

# APSIN20G Specification 1.52

## Portable Microwave Signal Generator



## **Introduction**

The APSIN20G is a low-noise and fast-switching microwave signal generator covering a frequency range from 10 MHz up to 20 GHz+. The lowest settable frequency is however as low as 9 kHz with some reduced maximum output power.

The APSIN20G a wide and 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 frequency resolution.

Various power level extensions are available to accurately level down to -120 dBm.

The APSIN20G includes AM, DC-coupled, low distortion wideband-FM, PM, FSK and PSK, frequency chirp, and fast pulse modulation with internal pulse train generator as standard. Three internal modulations sources are available. All modulation modes of the APSIN20G 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.

The APSIN20G allows 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.

The APSIN20G operates with an ultra-stable temperature compensated 100 MHz reference (OCXO) to ensure minimal drift, and can be phase-locked to almost any stable external reference in a range from 1 to 200 MHz.

The APSIN20G support various standard interfaces such as USB-TMC, LAN, and GPIB.

It is targeted for applications where a high-quality CW microwave source with versatile modulation is required. It offers an alternative to expensive high-end microwave signal generators, where small size and excellent microwave performance at an attractive cost is required.

**Applications for the APSIN20G 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

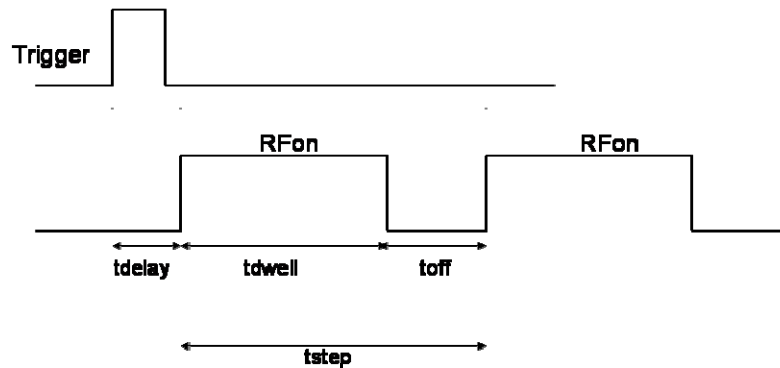
The specifications in the following pages describe the warranted performance of the signal generator for  $23 \pm 10$  °C after a 30 minute warm-up period and for all configurations (options PE2/PE3/HP if not explicitly stated). Typical specifications describe expected, but not warranted performance. Min and Max specifications are warranted.

Parameter	Min.	Typ.	Max.	Note
Frequency range	10 MHz 9 kHz		20 GHz 20.5 GHz	With guaranteed specs Settable
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Settling time		20 $\mu$ s	100 $\mu$ s	
Frequency update rate List/Sweep mode		200 $\mu$ s 100 $\mu$ s		time from receipt of SCPI command
SSB Phase noise at 10 GHz				
at 1 kHz from carrier		-100 dBc/Hz		
at 20 kHz from carrier		-108 dBc/Hz		
Wideband noise		-150 dBc/ Hz		
Total jitter		100 fs RMS		BW over 10 Hz to 20 MHz
Amplitude Noise at 10 GHz		-130 dBc/Hz -140 dBm		Pout=+10 dBm, 100 kHz offset noise floor
Output power level				
Range				
9 kHz to 10 MHz	-20 dBm -90 dBm -120 dBm		0 dBm 0 dBm 0 dBm	with Option PE3 with option PE2
10 MHz to 100 MHz	-20 dBm		+8 dBm	
100 MHz to 18 GHz	-20 dBm		+13 dBm	
18 GHz to 20 GHz	-20 dBm		+10 dBm	
10 MHz to 20 GHz	-90 dBm		+8 dBm	with Option PE3
10 MHz to 20 GHz	-120 dBm		+8 dBm	with option PE2
Resolution		0.01 dB		
Level uncertainty, ALC on			< 1 dB < 1.5 dB	> -15 dBm > -90 dBm
User flatness correction		up to 2000 points		
Output impedance VSWR		50 $\Omega$ 2.0		
Spectral purity at + 5 dBm Output harmonics		-40 dBc -35 dBc -45 dBc	-30 dBc -30 dBc -30 dBc	At +15 dBm w option HP 0.1 to 5.1 GHz 5.1 to 11 GHz 11 GHz to 20 GHz
Sub-harmonics		-75 dBc	-60 dBc	0.01 to 20 GHz
Non-harmonic spurious		-75 dBc	-60 dBc	at +10 dBm output power
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
<b>Frequency sweep</b>				
Sweep type: linear, logarithmic, random				
Step time ( $t_{step}$ )	400 $\mu$ s			
Dwell time ( $t_{dwell}$ )	10 $\mu$ s			
Off-time (incl. transient time) ( $t_{off}$ )	50 $\mu$ s		$t_{step}$	
Timing accuracy per point		1 $\mu$ s		



## Generalized list sweep

allows individual setting of frequency, power, dwell-time, and off-time for each point

