Modular Plugs, Unshielded and Shielded

1. SCOPE

1.1. Content

This specification covers performance, tests and quality requirements for Shielded and Unshielded Modular Plugs used to provide a universal connection interface between premise wiring of an office and the user's network of communications equipment (for data and voice networking systems). These assemblies are designed for installation onto various cables. Plugs incorporate IPC terminal for terminating twisted pair communications cable. See customer drawings for cable conductor diameter, insulation diameter and cable diameter compatibility

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.

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. **CommScope®** Documents

- 501-131013: Qualification Test Report (Modular Plugs) Revision A
- 408-8734 Terminating Modules 791804-[ ] for Use with Modular Plug Dual Terminators
- 408-8738: PRO-CRIMPER* III Hand Crimping Tool Assembly 790163-[ ]
- 408-9930: PRO-CRIMPER* III Hand Crimping Tool Frame Assembly 354940-[ ]
- 409-10010 Modular Plug Dual Terminator 1320840-[ ]

2.2. Industry Documents

- ISO/IEC 11801: Edition 2.2 : Generic Cabling for Customer Premises
- ISO/IEC 60603-7 Edition 3.1: Detail Specification for 8-way, Unshielded, Free and Fixed Connectors
- ISO/IEC 60603-7-1 Edition 3.0: Detail Specification for 8-way, Shielded, Free and Fixed Connectors
- ANSI/TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- IEC 61935-2 Edition 3.0: Specification for the Testing of Balanced and Coaxial Information Technology Cabling – Part 2: Cords as Specified in ISO/IEC 11801 and Related Standards
- IEC 60352-6 Edition 1.0: Insulation Piercing Connections- General Requirements, Test Methods and Practical Guidance
- IEC 60512: Basic Testing Procedures and Measuring Methods for Electromechanical Components for Electronic Equipment (as indicated in Figure 1)
- IEC 60068: Basic Environmental Testing Procedures (as indicated in Figure 1)

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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

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

3.3. Wire Range

- See specific customer drawings for appropriate cable dimensions compatibility

3.4. Ratings

- Voltage: 150 volts AC maximum
- Current: Signal application only, 0.75 ampere maximum
- Temperature: -10 ℃ to +60 ℃ (per ISO/IEC 11801, Section 10.1.4)

  Increased temperatures will affect the current carrying capacity of the electrical system. Consult the Environmental Testing section of this specification and the De-rating Curve, per IEC 60603-7, Figure 10 to determine the appropriate application of product.

3.5. Tooling

Connectors shall be terminated using Modular Plug tooling shown in the application specification, customer drawings, and instruction sheets appropriate for each part number.

3.6. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 1. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Examination		
Test Description	Requirement	Procedure
Initial examination of product	ISO/IEC 11801, Annex C There shall be no defects that would impair normal operation. Dimensions shall comply with those specified on product drawing.	IEC 60512-1-1 and -2 Visual and dimensional per quality inspection plan with Certificate of Conformance (C of C)
	Verify contact termination heights	IEC 60603-7 unshielded or 60603-7-1 for shielded connectors
	Verify plating thicknesses	Dimensional per quality inspection plan with Certificate of Conformance (C of C) or laboratory verification
Visual examination of product	ISO/IEC 11801, Annex C There shall be no defect that would impair normal operation.	IEC 60512-1-1 Visual inspection.
Length, uncoiled patch cord	Length to be within print tolerance	Measure physical length of patch cord as shown on customer drawing

