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**Industrial M12 X-code & D-code & RJ45 Cable Assembly****1. SCOPE****1.1. Content**

This specification defines performance, tests and quality requirements for the M12 X-code & D-code & RJ45 connector cable series.

**2. APPLICABLE DOCUMENTS AND FORMS**

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

**2.1. TE Documents**

- 114-137114: Application Specification
- 501-137523: Qualification Test Report

**2.2. Reference Documents**

- IEC 61076-2-109: Detail specification for M12 X-code connectors
- IEC 61076-2-101: Detail specification for M12 connectors with screw-locking
- IEC 60512: Electromechanical Components For Electronic Equipment; Basic Testing Procedure and Measuring Methods
- IEC-60529: Degree of Protection Provided by Enclosures(IP Code)
- ISO 1302: Geometrical Product Specifications (GPS)-Indication of surface texture in technical production documentation
- IEC 60068: Environmental testing
- IEC 60603-7: Detail specification for 8-way, shielded, free and fixed connectors
- EIA 364-98: Housing Locking Mechanism Strength Test Procedure for Electrical
- EIA-364-26 Salt Spray Test Procedure for Electrical Connectors, Contacts and Sockets
- 0260-11395 Customer test requirement.

**3. REQUIREMENTS****3.1. Design and Construction**

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

**3.2. Ratings**

- Rated voltage: 30 V
- Current-carrying capacity:0.5A
- Insulation Resistance >100MΩ
- Temperature Rating: -25° C to +85° C;

### 3.3. Environmental

IP67 according to IEC 60529 connectors in mated and locked position(M12 Connector)

### 3.4. Test Requirements and Procedures Summary (X-code Side)

Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Test Description	Requirement	Procedure
Initial examination of product.	Meets requirements of product drawing and Application Specification	IEC 60512, Test 1a Visual and dimensional (C of C) inspection per product drawing.
<b>ELECTRICAL</b>		
Low Level Contact Resistance(LLCR)	Initial value: 15mΩ maximum Final value: Δ15mΩmaximum	IEC 60512-2-1, Test 2a Subject specimens to 100 milliamperes maximum and 20 millivolts maximum open circuit voltage
Insulation Resistance	100MΩMin.	IEC 60512-3-1, Method A 500V±15V DC between adjacent contacts, 1 minute hold
Voltage proof (withstanding voltage)	1 minute hold with no breakdown or flashover.	750 volts DC Max, hold for 1 minute between adjacent contacts/ between contacts and shield IEC 60512-4-1
Electrical load and temperature	See note	IEC60512, Test 9b Duration: 1000h Amp. Temp: 40°C Current load:0.5A, single contact Recovery time:2 h Temperature: sensor in center of specimen
<b>MECHANICAL</b>		
Sinusoidal vibration	No electrical discontinuity greater than 1μs	IEC 60512, Test 6d 10Hz to 500Hz and 0.35mm or 5g Sweep cycles:10 Full duration:6H
Mechanical Shock	No electrical discontinuity greater than 1μs	IEC 60512, Test 6c Half sine shock acceleration 490m/s <sup>2</sup> (50g) Duration of impact:11ms
Durability	See note	IEC 60512, Test 9a Max speed of operations= 10 mm/s Rest:30s, unmated For gold contact finish, Mate and unmated specimens for 50 cycles.
<b>ENVIRONMENTAL</b>		
Rapid change in temperature (30 minutes dwells at temperature extremes)	See note.	IEC 60512 test 11d Subject specimens to 5 cycles between -25 and 85°C with 30 minute at temperature extremes.

Test Description	Requirement	Procedure
Rapid change in temperature (60 minutes dwells at temperature extremes)	See note.	IEC 60512 test 11d Subject specimens to 5 cycles between -25 and 85°C with 60 minute at temperature extremes.
Damp heat, cycle, first cycle	See note	IEC 60512-11-12 Method dB Subject specimens to 5 cycles (5 days) between 40 and 55°C at 90 to 100% RH
Damp heat, remaining cycle	See note	IEC 60512-11-12 Method dB Subject specimens to 5 cycles (5 days) between 40 and 55°C at 90 to 100% RH
Dry heat	See note	IEC 60512-11-9 Temperature:85°C Duration: 16 hours
Max flowing gas	See note	IEC 60512-11-7 test method 4 Flowing mixed gas – 4 days, according 60068-2-60
Degree of protection IP6X	No ingress of dust	Test IP 6X according to IEC 60529
Degree of protection IPX7	No ingress of water	Test IP X7 according to IEC 60529 Water immersion: 1m, 30 minutes, No water immerge. 7.3.6.3&7.3.7of EN61984
Cold	There shall be no defect that would impair normal operation	IEC 60512-11 Temperature:-25°C Duration: 2h Recovery time:2h


