APSIN12G-APSIN20G-APSIN26G

Specification 2.46 (April 2016)

Portable 12,20, 28 GHz Microwave Signal Generators

with Options **HP, PE3, NM, LN, FS, TP**

Authorized UK & Ireland Distributor

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Introduction

The APSINXXG is a series of low-noise and fast-switching microwave signal generators covering a continuous frequency ranges from as low as 100 kHz up to 12, 20, and 26.5 GHz, respectively, with a 0.001 Hz resolution.
The APSINXXG provide an accurately levelled output power range and high spurious suppression. Advanced frequency synthesis with fractional-N divider makes for low SSB phase noise and micro-Hz resolution.

Available Options:

Option HP delivers higher maximum output power to a level up to +27 dBm.
Option PE3 is an optional power level extension to accurately level below -90 dBm.
Option LN provides ultra low phase noise and further improves frequency stability
Option FS substantially reduces the switching speed
Option NM removes all built-in modulation capabilities if not needed (APSIN20G, APSIN26G only)
Option B3 adds an internal rechargeable battery module
Option 1URM modifies form-factor to a 19'' rack-mountable 1HU enclosure
Option TP modifies form-factor to a 3HU 19'' bench-top enclosre with touch-display control

The standard APSINXXG includes amplitude modulation (AM), DC-coupled, low distortion wideband frequency modulation (FM), PM, FSK and PSK, frequency chirp, and fast pulse modulation with internal pulse train generator. Three internal modulations sources are available. All modulation modes of the APSINXXG can be combined. This allows the generation of complex modulation signals for modern communication and location systems. The combination of pulse modulation and FM simulates Doppler effects or chirp signals. Simultaneous AM and pulse modulation provides the types of signal occurring in pulse radar applications with rotating antenna. The combination of FM and AM can be used to check fading effects of FM receivers.
All APSINXXG allow fast analog and digital sweeps including flexible list sweeps, where frequency, power and dwell times can be set individually. A flexible triggering capability simplifies synchronization within test environments.
All APSINXXG operate with an ultra-stable temperature compensated 100 MHz reference (OCXO) to ensure minimal drift, and can be phase-locked to any stable external reference in a range from 1 to 250 MHz. Additionally, optimum phase synchronous signals can be achieved by bypassing internal and feeding a 100 MHz signal directly as reference.

The APSINXXG support various standard interfaces such as USB-TMC, LAN, and GPIB.

Applications for the APSINXXG include

- R&D low noise microwave source
- Production testing (industry-leading switching times; high dynamic range)
- Service and maintenance (battery operation)
- Signal simulation (Radar, WiMax, UWB)
- Aerospace & Defence (Pulse modulator, Chirps)

Signal Specifications

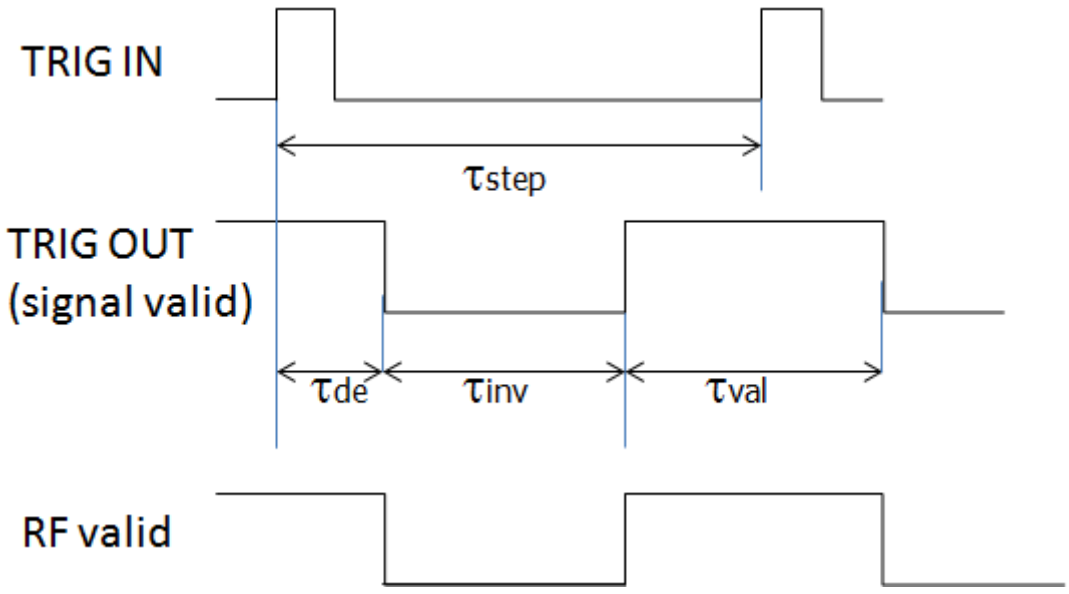
The specifications in the following pages describe the warranted performance of the signal generator for 23 ± 10 °C after a 30 minute warm-up period and for all configurations (options PE3 if not explicitly stated). Typical specifications describe expected, but not warranted performance. Min and Max specifications are warranted.

