connectors (Standard-A and Standard-B) is nine. The USB 3.0 Powered-B connector has 11 contacts, and the USB 3.0 micro connectors have 10 contacts. USB 3.0 connectors with more or less contacts than those defined by the USB 3.0 Specification are not compliant and are not eligible for certification. The laboratory conducting the compliance testing is required to visually verify, where possible, the number of contacts implemented in the connector.

No two contacts of a USB 3.0 connector are permitted to be interconnected with the exception of the ID pin and ground of the micro A connector.

4.10.1.1.2 Cable Constructions

The cable construction for standard detachable USB 3.0 cable assemblies is to be visually verified. Cable construction must contain a braided outer shield. Cables must contain a power pair, a UTP D+/D- data-pair, and two shielded SuperSpeed data pairs. Laboratory conducting the compliance testing is required to visually verify the construction of the cable. See USB 3.0 section 5.4.1 for details of the cable construction.

Due to EMI and signal integrity requirements, each cable differential pair used for the SuperSpeed in a USB 3.0 cable assembly must be shielded; the UTP (unshielded twist pair) used for D+/D- is NOT allowed for SS.

- The wire connections between plugs of a cable assembly must be verified by following the appropriate wiring table in the USB 3.0 Specification. Table 5-9. USB 3.0 Standard-A to USB 3.0 Standard-B Cable Assembly Wiring
- Table 5-10. USB 3.0 Standard-A to USB 3.0 Standard-A Cable Assembly Wiring**
- Table 5-11. USB 3.0 Standard-A to USB 3.0 Micro-B Cable Assembly Wiring
- Table 5-12. USB 3.0 Micro-A to USB 3.0 Micro-B Cable Assembly Wiring
- Table 5-13. USB 3.0 Micro-A to USB 3.0 Standard-B Cable Assembly Wiring

**** Incorrect wiring of A-to-A cable assemblies can be hazardous! VBus and USB 2.0 data lines must not be interconnected.**

Bulk cable is not eligible for USB certification.

4.10.1.2 Dimensional Inspection

Since the contact plating material and thickness is a good indicator if the connector can pass the required tests, the test laboratory shall check the plating thickness as the first measurement. The connector manufacturer shall be informed by the test laboratory if the plating does not meet the required thickness; all the remaining testing shall be stopped unless instructed otherwise by the connector manufacturer.

SMT coplanarity of all solderable surfaces on the receptacle shall be 0.08 mm maximum. See section 5 in the USB 3.0 specification for details of the foot print..

The laboratory conducting the compliance testing will measure and record critical dimensions.

Important Note: Critical dimension and physical inspection may require the destructive physical analysis of a minimum of three samples. When performing this procedure the testing laboratory must verify Series 'A', 'B', Powered-B, and Micro Series Connectors. USB 3.0 cable assemblies submitted for compliance testing are required to use certified connectors. Micro Series plugs and receptacles will use Go/No-go gauges to confirm all interface critical dimensions and will undergo physical measurement of all latch-related critical dimensions.

4.10.2 Test Groups A

Test Groups A consists of all the test groups defined in EIA-364-1000.01- there are a total of 7 test groups there. All the EIA-364-1000.01 test groups shall be exactly followed, except that the EIA-364-1000.01 Test Group 7, or the Test Group A-7 shall be modified as the following:

Table 4-4 Modified EIA-364-1000.01 Test Group 7

Test Order	Test	Test Procedure	Condition of Test Specimens	Test Criteria
1	Dielectric withstanding voltage	EIA-364-20, 100 VAC (RMS)	Mated	No disruptive discharge
2	LLCR	EIA 364-23	Mated	30 mohms maximum for VBUS and GND 50 mohms maximum for all other contacts Base line measurement
3	Insertion force	EIA 364-13 At a maximum rate of 12.5 mm (0.492") per minute.		35 N maximum
4	Extraction force	EIA 364-13D At a maximum rate of 12.5mm (0.492") per minute.		10 N minimum 25N maximum No burs or sharp edges are allowed on top of locking latches (hook surfaces which will rub against receptacle shield).
5	Durability	EIA 364-9 Cycle rate of 200 cycles per hour manually or 500 cycles maximum automatically		No evidence of physical damage
6	Extraction force	EIA 364-13D At a maximum rate of 12.5mm (0.492") per minute		8 N minimum. 25N maximum No burs or sharp edges are allowed on top of locking latches (hook surfaces which will rub against receptacle shield).
7	LLCR	EIA 364-23	Mated	10 mohm maximum change over the

				baseline
8	Dielectric withstanding voltage	EIA-364-20, 100 VAC (RMS)	Mated	No disruptive discharge

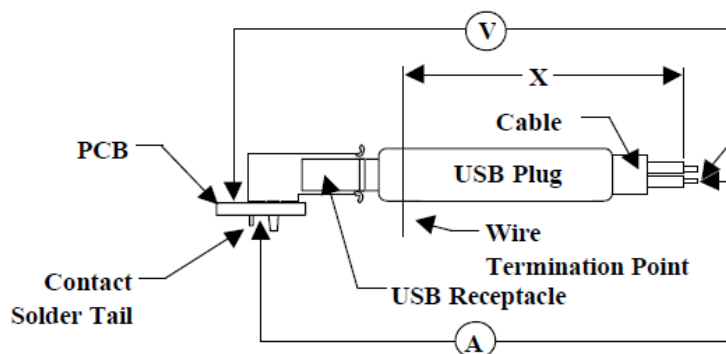


Figure 4-1 - Typical Contact Resistance Measurement

4.10.3 Test Groups B

Test Groups B cover all the other tests not included in EIA 364-1000.01. There are a total of 5 test groups in Test Groups B, as defined in the tables below.

Table 4-5 Test Group B-1: Cable Assembly

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-1-1	Cable Pull Out	38b	Apply steady state axial load to the cable for one minute.			40 Newtons Minimum (cable assembly shall have no electrical discontinuity and cable shall have no mechanical separation from connector.)
B-1-2	Cable Flex	41	X=3.7 x cable diameter 100 cycles 2 planes 120 degree arc			No loss of continuity during cycling

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-1-3	4-Axis Continuity	n/a	Applicable only to micro connectors and cable assemblies with micro plugs. Tested as mated connectors Apply 8N perpendicular force to connection at 0, 90, 180 and 270 degrees, 10 seconds duration at each axis Verify electrical continuity of all pin contacts at each axis	Test jig defined in Appendix C.	n/a	No contact chatter greater than 1.0 microsecond during 10 seconds at each axis. Micro Series only. Note: When testing a USB2.0 MicroUSB plug in a USB 3.0 receptacle, if the combination does not pass at 8N at 180 degrees, then 7N may be used for the 180 degree direction.
B-1-4	Voltage drop	n/a	5V nominal at 900mA. Applies to cable assemblies only			VBUS & GND each have 225 mV maximum drop through the mated connectors and cable
B-1-5	Visual Inspection			Cable Construction		Existence of braided shield attached to shell of connector SS lines are shielded differential pairs with drain wires.
B-1-6	Wiring		Verify wiring to plugs to match appropriate tables in the USB 3.0 Specification: Tables 5-9, 5-10, 5-11, 5-12 or 5-13	Cable wire connections	na	Using an ohmmeter, verify wiring pin-to-pin
B-1-7	ID Pin Resistance		Verify the resistance of the ID pin to ground.			Micro-USB connectors only <ul style="list-style-type: none"> The MicroUSB A-Plug must have its ID pin 4 grounded with <10 Ohms (Ra_PLUG_ID). The MicroUSB B-Plug or a MiniUSB B-plug must have a resistance to ground greater than 1MOhms (Rb_PLUG_ID) on the ID pin.

- Note: Standard detachable cable assemblies only. Flat cables are prohibited for standard detachable cable assemblies.

Table 4-6 Test Group B-2: Connector Electrical

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-2-1	Capacitance	30	Test between adjacent contacts, unmated connector at 1 KHz.			2 pF maximum
B-2-2	Insulation Resistance	21	100 VDC for two minutes maximum, or until stabilized, mated.	Insulation Resistance		100 MΩ minimum.
B-2-3	General Examination		Unmated connectors	Visual & Dimensional Inspection	18	There shall be no defects that would impair normal operations. Dimensions shall comply with the most current version of the USB Specification

Table 4-7 Test Group B-3: Solderability

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-3-1	Solderability	52	Category 3 Steam Age RMA Class 2 flux immerse in molten solder at a temperature of $+255^{\circ}\text{C} \pm 5^{\circ}\text{C}$ at rate of $25.4 \text{ mm} \pm 6.35 \text{ mm}$ ($1.00 \text{ in} \pm 0.25 \text{ in}$) per second, hold in solder for 5 ± 0.5 seconds To include solder pins and mounting pads.			Solderable area shall have a minimum of 95% solder coverage.
B-3-2	General Examination		Unmated connectors	Visual & Dimensional Inspection	18	There shall be no defects that would impair normal operations. Dimensions shall comply with the most current version of the USB Specification

Table 4-8 Test Group B-4: High Speed Testing

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-4-1	D+/D-Pair Attenuation	101	12 to 400 MHz			-0.67 dB Maximum @ 12 MHz -0.95 dB Maximum @ 24 MHz -1.35 dB Maximum @ 48 MHz -1.90 dB Maximum @ 96 MHz -3.20 dB Maximum @ 200.0 MHz -5.80 dB Maximum @ 400.0 MHz
B-4-2	D+/D- pair Propagation Delay	103	200 ps (10%-90%) rise time			16 ns maximum 10 ns maximum for Micro Series
B-4-3	D+/D-pair Propagation Delay Skew	103	200 ps (10%-90%) rise time			D+/D- lines: 100 ps maximum
B-4-4	Differential impedance (SS) of Mated Connectors	108	50 ps (20%-80%) rise time			75 Ω minimum 105 Ω maximum
B-4-5	Differential Insertion Loss (SS) of Mated Cable Assemblies	101	100 MHz to 7.5 GHz Normalized to 90 ohm differential impedance			See Appendix C
B-4-6	Differential to Common Mode Conversion (SS) of Mated Cable Assembly		100 MHz to 7.5 GHz Normalized to 90 ohm differential impedance			Less than or equal to -20 dB (See Appendix C)
B-4-7	Differential Near-End Crosstalk between SS Pairs	90	50 ps (20-80%) rise time			See Appendix C
B-4-8	Differential Near-End and Far-End Crosstalk between SS and D+/D-Pairs	90	500 ps (10-90%) rise time			See Appendix C

Table 4-9 Test Group B-5: Critical Dimensions

Test Phase	Test			Measurement To Be Performed		Common Requirements
	Title	EIA 364 Test	Severity or Condition of Test	Title	EIA 364 Test	
B-5-1	Critical Dimensions	18				See Addenda B Resolution +-1micrometer
B-5-2	Plating thickness		Must meet minimum requirement as defined in the USB 3.0 Specification (Including ECRs)	Use of X-ray to determine thickness of plating on the contacts.		Performed first. Measured thickness will be listed in the test report

5 Certification Acceptance and Submission

Manufacturers of USB 3.0 connectors and/or cable assemblies desiring to have a product or products listed on the USB Implementers' Forum (USB-IF) Integrators List (IL) are required to submit 'certified proof' that their USB 3.0 product meets or exceeds the performance requirements specified in the most current version of the USB 3.0 Specification and this document. Certified proof of compliance shall be in the form of a Compliance Test Report (CTR) completed by an A2LA /CNLA or equivalent certified testing laboratory per IEC/ISO 17025.