**NOTE**

*Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and above Requalification Test Sequence.*

### 3.5. ELECTRICAL TRANSMISSION REQUIREMENTS

Requirements: X-code to RJ45 series, the results were compared to the limit lines specified in the ISO/IEC 11801-1 for category Class Ea level performance. Detail see *appendix 1. Network Cable Certification Requirements (0260-11395)*

### 3.6. Product Qualification and Requalification Test Sequence

Test Examination	Test Group (a)			
	1	2	3	4(c)
	Test Sequence (b)			
Examination of product	1,22	1,13	1,14	
Voltage proof(withstanding voltage)	4,11,19	4,12	4,8,13	
Insulation resistance	3,10,13,18	3,11	3,7,12	
LLCR	2,7,9,17	2,6,8,10	2,6,11	
Degree of protection IP6X	20			
Degree of protection IPX7	21(d)			
Durability 50cycles		5,9	9	
Sinusoidal vibration	5			
Mechanical shock	6			
Rapid change in temperature (30 minutes dwells at temperature extremes)	8			
Rapid change in temperature (60 minutes dwells at temperature extremes)			5	
Dry heat	12			
Damp heat, cyclic, first cycle	14			
Damp heat, cyclic, remaining cycles	16			
Cold	15			
Mixed flowing gas		7		
Electrical load and temperature			10	
Transmission requirement				1



#### NOTE

- (a) Test groups 1~3 shall have 3 samples each; Group4 shall have 2samples Min each PN.
- (b) Numbers indicate sequence in which tests are performed.
- (c) Test group 4 is according to Electrical transmission requirements table.
- (d) It's allowed to perform with an additional specimen, extending the total number of specimen by 1.

### 3.7 Test Requirements and Procedures Summary(D-code Side)

Para	Test Items	Requirements	Procedures
3.7.1	Examination of product	No defect would impair normal operation	Visual inspection No physical damage. IEC 60512, Test 1a
<b>Electrical Requirements</b>			
3.7.2	Voltage proof (withstanding voltage)	1 minute hold with no breakdown or flashover.	750 volts DC Max, hold for 1 minute between adjacent contacts/ between contacts and shield IEC 60512-4-1
3.7.3	Insulation Resistance	100MΩMin.	500V DC between adjacent contacts IEC 60512, Test 3a, Method A

3.7.4	LLCR	Initial value: 10mΩ max. Rise in relation to initial values ≤15 mΩ	Subject specimens to 100 milliamps maximum and 20 millivolts maximum open circuit voltage Test points refer to Fig.4 IEC 60512-2-1, Test 2a
3.7.5	Temperature Rising	30° C MAX under loaded rating current. (See fig.3)	Stabilize at rate current level until 3 readings at 5 minutes intervals are within 1°C IEC 60512-5-2
<b>Mechanical Requirements</b>			
3.7.6	Degree of protection IP6X	No ingress of dust	Test IP 6X according to IEC 60529
3.7.7	Degree of protection IPX7	No ingress of water	Test IP X7 according to IEC 60529 Water immersion: 1m, 30 minutes, No water immerge. 7.3.6.3&7.3.7of EN61984
3.7.8	Durability	Contact resistance: Δ15mΩ max.	Mate and un-mate specimens for cycles at a maximum speed of operations=10mm/s, Rest:30s,unmated 100 cycles for gold plating EIA364-09-1
3.7.9	Mating/Un-mating Force	15N/15N Max. for 2-5 pins	Operation speed: 10mm/min. Measure force necessary to mate samples. EIA364-13
3.7.10	Sinusoidal vibration	1: Duration of disturbance 1μs max. 2: Contact resistance: Δ15mΩ max. 3:There shall be no defect that would impair normal operation	10Hz to 500Hz and 0.35mm or 50 m/s <sup>2</sup> Sweep cycles:10 Full duration:6H IEC60512, Test 6d
3.7.11	Mechanical Shock	1:No discontinuities of 1 microsecond or longer duration 2: Contact resistance: Δ15mΩ max. 3:There shall be no defect that would impair normal operation	Subject mated specimens to 50G's half-sine shock pulses of 11 milliseconds duration with 3.44m/s velocity change. Three shocks in each direction applied along 3 mutually perpendicular planes, 18 total shocks. EIA364-27
<b>Environmental Requirements</b>			
3.7.12	Rapid change in temperature	See Note.	IEC 60512-11-4 Subject specimens to 5 cycles between -25°C to 85°C with 30 minutes dwells at temperature extremes Refer to 3.3.1.C : Temperature Rating
3.7.13	Dry heat	See Note. Insulation resistance at high temperature	IEC 50512-11-9 Subject mated specimens to 85°C for 16 hours

