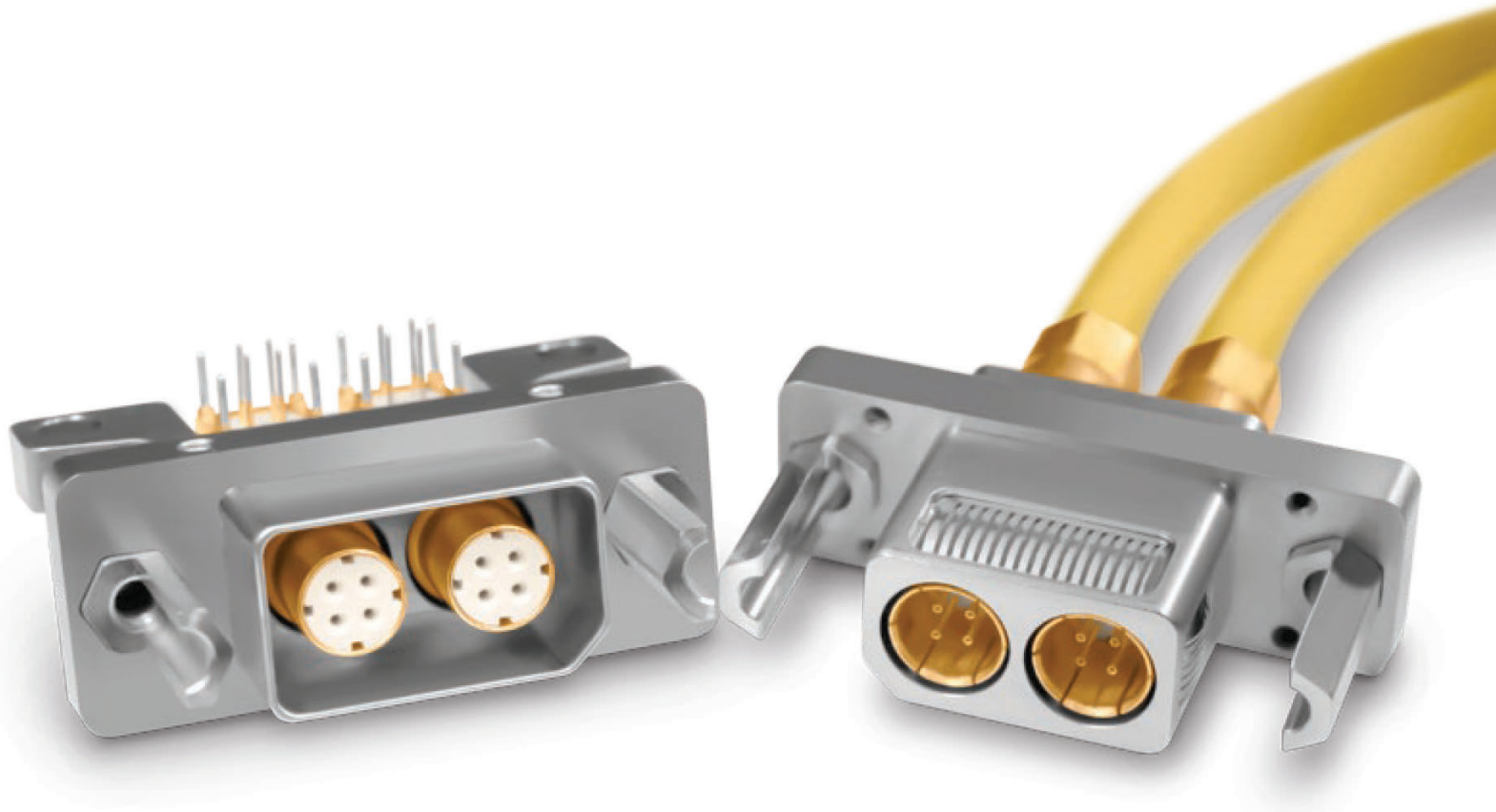


# Fibre Channel D-Sub Connector Series

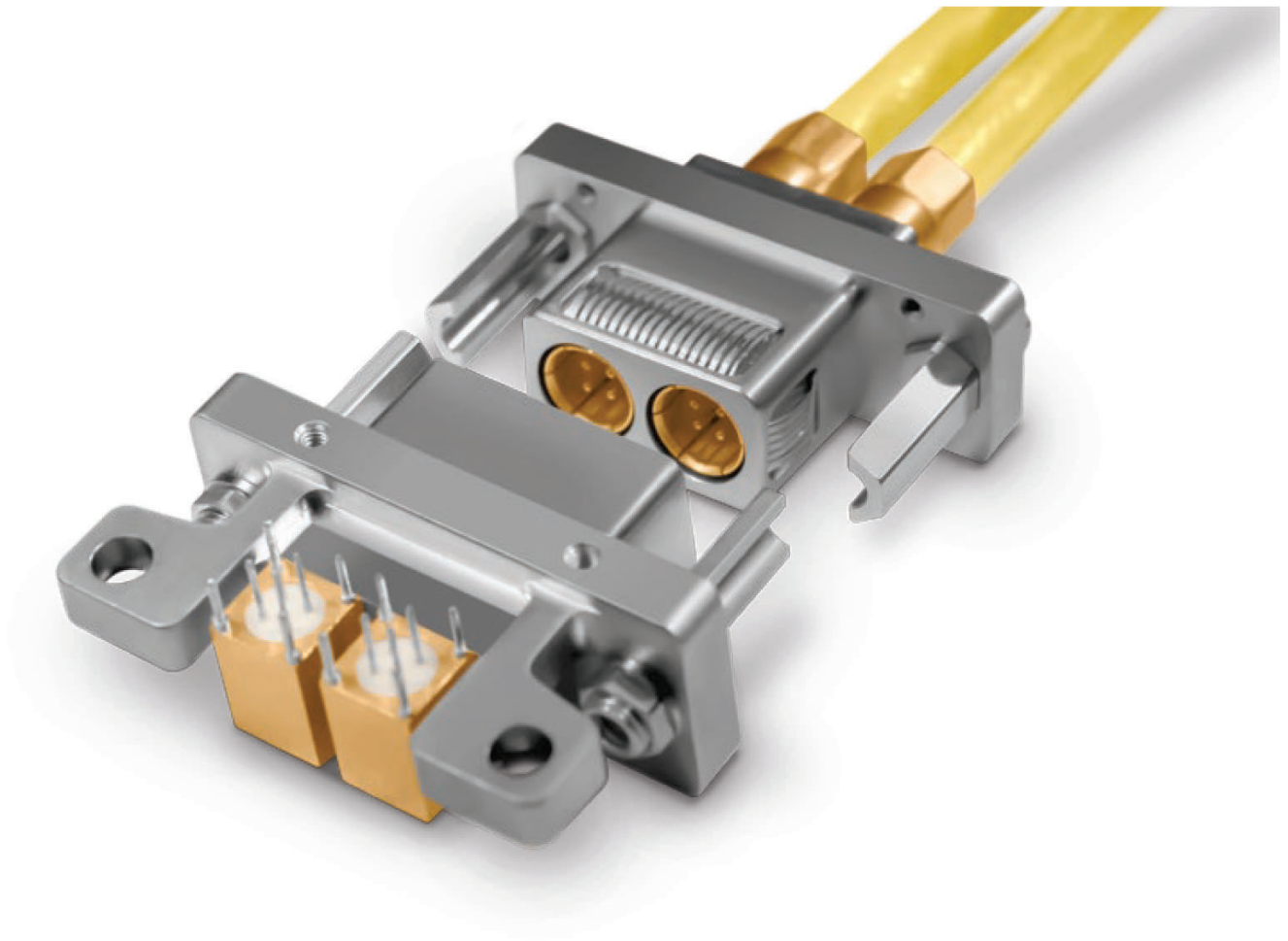
White Paper



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# Fibre Channel D-Sub Connector Series



## Background

Smiths Connectors offers a complete line of differential quadrx connectors, contacts, and cable assemblies for high speed Ethernet, Firewire, and Fibre Channel applications. Quadrx connectors offer superior performance in high speed matched impedance data-on-demand applications. The signal to signal and signal to shield characteristic impedance is maintained throughout the connector pair.

