

GPL 394 MONO-SHAPE Mark II PCB Connector

P Code H943

1. SCOPE

1.1 Content

This specification covers performance, test and quality requirements for the Mono-Shape™ 5 mm Pitch I.D.C. Connectors for Printed Circuit Board Applications. These connectors are designed and developed for multiple lead connections for household appliances and other commercial equipment. The proper mateable counterparts are PCB, properly shaped in order to obtain a polarization system between PCB and Connectors to improve reliability of product and application. Forms, shape and dimensions of involved P.C.B. in the connector mating area has been defined by the customer interface requirements.

Product is applicable on 0.5- 0.75 mm² single or double stranded wires as describe on par.3.2 (**0.35 wire section allowed on several application but not yet fully tested)

N.B. Please contact Engineering Department when double crimp and/or 0.35 wire section is needed

2. APPLICABLE and REFERENCED 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 requirements of this Specification and Product Inspection Drawing, Product Inspection Drawing shall take precedence. In the event of conflict between requirements of this Specification and referenced documents, this Specification shall take precedence.

- TYCO Product Drawings	Refer to TYCO Customer and Inspection Drawing N° 284471
- TYCO Application Spec.	114-20104 & 114-20111 Mono-Shape™ Mark II - 5mm Pitch I.D.C. Connectors
- Tyco Electronics 109- series	Test specifications
- RAST5	Raster Anschluß Steck Technik 5mm Teilung
- DIN 0281 HD 21.3 S3	PVC insulated cables of rated voltages up to 450/750 V General requirements.
- VDE 0627 (Rev. 09/91)	Connector and plug-and-socket devices for rated voltages up to 1000Va.c./d.c. and rated currents up to 500A for each pole.
- IEC 60352-3/4 (Rev. 11/95)	Testing For Insulation Displacement Connection
- IEC 60998-1/-2,-3 (rev.90-04/91-10)	Connecting devices for low-voltage circuits for household
- IEC 60068-2-6 (Rev '95)	Environmental testing – vibration sinusoidal
- IEC 60512-2-1	Contact Resistance dry circuit
- IEC 60512-2-2	Contact Resistance At Specified Current
- IEC 60512-4-1	Withstanding Voltage
- IEC 60512-5-1	Temperature Rise Versus Current
- IEC 60512-7	Insertion and Withdrawal force
- IEC 60512-11-9	Temperature Life
- IEC 60512-11-12	Humidity & Temperature Cycling
- IEC 60512-16-4 and 16-20	Wire Termination tensile Strength
- EIA 364 –TSB	Salt Spray Corrosion (see
- IEC60335-1(ed.4.0)	Household and similar electrical appliances (safety)
- IEC 60112	Current Tracking Index
- EN 60998 - 1	Ball Pressure Test

E	REVISED PAR. 5.5.1	C.CORDOLA	G. TURCO	FEB 08
D2	RELEASED GLOW WIRE VERSION REVISED PAR. 5.1.5 EC ET00-0033-04 ADDED FIG. 6A FOR PERPENDICULAR WIRE EXIT, TENSILE TEST	C.CORDOLA	G. TURCO	MAR 04
C4	REVISED EC ET00-0219-03	C.CORDOLA	G. TURCO	DEC. 03
B	REVISED ET00-0112-02	C.CORDOLA	G. TURCO	19JUN02
A	ACTIVE PER EC ET00-0004-02	C.CORDOLA	G. TURCO	10JAN02

Amp Italia S.p.A. - C.so F.lli Cervi, 15 - COLLEGNO (TO) 10093 - Tel 011-40121

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3. REQUIREMENTS

3.1 Design and Construction

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

3.2 Definition

3.2.1 Insulation Displacement Connection (I.D.C.)

A terminating technique whereby an insulated wire is forced into a restrictive slot in a terminal, during which time the wire insulation is displaced, and the bare wire engages the sides of the slot.

3.2.2 Double Crimp Connection (D.C.C)

A terminating technique whereby two insulated wires are forced into a restrictive slot in a single terminal, during which time the wires insulation is displaced, and the bare wire engages the sides of the slot.

3.2.3 Housing Connector

An insulating encapsulation for contacts. When pins or sockets are inserted into a housing, the assembly is usually referred to as a connector. Housing is sometimes referred to as "block."

