APSIN12G-APSIN20G-APSIN26G

Specification 2.3 (Jan 2015)

Portable 12,20,26 GHz Microwave Signal Generators

with Options **HP, PE3, NM**

(Serial xxx-xxxx8xxxx-xxxx and higher)

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 NM removes all built-in modulation capabilities if not needed (APSIN20G, APSIN26G only)
Option B3 adds an internal rechargeable battery module

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		12.0 GHz	**APSIN12G**
	100 kHz		20.0 GHz	**APSIN20G**
	100 kHz		26.5 GHz	**APSIN26G**
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Frequency update rate		400 μs		time from receipt of SCPI command
List/Sweep mode		400 μs		
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		
Amplitude Noise at 10 GHz		-130 dBc/Hz		Pout=+10 dBm, 100 kHz offset
		-140 dBm		noise floor
Output power				Check maximum output power plots on page 10
Output power				
Standard				
100 kHz to fmax	-20 dBm		+15 dBm	SN xxx-xxxx8xxxx-xxxx
Option PE3 only				
100 kHz to fmax	-90 dBm		+13 dBm	
Option HP only				
	-20 dBm		+23 dBm	< 18 GHz
	-20 dBm		+20 dBm	>18 GHz, see plot
Options HP and PE3				
	-90 dBm		+20 dBm	< 18 GHz
	-90 dBm		+17 dBm	>16 GHz, see plot
Level resolution		0.01 dB		
Level uncertainty, ALC on		0.3 dB	< 1 dB	> -15 dBm
			< 1.5 dB	< -15 dBm
User flatness correction		up to 2000 points		
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	0.1 to 5.0 GHz
	-35 dBc		-30 dBc	5.0 to 10.0 GHz
	-45 dBc		-30 dBc	> 10 GHz

Parameter	Min.	Typ.	Max.	Note
Sub-harmonics		-75 dBc	-65 dBc	
Non-harmonic spurious		-75 dBc	-60 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 frequency sweep				
Sweep type: linear, logarithmic, random				
Step time (t_{step})	400 ⃞s		19998 s	
Dwell time (t_{dwell})	10 ⃞s		9999 s	
Off-time (incl. transient time) (t_{off})	0 / 50 ⃞s		9999 s	
Timing accuracy per point		1 ⃞s		
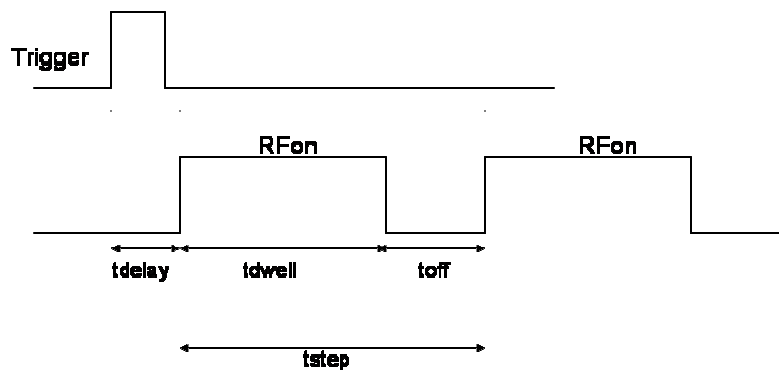
Parameter	Min.	Typ.	Max.	Note
Generalized list sweep				
allows individual setting of frequency, power, dwell-time, and off-time for each point				
List size	2		65'000	
Step time (t_{step})	400 µs		19998 s	mechanical attenuator not used
Dwell time (t_{dwell})	50 µs		9999 s	
Off-time (incl. transient time) (t_{off})	0 / 50 µs		9999 s	
Time resolution		0.1 µs		
Timing accuracy per point		1 µs		
Ramp (analog) sweep				
Sweep span		20 %		of carrier frequency
Sweep rate	tbd		N · 5 GHz / ms	
Sweep time	0.1 ms		100 ms	
Frequency Chirps				
(linear ramp, up/down)				
Bandwidth	10 %			of carrier frequency
Dwell time (t_{dwell})	10 ns		10000 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		
Initial accuracy			±40 ppb	calibrated at 23 ± 3 °C at time of calibration , user adjustable
Temperature stability (0 to 50 degC)			±100 ppb	
Aging 1st year		0.5 ppm		
Aging per day (after 30days operations)			5 ppb	
Warm-Up time		5 min		
Output of internal reference		10 MHz 10/100 MHz		
Output power		0 dBm		
Output impedance		50 Ohms		
Bypass Internal reference Input		100 MHz, -5 to +10 dBm		High phase synchronous mode
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	
RF delay		10 ns		

