



PRODUCT SPECIFICATION

USB TYPE C PLUG CONNECTOR (MOLEX P/N:105444 series)

<u>REVISION:</u> A	<u>ECR/ECN INFORMATION:</u> EC No: 102278 DATE: 2015/12/25	<u>TITLE:</u> USB TYPE C PLUG CONNECTOR	<u>SHEET No.</u> 1 of 19
<u>DOCUMENT NUMBER:</u> PS-10544-001	<u>CREATED / REVISED BY:</u> ABIN	<u>CHECKED BY:</u> FYANG05	<u>APPROVED BY:</u> RZHANG



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TITLE

1.0 SCOPE

This Product Specification covers the requirement of the USB TYPE C CONNECTOR

2.0 PRODUCT DESCRIPTION

- 2.1. Sales drawings and other sections of this specification for the relevant reference documents. In cases where the specification differs from the drawings, the sales drawings take precedence.
- 2.2. Product name: USB TYPE C SPLINT PLUG CONNECTOR
- 2.3. Series number: 105444

3.0 RATINGS

3.1 RATED VOLTAGE

30 Volts AC(rms)

3.2 RATED CURRENT

5 A for A4, A9, B4, B9 VBUS; A1, A12, B1,B12 GND
1.25 for B5\A5 \A8\B8
0.25A for other pin

3.3 TEMPERATURE

Operating Temperature Range: -30°C to +85°C : (Including Terminal Temperature Rise)

Storage Temperature Range : -45°C to +85°C

4.0.APPLICABLE DOCUMENTS AND SPECIFICATIONS

EIA-364.

Universal Serial Bus Type-C Connectors and Cable Assemblies Compliance Document

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4.1. TEST METHODS AND REQUIREMENT

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
4.1.1	Examination	Test Methods: Visual inspection EIA-364-18 Test Requirement: Meets requirements of product drawing. No physical damage.	Meets requirements of product drawing. No physical damage.
4.1.2	Low Level Contact Resistance	EIA 364-23 The low level contact resistance (LLCR) measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. The test boards shall be provided with the connectors to be tested. • Measure at 20 mV (max) open circuit at 100 mA.	The following requirements apply to the power and signal contacts: • 40 mΩ (max) initial for VBUS, GND and all other contacts. • 50 mΩ maximum after initial measurement.
4.1.3	Dielectric Withstanding Voltage	EIA 364-20 Applicable to both receptacle and plug. • Measurement per Method B.	The dielectric shall withstand 100 VAC (RMS) for one minute
4.1.4	Insulation Resistance	EIA 364-21 Applicable to both receptacle and plug.	A minimum of 100 MΩ insulation resistance is required between adjacent contacts of unmated and mated connectors.
4.1.5	Contact Current Rating	See Appendix C	When current is applied to the contacts, the temperature rise shall not exceed limit at the location defined in Appendix C.

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
4.1.6	Insertion Force	EIA 364-13 The insertion force test shall be done at a maximum speed of 12.5 mm (0.492") per minute.	Within the range from 5 N to 20 N. This requirement does not apply to the plugs that are used for direct docking without a cable.

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4.1.7	Extraction Force	<p>EIA 364-13</p> <p>The extraction force test shall be done at a maximum speed of 12.5 mm (0.492") per minute.</p>	<p>Within the range of 8 N to 20 N , measured after a preconditioning of five insertion/extraction cycles (i.e., the sixth extraction). After an additional twenty-five insertion/extraction cycles, the extraction force shall be measured again (i.e., the thirty-second extraction) and the extraction force shall be within:</p> <p>a) 33 % of the initial reading, and b) within the range of 8 N to 20 N.</p> <p>The extraction force shall be within the range of 6 N to 20 N after 10,000 insertion/extraction cycles.</p> <p>This requirement does not apply to the plugs that are used for direct docking without a cable.</p>
4.1.8	Durability or Insertion/Extraction Cycles	<p>EIA 364-09</p> <p>The object of this test procedure is to detail a uniform test method for determining the effects caused by subjecting a USB connector to the conditioning action of insertion and extraction, simulating the expected life of the connectors. 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.</p>	<p>Appearance-No breakdown</p> <p>10,000 cycles rate of 200 cycles per hour</p> <p>Low level contact resistance and dielectric withstanding voltage shall be checked to be within spec after the 10,000 durability cycles</p>

