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## Modular Plugs, Unshielded and Shielded

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### 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)

### 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 °C to +60 °C (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.  Verify contact termination heights  Verify plating thicknesses	IEC 60512-1-1 and -2 Visual and dimensional per quality inspection plan with Certificate of Conformance (C of C)  IEC 60603-7 unshielded or 60603-7-1 for shielded connectors  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 <sub>AD</sub> ): 200 mΩ max.  IEC 60603-7-1, Section 6.4.5 Shield (R <sub>AD</sub> ): 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 <sub>AD</sub> ): 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 $\mu$ s. 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 $\alpha = 30$ 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 $\mu$ s. 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 <sup>2</sup> ) 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 $\mu$ s. 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°) Solid conductor: 50 (0°+90°-0°-90°) 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°-180°) 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°C & 65°C at 93% RH with 5 sub-cycle shocks at -10°C in the 1 <sup>st</sup> 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°C & cold -40°C 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°C, 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 <sub>2</sub> S: 100 ± 20 (10 <sup>-9</sup> vol/vol), SO <sub>2</sub> : 500 ± 100 (10 <sup>-9</sup> vol/vol), Temp.: 25 ± 1°C, 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 <sub>2</sub> S: 100 ± 20 (10 <sup>-9</sup> vol/vol), SO <sub>2</sub> : 500 ± 100 (10 <sup>-9</sup> vol/vol), Temp.: 25 ± 1°C, 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.

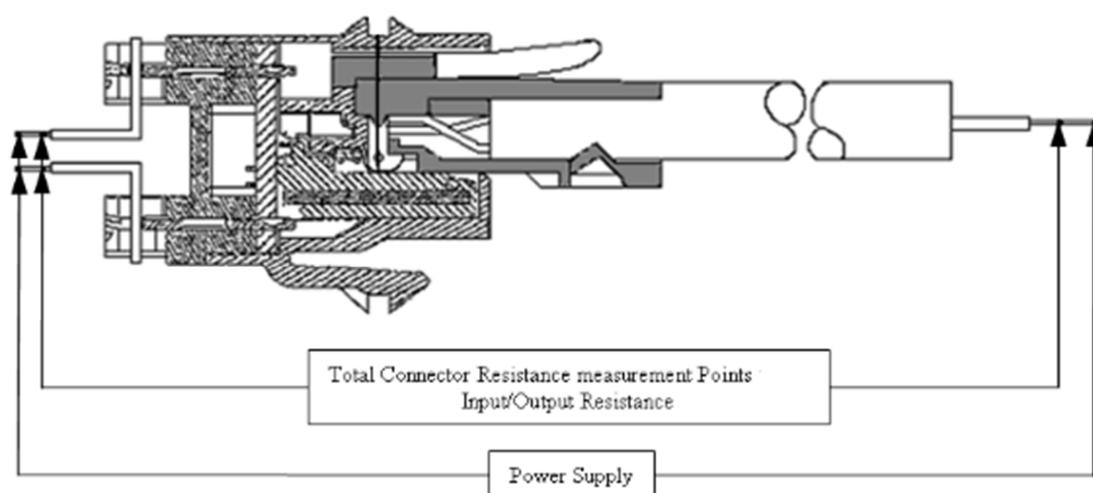
### 4.3. Acceptance

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.

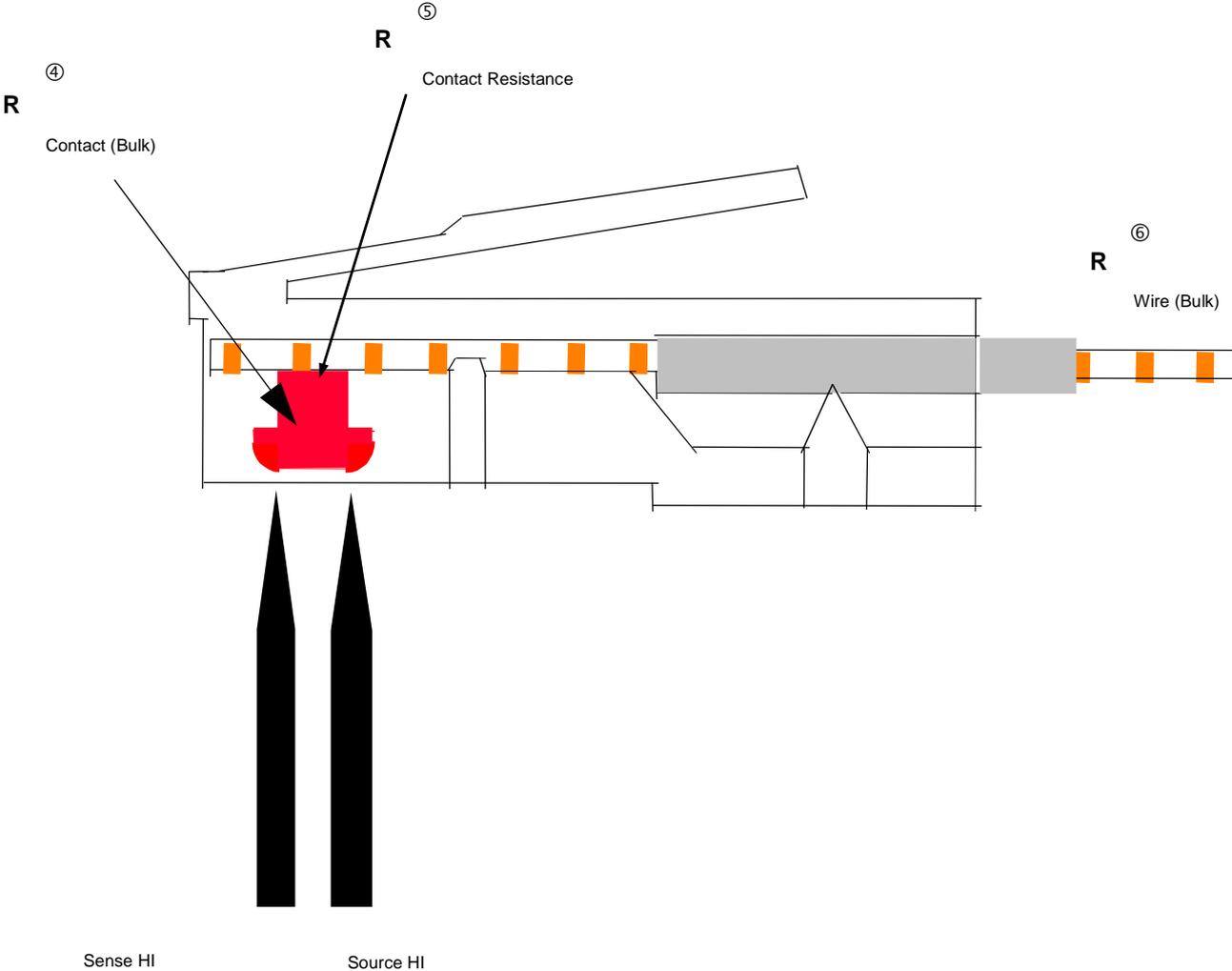
### 4.4. Quality Conformance Inspection

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



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

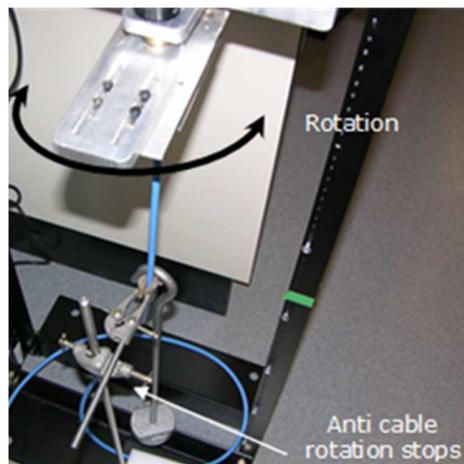
Contact Resistance of RJ Style Plug

Figure 4

Flexural Test  
Figure 5

## 6. REVISION SUMMARY

- Rev. A – Initial release.



## Modular Plugs, Unshielded and Shielded

### 1. INTRODUCTION

#### 1.1. Purpose

Testing was performed on modular plugs to determine their conformance to the requirements of Product Specification 108-131013 Revision A. Test specimens are representative of the entire modular plug product line.

#### 1.2. Scope

This report covers the electrical, mechanical, environmental and transmission performance of modular plugs. Testing was performed and test reports are on file with the Commscope test lab.

#### 1.3. Conclusion

The modular plugs listed in paragraph 1.5 conformed to the electrical, mechanical, environmental and transmission performance requirements of Product Specification 108-131013 Revision A.

#### 1.4. Product Description

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

#### 1.5. Test Specimens

Test specimens were representative of normal production lots. Specimens used as control specimens are not listed in the table below, but shown on the respective test requests in the final test reports. Specimens identified with the following part numbers were used for each test sequence:

Catalog No.	Part Number	Description
MP-6S-(X)	6-2111989-(X)	8P Cat. 6 Shielded Plug
MP-5EMT-B-(X)	6-2111986-(X)	8P Cat 5e EMT Shielded Plug
MP-5EU-(X)	6-569278-(X)	8P Cat. 5e UTP Plug
MP-88U-R-(X)	6-557315-(X)	8P Cat. 5 UTP Plug
MP-44U-F-(X)	6-641334-(X)	4P UTP Plug
MP-6AU-PLUG-A-(X)	6-2843007-(X)	8P UTP Plug
MP-6AU-PLUG-B-(X)	6-2843008-(X)	8P UTP Plug

**NOTE**

*“(X)” Represents packaging quantity designation.*

#### 1.6. Test Conditions:

Unless otherwise stated, tests have been performed at the following ambient conditions:

- Temperature: 70°F ± 5°F
- Relative Humidity: 50% ±10%

## 1.7. 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

## 2. SUMMARY OF TESTING

### 2.1. Initial Examination of Product – All Test Sequences.

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued and stored in the lab test files storage location.

### 2.2. Visual Examination of Product – All Test Sequences

All specimens were visually examined after testing and no evidence of physical damage detrimental to product performance was observed.

### 2.3. Length, Uncoiled Patch Cords – Test Sequence C1

All patch cord lengths were measured to be within print tolerances.

### 2.4. Contact Resistance, IPC/Wire Interface – Test Sequences A1, A2, & A3

Final delta resistance measurements taken at 100 mA maximum and 20 mV maximum open circuit voltage were within specified limits.

### 2.5. Input to Output DC Resistance – Test Sequences B1, B2, B3, & B4

Maximum total mated connector resistance measured values were less than 200 mΩ.

### 2.6. Input to Output DC Resistance Unbalance – Test Sequences B1, B2, B3, & B4

The differences between maximum and minimum total connector resistance measured values were less than 50 mΩ.

### 2.7. Insulation Resistance – Test Sequence B1, B2, B3, & B4

All insulation resistance measurements were greater than 500 MΩ minimum.

### 2.8. Voltage Proof - Test Sequence B1, B2, B3, & B4

All specimens passed testing with no dielectric breakdown or flashover occurring.

### 2.9. Current Carrying Capacity – Test Sequence B5

The maximum allowed environmental temperature at rated current is 60°C.

### 2.10. Plug Insertion & Withdrawal Force – Test Sequence B1

All forces were less than 20 N.

### 2.11. Plug Retention in Jack – Test Sequence B1

All specimens withstood an applied axial load of 50 N with latch engaged for 60 seconds.

### 2.12. Mechanical Operation Durability – Test Sequence B2

No physical damage occurred to the specimens as a result of mating and un-mating the specimens for 375 cycles with latch inoperative.

### 2.13. Cable Bending – Test Sequence A1

No physical damage or discontinuity occurred to the specimens as a result of cable bending for the total number of cycles.

### 2.14. Vibration, IPC/Wire Interface – Test Sequence A2

All specimens passed vibration testing with no evidence of physical damage.

