POWER TRIPLE LOCK* Connector System

1. SCOPE

1.1. Content

This specification covers the requirements for product performance, test methods, and quality assurance provisions of POWER TRIPLE LOCK* wire-to-wire connectors. A complete connector consists of a POWER TRIPLE LOCK* cap housing with tab contacts crimped to wires and inserted, a POWER TRIPLE LOCK* plug housing with receptacle contacts crimped to wires and inserted, a TPA (optional) and a CPA (optional).

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing. All contacts must be crimped to comply with the Application Specification listed below using the appropriate TE Applicator or Hand Tool as specified in that document.

1.3. Revision Summary

Revisions to this specification include:

- Design Objective changed to Product Specification
- Disclaimer note removed
- Added 501 document number in paragraph 2.1
- Clarified Product Examination Procedure
- Updated Dielectric Withstanding Voltage per UL1977.
- Updated Mechanical shock to Method A to match Procedure description.
- Added Appendix 2
- Updated Temp Life criteria
- Added Group 10 sequence
- Appendix: Added Titles; Updated Appendix 2 and 3, removed remaining

2. APPLICABLE DOCUMENTS AND FORMS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Connectivity Specifications

501-143210	Qualification Test Report
114-106118	Application Specification

2.2. Commercial Standards and Specifications

EIA-364	Electrical Connector/Socket Test Procedures Including Environmental Classifications

2.3. Reference Documents

109-1	General Requirements for Testing

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction, materials and physical dimensions specified on the applicable product drawing.

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable TE drawing.

A. Contact (Crimp Type): Copper Alloy Pre-tin plated. Refer to TE product drawing for details.

B. Housing: Thermoplastic. Refer to TE product drawing for details.

C. Terminal Position Assurance (TPA): Thermoplastic. Refer to TE product drawing for details.

D. Connector Position Assurance (CPA): Thermoplastic. Refer to TE product drawing for details.

3.3. Ratings

A. Voltage Rating: 600V AC/DC

B. Current Rating: See Appendix 1 for applicable current carrying capability. The maximum rated current that can be carried by this product is limited by the maximum operating temperature of the housings and the temperature rise of the contacts.

C. Temperature Rating (Includes ambient temperature plus thermal increase due to current flow):

- Standard Temp and Hot Wire versions: –55°C to +105°C
- High Temperature version: –55°C to +150°C (rating requires the use of High Temp housings with -2 High Temp contacts)
- GWT version: –55°C to +105°C with Standard Temp (-1) contacts inserted
  –55°C to +140°C with High Temp (-2) contacts inserted

3.4. Performance Requirements and Test Description

The product should meet the electrical, mechanical and environmental performance requirements specified in Figure 1. All tests shall be performed at ambient environmental conditions otherwise specified.

3.5. Test Requirements and Procedure Summary

Test Description	Requirement	Procedure
Examination of Product	Meet requirements of product drawing and TE specification (114-106118). After testing, there shall be no corrosive influence on the performance and no physical damage.	EIA-364-18 Visual, dimensional, and functional per the product drawing or inspection plan with no physical damage.
Electrical		
Termination Resistance (Low Level Contact Resistance)	Initial: 3.5 mΩ (milliohms) maximum Final: 10 mΩ (milliohms) maximum	EIA-364-23 Subject contacts assembled in a housing to 20mV Max. Open Circuit at 100mA. Subtract the resistance of the wire from measurement. Connection per Figure 4 below.
Insulation Resistance	Initial: 1000 MΩ minimum Final: 100 MΩ minimum	EIA-364-21 Apply 500 VDC and hold for 2 minutes. Test between contacts in adjacent circuits and between housing and contacts in an unmated connector.