Parameter	Min.	Typ.	Max.	Note
CW mode				
Frequency range	100 kHz 100 kHz 100 kHz		12.0 GHz 20.0 GHz 26.5 GHz	**APSIN12G** **APSIN20G , settable to 20.5 GHz** **APSIN26G, settable to 30 GHz**
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Frequency / Amplitude settling time		200 µs	300 µs 30 µs	time from receipt of SCPI command option FS
SSB Phase noise (standard)				
500 MHz 10 Hz offset 1kHz offset 100 kHz offset		 -74 dBc/Hz -126 dBc/Hz -137 dBc/Hz		
4 GHz 10 Hz offset 1kHz offset 100 kHz offset		 -68 dBc/Hz -108 dBc/Hz -119 dBc/Hz		
20 GHz 10 Hz offset 1kHz offset 100 kHz offset		 -51 dBc/Hz - 91 dBc/Hz - 104 dBc/Hz		
Wideband noise		-150 dBc/ Hz		
SSB Phase noise (option LN)				
500 MHz 10 Hz offset 1kHz offset 100 kHz offset		 -106 dBc/Hz -131 dBc/Hz -147 dBc/Hz		
4 GHz 10 Hz offset 1kHz offset 100 kHz offset		 -88 dBc/Hz -115 dBc/Hz -128 dBc/Hz		
20 GHz 10 Hz offset 1kHz offset 100 kHz offset		 -74 dBc/Hz - 100 dBc/Hz - 113 dBc/Hz		
Amplitude Noise at 10 GHz		-130 dBc/Hz -140 dBm		Pout=+10 dBm, 100 kHz offset noise floor
Output power				Check maximum output power plots on page 10
Standard 100 kHz to fmax	 -20 dBm		 +15 dBm	
Option PE3 only 100 kHz to fmax	 -90 dBm		 +13 dBm	

Parameter	Min.	Typ.	Max.	Note
Option HP only	-20 dBm		+25 dBm	0.2 to 10 GHz
	-20 dBm		+23 dBm	10 to 16 GHz, see plot
	-20 dBm		+18 dBm	>18 GHz, see plot
Options HP and PE3				
	-90 dBm		+22 dBm	< 10 GHz
	-90 dBm		+20 dBm	10 to 16 GHz
	-90 dBm		+18 dBm	16 to 20 GHz
	-90 dBm		+15 dBm	>20 GHz
Level resolution		0.01 dB		
Level uncertainty, ALC on		0.3 dB	1.0 dB	-15 to +15 dBm
		0.6 dB	1.5 dB	-65 dBm to -15 dBm , option PE3
			2.5 dB	< -65 dBm, f< 10 GHz option PE3
			5.0 dB	< -65 dBm, f> 10 GHz option PE3
		0.8 dB	2.0 dB	< -65 dBm, options PE3 & 1URM
		0.5 dB	2.0 dB	> 15 dBm to Pmax, option HP
Temperature effects				
User flatness correction		0.015 dB/ °C up to 2000 points		0 to 45 °C
Output impedance		50 Ω		
VSWR		2.0		
Reverse Power Protection				
DC Voltage			±15 V	
RF power			30 dBm	
Spectral purity at + 5 dBm				
Output harmonics		-40 dBc	-30 dBc	See plot
Sub-harmonics		-75 dBc	-65 dBc	< 20 GHz
Non-harmonic spurious				
< 312 MHz				
> 312 to 625 MHz		-75 dBc	-70 dBc	
> 625 MHz to 1.5 GHz		-75 dBc	-65 dBc	
> 1.5 GHz to 2.5 GHz		-70 dBc	-65 dBc	
> 2.5 GHz to 5 GHz		-65 dBc	-60 dBc	
> 5 GHz to 10 GHz		-60 dBc	-55 dBc	
> 10 GHz to 20 GHz		-55 dBc	-50 dBc	
> 20 GHz		-50 dBc	-45 dBc	
Residual FM @ 10 GHz		15 Hz		0.3 kHz to 3 kHz, weighted (ITU-T), RMS
Residual AM @ 10 GHz		0.02 %		RMS value (0.01 kHz to 15 kHz)

Sweeping Capability

Sweeps can be performed with combined internal or external AM/FM/PM/pulse modulation running. With modulation enabled, the minimum step time increases to 2 ms.

Parameter	Min.	Typ.	Max.	Note
Digital power / frequency / list sweeps Sweep type: linear, logarithmic, random				
Step time (τ_{step})	400 µs 40 µs		19998 s	 Option FS
Dwell time (τ_{val})	10 µs		9999 s	
Off-time (incl. transient time) (t_{off})	0		9999 s	
Transient time (τ_{inv})			270 µs 30 µs	 Option FS
Timing delay (τ_{de})		2 to 10 µs 50 ns		 Option FS
Time resolution		0.1 µs 5 ns		 Option FS
Timing accuracy per point		3 µs 5 ns		 Option FS
				
Frequency Chirps (linear ramp, up/down)				
Bandwidth	10 %			of carrier frequency
Dwell time (t_{dwell})	10 ns		10000 µs	
Slope			100 MHz / µs	
Number of frequencies			65’000	

Reference Frequency

REF IN input and REF OUT output are at rear panel

Parameter	Min.	Typ.	Max.	Note
Internal reference frequency		100 MHz 10 / 100 MHz		 Option LN
Initial accuracy			±40 ppb	calibrated at 23 ± 3 °C at time of calibration , user adjustable
Temperature stability (0 to 50 degC)			±100 ppb ±20 ppb	 Option LN
Aging 1st year		0.5 ppm 0.1 ppm		 Option LN
Aging per day (after 30days operations)			5 ppb tbm	 Option LN
Warm-Up time		5 min		
Output of internal reference Output power Output impedance		10 MHz 10/100 MHz 0 dBm 50 Ohms		
Bypass Internal reference Input		100 MHz, -5 to +10 dBm 100 MHz, 1 GHz		High phase synchronous mode Option LN
Phase Lock to External Reference External Input Range	 1 MHz		 250 MHz	 User programmable
Reference input level	-5 dBm	0 dBm	+13 dBm	
Lock Range			±1.5 ppm	
Reference input impedance		50 Ohms		

Multi Purpose Output (FUNC OUT)

