

# Extended Data Sheet

## Cobalt Series: 20 GHz



COPPER MOUNTAIN®  
TECHNOLOGIES



- **Frequency range:** 100kHz - 20 GHz
- **Wide output power range:** -60 dBm to +10 dBm
- **Dynamic range:** 135 dB (10 Hz IF bandwidth) typ.
- **Measurement time per point:** 12  $\mu$ s per point, min typ.
- **16 logical channels with 16 traces** each max.
- **Automation programming** in LabVIEW, Python, MATLAB, .NET, etc.
- 2- and 4-port models with **Direct Receiver Access** and **Frequency Extension** as available options
- **Time domain and gating** conversion included
- **Fixture simulation**
- **Frequency offset mode**, including vector mixer calibration measurements
- Up to **500,001 measurement points**
- Multiple **precision calibration** methods and automatic calibration

# Cobalt 20 GHz Product Series Specs<sup>1</sup>

## Measurement Accuracy<sup>3</sup>

Accuracy of transmission measurements <sup>4</sup>	Magnitude / Phase
100 kHz to 1 MHz	
-40 dB to 0 dB	$\pm 0.2$ dB / $\pm 2^\circ$
-60 dB to -40 dB	$\pm 0.3$ dB / $\pm 3^\circ$
-80 dB to -60 dB	$\pm 1.1$ dB / $\pm 7^\circ$
1 MHz to 20 GHz	
0 dB to 10 dB	$\pm 0.2$ dB / $\pm 2^\circ$
-60 dB to 0 dB	$\pm 0.1$ dB / $\pm 1^\circ$
-80 dB to -60 dB	$\pm 0.2$ dB / $\pm 2^\circ$
-100 dB to -80 dB	$\pm 1.0$ dB / $\pm 6^\circ$
Accuracy of reflection measurements <sup>5</sup>	Magnitude / Phase
100 kHz to 10 GHz	
-15 dB to 0 dB	$\pm 0.4$ dB / $\pm 3^\circ$
-25 dB to -15 dB	$\pm 1.0$ dB / $\pm 6^\circ$
-35 dB to -25 dB	$\pm 3.0$ dB / $\pm 20^\circ$
10 GHz to 20 GHz	
-15 dB to 0 dB	$\pm 0.5$ dB / $\pm 4^\circ$
-25 dB to -15 dB	$\pm 1.5$ dB / $\pm 10^\circ$
-35 dB to -25 dB	$\pm 5.5$ dB / $\pm 30^\circ$
Trace noise magnitude (IF bandwidth 3 kHz)	
100 kHz to 1 MHz	0.020 dB rms
1 MHz to 20 GHz	0.001 dB rms
Temperature dependence	0.02 dB/°C (0.01 dB/°C typ.)

## Effective System Data

<b>100 kHz to 1 MHz</b>	
Directivity	46 dB
Source match	40 dB
Load match	46 dB
Reflection tracking	$\pm 0.05$ dB
Transmission tracking	$\pm 0.20$ dB
<b>1 MHz to 10 GHz</b>	
Directivity	46 dB
Source match	40 dB
Load match	46 dB
Reflection tracking	$\pm 0.05$ dB
Transmission tracking	$\pm 0.05$ dB
<b>10 GHz to 20 GHz</b>	
Directivity	42 dB
Source match	38 dB
Load match	42 dB
Reflection tracking	$\pm 0.10$ dB
Transmission tracking	$\pm 0.05$ dB

## Test Port Output

Power range	-60 dBm to +10 dBm
Power accuracy	$\pm 1.5$ dB
Power resolution	0.05 dB
Harmonic distortion <sup>6</sup>	-25 dBc
Non-harmonic spurious <sup>6</sup>	-30 dBc

## Measurement Speed

Time per point	12 $\mu$ s typ.	
Port switchover time	0.2 ms typ.	
Typical cycle time vs number of measurement points <sup>7</sup>		
Number of points (IF bandwidth 1 MHz)	Uncorrected	2-port calibration
51	2.3 ms	4.4 ms
201	4.2 ms	8.2 ms
401	6.5 ms	12.8 ms
1601	20.5 ms	40.8 ms

## Frequency Reference Input

Port	10 MHz Ref In
External reference frequency	10 MHz
Input level	-2 dBm to 4 dBm
Input impedance	50 Ohm
Connector type	BNC, female

## Frequency Reference Output

Port	10 MHz Ref Out
Internal reference frequency	10 MHz
Output reference signal level at 50 Ohm impedance	0 dBm to 2 dBm
Connector type	BNC, female

[1] All specifications subject to change without notice. [3] Reflection and transmission measurement accuracy applies over the temperature range of (73  $\pm$  9) °F or (23  $\pm$  5) °C after 40 minutes of warming-up, with less than 1 °C deviation from the full two-port calibration temperature, at output power of 0 dBm. Frequency points have to be identical for measurement and calibration (no interpolation allowed). [4] Transmission specifications are based on a matched DUT, and IF bandwidth of 1 Hz. [5] Reflection specifications are based on an isolating DUT. [6] Specification applies over frequency range from 1 MHz to 20 GHz, at output power of -5 dBm. [7] Display Update: OFF. © Copper Mountain Technologies - www.coppermountaintech.com - Rev. 2022Q2

# Cobalt 20 GHz Product Series Specs<sup>1</sup>

## Trigger Input

Port	Ext Trig In
Input level	
Low threshold voltage	0.8 V
High threshold voltage	2.7 V
Input level range	0 to + 5 V
Pulse width	≥2 μs
Polarity	positive or negative
Input impedance	≥10 kOhm
Connector type	BNC, female

## Trigger Output

Port	Ext Trig Out
Maximum output current	20 mA
Output level	
Low level voltage	0.4 V
High level voltage	3.0 V
Polarity	positive or negative
Connector type	BNC, female

## Aux Ports (Optional)

Port	AUX In1, AUX In2
DC voltage range	±1 V, or ±10 V selectable
Measurement accuracy	
±1 V input	1 % ± 1 mV
±10 V input	1 % ± 10 mV
Input impedance	≥10 kOhm
Damage voltage	30 V
Number of ports	2
Connector type	BNC, female

## Calibration

Recommended Factory Adjustment Interval	3 Years
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## Environmental Specifications

