

**Power Versa Lock TNL Connector System**

**1. INTRODUCTION**

1.1 Purpose

Testing was performed on Power Versa Lock 6 Pos connectors to determine its conformance related to the requirements of product specification 108-143081 Rev.7.

Scope of the test is the qualification with glass filled PBT resin material. Not all of testing has been performed, such as group 6, group 11 and group 13, since these parts are unsealed and not tool removable connector versions and not glow wire materials.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of Power Versa Lock 6 Pos connectors. Testing was performed at the Shanghai Electrical Components Test Laboratory between Dec. 29, 2018 and Jan. 23, 2019. The associated test number is TP-18-03319.

1.3 Conclusion

Connector passed all the requirements per product specification 108-143081 Rev 7.

1.4 Test Specimens

Specimens with the following part numbers were used for test:

Table 1

P/N	Description	Quantity	Note
1-2336229-6	PLUG HSG, 2X3, PWR VERSA LOCK, KEYA	88	Raw Material: PBT glass filled
1-2336231-6	CAP HSG, 2X3, PWR VERSA LOCK, KEYA	88	
2329906-1	PWR VERSA LOCK TAB UNSEALED 18-20, 2X22 AWG	414	20AWG
2329912-1	PWR VERSA LOCK REC UNSEALED 18-20, 2X22 AWG	414	20AWG
2329909-1	TAB CONTACT, 22-26 AWG, POWER VERSA LOCK	42	22AWG
2329915-1	RECPT CONTACT, 22-26 AWG, POWER VERSA LOCK	42	22AWG



Fig.1

1.5 Test Sequence

The specimens listed in Table 1 were subjected to the test sequences listed in Table 2.

Table 2

Test Item	Test Group (a)										
	1	2	3	4	5	7	8	9	10	12	
	Test Sequence (b)										
Examination of Product	1,9	1,5	1,9	1,4	1,4	1,5	1,5	1,5	1,5	1,3	
Low Level Contact Resistance	3,7	2,4				2,4	2,4	2,4	2,4		
Insulation Resistance			2,7								
Dielectric Withstanding Voltage			3,8								
Temperature Rise vs. Current		3									
Sinusoidal Vibration	5								3		
Mechanical Shock	6										
Durability	4										
Connector Mating Force	2										
Connector Unmating Force	8										
Crimp Tensile Strength										2	
Housing Panel Retention Force					2						
Housing Lock Strength					3						
Contact Insertion Force				2							
Contact Retention Force				3							
Thermal Shock			4								
Humidity-Temperature Cycling			5				3(c)				
Temperature Life								3			
Resistance to Cold			6								
Salt Spray						3					

Note: a). Test group defined per customer requirement  
 b). Numbers indicate sequence in which tests are performed.  
 c). Connectors for these tests shall be preconditioned with 5 durability cycles.

1.6 Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15°C to 35°C  
 Relative Humidity: 25% to 75%

2. TEST PROCEDUES

2.1 Visual Examination of Product

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

After test, there shall be no corrosive influence on the performance and no physical damage that would impair product performance.

Test Method: EIA-364-18.

2.2. Low Level Contact Resistance

Subject contacts assembled in a housing to 20mV (max.) open circuit at 100 mA. Subtract the resistance of the wire from the measurement. Connection per Figure 2.

Requirement: Initial: 10 mΩ (milliohm) maximum

Final: 20 mΩ (milliohm) maximum

Test Method: EIA-364-23.

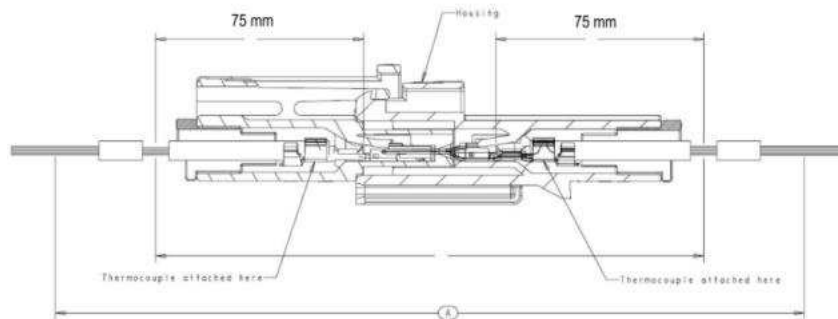


Fig.2

2.3. Insulation Resistance

Apply 500 VDC and hold for 2 minutes. Test between contacts in adjacent circuits and between housing and contacts in a mated connector.

Requirement: Initial: 1000 MΩ minimum

Final: 500 MΩ minimum

Test Method: EIA-364-21.

2.4. Dielectric Withstanding Voltage

Hold at 2.2 kV AC at sea level for 1 minute. Test between contacts in adjacent circuits and between housing and all contacts in a mated connector.

