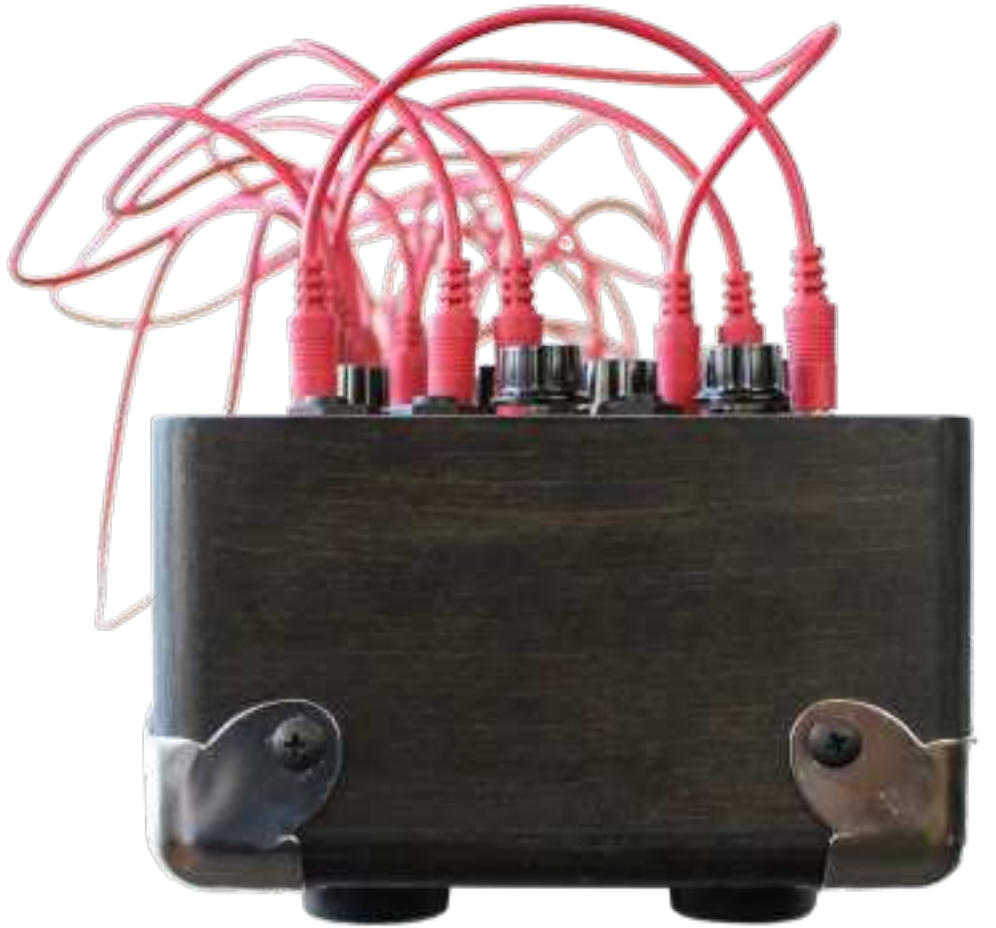
PITTSBURGH MODULAR
FOUNDATION 3.1 and 3.1+
SYNTHESIZER

MANUAL AND PATCH GUIDE



Important Instructions – PLEASE READ



Read Instructions:
Please read the Foundation 3.1 Synthesizer manual completely before use and retain for future reference.

IMPORTANT Ribbon Cable Power Information:
The Foundation 3.1 combines a set of individual modules to create a complete instrument. The individual modules can be rearranged, removed, and replaced with any compatible eurorack modules from Pittsburgh Modular and other manufacturers.

The Foundation 3.1 uses a standard eurorack power rail to connect the modules to the internal +12v / -12v / +5v 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 rail 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 rail, 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 synthesizer is plugged in.

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

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Case and Power Specifications



