NOTE
The product described in this document has not been fully tested to ensure conformance to the requirements outlined below. Therefore, TE Connectivity (TE) makes no representation or warranty, express or implied, that the product will comply with these requirements. Further, TE may change these requirements based on the results of additional testing and evaluation. Contact TE Engineering for further details.

Power Triple Lock Connectors

1. SCOPE

1.1. Contents

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 PTL Cap housing with Tab Contacts crimped to wires and inserted, a PTL 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 3.5 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.

2. APPLICABLE DOCUMENTS

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

102-950	Quality Specification (Qualification of Separable Interface Connectors)
501-TBD	Qualification Test Report
114-106118	Application Specification

2.2. Commercial Standards and Specifications

EIA-364	Electrical Connector Test Procedures Including Environmental Classifications

2.3. Reference Document

109-197	Test Specification (TE Test Specifications vs. EIA and IEC Test Methods)

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, materials, construction and physical dimension 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

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, Glow Wire 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)

3.4. Performance Requirements and Test Description

The product should meet the electrical, mechanical and environmental performance requirements specified in 3.5. All tests shall be performed at room temperature unless 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 and dimensional (C of C) inspection per the product drawing.
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 1 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.
Dielectric Withstanding Voltage	1 minute hold without a creep discharge or flashover. Current leakage: 5 mA maximum	EIA-364-20, Condition I 5 kilovolts AC at sea level (initial) 3 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. 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 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
Random Vibration	No electrical discontinuity greater than 1 µs shall occur. Final LLCR: 10 mΩ (milliohms) maximum No physical damage.	EIA-364-28, Test Condition VII D Subject mated specimens to 3.10G's RMS between 20 and 500 Hz. Apply fifteen minutes in each of 3 mutually perpendicular planes.
Mechanical Shock	No electrical discontinuity greater than 1 µs shall occur. Final LLCR: 10 mΩ (milliohms) maximum No physical damage.	EIA-364-27 Method H 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 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

Wire Crimp Tensile Strength		
	Wire Size (AWG)	**Crimp Tensile (min.) (N)**
	22, 2x22	62.3
	20, 2x20	62.3
	19	66.7
	18, 2x18	133.4
	16	133.4
	14	200.0
	12	200.0

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.

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	Final Termination Resistance: 10 mΩ (milliohms) maximum	EIA-364-17, Method A Subject mated connector to 105±2ºC (High Temp @ 150+/-2ºC) for a duration of 500 hours. Measurement to be recorded after specimens are held for 3 hours at ambient temperature and humidity.
Glow Wire Test 850°C & 750ºC (GWT version only)	Test at 850°C (Flame duration ≤ 30 seconds. Test 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.

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 3.6

3.6. Product Qualification and Requalification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)								
	1	2	3	4	5	6	7	8	9
	TEST SEQUENCE (b)								
Examination of Product	1, 8	1, 9	1, 8	1, 3	1, 4	1, 4	1, 7	1, 3	1, 3
Termination Resistance (Low Level)	2, 6	2, 7					2, 5		
Insulation Resistance			2, 6				3, 6		
Dielectric Withstanding Voltage			3, 7						
Temperature Rising		3, 8							
Sinusoidal Vibration (Low Frequency)	4								
Random Vibration		6 (c)							
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		4 (d)	5						
Salt Spray							4		
Temperature Life		5							
Glow Wire Test								2	

NOTE

(a) See paragraph 4.2.A.

(b) Numbers indicate the sequence in which tests are performed.

(c) Discontinuities shall not be measured; Energize at 18ºC T-Rise current level per Quality Specification 102-950.

(d) Precondition specimens with 5 durability cycles

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.

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

4.2. Tests

A. Test Specimens

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 of Section 3.5. 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 resubmitted.

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.