3.2.3 Printed Circuit Board (P.C.B.)

A conductive pattern, that may or may not include printed components, formed in a predetermined design on the surface of an insulating base in an accurately repeatable manner. The two most common types of printed circuits are etched and plated. Test PCB

3.3 Materials

- (1) I.D.C. Terminals: Brass (contact finishing Tin Pltd.)
- (2) Housings: Different materials for different application:
 - A -Part Numbers with pre dash **0** (like **0-284482-1**) Un-filled PA 6/6, UL 94V-2 (standard)
 - ***B -P.N. pre dash **1** (like **1-284482-1**) Un-filled PA 6/6, UL 94V-0 (V0 requirements)
 - ***C -P.N. pre dash **3** (like **3-284482-1**) Un-filled PA 6, UL 94V-2 (Glow Wire 750° no flame)
- (3) Printed Circuit Board Single Layer, 1.5 ±0.14 mm thickness, tin coated tracks.
See Drawing N.° 92-330805-2 Test PCB Layout for reference,
- (4) Wires Types suitable for this product refer to the table shown below
(***0.35 wire section allowed on several application but not yet fully tested)

cross section nominal mm ² (AWG)	Stranded Wires diameter mm	numbers of single wire and max. diameter mm	single wire material*	insulation material type**	Insulation Outside dia. MAX
***0.35 - (AWG20)	1	12x0.21	tinned or unplated copper	PVC	(1.2 Min.) 1.4 Max.
0.5 - (AWG20)	1	16x0.21	tinned or unplated copper	PVC	2.3
0.75 – (AWG18)	1.2	24x0.21	tinned or unplated copper	PVC	2.5

NOTE: * Connectors are suitable for both tinned and un-plated cables material when a single cable is crimped. Double Crimp applications always need tinned wires only.

**** Cable termination process on product, looking at insulation material type, must be analyzed and examined together with the Application Tooling Manufacturer of the Tooling used to terminate the product.**

***** Version is not yet released for production.**

3.4 Ratings

3.4.1 Voltage/Current : Voltages 380 Max, current Rating according to wire size and wire application.
 (see also Note 1)

Wire Sec.(mm ²) SINGLE CRIMP	Wire Sec.(mm ²) DOUBLE CRIMP	Current (max.)
***0.35		2A
	***0.35 + 0.35	1A+1A
	***0.35 + 0.5	1A+3A
0.5		3A
	0.5 + 0.5	3A + 3A
	0.5 + 0.75	6A TOTAL
0.75		6A
	0.75 + 0.75	6A TOTAL

Note 1) - Please contact Engineering Department when double crimp and/or 0.35 wire section is needed

Operating temperature:

-25°C to +110°C (including the temperature increase due to current load)

3.4.2 4. SAMPLE COMPOSITION AND PREPARATION.

Connectors are designed to meet the electrical, mechanical and environmental performances requirements according to test conditions as specified on following paragraphs.

Tests are divided in four sections

SECTION A: Tests on connection between Wire and I.D.C. contact slot

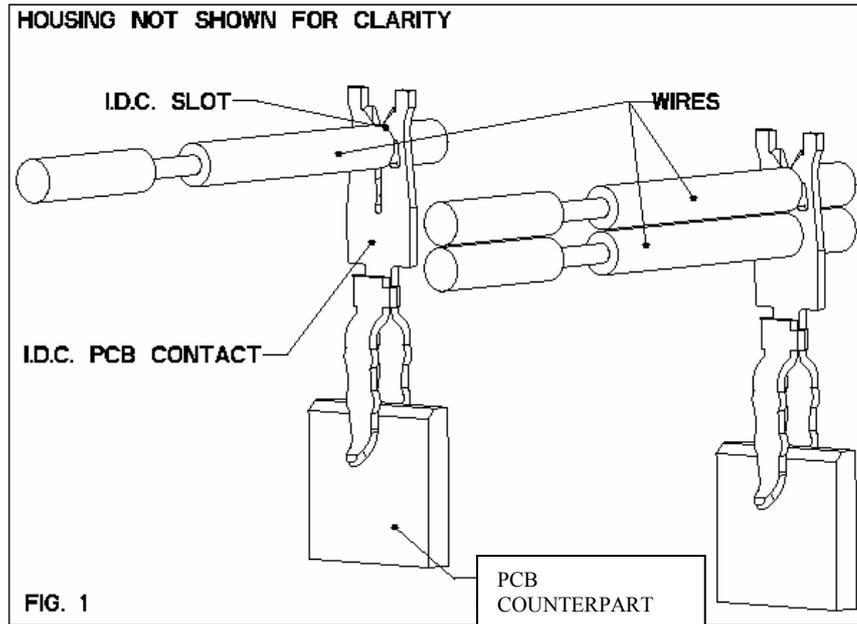
SECTION B: Tests on connection between Contacts and P.C.B.