Operating temperature	+5 °C to +40 °C (41 °F to 104 °F)
Storage temperature	-50 °C to +70 °C (-58 °F to 158 °F)
Humidity	90 % at 25 °C (77 °F)
Atmospheric pressure	70.0 kPa to 106.7 kPa

# C1220 Specifications<sup>1</sup>

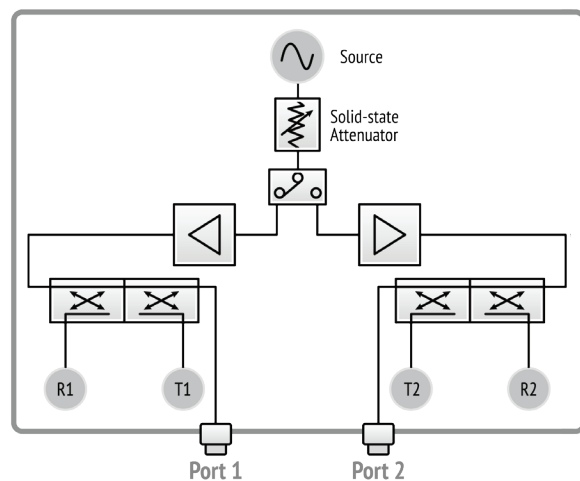
## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	2 ports
Direct Access (Source, Ref, and Meas)	No
Frequency extender compatible	No
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 1 MHz
Dynamic range <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	133 dB (135 dB typ.)

## Uncorrected System Performance

<b>100 kHz to 1 MHz</b>	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
<b>1 MHz to 10 GHz</b>	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
<b>10 GHz to 20 GHz</b>	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Block Diagram of Cobalt C1220



## Test Port Input

<b>Noise floor</b>	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-133 dBm/Hz
<b>Damage level</b>	+26 dBm
<b>Damage DC voltage</b>	35 V

## System & Power

<b>Operating system</b>	Windows 7 and above
<b>CPU frequency</b>	1.5 GHz
<b>RAM</b>	1 GB
<b>Interface</b>	USB 2.0
<b>Connector type</b>	USB B
<b>Power supply</b>	100-253 V, 50/60 Hz
<b>Power consumption</b>	110 W

## Dimensions

<b>Length</b>	430 mm
<b>Width</b>	440 mm
<b>Height</b>	140 mm
<b>Weight</b>	14 kg (494 oz)

[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - [www.coppermountaintech.com](http://www.coppermountaintech.com) - Rev. 2022Q2

# C2220 Specifications<sup>1</sup>

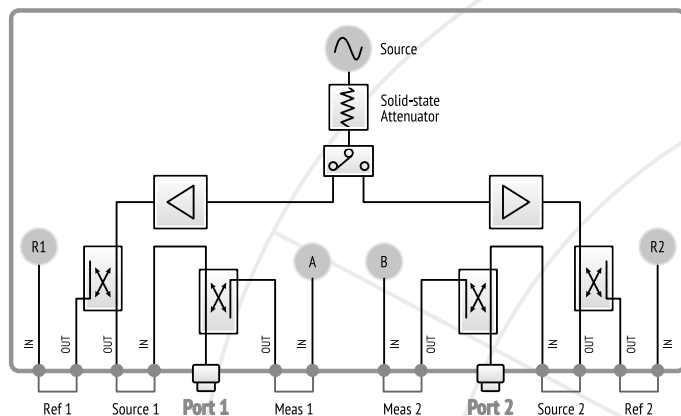
## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	2
Direct access	Source, Ref, and Meas
Frequency extender compatible	No
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 1 MHz
Dynamic range <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	130 dB (135 dB typ.)

## Uncorrected System Performance

<b>100 kHz to 1 MHz</b>	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
<b>1 MHz to 10 GHz</b>	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
<b>10 GHz to 20 GHz</b>	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Block Diagram of Cobalt C2220



## Test Port Input

<b>Noise floor</b>	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-130 dBm/Hz
<b>Damage level</b>	+26 dBm
<b>Damage DC voltage</b>	35 V
<b>Direct receiver access ports</b>	
Maximum operating input power level	
Ref	-5 dBm
Source	10 dBm
Meas	-5 dBm
<b>Damage level</b>	
Ref	13 dBm
Source	26 dBm
Meas	13 dBm
<b>Damage DC voltage</b>	
Ref	0 V
Source	35 V
Meas	0 V

## System & Power

<b>Operating system</b>	Windows 7 and above
<b>CPU frequency</b>	1.5 GHz
<b>RAM</b>	1 GB
<b>Interface</b>	USB 2.0
<b>Connector type</b>	USB B
<b>Power supply</b>	100-253 V, 50/60 Hz
<b>Power consumption</b>	110 W

## Dimensions

<b>Length</b>	430 mm
<b>Width</b>	440 mm
<b>Height</b>	140 mm
<b>Weight</b>	14 kg (494 oz)

[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - www.coppermountaintech.com - Rev. 2022Q2

# C4220 Specifications<sup>1</sup>

## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	2
Direct access	No
Frequency extender compatible	CobaltFx (2 ports)
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	133 dB (135 dB typ.)

## Uncorrected System Performance

100 kHz to 1 MHz	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
1 MHz to 10 GHz	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
10 GHz to 20 GHz	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Test Port Input

Noise floor	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-133 dBm/Hz
Damage level	+26 dBm
Damage DC voltage	35 V

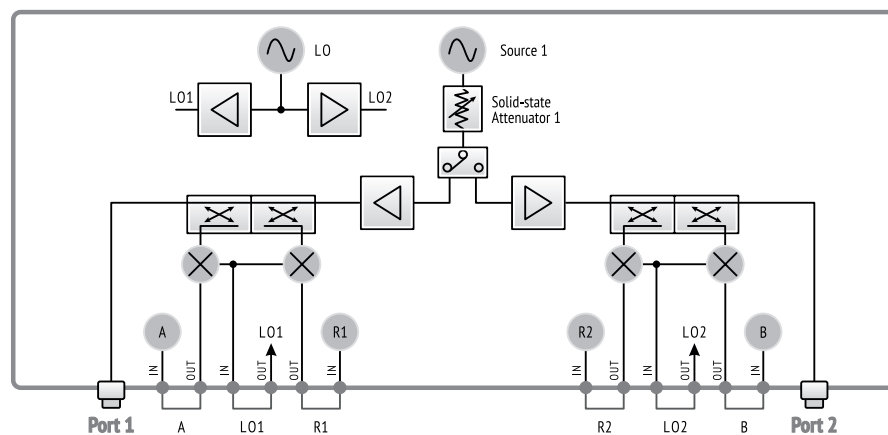
## System & Power

Operating system	Windows 7 and above
CPU frequency	1.5 GHz
RAM	1 GB
Interface	USB 2.0
Connector type	USB B
Power supply	100-253 V, 50/60 Hz
Power consumption	145 W