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4.1.9	Wrenching Strength (Plug-only)	<p>Perpendicular forces are applied to the plug in four directions (i.e., left, right, up, and down). A metal fixture with opening and tongue representative of a receptacle shall be used.</p> <p>Appendix E</p>	<p>a) A single plug shall be used for this test. Some mechanical deformation may occur. The plug shall be mated with the continuity test fixture after the test forces have been applied to verify no damage has occurred that causes discontinuity or shorting. The Dielectric Withstanding Voltage test shall be conducted after the continuity test to verify plug compliance.</p> <p>b) A new plug is required for each of the four test directions. The plug shall disengage from the test fixture or demonstrate mechanical failure (i.e., the force applied during the test procedure peaks and drops off) when a moment of 2.0 Nm is applied to the plug in the up and down directions and a moment 3.5 Nm is applied to the plug in the left and right directions.</p> <p>See Appendix E</p>
4.1.10	4-Axes Continuity	<p>See Appendix D for detailed test fixtures and procedures.</p> <p>Plug and Receptacle: Subject the mating interface to the moments defined in Appendix D for at least 10 seconds.</p>	<p>No discontinuities greater than 1 microsecond duration in any of the four orientations tested.</p>

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
4.1.11	Temperature Life	EIA 364-17, Method A. 105° C without applied voltage for 120 hours. 105° C without applied voltage for 72 hours when used as preconditioning.	Low level contact resistance meets spec before and after the Temperature Life test.
4.1.12	Vibration	EIA 364-28 Test Condition VII, Test Letter D	No evidence of physical damages and no discontinuity longer than 1 microsecond. Low level contact resistance meets spec before and after the Vibration test.

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4.1.13	Cyclic Temperature and Humidity	EIA 364-31 Cycle the connector between 25 °C ±3 °C at 80 % ±3% RH and 65 °C ±3 °C at 50 % ±3% RH. Ramp times should be 0.5 hour and dwell times should be 1.0 hour. Dwell times start when the temperature and humidity have stabilized within the specified levels. Perform 24 such cycles.	Low level contact resistance meets spec before and after the Cyclic Temperature and Humidity test.
4.1.14	Thermal Shock	EIA 364-32, Test Condition I 10 Cycles -55°C and +85°C.	No evidence of any physical damage. Low level contact resistance meets spec before and after the Thermal Shock test
4.1.15	Mixed Flowing Gas	EIA 364-65, Class II A 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. Test duration is 7 days.	Low level contact resistance meets spec before and after the Mixed Flowing Gas test. (Only for gold-plated terminals more than 30microinch gold or gold flash over 30microinch PbNi)
4.1.16	Solderability	EIA 364-52 The object of this test procedure is to detail a uniform test method for determining USB 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.	USB contact solder tails shall pass 95% coverage after 8-hour steam age. Note: If lead free solder is required, solder temperature is 245 ±5° C .
4.1.17	Salt Spray	The object of this test procedure is to detail a standard method for the evaluation of the properties of materials used in USB 3.1 connectors as these influenced by the effects of salt spray	Subject mated connectors to two cycles(24h) at 35°C with 5%-Salt-solution concentration. 1). Shall meet visual requirement, show no physical damage. 2). Shall meet requirements of additional tests as specified in test

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C Current Rating Test

The current rating testing for the Type-C connector (plug and receptacle) shall be conducted per the following set up and procedures:

- A current of 5 A shall be applied collectively to VBUS pins (i.e., pins A4, A9, B4, and B9) and 1.25 A shall be applied to the VCONN pin (i.e., B5) as applicable, terminated through the corresponding GND pins (i.e., pins A1, A12, B1, and B12). A minimum current of 0.25 A shall also be applied individually to all the other contacts, as applicable. When current is applied to the contacts, the temperature of the connector pair shall be allowed to stabilize. The temperature rise of the outside shell surface of the mated pair above the VBUS and GND contacts shall not exceed 30°C above the ambient temperature. Figure C-1 provides an illustration of the measurement location.
- The measurement shall be done in still air.
- The connectors shall be oriented such that the accessible outer shell surface is on top and horizontal to the ground.
- The plug and receptacle may require modification to access solder tails or cable attachment points.
- Either thermocouple or thermo-imaging (preferred) method may be used for temperature measurement.
- For certification, the connector manufacturer shall provide the receptacle and plug samples under test mounted on a current rating test PCB with no copper planes. The current rating test PCBs shall be of 2-layer construction. Table C-1 defines the requirements for the test PCB thickness and traces. The trace length applies to each PCB (receptacle PCB and plug PCB) and is from the contact terminal to the current source tie point. Figure C-2 provides an informative partial trace illustration of the current rating test PCB.