Figure 1 (continued)

Dielectric Withstanding Voltage	1 minute hold without a creep discharge or flashover. Current leakage: 5 mA maximum	EIA-364-20, Condition I 3.2 kilovolts AC at sea level (initial) 2.2 kilovolts AC at sea level (final) Hold at specified voltage for 1 minute. Test between contacts in adjacent circuits and between housing and all contacts in an unmated connector.
Temperature Rise	30ºC maximum when subjected to the specified current indicated in Appendix 1.	EIA-364-70, Method 1 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. Stabilize at a single current level until 3 readings at 5 minute intervals are within 1ºC.
Mechanical		
Sinusoidal Vibration (Low Frequency)	No electrical discontinuity greater than 1 µs shall occur. Final LLCR: 10 mΩ (milliohms) maximum No physical damage.	EIA-364-28, Test Condition I Subject mated connectors to 10-55-10 Hz frequency range traversed over 1 minute at an amplitude of 1.52mm. Apply for 2 hours in each of 3 mutually perpendicular planes. 100 mA applied electrical load
Mechanical Shock	No electrical discontinuity greater than 1 µs shall occur. Final LLCR: 10 mΩ (milliohms) maximum No physical damage.	EIA-364-27 Method A Subject mated connector to 50G's half-sine shock pulse of 11ms duration. 3 drops each to normal and reversed directions of X, Y and Z axis. Total of 18 drops.
Connector Mating Force	(6.67 x Pos.) N maximum per contact	EIA-364-13 Operation speed: 12.7mm/min. Measure the force required to mate connectors without locking latches.
Contact Insertion Force	17.7 N maximum per contact	EIA-364-5 Operation speed: 12.7mm/min. Measure the force required to insert a contact into the housing.
Contact Retention Force	Without / With Terminal Position Assurance (TPA) engaged.	EIA-364-29. Operation speed: 12.7mm/min. Apply an axial pull force to the crimped wire while the housing is secured.

Material Type	Minimum (N)
Standard Temp	66.7 / 66.7
High Temp	44.5 / 66.7
Glow Wire (GWT)	66.7 / 66.7
Hot Wire (HWI)	66.7 / 66.7

Figure 1 (continued)

Wire Crimp Tensile Strength	**Wire Size (AWG)**	**Crimp Tensile (min.) (N)**	EIA-364-8 Operation speed: 25.4mm/min. Apply an axial pull force to the crimped wire. Contact to be secured on the tester. Insulation barrel to be disabled. *Terminal to be held in a fixture to equalize the forces applied during the test.
	24	28	
	22, 2x22, 22+18	40	
	20, 2x20	60	
	19	66.7	
	18, 2x18	90	
	16	135	
	14	200	
	12	275*	
Durability (Manually repeated Mate / Un-mating)	Final LLCR: 10 mΩ (milliohms) maximum		Manually mate and un-mate specimens No. of Cycles: 50 cycles
Housing Locking Strength	Without CPA: 98 N minimum With CPA: 133.5 N minimum		EIA-364-98 Operation speed: 25.4 mm/min. Measure connector locking strength.
Housing Panel Retention Force	98 N minimum		EIA-364-97 Operation speed: 100mm/min. Measure panel retention force using a panel cut with nominal dimensions as specified in the TE customer drawing.
Environmental			
Thermal Shock	Final LLCR: 10 mΩ (milliohms) maximum		EIA-364-32, Test Condition I Subject mated specimens to 25 cycles between -55 °C and 85 °C with 30 minute dwell time at temperature extremes and 1 minute transition between temperatures. This measurement is taken after specimens are held at ambient room temperature for 3 hours.
Humidity-Temperature Cycling	Dielectric withstanding voltage (final) 3kV AC 1 minute Final Insulation Resistance: 100 MΩ minimum Final Termination Resistance: 10 mΩ (milliohms) maximum		EIA-364-31, Method III Subject mated specimens to 10 cycles between 25ºC and 65ºC at 80-100% R.H. Measurements to be recorded after specimens are held for 3 hours at ambient temperature and humidity. 1 cycle is 24 hours.
Salt Spray	Final Termination Resistance: 10 mΩ (milliohms) maximum No corrosive influence on the performance.		EIA-364-26, Condition B Subject mated connectors to 5±1% salt concentration for 48 hours. Measurement is taken after removing the salt. Specimens dried per the specification.
Temperature Life	No damage detrimental to product performance.		EIA-364-17, Method A Subject mated connector to 105±2ºC for a duration of 500 hours, T-rise Group 2 only. 150+/-5C for duration of 500 hours, High temp (-2) terminals only, LLCR Group 10 only Measurement to be recorded after specimens are held for 3 hours at ambient temperature and humidity.

