

APSIN2010 Specification 1.13

9 kHz to 2 GHz Analog Signal Generator



Introduction

The APSIN2010 is a low-noise and fast-switching RF signal generator covering a frequency range from 9 kHz up to 2000 MHz. Other APSIN models range to 4.0, 6.1, 12, or 20.5 GHz.

The APSIN2010 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.

Power level extension is available to accurately level down to -130 dBm.

The APSIN2010 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 APSIN2010 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 APSIN2010 operates 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 200 MHz.

The APSIN2010 support various standard interfaces such as USB-TMC, LAN, and GPIB.

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
Frequency range	9 kHz		2 GHz	
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Settling time		20 μ s	100 μ s	
Frequency update rate List/Sweep mode		400 μ s 400 μ s		time from receipt of SCPI command
SSB Phase noise at 1 GHz				
at 1 kHz from carrier		-120 dBc/Hz		
at 20 kHz from carrier		-128 dBc/Hz		
Spectral purity				
Output harmonics Sub-harmonics		-40 dBc	-30 dBc -70 dBc	$P_{out} = +10$ dBm; $f > 10$ MHz
Non-harmonic spurious < 1 MHz > 1 MHz		-70 dBc -75 dBc	-60 dBc -65 dBc	$P_{out} = +10$ dBm
Residual FM @ 1 GHz				
			12 Hz	0.03 kHz to 23 kHz
Power level				
Range 9 kHz to 10 MHz 10 MHz to 2.0 GHz	-30 dBm -30 dBm -130 dBm		+13 dBm +16 dBm	ALC ON with Option PE3
Level resolution		0.01 dB		
Level uncertainty			< 0.8 dB < 1.2 dB	ALC ON, > -30 dBm ALC ON, > -110 dBm
Output impedance VSWR		50 Ω < 2		
Reference frequency input	8 MHz		250 MHz	User programmable
Reference input level	-5 dBm	0 dBm	+13 dBm	
Lock Range			+/- 1.0 ppm	
Reference input impedance		50 Ω s		
Internal reference frequency output		10 MHz		
Initial accuracy of internal reference		± 40 ppb		calibrated at 23 ± 3 °C at time of calibration
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		

Parameter	Min.	Typ.	Max.	Note
Output of internal reference		+5 dBm 50 Ohms		
Reverse Power Protection				
DC Voltage		30 V		
RF power			36 dBm	
Dimensions				
Excluding connectors	W x L x H = 172 x 250 x 106 mm			
Including connectors	W x L x H = 172 x 273 x 106 mm			

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
Frequency sweep				
Sweep type: linear, logarithmic, random				
Step time (t_{step})	200 μ s			
Dwell time (t_{dwell})	50 μ s			
Off-time (incl. transient time) (t_{off})	50 μ s		t_{step}	
Timing accuracy per point		1 μ 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})	200 μ s			
Dwell time (t_{dwell})	50 μ s			
Off-time (incl. transient time) (t_{off})	50 μ s		t_{step}	
Time resolution		0.1 μ s		
Timing accuracy per point		1 μ s		
Frequency Chirps (linear ramp, up/down)				
Bandwidth	10%			
Dwell time (tdwell)	10 ns		100 μ s	
Number of frequencies			65'000	

Modulation Capabilities

All modulation types (FM, PM, AM, and pulse modulation) may be simultaneously enabled except: FM and phase modulation can not be combined. For example, AM and FM can run concurrently and will modulate the output RF.

