

Lightweight airframe solution with lowest insertion loss before and after installation



Typical Applications

- C5ISR
- Airborne electronic surveillance / countermeasures / jamming
- EW (Electronic Warfare) systems
- RWR (Radar Warning Receiver) systems
- Radar interconnects
- Electronic / signal intelligence
- Navigation / communication systems
- Millimeter wave technologies

Benefits

- Outstanding signal integrity with lowest insertion loss up to 40 GHz before/after installation
- Lower installation costs due to fewer failures and reduced aircraft production delays
- Improved fuel efficiency and increased payload with lightweight assembly
- Longer system life and reduced downtime due to mechanically robust construction
- Less RF interference among electronic systems due to superior shielding effectiveness
- Proven compliance with stringent industry requirements

Airframe cable assemblies are exposed to extreme conditions that can compromise their performance — beginning with the challenges of installation and continuing through the rigorous flight conditions that combine rapid temperature and pressure changes with potential contamination from fuels, oils, and fluids. Maintaining signal integrity in these challenging environments is essential to ensuring the reliability of the sophisticated electronic systems in the aircraft. At the same time, the assemblies must be lightweight and durable to improve fuel efficiency and reduce operating costs.

Award-winning GORE-FLIGHT® Microwave Assemblies are lightweight cable solutions that deliver the lowest insertion loss before and after installation, ensuring reliable performance for the life of the system (Table 1). The robust construction of these assemblies reduces total costs by withstanding the challenges of installation, reducing costly production delays, field service frequency, and the need for purchasing replacements. Also, they are lighter weight, which improves fuel efficiency and increases payload.



These cable assemblies have been qualified to the most stringent specifications for airframe assemblies. Gore controls the entire manufacturing process from purchasing raw materials and creating and applying the proprietary dielectric material, through testing and shipping the final cable assembly. This unsurpassed vertical integration allows Gore the complete control necessary to achieve tight specifications consistently. This process includes testing 100% of the assemblies for vapor leakage, dielectric withstanding voltage, VSWR, insertion loss, impedance, and velocity of propagation — ensuring that every assembly will deliver the highest-quality performance required for today's civil and defense aircraft.

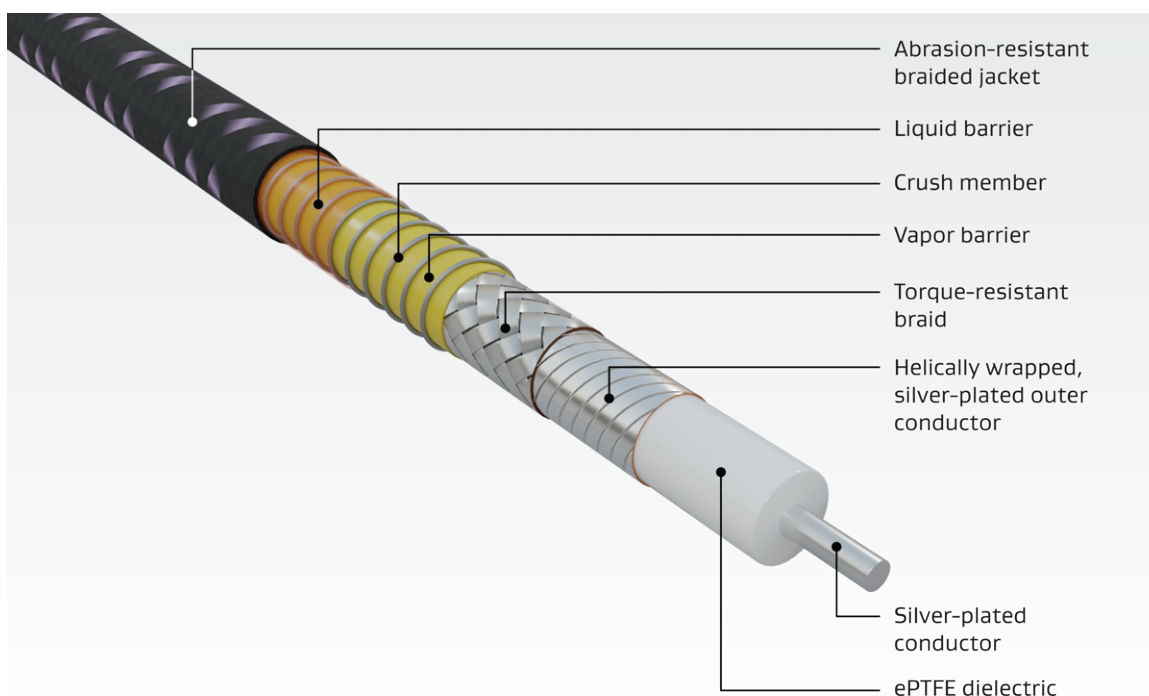
Rugged Construction for Longer Service Life

