

NUMBER GS-12-1351	TYPE PRODUCT SPECIFICATION	Amphenol FCi	
TITLE USB3.1 Type-C Connector		PAGE 1 of 12	REVISION A
		AUTHORIZED BY LQ.Lei	DATE 5/18'17
		CLASSIFICATION UNRESTRICTED	

1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the USB3.1 Type-C product.

2.0 Scope

This specification is applicable to the termination characteristics of the USB3.1 type-c products with 0.5 pitch which provides type-c plug to PCB interconnecting.

Refer to GS-01-029 section 5.2 for additional scope content recommendations

3.0 Ratings

- 3.1 Operating Voltage Rating = 20 V_{DC}
- 3.2 Operating Current Rating = 5A/ VBUS and GND
- 3.3 Operating Temperature Range = -55°C to + 85°C
- 3.4 Storage Temperature Range =- 40°C to +60°C

Note 1: includes the terminal temperature rise when powered

4.0 Applicable Documents

- 4.1 FCI Specifications
 - 4.1.1 Engineering drawings
 - 10133475: Plug
 - 10132328: Vertical type for receptacle
 - 10133476: Hybrid type for receptacle
 - 10133477: Mid-mouth for receptacle

List all referenced ELX division documents including the test and procedure specifications referenced in the selected 6.0, 7.0, and 8.0 paragraphs

- 4.2 Industry or Trade Association standards
 - 4.2.1 Universal Serial Business Type-C and Connector Specification revision 1.1
 - 4.2.2 Type-C_Compliance_Document_rev_1.1

List any applicable specifications, such as Telcordia Technologies, USB, etc.

- 4.3 National or International Standards
 - List applicable specifications that are referenced in the specification e.g.:*

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4.3.1 Flammability: UL94V-0 or similar applicable specification

4.3.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.

4.3.3 IEC 60512: Connectors for Electronic Equipment – Tests and Measurement

4.4 FCI Laboratory Reports - Supporting Data

List lab report numbers that contain the supporting qualification test data

4.5 Safety Agency Approvals

List the UL, CSA, TUV other product safety agency certification file numbers.

5.0 Requirements

5.1 Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

5.2 Material

The material for each component shall be as specified herein or equivalent.

Refer to GS-01-029 section 5.5 for additional material content recommendations

5.3 Finish

The finish for applicable components shall be as specified herein or equivalent.

Refer to GS-01-029 section 5.5 for additional finish content recommendations

5.4 Design and Construction

Connectors shall be of the design, construction, and physical dimensions specified on the applicable product drawing. There shall be no cracks, burrs, or other physical defects that may impair performance. All materials conform to RoHS.

Include any additional product information that would provide the reader with a better understanding of the design, construction, and intended use or application of the product. Refer to GS-01-029 section 5.5 for additional information regarding design and construction content

