

## APSIN 6000 Product Specification V1.8

Fast-Switching Low-Noise Signal Generator



# Introduction

The APSIN6000 is a low-noise and fast-switching CW signal source covering a frequency range from 9 kHz up to 6.4 GHz.

The APSIN3000 signal generator unifies excellent technical performance with true portability in a tiny and robust enclosure. It is targeted for applications where a high-quality CW source is required, regardless whether in crowded indoor environments or (internal battery powered) outdoor applications. It offers an alternative to expensive high-end RF signal generators, where small size and excellent RF performance at an attractive cost is required.

The very compact and rugged design of the APSIN allows multiple units to be stacked in crowded environments like laboratories or production test facilities. A 19 inch rack-mount solution is also available. Light weight (less than three kilograms fully equipped) and optionally internal rechargeable batteries make the APSIN an easy-to-use truly portable instrument.

The APSIN operates with an ultra-stable temperature compensated 100 MHz reference (OCXO, <100 ppb accuracy and temperature stability) and can be phase-locked to a selectable external reference. Multiple units can be synchronized daisy-chaining the units' reference inputs and outputs. Integration of multiple signal sources within a production test environment is now easy, affordable and repeatable.

The APSIN uses a standard Ethernet LAN interface (RJ-45) with a TCP/IP protocol and uses SCPI 1999 command language, enabling remote control over the LAN or from any PC or Laptop computer. The instrument is supplied with a quickly installed graphical user interface (GUI). Additional supplied software (API, DLLs) enable straightforward integration of the signal generator into larger automated test systems or measurement equipment. An intuitive front panel with rotary knob allow easy direct access to all the functionality of the APSIN.

# Specifications

The specifications in the following pages describe the warranted performance of the signal generator for  $25 \pm 10 \text{ }^\circ\text{C}$  after a 30 minute warm-up period. Typical specifications describe expected, but not warranted performance. Min and Max specifications are warranted.

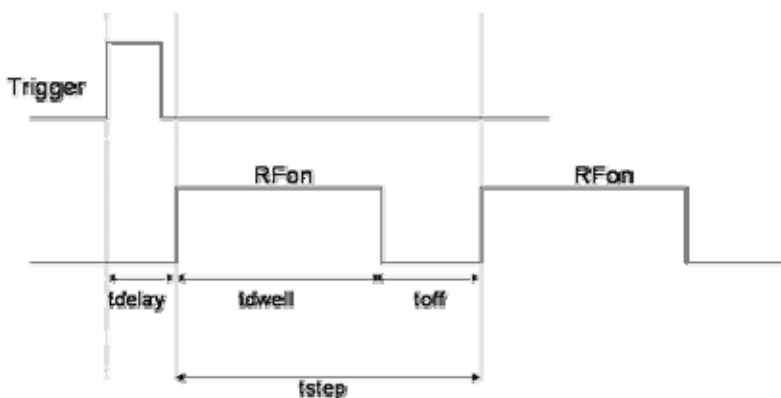
Parameter	Min.	Typ.	Max.	Note
<b>Frequency range</b>	9 kHz		6500 MHz	
resolution		0.001 Hz		1
Phase resolution		0.2 deg		
Settling time		20 $\mu\text{s}$	200 $\mu\text{s}$	
Frequency update rate		2 ms		2
List/Sweep mode			1 ms	
<b>SSB Phase noise</b>				
at 1 kHz from carrier		-120 dBc/ Hz		3
at 20 kHz from carrier		-130 dBc/ Hz		3
at 1 MHz from carrier		-135 dBc/ Hz		3
Wideband noise		-146 dBc/ Hz -155 dBc/ Hz		carrier <1.5 GHz carrier >1.5 GHz
<b>Total jitter</b>		120 fs RMS		BW over 10 Hz to 20 MHz
<b>Power level</b>				
Range				
9 kHz to 10 MHz	-30 dBm		+8 dBm	4
10 MHz to 6.0 GHz	-30 dBm -100 dBm -140 dBm		+13 dBm +13 dBm +13 dBm	4 option PE option PE2
Resolution		0.1 dB		0.02 dB via SCPI
Level uncertainty		$\pm 0.2$ dB	$\pm 1$ dB	5
Output impedance		50 Ohms		
<b>Spectral purity</b>				
Output harmonics		-45 dBc	-30 dBc	6
Sub-harmonics		-70 dBc		
Non-harmonic spurious close to carrier (< 1 MHz offset)		-75 dBc	-55 dBc	
wideband		-65 dBc	-55 dBc	6
Residual FM @ 1GHz		1.5 Hz RMS		0.3 kHz to 3 kHz, weighted (ITU-T)
		18 Hz RMS		0.01 kHz to 15 kHz
Residual AM @ 1GHz		0.01 %		RMS value (0.01 kHz to 15 kHz)
<b>Frequency sweep</b>	Sweep type: linear, logarithmic, random			
Step time ( $t_{step}$ )	1.0 ms			7
Dwell time ( $t_{dwell}$ )	50 $\mu\text{s}$		10 s	
Off-time (incl. transient time) ( $t_{off}$ )	0 or 50 $\mu\text{s}$		Step time	8
Timing accuracy per point		0.2 $\mu\text{s}$	0.6 $\mu\text{s}$	
<b>Power sweep</b>	Sweep type: linear, list			
Step time ( $t_{step}$ )	400 $\mu\text{s}$			7
Dwell time ( $t_{dwell}$ )	50 $\mu\text{s}$		10 s	
Off-time (incl. transient time) ( $t_{off}$ )	0 or 50 $\mu\text{s}$		Step time	8
Time resolution		0.2 $\mu\text{s}$		
Timing accuracy per point		0.2 $\mu\text{s}$	0.6 $\mu\text{s}$	
<b>Generalized list sweep</b>	allows individual setting of frequency, power, dwell-time, and off-time for each point			
List size	2		3'501	
Step time ( $t_{step}$ )	1.0 ms			7
Dwell time ( $t_{dwell}$ )	50 $\mu\text{s}$		10 s	
Off-time (incl. transient time) ( $t_{off}$ )	0 or 50 $\mu\text{s}$		Step time	8
Time resolution		0.2 $\mu\text{s}$		
Timing accuracy per point		0.2 $\mu\text{s}$	0.6 $\mu\text{s}$	