SECTION C: Tests on the total connection (wire-I.D.C. contact- P.C.B.)

SECTION D: Tests on the connector (mechanical-materials tests)

For each section of wire applicable the minimum suggested group submitted to the test sequence is listed on paragraph 4.4, at least minimum wire section (0,5mm² for single wire application and 0.5mm²+0.5mm² for D.C.C application) and the maximum (0.75mm²for single wire application and 0.75mm²+0.75mm² for D.C.C application) must be used for testing.

See attached Fig.1 for details on mentioned features:



4.1 Samples selection

Samples for testing must be selected at random for current production, must be in accordance to relevant Product Inspection Drawings and functional per applicable inspection plan.

4.2 Samples Preparation

All the operation made in order to prepare Samples for testing must be done in accordance to relevant Specification (Application spec for termination), wires P.C.B. must be inspected to verify the conformance to the correspondent specification. Where a temperature measurement probe on the product is requested, this must be applied at the hottest point of the connection. Operations which could be cause of damage or could influence the functionality of the product must be avoided.

4.3 Environmental Test Condition (Laboratory).

Unless otherwise specified, all tests shall be conducted at:

- Temperature 20°C ±5°
- Relative humidity 30 ÷ 95 %
- Atmospheric pressure 860 ÷ 1060 mBar

4.4 Suggested Samples for Test Group Composition.

Unless otherwise specified each group of connectors to be tested, shall be composed at least by:

- N°6 PCB Connector 2 ways
- N°2 PCB Connector 3 ways
- N°1 PCB Connector 5 ways
- N°1 PCB Connector 8 ways
- N°1 PCB Connector 10 ways

Unless otherwise specified above listed quantity is requested for each section of the wire used to terminate samples under test (see Par. 6 for test group and sequence).

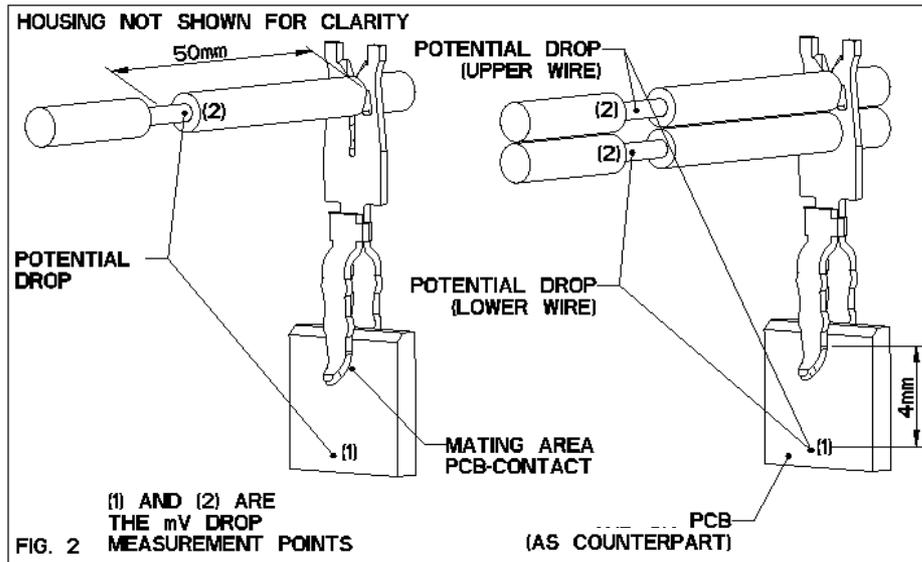
5. PERFORMANCE: TEST DESCRIPTION.

5.1 SECTION A - TESTS ON CONNECTION BETWEEN WIRE AND I.D.C. CONTACT SLOT

This section is focused on testing the performance of the I.D.C. connection. To reduce the influence of the P.C.B. portion of the connection, the contact must be soldered to the PCB in the mating area (see Fig. 1 for reference).

5.1.1 Contact Resistance (dry circuit IEC 60512-2-1 was TYCO#109-6-6)

Conformance of the product shall be measured as shown on following Fig.2. The potential drop shall be measured between points (1) and (2) the applicable test Voltage/Current is 20mV/20mA. After mechanical, electrical or environmental tests sequences, were a contact resistance check is requested, and if not otherwise specified, the difference between Initial and Final values must be ≤ 5mΩ.



