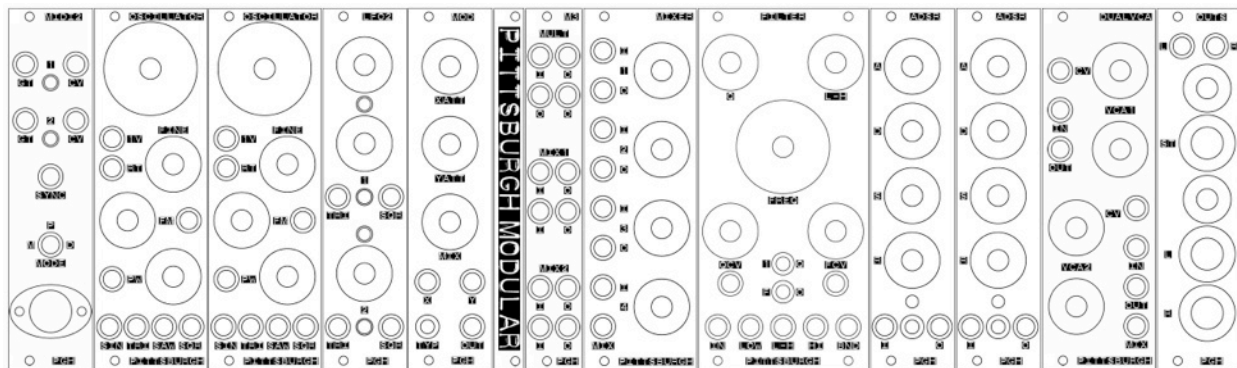# Pittsburgh Modular
Foundation 2.0 Synthesizer
Manual and Patch Guide

Important Instructions – PLEASE READ

Read Instructions:
Please read the Foundation Synthesizer manual completely before use and retain for future reference.

IMPORTANT Ribbon Cable Power Information:
The Foundation combines a set of individual modules to create a complete synthesizer. The individual modules can be rearranged, removed, and replaced with other Foundation and Eurorack compatible modules from Pittsburgh Modular or other manufacturers.

The Foundation uses standard Eurorack ribbon power cables to connect the modules to the internal bipolar +/-12v DC power supply. Please pay very close attention to the orientation of the ribbon cable when adding and removing modules. The stripe on the ribbon cable marks -12v. This stripe needs to line up with the -12v pins on the power supply and the -12v pins on the module. **Failure to match up the pins correctly can result in damage to one or all the modules in the Foundation.** On the power board, the -12v pins are clearly labeled. On the individual modules, the positive and negative sides of the pin connectors are labeled next to the power header on either the top or bottom of the PCB.

Do **NOT** remove individual modules from the Foundation while Foundation is plugged in.

Do **NOT** unplug ribbon cables from the Foundation or individual modules while the Foundation is plugged in.

Table of Contents

Specifications and Foundation Package Contents

Foundation Package Contents:
    1 - Foundation Modular Synthesizer
    1 – Pittsburgh Modular Patch Cable Kit
    1 – Manual and Patch Guide
    1 – External Power Adapter

Case and Power Supply:
    External Dimensions:
        Heavy Duty Road Case with Removable Lid: 19.25" x 6.25" x 6"
        Custom Hardwood Desktop Case: 19.25" x 4.5" x 6.5"

    Internal Specifications:
        90hp Eurorack Case
        Sliding Nut Mounting System

    External Power Adapter:
        Connection: 2.1mm Barrel Type
        Output: 15V-18V DC / 1A

An Introduction to Modular Synthesis

The Foundation was designed to be a complete, fully modular analog synthesizer. A modern version of the great 1970's monosynths conveniently broken down into individual components with no hardwired signal flow to restrict experimentation. Oscillators, mixer, filter, ring modulator, ADSR, etc. are all individual modules.

Because each module performs a single function, without patch cables the Foundation will not produce sound. A synthesizer voice must first be patched up using cables to wire modules together. The Foundation allows the signal flow to be rewired with every patch. The voice can be as simple as listening to the triangle output of an oscillator or as complex as a self running patch using all the modules.

Audio Signal Path and Control Voltage Signal Path

The Foundation signal path is divided into two types of signals. Audio signals and control voltages.

The audio signal is represented by the sound that is produced. The audio signal path starts at a sound source such as an Oscillator, LFO running at audio rate, or the Filter in oscillator mode. The audio signal is then patched through other modules used to shape the sound such as mixers, filters, and amplifiers.

Control voltages (CV) are used to manipulate the audio signal in several different ways.

Gates are represented by a high or low control voltage. A gate can be generated using a square or pulse wave from an oscillator or LFO, or by using the GATE output on Midi module. A gate can be shaped using an envelope generator to control the attack, decay, sustain, and release of the gate. The modified gate signal can then be sent to any CV input on the Foundation.

A second use for control voltages is as a modulation source. For example, a control voltage from the CV output of the Midi module patched into the 1V input on the Oscillator controls the frequency of the Oscillator based on the Midi note received. The LFO2 module provides two separate low frequency oscillators that make perfect control voltage modulation sources. Audio signals also make a great control voltage source for Oscillator FM (frequency modulation).

As always, experimentation is essential to getting the most out of the Foundation.

Individual Modules
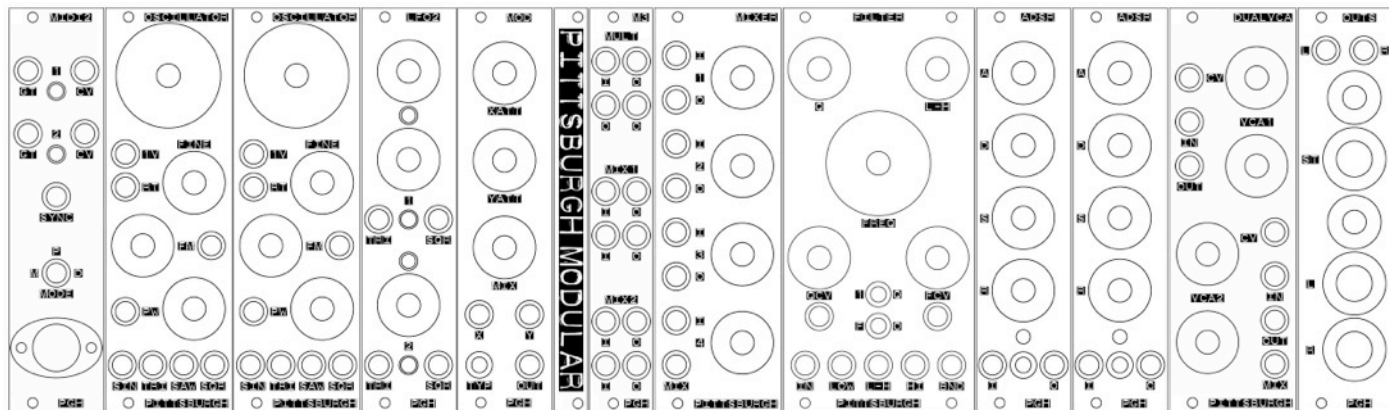
The Foundation is a collection of 13 modules chosen to allow the creation of complex analog sounds. The modular nature of the Foundation allows for deep experimentation and a virtually unlimited sound palate with no hardwired signal path or fixed voice architecture to restrict creativity.

The following pages describe the functionality and controls of each module.