3.7.14	Damp heat, cyclic	See Note.	IEC 60512-11-12 Subject specimens to 5 cycles(5 days) Temperature:40°C Recovery time:2h
3.7.15	Cold	See Note.	IEC 60512-11 Temp.: -25°C Duration:2h Recovery time:2h Refer to 3.3.1.C : Temperature Rating
3.7.16	Mixed flowing gas	See Note.	IEC 60068-2-60, Method 4 Subject mated specimens to flowing mixed gas corrosion-4 days

**NOTE:** Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Re qualification Test Sequence shown in table 3.7

### 3.8 ELECTRICAL TRANSMISSION REQUIREMENTS

Requirements: D-code to RJ45 and D-code to D-code series, the results were compared to the limit lines specified in ANSI/TIA 568.2 Cat 5e level performance. Detail see see *appendix 1. Network Cable Certification Requirements (0260-11395)*

### 3.9 Product Qualification Test Sequence

Test or Examination	Test Group					
	A(a)	B	C	D	E(f)	F
	Test Sequence					
Examination of product	1	3,6,11,20,26	8	9	1	
Voltage proof(withstanding voltage)	4	10,19,25	4,7	4,8		
Insulation resistance	3	9,13,18,24	3,6	3,7		
LLCR	2	2,5,8,17,23	2	2	2,6	
Temperature Rising				5(e)		
Degree of protection IP6X		21	5	6		
Degree of protection IPX7		22(b)				
Durability					4	
Mating and Un-mating Force					3,5	
Sinusoidal vibration		1				
Mechanical shock		4				
Rapid change in temperature		7		1		
Dry heat		12				
Damp heat, cyclic		14(c),16(d)				
Cold		15				
Mixed flowing gas			1			
Transmission requirement						1

**NOTE:**

- When the initial test group A has been completed, the specimens are divided in the 3 groups B, C, D. All connectors in each group shall undergo the tests specified for the relevant group numbers indicate sequence in which tests are performed.
- It's allowed to perform with an additional specimen, extending the total number of specimen by 1.
- First cycle
- Remaining cycles
- Test with additional specimen for over-molding type cable assembly
- This test group should be tested without the screw nut

#### 4.0. Test Requirements and Procedures Summary(RJ45 Side)

General			
No.	Test Items	Requirements	Condition according to
4.0.1	Visual and dimensional examination	Meets requirements of product drawing	Visual and dimensional examination dimensional and functional per applicable quality inspection plan

Mechanical			
4.0.2	Durability of marking	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60512-9-1. Mate and unmate plug and jack interface with latch inoperative for 1000 cycles at a maximum rate of 500 (automatic) per hour.
4.0.3	Plug withdrawal force, jack-plug interface.	20N MAX.(Unshielded) 30N MAX.(Shielded)	IEC 60512-13-1. Measure force required to unmate plug and jack with latch depressed at a maximum rate of 0.5 inch(1.27mm) inch per minute.
4.0.4	Plug retention in jack, jack-plug interface.	Plug shall not dislodge from jack.	EIA 364-98. Apply an axial load of 50N or 90N to plug housing at a rate of 1.27mm per minute with plug mated in jack and latch engaged. Maintain load
4.0.5	Plug insertion force, jack-plug interface.	20N MAX.(Unshielded) 30N MAX.(Shielded)	IEC 60512-13-1. Measure force required to mate plug and jack with latch depressed at a maximum rate of 0.5 inch(1.27mm) per minute.
4.0.6	Durability, jack-plug interface.	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60512-9-1. Mate and unmate plug and jack interface with latch inoperative for 1000 cycles at a maximum rate of 500 (automatic) per hour.
4.0.7	Vibration, jack-plug interface.	No discontinuities of 1 microsecond maximum.Shall remain mated and show no evidence of physical damage.	EIA364-27,Subject mated specimens to 50 G's half-sine shock pulsed of 11 milliseconds duration. Three shocks in each direction applied along 3 mutually perpendicular planes, 18 total shock. Discontinuity less than 1 $\mu$ s, No damage.
4.0.8	Mechanical shock, jack-plug interface.	No discontinuities of 1 microseconds maximum. No damage.	Subject mated specimens to 3.10G's rms between 20~500Hz. 15 minutes in each of 3 mutually perpendicular planes. Discontinuity less than 1 $\mu$ s, No damage.

