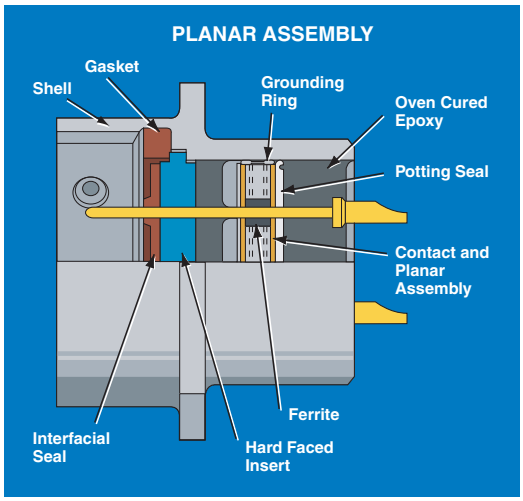
Amphenol Lightning Protection Connectors

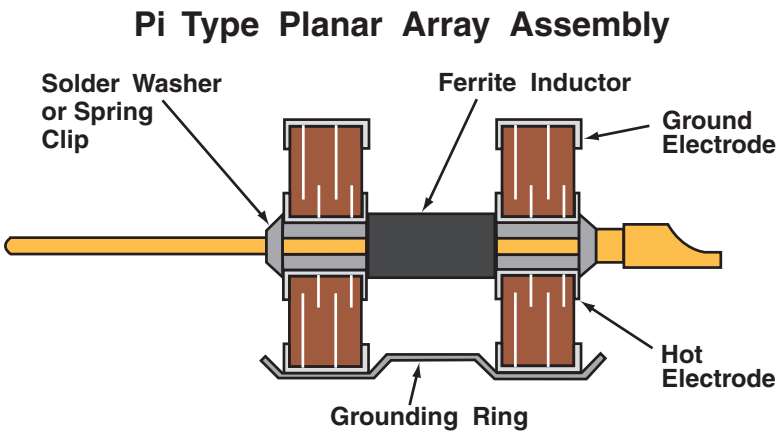
Background

As the shift to more-electric and all-electric aircraft accelerates, so too does the need to dramatically reduce airframe weight. Many commercial and military aircraft already have significant portions of their bodies constructed of advanced carbon composite materials, but the proliferation of this technology is still an aircraft manufacturer's single-greatest opportunity for further weight reduction. Though composites offer many performance advantages over traditional metal materials, the industry has yet to develop a composite material with shielding properties equal to that of their metal equivalents. Which means – now more than ever – the sensitive electronic equipment within aircraft are susceptible to transient voltage events. Transient voltage suppression (TVS) devices, which is a general classification of an array of devices that are designed to react to sudden overvoltage conditions, have become the popular choice for protection of sensitive downstream components. At Amphenol Aerospace's Lightning Lab, we have decades of experience in packaging these devices inside of our industry-leading aerospace interconnect, saving you cost, weight, and design time.

Overview

In addition to proven filtering capabilities, Amphenol offers superior transient protection from numerous threats, including direct or indirect lightning strikes. Amphenol's transient voltage protection connectors combine the traditional environmental protections of our standard connector products with transient voltage protection to meet all aircraft performance requirements. This technology can be a standalone component inside the connector or be coupled with additional filtering components to provide both filtering and transient protection capabilities in the same package. Amphenol transient protection connectors offer optimal weight and space saving capabilities while increasing reliability as no additional downstream circuits are required.