Midi2 Module

Description:
The Midi2 converts standard midi note messages into the analog control voltages used by modular synthesizers. This allows a modular synthesizer to be controlled by a midi keyboard, sequencer, or DAW. The Midi2 module has 3 distinct modes of operation.
1. Monophonic - Gate2 and CV2 outputs mirror the outputs of Gate1 and CV1. Monophonic mode works great when using a modular as a single voice synthesizer.
2. Duophonic - The Midi2 module uses the two sets of Gate and CV outputs to allow two notes to be played simultaneously. The first midi note is sent to the Gate1 and CV1 outputs and the second is sent to the Gate2 and CV2 outputs. Duophonic mode is perfect when working with a two voice modular synthesizer.
3. Dual Monophonic - Gate 2 and CV2 outputs are controlled by a different midi channel than the Gate 1 and CV 1 Outputs. Dual Monophonc mode allows a modular to be controlled by two separate sets of midi data. This mode works well when using a modular as two single voice synthesizers

Controls:
GT1 Output – Note on = Gate high (+5v), Note off = gate low (0v)
CV1 Output – 1 volt per octave voltage derived from note played on keyboard.
GT2 Output – Note on = Gate high (+5v), Note off = gate low (0v)
CV2 Output – 1 volt per octave voltage derived from note played on keyboard.
Sync Output – Press to assign midi note channel or midi CC channel.
Midi Input – Input jack for a standard 5-pin midi cable.

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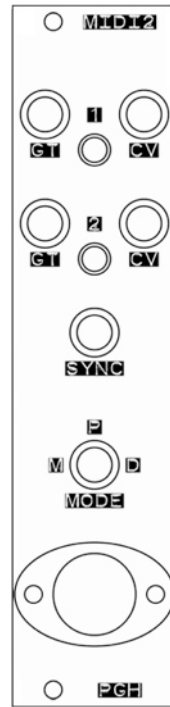
Oscillator Module(x2)

Description:
A wide range, multiple waveform generator. The Oscillator has a frequency range starting as low as 7 seconds per cycle, allowing it to double as a voltage controlled LFO.

Controls:
Big Knob – Course frequency setting.
Fine Knob - Fine tune frequency setting. This control is calibrated to a range of 1 octave.
1V Input - CV input used to track the Oscillator at 1 volt per octave.
RT - CV Input used to hard reset the Oscillator on the falling edge of the incoming waveform.
FM Knob and Input - Linear frequency modulation CV input attenuator and input.
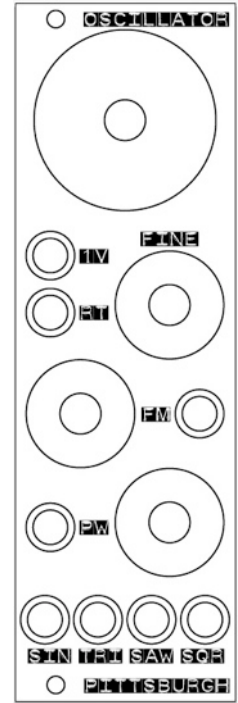PW Input - Pulse width modulation CV input. Affects the pulse width of the square wave
PW Knob - Manually controls the pulse width of the square wave.
SIN Output – Sine wave output
TRI Output – Triangle wave output
SAW Output – Saw wave output
SQR Output – Square wave output

M3 Module

Description:
The M3 is a unique signal routing module with 3 distinct sections able to perform several different functions at once. Signal splitting, mixing, and buffering are combined to create a module that is both compact and incredibly useful.

The top section labeled MULT, is a standard 4 jack passive multiple used to create 3 copies of the original signal. One input becomes up to 3 identical outputs.

The bottom 2 sections, MIX1 and MIX2, both function the same way. Two input and 2 outputs allow each section to be used as a 2 channel unity gain mixer, signal buffer, and buffered multiple.
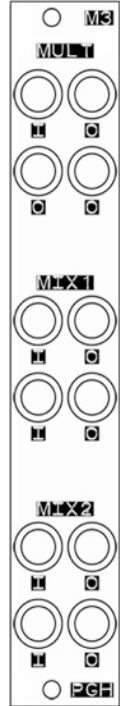
Controls:
Section 1 (MULT)
All 4 jacks function the same. Although the jacks are labeled I, O, O, O, any jack can be used as the input allowing the remaining 3 jacks to be used as outputs.

Section 2 and 3 (MIX1 and MIX2)
There are two types of jacks in the Mix sections, inputs (I) and outputs (O). Each Input functions identically and each output functions identically. The two inputs can be used together to create a 2 channel unity gain mixer and the two outputs can be used as a buffered multiple. Combining both features together allows the M3 to perform a wide range of functions at once.

LFO2 Module

Description:
A dual low frequency oscillator module. It uses two different types of low frequency oscillator circuits to provide a variety of CV and audio rate modulation options. The top LFO utilizes rate and symmetry controls to generate shifting waveforms. Adjusting the symmetry control varies the shape of the TRI output waveform from a saw tooth to triangle to ramp wave. The symmetry control also adjusts the pulse width of the SQR wave output. The bottom LFO is a simple triangle based low frequency oscillator with rate control over the triangle and square outputs.

LFO 1 Controls (top)
Rate Knob - Coarse frequency setting.
Symmetry Knob - Modify the shape of the waveforms.
TRI Output - Saw / Triangle / Ramp wave output
Range Switch - Switches the frequency range.
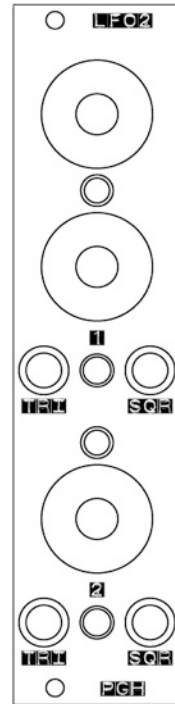SQR Output - Square / Pulse wave Output

LFO 2 Controls (bottom)
Rate Knob - Coarse frequency setting.
TRI Output - Triangle wave output
Range Switch - Switches the frequency range of LFO 2.
SQR Output - Square wave output

Modulator Module

Description:
The Modulator offers 3 types of effects based on the standard Ring Modulator circuit. Typical uses can create bell-like or metallic sounds.

Type 1: Ring Modulator - Outputs the sum and difference of the X and Y inputs.
Type 2: Floating Z Modulator - Outputs the sum and difference of the X and Y inputs summed with the ambient voltage within the circuit.
Type 3: Linear Amplitude Modulator - Outputs the sum and difference of the X and Y inputs summed with the carrier (Y) signal.

Controls:
X Signal Attenuator and Input
Y Signal Attenuator and Input
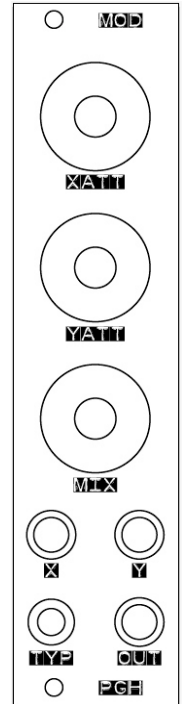X Mix Output Attenuator used to mix the X input with the output of the modulation circuit
Ring Modulator Type Switch
OUT - Ring modulator output

LFO 1 Controls (top)
Rate Knob - Coarse frequency setting.
Symmetry Knob - Modify the shape of the waveforms.

Mixer Module

Description:
A flexible, low-noise four channel mixer and/or attenuator for audio and CV that can be used in several ways.

Three of the four channels have an output that removes the channel from the mixer circuit and allows it to become a standalone attenuator. The pots are wired with a logarithmic volume curve that is tuned for use with audio but it will work with CV as well.

