

Pico 4 Pico – Oscilloscope & Signal Generator

Project Documentation

1. Introduction

The Pico 4 Pico project aims to design and implement a digital oscilloscope and signal generator using the Raspberry Pi Pico. All AD conversions occur on the Pico, while visualization and measurement are handled on a PC host application. This project encourages creative UI design rather than copying traditional oscilloscope layouts.

2. Learning Objectives

- Implement a custom 2-channel digital oscilloscope.
- Perform ADC sampling on the Raspberry Pi Pico.
- Display signals on a PC GUI.
- Implement triggering for periodic signals.
- Auto-measure Vpp, frequency, period, and duty cycle.

3. Pre-project Recommendations

Students are encouraged to review oscilloscope basics and triggering concepts.

Reference: <https://www.youtube.com/watch?v=LaY47Qrfs0c>

4. System Requirements

4.1 Scope Requirements

- Voltage Range: 0–3.3V
- Minimum 2 channels
- Single sweep for non-periodic signals
- Triggering for stable periodic display
- Auto-measurements: Vpp, frequency, period, duty cycle

4.2 Signal Generator Requirements

To be defined by each project group. Options:

- Sine / Square / Triangle wave output
- Adjustable frequency or amplitude

5. Recommended Architecture

- Raspberry Pi Pico for ADC, buffering, USB transfer
- Firmware in C/C++
- Host PC GUI (PyQtGraph / matplotlib)
- USB Serial for real-time streaming

6. Creative Design Emphasis

Students should design intuitive, modern, interactive interfaces—sliders, panels, color-coded channels—rather than classical UI.

7. Bonus Features

- XY Mode for Lissajous patterns
- Advanced GUI features
- Low-latency UI response

8. Summary

The Pico 4 Pico project combines embedded systems, high-speed acquisition, signal analysis, and GUI/UX engineering, teaching both technical and conceptual instrument-design skills.