

4 Essential Methods for Creating and Editing Waveforms

PATHWAVE

Introduction

Creating and editing waveforms does not require complex programming or a sophisticated interface. Many engineers think of the tedious process of learning how to use waveform software or, worse yet, writing a program to generate a waveform. With modern waveform generators, you no longer have to look at creating and editing waveforms with a sense of doom and gloom.

This white paper covers four essential methods for creating and editing waveforms using the Keysight Trueform Series waveform generator: editing on the front panel, using Excel, using Keysight's PathWave BenchVue software, and using MATLAB.

1. Editing Waveforms on the Front Panel

The simplest method to edit your waveform is on the front panel of your waveform generator. Modern waveform generators have soft buttons and dial knobs that let you do quick and basic edits.

Take a look at the built-in waveform editor in a Trueform Series waveform generator. Figure 1 shows the ability to select a single point or a range of points to change. The dark portion between the two markers shows the selected range.



Create and edit waveforms with Keysight's Trueform series waveform generator:

- Edit waveforms on the front panel.
- Create and edit waveforms using Excel.
- Create and edit waveforms with PathWave BenchVue software.
- Create and edit waveforms using MATLAB.

You can cut the range of data, copy it, or paste it to other areas of the waveform. A spreadsheet-like table on the screen lets you edit the points. You can even perform math on the range of points selected. To create a glitch in the test signal, you can edit a single point or a small range of points, as shown in Figure 2.

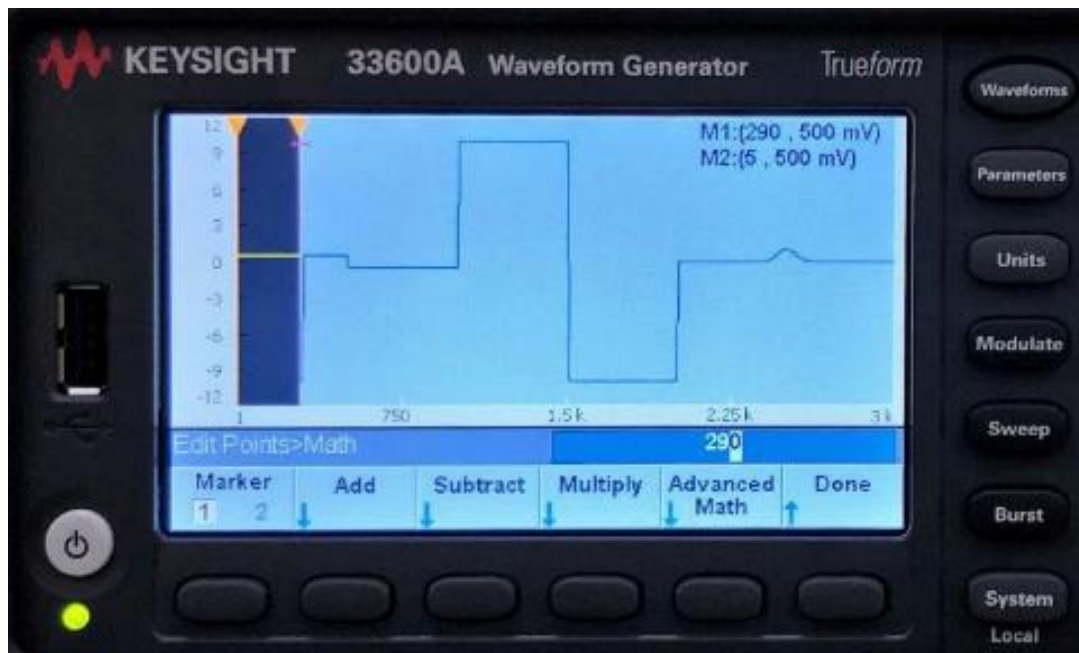


Figure 1. Edit a single point by selecting a range, then cut, copy, and paste data



Figure 2. Edit a single point to create a glitch in the test signal

One of the flexible options available in Trueform Series waveform generators is the ability to perform a math function on the waveform. You can add, subtract, or multiply with your waveform of choice, as shown in Figure 3. The built-in waveforms shown are sine, square, ramp, line, DC, noise, Gaussian, sinc, Lorentz, exponential fall and rise, and haversine.