Patching the output of channel 1, 2, or 3 will remove it from the mixer circuit. Channel 4 can not be removed from the mixer circuit, however if channel 1, 2, and 3 are all being used as attenuators, channel 4 is the only input remaining in the mixer allowing it to be used as a buffered attenuator.
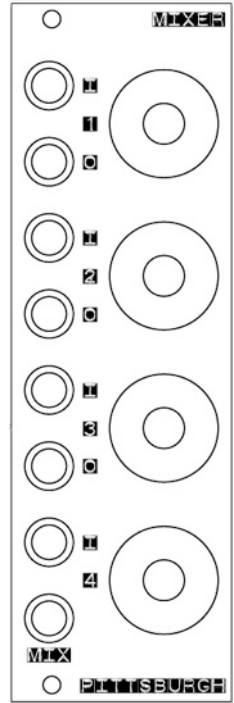
The Mixer can be used as a...
4 Channel Mixer
4 Independent Attenuators
2 Attenuators and a 2 Channel Mixer
1 Attenuator and a 3 Channel Mixer

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Filter Module

Description:
The Filter is a voltage controlled, analog, state variable filter. The state variable topology was chosen because it allowed us to produce a very smooth and natural sounding filter, in addition to offering several other modes of operation, each with a unique sound and energy all their own.

The Filter defines the sound of Pittsburgh Modular. It offers a warm, organic sweep through the full frequency range. The lowpass filter is gummy and relaxed while the highpass is clean and defined. The goal was to produce a filter that did not have a sweet spot; where the every turn of the frequency knob produced something interesting.

Modes of Sound
Multiple filter responses are available simultaneously including lowpass, highpass, and bandpass. The fourth filter response is a variable response that shifts between lowpass, notch, and highpass.

Switch It Up
Two switches, Gain and Mode, further expand the capabilities of the Filter. The Gain switch modifies the functionality of the Q while the Mode switch toggles between filter and oscillator modes. Setting the Gain switch to "1" converts the Q setting into a VCA circuit for the audio input. Switching the Gain switch to "Q" returns the standard filter Q response.
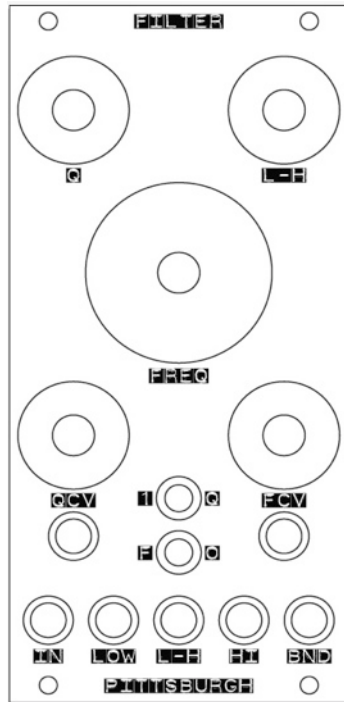
Filter Module (continued)

Mode switches between Filter and Oscillator modes. Set to "Filter", the Pittsburgh Modular Filter will not self oscillate. Set to "Oscillator" the Filter produces a high quality voltage controlled sine wave. Adjusting the Q while in Oscillator mode modifies the shape of the waveform. At more extreme settings the Q adds anything from warm fuzz to heavy distortion the incoming audio.

Controls:
Q Pot: Adjusts the resonance (Q) of the filter.
FREQ Pot - Adjusts the Frequency of the filter.
L-H Pot - Sweeps between lowpass, notch, and highpass filters.
QCV Pot and Jack - Resonance (Q) control voltage input and attenuverter.
FCV Pot and Jack - Frequency control voltage input and attenuverter.

1-Q Switch - Switch between Gain to 1 (VCA Mode) and Gain of Q (Standard Mode)
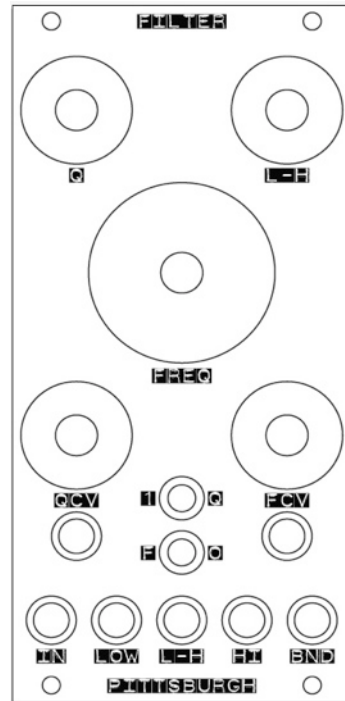F-O Switch - Switch between Filter and Oscillator Modes

LOW Jack - Lowpass Output
L-H Jack - Output based off of the L-H Pot
HI Jack - Highpass Output
BND Jack – Bandpass Output

ADSR Module (x2)

Description:
The ADSR is a four stage envelope generator with independently adjustable Attack, Decay, Sustain, and Release stages. An envelope generator is used to shape control voltages such as the gate of the Midi module or a square wave from the LFO2.

Controls:
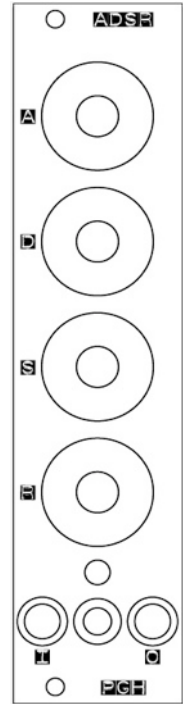A Pot - Attack Stage Control
D Pot - Decay Stage Control
S Pot - Sustain Stage Control
R Pot - Release Stage Control
I Jack - Input Jack
Range Switch - Adjust the range of the stage controls between short and long.
O Jack - Output Jack

Dual VCA Module

Description:
The Dual Index is a dual linear voltage controlled amplifier (VCA) and a two channel voltage controlled mixer. It has two standalone VCAs and a fully buffered mix output. Each channel offers offset gain and CV attenuation. The CV and IN of channel 2 are normaled to channel 1. If left un-patched, channel 2 will operate using the channel 1 CV and IN signals.

Controls:
Index 1 (VCA 1):
CV - CV Input used to control the VCA.
CV Knob - CV input attenuator.
In - Signal Input
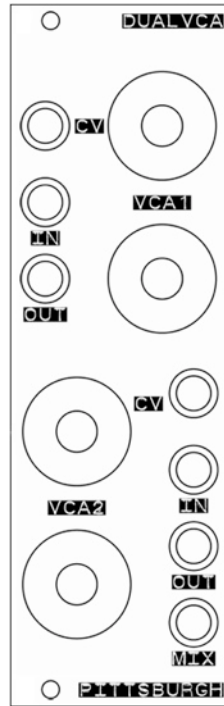Out - Signal Output

Index 2 (VCA 2):
CV - CV Input used to control the VCA.
CV Knob - CV input attenuator.
In - Signal Input
Out - Signal Output
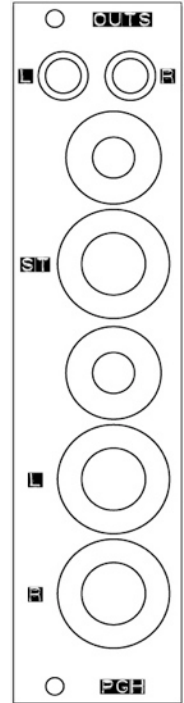
Mix - Fully Buffered mix of the VCA 1 and VCA 2 outputs.

Outs Module

Description:
A simple way to get sound out of the Foundation. Outs is a dual independent output module featuring a stereo 1/4" headphone amplifier output and dual mono 1/4" line level outputs.

