DATASHEET APSINX010 Specification v2.25

Signal Generator

9 kHz to 2000 MHz, 4000 MHz and 6100 MHz

DEFINITIONS

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.

INTRODUCTION

APSIN HC models comprises a set of very compact, portable analog signal generator models from 9 kHz up to 6100 MHz. A combination of good signal purity, fast switching speed and wide dynamic range makes these units useful for a variety of applications.

The APSINX010 is a series of a low-noise and fast-switching analogue signal generator covering a frequency range from 9 kHz up to 2.0, 4.0, and 6.1 GHz, respectively.

The APSINX010 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 APSINX010 operates at very low DC power consumption (only 12 watts), with minor heat dissipation and not requiring noisy fan. This gives the APSINX010 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.

Available Options:

- **Option PE3** is an optional power level extension to accurately level below -120 dBm.
- **Option B3** adds an internal rechargeable battery module
- **Option AVIO** adds dedicated avionics modulation like VOR/ILS
- **Option 1URM** modifies form-factor to a 19'' rack-mountable 1HU enclosure
- **Option EB6** adds an external power bank adapter cable with voltage converter for 12 to 25 V supply

The APSINX010 support various standard interfaces such as USB (USBTMC), LAN (VXI-11), or GPIB and extensive API with programming examples are available.

SPECIFICATIONS

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency range	9 kHz		2.0 GHz 4.0 GHz 6.1 GHz	**APSIN2010HC** **APSIN4010HC** **APSIN6010HC**
resolution		0.001 Hz		
Phase resolution		0.1 deg		
Settling time		20 µs 20 µs	100 µs 200 µs	<= SN xx-xxx2xxxxx-xxxx >= SN xx-xxx3xxxxx-xxxx
Frequency update rate List/Sweep mode		400 µs 400 µs		time from receipt of SCPI command firmware
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 Sub-harmonics		 -40 dBc -80 dBc	 -30 dBc -70 dBc	 P_{out} = +10 dBm
Non-harmonic spurious < 1 MHz 1 MHz to 5.8 GHz 5.8 GHz to 6.1 GHz		 -70 dBc -65 dBc -60 dBc	 -60 dBc -55 dBc -50 dBc	 P_{out} = +10 dBm
Residual FM @ 1 GHz			 3 Hz	0.3 kHz to 3 kHz, weighted (ITU-T)
			12 Hz	0.03 kHz to 23 kHz
Power level				
Without Option PE3 With Option PE3	-30 dBm -120 dBm		+18 dBm +10 dBm +17 dBm +10 dBm	See plots on page 8 >50 MHz & <6 GHz < 50 MHz >50 MHz & <6 GHz < 50 MHz
Resolution		0.01 dB		
Level uncertainty		0.3 dB 0.5 dB 1.8 dB	< 0.8 dB < 1.3 dB	-20 to + 10 dBm -80 to -20 dBm < -80 dBm
Output impedance VSWR		50 Ω 1.5 1.7	 1.8 2.0	 < 3 GHz > 3 GHz
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 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		
Output of internal reference		+0dBm 50 Ω		
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	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		
Frequency Chirps (linear ramp, up/down)				
Bandwidth			10%	
Dwell time (tdwell)	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 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 trainslength (pulses)	2		4192	
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		0.05·f N·200 MHz	< 0.25 GHz 0.25 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 Max. phase deviation degrades above 20 kHz modulation rate
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	10 Hz 10 Hz		20 kHz 50 kHz	applies for internal and external >= SN xx-xxx5xxxxx-xxxx
Modulation depth	0 %		95 %	
Modulation waveforms	Sine, triangle, square			
Distortion		2 %		
Accuracy		3 %		in absolute percentage points
External input sensitivity	X % per 1 Vpp			settable