Figure 3. Build-in waveforms shown are sine, square, ramp, line, DC, noise, Gaussian, sinc, Lorentz, fall and rise, and haversine

2. Creating and Editing Waveforms Using Excel

Excel is a useful tool for building custom waveforms because it provides built-in advanced mathematical functions, it can handle large amounts of data (waveform points), and it is already on just about everybody's computer.

Figure 4 displays a screenshot of the Excel spreadsheet, showing a sine wave summed with the third harmonic noise and random noise. You can graph the tabulated points in column A for quick viewing, then save them to a file.

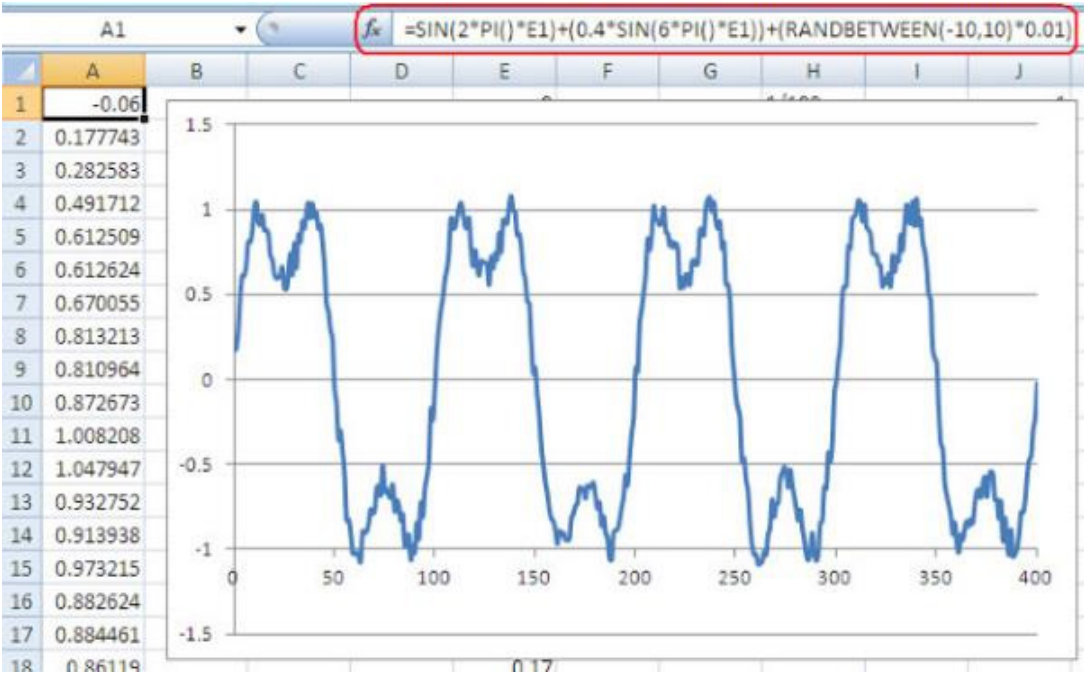


Figure 4. An arbitrary waveform in Excel showing a sine wave summed with third harmonics noise and random noise

How do you get the waveform from Excel to the waveform generator?

Excel and waveform generators have something in common — the CSV file format. Excel can read CSV files, and you can save Excel spreadsheets as CSV files. Waveform generators can read and write CSV files. To move the CSV to the waveform generator, transfer the file from a PC to a waveform generator front panel and load it into the waveform memory.

Figure 5 shows the earlier waveform generated from the spreadsheet, played back by the waveform generator, and displayed as a real waveform on an oscilloscope.

