GORE® PHASEFLEX®

Microwave/RF Test Assemblies

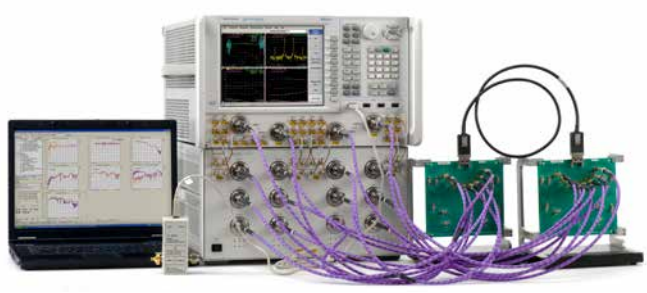
Together, improving life

Reduce total cost of test with durable, reliable performance

GORE® PHASEFLEX® Microwave/RF Test Assemblies provide excellent loss and phase stability with flexure for test applications that require precise, repeatable measurements, and electrical performance up to 110 GHz.

GORE® PHASEFLEX® Microwave/RF Test Assemblies have a durable construction with inner layers that provide excellent electrical performance, as well as outer layers that provide mechanical protection to allow these test assemblies to perform throughout the life of a system, and reduce the need for replacement cables.

GORE® PHASEFLEX® Microwave/RF Test Assemblies are crush resistant and provide greater than 250 pounds per linear inch of protection. These test assemblies perform reliably even after extensive flexing with some cables exceeding 100,000 flex cycles. They can also withstand demanding conditions such as continuous flexing, temperature cycling, broad temperature ranges, and frequent connect and disconnect in laboratory, production, and field testing.



Courtesy, Keysight Technologies, Inc.

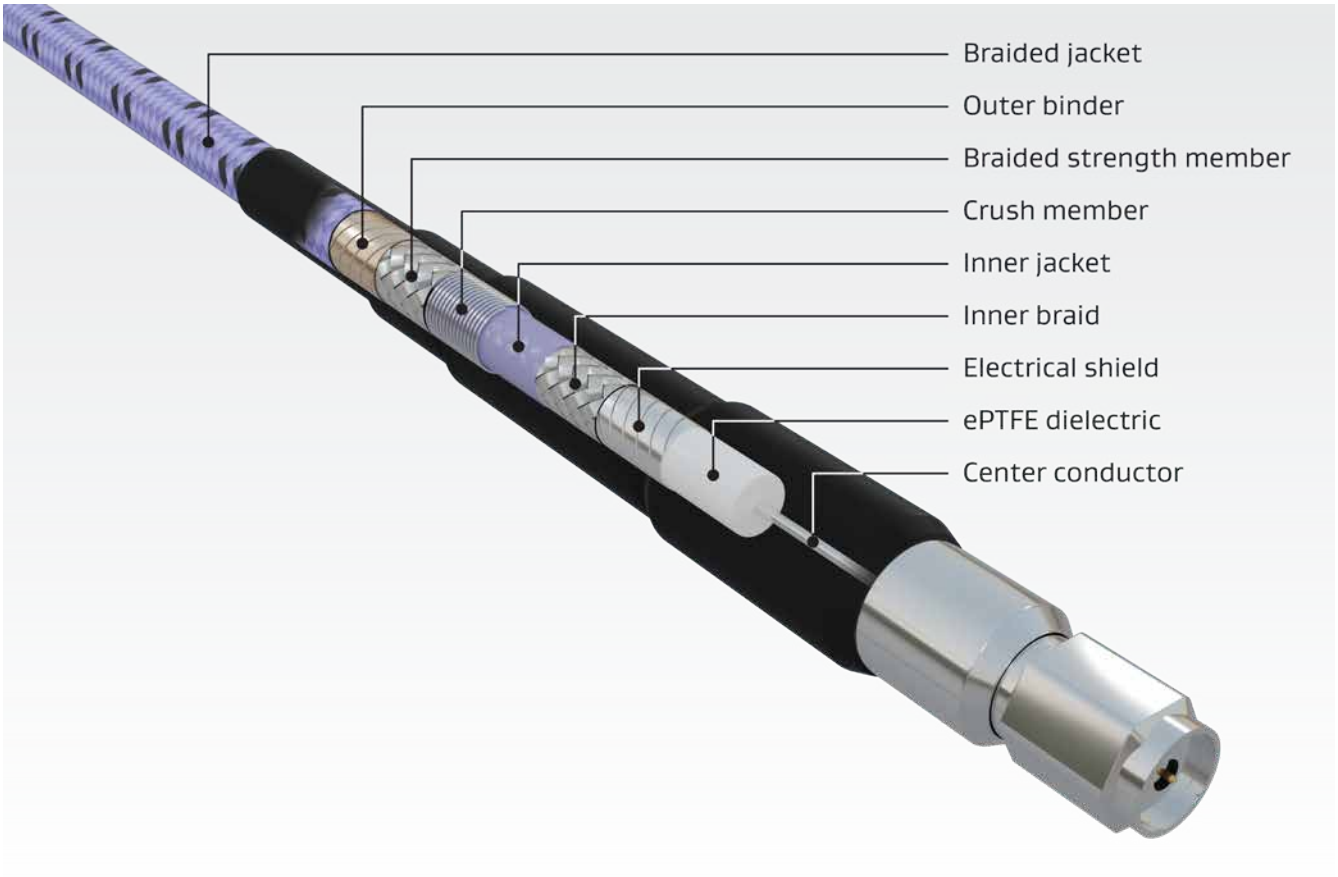
Benefits of GORE® PHASEFLEX® Microwave/RF Test Assemblies