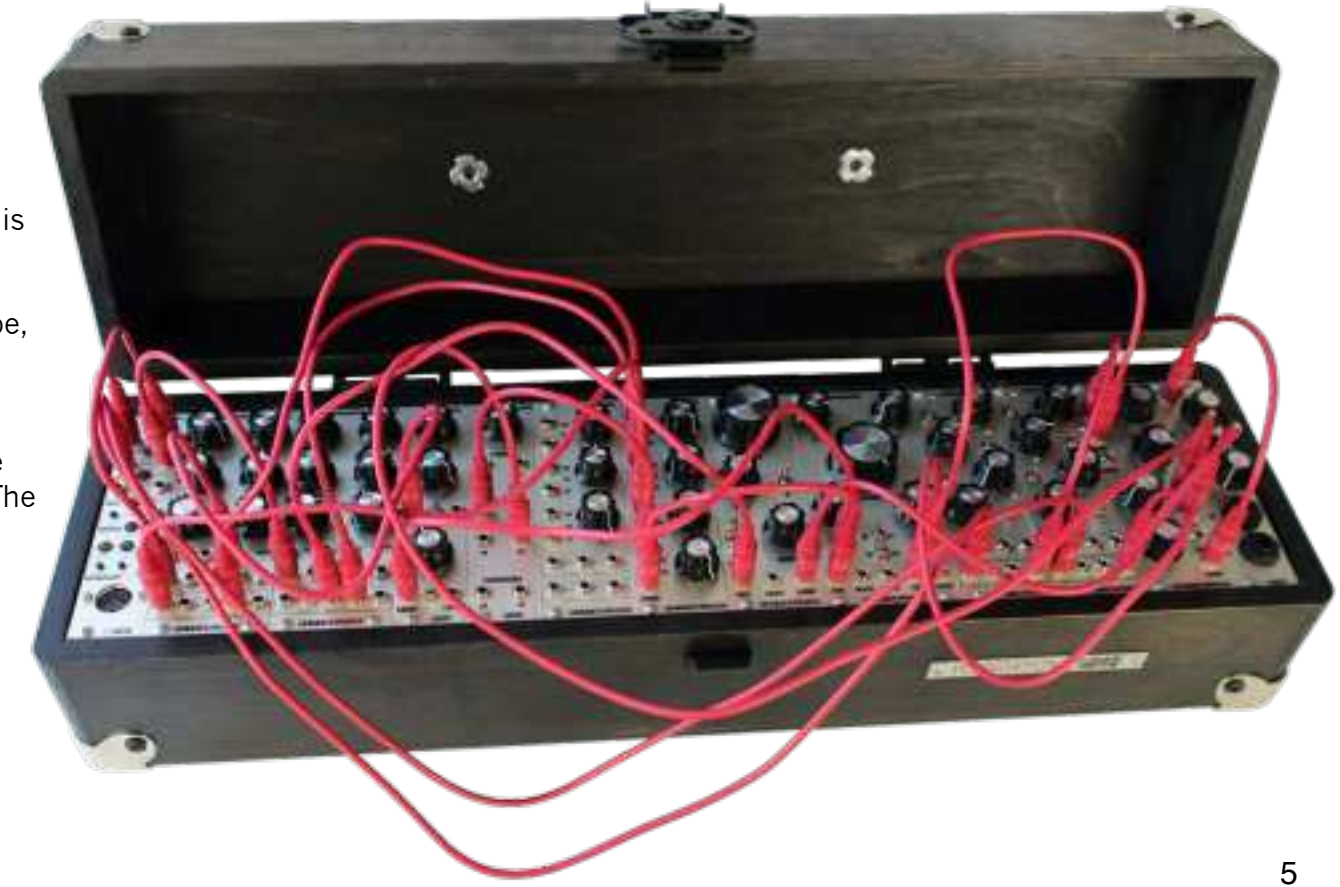
Foundation 3.1 Package Contents
1x Foundation 3.1 Modular Synthesizer
1x Pittsburgh Modular Patch Cable Kit
1x External Power Adapter

Foundation 3.1 Move [104] Case and Power Supply Info
External Dimensions Including Removable Lid: 23.5” x 6.25” x 7”
104hp Move [104] Black Eurorack Case
Sliding Square Nut Mounting System with 20 Nuts Per Rail
External Power Adapter Connection: 2.1mm Barrel Type
External Power Adapter Output: 15V DC / 2.6A-5A

Foundation 3.1+ Move [208] Case and Power Supply Info
External Dimensions Including Removable Lid: 23.5” x 12” x 7”
208hp Move [208] Black Eurorack Case
Sliding Square Nut Mounting System with 20 Nuts Per Rail
External Power Adapter Connection: 2.1mm Barrel Type
External Power Adapter Output: 15V DC / 2.6A-5A

A complete, fully modular analog synthesizer, the Foundation 3.1 is 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, filters, envelope, VCAs, 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.



Modular Signal Paths

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

The audio signal is the sound that is produced. The audio signal path starts at a sound source such as a Waveforms 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) 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 from the Midi 3 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 3 module patched into the 1V/O input on the Waveforms oscillator module 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 that will allow you to create complex analog sounds. The modular nature of the Foundation allows for deep experimentation and a virtually unlimited sound palate. The following pages describe the functionality and controls of each module.

