

# DATASHEET APVSG(-X) Specification V1.29

Single- and Multi-Channel Ultra-Agile Vector Signal Generators

Models up to 4, 6, 12, 20, and 40 GHz



Document size:

1 title page  
32 content pages

## DEFINITIONS

- The specifications in the following pages describe the warranted performance of the instrument for  $23 \pm 5$  °C after a 30-minute warm-up period.

**Typical:** Expected mean values, not warranted performance

**Min and max:** Parameter range that is guaranteed by product design, and/or production tested. Warranted performance specifications include guard-bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

## INTRODUCTION

### • Ultra-Agile Vector Signal Generator

The APVSG is an ultra-fast-switching vector-modulated signal generator series covering continuous frequency ranges from 10 MHz to 4, 6, 12, 20, or 40 GHz, respectively, with 0.001 Hz resolution, and 400 MHz RF modulation bandwidth.

The APVSG-X is the corresponding multi-channel product series – up to 4 channels per device.

A high performance internal I/Q modulator enables customized waveforms as modulation signals and supports variety of modulation schemes including avionics modulation. The digital I/Q modulator ensures excellent carrier suppression and a very high image suppression.

The standard APVSG enables ultra-fast CW frequency sweeping, chirping, intra-pulse modulation, pulse shaping with very low phase noise.

Among others, the following use cases are supported:

- Upload multiple formats of I/Q Data into APVSG Memory. An APVSG GUI supports data formats from various vendors. The internal RAM can store up to 512 MS (32 bits per I/Q sample) of I/Q data. The APVSG internal AWG can play selected sections of the RAM upon a user trigger.
- Use APVSG to synthesize and play predefined digital modulation formats (option IVM)
- Use the analog I & Q inputs (option AIQ) with up to 50 MHz analog bandwidth.
- Use FCP interface (option FCP) to:
  - live stream digital I/Q data.
  - instantaneously switch between pre-loaded I/Q data segments.
  - control for ultra-fast frequency hopping (additionally, option UFS required).

All APVSGs operate with an ultra-stable temperature compensated frequency reference (OCXO) that can be phase-locked to an external reference.

The compact device can be controlled by the touch display and a PC user interface.

# FACTS & FIGURES & SPECIFICATIONS

## RF Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Range	100 kHz			Option 100K
	10 MHz		4 GHz 6 GHz 12 GHz 20 GHz 40 GHz	APVSG04 APVSG06 APVSG12 APVSG20 APVSG40
Settable Frequency Range	100 kHz			Option 100K
	10 MHz		4.15 GHz 6.6 GHz 12 GHz 20 GHz 43.5 GHz	APVSG04 APVSG06 APVSG12 APVSG20 APVSG40
Frequency Resolution		0.001 Hz		
Phase Resolution		0.01 deg		
Frequency & Amplitude Switching Time		1.5 ms 500 μs <100 ns <1 μs <2 μs		valid signal after SCPI received List sweep within 400 MHz BW, Option UFS APVSG04, Option UFS APVSG20 & APVSG40, Option UFS
<b>Output Power Level APVSG</b>				
100 kHz to 10 MHz	-20 dBm		+15 dBm	Option 100K
<b>Output Power Level APVSG04</b>				
10 to 100 MHz	-20 dBm		+15 dBm	Option PE4 Option PE2 Option PE
	-55 dBm		+13 dBm	
	-90 dBm		+13 dBm	
	-120 dBm		+13 dBm	
0.1 to 4 GHz	-20 dBm		+18 dBm	Option PE4 Option PE2 Option PE
	-55 dBm		+17 dBm	
	-90 dBm		+17 dBm	
	-120 dBm		+17 dBm	
<b>Output Power Level APVSG06</b>				
10 to 100 MHz	-20 dBm		+15 dBm	Option PE4 Option PE Option PE2
	-55 dBm		+13 dBm	
	-90 dBm		+13 dBm	
	-120 dBm		+13 dBm	
0.1 to 6 GHz	-20 dBm		+15 dBm	Option PE4 Option PE Option PE2
	-55 dBm		+15 dBm	
	-90 dBm		+15 dBm	
	-120 dBm		+15 dBm	
<b>Output Power Level APVSG12</b>				
10 to 100 MHz	-20 dBm		+15 dBm	Option PE4 Option PE Option PE2
	-65 dBm		+13 dBm	
	-90 dBm		+13 dBm	
	-120 dBm		+13 dBm	
0.1 to 12 GHz	-20 dBm		+15 dBm	Option PE4 Option PE Option PE2
	-55 dBm		+15 dBm	
	-90 dBm		+15 dBm	
	-120 dBm		+15 dBm	
<b>Output Power Level APVSG20</b>				
10 to 100 MHz	-20 dBm		+15 dBm	Option PE Option PE2
	-90 dBm		+15 dBm	
	-120 dBm		+15 dBm	
0.1 to 20 GHz	-20 dBm		+17 dBm	Option PE Option PE2
	-90 dBm		+16 dBm	
	-120 dBm		+16 dBm	
<b>Output Power Level APVSG40</b>				

10 to 100 MHz	-20 dBm -90 dBm -120 dBm		+15 dBm +15 dBm +15 dBm	Option PE Option PE2
0.1 to 20 GHz	-20 dBm -90 dBm -120 dBm		+17 dBm +16 dBm +16 dBm	Option PE Option PE2
20 to 26 GHz	-20 dBm -90 dBm -120 dBm		+16 dBm +15 dBm +14 dBm	Option PE Option PE2
26 to 40 GHz	-20 dBm -90 dBm -120 dBm		+15 dBm +13 dBm +12 dBm	Option PE Option PE2
<b>Power Resolution</b>		0.01 dB		
<b>Power Level Uncertainty</b>				See Figure 5
<4 GHz		0.25 dB	0.7 dB	>-20dBm
4 to 6 GHz		0.3 dB	1.0 dB	
6 to 20 GHz		0.3 dB	1.3 dB	
20 to 40 GHz			1.5 dB	
<4 GHz		0.3 dB	0.8 dB	Pmin to -20 dBm
4 to 6 GHz		0.35 dB	1.2 dB	
6 to 20 GHz		0.4 dB	1.4 dB	
20 to 40 GHz		0.5 dB	1.6 dB	
<b>Reverse Power Protection</b>				
DC Voltage			±10 V	
RF Power			26 dBm	
<b>Output Impedance</b>		50 Ω		
VSWR		1.8		See Figure 20
<b>SSB Phase Noise at 1 GHz , 10 dBm</b>				See Figures 1, 2
at 10 Hz from Carrier		-87 dBc/Hz -98 dBc/Hz	-84 dBc/Hz	Option LN
at 1 kHz from Carrier		-130 dBc/Hz		
at 20 kHz from Carrier		-145 dBc/Hz		
at 100 kHz from Carrier		-150 dBc/Hz		
<b>SSB Phase Noise at 4 GHz , 10 dBm</b>				See Figures 1, 2
at 10 Hz from Carrier		-74 dBc/Hz -90 dBc/Hz	-74 dBc/Hz	Option LN
at 1 kHz from Carrier		-121 dBc/Hz		
at 20 kHz from Carrier		-133 dBc/Hz		
at 100 kHz from Carrier		-138 dBc/Hz		
<b>APVSG20G &amp; APVSG40G</b>				
<b>SSB Phase Noise at 10 GHz, 10 dBm</b>				See Figures 1, 2
at 10 Hz from Carrier		-66 dBc/Hz -76 dBc/Hz	-65 dBc/Hz	Option LN
at 1 kHz from Carrier		-104 dBc/Hz		
at 20 kHz from Carrier		-115 dBc/Hz		
at 10 MHz from Carrier		-118 dBc/Hz		
<b>SSB Phase Noise at 20 GHz, 10 dBm</b>				See Figures 1, 2
at 10 Hz from Carrier		-60 dBc/Hz -70 dBc/Hz	-59 dBc/Hz	Option LN
at 1 kHz from Carrier		-104 dBc/Hz		
at 20 kHz from Carrier		-115 dBc/Hz		
at 10 MHz from Carrier		-118 dBc/Hz		
<b>Harmonics @ 0 dBm</b>				
0.01 to 2 GHz		-55 dBc	-48 dBc	<b>APVSG4</b>
2 to 4 GHz		-45 dBc	-40 dBc	
<b>Harmonics @ 0 dBm</b>				<b>APVSG6 &amp; APVSG12</b>
0.01 to 4 GHz		-45 dBc	-40 dBc	
4 to 7 GHz		-35 dBc	-30 dBc	
7 to 12 GHz		-55 dBc	-50 dBc	
<b>Harmonics @ 0 dBm</b>		-50 dBc	-45 dBc	<b>APVSG20</b>

0.01 to 4.5 GHz 4.5 to 10.5 GHz >10.5 GHz		-40 dBc -55 dBc	-35 dBc -48 dBc	
<b>Harmonics @ 0 dBm</b> 0.01 to 4.5 GHz 4.5 to 20 GHz >20 GHz		-50 dBc -35 dBc -35 dBc	-45 dBc -30 dBc -30 dBc	<b>APVSG40</b>
<b>Non-Harmonic Spurious</b> (at 0 dBm Output, > 10 kHz Offset)		-90 dBc -80 dBc -80 dBc -70 dBc -60 dBc -55 dBc	-75 dBc -70 dBc -55 dBc -50 dBc -50 dBc -45 dBc	< 1.2 GHz 1.2 to 2.5 GHz 2.5 to 4 GHz 4 to 12 GHz 12 to 20 GHz > 20 GHz

## I/Q Modulator

PARAMETER	MIN	TYPICAL	MAX	NOTE
RF modulation bandwidth		400 MHz		
I/Q Frequency Response over full I/Q Bandwidth		<±1.0 dB <±2.0 dB <±3.5 dB		< 10 GHz 10 to 30 GHz 30 to 40 GHz
Carrier Leakage		-90 dBc	-70 dBc	
Image Sideband Rejection		-85 dBc	-65 dBc	

## Internal I/Q Baseband Generator

PARAMETER	MIN	TYPICAL	MAX	NOTE
Sample Resolution		16 bits		each I and Q
Clock Source		Internal		
Sample Rate	10 Hz		500 MHz	
Sample Rate Resolution		1 Hz		
Waveform length, Number of Samples	96 * 246 *		512 M 334 M	Marker signals active
<b>Segment Mode</b>				
Number of Segments	1		65k	
Segment Changeover	Seamless, immediate			
Trigger Modes	Same segment, next segment, addressed segment			
Sequencer Play List Length	1		2048	
Sequence Segment Repetitions	1		10 M	
Changeover Time		2 μs		500 MHz sample rate, after trigger event received, immediate segment changeover
<b>Arbitrary Trigger</b>				
Trigger Type	Normal, Next segment, next sequence			Check with Anapico support
Trigger Parameters	See chapter "Trigger Capability"			
External Trigger Event to RF Output Delay	0.5 μs +/-100 ns			500 MHz sample rate
<b>Marker Signals</b>				
Markers are defined during the waveform generation process.				
Number of Markers		4		
Type	Waveform			
Marker Delay Setting Range		tbd		
Marker Delay Setting Resolution		tbd		
Marker Duration Minimum Value		1 sample 4 samples		Sample rate ≤ 125 MHz Sample rate > 125 MHz
Marker Duration Variation			+/- 1 sample +/- 8 ns	Sample rate < 125 MHz Sample rate ≥ 125 MHz
Marker Jitter			+/- 1 sample +/- 8 ns	Sample rate < 125 MHz Sample rate ≥ 125 MHz
Marker Polarity	Normal, inverted			
Marker Output to RF Output Delay		tbd		

\* Shorter Waveforms will be automatically extended by cyclically repeating the waveform.

## Internal Vector Modulation (Option IVM)

PARAMETER	MIN	TYPICAL	MAX	NOTE
Modulation Schemes	8QAM, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM			
Symbol Rate	10 S/s		200 MS/s	
Filter Type	cosine, root cosine, gaussian, rectangular, dirac, rectangular asymmetric			
Filter Parameter Range	0.05 0.05		1 2.5	Cosine, Root Cosine (Parameter $\alpha$ ) Gaussian (Parameter B x T)
Data Source	PRBS generator, user data list, external real-time data			Optional, check with Anapico support
Data Lists	8 bits		256 Mbits	Optional, check with Anapico support

## Multicarrier Generation (Option IVM)

PARAMETER	MIN	TYPICAL	MAX	NOTE
Number of Carriers	1		1k	
Frequency Offset	-200 MHz		200 MHz	
Power Offset	-60 dB		0 dB	0.1 dB resolution
Tone Initial Phase Offset	0 deg		360 deg	0.1 deg resolution

## Avionics Modulation (Option AVIO)

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>AVIO Modulation DME</b>				
Operating Modes	interrogation & reply			
DME Channel	X, Y			
Frequency Range	960 MHz		1215 MHz	
Pulse On/Off ratio		80 dB	70 dB	
Pulse Rise/Fall times	100 ns		50 $\mu$ s	100 ns resolution
Pulse Width	100 ns		50 $\mu$ s	100 ns resolution
Pulse Spacing	100 ns		300 $\mu$ s	100 ns resolution
Pulse Rate	10 Hz		10 kHz	1 Hz resolution
Pulse Shaping	cos, cos <sup>2</sup> linear, gauss			individually settable for rising & falling edge
<b>AVIO Modulation VOR</b>				
Bearing Accuracy	$\pm 2\%$ / $\pm 0.5$ deg			
Subcarrier Frequency Accuracy	9960 $\pm$ 2 Hz			
AM Accuracy	30 $\pm$ 1%			
AM Distortion (THD)			2%	
FM Accuracy	480 $\pm$ 1 Hz			
IDENT AM depth	10 %		30 %	
<b>AVIO Modulation ILS</b>				
AM Accuracy	40 $\pm$ 1%			
AM Distortion			0.5%	
DDM Resolution		0.0002 0.0004		Localizer Glide Slope
DDM Accuracy		0.0004 0.0008		Localizer Glide Slope
<b>Marker Beacon</b>				
AM Tone Accuracy (95% AM)		5% of setting		
AM Tone Distortion (95% AM)		5%		



## Analog Modulation (Option MOD)

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Pulse Modulation</b>				
Modulation Source	Internal pulse generator, external			
Modulator	RF, BB (baseband)			
Pulse Rise/Fall Time		5 ns		10% / 90% of amplitude
On/Off Ratio	40 dB 90 dB 50 dB tbd dB	45 dB 95 dB 50 dB tbd dB		BB pulse modulator <4 GHz RF pulse modulator >4 GHz RF pulse modulator
Pulse Overshoot			1 dB	
Video Feedthrough		tbd		
Polarity / Video Polarity	Normal, inverted			independently selectable
External Pulse Input to Video Output Delay		20ns (meas)		
Video Output to RF Output Delay		5ns (meas) 400ns (meas)		RF modulator BB modulator
External Trigger to Video Output Delay		tbd		
Pulse Jitter		<10 ps +/-8 ns	<1 ps	Internal External, RF pulse modulator External, BB pulse modulator
<b>Internal Pulse Generator</b>				
Pulse Mode	single pulse			
Pulse Period Setting Range	16ns		10s	
Pulse Period Setting Resolution		8ns		
Pulse Width Setting Range	0ns		10s	
Pulse Width Setting Resolution		8ns		
Pulse Width Accuracy	same as time base			
<b>Amplitude Modulation</b>				
Modulation Source		Internal External		Option AIQ
Modulation Depth	0%		99.9%	Output is clipped at max power level
Deviation Accuracy		0.1%	1%	1 kHz rate, 80% depth
Deviation Resolution		0.1%		
Distortion (THD)			1%	1 kHz rate, 80% depth
Modulation Frequency Range	0.1 Hz		100 MHz	
Modulation Waveforms		Sine		
<b>Frequency Modulation</b>				
Modulation Source		Internal External		Option AIQ
Maximum Frequency Deviation (peak)	200 MHz			
Deviation Accuracy		0.5%	1%	
Distortion (THD)		< 1%		1 kHz rate, 10 kHz deviation
Modulation Frequency Range	0.1 Hz		100 MHz	
Modulation Waveforms	Sine			
<b>Phase Modulation</b>				
Modulation Source		Internal External		Option AIQ
Phase Deviation (peak)	0		100 rad	
Deviation Accuracy		0.5%	1%	
Modulation Frequency Range	0.1 Hz		100 MHz	
Modulation Waveforms	Sine			
Distortion (THD)		< 1%		1 kHz rate & N x rad deviation