## Dimensions

Length	430 mm
Width	440 mm
Height	140 mm
Weight	14 kg (494 oz)

## Block Diagram of Cobalt C4220



[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - www.coppermountaintech.com - Rev. 2022Q2

# C1420 Specifications<sup>1</sup>

## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	4
Direct access	No
Frequency extender compatible	No
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	133 dB (135 dB typ.)

## Uncorrected System Performance

<b>100 kHz to 1 MHz</b>	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
<b>1 MHz to 10 GHz</b>	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
<b>10 GHz to 20 GHz</b>	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Test Port Input

Noise floor	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-133 dBm/Hz
Damage level	+26 dBm
Damage DC voltage	35 V

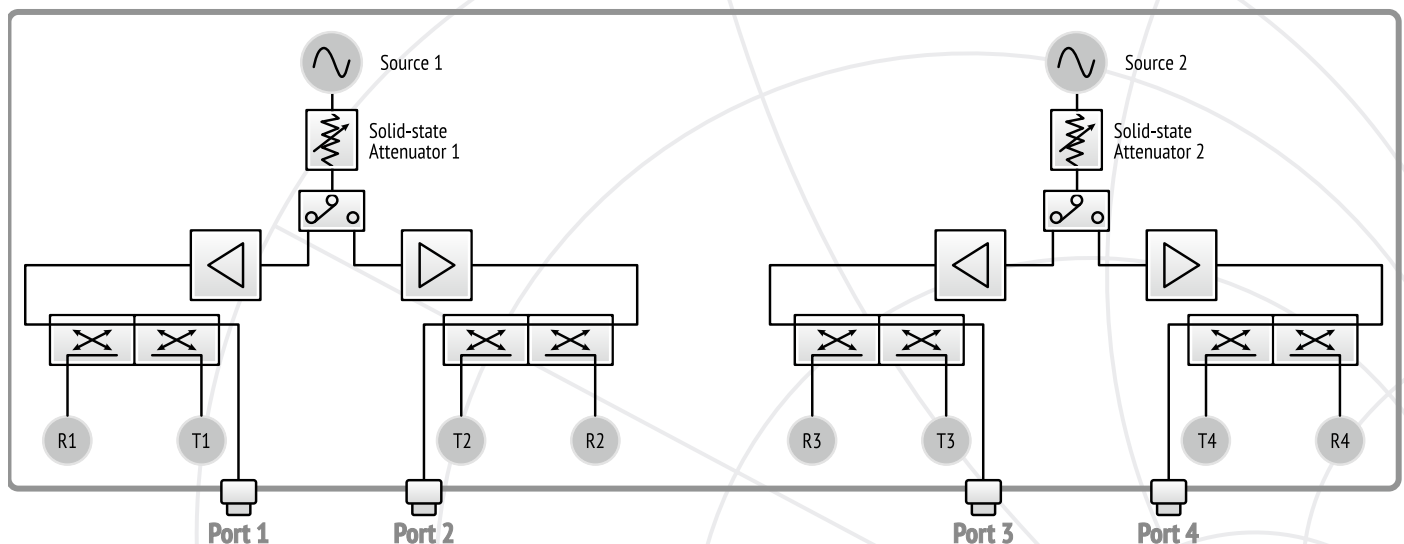
## System & Power

Operating system	Windows 7 and above
CPU frequency	1.5 GHz
RAM	1 GB
Interface	USB 2.0
Connector type	USB B
Power supply	100-253 V, 50/60 Hz
Power consumption	200 W

## Dimensions

Length	600 mm
Width	440 mm
Height	140 mm
Weight	22 kg (776 oz)

## Block Diagram of Cobalt C1420



[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - www.coppermountaintech.com - Rev. Rev. 2022Q2

# C2420 Specifications<sup>1</sup>

## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	4
Direct access	Source, Ref, and Meas
Frequency extender compatible	No
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	130 dB (135 dB typ.)

## Uncorrected System Performance

<b>100 kHz to 1 MHz</b>	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
<b>1 MHz to 10 GHz</b>	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
<b>10 GHz to 20 GHz</b>	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Test Port Input

<b>Noise floor</b>	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-130 dBm/Hz
<b>Damage level</b>	
+26 dBm	
<b>Damage DC voltage</b>	
35 V	
<b>Direct receiver access ports</b>	
Maximum operating input power level	
Ref	-5 dBm
Source	10 dBm
Meas	-5 dBm
Damage level	
Ref	13 dBm
Source	26 dBm
Meas	13 dBm
Damage DC voltage	
Ref	0 V
Source	35 V
Meas	0 V