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- 2.15. Vibration, Plug/Jack – Test Sequence B3  
All specimens passed vibration testing with no evidence of physical damage.
  - 2.16. Rapid Change of Temp, IPC/Wire Interface – Test Sequence A2  
No evidence of physical damage was visible as a result of exposure to rapid change in temperature.
  - 2.17. Rapid Change of Temp, Plug/Jack – Test Sequence B1  
No evidence of physical damage was visible as a result of exposure to rapid change in temperature.
  - 2.18. Climatic Sequence – Test Sequence A2  
No evidence of physical damage was visible as a result of exposure to climatic sequence.
  - 2.19. Cyclic Damp Heat – Test Sequence B1  
No evidence of physical damage was visible as a result of exposure to cyclic damp heat sequence.
  - 2.20. Electrical Load and Temperature – Test Sequence B4  
No evidence of physical damage was visible as a result of exposure to stress relaxation.
  - 2.21. Flowing Mixed Gas Corrosion, IPC/Wire Interface – Test Sequence A3  
No evidence of physical damage was visible as a result of exposure to flowing mixed gas corrosion.
  - 2.22. Flowing Mixed Gas Corrosion, Plug/Jack – Test Sequence B2  
No evidence of physical damage was visible as a result of exposure to flowing mixed gas corrosion.
  - 2.23. Tensile, Patch Cord – Test Sequence C1  
No physical damage occurred to the specimens for the applied tensile load.
  - 2.24. Flexural, Patch Cord – Test Sequence C1  
No physical damage occurred to the specimens for the total number of flexural cycles.
  - 2.25. Torsional, Patch Cord – Test Sequence C1  
No physical damage occurred to the specimens for the total number of torsional cycles.
  - 2.26. Wire Map, Patch Cord – Test Sequence C1  
Specimens passed the wire maps.
  - 2.27. Return Loss, Patch Cord – Test Sequence C1  
Specimens passed RL requirements before and after mechanical testing.
  - 2.28. NEXT, Patch Cord – Test Sequence C1  
Specimens passed NEXT requirements before and after mechanical testing.

### **3. TEST METHODS**

#### **3.1. Initial Examination of Product**

A Certificate of Conformance was issued stating that all specimens in this test package have been produced, inspected, and accepted as conforming to product drawing requirements, and made using the same core manufacturing processes and technologies as production parts.

Contact termination heights were measured and recorded to confirm within acceptable tolerance limits.

#### **3.2. Visual Examination of Product – All Test Sequences**

Visual inspection was performed at the end of each test sequence.

3.3. Length, Uncoiled Patch Cords – Test Sequence C1

Physical length of each patch cord assembly was measured for reference.

3.4. Contact Resistance, IPC/Wire Interface – Test Sequences A1, A2, & A3

Termination resistance measurements were derived by measuring the total voltage drop from an applied 20 mV maximum open circuit voltage at 100 mA maximum across the plugs IPC contact and terminated wire, then subtracting the average bulk resistance of these components.

3.5. Input to Output DC Resistance – Test Sequences B1, B2, B3, & B4

Input to output resistance measurements were made using the four-terminal technique as shown in Figure 1.

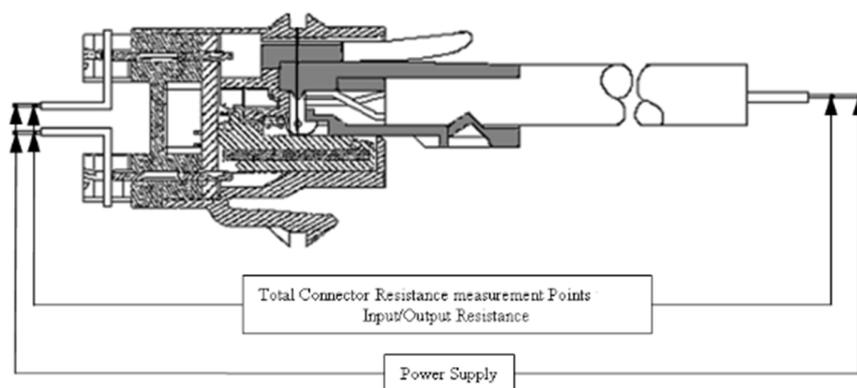


Figure 1

Input to Output DC Resistance Measurement Points

3.6. Input to Output DC Resistance Unbalance – Test Sequences B1, B2, B3, & B4

Input to output resistance unbalance was calculated as the maximum difference between maximum and minimum resistance measurements.

3.7. Insulation Resistance – Test Sequence B1, B2, B3, & B4

Insulation resistance was measured between adjacent contacts of mated specimens. A test voltage of 100 volts DC, 500 MΩ minimum was applied for a 1 minute hold.

3.8. Voltage Proof - Test Sequence B1, B2, B3, & B4

A test potential of 1000 volts DC was applied to a terminated jack with a mated plug, between each contact and all other contacts being connected together, and held for 1 minute.

3.9. Current Carrying Capacity – Test Sequence B5

A series of DC loading currents were applied to the specimen, each application of current being allowed to reach thermal stability. The hottest contact temperature and ambient temperature were recorded at each current. The average temperature rise was calculated and used to generate the basic current current-carrying curve, which was in turn used to generate the de-rating curve. The de-rating curve was compared with the ambient temperature rating.

3.10. Plug Insertion & Withdrawal Force – Test Sequence B1

The force required to mate & unmate individual specimens was measured with latch depressed at a maximum rate of 50 mm per minute per IEC 60512-13-2.

3.11. Plug Retention in Jack – Test Sequence B1

An axial load of 50N was applied for 60 seconds to mated connector assemblies in a direction that would cause the connector latches to disengage.

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3.12. Mechanical Operation Durability – Test Sequence B2

Specimens were mated and unmated for 375 cycles with latch inoperative; maximum rate was 10mm/sec.

3.13. Cable Bending – Test Sequence A1

An axial load of 22 N was applied to the free end of a cable terminated to a plug. The plug was then rotated 30 degree in both directions to bend the cable a total of 5 cycles in each direction. Contact disturbance was monitored throughout the test.

3.14. Vibration, IPC/Wire Interface – Test Sequence A2

Specimens were subjected to sinusoidal vibration from 10 to 55 Hz; displacement amplitude: 0.35mm; 10 sweeps per axis of 3 mutually perpendicular axes.

3.15. Vibration, Plug/Jack Interface – Test Sequence B3

Specimens were subjected to sinusoidal vibration from 10 to 500 Hz; displacement amplitude: 0.35mm; acceleration: 5g; 10 sweeps per axis of 3 mutually perpendicular axes.

3.16. Rapid Change of Temp, IPC/Wire Interface – Test Sequence A2

Terminated plugs were subjected to 5 cycles between -40°C & 70°C with 30 minute dwells at temperature extremes. 2 hour recovery time.

3.17. Rapid Change of Temp, Plug/Jack – Test Sequence B1

Specimens were subjected to 25 cycles between -40°C & 70°C with 30 minute dwells at temperature extremes. 2 hour recovery time.

3.18. Climatic Sequence – Test Sequence A2

Terminated plugs were subjected to a dry heat of 70°C & -40°C for 1 cycle.

3.19. Cyclic Damp Heat – Test Sequence B1

Specimens were subjected to 21 cycles between 25 and 65°C with 93% RH with 5 subcycles at -10°C.

3.20. Electrical Load and Temperature – Test Sequence B4

Specimens were subjected to 70°C for 500 hours, 2 hour recovery. Half of the specimens were energized with 0.8 ampere DC, the remaining half not energized.

3.21. Flowing Mixed Gas Corrosion, IPC/Wire Interface – Test Sequence A3

Terminated plugs were exposed for 10 days to a mixed flowing gas per IEC 60512-11-7 Method 1. Exposure is defined as a temperature of 25°C and a relative humidity of 75% with the pollutants of H<sub>2</sub>S: 100±20 (10<sup>-9</sup> vol/vol), SO<sub>2</sub>: 500±100 (10<sup>-9</sup> vol/vol).

3.22. Flowing Mixed Gas Corrosion, Plug/Jack – Test Sequence B2

Specimens were exposed for 4 days to a mixed flowing gas per IEC 60512-11-7 Method 1. Exposure is defined as a temperature of 25°C and a relative humidity of 75% with the pollutants of H<sub>2</sub>S: 100±20 (10<sup>-9</sup> vol/vol), SO<sub>2</sub>: 500±100 (10<sup>-9</sup> vol/vol). Half of the specimens were mated (terminated plug/jack) & half unmated.

3.23. Tensile, Patch Cord – Test Sequence C1

An axial load of 22 N was applied to the common axis of the cable and plug with a 1 minute hold.

3.24. Flexural, Patch Cord – Test Sequence C1

An axial load of 2 N was applied to the free end of a cable terminated to a plug. The plug was then rotated 90 degrees in both directions to flex the cable. Flexural cycles were performed between two perpendicular axis with a total of 250 cycles applied for stranded conductor wire and 50 cycles for solid conductor wire.

**3.25. Torsional, Patch Cord – Test Sequence C1**

An axial load of 10 N was applied to the free end of a cable terminated to a plug. The plug was then rotated 180 degrees in both direction with the cable fixed at a distance of 330 mm from the plug to apply a torsional force. Rate was 20 complete torsion cycles per minute.

**3.26. Wire Map, Patch Cord – Test Sequence C1**

Patch cord cable assemblies were tested in wire map scanning mode using a calibrated Fluke DTX-1800 cable analyzer together with patch cord test heads.

**3.27. NEXT, Return Loss, & Wire Map, Patch Cord – Test Sequence C1**

Transmission testing was performed using a calibrated Fluke Networks DTX-1800 cable analyzer together with the appropriate patch cord test heads.

**4. REVISION SUMMARY**

- Revision A – Initial Release
- Revision B – Remove 2.1 Test Sequence / Report Summary, Add 2 additional Catalog Nos.

# CERTIFICATE

Certificate Number: 111045.000  
Including Seven Page Addendum

The Quality Management System and implementation of:

## CommScope, Inc.

With Virtual Central Function at:  
1100 CommScope Place SE  
Hickory, NC 28602  
United States

meets the requirements of the standard:

## ISO 9001:2015

### Scope:

The sales, marketing, design, manufacture, test, repair, support, service, and distribution of telecommunications products, components, and services for the telecommunications, wireless, and broadcast networks industries

Certificate Expires: January 04, 2026  
Certificate Issued: January 05, 2023  
Certified Since: January 10, 2001

Business Segments	Exceptions
Connectivity and Cable Solutions (CCS)	None
Networking, Intelligent Cellular & Security Solutions (NICS)	None
Outdoor Wireless Networks (OWN)	None
Access Network Solutions (ANS)	None



Dr. Cem O. Onus  
Managing Director

DEKRA Certification, Inc.  
1945 The Exchange SE #300  
Atlanta, GA 30339 USA  
(215) 997-4519  
<https://www.dekra.us/en/audits/>



# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
ADDENDUM Page One of Seven

The Quality Management System and implementation of:

## CommScope, Inc.

meets the requirements of the standard:

## ISO 9001:2015

<b>Site Activities Legend:</b>	HQ = Headquarters	MFG = Manufacturing	SER = Services (Professional Services and/or Technical Support)
	HW DE= Hardware Development	REP = Repair	SC = Purchasing, Supplier Management, Manufacturing Support, Repair Support
	SW DE= Software Development	SAL = Sales, Marketing	DIST = Distribution

<b>Site Address</b>	<b>Site Activities</b>
CommScope Inc 1100 CommScope Place SE Hickory, NC 28602 United States	HQ (Virtual)
ARRIS Technology, Inc. 3871 Lakefield Drive Suwanee, GA 30024 United States	HW & SW DE, SAL, SER, SC
ARRIS Technology, Inc. 101 Tournament Dr. Horsham, PA, 19044 United States	HW & SW DE, SAL, SER, SC
ARRIS Technology, Inc. 6450 Sequence Drive San Diego, CA 92121 United States	SW DE, SER
ARRIS Technology, Inc. 900 Chelmsford St. Lowell, MA 01851 United States	HW & SW DE, SER, SC

Certificate Expires: January 04, 2026  
Certificate Issued: January 05, 2023  
Certified Since: January 10, 2001



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# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
 ADDENDUM Page Two of Seven

The Quality Management System and implementation of:

**CommScope, Inc.**

meets the requirements of the standard:

**ISO 9001:2015**

Site Address	Site Activities
ARRIS Solutions, Inc. 2400 Ogden Ave., Suite 180 Lisle, IL 60532 United States	HW & SW DE, SAL, SER, SC
ARRIS 15 Sterling Drive Wallingford, CT 06492 United States	HW & SW DE, SER, SC
ARRIS Technology, Inc. 2450/2500 Walsh Avenue Santa Clara, CA 95051 United States	HW & SW DE, SAL, SER
Ruckus Wireless International Inc. 350 West Java Dr. Sunnyvale, CA 94089 United States	HW & SW DE, SER
Ruckus Wireless Network Technology (Shenzhen) Co. Ltd. Units C&D, 5th Floor, No. 2 Finance base, 8 KeFa Road, Shenzhen, China	SW DE, SC, HW DE

Certificate Expires: January 04, 2026  
 Certificate Issued: January 05, 2023  
 Certified Since: January 10, 2001



Dr. Cem O. Onus  
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# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
ADDENDUM Page Three of Seven

The Quality Management System and implementation of:

**CommScope, Inc.**

meets the requirements of the standard:

**ISO 9001:2015**

Site Address	Site Activities
CommScope Asia (Suzhou) Technologies Co., Ltd. 77 Qiming Road, Suzhou Industrial Park Suzhou, Jiangsu 215121 Peoples Republic of China	MFG, SC
Ruckus Wireless International Inc., Taiwan Branch @ Neihsu District, Taipei City, Rui Road 411, 10th floor, Taipei	SW DE
ARRIS Group India Pvt Limited (AGIPL) Salarpuria Supreme, Ground Floor West Wing & First Floor Munnekolalu Village, Varthur Hobli, Outer Ring Road, Bangalore-560037	SW DE
ARRIS Group de Mexico S.A. de C.V. Av. La Paz 11721 Parque Industrial Pacifico Tijuana, BC 22643 Mexico	MFG, REP, SC
ARRIS Communications Ireland Limited Building 4300, Cork Airport Business Park Kinsale Road Cork County Ireland	HW & SW DE
ARRIS Group India Private Limited "The Senate" No:33/1, Ulsoor Road, Bangalore - 560 042 India	HW & SW DE

Certificate Expires: January 04, 2026  
Certificate Issued: January 05, 2023  
Certified Since: January 10, 2001



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# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
ADDENDUM Page Four of Seven

The Quality Management System and implementation of:

**CommScope, Inc.**

meets the requirements of the standard:

**ISO 9001:2015**

Site Address	Site Activities
ARRIS Group, Inc. 50 Stranmillis Embankment Belfast, BT95FL Northern Ireland	SW DE
CommScope Czech Republic, s.r.o Turanka 856/98B 627 00 Brno Czech Republic	HW DE,
CommScope CZ, spol. s.r.o. U Morusi 888, 53006 Pardubice Czech Republic Czech Republic	HW DE,
CommScope Connectivity UK Limited Units 1 and 4 Kinmel Park Industrial Estate Bodelwyddan, Denbighshire, LL18 5TZ United Kingdom	HW DE, MFG, SAL
CommScope Design & Integration UK Ltd. Unit 5 & 6 Eden Business Park Eden House Drive Old Malton, Malton, North Yorkshire YO17 6AE United Kingdom	HW DE, MFG, SC

Certificate Expires: January 04, 2026  
Certificate Issued: January 05, 2023  
Certified Since: January 10, 2001



Dr. Cem O. Onus  
Managing Director

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1945 The Exchange SE #300  
Atlanta, GA 30339 USA  
(215) 997-4519  
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# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
ADDENDUM Page Five of Seven

The Quality Management System and implementation of:

## CommScope, Inc.

meets the requirements of the standard:

## ISO 9001:2015

Site Address	Site Activities
CommScope Design & Integration UK Limited 412 The Quadrant, Birchwood Park Warrington, WA3 6FW United Kingdom	SER
CommScope EMEA Ltd. Corke Abbey Avenue Bray, Co. Dublin Ireland	MFG, SAL
CommScope EMEA Ltd. Diestsesteenweg 692 3010 Kessel-Lo, Belgium	HW DE, MFG, SAL
CommScope Italy Srl Via Archimede, 22/24 Agrate Brianza (MB) 20864 Italy	HW DE, REP, SW DE
Telecom Networks Americas AV. HIPOLITO YRIGOYEN 2999, DEPOSITO 6 EL TALAR, TIGRE Buenos Aires B1618AXD Argentine Republic	SAL, DIST
CommScope Networks India Private Limited Salarpuria Softzone, A Block, 1st Floor Survey No 80/1, 81/1, 81/2, B Wing, Belandur Village, Varthur Hobli, Outer Ring Bangalore – Karnataka 560103 India	SW DE
ADC India Communications Ltd. No 10 C , 2nd Phase Peenya Industrial Area Bangalore – Karnataka 560058 India	MFG, SC

Certificate Expires: January 04, 2026  
Certificate Issued: January 05, 2023  
Certified Since: January 10, 2001



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# CERTIFICATE ADDENDUM

Certificate Number: 111045.000  
ADDENDUM Page Six of Seven

The Quality Management System and implementation of:

## CommScope, Inc.

With site at:

## CommScope Asia (Suzhou) Technologies Co.,Ltd.

77 Qiming Road, Suzhou Industrial Park  
Suzhou, Jiangsu 215121  
Peoples Republic of China

meets the requirements of the standard:

## ISO 9001:2015

The validity of this certificate depends on the validity of the main certificate.

### Scope:

Production of network cable, fiber cable and communication equipment component (copper patch cords, copper panel, accessories etc.)

**Certification Structure:** Multi-site

Certificate Expires:	January 04, 2026
Certificate Issued:	January 05, 2023
Certified Since:	January 10, 2001



Dr. Cem O. Onus  
Managing Director

DEKRA Certification, Inc.  
1945 The Exchange SE #300  
Atlanta, GA 30339 USA  
(215) 997-4519  
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# 证书附录

证书编号: 111045.000

附录第7页,共7页

质量管理体系和实施:

**CommScope, Inc.**

其场所:

**康普科技 (苏州) 有限公司**

中国江苏省苏州工业园区启明路77号,邮编215121

符合以下标准要求:

## ISO 9001:2015

本证书的有效性取决于主证书的有效性。

### 范围:

网络线、光缆、通信系统设备材料(网络跳线、配线装置等)的生产。

认证结构: 多场所

证书有效期: 2026.01.04

发证日期: 2023.01.05

首次发证日期: 2001.1.10



Dr. Cem O. Onus  
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# Certificate of Registration

ENVIRONMENTAL MANAGEMENT SYSTEM - ISO 14001:2015

This is to certify that:

CommScope, Inc. of North Carolina  
1100 CommScope Place SE  
Hickory  
North Carolina  
28603-0339  
USA

Holds Certificate No:

**EMS 648387**

and operates an Environmental Management System which complies with the requirements of ISO 14001:2015 for the following scope:

The environmental management system to control the risks associated with the manufacture, distribution, field support and central function of telecommunication products and services.

For and on behalf of BSI:

  
\_\_\_\_\_  
Carlos Pitanga, Chief Operating Officer Assurance – Americas

Original Registration Date: 2016-03-01

Effective Date: 2022-03-15

Latest Revision Date: 2022-04-21

Expiry Date: 2025-03-14

Page: 1 of 5



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Certificate No: **EMS 648387**

Location	Registered Activities
Andrew Telecommunications de Reynosa S. de R.L. de C.V. Av. Industrial Reynosa Lte 2 al 5 Parque Industrial Center Reynosa Tamaulipas 88780 Mexico	Manufacture and distribution of telecommunication products including antenna and cable.
CommScope Asia (Suzhou) Technologies Co., Ltd. EPZ II, 77 Qiming Road Suzhou Industrial Park Suzhou Jiangsu 215121 China	Manufacture and distribution of telecommunication products, including cable.
Andrew Telecommunications India Pvt. Ltd. Plot No. N-2, Phase IV Verna Industrial Estate Verna Salcette Goa 403 722 India	Manufacture and distribution of telecommunication products, including antenna and cable.
CommScope EMEA Ltd. Corke Abbey Avenue Bray County Dublin A98FY03 Ireland	Manufacture and distribution of telecommunication products, including cable and connectors.
CommScope Telecommunications (China) Co., Ltd. 68 West Su Hong Xi Lu Suzhou Industrial Park Suzhou Jiangsu 215021 China	Manufacture and distribution of telecommunication products, including antenna and cables.

Original Registration Date: 2016-03-01

Latest Revision Date: 2022-04-21

Effective Date: 2022-03-15

Expiry Date: 2025-03-14

Page: 2 of 5

Certificate No: **EMS 648387**

Location	Registered Activities
Andrew Wireless Systems GmbH Industriering 10 Buchdorf 86675 Germany	Manufacture and distribution of telecommunication products, including amplifiers and antenna systems.
CommScope, Inc. of North Carolina 1100 CommScope Place SE Hickory North Carolina 28603-0339 USA	Corporate headquarters responsible for management system oversight of all locations listed on this certificate.
CommScope Inc. 6519 CommScope Road Catawba North Carolina 28609-0199 USA	Manufacture and distribution of telecommunication products, including cable.
CommScope Inc. 3642 US Hwy 70 East Claremont North Carolina 28610-0879 USA	Manufacture and distribution of telecommunication products, including cable.
CommScope Czech Republic s.r.o. Turanka 98B Brno 62700 Czech Republic	Manufacture and distribution of telecommunication products, including connectors and terminations.
CommScope Inc. of North Carolina 1100 CommScope Place SE Hickory North Carolina 28603-0339 USA	Customer care, facility maintenance, and administrative functions.
ADC de Delicias, S. de R.L. de C.V. Blvd. Fernando Baeza No. 1301 Sur Delicias Chihuahua 33000 Mexico	Manufacturing and distribution of telecommunication products.

Original Registration Date: 2016-03-01

Latest Revision Date: 2022-04-21

Effective Date: 2022-03-15

Expiry Date: 2025-03-14

Page: 3 of 5

Certificate No: **EMS 648387**

Location	Registered Activities
ADC de Juarez S. de R.L. de C.V. Parque Industrial Antonio J Bermudez Ciudad Juarez Chihuahua 32470 Mexico	Manufacturing and distribution of telecommunication products.
CommScope Connectivity Belgium bvba Diestsesteenweg 692 Kessel-lo 3010 Belgium	Manufacture and distribution of telecommunication products.
CommScope Technologies de Juarez S. de R.L. de C.V. Santiago Troncoso 331 Praderas del Sur, Ciudad Juarez Chihuahua 32575 Mexico	Manufacture of Fiber Optic Splice Closures (FOSC), Fiber Guide Systems (FGS), Hardened Connectivity and Molding-Gel Filling, including: plastic injection molding, plastic extrusion, plastic and metal machining, and assembly operations.
CommScope Connectivity UK Limited Unit 1 Kinmel Park Bodelwyddan Rhyl, Denbighshire LL18 5TZ United Kingdom	Fibre optic cable manufacturing, termination and design of other telecommunication products and services.
CommScope 11312 S. Pipeline Road Eules Texas 76040 USA	Manufacture, distribution, field support and central function of telecommunication products.
ARRIS GROUP DE MEXICO SA DE CV Av. De la Paz, #11721 Parque Industrial Pacifico Tijuana Baja California 22643 Mexico	Manufacture, repair, support, repair service, distribution of products and components for telecommunications that provide integrated solutions for voice, video and data through the processes of SMT, manual and mechanical assembly, soldering (manual, selective, printed, wave) electrical testing and packaging.

Original Registration Date: 2016-03-01

Effective Date: 2022-03-15

Latest Revision Date: 2022-04-21

Expiry Date: 2025-03-14

Page: 4 of 5

Certificate No: **EMS 648387**

Location	Registered Activities
CommScope Design & Integration UK Ltd Unit 5 & 6, Eden Business Park Edenhouse Drive Old Malton Malton YO17 6AE United Kingdom	Manufacture and distribution of telecommunications products including cabinets.
Arris Indústria Eletrônica do Brasil Ltda. CNPJ: 09.154.836/0001-15 Avenida Torquato Tapajós, 9475 Tarumã Manaus Amazonas 69041-025 Brasil	Manufacturer and distribution of Receivers, Television signal Decoders and Modulator/Router.
CommScope Design and Integration UK Ltd. Lovell House, 412 The Quadrant Birchwood Park Warrington WA3 6FW United Kingdom	Telecommunications project management, site surveys, installations commissioning and rigging.

Original Registration Date: 2016-03-01

Latest Revision Date: 2022-04-21

Effective Date: 2022-03-15

Expiry Date: 2025-03-14

Page: 5 of 5



# Implementation considerations for cabling supporting remote powering

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# Background

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Remote powering, such as Power over Ethernet (PoE), is a popular method of dc power delivery using communications cabling, with more than 100 million nodes installed around the globe. Power over Ethernet has evolved—from initially sourcing up to 15 watts at the power source equipment (PSE) as specified in IEEE Std. 802.3af-2003, increasing to up to 30 watts in IEEE Std 802.3at-2009, and now increasing further by IEEE 802.3bt standard to source up to 90 watts at the PSE. It is important to note that all PoE powering levels and classifications comply with the SELV (Safety Extra Low Voltage) 60 volts and LPS (Limited Power Source) 100 VA (watts) requirements in IEC 60950-1, making PoE a low-risk, reliable, and cost-effective application for delivering power over the same balanced twisted-pair cabling used for data communications.

Cabling infrastructure standards development organizations such as TIA, ISO/IEC, CENELEC, and NEC have published and/or are developing specifications with design, installation and operational guidelines to facilitate reliable and robust deployment of remote powering networks, including PoE. The documents listed below are the source of many of the guidelines included in these implementation considerations.