## Frequency Reference

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Internal Reference Frequency</b>		100 MHz 10 MHz		Options LN / LN+
Initial Calibrated Accuracy			±10 ppb	At 23 ± 3 °C
Temperature Stability 0 to 50 °C			±100 ppb ±20 ppb	Options LN / LN+
Aging after 1st Year			1 ppm 30 ppb 20 ppb	Option LN Option LN+
Aging per Day			5 ppb 0.5 ppb	after 30 days operation Options LN / LN+
Warm-up Time	5 min			
<b>Reference Output</b>				
Output Frequency	10 MHz, 100 MHz			
Output Power	0 dBm 9 dBm			10 MHz 100 MHz
Output Impedance	50 Ω			
<b>External Reference Input</b>				
Input Frequency Range	5 MHz	10 MHz	250 MHz	Option VREF
Frequency Resolution	1 MHz			Option VREF
Input Impedance		50 Ω		
Input Power Level	-5 dBm	0 dBm	+10 dBm	
Lock Range			±1.5 ppm	



## Sweeping Capability

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Sweep Type</b>	Digital sweep in discrete steps			
Automatic Level Control Mode	OFF			
Power Level Uncertainty		0.5 dB	1 dB	APVSG04
<b>Sweep Spacing</b>	Linear			
<b>Sweep Shape</b>	Sawtooth			
<b>Sweep Parameters</b>	Frequency, power			
Sweep Range	Full specified range -20 to +15 dBm			Frequency sweep Power sweep, APVSG04
Step Size Setting Resolution	0.001 Hz 0.01 dB			Frequency sweep Power sweep
Dwell Time Setting Range	500 μs 800 ns TBD		34.35 s 34.35 s 34.35 s	APVSG04, Option UFS APVSG20, APVSG40, Option UFS
Delay Time Setting Range	200 ns 200 ns		34.35 s 34.35 s	APVSG04 APVSG20, APVSG40
Dwell/Delay Time Resolution	8 ns			
<b>Sweep Count</b>	Infinite, 1 to 1 M			
<b>Sweep Trigger</b>				
Trigger Type	Normal (full sweep), Point (one step)			Check with Anapico support
Trigger Parameters	See chapter "Trigger Capability"			
Retrigger Setup Time	200 ns			
External Trigger Event to RF Output Delay	TBD ns typ TBD			APVSG04, Option UFS APVSG20, APVSG40, Option UFS

## Trigger Capability

PARAMETER	MIN	TYPICAL	MAX	NOTE
Trigger Mode	Single, continuous			
Trigger Source	Internal (Immediate, bus), external			
External Trigger Input				
Connector Type	MF1 IN, MF2 IN			See chapter "External Multi-Function Inputs"
Delay Setting Range	0 s		8.5 s	
Delay Setting Resolution		2 ns		
Jitter		+/-2 ns		
Slope	Rising, falling			
Trigger Output				
Connector Type	MF1 OUT, MF2 OUT			See chapter "External Multi-Function Outputs"
Polarity	Normal, inverted			
Delay Setting Range	0 s		2 μs	
Delay Setting Resolution		2 ns		
Pulse Width Setting Range	8 ns		16 μs	
Pulse Width Setting Resolution		8 ns		

## Additive White Gaussian Noise (Option AWGN)

PARAMETER	MIN	TYPICAL	MAX	NOTE
Noise				
Distribution Density	Gaussian, statistical, $\mu = 0, \sigma^2 = 1$			Separate for I and Q
Crest Factor	$\leq 21.07$ dBm			Depending on C/N ratio
Periodicity	$> 7 \times 10^{44}$ s			
Carrier to Noise Ratio C/N				
Range	-60 dB		90 dB	Limited by the RF output power
Resolution		0.01 dB		See application note "AN6005"
Noise Bandwidth				
Dependency	0.8 of I/Q baseband generator sample rate Manually			Any modulation active All modulations inactive
Range	10 Hz		400 MHz	
Resolution	1 Hz			
Power Control Mode	Total, carrier, noise			

## External Multi-Function Inputs

PARAMETER	MIN	TYPICAL	MAX	NOTE
Connector	MF1 IN, MF2 IN			see chapter "I/O CONNECTOR"
Application	External pulse modulation, external trigger			
Nominal Input Impedance	DC 10k Ω and AC 50 Ω			
Threshold Voltage	0.85V	0.9 V	0.95 V	
Nominal Input Voltage	0 V		3.3 V	TTL compatible
Hysteresis		60 mV		

## External Multi-Function Outputs

PARAMETER	MIN	TYPICAL	MAX	NOTE
Connector	MF1 OUT, MF2 OUT			see chapter "I/O CONNECTOR"
Application	Pulse video signal, trigger, marker signals (1-4)			
Nominal Output Impedance	tbd			
Nominal Output Voltage	0 V		3.3 V	LVTTL

## Fast Control Port (Option FCP)

PARAMETER						
<b>Interface</b>	Parallel, bidirectional LVDS with 100 Ω termination at receiver					
Common Mode Level	typ. 1.2V					
Differential Input Threshold	typ. +/-100mV					
Differential Output Voltage	typ. 300mV					
Connector	FCP I/O - see chapter "I/O CONNECTOR"					
<b>Mode: I/Q Data Streaming</b>						
Sample Rate ( )	125 and 250 MHz					
Input/Output Format	data (16 bits), clock signal, valid signal					
Valid I/Q Data Input to RF Output Delay	typ. tbd ns					
<b>Mode: Segment ID Streaming</b>						
Input Format	data (16 bits), valid signal (signal must be static low or high)					
Valid Segment ID Input to RF Output Delay (immediate segment changeover)	typ. tbd ns					
Valid Segment ID Jitter	+/- 8 ns					
<b>Mode: Parameter Streaming</b>						
Parameter	Frequency (up to 48bit), amplitude, phase					
Input Format	address (8 bits), data (8 bits), valid signal					
<b>Pin assignment</b>	Pin (P/N)	Signal	Pin (P/N)	Signal	Pin (P/N)	Signal
	1/19	data bit 0	2/20	data bit 1	3/21	data bit 2
	4/22	data bit 3	5/23	data bit 4	6/24	data bit 5
	7/25	data bit 6	8/26	data bit 7	9/27	data bit 8
	10/28	data bit 9	11/29	data bit 10	12/30	data bit 11
	13/31	data bit 12	14/32	data bit 13	15/33	data bit 14
	16/34	data bit 15	17/35	valid	18/36	clock

## External Analog Inputs (Option AIQ)

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Connector</b>	I IN, Q IN			see chapter "I/O CONNECTOR"
<b>Analog Bandwidth</b>	50 MHz			
<b>Maximum Input Voltage</b>	-2 V		+ 2 V	
<b>Nominal Input Voltage Range</b>		+/- 0.5 V		90% full scale
<b>Input Impedance</b>		50 Ω		
<b>Additional Features</b>	Individual gain and DC offset adjustment, overrange detection			
<b>Application</b>	Analog I/Q data modulation external AM, FM, PM modulation			Option AIQ Option AIQ & MOD

## Multi-Channel Performance

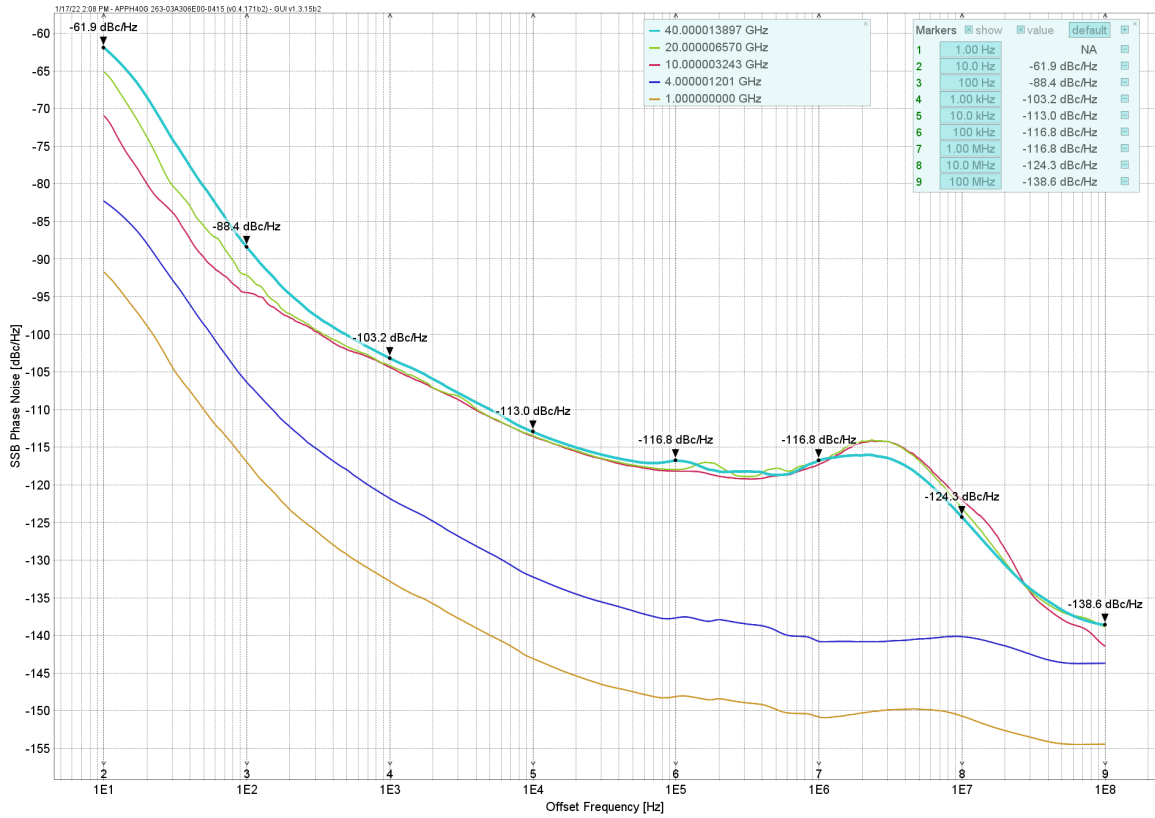
PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Isolation between Channels</b>	> 90 dB			
<b>Relative Phase Stability</b>	TBD			
<b>Additional Features</b>				
Trigger Source	Synchronous (initiate and trigger multiple channels)			
Additional Delay to Asynchronous Characterizations	1 μs +/- 100 ns			
Channel to Channel Jitter	+/- 10 ps typ.			

## Multi-Device Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Multi-Device Synchronization</b>	TBD			Only available at 2U Multi-Channel models
<b>Relative Phase Stability</b>	TBD			

# TYPICAL PERFORMANCE CURVES

**Figure 1: SSB Phase Noise Performance, APVSG20/40, CW without option LN, Pout = 10 dBm**



**Figure 2: SSB Phase Noise Performance, APVSG06, CW without option LN, Pout = 10 dBm**

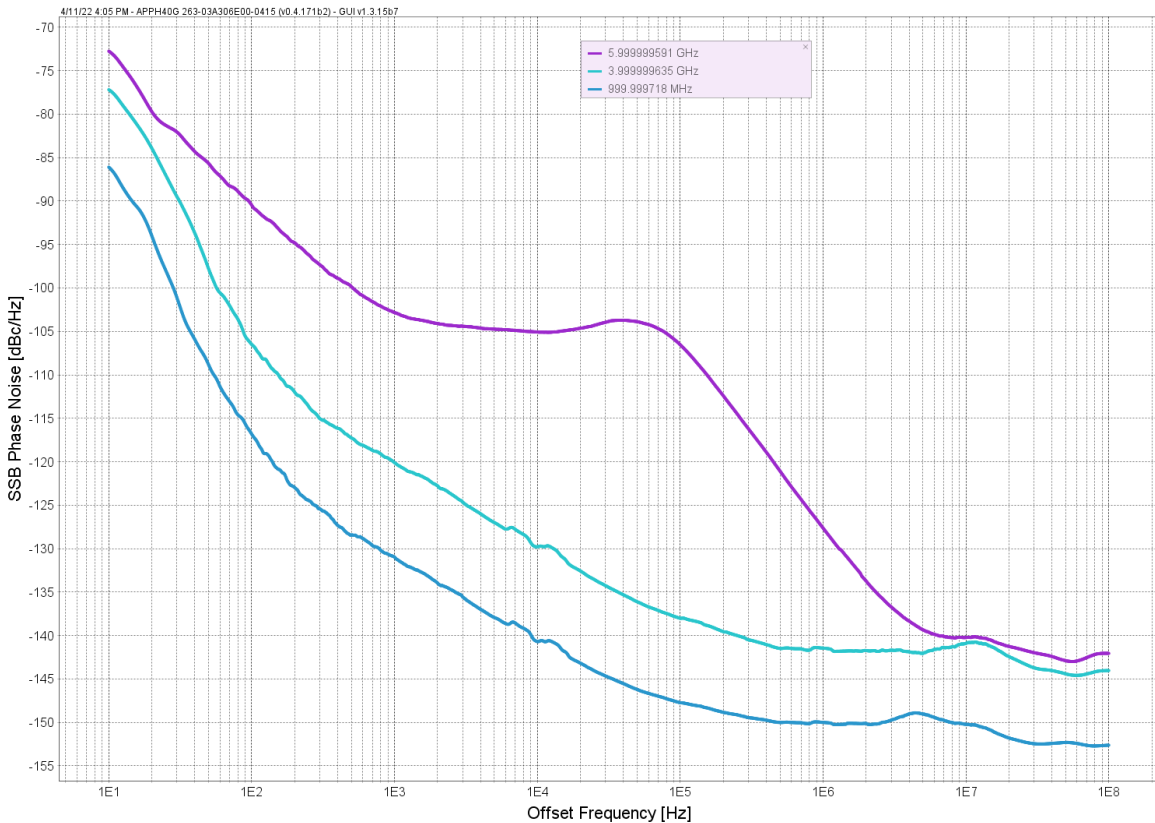
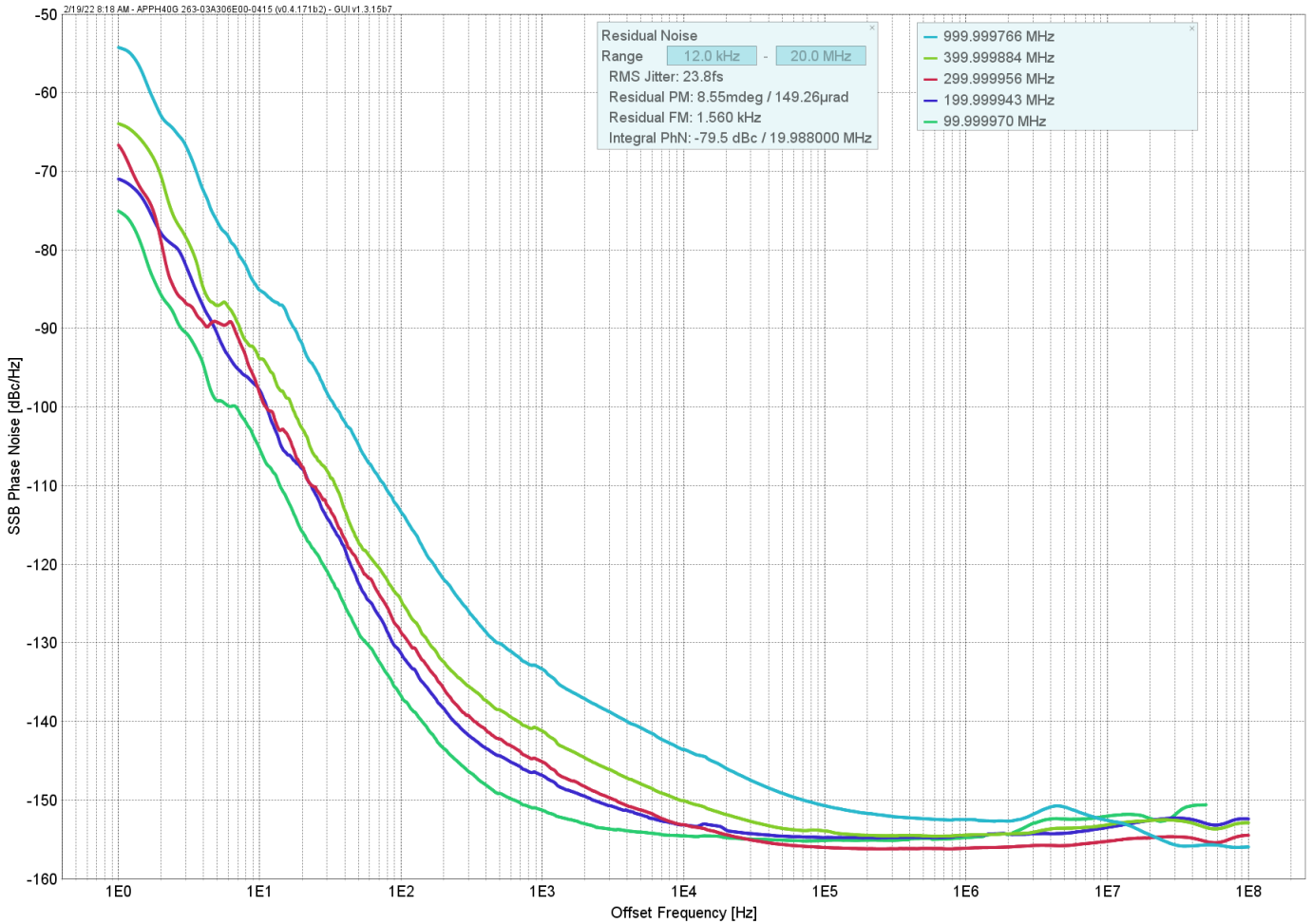