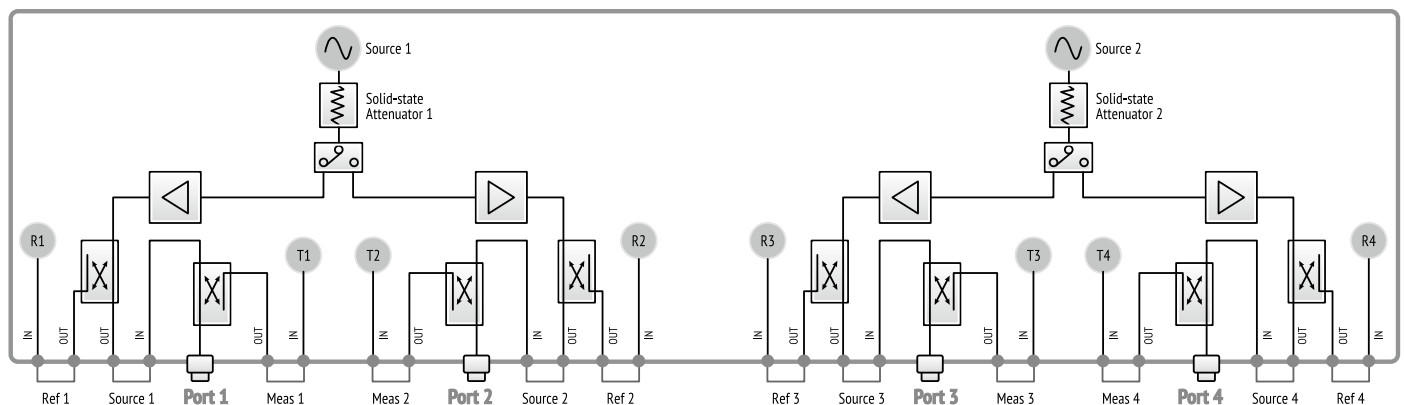
## System & Power

Operating system	Windows 7 and above
CPU frequency	1.5 GHz
RAM	1 GB
Interface	USB 2.0
Connector type	USB B
Power supply	100-253 V, 50/60 Hz
Power consumption	200 W

## Dimensions

Length	600 mm
Width	440 mm
Height	140 mm
Weight	22 kg (776 oz)

## Block Diagram of Cobalt C2420



[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - www.coppermountaintech.com - Rev. 2022Q2



# C4420 Specifications<sup>1</sup>

## Primary Specifications

Impedance	50 Ohm
Test port connector	NMD 3.5 mm, male
Number of test ports	4
Direct access	No
Frequency extender compatible	CobaltFx (4 ports)
Frequency range	100 kHz to 20.0 GHz
Full frequency accuracy	$\pm 2 \cdot 10^{-6}$
Frequency 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 <sup>2</sup>	
100 kHz to 1 MHz	110 dB
1 MHz to 20 GHz	133 dB (135 dB typ.)

## Uncorrected System Performance

<b>100 kHz to 1 MHz</b>	
Directivity	10 dB
Source match	10 dB
Load match	10 dB
<b>1 MHz to 10 GHz</b>	
Directivity	20 dB
Source match	15 dB
Load match	15 dB
<b>10 GHz to 20 GHz</b>	
Directivity	15 dB
Source match	15 dB
Load match	15 dB

## Test Port Input

<b>Noise floor</b>	
100 kHz to 1 MHz	-110 dBm/Hz
1 MHz to 20 GHz	-133 dBm/Hz
<b>Damage level</b>	+26 dBm
<b>Damage DC voltage</b>	35 V

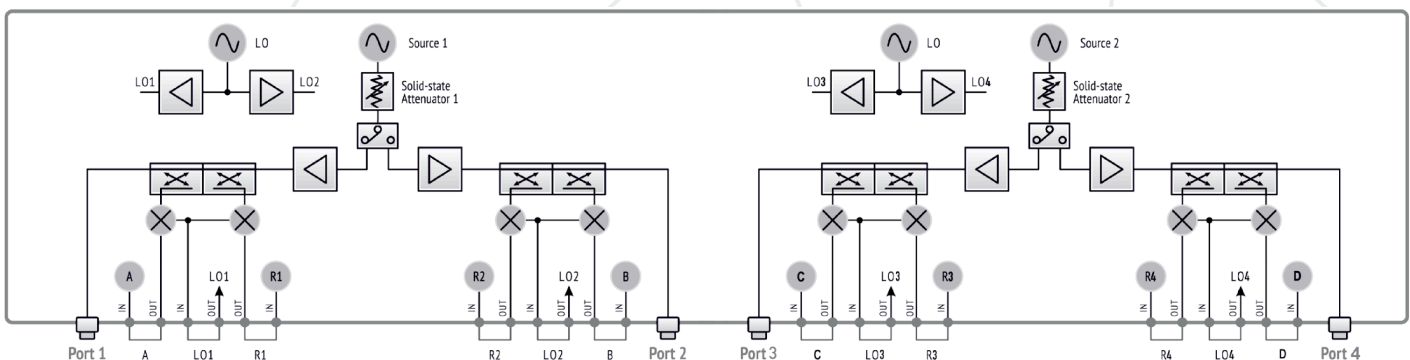
## System & Power

<b>Operating system</b>	Windows 7 and above
<b>CPU frequency</b>	1.5 GHz
<b>RAM</b>	1 GB
<b>Interface</b>	USB 2.0
<b>Connector type</b>	USB B
<b>Power supply</b>	100-253 V, 50/60 Hz
<b>Power consumption</b>	270 W

## Dimensions

<b>Length</b>	600 mm
<b>Width</b>	440 mm
<b>Height</b>	140 mm
<b>Weight</b>	22 kg (776 oz)

