

Bringing Laboratory Performance and Precision Into the Field

by Robert John, Product Manager, W. L. Gore & Associates

Agilent's FieldFox Handheld RF and Microwave Analyzers bring the performance and precision of the company's industry-standard bench-top analyzers into the field. Making accurate and reliable RF and microwave measurements is becoming more of a necessity in harsh and hard-to-reach environments. Conditions include day or night, rain or shine, hot or cold, aboard a ship, in an aircraft, or in a vehicle. Examples of real-world applications include use in a base transceiver station (BTS) during a snowstorm, aboard a ship in rough seas, at a satellite trailer in a sandstorm, and other rough environments.

In these situations, a handheld instrument must be capable of making the required measurements with sufficient levels of performance and accuracy. And, given the expected operating conditions, physical and environmental specifications are equally important to the instrument and the user, both for the instrument itself and any accessories, such as microwave/RF cable assemblies, that are used with it. A harsh environment can be considered any combination of conditions unique to an application that can compromise the reliability and performance of the test instrument or the cable assemblies used with it. The environments in which cable assemblies are being used today are becoming more challenging. For example, cables are being exposed to extreme temperatures, chemicals, abrasion, and extensive flexing.

Making It Rugged and Reliable

FieldFox analyzers were designed from the ground up as handheld units, as opposed to repackaging a conventional benchtop analyzer. They can be configured with the capabilities desired—cable and antenna analyzer, vector network analyzer, spectrum analyzer, or the all-in-one combination analyzer. Additional capabilities include a power meter, vector volt meter, an independent signal source, a variable DC supply, a frequency counter, an interference analyzer, and a built-in GPS receiver. Any and all fit into an ergonomic MIL-rugged 3.0 kg (6.6 lb.) package. Instrumentation costs are reduced by using a single, multi-function handheld unit that covers RF and microwave frequencies.

Using MIL-PRF-28800F as a yardstick, many of today's "repackaged" instruments fall short in several key areas: temperature and humidity, vibration, mechanical



Figure 1: Portable handheld RF and microwave analyzers bring the performance and precision of standard benchtop analyzers into the field for precise, on-the-go measurements.

shock, water resistance and dust exposure. Most stumble due to poor choices in areas such as component selection and package design. For example, components designed to work in an AC-powered device tend to be power-hungry, which has two undesirable consequences. One is shorter battery life, which is a significant shortcoming in the absence of AC outlets or spare batteries. The other is heat: these components often need fan-based cooling, and this requires vents to provide airflow through the instrument enclosure.

With these attributes, a typical repackaged design will have a hard time operating in tough—but typical—conditions: rain, dust, humidity, fluctuating temperatures, and so on. As a worst-case example, imagine a day in the desert, working on satellite ground stations with a fan-cooled handheld. Sandstorms are common and the instrument is likely to ingest significant amounts of foreign matter, which can lead to overheating more quickly than when operating in ideal conditions.

To ensure durability in harsh environments, the FieldFox's completely sealed enclosure is compliant with US MIL-PRF-28800F Class 2 requirements. Equipment designated as Class 2 is capable of operat-

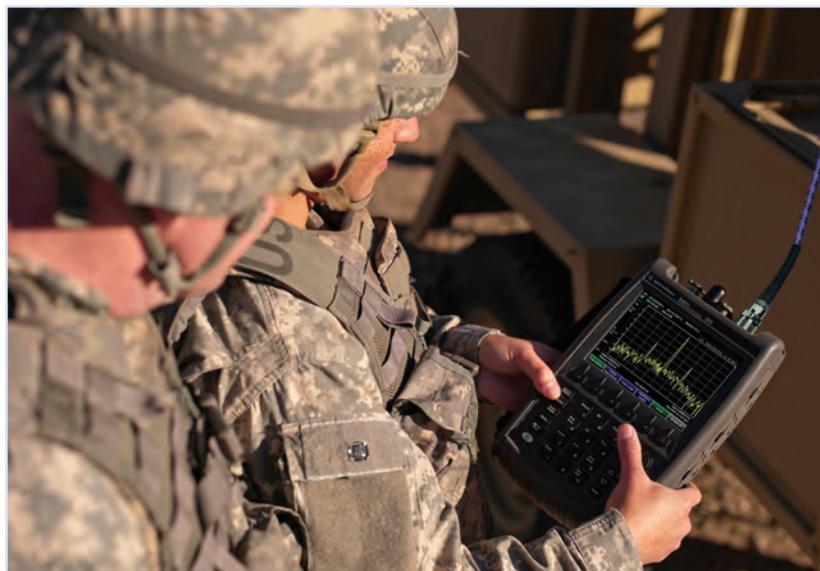


Figure 2: FieldFox handheld analyzers provide precise microwave measurements in harsh conditions.

ing in rugged environments that include unprotected, uncontrolled climatic conditions.

Applications

FieldFox can be used in a wide range of applications—anywhere—including cable and antenna testing for cellular installation and maintenance, validation of radar system performance in the field (including mission-critical systems that need to be up 24/7), as a teaching tool in engineering lectures and labs, in military aircraft, and in calibrating a variety of RF and microwave devices including cables, filters and amplifiers.

Accessories Need to be Rugged, Too

Performance over time is critical. Like the FieldFox Handheld RF and Microwave Analyzer, key components used with it,

such as microwave/RF cable assemblies, should undergo rigorous environmental testing for the variety of demanding environments they may experience. This includes water, electrostatic discharge, vibration, shock and flexure testing.