Requirement: 1 minute hold without a creep discharge or flashover.

Current Leakage: 5 mA (maximum)

Test Method: EIA-364-20, Method A, Condition 1.

2.5. Temperature Rise vs. Current

Measure the temperature rise above ambient created by the energizing current. Measurement must be taken at a place where there is no influence from air convection. Contacts to be assembled in housing with all circuits connected. The thermocouple is to be attached to the contact in the center circuit. Stabilize at a single current level until 3 readings at 5 minute intervals are within 1°C.

Requirement: 30°C maximum when subjected to rated current

Test Method: EIA-364-70, Method 1

- 2.6. Sinusoidal Vibration  
Subject mated connector to 10-55-10 Hz traversed in 1 minute at 1.52 mm amplitude. Apply 2 hours in each of 3 mutually perpendicular planes. 100 mA applied.  
Requirement: No electrical discontinuity greater than 1  $\mu$ s shall occur.  
No physical damage that would impair product performance.  
Test Method: EIA-364-28, Condition 1.
- 2.7. Mechanical Shock  
Subject mated connector to 50G's half -sine shock pulse of 11 ms duration. 3 drops each to normal and reversed directions of X, Y and Z axis. Total of 18 drops.  
Requirement: No electrical discontinuity greater than 1  $\mu$ s shall occur.  
No physical damage that would impair product performance.  
Test Method: EIA-364-27, Condition A.
- 2.8. Durability  
Manually mate and unmate connectors for 25 cycles.  
Requirement: No physical damage that would impair product performance.  
Test Method: EIA-364-09.
- 2.9. Connector Mating Force  
Measure the force required to mate connectors with locking latches. Operation Speed: 25.4 mm/min.  
Requirement: 40.02N maximum.  
Test Method: EIA-364-13, Method A.
- 2.10. Connector Unmating Force  
Measure the force required to unmate connectors without locking latches. Operation Speed: 25.4 mm/min.  
Requirement: 7.5N minimum.  
Test Method: EIA-364-13, Method A.
- 2.11. Crimp Tensile Strength  
Apply an axial pull force to the crimped wire. Contact to be secured to the tester. Insulation barrel crimp to be disabled. Operation Speed: 25.4 mm/min.  
Requirement: 49N minimum for 22AWG  
60N minimum for 20AWG  
Test Method: EIA-364-08.
- 2.12. Housing Panel Retention Force  
Measure panel retention force using a panel cut with nominal dimensions as specified in the TE customer drawing.  
Operation Speed: 100 mm/min.  
Requirement: 98N Minimum  
Test Method: EIA-364-97.
- 2.13. Housing Locking Strength  
Ensure that locking latches are fully engaged. Operation Speed: 13 mm/min.  
Requirement: Initial: 98N minimum  
Test Method: EIA-364-98.
- 2.14. Contact Insertion Force  
Measure the force required to insert contact into housing.  
Requirement: 13.3N maximum  
Test Method: EIA-364-05.

- 2.15. Contact Retention Force  
Measure the axial force required to remove contact from the housing with a TPA accessory.  
Operation Speed: 25.4 mm/min.  
Requirement: 66.7N minimum  
Test Method: EIA-364-29.
- 2.16. Thermal Shock  
Subject mated specimens to 25 cycles between - 55°C and 85°C with 30-minute dwell time at temperature extremes and 5 minute transition (maximum) between temperatures.  
Requirement: No physical damage that would impair product performance.  
Test Method: EIA-364-32, Method A, Test Condition I.
- 2.17. Humidity-Temperature Cycling  
Subject mated specimen to 10 cycles between 25°C and 65°C at 80-100% RH. Measurements to be recorded after specimens are held for 3 hours at ambient temperature and humidity. 1 cycle is 24 hours.  
Requirement: No physical damage that would impair product performance.  
Test Method: EIA-364-31, Method IV.
- 2.18. Temperature Life  
Subject mated connector to 105°C for a duration of 8 hours. Measurements to be recorded after specimens are held for 3 hours at ambient temperature and humidity.  
Requirement: No physical damage that would impair product performance.  
Test Method: EIA-364-17.
- 2.19. Resistance to Cold  
Subject mated connector to - 30°C ± 2°C for 96 hours.  
Requirement: No physical damage that would impair product performance.  
Test Method: IEC 60512-11-10.
- 2.20. Salt Spray  
Subject mated connectors to 5±1% salt concentration for 48 hours.  
Requirement: No physical damage that would impair product performance.  
Test Method: EIA-364-26, Condition B.
- 2.21. Glow Wire Test  
Tests to be conducted on each of 3 perpendicular sides. Perform a visual check and take picture after the test.
- Test group 13:  
Requirement: Test at 750°C, no flame or flame duration ≤ 2 seconds.  
Lighted tissue paper shall not burn.  
Test Method: IEC 60335-1-2016.
- Test group 14:  
Requirement: Test at 850°C, flame duration ≤ 30 seconds after probe removal.  
Lighted tissue paper shall not burn.  
Test Method: IEC 60695-2-11-2014.