GORE-FLIGHT® Microwave Assemblies are engineered with a rugged construction that withstands the challenging environments they encounter throughout an aircraft's service life (Figure 1). The engineered fluoropolymers used in this construction help reduce abrasion caused by routing during installation, and they help maintain stable performance by resisting the effects of vibration and temperature changes during flight.

With a concentrated load resistance that exceeds rigorous requirements, Gore's microwave assemblies prevent the internal core from being compromised and protect against uncontrolled changes in impedance and dielectric constant. At the same time, this rugged construction is lighter than leading competitor assemblies, improving fuel efficiency and increasing payload.

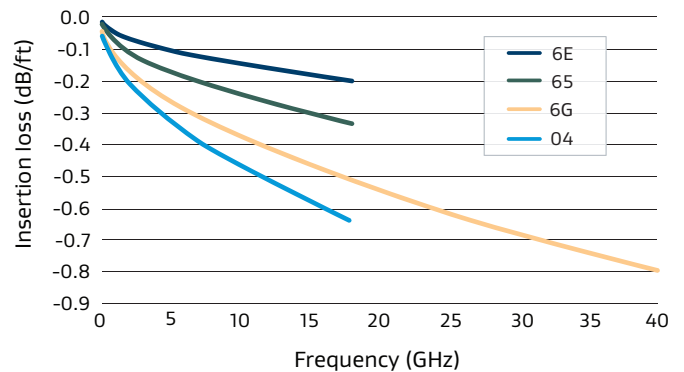
Gore's expanded polytetrafluoroethylene (ePTFE) insulation has the lowest dielectric constant in the industry. In combination with the rugged construction, this allows GORE-FLIGHT Microwave Assemblies to have the lowest insertion loss before and after installation (Figure 2).

Figure 1: Rugged Construction^a



a. Construction for Types 65, 6E and 6G.

Figure 2: Insertion Loss^a



a. Measured assemblies are 10 feet long including straight threaded male connectors.

Reliable mmWave Performance

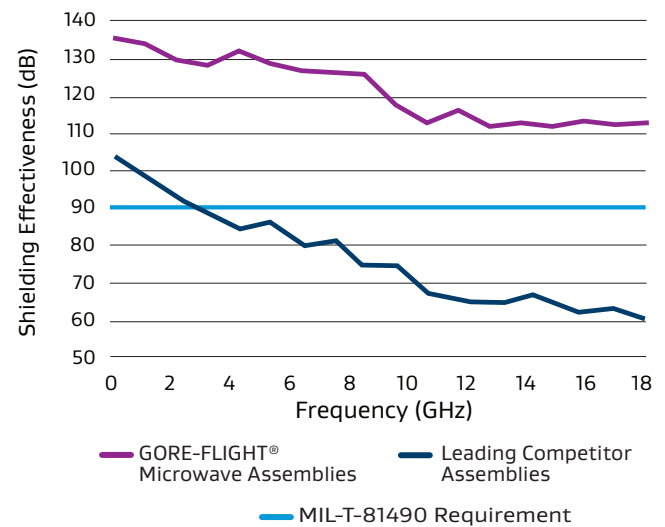
Higher frequency mmWave components are being added to electronic warfare (EW) and aircraft survivability equipment (ASE) in today's military aircraft and future fleets. These components and systems require microwave/RF assemblies to operate within Ka-band frequencies from 26 to 40 GHz and V-band frequencies from 40 to 75 GHz. Microwave/RF assemblies are also susceptible to electrical challenges and mechanical stresses due to damage from installation and harsh environmental conditions. Small, rugged GORE-FLIGHT® Microwave Assemblies, Type 6G, is proven to perform reliably up to 40 GHz over the aircraft's lifetime, ensuring mission-critical success and peace of mind.