Left and Right inputs are available. If only the left input is used, it is sent to both the Left and Right outputs.

Patching a Modular Synthesizer

The following pages contain many examples of how to patch the Foundation. The examples have been chosen to showcase the flexibility of the Foundation and to highlight as many features from each module as possible. Use the patches provided as a teaching tool. Once you have setup a patch, adjust knobs and remove cables from the Foundation while referencing the module description pages within the manual. This will help develop an understanding of what function each part of the patch is performing.

The patch guide provides at least one "_____ Module Highlight" Patch for each module within the Foundation. These patches are designed to showcase the core functionality as well as additional features of the highlighted module. In general, the Highlight patches will provide a way to focus attention on the capabilities of a single module and may not provide results that would be considered musical.

Working with individual modules can be fun but the true power of any modular synthesizer comes when different modules start to interact. Patching the output of one module to the input of another is a fundamental part of modular synthesis. Even though the Foundation is designed to be a tabletop modular, the patches can become complex quickly. Any output on the Foundation can be patched to any input. Understanding the capabilities and functionality available from each module will allow even the most complex patches to be understood easily.
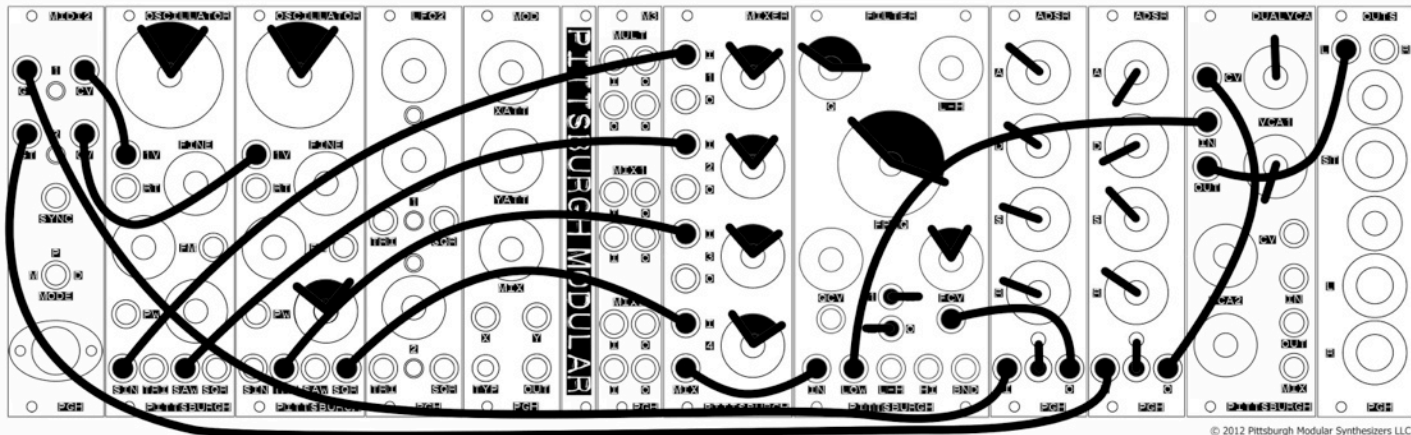
If you come up with a good patch, we want to try it! Send all your interesting patches to info@pittsburghmodular.com.

Patch Name: Vintage Mono-Synth

Patch Description: Monophonic Starting Point

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Patch Notes: Use this patch as a starting point for huge bass and classic leads.

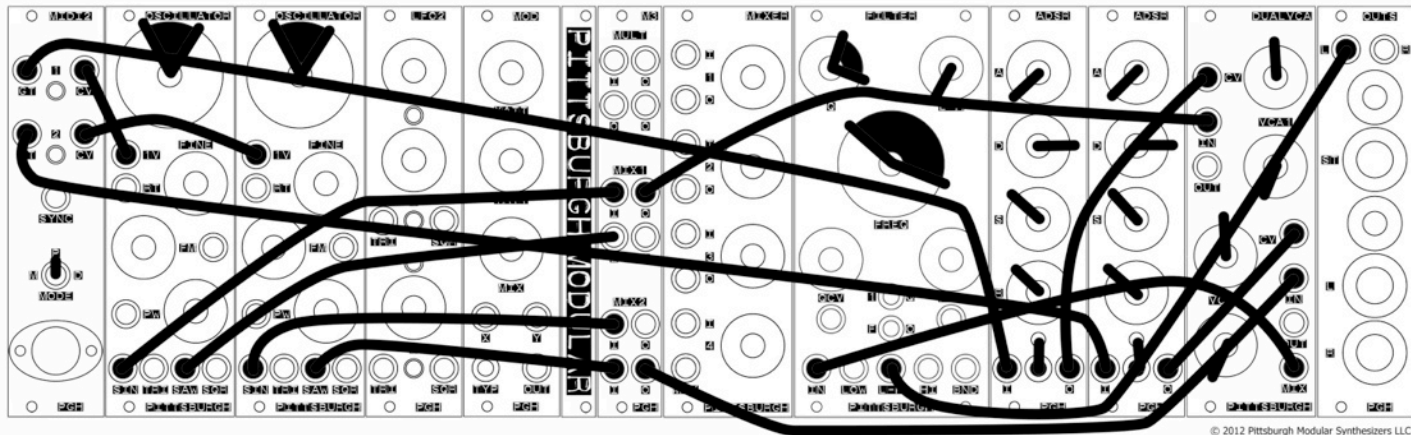© 2012 Pittsburgh Modular Synthesizers LLC.

Patch Name: Duophonic Synthesizer

Patch Description: Basic Duophonic Synth

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Patch Notes: Use this patch as a starting point for a duophonic synthesizer.

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Patch Name: Duophonic Synthesizer