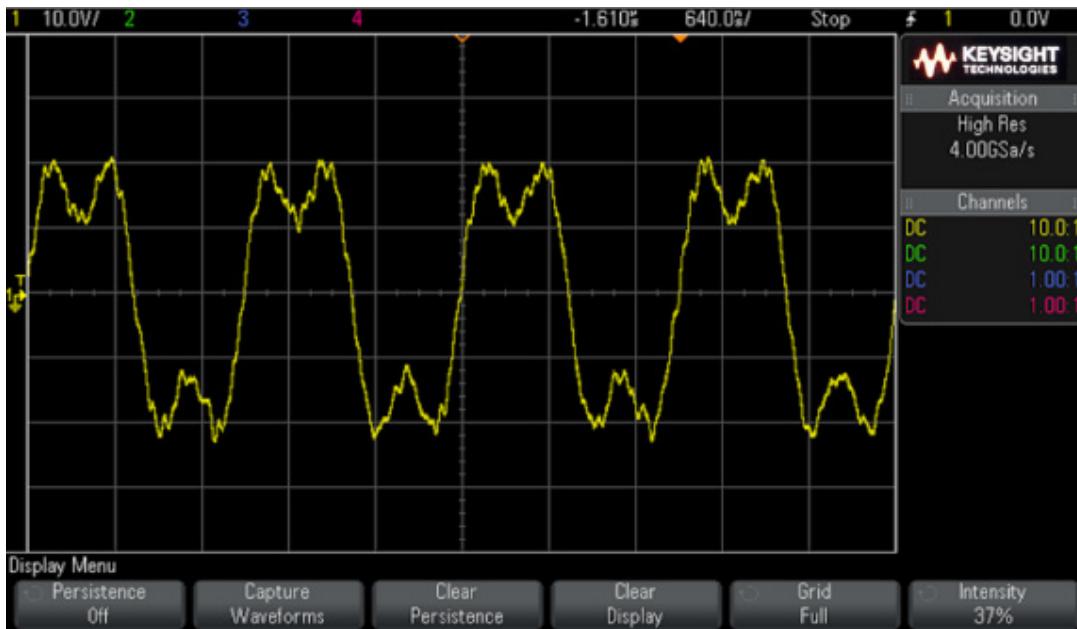


Figure 5. An arbitrary waveform created by a Trueform Series waveform generator and captured on an InfiniiVision 2000 X-Series oscilloscope

3. Creating and Editing Waveforms with PathWave BenchVue Software

PathWave BenchVue software is full-featured waveform-creation software for waveform generators. The software enables engineers to take full advantage of signal-generation capabilities and makes custom waveform creation fast and simple.

PathWave BenchVue software is a PC application that provides easy-to-use creation tools, such as an equation editor and waveform math and drawing tools, that you can use to create custom signals. Plug-and-play functionality enables you to connect your instrument to your PC and immediately begin controlling it in BenchVue.

When you open BenchVue and connect to your waveform generator, you will see a graphical instrument control window of your waveform generator, as shown in Figure 6. You can set up normal sine, square, ramp, pulse, triangle, noise, PRBS, and DC waveforms with desired parameters using the graphical user interface.