Outstanding EMI Shielding

The MIL-T-81490 standard requires a minimum shielding effectiveness of 90 dB. As the power and frequency requirements increase in today's applications, radiating cable assemblies can interfere with mission-critical systems. These systems can also be susceptible to interference due to inadequate shielding effectiveness.

With proven EMI shielding performance, GORE-FLIGHT® Microwave Assemblies improve signal integrity by reducing RF interference among multiple electronic systems (Figure 3).

Figure 3: Shielding Effectiveness^a



a. Data in this graph reflects Type 6E test results. Results for Type 65 and 6G are similar.

Table 1: Cable Assembly Properties

Electrical

Property	Value			
	Type 04	Type 65	Type 6E	Type 6G
Maximum Frequency GHz	18	18	18	40
Typical VSWR (straight connector)	1.25:1	1.25:1	1.25:1	1.30:1
Guaranteed VSWR (straight connector)	1.40:1	1.40:1	1.40:1	1.45:1
Typical Insertion Loss at max frequency dB/ft	0.633	0.342	0.198	0.795
Guaranteed Insertion Loss at max frequency dB/ft	0.673	0.384	0.208	0.870
Standard Impedance Ohms	50 ± 1	50 ± 1	50 ± 1	50 ± 1
Nominal Dielectric Constant	1.40	1.35	1.35	1.40
Nominal Velocity of Propagation %	85	86	86	85
Nominal Time Delay ns/in (ns/cm)	0.103 (0.04)	0.0984 (0.0387)	0.0984 (0.0387)	0.103 (0.04)
Shielding Effectiveness through 18 GHz dB	> 90	> 90	> 90	> 90

Mechanical / Environmental

Property	Value			
	Type 04	Type 65	Type 6E	Type 6G
Overall Diameter in (mm)	0.18 (4.55)	0.24 (6.1)	0.35 (8.9)	0.195 (4.95)
Nominal Weight lb/ft (g/m)	0.027 (41)	0.040 (60)	0.084 (125)	0.033 (49)
Minimum Bend Radius in (mm)	0.5 (12.5)	1.0 (25.4)	1.9 (48.3)	0.75 (19.0)
Temperature Range ^a °C	-55 to +125	-55 to +125	-55 to +125	-55 to +125
Concentrated Load lb (MIL-T-81490, paragraph 4.7.18)	> 150	> 150	> 150	> 150

a. For applications outside of these temperatures, please contact a Gore representative.

GORE-FLIGHT® Microwave Assemblies

Proven Performance Through Testing

Gore has designed a simulator to evaluate the stress of installation on microwave airframe assemblies (Figure 4). The simulator has several features that replicate minimum bend radius conditions, routing guides that induce torque, and an abrasive edge to simulate routing across sharp edges or through access holes in the airframe structure (Figure 5).

The simulator enables Gore to evaluate the electrical performance of various cable assemblies after installation. Testing electrical characteristics such as insertion loss and VSWR before and after routing through the simulator verifies whether an assembly can withstand the rigorous challenges of installation — resulting in lower total costs and longer service life.

To evaluate the insertion loss of GORE-FLIGHT® Microwave Assemblies, Gore ran a 10-foot assembly through the simulator for 3 cycles. The results of this simulation demonstrate the importance of testing insertion loss after installation (Table 2).

Table 2: Insertion Loss After Installation

Property	Value	
	Type 6S	Type 6E
Typical ^a Insertion Loss at 18 GHz dB/ft	0.342	0.198
Installed ^b Insertion Loss at 18 GHz dB/ft	0.354	0.219

a. New out of the box assembly.

b. Performance after routing three times through the installation simulator.

With GORE-FLIGHT® Microwave Assemblies, a fit-and-forget philosophy is now a reality — providing the most cost-effective solution that ensures critical system performance for civil and defense applications.

For more information about the installation simulator, visit gore.com/simulator.

