APSIN 3000HC Product Specification V1.84

Fast-Switching Low-Noise Signal Generator

- **Excellent signal quality and stability**

- **Fast switching and trigger modes**

- **Powerful Ethernet LAN control (GUI, API, Web, SCPI)**

- **Handheld: light weight, compact and rugged design**

- **Truly Portable: rechargeable internal battery (optional)**

- **Reliable: quality design for low cost of ownership**

Introduction

The APSIN3000 is a low-noise and fast-switching analog signal generator. The frequency range covered with a 0.001 Hz resolution is from 9 kHz up to 3.3 GHz (APSIN3000).

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 kit 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 internal ultra-stable temperature compensated 100 MHz reference (OCXO, <100 ppb accuracy) 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 ± 10 °C after a 30 minute warm-up period. Typical specifications describe expected, but not warranted performance. Min and Max specifications are warranted.
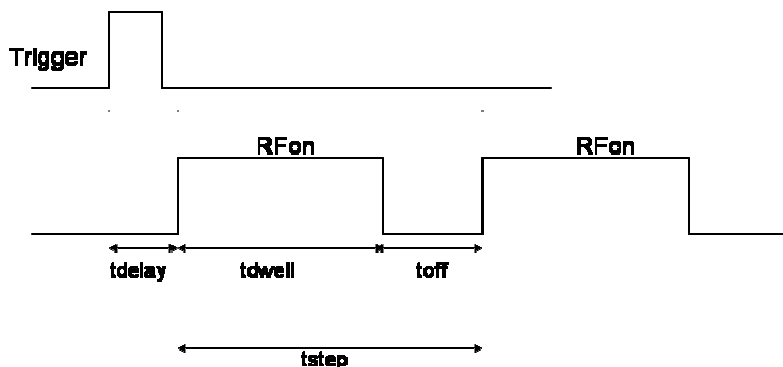
Parameter	Min.	Typ.	Max.	Note
Frequency range	9 kHz		3300 MHz	settable to 3400 MHz
resolution		0.001 Hz		1
Phase resolution		0.1 deg		
Settling time		20 µs	200 µs	
Frequency update rate		2 ms		2
List/Sweep mode			1 ms	
SSB Phase noise				
at 1 kHz from carrier		-120 dBc/ Hz		3
at 20 kHz from carrier		-130 dBc/ Hz		3
at 100 kHz from carrier		-132 dBc/ Hz		3
Wideband noise		-146 dBc/ Hz		*carrier* <1.5 GHz
		-150 dBc/ Hz		*carrier* >1.5 GHz
Total jitter		< 100~~120~~ fs RMS		BW over 10 Hz to 20 MHz (f=1 GHz)
Power level				
Range				
9 kHz to 10 MHz	-30 dBm		+8 dBm	4
10 MHz to 3.3 GHz	-30 dBm		+13 dBm	4
9 kHz to 3.3 GHz	-100 dBm			option PE
9 kHz to 3.3 GHz	-120 dBm			option PE3
Resolution		0.1 dB		0.02 dB via SCPI
Level uncertainty		±0.2 dB	±1 dB	5
Output impedance		50 Ohms		
Spectral purity				
Output harmonics		-40 dBc	-30 dBc	6
Sub-harmonics		-70 dBc		
Non-harmonic spurious				
close to carrier (< 1 MHz offset)		-80 dBc	-60 dBc	
wideband		-70 dBc	-55 dBc	6
Residual FM @ 1GHz		1.5 Hz RMS		0.3 kHz to 3 kHz, weighted (ITU-T)
		15 Hz RMS		0.01 kHz to 15 kHz
Residual AM @ 1GHz		0.01 %		RMS value (0.01 kHz to 15 kHz)
Frequency sweep				
Sweep type: linear, logarithmic, random				
Step time	1.0 ms			
Dwell time	50 µs		10 s	
Off-time (incl. transient time)	0 or 50 µs		*Step time*	7
Timing accuracy per point		0.2 µs	0.6 µs	
Power sweep				
Sweep type: linear, list				
Step time	400 µs			
Dwell time	50 µs		10 s	
Off-time (incl. transient time)	0 or 50 µs		*Step time*	7
Time resolution		0.2 µs		
Timing accuracy per point		0.2 µs	0.6 µs	
Generalized list sweep				
allows individual setting of frequency, power, dwell-time, and off-time for each point				
List size	2		3'501	
Step time	1.0 ms			
Dwell time	50 µs		10 s	
Off-time (incl. transient time)	0 or 50 µs		*Step time*	7
Time resolution		0.2 µs		