5.1 Compliance Test Report

Upon successful completion of the compliance testing, the certified laboratory performing the specified tests will issue a formal compliance test report. This confidential report will only be available to the manufacturer, test laboratory submitting the report and USB-IF Administration.

5.2 Listing, Authorization and Notification

5.2.1 Listing

Upon successful completion of the voluntary compliance testing, the certified laboratory performing the specified tests will provide the USB IF Administration the test results. Upon approval by the USB IF Administration of the test results, the product (s) will be added to the integrators list. The manufacturer has the option whether to display their certified products via the integrators list to the USB IF membership.

5.2.2 Authorization to use Certified USB 3.0 Logo

Products that are listed on the USB IF Integrators List may use the Certified USB 3.0 Logo provided that the manufacturer has agreed to and signed the USB IF Logo Trademark License Agreement. Possession of a TID does not indicate that a product is certified. Only products that are listed on the integrators list are certified.

If a manufacturer wishes to use the trademarked '*USB3.0 logo*' on more than one USB 3.0 product, each product displaying the '*USB3.0 logo*' must have successfully completed the Voluntary Compliance Testing Program, must have a TID assigned by USB-IF, and have each product listed on the integrators list.

Only upon receiving official USB-IF Notification the manufacturer may emboss the '*USB3.0 logo*' on the listed product.

5.2.3 Notification

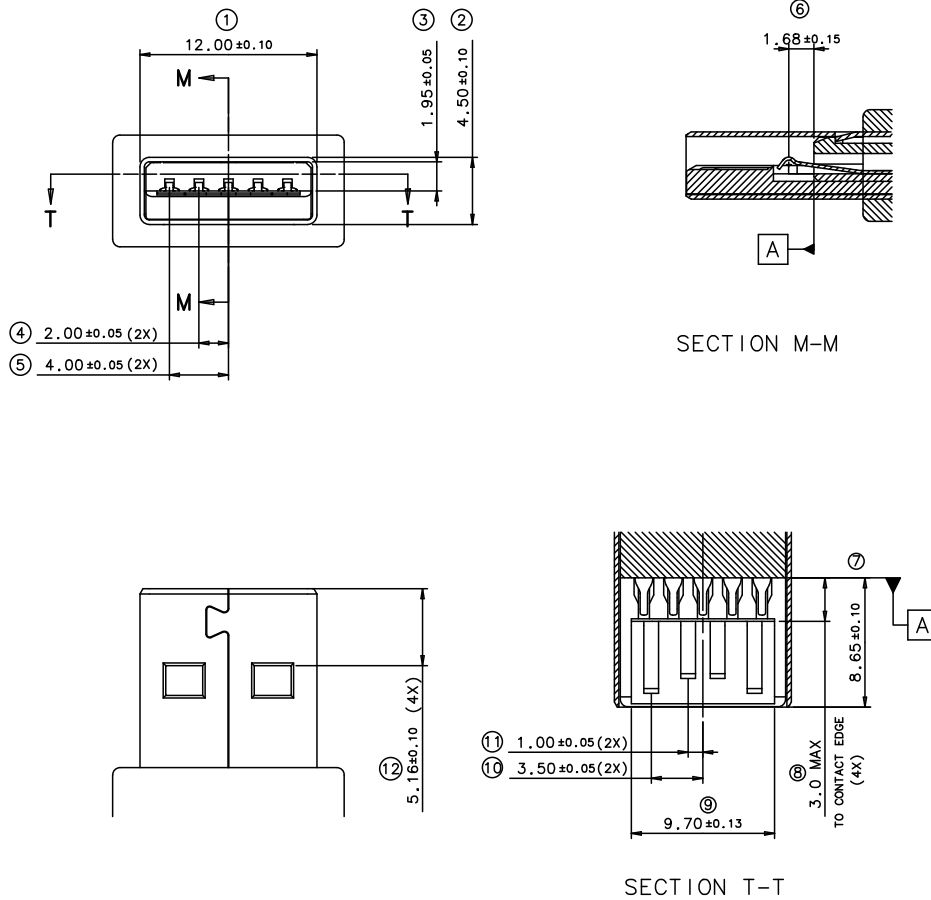
The manufacturer of record will be notified by E-mail that their product has been listed.

Appendices

This document is developed as a 'living document.' In order to provide system engineers and designers the most current USB 3.0 cable and connector information, USB-IF Device Working Group members may from time to time choose to add additional useful information to this document, e.g., product drawings for new USB industry standards, listings of international laboratories capable of performing approval testing, et cetera.

Appendix A Critical Dimensions

A.1 USB 3.0 Standard "A" Plug

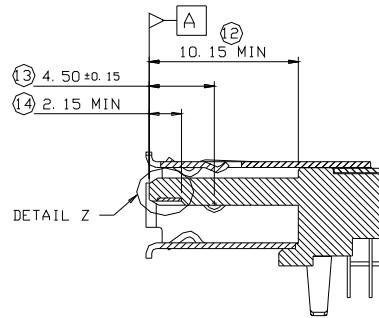
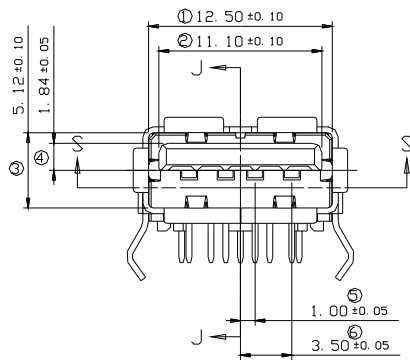


USB3.0 STANDARD A CABLE PLUG CONNECTOR CRITICAL DIMENSIONS:

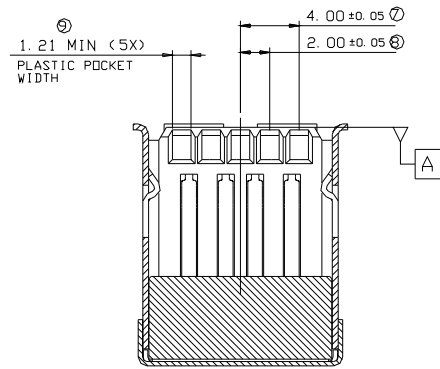
DESCRIPTION	DIMENSION	+ TOL	- TOL
1. PLUG WIDTH	12.00	0.10	-0.10
2. PLUG HEIGHT	4.50	0.10	-0.10
3. PLUG OPENING	1.95	0.05	-0.05
4. SS CONTACT PITCH	2.00	0.05	-0.05
5. SS CONTACT PITCH	4.00	0.05	-0.05
6. SS CONTACT LOCATION	1.68	0.15	-0.15
7. PLUG DEPTH	8.65	0.10	-0.10
8. BLADE LENGTH	3.00	0.00	N/A
9. PLASTIC WIDTH	9.70	0.13	-0.13
10. BLADE PITCH	3.50	0.05	-0.05
11. BLADE PITCH	1.00	0.05	-0.05
12. LATCH OPENING	5.16	0.10	-0.10

All Values are in Millimeters

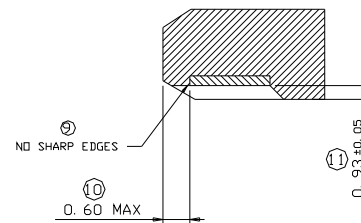
A.2 USB 3.0 Standard "A" Receptacle



SECTION J-J



SECTION S-S



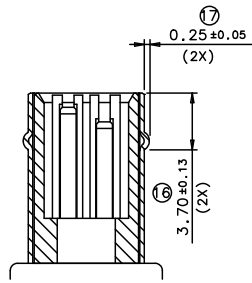
DETAIL Z

USB3.0 STANDARD A RECEPTACLE CONNECTOR CRITICAL DIMENSIONS:

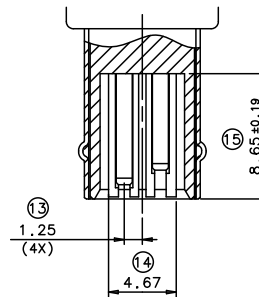
DESCRIPTION	DIMENSION	+ TOL	-
1. INSIDE WIDTH	12.50	0.10	-
2. PLASTIC WIDTH	11.10	0.10	-
3. INSIDE HEIGHT	5.12	0.10	-
4. PLASTIC HEIGHT	1.84	0.05	-
5. CONTACT PITCH	1.00	0.05	-
6. CONTACT PITCH	3.50	0.05	-
7. SS CONTACT PITCH	4.00	0.05	-
8. SS CONTACT PITCH	2.00	0.05	-
9. NO SHARP EDGES	N/A	N/A	-
10. PLASTIC NOSE	0.60	0.00	-
11. SS BLADE HEIGHT	0.28	0.05	-
12. POCKET DEPTH	10.15	N/A	-
13. CONTACT LOCATION	4.50	0.15	-
14. SS BLADE LENGTH	2.15	N/A	-

All Values are in Millimeters

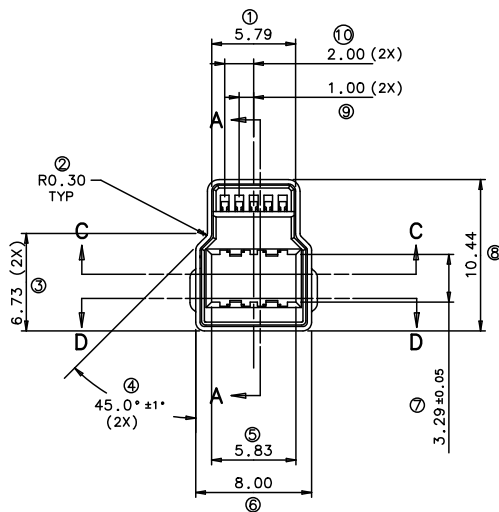
A.3 USB 3.0 Standard "B" Plug



SECTION C-C



SECTION D-D



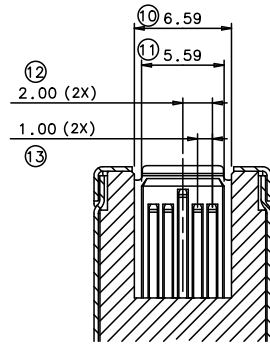
SECTION A-A

USB3.0 B CABLE PLUG CONNECTOR CRITICAL DIMENSIONS:

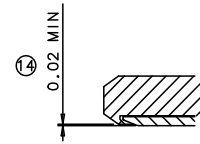
DESCRIPTION	DIMENSION	+ TOL	- TOL
1. PLUG WIDTH TOP	5.79	0.10	-0.10
2. TRANSITION RADIUS	0.30	0.10	-0.10
3. TRANSITION HEIGHT	6.73	0.10	-0.10
4. TRANSITION ANGLE	45.00	1.00	-1.00
5. INSIDE WIDTH	5.83	0.10	-0.10
6. PLUG WIDTH BOTTOM	8.00	0.10	-0.10
7. INSIDE HEIGHT	3.29	0.05	-0.05
8. PLUG HEIGHT	10.44	0.10	-0.10
9. SS CONTACT PITCH	1.00	0.10	-0.10
10. SS CONTACT PITCH	2.00	0.10	-0.10
11. POCKET HEIGHT	4.61	0.10	-0.10
12. CONTACT LOCATION	4.48	0.15	-0.15
13. BLADE PITCH	1.25	0.10	-0.10
14. PLASTIC WIDTH	4.67	0.10	-0.10
15. MATING DEPTH	8.70	0.19	-0.19
16. LATCH LOCATION	3.70	0.13	-0.13
17. LATCH HEIGHT	0.25	0.05	-0.05

All Values are in Millimeters

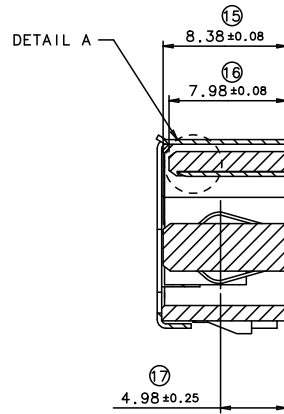
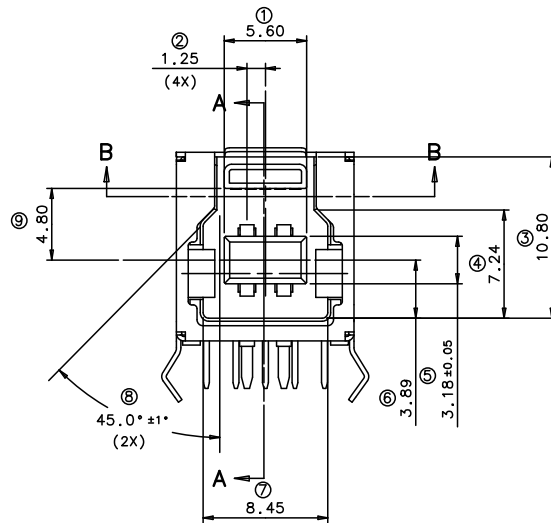
A.4 USB 3.0 Standard “B” Receptacle



SECTION B-B



DETAIL A



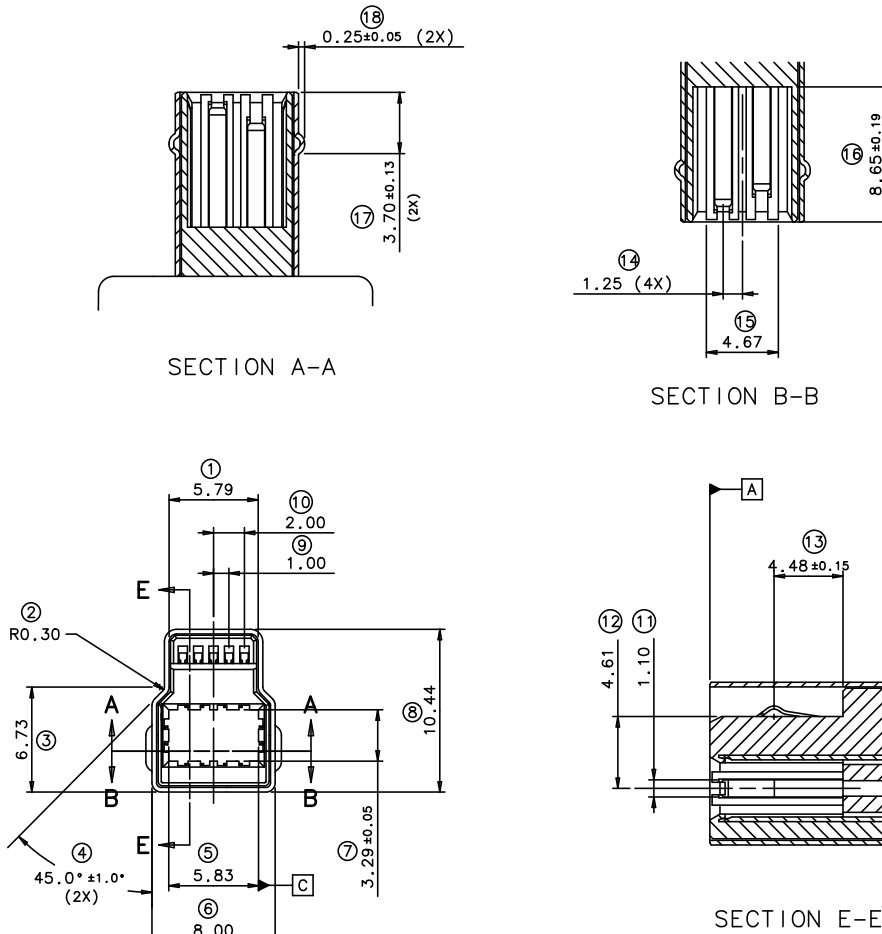
SECTION A-A

USB3.0 B RECEPTACLE CONNECTOR CRITICAL DIMENSIONS:

DESCRIPTION	DIMENSION	+ TOL	- TOL
1. NOSE WIDTH	5.60	0.10	-0.10
2. CONTACT PITCH	1.25	0.10	-0.10
3. OPENING HEIGHT	10.80	0.10	-0.10
4. TRANSITION HEIGHT	7.24	0.10	-0.10
5. NOSE HEIGHT	3.18	0.05	-0.05
6. NOSE HEIGHT LOCATION	3.89	0.10	-0.10
7. OPENING WIDTH	8.45	0.10	-0.10
8. TRANSITION ANGLE	45.00	1.00	-1.00
9. SS CONTACT LOCATION	4.80	0.10	-0.10
10. PLASTIC WIDTH	6.59	0.10	-0.10
11. SS NOSE WIDTH	5.59	0.10	-0.10
12. SS CONTACT PITCH	2.00	0.10	-0.10
13. SS CONTACT PITCH	1.00	0.10	-0.10
14. SS CONTACT HEIGHT	0.02	N/A	-0.00
15. NOSE DEPTH	8.38	0.08	-0.08
16. SS NOSE DEPTH	7.98	0.08	-0.08
17. CONTACT LOCATION	4.98	0.25	-0.25

All Values are in Millimeters

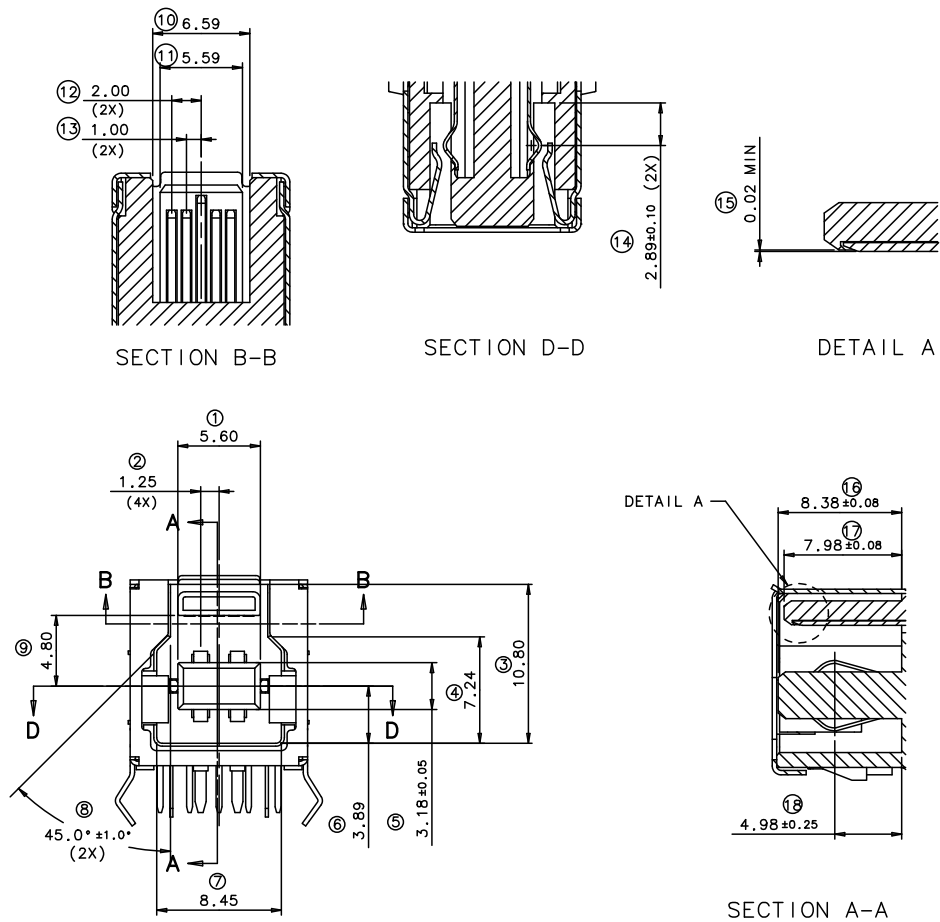
A.5 USB 3.0 Powered-B Plug



USB3.0 B CABLE PLUG CONNECTOR WITH POWER CRITICAL DIMENSIONS:

DESCRIPTION	DIMENSION	+ TOL	- TOL
1. PLUG WIDTH TOP	5.79	0.10	-0.10
2. TRANSITION RADIUS	0.30	0.10	-0.10
3. TRANSITION HEIGHT	6.73	0.10	-0.10
4. TRANSITION ANGLE	45.00	1.00	-1.00
5. INSIDE WIDTH	5.83	0.10	-0.10
6. PLUG WIDTH BOTTOM	8.00	0.10	-0.10
7. INSIDE HEIGHT	3.29	0.05	-0.05
8. PLUG HEIGHT	10.44	0.10	-0.10
9. SS CONTACT PITCH	1.00	0.10	-0.10
10. SS CONTACT PITCH	2.00	0.10	-0.10
11. BLADE WIDTH	1.10	0.10	-0.10
12. POCKET HEIGHT	4.61	0.10	-0.10
13. CONTACT LOCATION	4.48	0.15	-0.15
14. BLADE PITCH	1.25	0.10	-0.10
15. PLASTIC WIDTH	4.67	0.10	-0.10
16. MATING DEPTH	8.65	0.19	-0.19
17. LATCH LOCATION	3.70	0.13	-0.13
18. LATCH HEIGHT	0.25	0.05	-0.05

A.6 USB 3.0 Powered-B Receptacle

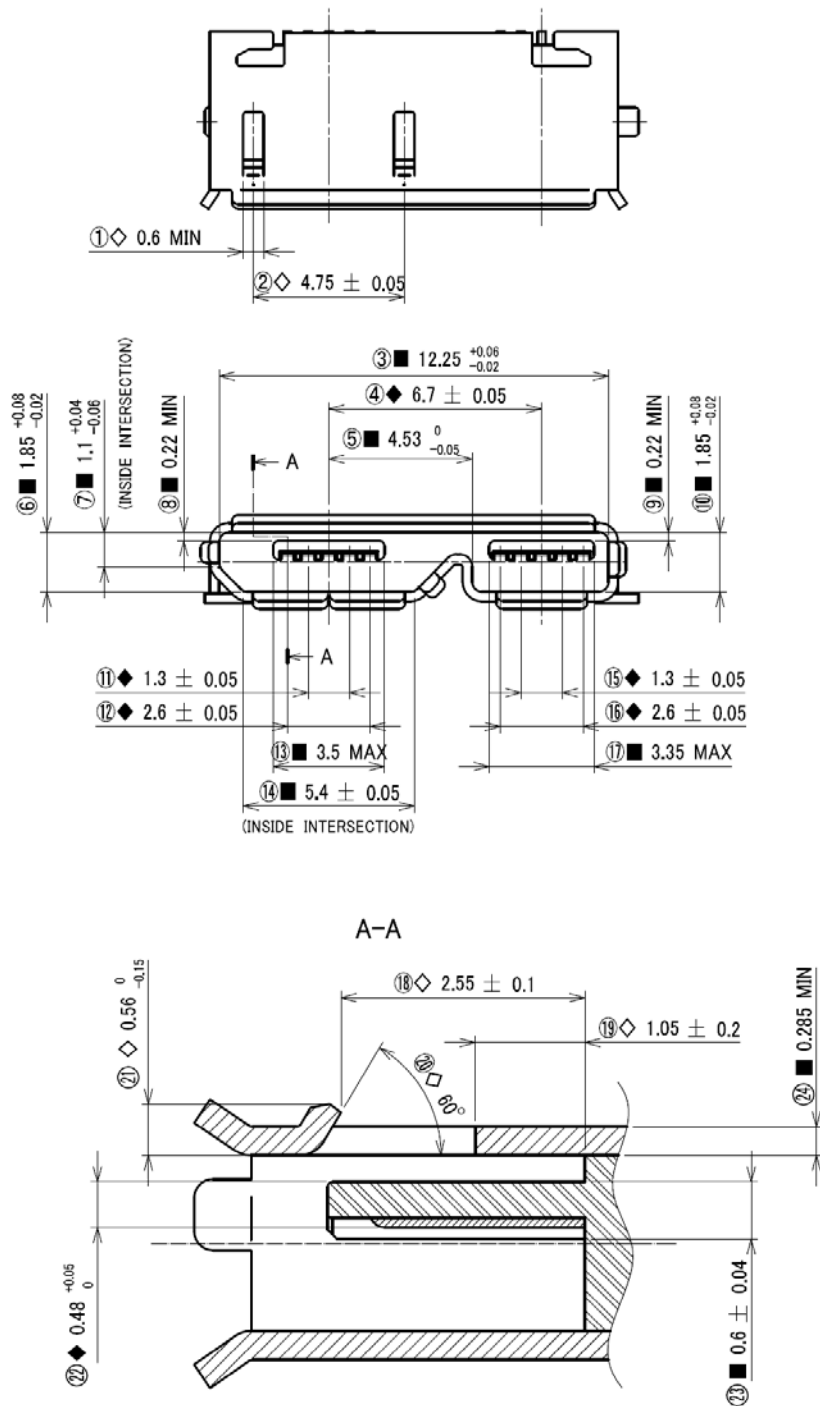


USB3.0 B RECEPTACLE CONNECTOR WITH POWER CRITICAL DIMENSIONS:

DESCRIPTION	DIMENSION	+ TOL	- TOL
1. NOSE WIDTH	5.60	0.10	-0.10
2. CONTACT PITCH	1.25	0.10	-0.10
3. OPENING HEIGHT	10.80	0.10	-0.10
4. TRANSITION HEIGHT	7.24	0.10	-0.10
5. NOSE HEIGHT	3.18	0.05	-0.05
6. NOSE HEIGHT LOCATION	3.89	0.10	-0.10
7. OPENING WIDTH	8.45	0.10	-0.10
8. TRANSITION ANGLE	45.00	1.00	-1.00
9. SS CONTACT LOCATION	4.80	0.10	-0.10
10. PLASTIC WIDTH	6.59	0.10	-0.10
11. SS NOSE WIDTH	5.59	0.10	-0.10
12. SS CONTACT PITCH	2.00	0.10	-0.10
13. SS CONTACT PITCH	1.00	0.10	-0.10
14. SIDE CONTACT LOCATION	2.89	0.10	-0.10
15. SS CONTACT HEIGHT	0.02	N/A	-0.00
16. NOSE DEPTH	8.38	0.08	-0.08
17. SS NOSE DEPTH	7.98	0.08	-0.08
18. CONTACT LOCATION	4.98	0.25	-0.25

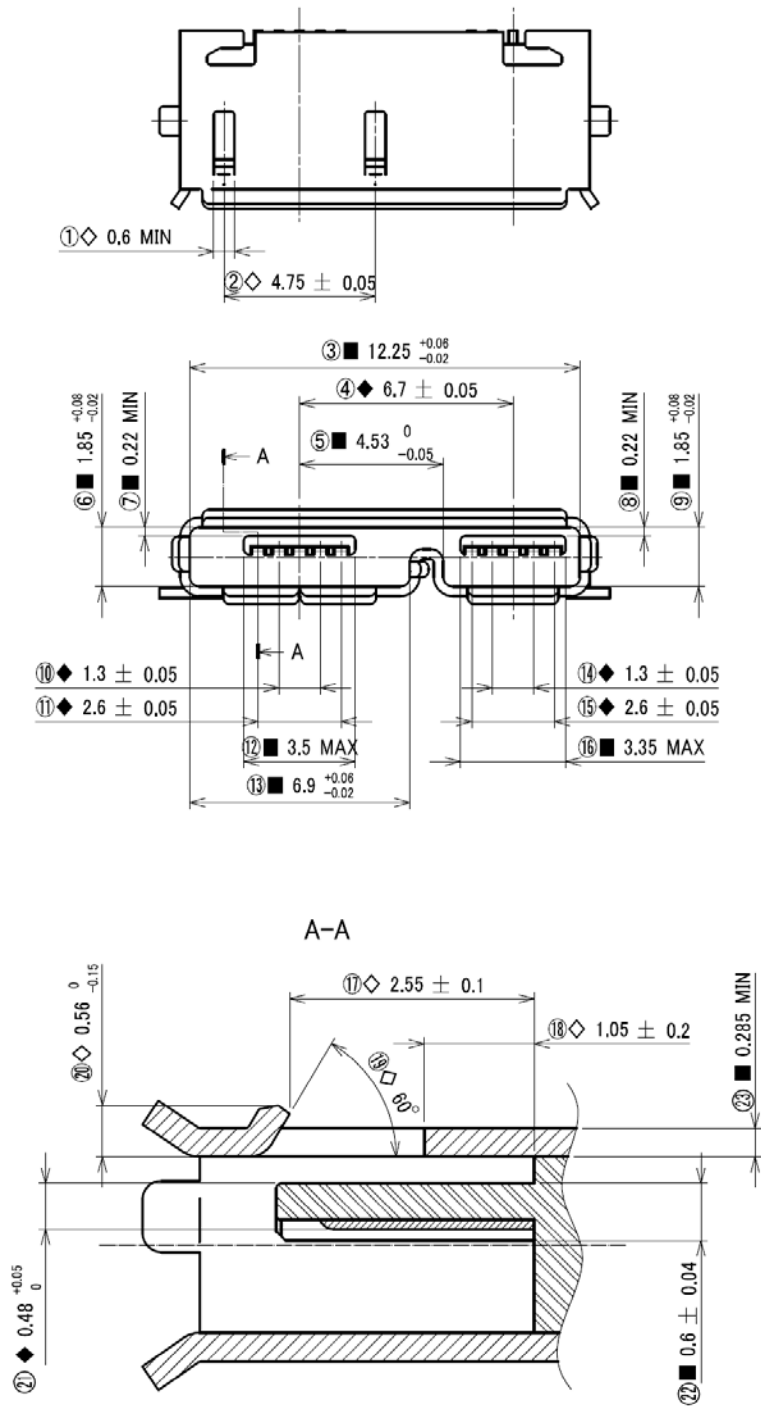
A.7 USB 3.0 Micro-series Connector Family

USB3.0 Micro-B RECEPTACLE



- Overall Mate—submitted by supplier, and verified by lab.
- ◇ Latching—to be submitted by supplier.
- ◆ Electrical Contact—to be submitted by supplier.