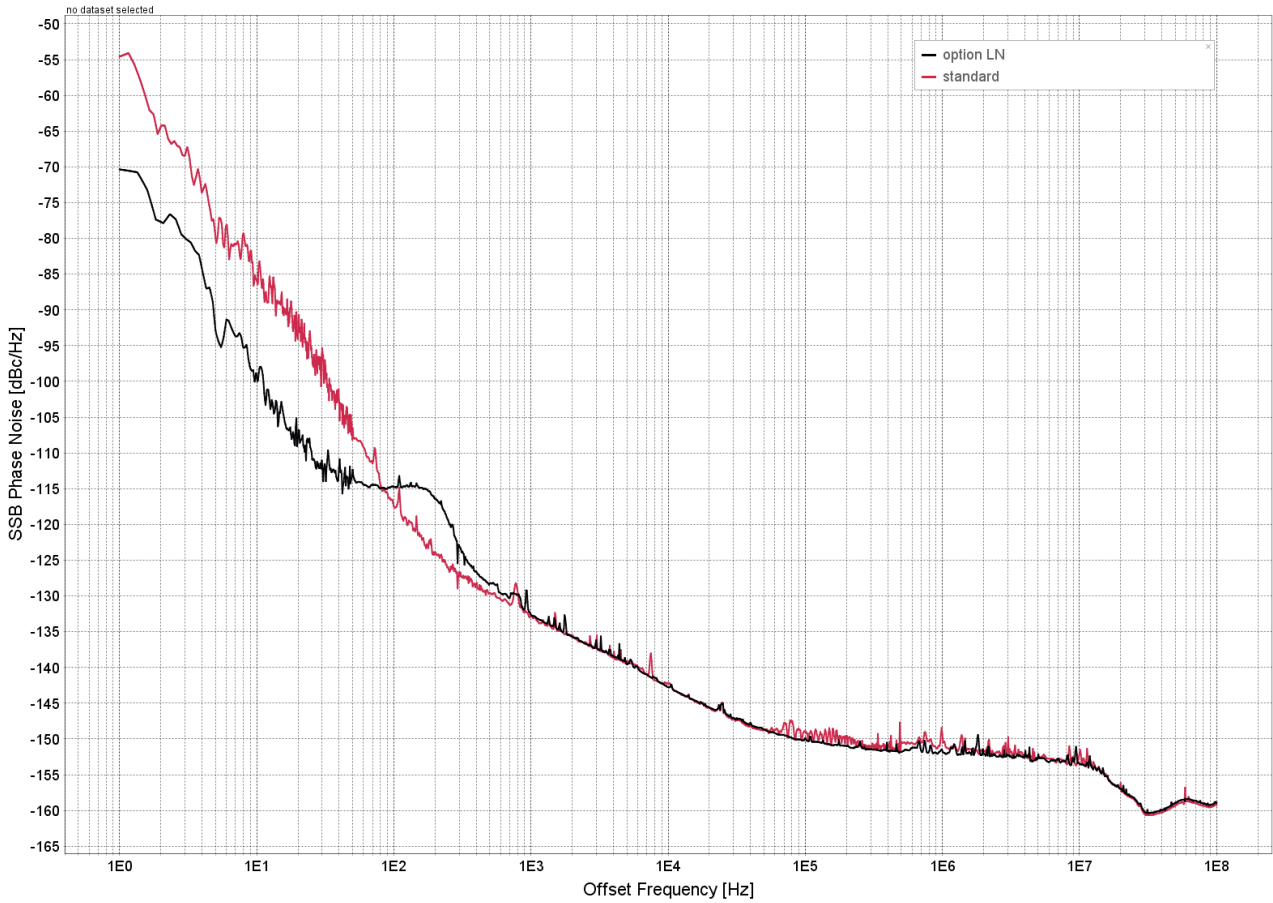


Figure 3: SSB Phase Noise Performance, APVSGXX, low frequency CW without option LN, Pout = 10 dBm



Offset → RF ↓	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	floor
100 MHz		-119	-135	-148	-155	-156	-158	-159
1 GHz		-100	-114	-129	-140	-150	-152	-160
4 GHz		-87	-102	-118	-129	-139	-140	-151
40 GHz		-62	-89	-103	-113	-117	-117	-139

**Figure 2: SSB Phase Noise Performance, CW with Option LN, 1 GHz, Pout = 10 dBm**



**Figure 2a: Amplitude Noise, 2 GHz, Pout = 10 dBm**

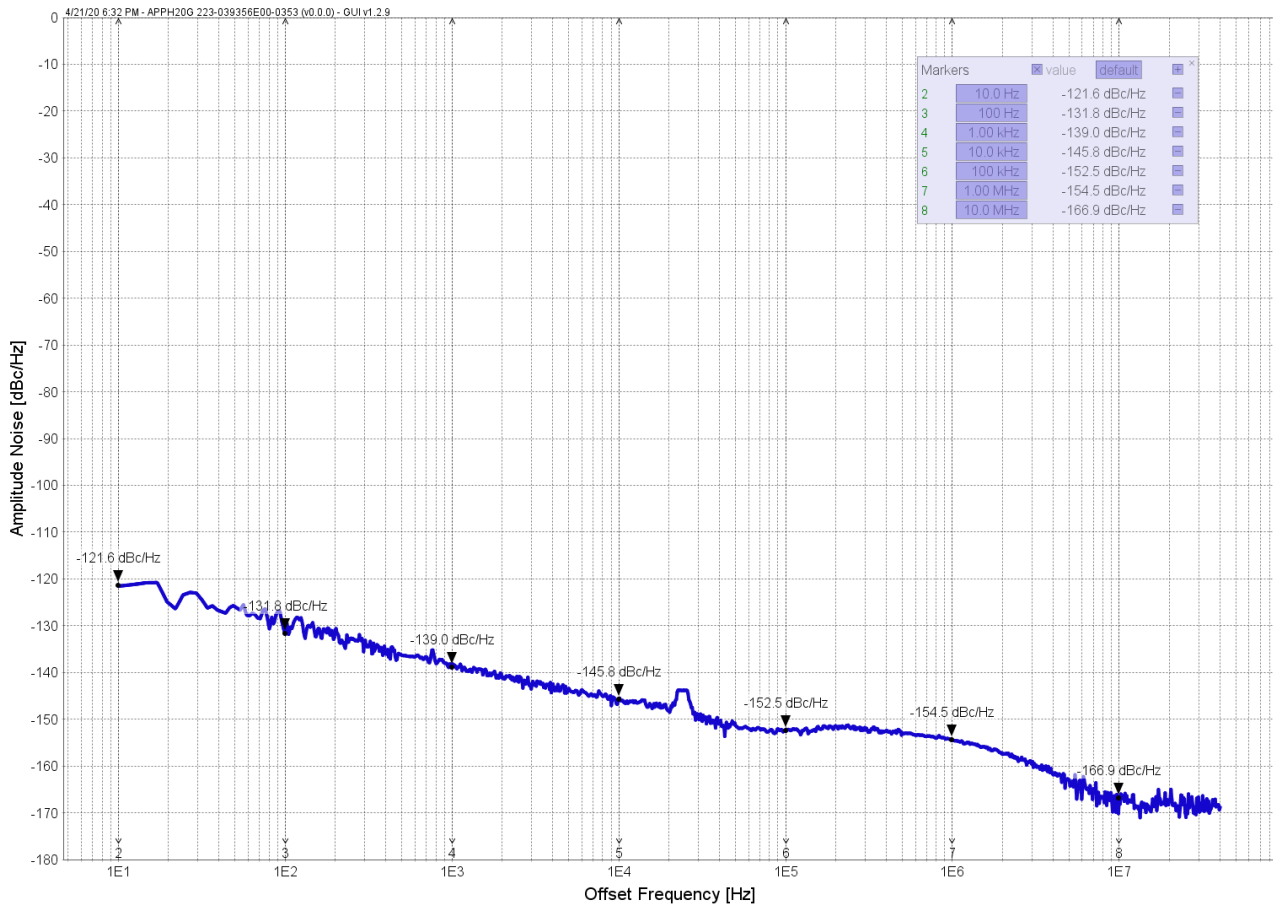
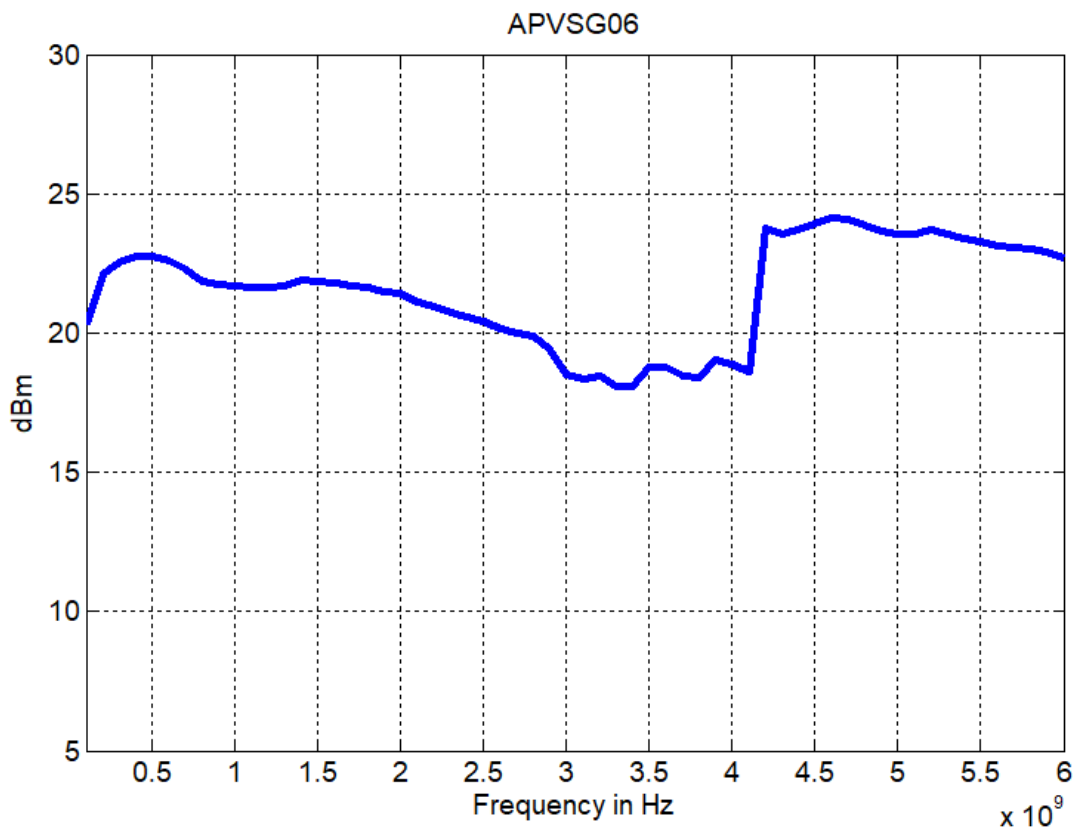
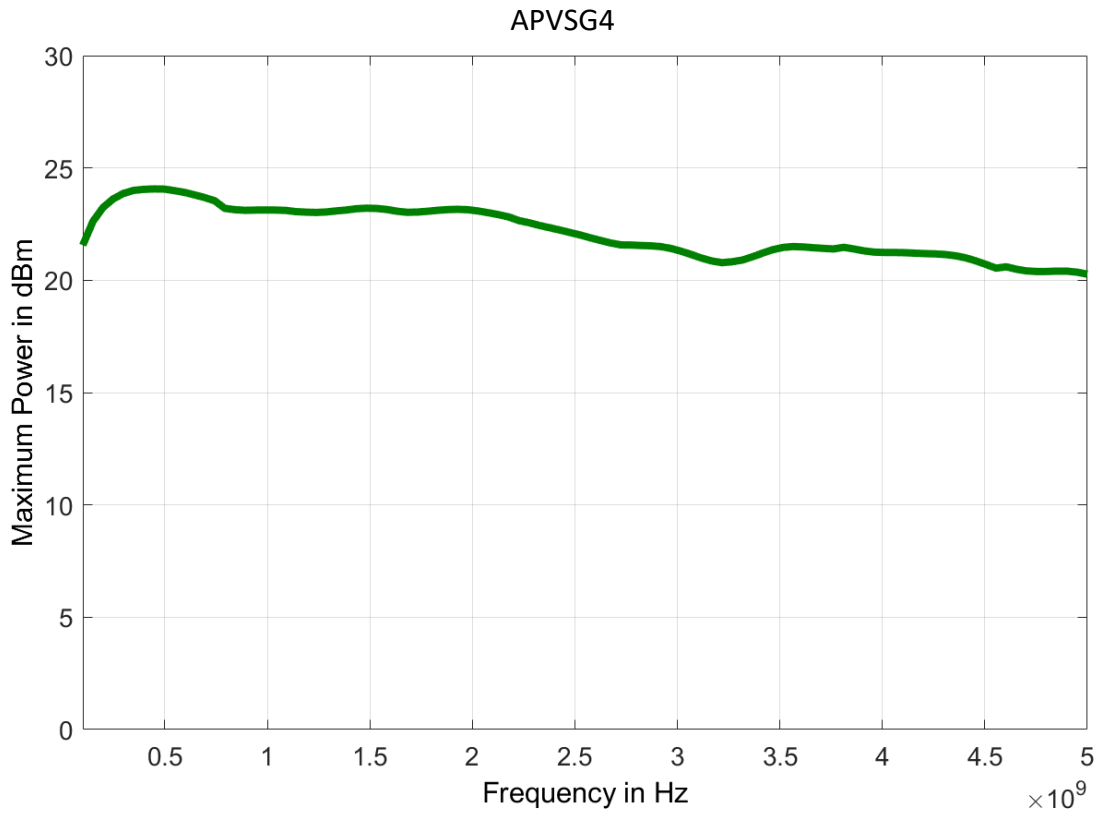