- Consistent, repeatable measurements with stable electrical performance up to 110 GHz
- Longer service life with durable construction that resists crushing, twisting and kinking
- Enhanced phase and amplitude stability with flexure and temperature
- Increased throughput and reduced downtime with durable and reliable performance

Typical Applications

- Bench-top testing
- High throughput RF production testing
- Portable analyzers
- Test rack systems
- Vector network analyzers (VNAs)
- Scalar network analyzers
- Antenna ranges
- Anechoic chambers
- Thermal vacuum chambers
- Nearfield scanners
- Wireless telecommunication module testing
- Electromagnetic compliance testing
- Automated test equipment
- High speed digital test
- 5G test and interconnection

Figure 1: The anatomy of GORE® PHASEFLEX® Microwave/RF Test Assemblies



Rugged Construction Delivers Longer Service Life

The consistent performance and reliability of GORE® PHASEFLEX® Microwave/RF Test Assemblies increase the interval between time-consuming calibrations of the test system, which in turn increases throughput and reduces the total cost of test.

With a unique construction that is more durable, these cables allow for a small bend radius without affecting performance (Figure 1). Some cables have a minimum bend radius as small as 0.5 inches.

GORE® PHASEFLEX® Microwave/RF Test Assemblies offer excellent electrical and mechanical performance (Tables 2 and 3). Assemblies are available in 12, 24, 36, 48 and 60 inch lengths. These predetermined lengths correspond to 0.30, 0.61, 0.91, 1.22 and 1.52 meters. Custom lengths are also available upon request.

Features for GORE® PHASEFLEX® Microwave/RF Test Assemblies include:

- torque, crush and kink resistance
- abrasion resistance
- dust/moisture resistance
- performance over a wide temperature range
- chemical resistance
- high connector pull strength

Precise and Repeatable Measurements

The exceptional phase and amplitude stability of GORE® PHASEFLEX® Microwave/RF Test Assemblies ensures accurate and repeatable measurements. Although all of these assemblies exceed specifications for phase and amplitude stability, additional testing is performed on assemblies using cable types 0U, 0T, 0D, 0Z and 0F to guarantee their phase and amplitude performance with flexure (Table 1). While all other cable types (0H, 0X, 0S, 0Q, 0P, 0M, 0W, 0R, 5R, 0K, 0N, CX) do not under go this guaranteed stability testing, phase and amplitude stability performance is incorporated by design.

Phase Matching

Upon request, phase or time delay matching can be specified for GORE® PHASEFLEX® Microwave/RF Test Assemblies with frequencies through 70 GHz.

Gore can provide absolute and relative time delay matching to sub-picosecond tolerances. According to the performance requirements of the application, cable assemblies may be specified to meet absolute or relative matching values.

- **Absolute match:** One or more assemblies having a specific time delay or phase length target value ± some tolerance value. This type of specification allows replacement or addition of individual cables in a matched set.

