KEYSIGHT

Waveform and Function Generators

From basic waveform generation to cutting-edge research

BUYING GUIDE

Keysight Benchtop Waveform and Function Generators

One family. Three performance grades. 3 classes.

ESSENTIAL

WG1-class

- 20 MHz Bandwidth
- 250 MSa/s Maximum sample rate

ADVANCED

WG2-class

- 20 MHz to 100 MHz Bandwidth
- 160 MSa/s to 320 MSa/s Maximum sample rate

EXPERT

WG3-class

- 80 MHz to 120 MHz Bandwidth
- 660 MSa/s to 1 GSa/s Maximum sample rate

Introduction

Selecting the right waveform or function generator depends on the signal fidelity, bandwidth, and waveform complexity your application demands. Keysight offers three performance grades of Waveform and Function Generators - Essential, Advanced and Expert. This buying guide compares these grades and their specifications. Whether you are generating simple signals in a teaching lab or replicating high-speed patterns for standards compliance, each waveform and function generator grade offers a unique combination of bandwidth, channels, arbitrary waveform capability, sample rate, and interfaces. Use this guide to determine which waveform and function generator aligns with your signal generation needs.

Essential

The WG1-class Essential waveform and function generators includes the EDU33210 series. They deliver fundamental signal types, built-in modulation, and intuitive usability in a compact, entry-level instrument. This grade is ideal for teaching labs and basic signal generation, featuring a large color display and remote connectivity.

Advanced

The WG2-class Advanced waveform and function generators includes 33500-series. They extend signal generation with low-jitter outputs, noise control, waveform summing, and flexible pulse capabilities. This grade is well-suited for simulating real-world conditions and digital communication environments.

Expert

The WG3-class Expert waveform and function generators includes 33600-series. These push performance further with high bandwidth, deep memory, and fast sampling. This grade supports precise synchronization and timing-critical applications like wireless communications, automotive systems, and high-speed pulse testing.

Step 1. Check the General Specifications

Keysight waveform and function generators enable a wide range of capabilities, from basic signal outputs for simple, functional tests to ultra-fast synthesis for complex signal simulations. Our entire line of waveform and function generators comes with Keysight Trueform technology, which generates waveforms with superior signal integrity, ultra-low jitter, and complete waveform point coverage. The waveform and function generators precisely reproduce every waveform, which is ideal for edge-sensitive and high-precision applications.

Coupled with instrument control and waveform builder software, the waveform and function generator instrument controls enable you to create and edit complex waveforms from a PC and quickly transfer them to the instruments with no programming knowledge required. The first part of your selection process will be based on bandwidth, number of channels, waveform capabilities, sample rate, and interfaces.

Benchtop waveform and function generator comparison of specifications

Specifications	Essential	Advanced	Expert
Class	WG1	WG2	WG3
Bandwidth	20 MHz	20 MHz to 100 MHz	80 MHz to 120 MHz
Output channels	1 or 2	1 or 2	1 or 2
Arbitrary waveforms	Yes	Varies	Yes
Maximum sampling rate	250 MSa/s	160 MSa/s to 320 MSa/s	660 MSa/s to 1 GSa/s
Interface	USB, LAN	USB, LAN, GPIB	USB, LAN, GPIB
	EXPLORE ESSENTIAL	EXPLORE ADVANCED	EXPLORE EXPERT

Step 2.
Look at Key Features

Essential

Core Features

- 17 built-in waveforms
- 7-inch color display
- 6 modulation types (AM, FM, PM, FSK, BPSK, PWM)
- USB and LAN connectivity

Key Capabilities

Full-featured entry-level signal generation with modulation support and intuitive operation, ideal for teaching labs and circuit troubleshooting. Enables basic waveform creation and protocol simulation across a 20 MHz bandwidth.

Advanced

Core Features

- as low as < 40 ps jitter and < 0.04% THD
- variable bandwidth noise generation
- waveform summing capabilities
- precise pulse generation and modulation

Key Capabilities

Provides clean, precise signal generation with enhanced control features for real-world signal simulation and wireless communication environments. Supports variable bandwidth noise simulations and waveform sequencing up to 30 MHz.

