LabVIEW Analog Waveform Generator User Manual and Documentation

August 11, 2025

Contents

1 Introduction

1.1 Purpose

The LabVIEW Analog Waveform Generator (Figure 1) is a Virtual Instrument designed to generate standard waveform signals for testing and measurement applications. The application interfaces with a Data Acquisition System (DAQ) to output analog signals to the Match-DSP. It supports standard waveforms (sine, square, triangle, sawtooth) with independent or synchronized dual-axis output.

1.2 Key Features

- Dual-axis (X and Y) waveform generation with independent or synchronized control
- Support for standard waveforms (sine, square, triangle, sawtooth)
- Real-time waveform visualization
- National Instruments DAQ hardware integration
- Flexible parameter control (amplitude, frequency, phase)

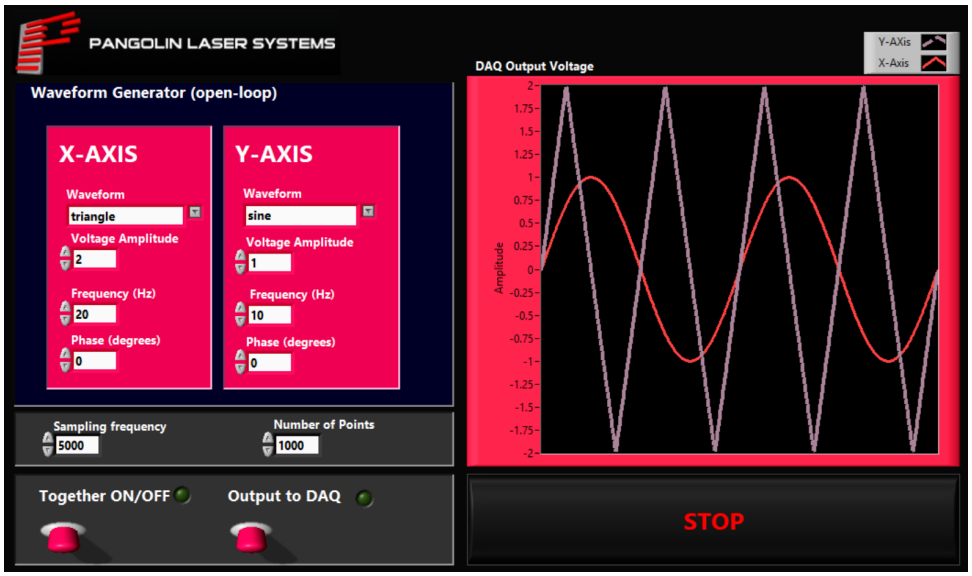

Figure 1: Main application front panel

2 System Requirements

2.1 Hardware Requirements

- National Instruments DAQ device (compatible with NI-DAQmx)
- List of NI DAQ tested at the moment the release of these manual:
  - NI USB-6003, NI USB-6211