Electrical				
4.0.9	Low Level Contact Resistance	Initial	Max. 20mΩ	IEC 60512-2-1. Measure at to 20mV open circuit
		Final	ΔR 10 milliohms	

		maximum.	at 100mA maximum.
4.0.10	Voltage proof.	One minute hold with no breakdown or flashover	IEC 60512-4-1. 1000 volts AC at sea level. Test between adjacent contacts of mated plug and jack.
4.0.11	Insulation Resistance	1000 megohms minimum.	Test voltage 500V DC Time:60s IEC 60512-3-1 Test 3a Method B

Environmental			
4.0.12	Thermal shock	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60512-3-1. Test voltage of 100 volts DC with 1 minute hold. Test between adjacent contacts of mated plug and terminated jack
4.0.13	Humidity, steady state	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60512-11-12. Subject mated plug and terminated jack to 55°C (PC) and 95% RH for 10 days.
4.0.14	Humidity / temperature cycling	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60068-2-38. Subject mated plug and terminated jack to 21 cycles (cycle time 24 hours) between 25 and 65°C at 95% RH with a -10°C sub-cycle shock.
4.0.15	Stress relaxation	$\Delta R$ 10 milliohms maximum. No physical damage.	IEC 60068-2-2, Test Method Ba. Subject mated plug and terminated jack to 70°C for 500 hours.
4.0.16	Salt Spray Test	(1) $\Delta R$ 10 milliohms maximum.(2)10 times under the magnifying glass to observe the coating without peeling, cracks wrinkling, separation and other phenomena, allowing up to one terminal has a corrosion point, the area does not exceed 5%	EIA-364-26, Condition B. Temperature: 35 $\pm$ 2 ° C, humidity: 100% RH, NaCl concentration: 5% Time: 48hours.

#### 4.1 Electrical Transmission Requirements.

##### 4.1.1 Requirements:

RJ45 to x-code, RJ45 to RJ45 series, The results were compared to the limit lines specified in the ISO/IEC 11801-1 for category Class Ea level performance. Detail see *appendix 1. Network Cable Certification Requirements (0260-11395)*

##### 4.1.2 Requirements:

RJ45 to d-code series, The results was compared to the limit lines specified in ANSI/TIA 568.2 CAT 5E level performance. Detail see *appendix 1. Network Cable Certification Requirements (0260-11395)*

Number of Specimen as below table1:



Number of Specimen	
Test	Numbers & consist of
Group A	5 pair
Group B	5 pair
Group C	5 pair
Group D	5 pair
Group E	5 pair
Group F	5 pair
Group G	5 pair
Group H	2 pc/PN

#### 4.1.3 Test Sequences

No.	Test or Examination	Test Group							
		A	B	C	D	E	F	G	H
		Test Sequence							
1	Visual and dimensional examination	1	1	1	1,5	1,5	1,4	1,4	
2	Contact resistance	2	2,4		2,6	2,6	2,5	2,5	
3	Insulation resistance	3			7	7	6		
4	Voltage proof	4			8	8	7		
5	Durability, jack-plug interface	5	3		9		8		
6	Plug insertion force, jack-plug interface			2					
7	Plug withdrawal force, jack-plug interface			3					
8	Plug retention in jack, jack-plug interface			4		9	9		
9	Thermal shock				3	3			
10	Humidity/temperature cycling					4			
11	Humidity, steady state				4				
12	Salt Spray Test							3	
13	Stress relaxation						3		
14	Transmission requirement								1

## Appendix 1: Network Cable Certification Requirements (0260-11395)

### 1. OBJECTIVE

The purpose of this test procedure is to establish minimum certification requirements for all Applied Materials network cables. All Applied Materials network cables shall meet or exceed the minimum test requirements set forth in this document or as specified by engineering drawing or other specified test procedures.