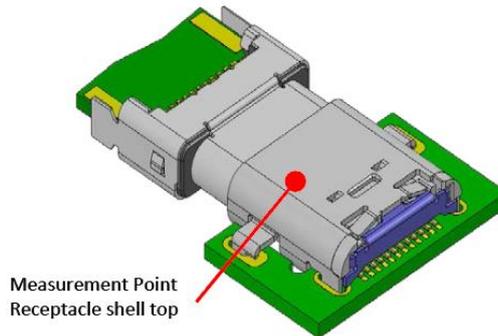


Figure C-4 Temperature Measurement Point

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Table C-1 Current Rating Test PCB

Item	Trace width (mm)	Trace length (mm) on each PCB	Thickness
Signal trace	0.25 max.	13 max.	35 μm (1 oz. copper)
Ground trace	1.57 max.	38 max.	35 μm (1 oz. copper)
V_{BUS} and V_{CONN}	1.25 max.	30 max.	35 μm (1 oz. copper)
PCB	N/A	N/A	0.80 - 1.20 mm

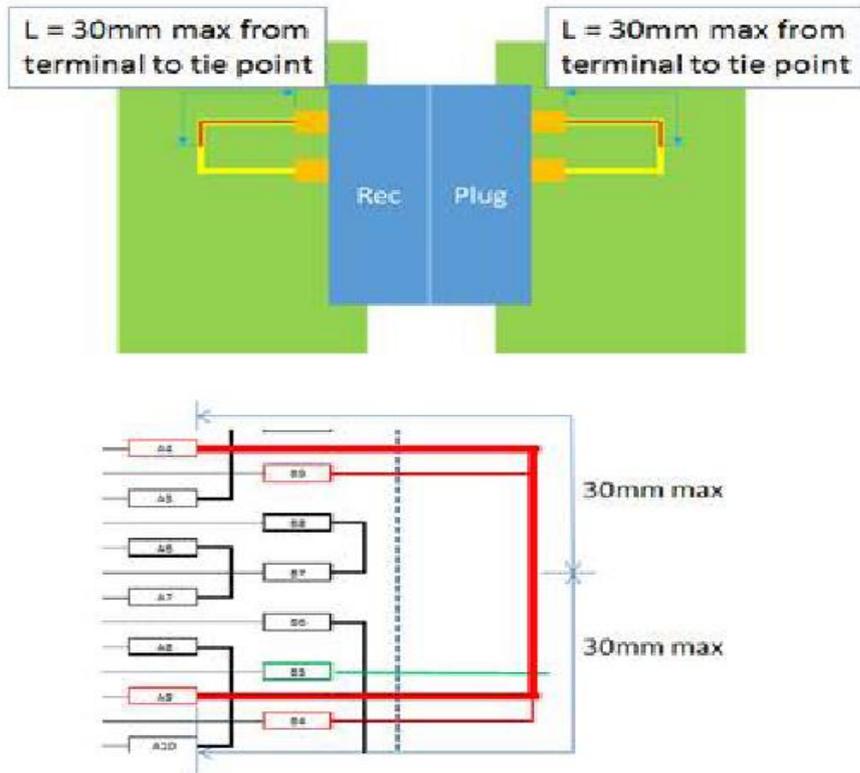


Figure C-2 Example Current Rating Test Fixture Trace Configuration

D 4-Axis Continuity Test

The USB Type-C connector family shall be tested for continuity under stress using a test fixture shown in Figure D-2 or equivalent.