Figure 4: Installation Simulator

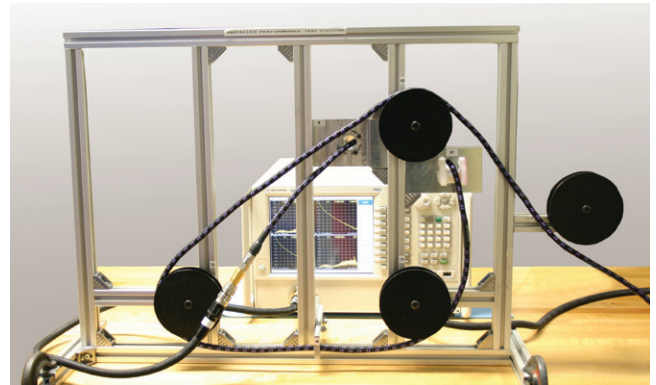


Figure 5: Abrasive Edge



Decades of Proven Heritage

Gore has provided microwave/RF cable assemblies to the aerospace industry since 1976. We offer solutions capable of operating reliably from DC to 110 GHz in the most demanding aircraft and spacecraft environments.

Since 1958, we have been a long-trusted partner to the aerospace and defense industry for wires, cables, sealants, aerospace materials, technical fabrics, and outerwear. Our products have won industry awards and have been used in many applications, including every major defense aircraft.



GORE-FLIGHT® Microwave Assemblies, Type 6G, is proven to perform reliably up to 40 GHz.



Excellent Signal Integrity for Improved Reliability

GORE-FLIGHT® Microwave Assemblies improve system performance by withstanding the challenges of installation, maintenance activities, and flight conditions. When compared to leading competitor assemblies (Figure 6), Gore's cable assemblies maintain the lowest insertion loss before and after installation (Figure 7) — providing stable and accurate system performance.

Likewise, the VSWR of leading competitor assemblies is less reliable due to impedance changes from damage (Figure 8), while the VSWR for Gore's cable assemblies are well controlled (Figure 9). With this level of performance, GORE-FLIGHT® Microwave Assemblies maintain consistent impedance of 50 ± 1 ohms, eliminating insertion loss stack-up issues when routing through airframe bulkheads.

