KEYSIGHT



Analog Signal Generators

From research to manufacturing testing

BUYING GUIDE

Keysight Signal Generators

One family. Three performance grades. 6 classes.

Vector Signal Generators



ESSENTIAL

XG1, XG2-class

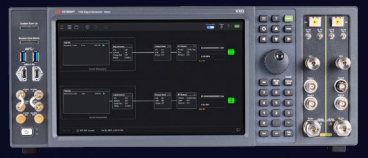
- 6 GHz to 40 GHz Maximum frequency
- 120 MHz to 160 MHz Maximum modulation bandwidth



EXPERT

XG4, XG5-class

- 8.5 GHz to 40 GHz Maximum frequency
- 400 MHz to 1 GHz Maximum modulation bandwidth



PRO

XG7-class

- 54 GHz Maximum frequency
- 2.5 GHZ Maximum modulation bandwidth

Analog Signal Generators



ESSENTIAL

XG1, XG2-class

- 6 GHz to 40 GHz Maximum frequency
- 1 to 4 Outputs



EXPERT

XG5, XG6-class

- 8.5 GHz to 54 GHz Maximum frequency
- 1 to 4 Outputs



PRO

XG7-class

- 67 GHz Maximum frequency
- 1 to 2 Outputs

Introduction

Selecting the right analog signal generator depends on a number of factors, including the purity, power, and throughput your application demands. Keysight offers three performance grades of vector signal generators — Essential, Expert, and Pro. This buying guide compares these grades and their specifications. Whether you are working on general-purpose RF applications, conducting demanding signal tests, or performing sophisticated research, aerospace and defense, or satellite testing, each signal generator offers a unique combination of frequency range, channels, phase noise, and output power. Use this guide to determine which signal generator grade aligns with your application requirements.

Essential

Essential analog signal generators come in two classes. The XG1-class includes AP5001A-AP5002A, and the XG2-class includes AP5011A-AP5012A, N5171B and N5173B signal generators. They feature low phase noise, a wide output power range, and switching speeds down to 20 µs, ideal for testing a broad range of general-purpose devices and communication systems with frequencies up to 40 GHz.

Expert

Expert analog signal generators come in two classes. The XG5-class includes N5185A, N5181B-N5183B, and AP5021A-AP5022A, and the XG6-class includes AP5031A-AP5032A signal generators. For RF applications with frequencies up to 54 GHz requiring high signal stability and purity, they offer lower phase noise and switching speeds down to 3 µs for precise replication of real-world RF environments.

Pro

The XG7-class Pro analog signal generators include the SG6311A, E8257D, and E8663D signal generators. For labs that need to push performance limits, they deliver metrology-grade performance with one or two RF channels and maximum frequencies up to 67 GHz (1.1 THz with extenders), ideal for precision signal generation in higher-end R&D, military testing, and satellite communications.



Step 1. Check the General Specifications

Keysight analog signal generators deliver low-phase-noise signals with precise frequency control, flexible configurations, and fast switching speeds. They are ideal for testing components like oscillators and amplifiers in wireless communications and aerospace and defense applications. The first part of your signal generation selection process will be based on maximum frequency, bandwidth, maximum channels, and phase noise. The table below summarizes the key specifications by product grade — Essential, Expert, and Pro — to help you select the analog signal generator that is right for your application.

Analog signal generator comparison of specifications

Specifications	Essential	Expert	Pro
Class	XG1, XG2	XG5, XG6	XG7
Maximum frequency	6 GHz to 40 GHz	8.5 GHz to 54 GHz	67 GHz
Number of outputs	1 to 4	1 to 4	1 to 2
Phase noise @ 1 GHz (20 kHz offset)	-122 dBc/Hz to -130 dBc/Hz	-145 dBc/Hz to -150 dBc/Hz	-143 dBc/Hz to -153 dBc/Hz
Output power @ 1 GHz	+17 dBm to +25 dBm	+17 dBm to +25 dBm	+21 dBm
Harmonics @ 1 GHz	-33 dBc to -40 dBc	-33 dBc to -60 dBc	-55 dBc
Frequency switching speed	800 µs to 20 µs	800 µs to 3 µs	11 ms to 7 ms
	EXPLORE ESSENTIAL	EXPLORE EXPERT	EXPLORE PRO

Step 2.
Look at Key Features



Essential

Core Features

- phase noise down to -130 dBc/Hz*
- output power up to 25 dBm @ 1 GHz
- switching speed down to 20 µs
- analog modulation capabilities

Key Capabilities

Generate AM, FM, PM, and pulse modulated signals with low phase noise, a wide output power range, and fast switching speeds at frequencies up to 40 GHz.

