AP5001A RF Analog Signal Generator

9 kHz to 2, 4, or 6.1 GHz

KEYSIGHT

Definitions and Conditions

The specifications in the following pages describe the warranted performance of the instrument for 23 ± 5 °C after a 30-minute warm-up period (unless otherwise stated).

Min/Max: Parameter range that is guaranteed by product design, and/or production tested. Warranted performance specifications include guard-bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Typical: Expected mean values, not warranted performance.

Specifications

Frequency Parameters / Range

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency range	9 kHz		2.0 GHz	AP5001A-502
	9 kHz		4.0 GHz	AP5001A-504
	9 kHz		6.1 GHz	AP5001A-506
Resolution		0.001 Hz		
Phase resolution		0.1 deg		
Settling time		20 µs	200 µs	
Frequency update rate List/Sweep mode		400 µs		time from receipt of SCPI command firmware
Total jitter		68 fs RMS		10 Hz to 1 MHz BW
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 Ω		
Internal reference frequency output		10 MHz		
Initial accuracy of internal reference		± 40 ppb		calibrated at 23 ± 3 °C at the time of calibration
Temperature stability (0 to 50 °C)			±100 ppb	
Aging 1st year		0.5 ppm		
Aging per day (after 30 days of operations)			5 ppb	
Warm-Up time		5 min		
Output of internal reference		+0 dBm, 50 Ω		

Level Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
Power level				
Standard	-30 dBm		+17 dBm +10 dBm	> 50 MHz & < 6 GHz ≤ 50 MHz
Option 1E1	-120 dBm		+17 dBm +10 dBm	> 50 MHz & < 6 GHz ≤ 50 MHz
Resolution		0.01 dB		
Level uncertainty		± 0.3 dB ± 0.5 dB ± 0.8 dB	± 0.8 dB ± 1.3 dB	-20 to + 10 dBm -80 to -20 dBm < -80 dBm

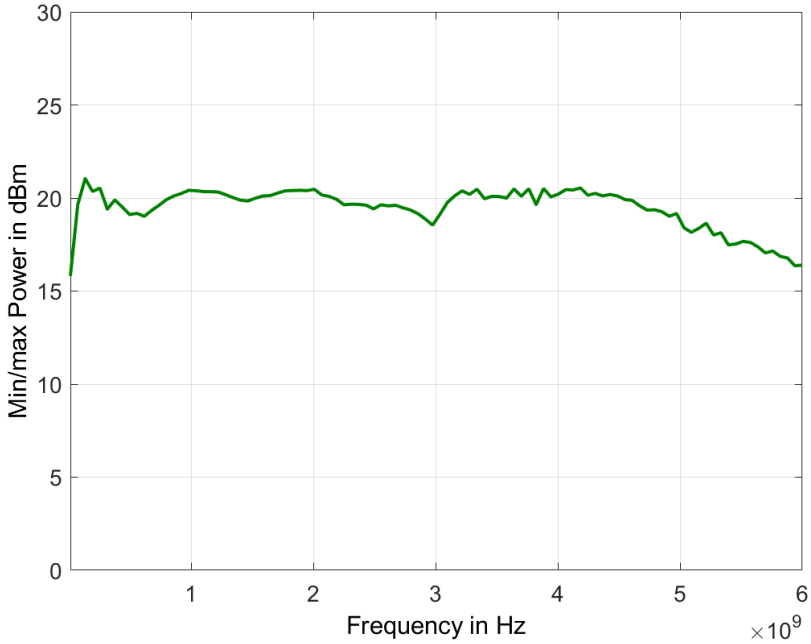


Figure 1. Typical maximum output power

Reverse Power Protection and VSWR

PARAMETER	MIN	TYPICAL	MAX	NOTE
Reverse Power Protection				
DC Voltage		30 V		
RF power			36 dBm	
Output impedance		50 Ω		
VSWR		1.5 1.7	1.8 2.0	< 3 GHz > 3 GHz

Phase Noise

PARAMETER	MIN	TYPICAL	MAX	NOTE
SSB Phase noise at 1 GHz, at 20 kHz from carrier		-130 dBc/Hz	-128 dBc/Hz	

