



GORE® Microwave/RF Cable Assemblies

IMPROVE 5G TESTING WITH RELIABLE MICROWAVE/RF CABLE ASSEMBLIES

White Paper

Introduction

Current LTE and LTE-Advanced communication architectures cannot accommodate today's market demand for higher data throughput, greater cell capacity, and more reliability. As a result, new 5G cellular standards are being developed to achieve the desired performance goals. 5G wireless technology is designed to exploit existing 2G/3G/4G technology, as well as leverage mmWave transmission operating within the frequency range of 24 to 100 GHz. Components such as mmWave and massive MIMO (multiple input/multiple output) antenna technology using 5G have a higher frequency and multi-port density compared to LTE/LTE-A.

A significant portion of a test system's stability and repeatability is determined by the precise performance of microwave/RF cable assemblies connected to it. They are an integral part of 5G test systems and play a key role in ensuring test reliability and measurement accuracy. The challenges with cable assemblies in 5G test systems are generally no different than any other test system. However, 5G testing does have the added twist of over-the-air (OTA) testing.

Therefore, cable assemblies should have the following attributes to accurately and effectively support component and system testing:

- Consistent performance under a variety of environmental conditions and over time
- Reliable and repeatable performance without negatively impacting test system operation
- Phase and amplitude stability with movement without operating on signals being conveyed
- Added durability to withstand handling, hard use, and multiple connect/disconnect cycles without performance degradation
- Excellent shielding effectiveness without accepting or creating electromagnetic interference, particularly in 5G OTA test chambers
- High flexibility and easy to use without any spring back

The 5G test industry requires improved reliability of cable assemblies to help improve test outcomes. You cannot trust the product performance if you cannot trust the test results. Therefore, engineers should understand how cable assemblies affect the test system to maximize and optimize overall performance. Selecting a reliable, high-performing microwave/RF cable assembly will eliminate many of the common problems experienced with test systems. For instance, poor-performing cable assemblies can cause delayed production, increased troubleshooting and maintenance, frequent calibration, data integrity issues, additional re-testing, higher total cost of ownership, compromised test system performance, and reduced test throughput.



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Key Factors Impacting Cable Assembly Reliability

The reliability of microwave/RF test cable assemblies is based on electrical performance, durability, and stability no matter the environment or application in which they are used. The 5G test industry requires cable assemblies to deliver reliable performance and phase stability with improved durability and greater flexibility in small, lightweight constructions.

Electrical Performance

Most microwave/RF cable assemblies perform well when new or right out of the bag. However, problems begin when inferior cable assemblies are subjected to the rigors of daily use in a test system. For instance, repeated handling can cause an inferior cable assembly to become unstable in phase and amplitude with even the slightest movement. Repeated connect and disconnect cycles can prematurely wear a poorly engineered connector interface, causing VSWR, insertion loss, and measurement repeatability issues. Cable assemblies that are not adequately ruggedized for a test environment will quickly become damaged, compromising loss and VSWR performance. Over a very short time, an inferior cable assembly will become a test system liability, which in turn compromises data integrity, leading to frequent instrument re-calibration and doubts around measurement accuracy.

Durability

Mechanical stress occurs when cable assemblies are exposed to various types of movement. One of the biggest causes of mechanical stress on cable assemblies is when they are frequently handled. An operator can kink, pinch, or crush a non-ruggedized or poorly-protected cable assembly by stepping on it or rolling an office chair over it. Therefore, crush and tensile strength are essential in overcoming mechanical stress. Also, cable assemblies used with portable equipment can come into contact with sharp surfaces that cut the cable assemblies or expose them to abrasion.

Stability

It is a common misconception that all cable assemblies are stable. The notion and importance of stability are often overlooked or misunderstood. Stability comes in many forms, all of which are critical to cable assembly performance. There is stability in phase and amplitude with movement. Without it, the user cannot move or flex the cable assembly once they have calibrated the instruments. Stability and consistency of performance over time are critical cable assembly features. All users, whether aware of it or not, want cable assemblies to perform in a stable and consistent manner for as long as possible no matter how they are used.