List size	2		65'000	
Step time ( $t_{step}$ )	400 $\mu$ s			mechanical attenuator not used
Dwell time ( $t_{dwell}$ )	10 $\mu$ s		1000 s	
Off-time (incl. transient time) ( $t_{off}$ )	50 $\mu$ s		$t_{step}$	
Time resolution		0.1 $\mu$ s		
Timing accuracy per point		1 $\mu$ s		

## Fast sweep

Sweep span		10 %		varies with carrier frequency
Sweep rate	tbd		N · 5 GHz / ms	
Sweep time	0.1 ms		100 ms	

Reference frequency input	1 MHz		200 MHz	User programmable
Reference input level	-5 dBm	0 dBm	+13 dBm	
Lock Range			$\pm 1.0$ ppm	
Reference input impedance		50 Ohms		
Internal reference frequency output		100 MHz 10 MHz		Opt. improved stability >0 dBm
Temperature stability (0 to 50 degC)			$\pm 100$ ppb	
Aging 1 <sup>st</sup> year		0.5 ppm		
Aging per day (after 30 days operations)			5 ppb	

<b>Parameter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Note</b>
Warm-Up time		5 min		
Output of internal reference		5 dBm 50 Ohms		
Reverse Power Protection				
DC Voltage		15 V		
RF power			30 dBm	
Dimensions				
Excluding connectors	W x L x H = 172 x 220 x 106 mm			
Including connectors	W x L x H = 172 x 243 x 106 mm			

Notes:

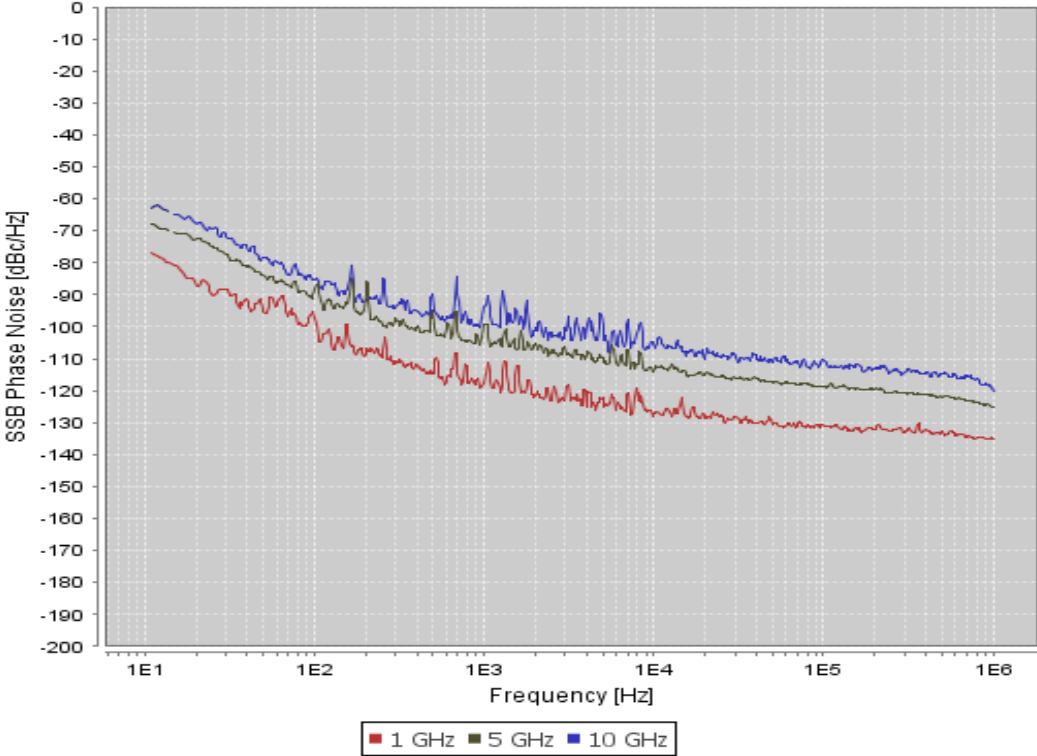
# Modulation Capabilities

Parameter	Min.	Typ.	Max.	Note
<b>Multifunction Generator</b> sine, triangle, square wave				
Output is Sync 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
<b>Pulse Modulation</b>				
On/off ratio		70 dB		
Repetition frequency	DC		10 MHz	
Pulse width	40 ns 50 μs			ALC hold ALC on
Pulse rise/fall time		7 ns		
Pulse train (optional)	2		1024	with settable pulse duration
Polarity		selectable		
External input amplitude		1 V TTL		AC DC
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)
Modulation rate	DC		800 kHz	> -3dB frequency response
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
Phase modulation Phase deviation (peak)	0		N·300 rad	
Modulation rate	DC		800 kHz	> -3dB frequency response
External Input sensitivity	Settable 0.1 rad/V to 360 rad/V			
Total harmonic distortion		< 1%		1 kHz rate & N x 100 rad deviation
<b>AM Modulation</b>				
Modulation rate	0.1 Hz		20 kHz	
Modulation depth	0 %		90 %	
Distortion		2 %		at 60% modulation depth
Accuracy		5 %		