Parameter	Min.	Typ.	Max.	Note
TRIGGER OUT	Synchronization mode for multiple sources			
Modes	Trigger on sweep start Trigger on each point			
Trigger waveform pulse width		100 ns		

Trigger (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		tbd		
Trigger uncertainty		5 ⁊s		
External Trigger delay	50 ⁊s		40 s	
External Delay Resolution		15 ns		
Trigger Modulo	1		255	Execute only on Nth trigger event
Trigger Polarity	Rising, falling			

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		3 MHz	sine
	1 Hz		1 MHz	triangle
			50 kHz	square
Frequency resolution		0.1 Hz		
Output voltage amplitude peak-peak	10 mV		2 V	Sine, triangle
		5V		Square (CMOS output)
Harmonic Distortion		1 %		< 100 kHz, 1 Vpp
Output impedance		50 Ohms		Sine, triangle
		CMOS		square wave
Pulse Modulation				
On/off ratio		70 dB		**at +10 dBm**
Repetition frequency	DC		10 MHz	
Pulse width	30 ns			ALC hold
	500 ns			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		AC
		TTL		DC
Pulse Pattern Modulation				Using internal pattern generator
On/off ratio		70 dB		**at +10 dBm**
Pulse bit width	30 ns			ALC hold
	500 ns			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		> 0.05·f		*< 1.25 GHz*
Maximum Frequency deviation (peak)		N · 200 MHz		*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
Modulation waveforms		Sine, triangle, FSK		
External input sensitivity				
AC		0 to N · 200 MHz / V		adjustable for ±1 V range
DC		0 to N · 100 MHz / V		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	

| Parameter	Min.	Typ.	Max.	Note
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

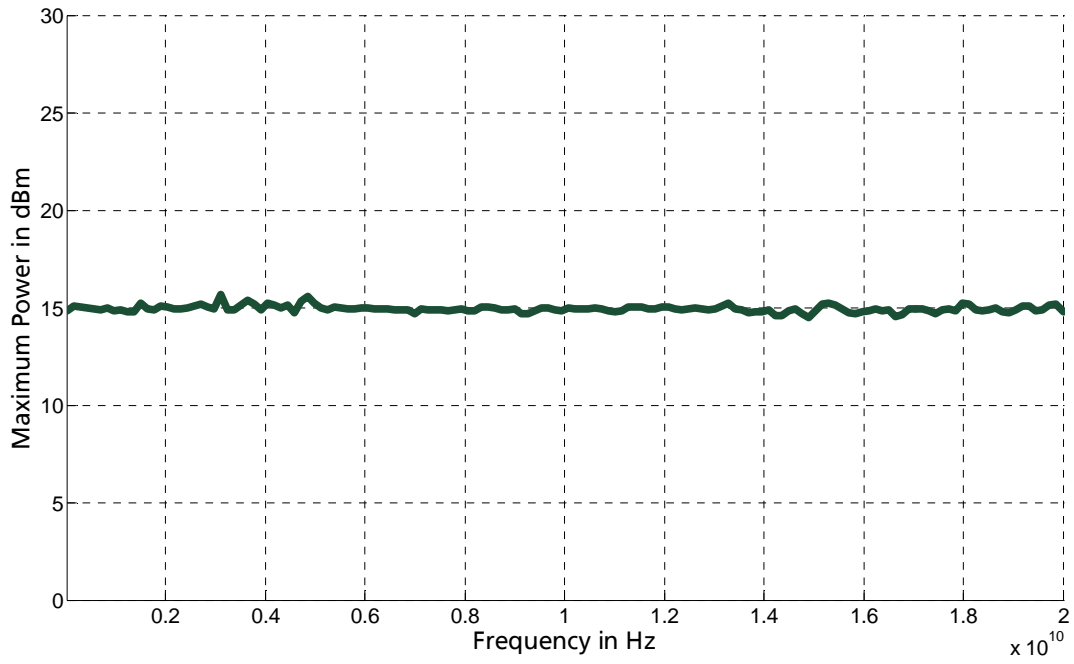| **Amplitude Modulation**				
Modulation rate	0.1 Hz		20 kHz	
Modulation waveforms		Sine, triangle, square		
Modulation depth	0 %		90 %	
Distortion (sine wave)		2 %		at 60% modulation depth
Accuracy		4 %		