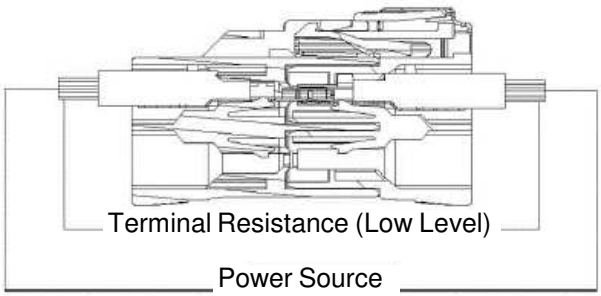


Figure 1: Low Level Contact Resistance Measuring Method

(Resistance of the wire to be subtracted)

Appendix 1

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

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 consecutive sequential testing (i.e. Humidity Temperature Cycling, Temperature Life and Random Vibration) may be higher.

(b) When using #14 through #22 AWG wire with Standard Temp contact #1971781-1, 1971782-1, 1971783-1, 1971784-1, 1971785-1, 1971786-1, 2238066-1 and 2238067-1, reduce the maximum current shown by 20%.

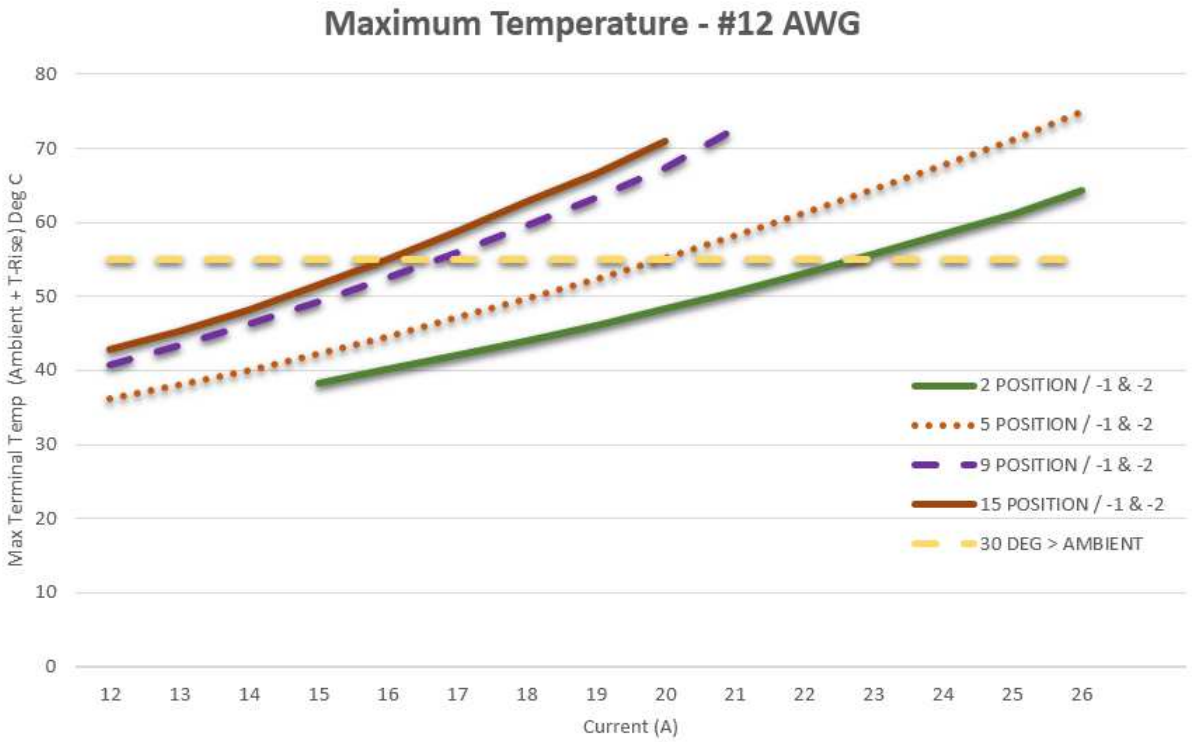
(c) Current shown is the maximum combined for both wires with the current in each wire not to exceed 50% of the total current.

(d) Maximum current for 6 positions with contacts 2238066-2 and 2238067-2 is 9.4 Amps.