 Figure 3: Maximum Output Power



APVSG20 / 40

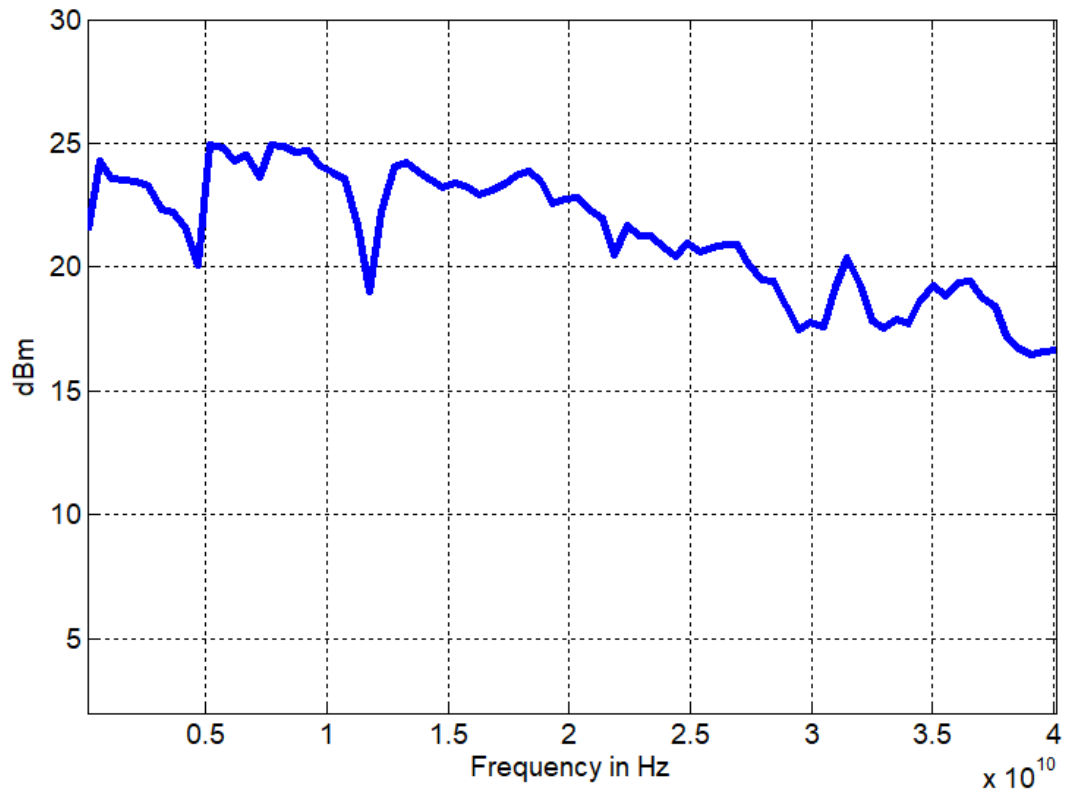




Figure 4: Harmonic Performance at Pout = 0 dBm

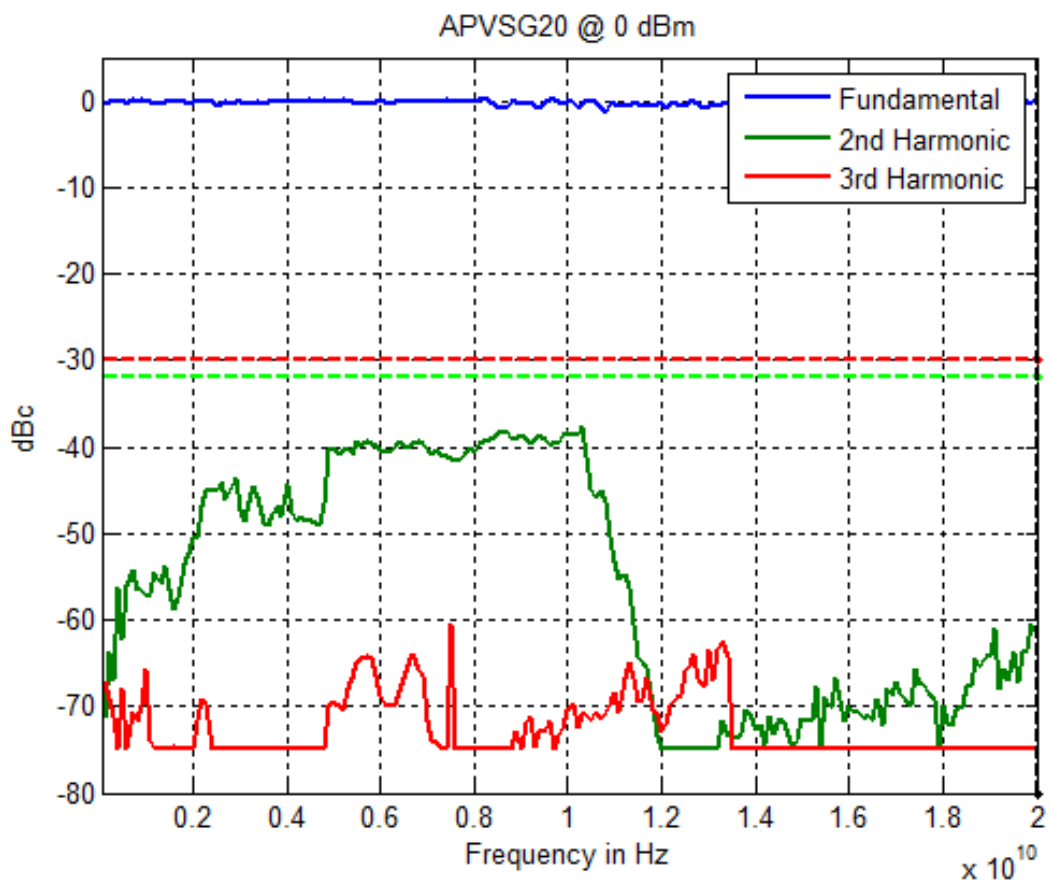
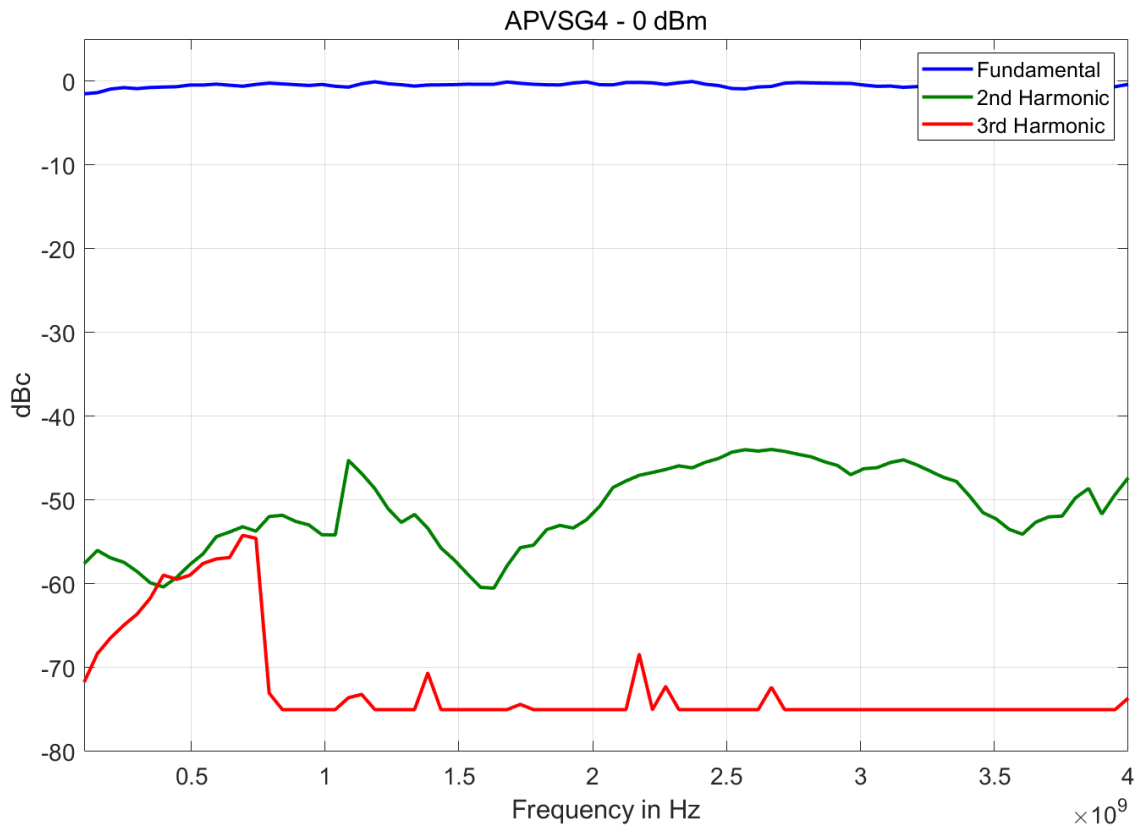
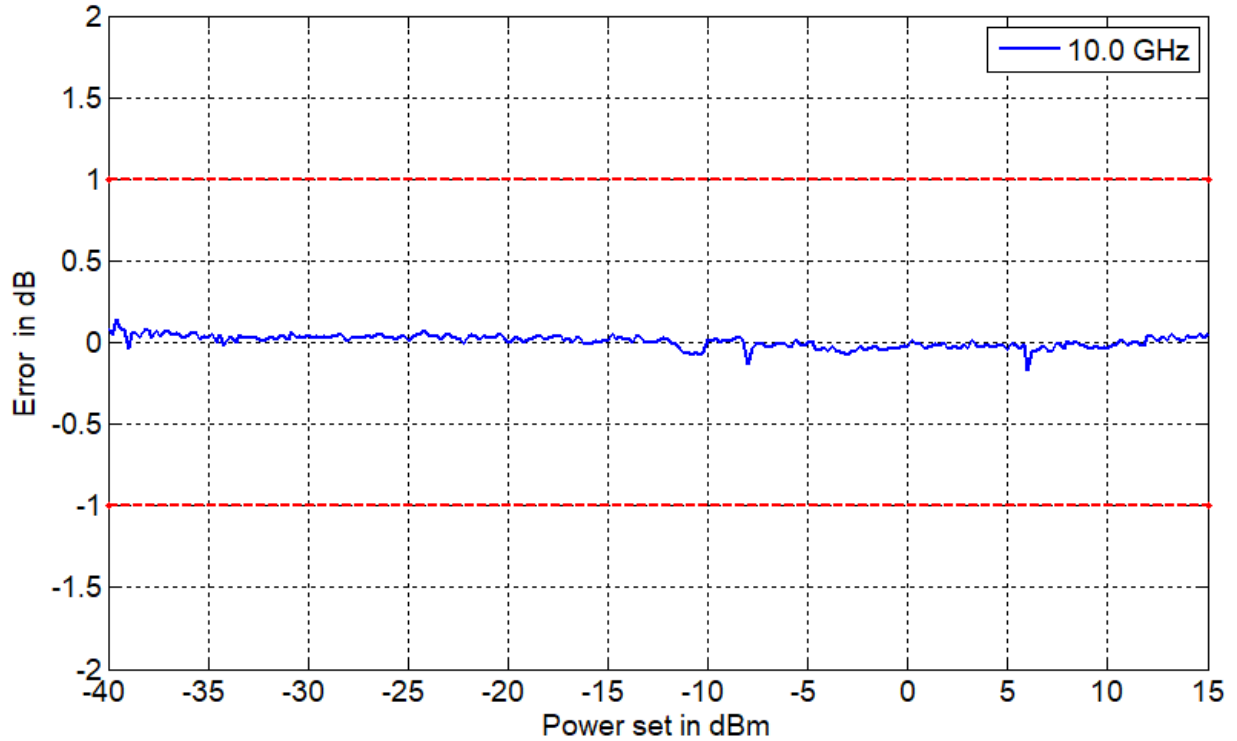
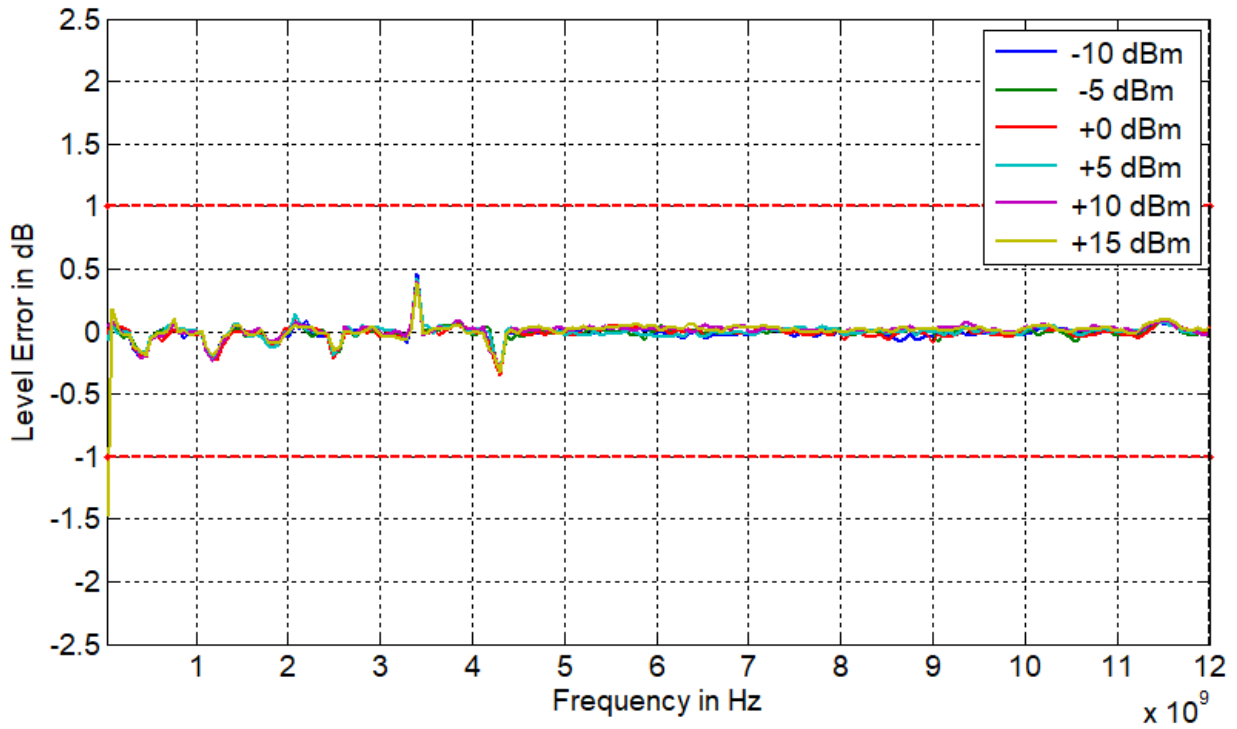
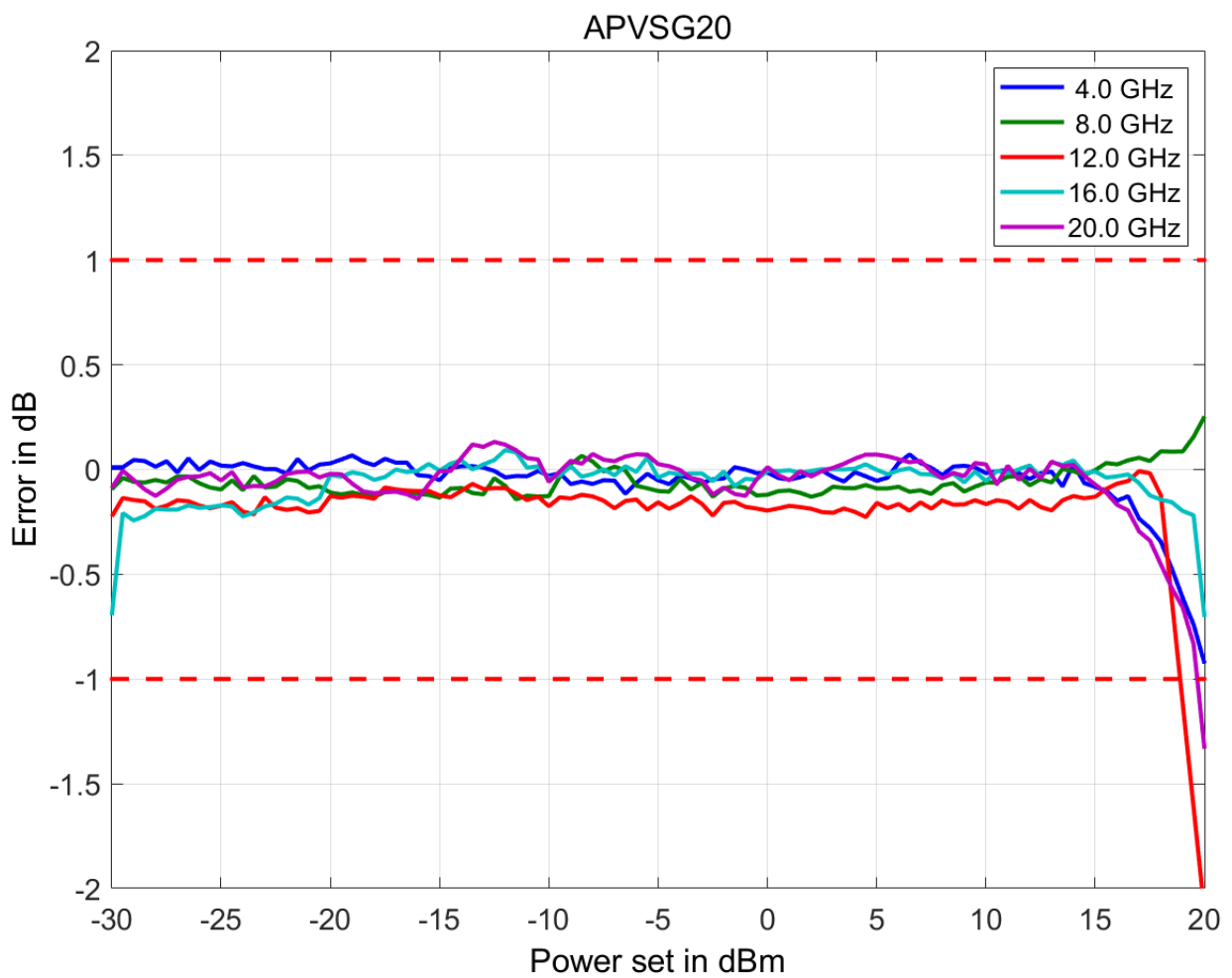
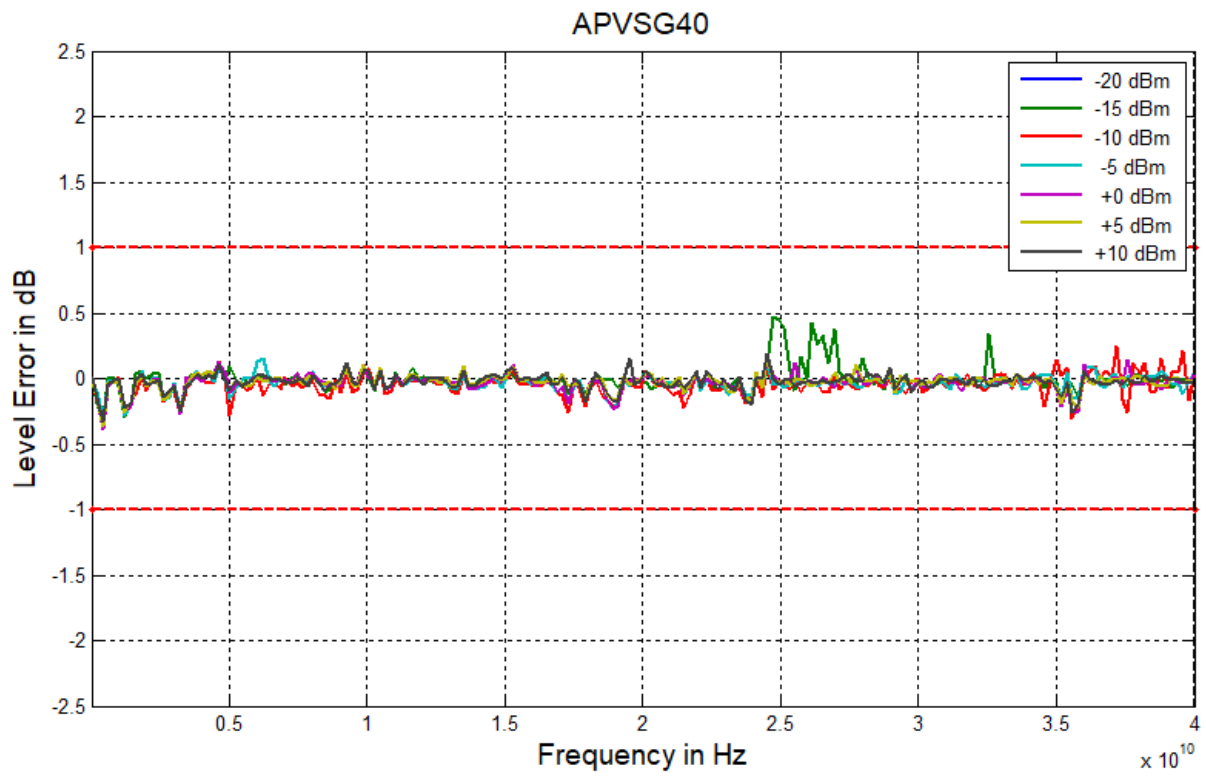


