CobaltFx Series

COPPER MOUNTAIN™ TECHNOLOGIES

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Frequency Extender System from

COPPER MOUNTAIN™ TECHNOLOGIES

Farran Technology

- **Frequency bands from:** 50-75 GHz, 60-90 GHz, 75-110 GHz

EXTEND YOUR REACH

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Cost-effective mmWave Frequency Extension System

Farran Technology and Copper Mountain Technologies, globally recognized innovators, with a combined 50 years' experience in RF test and measurement systems have partnered to create CobaltFx, a new millimeter-wave frequency extension solution. CobaltFX is the first mmWave frequency extension solution that utilizes a 9 GHz VNA. CobaltFx's high dynamic range and directivity allow for highly accurate and stable millimeter-wave S-parameter measurements in three dedicated waveguide bands; 50-75 GHz, 60-90 GHz and 75-110 GHz. CobaltFx offers an unparalleled combination of price, performance, flexibility and size.

The VNAs used in this system are from Copper Mountain Technologies' industry leading Cobalt Series. They feature fast sweep speeds down to 0.2 microseconds per point and a dynamic range of up to 162 dB, all comprised in a compact, USB form factor. The VNAs work seamlessly with Farran Technology's millimeter-wave FEV frequency extenders.

The extenders are packaged in small and 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 industry-leading alignment and repeatability of connection, allowing for long intervals of time between calibration. The system comes with a precision calibration kit containing flush short, offset piece and broadband load, and allows for full 12-term calibration.

Copper Mountain Technologies' USB VNAs are next generation analyzers designed to meet the needs of 21st Century engineers. Our VNAs include an RF measurement module and a processing module, a software application which runs on a Windows PC, laptop or tablet, connecting to the measurement hardware via USB interface.

This innovative approach delivers high measurement accuracy and enables users to take advantage of faster processors, newer computers and larger displays. USB VNAs have lower Total Cost of Ownership and fewer potential failure points.

These instruments are smaller and lighter, can go almost anywhere, are very easy to share and eliminate the need for data purging or hard drive removal in secure environments.

Applications & Examples

Antenna Range Measurements

Due to high free space loss between the transmitting and receiving antennas, near and far field antenna measurements as well as radar cross section measurements require 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 a radome. Directivity and reflectivity measurements are fundamental for evaluating the backscatter parameters of the target. All these measurements can be performed by a millimeter wave S-parameter measurement system. CobaltFx offers industry-leading dynamic range and sweep time, as well as stability and ease of use.

Material Characterization

Increase in usage of millimeter waves 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 times and ultimately lower cost of products. The CobaltFx system is designed to be used for various methods of material characterization – free space, transmission line and resonance type. It offers an accurate, compact and cost-effective way of understanding the impact of various materials on high frequency performance in millimeter wave components and systems.

Wafer S-Parameter Measurements

On wafer S-parameters measurements provide for model generation of discrete semiconductor devices (diodes, transistors, mmics etc.). For accurate models, the data obtained during measurements must be accurate and the system must allow for long time intervals between calibrations. Such tasks require that millimeter-wave test equipment is stable and accurate while at the same time being compact and flexible. CobaltFx fits those two criteria perfectly.

"Frost & Sullivan analysis confirms that CMT distinguishes itself from competition by offering quality measurement VNAs that provide reliable results, yet are small, can be simply integrated into systems, and are more affordable than traditional analyzers."