Figure 6: Leading Competitor Assemblies Insertion Loss

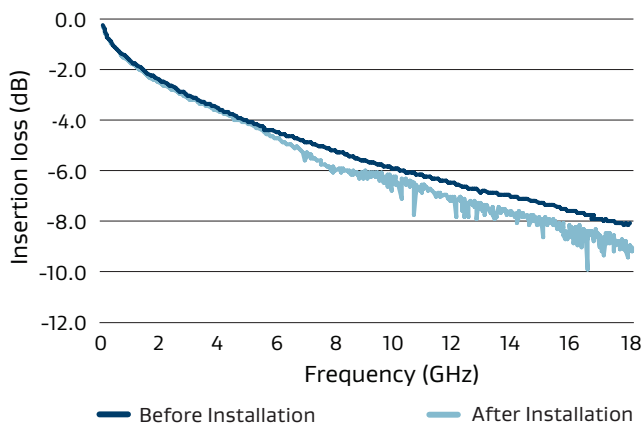


Figure 7: GORE-FLIGHT® Microwave Assemblies Insertion Loss^a

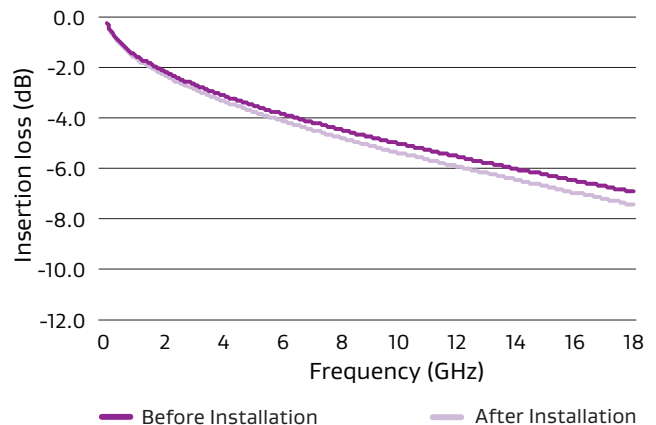


Figure 8: Leading Competitor Assemblies VSWR

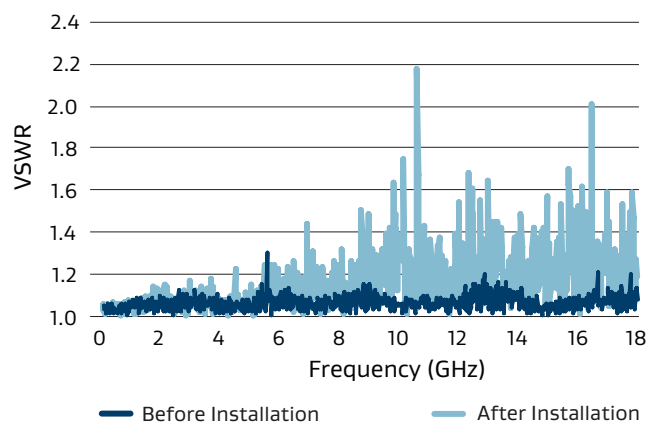
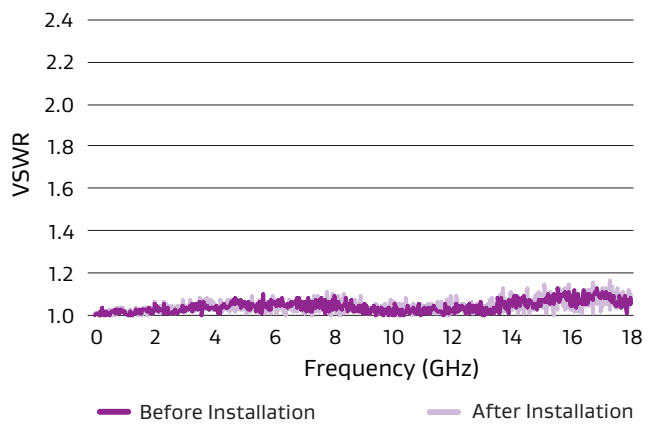


Figure 9: GORE-FLIGHT® Microwave Assemblies VSWR^a



a. Data in this graph reflects Type 6E test results. Results for Type 65 are similar.

Connector Options

Connectors available for GORE-FLIGHT® Microwave Assemblies are specifically engineered to optimize performance of the assembly (Table 3). Gore also offers an interface that allows the use of replaceable connectors.

Table 3: Connector Options

The maximum operating frequency of an assembly is determined as the lowest frequency of either the connectors or the assembly.

Connector Type	Direct Mount Connector Code	Replaceable End Connector Code	Cable Type Applicability
SMA Straight Male	R01 ¹	701 ¹	04 / 65 / 6E
SMA 90° Male	R71 ¹	7V1 ¹	04 / 65 / 6E
SMA 45° Male		7P1 ¹	04 / 65 / 6E
SMA Straight Female	R02		04 / 65 / 6E
SMA Bulkhead Female	R42		04 / 65 / 6E
SMA Flangemount Female	R52		04 / 65 / 6E
TNCA Straight Male	C01 ¹	801 ¹	04 / 65 / 6E
TNCA 90° Male	C71 ¹	8V1 ¹	04 / 65 / 6E
TNCA 45° Male		8P1 ¹	04 / 65 / 6E
TNCA Straight Female		802	04 / 65 / 6E
TNCA Bulkhead Female	C42	842	04 / 65 / 6E
TNCA Flangemount Female	C52	852	04 / 65 / 6E
Type N Straight Male		901	04 / 65 / 6E
Type N 90° Male		9V1	04 / 65 / 6E
Type N 45° Male		9P1	04 / 65 / 6E
Type N Straight Female		902	04 / 65 / 6E
Type N Bulkhead Female		962	04 / 65 / 6E
HN Straight Male		ZJS	04 / 65 / 6E
HN 90° Male		ZNM	04 / 65 / 6E
HN Bulkhead Female		ZNL	04 / 65 / 6E
Size 8 Pin Contact BMA ²	Z8T		04 / 65
Size 8 Socket Contact BMA ²	ZJA		04 / 65
Size 8 Pin Contact BMA ³	Z8T-001		04 / 65
Size 8 Socket Contact BMA ³	ZY2		04 / 65
Size 8 Pin Contact BMB ²	ZR3		04 / 65
Size 8 Socket Contact BMB ²	ZR2		04 / 65
Size 8 Pin Contact BMB ³	ZR3-001		04 / 65
Size 8 Socket Contact BMB ³	ZNS		04 / 65
M8 Multiport Straight Male	ZXE	ZTC	04 / 65 / 6E
M8 Multiport Straight Female	ZUD	ZTD	04 / 65 / 6E
M8 Multiport 90° Male		Y1C / Y1D ⁴	04 / 65 / 6E
M8 Multiport 90° Female		Z1C / Z1D ⁴	04 / 65 / 6E
M8 Multiport 45° Male		Z1A / Z1B ⁴	04 / 65 / 6E
M8 Multiport 45° Female		Y1A / Y1B ⁴	04 / 65 / 6E
TK Straight Male		ZVM	04 / 65 / 6E
TK 90° Male		Y13	04 / 65 / 6E
TK 45° Male		ZVN	04 / 65 / 6E
BMB Pin	ZPB		04 / 65