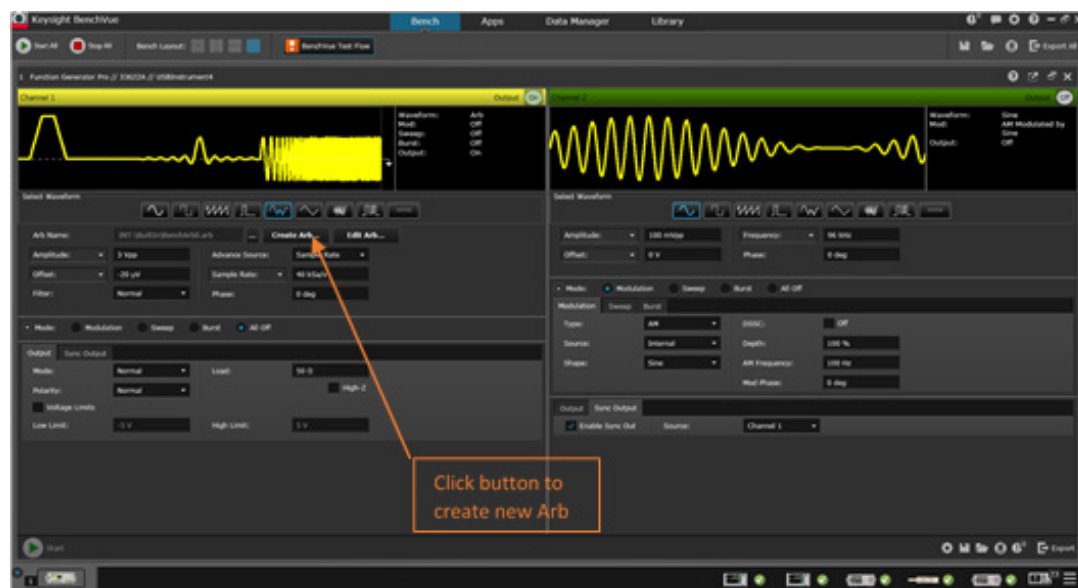


Figure 6. BenchVue's waveform generator application

A PathWave BenchVue Waveform Builder Pro editor window will pop up when you click on the “create Arb” button, as shown in Figure 7. You can create basic and advanced waveforms and even use the computer to draw custom waveforms.

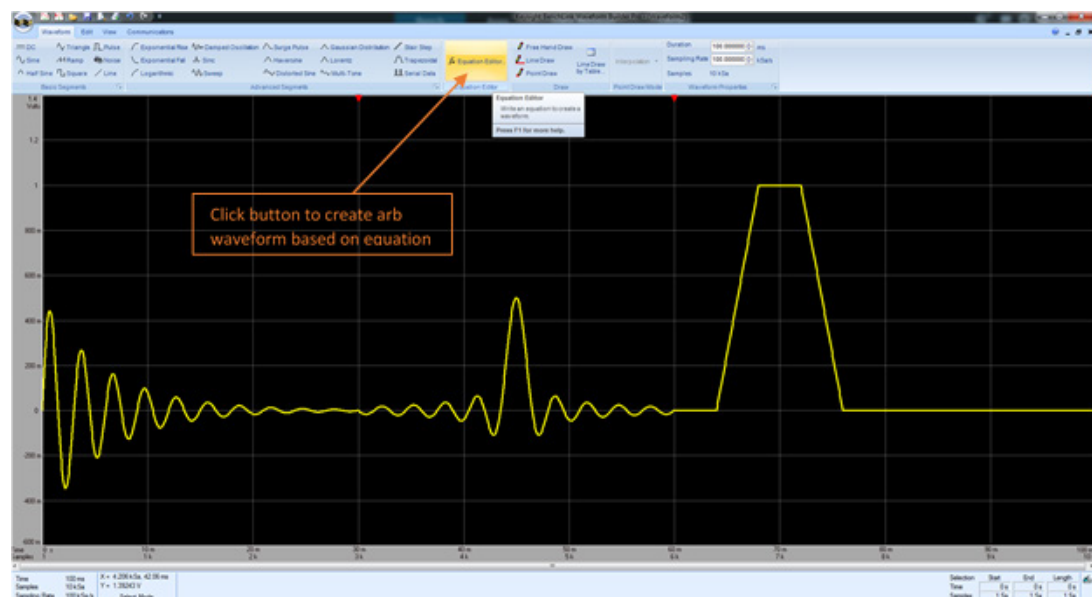


Figure 7. Keysight's PathWave BenchVue Waveform Builder Pro (33503A) window

If you prefer, you can also create waveforms using the equation editor (Figure 8). You can build your math equation by selecting the math functions and operators, evaluating and previewing your equation graphically, and loading it into your waveform generator.