Jessy Cavazos
Industry Director, Frost & Sullivan

Applications & Examples

5G Applications

5G technology is considered to be a fundamental medium for the Internet of Things (IoT). It is believed that 5G will enable very diverse bandwidth usage with challenging requirements (up to 1Tb/s/km2 by 2030). With 3D/4K video streaming, vast millimeter wave and smart camera sensor networks, working in the cloud, autonomous driving and mission-critical broadcasting all planned to be part of IoT, the need for bandwidth and data transmission speed has never been greater. Unlocking the high frequency part of the frequency spectrum (>50 GHz) is fundamental to this concept. Such a system will be based on small antennas operating in standalone as well as multiple user arrangements with beamforming capabilities, where amplitude and phase shift need to be very well characterized. Base stations as well as handset devices will require comprehensive discrete components as well as system level characterization. The system to be deployed and consumer devices need to comply with very strict specifications and emission requirements, but also meet low cost requirements. CobaltFx is the most cost-effective solution to enable the integration of various devices, materials, antenna beamforming and channel propagation concepts for indoor and outdoor 5G communication.

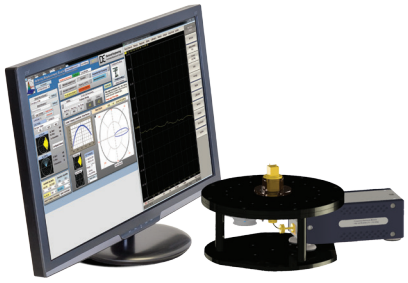
Benchtop DUT Characterization

Benchtop S-parameter measurements allow for accurate and time-effective verification of packaged products. Every test laboratory in a commercial or industry orientated organization involved in production and testing of various components must have a means of evaluating their products. These normally involve DUT-type unilateral or bilateral S-parameter measurements of passive and active components, compression point measurements for amplifiers and mixers, and intermodulation distortion. The measurement domain is either frequency or time. CobaltFx allows for all these measurements and with its flexibility and compactness it easily fits on the bench. It also fits the financial constraints that every commercial organization must take into account. What all these applications have in common is that they require an accurate, compact and affordable millimeter wave test and measurement solution and CobaltFx meets all these criteria.

Wigig at 60 GHz

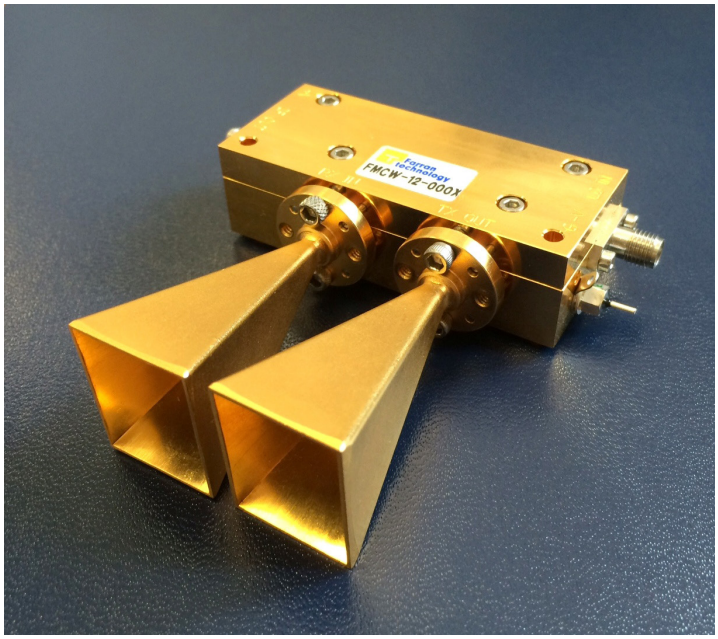
Multi Gigabit WiFi technology operating at 60 GHz will expand capacity for indoor WiFi data transmission. With 3D and 4K video streaming within the wireless network and devices, there is a need for chipset and antenna technology to offer bandwidth and range that will reliably replace cable connectivity. Such applications put big constraints on the cost of the router as well as wireless devices. 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. CobaltFx is a system that allows for very cost effective, accurate and flexible verification of the product at the device or system level, allowing for low cost production.

Automotive Radar & Sensor Testing



With various automotive and non-automotive radar sensors, the need for thorough characterization of devices and materials at 77 and 79 GHz has never been greater. With adaptive cruise control (ACC), collision mitigation (CM) and pedestrian detection (PD) systems already available-and autonomous driving under development-the automotive industry is in need of cost- and time-effective test solutions for radar sensors.