Smiths Connectors manufactures connectors for the following protocols:

- ▶ Fibre Channel
- ▶ Ethernet: 10 Base-T, 100 Base-T, 1000 Base-T
- ▶ Firewire: IEEE 1394a and 1394b
- ▶ USB, DVI, and Infiniband

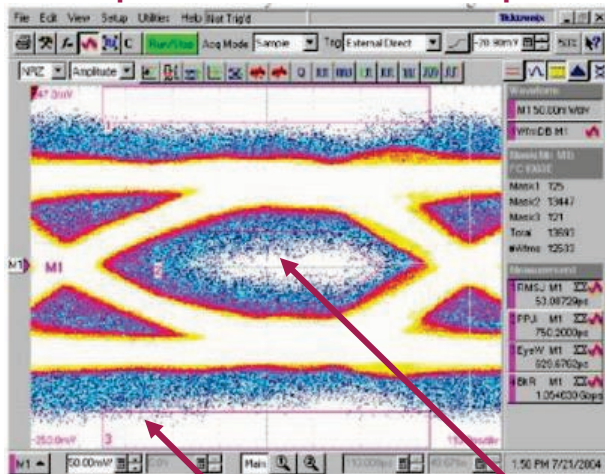
Fibre Channel is a high speed technology primarily used to connect computer data storage applications and has become a common connection type for storage area networks. Fibre Channel is standardized in the T11 Technical Committee of the Information Technology Standards (NCITS). Fibre Channel electrical signals are sent over a differential pair cable with a nominal impedance of 150 Ohms.