5.1.2 Current Overload

The connectors shall be subjected for a period of 45 minutes to an overload of 1.3 times the nominal current in relations with the wire section used, as specified on Par. 3.4. After the test, connectors shall show no evidence of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.3 Vibration (see also IEC60068-2-6 & Mil STD 1344 A - was Tyco 109-21)

The connectors shall be mounted assembled with a proper counterpart simulating a typical application (see attached Fig.3 for reference) and fixed on a suitable adapter plate rigidly attached to the vibration table. The wire bundles shall be clamped to the plate in a points at least 200mm from the rear of the connectors.

Test Condition and procedure:

Displacement Amplitude 1.0mm acceleration amplitude 5g (peak values).

Frequency ranges , 10-200-10Hz, speed 1 octave/minute

duration 8 hours in each of 3 mutually perpendicular planes.

Contacts shall be wired in series and powered with 100 ± 10 mA of current flow, to monitor electrical discontinuance (resistance limit 100 Ohm). During the test electrical discontinuities of 1 microsecond or longer duration shall be monitored and registered. Mated connector are subjected to sinusoidal vibration having an harmonic motion with amplitude of 1,0 mm pk to pk up to crossover frequency, than with an acceleration of 5g. The vibration frequency varies logarithmically between the limits of 10 and 200 Hz and return to 10 at a rate of 1 octave/minute. At the end of the test there shall be no loosening of parts nor indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

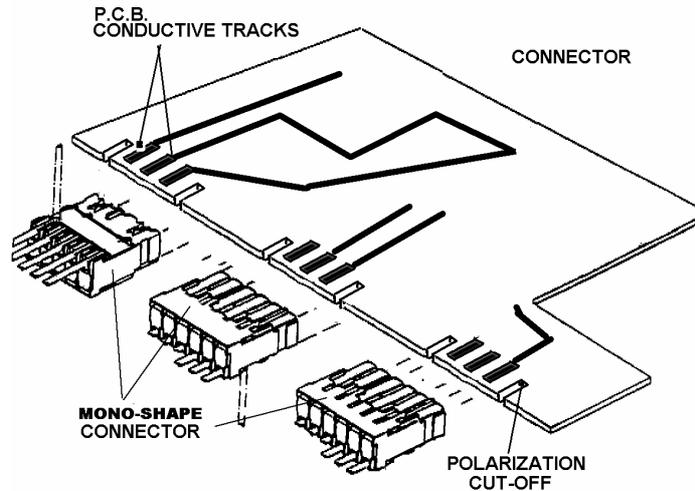


FIG. 3

5.1.4 Wires Movement (see IEC 60352)

Connector under test shall be subjected to 2 cycles of wire movement. At the end of the test there shall be no evidence of wires damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.5 Current Cycling (test Condition A, method 4,) at max. operating temperature (110°C as per par. 3.4.2) - Tyco 109-51

Connectors under test shall be subjected to 500 cycles. Contacts shall be wired in series and powered at a current rate according to wire section as reported on Par. 3.4.1.

Each cycle consist of: 45 minute power on and 15 minute power off. Test must be performed in a climatic chamber, chamber temperature shall be arranged in order to have a temperature of 110°C max on the hottest connection point when the power is on. Chamber temperature must be reached within 20 minute from the beginning of each cycle and maintained for the remaining portion of 45 minute, than the current must be switched off for 15 minutes; this is a complete cycle. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.6 Temperature Life (see IEC 60512-11-9 was TYCO 109-43 test level 10)

Connectors under test shall be withstand for 16 hours at a temperature of 110°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.7 Damp Heat steady state (see IEC 60512-11-12 was TYCO 109-23-2 Cond. B)

Connectors under test shall be withstand for 10 days at a temperature of 40°C and a relative humidity of 93%±2°. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.8 Thermal Shock (see IEC 60512-11-4 was Spec. 109-22)

Connectors under test shall be withstand for 10 cycles. First step is 30 minute at a room temperature of 110°C, second step is 30 minute at -25°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.1.9 Saturated atmosphere in the presence of sulfur dioxide-Kesternich (see DIN 50018-0.2S)

Connectors under test shall be withstand for 1 cycle to SO₂ exposure. Test condition as follows:
 Room temperature +40 °C, SO₂ = 0.2 dm³ H₂O = 2 dm³.