Patch Description: Basic Duophonic Synth

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Patch Notes: Use this patch as a starting point for a duophonic synthesizer.
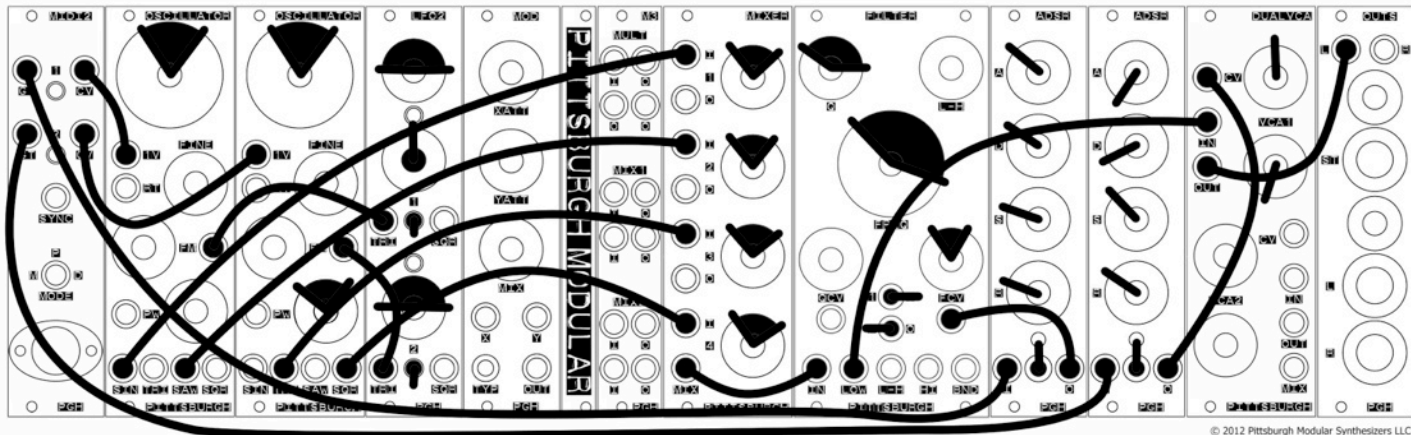
© 2012 Pittsburgh Modular Synthesizers LLC.
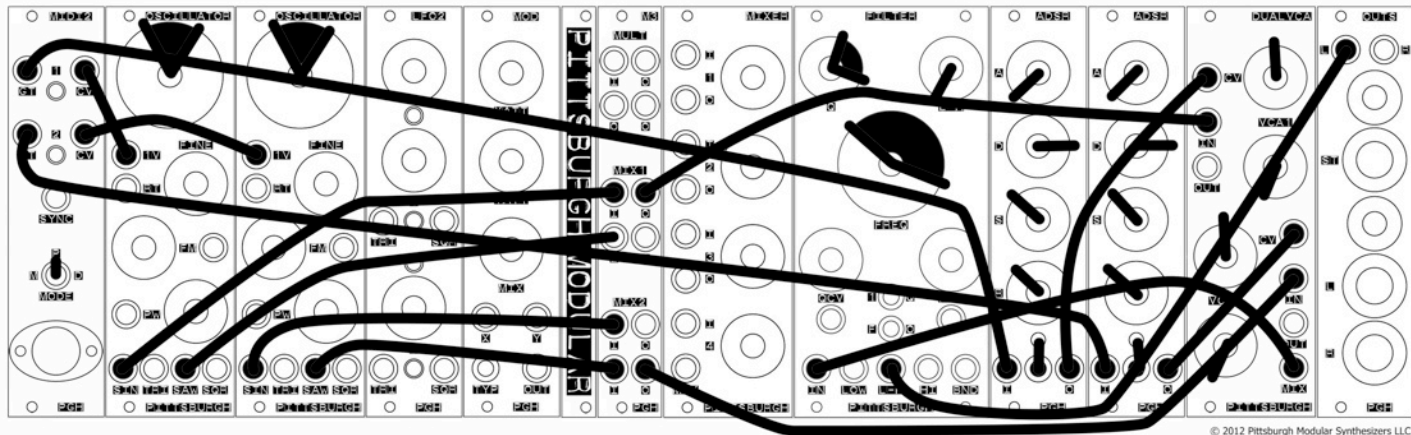
Patch Name: Vintage Frequency Modulation

Patch Description: Monophonic Synth with Modulation

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Patch Notes: Vintage Mono-synth patch with added frequency modulation.
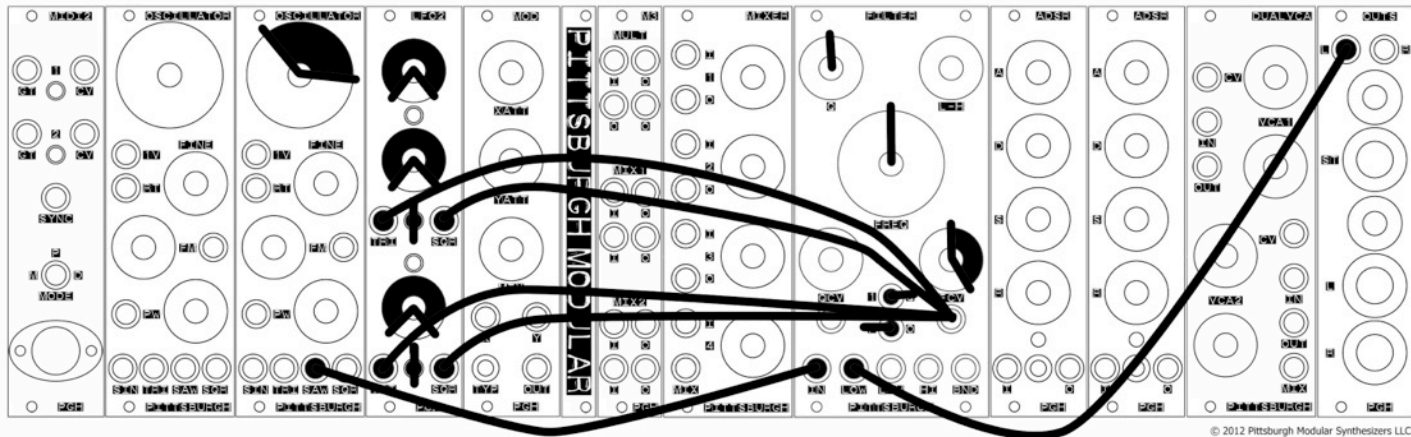
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Patch Name: Midi2 Test

Patch Description: Midi2 Features Highlight

Patch Notes: Audition the features of the Midi2 module.

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Patch Name: Oscillator Test

Patch Description: Oscillator Features Highlight

Patch Notes: Simple patch to audition the Oscillator waveform and modulation options.

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Patch Name: LFO2 Test

Patch Description: LFO2 Features Highlight

Patch Notes: Test the LFO2 waveforms one at a time by modulating the Filter frequency.

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Patch Name: Modulator Test

Patch Description: Ring Modulator Features Highlight

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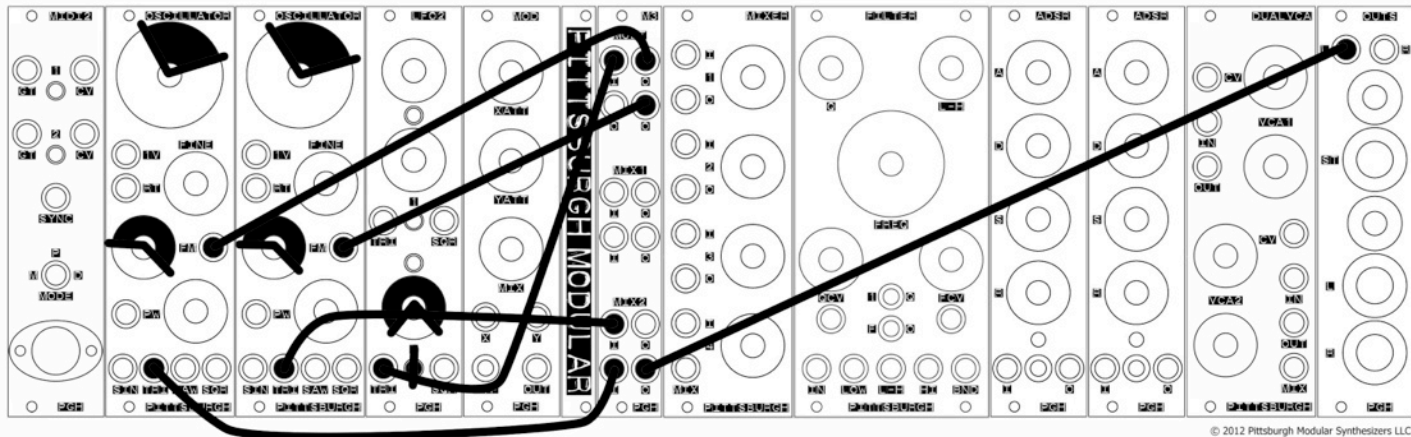Patch Notes: Audition the ring modulator capabilities of the Modulator module.