### 3. SUMMARY OF TESTING

- 3.1 Visual Examination  
All group specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3.2. Low Level Contact Resistance  
Test result are shown in Table 3.

Table 3

Unit: mΩ

Group	Quantity	Condition	Low Level Contact Resistance			Requirement	Judgment
			Max.	Min.	Ave.		
1	10	Initial	2.42	1.89	2.06	10mΩ Max.	Meet spec.
	10	After Durability, Vibration and Mechanical Shock	2.70	2.06	2.28	20mΩ Max.	Meet spec.
2	6	Initial	3.29	1.08	2.20	10mΩ Max.	Meet spec.
	6	After Temperature Rise	5.03	2.08	2.94	20mΩ Max.	Meet spec.
7	10	Initial	2.45	2.02	2.20	10mΩ Max.	Meet spec.
	10	After Salt Spray	2.33	1.94	2.12	20mΩ Max.	Meet spec.
8	10	Initial	2.15	1.82	2.03	10mΩ Max.	Meet spec.
	10	After Humidity and Temperature Cycling	2.41	1.91	2.17	20mΩ Max.	Meet spec.
9	10	Initial	2.41	2.09	2.22	10mΩ Max.	Meet spec.
	10	After Temperature Life	2.55	1.99	2.21	20mΩ Max.	Meet spec.
10	10	Initial	2.57	1.38	2.06	10mΩ Max.	Meet spec.
	10	After Vibration	3.01	1.14	2.19	20mΩ Max.	Meet spec.

2.3. Insulation Resistance  
Test result are shown in Table 4.

Table 4

Unit: 10<sup>10</sup>Ω

Group	Quantity	Condition	Insulation Resistance			Requirement	Judgment
			Max.	Min.	Ave.		
3	10	Initial	26.19	6.47	12.71	1000MΩ min.	Meet spec.
	10	After Thermal Shock Humidity and Temperature Cycling	22.96	0.12	3.93	500MΩ min.	Meet spec.

2.4. Dielectric Withstanding Voltage  
Test result are shown in Table 5.

Table 5

Group	Quantity	Condition	Dielectric Withstanding Voltage			Requirement	Judgment
			Max.	Min.	Ave.		
3	10	Initial	No breakdown, no flashover.			No breakdown or flashover.	Meet spec.
	10	After Thermal Shock Humidity and Temperature Cycling	No breakdown, no flashover.				Meet spec.

2.5. Temperature Rise vs. Current  
Test result are shown in Table 6.

Table 6

Unit: ° C

Group	Quantity	Specimen Description	Current	Temperature Rise			Requirement	Judgment
				Max.	Min.	Ave.		
2	6	20 AWG Wire	5A	15.11	8.75	12.51	30°C maximum	Meet spec.
	6	22 AWG Wire	3A	8.35	5.07	6.94		Meet spec.

2.6. Sinusoidal Vibration  
Both test group 1 and group 10: No physical damage and no electrical discontinuity greater than 1 µs were found during and after test.

2.7. Mechanical Shock  
No physical damage and no electrical discontinuity greater than 1 µs were found during and after test.

2.8. Durability  
No physical damage.

2.9. Connector Mating Force  
Test result are shown in Table 7.

Table 7

Unit: N

Group	Quantity	Condition	Connector Mating Force			Requirement	Judgment
			Max.	Min.	Ave.		
1	10	Initial	42.96	33.35	39.62	44.48 Max.	Meet spec.

2.10. Connector Unmating Force  
Test result are shown in Table 8.

Table 8

Unit: N

Group	Quantity	Condition	Connector Unmating Force			Requirement	Judgment
			Max.	Min.	Ave.		
1	10	After Durability, Vibration and Mechanical Shock	35.03	21.42	28.69	7.5N Min.	Meet spec.

2.11. Crimp Tensile Strength  
Test result are shown in Table 9.

Table 9

Unit: N

Group	Quantity	Specimen Description	Crimp Tensile Strength			Requirement	Judgment
			Max.	Min.	Ave.		
12	6	2329906-1 with 20AWG	144.70	125.50	140.00	60N Min.	Meet spec.
	6	2329906-1 with 20AWG	139.00	127.50	132.98	60N Min.	Meet spec.
	6	2329909-1 with 22AWG	87.50	79.20	85.38	49N Min.	Meet spec.
	6	2329915-1 with 22AWG	87.00	79.00	84.57	49N Min.	Meet spec.