2.2 Software Requirements

- LabVIEW 2018 or later
- NI-DAQmx driver software

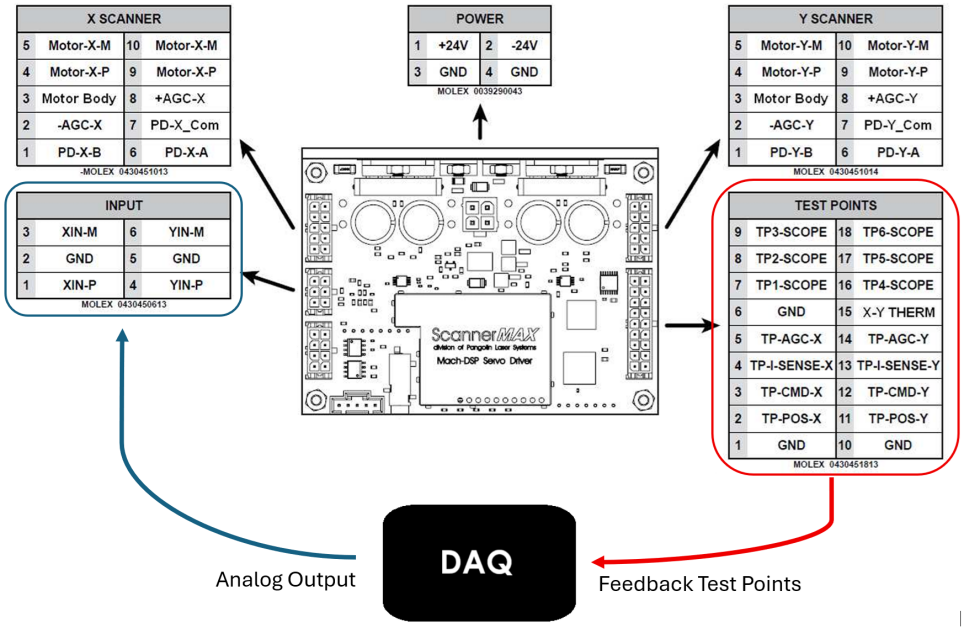

Figure 2: Match-dsp and DAQ connections

3 Installation Guide

3.1 Software Installation

1. Install LabVIEW from the National Instruments website
2. Install the appropriate NI-DAQmx driver for your hardware
3. Open the provided VI file in LabVIEW
4. 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 3., the samples to be written were set as 5K samples, since a NI-USB 6003 was used for this example.
5. For low-level block NI USB-DAQ programming and setup. Please visit our example **(NI Low level DAQ configuration)**.

4 User Interface Overview

4.1 Front Panel Components

- **Waveform Controls**
  - Waveform type selector (sine, square, triangle, sawtooth)
  - Voltage amplitude control (peak value)
  - Frequency control (Hz)
  - Phase control (degrees)
- **Output Configuration**
  - Together ON/OFF switch (synchronizes X and Y outputs). Together will send same data from X-Axis to both galvanometers.
  - Output to DAQ enable/disable
  - Sampling frequency control. Notice that sampling frequency have to be the same for both signals X and Y.
  - Number of points control
- **Graph Display**

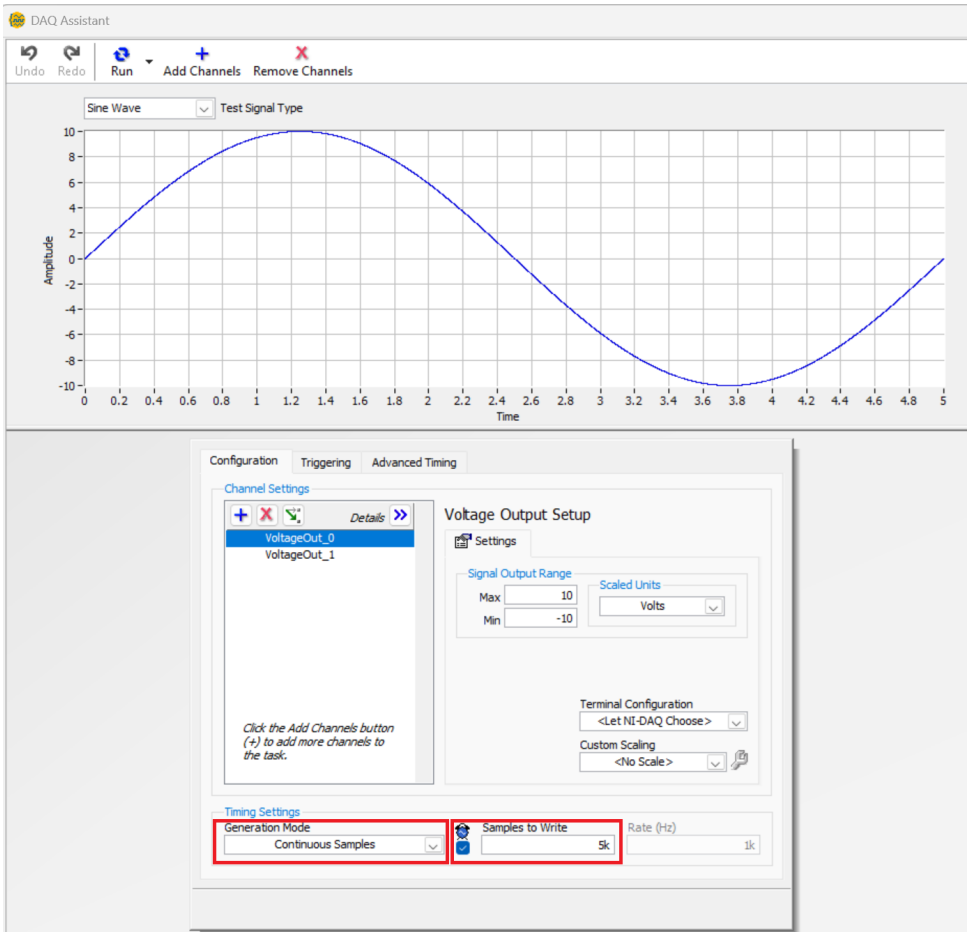

Figure 3: DAQ assistant setup

  - Real-time waveform visualization

- **System Controls**
  - Stop button for terminating the application

5 Block Diagram Architecture

5.1 Main Loop Structure

The VI runs inside a While Loop for continuous operation until the user presses the stop button. The loop contains the waveform generation and output logic.

5.2 Waveform Generation

- Two parallel Case Structures handle X and Y waveform generation
- Each waveform type has a dedicated subVI (Sine Waveform.vi, Square Waveform.vi, etc.)

  Inputs: Amplitude, Frequency, Phase, Sampling info

  Output: Waveform data type
- The "Together ON/OFF" control determines if waveforms are:

  Independent (false): Separate generation for X and Y

  Synchronized (true): Duplicates one waveform for both outputs

5.3 DAQ Output

- The generated waveforms are combined into an array
- When "Output to DAQ" is enabled, waveforms are sent to the DAQ device

- Uses DAQmx Assistant for hardware communication

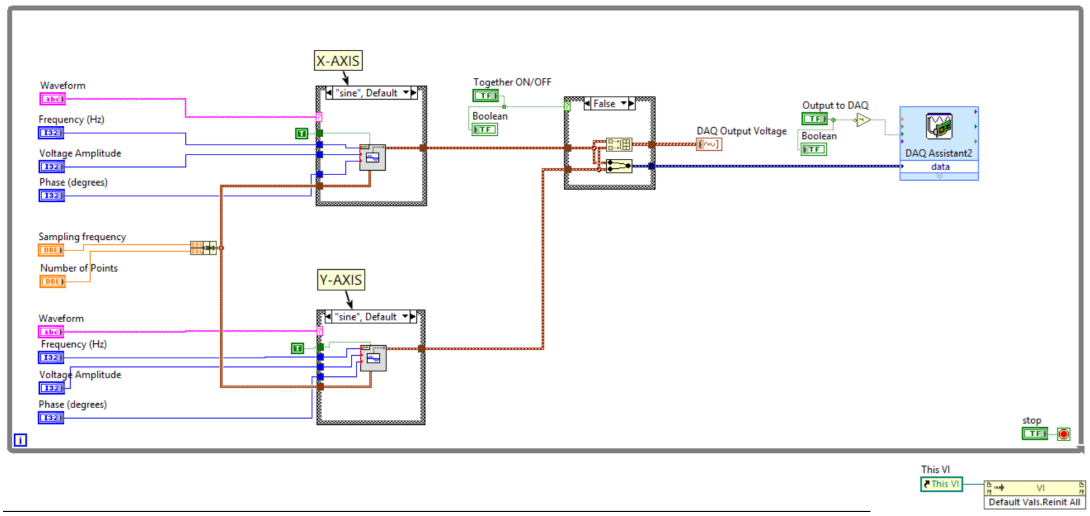

Figure 4: Block diagram architecture

6 Getting Started

6.1 Generating a Basic Waveform

1. Select waveform type from the dropdown (e.g., "sine")
2. Set desired amplitude (e.g., 5V)
3. Set frequency (e.g., 1Hz)
4. Set phase if needed (default 0 degrees)
5. Configure sampling:
   Sampling frequency (e.g., 5000Hz)
   Number of points (e.g., 1000)
6. View the waveform in the graph display

6.2 Outputting to DAQ

1. Configure a waveform as above
2. Enable "Output to DAQ"
3. For synchronized outputs, enable "Together ON/OFF"
4. Click "Stop" to end output

7 Technical Specifications

7.1 Waveform Generation

- Supported waveforms: Sine, Square, Triangle, Sawtooth
- Amplitude range: Limited by DAQ hardware (typically ± 10V)

7.2 Sampling Parameters

- Sampling frequency: User configurable (must be at least $2\times$ signal frequency)
- Number of points: Determines waveform duration
- Buffer size: Automatically managed by DAQmx

8 Troubleshooting

Issue	Solution
DAQ not detected	Verify NI-DAQmx driver is installed and device is connected
No waveform displayed	Check parameter values and ensure stop is not pressed
Distorted waveform	Increase sampling frequency or check amplitude limits
DAQ output stops unexpectedly	Check for voltage limits (±10V)

Table 1: Troubleshooting guide

9 Best Practices

- **Waveform Quality:** Use sampling frequency 10× signal frequency for smooth output
- **Amplitude Limits:** Stay within DAQ hardware specifications (±10V typical)
- **Synchronization:** Use "Together ON/OFF" for identical X/Y outputs
- **Signal Integrity:** Use shielded cables and proper grounding

10 Appendices

10.1 Version History

- 1.0: Initial release