1. INTRODUCTION

1.1 Purpose

Testing was performed on TE Connectivity (TE) Crown Clip™ Senior Bus Bar Power Connector series to determine its conformance to the requirement of Product Specification.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of TE Connectivity (TE) Crown Clip™ Senior Bus Bar Power Connector series. Qualification Test was performed at the China Engineering Center Testing Laboratory.

1.3 Conclusion

TE Connectivity (TE) Crown Clip™ Senior Bus Bar Power Connector series conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-128050.

1.4 Test Specimens

The specimens were representative of normal production lots, Specimens identified with the following part numbers were used for test.

TE Part Number	Description
1643906-1	Crown Clip™ Single Pole Bus Bar Power Connector, Gold Plating
1926671-1	Crown Clip™ Dual-Pole Bus Bar Power Connector, Gold Plating
~~1926671-2(EOL)~~	Crown Clip™ Dual-Pole Bus Bar Power Connector, Silver Plating
1643903-1	Crown Clip™ Senior II Bus Bar Power Connector, General Version
1643903-2	Crown Clip™ Senior II 3000 Power Bus Bar Connector, Gold Plating
1643903-3	Crown Clip™ Senior II Bus Bar Power Connector, Silver Plating
2204700-1	Crown Clip™ 4200 Rising Power Connector, Gold Plating
Mating Bus Bar I	Mating Bus Bar, gold plating
Mating Bus Bar II	Mating Bus Bar, semi-bright silver plating
Bottom Bus Bar I	Screw-Mounting Bus Bar Board, tin plating
Test Hardware	M4*0.7 Screw, Nut and others.

Figure 1

1.5 Environmental Conditions

Unless otherwise stated. The following environmental conditions prevailed during testing

Temperature: 25±10 °C
Relative Humidity: 50±25% RH

1.6 Product Qualification and Requalification Test Sequence

Test or Examination	Test Group					
	1	2	3	4	5	6
	Test Sequence					
Initial examination of product	1	1	1	1	1	1
Low level contact resistance	2,5,7	4,7,9,13	3,5,7,9	2,7(a),11	2,4	2,4
Contact resistance at rated current				5,9		
Insulation resistance		2,10				
Withstanding voltage		3,11				
Temperature rise vs. Current				4,8		
Vibration			8			
Mechanical shock			6			
Durability	3(b)	5	4(b)	3(b)		
Mating force			2			
Unmating force			10			
Thermal shock		6				
Humidity-temperature cycling		8				
Temperature life	4					
Salt Spray Test					3	
Mixed flowing gas				6(c)		
Floating Contact with ±6°						3
Reseating	6	12		10		
Final examination of product	8	14	11	12	5	5

NOTE

(a) LLCR shall be measured according to MFG test sequence.
(b) Durability (preconditioning) 5 cycles.
(c) MFG test. ½ samples mated 14days; ½ samples mated 7 days, and then unmated 7days.

2. SUMMARY OF TESTING

2.1 Initial Examination of Product – All Test Groups

All specimens submitted for testing were representative of normal production lots. A Certificate Conformance (C of C) was issued by Product Assurance. Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2 Low Lever Contact Resistance - All Test Group

Contact resistance measurements for TE Connectivity (TE) Crown Clip™ Senior Bus Bar Power Connector series meet product specification, as below table.

TE P/N	Description	LLCR Spec. initial state (mΩ)	Test Record initial state (mΩ)	LLCR Spec. final state (mΩ)	Test Record final state (mΩ)
1643906-1	CCS Single Pole	0.5 mΩ	0.11 mΩ	1mΩ	0.57 mΩ
1926671-1	Dual-CCS Gold Plating	0.5 mΩ	0.10 mΩ	1mΩ	0.39 mΩ
~~1926671-2~~(EOL)	Dual-CCS Silver Plating	0.5 mΩ	0.084 mΩ	1mΩ	0.31 mΩ
1643903-1	CCS II General Version	0.20 mΩ	0.043 mΩ	0.50mΩ	0.084 mΩ
1643903-2	CCS II 3000	0.20 mΩ	0.051 mΩ	0.50mΩ	0.137 mΩ
1643903-3	CCS II Silver Plating	0.20 mΩ	0.039 mΩ	0.50mΩ	0.080 mΩ
2204700-1	CC 4200	0.10 mΩ	0.028 mΩ (0.04 mΩ max)	0.10mΩ	0.049 mΩ

Figure 2. Crown Clip™ Senior Power Connector LLCR Specification and Test Record.