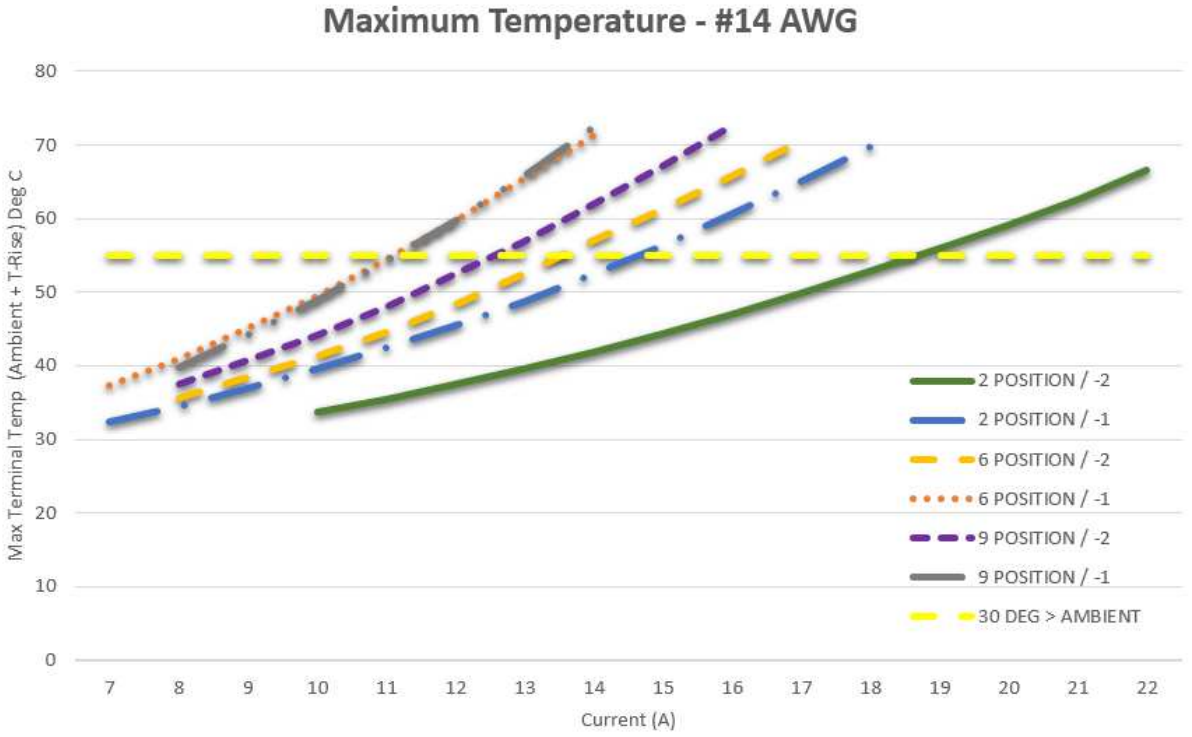
(e) Maximum current for 9 positions with contacts 2238066-2 and 2238067-2 is 8.5 Amps.