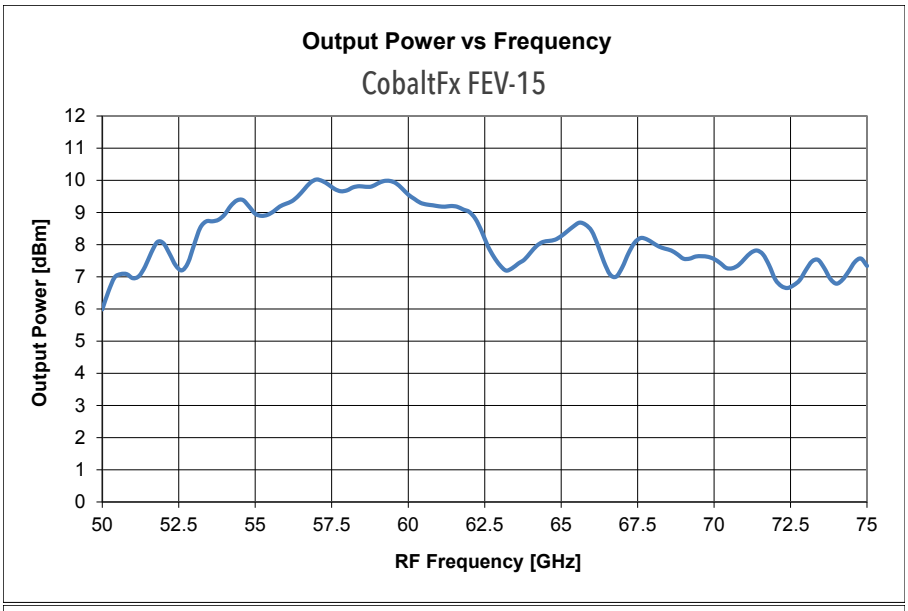
Also, non-automotive 77 GHz FMCW radar applications that cover foreign object detection, perimeter and security detection, collision avoidance and moving object detection also require test and measurement systems during their development and production. CobaltFx offers the most cost effective and flexible T&M solution for radar applications on the market.