Finally, there is stability with temperature in applications such as semiconductor and wafer probe testing. Without it, a cable assembly's performance becomes unpredictable when subjected to temperature extremes. While many tests are conducted at room temperature, component manufacturers also seek to accurately characterize the performance of their products over their guaranteed temperature range. Unstable cable assemblies can severely impact the most sophisticated vector network analyzers (VNAs) by not retaining the original conditions under which the VNA was initially calibrated. VNAs are not designed to anticipate the shortcomings of cable assemblies because stability is assumed during calibration. Subsequently, the stability of cable assemblies preserves the VNA's measurement precision, accuracy, and repeatability.

The Industry Benchmark in Microwave/RF Cable and Cable Assemblies Manufacturing

With more than 40 years of design expertise, W. L. Gore & Associates manufactures microwave/RF cable assemblies that provide enhanced durability while delivering proven phase and amplitude stability with flexure and over temperature. We offer a broad portfolio of cable assemblies for test and measurement, spaceflight, and aerospace and defense applications. Our portfolio includes cable diameters ranging from 0.047 to 0.420 inches at frequencies from DC to 110 GHz in low-loss cable constructions. We also design and manufacture a selection of connector options to optimize the performance of our cable assemblies.

Unlike other suppliers, we manufacture our own dielectric materials and precision flat wire outer conductors for microwave/RF cable assemblies. We ensure consistent performance and quality control of our products throughout the entire manufacturing process — from raw materials to the finished product.

GORE® PHASEFLEX® Microwave/RF Test Assemblies

Our most popular cable assemblies are proven to deliver excellent phase and loss stability with flexure for test applications that require precise, repeatable measurements up to 110 GHz. Their excellent stability and lifelong performance enable longer test system uptime between calibrations for greater measurement accuracy, repeatability, and throughput. These assemblies have a unique internally ruggedized construction that protects against crushing, kinking, and fluid ingress while also being highly flexible and easy to handle (Figure 1). The newest version, Type ON, is designed explicitly for multi-port test equipment (Figures 2 and 3). GORE® PHASEFLEX® Microwave/RF Test Assemblies are the ideal solution for test lab and production test environments.

Figure 1: Ruggedized, Flexible Construction of GORE® PHASEFLEX® Microwave/RF Test Assemblies