© 2012 Pittsburgh Modular Synthesizers LLC.
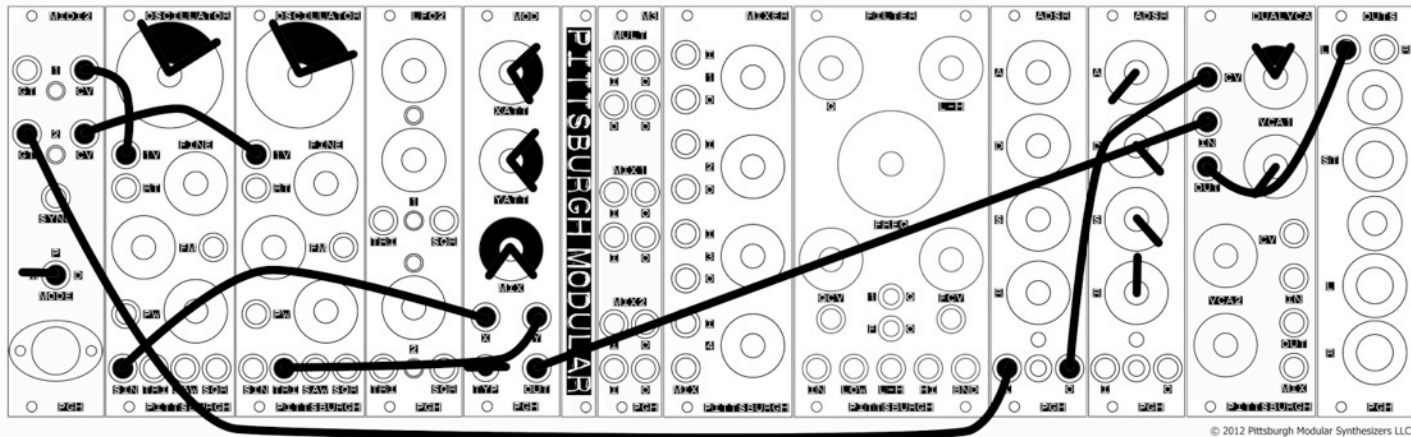
Patch Name: M3 Test

Patch Description: M3 Multiple and Mixer Highlight

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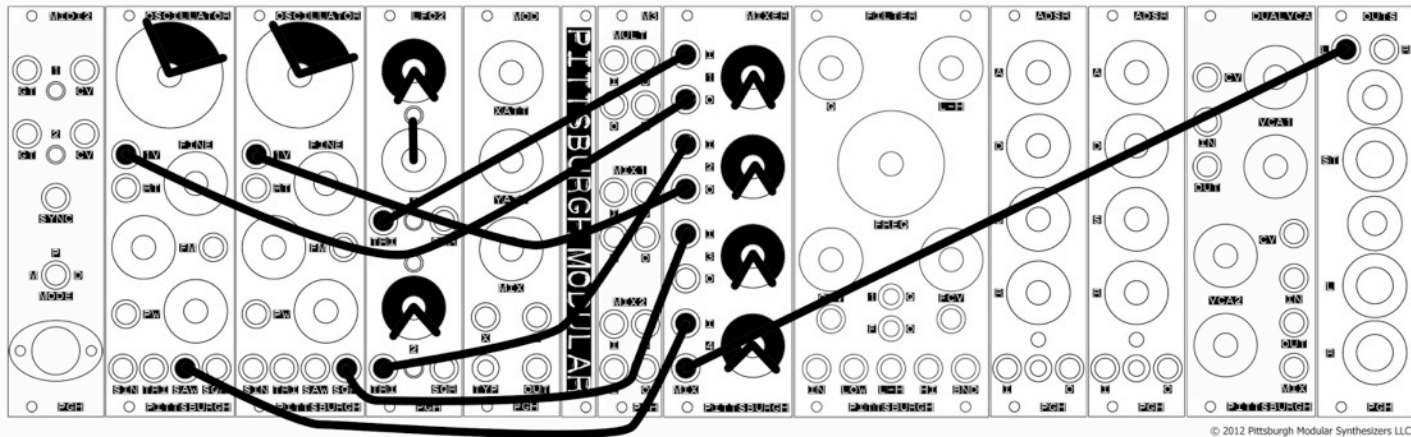Patch Notes: Test the Mult and Mix sections of the M3 module. Mix1 and Mix2 are the same.

Patch Name: Mixer Test

Patch Description: Mixer Module Highlight

Patch Notes: Simple patch to audition the mixer and attenuator features.

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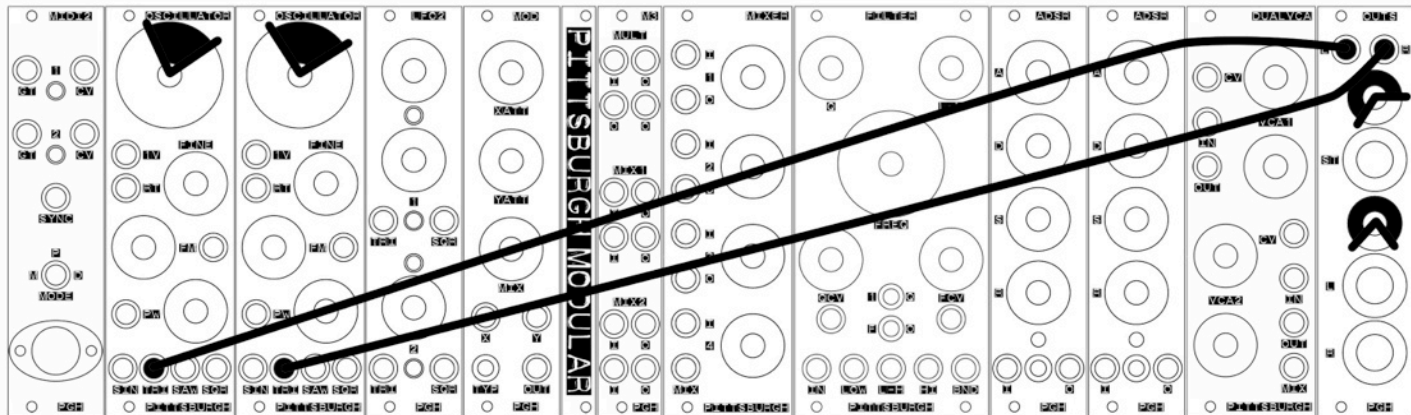
Patch Name: Filter Test

Patch Description: Filter Module Highlight

Patch Notes: Simple patch to audition the different outputs and settings of the Filter module.

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Patch Name: ADSR Test

Patch Description: ADSR Module Highlight

Patch Notes: Simple patch to audition the ADSR shaping options.

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Patch Name: Dual VCA Test

Patch Description: Dual VCA Module Highlight

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Patch Notes: Simple patch to audition the different options of the Dual VCA module. The Dual VCA allows for complex routing options (see page 18). Please experiment .