Expert

Core Features

- phase noise down to -150 dBc/Hz*
- output power up to +25 dBm @ 1 GHz
- switching speed down to 3 µs
- up to four output channels

Key Capabilities

Provides highly stable and pure signals with ultra-low harmonic distortion down to -60 dBc @ 1 GHz, as required for complex signals in applications with frequencies up to 54 GHz.

Pro

Core Features

- phase noise down to -153 dBc/Hz with exceptional spectral purity*
- max frequency up to 1.1 THz
- up to two output channels
- output power up to +30 dBm with high power extensions

Key Capabilities

Metrology-grade accuracy and phase noise with frequency coverage up to 67 GHz (extendable to 1.1 THz) for testing the most sophisticated applications.

* Phase noise measured at 1 GHz, 20 kHz offset

Step 3. Consider Your Use Cases

While specifications are important, considering the various ways your team will use an instrument will determine which grade is best for your lab's needs. Here are a few typical use cases for each grade.

Essential: General-purpose RF testing

Keysight Essential analog signal generators feature low phase noise, a wide output power range, and fast switching speeds needed to test various devices and communication systems. Essential generators can be configured to support up to four phase-coherent outputs at 40 GHz frequency, ideal for evaluating signal strength, frequency response, or noise performance in multiport receiver testing.

Common Essential analog signal generator use cases include:

- How to Test IoT Regulatory Compliance
- How to Conduct Fast RF Device Testing with Analog Sources
- How to Achieve Phase Coherence for Multi-Port Testing



Expert: More sophisticated testing requiring enhanced precision

Keysight Expert analog signal generators build upon the capabilities of our Essential model, featuring a higher 54 GHz maximum frequency and lower phase noise. Expert generators feature fast switching speeds down to 3 microseconds and offer a range of single and multichannel configurations to meet your application needs. The ultra-low phase noise ensures the signal stability and purity required for demanding cellular, radar, analog-to-digital converter (ADC), and receiver-blocking tests.

Common Expert analog signal generator use cases include:

- How to De-embed Fixtures and Correct Mismatch Errors
- How to Perform 5G Channel Sounding Measurements
- How to Characterize 5G Air Interfaces



Consider Your Use Cases (cont.)

Pro: Metrology-grade performance for enhanced applications

Keysight Pro analog signal generators offer metrology-grade signal purity with frequency coverage up to 67 GHz, extendable to 1.1 THz. The Pro generators are the right choice for critical applications in calibration labs, research environments, and production testing. With up to two RF channels, Pro signal generators support demanding single- and multichannel test requirements. Generate high-quality signals, from pure continuous wave (CW) tones to complex analog modulated signals with up to 1 W of power using an optional high-power extension.

The metrology-grade signals are traceable to national and international standards, ensuring accurate, repeatable results with minimal errors. They are ideal for precision signal generation in sophisticated R&D, military testing, and satellite communications.

Common Pro analog signal generator use cases include:

- How to Generate an RF Carrier Signal
- How to Characterize 6G Sub-THz Wideband Signals
- How to Improve Local Oscillator Purity for Radar and Defense Systems

Explore more signal generator use cases to help you innovate faster and with greater confidence.



Final Key Considerations

As you look across basic features, enhanced features, and your lab's typical use cases, it is good to revisit how use cases might drive each of your instrument's features. When evaluating each specification, be sure to account for future needs, including new standards, by adding a margin beyond your current requirements. Factors to consider when choosing an analog signal generator:

Maximum frequency

Maximum frequency defines the highest signal your generator can produce. Choose Essential for ≤ 40 GHz, Expert for ≤ 54 GHz, and Pro for demanding applications needing up to 67 GHz or beyond.

Number of channels

Number of channels impacts multiport and multichannel testing. Select Essential or Expert for up to four channels; choose Pro for up to two RF channels with metrology-grade signal purity.

Phase noise

Phase noise affects signal purity and modulation accuracy. Use Essential for general testing at -130 dBc/Hz*, Expert for ultra-low noise at -150 dBc/Hz*, and Pro for metrology-grade applications requiring the highest spectral purity.

Output power

Output power ensures sufficient signal strength for overcoming losses and testing high-power components. Choose Essential or Expert for up to +25 dBm; select Pro for applications needing output up to +30 dBm.

*@ 1 GHz, 20 kHz offset



Common mistakes to avoid when selecting an analog signal generator

- Choosing insufficient frequency coverage to meet current and future test requirements.
- Overlooking the need for phase-coherent, time-aligned signals in multiport tests.
- Not ensuring adequate output power to overcome losses in cabling or switching.
- Ignoring rack space or future channel needs, leading to oversized or insufficient setups.

