LabVIEW Custom Waveform Generator User Manual and Documentation

July 31, 2025

Contents

1 Introduction

1.1 Purpose

The LabVIEW Custom Waveform Generator (Figure 1) is designed to import and output user-defined waveforms from text files. This flexible solution enables precise control over analog waveform generation for specialized testing applications, supporting dual-channel operation with independent or synchronized outputs.

1.2 Key Features

- Text file import for custom waveform generation (CSV or delimited formats)
- Dual-channel operation with independent or synchronized control
- Real-time parameter adjustment (amplitude, sample rate, points)
- National Instruments DAQ hardware integration
- Waveform duration and frequency calculation

Figure 1: Main application front panel

2 System Requirements

2.1 Hardware Requirements

- National Instruments DAQ device (compatible with NI-DAQmx)
- Tested DAQ devices:
- When setting up the DAQ assistant select "continuos Samples" in Generation Mode and write the number of sampler to write depending on your hardware capabilities. In the example shown in Figure 2., the samples to be written were set as 5K samples, since a NI-USB 6003 was used for this example.
  - NI USB-6003, NI USB-6211

2.2 Software Requirements

- LabVIEW 2018 or later
- NI-DAQmx driver software

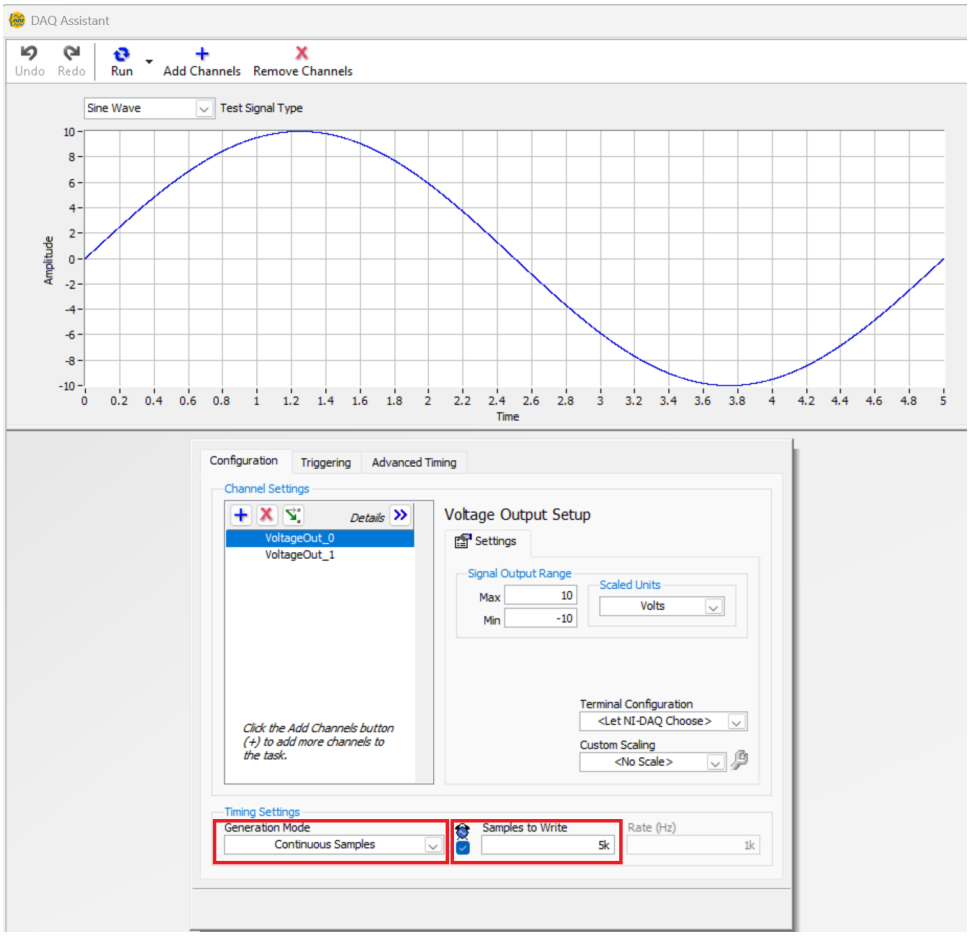

Figure 2: DAQ assistant setup

3 User Interface Overview

3.1 Front Panel Components

- **File Input Controls**
  - File path selectors for Channel 1 and Channel 2
  - Update button to reload waveform files
- **Waveform Parameters**
  - Voltage amplitude scaling factor
  - Number of points to use from file
  - Sampling rate (samples/second)
- **Output Configuration**
  - Together ON/OFF switch (synchronizes channels)
  - Output to DAQ enable/disable
- **Waveform Information**
  - Points in file indicator
  - Duration calculation (seconds)
  - Waveform frequency calculation (Hz)
- **Graph Display**
  - DAQ Output Voltage waveform visualization