### 2. SCOPE

This specification applies to all network cables manufactured for Applied Materials referencing this part number.

### 3. REFERENCE

<b>0260-17000</b>	Cable and Harness Test Requirements
<b>ANSI/TIA-568.2</b>	Balanced Twisted-Pair Telecommunications Cabling and Components Standard
<b>ANSI/TIA 1005</b>	Telecommunications Infrastructure Standard for Industrial Premises
<b>ISO/IEC 11801</b>	Information Technology – Generic Cabling for Customer Premises
<b>IPC/WHMA-A-620</b>	Requirements and Acceptance for Cable and Wire Harness Assemblies.

### 4. REQUIREMENTS

The final assembly of all category 6A cables must pass ISO/IEC 11801 Class E<sub>A</sub> certification. The final assembly of all category 5e cables must pass ANSI/TIA 568.2 category 5e certification. Testing must be performed using a qualified cable certifier. Test results shall be retained in accordance with 0260-17000 section 6.2.3.

### 5. ISO/IEC 11801 CLASS EA PATCH CABLE TEST SETUP

6. Notice. The following section outlines ISO/IEC 11801 Class EA certification test setup on a Fluke DSX-5000 cable certifier using patch cable test adapters such as the DSX-PC6AS and DSX-CHA-M12-X. This setup covers RJ45 to RJ45, RJ45 to male X-code, and male X-code to male X-code type network cable configurations. Typically, an RJ45 plug can move slightly in or out of the jack even when the latch engages. For consistent results, ensure each RJ45 plug is pushed in completely to the patch cord test adapters. An alternate test setup for other cable and test adapter configurations is described in section 7. Please note that the following steps are for example purposes only and that any qualified cable certifier may be used. Test setup may vary on other devices.

- 6.1. Cable Type. Cable type should be selected in accordance to the bulk cable called out in the bill of materials. For shielded category 6A network cables this shall be set to “Cat 6A F/UTP” on the DSX-5000. This setting applies to bulk cable of type SF/UTP, indicating overall braid and foil screens and individually unscreened twisted pairs, or of type F/UTP, indicating a foil screen and individually unscreened twisted pairs.

- 6.2. NVP. The NVP parameter, used to electrically determine cable length, shall be set per the bulk cable manufacturer's recommendation. If no manufacturer recommendation is available, the default value of "74,0%" may be used.
- 6.3. Shield Test. For any Category 6A cables with shielding, such as cable type SF/UTP or F/UTP, a shield test shall be performed.
- 6.4. Test Limit. The test limit for all Category 6A cables shall be in accordance with the ISO/IEC 11801 Class EA standard. When using the DSX-PC6AS and/or DSX-CHA-M12-X patch cable test adapters, the ISO patch cord test limits shall be selected according to table 1 below. Additionally, the Store Plot Data parameter shall be set to "On" and the Bi-directional parameter shall be set to "On".

Table 1: ISO Patch Cable Test Limits	
Cable Length, $l$ (m)	Test Limit
$0 < l \leq 0.5$	ISO Patch Cord Cat6A 0.5m
$0.5 < l \leq 1.0$	ISO Patch Cord Cat6A 1.0m
$1.0 < l \leq 1.5$	ISO Patch Cord Cat6A 1.5m
$1.5 < l \leq 2.0$	ISO Patch Cord Cat6A 2.0m
$2.0 < l \leq 2.5$	ISO Patch Cord Cat6A 2.5m
$2.5 < l \leq 3.0$	ISO Patch Cord Cat6A 3.0m
$3.0 < l \leq 3.5$	ISO Patch Cord Cat6A 3.5m
$3.5 < l \leq 4.0$	ISO Patch Cord Cat6A 4.0m
$4.0 < l \leq 5.0$	ISO Patch Cord Cat6A 5.0m
$5.0 < l \leq 7.5$	ISO Patch Cord Cat6A 7.5m
$7.5 < l \leq 10.0$	ISO Patch Cord Cat6A 10.0m
$10.0 < l \leq 15.0$	ISO Patch Cord Cat6A 15.0m
$15.0 < l \leq 20.0$	ISO Patch Cord Cat6A 20.0m
$l > 20.0$	ISO Patch Cord Cat6A >20.0m

- 6.5. HDTDR/HDTDX. This parameter shall be set to "All Autotests".
- 6.6. Outlet Configuration. Outlet configuration shall be set to T568B unless otherwise specified in the cable drawing.
- 6.7. AC Wire Map. The AC Wire Map parameter is used to test Power over Ethernet (PoE) applications through a PoE device and therefore shall always be set to "Off".



