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**Industrial M12 L-code Series Circular Connector**

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**1. Scope**

1.1 Contents

This specification covers the requirements for product performance, test methods and quality assurance provisions of M12 L-code connector.

**2. Applicable Documents:**

The following documents form a part of this specification to the extent specified herein. 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 Specifications:

- 501-137350: Qualification Test Report  
M12 Panel mount (T413XXXXXXXX-XXX and T414XXXXXXXX-XXX and T417XXXXXXXX-XXX)
- 501-137350-1: Qualification Test Report  
M12 Screw Type Connector(T411XXXXXXXX-XXX)
- 501-137350-2  
M12 Cable Assembly (T415XXXXXXXX-XXX)

2.2 Commercial Standards and Specifications:

- IEC 61076-2-111: Detail specification for power connectors with M12 screw locking
- IEC 60512: Electromechanical Components for Electronic Equipment; Basic Testing Procedure and Measuring Methods
- IEC-60529: Degree of Protection Provided by Enclosures (IP Code)

**3. Requirements:**

3.1 Design and Construction:

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

3.2 Materials:

Material use in the construction of this product should be as specified on the applicable product drawing.



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### 3.3 Ratings:

#### 3.3.1 Electrical

- A. Rated voltage: 63 volts for 3 to 5 poles.
- B. Current-carrying capacity: 16A for 3 to 5 poles
- C. Contact resistance: 5mΩ Max(Initial); ΔR=10mΩ Max.(After)
- D. Insulation Resistance: 10<sup>8</sup> Ω Min.
- E. Temperature Rating: -40° C to +85° C (Screw type connector & Panel Mount Connector)  
-25° C to +85° C (Cable Assembly)

#### 3.3.2 Environmental

Sealing Requirements: IP65/67

Durability: 100 cycles

### 3.4 Performance Requirements and Test Descriptions:

The product shall be designed to meet the electrical, mechanical, environmental and electrical transmission performance requirements specified in Fig 1.

All tests shall be performed at the ambient environmental conditions per IEC 60512, unless otherwise specified.

### 3.5 Test Requirements and Procedures Summary

Para	Test Items	Requirements	Procedures
3.5.1	Examination of product	No defect would impair normal operation	Visual inspection No physical damage. IEC 60512, Test 1a
<b>Electrical Requirements</b>			
3.5.2	Voltage proof (withstand voltage)	1 minute hold with no breakdown or flashover	840V for 3,4,5 pin, AC or DC, hold for 1 minute between adjacent contacts/between contacts and metal housing. IEC 60512-4-1 Test 4a, standard atmospheric condition mated connectors.



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3.5.3	Insulation Resistance	100 MΩ Min.	500V ± 15V DC between adjacent contacts, 1 minute hold IEC 60512-3-1, Test 3a, Method A
3.5.4	LLCR	Initial value: 5mΩ Max. After value: ΔR=10mΩ Max.	Subject specimens to 100 milliamps maximum and 20 millivolts maximum open circuit voltage Test points refer to Fig.3 IEC 60512-2-1, Test 2a
3.5.5	Temperature Rising	30° C MAX under loaded rating current 16 A at 40°C ambient	Wire all contacts as a series for loading 16A DC current. Stabilize at rate current level until 3 readings at 5 minutes' intervals are within 1° C, IEC 60512-5-2. TEST 5a
<b>Mechanical Requirements</b>			
3.5.6	Durability	Initial value: 5mΩ Max. After value: ΔR=10mΩ Max.	Mated and un-mate specimens for cycles at a maximum speed of operations=10mm/s, Rest: 30s, unmated 100 cycles for gold plating EIA364-09-1
3.5.7	Mating and Un-Mating Force	Total insertion force 30 N max for 2 to 4 poles Total withdrawal force 45 N max for 5 to 6 poles	Max. speed= 10 mm/s Measure force necessary to mate samples without locking latch Rest time: 30s. EIA364-13
3.5.8	Sinusoidal vibration	1: Duration of disturbance 1μs max. 2: Contact resistance: ΔR=10mΩ max 3: There shall be no defect that would impair normal operation.	10Hz to 500Hz and 0.35mm or 5g Sweep cycles:10 Full duration:6H IEC60512, Test 6d



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3.5.9	Mechanical Shock	1: No discontinuities of 1 microsecond or longer duration 2: Contact resistance: $\Delta R=10m\Omega$ max 3: There shall be no defect that would impair normal operation	Subject mated specimens to 50G's half-sine shock pulses of 11 milliseconds duration with 3.44m/s velocity change.  Three shocks in each direction applied along 3 mutually perpendicular planes, 18 total shocks.  EIA364-27
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### Environmental Requirements