- **Relative match:** Two or more assemblies whose time delay or phase length fall within a specified match window. Relative matching ensures consistent matching within a set of cables, but an assembly from one set may not necessarily be matched with cable assemblies in another set.

Table 1: Test Assemblies with Guaranteed Phase and Amplitude Stability with Flexure[1]

	Phase Stability with Flexure (± °)		Amplitude Stability with Flexure (± dB)	
Gore Cable Type	Typical Value	Maximum Value	Typical Value	Maximum Value
0U	2.0	4.7	0.05	0.15
0T	3.0	6.6	0.05	0.15
0D	5.0	9.6	0.05	0.15
0Z	6.0	11.8	0.05	0.15
0F	8.0	15.6	0.05	0.10

[1] The maximum value for guaranteed phase and amplitude stability was established using the following test method. The assembly was terminated with a short circuit and tested on a calibrated system. The VNA was normalized. A mandrel of 57 mm (2.25 in) radius was placed adjacent to the left or right side of the assembly, approximately at its midpoint. The assembly was coiled 360° around the mandrel and held in this position for one full sweep. Maximum deviation over the frequency range of analysis was recorded. The assembly was then returned to its initial straight position, and the VNA was normalized again. The mandrel was placed on the opposite side of the assembly, and the test was repeated. All of the assemblies above are tested using this test method.

Table 2: Test Assembly Specifications up to 18 GHz[1]

Electrical Properties

Gore Cable Type	0H	0X	0S	0U	0Q	0P	0M
Maximum Frequency (GHz)	18	18	18	18	18	18	18
Typical VSWR	1.19:1	1.19:1	1.19:1	1.19:1	1.22:1	1.24:1	1.28:1
Typical Insertion Loss (dB)	2.15	1.13	1.36	1.36	0.80	1.00	0.75
Impedance (Nominal) (Ohms)	50						
Guaranteed Phase and Amplitude Stability	No	No	No	Yes	No	No	No
Typical Phase Stability (degree)[2]	±2.0	±2.0	±2.0	±2.0	±8.0	±6.0	±15.0
Typical Amplitude Stability (dB)[2]	< ±0.05						
Dielectric Constant (Nominal)	1.4						
Velocity of Propagation (Nominal) (%)	85						
Shielding Effectiveness (dB through 18 GHz)[3]	> 100						
Time Delay (Nominal) ns/m (ns/ft)	4 (1.22)						

Mechanical/Environment Properties

Gore Cable Type	0H	0X	0S	0U	0Q	0P	0M
Center Conductor	Stranded	Solid	Stranded	Stranded	Solid	Stranded	Solid
Overall Diameter mm (in)	5.3 (0.210)	7.7 (0.305)	7.7 (0.305)	7.7 (0.305)	10.2 (0.400)	10.2 (0.400)	10.7 (0.420)
Nominal Weight g/m (g/ft)	68.9 (21)	147.6 (45)	147.6 (45)	147.6 (45)	275.5 (84)	275.5 (84)	295.2 (90)
Minimum Bend Radius mm (in)	12.7 (0.5)	25.4 (1.0)	25.4 (1.0)	25.4 (1.0)	38.1 (1.5)	38.1 (1.5)	38.1 (1.5)
Typical Flex Cycles[4]	100,000	50,000	100,000	100,000	10,000	15,000	10,000
Temperature Range (˚C)	-55 to 125						
Crush Resistance kgf/cm (lbf/in)	33.5 (187)	44.6 (250)					

Table 3: Test Assembly Specifications up to 70 GHz[1]

Electrical Properties

Gore Cable Type	0W	0R	0T	5R	0K	0D	0N	0Z	0F
Maximum Frequency (GHz)	26.5	26.5	26.5	32	40	40	50	50	70
Typical VSWR	1.17:1	1.17:1	1.17:1	1.30:1	1.30:1	1.30:1	1.25:1	1.26:1	1.30:1
Typical Insertion Loss (dB)	1.43	1.71	1.71	1.81	2.65	3.37	3.67	3.80	5.99
Impedance (Nominal) (Ohms)	50								
Guaranteed Phase and Amplitude Stability	No	No	Yes	No	No	Yes	No	Yes	Yes
Typical Phase Stability (degree)[2]	±3.0	±3.0	±3.0	±5.0	±5.0	±5.0	±6.0	±6.0	±8.0
Typical Amplitude Stability (dB)[2]	< ±0.05								
Dielectric Constant (Nominal)	1.4								
Velocity of Propagation (Nominal) (%)	85								
Shielding Effectiveness (dB through 18 GHz)[3]	> 100								
Time Delay (Nominal) ns/m (ns/ft)	4 (1.22)								