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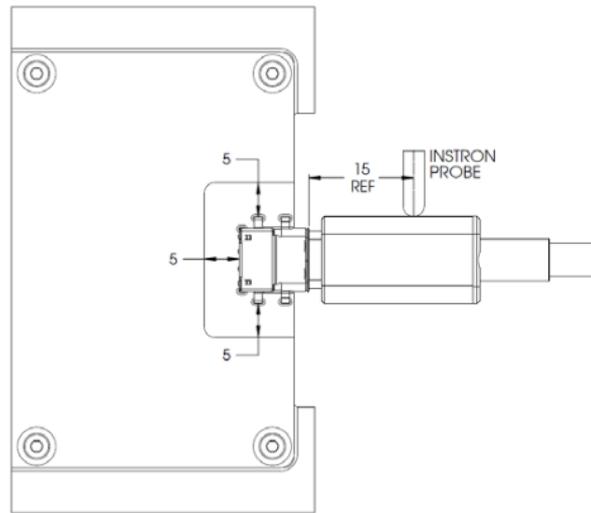


Figure D-1. Example of 4-Axis Continuity Test Fixture

Plugs shall be supplied with a representative overmold or mounted on a 2-layer printed circuit board (PCB) between 0.8 mm and 1.0 mm thickness as applicable. A USB Type-C receptacle shall be mounted on a 2-layer PCB between 0.8 mm and 1.0 mm thickness. The PCB shall be clamped on three sides of the receptacle no further than 5 mm away from the receptacle outline. The receptacle PCB shall initially be placed in a horizontal plane, and a perpendicular moment shall be applied to the plug with a 5 mm ball tipped probe for a period of at least 10 seconds at a distance of 15 mm from the mating edge of the receptacle shell in a downward direction, perpendicular to the axis of insertion. See Table D-1 for the force and moment to be applied.

Table D-1 Force and Moment Requirements

Receptacle configuration with respect to mounting surface	Force at 15 mm from receptacle shell mating edge (N)	Moment with respect to receptacle shell mating edge (Nm)
Right angle	20	0.30
Vertical	8	0.12

The continuity across each contact shall be measured throughout the application of the tensile force. Each non-ground contact shall also be tested to confirm that it does not short to the shell during the stresses. The PCB shall then be rotated 90 degrees such that the cable is still inserted horizontally and the tensile force in Table D-1 shall be applied again in the downward direction and continuity measured as before. This test is repeated for 180 degree and 270 degree rotations. Passing parts shall not exhibit any discontinuities or shorting to the shell greater than 1 μ s duration in any of the four orientations.

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One method for measuring the continuity through the contacts is to short all the wires at the end of the cable pigtail and apply a voltage through a pull-up to each of VBUS, USB D+, USB D-, SBU, CC, and USB SuperSpeed pins, with the GND pins connected to ground. Alternate methods are allowed to verify continuity through all pins.

E Wrenching Strength Test

Type-C plugs shall be tested using the mechanical wrenching test fixture, as illustrated in Figure E-2. The fixture substitutes machined metal parts for the receptacle. Perpendicular moments are applied to the plug with a 5 mm ball tipped probe for a period of at least 10 seconds when inserted in the test fixture to achieve the defined moments in four directions of up or down (i.e., perpendicular to the long axis of the plug opening) and left or right (i.e., in the plane of the plug opening). Compliant connectors shall meet the following force thresholds:

- a) A moment of 0-0.75 Nm (e.g., 50 N at 15 mm from the edge of the receptacle) is applied to a plug inserted in the test fixture in each of the four directions. A single plug shall be used for this test. Some mechanical deformation may occur. The plug shall be mated with the continuity test fixture after the test forces have been applied to verify no damage has occurred that causes discontinuity or shorting. The continuity test fixture shall provide a planar surface on the mating side located 6.20 ± 0.20 mm from the receptacle Datum A, perpendicular to the direction of insertion. No moment forces are applied to the plug during this continuity test. Figure E-3 illustrates an example continuity test fixture to perform the continuity test. The Dielectric Withstanding Voltage test shall be conducted after the continuity test to verify plug compliance.
- b) The plug shall disengage from the test fixture or demonstrate mechanical failure (i.e., the force applied during the test procedure peaks and drops off) when a moment of 2.0 Nm is applied to the plug in the up and down directions and a moment 3.5 Nm is applied to the plug in the left and right directions. A new plug is required for each of the four test directions. An example of the mechanical failure point is shown in Figure E4.