Agile Signal Generators

Accurately simulate complex signal scenarios

Keysight agile signal generators stimulate complex signal environments with an arbitrary waveform generator for testing specific protocols or unique communication formats for radar, electromagnetic spectrum operations (EMSO), and antenna testing. Its nanosecond-level frequency, amplitude, and phase-switching capabilities allow for accurate emulation of multi-threat scenarios.

Plus, you can simulate complex electromagnetic environments across the full frequency range by adding an optional 1.6 GHz bandwidth baseband vector generator.



Maximum frequency	40 GHz
Maximum modulation bandwidth	1.6 GHz
Number of outputs	1
Phase noise @ 1 GHz (20 kHz offset)	-144 dBc/Hz
Output power @ 1 GHz	+3 dBm to +10 dBm
Harmonics @ 1 GHz	< -50 dBc to < -60 dBc
Frequency switching speed	220 ns to 180 ns

EXPLORE

Frequency Synthesizers

Keysight frequency synthesizers provide stable, precise fixed frequencies when the more sophisticated modulation capabilities of a signal generator are not required. Get fast switching speeds, low phase noise, and a high-quality signal in a compact form factor, in single-channel or multichannel configurations.

The compact size of a frequency synthesizer allows you to easily integrate it into your test or production system for various applications, including wireless communications, radar, electronic warfare, and quantum computing. Select the frequency synthesizer performance grade you need based on max frequency, number of phase-coherent channels, phase noise, and switching frequency.



Maximum frequency	20 to 40 GHz
Number of outputs	1 to 4
Phase noise @ 1 GHz (20 kHz offset)	-125 dBc/Hz to -147 dBc/Hz
Frequency switching speed	20 µs to 5 µs
Output power @ 1 GHz	+15 dBm to +25 dBm

EXPLORE

Modular Signal Generators

Keysight modular analog and vector signal generators are built for applications that require multichannel measurement capabilities, measurement speed, and a small footprint. They provide you with the scalability and flexibility needed to create test systems with a shared processor, chassis, and other modular instruments.

With models ranging from 6 GHz to 44 GHz with varying performance grades, select the modular signal generator that is right for your application.



Maximum frequency	6 GHz to 44 GHz
Maximum modulation bandwidth	2 GHz
Phase noise @ 1 GHz (20 kHz offset)	-118 dBc/Hz to -137 dBc/Hz
Output power @ 1 GHz	+19 dBm to +20 dBm
Harmonics @ 1 GHz	-29 dBc to -46 dBc
Frequency switching speed	5 ms to 10 µs

EXPLORE

Why Choose Keysight?

Keysight analog signal generators are trusted by engineers for their precision, reliability, and enhanced capabilities. Whether you're conducting basic RF tests or leading-edge research, Keysight delivers consistent, high-quality performance across all applications. Here's what sets them apart:

High signal quality

- Test your device with realistic, pure signals to see its true performance.
- Improve test repeatability with low phase noise, broadband noise, and spurious levels, minimizing result variability.

Broad frequency coverage

- Enables testing of enhanced RF and microwave radar systems.
- Future-proof test setups with high max frequencies.

Fast, flexible integration

- Rapid switching speed reduces test time and increases throughput.
- Software APIs enable enhanced automation and control over RF signal generation.

Multiport capabilities

- Streamline enhanced multiport receiver testing with phase-coherent multiple output capabilities.
- Save rack or test bench space with multiple ports integrated into a compact unit.

Feature	Specification
Signal purity	Phase noise down to -153 dBc/Hz @ 1 GHz, 10 kHz offset
Frequency coverage	Up to 67 GHz (1.1 THz with extenders)
Output power	Up to +30 dBm
Multichannel support	Up to 4 coherent channels
Switching speed	As fast as 180 ns
Modulation options	Full AM / FM / PM / pulse support



Calibration

Ensure your test system performs to specification and meets local and global standards.



Repair

Restore equipment to original functionality and specifications with trained technicians.



KeysightCare

Innovate at speed with curated support plans and prioritized response and turnaround times.



Education

Make measurements quickly with eLearning and in-house, instructor-led training.



Keysight Support

Get 24x7 access to service requests, case management help, and technical articles.

Select the Signal Generator That Is Right for You

Should you need more information on Keysight signal generator offerings, visit our extensive **library of resources** to help you select the right signal generator for your application. Here are some of the resources that can guide you in determining the best signal generator for your needs:

- The Essential Signal Generator Guide Part 1
- The Essential Signal Generator Guide Part 2
- Understanding Phase Noise Needs and Choices in Signal Generation



Once you are ready, visit **Keysight signal generators** to select one of our popular configurations or build one to meet your specific application.

KEYSIGHT

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.

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