Output is FUNC OUT at rear panel

Parameter	Min.	Typ.	Max.	Note
MULTIFUNCTION GENERATOR	sine, triangle, square wave			
Frequency range	1 Hz 1 Hz		3 MHz 1 MHz 50 kHz	sine triangle square
Frequency resolution		0.1 Hz		
Output voltage amplitude peak-peak	10 mV	 5V	2 V	Sine, triangle Square (CMOS output)
Harmonic Distortion		1 %		< 100 kHz, 1 Vpp
Output impedance		50 Ohms CMOS		Sine, triangle square wave
VIDEO OUTPUT (of internal pulse modulator)				
Output		CMOS		
Period	30 ns		50 s	
Pulse Width	15 ns		50 s	

Parameter	Min.	Typ.	Max.	Note
RF delay		10 ns		
TRIGGER OUT	**Synchronization mode for multiple sources**			
Modes		Trigger on sweep start Trigger on each point Signal Valid		 Option FS

Trigger Input (TRIG IN)

Input is TRIG IN at rear panel

Parameter	Min.	Typ.	Max.	Note
Trigger Types		**Continuous, single, gated, gated direction**		
Trigger Source		**RF key, external, bus (GPIB, LAN, USB)**		
Trigger Modes		**Continuous free run, trigger and run, reset and run**		
Trigger latency		2 µs 5 ns		 Option FS
Trigger uncertainty		5 µs 10 ns		 Option FS
External Trigger delay	50 µs 50 ns		40 s 10 s	programmable Option FS
External Delay Resolution		15 ns 10 ns		 Option FS
Trigger Modulo	1		255	Execute only on Nth trigger event
Trigger Polarity		Rising, falling		

Trigger Output (TRIG OUT)

see Multi Purpose Output (FUNC OUT)

Modulation Capabilities (not with option NM)

Combined AM/PM/FM/PULSE possible (see user manual)

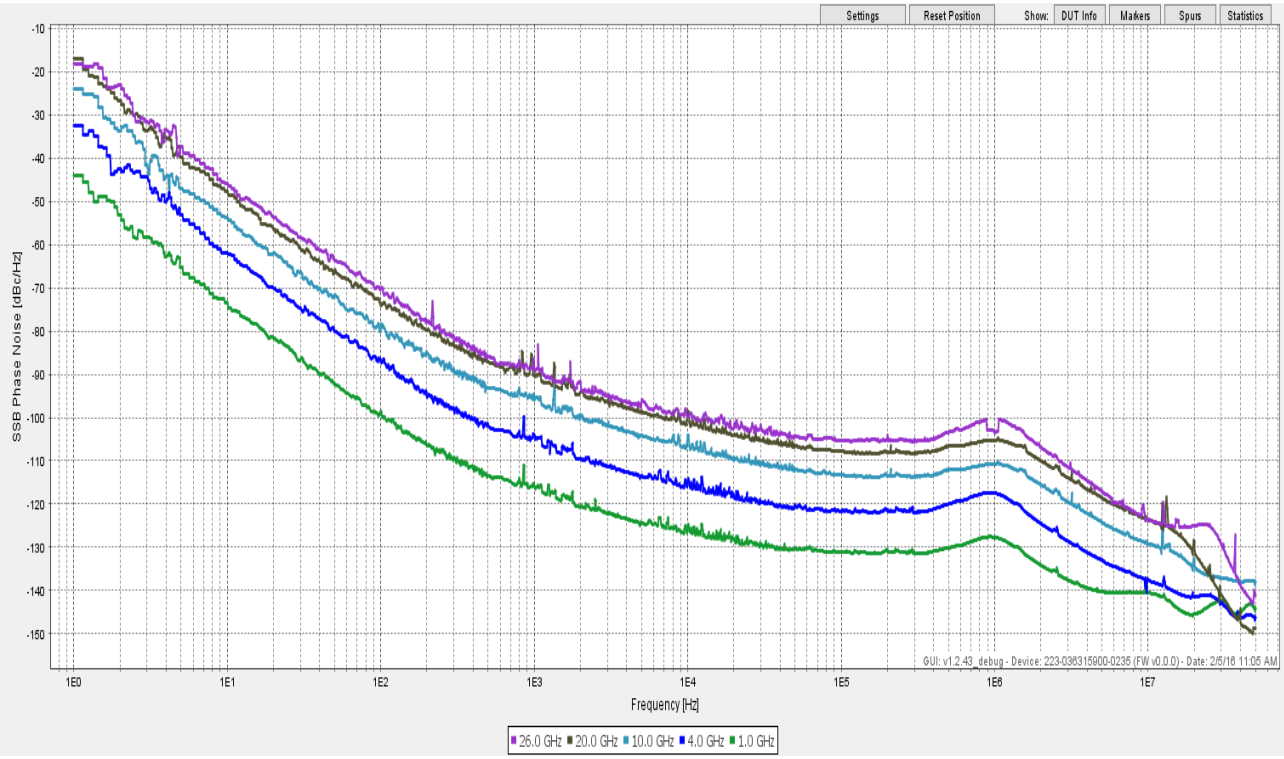
Parameter	Min.	Typ.	Max.	Note
Multifunction Generator sine, triangle, square wave Output is FUNC OUT at rear panel				
Frequency range	1 Hz 1 Hz		3 MHz 1 MHz 50 kHz	sine triangle square
Frequency resolution		0.1 Hz		
Output voltage amplitude peak-peak	10 mV	 5V	2 V	Sine, triangle Square (CMOS output)
Harmonic Distortion		1 %		< 100 kHz, 1 Vpp
Output impedance		50 Ohms CMOS		Sine, triangle square wave
Pulse Modulation On/off ratio		70 dB		**at +10 dBm**
Repetition frequency	DC		10 MHz	
Pulse width	30 ns 500 ns			ALC hold ALC on
Pulse rise/fall time		7 ns		
Pulse width	30 ns		100 µs	
Pulse resolution		15 ns		
Polarity		selectable		
External input amplitude		1 V TTL		AC DC
Pulse Pattern Modulation On/off ratio		70 dB		Using internal pattern generator **at +10 dBm**
Pulse bit width	30 ns 500 ns			ALC hold ALC on
Pulse rise/fall time		7 ns		
Programmable pattern length	2		4192	
Pulse width	30 ns		100 µs	
Pulse bit resolution		15 ns		
Polarity		selectable		
Frequency Modulation Maximum Frequency deviation (peak)		> 0.05·f N · 200 MHz		*< 1.25 GHz* *1.25 GHz to 2.5 GHz (N=0.125)* *2.5 GHz to 5 GHz (N=0.25)* *5 GHz to 10 GHz (N=0.5)* *> 10 GHz to 20 GHz (N=1)*
Deviation accuracy (1kHz rate, 50 kHz deviation)		< 2%		
Modulation rate	DC		800 kHz	> -3dB frequency response
Modulation waveforms		Sine, triangle, FSK		
External input sensitivity AC DC		 0 to N · 200 MHz / V 0 to N · 100 MHz / V		 adjustable for ±1 V range discr. values ; ±5 V range
Total harmonic distortion		< 1%		1 kHz rate & N · 1 MHz deviation