Avionics Modulation (option AVIO)		
ILS		
Localizer RF frequency	108 to 112 MHz	
Nominal tone frequencies	90 & 150 Hz	
Frequency accuracy	< 0.02 Hz	
Centerline (in %)	DDM: 0 ± 0.1; SDM: 40 ± 2.0	
Fly left (in %)	DDM: 15.5 ± 0.5; SDM: 40 ± 2.0	
Fly right (in %)	DDM: -15.5 ± 0.5; SDM: 40 ± 2.0	
Flag (in %)	DDM: 0 ± 0.1; SDM: 30 ± 2.0	
Glide Path RF frequency	328.6-335.4 MHz	
Angle of Descent (in %)	DDM: 0 ± 0.1; SDM: 80 ± 3.0	
Fly up (in %)	DDM: 17.5± 0.5; SDM: 80 ± 3.0	
Fly down (in %)	DDM: -17.5± 0.5; SDM: 80 ± 3.0	
Flag (in %)	DDM: 0 ± 0.1; SDM: 70 ± 2.5	
VOR RF frequency	108 - 118 MHz	
Subcarrier Frequency	9960 ± 2.0 Hz	
FM deviation	480 Hz	
AM tone	30 ± 0.02 Hz	
Bearing north	TDM: 30 ±2.0 % Phase: 180 ± 0.5 deg	
Bearing south	TDM: 30 ± 2.0 % Phase: 90 ± 0.5 deg	
Bearing east	TDM: 30 ± 2.0 % Phase: 0 ± 0.5 deg	
Bearing west	TDM: 30 ± 2.0 % Phase: 270 ± 0.5 deg	
Test 1	TDM: 20 ± 1.5 % Phase: 0 ± 0.5 deg	
Test 2	TDM: 40 ± 2.0 % Phase: 0 ± 0.5 deg	

Multi-Purpose Output (FUNC OUT)

Output is FUNC OUT at rear panel

PARAMETER	MIN	TYPICAL	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 Ω CMOS		Sine, triangle squarewave
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		

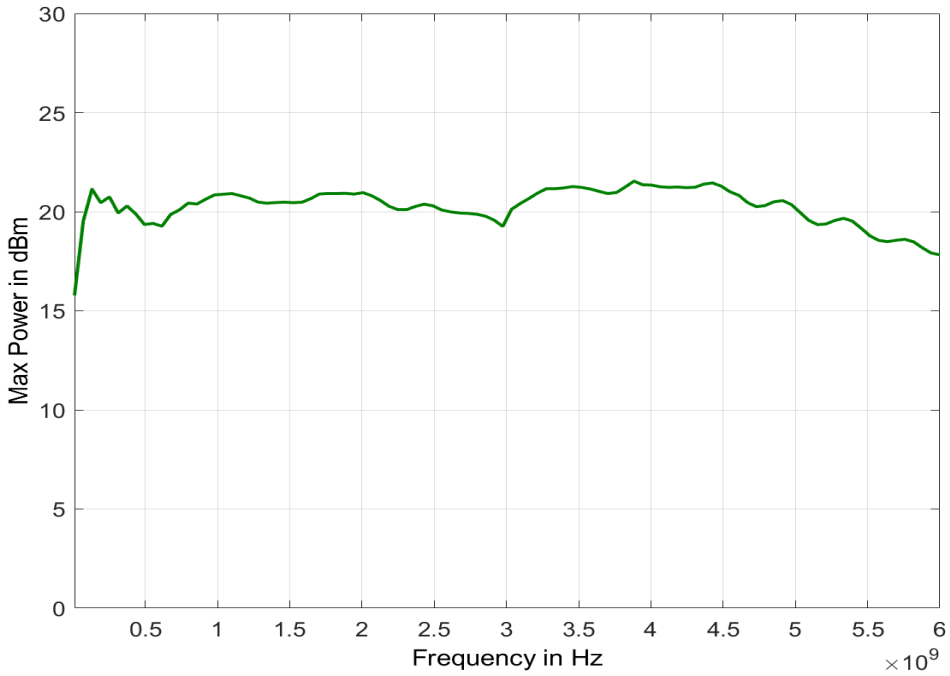
Trigger (TRIG IN)