Samples exposure 8 hours plus 16 hours on air. Measure the contact resistance after test, the difference between Initial and Final values must be ≤ 5mΩ.

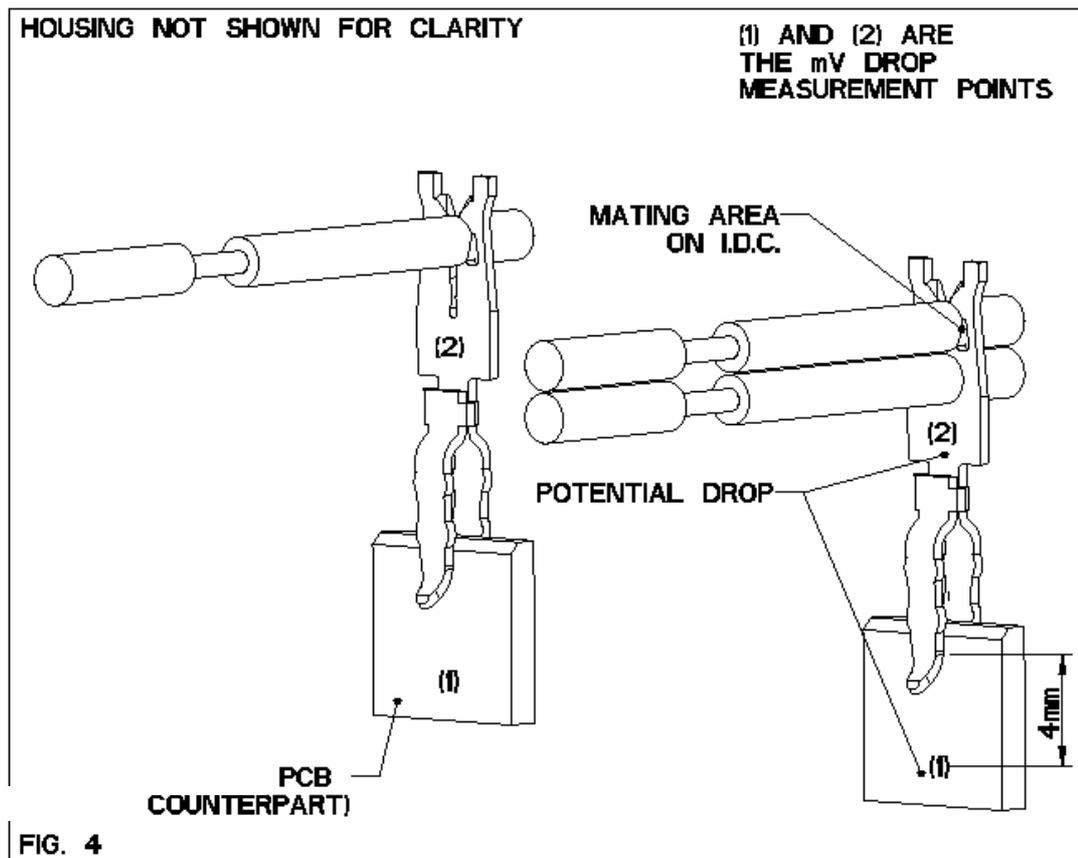
N.B. As alternative the Industrial Atmosphere - SO₂ test shall be performed , according to AMP#109-5107-1)

5.2 SECTION B - TESTS ON CONNECTION BETWEEN I.D.C. CONTACT AND TAB

This section is focused on testing the performance of the P.C.B. side of the connection. To reduce the influence of the IDC portion of the connection, the wires could be soldered into the I.D.C. slot (see Fig. 1 for reference).

5.2.1 Contact Resistance At Specified Current (see IEC 60512-2-2 was TYCO 109-25)

Conformance of the product shall be measured as shown on following Fig.4 The potential drop shall be measured between points (1) and (2) the applicable test current is according to wire section as reported on Par. 3.4.1. After mechanical, electrical or environmental tests sequences (if a contact resistance check is requested), the difference between Initial and Final values must be ≤ 5mΩ.



5.2.2 Durability Cycles (see IEC 60512-9-1 was TYCO 109-27)

Connector under test shall be withstand for 1 day of a pre-conditioning cycle, at 50% of relative humidity exposure. Than subjected to 5 cycles of Mating / Unmating using a proper PCB. As counterpart, Cycle rate shall be V= 10mm/minute.