Mechanical/Environment Properties

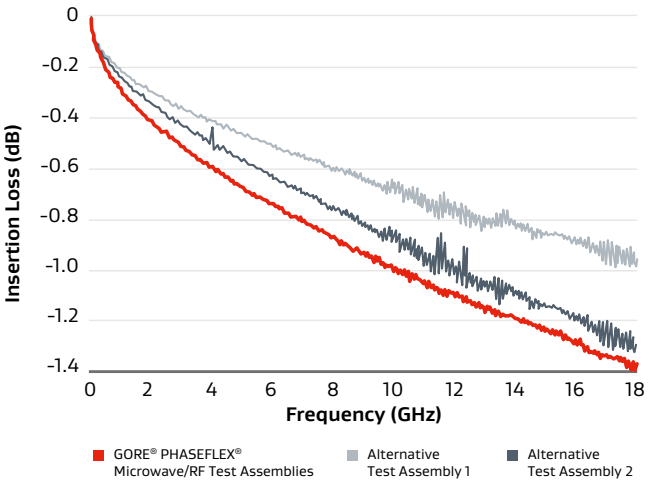
Gore Cable Type	0W	0R	0T	5R	0K	0D	0N	0Z	0F
Center Conductor	Solid	Stranded	Stranded	Solid	Solid	Solid	Solid	Solid	Solid
Overall Diameter mm (in)	7.7 (0.305)	7.7 (0.305)	8.0 (0.315)	6.9 (0.270)	6.1 (0.240)	6.1 (0.240)	5.3 (0.210)	6.1 (0.240)	5.8 (0.230)
Nominal Weight g/m (g/ft)	147.6 (45)	147.6 (45)	147.6 (45)	123 (37.5)	98.4 (30)	101.7 (31)	68.9 (21)	101.7 (31)	88.6 (27)
Minimum Bend Radius mm (in)	25.4 (1.0)								
Typical Flex Cycles[4]	50,000	100,000	100,000	2,500	50,000	20,000	12,500	20,000	20,000
Temperature Range (˚C)	-55 to 125					-55 to 75	-55 to 125	-55 to 75	
Crush Resistance kgf/cm (lbf/in)	44.6 (250)						33.5 (187)	44.6 (250)	

[1] The electrical specifications in this table are based on a 0.91 m (36 in) assembly length and maximum frequency with straight connectors.
[2] When cable is wrapped 360˚ around a 57 mm (2.25 in) radius mandrel.
[3] Per MIL-STD-1344, method 3008.
[4] When bent ± 90˚ at a radius that is twice the minimum bend radius, test assembly performs reliably through the stated flex cycles.

Reliable Performance Now and Over Time

Unlike conventionally designed RF test assemblies, GORE® PHASEFLEX® Microwave/RF Test Assemblies maintain excellent phase and amplitude stability with flexure. When tested right out of the box, the insertion loss traces for these assemblies were smooth indicating stable electrical performance compared to other assemblies that were fairly rough, which may indicate electrical problems in the future (Figure 2).

Figure 2: Insertion Loss of New Cables at 18 GHz



When flexed, the other assemblies experienced significant changes in loss and phase stability compromising their signal integrity (Figures 3 and 4). However, GORE® PHASEFLEX® Microwave/RF Test Assemblies successfully maintained loss and phase stability, indicating their signal integrity remained constant without then need for calibration.