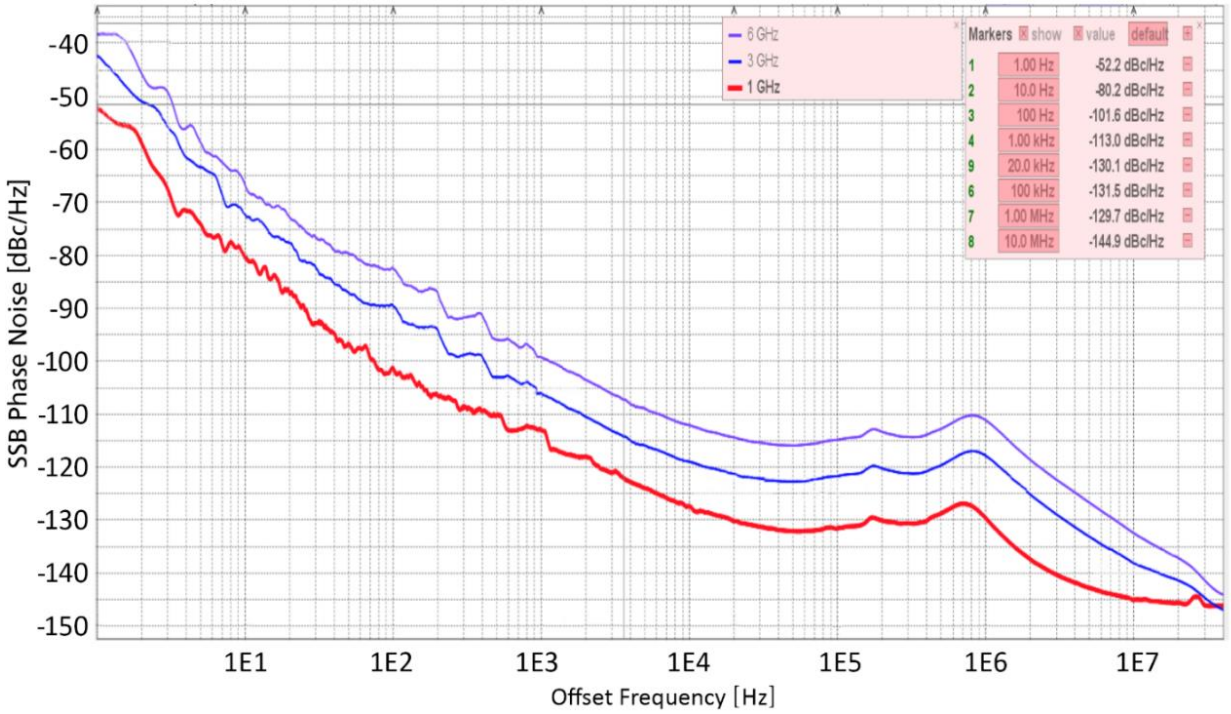


Figure 2. Typical phase noise

Spectral Purity

PARAMETER	MIN	TYPICAL	MAX	NOTE
Output harmonics		-40 dBc	-30 dBc	P_{out} = +10 dBm
Sub-harmonics		-80 dBc	-70 dBc	
Non-harmonic spurious				
< 1 MHz		-70 dBc	-60 dBc	P_{out} = +10 dBm
1 MHz to 5.8 GHz		-65 dBc	-55 dBc	P_{out} = +10 dBm
5.8 GHz to 6.1 GHz		-60 dBc	-50 dBc	P_{out} = +10 dBm
Residual FM at 1 GHz			3 Hz 12 Hz	0.3 kHz to 3 kHz, weighted (ITU-T) 0.03 kHz to 23 kHz