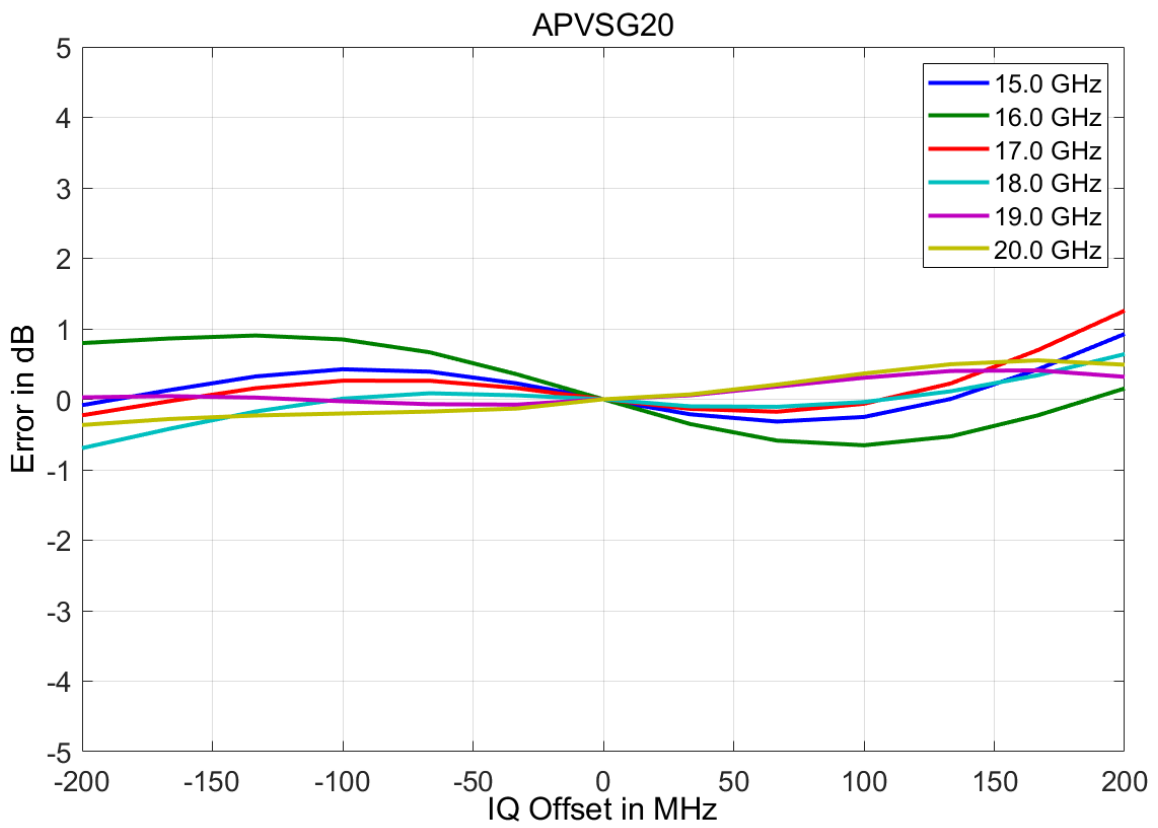
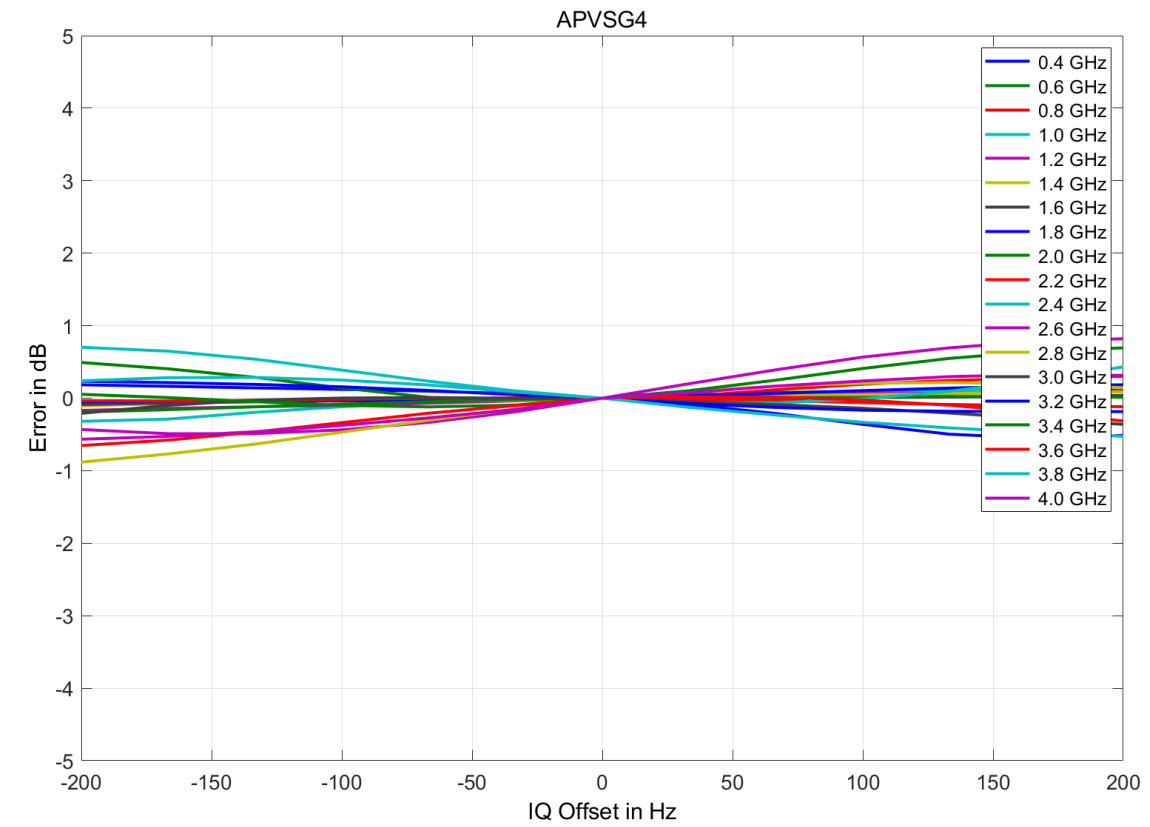
Figure 5: Level Accuracy

APVSG12

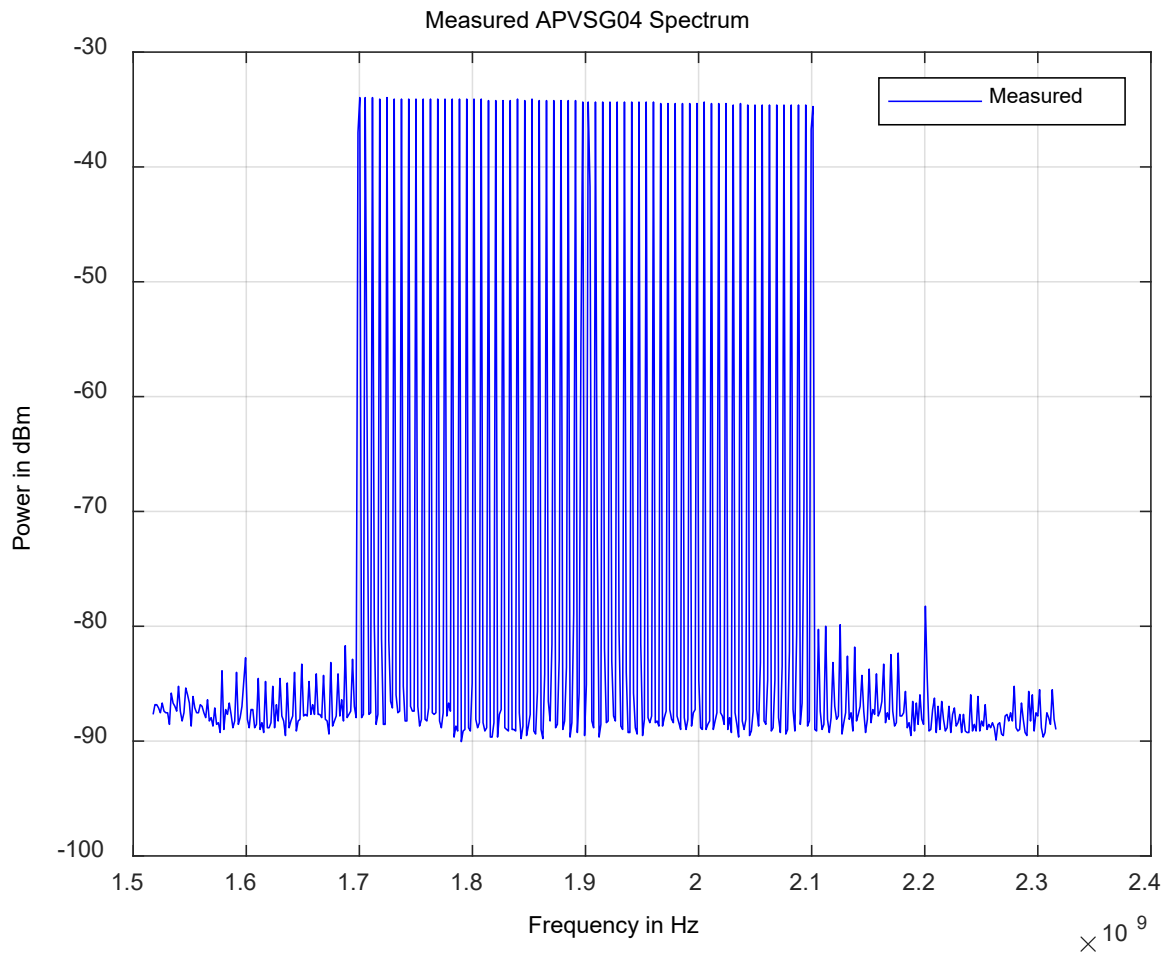




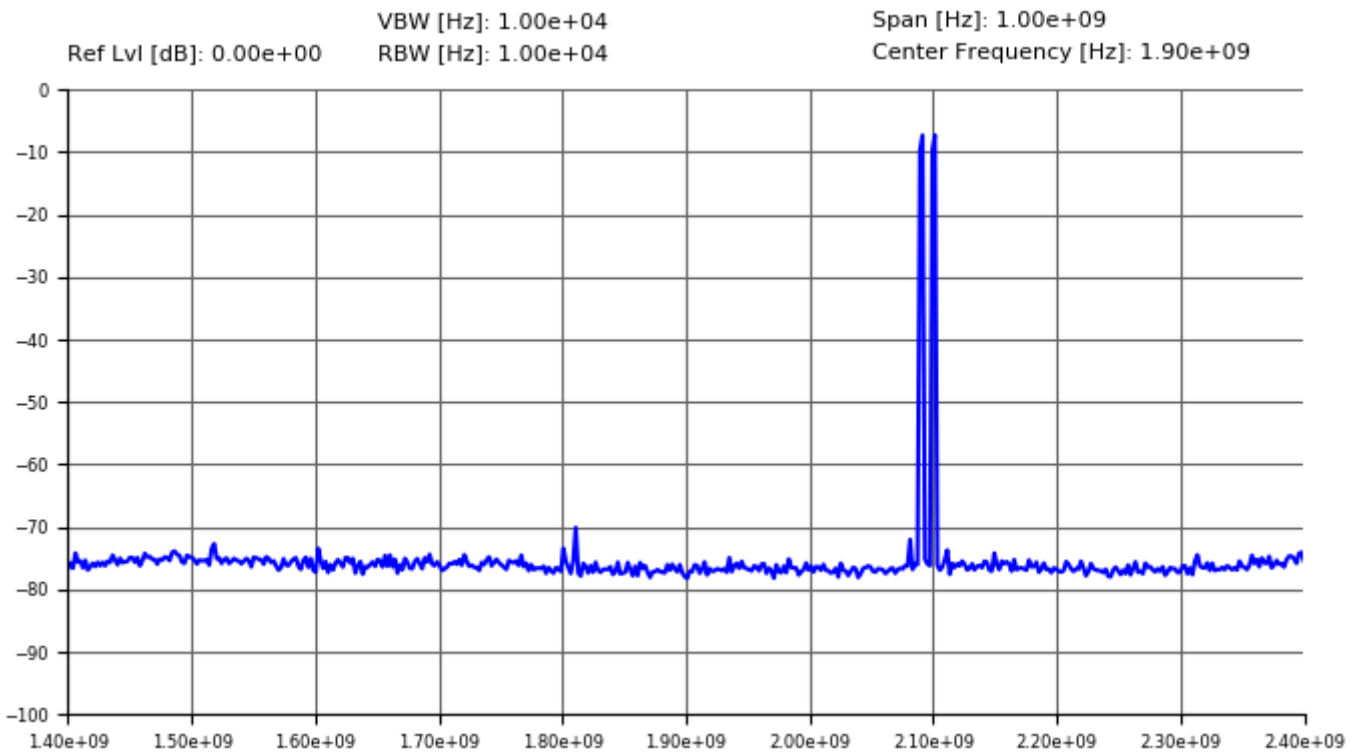
 **Figure 6: I/Q Relative Response (measured)**