Input is TRIG IN at rear panel

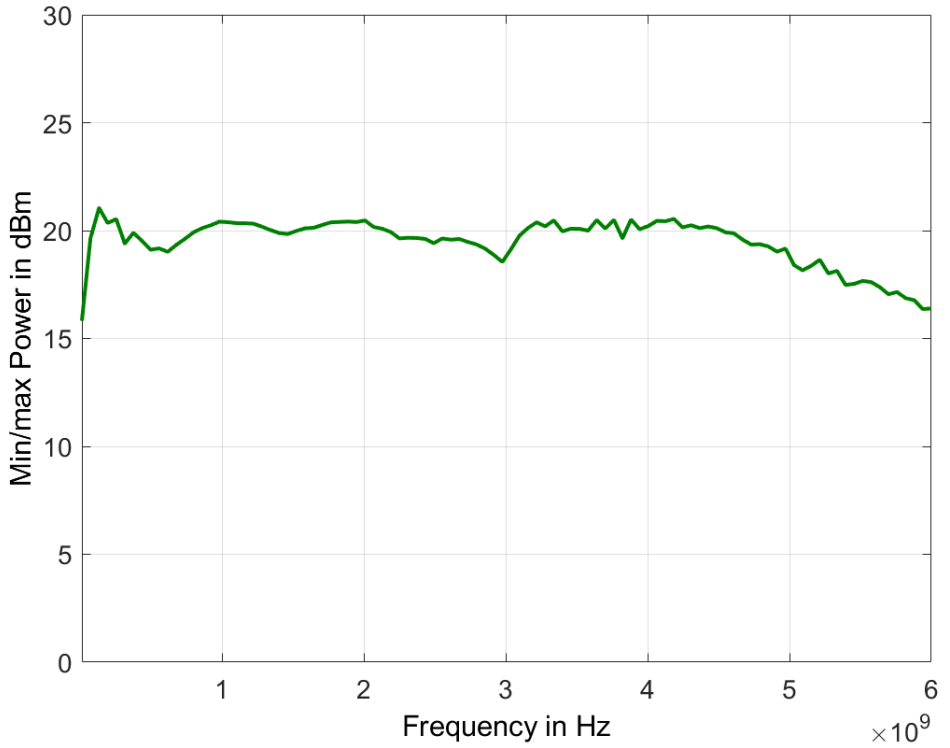
PARAMETER	MIN	TYPICAL	MAX	NOTE
Trigger Types	Continuous, single, gated, gated direction			
Trigger Source	RF key, external, bus (GPIB, LAN, USB)			
Trigger Modes	Continuous free run, trigger and run, reset and run			
Trigger latency		tbd		
Trigger uncertainty		5 µs		
External Trigger delay	50 µs		40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

PERFORMANCE CURVES

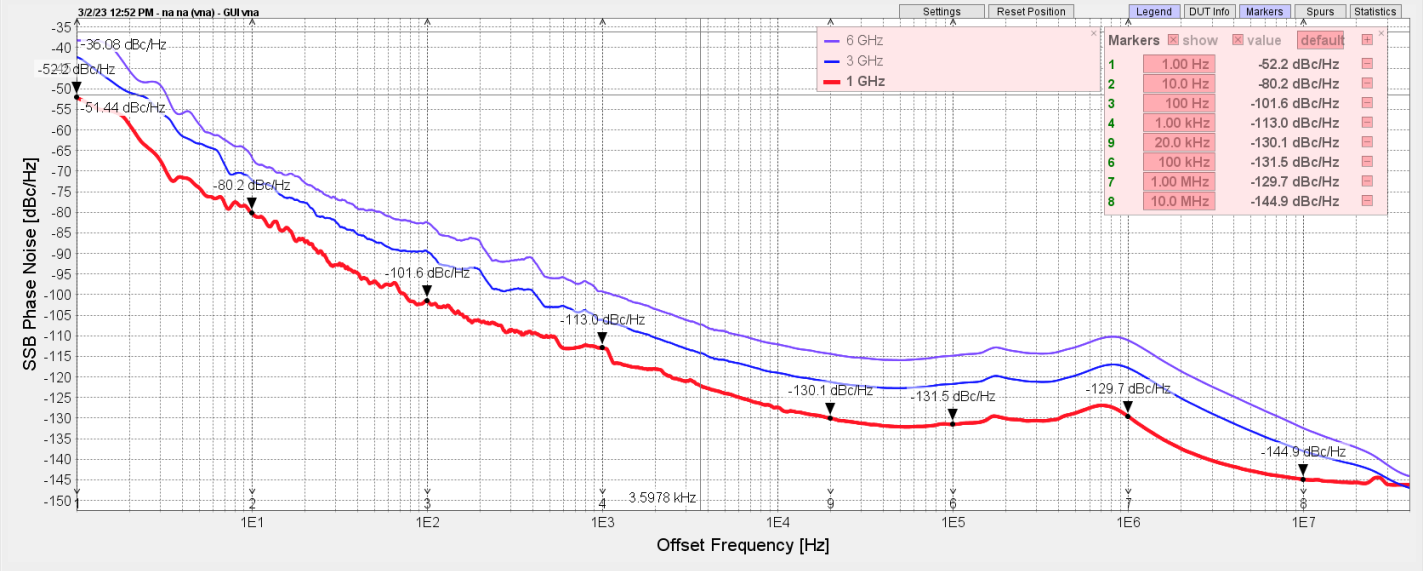
Typical Maximum Output Power (without option PE3)