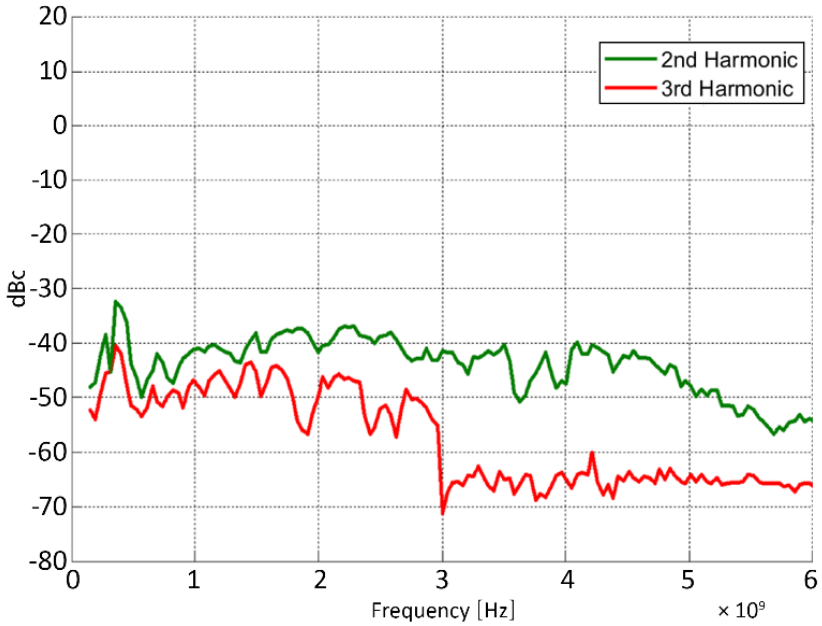


Figure 3. Typical harmonics, at +10 dBm

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	TYPICAL	MAX	NOTE
Frequency sweep (Sweep type: linear, logarithmic, random)				
Step time (t_{step})	400 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		
Generalized list sweep (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		

Modulation Capabilities

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

PARAMETER	MIN	TYPICAL	MAX	NOTE
Pulse modulation				
On/off ratio		70 dB		
Repetition frequency	DC		33 MHz	
Pulse width	30 ns 50 µs		20 s 20 s	ALC hold ALC on
Pulse rise/fall time		25 ns		
Pulse train length (pulses)	2		4,192	
Video crosstalk		-40 dB		
External input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External input voltage range	-0.5 V		+5.5 V	TTL compatible
External input hysteresis		60 mV		
Delay (to RF)		20 ns	40 ns	
Frequency modulation				
Maximum Frequency deviation (peak)	0		0.05 x f	< 0.25 GHz
	0		N x 200 MHz	0.25 to 0.75 GHz (N=0.125) 0.75 to 1.5 GHz (N=0.25) 1.5 to 3 GHz (N=0.5) > 3 to 6.1 GHz (N=1)
Modulation waveforms	Sine, triangle, FSK			
Modulation rate	1 Hz/DC		800 kHz	-3 dB frequency response Max. phase deviation degrades above 20 kHz modulation rate
External input sensitivity	< N x 100 MHz for 1 Vpp			settable in AC mode discrete values in DC mode
Total harmonic distortion	< 1%			1 kHz rate & N x 100 kHz deviation
Frequency chirps (linear ramp, up/down)				
Span			10%	
Dwell time (t_{chirp})	10 ns		60 s	
Slope			100 MHz/µs	
Total duration of finite repeated chirps (t_{chirp} x repetitions)			64.1 s	
Number of frequencies			20,000	
Phase modulation				
Phase deviation (peak)	0		N x 80 rad	
Modulation rate	1 Hz		800 kHz	> -3 dB frequency response
Modulation waveforms	Sine, triangle, FSK			
External Input sensitivity	N x 40 rad for 1 Vpp			
Total harmonic distortion	< 1%			1 kHz rate & N x 20 rad deviation
Amplitude modulation				
Modulation rate	10 Hz		50 kHz	Applies to internal and external
Modulation depth	0 %		95 %	
Modulation waveforms	Sine, triangle, square			
Accuracy (f<10 MHz)		1.3 %	2 %	f-carrier, modulation depth <80% & 1 kHz modulation rate, power 0 dBm
Distortion (f<10 MHz)		1.6 %	3 %	
Accuracy (f>10 MHz)		0.6 %	1.4 %	
Distortion (f>10 MHz)		1 %	2 %	
External input sensitivity	X % per 1 Vpp			settable

Multi-Purpose Output (FUNC OUT)

PARAMETER	MIN	TYPICAL	MAX	NOTE
Multifunction generator (sine, triangle, square wave)				
Frequency range	10 Hz		3 MHz	sine
	10 Hz		1 MHz	triangle
	10 Hz		50 kHz	square
Frequency resolution		0.6 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 Ω		Sine, triangle
		CMOS		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)