Parameter	Min.	Typ.	Max.	Note
Timing accuracy per point		0.2 µs	0.6 µs	
Trigger auto, bus (SCPI), trigger key, external				
Trigger delay	50 µs		10'000 µs	
Trigger modulo (use every Nth trigger)	1		255	
Trigger edge: positive or negative				
Reference frequency input	1 MHz		100 MHz	8
Reference input level	-5 dBm	0 dBm	+13 dBm	9
Accuracy/ Locking Range			+/- 1.0 ppm	
Reference input impedance		50 Ohms		
Internal reference frequency		100 MHz		
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		5 dBm 50 Ohms		
Reverse Power Protection				
DC Voltage		10 V		
RF power			36 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:

1. internal resolution is much smaller
2. time from receipt of SCPI command or trigger signal
3. at 1 GHz output carrier frequency; scales with frequency for >143 MHz. For <143 MHz: -115 dBc/Hz at 20 kHz offset
4. guaranteed level is -30 to + 13dBm in 0.1 dB resolution; below -30 dBm the resolution is 0.5 dB. Settable level is -45 to +16 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 +16 dBm

   option PE2: guaranteed level is -135 to + 13 dBm with 0.1 dB resolution. Below -135 dBm the resolution is 0.5 dB. Settable level is -150 to +16 dBm
5. ALC on, -30 dBm < Pout < +13 dBm
6. at output connector, -10 dBm < P_{out} < +10 dBm; 3000 MHz > f >143 MHz. For < 143 MHz: harmonics < 25 dBc, Spurious < 50 dBc.
7. if off time is set >0 then it must be at least 50µs
8. must be integer N • 1 MHz;
9. slew rate must be > 10V/µs

## Timing of Trigger + List sweep

Modulation Capabilities

| Parameter	Min.	Typ.	Max.	Note
Multifunction Generator sine, triangle, square wave				
Output is Sync Out at rear panel.				
For internal FM/PM modulation, connect FUNCT OUT to FM/PM IN at the rear panel.				
Frequency range	10 Hz		4 MHz	sine
	10 Hz		1 MHz	triangle
			50 kHz	square
Frequency resolution		5 Hz		
Output voltage amplitude peak-peak into 50 Ohms load	5 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 (internal & external) On/off ratio		80 dB		Pout=10 dBm
Pulse Rate	DC		4 MHz	External
	0.1 Hz		100 kHz	internal
Pulse width	40 ns			External, ALC hold
	180 ns		9 s	Internal (programmable)
Pulse rise/fall time		~~10~~< 10 ns		
Video crosstalk		-40 dB		
External input amplitude		1 V		AC
		TTL		DC
Frequency modulation (internal & external) (see note 1) Maximum Frequency deviation (peak)	200 kHz AND modulation index < 10			*< 143 MHz*
	50 kHz AND modulation index < 3			*>143 MHz to 490 MHz (N=0.125)*
	100 kHz AND modulation index < 5			*>490 MHz to 830 MHz (N=0.25)*
	200 kHz AND modulation index < 10			*> 830 MHz to 1.65 GHz (N=0.5)*
	400 kHz AND modulation index < 20			*> 1.65 GHz to 3.3 GHz (N=1)*
Modulation rate	300 Hz		300 kHz	> -3dB frequency response
External input sensitivity		Settable 1 kHz/V to 300 kHz/V		1V amplitude corresponds to N· kHz deviation
Total harmonic distortion				1 kHz rate
Phase modulation (internal & external) (see note 1)				
Phase deviation (peak)	0		N·12 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				
AM Modulation (internal only) Modulation rate	1 Hz		10 kHz	
Modulation depth	1 %		~~90~~80 %	
Distortion		3 %		1 kHz rate, 80% depth
Accuracy		<5 %		