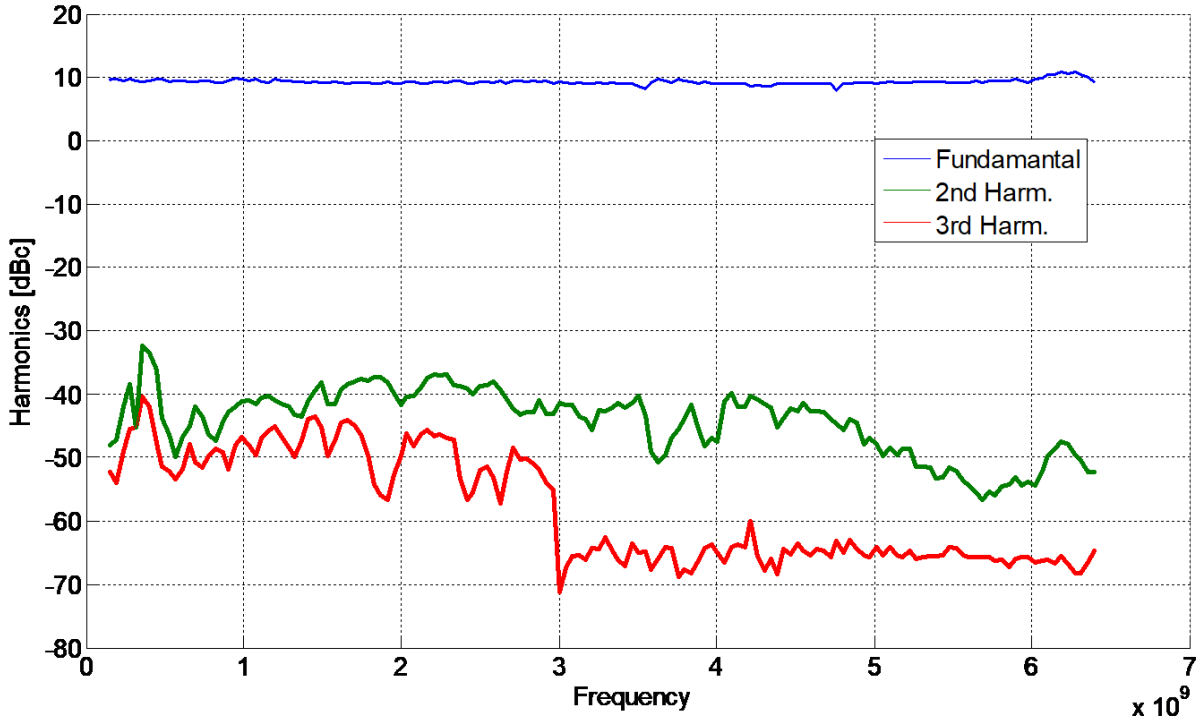
Typical Maximum Output Power (WITH option PE3)



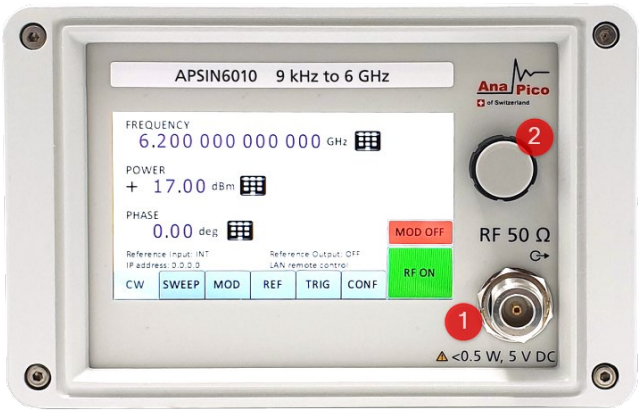
Phase Noise Performance (1, 3 and 6 GHz)



Harmonic performance at + 10 dBm

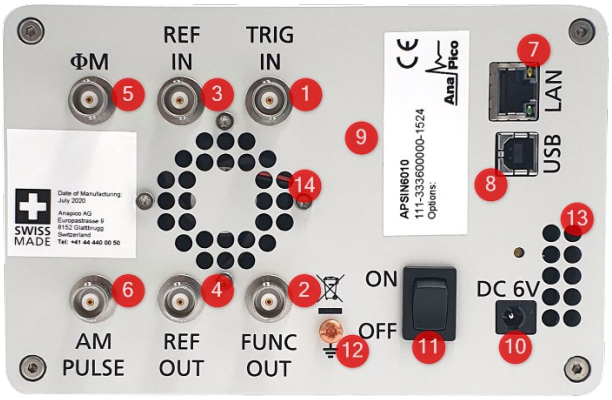


Connectors (Front)