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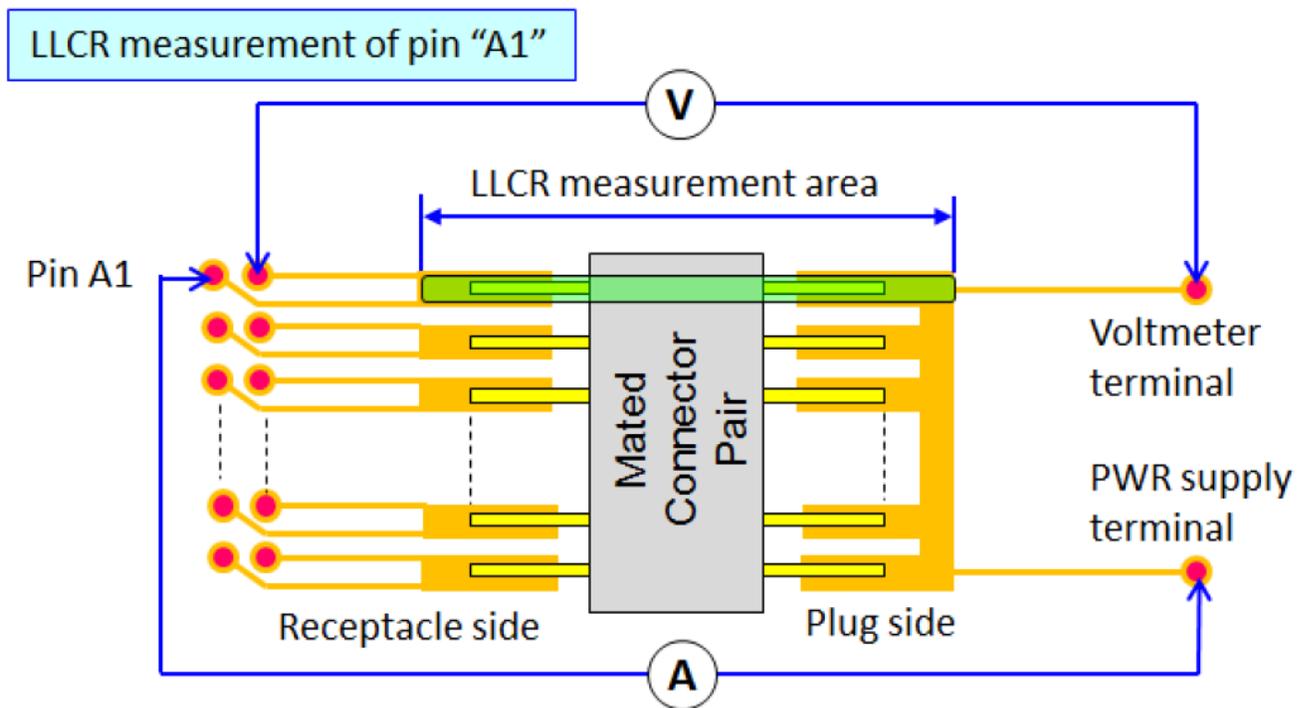
6.0 Electrical Characteristics

6.1 Contact Resistance, Low Level (LLCR)

The low level contact resistance shall not exceed 40 milliohms initially. The low level contact resistance shall also not exceed 50 milliohms after any treatment and/or environmental exposure. Measurements shall be in accordance with EIA 364-23.

The following details shall apply:

- a. Test Voltage - 20 milli-volts DC max open circuit.
- b. Test Current - Not to exceed 100 milli-amperes.



6.2 Insulation Resistance

The insulation resistance of (*unmated or mated*) connectors shall not be less than 100M ohms initially and after environmental exposure.

Measurements shall be in accordance with EIA 364-21.

The following details shall apply:

- a. Test Voltage - 100 volts DC.
- b. Electrification Time - 2 minutes, unless otherwise specified.
- c. Points of Measurement - Between adjacent contacts (*and between contacts and other conductive surfaces, if applicable*).

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6.3 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current >1 milliamperere when (*unmated or mated*) connectors are tested in accordance with IEC 60512-4-1 or EIA 364-20.

The following details shall apply:

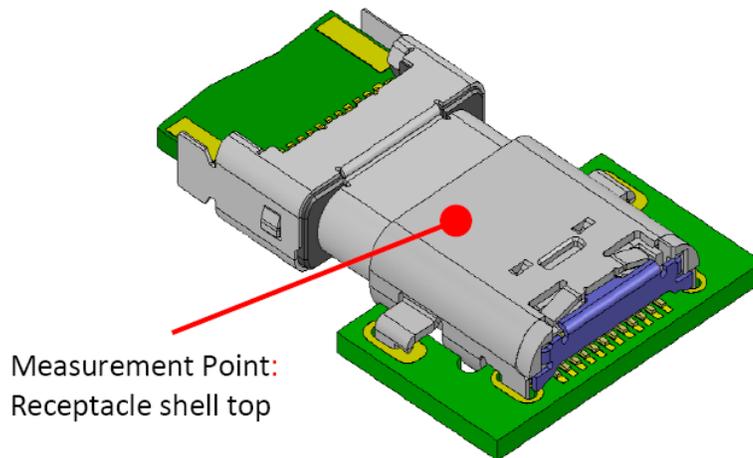
- a. Test Voltage -100 volts (AC RMS, 60Hz).
- b. Test Duration - 60 seconds.
- c. Test Condition - 1 (760 Torr - sea level).
- d. Points of Measurement - Between adjacent contacts (*and between contacts and other conductive surfaces, if applicable*).