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Figure E-1. Wrenching Strength Test Fixture

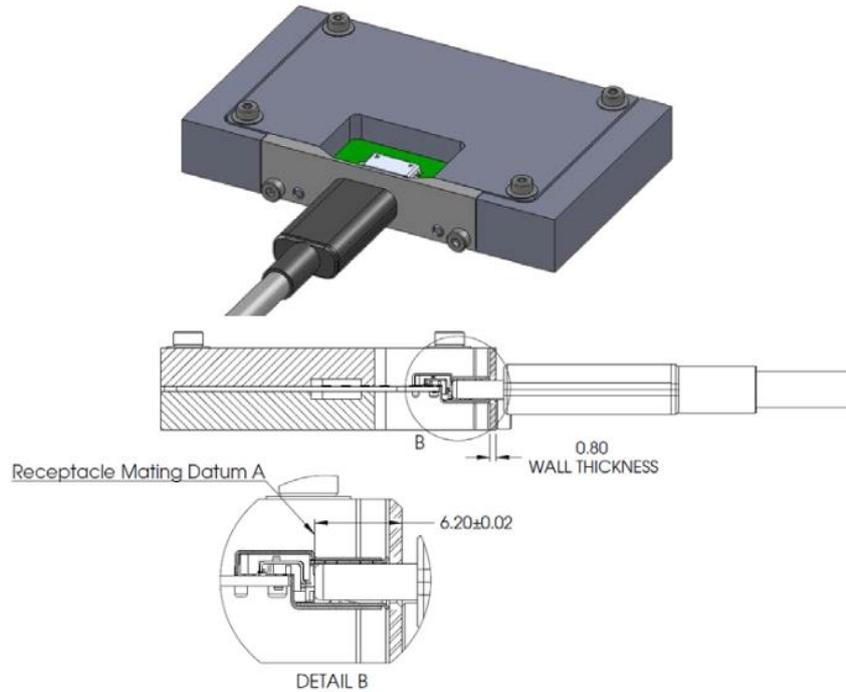


Figure E-2. Reference Wrenching Strength Continuity Test Fixture

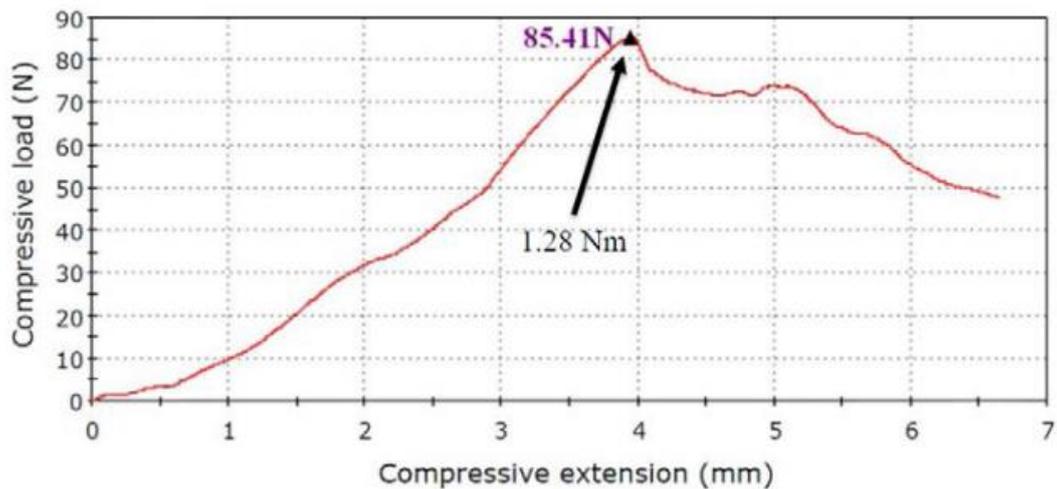


Figure E-3. Example of Wrenching Strength Test Mechanical failure point

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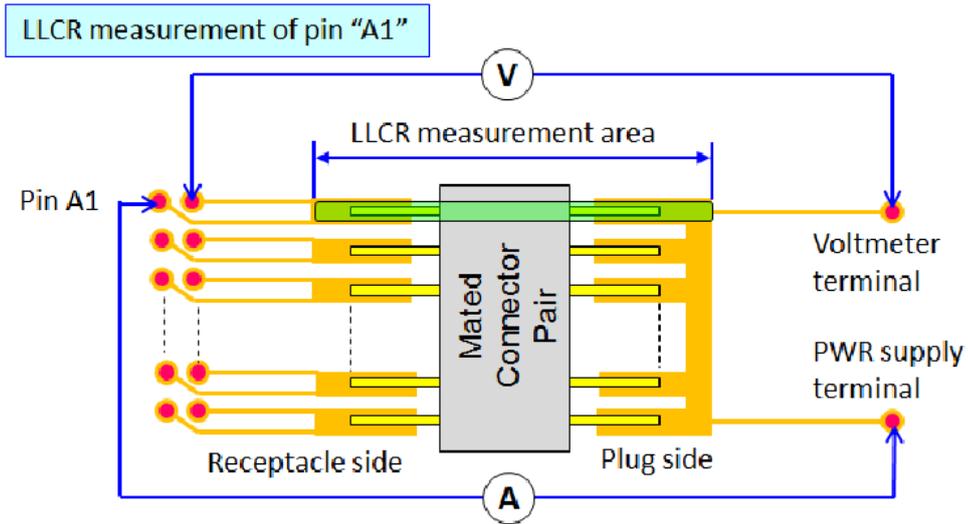