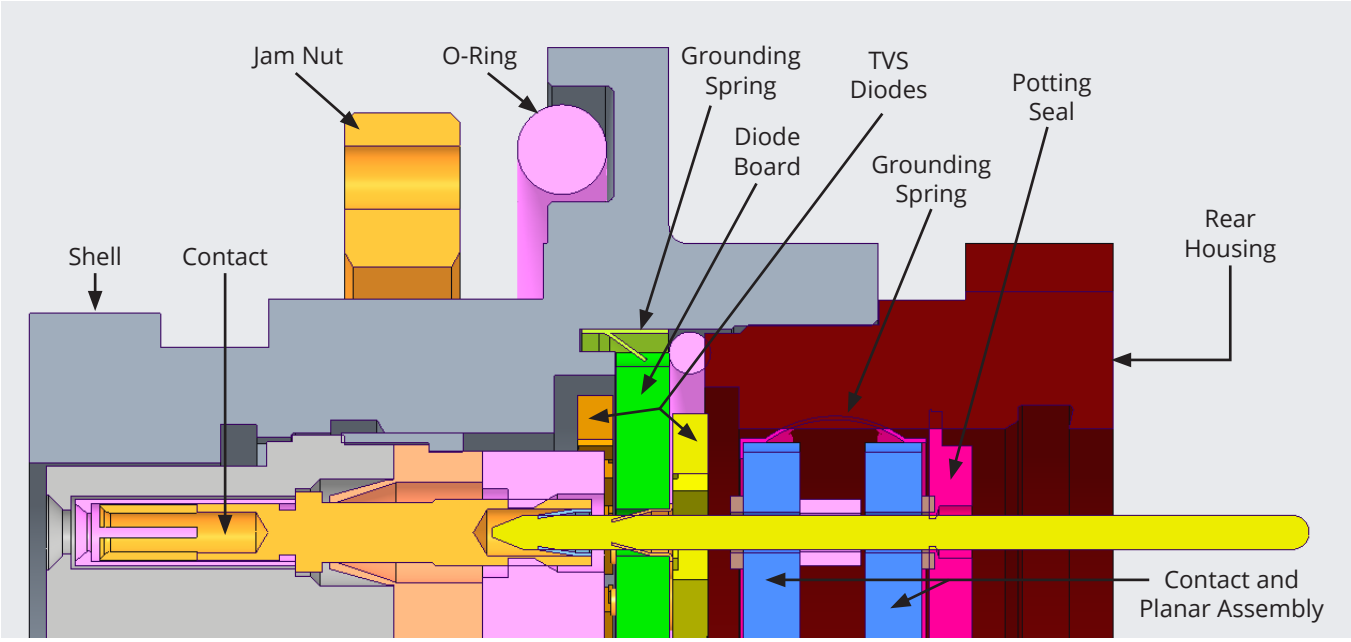


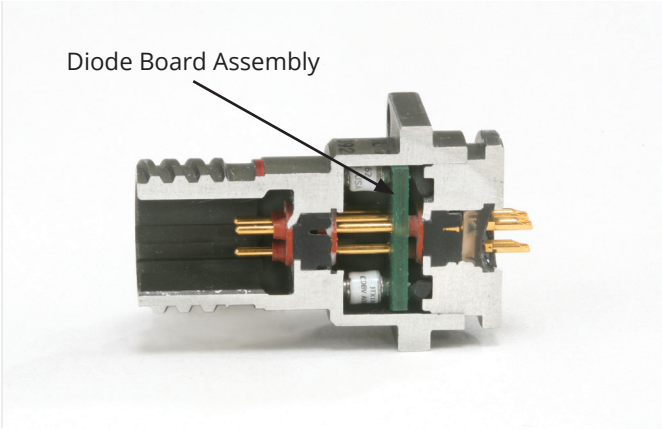


Design and Construction

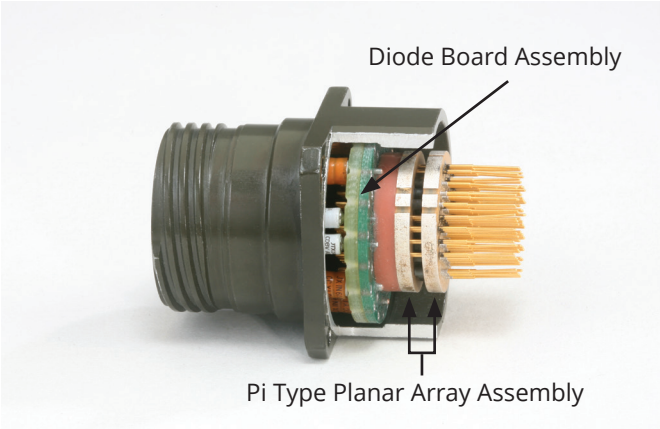
The Amphenol transient voltage protection connector utilizes the design and framework of numerous MIL-Spec connectors to preserve intermateability within the connector class while also maintaining many qualification requirements. Transient protection is achieved by utilizing passive components to clamp voltage spikes to protect sensitive downstream circuits. Amphenol offers two distinct component types to achieve

this protection in the form of MOV (Metal Oxide Varisitor) planar and TVS (Transient Voltage Suppression) diodes. These components are strategically chosen to offer the optimal solution given the application requirements, and their advantages are explained below. Once the components are chosen, mechanical design considerations are taken into account to install these passive components into the connector shell while maintaining connector intermateability.