The benefits of the 150 Ohm quadrx over the 100 Ohm quadrx are:

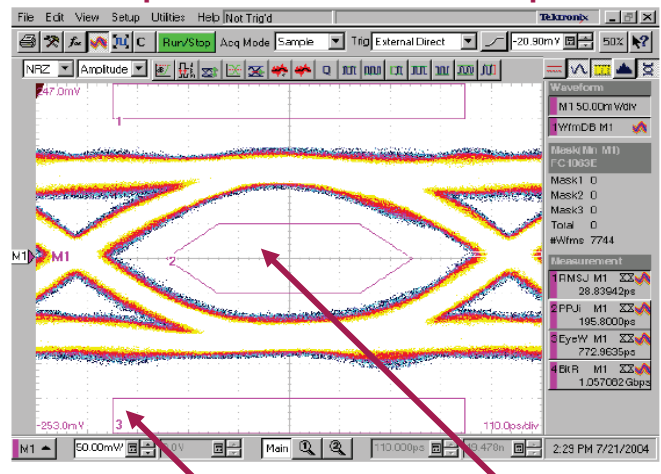
- ▶ Lower current and power consumption system requirements
- ▶ Increased cable distance – longer lengths of the 150 ohm quadrx cable can be used compared to 100 Ohm quadrx cable at equivalent data rates
- ▶ The quadrx contact designed for the 100 Ohm quadrx is a Size 9 configuration. The Fibre Channel D-sub quadrx contact is a Size 3 configuration (30% larger in size) to ensure a matched impedance signal throughout the quadrx contact mated pair at 150 Ohm differential pair impedance.

Quadrx contacts consist of an outer shield with four inner conductors paired orthogonally to one another forming two 150 Ohm controlled impedance differential pair signals. The inner contacts are housed within a Size 3 keyed rugged D-sub outer metal shell. An alignment key is machined onto the body of the contact to insure that the contact is anti-rotational. The design engineer’s job is to ensure that the quadrx contact maintains constant impedance and that each and every discontinuity is properly compensated to minimize reflections and preserve signal integrity. The first eye pattern shows a contact that was not designed for constant impedance through the entire contact. The second eye pattern shows a contact that is designed with a constant impedance through the entire contact mated pair.

**Eye Pattern Without Match Impedance Quadrx at 1 Gbps**



**Eye Pattern With Match Impedance Quadrx at 1 Gbps**



Eye Lash

Keep Out Region

Eye Lash

Keep Out Region

## Terms

- ▶ Signal Integrity: ensuring properly shaped pulses reach the receiver from the transmitter
- ▶ Eye Pattern: a graph which overlays thousands of pulses as an easy way to evaluate signal integrity
- ▶ Skew: difference in time delay between different signal paths
- ▶ Jitter: noise induced timing error

All four contact configurations support a 250 Mbps signal dependent on electronic system design / budget (the connector looks like a single lumped impedance at this speed). The competitor's cable to PCB contact pair is likely to cause a signal integrity issue at higher data rates > 1 Gbps (Gigabit Ethernet) speed (the discrete segments of the contact are visible at, and above, that signal speed).

Quadax contacts offer several advantages for high data transfer rates, low power consumption and excellent EMI compatibility:

- ▶ Four strategically spaced inner contacts forming two 150 Ohm matched impedance differential pairs.
- ▶ Outer contact with rugged wall section.
- ▶ Available in Size 3 crimp termination style.
- ▶ Size 3 pin also available as either straight or right angle PC tail configurations.

## Reverse Gender Design

In a traditional quadax design, the four inner pin contacts protrude from the insulator surface. Because of the contact pins' small gage, there is potential for the contacts to be bent or damaged during assembly and handling. This could lead to problems when the connectors are mated as contacts with just the smallest misalignment could experience breaking or bending. In some cases the pins could damage the mating socket contact or puncture the mating contact dielectric material.

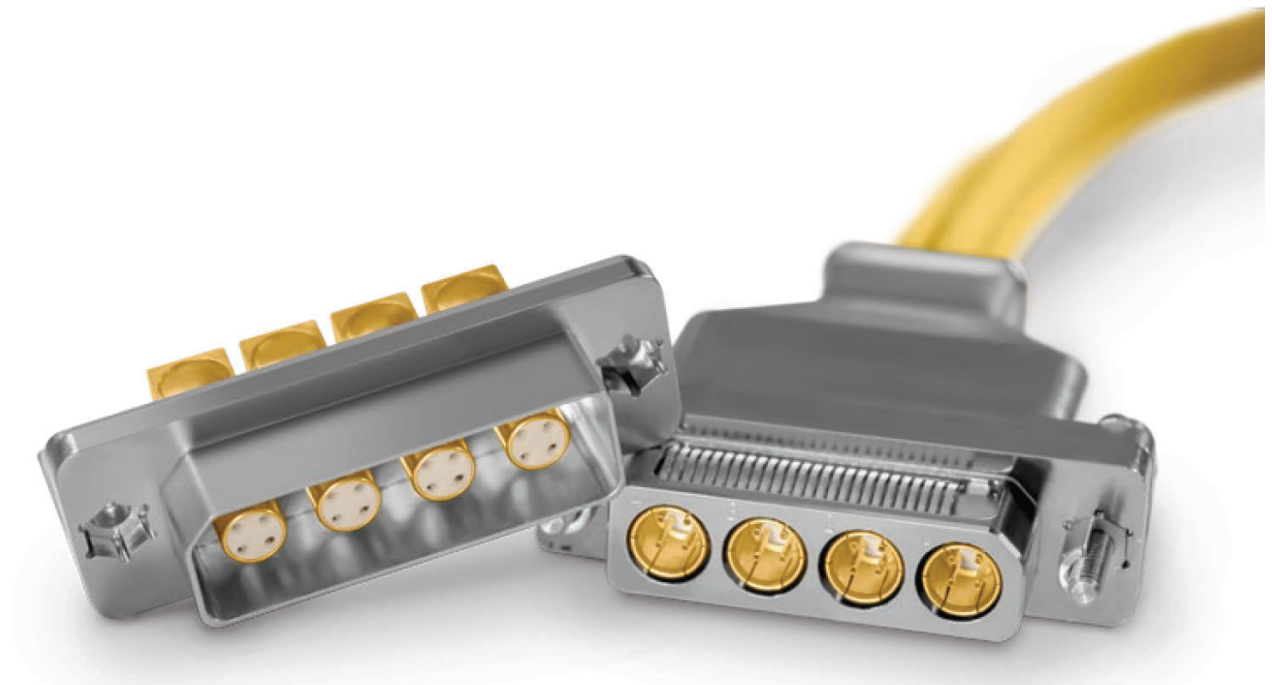
To avoid this potential problem, Smiths Connectors' quadax design is reverse gender. The inner quadax pin is recessed within the dielectric material. The inner socket contact is exposed air dielectric and protruding from the insulator front surface.