Figure 3: Loss Stability with Flexure of New Cables

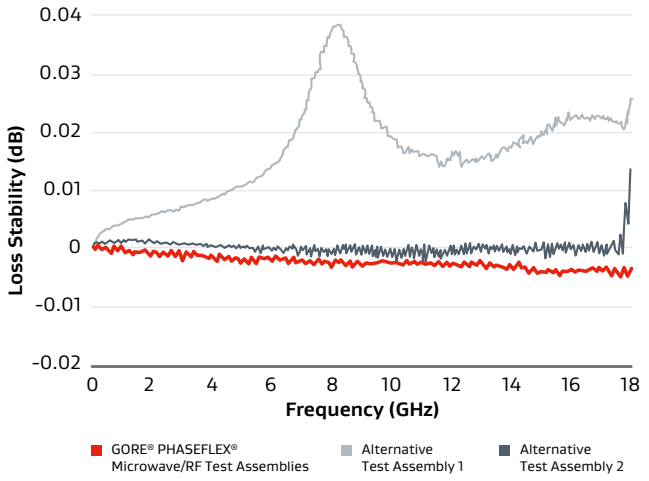
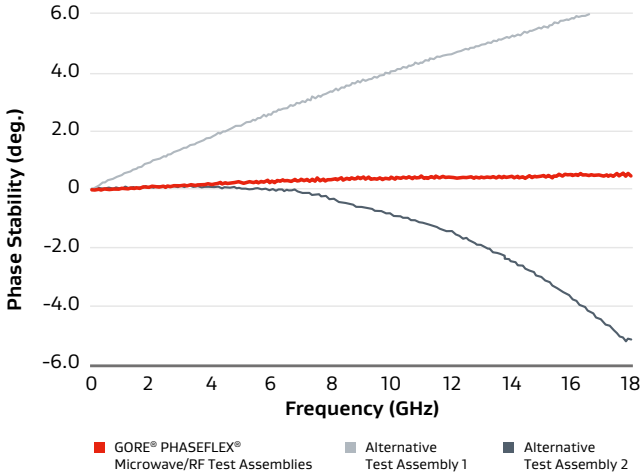


Figure 4: Phase Stability with Flexure of New Cables



During an accelerated life test, GORE® PHASEFLEX® Microwave/RF Test Assemblies showed no change in performance after 10,000 flex cycles compared to other assemblies that experienced a significant change after only 100 and 300 flex cycles (Figures 5 and 6).

Figure 5: Loss Stability Over Time

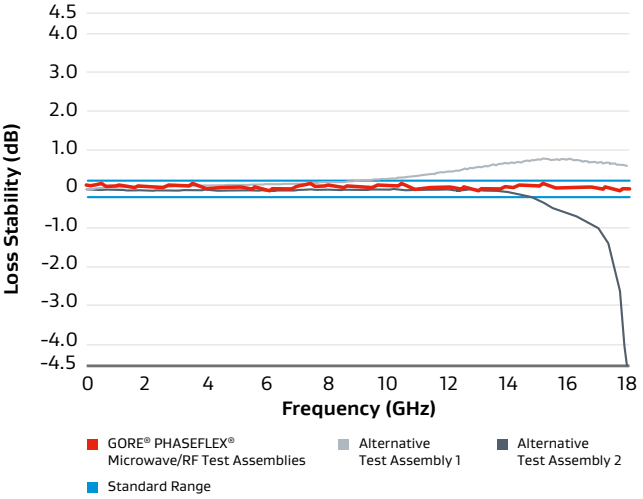
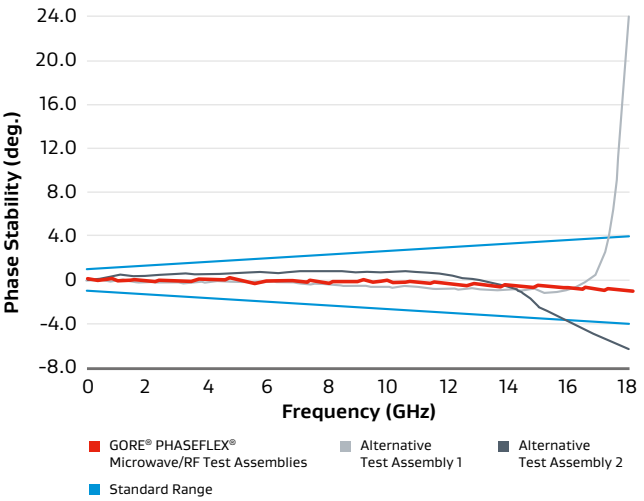


Figure 6: Phase Stability Over Time



High phase and amplitude stability at an affordable price for high-density and modular test applications

Courtesy of Keysight Technologies, Inc.