Figure 1 (continued)

Glow Wire Test 850°C (HDT version only)† Glow Wire Test 850°C & 750ºC (GWT version only)	Test at 850°C (Flame duration ≤ 30 seconds after probe removal). For GWT versions, test also at 750°C (Flame duration ≤ 2 seconds). Lighted tissue paper shall not burn.	IEC 60695-2-11 and IEC 60335-1 Tests to be conducted on each of 3 perpendicular sides. Perform a visual check and take picture after the test.

† In addition to the 850°C test, the resin must have a GWIT ≥ 775°C.

NOTE
Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Figure 2.

Figure 1 (end)

3.6. Product Qualification and Requalification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)									
	1	2	3	4	5	6	7	8	9	10
	TEST SEQUENCE (b)									
Examination of Product	1, 7	1, 5	1, 8	1, 3	1, 4	1, 4	1, 7	1, 3	1, 3	1,5
Termination Resistance (Low Level)	2, 6						2, 5			2,4
Insulation Resistance			2, 6				3, 6			
Dielectric Withstanding Voltage			3, 7							
Temperature Rising		2, 4								
Sinusoidal Vibration (Low Frequency)	4									
Mechanical Shock	5									
Connector Mating Force									2	
Contact Insertion Force					2					
Contact Retention Force					3					
Crimping Tensile Strength				2						
Durability (Repeated Mating/Un-mating)	3									
Housing Locking Strength						2				
Housing Panel Retention Force						3				
Thermal Shock			4							
Humidity-Temperature Cycling			5							
Salt Spray							4			
Temperature Life		3								
Temperature Life, 150C, Using -2 terminals only										3
Glow Wire Test (HDT & GWT versions only)								2		

NOTE
(a) See paragraph 4.2.
(b) Numbers indicate sequence in which tests are performed.

Figure 2

4. QUALITY ASSURANCE PROVISIONS

4.1. Test Conditions

Unless otherwise specified, all the tests shall be performed in any combination of the following test conditions shown in Figure 3.

Temperature	15°C – 35°C
Relative Humidity	20% – 80%
Atmospheric Pressure	685 – 785 mmHg

Figure 3

4.2. Qualification Testing

A. Specimen Selection

The test specimens to be employed for tests shall conform to the requirements specified in the applicable product drawings. The crimped contacts shall be prepared in accordance with the requirements of Application Specification 114-106118 and are to be selected at random from current production.

B. Applicable Wires

The wires to be used for crimping the samples for performance testing shall be conforming to the requirements specified in Application Specification 114-106118.

4.3. Requalification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.4. Acceptance

Acceptance is based on verification that the product meets the requirements in Figure 1. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.5. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

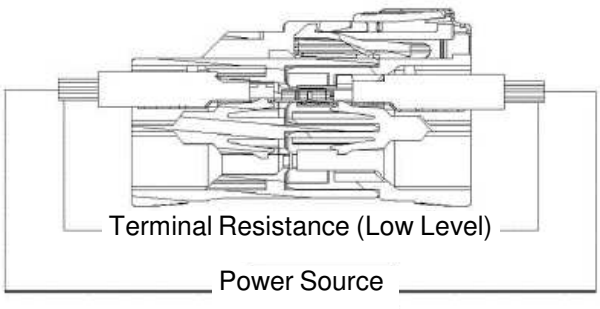


Figure 4: Low Level Contact Resistance Measuring Method
(Resistance of the wire to be subtracted)