ELECTRICAL		
Test Description	Requirement	Procedure
Contact resistance, IPC/wire interface	IEC 60352-6, Section 5, Table 2 Initial: IPC/wire: 10 mΩ max. Change from initial after conditioning: IPC/plated wire: 10 mΩ max. IPC/un-plated wire: 15 mΩ max.	IEC 60512-2-1 Derived by measuring the total voltage drop between the plugs IPC contact and terminated wire, then subtracting the average bulk resistance of these components. Test voltage shall not exceed 20 mV d.c. or peak voltage a.c. and test current shall not exceed 100 mA, a.c. or d.c. (See Figure 4)
Input to output DC resistance	IEC 60603-7, Section 6.4.5. TIA-568-C.2, Section 6.8.1. Signal conductors (R_{AD}): 200 mΩ max. IEC 60603-7-1, Section 6.4.5 Shield (R_{AD}): 100 mΩ max.	IEC 60512-2-1. Derived by measuring the total voltage drop of terminated plugs mated to terminated jacks. (See Figure 3)
Input to output DC resistance unbalance	IEC 60603-7, Section 6.4.6. Difference between all signal conductors (R_{AD}): 50 mΩ max.	IEC 60512-2-1. Derived by calculating the maximum difference between input to output DC resistance measurements. (See Figure 3)
Insulation Resistance	IEC 60603-7, Section 6.4.7 500 megaΩ minimum	IEC 60512-3-1, Method A. 100 volts DC, 1 minute hold.
Voltage proof	IEC 60603-7, Section 6.4.2 One minute hold with no breakdown or flashover.	IEC 60512-4-1, Method A. 1000 volts DC or AC peak. Terminated jack with mated plug. One contact to all other contacts connected together. All contacts bundled to shield, 1500 volts DC or AC peak.
Current temperature de-rating	IEC 60603-7, Section 6.4.3 Shall comply with de-rating curve.	IEC 60512-5-2, test 5b Contacts connected in series.
MECHANICAL		
Test Description	Requirement	Procedure
Locking device mechanical operations	60603-7, Visual examination, locking device must function in jack and show no indication of stress cracking. See Note (a)	60603-7 Annex B 1,500 operation cycles. Locking device shall be depressed until it contacts the body of the plug. Speed shall not exceed 20 cycles per minute.
Plug insertion & withdrawal force	IEC 60603-7, Section 6.6.3 Unshielded connectors: 20 N max. IEC 60603-7-1, Section 7.7.2.3 Shielded Connectors: 30 N max.	IEC 60512-13-2. Measure force required to mate/unmate plug & jack with latch depressed at a constant speed with a maximum rate of 50 mm per minute.
Plug retention in jack (effectiveness of connector coupling device)	IEC 60603-7, Section 6.6.2. No discontinuities greater than 10 µs. Shall remain mated and show no evidence of physical damage. See Note (a)	IEC 60512-15-6. Apply an axial load of 50 N to plug mated to jack with latch engaged and hold for 60±5 seconds. Load shall be applied at a maximum rate of 44.5 N per second.
Mechanical operations durability	IEC 60603-7, Section 6.6.1. See Note (a)	IEC 60512-9-1. Mate and unmate plug to jack interface with locking device inoperative for 375 cycles at a maximum rate of 10mm per second.

Bending of the wire/cable	IEC 60352-6, Section 5.2.2.2 No discontinuities greater than 10 µs. Termination shall not be damaged and conductors shall not be broken. See Note (a)	IEC 60352-6, Section 5.2.2.2 Apply a 22 N axial load to the free end of cable terminated to a plug Bend cable α = 30 degrees in both directions from vertical position for 5 cycles each direction (10 cycles total). Monitor contact disturbance per IEC 60512-2-5.
Vibration, Plug/Jack interface	IEC 60603-7, Section 7.7.2.5. No discontinuities greater than 10 µs. Shall remain mated and show no evidence of physical damage. See Note (a)	IEC 60512-6-4. Subject mated plug & jack to: Frequency: 10 to 500 Hz. Displacement Amplitude: 0.35 mm Acceleration: 5g (50 m/s^2) 10 sweep cycles per axis of 3 mutually perpendicular planes. Sweep rate: 1 octave per minute. Refer to IEC 60603-7, Section 7.3, for arrangement of vibration test. Monitor contact disturbance per IEC 60512-2-5.
Vibration, IPC/wire interface	IEC 60352-6-7, Section 5.2.2.3 No discontinuities greater than 10 µs. Shall show no evidence of physical damage. See Note (a)	IEC 60512-6-4. Subject terminated plug to: Frequency: 10 to 55 Hz. Displacement Amplitude: 0.35 mm 10 sweep cycles per axis of 3 mutually perpendicular planes. Full Duration: 2.25 hours. Test specimen shall be firmly held on a vibration table. Monitor contact disturbance per IEC 60512-2-5.
Tensile, patch cord	IEC 61935-2, Section 6.2 1 mm maximum outer cable sheath movement relative to plug boot. See Note (a)	Tensile force: 22 N applied along the common axis of the cable & plug. Duration: 1 minute Electrical testing not required during tensile.
Flexural, patch cord	IEC 61935-2, Section 6.3 Shall show no evidence of physical damage. See Note (a)	Test shall be performed using fixture setup similar to that shown in Figure 5 of this spec. Axial force applied on cable: 2 N Total cycles divided between two perpendicular axis: Stranded conductor: 250 (0°+90°-0°-90°0°) Solid conductor: 50 (0°+90°-0°-90°0°) Rate of flex: 20 complete cycles per minute. Electrical testing not required during flexure.
Torsional, patch cord	Shall show no evidence of physical damage. See Note (a)	Test shall be performed using fixture setup similar to that shown in Figure 6 of this spec. Twist length: 330 mm Axial force applied to cable: 10 N Total cycles: 100 (0°+180°0°-180°0°) Rate of torsion: 20 complete cycles per minute.
ENVIRONMENTAL		
Test Description	Requirement	Procedure
Rapid change of temperature, Plug/Jack interface	IEC 60603-7, Section 7.7.2.3. See Note (a)	IEC 60068-2-14, Test Na or Nb Subject mated connectors to 25 cycles between -40°C & 70°C with 30 minute dwells at temperature extremes. 2 hour recovery time.
Rapid change of temperature, IPC/wire interface	IEC 60352-6, Section 5.2.4.1 See Note (a)	IEC 60068-2-14, Test Na or Nb Subject terminated plugs to 5 cycles between -40°C & 70°C with 30 minute dwell at temp. extremes. 2 hour recovery time.