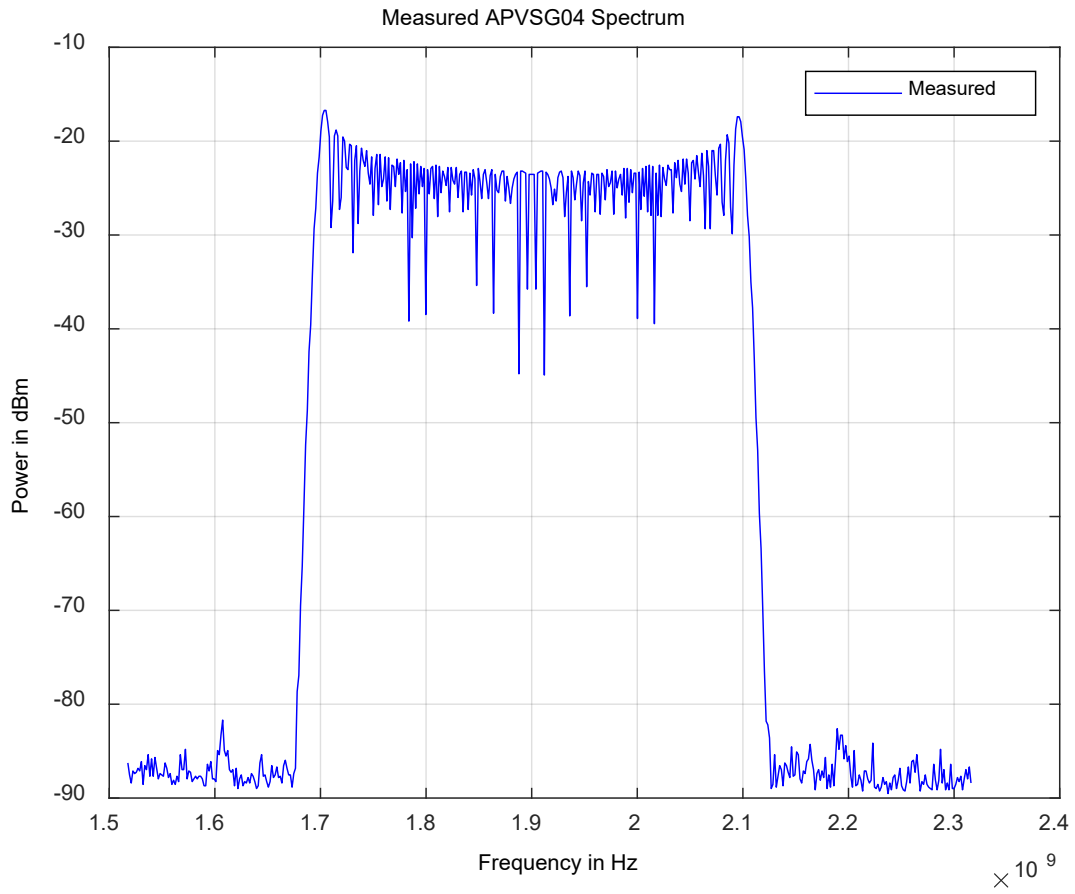
**Figure 7: 64-tone 400 MHz Bandwidth Signal**



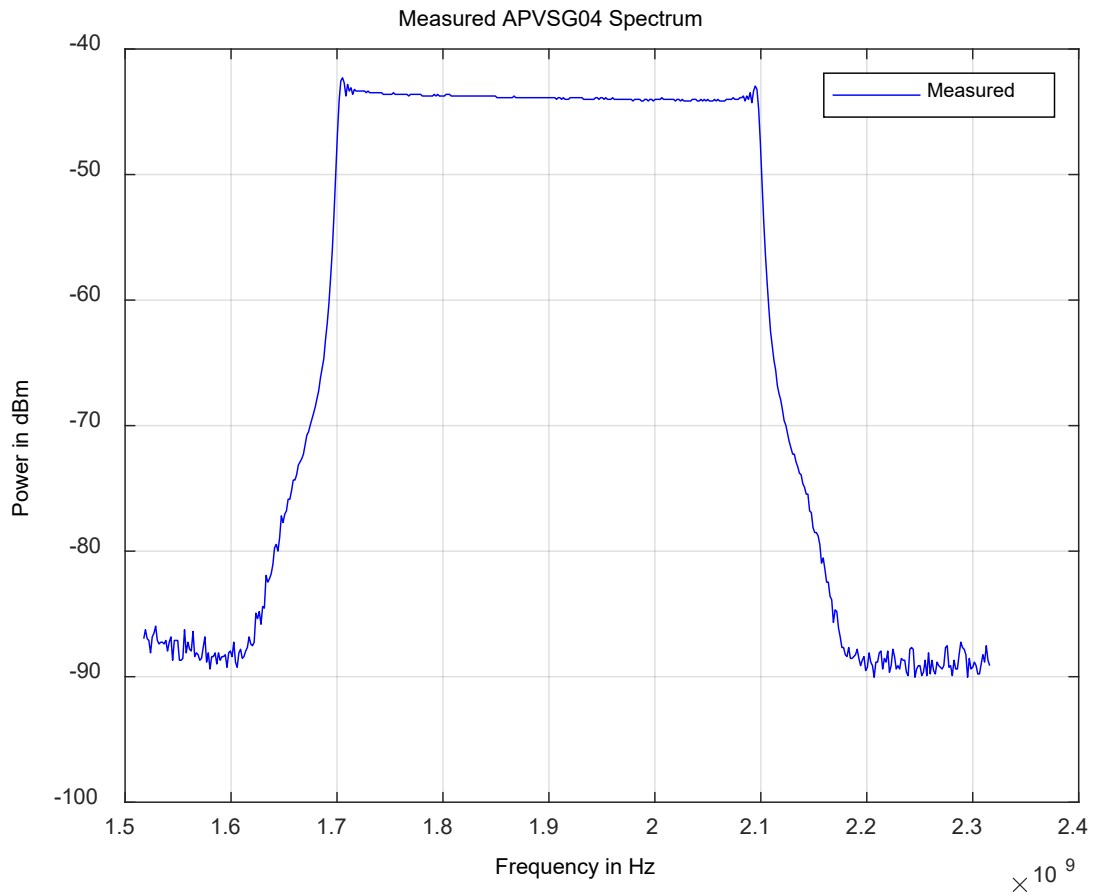
**Figure 8: Two-tone Sideband Rejection**



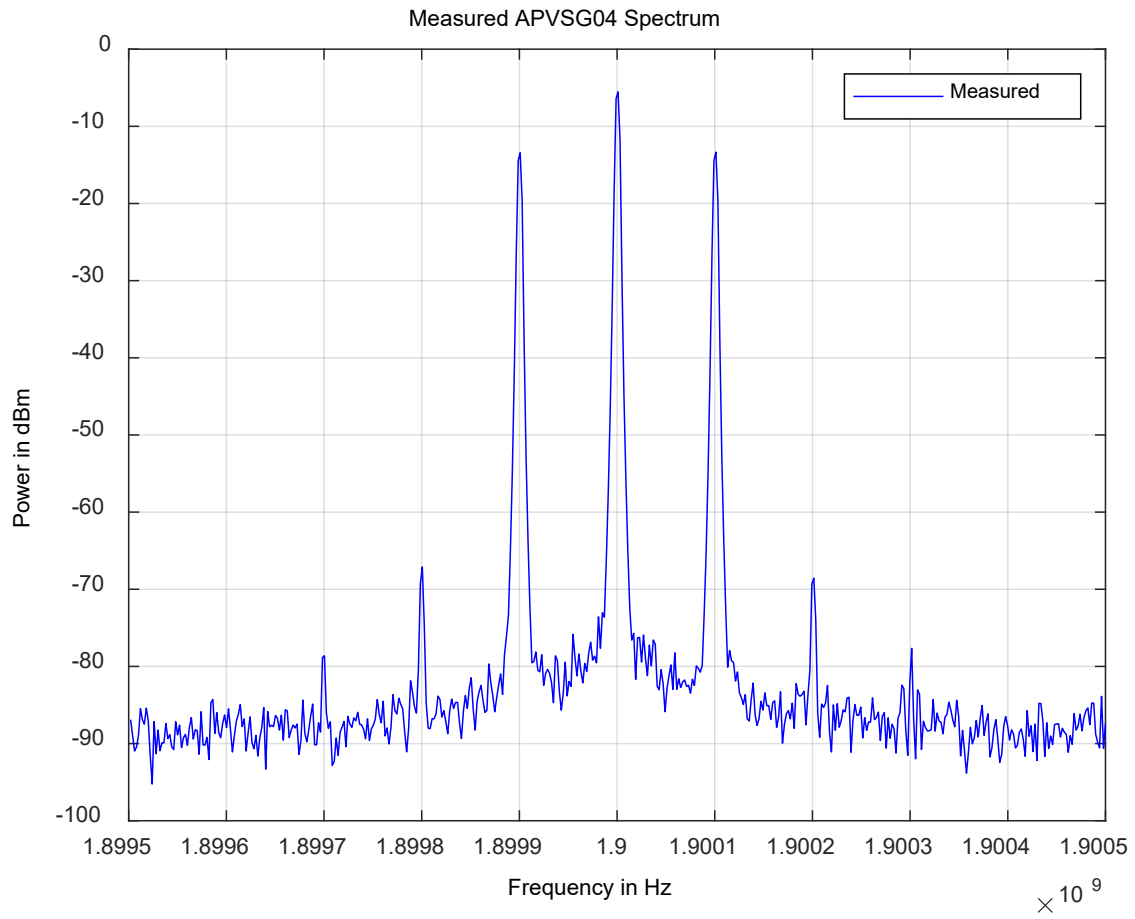
**Figure 9: Wideband FM (1MHz Rate, 200 MHz Deviation)**



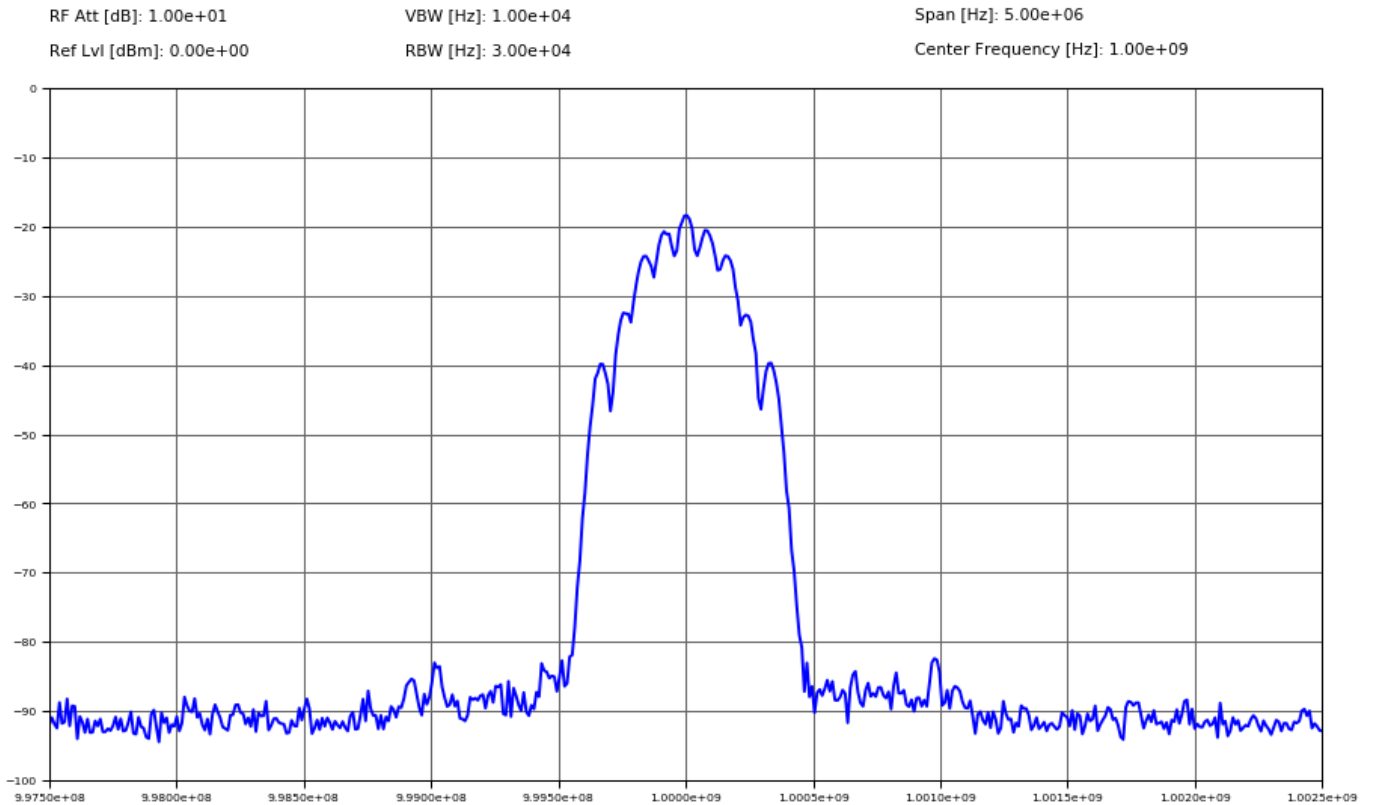
**Figure 10: Pulsed Chirp (10  $\mu$ s, 400 MHz Bandwidth)**