Benefits of reverse gender design:

- ▶ Better blind mate capability
- ▶ Reduced chance of bent inner pins
- ▶ Larger, heat-treated rigid socket contacts protruding from the insulator surface

In the Fibre Channel D-Sub receptacle, the termination style can be a cable mount crimp version, straight PC tail or right angle PC tail. In the straight and right angle pin PC tail versions the contacts are included when the high speed D-Sub receptacle connector is purchased. The termination style of the quadrax socket designed for the Fibre Channel plug is a straight cable mount crimp version.



### Rugged D-Sub Connector Design

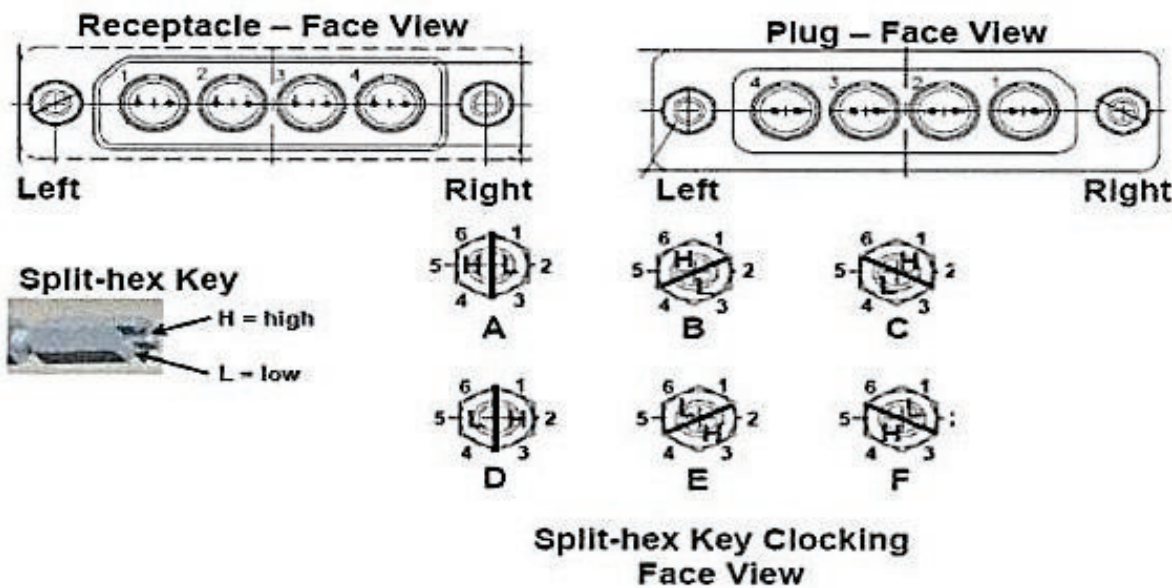
- ▶ The plug and receptacle are supplied with aluminum nickel plated housing. For other plating options, please consult the factory
- ▶ The plug is designed with integrated multi-finger contact engagement for superior EMI shielding and lower contact resistance
- ▶ Standard non-keyed insert arrangements are offered in 2, 4, 6, 8 ways (hybrid options available)
- ▶ Standard keyed insert arrangements are offered in 2, 4, 6 and 8 ways
- ▶ Six-position keyed and non-keyed jack post accessory hardware available

## Six-Position Keyed Jack Post

To ensure that the correct high speed connectors are mated to address specific wiring requirements and keying combinations, a keyed jack post was incorporated into the design. The six position keyed jack post allows for 36 possible keying combinations ensuring the correct high speed plug is mated to the corresponding receptacle. With use of the keyed D-Sub, customers can be certain the correct plug is mated to the proper receptacle if there are multiple receptacles on their box.