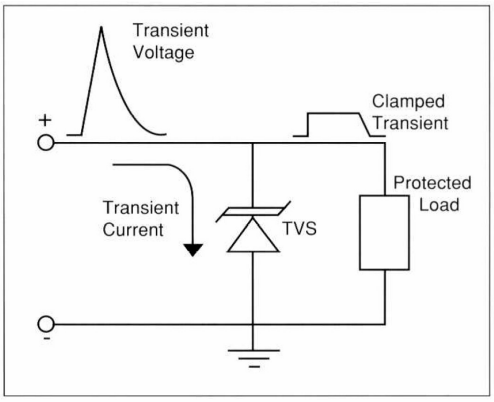
Transient Protection Connector Cross Section



Dual Transient and Filter Connector Cross Section

MOV Planar Vs. TVS Diode

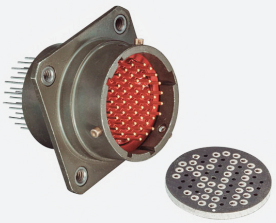
Amphenol Aerospace primarily utilizes either MOV planar technology or board mounted TVS diodes to accomplish transient suppression. Both devices are designed to fulfill similar electrical requirements. The MOV planar accomplishes this by installing a ceramic mass composed of metal oxide grains in between two metal electrode plates. Board mounted TVS diodes are comprised of standard semiconductor diodes mounted to a ceramic board.



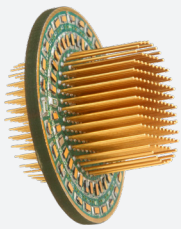
TVS Diode Schematic

Both protection devises offer nanosecond transient clamping response time, ensuring reliable protection of components. A breakdown of the advantages and disadvantages of each suppression device can be seen below.

Protection Device	MOV Planar	TVS Diode
Energy Suppression	Higher	Lower
Clamping Voltage	Higher	Lower
Polarity	Bipolar Only	Unipolar and Bipolar
Capacitance	1nF to 4nF	100pF to 3nF
Standoff Voltage	Medium to High	Low to Medium
Leakage Current	Higher	Lower
Screening	Limited	Extensive (TX/TXV/S)
Contact Sizes	16, 20, 22	20, 22
Cost	Lower	Higher



MOV Planar



TVS Diode Schematic

Compatibility

The Amphenol transient voltage protection connector are offered popularly in any style connector and can be made in accordance with the below MIL-Specs and more:

- MIL-DTL-5015
- MIL-DTL-26482
- MIL-DTL-26500
- MIL-DTL-27599
- MIL-DTL-38999
- MIL-DTL-83723

For more information contact Brennen Levis at Filterapps@amphenol-aao.com

Protection devices can be designed into plugs, receptacles, or adapters. Adapters are a convenient and economical method of introducing transient and/or filtering protection into an installed system by offering a connector with a plug mating interface on one end and a receptacle interface on the other to mate with preexisting plug and receptacle infrastructure.

Qualifications and Testing

Amphenol Aerospace can meet the applicable transient protection profiles for lightning strikes as outlined in RTCA-DO-160G and MIL-STD-461G. After a quick consultation, Amphenol's Lightning Lab will recommend the optimal transient protection solution given any requirement or threat environment. With industry-leading quality systems and testing requirements, Amphenol Aerospace ensures a compliant and reliable product, every time. All TVS diodes are screened to the applicable requirements of MIL-S-19500TX/TXV.

M.O.V. PERFORMANCE CHARACTERISTICS

		Maximum Rating (125°C)				Specifications (25°C)							Maximum Leakage Current at V_t (dc)	
		Continuous		Transient		Varistor Voltage at 1mA (DC)			Maximum Clamping Voltage V_c at Test Current Ip (8/20µS)		Capacitance at 1 MHz		I_L Max.	I_L Max.
		DC Voltage	RMS Voltage	Energy (10/1000µS)	Peak Current (8/20µS)						Picofarads		25°C	125°C
Designation	Contact Size	V_m Volts	V_m Volts	W_{tm} Joules	I_{tm} Amperes	Min. Volts	Nominal Volts	Max. Volts	V_c Volts	I_p Amps	Min.	Max.	µA	µA
F8	22	**8**	5.6	1.2	250	12	**14**	17	28	10	1000	2500	5	50
	20			1.3	300					10				
	16			1.5	350					20				
F14	22	**14**	10	1.2	250	18.5	**22**	25	40	10	800	2000	5	50
	20			1.5	300					10				
	16			1.5	350					20				
F31	22	**31**	22	1.5	250	35	**39**	45	80	5	400	1400	5	50
	20			2	300					10				
	16			2	350					20				
F38	22	**38**	27	1.5	250	42	**47**	55	90	5	200	1000	5	50
	20			2	300					10				
	16			2.5	350					20				
F45	22	**45**	32	1.5	250	53	**59**	68	100	5	200	850	5	50
	20			2.5	300					10				
	16			3	350					20				

NOTE: Continuous voltage ratings are based on 1000 hour reliability assurance tests at 125°C rated ambient temperature per MIL-STD-202 method 108. Contact Amphenol Sidney for options not listed in chart.