

# APSIN6010 Specification 1.46

## Portable Analog Signal Generator



## Introduction

The APSIN6010HC is a low-noise and fast-switching analogue signal generator covering a frequency range from 9 kHz up to 6.1 GHz.

The APSIN 6010 provides full RF signal generator capabilities including OCXO-stabilized low phase-noise signal with micro-Hz frequency resolution, wide and accurately levelled output power range, extensive modulation capabilities, and fast switching.

It is targeted for a wide range of applications where a high-quality analogue signal is mandatory, offering 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 APSIN6010HC operates at very low DC power consumption (only 12 watts), with minor heat dissipation and not requiring noisy fan. This gives the APSIN 6010 a great advantage in laboratories or production test facilities.

The low power design allows the use of optional internal battery modules which make it a truly portable instrument, ideally suited for field testing, installation, and maintenance.

19 inch rack-mount solutions are also available.

The APSIN 6010 support various standard interfaces such as USB (USBTMC), LAN (VXI-11), or GPIB and extensive API with programming examples are available.

# Signal Specifications

The specifications in the following pages describe the warranted performance of the signal generator for  $25 \pm 10$  °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		6.1 GHz	
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Frequency update rate		300 $\mu$ s		time from receipt of SCPI command firmware
List/Sweep mode		200 $\mu$ s		
SSB Phase noise at 1 GHz				
at 20 kHz from carrier		-130 dBc/Hz		See measured phase noise plots
Total jitter		68 fs RMS		10 Hz to 1 MHz BW
Spectral purity				
Output harmonics		-40 dBc	-30 dBc	$P_{out} = +10$ dBm;
Sub-harmonics			-70 dBc	
Non-harmonic spurious				
< 1 MHz		-70 dBc	-60 dBc	$P_{out} = +10$ dBm
> 1 MHz		-75 dBc	-65 dBc	
Residual FM @ 1 GHz			3 Hz	0.3 kHz to 3 kHz, weighted (ITU-T)
			12 Hz	0.03 kHz to 23 kHz
Residual AM @ 1 GHz		tbd		RMS value (0.01 kHz to 15 kHz)
Power level				
Range				
<5.0 GHz	-30 dBm		+15 dBm	ALC ON  with Option PE3
>5.0 GHz	-30 dBm		+13 dBm	
	-120 dBm		+13 dBm	
Resolution		0.01 dB		
Level uncertainty			< 0.8 dB < 1.2 dB	ALC ON, > -30 dBm ALC ON, > -110 dBm
Output impedance		50 $\Omega$		
VSWR		< 2		
Reference frequency input	8 MHz		200 MHz	User programmable
Reference input level	-5 dBm	0 dBm	+13 dBm	
Lock Range			+/- 1.0 ppm	
Reference input impedance		50 $\Omega$ s		
Internal reference frequency output		10 MHz		
Initial accuracy of internal reference		$\pm 40$ ppb		calibrated at $23 \pm 3$ °C at time of calibration
Temperature stability (0 to 50 degC)			$\pm 100$ ppb	
Aging 1 <sup>st</sup> year		0.5 ppm		

Parameter	Min.	Typ.	Max.	Note
Aging per day (after 30days operations)			5 ppb	
Warm-Up time		5 min		
Output of internal reference		+5 dBm 50 Ωs		
Reverse Power Protection				
DC Voltage		30 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:

## 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 ( $t_{step}$ )	600 μs		19998 s	
Dwell time ( $t_{dwell}$ )	50 μs		9999 s	
Off-time (incl. transient time) ( $t_{off}$ )	0 / 50 μs		9999 s	
Timing accuracy per point		1 μs		
<b>Generalized list sweep</b>				
allows individual setting of frequency, power, dwell-time, and off-time for each point				
List size	2		20.000	
Step time ( $t_{step}$ )	200 μs		19998 s	
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		
<b>Frequency Chirps</b> (linear ramp, up/down)				
Bandwidth	10%			
Dwell time ( $t_{dwell}$ )	10 ns		100 μs	
Number of frequencies			20'000	