Parameter	Min.	Typ.	Max.	Note
Phase Modulation				
Phase deviation (peak)	0		N·300 rad	
Modulation rate	DC		800 kHz	> -3dB frequency response Max. phase deviation degrades above 20 kHz modulation rate
Modulation waveforms	Sine, triangle, FSK			
External Input sensitivity	Settable 0.1 rad/V to 360 rad/V			
Total harmonic distortion	< 1%			1 kHz rate & N x 100 rad deviation
Amplitude Modulation				
Modulation rate	0.1 Hz		50 kHz	
Modulation waveforms	Sine, triangle, square			
Modulation depth	0 %		90 %	
Distortion (sine wave)		2 %		at 60% modulation depth
Accuracy (1kHz, 80%)	- 4%		4 %	for 10 to 80%, 0 dBm

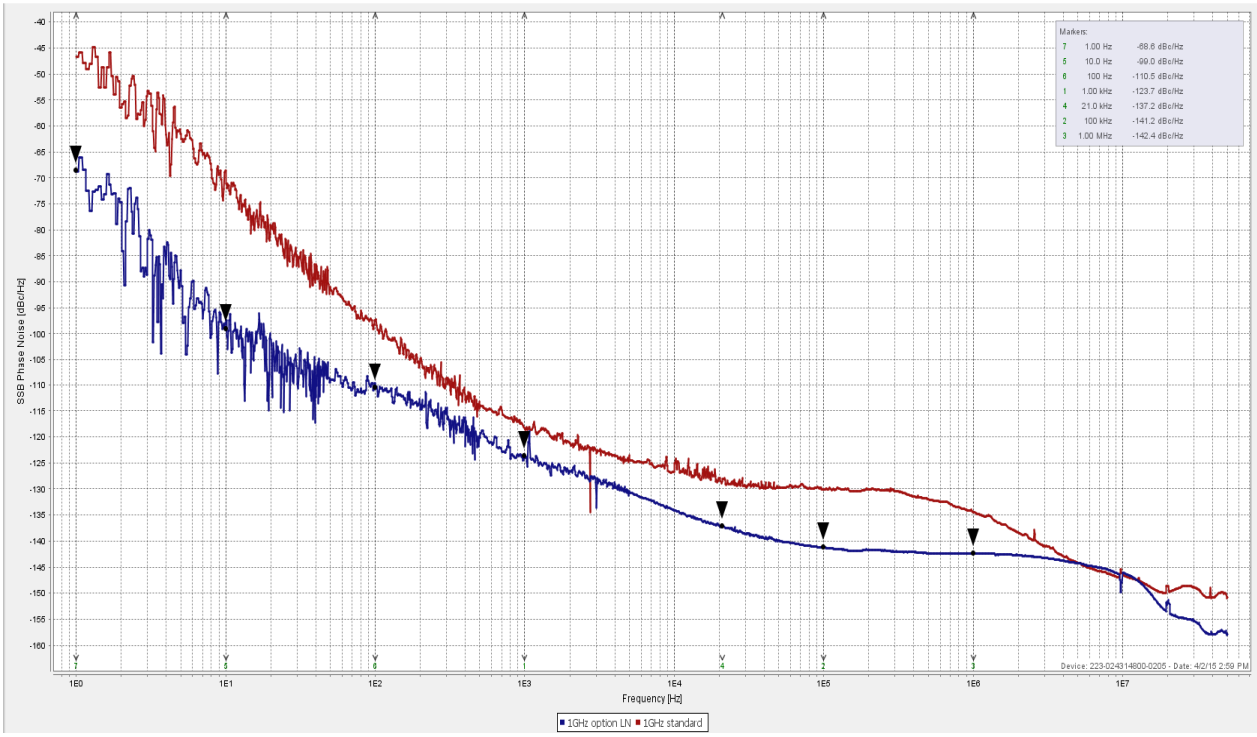
Notes:

Typical performance curves

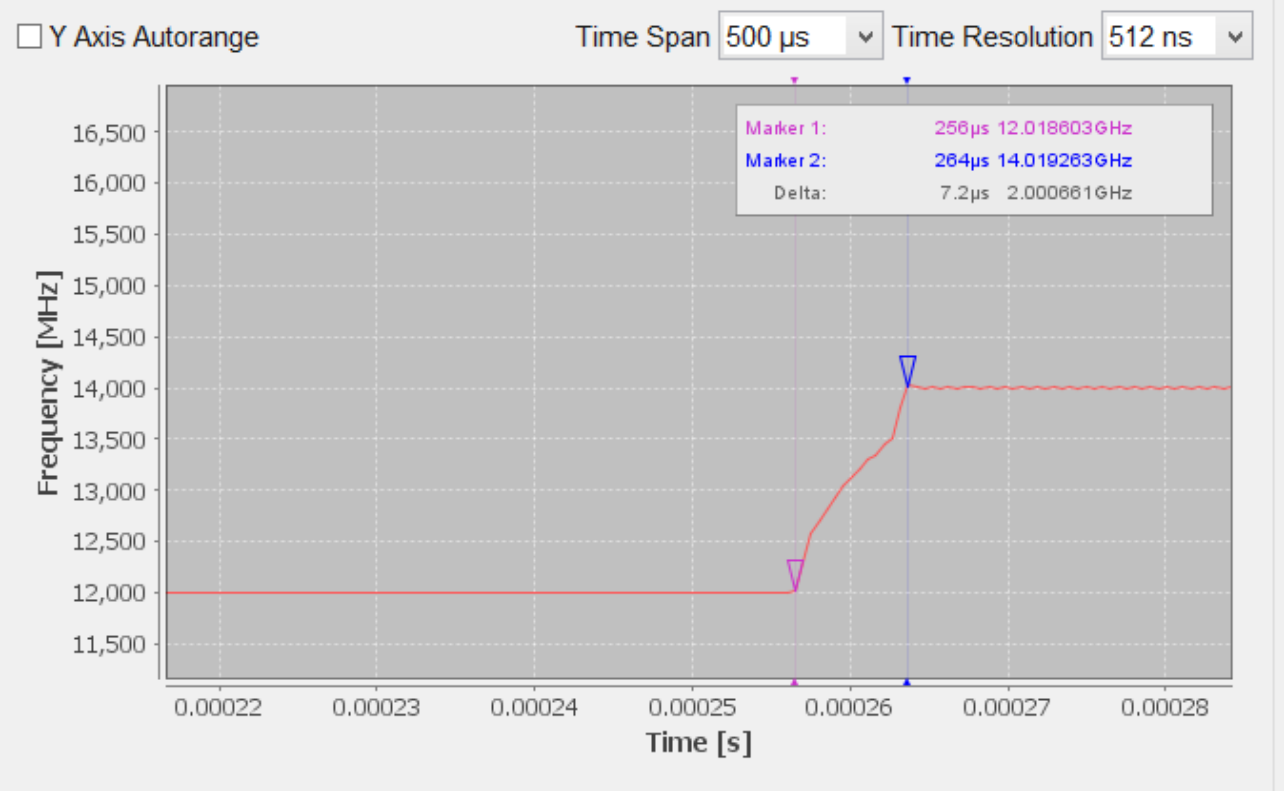
Phase Noise Performance (10 Hz to 50 MHz offset) at 1,4,13 and 26 GHz