The guidelines in the documents to the right include maximum current carrying capacity of category cables typically used in enterprise commercial buildings under various installation conditions and ambient temperatures. This allows the cabling to be designed, installed and operated to optimize thermal and electrical performance in various configurations. The guidelines support delivery of power using all four pairs with up to 1000 mA per pair (500 mA per conductor) for a maximum power of 100 VA (100 watts) at the power source over four-pair cabling, assuming a nominal 50 V power supply at the PSE.

Additionally, to improve the consistency and harmonization of installation practices, the proposed IEC 60364-7-716 (new part of the IEC Electrical installation standard used as a reference document in many international electrical codes) states that—if telecommunication cabling is used for power delivery—it shall be planned and installed in accordance with ISO/IEC 14763-2 or CENELEC EN 50174 series.

## Implementation Considerations

- A** TIA TSB 184-A Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
- B** ISO/IEC TS 29125 INFORMATION TECHNOLOGY—TELECOMMUNICATIONS CABLING REQUIREMENTS FOR REMOTE POWERING OF TERMINAL EQUIPMENT
- C** CENELEC CLC/TR 50174-99-1 Information technology—Cabling installation—Part 99-1: Remote powering
- D** NEC NFPA 70 Code
- E** TIA 569.D-2 Additional pathway and space considerations for supporting remote powering over balanced twisted-pair cabling
- F** ISO/IEC 14763-2 revision including remote power planning and installation is in development

## Advantages of remote powering using communications cabling

Remote powering such as PoE facilitates the use of communications cabling for the support of remote power delivery without compromising the data communications functionality, thereby increasing the utility of communications cabling. This dual usage makes power delivery cost-effective while also enabling power delivery to a wider range of devices. These guidelines are intended to support all types of power and classifications being developed by IEEE 802.3bt, IEEE 802.3at and IEEE 802.3af for a variety of use cases, ranging from wireless access points (WAPs) to cameras, lighting, and intelligent building systems (IBS) devices. Other advantages of remote dc powering over communications cabling include:

- Smaller size of cables and connectors compared to ac line power, enabling higher density
- Enhanced communication between PSE and powered device (PD) for calibrated and reliable powering
- Continuous monitoring of the circuit for faults and other operating conditions
- Lower installation costs since low-voltage-cabling installers can install the cabling at the same time as part of communications cabling
- Improved control and operation of devices for better facility management
- Synergies created by power delivery simultaneous with communication, enabling a diverse and intelligent infrastructure (e.g., smart LED lighting)
- UPS backup, enabling robust and reliable operation

## CommScope implementation considerations for remote powering

### WHAT ARE THE VARIOUS FACTORS TO CONSIDER WHEN IMPLEMENTING REMOTE POWERING?

Factors that affect and influence the efficient operation of remote powering include:

1. Type of cables, cords, and connectors selected
2. Type of pathway infrastructure used to support the cables
3. Cable bundling configurations
4. Cable routing lengths

### COMMSCOPE APPROACH TO DESIGN AND INSTALLATION

CommScope's recommendation for a robust and reliable installation to support remote powering is to use a holistic approach covering all aspects, including:

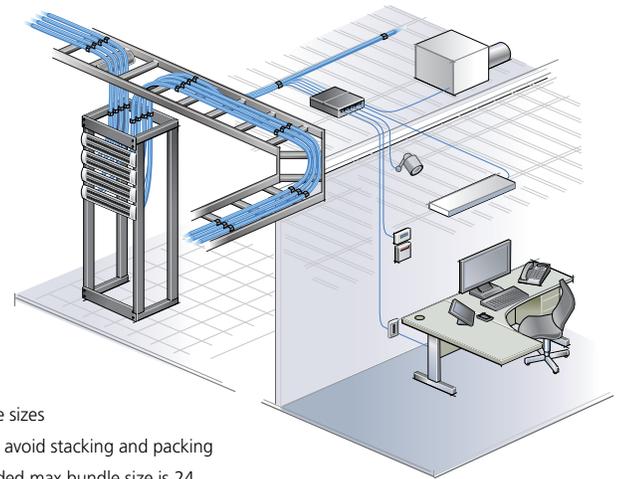
- Cable types and installation practices
- Pathway types and routing distances
- Accurate administration and optimal operations

# CommScope implementation considerations for remote powering

## TYPICAL DISTRIBUTION TOPOLOGY IN BUILDINGS

Figure 1 shows an illustration for the typical cabling topology used in buildings. For efficient PoE deployments, bundle sizes should be limited—and bundles should not be stacked or packed tightly. As a simple rule of thumb, we recommend that bundle sizes be limited to a maximum of 24 cables per bundle\*, allowing gauge sizes from 24 AWG or larger to be within the cable temperature rating of 60°C when installed in worst-case conditions. A worst-case ambient temperature of 45°C is used for both air and conduit, with the conduit being the worst-case installation condition.

NOTE: 24-cable bundles match typical patch panel configurations, and is a practical configuration—for installation considerations—that also provides some extra margin.



NOTES:

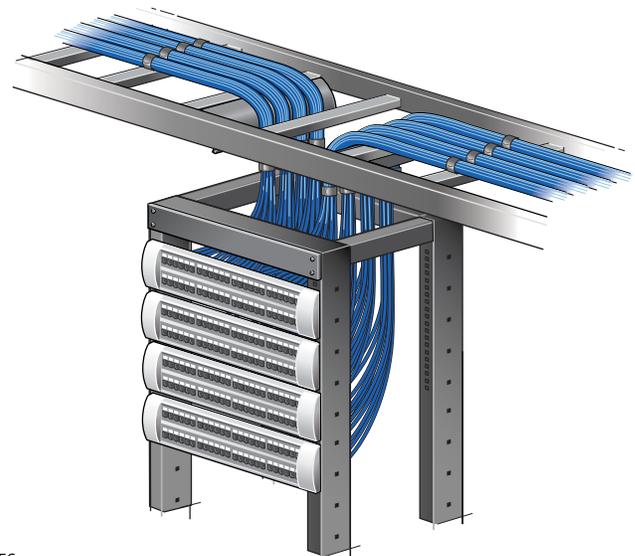
1. Limit bundle sizes
2. Organize to avoid stacking and packing
3. Recommended max bundle size is 24

**Figure 1**

Illustration of typical cabling topology

## CABLE MANAGEMENT IN EQUIPMENT ROOMS AND TELECOMMUNICATIONS ROOMS

Cable bundles are commonly used in telecommunications rooms, equipment rooms and entrance facilities to manage and route cables in an aesthetic manner. Figure 2 illustrates a typical cabling topology used in equipment rooms and telecommunications rooms.



NOTES:

1. Cable bundles open to air flow throughout rack space
2. 24 cable bundles patch panel exiting on both sides of patch panel

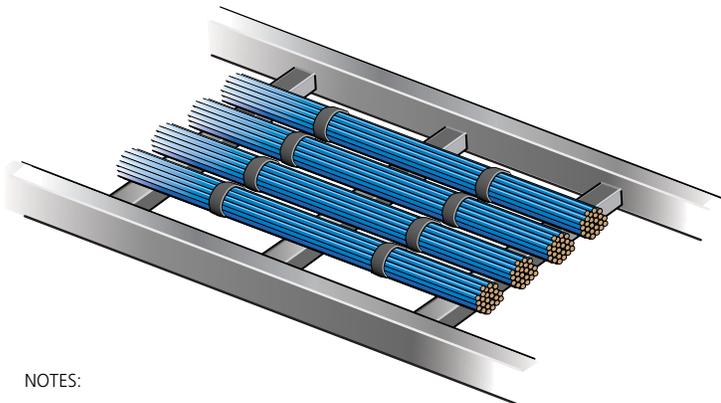
**Figure 2**

Illustration of 24-cable bundles in equipment and telecommunications rooms

# CommScope implementation considerations for remote powering

## CABLE MANAGEMENT IN HORIZONTAL DISTRIBUTION

The horizontal cabling design should configure cables to allow maximum ventilation by selecting pathway systems that spread the cables over the full width of a pathway. Figure 3 shows an illustration for typical cabling installation in a tray. Figure 4 shows an example of a typical installation of multiple bundles in ceiling trays.



NOTES:

1. Some amount of space should be maintained between bundles to allow for free air flow
2. Aligned strap positioning can be used to create gap

**Figure 3**

Illustration of cables in ceiling trays



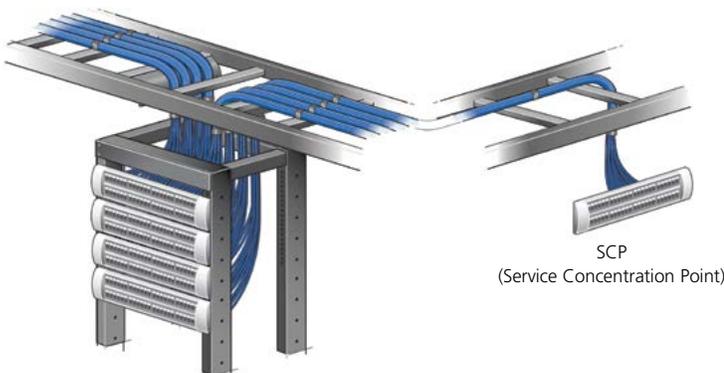
**Figure 4**

Example installation of cables in ceiling trays

## SERVICE CONCENTRATION POINT TERMINATION

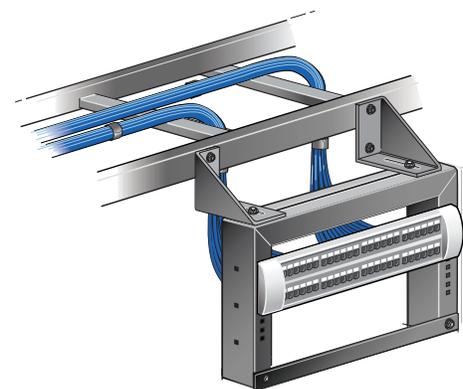
Figure 5 shows an illustration for routing and termination at service concentration points (SCP) near the ceiling. A distributed ceiling grid cabling installation—according to ISO/IEC 11801-6 (in development), EN 50173-6 or TIA-862-B—allows future proofing and flexibility when installing several different remote-powered applications that are connected above the ceiling.

Figure 6 shows close-up detail of cable termination at a service concentration point (SCP).



**Figure 5**

Illustration of routing and termination at an SCP



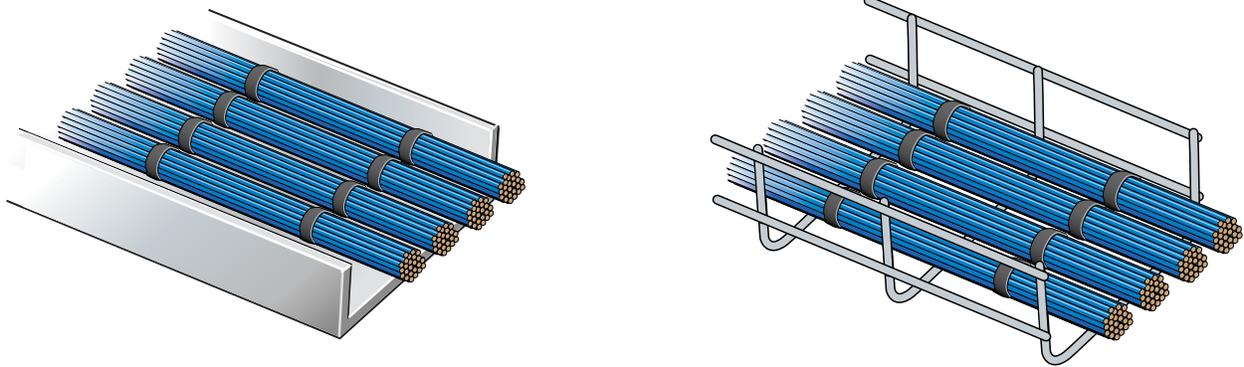
**Figure 6**

Illustration of mounting and cable termination at a SCP

# CommScope implementation considerations for remote powering

## PATHWAY SYSTEMS

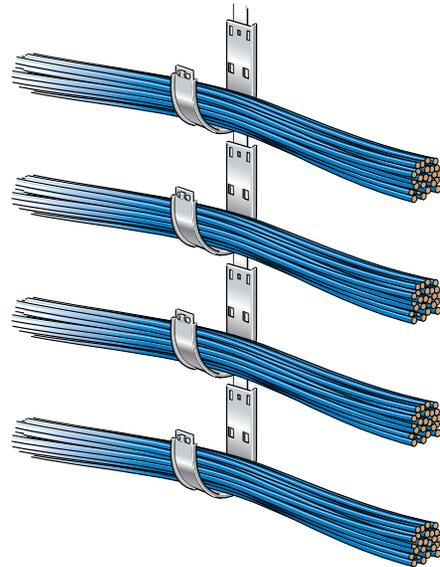
Pathway systems can affect heat dissipation and impact the temperature rise in a cable bundle. Figure 7 shows two pathways with identical cable bundles and size. Typically, the wire basket has a lower temperature rise than the solid bottom cable tray because of more air circulation.