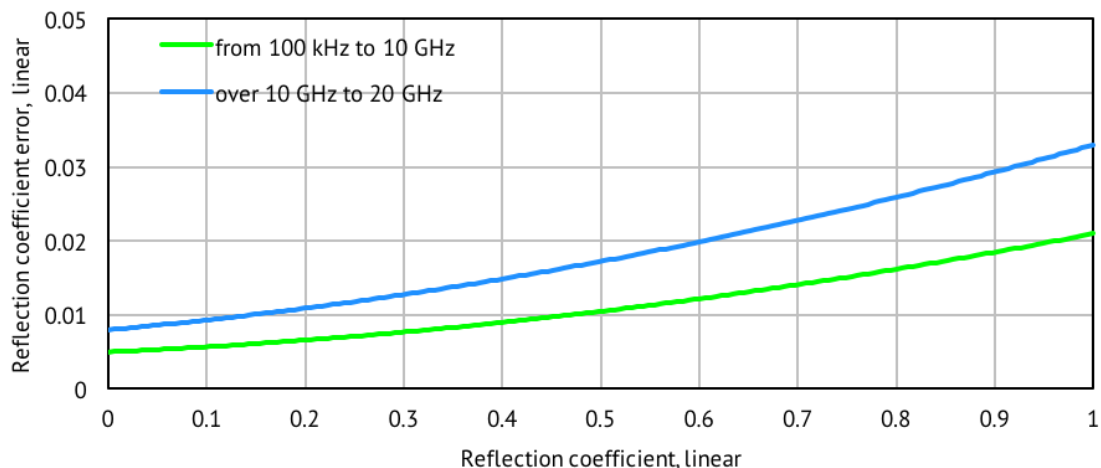
## Block Diagram of Cobalt C4420



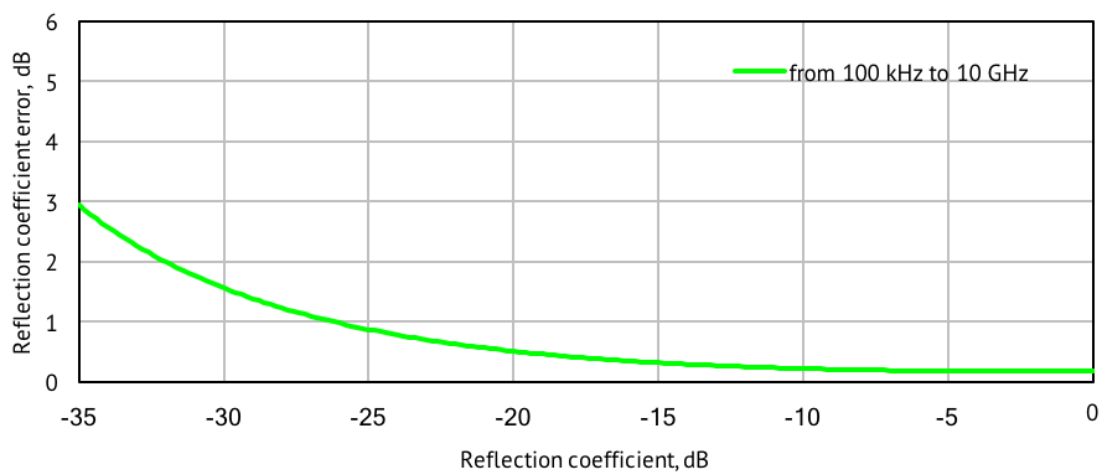
[1] All specifications subject to change without notice. [2] The dynamic range is defined as the difference between the specified maximum power level and the specified noise floor. The specification applies at 10 Hz IF bandwidth. © Copper Mountain Technologies - [www.coppermountaintech.com](http://www.coppermountaintech.com) - Rev. 2022Q2

# Reflection Accuracy Plots

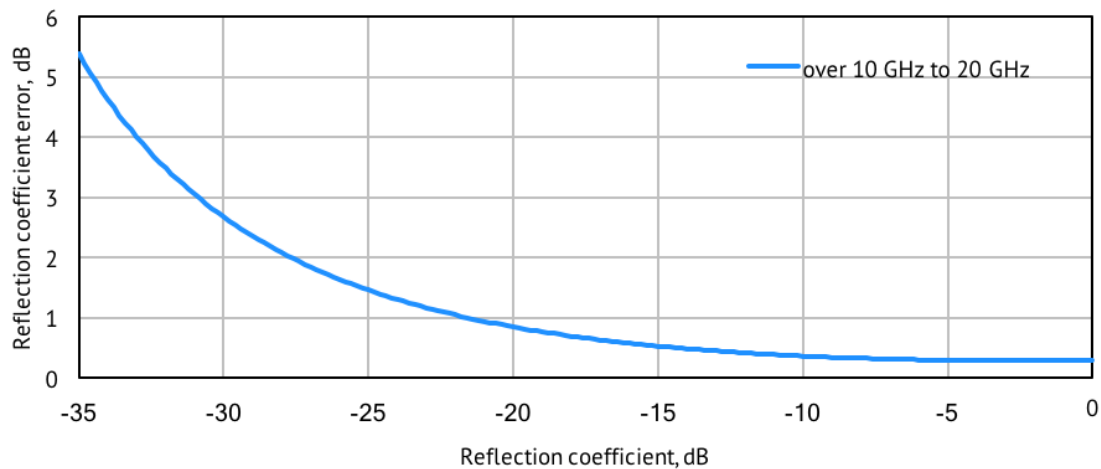
## Reflection Magnitude Errors



Specifications are based on isolating DUT ( $S_{21} = S_{12} = 0$ )



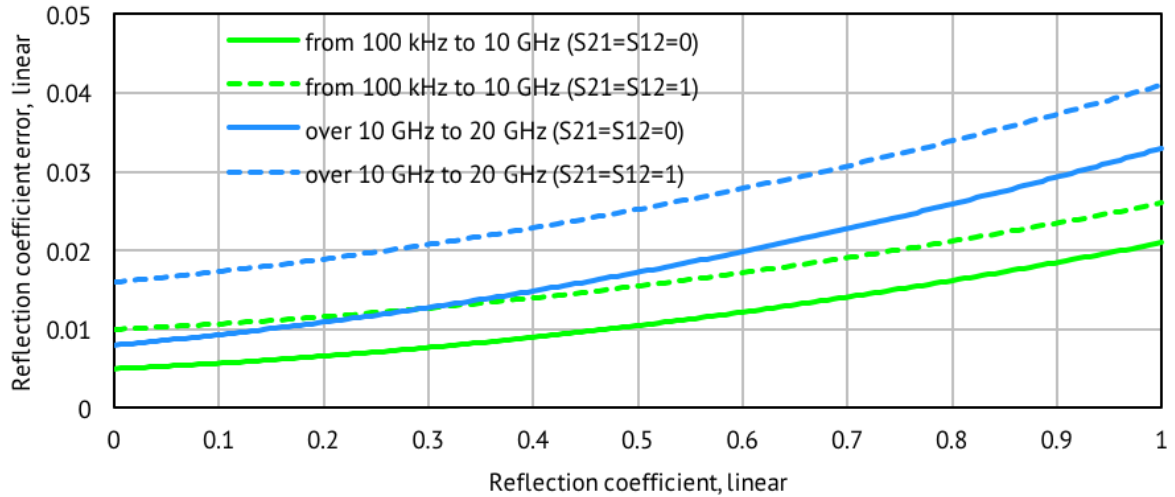
Specifications are based on isolating DUT ( $S_{21} = S_{12} = 0$ )