Expert

Core Features

- jitter down to < 1 ps
- fast sampling up to 1 GSa/s
- deep memory up to 64 MSa/channel
- enhanced triggering and burst modes

Key Capabilities

Delivers high-fidelity, complex waveform reproduction for mission-critical testing in automotive, aerospace, and defense systems. Supports tightly synchronized outputs and high-speed timing for integration with complex gated pulse output, burst mode, and complex arbitrary waveforms test scenarios at bandwidths up to 120 MHz.

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 waveform generation and education

Even at the entry grade, Keysight Essential waveform and function generators offer robust capabilities with built-in waveforms, modulation types, and a clear 7-inch display. Our Essential model simplifies waveform setup, reduces user errors, and allows for remote access via USB or LAN.

Ideal for electronics labs and academic settings, Essential models enable users to generate basic signals, six different modulation schemes, and load seventeen prebuilt waveform patterns. Our Essential models are ideal for troubleshooting circuits, simulating communication signals, and teaching waveform fundamentals.

Common use cases for Essential waveform and function generators include:

- How to Generate a Two-Tone Signal for a Stress Test
- How to Easily Create an Arbitrary Waveform Without Programming
- Waveform Sequencing with Keysight Waveform Builder Software

Advanced: Complex waveform generation and pulse signal testing

Keysight Advanced waveform and function generators provide clean, precise signals for simulating real-world conditions and ensuring reliable device characterization in complex signal environments like multitone communication signals in RF systems, pulse-modulated waveforms in radar and digital communications, and frequency hopping in wireless communications.

With ultra-low jitter and minimal total harmonic distortion (THD), our Advanced waveform and function generators enable realistic simulation and reliable testing of devices in high-signal-complexity scenarios.

Featuring waveform summing, adjustable noise bandwidth, and pulse generation, these instruments are commonly used in automotive, aerospace, and wireless R&D labs that require high signal accuracy.

Common use cases for Advanced waveform and function generators include:

- Stress Testing Your Device with Simulated Waveforms
- How to Simplify Testing with Waveform Summing
- How to Use a Function/Arbitrary Waveform Generator to Generate Pulses
- How to Generate Flexible Digital Modulation Signals

Consider Your Use Cases (cont.)

Expert: Mission-critical waveform generation and timing validation

Keysight Expert waveform and function generators deliver the speed, precision, and memory required to test demanding applications such as automotive electronic control units, including braking systems and airbags, IoT device validation, and aerospace defense systems. These models are purpose-built for high-performance environments that require high bandwidth, fast sampling, and deep waveform memory. The Expert models include enhanced triggering and timing capabilities for reproducing high-speed, precision waveforms needed in critical validation scenarios.

These models support synchronized outputs and high-speed timing for integration with complex gated pulse output, burst mode, and arbitrary waveforms test scenarios. The Advanced and Expert models offer an optional oven-controlled frequency reference for improved stability, jitter, and phase noise.

Common use cases for Expert waveform and function generators include:

- Create a Pseudorandom Binary Sequence Signal
- IQ Signal Generation Made Easy
- Overcome Your Test Challenges by Using a Waveform Generator
- A Flexible Test Solution for 2.4 GHz ZigBee Transmitters and Receivers
- Adding DC Offsets to a Function Generator's Output

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

Step 4. Final Key Considerations

As you consider your application and its unique requirements, it is important to revisit how use cases might drive feature requirements. Factors to consider when choosing a waveform and function generator:

Bandwidth

Bandwidth determines the frequency range over which a generator can accurately reproduce signal content.

Select Essential for signals up to 20 MHz, Advanced for up to 30 MHz, and Expert for complex designs requiring up to 120 MHz. Choose a modular arbitrary waveform generator for up to 80 GHz or a Keysight pulse generator for edge-focused signals at bandwidths up to 3.35 GHz.

Output channels

The number of output channels needed depends on your applications. All Keysight dual-channel waveform function generators can provide independent or synchronized outputs.