Appendix 1: Initial 30°C T-rise Currents

High Temperature (-2) Terminals

Current (A) / Circuits	Wire Size (AWG) (a)									
	#12	#14	#16	#18	#20	#22	#24	2x#18 (b)	2x#20 (b)	2x#22 (b)
1-2	20	15	15	10	9	6.2	5	16	12	6
3	20	15	12	10	9	6.2	5	16	12	6
4	19	14	12	9.8	6.8	6.2	4.7	16	12	4.5
5-6	18	13	12	9.8 (c)	6.8	6.2	4.7	14	12	4.5
7-9	16	12	11	9 (d)	6.8	6.2	4.5	14	10	4
10	15	12	11	7	6.5	5.8	4.5	12	10	4
11-12	15	12	8	7	6.5	5.8	4.5	12	10	4
13-15	14	10	8	6	6.5	5	4	10	8	3.5

Standard Temperature (-1) Terminals

Current (A) / Circuits	Wire Size (AWG) (a)						
	#14	#16	#18	#20	#22	#24	2x#22 (b)
1-2	12	12	8	7.2	5	4	4.8
3	12	9.6	8	7.2	5	4	4.8
4	11.2	9.6	7.8	5.4	5	3.7	3.6
5-6	10.4	9.6	7.8 (c)	5.4	5	3.7	3.6
7-9	9.6	8.8	7.2 (d)	5.4	5	3.6	3.2
10	9.6	8.8	5.6	5.2	4.6	3.6	3.2
11-12	9.6	6.4	5.6	5.2	4.6	3.6	3.2
13-15	8	6.4	4.8	5.2	4	3.2	2.8

NOTE

(a) These currents are expected to produce an initial 30°C maximum temperature rise at the contacts. The temperature rise at the end of testing (i.e. Temperature Life) may be higher.

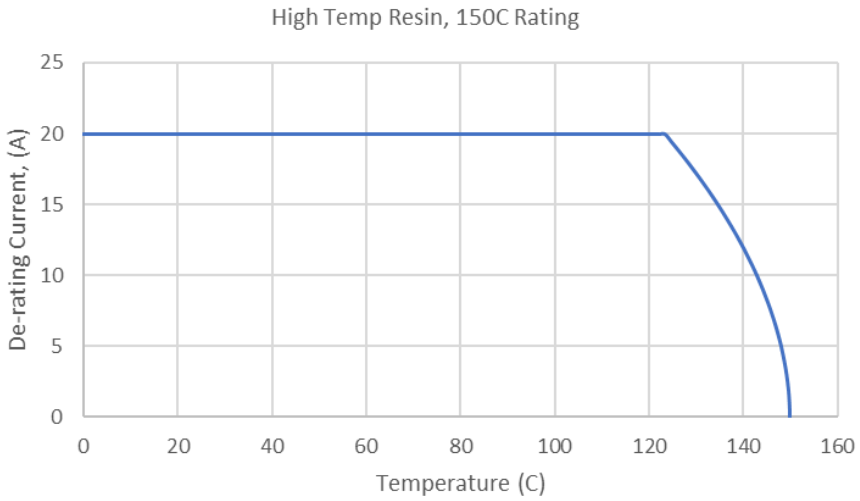
(b) Current shown is the maximum combined for both wires with the current in each wire not to exceed 50% of the total current.