2.12. Housing Panel Retention Force  
Test result are shown in Table 10.

Table 10

Unit: N

Group	Quantity	Condition	Housing Panel Retention Force			Requirement	Judgment
			Max.	Min.	Ave.		
5	5	Initial	Load force until 200N, no physical damage was found after test.			98N Min.	Meet spec.

2.13. Housing Locking Strength  
Test result are shown in Table 11.

Table 11

Unit: N

Group	Quantity	Condition	Housing Locking Strength			Requirement	Judgment
			Max.	Min.	Ave.		
5	5	Initial	119.44	108.70	115.24	98N Min.	Meet spec.

2.14. Contact Insertion Force  
Test result are shown in Table 12.

Table 12

Unit: N

Group	Quantity	Specimen Description	Contact Insertion Force			Requirement	Judgment
			Max.	Min.	Ave.		
4	6	REC 2322912-1	4.29	3.64	4.05	13.3N Max.	Meet spec.
	6	TAB 2322906-1	3.63	2.92	3.27	13.3N Max.	Meet spec.

2.15. Contact Retention Force  
Test result are shown in Table 13.

Table 13

Unit: N

Group	Quantity	Specimen Description	Condition	Contact Retention Force			Requirement	Judgment
				Max.	Min.	Ave.		
4	6	REC 2322912-1	With TPA	153.73	96.46	120.94	66.7N Min.	Meet spec.
	6	TAB 2322906-1		153.51	89.82	123.95		Meet spec.

Note: Two peak values exist in test curves of Contact Retention Force test with TPA, above value are the second peak value, details below.

Unit: N

Part Number	Sample NO.	First Peak Force	Second Peak Force	Breakage Mode
Female (1-2336229-6 with 2329912-1)	1	68.51	96.46	contact pulled out
	2	67.83	153.73	wire broken
	3	71.41	113.36	TPA broken
	4	57.16	113.33	TPA broken
	5	59.62	148.26	wire broken
	6	63.66	100.51	contact pulled out
Male (1-2336231-6 with 2329906-1)	1	69.01	153.51	wire broken
	2	51.40	89.82	contact pulled out
	3	42.43	109.70	TPA broken
	4	42.11	128.74	TPA broken
	5	49.33	151.99	wire broken
	6	43.63	109.94	TPA broken



2.16. Thermal Shock

No physical damage was found after test. Test picture is shown in Fig.3.



Fig.3

2.17. Humidity-Temperature Cycling

Both group 3 and group 8: No physical damage was found after test. Test pictures are shown in Fig.4 (group 3) and Fig.5 (group8).



Fig.4



Fig.5

2.18. Temperature Life

No physical damage was found after test. Test picture is shown in Fig.5.



Fig.5

#### 2.19. Resistance to Cold

No physical damage was found after test. Test picture is shown in Fig.6.

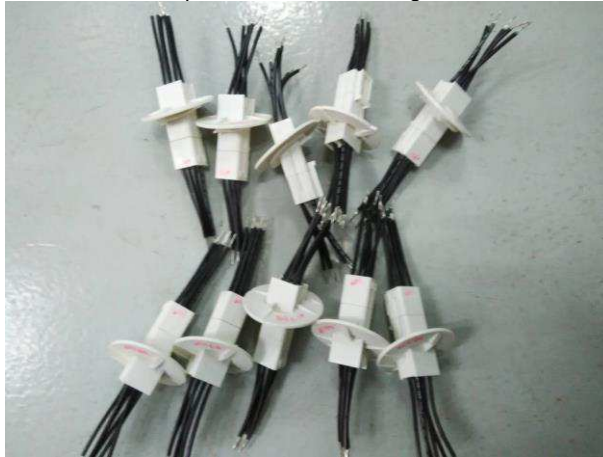


Fig.6

#### 2.20. Salt Spray

No corrosion was found after test. Test picture is shown in Fig.7.

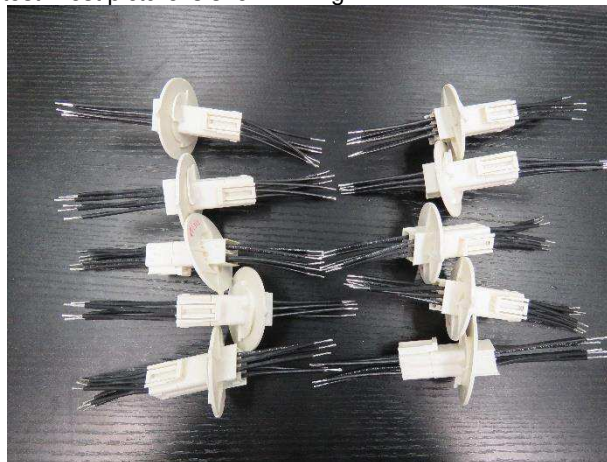


Fig.7

## 4. CALIBRATION

### 4.1 Calibration Statement

All equipment containing a calibration number is calibrated and traceable through TE Connectivity (TE).