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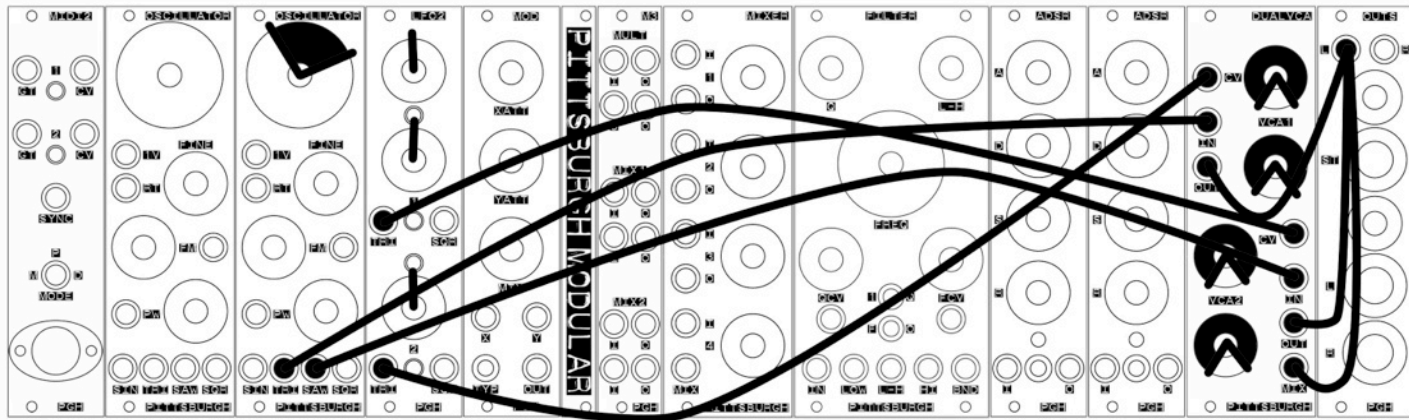
Patch Name: Outs Test

Patch Description: Outs Module Highlight

Patch Notes: Simple patch to audition the different options of the Outs module.

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Patch Name: Interesting Filter Modulation **Patch Description:** Modulate Filter with Oscillator

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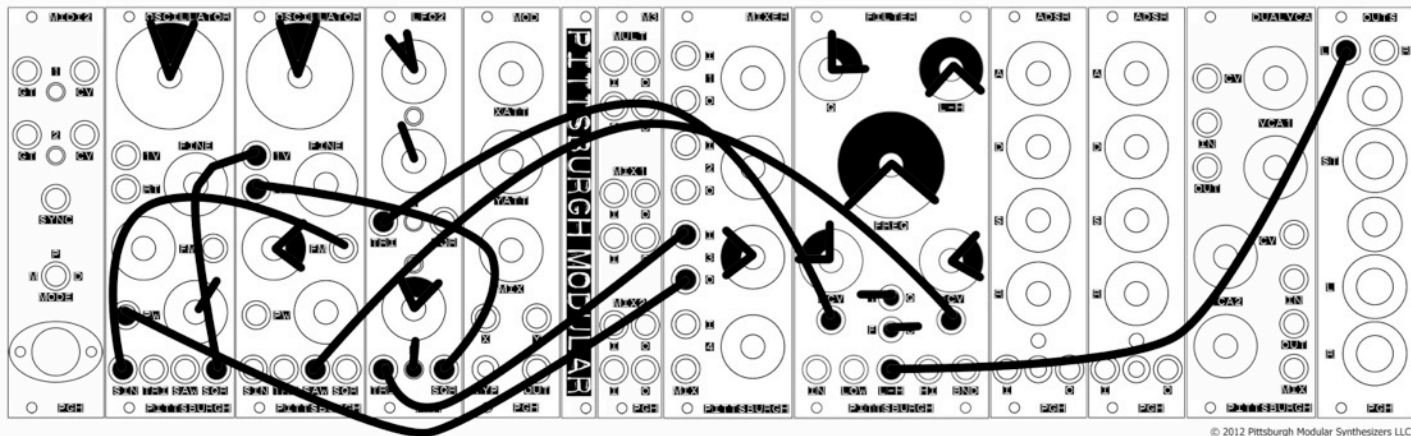**Patch Notes:** LFO modulated oscillator modulating filter frequency.

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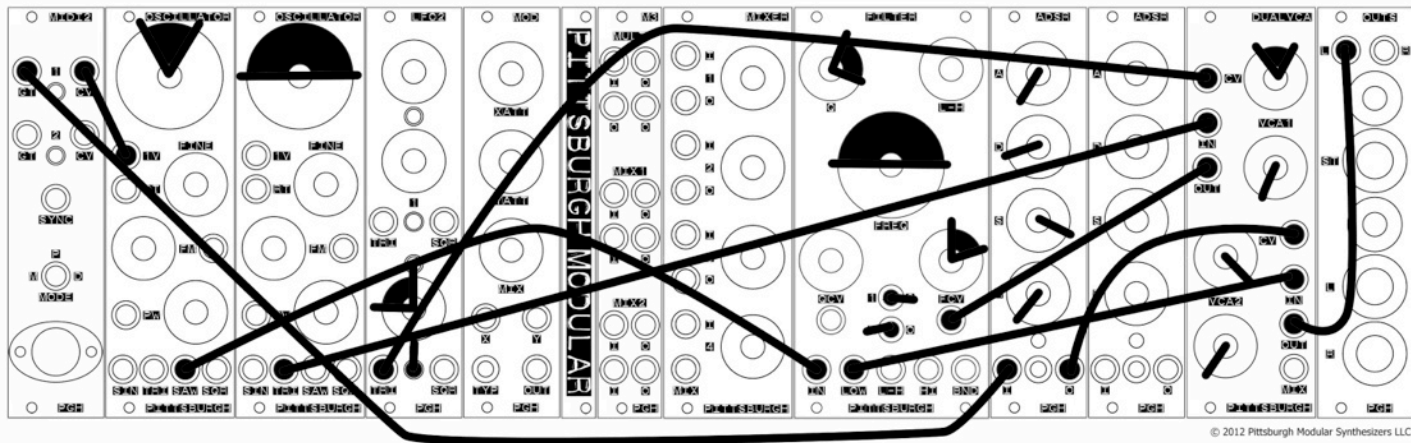
Patch Name: Mechanical Birds

Patch Description: Self Generating Avian Robots

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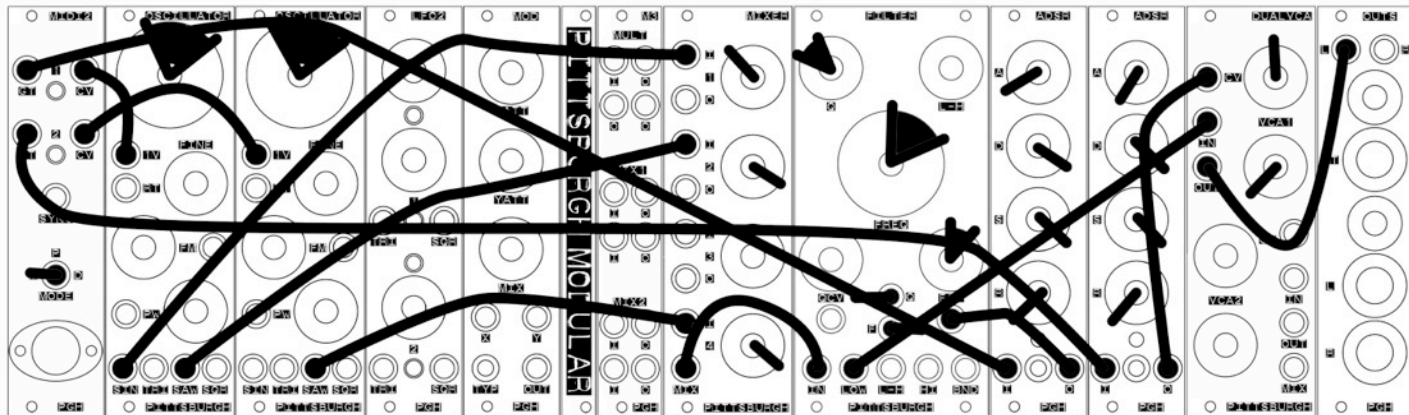Patch Notes: Lots of room left for tweaking. Turn this patch up very loud and leave for the night.