Cyclic damp heat	IEC 60603-7, Section 7.7.2.3. See Note (a)	IEC 60068-2-38. Subject connectors to 21 cycles (21 days) between 25℃ & 65℃ at 93% RH with 5 sub-cycle shocks at -10℃ in the 1 st 9 cycles. Half specimens mated, other half unmated.
Climatic sequence	60352-6 Section 5.2.4.2 See Note (a)	IEC 60068-2-61, Method 1 Subject terminated plugs to dry heat +70℃ & cold -40℃ for 1 cycle.
Electrical load & temperature	IEC 60603-7, Section 7.7.2.6 See Note (a)	IEC 60068-2-2, Tests Bd & Be Temperature: 70℃, RH: uncontrolled Test Time: 500 hours & 2 hours recovery Test Currents: Signal contacts: 0.8A d.c. per contact Half the specimens energized [test Be], the remaining half not energized [test Bd].
Flowing mixed gas corrosion, Plug/Jack interface	IEC 60603-7, Section 7.7.2.4 See Note (a)	IEC 60512-11-7, Method 1. H_2S: 100 ± 20 (10^{-9} vol/vol), SO_2: 500 ± 100 (10^{-9} vol/vol), Temp.: 25 ± 1℃, RH: 75 ± 3%, Test time: 4 days, Half specimens mated, other half unmated.
Flowing mixed gas corrosion, IPC/wire interface	IEC 60352-6, Section 5.2.4.3 See Note (a)	IEC 60512-11-7, Method 1. H_2S: 100 ± 20 (10^{-9} vol/vol), SO_2: 500 ± 100 (10^{-9} vol/vol), Temp.: 25 ± 1℃, RH: 75 ± 3%, Test time: 10 days
TRANSMISSION (Stranded Conductors Only) Patch Cord Component		
Test Description	Requirement	Procedure
Wire Map	Wiring pattern as specified in test request.	IEC 61935-2 Section 5.2, as specified If not otherwise noted, test in the coiled state.
Return Loss, Coiled	TIA-568-C.2, Section 6.2.6	IEC 61935-1, Section 5.6 TIA-568-C.2, Annex C.5.2.3, Test in coiled state
Pair to Pair Near End Crosstalk (NEXT) loss, Coiled	ISO 11801, Section 6.4.4.1, TIA-568-C.2, Section 6.2.8,	IEC 61935-1, Section 5.7 TIA-568-C.2, Annex C.5.2.1, Test in coiled state
Return Loss, Uncoiled	TIA-568-C.2, Section 6.2.6	IEC 61935-1, Section 5.6 TIA-568-C.2, Annex C.5.2.3, Test in uncoiled state.
Pair to Pair Near End Crosstalk (NEXT) loss, Uncoiled	ISO 11801, Section 6.4.4.1, TIA-568-C.2, Section 6.2.8,	IEC 61935-1, Section 5.7 TIA-568-C.2, Annex C.5.2.1, Test in uncoiled state.