6.4 Current Rating

A current of 5.0 A shall be applied collectively to VBUS pins (i.e., pins A4, A9, B4, and B9) and 1.25 A applied to the VCONN pin (i.e., B5 of the plug connector) with the return path 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. When the currents are applied to the contacts, The temperature rise above ambient shall not exceed 30 deg C at at any point on the USB Type-C mated plug and receptacle under test.

The following details shall apply:

- a. Ambient Conditions – 25°C, still air.
- b. Test configuration (*specify wire gage, test board requirements, thermocouple placement, sample orientation, etc.*)
- c. Reference - EIA 364-70



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7.0 Mechanical Characteristics

7.1 Insertion/Extraction Force

The force to mate a receptacle connector and compatible header shall within the range from 5-20N. The Extraction force shall be measured after a preconditioning of 5 insertion/extraction cycles. After an additional 25 insertion/extraction cycles, the extraction force shall be measured and the extraction force shall be within 33 % of the initial reading, and within the range of 8 N to 20 N. After 10,000 insertion/extraction cycles, the extraction force shall be within the range of 6 N to 20 N

The following details shall apply:

- a. Cross Head Speed -12.5 mm per minute.
- b. Lubrication - non-silicon based lubricant on the latching mechanism to reduce wear is recommended. If used, the lubricant may not affect any other characteristic of the system.
- c. Utilize free floating fixtures.
- d. Reference –EIA 364-13.

7.2 Durability- EIA 364-09

The connector pairs shall be capable of withstanding 10000 Insertion/Extraction cycles, **Rotate the receptacle or plug 180° per 2500cycles**, the durability test shall be done at a maximum rate of **500±50** cycles per hour and no physical damage to any part of the connector and cable assembly shall occur.

7.3 Durability (Preconditioning)- EIA 364-09

- a. Number Cycles 50 cycles
- b. Cycling Rate – 500±50 cycle per hour.
- c. Latches disabled (If applicable)
- d. Use free floating fixtures

7.4 Reseating

Manually insert/extract the connector 3 cycles, there shall no evidence of physical damage.

7.5 Axis Continuity Test

The USB Type-C connector family shall be tested for continuity under stress using the test configurations. PCB between 0.8 mm and 1.0mm thickness. The continuity across each contact shall be measured throughout the application of the tensile force. Passing parts shall not exhibit any discontinuities or shorting to the shell greater than 1 µs duration in any of the four orientations.

Alternate methods are allowed to verify continuity through all pins.

- a. Loading: see below table
- b. A period of at least 10 seconds
- c. Direction :4 Axis (0 degrees ; 90 degrees ; 180 degrees ;270 degrees)

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Force and Moment Requirements

Receptacle configuration with respect to mounting surface	Force at 15 mm from receptacle shell Insertion edge (N)
Right angle	20
Vertical	8

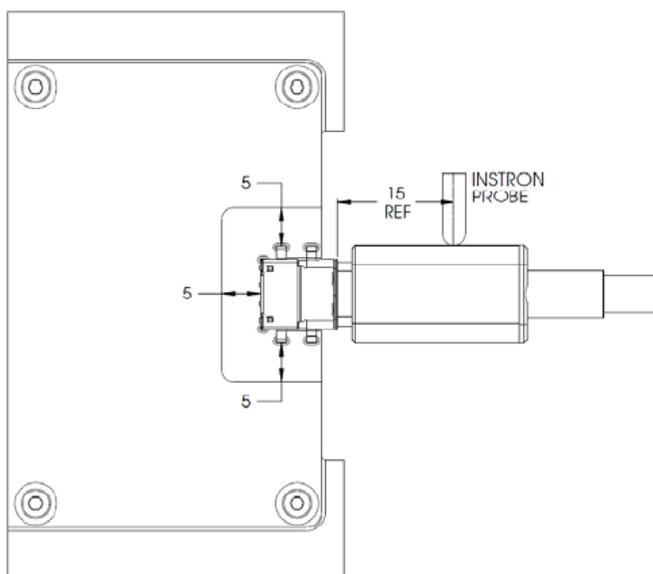
7.6 Cap Retention

Confirm the cap holding

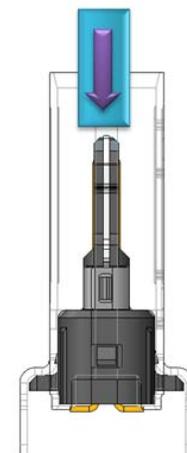
- a. Test standard: EIA 364-29
- b. Acceptance criteria: 2.8 N Min
- c. Application Rate : 25.4 mm/ minute