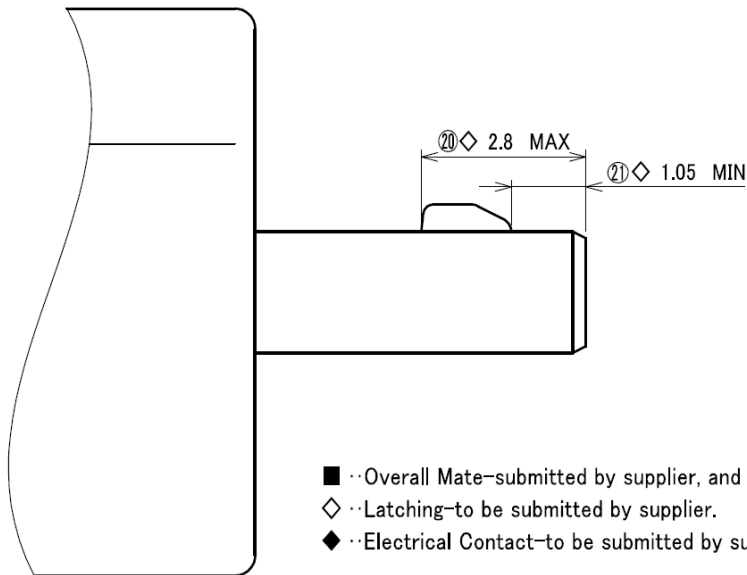
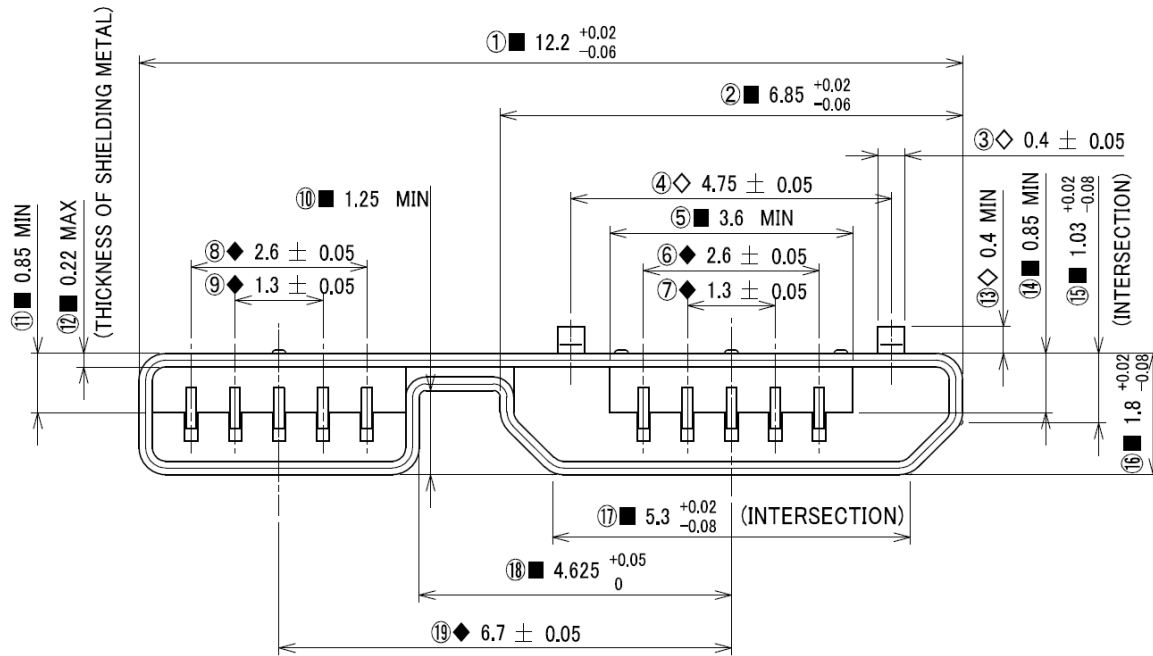
USB3.0 Micro-AB RECEPTACLE



- Overall Mate—submitted by supplier, and verified by lab.
- ◇ Latching—to be submitted by supplier.
- ◆ Electrical Contact—to be submitted by supplier.

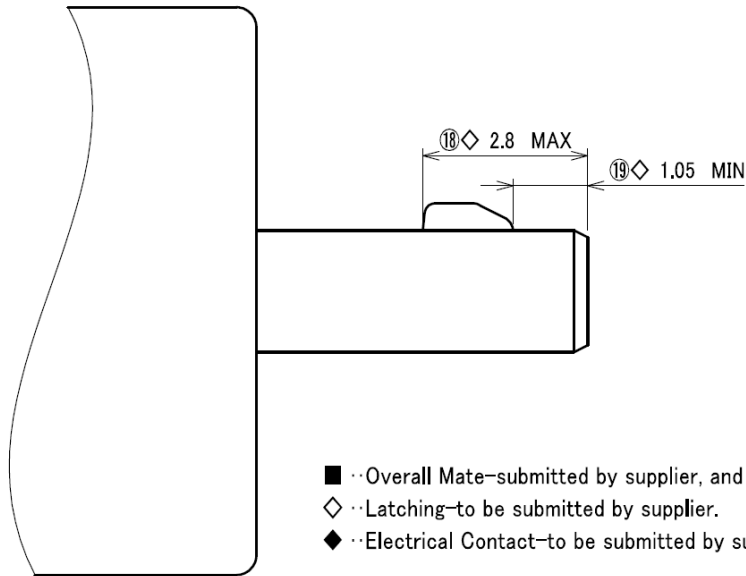
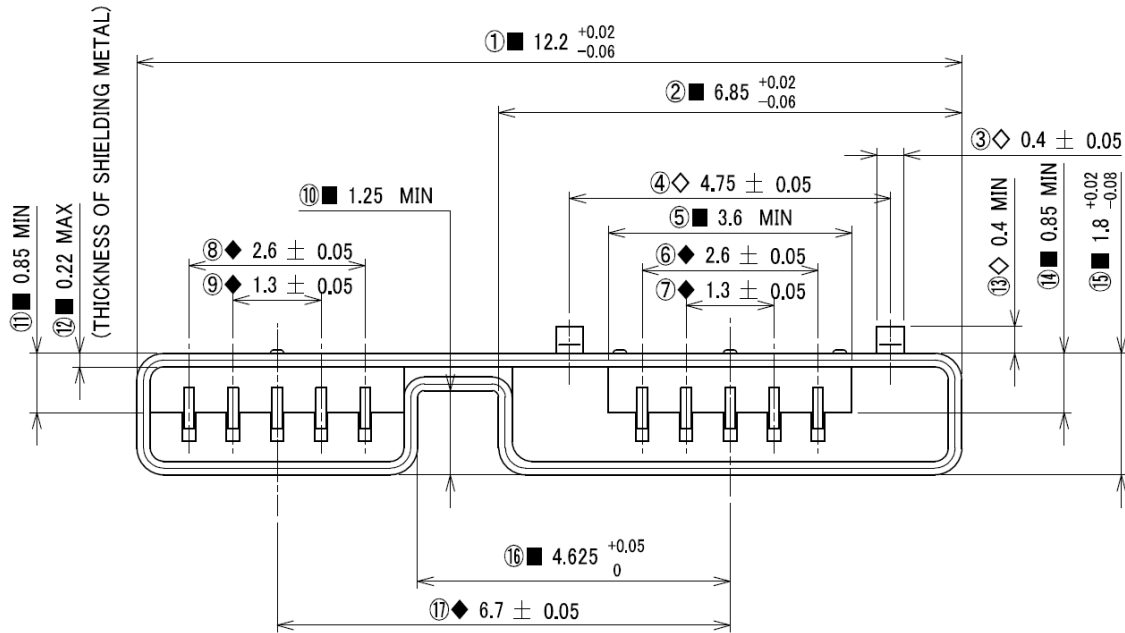
USB 3.0 Micro-B and-AB Receptacles Interface Dimensions

USB3.0 Micro-B Plug



- ··Overall Mate-submitted by supplier, and verified by lab.
- ◇ ··Latching-to be submitted by supplier.
- ◆ ··Electrical Contact-to be submitted by supplier.

USB3.0 Micro-A Plug



- Overall Mate—submitted by supplier, and verified by lab.
- ◇ Latching—to be submitted by supplier.
- ◆ Electrical Contact—to be submitted by supplier.

USB 3.0 Micro-B and -A Plug Interface Dimensions

USB3.0 Micro Family Critical Dimension Parameters

3.0 Micro-B receptacle

Description #	DIMENSION	+TOL	-TOL
1	0.6	N/A	0
2	4.75	0.05	-0.05
3	12.25	0.06	-0.02
4	6.7	0.05	-0.05
5	4.53	0	-0.05
6	1.85	0.08	-0.02
7	1.1	0.04	-0.06
8	0.22	N/A	0
9	0.22	N/A	0
10	1.85	0.08	-0.02
11	1.3	0.05	-0.05
12	2.6	0.05	-0.05
13	3.5	0	N/A
14	5.4	0.05	-0.05
15	1.3	0.05	-0.05
16	2.6	0.05	-0.05
17	3.35	0	N/A
18	2.55	0.1	-0.1
19	1.05	0.2	-0.2
20	60		
21	0.56	0	-0.15
22	0.48	0.05	0
23	0.6	0.04	-0.04
24	0.285	N/A	0

3.0 Micro-B plug

Description #	DIMENSION	+TOL	-TOL
1	12.2	0.02	-0.06
2	6.85	0.02	-0.06
3	0.4	0.05	-0.05
4	4.75	0.05	-0.05
5	3.6	N/A	0
6	2.6	0.05	-0.05
7	1.3	0.05	-0.05
8	2.6	0.05	-0.05
9	1.3	0.05	-0.05
10	1.25	N/A	0
11	0.85	N/A	0
12	0.22	0	N/A
13	0.4	N/A	0
14	0.85	N/A	0
15	1.03	0.02	-0.08
16	1.8	0.02	-0.08
17	5.3	0.02	-0.08
18	4.625	0.05	0
19	6.7	0.05	-0.05
20	2.8	0	N/A
21	1.05	N/A	0

3.0 Micro-AB receptacle

Description #	DIMENSION	+TOL	-TOL
1	0.6	N/A	0
2	4.75	0.05	-0.05
3	12.25	0.06	-0.02
4	6.7	0.05	-0.05
5	4.53	0	-0.05
6	1.85	0.08	-0.02
7	0.22	N/A	0
8	0.22	N/A	0
9	1.85	0.08	-0.02
10	1.3	0.05	-0.05
11	2.6	0.05	-0.05
12	3.5	0	N/A
13	6.9	0.06	-0.02
14	1.3	0.05	-0.05
15	2.6	0.05	-0.05
16	3.35	0	N/A
17	2.55	0.1	-0.1
18	1.05	0.2	-0.2
19	60		
20	0.56	0	-0.15
21	0.48	0.05	0
22	0.6	0.04	-0.04
23	0.285	N/A	0

3.0 Micro-B plug

Description #	DIMENSION	+TOL	-TOL
1	12.2	0.02	-0.06
2	6.85	0.02	-0.06
3	0.4	0.05	-0.05
4	4.75	0.05	-0.05
5	3.6	N/A	0
6	2.6	0.05	-0.05
7	1.3	0.05	-0.05
8	2.6	0.05	-0.05
9	1.3	0.05	-0.05
10	1.25	N/A	0
11	0.85	N/A	0
12	0.22	0	N/A
13	0.4	N/A	0
14	0.85	N/A	0
15	1.8	0.02	-0.08
16	4.625	0.05	0
17	6.7	0.05	-0.05
18	2.8	0	N/A
19	1.05	N/A	0

Appendix B 4-Axes Continuity Test

USB 3.0 Micro connector family shall be tested for continuity under stress using the test configurations shown below. Plugs must be supplied in a cable assembly with a representative overmold. A USB 3.0 Micro-B or -AB receptacle shall be mounted on a 2-layer printed circuit board (PCB) of between 0.8 and 1.0 mm thickness. The PCB shall be clamped on either side of the receptacle no further than 5 mm away from the solder tails. The PCB shall initially be placed in a horizontal plane, and an 8-Newton tensile force shall be applied to the cable in a downward direction, perpendicular to the axis of insertion, for a period of at least 10 seconds.