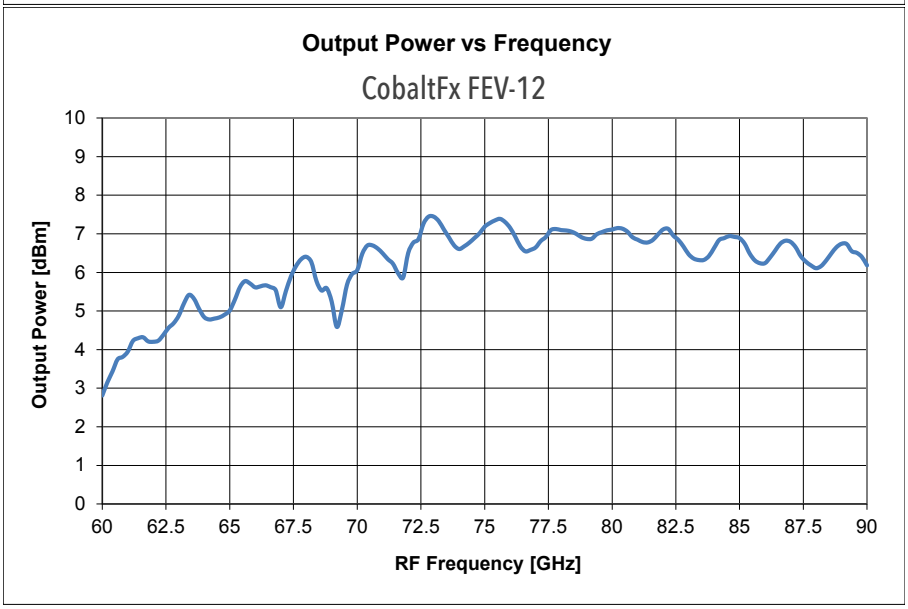


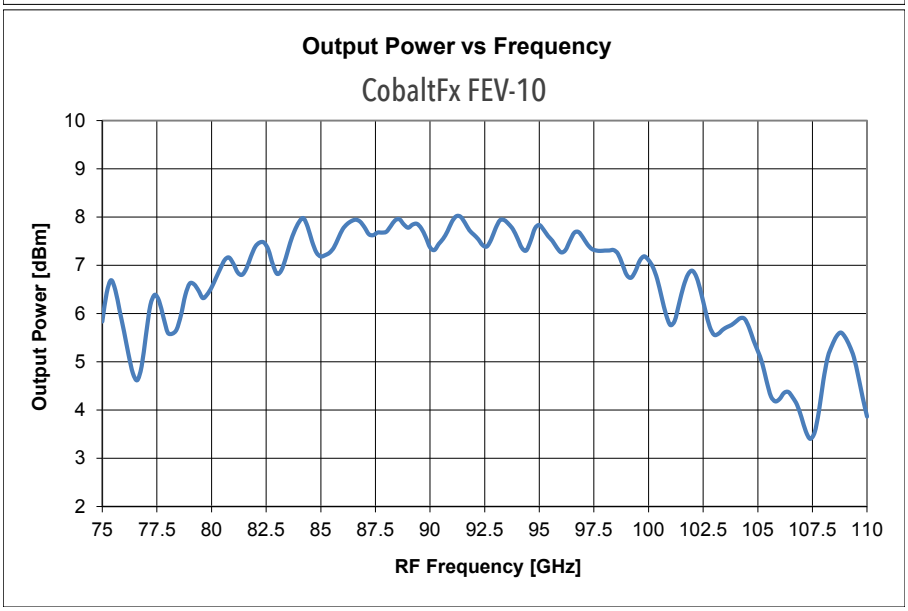
Backhaul at 70 & 80 GHz

Backhaul radio communication is another technology that will support mobile data networks and IoT in the future. The technology provides short range 1-3 km, high speed 1-2 Gb/s radio transmission for existing mobile networks. Due to its flexibility, ease of deployment and capacity it is frequently used for point-to-point links where fiber networks are not feasible from an environmental point of view (water crossing etc.) or cost. Thorough characterization of passive and active devices (amplifiers, filters, up and down-converters, antennas) is always required as these systems must meet stringent spectrum mask requirements for licensed frequency range. CobaltFx is a system that allows for cost and time effective measurement of Backhaul components and subsystems.