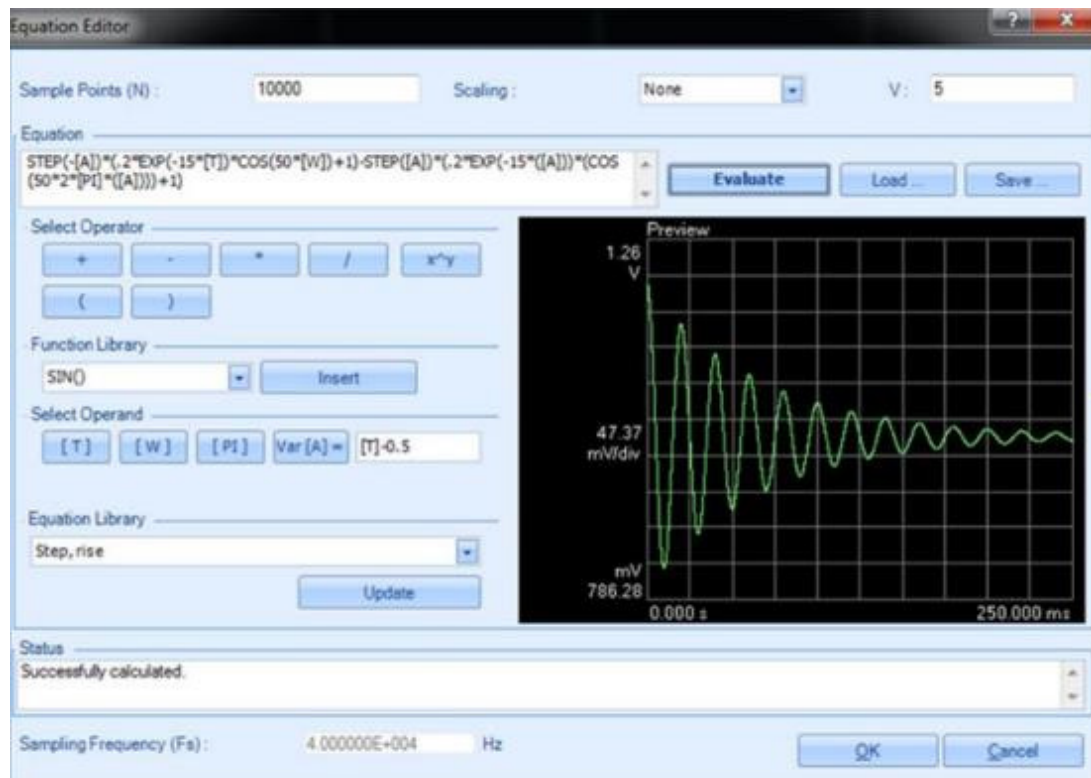


Figure 8. Waveform Builder Pro's equation editor

The software also allows you to sequence different waveforms together. You can set the waveform order and make segments repeat as many times as you want.

Filters and windowing functions allow you to modify and further define your waveform. With this software, you get advanced signal creation and editing capabilities without spending hours programming.

4. Creating and Editing Waveforms Using MATLAB

MATLAB is a proprietary numerical programming language that allows simplified matrix manipulations. Its application is mainly for the generation of a table of sampled values for a given waveform, utilizing many of its powerful controlling structures and instrumentation control capabilities. Using the instrument control module in MATLAB, you can program the waveform generator directly. Doing so allows for fast editing and transfer to the waveform generator.

Figure 9 shows how MATLAB understands the plotting or graphing of this complex waveform. It is a simulation of an electrocardiograph heart signal with the QRST points. Figure 10 shows MATLAB's translation of all these points into XY plotting equation and program.

MATLAB provides the option to send waveform points as a binary block to a function generator. The reason for sending a waveform as binary data versus ASCII data is simple: the binary data is much smaller than the equivalent ASCII data. The smaller size cuts down on remote input / output latency between the computer and the waveform generator for faster performance. You can generate complicated signals via MATLAB and use PathWave BenchVue Waveform Builder Pro to generate simple waveforms.

Besides building waveforms, Waveform Builder Pro can open several files to access any list of sampled waves, whether they are in DAT, CSV, TXT, or even XLS format. You can extract the data from these files and play them directly on the waveform generator.