Table 3: Connector Options (continued)

Connector Type	Direct Mount Connector Code	Replaceable End Connector Code	Cable Type Applicability
SMP Floatmount Socket	ZKY		04
SMP Floatmount 90° Socket	ZW2		04
2.92 mm Straight Male	OCQ		6G
2.92 mm 90° Male	ZQA		6G
2.92 mm Straight Female	OCF		6G
2.4 mm Straight Male	OCJ		6G
2.4 mm Straight Female	OCK		6G

1. Also available in Lock Wire Hole and Self-Locking versions. For Lock Wire version, replace "1" with "L" eg. R01 would be R0L. For Self-Locking version, replace "1" with "S" eg. R01 would be R0S.
2. For use in MIL-DTL-38999 connector systems.
3. For use in ARINC 600 connector systems.
4. Y1B and Y1D are extended versions of Y1A and Y1C connectors respectively. Z1B and Z1D are extended versions of Z1A and Z1C connectors respectively.

Torque Values

The recommended mating and installation torque values for Gore connector options are provided in Table 4.

Table 4: Mating/Installation Torque Values

Connector	Installation Torque in-lbs (Nm)
TNCA ^a	23 ± 3 (2.59 ± 0.33)
TNCA Bulkhead Mount Panel Nut	35 ± 5 (3.95 ± 0.56)
SMA	12 – 15 (1.35 – 1.69)
2.4 mm	12 – 15 (1.35 – 1.69)
2.92 mm	12 – 15 (1.35 – 1.69)
Type N ^m	23 ± 3 (2.59 ± 0.33)
Type N Bulkhead Mount Panel Nut	35 ± 5 (3.95 ± 0.56)
TK	19 – 21 (2.15 – 2.37)
HN	15 ± 3 (1.69 ± 0.33)
HN Bulkhead Mount Panel Nut	35 ± 5 (3.95 ± 0.56)
Replaceable Adapter	45 ± 5 (5.08 ± 0.56)
Size 8 – Pin Contact (socket Microwave Interface)	Not applicable

a. Based on MIL-T-81490 requirements.

Ordering Information

GORE-FLIGHT® Microwave Assemblies are identified by a 12-character part number. This number designates the cable type, connector types, and assembly length:

1	2	3	4	5	6	7	8	9	10	11	12
Cable Type		Connector A			Connector B			Assembly Length			

Positions 1–2: Enter 04, 6E, 6S or 6G to identify the specific cable type of GORE-FLIGHT® Microwave Assemblies.

Positions 3–5 and 6–8: See Table 3 for the list of connectors available for each cable type. When reading the label, Connector A is on the left-hand side. Additionally, Gore offers an interface that can be used with replaceable connectors (see Table 4).

Positions 9–12: The length of the assembly is expressed in inches to the nearest tenth, including zeroes to fill positions if the length is less than three digits. For example, the length of a 24.0-inch assembly is specified as 0240 in the last four digits of the part number.

Build an assembly and request a quote using the **GORE® Microwave/RF Assembly Builder** at gore.com/rfcablebuilder. Alternatively, contact a Gore representative at gore.com/contact.

Calculate insertion loss, VSWR, and other parameters of Gore's assemblies using the **GORE® Microwave/RF Assembly Calculator** at tools.gore.com/gmcacalc.