Figure 1

NOT

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

3.7. Product Qualification and Requalification Test Sequence

Test or Examination	Test Sequence								
	IPC / Wire Interface			Plug / Jack					Patch Cord
	A1	A2	A3	B1	B2	B3	B4	B5	C1
Initial examination of product	1	1	1	1	1	1	1	1	1
Visual examination of product	5	7	5	12,17	13	8	8	3	13
Length, uncoiled patch cord									5
Contact resistance, IPC/wire interface	2,4	2,6	2,4						
Input to output resistance				2,7,10,14	4,6,8,10	2,6	2,9		
Input to output resistance unbalance									
Insulation resistance				3,9	2,11	3,7	3,6		
Voltage proof				4,11	3,12	4	4,7		
Current carrying capacity								2	
Plug insertion & withdrawal force				5,15					
Plug retention in jack				6,16					
Cable bending	3								
Mechanical operation durability					5,9				
Vibration, plug/jack						5			
Vibration, IPC/wire		3							
Tensile, patch cord									8
Flexural, patch cord									9
Torsional, patch cord									10
Rapid change of temp, plug/jack				8					
Rapid change of temp, IPC/wire		4							
Cyclic damp heat				13					
Climatic Sequence		5							
Electrical load and temperature							5		
Flowing mixed gas corrosion, plug/jack					7				
Flowing mixed gas corrosion, IPC/wire			3						
Wire Map, patch cord coiled									2
Return Loss, patch cord coiled									3
Next loss, patch cord coiled									4
Return Loss, patch cord uncoiled									6, 11
Next loss, patch cord uncoiled									7, 12

Figure 2

4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

A. Specimen Selection

Modular Plugs: Specimens shall be selected at random from current production and prepared in accordance with applicable Instruction Sheets.

Cable: Engineering discretion, customer drawings and product specifications shall be used to choose cables to qualify/requalify new products and design changes. Cables may be chosen with minimum and maximum conductor sizes, insulations sizes and jacket sizes commonly available in the industry.

B. Test Sequence

Product qualification shall be verified by testing specimens per test sequence defined in Figure 2.

4.2. 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.

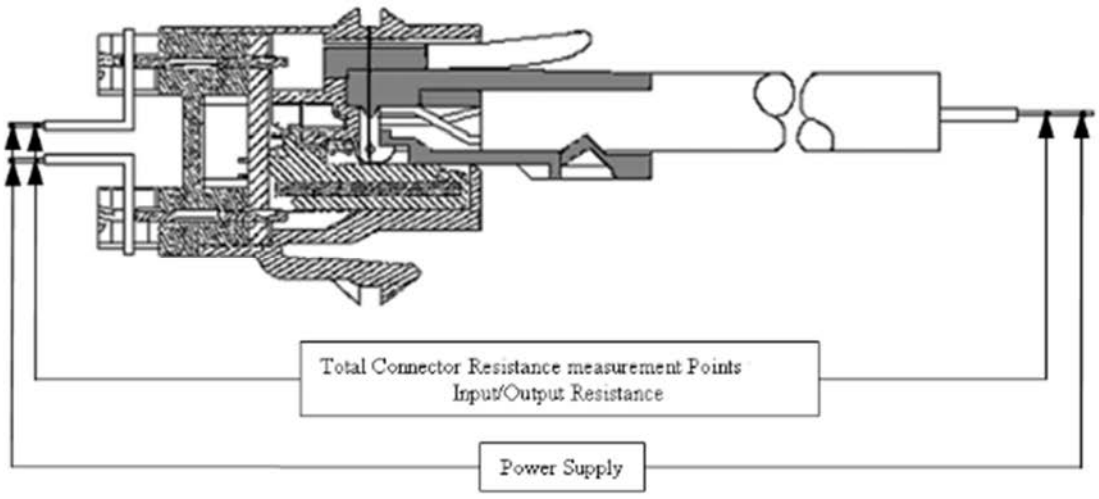
4.3. Acceptance

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 specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