Select Essential models to create modulated or differential output waveforms. Advanced and Expert provide more time-based stability and the ability to cross-synchronize with multiple instruments. Modular arbitrary waveform generator enables you to scale up multiple-channel synchronization with multiple modules within a chassis.

Arbitrary waveform

Consider whether you'll need to generate standard shapes or simulate higher-level protocols and real-world complex waveforms.

The Essential model supports built-in and basic arbitrary waveforms, Advanced adds summing and noise shaping, and Expert enables deep sequencing, long memory, and real-time variation. Keysight pulse generators specialize in highly accurate, sharp-edged pulses and programmable patterns. Keysight modular arbitrary waveform generators deliver precise, synchronized complex waveforms with high sampling rates, ultrawide bandwidths, and flexible sequencing.

Final Key Considerations (cont.)

Sampling rate

Sampling rate affects how well a generator can reconstruct complex or fast-changing waveforms.

Use Essential or Advanced for applications up to 250 NSA/s, and Expert for high-speed waveform testing up to 1 GSa/s. Choose a modular arbitrary waveform generator for up to 256 GSa/s.

Interface and security

The instrument interface provides you with the ability to configure and control them remotely. LAN and USB are typically preferred for modern high-performance applications, while GPIB is available for legacy compatibility.

Essential, Advanced, and Expert models feature LAN and USB interfaces, and are equipped with the ability to communicate using SCPI (Standard Commands for Programmable Instruments) and via graphical instrument control and data logging software. Advanced and Expert models offer GPIB for legacy compatibility. Request the NISPOM security option to meet classified information protection requirements and to protect files and data against unauthorized access, theft, or misuse. Keysight modular arbitrary waveform generators feature remote interfaces via their AXI or PXI chassis via USB, LAN, or PCIe connections.

Memory depth

Memory depth determines the duration and detail of a waveform.

Choose Essential for simple burst signals, Advanced for waveform sets or simulations, and Expert for extended patterns with looping and conditional control. Our pulse generators and modular arbitrary waveform generators offer fast memory access optimized for deterministic timing and precise generation of complex waveforms.

Final Key Considerations (cont.)

Jitter and edge precision

For timing-critical tests, low jitter and fast transitions are key.

Essential and Advanced models are suitable for general signal quality. Choose Expert for jitter-sensitive digital, analog, and mixed-signal testing. Our pulse generators deliver picosecond-level jitter and sharp edges ideal for validating clock timing and high-speed serial interfaces.

The Advanced and Expert models offer an optional oven-controlled frequency reference for improved stability, jitter, and phase noise.

Triggering and synchronization

Accurate reproduction of signal timing often depends on flexible and precise triggering.

Advanced and Expert models provide gated, burst, and delay modes. Our pulse generators and modular arbitrary waveform generators offer fine-grain trigger delay, external sync, and real-time edge control for precise clock and event alignment.

Common mistakes to avoid when selecting a waveform and function generator

- Choosing insufficient bandwidth or sampling rate, resulting in distorted or incomplete signal reproduction.
- Underestimating the importance of memory depth for long or complex waveform playback.
- Overlooking jitter and rise / fall time specifications when testing timing-sensitive devices.
- Ignoring software capabilities for waveform creation, pattern generation, and remote control.
- Selecting a generator without flexible triggering, limiting test synchronization options.
- Failing to consider future scalability, especially for modular, multichannel, or automated environments.

Modular Arbitrary Waveform Generators

Scalable signal generation for manufacturing test and cutting-edge research

When you need waveform generation functionality but don't need the display and front-panel interface, Keysight modular arbitrary waveform generators come in a compact, flexible form factor — helping you conserve valuable rack space. Our modular arbitrary waveform generators offer our highest-performance, scalable signal generation for cutting-edge testing in high-speed digital, RF, and optical applications.

Ideal for dense test systems, synchronized multichannel environments, or time-sensitive research, our modular arbitrary waveform generators complement pulse generators in applications requiring both arbitrary signal definition and deterministic timing.

Choose from multiple modular waveform generator models, offering bandwidths from 200 MHz to 80 GHz, to get the one that is right for your application.