Appendix 2 – Appendix 7

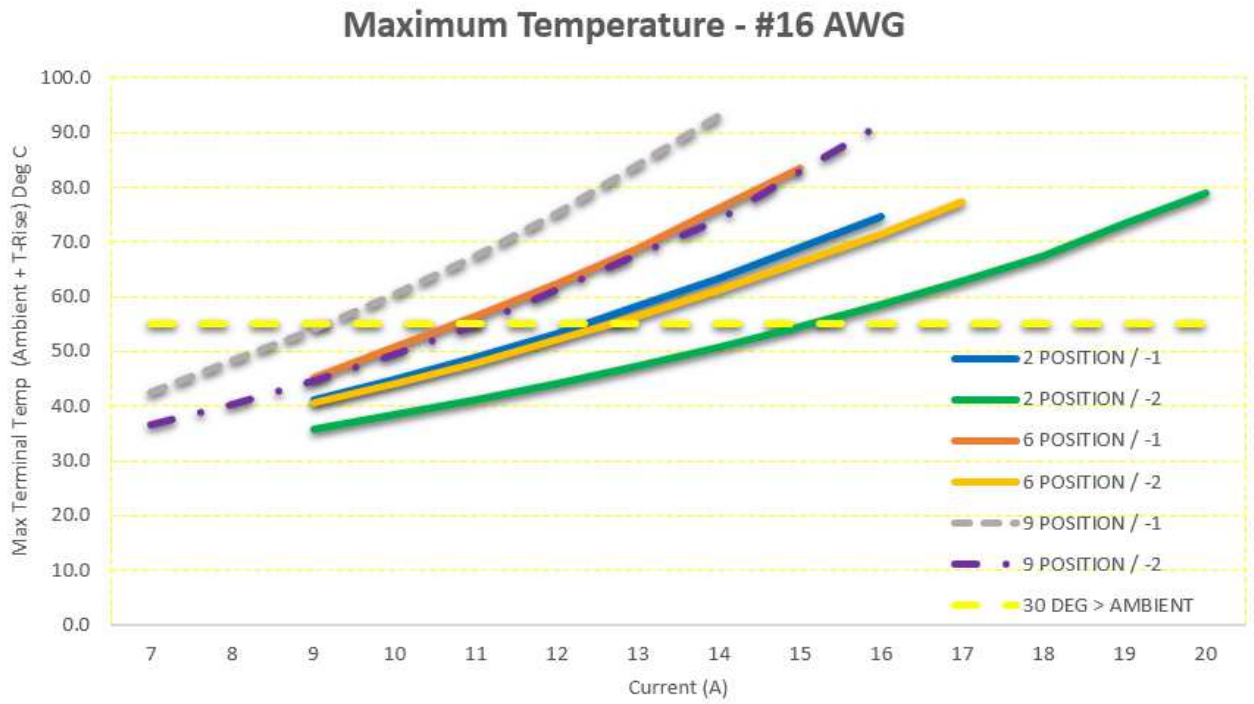
The following graphs show the expected initial max temperature when a current is applied to crimped contacts. They are intended as a general indication for applications where the ambient temperature is approx. 25°C.