# 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
<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	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
<b>Pulse modulation</b>				
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
<b>Frequency modulation</b>				
Maximum Frequency deviation (peak)	> 2 MHz N x 100 MHz		< 0.37 GHz 0.37 GHz to 0.75 GHz (N=0.125) 0.75 GHz to 1.5 GHz (N=0.25) 1.5 GHz to 3 GHz (N=0.5) > 3 GHz to 6.1 GHz (N=1)	
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	
<b>Phase modulation</b>				
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	

<b>Parameter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Note</b>
<b>Amplitude Modulation</b>				
Modulation rate	0.1 Hz		20 kHz	
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
<b>MULTIFUNCTION GENERATOR</b> 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>VIDEO OUTPUT (of internal pulse modulator)</b>				
Output		CMOS		
Period	30 ns		50 s	
Pulse Width	15 ns		50 s	
RF delay		10 ns		
<b>TRIGGER OUT</b> Synchronization mode for multiple sources				
Modes	Trigger on sweep start Trigger on each point			
Trigger waveform pulse width		100 ns		

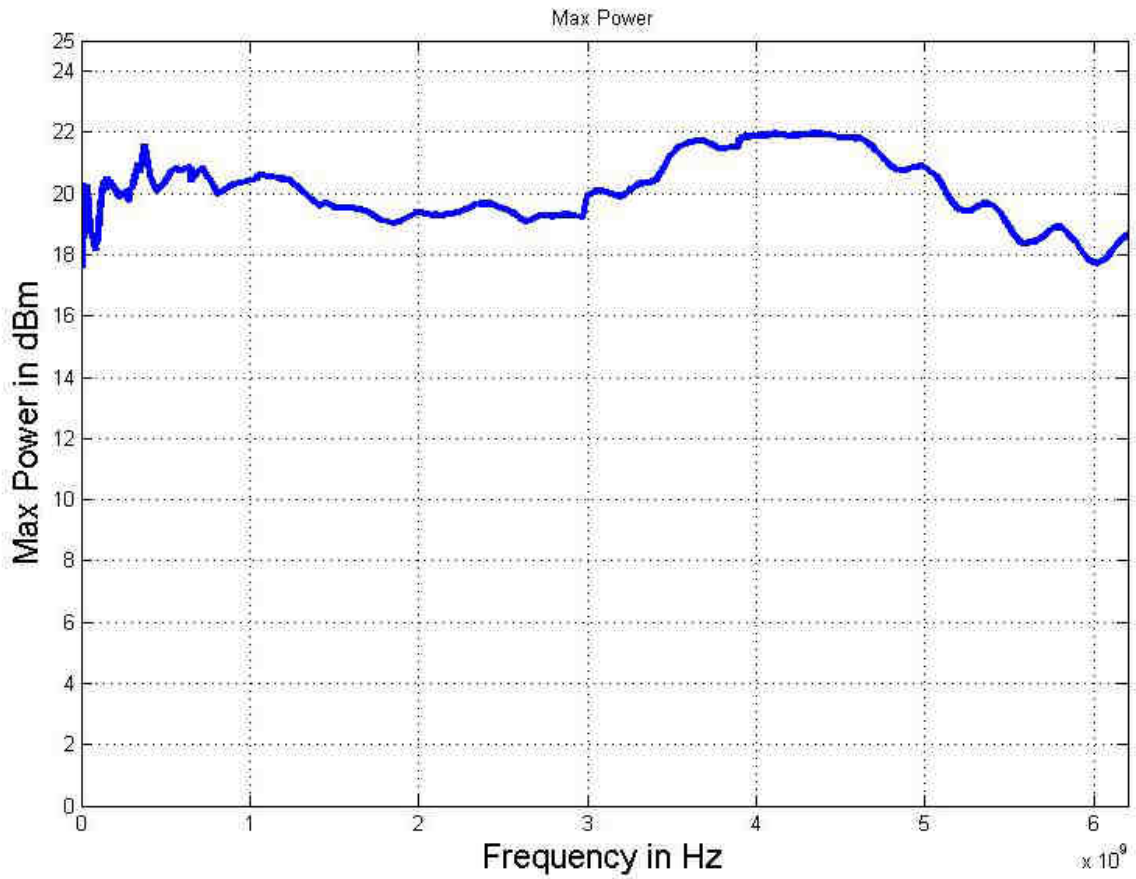
## Trigger (TRIG IN)