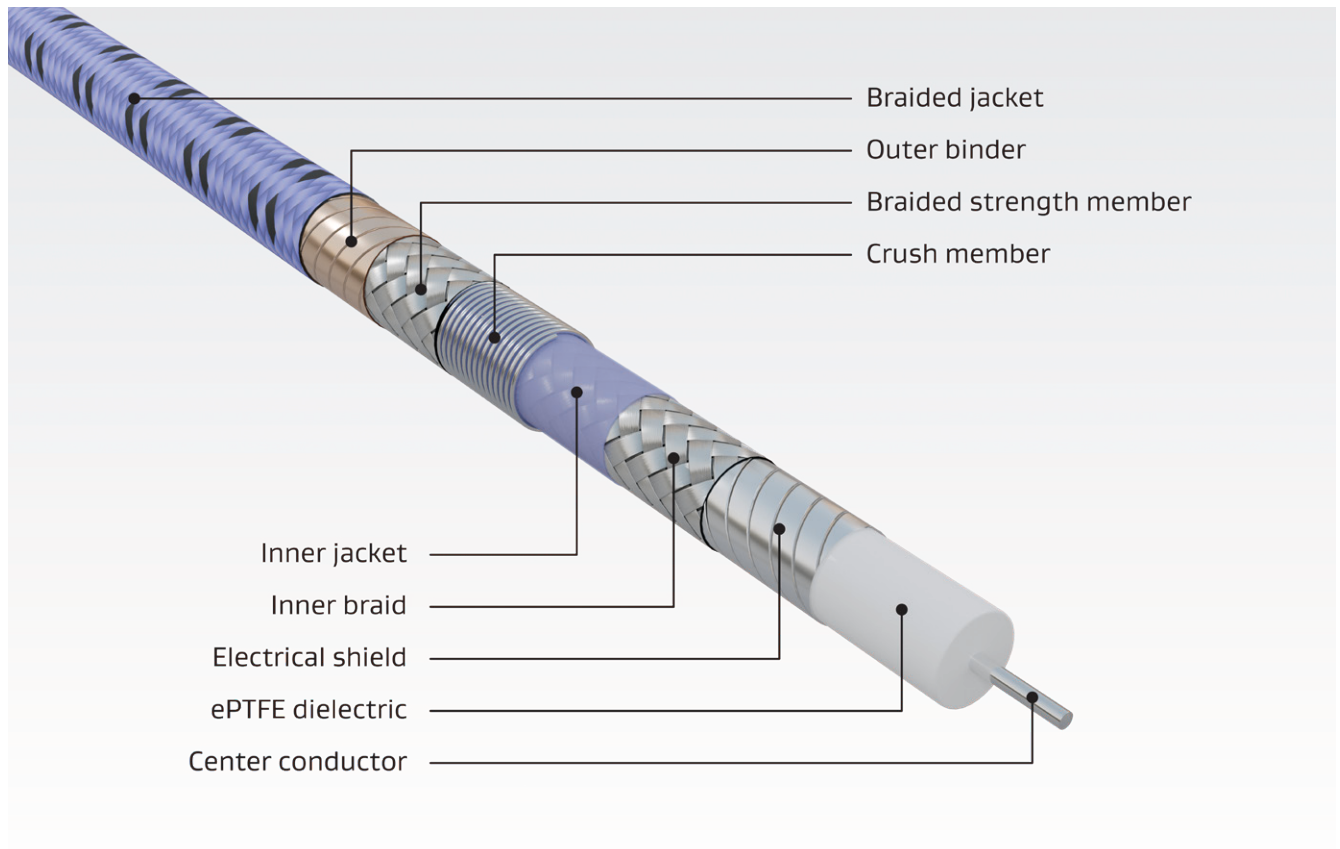


Figure 2: Keysight M9804A Multiport Test System connected with Type ON of GORE® PHASEFLEX® Microwave/RF Test Assemblies

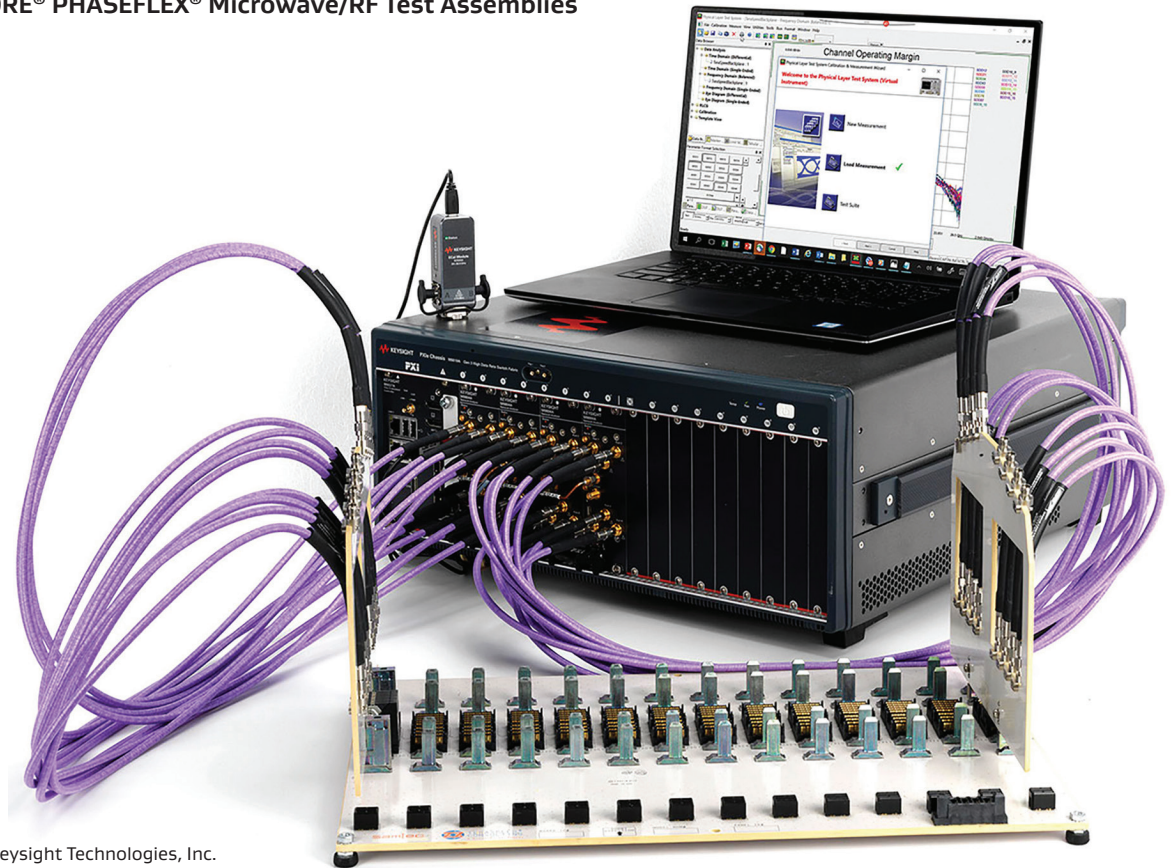


Image courtesy of Keysight Technologies, Inc.

Figure 3: R&S®ZNB Vector Network Analyzer connected with Type ON of GORE® PHASEFLEX® Microwave/RF Test Assemblies



Image courtesy of Rohde & Schwarz GmbH & Co.

GORE® Microwave/RF Assemblies, General Purpose Test & High-Density Interconnects

For general purpose test applications that require consistent and highly repeatable measurements, our cable assemblies provide reliable electrical performance with proven phase and amplitude stability from DC to 70 GHz. They deliver mechanical and electrical integrity in lightweight, durable construction with smaller diameters and high flexibility (Figure 4). These cable assemblies simplify the routing process while ensuring long-lasting electrical performance after installation — particularly in board-to-board and inside-the-box applications.