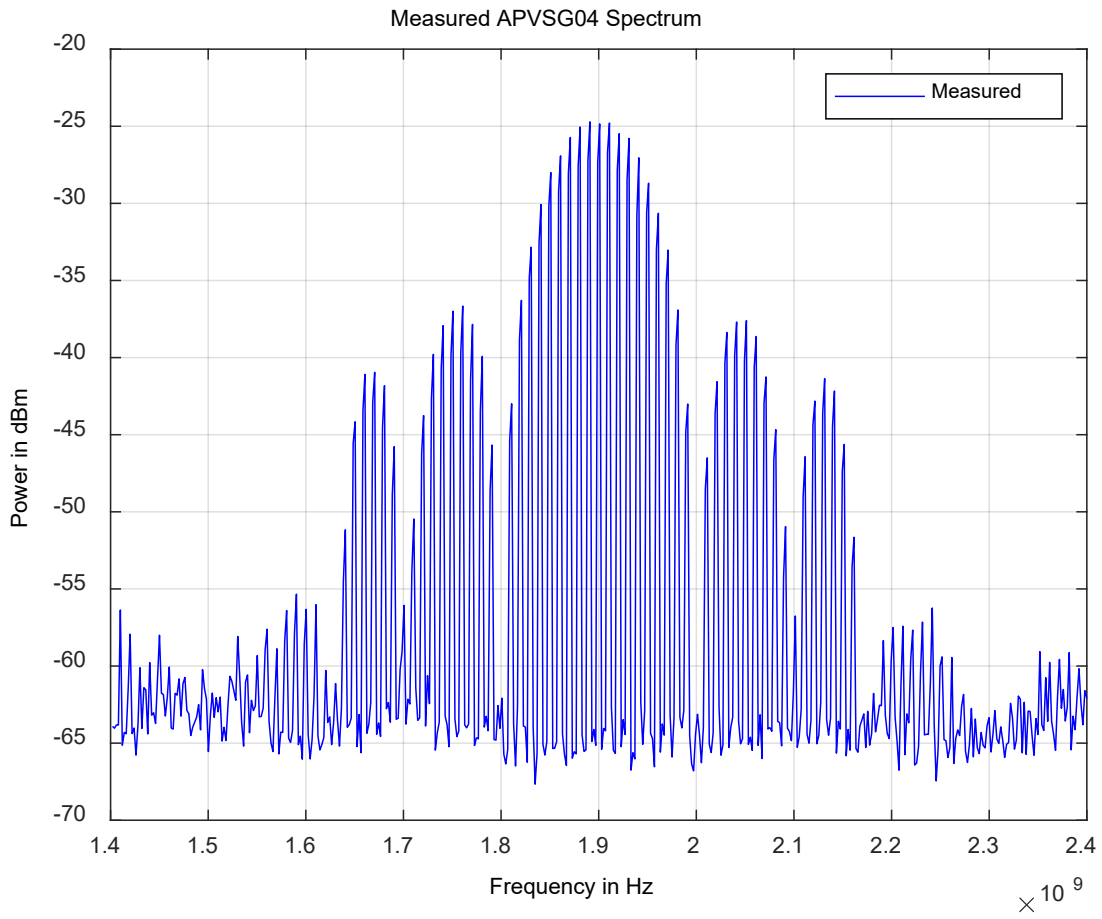
**Figure 11: Amplitude Modulation (1 kHz Rate, 80% Depth)**



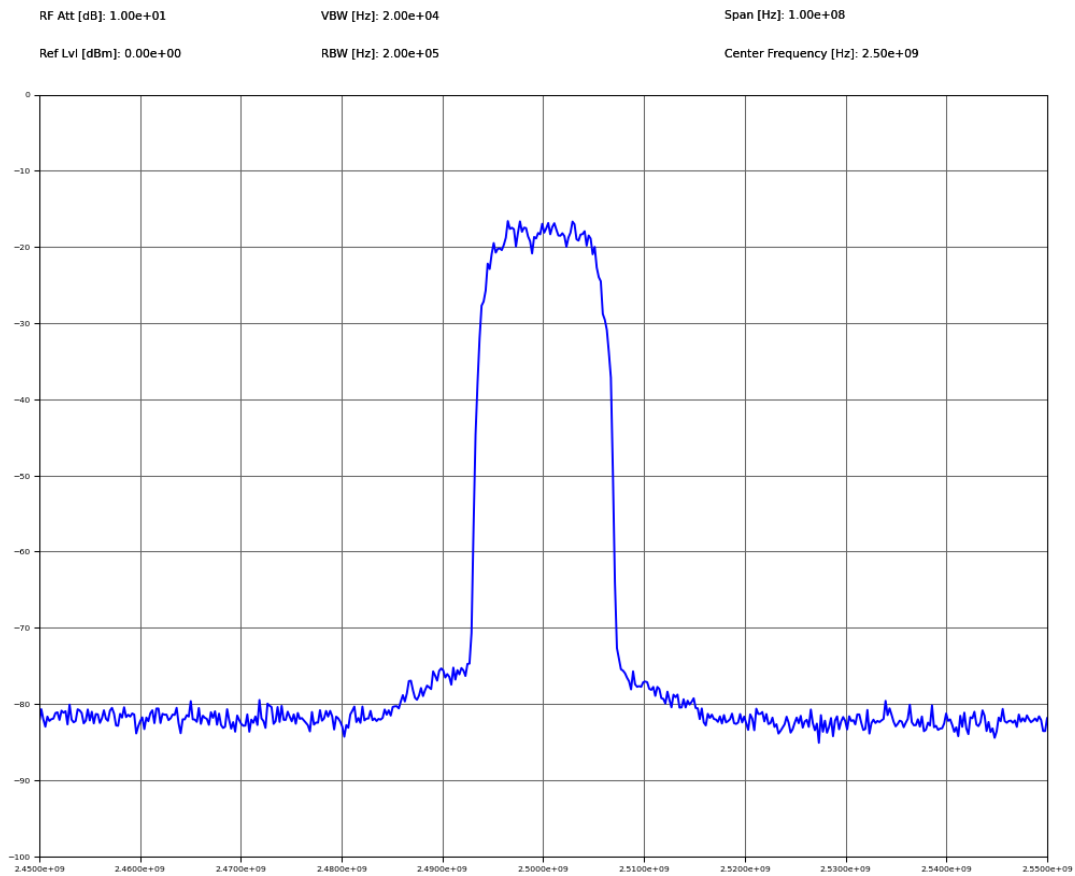
**Figure 12: DME Spectrum (X Channel, Raised Cosine Filter)**



**Figure 13: Pulse Modulation (10 MHz Rate, 10 ns Pulse Width)**

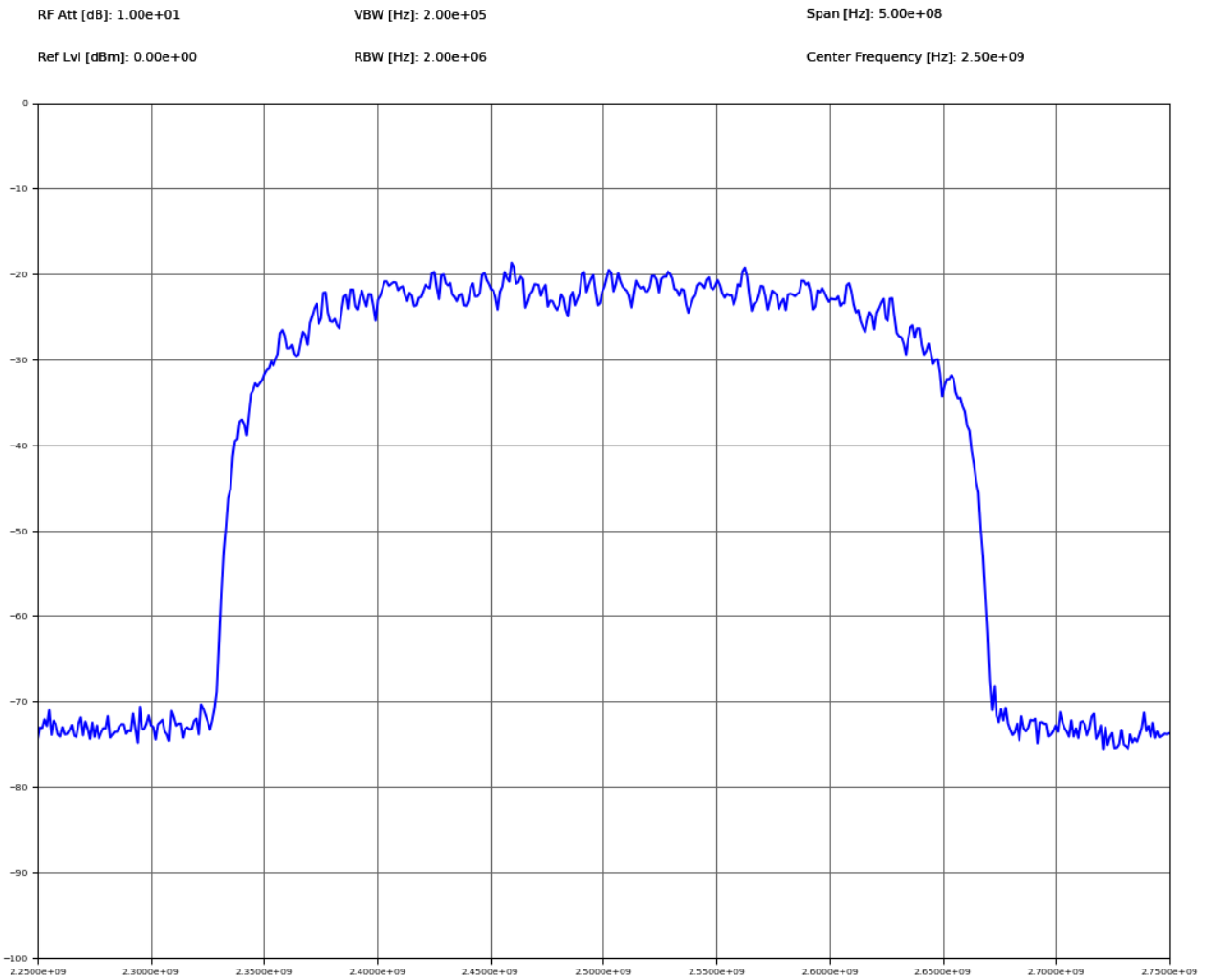


**Figure 14: 256QAM 10 MS/s**

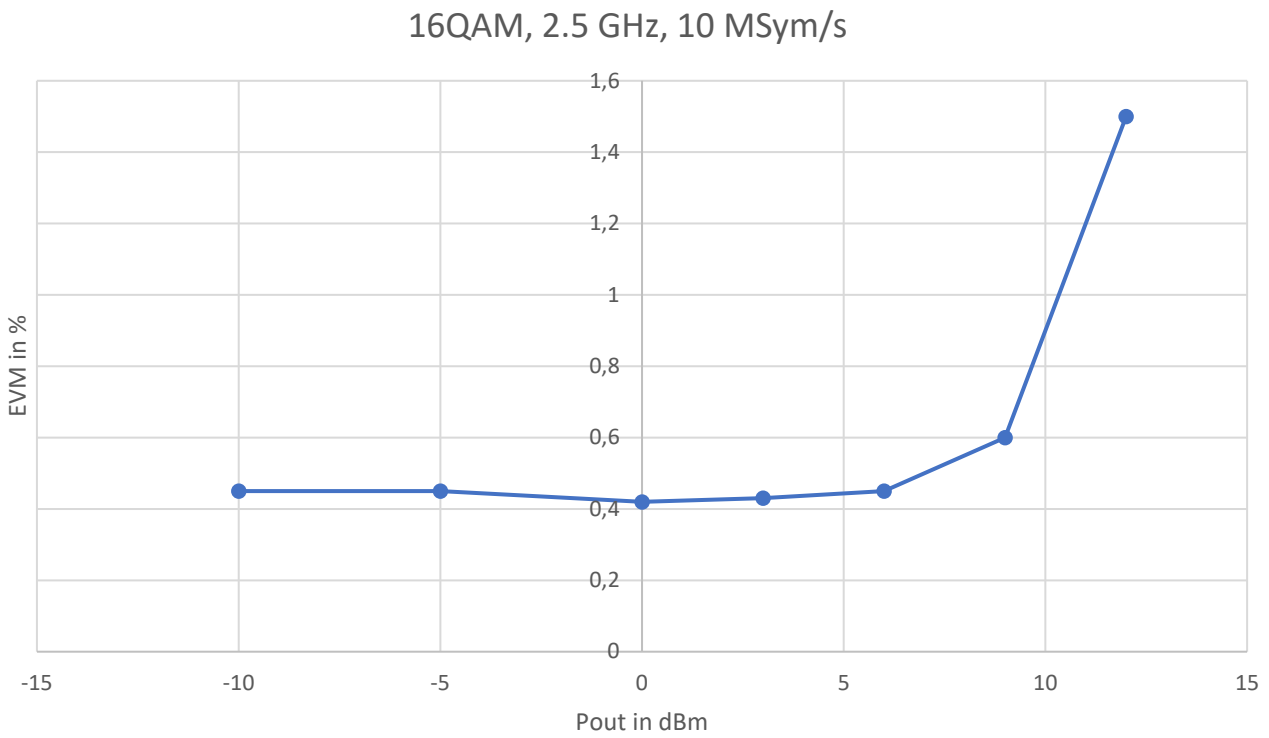




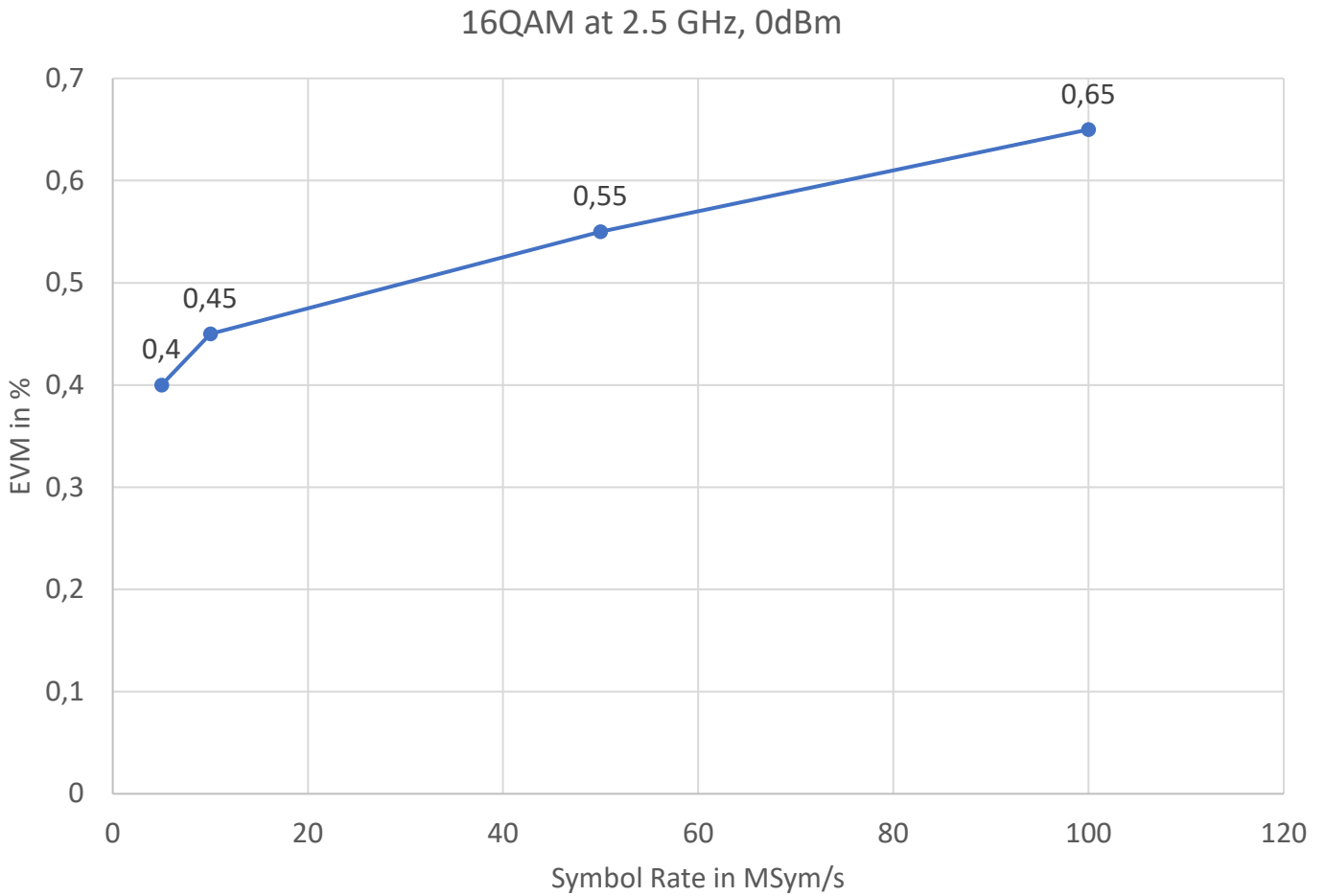
**Figure 15: 16QAM 250 MS/s**



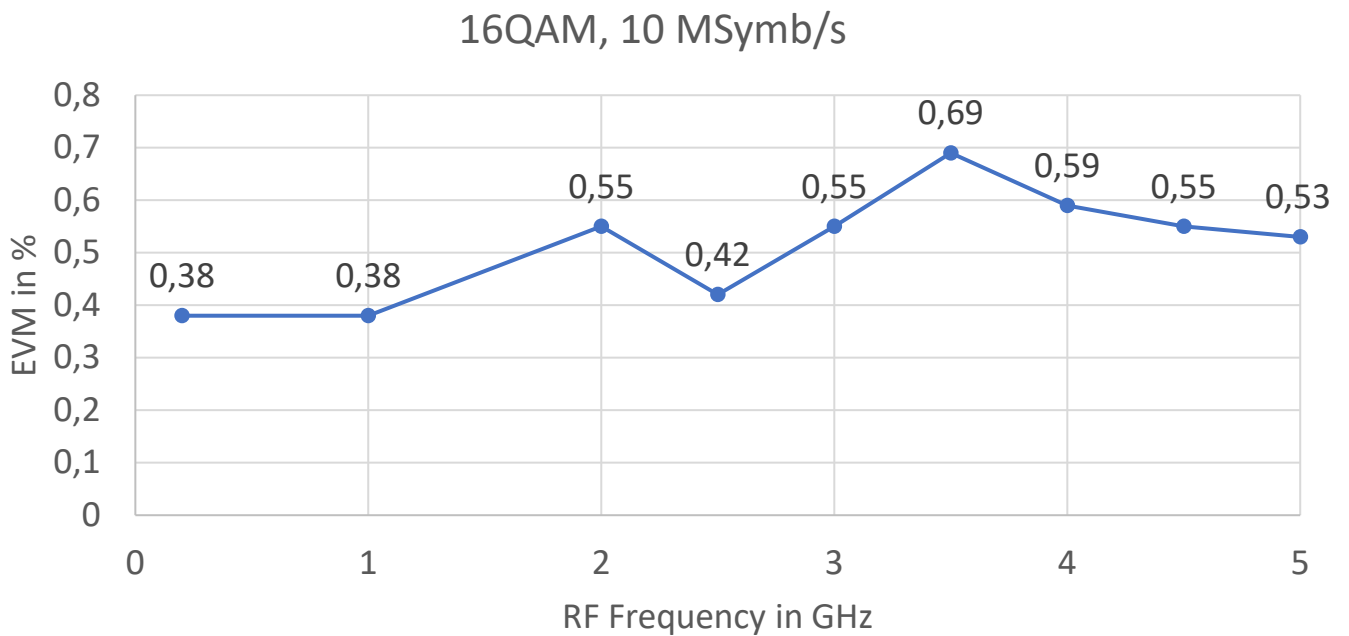
**Figure 16: EMV vs Output Power, 16QAM, 10 MS/s, 2.5 GHz**