**Figure 7**

Illustration of cable bundles in solid-bottom and wire mesh cable tray

Figure 8 shows an illustration of cables installed in non-continuous cable supports—allowing air circulation around the cables and also serving to control the number of cables in the bundle.



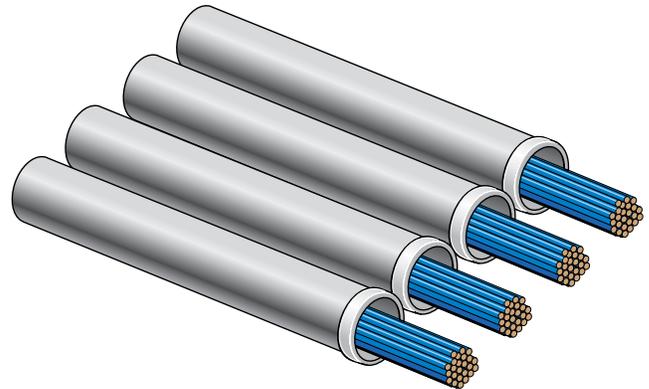
**Figure 8**

Example of cables in non-continuous support

# CommScope implementation considerations for remote powering

## INSTALLATION IN CONDUIT

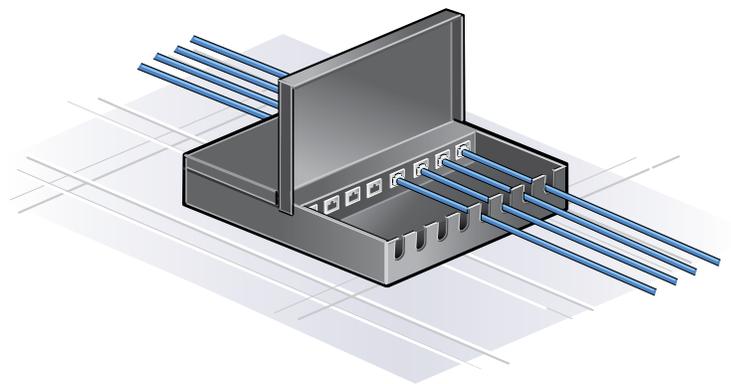
Installation in conduit degrades thermal performance—with a higher temperature rise than open-air installation. Conduit installation should be minimized to only those areas mandated by the local authority having jurisdiction (AHJ), using a maximum fill percentage of 40 percent and maximum bundle sizes of 24 cables per bundle. Figure 9 shows an example of a 2-inch conduit installation with an approximate fill of 24 percent for typical Category 5e cables.



**Figure 9**  
Example of cables in conduits

## Remote powering equipment

Equipment for remote power delivery connected to cabling shall comply with IEC 62949 or EN 62368-3. The installer should check the nameplate on the remote powering equipment to determine if there is a maximum current per conductor at each port. If the current is less than 0.3 amps nominal, the port can, without further consideration, be connected to Category 5 or higher communications cabling as specified in TIA, ISO/IEC, and CENELEC standards. If the port has a maximum current above 0.3 amps nominal per conductor, the applicable standards or codes will need to be consulted for the maximum bundle size. If bundle size is limited to 24 cables, there is no need for any further consideration for current up to 0.5 amps per conductor in a four-pair cable with conductors 24 AWG or larger.



**NOTES:**

1. Check for maximum current on equipment nameplate
2. Current less than 300 mA nominal per conductor is safe for Category 5 and above
3. Standards and codes limit bundle sizes for higher current

**Figure 10**  
Example of cables in equipment

## CommScope administration support for remote powering

CommScope imVision® AIM System Manager software includes support for remote powering management features. The software has implemented the requirements of Annex C of TIA-568-C to create bundle identifiers, bundle records, and associated links. imVision System Manager software can list all the cables in a bundle, together with the maximum power on the power source equipment port where these cables are connected. This allows a network administrator to view the cables in a bundle, together with the power sourced by each cable. Alerts are issued when the number of cables in a bundle exceeds a given threshold (such as 24 cables) or the power levels exceed defined thresholds. This capability provides additional insight for ongoing administration operations of cables supporting remote powering.

## Checking suitability of higher bundle sizes

The 24-cable bundle size is a recommendation, not a requirement—but should be followed as a general rule of thumb. Sometimes, larger bundle sizes may be needed; a qualified designer/installer can make the necessary evaluation to determine if a bundle size will cause any overheating. Tables in the appropriate TIA, ISO/IEC and CENELEC cabling standards on remote powering implementation provide a mechanism to check if a particular cable category bundle size is acceptable. For a given ambient temperature and installation condition—if the current per pair is greater than the maximum current on the PoE port—the cable bundle size is acceptable.

An example of this is shown with data taken from **Table 1: Current capacity per pair at 45° C ambient temperature for a category of cable versus number of cables in bundle for standard 60° C rated cables**, shown below:

NO. OF CABLES	26 AWG		CATEGORY 5e		CATEGORY 6		CATEGORY 6A	
	Air	Conduit	Air	Conduit	Air	Conduit	Air	Conduit
1	2.664	2.091	3.492	2.844	4.099	3.243	4.380	3.541
7	1.545	1.223	1.971	1.628	2.287	1.857	2.460	2.039
19	1.140	0.909	1.424	1.188	1.638	1.356	1.770	1.496
24	1.059	0.846	1.314	1.100	1.509	1.255	1.632	1.386
37	0.919	0.737	1.128	0.949	1.290	1.084	1.399	1.200
48	0.842	0.677	1.026	0.866	1.170	0.989	1.271	1.097
52	0.819	0.660	0.997	0.842	1.135	0.962	1.234	1.067
61	0.775	0.625	0.939	0.795	1.068	0.908	1.162	1.008
64	0.763	0.615	0.922	0.781	1.049	0.893	1.141	0.991
74	0.725	0.586	0.873	0.741	0.991	0.847	1.079	0.941
91	0.673	0.545	0.806	0.686	0.914	0.784	0.996	0.873
97	0.658	0.533	0.787	0.670	0.891	0.766	0.971	0.852
100	0.651	0.528	0.777	0.662	0.880	0.757	0.960	0.843
127	0.596	0.485	0.708	0.605	0.799	0.691	0.872	0.771
169	0.536	0.437	0.631	0.541	0.711	0.619	0.777	0.691

## Checking suitability of higher bundle sizes

To determine the maximum current that will not exceed the temperature rating of a 60°C rated cable, a designer/installer can do a table lookup for the particular ambient temperature. For example, for Category 6A, if a 61-cable bundle is installed in 45°C ambient, the maximum current from Table 1 is 1.162 amps in air and 1.008 amps in conduit, which is more than the 0.96 maximum current IEEE 802.3bt equipment will source—so the 61-cable Category 6A bundle can easily support all IEEE 802.3 PoE applications at 45°C ambient. Additionally, it should be pointed out that these current capacities in IEEE 802.3bt are for a worst-case 100-meter 24-AWG cabling with a loop resistance of 25 ohms. CommScope cabling will do much better, and informed installers can certainly increase the bundle sizes for shorter distances and better gauge sizes than 24 AWG (Category 6A is 23 AWG). Check with your CommScope representative for CommScope-specific product information for PoE that will be published in a later document.

## NFPA NEC 2017 and LP cables

Some companies are touting LP rating as a requirement to support PoE above 60 watts per four-pair balanced twisted-pair cable. Article 840.160 of the NEC 2017 regulation exempts communications circuits delivering less than 60 watts (nominal 0.3 amps per conductor) to communications equipment. At higher power levels, the specifications require either adherence to a table (limiting the bundle size based on the current to be carried, the copper wire gauge used, and the temperature rating of the cabling) or they require providing the option of using cabling with a new rating, known as “LP” cabling. Table 725.144 as shown below is generic to all Class 2 and 3 cable types.

**Table 725.144, Ampacities of Each Conductor (in Amperes) in a 4-Pair Class 2 or Class 3 Data Cables, Based on Copper Conductors at Ambient Temperature of 30°C (86°F) with all Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (140°F) and 90°C (194°F) Rated Cables**

NUMBER OF 4-PAIR CABLE IN A BUNDLE																					
AWG	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temperature rating			Temperature rating			Temperature rating			Temperature rating			Temperature rating			Temperature rating					
	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C	60° C	75° C	90° C
26	1.0	1.0	1.0	1.0	1.0	1.0	0.7	0.8	1.0	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	N/A	N/A	N/A
24	2.0	2.0	2.0	1.0	1.4	1.6	0.8	1.0	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3.0	3.0	3.0	1.4	1.8	2.1	1.0	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

Note 1: For bundle sizes over 192 cable, or for conductor sizes smaller than 26AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.  
 Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.  
 Informational Note: The conductor sizes in data cables in wide-spread use are typically 22-26 AWG.

Article 725.144 specifies two options (shown below) for meeting the requirements for table 725.144:

**Option A:** Traditional CL3P, CL2P, CL3R, CL2R, CL3, or CL2 cables used to transmit power and data that comply with the requirements in Table 725.144 (e.g., 23-AWG 60°C-rated cable can support up to 0.4 amps per conductor in a 192-cable bundle). Article 840.160 additionally allows the substitution of communication cables (Class CM) for Class 2 and Class 3 (CL) cables.

**Option B:** Cables, as in Option A, with an “-LP” appended to the listing (e.g., CL2P-LP) that have been tested at UL up to a bundle configuration of 192 cables and have the corresponding ampacity rating marked on the jacket (e.g., CL2P-LP[0.5A], 23 AWG).

As described in these implementation considerations, CommScope uses a holistic approach for PoE that includes not only ampacity control but implementation of the practical guidelines for reducing temperature rise in ISO TR 29125, TIA TSB 184-A, and EN-50174 series. These documents recommend a maximum bundle size of 24 cables—significantly improving the thermal performance of Category cables to negate the need for LP cables.

# Remote powering and CommScope Application Warranties

For registered CommScope Network Infrastructure System installations, IEEE 802.3 Power over Ethernet applications are covered per the SYSTIMAX® Applications Assurance Program, and the Uniprise® and NETCONNECT® Application Warranty Programs, based on complying with the applicable standards, guidelines, and codes. Consult your local CommScope representative for details.

## Recommendations

To manage remote powering, CommScope recommends a holistic approach that includes not only controlling the maximum current in conductors, but implementation of the practical guidelines for reducing temperature rise in ISO/IEC TR 29125, CENELEC CLC/TR 50174-99-1, CENELEC EN 50174 series and TIA TSB 184-A. These documents recommend the use of Category 6A or Class EA or higher cabling for all new installations—based on its superior performance supporting remotely powered channels—and a maximum bundle size of 24 cables, which will significantly control cable thermal performance. Using these documents together with CommScope installation practices will lead to correct installations for all levels of remote powering, ranging from 15–90 watts delivered by the power source equipment (PSE).

It should also be pointed out that transmission parameters are specified up to 60°C in TIA, CENELEC and ISO cabling standards—and communications equipment has been designed to operate under these conditions. Hence, going above 60°C is nonstandard, not generic, and impractical since it poses considerable risk of applications not working at temperatures between the 60°C and 90°C currently allowed in Table 725.144 of NEC-2017.

It is also worth noting that compliance to safety regulations is facilitated by a similar comprehensive holistic approach taken by national and international cabling standards, including working closely with application committees such as IEEE 802.3. For example, star wiring (limiting one PSE port to power one PD) improves control and compatible power supply since LLDP is used to manage power to all devices connected to a PSE. The cabling committees reference national and international electrical codes to ensure compliance with local codes and regulations. It is this comprehensive coordinated and consistent approach that has led to a perfect record of no reported loss of life or property using communications networks for power delivery. CommScope is committed to maintaining this perfect record in the future for emerging standardized remote power applications by specifying and managing all aspects of the cabling infrastructure to improve thermal performance.