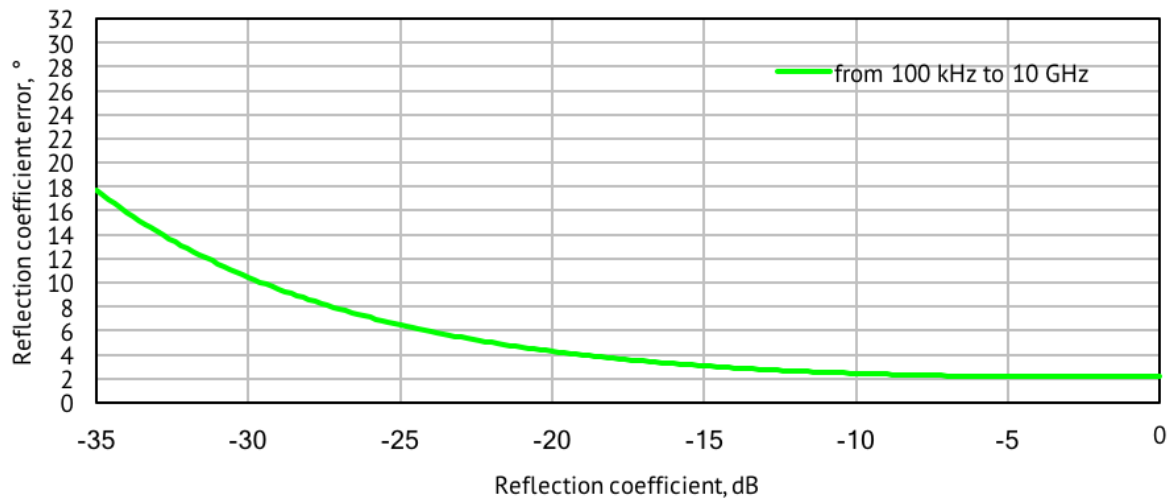
Specifications are based on isolating DUT ( $S_{21} = S_{12} = 0$ )

# Reflection Accuracy Plots

## Reflection Magnitude Errors



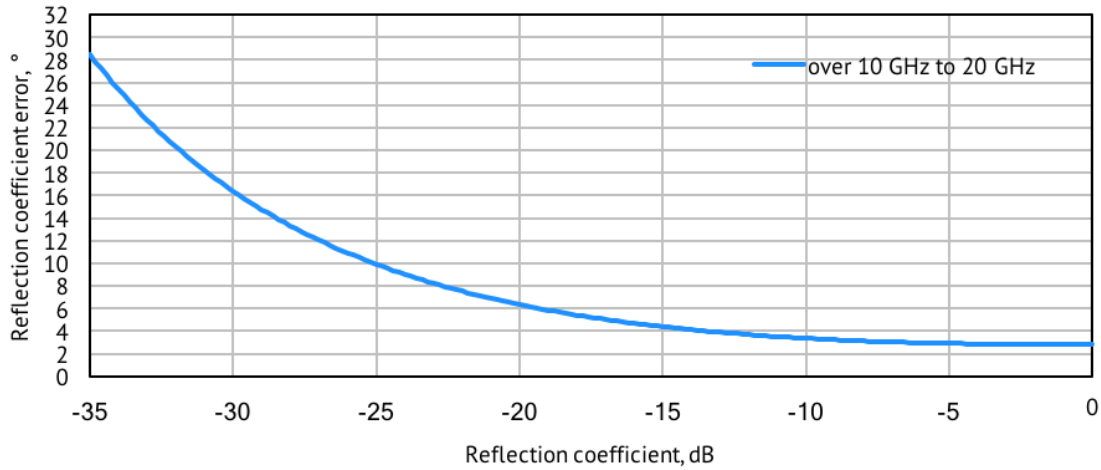
## Reflection Phase Errors



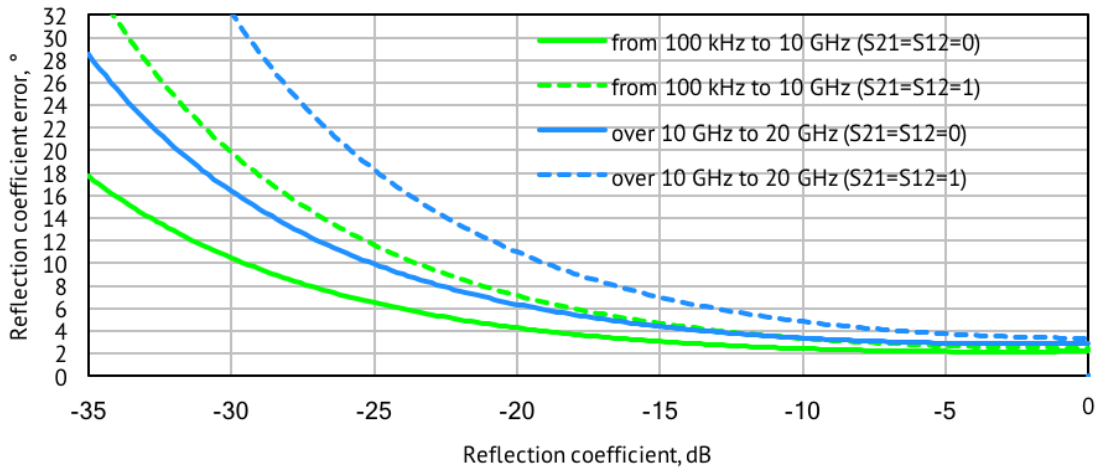
Specifications are based on isolating DUT ( $S_{21} = S_{12} = 0$ )