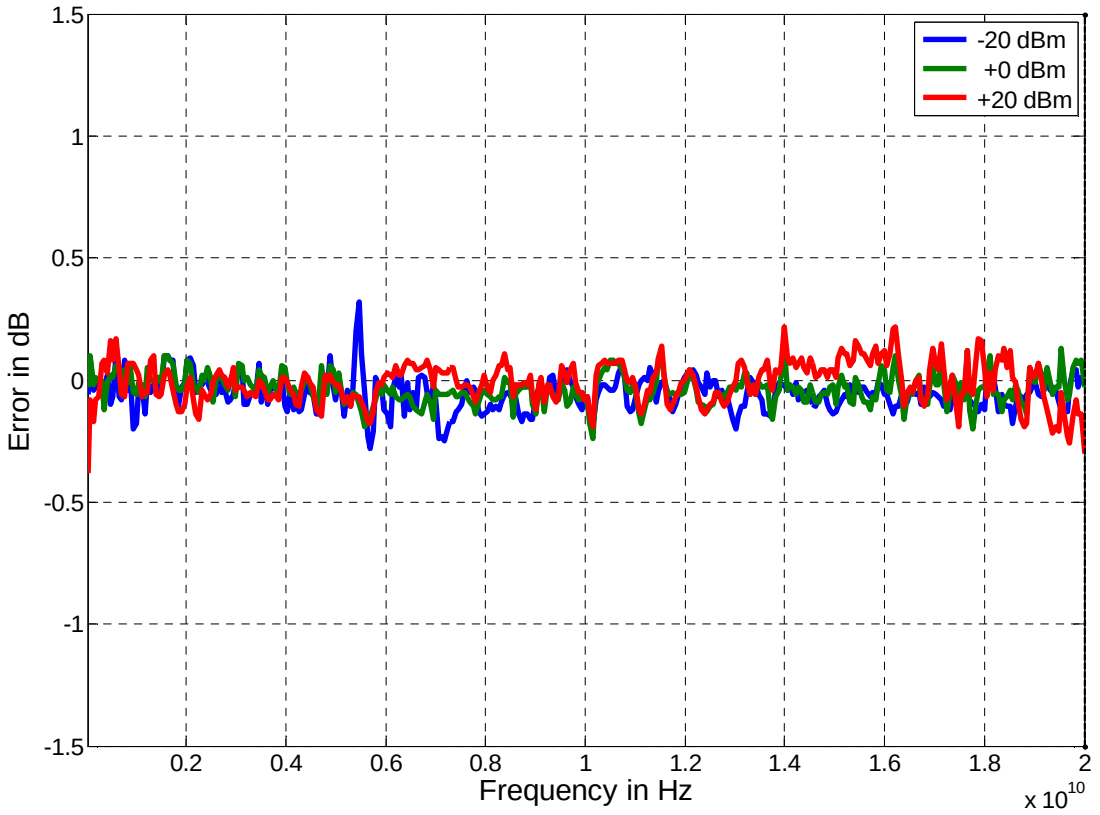
Phase Noise with Option LN

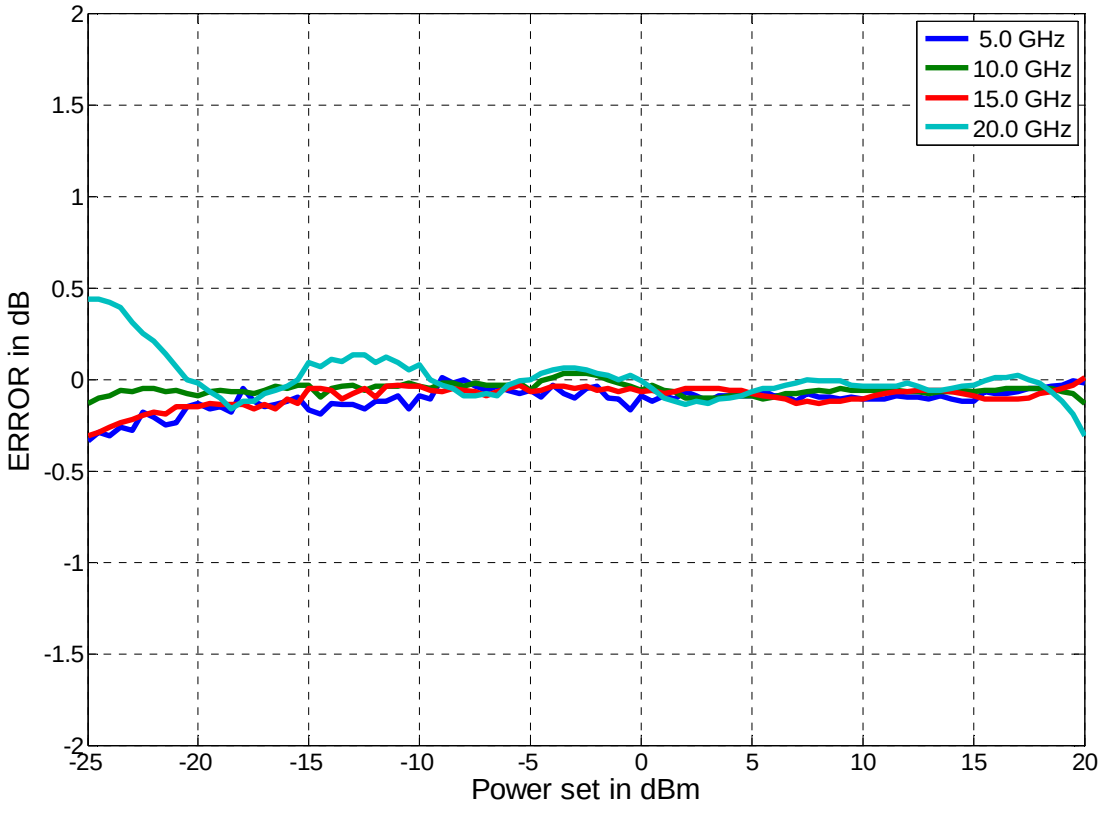


Typical Switching transient from 12 GHz to 14 GHz step

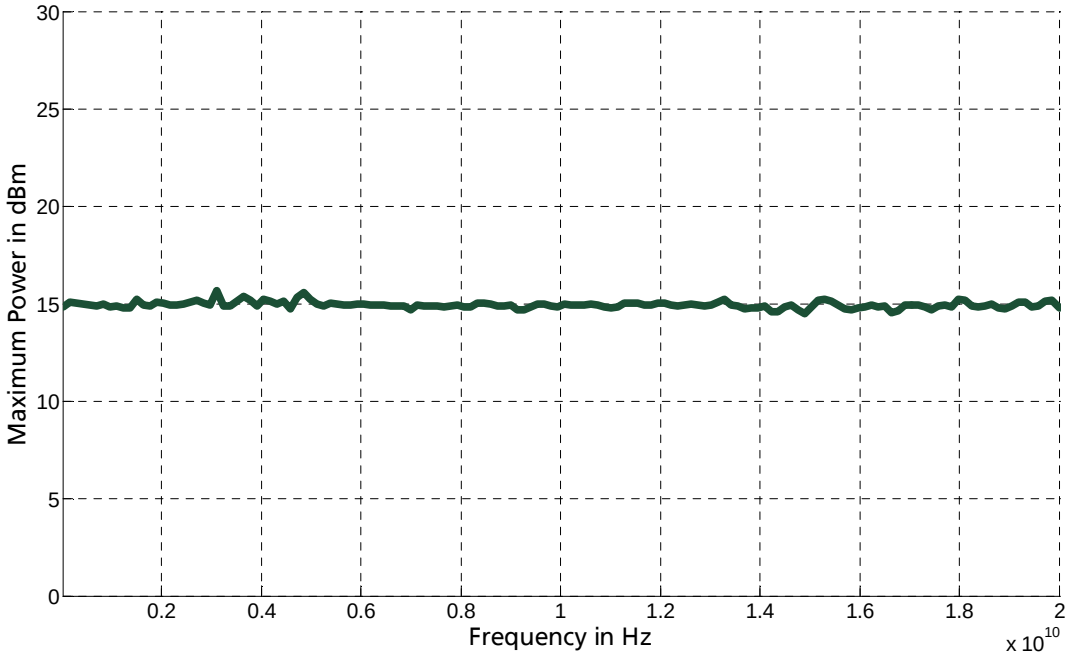


Typical Frequency Response 0 to 20 GHz at -20, 0, and +20 dBm