7.7 Housing Retention

- a. Test standard: EIA 364-29
- b. Acceptance criteria: 10 N Min
- c. Application Rate : 25.4 mm/ minute



Axis Continuity Test



Housing Retention

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8.0 Environmental Conditions

After exposure to the following environmental conditions in accordance with the specified test procedure and/or details, the product shall show no physical damage and shall meet the electrical and mechanical requirements per paragraphs 6.0 and 7.0 as specified in the Table 1 test sequences. Unless specified otherwise, assemblies shall be mated during exposure.

Use recommended details or select others as appropriate

8.1 Thermal Shock –EIA 364-32. method A, test condition I, test duration A4.

- a. Number of Cycles -10 cycles
- b. Temperature Range - Between -55 and 85 deg C
- c. Test step/duration, and temperature range see table.

Step	Temperature(□)	Time(minutes)
1	-55 +0/-3	30 Min
2	25 +10/-5	5 Max
3	85 +3/-0	30 Min
4	25 +10/-5	5 Max

8.2 Cyclic temperature & humidity – EIA 364-31 method III, initial measurements,

- a. Cycle the connector between 25°C ± 3°C at 80%±3% RH and 65°C±3°C at 50%±3%.
- b. Ramp times should be 0.5 hour and Dwell times should be 1.0 hours.
- c. Dwell times start when the temperature and humidity have stabilized within the specified levels.
- d. Duration – 24 cycles.

8.3 Temperature Life –EIA-364-17, method A.

- a. Test Temperature – 105□.
 - b. Test Duration - 120 hours.
- (Testing temperature/duration pertaining to 65□ for 5 years per EIA-364-1000)

8.4 Temperature Life (Preconditioning) –EIA-364-17, method A.

- a. Test Temperature – 105□.
- b. Test Duration - 72 hours.

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(Testing temperature/duration pertaining to 65° for 5 years per EIA-364-1000)

8.5 Mixed Flowing Gas corrosion (MFG) EIA 364-65

- a. Class - IIA
- b. Duration – Lever 2
- c. Specify mated only, unmated only, or unmated for ½ the duration and mated the remaining ½ duration

Level	Total MFG exposure hours	Unmated exposure hours	Mated exposure hours
Level 1	120 hours	80	40
Level 2	168 hours	112	56
Level 3	240 hours	160	80
Level 4	336 hours	224	112

8.6 Salt Spray –EIA-364-26

- a. Test Condition – B (refer to specified test method for condition)
- b. Duration – 48 (hours if not specified by selected condition above)
- c. Acceptance criteria – (visual examination requirements and/or LLCR criteria)

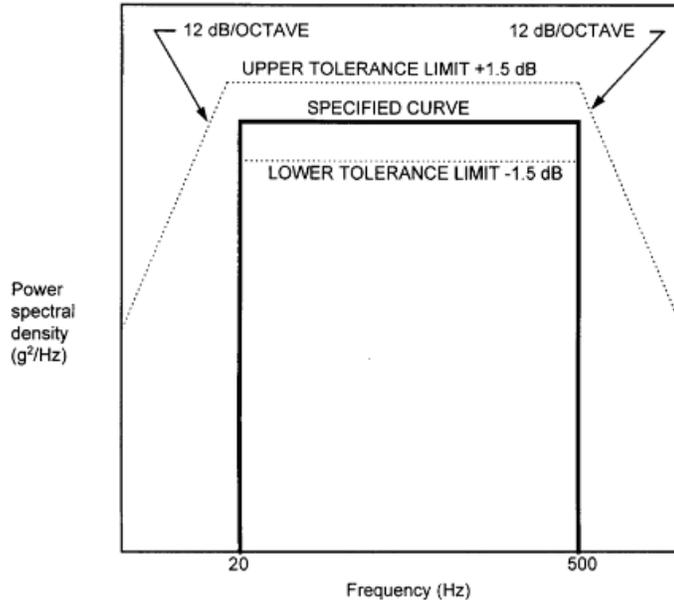
8.7 Thermal disturbance

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.