The continuity across each contact shall be measured throughout the application of the tensile force. The PCB shall then be rotated 90 degrees such that the cable is still inserted horizontally and the 8-Newton tensile force will be applied again in the downward direction and continuity measured as before. This test will be repeated for 180 and 270 degree rotations. Passing cables will exhibit no discontinuities of greater than 1 microsecond duration in any of the four orientations. Note: When testing a USB2.0 MicroUSB plug in a USB 3.0 receptacle, if the combination does not pass at 8N at 180 degrees, then 7N may be used for the 180 degree direction.

One method for measuring the continuity through the contacts is to short all the wires at the end of the cable pigtail. Then on the PCB apply a voltage through a pull-up to each of VBus, D+, D-, ID, and the SS pins, with the GND pins connected to ground.

When testing a USB 3.0 Micro-A plug, all the sense resistors must stay pulled down for the length of the test. When testing a USB 3.0 Micro-B plug, the ID pin must stay high and the other pins must remain low for the duration of the test. Test houses may use another method to verify continuity through all pins if they choose.

The 4-axes continuity tests shall be done with a USB 3.0 Micro-B/-A plug in a USB 3.0 Micro-B/-AB receptacle AND with a USB 2.0 Micro-B/-A plug in a USB 3.0 Micro-B/-AB receptacle, as illustrated in Figure B- 1. 4-Axes Continuity Test below.

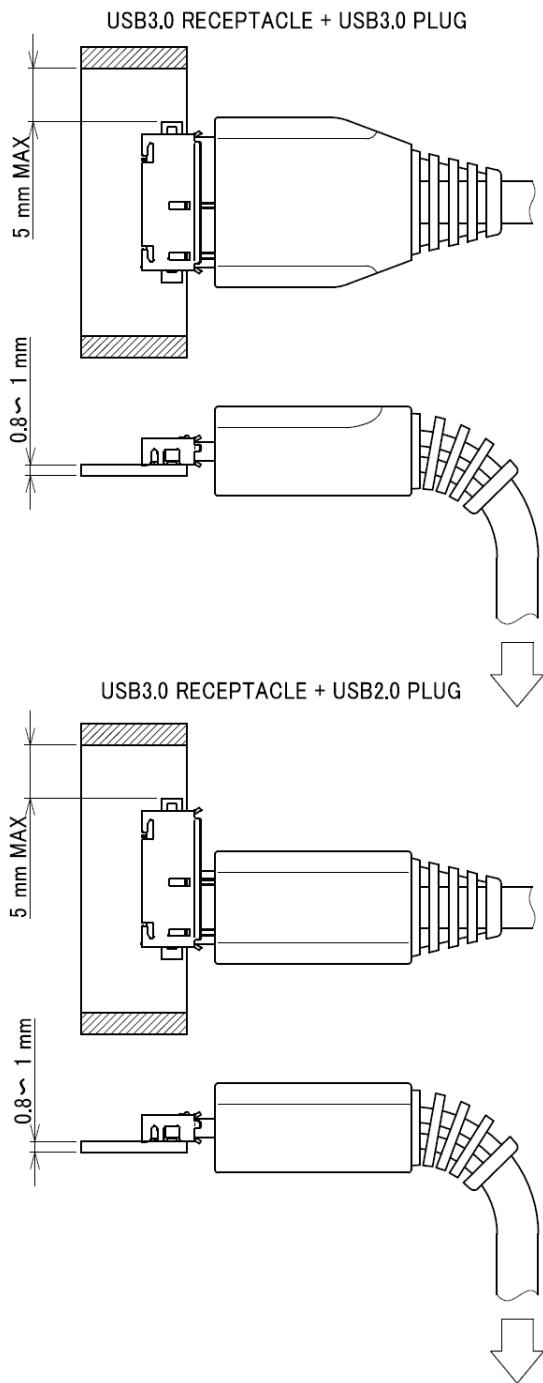


Figure B- 1. 4-Axes Continuity Test

Appendix C High Speed Tests of Mated Connectors and Cable Assemblies

See USB 3.0 section 5.6.1 thru 5.6.1.3.4 and related ECN for details

C.1 SS Differential Insertion Loss

SS Differential Insertion Loss shall be measured with 90 ohm normalized impedance.

The mated cable assembly meets the SS Differential Insertion Loss requirement if the measure insertion loss (SDD21) does not exceed the limits in Figure C-1, below.

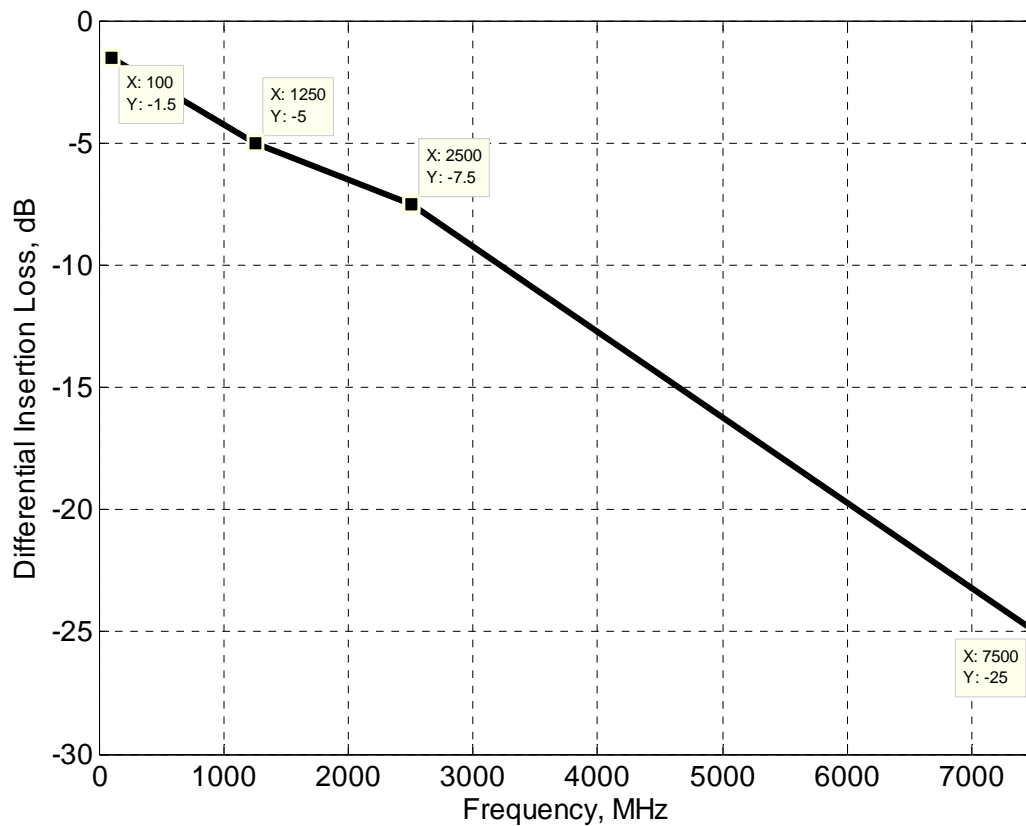


Figure C- 1. USB 3.0 Cable assembly differential insertion loss requirement

C.2 Differential Near-End Crosstalk (DDNEXT) between SS Pairs

The DDNEXT shall be measured in time domain with a rise time of 50 ps (20-80%) entering the connector under test. The mated cable assembly meets the DDNEXT requirement if its peak-to-peak DDNEXT does not exceed the limits below (see Figure C-2 for illustration of the peak-to-peak crosstalk):

- USB 3.0 Standard-A connector: 0.9%
 - USB 3.0 Standard-B connector: 1.8%
 - USB 3.0 Micro connector family: 1.2%
-

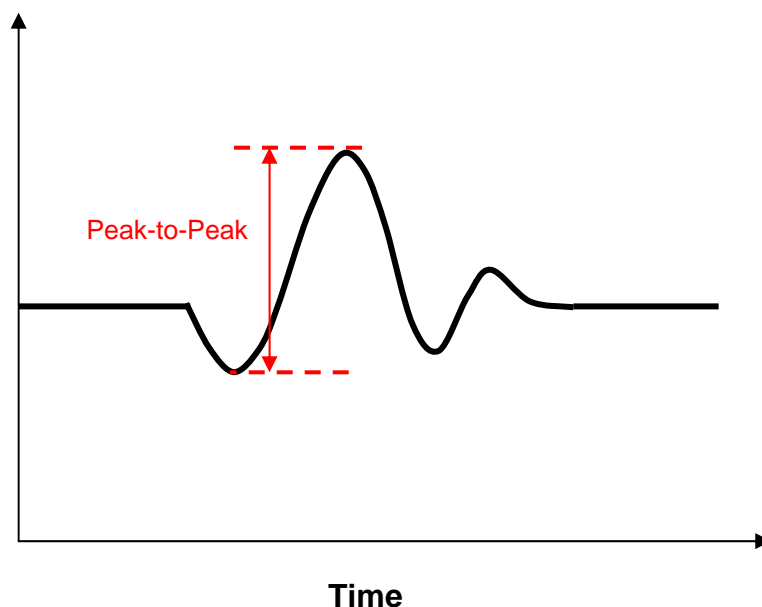


Figure C- 2. Illustration of peak-to-peak crosstalk

C.3 Differential Crosstalk (DDNEXT/DDFEXT) between SS and D+/D- Pairs

The DDNEXT and DDFEXT shall be measured in time domain with a rise time of 500 ps (10-90%) entering the connector under test. The mated cable assembly meets the DDNEXT/DDFEXT requirement if its peak-to-peak value does not exceed the limits below (see Figure C-2 for illustration of the peak-to-peak crosstalk):

- USB 3.0 Standard-A connector: 2%
- USB 3.0 Standard-B connector: 2%
- USB 3.0 Micro connector family: 2%

C.4 Differential to Common-mode Conversion (SS) Requirement

Differential to Common-mode Conversion shall be measured with 90 ohm normalized impedance.