Time interval between cycles 30 seconds. At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.2.3 Temperature Rise Versus Current (see IEC 60512-5-1 was TYCO 109-45-1)

Connector under test shall be withstand for 1 day of a pre-conditioning cycle, at 50% of relative humidity exposure. Than shall be withstand for 8 hours at the maximum current rate permitted, according to wire section as reported on Par. 3.4.1. Initial temperature T= 23°C. Test shall be considered passed if, within the 8 hours time line, thermal stability will be achieved and if temperature rise value will be according to following table:

Current (max.)	Max. T Rise
3A	≤20°C
6A	≤30°C

At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.2.4 Thermal Shock (see IEC 60512-11-4 was TYCO 109-22)

Connectors under test shall be withstand for 1 cycle. First step is 2 hours at a room temperature of -25°C , second step is 168 hours at 110°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.2.5 Withstanding Voltage (see IEC 60512-4-1 was TYCO 109-29-1)

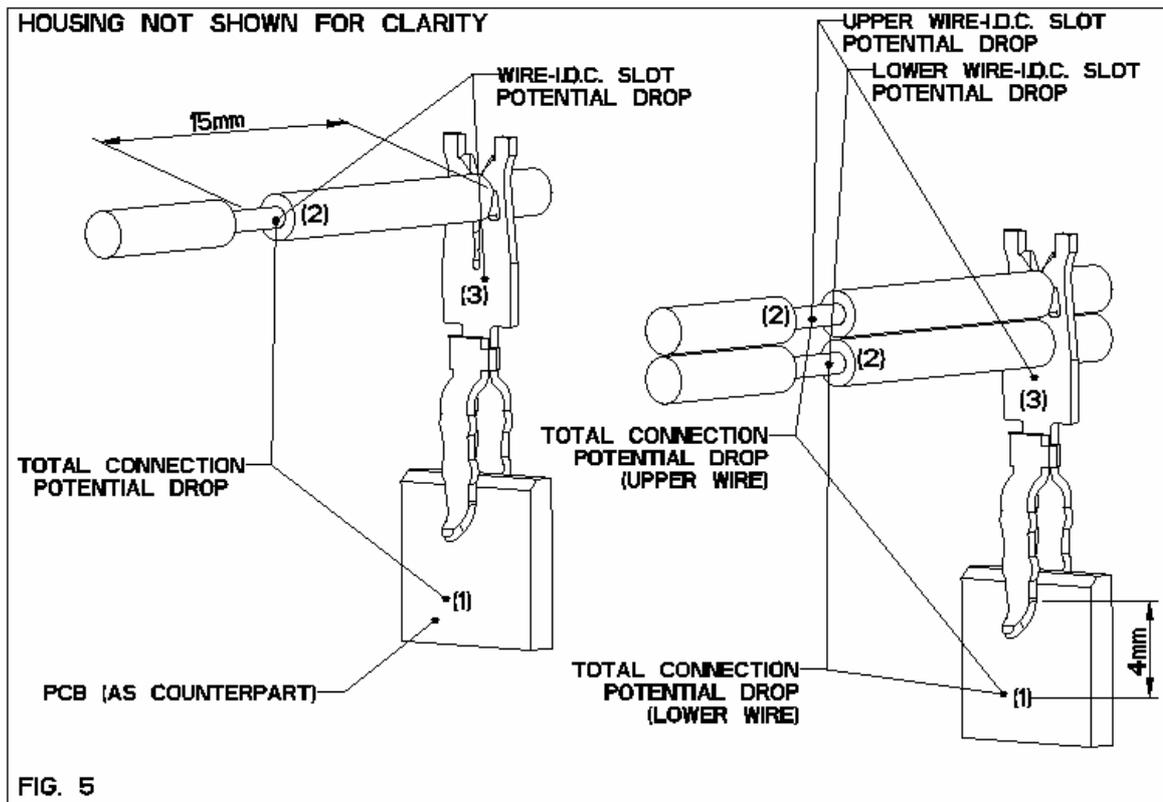
Connector under test shall be withstand for 4 minute at a Voltage rate of 1750V. Test shall be considered passed if, within the 4 minute time line, there will be no discharge. At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.3 SECTION C - TESTS ON THE TOTAL CONNECTION (WIRE+I.D.C. CONTACT+P.C.B.)

This section is focused on testing the performance of the total connection.