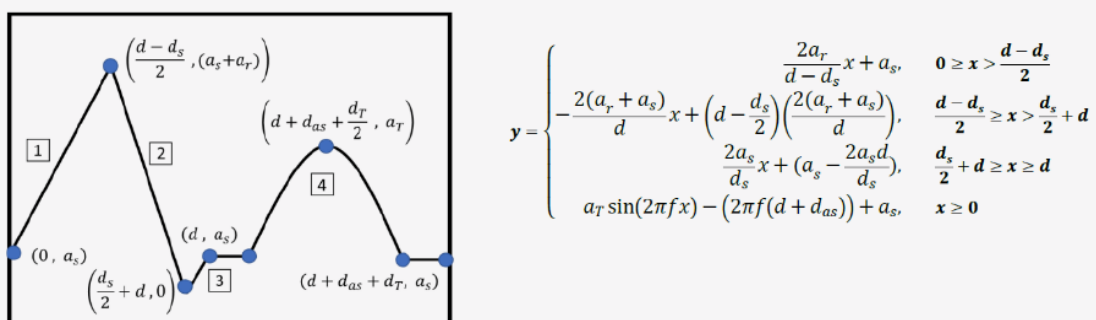


Figure 9. MATLAB's plotting of a complex waveform

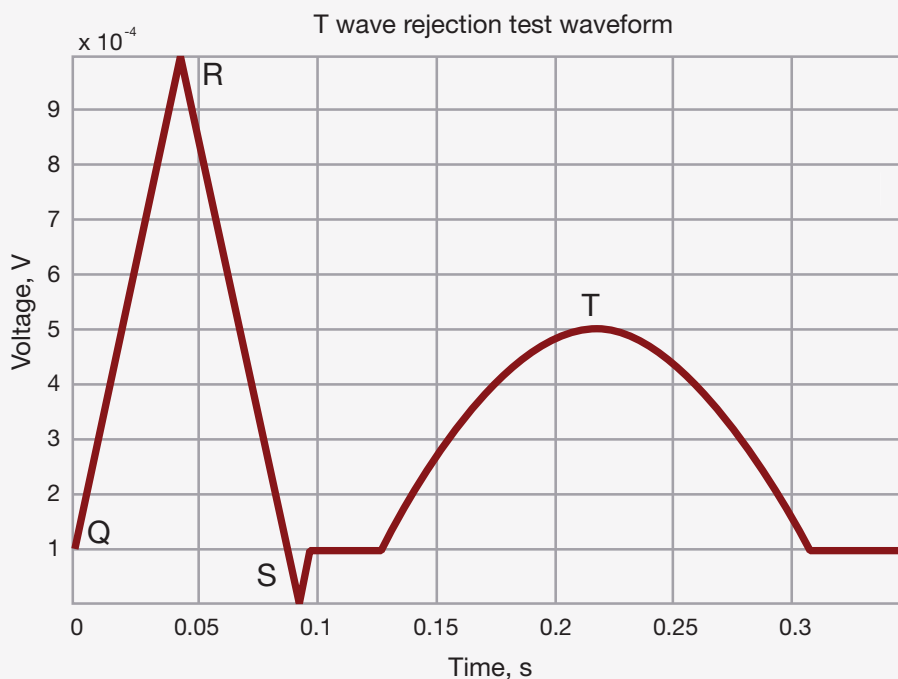


Figure 10. MATLAB translates all these points into an XY plotting equation and program

Conclusion

Creating and editing waveforms is not difficult. If you want to select a single point or a range of points to change, you can edit a waveform in the front panel. If you want to create a waveform quickly, you can use Excel. If you want to re-create or modify an existing waveform, you can capture and save the waveform using an oscilloscope. Then use a USB memory drive to load the resulting CSV file into your function generator.

Creating and editing waveforms using PathWave BenchVue Waveform Builder Pro software enables you to take full advantage of signal-generation capabilities and makes custom waveform creation fast and simple. The software provides a waveform sequencer, filters, and windowing functions, allowing you to modify and define your waveform. MATLAB allows simplified matrix manipulations, mainly for the generation of a table of sampled values for a given waveform, utilizing many of its powerful controlling structures and instrumentation control capabilities.

If you need more advanced creation capabilities, check out the BenchVue software, available for download here: <http://www.keysight.com/find/benchvue>.

To learn more about Keysight's Trueform waveform and function generators, go to <http://www.keysight.com/find/function-generators>

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