This measurement is defined as SCD21 from the Tx to Rx port of the measured SS pair.

The mated cable assembly meets the SS Differential Common-mode Conversion requirement if the measure SCD21 for each SS-pair does not exceed -20dB (as shown in Figure C-3, below)

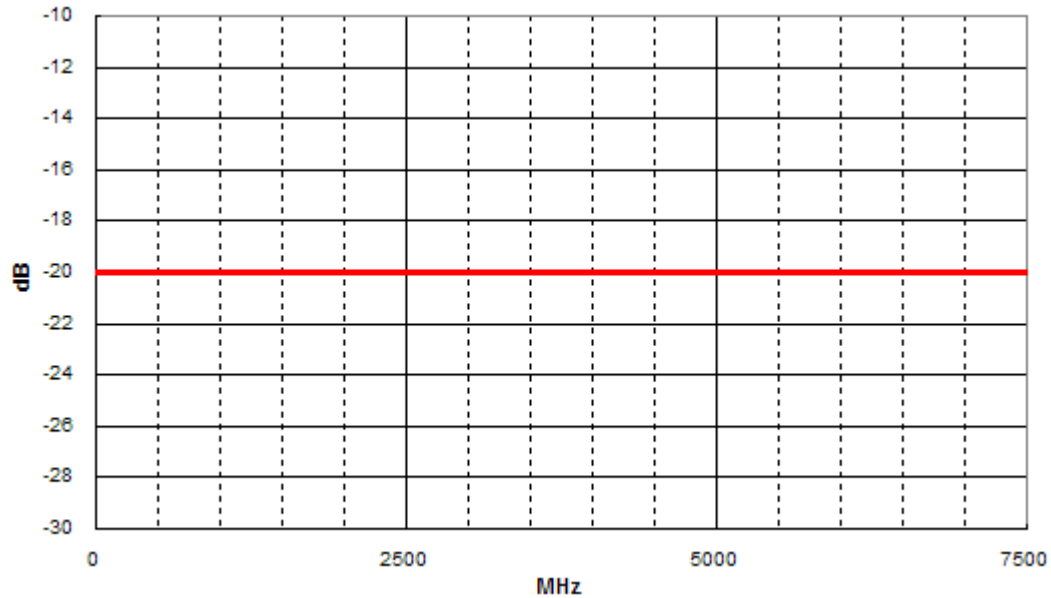


Figure C- 3. USB 3.0 Cable assembly differential to common model conversion ratio

C.4.1 Test Fixture

For proper measurements, the receptacles shall be mounted on a test board. The test board for connector impedance and S-parameter measurements shall be designed and built to specific requirements, as described below, to ensure good measurement quality and consistency:

- The test board shall be a FR4-based PCB of the microstrip structure; the dielectric thickness or stackup is illustrated in the table below. The total thickness of the test board PCB shall be 1.57 mm (0.062”).

Lamination Stackup:		Thickness and Tolerances:		Base Material Rqmts:		Dk @ 1Ghz
L#/Type	Description:	Cu+:	Laminate/PrePreg:	Type:	Description:	
1 Sig	Foil (H oz)	.00060				
2 Pln	Pre-Preg (1 x 2116)		.0047 +/- 0.0005		Isola 370HR	4.15
3 Pln	Core 0.0440 1/1	.00120	.0440		Isola 370HR	4.4
	Pre-Preg (1 x 2116)	.00120				
4 Sig	Foil (H oz)	.00060			Isola 370HR	4.15

- All of the traces on the test board must be held to a characteristic impedance of 50 Ohms with a tolerance of +/- 7%.
- The test board shall have thru calibration structures to remove the fixturing loss from the measurements. All non-ground pins that are adjacent but not connected to measurement ports shall be terminated with 50 Ω loads.
- Traces between the DUT and measurement ports (SMAs) should be uncoupled from each other, as much as possible. Therefore, the traces should be routed in such a way that traces will diverge from each other exiting from the connector pin field.
- The trace lengths between the DUT and measurement port should be around 1000 to 1500 mils. The trace lengths between the DUT and measurement port on the test board shall be equal.
- SMA connector is recommended for ease of use. The SMA launch structure shall be designed to minimize the connection discontinuity from SMA to the trace. The impedance range of the SMA seen from a TDR with a 50 ps rise time should be within 50+/-5 ohms.
- For through-hole application, the measurement signals shall be launched into the connector from the bottom of the test fixture. The through-hole on the test board shall have the following stackup: 28 mil finished hole, 43 mil pad, and 58 mil anti-pad- see diagram below.

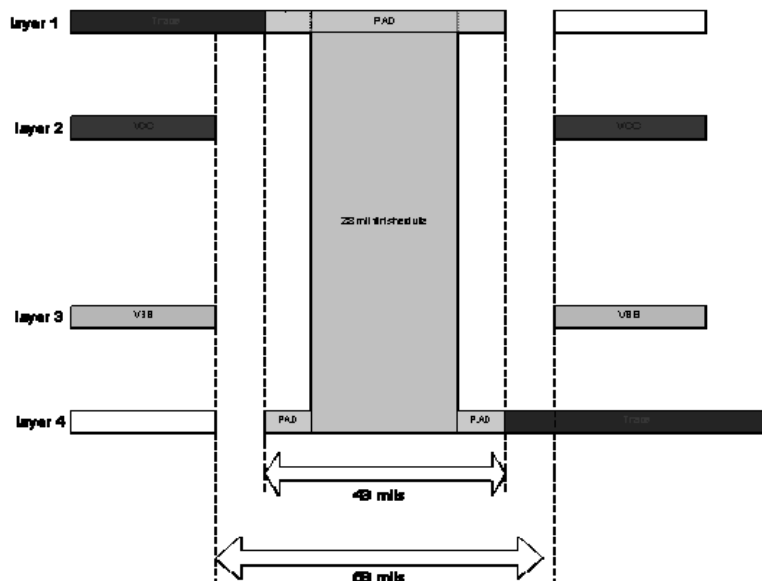


Figure C- 4. Thru-hole via dimension requirement

- For the Micro connector family with SMT, the measurement signals shall be launched into the connector from the top of the test fixture. The Gnd plane shall have the following ground void to reduce capacitance from solder to reference plane:

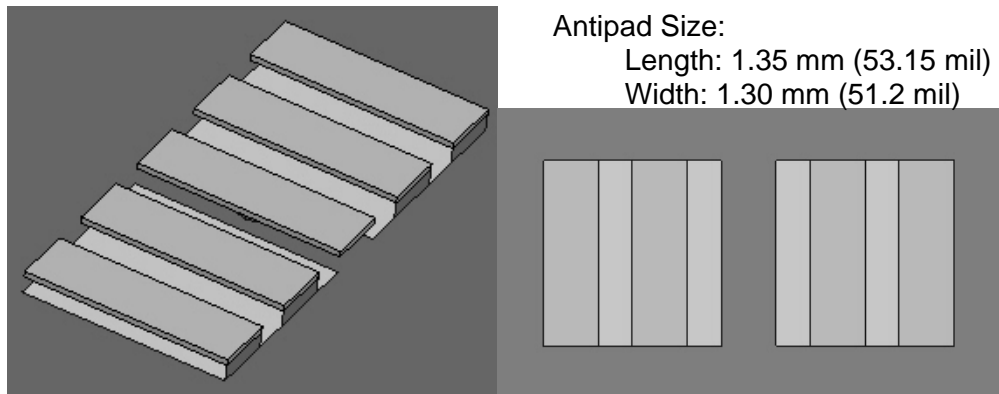


Figure C- 5. Surface mount pad reference layer void dimensions

- There is a reference test fixture design available from USB-IF. The reference test fixture includes the reference connector footprints defined in the USB 3.0 specification. If the USB 3.0 connector footprints deviate from the reference footprints, the connector manufacturer is responsible for providing the test fixture, which meets the fixture requirements defined in this section, for compliance testing.

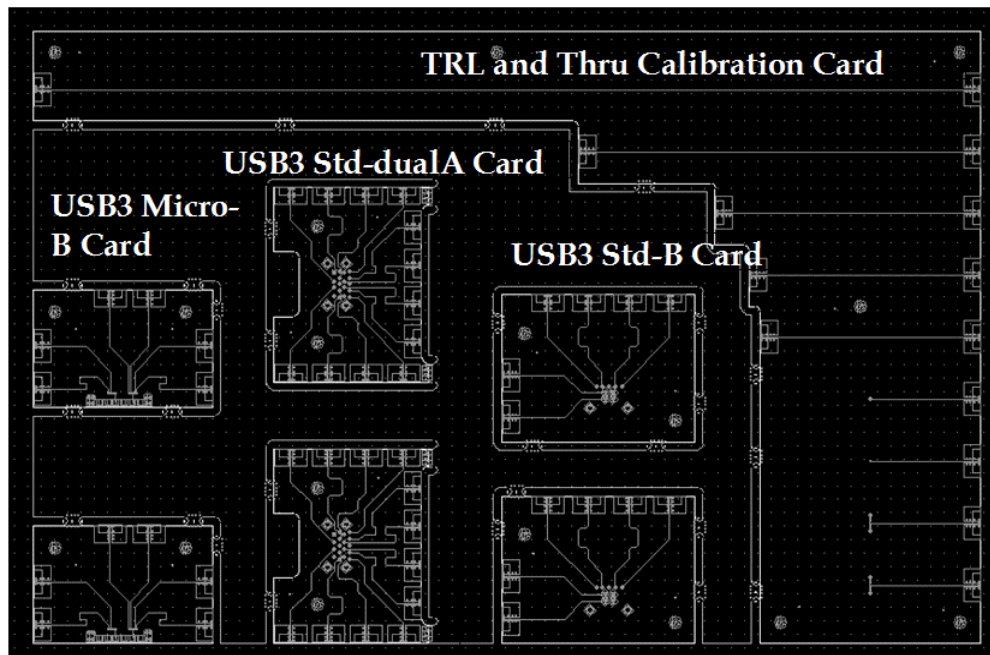


Figure C- 6. Reference test fixture design

C.5 TDR Measurement Requirements

C.5.1 Reference Equipment/Materials

TDR with differential sampling head capabilities is required for differential measurements. The following is provided for reference:

- Agilent 86100B/C DCA Mainframe with 54754 18GHz TDR head or Tektronix TDS8200/CSA8200/DSA8200 Sampling Oscilloscope Mainframe with 80E04 TDR module used for reference measurements.
- The VNA-based TDR measurement is also allowed
- Low loss, phase matched cables used to attach to TDR or VNA
- Micro-coax precision 3.5mm UFB197C-1-0393 1 meter cables used for reference measurements

C.5.2 Calibration and Rise time Adjustment.