Notes:

Typical performance curves

Phase Noise Performance (1 Hz to 50 MHz offset)
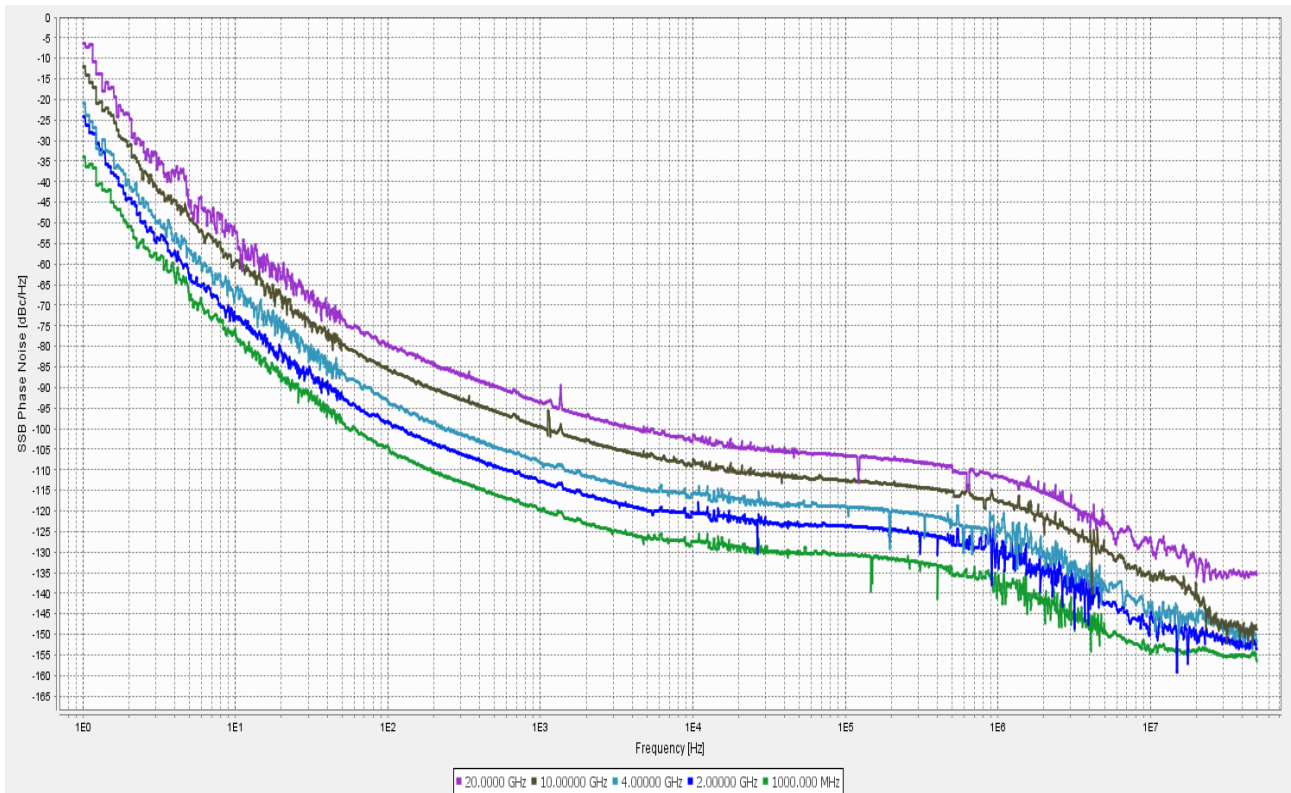
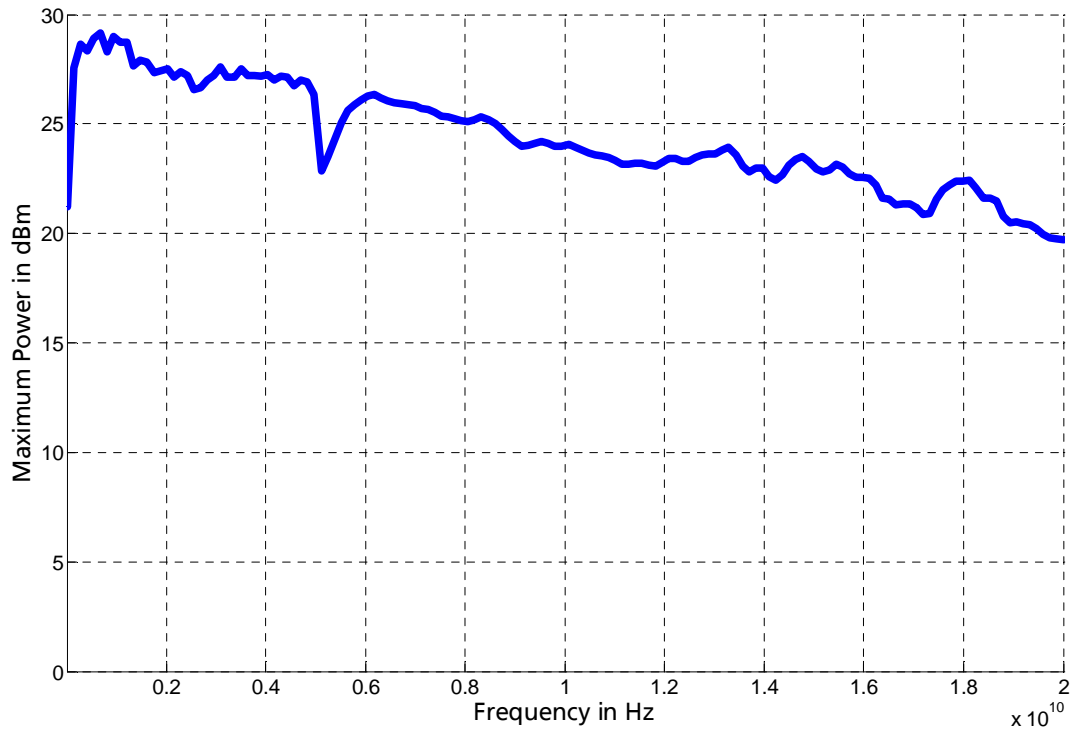**Typical