For complex instruments connecting up to 32 or more assemblies to test microwave/RF components and high-speed devices and assemblies, GORE® PHASEFLEX® Microwave/RF Test Assemblies Type 0N delivers consistent, repeatable measurements with stable electrical performance up to 50 GHz.

The combination of protection and performance coupled with the reduced size and weight makes Type 0N cables ideal for modular, multi-port VNAs, and multi-site test applications such as:

- 5G test and interconnection
- component and device R&D, and production test
- high-speed digital test devices and assemblies
- modular test instruments like PXIe and AXIe
- RF switches

See the Technical Notes at **gore.com/test0N** for more information.

110 GHz Test Assemblies

Gore's 110 GHz ruggedized cable assemblies can be flexed, formed or repositioned without damage while providing excellent stability with flexure and temperature and while maintaining excellent insertion loss and VSWR (Figures 7 and 8). These assemblies provide reliable electrical and mechanical performance (Table 4). See Table 7 for ordering information for 110 GHz Test Assemblies.

Figure 7: Typical VSWR[1]

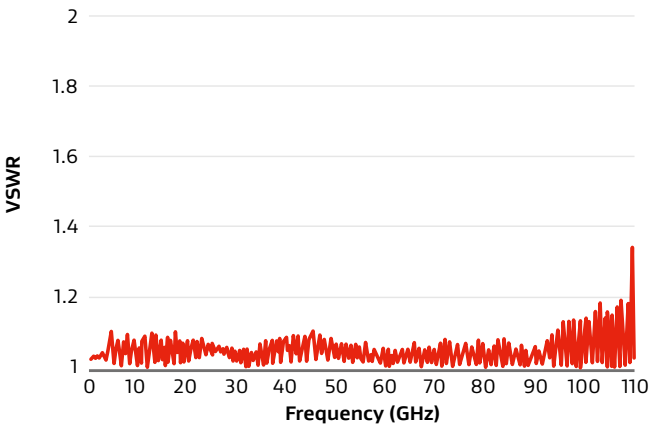


Figure 8: Typical Insertion Loss[1]

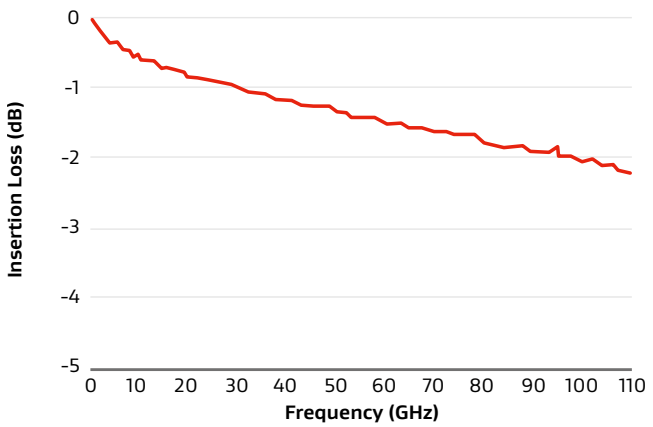


Table 4: 110 GHz Test Assembly Specifications[1]

Electrical Properties

Gore Cable Type	CX
Maximum Frequency (GHz)	110
Typical VSWR	1.34:1
Typical Insertion Loss (dB)	2.14
Impedance (Nominal) (Ohms)	50
Typical Phase Stability (degree)[2]	±1.0
Typical Amplitude Stability (dB)[2]	< ±0.05
Dielectric Constant (Nominal)	1.687
Velocity of Propagation (Nominal) (%)	77
Shielding Effectiveness (dB through 18 GHz)[3]	> 100
Time Delay (Nominal) ns/m (ns/ft)	4.33 (1.32)

Mechanical/Environment Properties

Gore Cable Type	CX
Center Conductor	Solid
Overall Diameter mm (in)	4.2 (0.167)
Nominal Weight g/m (g/ft)	55.8 (17)
Minimum Bend Radius mm (in)	10.2 (0.40)
Temperature Range (˚C)	-55 to 125
Crush Resistance kgf/cm (lbf/in)	44.6 (250)

[1] The electrical specifications in this table are based on a 16 cm (6.3 in) assembly length.
[2] When cable is bent 90˚ around a 25.4 mm (1 in) radius mandrel.
[3] MIL-STD-1344, method 3008.