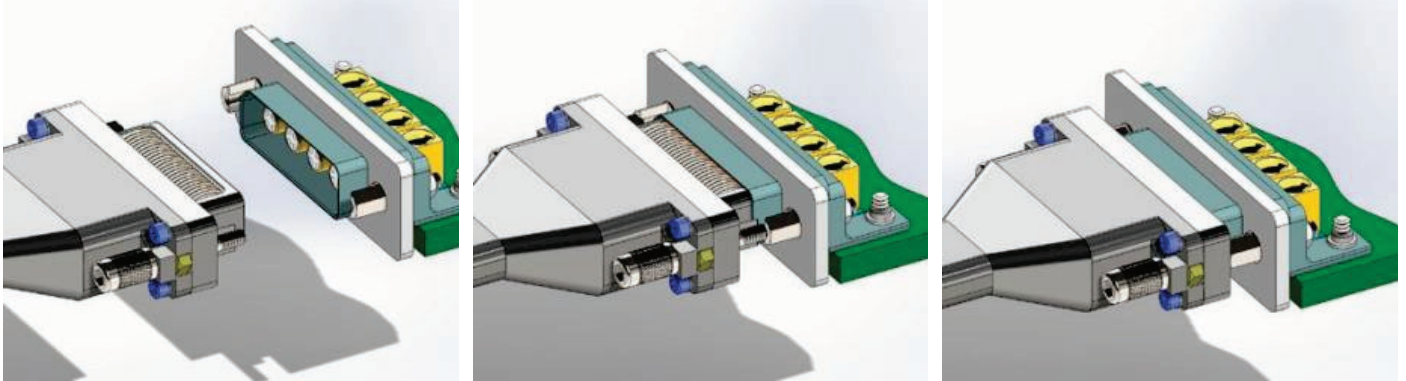
To set the key to the desired position:

1. Loosen the nut located in the back of the flange
2. Rotate the jack screw to the desired position (see chart)
3. Tighten the nut to 5 to 8 inch pounds



Key Position	Receptacle		Plug	
	Left	Right	Left	Right
1	A	A	A	A
2	A	B	F	A
“	“	“	“	“
23	D	E	C	D

## Keyed Fibre Channel D-Sub Mating Sequence



Improper mating of the Smiths Connectors' D-Sub connector can cause angular displacement of the high speed contacts which may result in reduced product life or damage to the contacts or PCB. The following instructions are recommended:

1. Visually inspect the contact assemblies in both the plug and receptacle. Look for bent, damaged or missing pins or socket contacts.
2. Ensure power is off and ESD considerations are met.
3. Check the plug connector using the appropriate inspection gauge to verify the proper orientation of the contacts.
4. Insert the plug into the receptacle carefully, as straight as possible, until the jackscrews contact the screw posts in the receptacle.
5. Turn the jackscrews. Turn each one only half turn, then move to the other screw. Continue alternating between the screws, half turn each, until the connector is fully mated. Recommended torque value is 4–5 in / lbs.
6. Un-mate the connector by reversing the procedure. Use the ½ turn technique to ensure the connector comes straight out of the receptacle without binding or putting undue stress on the connector components or PCB.

## Keyed Jack Post & Back Shell Accessories

To ensure mechanical stability of the cables when exiting the Fibre Channel D-Sub, plug back shells are included in the connector series.



# Performance

## Specifications

### Mechanical & Environmental

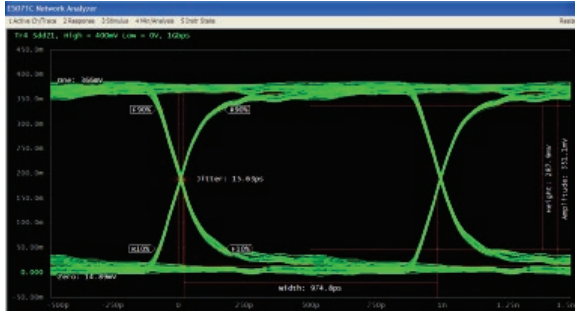
<b>Temperature Rating</b>	-65°C To 165°C
<b>Corrosion</b>	MIL-STD-202 METHOD 101, Test Condition B
<b>Shock</b>	MIL-STD-202 Method 213, Test Condition B
<b>Vibration</b>	MIL-STD-202 Method 204, Test Condition B
<b>Thermal Shock</b>	MIL-STD-202 Method 107, Test Condition B
<b>Durability</b>	500 Mating Cycles / Minute

### Electrical

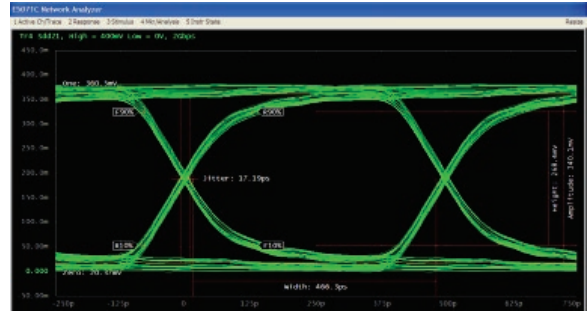
<b>DWV</b>	250V DC max
<b>Insulation Resistance</b>	5.00 MΩ/min.
<b>Contact Current Rating</b>	3.0 A DC min.
<b>Bandwidth</b>	Up to 10 GHz
<b>Data Rates</b>	Exceeding 5 Gbps
<b>Differential Pair Cable Impedance</b>	150 Ω ± 15 Ω