Frequency Response 0 to 20 GHz at -10, 0, and +10 dBm**
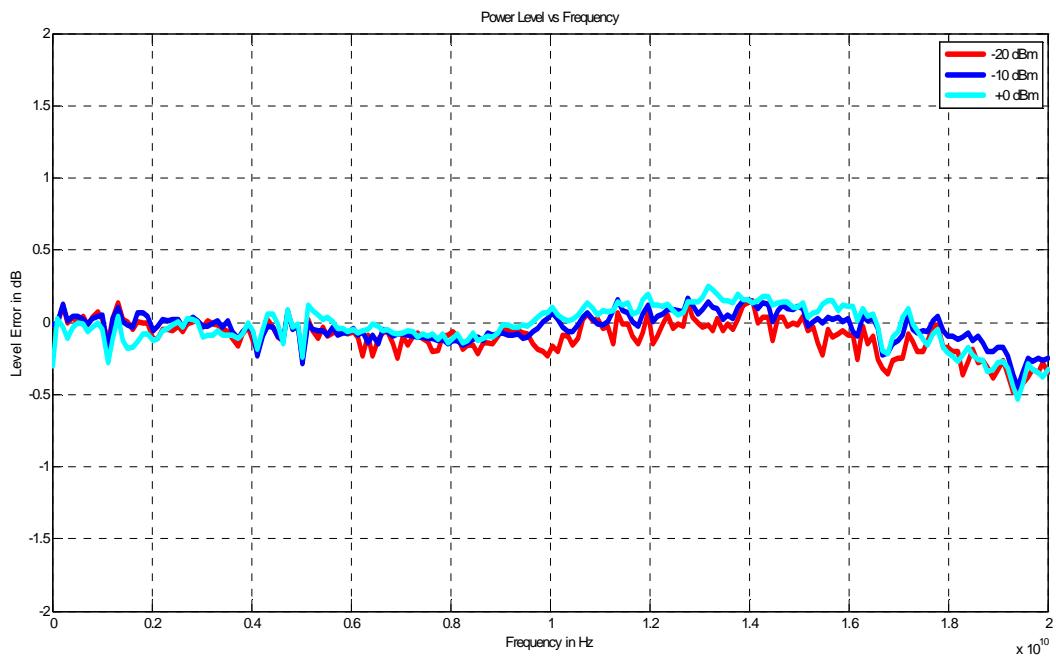
Typical Maximum Output Power (standard)