Thermal Vacuum Assemblies

GORE® PHASEFLEX® Microwave/RF Test Assemblies are available for thermal vacumm (TVac) applications. The cable and connector options listed in this data sheet are all available for TVac applications by configuring the part number with T/V at the end.

These assemblies will be manufactured using low outgassing materials having a TML of 1.0% or less and CVCM of 0.10% or less when tested per ASTM-595.

Integrity of critical hardware

- Gore's focus on fitness for use
- Over 40 years of TVac applications experience

Successful test execution

- Repeatable and reliable products
- Broad range of thermal vacuum solutions proven over time

Ensure program schedule

- Access to Gore's global experience and regional support
- Gore's application engineering support will help you determine the right cable solutions
- Reduce risk of delays/test idle time for troubleshooting and addressing test anomalies

Save total cost

- Gore's portfolio offers best total value with performance over time
- Solutions to fit testing budget
- Reduce risk of cost creep due to troubleshooting and replacement of faulty/unstable test equipment

Connector Options

Connectors available (Table 5) for GORE® PHASEFLEX® Microwave/RF Test Assemblies are specifically engineered to optimize performance of the assembly.

Thermal-vacuum chamber Credit: NASA

Table 5: Connector Options

		Gore Cable Type																
Connector Type	Max. Freq. (GHz)[1]	0H	0X	0S	0U	0Q	0P	0M	0W	0R	0T	5R	0K	0D	0N	0Z	0F	CX
		18	18	18	18	18	18	18	26.5	26.5	26.5	32	40	40	50	50	70	110
TNC Male (High Power)	5					ZLK		ZLK										
TNC Wedge Male (High Power)	5					ZVX		ZVX										
7/16 Male	7		ZLY	ZLY														
7/16 Female	7		ZLZ	ZLZ														
Type N Male	18		N01	N01		N01	N01	N01										
Type N Female	18		N02	N02		N02	N02											
SMA Male	18	R01	R01	R01	R01	R01	R01	R01					R01		R01			
SMA Box Right-Angle Male	18	R71	R71	R71	R71	R71	R71	R71					R71		R71			
SMA Female	18	R02	R02	R02	R02	R02	R02	R02							R02			
TNCA Male	18		C01	C01	C01	C01	C01	C01										
TNCA Box Right-Angle Male	18		C71	C71	C71	C71	C71	C71										
TNCA Female	18		C02	C02	C02	C02		C02										
Precision N Male (Field Grade)	18			ZKU														
Precision N Male (Instrument Grade)	18		Q01	Q01	Q01	Q01	Q01	Q01							Q01			
Precision N Right-Angle Male	18		Q71	Q71	Q71	Q71	Q71	Q71										
Precision N Female (Field Grade)	18			ZKV														
Precision N Female (Instrument Grade)	18		Q02	Q02	Q02	Q02	Q02	Q02										
7 mm Hermaphroditic	18		K00	K00	K00		K00											
3.5 mm Male	26.5		D01	D01	D01				D01	D01	D01				D01			
3.5 mm Female	26.5			D02	D02				D02	D02	D02				D02			
3.5 mm Ruggedized Port Female	26.5				0HA						0HA							
3.5 mm Ruggedized DUT Male	26.5				0HB						0HB							
2.92 mm Male	40											ZMQ	0CQ	0CQ	0CQ	0CQ		
2.92 mm Box Right-Angle Male	40												ZQA					
2.92 mm Female	40												0CP	0CP	0CP	0CP		
2.4 mm Male	50												0CJ		0CJ	0CJ		
2.4 mm Female	50												0CK		0CK	0CK		
1.85 mm Male	70																0CB	
1.85 mm Female	70																0CA	
1.0 mm Male	110																	0AB
1.0 mm Female	110																	0AA

[1] The maximum operating frequency of a test assembly is determined as the lowest frequency of either the connectors or the cable.

Torque Values

The recommended mating torque values for Gore connector types are provided in Table 6. They are intended for testing and measurement in the lab environment.