Parameter	Min.	Typ.	Max.	Note
<b>Trigger</b> auto, bus (SCPI), trigger key, external				
Trigger delay	50 $\mu$ s		10'000 $\mu$ s	
Trigger modulo (use every Nth trigger)	1		255	
Trigger edge: positive or negative				
<b>Reference frequency input</b>	1 MHz		100 Mhz	9
Reference input level	-5 dBm	0 dBm	+13 dBm	10
Accuracy/ Locking Range			+/- 1.0 ppm	
Reference input impedance		50 Ohms		
<b>Internal reference frequency</b>		100 Mhz		
Temperature stability (0 to 50 degC)			$\pm$ 100 ppb	
Aging 1 <sup>st</sup> year		0.5 ppm		
Aging per day (after 30days operations)			5 ppb	
Warm-Up time		5 min		
Output of internal reference		5 dBm 50 Ohms		
<b>Reverse Power Protection</b>				
DC Voltage		10 V		
RF power			36 dBm	
<b>Dimensions</b>				
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:

- internal resolution is much smaller
- time from receipt of SCPI command
- at 1 GHz output carrier frequency; scales with frequency for >143 MHz. For <143 MHz: -115 dBc/Hz at 20 kHz offset
- guaranteed level is -30 to + 13dBm in 0.1 dB resolution; below -30 dBm the resolution is 0.5 dB. Settable level is -60 to +25 dBm; for typical maximum power see plot on page 6. Below 10 MHz guaranteed level is + 8 dBm  
**option PE:** guaranteed level is -100 to + 13 dBm with 0.1 dB resolution. Below -100 dBm the resolution is 0.5 dB. Settable level is -120 to +25 dBm  
**option PE2:** guaranteed level is -140 to + 13 dBm with 0.1 dB resolution. Below -140 dBm the resolution is 0.5 dB. Settable level is -150 to +25 dBm  
**below 10 MHz:** maximum level is +10 dBm
- ALC on, -30 dBm < Pout < +13 dBm
- at output connector, -10 dBm < P<sub>out</sub> < +10 dBm; >143 MHz. For < 143 MHz: harmonics < 25 dBc, Spurious < 50 dBc.
- $t_{step} = t_{dwell} + t_{off} > 900 \mu$ s
- $t_{off}$  may be lower or zero, if no off time is required. But off times > 0 and < 200us may be inaccurate
- must be integer N • 1 MHz;
- slew rate must be > 10V/ $\mu$ s