Typical Output Power Plots





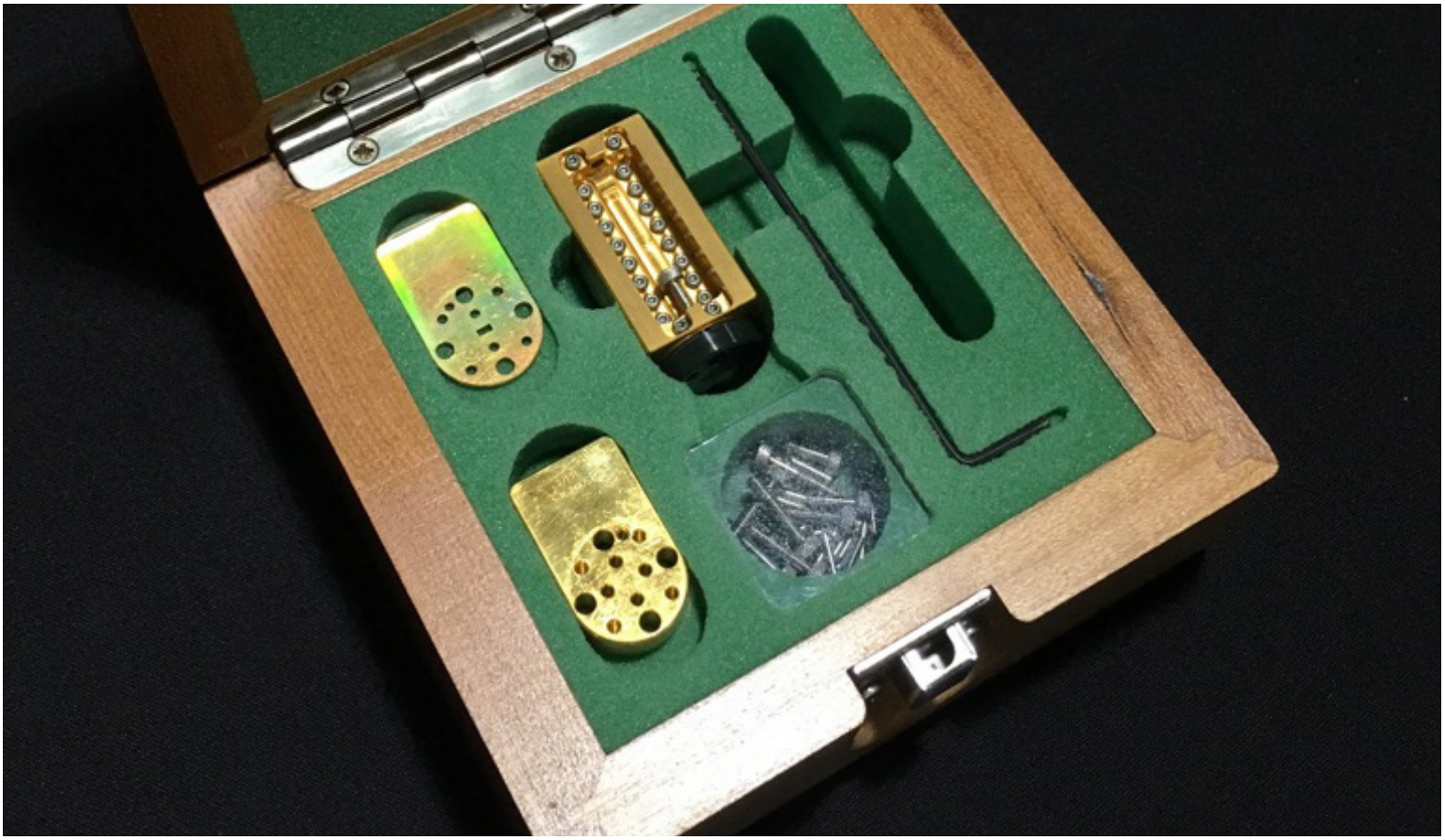


Waveguide Calibration Kits

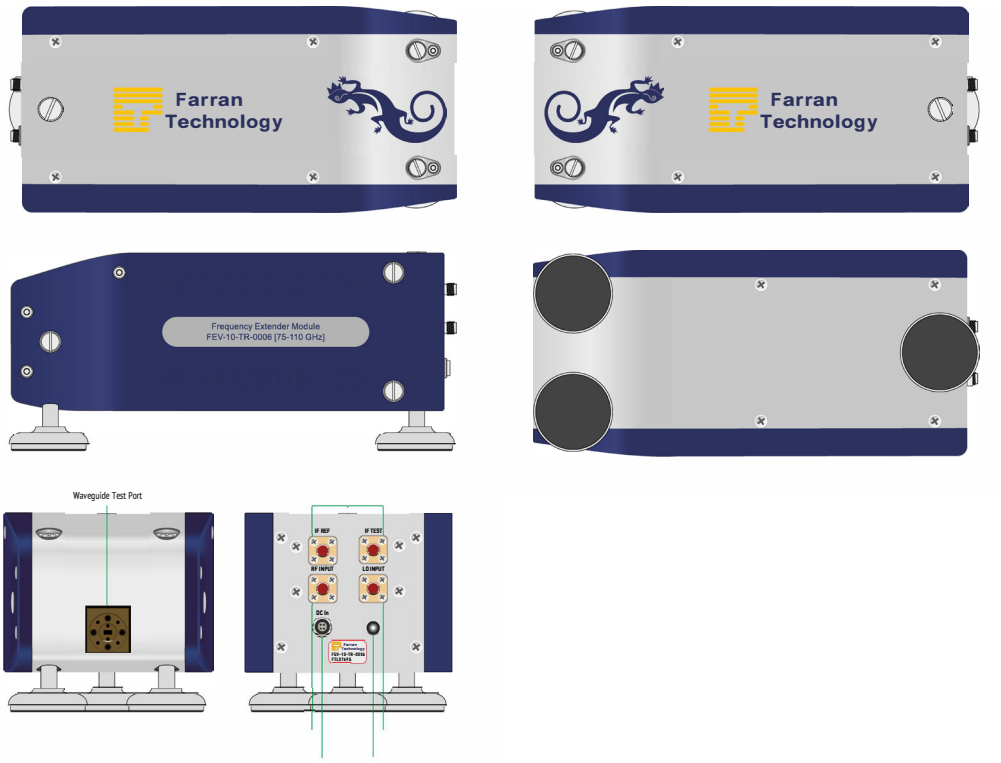
	FEK-15-0006	FEK-12-0006	FEK-10-0006
Operating Frequency Range	50 GHz to 75 GHz	60 GHz to 90 GHz	75 GHz to 110 GHz
Waveguide Designation	WR-15, WG-25, typ.	WR-12, WG-26, typ.	WR-10, WG-27
Flange Type	IEEE 1785-2a (Precision Style)	IEEE 1785-2a (Precision Style)	IEEE 1785-2a (Precision Style)
Cut Off Frequency	39.8765 GHz	48.3692 GHz	59.0143 GHz
Fixed Load VSWR	< 1.035:1	< 1.04:1	< 1.04:1
Flush Short Flatness	< 0.016 mm	< 0.012 mm	< 0.012 mm
Operating Temperature Range	20 to 30°C (68 to 86°F)	20 to 30°C (68 to 86°F)	20 to 30°C (68 to 86°F)

	Quantity	Quantity	Quantity
Broadband Termination	1 off	1 off	1 off
Flush Short	1 off	1 off	1 off
1/4 Lambda Offset	1 off	1 off	1 off

	Quantity	Quantity	Quantity
Hex Driver 5/64" A/F	1 off	1 off	1 off
Flange Screws - Short	4 off	4 off	4 off