Parameter	Min.	Typ.	Max.	Note
Multifunction Generator Output is Sync Out at rear panel	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	5 V	2 V	Sine, triangle Square (CMOS output)
Sine Harmonic Distortion		1 %		< 100 kHz, 1 Vpp
Output impedance		50 Ohms CMOS		Sine, triangle square wave
Pulse modulation On/off ratio		70 dB		
Repetition frequency	DC		5 MHz	
Pulse width	30 ns 50 μs			ALC hold ALC on
Pulse rise/fall time		5 ns		
Pulse trains length (pulses)	2		4192	
Pulse width	30 ns		100 μs	
Video crosstalk		-40 dB		
External input amplitude		1 V TTL		AC DC
Frequency modulation Maximum Frequency deviation (peak)		> 2 MHz 20 MHz 40 MHz		< 200 MHz 0.2 GHz to 0.75 GHz 0.75 GHz to 2 GHz
Modulation waveforms	Sine, triangle, FSK			
Modulation rate	1 Hz/DC		800 kHz	-3dB frequency response
External input sensitivity	< N · 100 MHz for 1 Vpp			settable in AC mode discrete values in DC mode
Total harmonic distortion	< 1%			1 kHz rate & N · 100 kHz deviation
Phase modulation Phase deviation (peak)	0		N·80 rad	
Modulation rate	1 Hz		800 kHz	> -3dB frequency response
Modulation waveforms	Sine, triangle, FSK			
External Input sensitivity	N · 40 rad for 1 Vpp			
Total harmonic distortion	< 1%			1 kHz rate & N · 20 rad deviation
Amplitude Modulation Modulation rate	0.1 Hz		20 kHz	

Parameter	Min.	Typ.	Max.	Note
Modulation depth	0 %		90 %	
Modulation waveforms	Sine, triangle, square			
Distortion		2 %		
Accuracy		3 %		

Notes:

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		
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)