# Eye Patterns

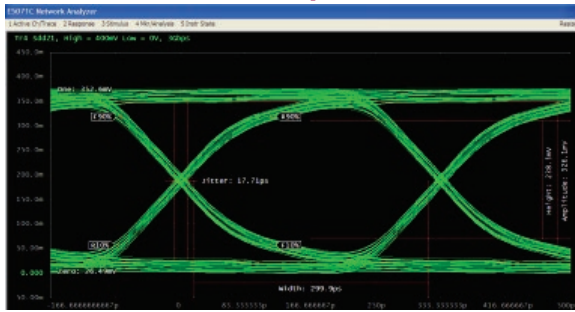
1 Gbps



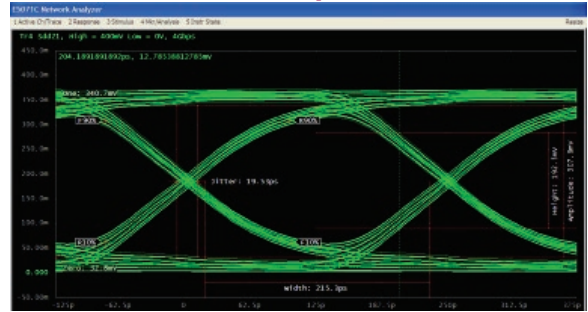
2 Gbps



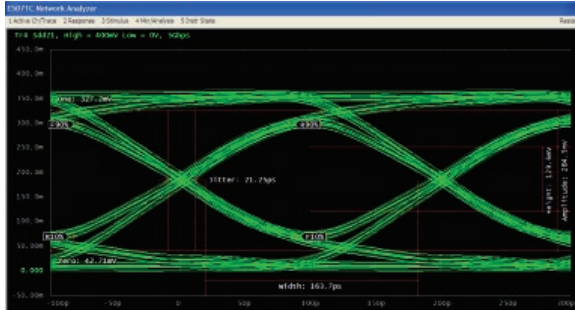
3 Gbps



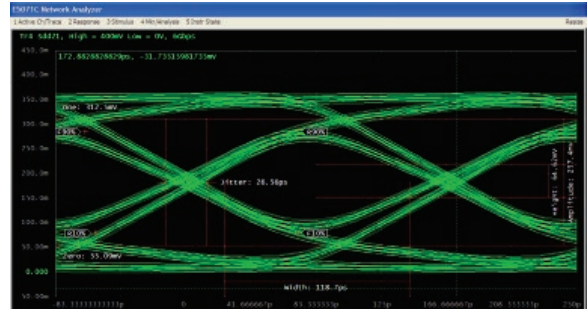
4 Gbps



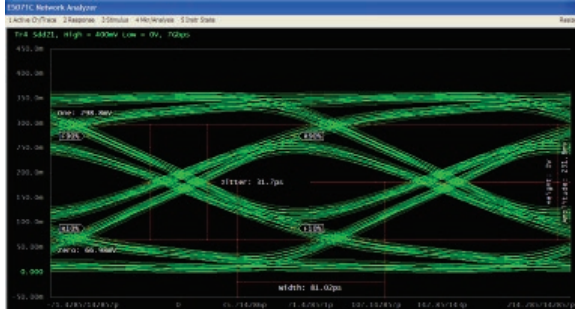
5 Gbps



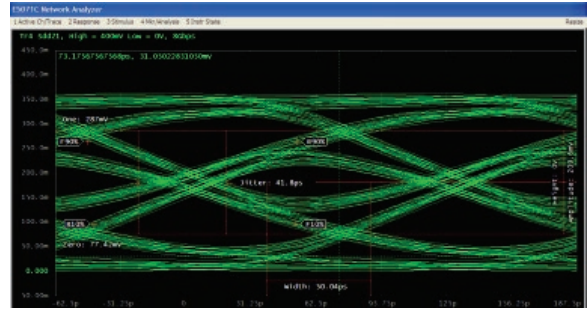
6 Gbps



7 Gbps



8 Gbps

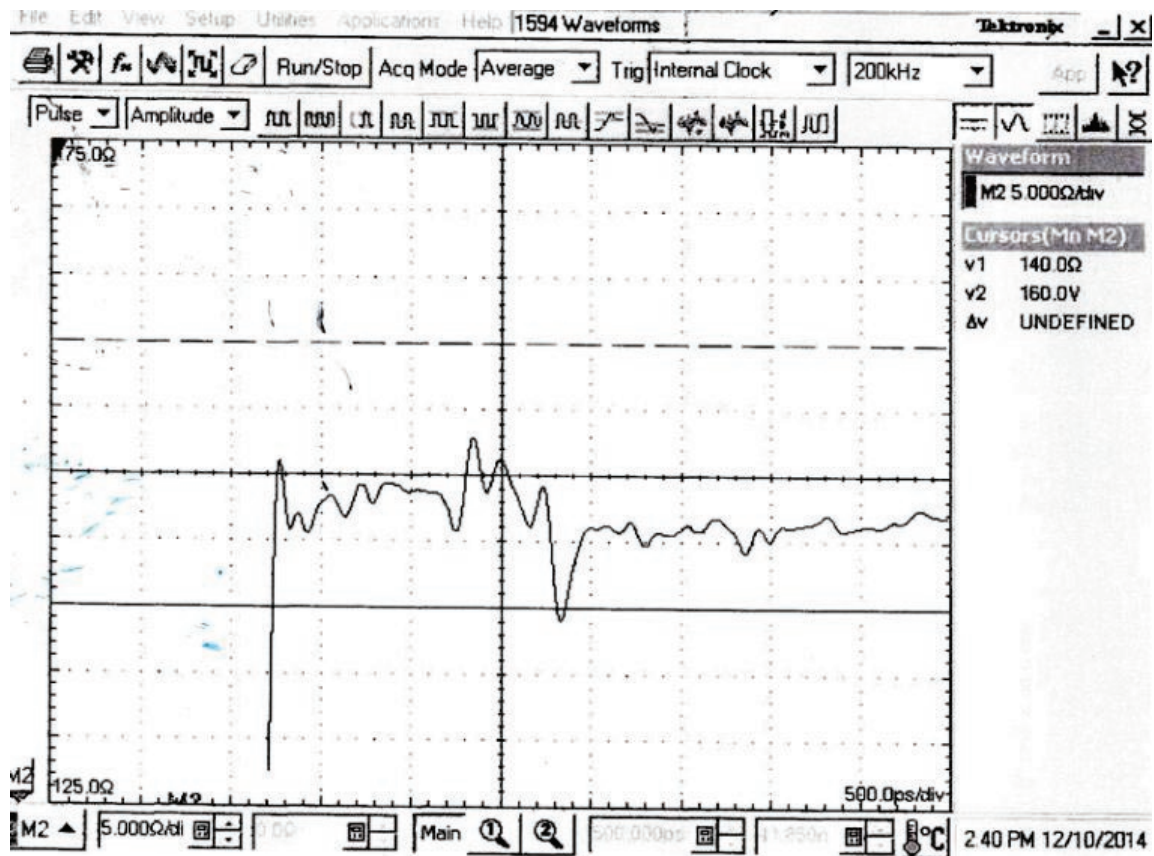


## Electrical Data

### Test

### Results

Impedance ( $150 \pm 10 \Omega$ )	135 to 165
Skew (150 ps max)	Pass, Pair 1,3 & 2,4