Flange Screws - Long	4 off	4 off	4 off
Alignment Pins	4 off	4 off	4 off
USB Flash Memory	1 off	1 off	1 off



CobaltFx FEV-15 Specifications[1]



CobaltFx FEV-15

System Operating Frequency	50 GHz to 75 GHz
Test Port Output Power	5 dBm min., 8 dBm typ.
System Dynamic Range[2]	110 dB min., 120 dB typ.
Raw Coupler Directivity	40 dB min., 45 dB typ.
Trace Stability Magnitude[3]	±0.2 dB
Trace Stability Phase[3]	2°
Test Port Input 0.1 dB Compression Point	15 dBm
RF Input Frequency	6.25 GHz to 9.375 GHz
RF Input Power	0 dBm
LO Input Frequency	4.17 GHz to 6.25 GHz
LO Input Power	-5 dBm
IF Output Frequency	7.5 MHz
Test Port Damage Level	+20 dBm
RF/LO Port Damage Level	+10 dBm
Test Port Interface	WR-15 IEEE 1785-2a compatible with UG-385/U
RF/LO/IF Connector	SMA (F)
DC Power Requirements	+6 V at 2200 mA
Weight	3.5 kg
Dimensions	220 x 105 x 80 mm (8 $^{3}/_{5}$ x 4 $^{1}/_{8}$ x 3 $^{1}/_{8}$ inches)
Operating temperature	0°C to 30°C (32°F to 86°F)