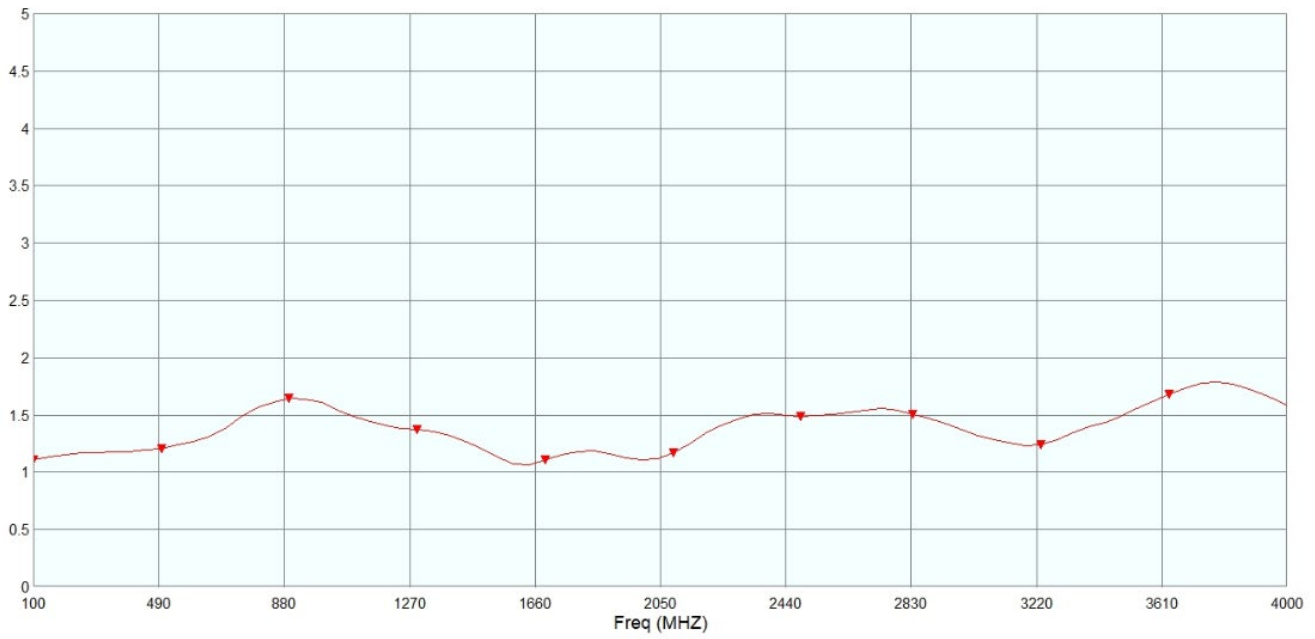
**Figure 17: EMV vs Symbol Rate, 16QAM**



**Figure 18: EMV vs RF Frequency, 16QAM, 10 Msymbols/s**



**Figure 19: Typical VSWR (APVSG04)**



**Figure 20: Typical VSWR (APVSG12 & APVSG20)**

tba

**Figure 21: User Interface**

**Carrier Settings:**

- Frequency: 1.000 GHz
- Power: 0.00 dBm
- Phase: 0°
- Step: 100.000 MHz
- RF Transition: Unbanked
- ALC Mode: Sample & Hold
- Readjust RF Level: [Dropdown]

**Modulation Settings:**

- File: [Dropdown]
- Generator: [Dropdown]
- Analog Modulation: [Dropdown]
- AVIO: [Dropdown]

File Name	File	#Samples (Duration)	ID	Backoff	Playback	Delete
	jktest5.qid	700 (1.4 µs)	0	0.00 dB	Select	X
	jktest7.qid	500 (998.0 ns)	1	0.00 dB	Select	X
	jktest5.qid	700 (1.4 µs)	2	0.00 dB	Select	X

Currently active segments: 8 Selected segment: 2

Playback Rate: 500.000 MHz

Buttons: Arbitrary Trigger, IQ Modulation ON

Plots: Constellation Diagram (I vs Q), Amplitude vs Time

# I/O CONNECTOR

## Front Panel (Single Channel Model):

LABEL	TYPE	DESCRIPTION	OPTION
RF 50 Ω	N female (APVSG04/APVSG06/APVSG12) SMA female (APVSG20) K (2.92mm) female (APVSG40)	RF output	



## Rear Panel (Single Channel Model):

LABEL	TYPE	DESCRIPTION	OPTION
DC24V	DC power plug female	Power of instrument	
⏏	M4	Ground reference screw	
USB	USB type B	Remote programming interface	
LAN	RJ-45	Remote programming interface	
GPIB	24-pin female	Remote programming interface	GPIB
SD	MicroSD	Card slot for non-volatile storage of I/Q data	
REF IN	BNC female	Reference frequency input	
REF OUT	BNC female	Reference frequency output	
MF1 IN, MF2 IN	BNC female	Multi-function inputs: User-configurable (e.g. trigger, external pulse)	
MF1 OUT, MF2 OUT	BNC female	Multi-function outputs: User-configurable (e.g. trigger, marker)	
I IN, Q IN	BNC female	Analog inputs: User-configurable (e.g. I/Q modulation, external analog modulations)	AIQ
FCP	36-pin mini-D female 3M MDR 102 Series	Fast control port, external digital I/Q data streaming (per channel)	FCP



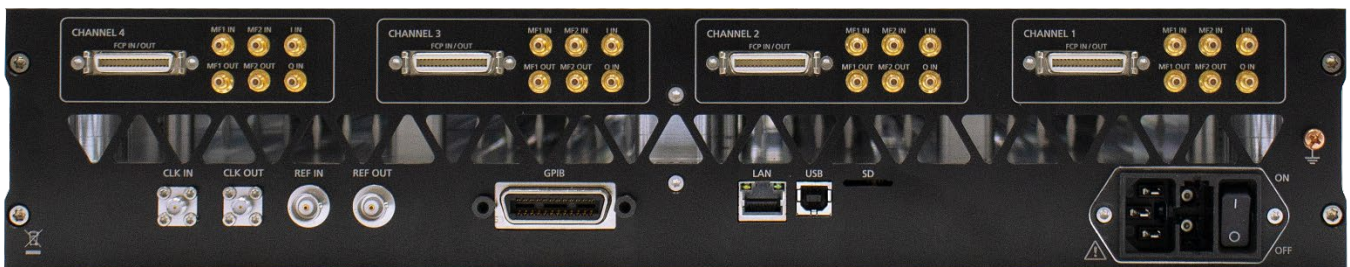
## Front Panel (2U Multi-Channel Model):

LABEL	TYPE	DESCRIPTION	OPTION
RF OUT (for each channel)	SMA female / K (2.92mm) female (APVSG40-X)	RF output	



## Rear Panel (2U Multi-Channel Model):

LABEL	TYPE	DESCRIPTION	OPTION
-	C13	Power of instrument	
⏏	M4	Ground reference screw (earth)	
USB	USB type B	Remote programming interface	
LAN	RJ-45	Remote programming interface	
GPIOB	24-pin female	Remote programming interface	GPIOB
SD	MicroSD	Card slot for non-volatile storage of I/Q data	
REF IN	BNC female	Reference frequency input	
REF OUT	BNC female	Reference frequency output	
CLK IN	SMA female	High-stability reference input	
CLK OUT	SMA female	High-stability reference output	
FCP (for each channel)	36-pin mini-D female 3M MDR 102 Series	Fast control port	FCP
MF1 IN, MF2 IN (for each channel)	SMB female	Multi-function inputs: User-configurable (e.g. trigger, external pulse)	
MF1 OUT, MF2 OUT (for each channel)	SMB female	Multi-function outputs: User-configurable (e.g. trigger, marker signals)	
I IN, Q IN (for each channel)	SMB female	Analog inputs: User-configurable (e.g. I/Q modulation, external analog modulations)	AIQ



## ORDERING INFORMATION



HOST MODEL	PRODUCT	DESCRIPTION
APVSG	APVSG04	4 GHz model
APVSG	APVSG06	6 GHz model
APVSG	APVSG12	12 GHz model
APVSG	APVSG20	20 GHz model
APVSG	APVSG40	40 GHz model
APVSG-X	APVSG04-X	4 GHz model (X channels)
APVSG-X	APVSG06-X	6 GHz model (X channels)
APVSG-X	APVSG12-X	12 GHz model (X channels)
APVSG-X	APVSG20-X	20 GHz model (X channels)
APVSG-X	APVSG40-X	40 GHz model (X channels)

2 to 4 channels



HARDWARE OPTIONS	PRODUCT	DESCRIPTION
APVSG(-X)	Option LN	Enhanced close-in phase noise & frequency stability
APVSG(-X)	Option LN+	Enhanced close in phase noise & further enhanced long term frequency stability
APVSG(-X)	Option FCP*	Fast control port, external digital I/Q data streaming (per channel)
APVSG(-X)	Option AIQ	External analog I/Q inputs (per channel)
APVSG(-X)	Option GPIB*	GPIB interface
APVSG04(-X) APVSG06(-X) APVSG12(-X)	Option PE4	Electrical step attenuator
APVSG(-X)	Option PE	Mechanical step attenuator (down to -90 dBm)
APVSG(-X)	Option PE2	Mechanical step attenuator (down to -120 dBm)
APVSG(-X)	Option 100K	Frequency range extension to 100 kHz

\* Option combination FCP / GPIB is not supported on single channel models.



SOFTWARE LICENSES	PRODUCT	DESCRIPTION
APVSG(-X)	Option MOD	Internal analog modulations
APVSG(-X)	Option UFS	Ultra-fast switching speed
APVSG(-X)	Option NEC	Fast switching speed (no export control, per channel)
APVSG(-X)	Option PHS	Phase-coherent switching (per output)
APVSG(-X)	Option IVM	Internal digital modulation schemes
APVSG(-X)	Option AVIO	Avionic modulations (DME, VOR, ILS, Marker Beacon)
APVSG(-X)	Option VREF	Variable external reference
APVSG(-X)	Option AWGN	Additive white gaussian noise generation, bandwidth selective
APVSG(-X)	Option SD	MicroSD card support for non-volatile storage of I/Q data



ACCESSORIES	PRODUCT	DESCRIPTION
APVSG	Option EB	External power bank adapter cable
APVSG	Option BAG	Portable bag



SERVICE	PRODUCT	DESCRIPTION
APVSG(-X)	Option WE	One year warranty extension
APVSG(-X)	Option ReCal	Recalibration with certificate (recommended: 2 years interval)

# GENERAL CHARACTERISTICS

## Remote Programming Interfaces

- Ethernet 100BaseT LAN Interface,
- USB 2.0 Device Interface
- GPIB (IEEE-488.2,1987) with listen and talk (Option GPIB)
- Control Language: SCPI Version 1999.0

## Power Requirements

### Single Channel Model

Input Voltage Range	24 VDC $\pm$ 3.0 V	
Power Consumption (typ) (without Options)	45W 55W 65W	APVSG04 APVSG06, APVSG12 APVSG20, APVSG40
Main Adapter supplied (without Options)	100 - 240 VAC 50/60Hz; 24 VDC and 65W max	APVSG04, APVSG06, APVSG12
	100 - 240 VAC 50/60Hz; 24 VDC and 160 W max	APVSG20, APVSG40

### Multi-Channel Model

Input Voltage Range	100 - 240 VAC 50/60Hz	
Fuse Rating	5x20mm, 250 V, 6.3 AT	2-poles, each
Power Consumption (max)	200 W  400 W	APVSG4-x, APVSG6-2, APVSG12-2, APVSG20-2, APVSG40-2 APVSG6-4, APVSG12-4, APVSG20-4, APVSG40-4

## Environmental (Levels similar to MIL-PRF-28800F Class 3/4)

Environmental stress Samples of this product have been type tested to be robust against the environmental stresses of storage, transportation, and end-use; those stresses to temperature, humidity, shock, vibration, altitude, and power line conditions.

**Operating temperature range:** 0 to 45 °C

**Storage temperature range:** -40 to 70 °C

**Operating and storage altitude** up to 15,000 feet (4600 m)

## CE notice

EMC complies to EMC regulations and directives for emission and immunity to interference (EN 61326-1 Industrial, EN/IEC 61326-2-1).

**Safety** complies to applicable safety regulation IEC/EN 61010-1.

This product complies with directive 2011/65/EU.

## Single-channel (portable / benchtop)

### Weight:

2.7 kg (6 lbs) to 4.0 kg (8.8 lbs) net without main adapter

### Dimensions:

incl. rubber: 124 mm H x 183 mm W x 305 mm L [4.88 in H x 7.20 in W x 12.01 in L]  
with RF output connector type N: 124 mm H x 183 mm W x 310 mm L [4.88 in H x 7.20 in W x 12.20 in L]

## Multi-channel (rack-mountable) 19" 2HU enclosure

### Weight:

18 kg (37 lbs) net,  $\leq$  25 kg (8 lbs) shipping

### Dimensions:

Body: 88 mm H x 444 mm W x 567mm L [3.5 in H x 17.5 in W x 22.3 in L]  
Front panel: 88 mm H x 486.2mm W [3.46 in H x 19.14 in W]

**Recommended calibration cycle:** 24 months



## Document History

Version/Status	Date	Author	Notes
V110	2019-10-28	jk	Update
V111	2020-02-20	yg/jk	Update
V113	2020-03-31	jk	Analog modulations revised, option EI/Q added, measurement plots added
V114	2020-04-31	jk	New plots added
V120	2020-11-10	jk	Extended to multi-channel, 12 GHz model
V121	2021-1-10	jk	Power specs refined, data plots added
V122	2021-05-03	rp	Pulse modulation, marker, multi-function in/outputs specs refined
V123	2021-06-01	ee	Updated product images
V124	2021-06-25	jk	Refined power ranges
V125	2021-07-20	rp	Updated FCP/baseband generator
V126	2022-02-04	jk	Plot update
V127	2022-03-21	jk/rp	Update
V128	2022-03-29	Jk ee	Option PE2 for APVSG6/12 , Option PE4, Option LN+, Reference bypass info Updated product images
V129	2022-10-29	jk	Phase Noise data refined



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