### Timing of Trigger + List sweep



# Modulation Capabilities

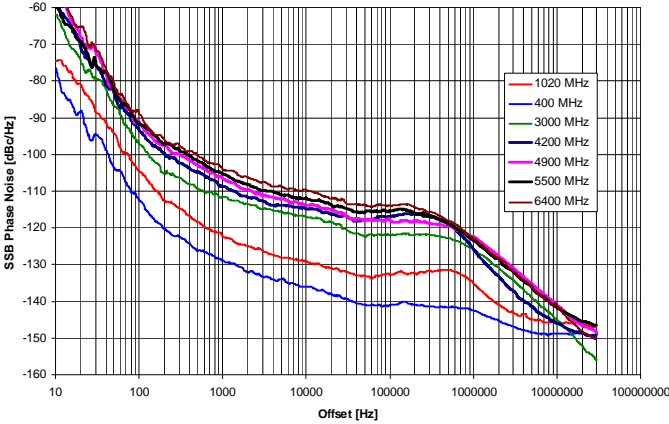
Parameter	Min.	Typ.	Max.	Note
<b>Multifunction Generator</b> Output is Sync Out at rear panel	sine, triangle, square wave			
Frequency range	1 Hz 1 Hz		3 MHz 1 MHz 50 kHz	sine triangle square
Frequency resolution		0.1 Hz		
Output voltage amplitude peak-peak	10 mV	5V	2 V	Sine, triangle Square (CMOS output)
Harmonic Distortion		1 %		< 100 kHz, 1 Vpp
Output impedance		50 Ohms CMOS		Sine, triangle square wave
<b>Pulse Modulation (internal &amp; external)</b> On/off ratio		80 dB		
Repetition frequency	DC 0.1 Hz		4 MHz 100 kHz	External internal
Pulse width	40 ns 180 ns		9 s	External internal
Pulse rise/fall time		10 ns		
Video crosstalk		-40 dB		
External input amplitude		1 V TTL		AC DC
External input amplitude		1 V TTL		AC DC
<b>Frequency modulation (internal &amp; external) (see note 1)</b> Maximum Frequency deviation (peak)	200 kHz AND modulation index < 10 50 kHz AND modulation index < 3 100 kHz AND modulation index < 5 200 kHz AND modulation index < 10 400 kHz AND modulation index < 20 800 kHz AND modulation index < 40		< 143 MHz > 143 MHz to 490 MHz (N=0.125) > 490 MHz to 830 MHz (N=0.25) > 830 MHz to 1.65 GHz (N=0.5) > 1.65 GHz to 3.3 GHz (N=1) > 3.3 GHz (N=2)	
Modulation rate	300 Hz		300 kHz	> -3dB frequency response
External input sensitivity	Settable 1 kHz/V to 200 kHz/V			1V amplitude corresponds to N· kHz deviation
Total harmonic distortion				1 kHz rate
<b>Phase modulation (internal &amp; external) (see note 1)</b>				
Phase deviation (peak)	0		N·5 rad	
Modulation rate	300 Hz		300 kHz	> -3dB frequency response
External Input sensitivity	Settable 0.1 rad/V to 2 rad/V			1V amplitude corresponds to N· rad deviation
Total harmonic distortion				
<b>AM Modulation (internal only)</b>				
Modulation rate	1 Hz		20 kHz	
Modulation depth	1 %		90 %	
Distortion		3 %		

Notes:

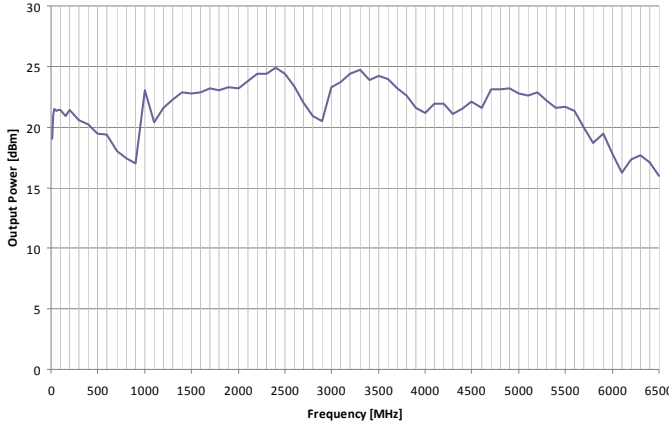
1. FM/PM modulator is supported for instruments with serial number **62233xxxxxxx** or higher.