Notes:

1. FM/PM modulator is supported for instruments with serial number **32233xxxxxxxx** or higher.
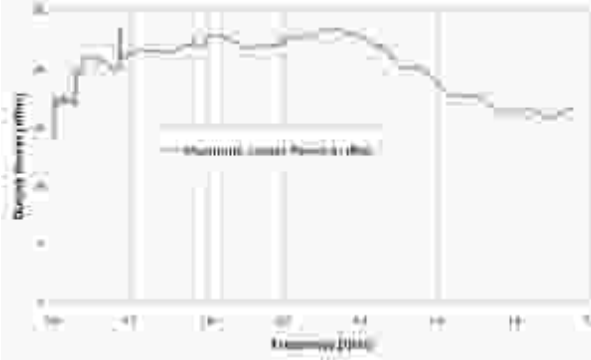
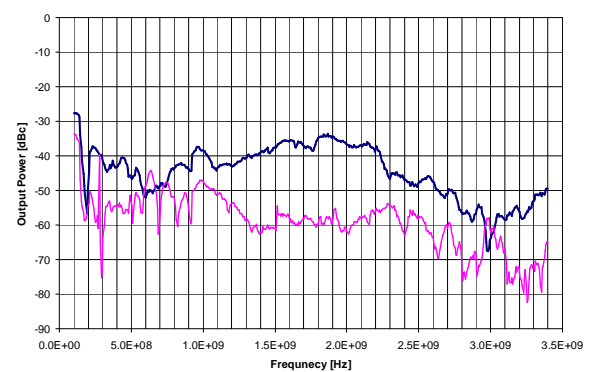# Typical performance curves

Phase Noise
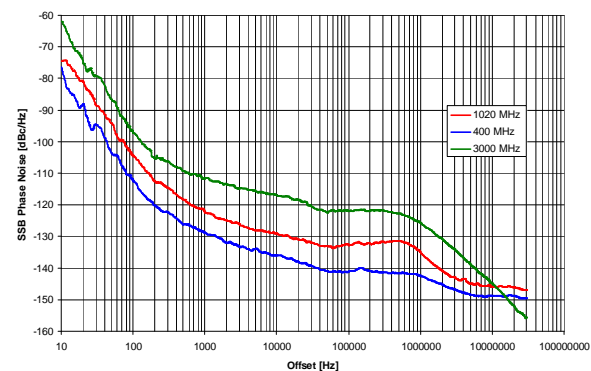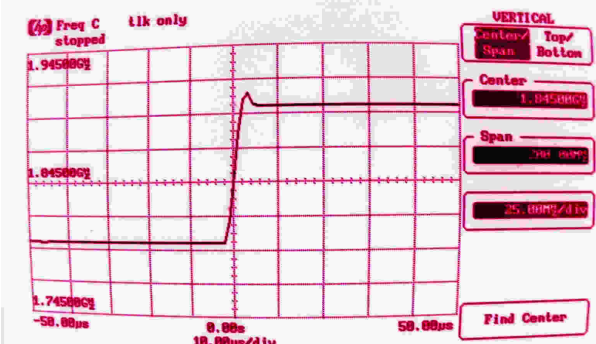