Midi 3 Module



Description
A midi to cv module converts standard midi note messages into the analog control voltages used by modular and other analog synthesizers. This allows the synthesizer to be controlled by a midi keyboard, sequencer, or DAW. The two CV outputs on the Midi 3 can be used to control the pitch of an oscillator, cutoff frequency of a filter, or any other function that requires a control voltage signal. The set of Gate outputs on the Midi 3 can be used to trigger envelope generators or other modules expecting a gate or clock source.

The Midi 3 is our third generation Midi to CV converter packed with a robust list of features. It includes the most complete set of mono and duophonic midi response modes available in a eurorack module, assignable CC and dedicated velocity outputs, a feature rich clock source with tap tempo, midi and external gate clock dividers, and multiple arpeggiator responses.

The Midi 3 is a deep module that can not be covered completely in the small amount of space allotted in this manual. Please download the standalone Midi 3 manual for a complete detailed description of all the features and settings. The Midi 3 manual is available for download from the Midi 3 web page. http://pittsburghmodular.com/midi3/

Waveforms Module x2



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

Controls
Frequency Control – Course frequency setting.
Fine Tune Control – Fine tune frequency setting.
Pulse Width CV Attenuator – Controls the amount of CV used to adjust the pulse width of the pulse wave.
Pulse Width Control – Manually controls the pulse width of the pulse wave.
FM CV Attenuator Control and Input – Frequency modulation CV input and attenuation control.
FM Type – Switches FM response type between linear and exponential.
Blade CV Attenuator Control and Input – Blade wave Y-axis modulation CV input and attenuation control.
1v/o Input – CV input used to track the oscillator at 1 volt per octave.
Reset Input – CV Input used to hard reset the Oscillator on the falling edge of the incoming waveform.
Blade Input – CV or audio rate input used to modulate the blade wave creating a ring mod type effect.
PWM Input – Pulse width modulation CV input. Affects the pulse width of the pulse wave.
Sub Output – Square wave sub oscillator output. Sub Oscillator is 1 lower than the oscillator core.
Sine Output – Sine wave output.
Triangle Output – Triangle wave output.
Blade Output – Blade wave output.
Saw Output – Saw wave output.
Pulse Output – Pulse wave output.

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 Control – Coarse frequency setting.
Symmetry Control – 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 Control – Coarse frequency setting.
TRI Output – Triangle wave output.
Range Switch – Switches the frequency range of LFO 2.
SQR Output – Square wave output.

Toolbox Module



Description
Multi-purpose slew, noise, sample & hold, and voltage inverter module. The slew control smoothly shifts from variable voltages creating a portamento or glide effect. This function works well patched between the CV output of the Midi 3 and the 1v/o input of the Waveforms oscillator. The Sample & Hold samples the voltage patched to the input and outputs that voltage until a new sample voltage is taken. A sample is taken when the Hold input receives a positive gate or trigger. The invert function is a simple voltage inverter. Send a positive 3 volts in and receive -3 volts from the output.

Slew Controls
Amount Control – Controls the amount of glide between voltages.
Slew Input – Voltage input.
Slew Output – Slewed voltage output.

Noise / Sample & Hold Controls
N Output – Noise output.
H Input – Hold input.
I Input – Sample input.
O Output – Sample and hold output.

Invert Controls
I Input – Voltage input.
O Output – Inverted voltage output.

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 cannot 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

MixMult Module



Description
The MixMult is a multi-function module. The top section is a flexible, low-noise three channel mixer and/or attenuator for audio and CV that can be used in several ways. The bottom section contains 2 sets of passive multiples.

Two of the three mixer 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 or 2 will remove it from the mixer circuit. Channel 3 cannot be removed from the mixer circuit, however if channel 1 and 2 are all being used as attenuators, channel 3 is the only input remaining in the mixer allowing it to be used as a buffered attenuator.

The mixer section can be used as a...
3 Channel Mixer
2 Channel Mixer and 1 Attenuator
3 Independent Attenuators

The bottom of the module contains two sets of passive multiples. Patching a signal into one of the multiple jacks will split the signal to the remaining two jacks, allowing a single audio or CV signal to be used in two places at once.

Lopass Gate Module



Description
The Lopass Gate module is a multi-mode filter/VCA combo module split into lopass gate, filter, and VCA modes. The lopass gate mode is unique in the way that it simulates the characteristics of natural instruments. Louder sounds contain more harmonic content and quieter sounds contain less harmonic content. Lowpass filter mode adds a resonance control creating a modern, aggressive filter sound. The VCA is an extremely clean, quiet voltage controlled amplifier.