# Reflection/Transmission Accuracy Plots

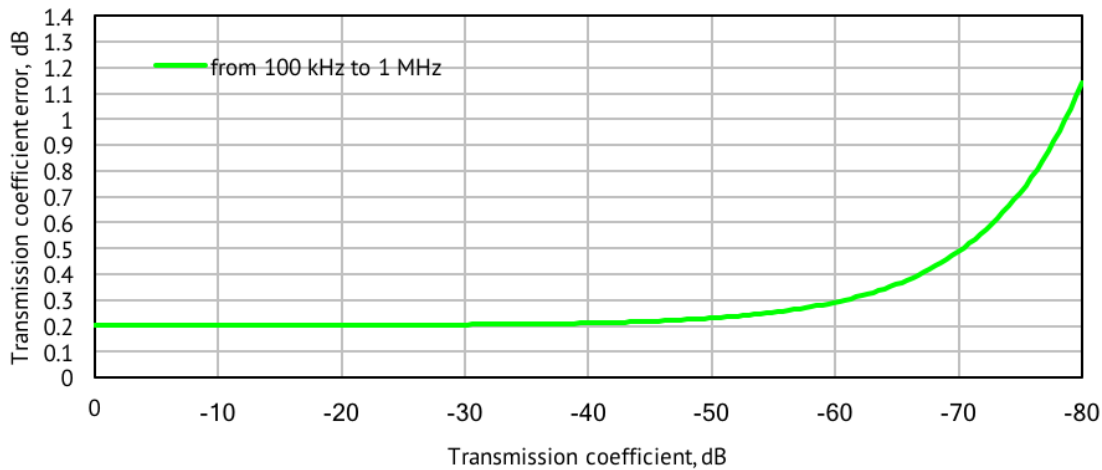
## Reflection Phase Errors



Specifications are based on isolating DUT ( $S_{21} = S_{12} = 0$ )



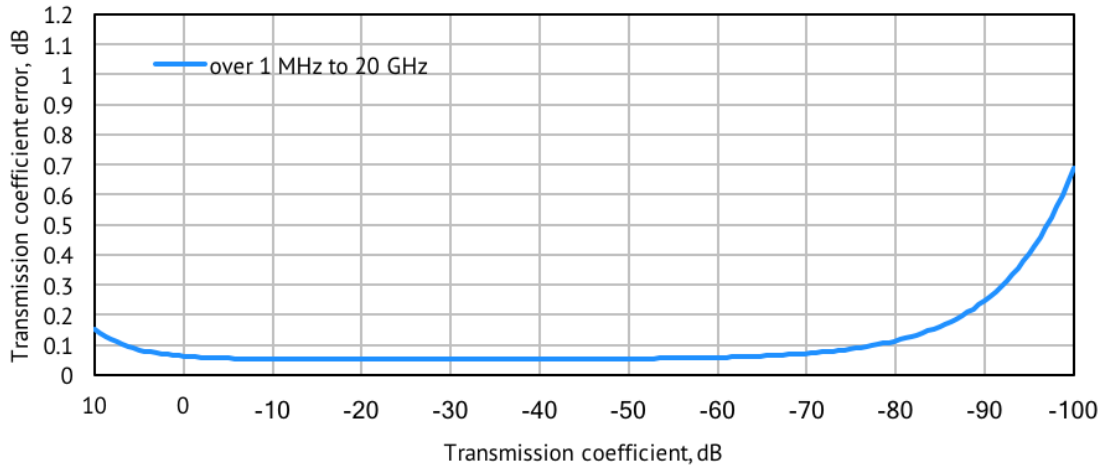
## Transmission Magnitude Errors



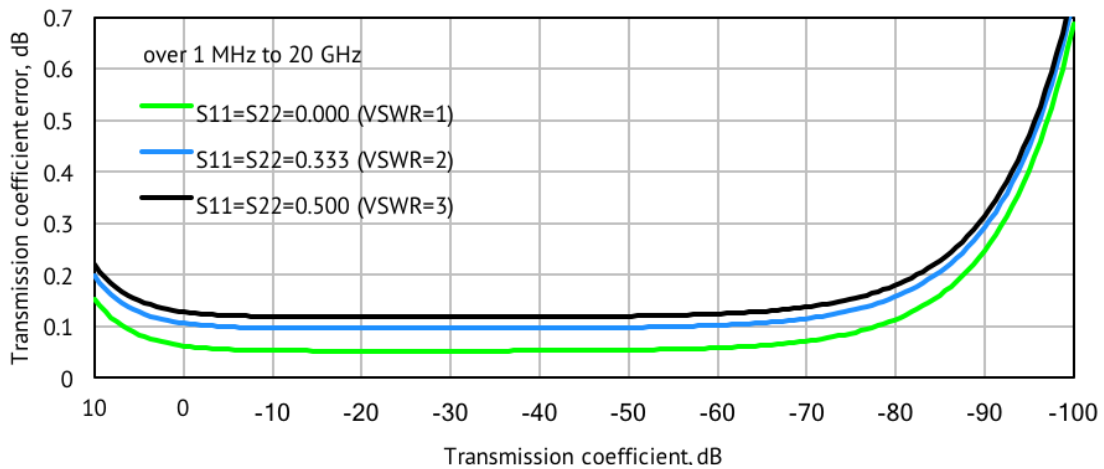
Specifications are based on matched DUT, and IF bandwidth of 1 Hz