Figure 4-1 Typical Contact Resistance Measurement

Group A-1

Test order	Description	Test procedure	Test criteria
1	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	40 milliohms max for all contacts. Baseline measurement.
2	Durability (PRECONDITIONING)	EIA-364-09 Perform 50 unplug/plug cycles.	No evidence of physical damage
3	Temperature life	EIA-364-17, method A 105° C without applied voltage for 120 hours.	None
4	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max

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5	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles.	No evidence of physical damage
6	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max

Group A-2

Test order	Description	Test procedure	Test criteria
1	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	40 milliohms max for all contacts. Baseline measurement.
2	Durability (PRECONDITIONING)	EIA-364-09 Perform 50 unplug/plug cycles.	No evidence of physical damage
3	Thermal shock	EIA-364-32, test condition I 10 cycles with the exception of exposure times. Place a thermocouple in the center of the largest mass component of the connector that is in the center of the test chamber to insure that the contacts reach the temperature extremes before ramping to the other temperature.	None.
4	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max for all contacts.

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5	Cyclic temperature and humidity	EIA-364-31 Cycle the connector between 25 °C ±3 °C at 80 % ±3% RH and 65 °C ±3 °C at 50 % ±3% RH. Ramp times should be 0.5 hour and dwell times should be 1.0 hour. Dwell times start when the temperature and humidity have stabilized within the specified levels. Perform 24 such cycles.	None.
6	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
7	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles.	No evidence of physical damage
8	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max

GROUP A-3

Test order	Description	Test procedure	Test criteria
1	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	40 milliohms max for all contacts. Baseline measurement.
2	Durability (PRECONDITIONING)	EIA-364-09 Perform 50 unplug/plug cycles.	No evidence of physical damage
3	Temperature life (preconditioning)	EIA-364-17, method A 105° C without applied voltage	None.

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		for 72 hours when used as preconditioning.	
4	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
5	Vibration	EIA-364-28, test condition VII, test condition letter D. 15 minutes in each of 3 mutually perpendicular directions. Both mating halves should be rigidly fixed so as not to contribute to the relative motion of one contact against another. The method of fixturing should be detailed in the test report.	No evidence of physical damage. No discontinuities of 1 μ S or longer duration when mated connector during test.
6	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max

Group A-4

Test order	Description	Test procedure	Test criteria
1	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	40 milliohms max for all contacts. Baseline measurement.
2	Durability (PRECONDITIONING)	EIA-364-09 Perform 50 unplug/plug cycles.	No evidence of physical damage
3	Temperature life (preconditioning)	EIA-364-17, method A 105° C without applied voltage for 72 hours when used as preconditioning.	None.
4	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated	50 milliohms max

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		contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	
5	Mixed flowing gas	EIA 364-65, Class II A 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. Test duration is 7 days.	Low level contact resistance meets spec before and after the mixed flowing gas test.
6	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
7	Thermal disturbance	Cycle the connector or socket between 15 °C ±3 °C and 85 °C ± 3 °C, as measured on the part. Ramps should be a minimum of 2 °C per minute, and dwell times should insure that the contacts reach the temperature extremes (a minimum of 5 minutes). Humidity is not controlled. Perform 10 such cycles.	None.
8	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
9	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles.	No evidence of physical damage

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10	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
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Group A-7