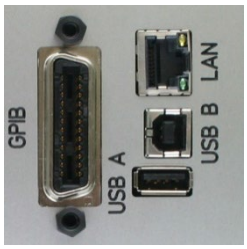
1. **RF output** N female
2. **Rotary knob**

Connectors (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.

ORDERING INFORMATION

HOST MODEL	PRODUCT	DESCRIPTION
APSINX010HC	**APSIN2010HC**	9 kHz – 2000 MHz Signal Generators
APSINX010HC	**APSIN4010HC**	9 kHz – 4000 MHz Signal Generators
APSINX010HC	**APSIN6010HC**	9 kHz – 6100 MHz Signal Generators
APSINX010HC	**Option B3**	Internal rechargeable battery module
APSINX010HC	**Option PE3**	Mechanical step attenuator
APSINX010HC	**Option FLASH**	MicroSD card slot for removable SD memory
APSINX010HC	**Option GPIB**	GPIB interface 
APSINX010HC	**Option EB6**	External power bank adapter cable with voltage converter for 12 to 25 V supply Required input connector: Inner / outer diameter 2.1 / 5.5 mm 
APSINX010HC	**Option AVIO**	Avionics modulation capability (VOR/ILS)
APSINX010HC	**Option 1URM**	1U rack-mount module  Dimensions 42 mm H x 426 mm W x 460 mm L [1.7 in H x 16.8 in W x 18.1 in L]
APSINX010HC	**Option RM**	19'' 3HU rack-mount kit
APSINX010HC	**Option REAR**	Move output to the rear panel
APSINX010HC	**Option OEM**	OEM package
APSINX010HC	**Option DATA**	Commercial Calibration Certificate with test data
APSINX010HC	**Option IEC**	IEC 17025 calibration with certificate
APSINX010HC	**Option Bag**	Portable Bag
APSINX010HC	**Option WE**	One-year warranty extension (standard: 2 years)
APSINX010HC	**Option ReCal**	Recalibration with test data (recommended: two years interval)
APSINX010HC	**Option Retrofit**	Applies when options are back-ordered

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

Storage temperature range –40 to 70 °C

Operating temperature range 0 to 45 °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:

116.9 mm H x 173.6 mm W x 270.7 mm L (incl. connectors)
[4.60 in H x 6.83 in W x 10.66 in L]

Recommended calibrationcycle24 months

Compatibility languages supporting commonly used commands

Agilent Technologies N5181A MXG, Aeroflex, Rohde & Schwarz SMA and SML models

Document History

Version	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	2011-03-10	jk	Concurrent sweeps / modulation
V140	2011-04-28	jk	Front panel, measurement plots
V142	2011-05-20	jk	Reference output 10 MHz, Pmax adjusted
V143	2011-09-1	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
V147	2013-10-04	db	Added frequency settling time specs
V148	2014-01-21	jk	Corrected dimensions
V149	2014-02-06	jk	Maximum power plot added
V150	2014-06-30	jk	New phase noise plot
V200	2014-12-10	jk	Unified data sheet for APSINX010HC series
V210	2015-05-10	jk	Updated sweeping timing parameters
V211	2015-06-23	db	Added >= SN xx-xxx5xxxxx-xxxx AM bandwidth data
V212	2016-07-05	db	Added option PE data
V214	2016-12-15	jk	Refine power level accuracy
V215	2017-05-15	jk	Option AVIO
V216	2017-08-15	jk	VSWR Spec refined
V217	2019-01-30	mm	Dimension update
V218	2019-03-25	mm	New layout
V219	2019-07-10	ee	Minor corrections
V220	2020-09-15	db	Clarified Power accuracy at > + 10 dBm
V221	2020-11-11	ee	Updated product images
V222	2021-01-10	jk	New power plots
V223	2021-02-25	db	Pulse and trigger input electrical specifications
V224	2021-05-10	ee	Added option EB6 & images for option GPIB and 1URM
V225	2023-04-05	ee/mh	Removed Option LH, updated non-harmonic spur data

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