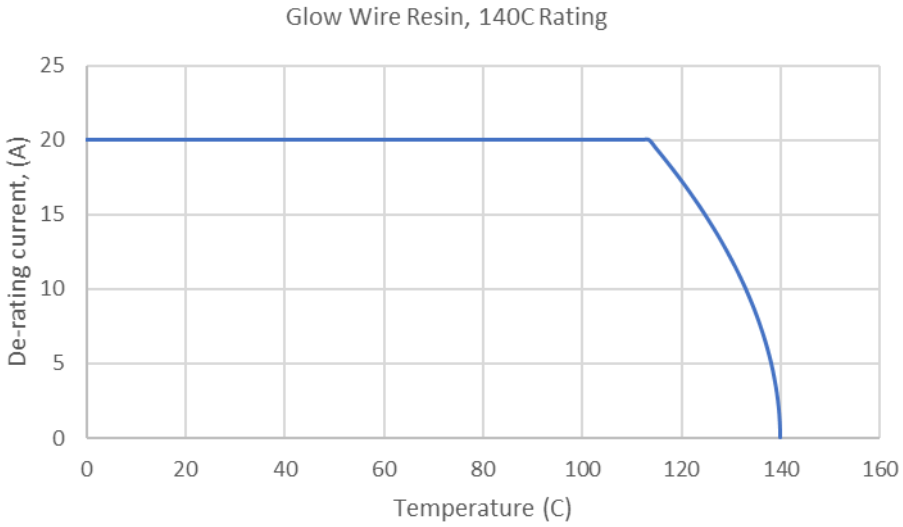
(c) Maximum current for 6 positions with contacts 2238066-2 and 2238067-2 is 9.4 A. Maximum current for 6 positions with contacts 2238066-1 and 2238067-1 is 7.5 A.

(d) Maximum current for 9 positions with contacts 2238066-2 and 2238067-2 is 8.5 A. Maximum current for 9 positions with contacts 2238066-1 and 2238067-1 is 6.8 A.

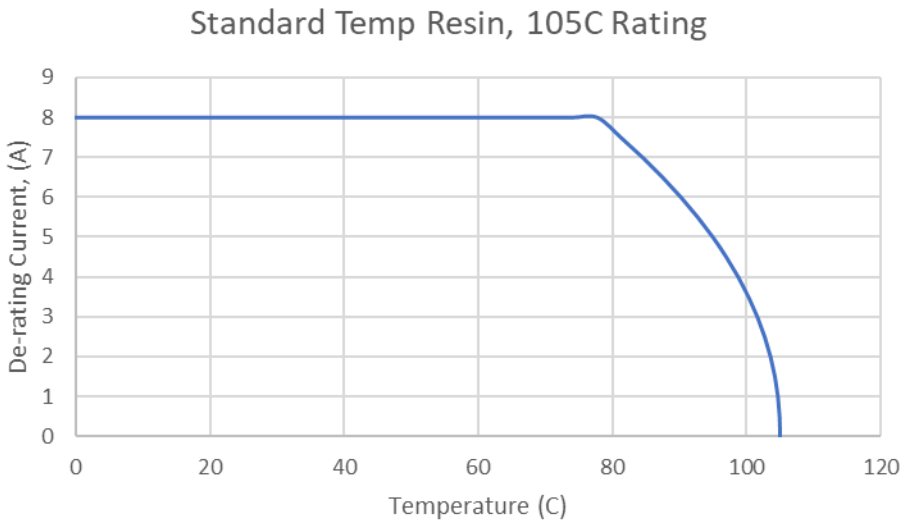
Appendix 2– 3: T-rise After Temp Life, 105C at 500 hours

The following graphs show the maximum recommended current when properly crimped contacts are inserted in a specific housing and energized at a given ambient temperature.





Appendix 2: 12 AWG Temperature Rise – High Temp Terminals 1971779-2 and 1971780-2 in 1x5 High Temp or Glow wire Cap and Plug Housings, 1 Circuit Energized [Charts generated using 10 data points]



Appendix 3: 14 AWG Temperature Rise, Standard Temp Terminals 1971781-1 and 1971782-1 in 3x5 Standard Temp or Glow wire Cap and Plug Housings, 15 Circuits Energized [Charts generated using 5 data points]