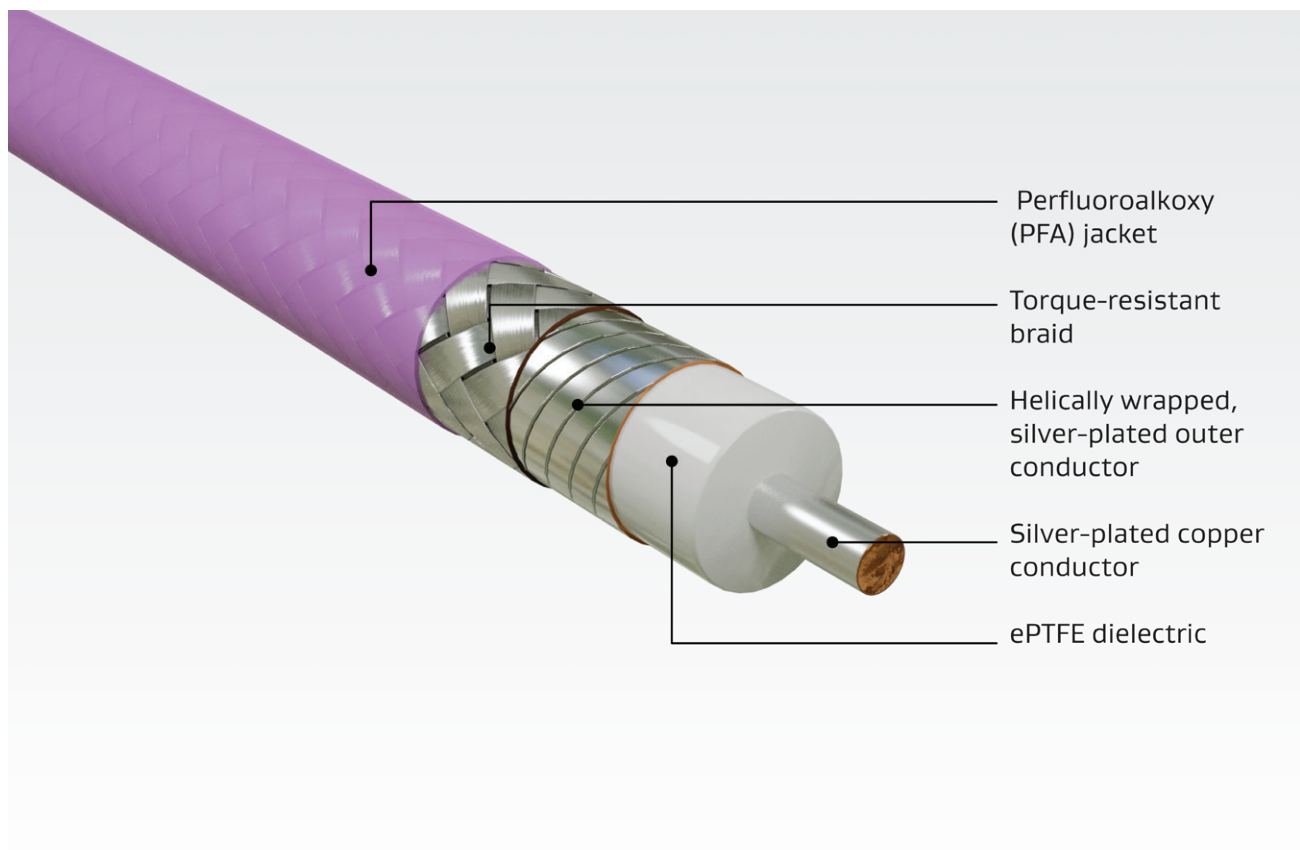
Gore's general purpose test assemblies deliver consistent and highly repeatable measurements with greater flexibility from DC to 70 GHz.

GORE® VNA Microwave/RF Test Assemblies

We set the industry benchmark with our cable assemblies for vector network analyzers (VNAs) through 70 GHz. Constant and/or highly repetitive movement of cables can compromise the measurement precision of high-performance VNAs. Our cable assemblies are specifically engineered to provide the most precise VNA measurements under laboratory conditions. Leading manufacturers choose our cable assemblies because of the improved performance they see in their test equipment.

GORE® VNA Microwave/RF Test Assemblies have a rugged, lightweight construction that enables longer service life, reduced downtime, and lower operating costs over the life of the test equipment. They are proven to deliver the highest accuracy and greatest time interval between re-calibrations.

Figure 4: Lightweight, Highly Flexible Construction of GORE® Microwave/RF Assemblies, General Purpose Test & High-Density Interconnects



Reliable Performance Now and Over Time

Unlike cheaper alternatives, Gore's broad portfolio of microwave/RF test assemblies provide unmatched precision, consistent electrical performance, and durability over time for longer service life. Their reliable performance reduces re-testing, re-calibration, extra troubleshooting, and the common misconception that test equipment may be faulty or unstable.

Learn more about Gore's broad portfolio of microwave/RF cable assemblies for test and measurement, spaceflight, and aerospace and defense applications by visiting [gore.com/performancevertime](https://www.gore.com/performancevertime).



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