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# Digitally Controlled Eurorack Modular VCA

# Objective

* 1. Creation of a working, ready to bring to market Voltage Controlled Amplifier in the Eurorack modular format, with a twist; The gain potentiometers will be motorized and digitally controlled.

# Background

* 1. Musicians who use modular synthesizers often times find that when they are preparing for a performance the patch that they have created may have changed timbrally as a direct result of just a few potentiometer controlled parameters having been changed. Using a modular synthesizer for live performance is already a difficult task, made more difficult by the inherent non-permanent nature of the way a modular synthesizer is patched together. Once a patch is removed, or drastically changed it is often impossible to totally recreate it. One might suggest the solution of using modules, or the individual building blocks of signal chain, that are digital. This is so that their last used states could be stored when the system is shut off. While this is an adequate solution, it does not account for the main attraction musicians have towards using a modular synthesizer; discrete analog circuitry and the rich sound it can create. So the best case solution is in fact a hybrid of the two, digitally controlled analog circuity. While the end objective of this project will not entirely solve the problem of ‘patch impermanence’ within the performative use case of modular synthesizers, it will create a template for use with other module designs whose functions may be state critical to preserving the tonality of a patch.

# Participants

* 1. Nicholas Blanchard – Designer

Mark Howell – Code Review, Mentor/Project Sponsor

* 1. Testers have not been found yet, but within the synthesizer and electronic music community testers can be found.

# Systems required / affected

* 1. N/A

# Use case scenarios

* 1. Performing Musicians/Synthesists – for use in touring set-setups to alleviate the issue of patches being changed drastically
  2. Studio Musicians – for use in recording set ups where multiple amplification presets are needed for one song or track.
  3. Mix Engineers/Producers – Often Mixing engineers will need to layer over tracks that they have been sent for mixing. Such tasks as mixing in synthesized sub-bass under kick drums of bass tracks could be done precisely through alternating through the preset states of the VCAs during a mix-down session.

# Implementation

## Code requirements/changes

* + 1. An abstraction for handling button press lengths will have to be written in order to give multi functionality to a limited number of buttons on the module

## User interface requirements/changes

* + 1. The user interface must adhere to the measurements set forth by Dieter Doepfer, the founder of the Eurorack standard for modular synthesizers. This means that the height of the front panel can be no more that 3u tall where 1u is 1.75 inches.
    2. The user interface must be analog; no screens and no contextual menu. In the realm of Eurorack format modular synthesizers, many companies have been including small OLED screens with menus and other graphical features to implement their modules core functions. While there is a use for such user interface choices, such OLED based modules detract from the simplicity that a modular synthesizer can boast. In other words, if one wants to make music by staring at a screen, use a computer.
    3. The spacing of the motorized potentiometers must be enough to allow for performative use without it feeling ergonomically cramped for four fingers on any one of the four faders/potentiometers at once.

## Process requirements/changes

* + 1. VCA’s normally require a manual change by the user.
    2. When a desired setting has been achieved the user will hold one of the 4 preset buttons for 3 seconds to save the stepped position of the motorized potentiometers and thus the gain state amount of the amplifier. That information should be saved to the non volatile portion of the onboard memory of the microcontroller

## Hardware requirements/changes

* + 1. The original circuit for the voltage controlled amplifier need the minor modification of using jumper wires to connect the panel mounted motorized potentiometers the circuit board
    2. To not hinder the projects momentum due to the long lead times for having printed circuit boards fabricated, an already fabricated PCB from a synthesizer hobbyist retailer will be used for the initial deployment of the prototype.

# Assumptions, Dependencies, Constraints

* 1. Distributors of electronic components will have stock of the necessary components used for the circuitry.

# Milestones

* 1. Hand-wired motor driver circuit completed allowing for additional work to be complete on the firmware
  2. Tools and materials received for hand etching a circuit board.
  3. A first version of the etched circuit board utilizing the Arduino Due platform was completed
  4. A second version of the circuit board has been designed to be a modular version of each motor driver channel
  5. Font panel design with good fitment and compliance to Eurorack modular size standards completed

# Revision history

* 1. Rev. 1 – hand-wired circuitry with hand-wired connections to MCU
  2. Rev 1.2 – motor driver circuitry with connection header pins to Arduino Due
  3. Rev 2.0 – modular version of Rev 1.2 with header connections to hand wire to each of the four Arduino Nanos’.