Table 6: Mating Torque Vales

Connector	Max Freq (GHz)	Recommended Mating Torque Value in-lbs (Nm)
7/16	7	15 - 25 (1.69 - 2.82)
Type N	12.4	9 - 15 (1.02 - 1.68)
TNC	12.4	10 - 12 (1.13 - 1.35)
TNCA	18	10 - 12 (1.13 - 1.35)
Precision N	18	10 - 12 (1.13 - 1.35)
7 mm	18	10 - 12 (1.13 - 1.35)
SMA	18	8 - 10 (0.90 - 1.13)
3.5 mm	26.5	8 - 10 (0.90 - 1.13)
2.92 mm	40	8 - 10 (0.90 - 1.13)
2.4 mm	50	8 - 10 (0.90 - 1.13)
1.85 mm	70	8 - 10 (0.90 - 1.13)
1.0 mm	110	3.5 - 4.5 (0.40 - 0.50)

Ordering Information

GORE® PHASEFLEX® Microwave/RF Test 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 13
Cable Type	Connector A	Connector B	Assembly Length -T/V

Positions 1–2: See Tables 2 and 3 for the two-letter codes representing each cable type.

Positions 3–5 and 6–8: See Tables 5 and 6 for the list of connectors available for each cable type. Connector codes A and B must be in alphanumeric order.

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-inch test assembly is specified as 0240 in the last four digits of the part number. Cables are available in standard lengths of 12 in (0.30 m), 24 in (0.61 m), 36 in (0.91 m), 48 in (1.22 m), and 60 in (1.52 m).

Position 13: Identifier T/V included only for an assembly that has been prepared for thermal vacuum chamber use.

The **GORE® Microwave/RF Assembly Builder** is a step-by-step tool that allows you to configure and request a quote for an assembly with different connector options, assembly lengths, and frequencies. For more information, visit **gore.com/rfcablebuilder**.

The **GORE® Microwave/RF Assembly Calculator** is an online tool that calculates and compares the insertion loss, VSWR, and other parameters for various cable types. For more information, visit **tools.gore.com/gmcacalc**.

Table 7: Ordering Information for 110 GHz Test Assemblies

Part Number	Gore Cable Type	Connector A	Connector B	Length cm (in)
CX0AB0ABC10.0	CX	1.0 mm Male	1.0 mm Male	10.0 (3.9)
CX0AA0ABC10.0	CX	1.0 mm Female	1.0 mm Male	10.0 (3.9)
CX0AA0AAC10.0	CX	1.0 mm Female	1.0 mm Female	10.0 (3.9)
CX0AB0ABC13.0	CX	1.0 mm Male	1.0 mm Male	13.0 (5.1)
CX0AA0ABC13.0	CX	1.0 mm Female	1.0 mm Male	13.0 (5.1)
CX0AA0AAC13.0	CX	1.0 mm Female	1.0 mm Female	13.0 (5.1)
CX0AB0ABC16.0	CX	1.0 mm Male	1.0 mm Male	16.0 (6.3)
CX0AA0ABC16.0	CX	1.0 mm Female	1.0 mm Male	16.0 (6.3)
CX0AA0AAC16.0	CX	1.0 mm Female	1.0 mm Female	16.0 (6.3)
CX0AB0ABC20.0	CX	1.0 mm Male	1.0 mm Male	20.0 (7.9)
CX0AA0ABC20.0	CX	1.0 mm Female	1.0 mm Male	20.0 (7.9)
CX0AA0AAC20.0	CX	1.0 mm Female	1.0 mm Female	20.0 (7.9)
CX0AB0ABC24.0	CX	1.0 mm Male	1.0 mm Male	24.0 (9.4)
CX0AA0ABC24.0	CX	1.0 mm Female	1.0 mm Male	24.0 (9.4)
CX0AA0AAC24.0	CX	1.0 mm Female	1.0 mm Female	24.0 (9.4)
CX0AB0ABC30.0	CX	1.0 mm Male	1.0 mm Male	30.0 (11.8)
CX0AA0ABC30.0	CX	1.0 mm Female	1.0 mm Male	30.0 (11.8)
CX0AA0AAC30.0	CX	1.0 mm Female	1.0 mm Female	30.0 (11.8)

NOTICE — USE RESTRICTIONS APPLY

Not for use in food, drug, cosmetic or medical device manufacturing, processing, or packaging operations.

W. L. Gore & Associates, Inc.
555 Paper Mill Road, Newark, DE 19711 UNITED STATES
T +1 302 738 4880 **F** +1 302 738 7710 gore.com

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