5.3.1 Contact Resistance At Specified Current (see IEC 60512-2-2 was TYCO 109-25)

Conformance of the product shall be measured as shown on following Fig.5 .The potential drop shall be measured between points (1) - (2) (total connection evaluation) and (2) - (3) (wire - I.D.C. slot) the applicable test Current is according to wire section as reported on Par. 3.4.1. After mechanical, electrical-environmental tests sequences (if a contact resistance check is requested), the difference between Initial and Final values must be ≤ 5mΩ.



5.3.2 Current Cycling (DIN EN60998-2-3 was Spec.#109-51) at max. operating temperature (110°C as per para. 3.4.2)

Connectors under test shall be subjected to 500 cycles. Contacts shall be wired in series and powered at a current rate according to wire section as reported on Par. 3.4.1.

Each cycle consist of: 45 minute power on and 15 minute power off. Test must be performed in a climatic chamber, chamber temperature shall be arranged in order to have a temperature of 110°C max on the hottest connection point when the power is on. Chamber temperature must be reached within 20 minute from the beginning of each cycle and maintained for the remaining portion of 45 minute, than the current must be switched off for 15 minutes; this is a complete cycle. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.3.3 Salt Spray Corrosion (see EIA 364 –TSB was TYCO 109-24)

Connectors under test shall be subjected for 96 hours to a controlled salt atmosphere, salt solution concentration 5%(NaCl) , Operating condition: Temperature 35°C±2. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

5.3.4 Insulation resistance (See EN61058)

The test is carried out measuring with a megaohmmeter the resistance after the application during one minute of 500 V DC between live parts, connected together, and earth (earth being the outer metal parts, including a metal foil sheet placed in contact with the outer parts).

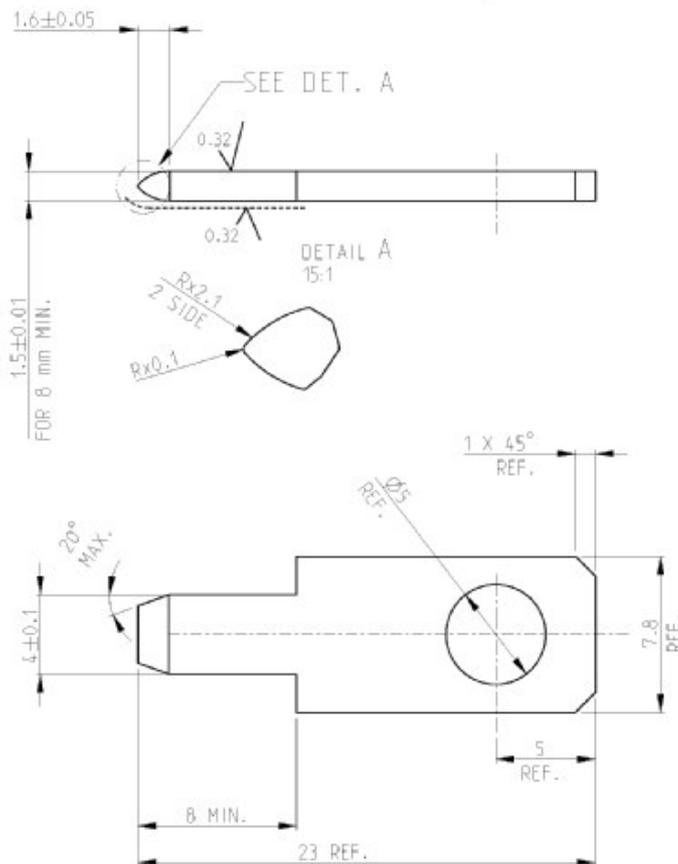
The insulation of the components must be 10 MΩ min.,

5.4 SECTION D – MECHANICAL AND MATERIAL TESTS ON THE CONNECTOR

This section is focused on testing the mechanical performance and housing plastic material of the connector. No electrical check are requested in this section.

5.4.1 – Contact Insertion / Withdrawal force. IEC 60512-7 PAR. TEST 13b

A value \leq of 8,0 N as insertion force, and \geq of 1,5 N as withdrawal force shall be verified using a polished flat steel gage, properly shaped as per below sketch. Rate value for insertion $V= 25.4$ mm / minute.