# Transmission Accuracy Plots

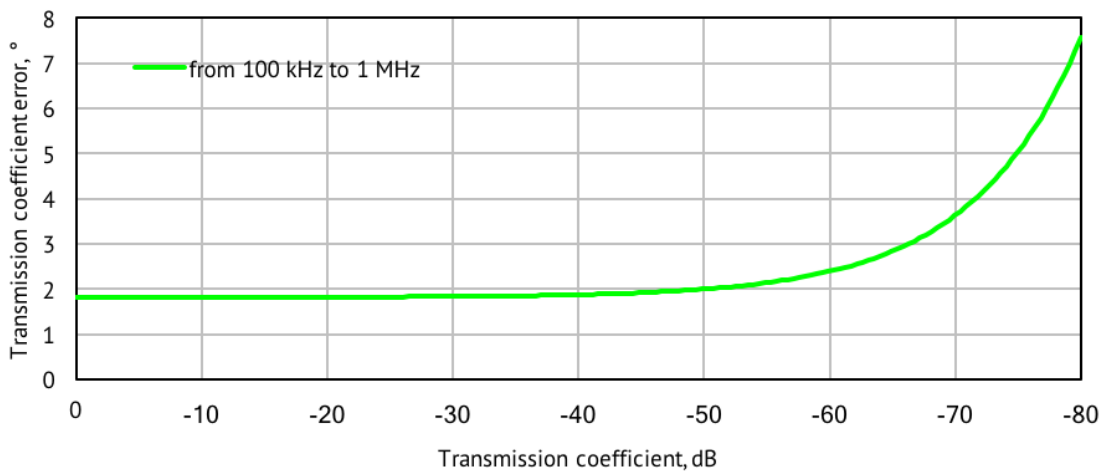
## Transmission Magnitude Errors



Specifications are based on matched DUT, and IF bandwidth of 1 Hz



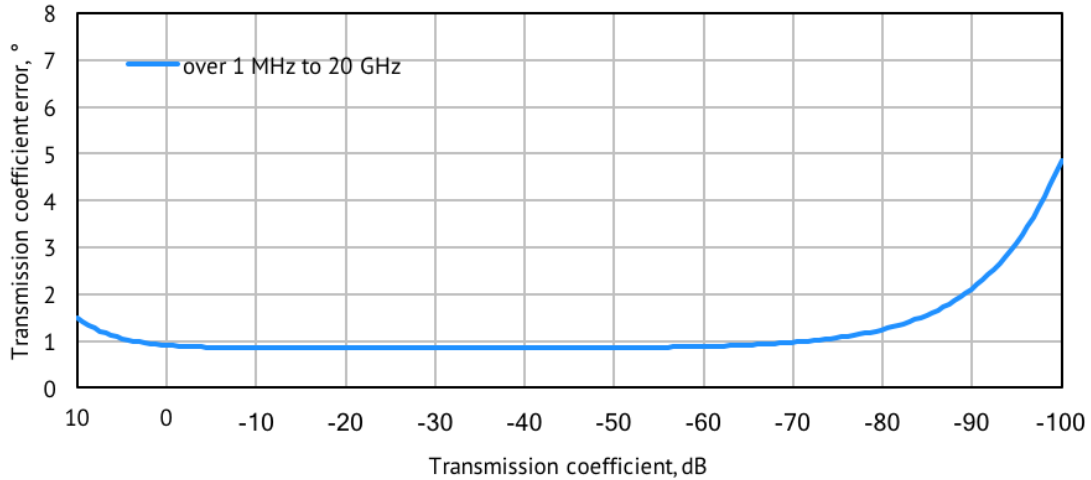
## Transmission Phase Errors



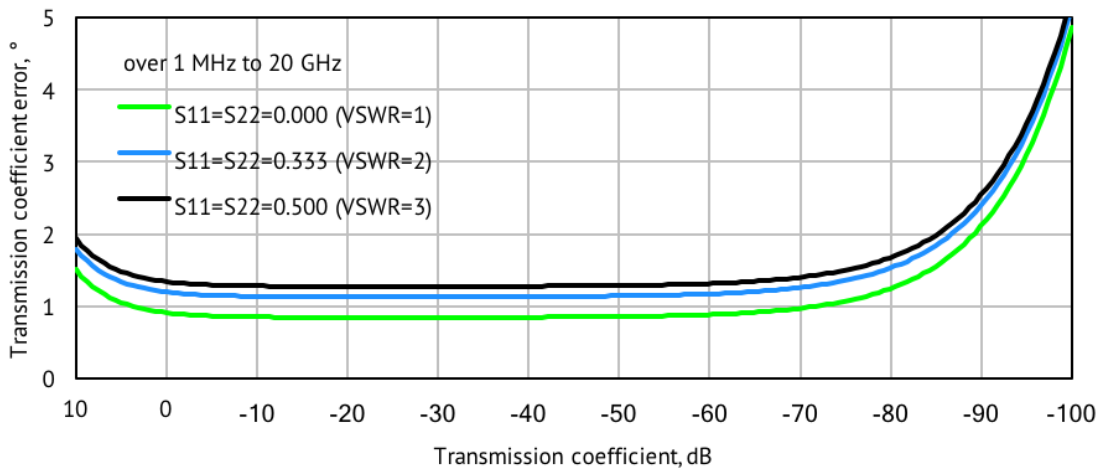
Specifications are based on matched DUT, and IF bandwidth of 1 Hz

# Transmission Accuracy Plots

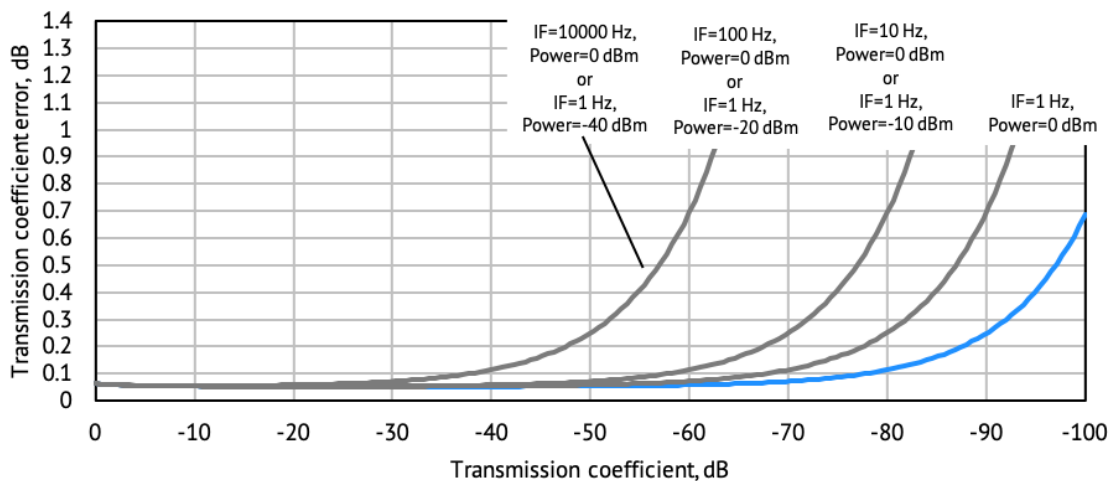
## Transmission Phase Errors



Specifications are based on matched DUT, and IF bandwidth of 1 Hz



## Transmission errors for matched devices vs. output power and IF Bandwidth





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 or Linux 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.*



## Cobalt Series Overview: 9 GHz

	C1209	C2209	C4209	C1409	C2409	C4409
Frequency Range	100 kHz to 9 GHz	100 kHz to 9 GHz	100 kHz to 9 GHz	100 kHz to 9 GHz	100 kHz to 9 GHz	100 kHz to 9 GHz
Number of Ports	2	2	2	4	4	4
Additional Features		Direct Receiver Access	Frequency Extension		Direct Receiver Access	Frequency Extension

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