Test order	Description	Test procedure	Test criteria
1	Dielectric Withstanding Voltage	EIA 364-20 100VAC(RMS)	No disruptive discharge.
2	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	40 milliohms max for all contacts. Baseline measurement.
3	Durability (PRECONDITIONING)	EIA-364-09 Perform 4 unplug/plug cycles, followed by an unplug.	No evidence of physical damage
4	Insertion force	EIA 364-13 Perform the measurement at a maximum speed of 12.5 mm (0.492") per minute.	Within the range of 5 N to 20 N.
5	Extraction force	EIA 364-13 Perform the measurement at a maximum speed of 12.5 mm (0.492") per minute.	Within the range of 8 N to 20 N. Initial reading
6	Durability	EIA 364-9 <i>Perform 25 plug/unplug cycles. Cycle rate of -500 ± 50 cycles per hour followed by a plug.</i>	No evidence of physical damage
7	Extraction force	EIA 364-13 Perform the measurement at a maximum speed of 12.5 mm (0.492") per minute.	Within: a) 33% of the initial reading, and b) B) 8 N to 20 N
8	Durability	EIA 364-9 Perform 2,468 plug/unplug cycles. Rotate the receptacle or plug 180° and perform	No evidence of physical damage

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		2,500 plug/unplug cycles. Rotate the receptacle or plug 180° and perform 2,500 plug/unplug cycles. Rotate the receptacle or plug 180° and perform 2,500 plug/unplug cycles. Cycle rate of 500 ± 50 cycles per hour (total of 10,000 plug/unplug cycles, flipping every 2,500 cycles).	
9	Extraction force	EIA 364-13 Perform the measurement at a maximum speed of 12.5 mm (0.492") per minute.	Within 6 N to 20 N.
10	LLCR	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. See Figure 4-1.	50 milliohms max
11	Dielectric Withstanding Voltage	EIA 364-20 100VAC(RMS)	No disruptive discharge.
12	Insulation Resistance	EIA 364-21. Applicable to both receptacle and plug.	A minimum of 100 MΩ insulation resistance is required between adjacent contacts of unmated and mated connectors

Group B-1

Test order	Description	Test procedure	Test criteria
1	4-Axis Continuity	See Appendix D for detailed test fixture and procedures.	No discontinuities greater than 1 microsecond duration in any of the four orientations tested.

Group B-6

Test order	Description	Test procedure	Test criteria
2	Contact Current Rating	See Appendix C	When current is applied to the contacts, the temperature rise shall not exceed 30°C at the outside surface of the shell. This requirement applies to the USB Type-C connector mated pair only.

Group B-7

<u>REVISION:</u> A	<u>ECR/ECN INFORMATION:</u> EC No: 102278 DATE: 2015/12/25	<u>TITLE:</u> USB TYPE C PLUG CONNECTOR	<u>SHEET No.</u> 18 of 19
<u>DOCUMENT NUMBER:</u> PS-10544-001	<u>CREATED / REVISED BY:</u> ABIN	<u>CHECKED BY:</u> FYANG05	<u>APPROVED BY:</u> RZHANG



PRODUCT SPECIFICATION

Test order	Description	Test procedure	Test criteria
1	Wrenching Strength	Perpendicular forces are applied to the plug in four directions (i.e., left, right, up, and down). A metal fixture with opening and tongue representative of a receptacle shall be used. See Appendix E.	The plug shall be mated with the continuity test fixture after the test forces have been applied to verify no damage has occurred that causes discontinuity or shorting.
2	Continuity	See Appendix E.	No discontinuities or shorts allowed.
3	Dielectric withstanding voltage	EIA364-20 Mated, 100 VAC (RMS)	No disruptive discharge
4	Wrenching Strength	Perpendicular forces are applied to the plug in four directions (i.e., left, right, up, and down). A metal fixture with opening and tongue representative of a receptacle shall be used. See Appendix E.	The plug shall disengage from the test fixture or mechanically fail (as defined in Appendix E) when a moment of 2.0 Nm is applied in the up and down directions and a moment 3.5 Nm is applied in the left and right directions.

Group C-1

Test order	Description	Test procedure	Test criteria
1	Examination	Visual inspection;	No physical damage
2	Solderability	USB contact solder tails shall pass 95% coverage after 8-hour steam age.	The welding area is greater than 95% response rate.
3	Examination	Visual inspection;	No physical damage

Group C-2

Test order	Description	Test procedure	Test criteria
1	Examination	Visual inspection;	No physical damage
2	Salt Spray	Subject mated connectors to two cycles(24h) at 35°C with 5%-Salt-solution concentration.	No physical damage
3	Examination	Visual inspection;	No physical damage

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