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Patch Name: Overdrive Filter

Patch Description: Non-Standard Filter Use

Patch Notes: Example of the quirks and noise of the Filter in Oscillator mode.
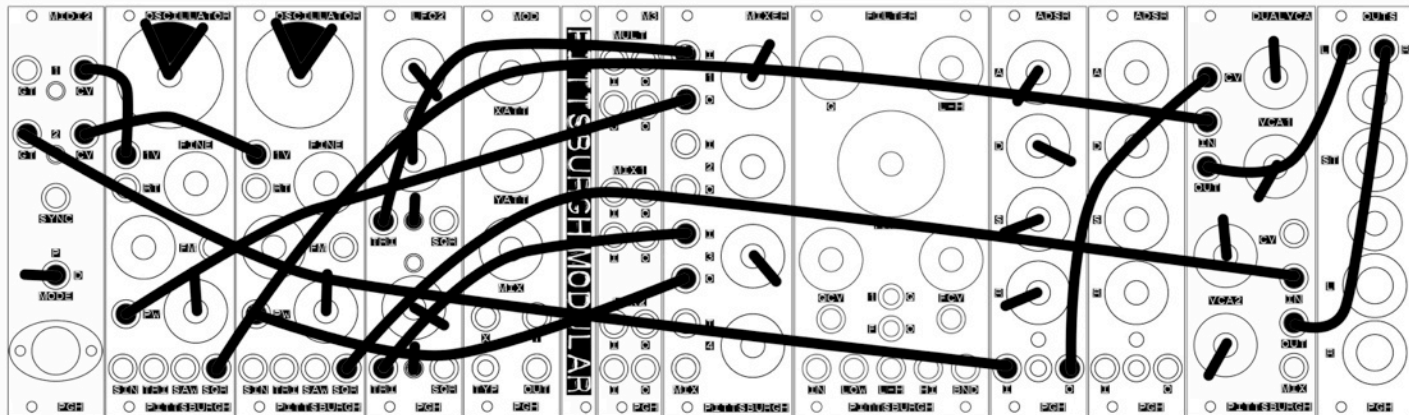
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Patch Name: Pulsewidth in Stereo

Patch Description: An Oscillator for Each Ear

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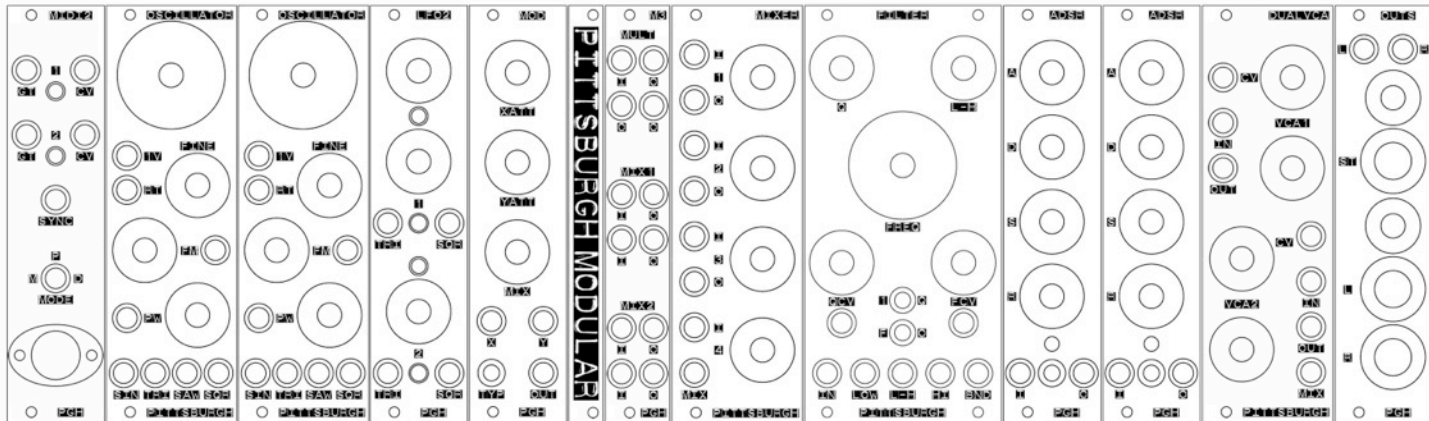Patch Notes: Modulated Square wave monosynth with stereo output.

Patch Name: _____

Patch Description: _____

Patch Notes: _____
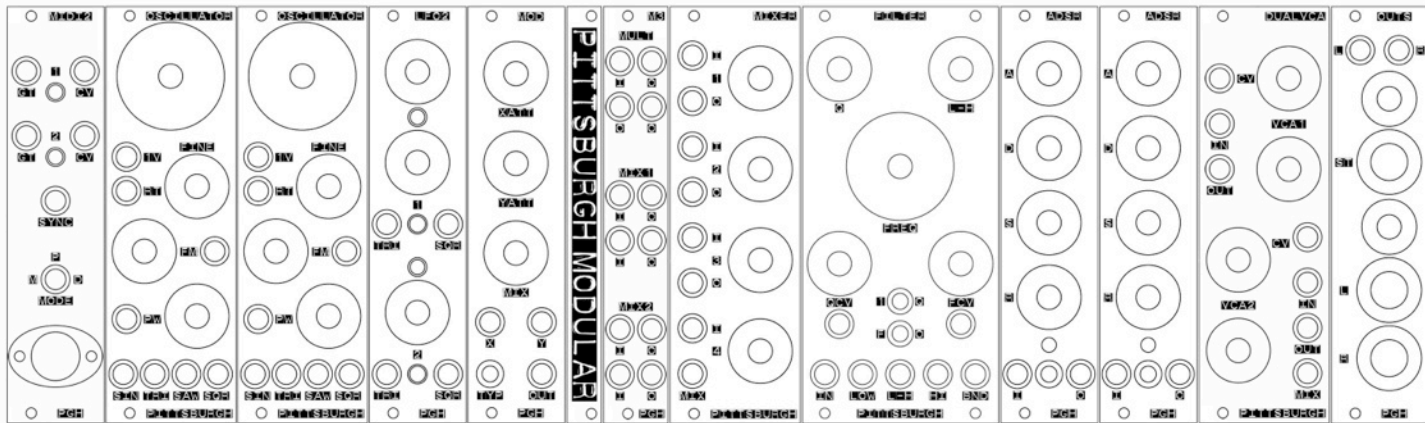
Warranty

1 Year Limited Warranty:

For a period of one year after the date of original purchase, the instrument and all factory installed parts and modules manufactured by Pittsburgh Modular Synthesizers LLC. are warranted to function properly and be free of defects in materials and workmanship. Should a factory installed module fail during the warranty period, contact Pittsburgh Modular Synthesizers. LLC. We will repair it (or at our option, replace it) at no charge, and pay the cost of shipping it back to you.

The case and all case related hardware are warranted to function properly and be free of defects in materials and workmanship for 1 year.

Patch Cables are not covered by the 1 Year Limited Warranty.

This warranty is void if in our opinion the instrument has been damaged by accident, mishandled, altered, improperly serviced, or repaired by the customer where such treatment has affected its performance or reliability. This includes but is not limited to damage related to incorrectly attaching power ribbon cables. In the event of such misuse/abuse by the customer, costs for repairs plus two-way shipping costs will be borne by the customer. Instruments found defective should be returned to the factory carefully packed, as the customer will be responsible for freight damage.

Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of Pittsburgh Modular Synthesizers LLC.

Service and Information

Please contact us for service or other information.

info@pittsburghmodular.com

www.pittsburghmodular.com/contact/

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