Calibration and rise time adjustment to 50 ps (20% to 80%) are required for mated connector TDR measurement.

TDR Calibration: Calibrate to the end of cables following the typical TDR calibration procedure; usually, it requires the short and load measurements. After calibration, the calibrated reference plane is established at the end of cables.

Rise Time Adjustment: Tune TDR rise time such that the measured rise time entering the USB 3.0 connector pins is 50 ps (20% to 80%)

Method 1: TDR systems with directly adjustable TDR step rise times:

- Do TDT measurement on the ½ THRU structure of the test fixture
- Adjust TDR output rise time until the measured rise time at the connector is 50ps.

Method 2: TDR systems without directly adjustable TDR step rise times:

- Setup a math waveform for the TDR signal with its math function = Filter(Cn), and the rise time specified for the filter of 50 ps
- Measure the rise time (20-80%) of the TDRmath rise time of the ½ THRU structure of the test fixture
- Adjust the filter rise time until the measured rise time at the connector is 50 ps.

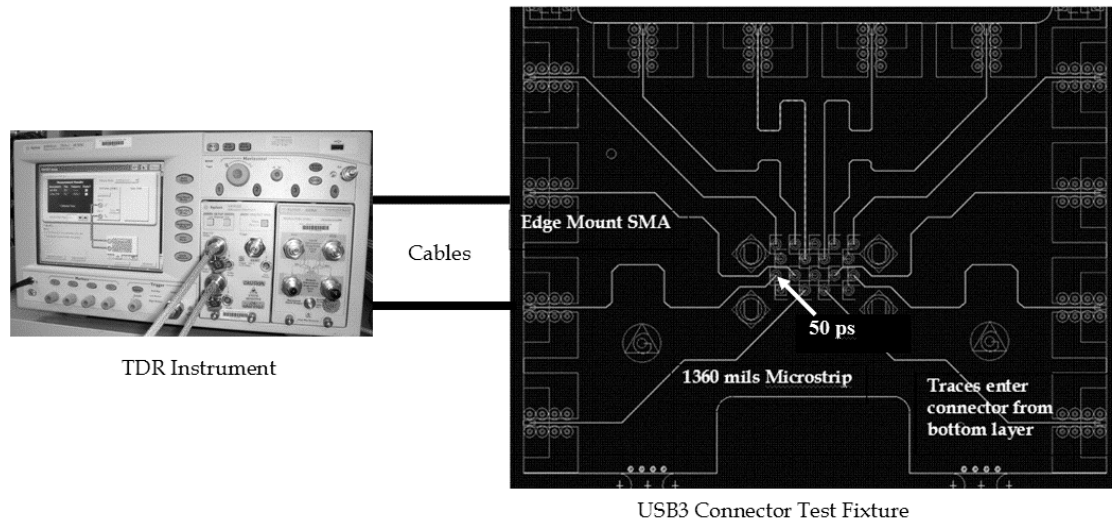


Figure C- 7. Mated connector TDR measurement illustration.

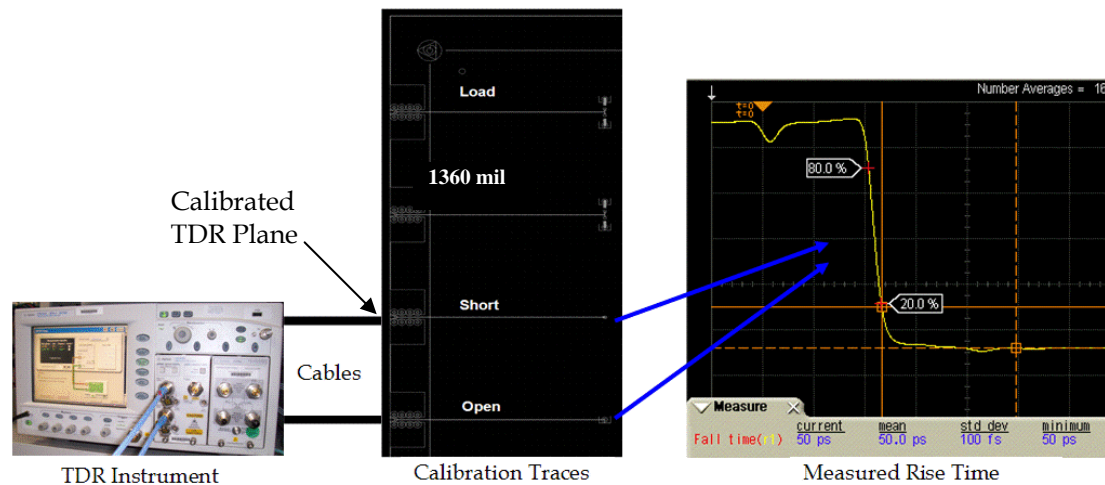


Figure C- 8. TDR calibration and rise time adjustment illustration.

C.6 Mated Connector TDR Measurement

Make sure that the TDR waveform captured on screen has settled to a relatively stable level for a sufficiently long time. Capturing a sufficient duration of the steady state waveform may require adjusting the time base on the TDR to ensure that a long enough sample waveform is acquired. Since the TDR will typically only export what is shown on the screen, the time axis must allow for an adequate portion of waveform to be displayed – it must also include the launch signal via effects and

cable termination effects in the waveform. In order to have a “clean” waveform for analysis, it is desirable for averaging (~16) to be enabled. Refer to Figure D-12.

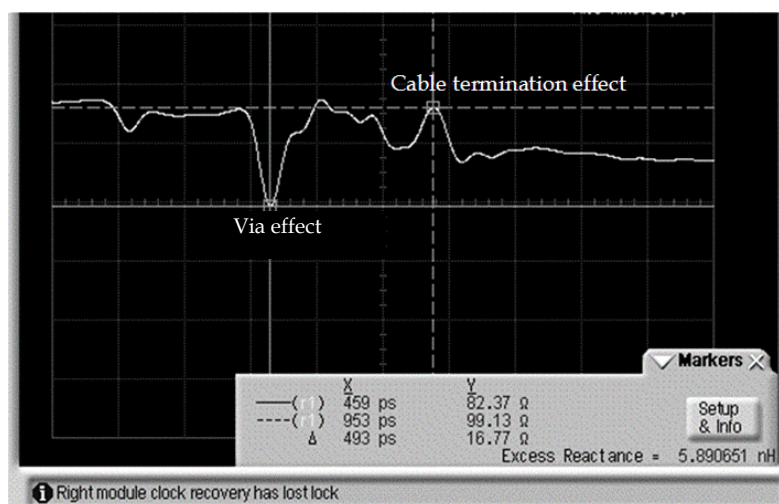


Figure C- 9. Mated connector TDR waveform illustration.

The mated connector TDR profile must meet TDR impedance specification. The differential impedance of a mated connector shall be within $90 \Omega \pm 15 \Omega$, as seen from a 50 ps (20%-80%) rise time of a differential TDR.

C.6.1 Reference Equipment/Materials

VNA with frequency range to at least 8 GHz may be used, for example the Agilent 20GHz E5071C with option TDR. Micro-coax precision 3.5mm UFB197C-1-0393 1 meter cables is used for connection between VNA and test fixture. The TDR-based S-parameter measurement is also allowed.

C.6.2 VNA Calibration Method

The TRL calibration method is chosen for its accuracy and consistency. The following is a brief discussion of the calibration and measurement procedures based on the Agilent E5071C:

- The VNA should be powered and allowed to warm up – recommendation is for 24 hours prior to measurement.
- For VNA bandwidth setup, it is recommended to limit the frequency sweep range to slightly higher than the limit required in the specification (e.g. a 8.5GHz sweep range for the USB3 target of 7.5GHz should be adequate). A sufficient number of points should also be included in the frequency sweep (say 801-1601 for up to 8.5GHz). Additionally, the IF Bandwidth should be low enough to help reduce noise effects (e.g. < 10kHz).

- Before any measurement is done with a VNA, TRL calibration shall be performed to extend the calibration plane to the receptacles on the fixture. Always verify the calibration by measuring a short or open plane to verify expected behavior before performing measurements.
- For TRL calibration using the Agilent E5071C, follow the procedures below:
 1. Press Cal Key at the front panel.
 2. Click Calkit and select the TRL standard.
 3. Then select Calibrate -> 4-Port TRL Cal



4. Connect THRU standard between the 3.5mm cables from Port 1 and 2. Then select Thru/Line -> 1-2 Thru/Line. Repeat the procedure for Port 1 and 3 with 1-3 Thru/Line and Port 3 and 4 with 3-4 Thru/Line.



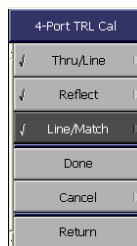
5. Go back to 4-Port TRL Cal and select Reflect. Connect the 3.5mm cable from Port 1 to SHORT standard and perform Port1 Reflect. Repeat the procedure for Port 2 with Port2 Reflect, Port 3 with Port3 Reflect, and Port 4 with Port4 Reflect.



6. Go back to 4-Port TRL Cal and select Line/Match. Connect LINE 1 standard between the 3.5mm cables from Port 1 and 2. Then select 1-2 Line/Match -> Line/Match 1. Repeat the procedure for Line/Match 2 with LINE 2 standard connected, Line/Match 3 with LINE 3 standard connected, and Line/Match 4 with LINE 4 standard connected.



7. Repeat step 6 for 1-3 Line/Match between Port 1 and 3 and 3-4 Line/Match between Port 3 and 4.
8. Go back to 4-Port TRL Cal and select Done



C.7 USB 3.0 Cable Assembly S Parameters Measurement

The single-ended S-parameters shall be measured in a 50 ohm system. To renormalize the S-parameters to a 90 ohm differential impedance, set the port reference impedance to 45 ohms, single-ended, for each port. The differential reference impedance will become 90 ohm once the single-ended S-parameters are converted to differential.