## Bibliography

- ISO/IEC 14763-2 INFORMATION TECHNOLOGY—IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING—Part 2: Planning and installation
- ANSI/TIA-569.D-2 Additional pathway and space considerations for supporting remote powering over balanced twisted-pair cabling
- CENELEC CLC/TR 50174-99-1 guidelines for remote powering
- IEC 60950-1 INFORMATION TECHNOLOGY EQUIPMENT—SAFETY—PART 1: GENERAL REQUIREMENTS, 2013
- IEEE Std 802.3af-2003, DTE Data Terminal Equipment (DTE) Power Via the Media Dependent Interface (MDI)
- IEEE Std 802.3at-2009 Data Terminal Equipment (DTE) Power Via the Media Dependent Interface (MDI) Enhancements
- IEEE 802.3bt Amendment: Physical Layer and Management Parameters for DTE Power via MDI over 4-Pair
- ISO/IEC TS 29125 INFORMATION TECHNOLOGY—TELECOMMUNICATIONS CABLING REQUIREMENTS FOR REMOTE POWERING OF TERMINAL EQUIPMENT
- NFPA 70® National Electrical Code® 2017 Edition
- TIA TSB-184-A Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling

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CO-1124351-EN (10/18)

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5. **Remedies.** Seller’s sole and exclusive obligation and Buyer’s exclusive remedy under this Warranty is Seller’s repair or replacement of the defective Product or re-performance of Services or issuance of a credit for the net book value of the purchase price of the defective Product. Seller shall have sole discretion as to which of these remedies Seller will provide. Seller is not liable for any repair or maintenance costs incurred by Buyer, unless Seller authorizes such charges in writing in advance of the commencement of the work. If Seller elects to replace or repair the defective Product, the replaced or repaired Product will be warranted for the remainder of the Warranty Period applicable to the originally shipped Product, but the Warranty shall not be extended beyond the original Warranty Period. Replacement Products may be new, refurbished or contain refurbished materials.

6. **Notice and Waiver.** If Buyer discovers any defect in the Product, Buyer must provide prompt (and in no case later than thirty (30) days after discovery) written notice to Seller of the claimed defect. Such notice shall describe, in reasonable detail, the symptoms of such defect. The notice must be received by Seller during the Warranty Period for such Product. Failure to give timely notice of a claim shall result in Buyer’s waiver of such claim.

7. **Transfer of Ownership.** This Warranty is not transferable unless Buyer is expressly authorized by Seller in writing to resell the Product. In addition, Buyer must notify Seller on or before the fifteenth (15<sup>th</sup>) day after the date on which it transfers ownership of the warranted Product. Any transfers in violation of this Section shall invalidate this Warranty. Notice of the transfer of ownership must be in writing and shall include the name and address of the new owner.

8. **Exclusions from Warranty.** This Warranty shall not apply to problems attributable to, or as a result of:

- (a) improper installation or misapplication of parts;
- (b) chain or system failures induced by other products or components;
- (c) lack of proper inspection or maintenance or failure to provide a suitable operating environment;
- (d) any consumables provided with the Product, including but not limited to batteries and other accessories, and any other materials, components or products manufactured by a third party;
- (e) power surges, fire, unusual mechanical, physical or electrical stress, severe weather conditions or acts of nature, including but not limited to, lightning or floods;
- (f) usage or operation not in accordance with published ratings, specifications or instructions, including but not limited to environmental specifications identified by Seller;
- (g) any adjustment, modification, alteration, removal or repair of any part of the Product, including but not limited to removal or alteration of serial numbers or other identifying marks not expressly authorized by Seller in writing;
- (h) accidental damage, misuse, abuse, neglect or unauthorized access of the Product or of any system of which the warranted Product is a part;
- (i) any type of aesthetic changes due to oxidation or corrosion occurring on stainless steel or galvanized steel parts installed in unusually corrosive marine and industrial atmospheres (in which case Seller’s only obligation shall be to ensure that Product complies with Seller’s published material specifications);
- (j) use of the Product for purposes other than that for which it was designed; or
- (k) mishandling during shipment of the Product.

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# LIMITED WARRANTY

## Exhibit A

Product Categories	Warranty Period from Original Shipment Date*
<p><b>Category A Products</b>                      E6000® Converged Edge Router (CER); E6000n™ Remote PHY Devices (RPDs); E6000r™ Remote PHY Shelves; E6000n™ Remote MACPHY Devices (RMDs); vManager; Remote OLT (R-OLT); associated power supplies and accessories.                      FLX PON OLT portfolio including vOLT.                      CherryPicker products, Encoder products including ME-7000, SE-6000; DSR-4xxx, DSR-6xxx and DSR-7xxx series IRD products, and Uplink systems including TME-2020, VDP-1000, BNC, DEM, and SEM; All APEX Universal EQAM including APEX1000 and APEX3000; All Aloha interactive products including OM2000, ARPD, ADM4000 and NC1500 4.0. All SDM products. All VUE and VTM Software Products. All STDC products.</p>	Hardware One (1) Year Software Ninety (90) Days
<p><b>Category B Products</b>                      All High and Standard Definition Transport Adapter                      MS4000™ Media Streamer</p>	Hardware One (1) Year Software Ninety (90) days ** For certain CPE, option for 1% overship in lieu of Hardware warranty is standard
<p><b>Category C Products</b>                      Intentionally left blank.</p>	
<p><b>Category D Products</b>                      All Third Party OEM Products: power meters; All VUE and VTM hardware platforms; NC1500 4.0 hardware platform; LQA256 Legacy QAM Adapter; Elemental Products including Live, Server, Delta, Conductor and StatMux; DC2180 Cabinet Node, Cooling Systems</p>	Pass Through from OEM: Hardware One (1) Year Software Ninety (90) Days
<p><b>Category E Products</b> Intentionally left blank</p>	
<p><b>Category F Products</b>                      All OM and SG optical node platforms, Flex Max® and Starline® amplifier platforms, RF Taps &amp; Passives, and Optical Passives</p>	Hardware Five (5) Years within the United States and Canada Hardware Three (3) Years outside United States and Canada Software Ninety (90) Days
<p><b>Category F1 Products</b>                      All CHP Headend Optical (HEO) Elements</p>	Hardware Three (3) Years Software Ninety (90) Days
<p><b>Category G1 Products</b>                      All NC optical node platforms and Optical Passives, including OP/NP/DP/DC models.</p>	Hardware Five (5) Years Software Ninety (90) Days
<p><b>Category G2 Products</b>                      All CH3 Headend (HEO) Elements</p>	One (1) year
<p><b>Category G3 Products</b>                      All EPON and GPON ONUs, RFoG/HPON R-ONUs, including, CP8 models and associated power supplies and accessories</p>	Hardware Three (3) Years Software Ninety (90) Days

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<p><b>Category H Products</b>                  All ConvergeMedia™ Distribution Platforms and Management Suite, AdManager™ including SkyVision Ad Management and EMP solutions CVEx™, SVA, all Vertasent products including SVOM, SVM and ERM, AdEdge™ COM and AdEdge APS,VMS, Manifest Delivery                  Controller (MDC), ARRIS Video Content Manager (AVCM) and Next Generation Insertion (NGI) and Multicast ABR.</p>	<p>Hardware One (1) Year Software                  Ninety (90) Days</p>
<p><b>Category I Products</b>                  ServAssure® Advanced, ServAssure® NXT - Alarm Central, ServAssure® NXT - Analyze, ServAssure Domain Manager and EventAssure™. WorkAssure™@ Workforce Management, Mobile TV, SecureMedia and Titanium</p>	<p>Hardware One (1) Year                  Software Ninety (90) Days</p>
<p><b>Category J Products</b>                  Intentionally left blank</p>	
<p><b>Category K Products</b>                  Intentionally left blank.</p>	
<p><b>Category L Products</b>                  Intentionally left blank</p>	
<p><b>Category M Products</b>                  Intentionally left blank.</p>	
<p><b>Category N Products</b>                  Intentionally left blank.</p>	
<p><b>Category O Products</b>                  All CAS Products including DAC, CASMR (and associated plug-ins), CAST, Advisor, CSS, OLL, CSS-Lite, KLS, DKS, CPMS</p>	<p>DAC, CASMR, CAST, Advisor, CSS Hardware Three (3) Years                  OLL, CSS-Lite, KLS, DKS, OLES, CPMS Hardware One (1) Year                  Software Ninety (90) Days</p>
<p><b>Category P Products</b>                  Intentionally left blank.</p>	
<p><b>Category P1 Products</b>                  Intentionally left blank</p>	
<p><b>Category Q Products</b>                  Intentionally left blank</p>	
<p><b>Category R Products</b>                  Intentionally left blank</p>	
<p><b>Category R1 Products</b>                  Intentionally left blank</p>	
<p><b>Category S Products</b>                  Intentionally left blank</p>	
<p><b>Category S1 Products</b>                  Intentionally left blank</p>	

## LIMITED WARRANTY

<p><b>Category T Products</b> RUCKUS Wi-Fi</p>	<p>Hardware:</p> <ul style="list-style-type: none"> <li>- Indoor Access Points and Wall Plate Access Points – Limited Lifetime Warranty,** except for access points with an “e” suffix (e.g., R350e), for which the HW warranty period is one (1) year.</li> <li>- Outdoor Access Points – One (1) Year</li> <li>- Controllers – One (1) Year, except ZoneDirector controllers are covered by the Limited Lifetime Warranty**</li> </ul> <p style="text-align: center;">Software Ninety (90) Days</p>
<p><b>Category T1 Products</b> RUCKUS ICX Switches</p>	<ul style="list-style-type: none"> <li>- ICX Switches (including switch modules, PSUs, and Fans, but excluding removable optics/transceivers and LEDs) – Limited Lifetime Warranty,** except for ICX 7150- C08PT, for which the HW warranty period is 13 months.</li> <li>- LEDs – 12 months</li> <li>- Removable Optics/Transceivers – 60 months (13 months if shipped from Seller prior to June 1, 2021)</li> </ul> <p>Software: Limited lifetime access to defect repairs, and software maintenance updates through end of support date of product</p>
<p><b>Category T2 Products</b> Intentionally left blank</p>	
<p><b>Category U Products</b></p> <p>Other OSP Cable Products (P3®, Drop Coax, Fiber Cable, Fiber Drop Cable, CIC)</p> <p>NovuX Products</p> <p>Prodigy</p> <p>Products FDH</p> <p>Products</p> <p>Multiservice terminals (MST), Open Terminals (OTE) and Hardened Drop Cable</p> <p>Assemblies OSP “Box” Products</p> <p>Mini-RDTs and RDTs</p> <p>FOSC™, FIST™ and</p> <p>Tenio™</p> <p>OSP Copper Connect and Closure Products</p> <p>HELIAX® FiberFeed® Products, including FiberFeed® hybrid and fiber cables and assemblies, power cables and junction boxes</p> <p>Fiber Optic Panels, including Accessories, Mounting Hardware, Modules</p> <p>Fiber Optic Field Terminated Connectors, Kits, Tools, Consumables,</p> <p>Accessories Indoor Fiber Cable, Patch Cords, Cable Assemblies, Fiber Trunks</p> <p>Passive Optical Components and Value Added Modules (VAMs)</p> <p>FiberGuide® : Fiber cable Management System</p> <p>Optical Distribution Frames, including Modules, Blocks, Accessories and</p> <p>Hardware Cabinets Cable and Apparatus Products</p> <p>Alifabs™ Cabinets &amp; Ancillary Products</p> <p>Alifabs™ Telecommunications Towers and Accessories</p> <p>Metro Cell Products, including Enclosures; Integrated Pole; Standard Poles; Accessories; and Wood Pole Brackets</p>	<p>One (1) year</p>

## LIMITED WARRANTY

<p><b>Category V Products</b>  ValuDAS® Passive Products, including Air Directional Couplers, Hybrid Couplers, High Power Splitters, and Cell-Max™ Antennas  Standard Tower Mounted Amplifier, Bias Tee and Power Distribution Unit Products Standard Filter &amp; Combiner Products</p> <p>Electronic Enclosure Products (Cabinets)</p> <p>Alifabs™ Free Cooling Products and Accessories and Spare Parts, including</p> <p>Monitor All-In-One FLX (Active Passive Cabines)</p> <p>PowerShift™ &amp; Power Products</p>	<p>Two (2) years</p>
<p><b>Category W Products</b>  ValuSite® Products</p> <p>I-Line Accessory Products</p> <p>Microwave Antennas</p> <p>Terrestrial Microwave System Products (including Microwave System Flex-Twist, Coupler, Filter and Diplexer Products)</p>	<p>Three (3) years</p>
<p><b>Category X Products</b>  Broadband RF Connectivity Products</p> <p>Premium Passive Products, including In-Building Directional Couplers, Hybrid Matrices, Tappers, Power Splitters, Terminations, Attenuators and CMAX Antenna Products</p>	<p>Five (5) years</p>
<p><b>Category Y Products</b>  QR® Coaxial Cable</p>	<p>Five (5) years</p>
<p><b>Category Z Products</b>  Standard RADIAX® Cable, Connector, Accessory and Cable Assembly* Products</p> <p>* RADIAX® Cable Assembly Product means any RADIAX® coaxial cable that has been fitted with Seller’s connectors in accordance with the installation instructions.</p>	<p>One (1) year</p>
<p><b>Category AA Products</b>  Standard CNT® Cable, Connector, Accessory and Cable Assembly* Products</p> <p>* CNT® Cable Assembly Product means any CNT® coaxial cable that has been fitted with Seller’s connectors by Seller or its certified distributor</p>	<p>Five (5) years; except that the Warranty Period for Products purchased for resale purposes shall be one (1) year.</p>
<p><b>Category BB Products</b>  Standard HELIAX® Cable, Connector, Accessory and Cable Assembly* Products</p> <p>* HELIAX® Cable Assembly Product means any HELIAX® coaxial cable or elliptical waveguide that has been fitted with Seller’s connectors by Seller or its certified distributor.</p>	<p>Ten (10) years; except for the following: (i) three (3) years for weatherproofing kits (including SureGuard boots); (ii) one (1) year for cable preparation tools (excluding blades); (iii) one year for single click-on hanger kits; and (iv) two (2) years for surge arrestors.</p>
<p><b>Category CC Products</b>  Standard ERA/ION-E®, ION-M®, ION-U®, MR, CMR, i-POI®, e-POI™, and Node Repeater Products</p>	<p>Hardware, the earlier of: (i) one (1) year from the date of installation; or (ii) fifteen (15) months from the date of shipment.</p> <p>Software Ninety (90) Days</p>
<p><b>Category DD Products</b>  In- Building and Fixed Subscriber Antennas</p>	<p>The earlier of: (i) three (3) years from the date of installation or (ii) thirty-nine (39) months from the date of original shipment</p>