2.3 Contact Resistance at Rated Current- Test Group 4

Contact resistance measurements for TE Connectivity (TE) Crown Clip™ Senior Bus Bar Power Connector series meet product specification, as below table.

TE P/N	Description	Contact Resistance Spec. (mΩ)	Test Record, Ave. (mΩ)
1643906-1	CCS Single Pole	0.5 mΩ	0.10 mΩ
1926671-1	Dual-CCS Gold Plating	0.5 mΩ	0.09 mΩ
1926671-2	Dual-CCS Silver Plating	0.5 mΩ	0.06 mΩ
1643903-1	CCS II General Version	0.20 mΩ	0.04 mΩ
1643903-2	CCS II 3000	0.20 mΩ	0.04 mΩ
1643903-3	CCS II Silver Plating	0.20 mΩ	0.03 mΩ
2204700-1	CC 4200	0.10 mΩ	0.02 mΩ

Figure 3. Crown Clip™ Senior Power Connector Contact Resistance Specification and Test Record.

2.4 Insulation Resistance – Test Group 2

All insulation resistance measurements were greater than 1000 megohms.

2.5 Withstanding Voltage – Test Group 2

No dielectric breakdown or flashover occurred

2.6 Temperature Rise vs. Current – Test Group 4

Rated current energized at specific current in accordance with Product Specification. Detail refer to the plot of Product Specification.

TE P/N	Description	Rated Current (A)
1643906-1	CCS Single Pole	220A General, 300A Max.
1926671-1	Dual-CCS Gold Plating	220A General, 300A Max.
~~1926671-2~~	Dual-CCS Silver Plating	220A General, 300A Max.
1643903-1	CCS II General Version	220A General, 300A Max.
1643903-2	CCS II 3000	220A General, 300A Max.
1643903-3	CCS II Silver Plating	220A General, 300A Max.
2204700-1	CC 4200	420A General, 450A Max.

Figure 4. Crown Clip™ Senior Power Connector Rated Current Specification and Test Record.

2.7 Vibration Test – Test Group 3

No discontinuities were detected during vibration testing. Flowing vibration test. No cracks, breaks, or loose parts on the specimens were visible.

2.8 Mechanical Shock – Test Group 3

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.9 Durability – Test Group1, 2, 3, 4

No evidence of physical damage was visible as the result of mating and unmating the specimens 100 cycles for gold plating version, 50 cycles for silver plating version.

2.10 Mating Force – Test Group 3

All mating force measurements product specification.

2.11 Un-mating Force – Test Group 3

All un-mating force measurements meet product specification.

TE P/N	Description	Mating Force Spec. Max.	MF Test Max.	Unmating Force Spec. Min.	UMF Test Min.
1643906-1	CCS Single Pole	60N max.	22N	8N min.	15N
1926671-1	Dual-CCS Gold Plating	60N max.	24N	8N min.	16N
~~1926671-2~~	Dual-CCS Silver Plating	150N max.	56N	15N min.	21N
1643903-1	CCS II General Version	100N max.	84N (3.17 bus) 62N (3.0 bus)	8N min.	66N (3.18 bus) 51N (3.00 bus)
1643903-2	CCS II 3000	60N max.	22N	8N min.	16N
1643903-3	CCS II Silver Plating	150N max.	91N (3.17 bus) 71N (3.0 bus)	15N min.	66N (3.18 bus) 51N (3.00 bus)
2204700-1	CC 4200	60N max.	20N	8N min.	16.6N

Figure 5. Crown Clip™ Senior Power Connector Mating/Unmating Force Specification and Test Record.

2.12 Thermal Shock – Test Group 2

No evidence of physical damage was visible as the result of thermal shock testing

2.13 Humidity/temperature cycling – Test Group 2

No evidence of physical damage was visible as the result of humidity/temperature cycling.

2.14 Temperature life – Test Group 1

No evidence of physical damage was visible as the result of temperature life testing.

2.15 Mixed Flowing Gas Test – Test Group 4

No evidence of physical damage was visible as the result of exposure to the pollutants of mixed flowing gas

2.16 Salt Spray Test – Test Group 5

No evidence of physical damage was visible as the result of exposure to the pollutants of salt spray test.