Input is TRIG IN at rear panel

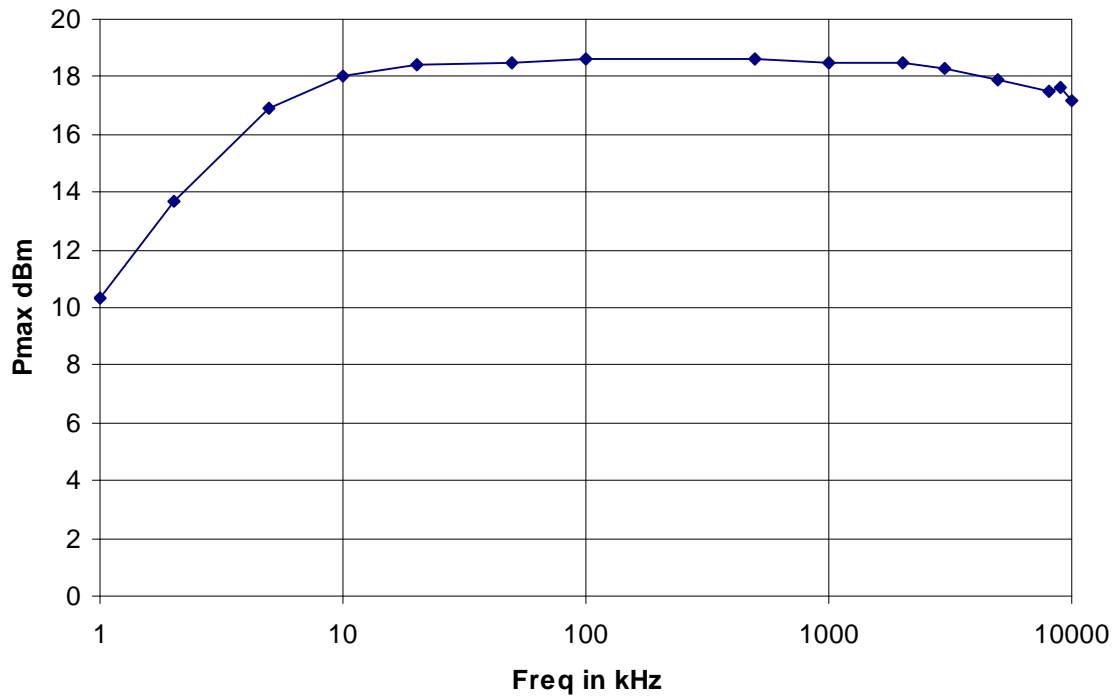
Parameter	Min.	Typ.	Max.	Note
Trigger Types	Continuous, single, gated, gated direction			
Trigger Source	RF key, external, bus (GPIB, LAN, USB)			
Trigger Modes	Continuous free run, trigger and run, reset and run			
Trigger latency		tbd		
Trigger uncertainty		5 μs		
External Trigger delay	50 μs		40 s	
External Delay Resolution		15 ns		
Trigger Modulo	1		255	Execute only on Nth trigger event
Trigger Polarity	Rising, falling			