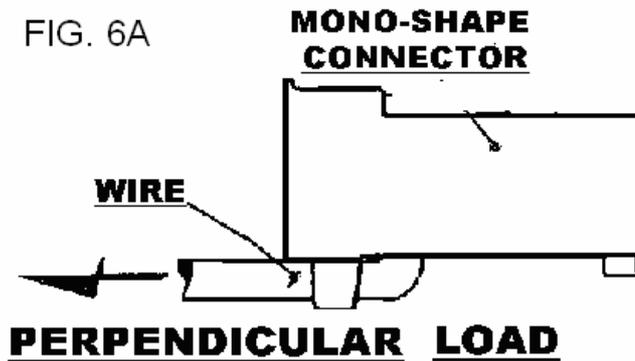
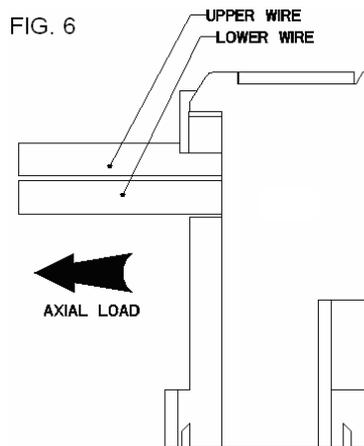
(For more detail see also gage drawing. 92-331567-09.)

5.4.2 Wire Termination Tensile Strength (90° to mating direction) (see IEC 60512-16-4 and 16-20 was TYCO109-16)

Wires terminated on the connectors under test shall be subjected to an axial tensile load according to following table. Load rate $V= 25.4$ mm/minute.

Wire size	Tensile Load
0.5 mm ²	30N
0.75 mm ²	40N

For samples terminated with double wires as shown on attached Fig.6, the tensile force shall be applied to the two wires simultaneously. If the load is applied in the mating direction (perpendicular load see FIG. 6A) a value of 35N shall be applied for all wires section or configuration. Test is passed if at above mentioned load the samples shall not shown evidence of cover damaging or separation between wire and I.D.C. contact Slot.



5.5.1 Glow Wire Resistance (IEC 60335-1 vedi anche IEC 60695-2-1/1)

- Glow-wire flammability test method for end-products

Connectors are produced using plastic compound according to IEC 60335-1 edition 4 requirements, test on product/connectors are performed according the indication of this norm. The Annex O of the norm is describing the flow chart of the test performed.

Test parameter are defined based on material type and Current rating.

5.5.2 Current Tracking Index (see IEC 60112 test A)

- Method for the determination of the proof and the comparative tracking indices of solid insulating materials

Wires terminated Connectors must be tested to be in according to IEC rules, using relevant test procedure.

Test passed if Samples shall withstand at a CTI value of 250V min.

5.5.3 Ball Pressure Test (EN 60998 - 1 test n° 16.3)

- Fire hazard testing - Abnormal heat - Ball pressure test

Wires terminated Connectors must be tested to be in according to IEC rules, using relevant test procedure.

Test at 125°C temperature for 1 hour, passed if ball imprint diameter < 2 mm

6. QUALIFICATION AND/OR PERIODIC TESTS, TABLE FOR GROUPS AND SEQUENCE.

TEST DESCRIPTION	TEST PAR.	TEST GROUP AND SEQUENCE												
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Contact Resistance	5.1.1	1,3,5,7,9,11	1,3,5	1,3	1,3									
Current Overload	5.1.2	2												
Vibration	5.1.3	4												
Wires Movement	5.1.4	6,10												
Current Cycling	5.1.5	8												
Temperature Life	5.1.6		2											
Damp Heat	5.1.7		4											
Thermal Shock	5.1.8			2										
Kesternich Test	5.1.9				2									
Contact Resistance	5.2.1					1,3	1,3	1,3						
Durability Cycles	5.2.2					2								
Temp. Rise Vs Current	5.2.3						2							
Thermal Shock	5.2.4							2						
Withstanding Voltage	5.2.5							4						
Contact Resistance	5.3.1								1,3,5					
Current Cycling	5.3.2								2					
Salt Spray Corrosion	5.3.3								4					
Insulation Resistance	5.3.4								6					
CTC insertion/Withdrawal Force	5.4.1									1				
Tensile Strength (Axial)	5.4.2										1			
Glow Wire	5.5.1											1		
Tracking Index	5.5.2												1	
Ball Pressure	5.5.3													1

Notes: Groups from I to IV are relevant to samples to be tested according Section A of this specification
 Groups from V to VII are relevant to samples to be tested according Section B of this specification
 Groups VIII is relevant to samples to be tested according Section C of this specification
 Groups from IX to XIII are relevant to samples to be tested according Section D of this specification.