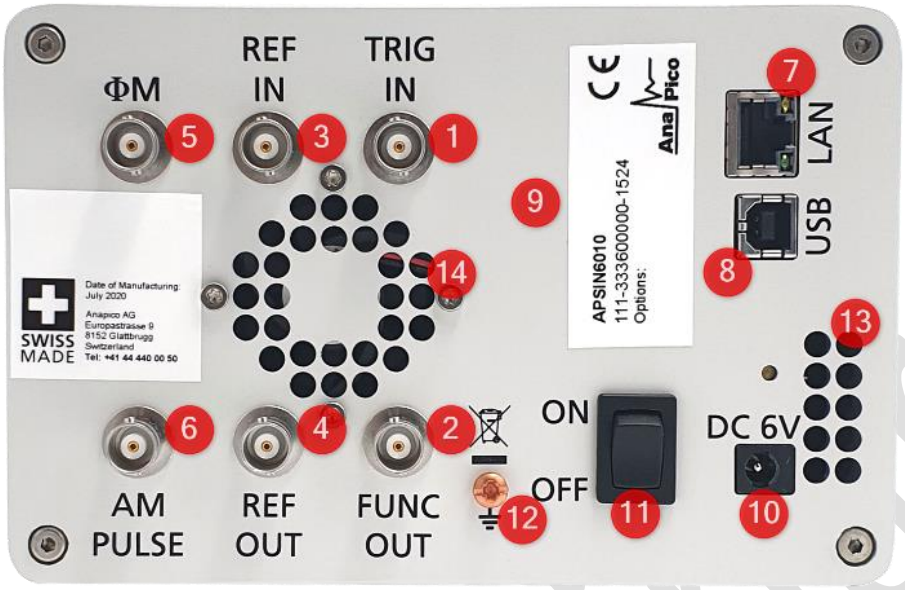
PARAMETER	MIN	TYPICAL	MAX	NOTE
Trigger types	Continuous, single, gated, gated direction			
Trigger source	RF key, external, bus (LAN, USB)			
Trigger modes	Continuous free run, trigger and run, reset and run			
Trigger latency		2 µs		
Trigger uncertainty		5 µs		
External trigger delay	50 µs		40 s	
External delay resolution		15 ns		
Trigger modulo	1		255	Execute only on the N^{th} trigger event
Trigger polarity	Rising, falling			
External trigger input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External trigger input voltage range	-0.5 V		+5.5 V	TTL compatible
External trigger input hysteresis		60 mV		

Connectors

Front

1. **RF output** N female
2. **Rotary knob**

Rear



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 device**
9. ~~**GPIB** IEEE-488.2, 1987 with listen and talk (optional)~~
10. **DC Power plug (6V, 6 A)**
11. **DC power switch**
12. **Ground Screw**
13. **Fan Holes** The air intake of the fan
14. **Fan Holes** The holes by which the air is extruded.

General Characteristics

Remote programming interfaces
Ethernet 100BaseT LAN interface
USB 2.0 host & device
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

Storage temperature range –40 to 70 °C

Operating temperature range 0 to 45 °C

Operating and storage altitude up to 15,000 feet

CE
Safety/EMC complies with applicable Safety and EMC regulations and directives.

Weight ≤ 2.5 kg (6 lbs) net, ≤ 4 kg (8 lb.) shipping

Dimensions:
Excluding connectors: W x L x H = 172 x 250 x 106 mm [6.83 x 9.84 x 4.60 in]
Including connectors: W x L x H = 172 x 273 x 106 mm [6.83 x 10.66 x 4.60 in]

Recommended calibration cycle 24 months

Compatibility languages supporting commonly used commands
Keysight N5171B EXG, N5173B EXG, N5181A/B MXG, N5183A/B MXG
Rohde & Schwarz SMB100A, SMB100B, SMC100A, SMCV100B, SMA and SML models

Ordering information

Model/Option	Description	Additional information
AP5001A	**RF Analog Signal Generator**	
AP5001A-502	Frequency range, 9 kHz to 2 GHz	
AP5001A-504	Frequency range, 9 kHz to 4 GHz	
AP5001A-506	Frequency range, 9 kHz to 6.1 GHz	
AP5001A-1E1	Step attenuator	
AP5001AU-F01	Frequency upgrade from 2 GHz to 4 GHz	License key only
AP5001AU-F02	Frequency upgrade from 2 GHz to 6.1 GHz	License key only
AP5001AU-F03	Frequency upgrade from 4 GHz to 6.1 GHz	License key only
AP5001AU-1E1	Add step attenuator	License key only

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.

Published in USA, Month XX, 2024, 3124-XXXX.EN