Level Accuracy
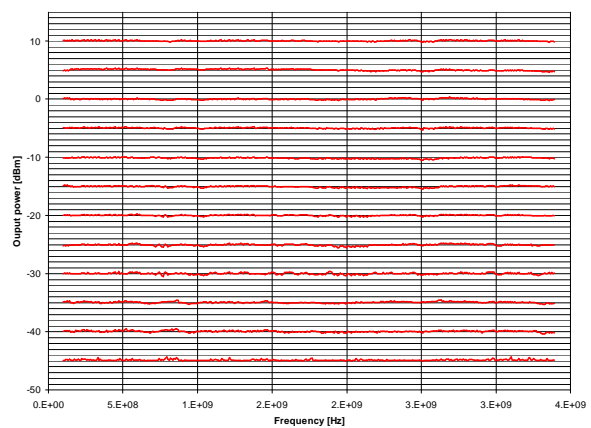
Maximum Output Power
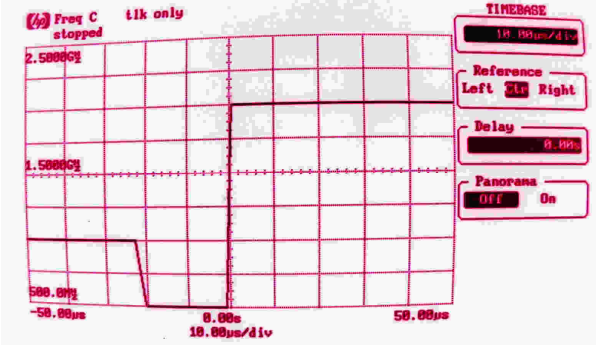

Harmonic Distortion @ +10 dBm Output Power
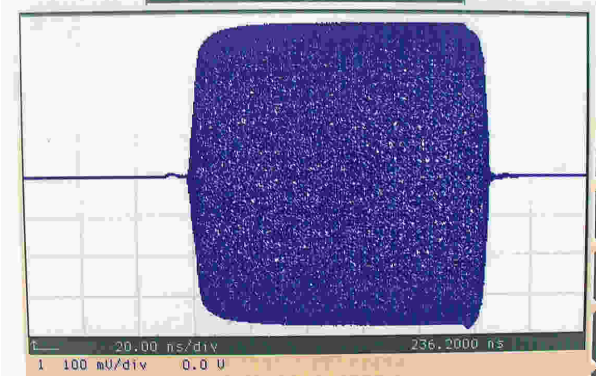

Switching transients
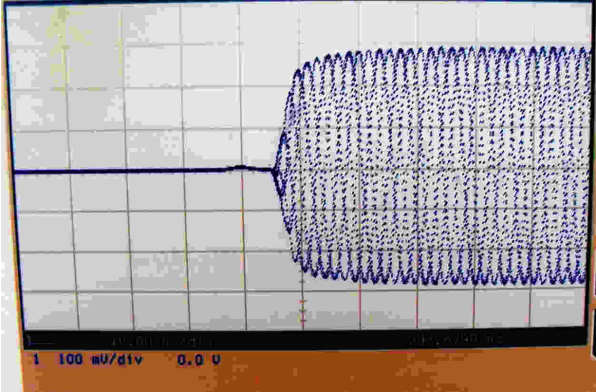### 1.8 to 1.9 GHz step (10µs/div)

1.0 GHz to 2.0 GHz step (10µs/div)

Pulse Modulation (100ns Pulse, 20ns/div)
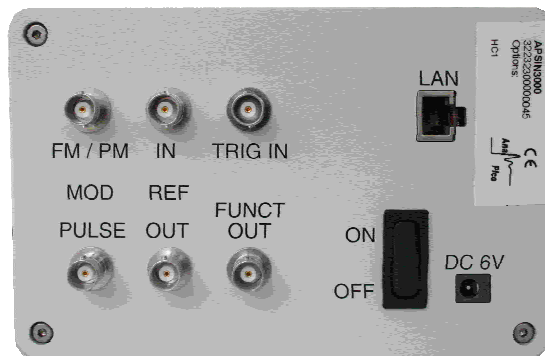

Rise Time (10 ns/div)

Connectors

Front panels:

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

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

- **B3**: Rechargeable battery pack (internal, 3 hours operation)
- **PE3**: Extended power range (-120 to + 13 dBm)
- **RM**: 19'' Rack mount (1 or 2 devices)

Document History

Version/Status	Date	Author		Notes
V10	2008-1-28	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	2008-7-29	jk		Added more modulation specs
V15	2009-1-20	jk		Specs for APSIN3000B
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
V181	2011-10-1	jk		Clarified option PE/PE2 ranges
V182	2011-10-1	jk		Option PE2 replaced by option PE3
V183	2013-5-12	jk		Remname unit
V184	2014-1-21	jk		Dimmensions corrected