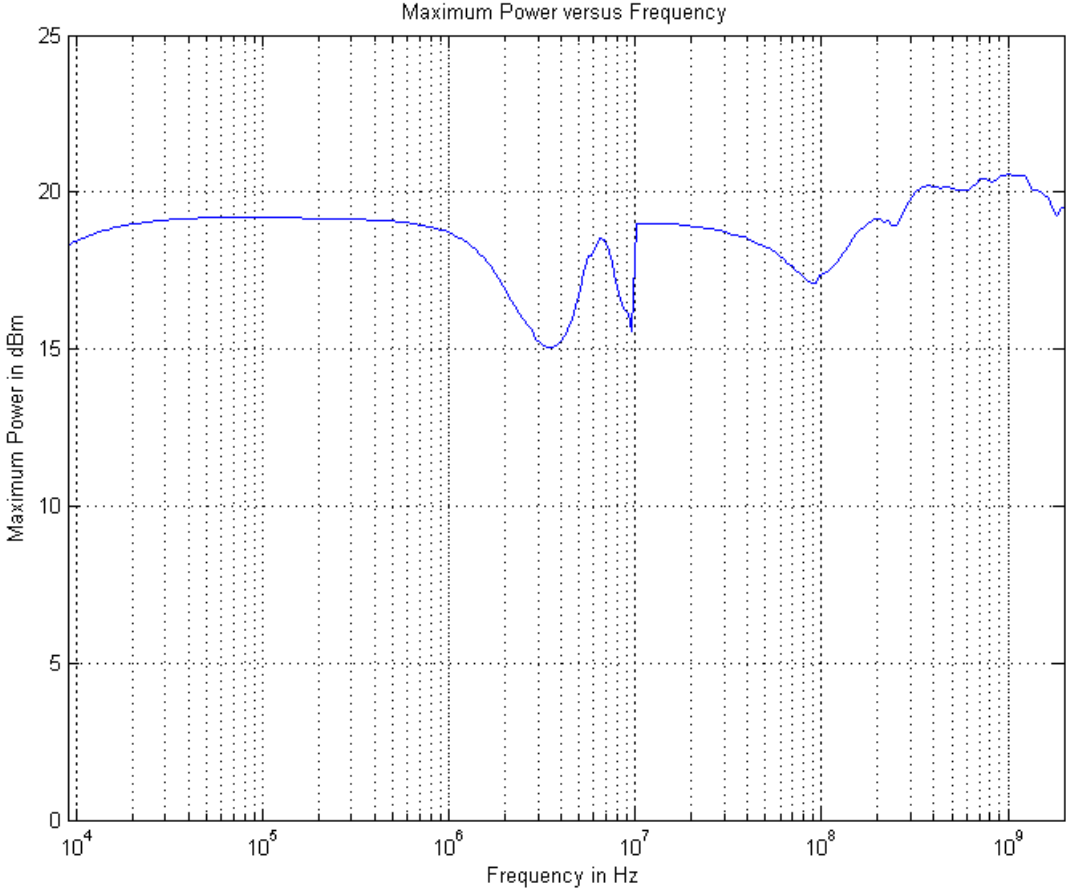
Input is TRIG IN at rear panel

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 μs		
External Trigger delay	50 μs		40 s	
External Delay Resolution		15 ns		
Trigger Modulo	1		255	Execute only on Nth trigger event
Trigger Polarity	Rising, falling			