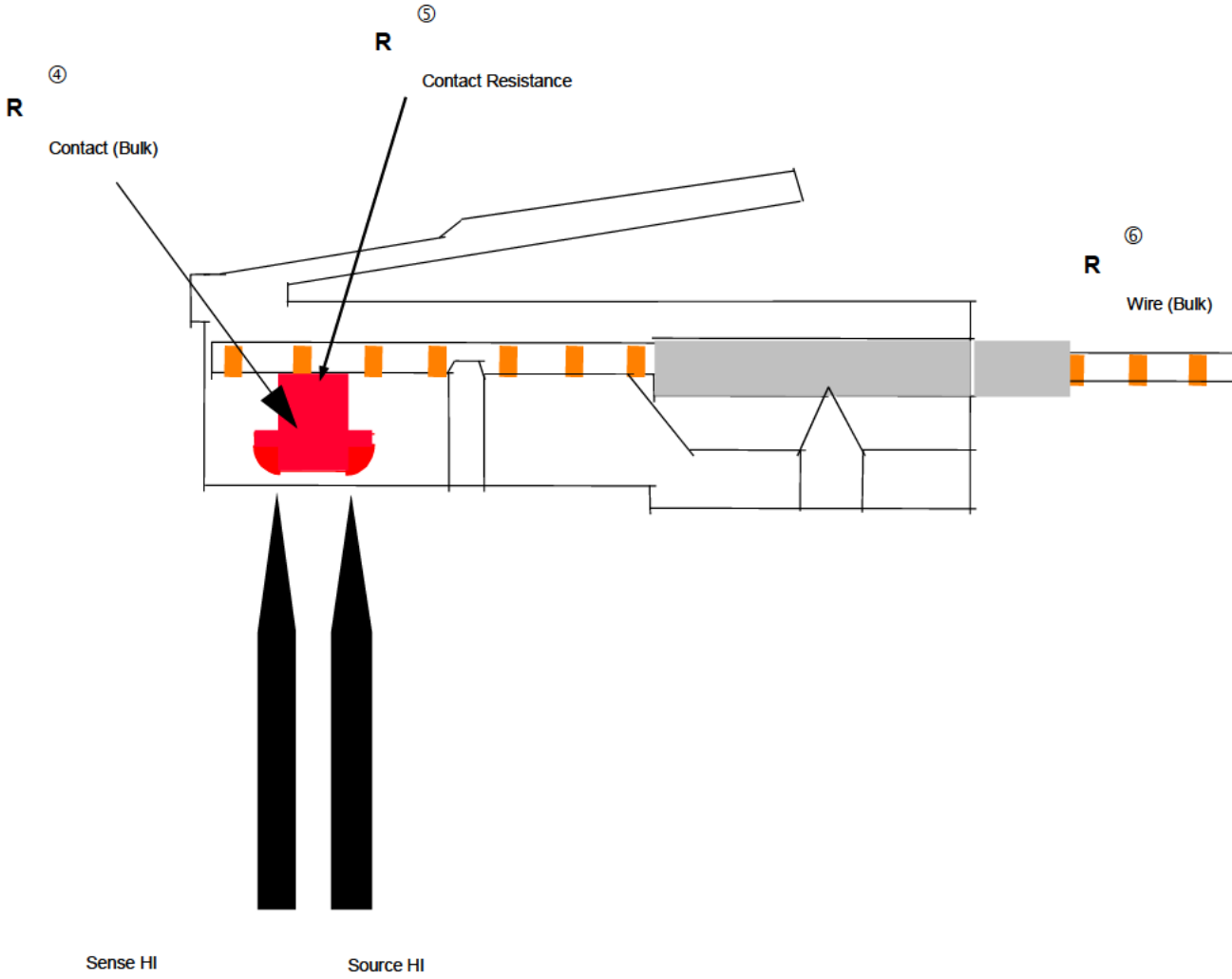
4.4. Quality Conformance Inspection

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 application product drawing and this specification.

5. FIGURES RELATED TO TEST PROCEDURES



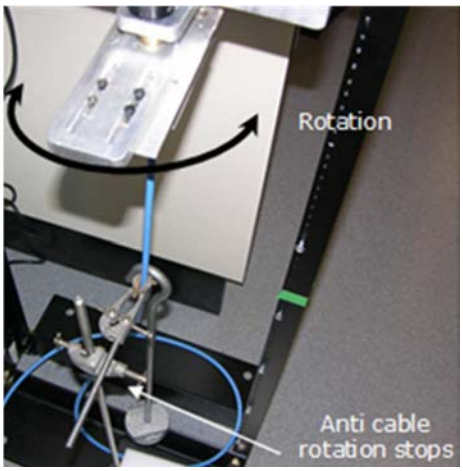
Resistance of Connector Assembly
Figure 3



$$\textbf{IPC Contact Resistance} = R^{⑤} = R_{\text{Plug (Bulk)}} - R^{④} - R^{⑥}$$

Contact Resistance of RJ Style Plug

Figure 4



Flexural Test

Figure 5



6. REVISION SUMMARY

- Rev. A – Initial release.