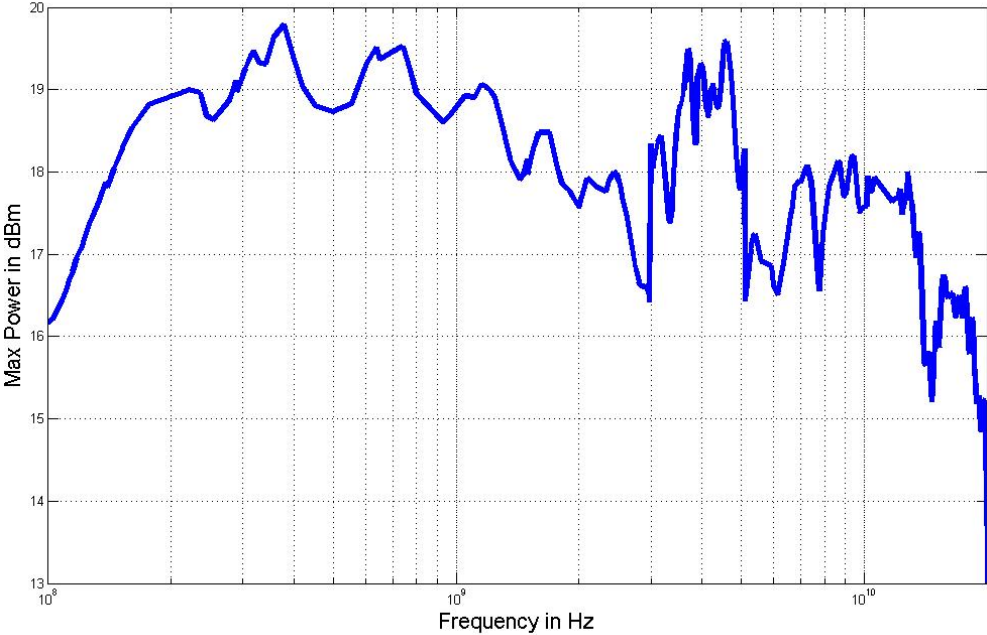
Notes:

# Typical performance curves

## Phase Noise Performance

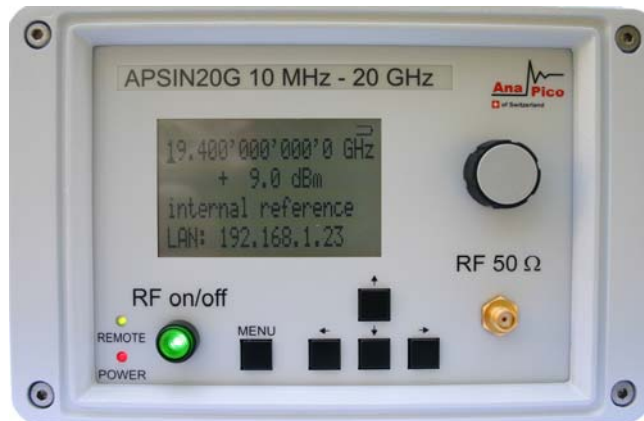


## Maximum Output Power



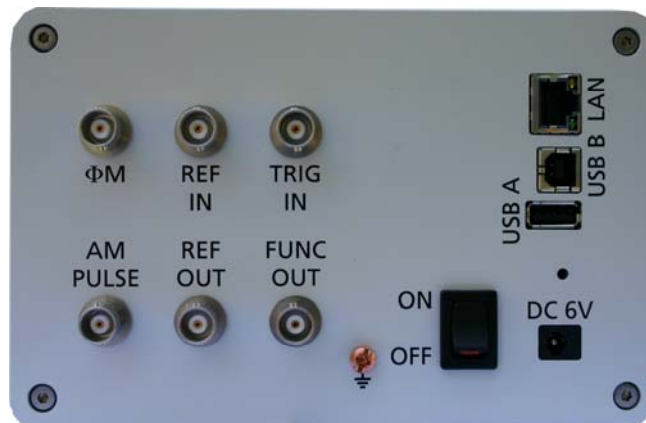
# Connectors

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, 2.5A)
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 VDC; 20 W maximum

Mains adapter supplied: 100-240 VAC in/ 6V 2.5A DC out

Operating temperature range 0 to 45 °C

Storage temperature range -40 to 70 °C

Operating and storage altitude up to 15,000 feet



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 220 mm L

[4.21 in H x 6.77 in W x 8.66 in L]

Recommended calibration cycle 24 months

## Options

- *PE3*: Extended power range down to <-90 dBm)
- *PE2*: Extended power range (down to <-120 dBm)
- *B3*: battery module (not for APSIN20RM)
- *GPIB*: IEEE-488.2,1987 programming interface (contact AnaPico about availability)



- *TB*: improved internal reference stability
- *RM*: 19" rackmount enclosure

## 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
V141	2011-05-22	jk		Low frequency specs, harmonics
V142	2011-06-12	jk		FM peak deviation changed
V143	2011-08-30	jk		Leveled output power, Harmonics specs
V152	2011-08-30	jk		Added Maximum Power Plot