2.17 Floating Contact with ±6° Test – Test Group 6

Specimens were visually examined manually mate/unmating with ±6° for 20 cycles, meet product contact resistance spec and no evidence of physical damage detrimental was observed.

2.18 Final Examination of Product – All Test Groups

Specimens were visually examined and no evidence of physical damage detrimental was observed.

3 TEST METHODS

3.1 Initial Examination of Product

A Certificate of Conformance was issued stating that all specimens in the test package were produced, inspected, and accepted as conforming to product drawing requirements, and manufactured using the same core manufacturing processes and technologies as production parts.

3.2 Low Level Contact Resistance

Low level contact resistance measurements were made with four terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage, in accordance with EIA-364-27

3.3 Contact Resistance at Rated Current

Specimens were subjected to contact resistance testing in accordance with product Specification 108-128066. And EIA –364-06. Specimens were energized at rated current and resistance measurements were recorded.

3.3 Insulation Resistance

Insulation resistance was measured between adjacent power contacts of mated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured, in accordance with EIA–364-21C

3.4 Withstanding Voltage

A test potential of 2500 volts DC was applied between the adjacent power contacts of mated specimens. This potential was applied for 1 minute and then returned to zero. In accordance with EIA–364-20B Condition I

3.5 Temperature Rise vs. Current

Stabilize at a single current level until 3 readings at 5 minute intervals are within 1^0C. Test with single energized contact and with all adjacent power contacts energized. In accordance with EIA-364-70, Method 1.

3.6 Vibration

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum with excitation frequency bounds of 20 and 2000 Hz. The spectrum remained flat at 0.06 G2/Hz from 20Hz to upper bound frequency of 500Hz. The root-mean square amplitude of excitation was 9.26 GRMS. The specimens were subjected to this test time of 120 minutes in each of three mutually perpendicular planes. Specimens were monitored for discontinuities of microsecond or greater using an energizing current of 100 milliamperes. In accordance with EIA–364-28 Condition V.

3.7 Mechanical Shock

Mated specimens were subjected to a mechanical shock test having a half – sine waveform of 50 gravity units (g peak) and duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of one microsecond or greater using a current of 100 milliamperes DC. In accordance with EIA–364-27B Method A.

3.8 Durability

Specimens were mated and unmated 100 cycles(gold plating version) and 50 cycles(silver plating version) at a maximum rate of 500 cycles per hour, in accordance with EIA–364-09.

3.9 Mating/Un-mating Force

The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 25.4 mm per minute, in accordance with EIA–364-13B.

3.10 Retention Force

The force required to the individual assembly specimens between housing and contact, was measured using a tensile/compression device with a free floating fixture and a rate of travel of 25.4 mm per minute in accordance with EIA–364-13B.

3.11 Thermal Shock

Mated specimens were subjected to 36 cycles of thermal shock with each cycle consisting of 30 minute dwells at -40° and 105°C. The transition between temperatures was less than 1 minute. In accordance with EIA–364-32C.

3.12 Humidity-temperature Cycling

Mated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 65°C at 80 to 100 %RH. In accordance with EIA–364-31B Method III.

3.13 Temperature Life

Mated specimens were exposed to a temperature of 125°C for 504 hours (21 days). In accordance with EIA–364-17B Method A.

3.14 Mixed Flowing Gas Test

Specimens were exposed for 14 days to a mixed flowing gas Class IIA exposure. Class IIA exposure is defined as a temperature of 30±1°C and a relative humidity of 70 ±2% with the pollutants of Cl2 at 10 ±3 ppb, NO2 at 200±50 ppb, H2S at 10±5 ppb and SO2 at 100±20 ppb, in accordance with EIA-364-65, class IIA. ½ subject samples mated for 336 hours (14days); ½ subject samples unmated 168 hours (7days), and then mated for final 168 hours (7days). In accordance with EIA–364-65 Class IIA.

3.15 Salt Spray Test

Mated specimens were exposed for 48 hours to a 5% solution salt spray, at 35 +1/-2°C, In accordance with EIA–364-26.

2.16 Floating Contact with ±6° Test

Specimens were visually examined manually mate/unmating with ±6° for 20 cycles, meet product contact resistance spec and no evidence of physical damage detrimental was observed.

2.17 Final Examination of Product

Specimens were visually examined for evidence of physical damage detrimental to produce performance.