# Typical performance curves

## Maximum Output Power



## Maximum Output Power (1 kHz to 10 MHz)

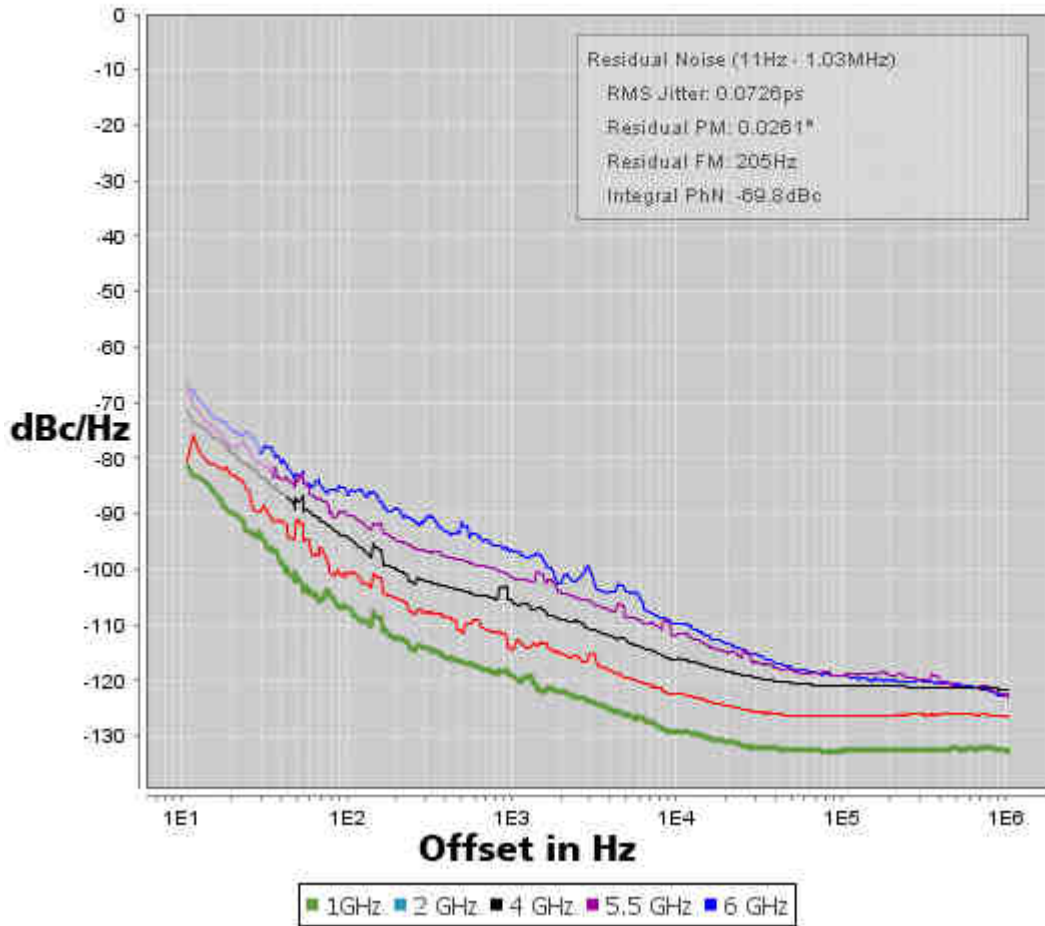




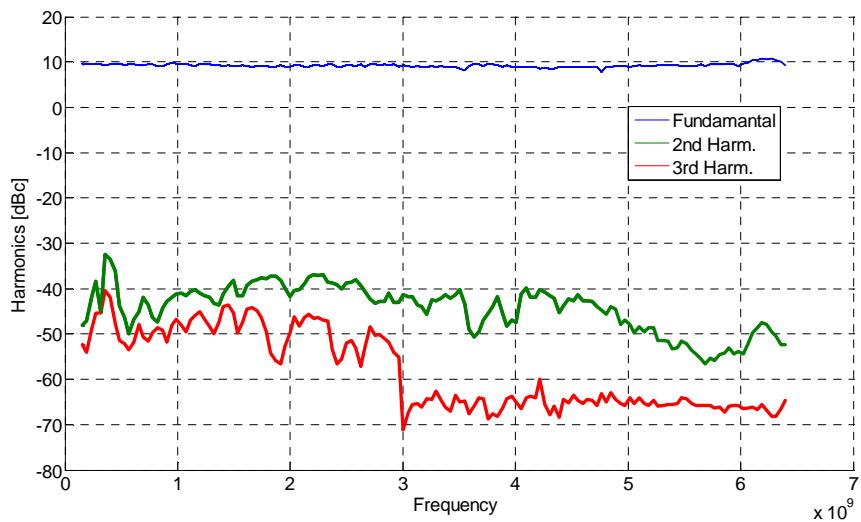
### Phase Noise Performance



### AnaPico Signal Source Analyzer APPH6000

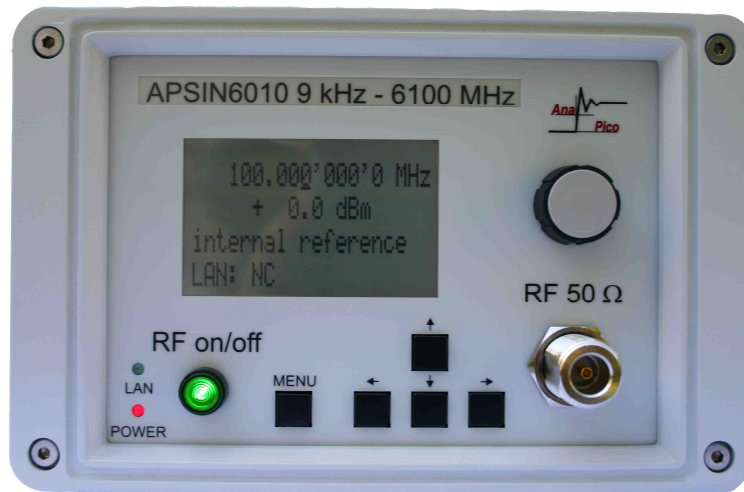


### Harmonic performance at +10 dBm



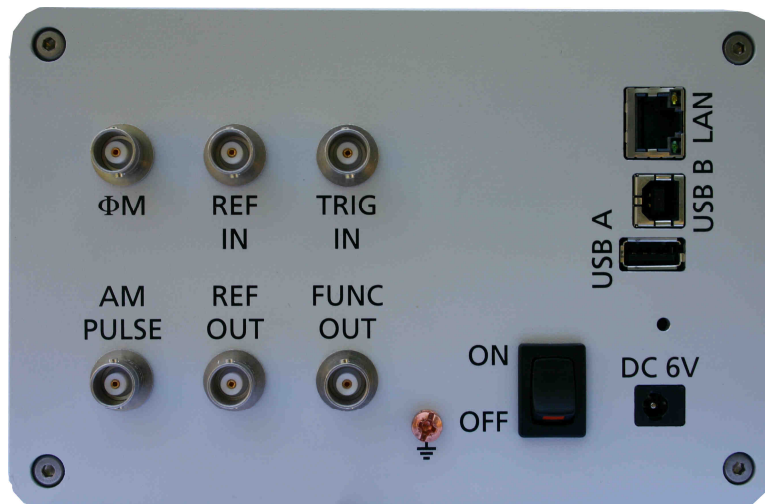
# Connectors

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, 6 A)
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 3.3 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

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

Recommended calibration cycle 24 months

Compatibility languages supporting commonly used commands  
 Agilent Technologies N5181A MXG,  
 Aeroflex  
 Rohde & Schwarz SMA and SML models

- **B3:** Rechargeable battery pack (internal, up to 2.5 hours operation)
- **PE3:** Extended power range (leveled down to -120 dBm)
- **AVIO:** VOR/ILS test signals
- **GPIB:** IEEE-488.2,1987 programming interface



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

# Document History

Version/Status	Date	Author	Notes
V10	2010-06-01	jk	first release
V11	2010-08-01	jk	mechanical information added
V12	2010-11-01	jk	Options,
V13	2010-12-30	jk	Measurements added
V131	2011-3-10	jk	Concurrent sweeps / modulation
V140	2011-4-28	jk	Frontpanel, measurement plots
V142	2011-5-20	jk	Reference output 10 MHz, Pmax adjusted
V143	2011-9-1	jk	Phase Noise plot
V144	2012-09-15	jk	Reference input range adjusted
V145	2012-09-15	jk	Added trigger, chirps, pulse trians
V146	2013-08-26	db	Modified sweep timing specs