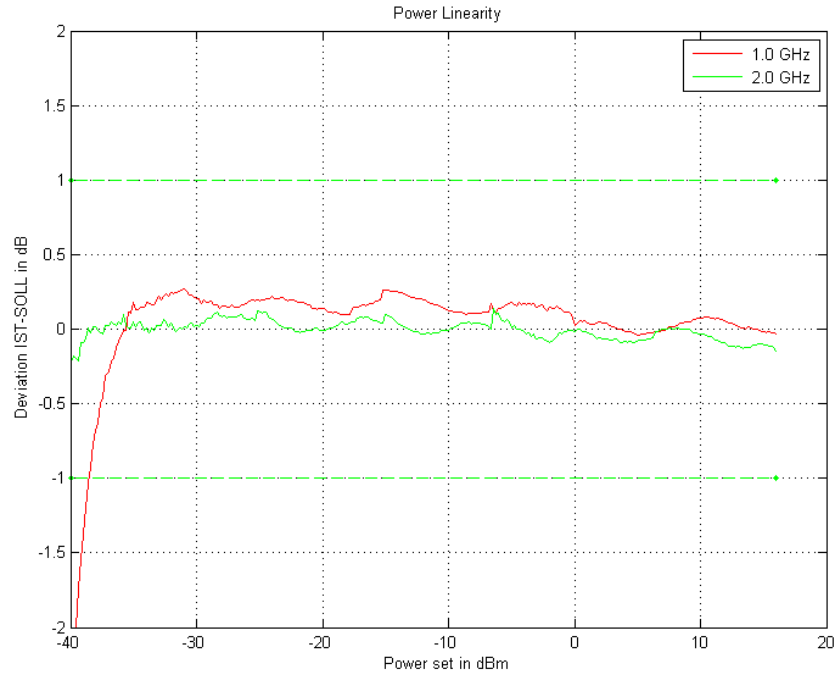
Typical performance curves

Phase Noise Performance

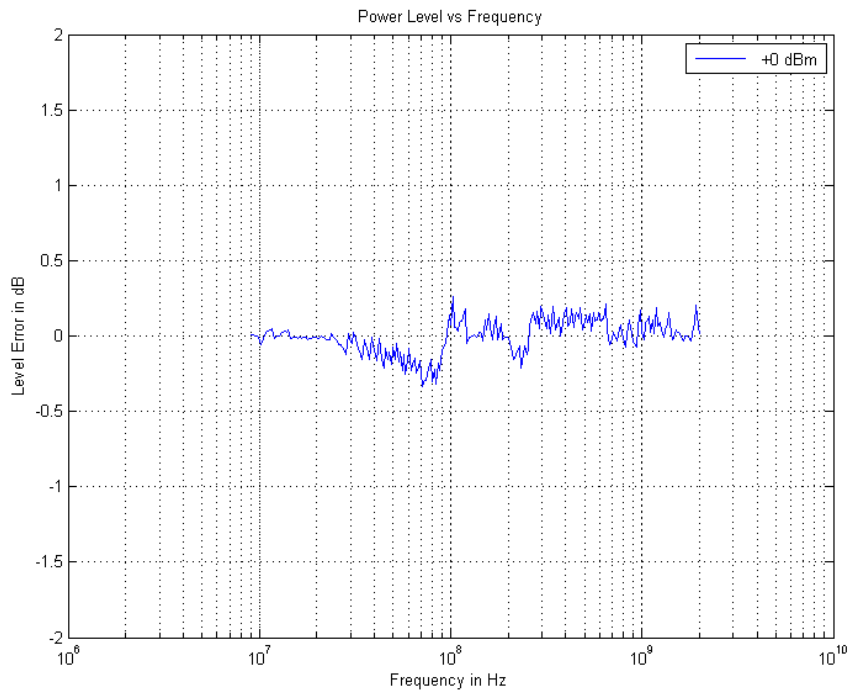
Typical Maximum Output Power



Power linearity



Typical Frequency Response



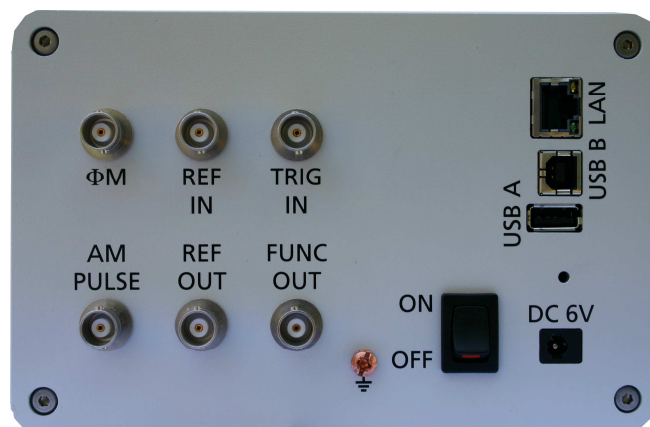
Connectors

Front panel:



1. RF output: N female
2. RF on/off button
3. Rotary knob
4. Menu and $\downarrow \uparrow \leftarrow \rightarrow$ 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 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 270 mm L (incl. connectors)
[4.21 in H x 6.77 in W x 10.63 in L]

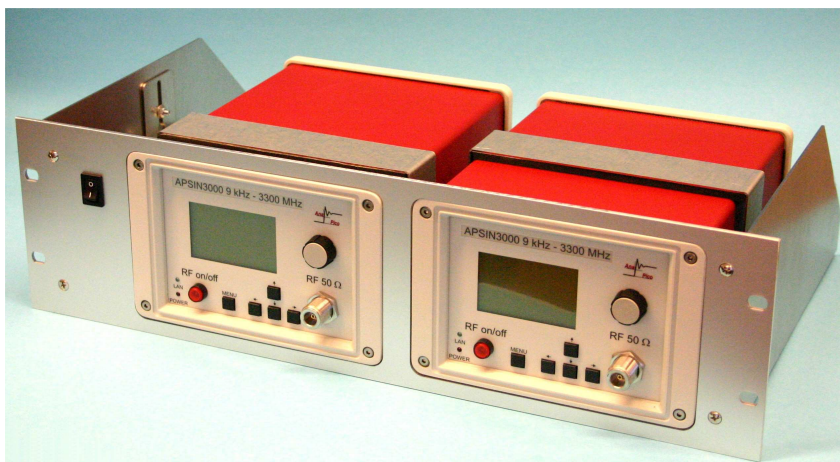
Recommended calibration cycle 24 months

Options

- PE3:** Extended power range down to <-130 dBm) step attenuator module
- B3:** battery module
- GPIB:** IEEE-488.2,1987 programming interface



- RM:** 19" rackmount enclosure: good for one or two adjacent APSIN



Document History

Version/Status	Date	Author		Notes
V10	2013-05-1	jk		first release
V111	2014-01-21	jk		corrected dimensions
V112	2014-01-21	jk		Added internal reference stability parameters
V113	2014-02-8	jk		Added product pictures