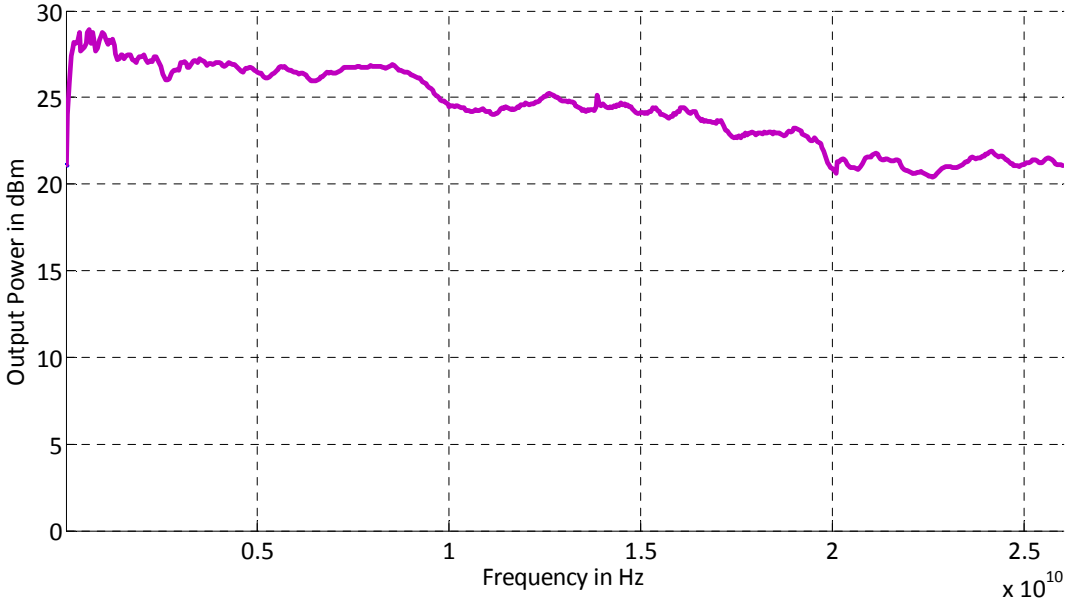




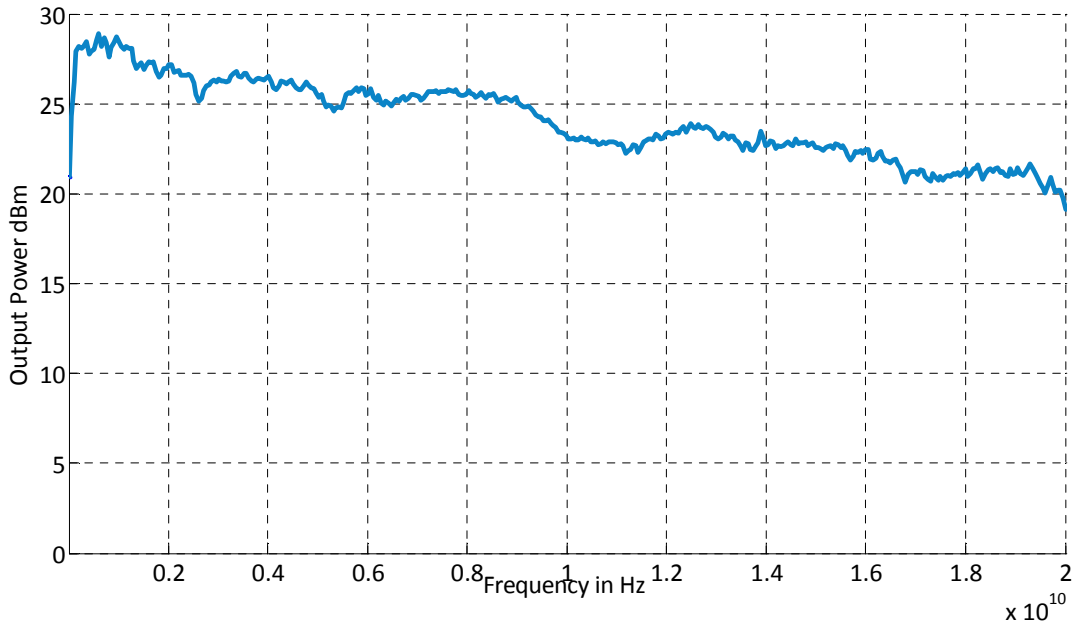
Typical Maximum Output Power (standard)



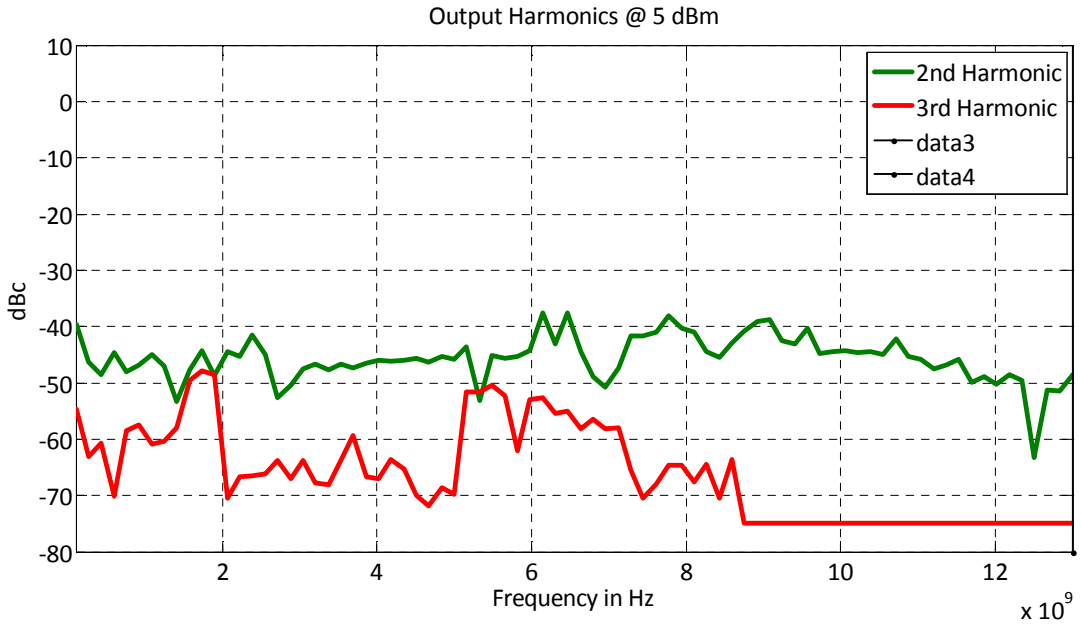
Typical Maximum Output Power (option HP)