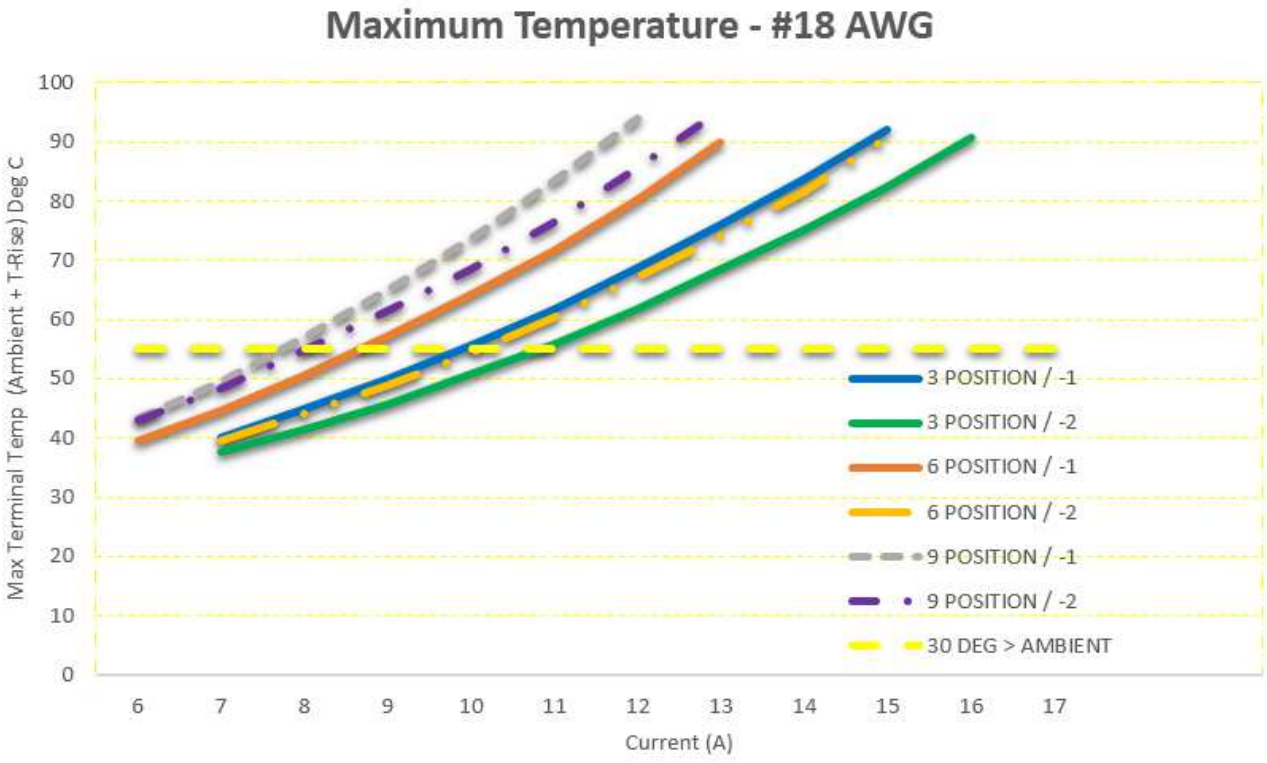
Appendix 2: 12 AWG Temperature Rise



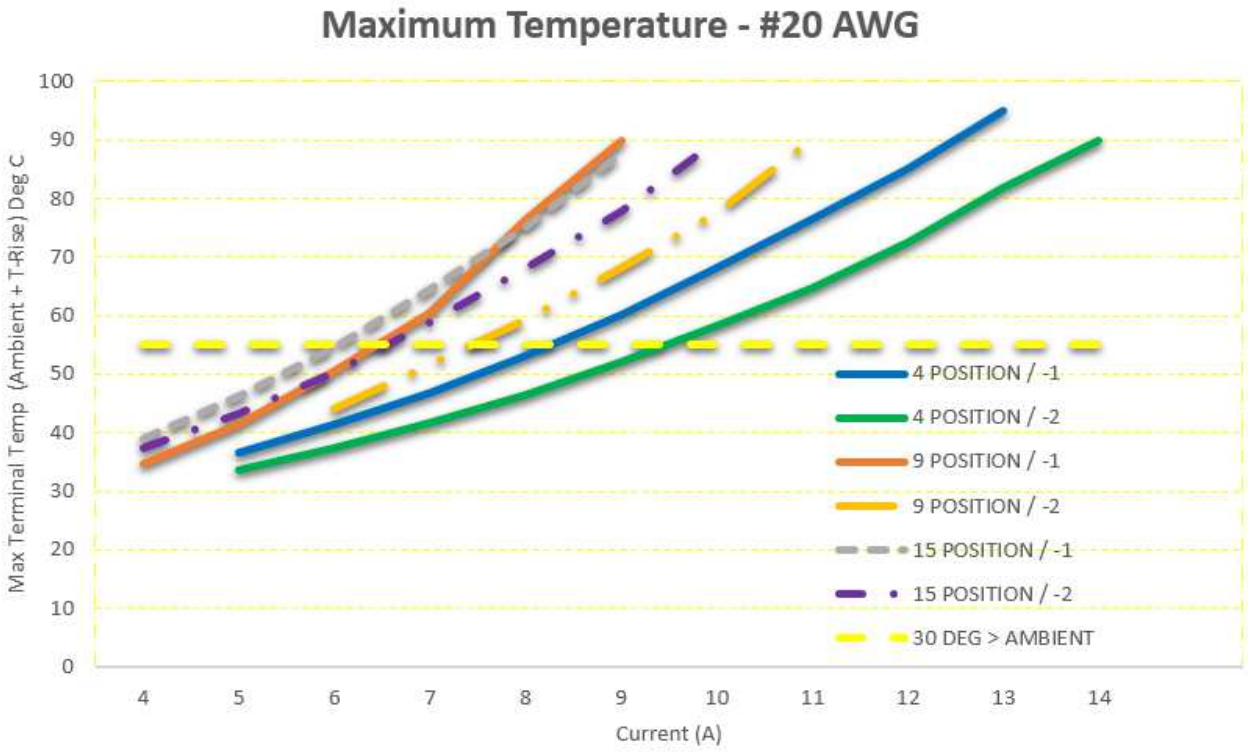
Appendix 3: 14 AWG Temperature Rise