## LIMITED WARRANTY

<p><b>Category EE Products</b> OneCell®</p> <p>Powered Fiber Cable Solution: Hybrid Copper and Fiber Cables, Class 2 Power Supplies, Indoor/Outdoor POE Extenders, Field Terminated Outlets, Consolidation Boxes and Related Passive Components</p>	<p>Hardware, the earlier of: (i) one (1) year from the date of installation; or (ii) fifteen (15) months from the date of original shipment Software Ninety (90) Days</p>
<p><b>Category FF Products</b> Small Cell Device Management System (DMS) Software DAS Device Management System (AIMOS) Software</p>	<p>Ninety (90) days</p>
<p><b>Category GG Products</b> Base Station Antenna, Small Cell Antenna &amp; Mosaic™ Products</p>	<p>Two (2) years for all base station antennas except base station antennas incorporating N-type connectors, which shall have a warranty of one (1) year</p>
<p><b>Category HH Products</b> DryLine® Dehydrator Systems and Line Monitoring Systems</p>	<p>Three (3) years or 3,000 hours of actual run time, whichever occurs first; except the Warranty Period for the compressor is only one (1) year or 1,000 hours of actual run time, whichever occurs first.</p>
<p><b>Category II Products</b> SiteRise™ Solutions</p>	<p>One (1) year on workmanship for the Solution.</p>
<p><b>Category JJ Products</b> Copper Structured Cabling Products</p> <p>Other Enterprise Products (Coax, Automotive Cables, Enterprise Enclosures and miscellaneous items) (excluding software)</p>	<p>One (1) year from the date of Installation</p>
<p><b>Category KK Products</b> Alifabs™ Services (power upgrades, enablements, installation and decommission work, rigging, and fault management)</p>	<p>One (1) year from the date of completion of the work.</p>
<p><b>Category LL Products</b> imVision Overlays and Controllers</p>	<p>Three (3) years</p>

*\* For Category H and Category I Products only, if Seller is engaged by Buyer to provide Services for the implementation of the purchased Products, warranty period for such Products shall commence upon Buyer's acceptance of the Products and Services.*

*\*\* For Category T Products only, "Limited Lifetime Warranty" means the period beginning on the Product shipment date and continuing for as long as the original end user of the Product continues to own and use the Product. For Category T1 Products only, "Limited Lifetime Warranty" means the period beginning on the Product shipment date and continuing (i) for as long as the original end user of the Product continues to own and use the Product or (ii) through the End of Support date, as defined in the RUCKUS End of Life Policy, whichever is earlier.*

# NPC06UZDB

## Base Product



## NETCONNECT® Cat 6 U/UTP RJ45 Patch Cord, LSZH

- High-performance patch cords exceeding industry standards supporting NETCONNECT channel specifications
- Standardized transparent, slim-line boots provides consistent patch cord appearance and supports highest density applications
- Colored clips are available to fit the transparent boot, eliminating the need of multiple colors for matching every jacket color
- Colored pull latch tabs are available for easier plug release handling from the modular jack

## Product Classification

<b>Regional Availability</b>	Asia   EMEA   Latin America
<b>Portfolio</b>	NETCONNECT®
<b>Product Type</b>	Twisted pair patch cord
<b>Product Series</b>	NPC
<b>Ordering Note</b>	Cords < 1 m are valid elements for use in a channel or as an equipment interconnect but due to their limited length are not guaranteed to meet component compliance requirements that were developed to assess the quality of longer cords   Cords > 1 m are authorized for use in channels and are an effective standalone method used to connect active devices

## General Specifications

<b>Product Number</b>	CC6ZH
<b>ANSI/TIA Category</b>	6
<b>Cable Type</b>	U/UTP (unshielded)
<b>Conductor Type</b>	Stranded
<b>Interface, Connector A</b>	RJ45 plug
<b>Interface Feature, connector A</b>	Standard
<b>Interface, Connector B</b>	RJ45 plug
<b>Interface Feature, connector B</b>	Standard
<b>Jacket Color</b>	Black   Blue   Green   Orange   Red   Slate   White   Yellow
<b>Pairs, quantity</b>	4
<b>Separator Type</b>	Bisector
<b>Transmission Standards</b>	ANSI/TIA-568.2-D   IEEE 802.3bt Type 4   ISO/IEC 11801 Class E
<b>Wiring</b>	T568B

# NPC06UZDB

## Dimensions

<b>Cable Assembly Length Range (m)</b>	1 – 30
<b>Cable Assembly Length Range (ft)</b>	1 – 100
<b>Cable Assembly Length Range (cm)</b>	15 – 999
<b>Cable Assembly Length Range (in)</b>	6 – 999
<b>Diameter Over Jacket</b>	5.97 mm   0.235 in
<b>Compatible Conductor Gauge, stranded</b>	24 AWG

## Electrical Specifications

<b>Nominal Velocity of Propagation (NVP)</b>	69 %
<b>Remote Powering</b>	Fully complies with the recommendations set forth by IEEE 802.3bt (Type 4) for the safe delivery of power over LAN cable when installed according to ISO/IEC 14763-2, CENELEC EN 50174-1, CENELEC EN 50174-2 or TIA TSB-184-A

## Ordering Tree

NPC       -

### Jacket Color

10	BK	Black
	BL	Blue
	GN	Green
	GY	Gray
	OR	Orange
	PK	Pink
	RD	Red
	WT	White
	YL	Yellow

### UOM

11	F	Foot
	M	Meter
	N	Inch
	C	Centimeter

### Length

12  XXX

### Notes

- Cords > 1m are authorized for use in channels and are an effective standalone method used to connect active devices
- Cords < 1m are also valid elements for use in a channel or as an equipment interconnect but due to their limited length are not guaranteed to meet component compliance requirements that were developed to assess the quality of longer cords

## Material Specifications

<b>Conductor Material</b>	Tin plated copper
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## Mechanical Specifications

<b>Plug Insertion Life, minimum</b>	750 times
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## Environmental Specifications

# NPC06UZDB

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<b>Operating Temperature</b>	-20 °C to +60 °C (-4 °F to +140 °F)
<b>Relative Humidity</b>	Up to 93%, non-condensing
<b>EN50575 CPR Cable EuroClass Fire Performance</b>	Dca
<b>EN50575 CPR Cable EuroClass Smoke Rating</b>	s2
<b>EN50575 CPR Cable EuroClass Droplets Rating</b>	d2
<b>EN50575 CPR Cable EuroClass Acidity Rating</b>	a1
<b>Environmental Space</b>	Low Smoke Zero Halogen (LSZH)
<b>Flame Test Method</b>	IEC 60332-3
<b>Safety Standard</b>	C-Tick   UL 1863
<b>Smoke Test Method</b>	IEC 61034-2

## Packaging and Weights

<b>Packaging quantity</b>	1
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## Regulatory Compliance/Certifications

<b>Agency</b>	<b>Classification</b>
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

## Included Products

2843020-3 MP-6AU-Boot-59-1	- Integrated Boot and Pair Manager for MP-6AU, size 59, transparent
6-2843007-1 MP-6AU-Plug-A-1	- Modular Plug, Category 6A/6, Unshielded, Cond Insulation OD - 0.99mm, 100 pcs

# 2843020-3 | MP-6AU-Boot-59-1



Integrated Boot and Pair Manager for MP-6AU, size 59, transparent

## Product Classification

<b>Regional Availability</b>	Asia   Australia/New Zealand   EMEA   Latin America   North America
<b>Portfolio</b>	CommScope®
<b>Product Type</b>	Modular plug boot

## General Specifications

<b>Boot Feature</b>	Color-clip compatible   Pull-tab compatible   Slimline   Snagless
<b>Color</b>	Clear
<b>Compatible Plug Type</b>	Cat 6   Cat 6A

## Dimensions

<b>Compatible Cable Diameter, maximum</b>	6.2 mm   0.244 in
<b>Compatible Cable Diameter, minimum</b>	5.6 mm   0.22 in

## Packaging and Weights

<b>Included</b>	Strain relief
<b>Packaging quantity</b>	100
<b>Packaging Type</b>	Bag   Box

## Regulatory Compliance/Certifications

<b>Agency</b>	<b>Classification</b>
CHINA-ROHS	Below maximum concentration value
REACH-SVHC	Compliant as per SVHC revision on <a href="https://www.commscope.com/ProductCompliance">www.commscope.com/ProductCompliance</a>
ROHS	Compliant
UK-ROHS	Compliant



# 6-2843007-1 | MP-6AU-Plug-A-1



Modular Plug, Category 6A/6, Unshielded, Cond Insulation OD - 0.99mm, 100 pcs

## Product Classification

<b>Regional Availability</b>	Asia   Australia/New Zealand   EMEA   Latin America   North America
<b>Portfolio</b>	CommScope®
<b>Product Type</b>	Modular plug

## General Specifications

<b>ANSI/TIA Category</b>	6   6A
<b>Cable Type</b>	Round, unshielded
<b>Conductor Type</b>	Solid   Stranded
<b>Interface</b>	RJ45
<b>Positions/Loaded Contacts</b>	8/8
<b>Termination Type</b>	IDC

## Dimensions

<b>Compatible Insulated Conductor Diameter, maximum</b>	1.09 mm   0.043 in
<b>Compatible Insulated Conductor Diameter, minimum</b>	0.89 mm   0.035 in
<b>Contact Plating Thickness</b>	1.27 µm
<b>Compatible Conductor Gauge, solid</b>	26-23 AWG
<b>Compatible Conductor Gauge, stranded</b>	26-23 AWG

## Electrical Specifications

<b>Current Rating, maximum</b>	0.75 A
<b>Insulation Resistance, minimum</b>	500 mOhm
<b>Safety Voltage Rating</b>	150 Vac

# 6-2843007-1 | MP-6AU-Plug-A-1

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## Material Specifications

<b>Contact Base Material</b>	Phosphor Bronze
<b>Contact Plating Material</b>	Gold
<b>Material Type</b>	Glass filled polycarbonate

## Mechanical Specifications

<b>Plug Insertion Life, minimum</b>	750 times
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## Environmental Specifications

<b>Operating Temperature</b>	-10 °C to +60 °C (+14 °F to +140 °F)
<b>Relative Humidity</b>	Up to 93%, non-condensing
<b>Safety Standard</b>	UL 1863

## Packaging and Weights

<b>Packaging quantity</b>	100
<b>Packaging Type</b>	Bag   Box   Carton

## Regulatory Compliance/Certifications

<b>Agency</b>	<b>Classification</b>
CHINA-ROHS	Below maximum concentration value
REACH-SVHC	Compliant as per SVHC revision on <a href="https://www.commscope.com/ProductCompliance">www.commscope.com/ProductCompliance</a>
ROHS	Compliant
UK-ROHS	Compliant



# RoHS Certificate of Compliance



Product Name: NPC Cat 6, UTP, LSZH

Product Number: NPC06UZDB

Company Name: CommScope  
3642 E US Highway 70  
Claremont, NC 28610 USA

Contact: ProductCompliance@Commscope.com

Generated on: May 03, 2024

Certified by:   
\_\_\_\_\_  
Vinatha Viswanathan, Director Product Compliance

## Disclaimer

This information is provided based on reasonable inquiry of our suppliers and represents our current actual knowledge based on the information they provided and our analysis and assessment of the risks. This information is subject to change and if a change occurs which affects compliance, then this Statement will be updated. Compliance to EU ROHS 2011/65 amended by EU RoHS 2015/863 means the part numbers have a maximum concentration of no more than 0.1% by weight in homogenous materials for lead, hexavalent chromium, mercury, PBB, PBDE, and 0.01% for cadmium, or qualify for an exemption to these limits as defined in the Annexes of Directive 2011/65/EU (RoHS2). These parts also have a maximum concentration of no more than 0.1% by weight in homogenous materials for DEHP, BBP, DBP and DIBP (substances that are restricted starting from July 22, 2019). Finished electrical and electronic products will be CE marked as required by Directive 2011/65/EU. Components may not be CE marked.