**Figure 1 – Example Category 6A Test Setup**

## 7. ANSI/TIA 568.2 CAT 5E PATCH CABLE TEST SETUP

- 7.1. Notice. The following section outlines ANSI/TIA 568.2 category 5e certification test setup on a Fluke DSX-5000 cable certifier using patch cable test adapters such as the DSX-PC5ES and DSX-CHA021S. This setup covers RJ45 to RJ45, RJ45 to male D-code, and male D-code to male D-code type network cable configurations. Typically, an RJ45 plug can move slightly in or out of the jack even when the latch engages. For consistent results, ensure each RJ45 plug is pushed in completely to the patch cord test adapters. An alternate test setup for other cable and test adapter configurations is described in section 7. Please note that the following steps are for example purposes only and that any qualified cable certifier may be used. Test setup may vary on other devices.
- 7.2. Cable Type. Cable type should be selected in accordance to the bulk cable called out in the bill of materials. For shielded category 5e network cables this shall be set to “Cat 5e F/UTP” on the DSX-5000. This setting applies to bulk cable of type SF/UTP, indicating overall braid and foil screens and individually unscreened twisted pairs, or of type F/UTP, indicating a foil screen and individually unscreened twisted pairs.
- 7.3. NVP. The NVP parameter, used to electrically determine cable length, shall be set per the bulk cable manufacturer’s recommendation. If no manufacturer recommendation is available, the default value of “69,0%” may be used.
- 7.4. Shield Test. For any category 5e cables with shielding, such as cable type SF/UTP or F/UTP, a shield test shall be performed.
- 7.5. Test Limit. The test limit for all category 5e cables shall be in accordance with the ANSI/TIA 568.2 category 5e standard. When using the DSX-PC5ES and/or DSX-CHA021S patch cable test adapters, the TIA patch cord test limits shall be selected according to table 2 below. Additionally, the Store Plot Data parameter shall be set to “On” and the Bi-directional parameter should be set to “On”.

Table 2: TIA Patch Cable Test Limits	
Cable Length, l (m)	Test Limit
$0 < l \leq 0.5$	TIA Patch Cord Cat5e 0.5m
$0.5 < l \leq 1.0$	TIA Patch Cord Cat5e 1.0m
$1.0 < l \leq 1.5$	TIA Patch Cord Cat5e 1.5m
$1.5 < l \leq 2.0$	TIA Patch Cord Cat5e 2.0m
$2.0 < l \leq 2.5$	TIA Patch Cord Cat5e 2.5m
$2.5 < l \leq 3.0$	TIA Patch Cord Cat5e 3.0m
$3.0 < l \leq 3.5$	TIA Patch Cord Cat5e 3.5m
$3.5 < l \leq 4.0$	TIA Patch Cord Cat5e 4.0m
$4.0 < l \leq 5.0$	TIA Patch Cord Cat5e 5.0m
$5.0 < l \leq 7.5$	TIA Patch Cord Cat5e 7.5m
$7.5 < l \leq 10.0$	TIA Patch Cord Cat5e 10.0m
$10.0 < l \leq 15.0$	TIA Patch Cord Cat5e 15.0m
$15.0 < l \leq 20.0$	TIA Patch Cord Cat5e 20.0m
$l > 20.0$	TIA Patch Cord Cat5e >20.0m

- 7.6. HDTDR/HDTDX. This parameter shall be set to “All Autotests”.
- 7.7. Outlet Configuration. Most Applied Materials category 5e cable assemblies will use two-pair bulk cable. Therefore, a custom outlet configuration must be used. To set up the correct outlet configuration select Outlet Configuration -> Custom -> Manage -> Create. Uncheck pairs 4-5 and 7-8, provide a name for the custom outlet configuration, and hit Save. See figure 2 below for an example of a correct custom outlet configuration.



**Figure 2 - Example Two-Pair Custom Outlet Configuration**

- 7.8. AC Wire Map. The AC Wire Map parameter is used to test Power over Ethernet (PoE) applications through a PoE device and therefore shall always be set to “Off”.