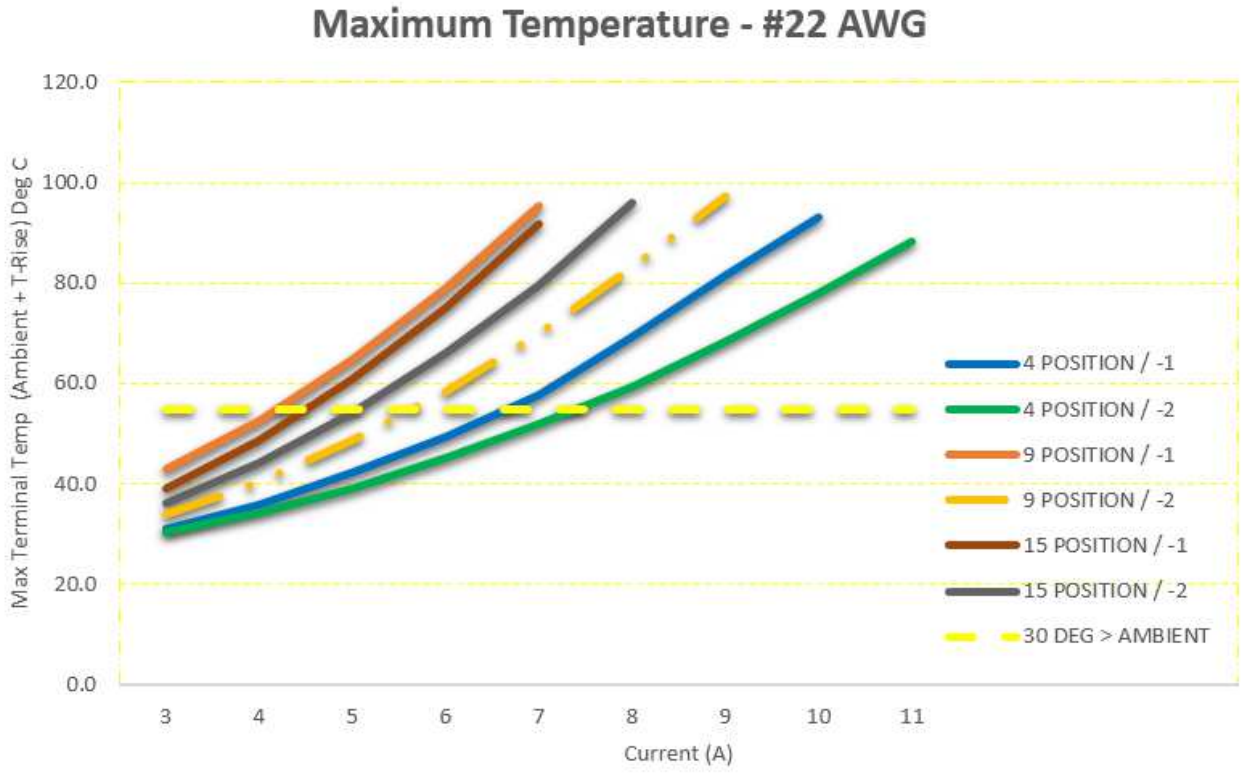
Appendix 4: 16 AWG Temperature Rise



Appendix 5: 18 AWG Temperature Rise



Appendix 6: 20 AWG Temperature Rise



Appendix 7: 22 AWG Temperature Rise