Bandwidth:
200 MHz to 80 GHz

Analog channels:
1 to 8

Maximum sample rate:
500 MSa/s to 256 GSa/s

Pulse Generators

High-performance pulse generation with precise timing

Keysight PW1-class Pulse Generators include the 81100A Series. They are well-suited for high-speed digital and mixed-signal testing when your application demands precise pulse timing, sharp edge transitions, and low jitter. Designed for clock signal emulation, margin testing, and pattern generation, these instruments offer precise timing, amplitude control, and programmable trigger options — critical for validating timing-critical components.

Achieve deterministic, repeatable signal output across a range of channels and voltages with pulse generators tailored for high-throughput and automated test environments.

Choose from high-performance pulse generator models to get the one that is right for your application.

Bandwidth:
240 MHz to 3.35 GHz

Channels:
1 to 2

Function:
Pulse generator, arbitrary noise generator, pattern generator

Jitter: As low as a few picoseconds

Triggering:
Internal, external, burst, gated, programmable delay

Interfaces:
USB, LAN, GPIB

Waveform Generator Software Functionality

When selecting the right waveform or pulse generator, it is important to consider the signals and test scenarios your team needs to replicate. Keysight software expands the functionality of both arbitrary waveform and pulse generators, enabling you to create, automate, and analyze a broad range of signals, including pulse patterns, modulated waveforms, and compliance test suites.

Explore Keysight signal creation and analysis tools to build complex waveforms, generate precise pulses, and integrate with automated test systems — without writing custom code.

EXPLORE THE SOFTWARE

Why Choose Keysight?

Keysight waveform, function, and pulse generators deliver high signal fidelity, timing precision, and software integration — enabling you to simulate real-world conditions with confidence. Whether you are developing basic waveforms, complex multitone patterns, or picosecond-accurate pulses, Keysight helps you generate signals you can trust. Here's why engineers choose Keysight:

High signal integrity

- Ultra-low jitter (as low as < 1 ps) and low total harmonic distortion (as low as < 0.03%) ensure clean, and repeatable outputs for accurate production of programmed signals.
- Fast rise / fall times (< 1 ns) and stable edges are ideal for clock reference and timing-critical signal applications.

Enhanced triggering

- Supports internal and external trigger sources, manual triggering, gated mode, burst mode, and programmable trigger delay to meet application needs such as radar pulses, laser pulses, wireless burst transmissions and more.
- Generate and control multiple independent waveform outputs that require precise timing, phase alignment, and coherence to meet your time-critical applications.

Powerful software integration

- Seamless waveform creation, pulse pattern building, and remote automation tools, to help save valuable product development time
- Support for compliance test suites including MIPI®, HDMI, USB, IEEE 802.3bs, and more.

High-performance modular and pulse capabilities

- AXIe and PXIe modular generators deliver up to 256 GSa/s and 80 GHz bandwidth for high-performance and content rich data transmitter and receiver testing.
- Dedicated pulse instruments offer flexible triggering and programmable delay for precision edge control on time-critical applications.

Feature	Specification
Jitter performance	As low as < 1 ps
Total harmonic distortion	As low as < 0.03%
Pulse generation precision	Programmable edge control, delay, and burst modes
Modular bandwidth performance range	PXIe (up to 2 GHz) and AXIe (up to 80 GHz)
Enhanced triggering	Gated, burst, holdoff, external trigger delay
Arbitrary waveform and pulse generation software	Unified creation tools across waveform and pulse gear
NISPOM-compliant security	To protect files and data against unauthorized access, theft, or misuse.
Oven-controlled oscillator	Oven-controlled frequency reference for improved stability, jitter, and phase noise.

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 Waveform, Function, or Pulse Generator That Is Right for You

Should you need more information on Keysight waveform, function, or pulse generator offerings, visit our extensive **library of resources** to help you select the right generator for your application.

Here are some of the resources that can guide you in determining the best generator for your needs:

- 5 Tips for Getting the Most Out of Your Function Generator
- 4 Tips to Generate Complex Waveforms
- Stress Testing Your Device with Simulated Waveforms

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

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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.