Insertion Loss @ 1,250 MHz	< 0.25 dB
Insertion Loss @ 1,870 MHz	< 1.20 dB

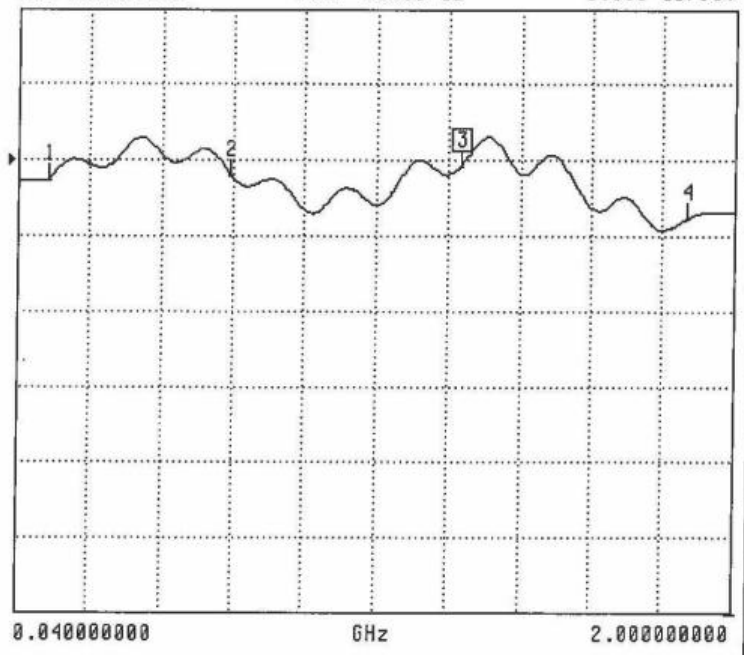


MODEL: ORION DATE: 12/11/2014 09:01 Page 1  
 DEVICE ID: OPERATOR:  
 START: 0.040000000 GHz GATE START: - ERROR CORR: 12-TERM  
 STOP: 2.000000000 GHz GATE STOP: - AVERAGING: 1 PT  
 STEP: 0.004900000 GHz GATE: - IF BNDWDTH: 1 KHz  
 WINDOW: -

-----CH1-----  
 PARAMETER: -S21-  
 NORMALIZATION: OFF  
 REFERENCE PLANE: 0.0000 mm  
 SMOOTHING: 9.0 PERCENT  
 DELAY APERTURE: -