8.8 Vibration (Random) –EIA-364-28.

- a. Test Condition VII, test condition letter D.
- b. Vibration Amplitude – 3.10 rms G minimum
- c. Power spectral density – 0.02 g²/Hz
- d. Duration – 15minutes in each of three mutually perpendicular directions.
- e. Mounting - Rigidly mount assemblies.
- f. No discontinuities greater than 1 microsecond.
- g. Random vibration test – curve envelope see figure.

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8.9 Solderability –ANSI-J-STD-002

- a. Test Condition A1 (ANSI-J-STD-002)
- b. Steam or dry aging 4 hours
- c. Minimum solder coverage: 95 %

8.10 Resistance to Solder Heat –EIA 364-56

- a. Test Procedure – 6
- b. Condition A
- c. Temperature: 250 +10/-0° C
- d. Dwell 10 seconds
- e. There shall be no evidence of physical or mechanical damage

9.0 QUALITY ASSURANCE PROVISIONS

9.1 Equipment Calibration

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with ANSI Z-540 and ISO 9000.

9.2 Inspection Conditions

Unless otherwise specified herein, all inspections shall be performed under the following

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ambient conditions:

- a. Temperature: 25 +/- 5 deg C
- b. Relative Humidity: 30% to 60%
- c. Barometric Pressure: Local ambient

9.3 Sample Quantity And Description

Use this paragraph to describe the test samples required for the specific Test Groups in the qualification test table. Include information such as: number and size of plug and receptacle connectors and/or mated pairs, terminated or not terminated, printed wiring board conditions, wire size, crimp conditions, lubrication conditions, etc. Attach and reference drawings if necessary to clarify the description.

Unless otherwise specified in the application specification, sample quantities for each test group shall be specified in this section and/or the qualification test table. Refer to GS-01-029 section 5.9 for sample quantity recommendations.

9.4 Acceptance

9.4.1 Electrical and mechanical requirements placed on test samples as indicated in paragraphs 6.0 and 7.0 shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with this product specification shall meet the stated requirements.

9.4.2 Failures attributed to equipment, test setup, or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

9.5 Qualification Testing

Qualification testing shall be performed on sample units produced with equipment and procedures normally used in production. The test sequences shall be as shown in the qualification test table. Data shall be provided with the samples noting production history: production lot codes for components and assemblies, components and assemblies produced to print revision __, verification of plating composition and thickness, etc.

9.6 Re-Qualification Testing

If any of the following conditions occur, the responsible product engineer shall initiate requalification testing consisting of all applicable parts of the qualification test matrix.

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- a. A significant design change is made to the existing product which impacts the product form, fit or function. Examples of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, contact force, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.
- b. A significant change is made to the manufacturing process which impacts the product form, fit or function.
- c. A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

9.7 Qualification Test Table

Insert qualification test table here. Refer to GS-01-029 and GS-03-004 for recommended test sequences.

Test	Para.	Test Group										
		1	2	3	4	5	6	7	8 _a	9	10	
Examination of Product	5.4	1,8	1,10	1,8	1,12	1,10	1,3	1,5	1	1	1,3	
Low Level Contact Resistance	6.1	2,5,7	2,5,7,9	2,5,7	2,5,7,9,11	3,5,9		2,4				
Insulation Resistance	6.2					7						
Dielectric Withstanding Voltage	6.3					2,6						
Current Rating	6.4						2					
Insertion/Extraction force	7.1					4						
Durability	7.2											
Per-Durability	7.3	3	3	3	3							
Reseating	7.4	6	8		10	8						
Axis Continuity Test	7.5										2	
Cap Retention	7.6								2			
Housing Retention	7.7								3			
Thermal Shock	8.1		4									
Cyclic temperature & humidity	8.2		6									
High Temperature Life	8.3	4										
Pre-High Temperature	8.4			4	4							
Mixed Flowing Gas	8.5				6							
Salt Spray	8.6							3				
Thermal disturbance	8.7				8							
Vibration Sinusoidal	8.8			6								
Solderability	8.9									2		
Resistance to Soldering Heat	8.10									3		
Notes:												
a. Group 8 only for Vertical REC Connector												

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REVISION RECORD

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A	all	Initial released	/	5/18'17