Controls
Frequency Control – In filter mode, the frequency knob controls the center frequency of the filter. In VCA mode, the frequency knob controls the pass through signal level. In lopass gate mode, the frequency knob controls both the center frequency of the filter and the pass through signal level.
Resonance Control – In filter mode, the resonance knob controls the amount of resonance. In VCA mode and lopass gate mode, the resonance knob is not active.
Mode Switch – Switch between G (Gate/VCA), B (Both/Lowpass Gate), and L (Low pass filter) modes.
FM CV Attenuator Control and Input – Frequency modulation CV input and attenuation control.
Invert Switch – Inverts the FM CV signal from positive to negative or negative to positive.
IN – Audio signal input.
PNG – Gate or trigger input used to ping the vactrol and quickly modulate the frequency of the module.
OUT – Audio signal output.

Filter Module



Description
The Filter is a voltage controlled, analog, state variable filter. State variable topology produces a very smooth and natural sounding filter, in addition to offering several other modes of operation, each with a 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.



Switch It Up (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 to the incoming audio.

Controls
Q Control – Adjusts the resonance (Q) of the filter.
FREQ Control – Adjusts the Frequency of the filter.
L-H Control – Sweeps between lowpass, notch, and highpass filters.
QCV Control and Input – Resonance (Q) control voltage input and attenuverter.
FCV Control and Input – 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 Output – Lowpass Output.
L-H Output – Output based off of the L-H Pot.
HI Output – Highpass Output.
BND Output – Bandpass Output.

Envelope Module x2



Description
The Envelope is a complex multi-stage envelope generator with voltage controllable rise and fall. Using the sustain switch to toggle between modes, the Envelope functions as either a 2 stage attack-decay envelope or a 3 stage attack-sustain-release envelope. This module can perform as a voltage controlled envelope generator, slew (portamento), envelope follower, VCO and LFO, pulse delay, wave shaper, and more.

Controls
Rise Response Switch – Switch between linear (up), and non-linear (down) response curve for rise.
Rise Control – Adjust the rise portion of the envelope. Left (short response). Right (long response).
Rise CV In Attenuverter - Attenuverter for Rise CV In. Also functions as log/lin/expo response control.
Sustain Switch - Enable (right) or disable (left) envelope sustain.
Fall Response Switch - Switch between linear (up), and non-linear (down) response curve for fall.
Fall Control - Adjust the fall portion of the envelope. Left (short response). Right (long response).
Fall CV In Attenuverter - Attenuverter for Fall CV In. Also functions as log/lin/expo response control.
Cycle Switch - The envelope will retrigger at the end of the fall stage. Creating a cycling envelope or LFO.
Rise CV Input - Rise CV input.
Both CV Input - Joint Rise and Fall CV input.
Fall CV Input - Fall CV input.
In - Main signal input.
EOA Output - Gate signal output. Signal goes high at end of rise.
Trigger Output - Trigger output. Trigger created at end of fall.
Output - Main signal output.

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 unpatched, 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 Control – CV input attenuator.
In – Signal input.
Out – Signal output.

Index 2 (VCA 2):
CV – CV Input used to control the VCA.
CV Control – 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, the signal 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 3.1. These examples showcase the flexibility of the Foundation and highlight as many features from each module as possible. Use the patches provided as a teaching tool. Once you have set up a patch, adjust knobs and remove cables from the Foundation while referencing the module description pages within the manual. This will help you develop an understanding of what function each part of the patch is performing. Red patch cables are CV signals. Green patch cables are audio signals. The blue dots represent the relevant control settings. These dots are meant to represent a starting point and are not definitive settings. Experimentation is essential.

The patch guide provides at least one "Module Test Patch" for each module within the Foundation. These patches showcase the core functionality as well as additional features of the highlighted module. In general, the test 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 3.1 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 of 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.



Vintage Monosynth Patch

Description - Monophonic Starting Point
Notes - Use this patch as a starting point for huge bass and classic leads.



Duophonic Synthesizer Patch

Description - Basic Duophonic Starting Point
Notes - Use this patch as a starting point for a duophonic synthesizer.



Dual Monophonic Synthesizers Patch

Description - Basic Dual Monophonic Synthesizer Starting Point
Notes - Use this patch as a starting point for creating two independent synthesizers.



Midi 3 Test Patch

Description - Midi 3 Module Features Highlight
Notes - Audition the features of the Midi 3 module.



Waveforms Test Patch

Description - Waveforms Module Features Highlight
Notes - Audition each of the waveforms. The pulse wave is modulated using the Pulse section and PWM CV input. The blade wave is modulated using the Blade CV IN section, Pulse section, PWM CV input, and the Blade Input. The sub oscillator is modulated and gated using the Pulse section and PWM CV input.



