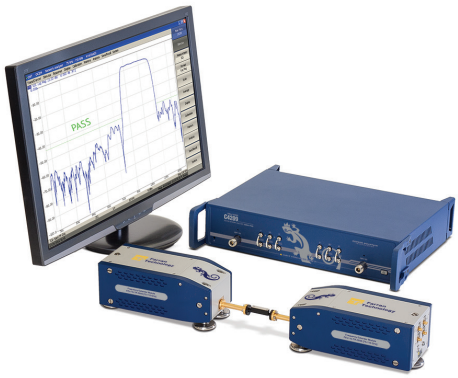
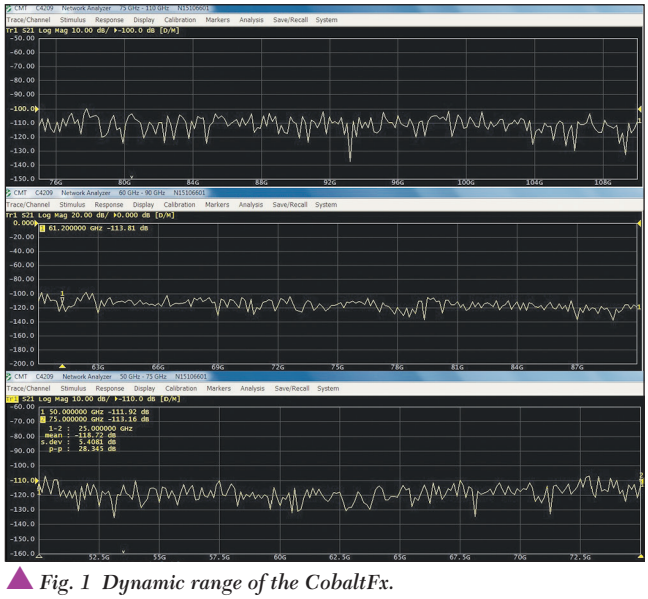


Affordable, mmWave VNA Solutions

Farran Technology
Cork, Ireland
Copper Mountain Technologies
Indianapolis, Ind.

With the advent of the Internet of Things (IoT), WiGig and 5G technologies moving to higher frequencies and backhaul at 60, 70 and 80 GHz, the need for S-parameter testing at higher frequencies is increasing. Traditional solutions also have to change to meet the requirements of today's applications: material characterization, on-wafer benchtop measurements, near and far field antenna and radar cross-section measurements, as well as automotive and non-automotive radar sensors.

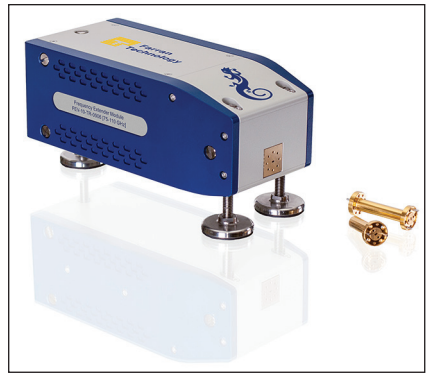


▲ *Fig. 1 Dynamic range of the CobaltFx.*

To address these issues, Farran Technology and Copper Mountain Technologies have partnered to create CobaltFx—a new mmWave frequency extension solution, which the companies say is the first mmWave frequency extension solution that utilizes a 9 GHz VNA. CobaltFx's high dynamic range (see ***Figure 1***) and directivity allows for highly accurate and stable mmWave S-parameter measurements in three dedicated waveguide bands; 50 to 75 GHz, 60 to 90 GHz and 75 to 110 GHz.

The C4209 VNA used in this system is from Copper Mountain Technologies' Cobalt series. It features fast sweep speeds down to 10 µs per point and a dynamic range of up to 162 dB, all contained in a compact, USB form factor.

The C4209 works seamlessly with Farran Technology's mmWave FEV frequency extenders (see ***Figure 2***) that are packaged in small,



▲ *Fig. 2 Farran Technology's mmWave FEV frequency extenders are packaged in small and versatile enclosures.*

versatile enclosures that allow for flexible port arrangements with respect to the waveguide. Waveguide ports are manufactured in accordance to the new IEEE 1785-2a standard and ensure alignment and repeatability of connection, allowing for long interval times between calibration. The system comes with a precision calibration kit containing flush short, offset piece and broadband load.

MEASUREMENT CAPABILITIES

The CobaltFx will perform full S-parameter measurements with full 12-term port calibration. Time domain measurements are also possible. Mounting feet can be removed or orientated on different faces, giving the maximum flexibility in waveguide positioning.

The CobaltFx incorporates various sweep features with up to 16 independent logical channels: each logical channel is represented on the screen as an individual channel window. Extensive trace functions are available, including the ability to view data trace, memory trace or both. Data trace modifications by math operations, autoscaling, electrical delay and phase offset are also standard functions. The system software is COM/DCOM compatible, which allows the system to be used as part of an ATE station. The system and software are also fully compatible with LabView applications, enabling flexibility in user-generated programming and automation.

Other features and specifications include: Test port output power is 0 to +5 dBm minimum and typically +5 to +8 dBm, while the test port input power is typically +10 to +15 dBm. The system dynamic range, shown in Figure 2, is typically 110 to 140 dB, and the trace stability is ±0.2 dB. The RF/LO port damage level is +10 dBm minimum.

Calibration kits (FEK-15/12/10-0006) are also supplied, which ensure accurate and repeatable measurements. They are compatible with TRL and SOLT calibration techniques and contain full characterization data for the components required by the CobaltFx system for calibration.

APPLICATIONS

The potential applications for the CobaltFx system are extensive. It can easily perform antenna range measurements requiring high dynamic range and a fast sweeping test system. During the measurement, antenna gain, pattern, efficiency and directivity can be verified as well as parameters of the radome, while directivity and reflectivity measurements are fundamental for evaluating the backscatter parameters of the target.

5G technology is considered to be a fundamental medium for the IoT, and unlocking the high frequency part of the frequency spectrum (>50 GHz) is key to this concept. CobaltFx is a cost effective solution to enable the integration of various devices, materials, antenna beam forming and channel propagation concepts for indoor and outdoor 5G communication.

Multi-Gigabit Wi-Fi technology operating at 60 GHz will expand the capacity for indoor Wi-Fi data transmission. With 3D and 4K video streaming within the wireless network and devices there is a need for chipset and antenna technology to offer bandwidth and range that will reliably replace cable connectivity. High levels of integration of various technologies operating from single MHz to the 60 GHz range requires very accurate and thorough characterization of consumer electronics equipment. The CobaltFx system can address this application very cost-effectively.

With adaptive cruise control, collision mitigation and pedestrian detection systems already available; autonomous driving under development; and various non-automotive radar sensor applications for foreign object detection, perimeter and security detection, collision avoidance and

moving object detection; the need for thorough characterization of devices and materials at 77 and 79 GHz has never been greater. CobaltFx offers a cost effective and flexible test and measurement solution for radar applications.

Every test laboratory in a commercial or industry orientated organization involved in production and testing of various components must have the means to evaluate their products. CobaltFx can carry out all these measurements and, with its flexibility and compactness, it easily fits on the lab bench.

On-wafer, S-parameter measurements provide for model generation of discrete semiconductor devices (diodes, transistors, MMICs). For accurate models, the data obtained during measurement must be accurate, and the system must allow for long time intervals between calibrations for development cost reduction. Such tasks require that mmWave test equipment is stable and accurate while being compact and flexible.

The increase in usage of mmWaves for high speed digital radio communications and radar sensors is driving the need for high frequency characterization of various materials: PCB laminates, antenna radomes and lenses, vehicle windscreens and various other dielectric composites. Accurate characterization is fundamental to understanding frequency dependent dielectric constant and loss tangents that allow for better modeling of structures, shorter development time and ultimately lower cost of the product. For material characterization, the CobaltFx system offers an accurate, compact and cost effective way of understanding the impact of various materials on the high frequency performance in today's and future mmWave components and systems.

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