[1] All specifications subject to change without notice. [2] Measured at 10 Hz IF BW
[3] At 23 ° C +/- 5 ° C after 1 hour warm-up and calibration. Assuming ideal RF and LO cables

FEV-12 Specifications[1] / FEV-10 Specifications[1]

CobaltFx FEV-12

System Operating Frequency	60 GHz to 90 GHz
Test Port Output Power	2 dBm min., 5 dBm typ.
System Dynamic Range[2]	100 dB min., 110 dB typ.
Raw Coupler Directivity	40 dB min., 45 dB typ.
Trace Stability Magnitude[3]	±0.2 dB
Trace Stability Phase[3]	2°
Test Port Input 0.1 dB Compression Point	15 dBm
RF Input Frequency	5 GHz to 7.5 GHz
RF Input Power	0 dBm
LO Input Frequency	5 GHz to 7.5 GHz
LO Input Power	-5 dBm
IF Output Frequency	7.5 MHz
Test Port Damage Level	+20 dBm
RF/LO Port Damage Level	+10 dBm
Test Port Interface	WR-12 IEEE 1785-2a compatible with UG-387/U
RF/LO/IF Connector	SMA (F)
DC Power Requirements	+6 V at 2200 mA
Weight	3.5 kg
Dimensions	220 x 105 x 80 mm (8 3/5 x 4 1/8 x 3 1/8 inches)
Operating temperature	0°C to 30°C (32°F to 86°F)

CobaltFx FEV-10

System Operating Frequency	75 GHz to 110 GHz
Test Port Output Power	0 dBm min., 5 dBm typ.
System Dynamic Range[2]	100 dB min., 110 dB typ.
Raw Coupler Directivity	40 dB min., 45 dB typ.
Trace Stability Magnitude[3]	±0.2 dB
Trace Stability Phase[3]	2°
Test Port Input 0.1 dB Compression Point	10 dBm
RF Input Frequency	6.25 GHz to 9.17 GHz
RF Input Power	0 dBm
LO Input Frequency	4.688 GHz to 6.875 GHz
LO Input Power	-5 dBm
IF Output Frequency	7.5 MHz
Test Port Damage Level	+20 dBm
RF/LO Port Damage Level	+10 dBm
Test Port Interface	WR-10 IEEE 1785-2a compatible with UG-387/UM
RF/LO/IF Connector	SMA (F)
DC Power Requirements	+6 V at 2200 mA
Weight	3.5 kg
Dimensions	220 x 105 x 80 mm (8 3/5 x 4 1/8 x 3 1/8 inches)
Operating temperature	0°C to 30°C (32°F to 86°F)

[1] All specifications subject to change without notice. [2] Measured at 10 Hz IF BW
[3] At 23 ° C +/- 5 ° C after 1 hour warm-up and calibration. Assuming ideal RF and LO cables

CobaltFx Compatible Cobalt USB VNAs

Cobalt C4209

Impedance	50 Ohm
Test port connector	N-type Female
Number of test ports	2
Frequency extender compatible	Yes; CobaltFx (2 ports)
Frequency range	100 kHz to 9.0 GHz
Full CW Frequency	$\pm 2 \times 10^{-6}$
Frequency setting resolution	1 Hz
Number of measurement points	2 to 500,001
Measurement bandwidths with 1/1.5/2/3/5/7 steps	1 Hz to 2 MHz
Dynamic range	
100 kHz to 1 MHz; 1 Hz IF BW	115 dB
1 MHz to 8 GHz; 1 Hz IF BW	158 dB/162 dB, typ.
8 GHz to 9 GHz; 1 Hz IF BW	148 dB/152 dB, typ.
Time per point (Typ.)	10 µsec
Port switchover time (Typ.)	0.2 msec