LFO2 Test Patch

Description - LFO2 Module Features Highlight
Notes - Audition the range and waveforms of the LFO2 module. Use the second knob from the top to adjust the waveform of LFO1. Use the switches to control the range of each LFO.



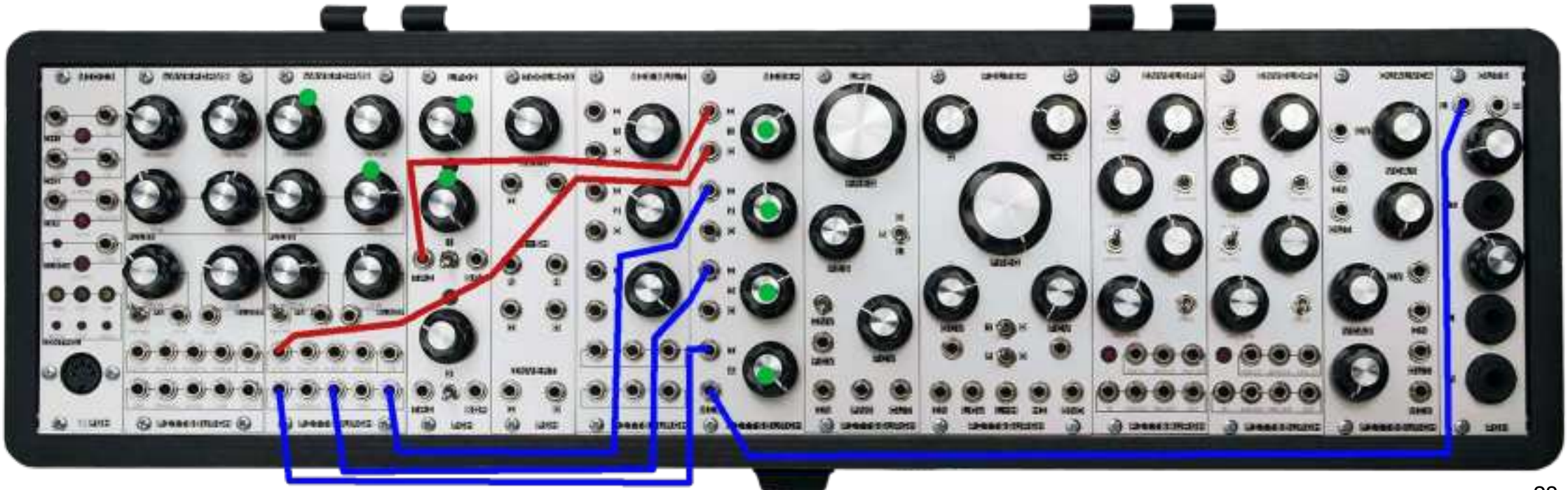
Toolbox Test Patch

Description - Toolbox Module Features Highlight
Notes - Audition each of the functions of the Toolbox. This patch creates the classic sample & hold random oscillator pitch. Patch the N (noise) output to listen to the noise.



Mixer Test Patch

Description - Mixer Module Features Highlight
Notes - Audition the features of the Mixer module. Note the first channel is used as a passive attenuator in this patch therefore bypasses the mixer circuit.



MixMult Test Patch

Description - MixMult Module Features Highlight
Notes - Audition the features of the MixMult module. Note the first channel is used as a passive attenuator and therefore bypasses the mixer circuit. The multiple section is used to split an LFO square wave and send it to two separate destinations.



Lopass Gate Test Patch

Description - LPG Module Features Highlight
Notes - Audition the features of the LPG module. Test the FCV (frequency CV input) and PNG (ping gate input) separately. The RES (resonance) control works only in L (low pass filter) mode.



Filter Test Patch

Description - Filter Module Features Highlight
Notes - Audition the features of the Filter module. Test each of the outputs separately. The QCV (resonance CV) control and FCV (frequency CV) control are attenuverters so left of 12 o'clock is inverting, 12 o'clock is off, and right of 12 o'clock is positive.



Envelope Test Patch

Description - Envelope Module Features Highlight
Notes - Audition the features of the Envelope module. Test each of the outputs separately. The Rise CV control and Fall CV control are attenuverters so left of 12 o'clock is inverting, 12 o'clock is off, and right of 12 o'clock is positive.



Dual VCA Test Patch

Description - Dual VCA Module Features Highlight
Notes - Audition the features of the Dual VCA module. Test each of the outputs separately. CV inputs and signal inputs are normaled so patching into the top VCA routes the signal to the bottom VCA unless a patch cable is patched into the inputs of the bottom VCA.



Outs Test Patch

Description - Outs Module Features Highlight
Notes - Audition the features of the Outs module. