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Pangolin Analog Waveform Generator User Manual and Documentation

July 2, 2025

Contents

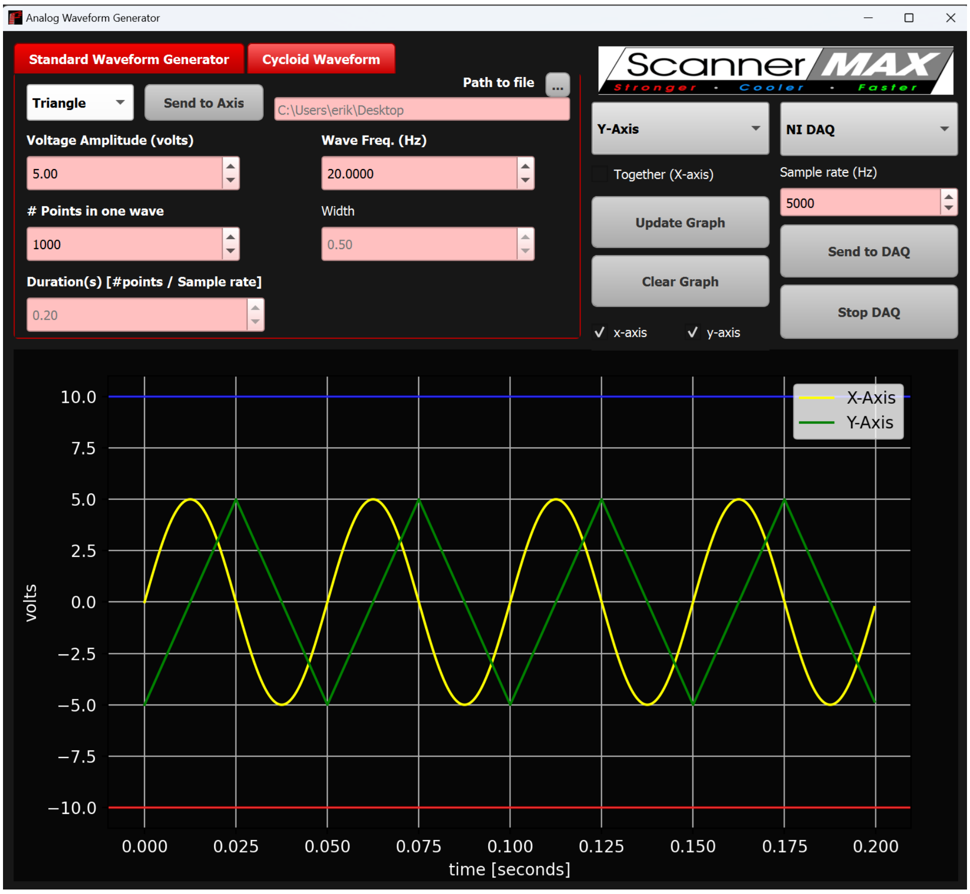
1 Introduction

1.1 Purpose

The Pangolin Waveform Generator is a Python SDK application (Figure 1.) designed to utilize analog command inputs available on the Match DSP. The application interfaces with a Data Acquisition System (DAQ), such as National Instruments hardware, to generate and output a variety of waveform signals (Figure 2.). It supports standard waveforms (sine, square, triangle, sawtooth), specialized cycloid waveforms, and can accommodate custom waveform shapes based on user requirements.

1.2 Key Features

- Dual-axis (X and Y) waveform generation
- Support for standard, cycloids, and custom waveforms
- Real-time waveform visualization
- National Instruments DAQ hardware integration



Analog Waveform Generator

Triangle

Path to file: C:\Users\erik\Desktop

Voltage Amplitude (volts): 5.00

Wave Freq. (Hz): 20.0000

Points in one wave: 1000

Width: 0.50

Duration(s) [#points / Sample rate]: 0.20

Y-Axis

NI DAQ

☐ Together (X-axis)

Sample rate (Hz): 5000

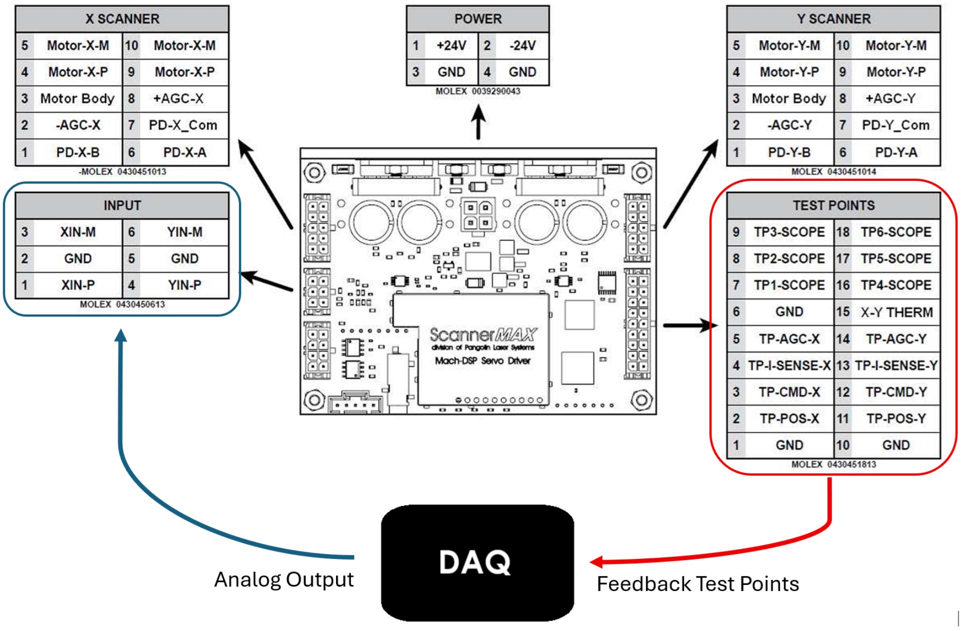
✓ x-axis ✓ y-axis

Figure 1: Main application window

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



X SCANNER			
5	Motor-X-M	10	Motor-X-M
4	Motor-X-P	9	Motor-X-P
3	Motor Body	8	+AGC-X
2	-AGC-X	7	PD-X_Com
1	PD-X-B	6	PD-X-A

-MOLEX 0430451013

POWER			
1	+24V	2	-24V
3	GND	4	GND

MOLEX 0039290043

Y SCANNER			
5	Motor-Y-M	10	Motor-Y-M
4	Motor-Y-P	9	Motor-Y-P
3	Motor Body	8	+AGC-Y
2	-AGC-Y	7	PD-Y_Com
1	PD-Y-B	6	PD-Y-A

MOLEX 0430451014

INPUT			
3	XIN-M	6	YIN-M
2	GND	5	GND
1	XIN-P	4	YIN-P

MOLEX 0430450613

TEST POINTS			
9	TP3-SCOPE	18	TP6-SCOPE
8	TP2-SCOPE	17	TP5-SCOPE
7	TP1-SCOPE	16	TP4-SCOPE
6	GND	15	X-Y THERM
5	TP-AGC-X	14	TP-AGC-Y
4	TP-I-SENSE-X	13	TP-I-SENSE-Y
3	TP-CMD-X	12	TP-CMD-Y
2	TP-POS-X	11	TP-POS-Y
1	GND	10	GND

MOLEX 0430451813

Figure 2: Match-dsp and DAQ connections

2.2 Software Requirements

- Python 3.7 or later
- Required Python packages:
  - PyQt5
  - NumPy
  - SciPy
  - Matplotlib
  - NI-DAQmx

3 Installation Guide

3.1 Python Installation

1. Download Python from `https://www.python.org/downloads/`
2. Run the installer, checking ”Add Python to PATH” (Figure 3.)
3. Verify installation by running `python --version` in Command Prompt

3.2 Library Installation

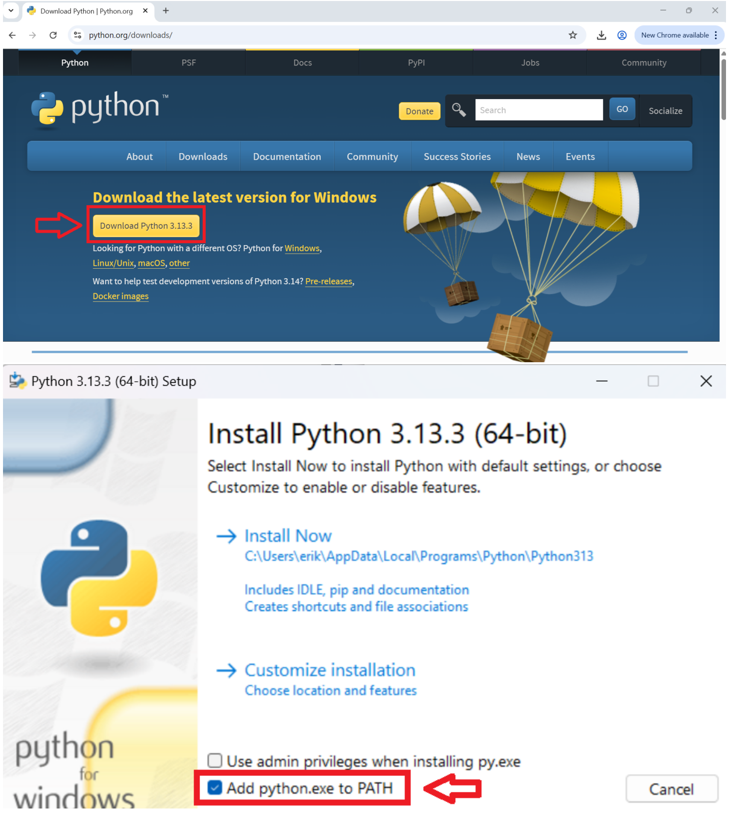
Run these commands in Command Prompt:

```
pip install pyqt5 numpy scipy matplotlib nidaqmx
```

3.3 Running the Application

1. Navigate to the application directory
2. Run the main script:

```
python pangolin_waveform_generator.py
```



Download the latest version for Windows

Download Python 3.13.3

Looking for Python with a different OS? Python for Windows, Linux/Unix, macOS, other

Want to help test development versions of Python 3.14? Pre-releases, Docker images

Python 3.13.3 (64-bit) Setup

Install Python 3.13.3 (64-bit)

Select Install Now to install Python with default settings, or choose Customize to enable or disable features.

→ Install Now
C:\Users\erik\AppData\Local\Programs\Python\Python313

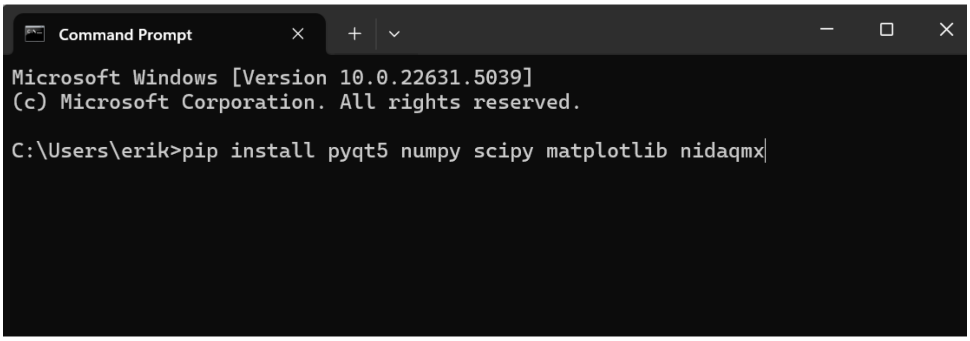
Includes IDLE, pip and documentation
Creates shortcuts and file associations

→ Customize installation
Choose location and features

☐ Use admin privileges when installing py.exe

☑ Add python.exe to PATH

Figure 3: Python installation screen



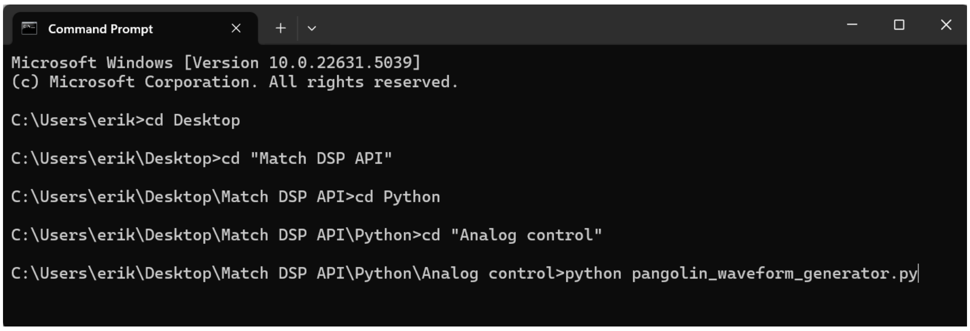
```
Microsoft Windows [Version 10.0.22631.5039]
(c) Microsoft Corporation. All rights reserved.

C:\Users\erik>pip install pyqt5 numpy scipy matplotlib nidaqmx
```

Figure 4: Successful library installation

4 User Interface Overview

4.1 Main Window Components

- **Waveform Selection Panel**
  - Standard waveform dropdown (sine, square, triangle, sawtooth, text input)
  - Cycloid waveform dropdown (triangle, sawtooth)
  - Parameter controls (amplitude, frequency, number of points, etc)
  - The Text Input Waveform allows the user to input a precomputed custom waveform. It is recommended to upload a text file that includes one period (or full cycle) of the desired waveform.
- **Axis Control Panel**
  - X/Y axis selection with color coding (x- axis parameter will be saved in light blue and y-axis parameters will be saved in light red). If no parameters are saved on a particular axis, parameters color background will be white.
  - Send to axis buttons will same the current waveform parameters in a selected galvanometer axis x or y.



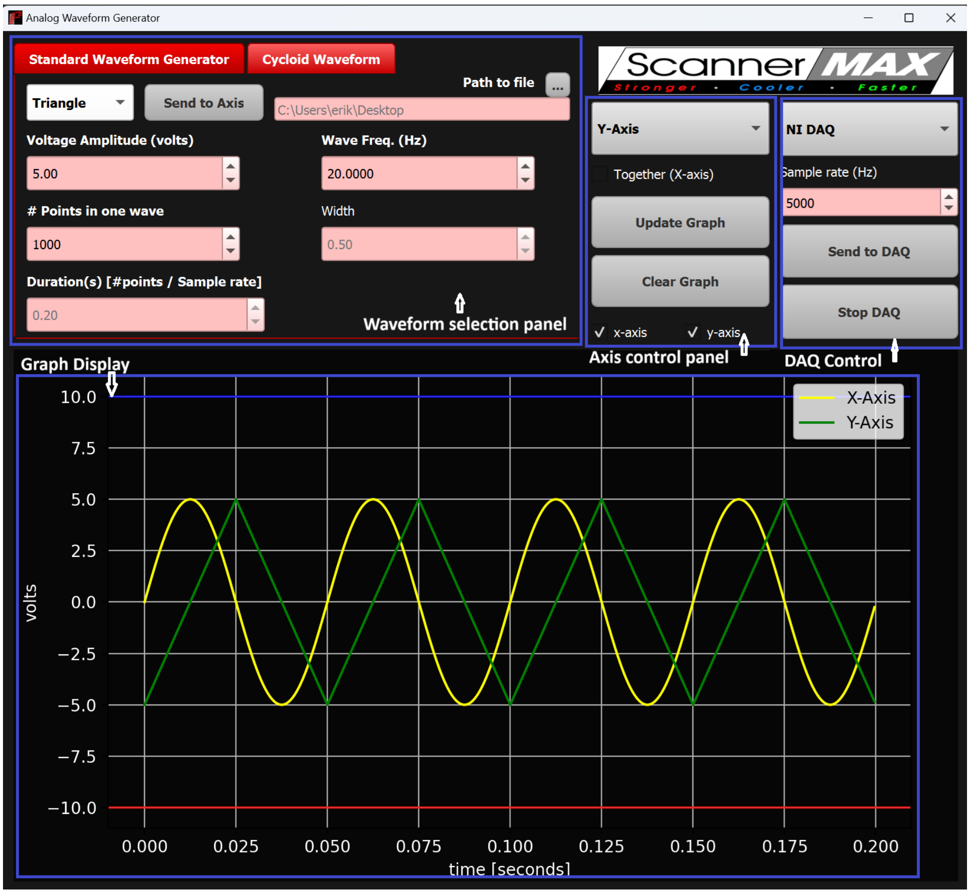
```
Microsoft Windows [Version 10.0.22631.5039]
(c) Microsoft Corporation. All rights reserved.

C:\Users\erik>cd Desktop

C:\Users\erik\Desktop>cd "Match DSP API"

C:\Users\erik\Desktop\Match DSP API>cd Python

C:\Users\erik\Desktop\Match DSP API\Python>cd "Analog control"

C:\Users\erik\Desktop\Match DSP API\Python\Analog control>python pangolin_waveform_generator.py
```

Figure 5: Running the main script

  - Mirror mode checkbox allows to y-axis to mimic the behavior of x-axis

- **Graph Display**
  - Real-time waveform visualization
  - Update/Clear graph buttons

- **DAQ Control**
  - Start/Stop DAQ buttons control when the DAQ should start producing the output voltage or to stop
  - Data selection will provide support only for National instrument devices at the moment of the release
  - Sample rate depends of your DAQ capabilities



Triangle

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Y-Axis

Together (X-axis)

✓ x-axis ✓ y-axis

NI DAQ

Sample rate (Hz): 5000

Figure 6: Main Window Components

5 Getting Started

5.1 Generating a Basic Waveform

1. Select "X-Axis" from the axis dropdown
2. Choose "Sine" from the standard waveform dropdown
3. Set amplitude to 5V and frequency to 1Hz
4. Click "Send to Axis"
5. View the waveform in the graph display

5.2 Outputting to DAQ

1. Configure a waveform as above
2. Click "Send to DAQ" to start output
3. Click "Stop DAQ" to end output

6 Troubleshooting

Issue	**Solution**
DAQ not detected	Verify NI-DAQmx library is installed and device is connected
No waveform displayed	Check axis selection and click "Update Graph"
Text file not loading	Ensure file contains numeric values only
DAQ output stops unexpectedly	Check for voltage limits (±10V)

Table 1: Troubleshooting guide

6.1 Electrical Specifications

- Output Voltage Range: ±10V
- Maximum Sampling Rate: [Your DAQ's maximum rate]

6.2 Software Architecture

- **GUI Framework:** PyQt5
- **Plotting:** Matplotlib
- **Signal Processing:** NumPy, SciPy
- **Hardware Interface:** NI-DAQmx

7 Appendices

7.1 Sample Text File Format

```
1.0
2.0
3.0
2.0
1.0
```

7.2 Version History

- 1.0: Initial release