Typical Maximum Output Power (options PE3 and HP)



Harmonics (with option PE3)

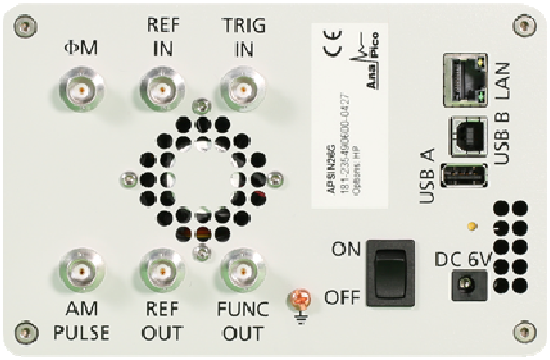


Connectors

Front panel:

1. RF output: SMA female
2. RF on/off button
3. Rotary knob
4. Menu and ↓ ↑ ← → arrow keys

Rear panel:



1. Trigger input: BNC female
2. Function output: BNC female
3. External reference input: BNC female
4. Internal reference output: BNC female
5. FM/PM modulation input: BNC female
6. AM and Pulse modulation: BNC female
7. LAN connection: RJ-45
8. USB 2.0 host and device
9. GPIB: IEEE-488.2, 1987 with listen and talk (optional)
10. DC Power plug (6V, 6A)
11. DC power switch

General Characteristics

Remote programming interfaces
Ethernet 100BaseT LAN interface,
USB 2.0 host & device
GPIB (IEEE-488.2,1987) with listen and talk (optional)
Control language SCPI Version 1999.0

Power requirements 6.25 ± 0.2 VDC ; 20 W maximum
Mains adapter supplied: 100-240 VAC in/ 6 V 6.0 A DC out
Operating temperature range 0 to 40 °C
Storage temperature range –40 to 70 °C
Operating and storage altitude up to 15,000 feet
CE **notice**
Safety/EMC complies with applicable Safety and EMC regulations and directives.

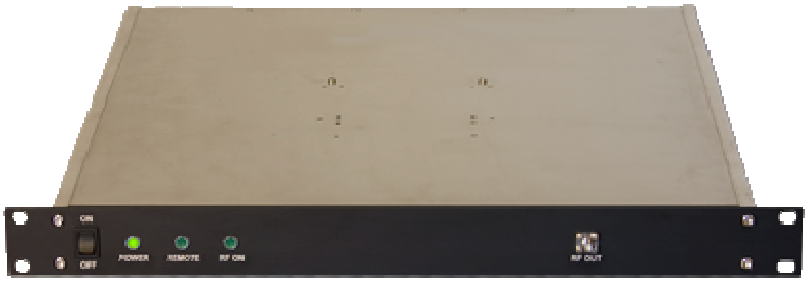
Weight ≤ 2.5 kg (6 lbs) net, ≤ 4 kg (8 lb.) shipping
Dimensions 106 mm H x 172 mm W x 270 mm L (incl. connectors)
[4.21 in H x 6.77 in W x 10.63 in L]

Recommended calibration cycle 24 months

Options

- ***HP***: High output power
- ***PE3***: Extended power range down to <-90 dBm) step attenuator module
- **NM**: remove modulation
- **LN**: ultra low phase noise, improved frequency stability
- **FS**: enhanced switching speed
- ***B3***: battery module
- ***TP***: 3HE enclosure with touch display. Dimensions incl. rubber: 154 mm H x 467.5 mm W x 342 mm L [6.1 in H x 18.4 in W x 13.5 in L]
- ***GPIB****: IEEE-488.2,1987 programming interface*

- **1URM**: 19'' 1HE enclosure with rack-mount capability. Dimensions 42 mm H x 426 mm W x 460 mm L [1.7 in H x 16.8 in W x 18.1 in L]



- ***GPIB***: IEEE-488.2,1987 programming interface

- **RM:** 19'' rackmount kit: good for one or two adjacent APSIN

Document History

Version/Status	Date	Author	Notes
V10	2010-06-01	jk	first release
V11	2010-08-30	jk	added specs for VSWR, AM noise, residual
V13	2010-10-15	jk	power, frequency range, modulation specs updated
V14	2011-04-28	jk	Frequency and power range , Output connector, added phase noise plot
V160	2013-08-26	db	Modified sweep timing specs, added max power measurement plots
V20	2014-07-30	jk	Combined APSIN20G and option HP
V21	2014-11-10	jk	Added pulse pattern specs
V22	2014-12-10	jk	Unified data sheet for APSINXXG
V23	2015-1-15	jk	Addeded max. power plots
V240	2015-10-29	jk	Clarified switching speed, Phase noise revised
V241	2015-12-18	jk	Power level accuracy refined
V241	2016_01-12	jk	Refined spurous specs
V245	2016_03-04	jk	Included ALC temp effects, renewed phase noise plots
V246	2016_04-04	jk	Power level accuracy option deppendant