Creating Arbitrary Points Using IntuiLink and Agilent Measurement Manager

Application Note

Introduction

Over the years, Agilent has developed many effective software solutions that enhance usability when combined with Agilent's world-renowned hardware. This application note focuses on the IntuiLink Waveform Editor and the Agilent Measurement Manager (AMM). AMM is bundled for free when you purchase a USB DAQ.

Agilent Technologies

Working with IntuiLink Waveform Editor

IntuiLink works with many products in Agilent's lineup. It is compatible with the oscilloscopes, pulse-function arbitrary noise generators, digital multimeters, frequency counters, network and spectrum analyzers, signal generators, and multi-function switches, among other devices.

If you already understand the fundamentals of drawing using Microsoft® Paint in the Windows® environment, you will see that the IntuiLink's user interface provides the same concept along with additional content and tools.

First, you have to identify all the points that you intend to draw and what equipment this waveform will be used in after the drawing process. By clicking the **Properties** command from **File > Properties ...**, you pop-up the Properties dialog box. See Figure 1.

It is a good practice to set the number of points and bits to make the waveform compatible with the equipment that will be using these points.

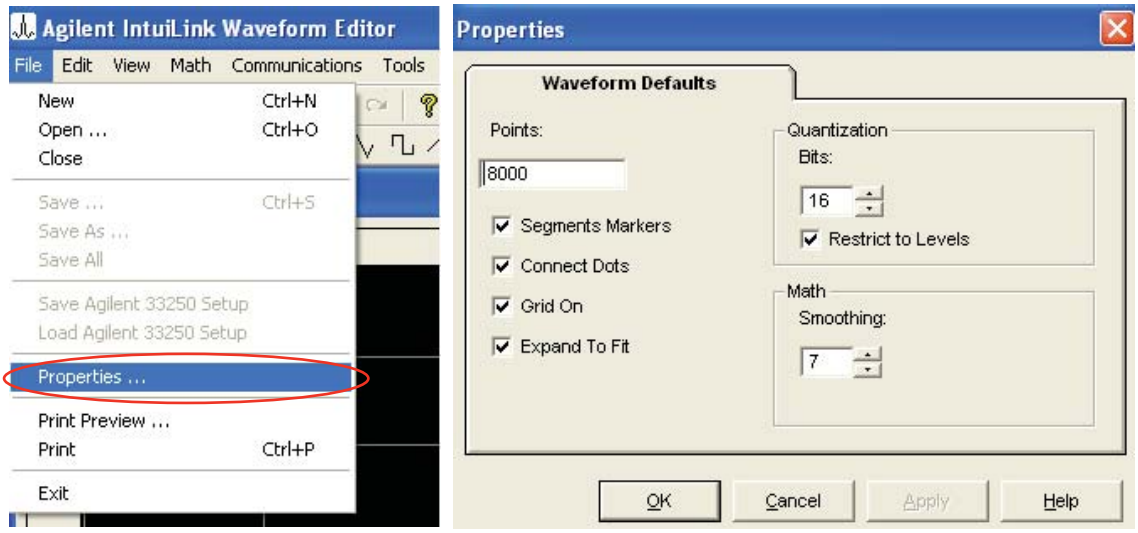


Figure 1. Properties dialog box for IntuiLink

Working with IntuiLink Waveform Editor (Continued)

This application note highlights ways for you to draw and edit simple waveforms using the tools in IntuiLink that are shown below:

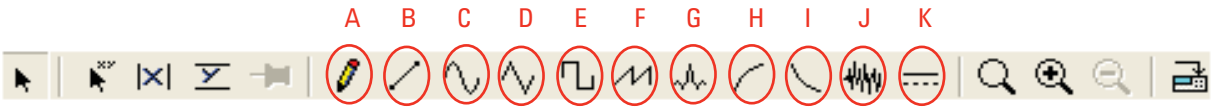


Table 1. IntuiLink toolbar description

Item		Description
A	Free hand mode	To draw and output the waveform accordingly, similar to writing or sketching the waveform on a piece of paper.
B	Line draw mode	To draw straight lines.
C	Sine wave segment	To draw sinusoidal waveform. Each cycle takes up 2,000 points by default.
D	Triangle wave segment	To draw triangular waveform. Each cycle takes up 2,000 points by default.
E	Square wave segment	To draw square waveform. Each cycle takes up 2,000 points by default.
F	Sawtooth wave segment	To draw sawtooth waveform. Each cycle takes up 2,000 points by default.
G	Sinc wave segment	To draw sinc waveform. Each cycle takes up 2,000 points by default.
H	Exponential rise wave segment	To draw exponentially rising waveform. Each cycle takes up 2,000 points by default.
I	Exponential fall wave segment	To draw exponentially falling waveform. Each cycle takes up 2,000 points by default.
J	Noise wave segment	To draw simulated noise waveform. Each cycle takes up 2,000 points by default.
K	DC wave segment	To draw DC waveform. Each cycle takes up 2,000 points by default.

For types A and B above, you can both edit waveform and overwrite it at given points wherever needed. For example, if point 0 to point 2,000 are all drawn using type A, this can be edited and overwritten on the same point range (0 to 2,000) using type B or vice versa.

However, if you have drawn sine waves or any other waveforms of type C to type K, these are typically write-protected waveforms. You cannot edit type C to type K waveforms into type A or type B.

Working with IntuiLink Waveform Editor (Continued)

A type A or type B waveform can be edited by double-clicking on the point region where it is located. Once you double-click on the empty grid within the waveform of interest, the Resize Waveform dialog box appears. See Figure 2. You can then choose to expand or shrink the waveform systematically within the x-axis or y-axis.

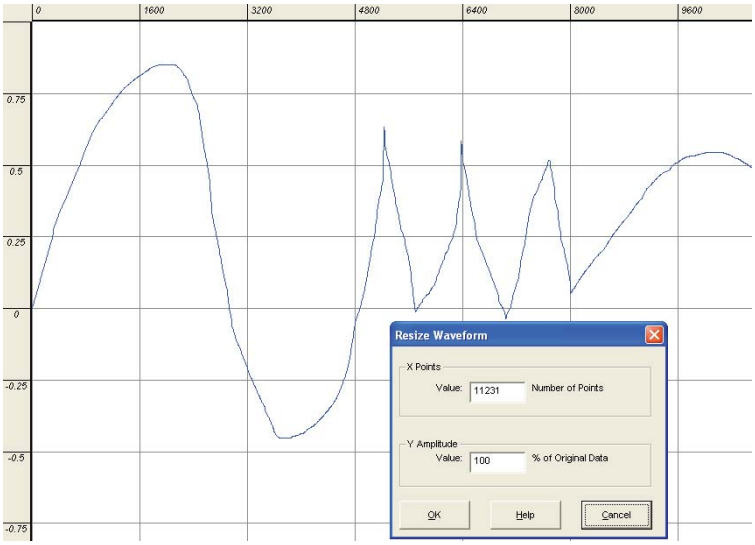


Figure 2. Resizing the waveform

Similarly, for type C to type K waveforms, you can edit parameters by double-clicking on the empty region within the waveform. The Segment Parameters dialog box appears.

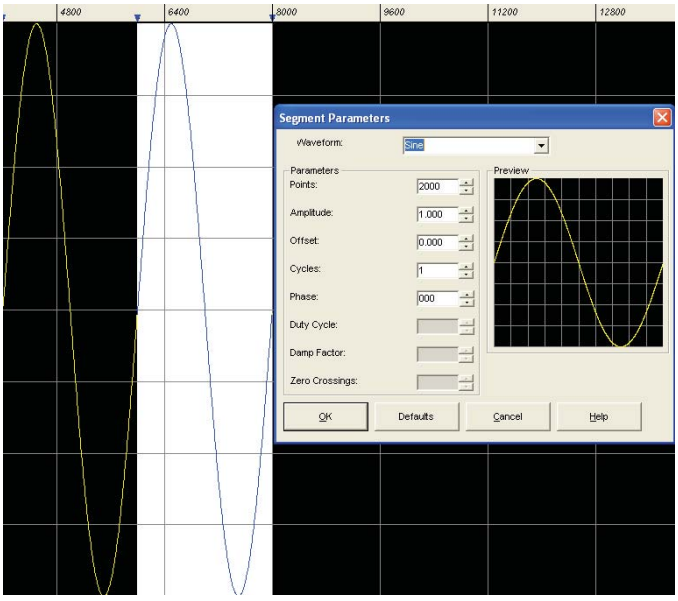


Figure 3. Setting the parameters of the waveform

Note: Depending on the waveform type, some parameters will not be active for editing in the Segment Parameters dialog box.

Working with IntuiLink Waveform Editor (Continued)

After drawing your desired waveform, you can save the waveform points into the Microsoft Excel spreadsheets. The process of saving the waveform points in an Excel spreadsheet is as shown below. The format for saving in Excel is *.csv.

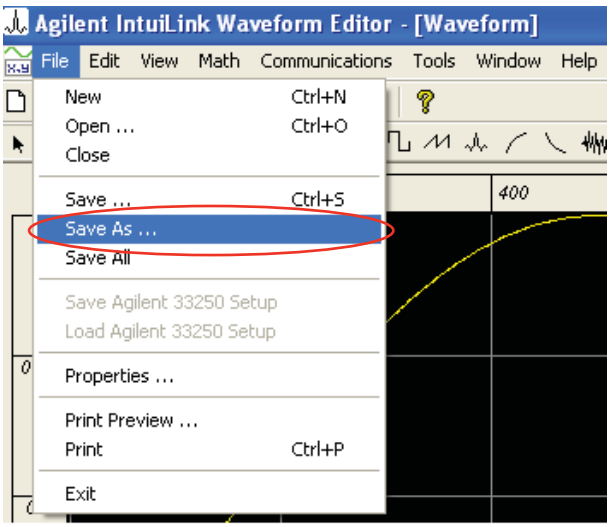


Figure 4. Saving your waveform

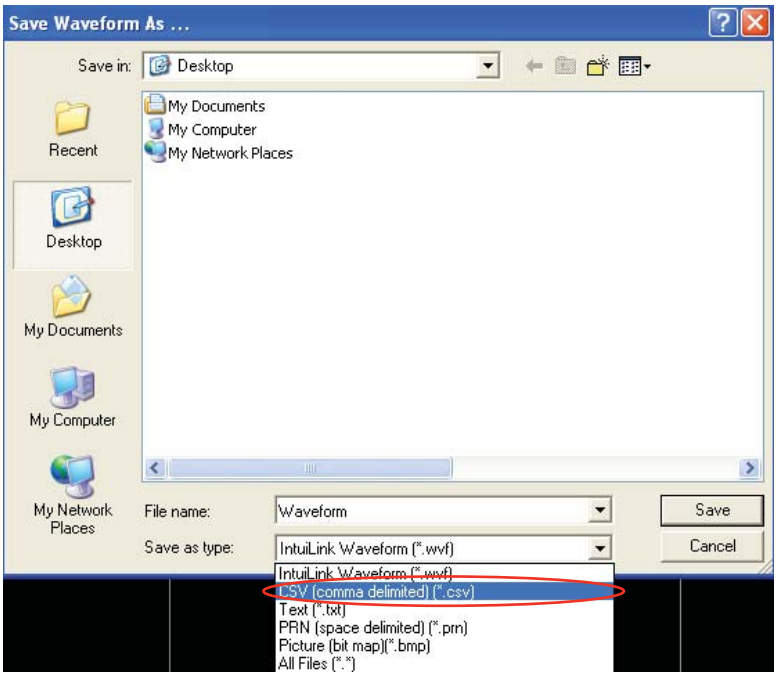


Figure 5. Supportable file format to be saved

Working with IntuiLink Waveform Editor (Continued)

The *.csv file created using IntuiLink is shown below :

	A	B	C	D	E	F
1	Data	Name	Freq (kHz)	Ampl (VPP)	Offset (VDC)	Points
2	0	VOLATILE	1	0.1	0	8000
3	3.14E-03					
4	6.28E-03					
5	9.42E-03					
6	1.26E-02					
7	1.57E-02					
8	1.88E-02					
9	2.20E-02					
10	2.51E-02					
11	2.83E-02					
12	3.14E-02					
13	3.46E-02					
14	3.77E-02					
15	4.08E-02					

Figure 6. Setting the parameters of the waveform

The first data point that is drawn in IntuiLink will be shown in location **A2** in the Excel spreadsheet. If the total points drawn are 8,000 points, intuitively, you will know that the last point in this Excel spreadsheet will reside in location A8001.

Working with AMM

For AMM, there is no direct method of drawing an arbitrary waveform with a data acquisition device (DAQ). You will have to generate the points either from IntuiLink or self-generate them in text or HTML format.

For convenience, we recommend drawing the arbitrary waveform in IntuiLink first and then converting it to AMM-readable *.csv or *.txt format. Note that if you were to create the waveform from IntuiLink, the HTML format is not supported; therefore IntuiLink will not be able to provide a file for conversion in HTML format.

On this topic, we will discuss only *.csv and *.txt file conversion from IntuiLink to AMM format. Although the file may be in *.csv or *.txt, IntuiLink format and AMM format differ because AMM format has header lines added on top of the data points.

AMM cannot output its waveform directly from an IntuiLink *.csv or *.txt file. AMM only recognizes the header lines before executing the data points. Therefore, we need to convert IntuiLink or self-generated *.csv or *.txt files.

One tool that is useful for this conversion task is the Data File Manager residing in the AMM. You can find this tool at **Tools > DAQ > Data File Manager** in AMM.

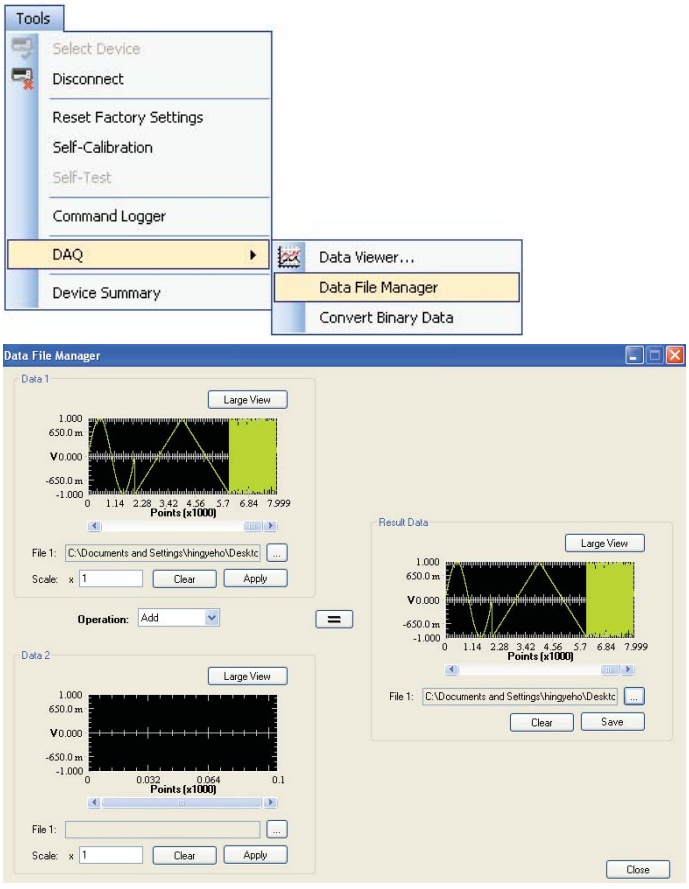


Figure 7. Invoking Data File Manager

Working with AMM (Continued)

For a single waveform file

1. In the Data 1 panel, click on the ... to select the file to be converted.
2. Click **Apply** to display the waveform of the selected file on the graph.
3. Scale the waveform to suit your needs.
4. If there are no other files to add in, click on the = . Your waveform in the Data 1 panel will be displayed in Result Data panel.
5. Click on the ... in Result Data panel and name the file and the path to save your file. Click **Save** to select and confirm your file name and location.
6. Click **Save** within Result Data panel. Your data is now successfully saved into AMM-readable format.

For two waveform files

7. If you want to manipulate two sets of waveform files, perform steps 1 to 3 in the Data 1 panel. Then select the proper operation (Add, Divide, Join, Merge, Minus, or Multiply). These operations are described below:

    - Add—Data 1 combined with Data 2 (Data 1 + Data 2)
    - Divide—Data 1 divided by Data 2 (Data 1/Data 2)
    - Join—Data 1 joined with Data 2 (Data 1 append Data 2)
    - Merge—Data 1 and Data 2 (Data 1 and Data 2)
    - Minus—Data 1 minus Data 2 (Data 1 – Data 2)
    - Multiply—Data 1 multiplied by Data 2 (Data 1 x Data 2)

8. Repeat steps 1 to 3 but in the Data 2 panel.
9. Proceed with steps 4 to 6.

Foundation of Arbitrary Waveform

Arbitrary waveform is a user-defined waveform that can take any form or shape according to your needs.

For U2300A Series and U2500A Series DAQs to draw an arbitrary waveform, you need to know the following basic characteristics of the DAQ's analog output.

- There are two analog output for each DAQ.
- The sampling rate is up to 1 MSa/s.
- The resolution is 12 bits or 16 bits depending on the models.
- The supported output voltage is –10 V to 10 V for bipolar and 0 to 10 V for unipolar
- The current drive is 5 mA.

You need to be aware of the applications for which a specific DAQ is being used. This will eliminate the possibility of using the DAQ for the wrong application.

Arbitrary Waveform Equation

The relationship of creating an arbitrary waveform through the DAQ is as follows.

Bipolar

For 12 bits:

$$\text{DAQ input code (decimal)} = \frac{\text{Desired output voltage } (V_o) + 10}{\frac{(2 \times 10)}{(2^{12} - 1)}}$$

For 16 bits:

$$\text{DAQ input code (decimal)} = \frac{\text{Desired output voltage } (V_o) + 10}{\frac{(2 \times 10)}{(2^{16} - 1)}}$$

Unipolar

For 12 bits:

$$\text{DAQ input code (decimal)} = \frac{\text{Desired output voltage } (V_o)}{\frac{10}{(2^{12} - 1)}}$$

For 16 bits:

$$\text{DAQ input code (decimal)} = \frac{\text{Desired output voltage } (V_o)}{\frac{10}{(2^{16} - 1)}}$$

These formulas are shown to let you determine the difference between unipolar and bipolar mode, and how the DAQ bits affect the resolution and the end result.

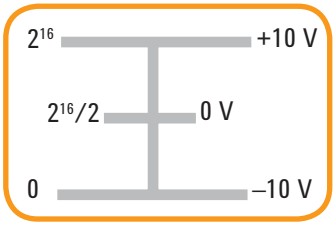
Bear in mind that the range of voltage that is used by default is 10 V. Hence the 10 V values are listed in the equations above.

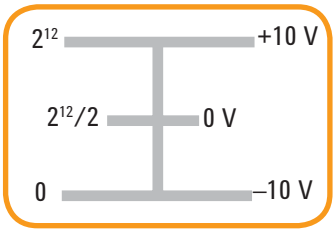
Note that for bipolar mode, the range is 2 x 10 V = 20 V as indicated in the denominator section. This is because the signals for bipolar mode are allowed into negative region and the range is therefore from –10 V to + 10 V.

Foundation of Arbitrary Waveform (Continued)

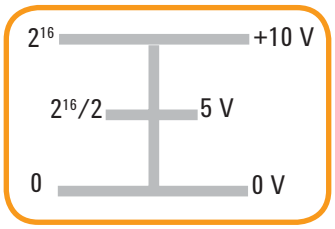
Basic representations of how bits affect the resolution in unipolar and bipolar mode are shown below. For bipolar, the figures illustrate that the total number of bits of 2^{bit} represents the spread of –10 V to 10 V; therefore, the smallest step voltage is 20 V/2^{bit}. For unipolar, the smallest step voltage is 10 V/2^{bit} because the total number of bits represents the spread of 0 V to 10 V.

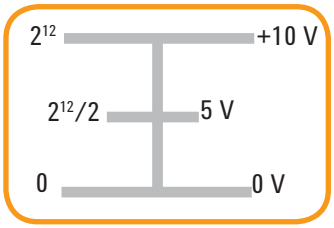
Bipolar mode





Unipolar mode





Conclusion

IntuiLink and AMM are both handy tools for creating arbitrary points. It is highly recommended to have hands-on experience in using IntuiLink and AMM in order to get used to the functionalities within both programs. To have a successful start in creating arbitrary waveform, you will need to apply the formulas given in this application note.

For more information about USB DAQ, refer to www.agilent.com/find/usbdaq

For more information about AMM, refer to www.agilent.com/find/AMM

For more information about IntuiLink, refer to www.agilent.com/find/IntuiLink

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