# Typical performance curves

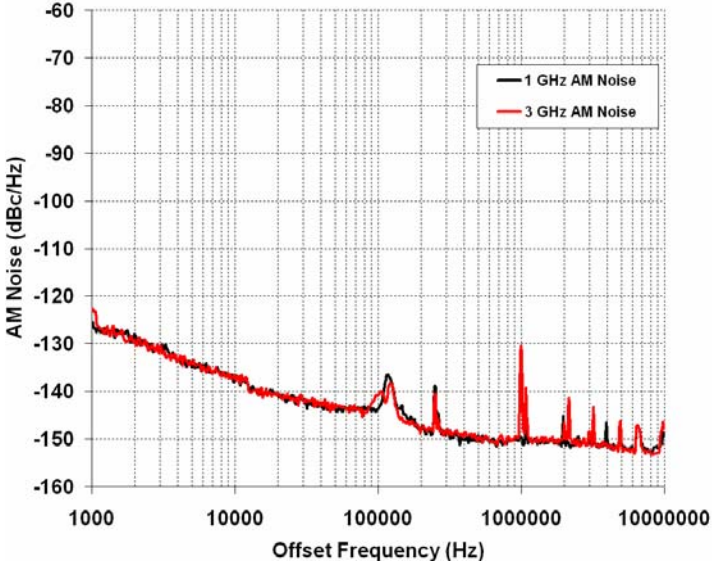
## Phase Noise



## Maximum output power



## AM noise performance



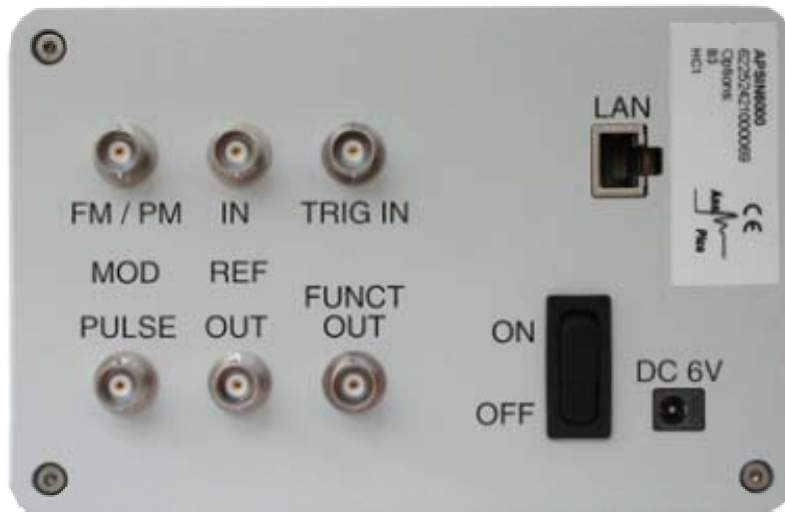
# Connectors

Front panel (HC option):



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 modulation input: BNC female
6. Pulse modulation and Trigger input: BNC female
7. LAN connection: RJ-45
8. DC Power plug (6V, 2.5A)

# General Characteristics

## Remote programming interfaces

LAN 10BaseT LAN interface,  
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 55 °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]

## Options

- **B3:** Rechargeable battery pack
- **PE:** Extended power range (-100 to +13 dBm)
- **PE2:** Extended power range to -140 to +13 dBm
- **-:** Display-only frontpanel (for ATE)
- **RM:** 19" Rack mount (1 or 2 devices)

## Document History

Version/Status	Date	Author	Notes
V10	2008-2-20	jk	first release
V11	2008-5-20	jk	Minor revision
V12	2008-7-2	jk	Minor revision
V13	2008-7-10	jk	Resized document
V14	2008-7-25	jk	Added list & trigger
V15	2009-1-20	jk	Added specs for option PE; AM modulation
V151	2009-2-23	jk	FM deviations changed
V16	2009-3-15	jk	Power level specifications clarified
V161	2009-4-2	jk	Modulation specs revised
V162	2009-8-22	jk	Added sweep timing accuracy
V17	2009-9-29	jk	FM specification adjusted
V18	2010-2-20	jk	Reduced max. output power for < 10 MHz