4 Block Diagram Architecture

4.1 Main Loop Structure

The VI utilizes a producer-consumer pattern with:

- Event-driven front panel handling
- Parallel waveform generation loops
- DAQ output management

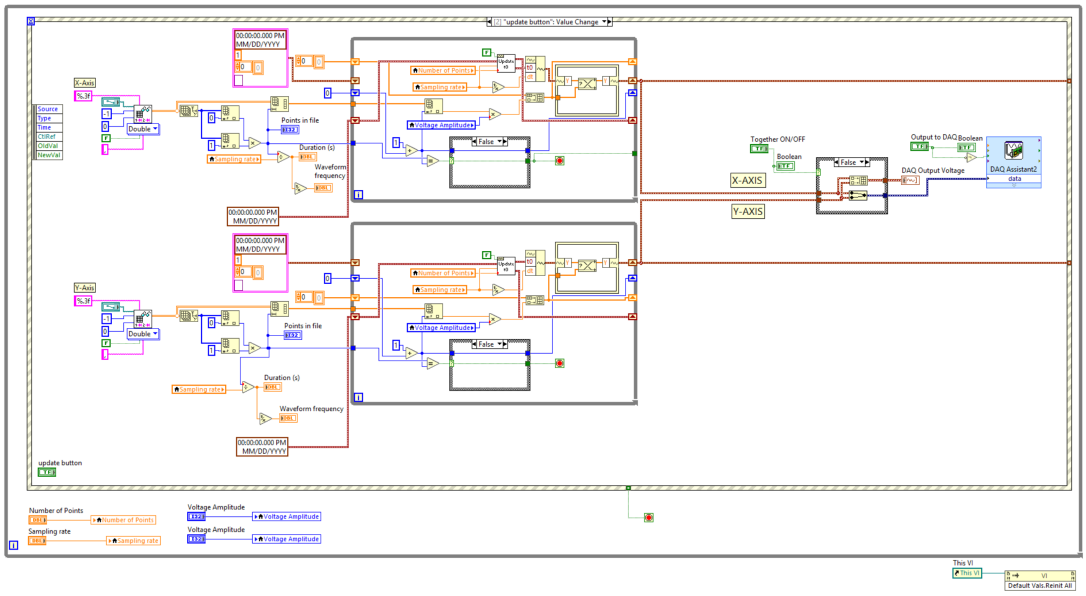

Figure 3: Custom waveform generator block diagram

4.2 Waveform Processing

- File reading using `Read Delimited Spreadsheet` VI
- Data reshaping based on user-selected points
- Amplitude scaling calculation:

$$V_{out} = V_{file} \times \text{Amplitude}$$

- Waveform construction with proper timing:

$$\Delta t = \frac{1}{\text{Sampling rate}}$$

- Duration calculation:

$$\text{Duration} = \frac{\text{Number of Points}}{\text{Sampling rate}}$$

5 File Format Requirements

5.1 Supported Formats

- Comma-separated values
- Tab-delimited text
- Space-delimited text

5.2 Data Structure

- Single column of voltage values is recommended
- One complete waveform cycle per file
- Numeric values only (no headers)

Example file content:

```
0.0
0.5
1.0
0.5
0.0
-0.5
-1.0
-0.5
```

6 Operation Guide

6.1 Loading Custom Waveforms

1. Click the file path control to select a waveform file
2. Set desired parameters:
    - Voltage amplitude (scaling factor)
    - Number of points (use all or subset)
    - Sampling rate (must match hardware capabilities)
3. Press "Update" button to load and process the file
4. Verify waveform in the graph display

6.2 Output Configuration

1. Select output mode:
    - Independent: Different files for each channel
    - Together: Same waveform on both channels (X-axis)
2. Enable "Output to DAQ" when ready
3. Monitor output indicators:
    - Points in file
    - Duration
    - Waveform frequency
4. Press "Stop" to terminate output

7 Technical Specifications

7.1 Waveform Generation

- Amplitude range: Limited by DAQ hardware (typically ±10V)
- Sampling rate: Limited by DAQ capabilities

Issue	Solution
File won't load	Verify file contains only numeric values
Distorted output	Check amplitude doesn't exceed DAQ limits
No output signal	Verify "Output to DAQ" is enabled
Incorrect frequency	Check sampling rate vs. points selected

Table 1: Troubleshooting guide

8 Troubleshooting

9 Best Practices

- **File Preparation:** Ensure clean data with consistent delimiters
- **Amplitude Scaling:** Start with 1.0 scaling factor for unmodified output
- **Sampling Rate:** Match to your application requirements
- **Testing:** Verify waveforms on graph before DAQ output
- **Data Size:** Balance between waveform detail and system resources

10 Appendices

10.1 Version History

- 1.0: Initial release (Custom Waveform Generator)