# Programmable Arbitrary Timing Pulse Generator

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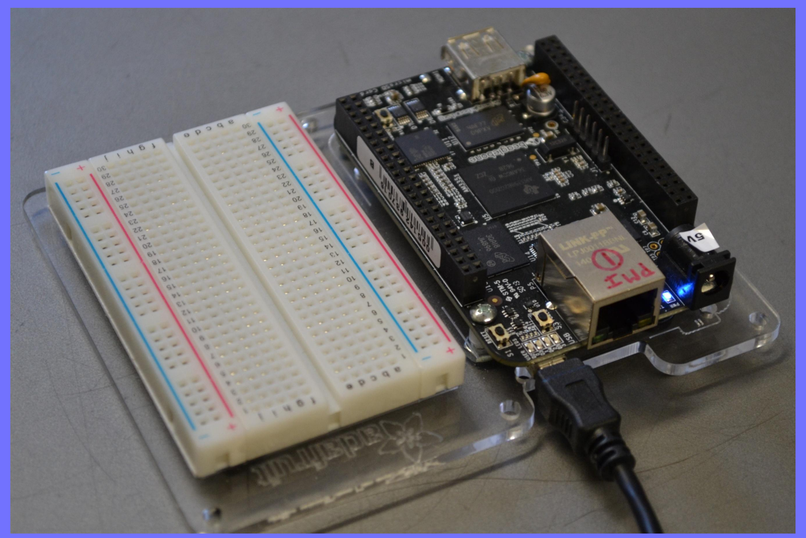
## Abstract

**We have developed a multi-channel, user programmable timing pulse generator of arbitrary TTL timing signals. Our device allows the user to specify signal outputs on up to 10 different channels during selected time intervals using a graphical user interface (GUI) and a BeagleBone Black (BBB) computer. With this pulse generator we can control the timing of multiple lasers, shutters, and other components in our experimental setups.**

## Goals and Need for Device

- **Need a simple and affordable device that outputs timing signals on multiple channels**
  - **Turn devices (for example, lasers) off/on**
  - **Provide timing information to data acquisition system**
- **Need a visually intuitive user interface**
- **Use a BeagleBone Black computer**

## The BeagleBone Black



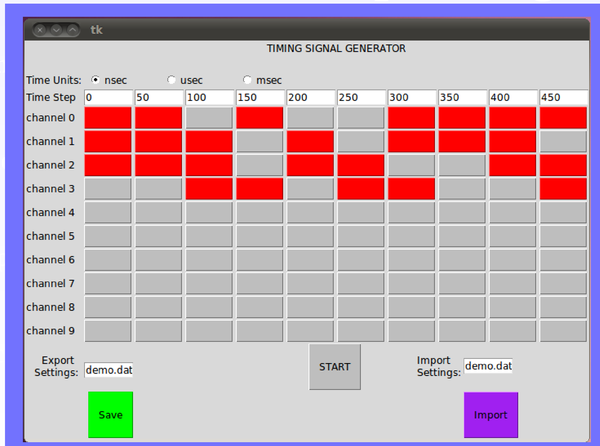
**The BBB is attached to the data acquisition computer's USB port.**

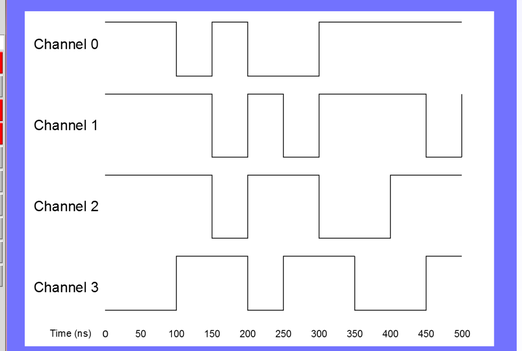
**The data acquisition computer becomes the user interface to the BBB.**

## Device Features

- **20 ns minimum time structure**
- **Unlimited temporal range**
- **Versatility**
- **10 independent output channels**
- **Simple, intuitive, and accessible interface**
- **Uses BeagleBone Black computer**
  - **ARM processor's PRU operates without interupts**
  - **Flexible operating system (Linux)**
  - **Large number of general purpose I/O ports**
  - **Gain experience with embedded devices**
  - **Affordable (The BBB is $45)**

## Graphical User Interface and Corresponding Signal Output




- **Each button corresponds to a specific time and channel; red is on, gray is off.**
- **The time steps can be changed by the user to allow unlimited temporal range.**
- **Settings can be saved and retrieved.**

## Summary

- **We have designed a multichannel, programmable timing signal generator.**
- **The programming interface is simple and intuitive.**
- **The device has both short minimum step size and "infinite" temporal range.**
- **By having the BBB's PRU control the outputs, interrupt issues are eliminated.**
- **The device is a convenient tool for controlling the timing of optical pulses, especially in multi-laser experiments, like those involving trapping and cooling of atoms and molecules.**

**Funding provided by NSF grant number: PHY-1157044**