S21 FORWARD TRANSMISSION

LOG MAGNITUDE REF=0.000 dB 1.500 dB/DIV

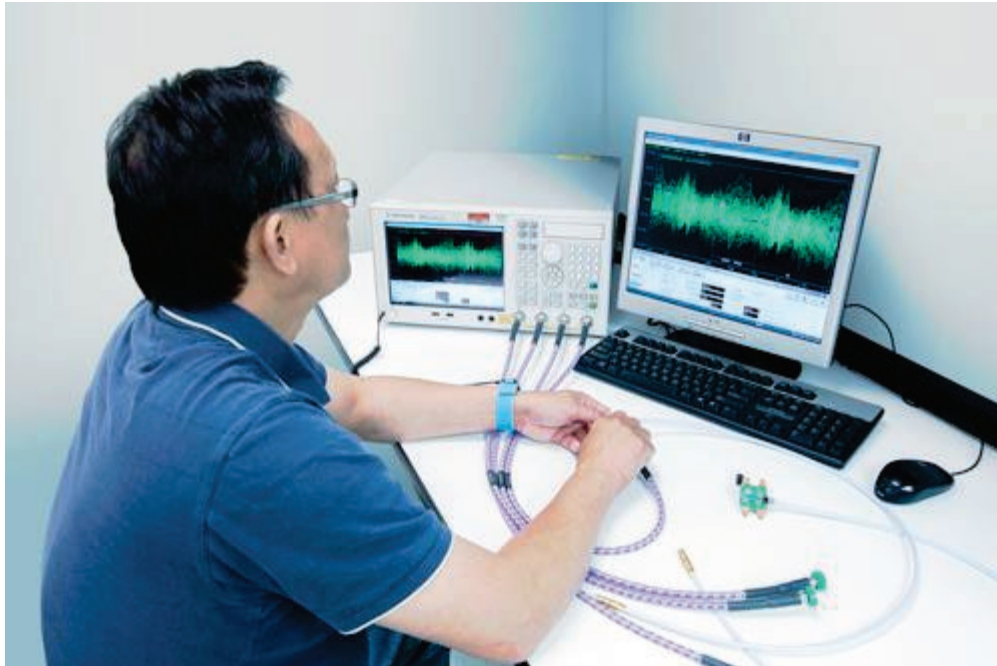


CH 1 - S21  
 REFERENCE PLANE  
 0.0000 mm  
 ▶MARKER 3  
 1.250300000 GHz  
 -0.118 dB  
 MARKER TO MAX  
 MARKER TO MIN  
 1 0.123300000 GHz  
 -0.410 dB  
 2 0.623100000 GHz  
 -0.319 dB  
 4 1.872600000 GHz  
 -1.163 dB  
 MARKER READOUT  
 FUNCTIONS

## Testing Capabilities

Smiths Connectors' quadrx interconnects are characterized for testing eye pattern, jitter, skew, and insertion loss on differential pair 100 Ohm high speed Gigabit Ethernet and 150 Ohm Fibre Channel applications with a wide variety of testing protocols. We utilize the Agilent E5071C 4-port network analyzer to measure the differential pair TDR impedance between quadrx connectors, cable assemblies, and quad cable, Ethernet and Fibre Channel interconnect systems ensuring the most accurate acquired signal for high speed communications testing.

The E5071C 4-port network analyzer is capable of highly accurate 100 and 150 Ohm differential measurements up to 20 GHz and can measure Eye Diagrams up to 16 Gbps.



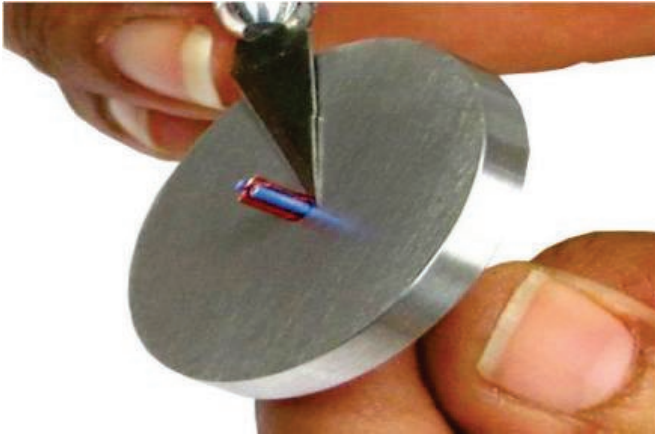
# Installation Instructions

## Tools

The following tools have been designed and are recommended when terminating the quadrx connectors to cable.

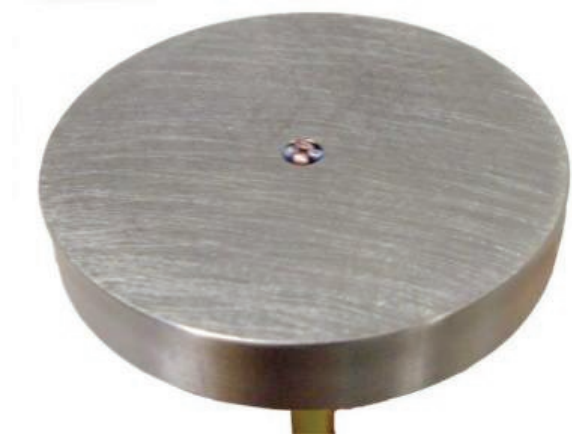
### T-2177-3

To ensure the insulation of the cable is at the correct dimension



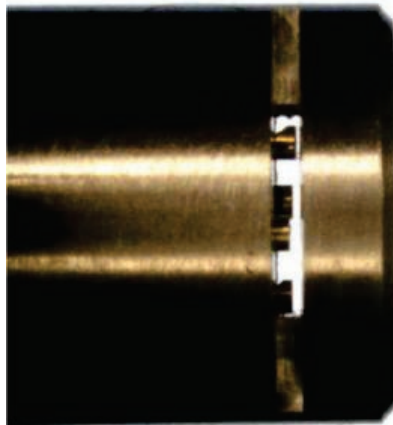
### T-2177-4

To ensure the wires are cut at the correct dimension



### T-2150

To ensure the wires are cut to the same dimensions as stated within the assembly instructions. All wires should be seen through the opening in T-2150. The use of a magnifying glass and backlight are highly recommended.



# Global Support

## Americas

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