Qualification Summary

Engineered to meet the stringent specification requirements of civil and defense aircraft, these assemblies have undergone substantial qualification testing to ensure that they meet the specifications of the most current industry standards (Table 5).

Table 5: Qualifications for GORE-FLIGHT® Microwave Assemblies

Examination or Test	Industry Standards	Status
Design and Construction	MIL-T-81490, Paragraph 4.7.1	Compliant
Markings	MIL-T-81490, Paragraph 4.7.1	Compliant
Workmanship	MIL-T-81490, Paragraph 4.7.1	Compliant
RF Insertion Loss	MIL-T-81490, Paragraph 4.7.3	Compliant
Voltage Standing Wave Ratio (VSWR)	MIL-T-81490, Paragraph 4.7.4	Compliant
Impedance	MIL-T-81490, Paragraph 4.7.5	Compliant
Vapor Leakage (Seal)	MIL-STD-202, Method 112E, Paragraph 5, Test Condition C, Procedure IV	Compliant
Velocity of Propagation	MIL-T-81490, Paragraph 4.7.7	Compliant
EMI Shielding Effectiveness	EIA-364-66, Mode Stirred Test	Compliant
Thermal Shock	MIL-STD-810, Method 503.5, Procedure I-C; MIL-STD-202, Method 107, Test Condition A-1 and B-1	Compliant
Power Handling Capability	MIL-T-81490, Paragraph 4.7.13, Procedure I	Compliant
Flexure	MIL-T-81490, Paragraph 4.7.15, Procedure I	Compliant
Torque	MIL-T-81490, paragraph 4.7.16, torque requirement of 50 in/lb replaced by $\pm 90^\circ$ angular displacement	Compliant
Tensile Load	MIL-T-81490, Paragraph 4.7.17	Compliant
Concentrated Load	MIL-T-81490, Paragraph 4.7.18, 100 $\pm$ 2 lb force Achieved $\geq$ 150 lb	Compliant
Abrasion	MIL-T-81490, Paragraph 4.7.19, Procedure II	Compliant
Sand and Dust	MIL-STD-810, Method 510, Procedure I	Compliant
Dielectric Withstanding Voltage	MIL-STD-202, Method 301	Compliant
Explosive Atmosphere	MIL-STD-810, Method 511, Procedure I	Compliant
Temperature, Humidity, Altitude, Vibration	MIL-STD-810, Method 520, Procedure III with Vibration as per MIL-STD-810, Method 514, Procedure I	Compliant
Humidity	Type 04: MIL-STD-810, Method 507 Types 6E/65/6G: MIL-STD-810, Method 520, Procedure III	Compliant
Vibration	MIL-STD-810, Method 514, Procedure I	Compliant
Salt Fog	MIL-STD-810 method 509	Compliant
Chemical Resistance	Type 04: BS3G100, Part 2, Section 3, Subsection 3.12, for Class A Types 6E/65/6G: MIL-STD-810, Method 504	Compliant
Icing/Freezing Rain	MIL-STD-810, Method 521	Compliant
Fungus Resistance	MIL-STD-810, Method 508	Compliant
Drip	MIL-STD-810, Method 506, Procedure III	Compliant
Rain & Blowing Rain	MIL-STD-810, Method 506, Procedure I	Compliant
Corona Extinction Voltage	MIL-DTL-17, Paragraph 3.7.5	Compliant
Flammability	Type 04: FAR25.853 (a), Appendix F, Part I (b)(7) Types 6E/65/6G: ABD0031, Paragraph 7.1.6; FAR25.853, Appendix F, Part I (b)(7); MIL-STD-202, Method 111	Compliant
Toxicity	Type 04: FAR25.853 (a), Appendix F, Part I (b)(7) Types 6E/65/6G: ABD0031, Paragraph 7.4	Compliant
Smoke Density	Type 04: FAR25.853 (a), Appendix F, Part I (b)(7) Types 6E/65/6G: ABD0031, Paragraph 7.3.5 (A1M 2.0008 B); FAR25.853, Appendix F, Part V	Compliant
Impact Shock	MIL-T-81490, Paragraph 4.7.14 Type 6E with 1.5 lb Type 65 with 1.0 lb Type 6G with 0.75 lb	Compliant

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