Cables are often the last component considered when designing an electronic system. Many of today's applications have environmental influences that require unique materials and mechanical properties to ensure reliable cable performance. First you need to consider the electrical, mechanical, and environmental stress that the cable will encounter in your application. In addition, most applications have unique issues that can stress a cable assembly. However, cables are really the system's lifeline—if a cable fails, the entire system can stop functioning. For example, if the cable system used for data transmission in a spacecraft fails, the communication between the craft and mission control could be lost. Cable performance is based on reliability, durability, and signal integrity, all of which can be compromised by electrical, mechanical, and environmental stress. The ideal cable assembly should be engineered to last the life of the test equipment in any environment.

When asked in a recent study by W. L. Gore & Associates to rank the criteria most valued

when selecting a cable assembly, the majority of test equipment users selected quality as the most important criteria. However, the results of this study indicate that most cable assemblies are not lasting for the life of the equipment, and that users are accustomed to replacing the assemblies frequently. They shouldn't be, particularly if they're using them out in the field with a portable analyzer like FieldFox.

Gore evaluated the durability and performance over time of several 18-GHz microwave/RF cable assemblies described as having a ruggedized construction with similar specifications. This testing showed that the performance of a new microwave/RF cable assembly does not necessarily ensure reliable performance for the life of a system. Selecting a durable cable assembly that has been tested to survive real-world conditions is the key to reducing replacement costs and the only way to ensure reliability over time.

Using Gore's loss and phase stability specifications for new assemblies, the other cable assemblies failed after only 100 and 300 flex cycles. However, GORE® PHASEFLEX® Microwave/RF Test Assemblies were tested for 10,000 flex cycles, at which point the test was halted because there was no change in performance.

These tests showed that the

failure rate of cables varied when new and after accelerated life testing was done. The internal construction of the other cable assemblies physically changed (i.e., stretched and distorted) after repeated use, which compromised their electrical performance. However, GORE PHASEFLEX Microwave/RF Test Assemblies performed significantly better over time without any physical changes, which means that these cable assemblies maintained electrical and mechanical integrity in environments where the other assemblies were compromised. Their unique dielectric and durable construction enabled them to withstand continuous movement, flexing, and exposure to harsh conditions while still maintaining excellent signal integrity.

Precision performance over time is the key for the FieldFox Handheld RF and Microwave Analyzer as well as the microwave/RF cable assemblies used with it. This requires a comprehensive, rigorous design approach, the right materials, and extensive testing to provide laboratory precision with environmental toughness from products that are built to last in demanding mechanical and environmental conditions. This results in products with high quality, durability and fitness for use that do what the manufacturers say they will do, providing confidence in their measurements and peace of mind for the users. Here, Agilent and W. L. Gore & Associates

have followed the same path and GORE PHASEFLEX Microwave/RF Test Assemblies have become the microwave/RF cable assemblies of choice for the FieldFox.

W. L. GORE & ASSOCIATES

As seen in Microwave Product Digest, August 2014.

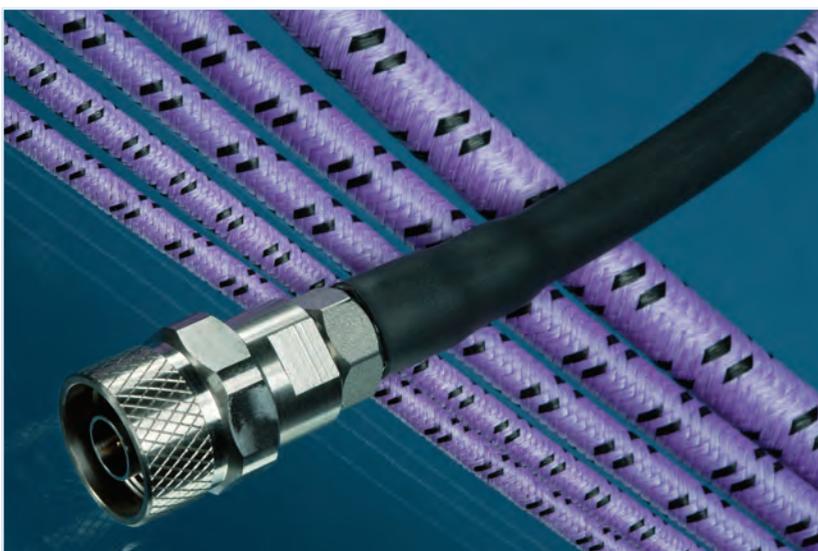


Figure 3: Microwave/RF cable assemblies need to be able to withstand extreme environments for optimum performance over time.

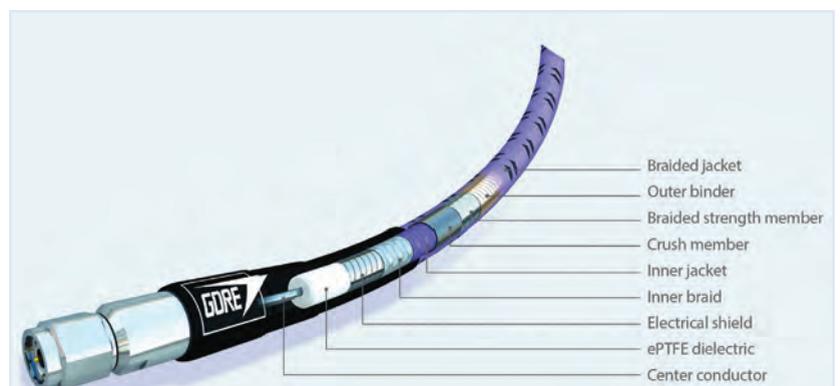


Figure 4: The construction of GORE® PHASEFLEX® cable assemblies enables them to withstand continuous movement, flexing, and exposure to harsh conditions while still maintaining excellent signal integrity.