Cobalt C4409

Impedance	50 Ohm
Test port connector	N-type Female
Number of test ports	4
Frequency extender compatible	Yes; CobaltFx (4 ports)
Frequency range	100 kHz to 9.0 GHz
Full CW Frequency	$\pm 2 \times 10^{-6}$
Frequency setting resolution	1 Hz
Number of measurement points	2 to 500,001
Measurement bandwidths with 1/1.5/2/3/5/7 steps	1 Hz to 2 MHz
Dynamic range	
100 kHz to 1 MHz; 1 Hz IF BW	115 dB
1 MHz to 8 GHz; 1 Hz IF BW	158 dB/162 dB, typ.
8 GHz to 9 GHz; 1 Hz IF BW	148 dB/152 dB, typ.
Time per point (Typ.)	10 µsec
Port switchover time (Typ.)	0.2 msec

[1] All specifications subject to change without notice. [3] At 23 ° C +/- 5 ° C after 1 hour warm-up and calibration. Assuming ideal RF and LO cables

Cobalt C4220

Impedance	50 Ohm
Test port connector	NMD 3.5 mm Male
Number of test ports	2
Frequency extender compatible	Yes; CobaltFx (2 ports)
Frequency range	100 kHz to 20 GHz
Full CW Frequency	$\pm 2 \times 10^{-6}$
Frequency setting resolution	1 Hz
Number of measurement points	2 to 500,001
Measurement bandwidths with 1/1.5/2/3/5/7 steps	1 Hz to 2 MHz
Dynamic range	
100 kHz to 1 MHz; 1 Hz IF BW	120 dB
1 MHz to 20 GHz; 1 Hz IF BW	143 dB/130 dB, typ.
Time per point (Typ.)	12 µsec
Port switchover time (Typ.)	0.2 msec

Cobalt C4420

Impedance	50 Ohm
Test port connector	NMD 3.5 mm Male
Number of test ports	4
Frequency extender compatible	Yes; CobaltFx (4 ports)
Frequency range	100 kHz to 20 GHz
Full CW Frequency	$\pm 2 \times 10^{-6}$
Frequency setting resolution	1 Hz
Number of measurement points	2 to 500,001
Measurement bandwidths with 1/1.5/2/3/5/7 steps	1 Hz to 2 MHz
Dynamic range	
100 kHz to 1 MHz; 1 Hz IF BW	120 dB
1 MHz to 20 GHz; 1 Hz IF BW	143 dB/130 dB, typ.
Time per point (Typ.)	12 µsec
Port switchover time (Typ.)	0.2 msec

[1] All specifications subject to change without notice. [3] At 23 ° C +/- 5 ° C after 1 hour warm-up and calibration. Assuming ideal RF and LO cables

Technology is supposed to move. It's supposed to change and update and progress. It's not meant to sit stagnant year after year simply because that's how things have always been done.

The engineers at Copper Mountain Technologies are creative problem solvers. They know the people using VNAs don't just need one giant machine in a lab. They know that VNAs are needed in the field, requiring portability and flexibility. Data needs to be quickly transferred, and a test setup needs to be easily automated and recalled for various applications. The engineers at Copper Mountain Technologies are rethinking the way VNAs are developed and used.

Copper Mountain Technologies' VNAs are designed to work with the Windows PC you already use via USB interface. After installing the test software, you have a top-quality VNA at a fraction of the cost of a traditional analyzer. The result is a faster, more effective test process that fits into the modern workspace. This is the creativity that makes Copper Mountain Technologies stand out above the crowd.

We're creative. We're problem solvers.

	FEV-15	FEV-12	FEV-10
System Operating Frequency	50 GHz-75 GHz	60 GHz-90 GHz	75 GHz-110 GHz
Test Port Output Power	5 dBm (Min.), 8 dBm (Typ.)	2 dBm (Min.), 5 dBm (Typ.)	0 dBm (Min.), 5 dBm (Typ.)
System Dynamic Range	110 dB (Min.), 120 dB (Typ.)	100 dB (Min.), 110 dB (Typ.)	100 dB (Min.), 110 dB (Typ.)

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