Figure 3 – Example Category 5e Test Setup

## 8. ALTERNATE TEST SETUP

- 8.1. Notice. The following procedures outline alternate network certification test setup for both Class E<sub>A</sub> and category 5e cables on a Fluke DSX-5000 cable certifier using either permanent link or channel test adapters, only when patch cable adapters are not applicable or not available. This section covers test setup for all network cable connector configurations. Refer to sections 5 and 6, for Class E<sub>A</sub> and category 5e respectively, to determine the following parameters: cable type, NVP, shield test, HDTDR/HDTX, outlet configuration, and AC wire map. Please note that the following steps are for example purposes only and that any qualified cable certifier may be used. Test setup may vary on other devices.

- 8.2. Permanent Link Adapter Test Setup. When patch cable test adapters are not available, a cable with an RJ45 connector may be put under test using a category 6A shielded coupler, such as 0720-15495, and a permanent link test adapter.
- 8.3. Channel Adapter Test Setup. For connector configurations such as M12 female or M12 male, a short adapter cable may be used along with a channel test adapter. See figure 2 below for an example of test setup for a RJ45 to female M12 test using a combination of permanent link and channel test adapters. Refer to table 3 for a list of adapter cable part numbers that can be built to adapt to M12 connectors as needed.

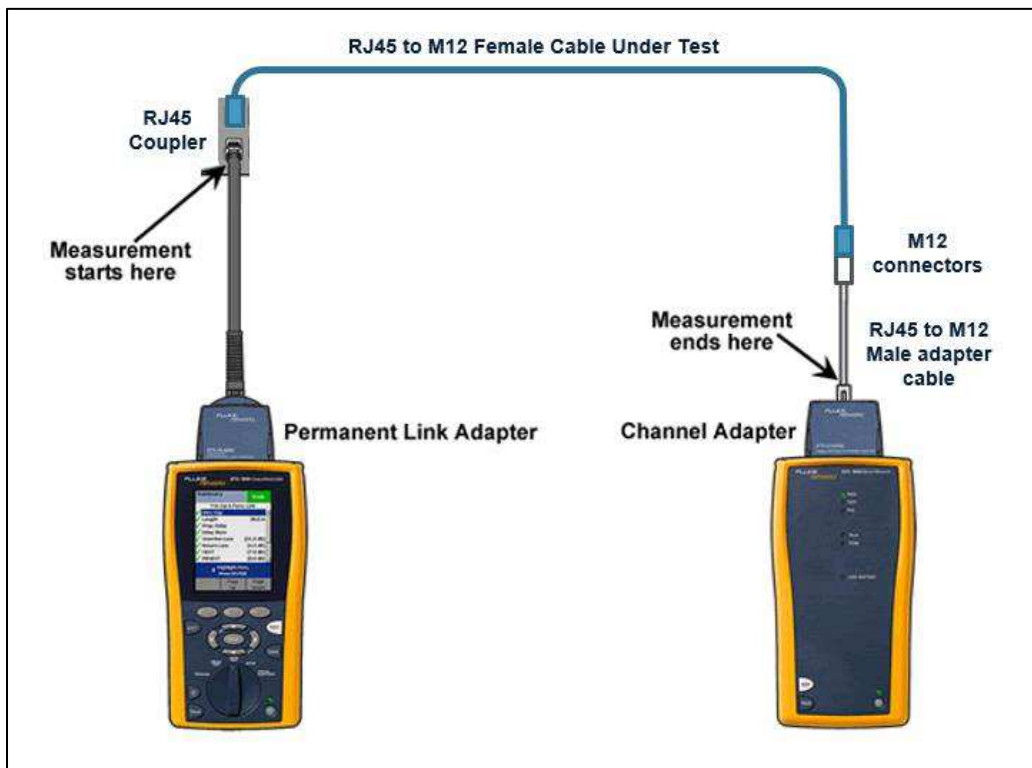


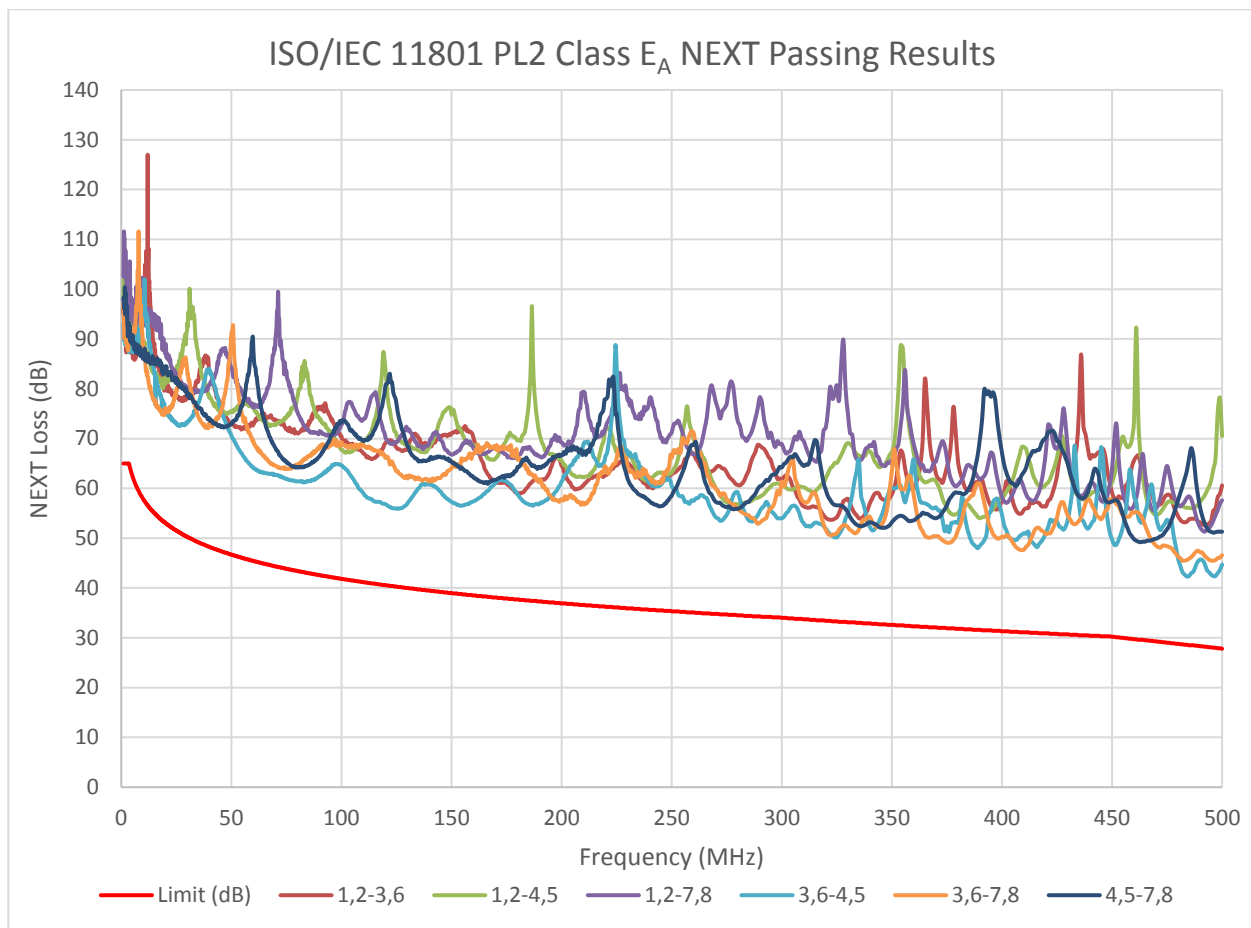
Figure 4 – Example Test with Permanent Link and Channel Test Adapters

Table 3 – Cat 6A Test Adapter Cables	
Description	Part Number
RJ45 to M12-8 Female X-Code	0150-61921
RJ45 to M12-8 Male X-Code	0150-61922
RJ45 to M12-4 Female D-Code	0150-61923
RJ45 to M12-4 Male D-Code	0150-61924

- 8.4. Test Limit. The test limit for all Category 6A cables shall be in accordance with the ISO/IEC 11801 Class EA standard. The test limit for all category 5e cables shall be in accordance with the ANSI/TIA 568.2 category 5e standard. When using permanent link and/or channel test adapters, the test limits shall be selected according to table 4 below. Additionally, the Store Plot Data parameter shall be set to "On".

Table 4 – Alternate Test Limits	
Cable Type	Test Limit
Category 5e	TIA Cat 5e Perm. Link (+All)
Category 6A	ISO11801 PL2 Class Ea (+All)





**Figure 5 – Example Passing Near-End Crosstalk Results**