3.5.10	Rapid change in temperature	1. Contact resistance: $\Delta R=10m\Omega$ max 2. There shall be no defect that would impair normal operation See note.	IEC 60512-11-4, test 11d Subject specimens to 5 cycles between -40°C to 85°C or -25°C to 85°C with 30 minute dwells at temperature extremes. Refer to 3.3.1 E Temperature Rating
3.5.11	Dry heat	Initial value insulation resistance $\geq 10^8 \Omega$	Temperature: 85°C Duration: 16 hours IEC 60512-11-9
3.5.12	Damp heat, cyclic	See Note.	IEC 60512-11-12 Subject specimens to 5 cycles (5 days) Temperature :40°C Recovery time: 2h
3.5.13	Impacting water	No ingress of water	IEC 60529, Test 14.2.7
3.5.14	Dust (IP6X)	No deposit dust on contact	IEC 60529, Test 6, table 7
3.5.15	Cold	There shall be no defect that would impair normal operation	Temperature: -40°C Duration: 2h Recovery time: 2h IEC 60512-11
3.5.16	Mixed flowing gas	Contact resistance: $\Delta R=10m\Omega$ max	Flowing mixed gas – 4 days, test method 4 according to IEC 60068-2-60

**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 as fig 2.

Fig.1 (END)

3.5 Product Qualification Test Sequence

Test Examination	Test Group					
	A(a)	B	C	D	E(e)	F
	Test Sequence					
Examination of product	1	2,9,18,23	5	8	1	6
Voltage proof (withstanding voltage)	4	8,17,22	4	4,7		5
Insulation resistance	3	7,11,16,21	3	3,6		4
LLCR	2	4,6,15,20	2	2	2,6	2
Temperature Rising				5(d)		
Durability					4	
Mating and Un-Mating Force					3,5	
Sinusoidal vibration		1				
Mechanical Shock		3				
Rapid change in temperature		5		1		
Dry heat		10				
Damp heat, cyclic		12(b),14(c)				
Impacting water		19				3
Dust (IP6X)						1
Cold		13				
Mixed flowing gas			1			

**NOTE:**

- (a) When the initial test group A has been completed, the specimens are divided in the 5 groups B, C, D, E and F, all connectors in each group shall undergo the tests specified for the relevant group numbers indicate sequence in which tests are performed.
- (b) First cycle
- (c) Remaining cycles
- (d) Test with additional specimen for over-molding type cable assembly
- (e) This test group should be tested without the screw nut and locking latch

**Fig.2**

**1. QUALITY ASSURANCE PROVISIONS**

4.1 Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable Instruction Sheet and shall be selected at random from current production. Each test group shall consist of a minimum of 3 specimens unless otherwise stated.

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in figure 2.

4.2 Requalification testing

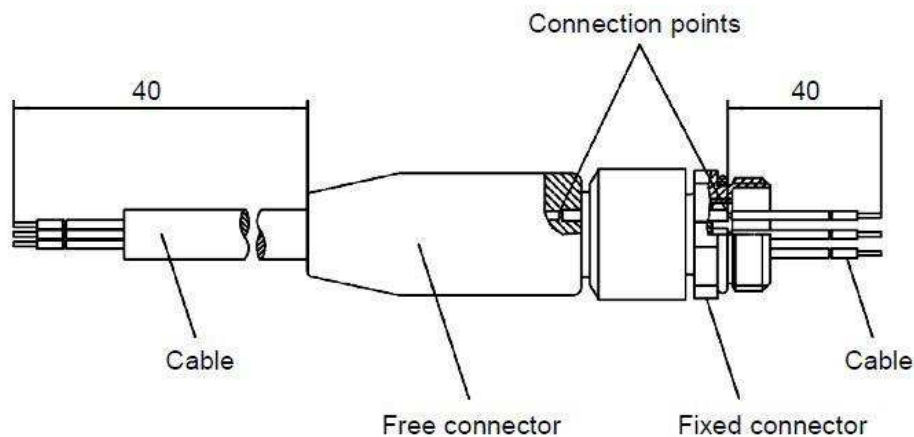
If changes significantly affecting form, fit or function are made to the product or manufacturing process or controlling industry specification, product assurance, shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product,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

4.3 Acceptance

Acceptance is based on verification that the product meets the requirements of 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 samples resubmitted for qualification. Testing to confirm corrective action is required before resubmitted.

4.4 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.



**Fig. 3- Contact resistance arrangement**