Typical Maximum Output Power (option HP)
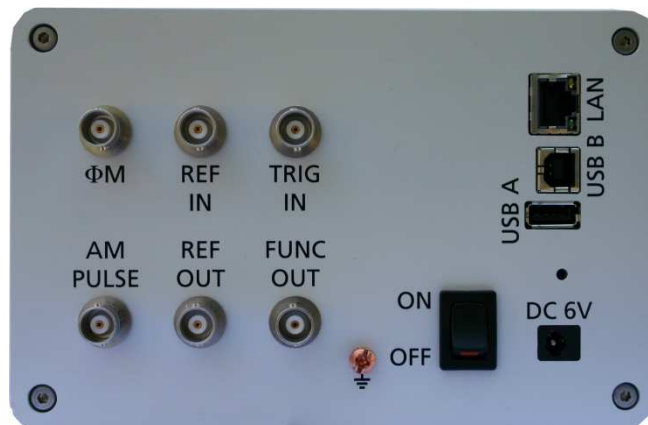
tbd

Typical Maximum Output Power (options PE3 and HP)

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/ 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

$C\hspace-0.2em\epsilon$ **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
- *B3*: battery module (not available for 1U APSIN20RM)
- *GPIB*: IEEE-488.2,1987 programming interface (not available for 1U APSIN20RM)

- **RM:** 19'' rackmount enclosure: good for one or two adjacent APSIN
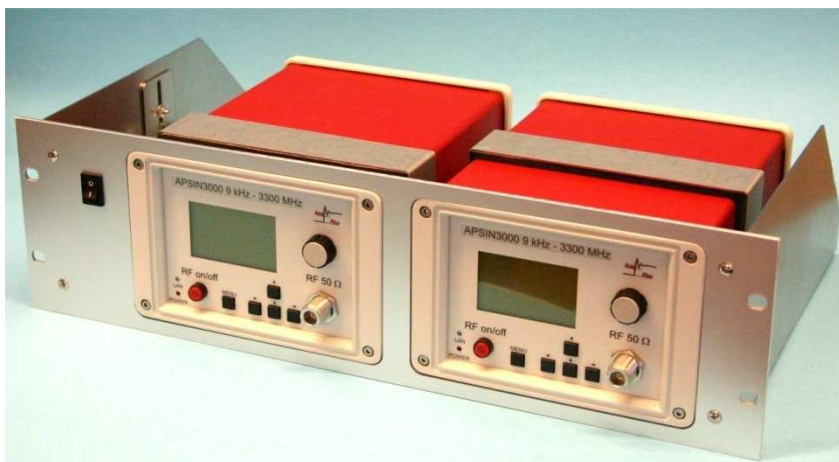
Document History

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
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
V153	2012-07-15	jk		Modified < 10 MHz performance values
V154	2012-09-15	jk		Reference input range adjusted
V155	2012-11-6	jk		Added FUNC OUT capability; Harmonics
V156	2013-01-6	jk		Added pulse trains, chirps, trigger
V157	2013-03-13	jk		Modified reference frequency specs, added option RM picture
V158	2013-05-15	jk		Added Model APSIN20G-NM
V159	2013-07-31	db		Included serial number dependant performance specs based on data sheet, modified PM peak deviation specs
V160	2013-08-26	db		Modified sweep timing specs, added max power measurement plots
V161	2013-09-4	jk		Modified power level specs
V163	2013-12-27	jk		New plots
V64	2014-01-21	jk		corrected dimensions
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