Compliance Status	Regulation	Revision	RoHS exemptions if any
Compliant	ROHS	EU RoHS - 2011/65/EU	

COMMScope®

# CommScope Network Infrastructure System

25 Year Extended Product and Application Warranty  
("System Warranty")

# Terms and Conditions

**Extended Product Warranty.** CommScope warrants, for a period of twenty-five (25) years from the Certification Date (the “Warranty Period”), that Products in the Registered System shall be free from defects in materials or workmanship subject, to the terms and conditions below and the terms, conditions and limitations of CommScope’s Limited Product Warranty in effect at the date of sale (available at <http://www.commscope.com/Resources/Warranties/>).

**Application Warranty.** During the Warranty Period, the Registered System will meet or exceed the specifications set forth in the System Specification and support Applications as documented therein.

**System Warranty Requirements.** The System Warranty applies only to Products that are: (i) installed by an Authorized Partner, at the location listed on the System Warranty Certificate; (ii) installed in compliance with CommScope’s written design, engineering and installation procedures, and the specifications for the Application and the System Specification; (iii) designed, installed, and maintained in compliance with the applicable industry standards as set forth in the System Specification; (iv) not subject to conditions that exceed the individual Product Specification(s); (v) used at the original site of installation; (vi) tested pursuant to industry standards and applicable CommScope testing requirements and satisfactorily pass such tests; and (vii) not otherwise expressly excluded or invalidated under the System Warranty Terms and Conditions. To qualify for a System Warranty, all documents, including the prescribed System test results, must be submitted to CommScope for review within sixty (60) days of installation, and registration for the System Warranty must be applied for with CommScope within ninety (90) days from the date the installation is complete. CommScope, in its sole judgment, shall determine if the System Warranty Requirements have been met. CommScope’s approval of a System Warranty shall be evidenced by a numbered registration System Warranty Certificate issued by CommScope. In the event a System Warranty Certificate is issued and CommScope subsequently discovers that any of the System Warranty requirements were not met, then the System Warranty shall be void.

**Beneficiary and Warranty Transfer.** CommScope will only honor System Warranty claims made by the person or entity to which the System Warranty Certificate is issued. The System Warranty may, upon prior written approval from CommScope, be transferred to a successor in interest to the site where the Registered System was originally installed.

**Modifications.** Moves, repairs, alterations, additions, or changes to the Registered System (“Change(s)”) are only covered by the System Warranty if: (i) performed by an Authorized Partner; (ii) installed in compliance with CommScope’s written design, engineering and installation procedures, and the specifications for the Application and the System Specification, and (iii) designed, installed, and maintained in compliance with the applicable industry standards as set forth in the System Specification. Day-to-day administration and maintenance of the Registered System by the End-Customer will not void the System Warranty if performed in compliance with applicable CommScope system design and installation guidelines using CommScope approved products. All test results shall be sent for approval to CommScope along with a detailed description of the Change(s) and bill of materials within thirty (30) days of installation. If the Change(s) are approved, CommScope shall update the System Warranty registration to indicate the Change(s). Failure to comply with the foregoing relating to Change(s) shall void the System Warranty.

**Exclusions from Warranty and Limitations on Liability.** The “Exclusions from Warranty” and “Limitations on Liability” in the Limited Product Warranty shall apply to the System Warranty. The occurrence of an Exclusion from Warranty in the Limited Product Warranty shall void the System Warranty. The System Warranty shall also be void if any Product in the Registered System has been (i) removed from the original site of installation, (ii) altered, repaired or disassembled by a non-Authorized Partner, or (iii) exposed to, or has outside materials applied to it, including but not limited to paint, water, chemicals, solutions, cleaning supplies and lubricants (“Contamination”). End-Customer must notify an Authorized Partner or CommScope within 24 hours of any Contamination.

Outside Plant Cable is excluded from and will void the System Warranty when installed above ground and exposed to the outside environment, including but not limited to, an aerial installation. Outside Plant Cable installed underground, either by direct burial or in conduit, is not excluded from the System Warranty.

Failure of the End-Customer to submit any System Warranty claim to the authorized CommScope office as designated by CommScope within thirty (30) days following expiration of the System Warranty shall be an admission by the End-Customer and conclusive proof that the Registered System and Product(s) are in every respect as warranted and shall release CommScope and the Authorized Partner from any and all claims for damage or loss sustained by the End-Customer.

Any violation or non-compliance with the System Warranty Terms and Conditions will void the System Warranty.

**Remedies.** If during the Warranty Period, the End-Customer experiences problems with a Registered System or a Product in a Registered System ("Problem") and suspects there is a potential warranty claim hereunder, the End-Customer must first reasonably investigate potential causes of the suspected Problem that are not CommScope related and reasonably determine that none of these potential causes were responsible for the Problem. Once the End-Customer reasonably believes that all non-CommScope causes for the Problem are ruled out, but in no event more than thirty (30) days after the End-Customer knew or should have known of the Problem, the End-Customer must contact the Authorized Partner that installed the Registered System to report the Problem. If the Authorized Partner is unable to resolve the Problem, then the Authorized Partner will contact CommScope and make a claim under the System Warranty for further investigation and resolution.

If CommScope determines that a Problem is due to a breach of the System Warranty, CommScope will repair or replace Product as CommScope deems necessary to correct the Problem, including the provision of reasonable labor and removal and reinstallation of such Product at CommScope's discretion. CommScope shall only be responsible for costs that have received the prior written authorization of CommScope. If CommScope chooses to repair Product, CommScope may use new or reconditioned replacement parts. If CommScope chooses to replace Product, CommScope may replace with new or reconditioned products of the same or similar design. Any repair or replacement will be warranted for either (a) 90 days or (b) the remainder of the original Warranty Period, whichever is longer. If the Problem is found by CommScope or an Authorized Partner not to be related to a Product or any warranty exclusions, then End-Customer will be responsible for any costs incurred related to the Problem claim.

**Choice of Law.** The System Warranty shall be governed by and construed in accordance with the laws of the State of North Carolina, U.S.A. The United Nations Convention on Contracts for the International Sale of Goods shall not apply. The End-Customer acknowledges that as a condition to receiving the System Warranty, End-Customer unconditionally submits to the jurisdiction of the North Carolina state and federal courts. If any portion of the System Warranty is not enforceable due to local legal requirements, then such specific language shall be modified to meet local legal requirements consistent with CommScope's intent.

# Definitions

The following definitions shall apply to the System Warranty:

**CommScope** shall mean CommScope Technologies LLC.

**Application** shall mean a standardized set of network technologies, protocols, and hardware for enabling communication over the prescribed System as documented by CommScope.

**Authorized Partner** shall mean a party that is certified by CommScope as a CommScope installation partner and that is in good standing with CommScope at the time of installation.

**Authorized Reseller** shall mean a party that is authorized in writing by CommScope to sell Products and that is in good standing with CommScope at the time of sale.

**Certification Date** shall mean the earlier of the registration date on the face of the System Warranty Certificate or the Original Installation Completion Date.

**End-Customer** shall mean the end-user who has the Products installed at its premises by an Authorized Partner.

**Original Installation Completion Date** shall mean the date that the Authorized Partner completed the installation and testing of the Registered System at the End-Customer's site being submitted for System Warranty eligibility.

**Outside Plant Cable** shall mean all cabling located between demarcation points in buildings, switching and data centers and the demarcation point in another such facility.

**Passive** shall mean signal-carrying components that exhibit no gain or contribute no energy.

**Product(s)** shall mean Passive products manufactured by CommScope that are contained in the bill of materials, for an end-to-end SYSTIMAX®, UNIPRISE®, or NETCONNECT® system, which were filed with the registration for the System Warranty and which were purchased from an Authorized Reseller.

**Product Specification** shall mean CommScope's published specification(s), in effect at the time of sale, which defines the optical and/or electrical capabilities of the individual Products.

**Registered System** shall mean the System designated on the System Warranty Certificate.

**System** refers to the end-to-end SYSTIMAX®, UNIPRISE®, or NETCONNECT® system, comprised entirely of Products approved by CommScope for the respective System and that meet all of the conditions in the "System Warranty Requirements" Section of these System Warranty Terms and Conditions.

**System Specification** shall mean CommScope's published specification(s) in effect at the time of sale, which describes the optical and/or electrical capabilities of the System as a whole.

**System Warranty** shall mean the Extended Product and Application Warranty.

**System Warranty Certificate** shall mean the certificate issued by CommScope evidencing CommScope's approval and issuance of a System Warranty and identifying the covered System.

**Precedence.** In the event of any conflict between the terms of the System Warranty and CommScope's Limited Product Warranty and/or a System Specification, the terms of the System Warranty shall control.



commscope.com

Visit our website or contact your local CommScope representative for more information.

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BR-1110431-EN (06/18)

## Use of CommScope NETCONNECT cabling for PoE applications

Early versions of the IEEE 802.3 standard covered the powering of remote devices over Type 1 (IEEE 802.3af) and Type 2 (IEEE 802.3at) systems. The IEEE 802.3bt standard covering the use of Type 3 and Type 4 power sourcing equipment (PSE) was published in January of 2019. A Type 4 PSE provides the maximum power to remote devices by supporting 0.86 Amps per pair (0.43 Amps per conductor) across all four pairs of the cabling. The standard recommends that Class D cabling (or better) be used to support Type 4 remote powering. In addition to the IEEE standard, the EN 50174-2: 2018 standard provides guidance on the bundling of cables supporting remote powering and recommends limiting bundle sizes to 24 cables taking care to include air gaps between bundles. These recommendations are consistent with those from CommScope and are in line with those contained in TIA TSB-184A aimed at limiting the temperature rise in bundled cabling<sup>1</sup>.

In addition to the structured cabling standards, there are additional requirements imposed on the connector contacts that ensure they do not corrode or suffer degradation due to arcing when unplugged while under load. The applicable test standard for Types 1 and 2 is IEC 60512-99-001 while Types 3 and 4 are covered by the IEC 60512-99-002 standard.

CommScope has performed the full complement of IEC 60512-99-001/002 testing on its products and can assure customers that the NETCONNECT connectivity including the KJ, SL and SLX family of modular jacks, NPP panels, NPC, NCC, MiNo6, and MiNo6A patch cords, fully comply with the requirements set forth in the IEC 60512-99-001 and IEC 60512-99-002 standards.

Further, CommScope has carried out extensive testing confirming that existing and legacy NETCONNECT Class D (Cat 5e) or higher cable fully complies with the recommendations contained in the IEEE 802.3af, IEEE 802.3at, and IEEE 802.3bt standards.

CommScope recommends that customers follow the CommScope installation guidelines when installing their cabling products. These guidelines were developed to ensure that the temperature rise of cable bundles used for PoE applications is limited to 15°C. This is most easily accomplished by limiting the number of cables in a bundle to 24 for horizontal cable and to 12 for 28 AWG cords.

### References

IEEE P802.3bt-2018 Standard for Ethernet Amendment 2: Power over Ethernet over 4 Pairs

EN 50174-2: 2018 Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings

IEC 60512-99-001:2012 Connectors for electronic equipment - Tests and measurements - Part 99-001: Test schedule for engaging and separating connectors under electrical load - Test 99a: Connectors used in twisted pair communication cabling with remote power

IEC 60512-99-002:2019 Connectors for electrical and electronic equipment - Tests and measurements - Part 99-002:

Endurance test schedules - Test 99b: Test schedule for unmating under electrical load

TIA TSB-184-A Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

Visit our website or contact your local CommScope representative for more information.

For technical assistance or customer service, visit us at:

<http://www.commscope.com/SupportCenter>

The products referenced by this bulletin may be covered by U.S. patents or their foreign equivalents. For patents, see

[www.commscope.com/ProductPatent/ProductPatent.aspx](http://www.commscope.com/ProductPatent/ProductPatent.aspx)

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<sup>1</sup> CommScope does not endorse the use of 30 AWG cables for use in PoE applications.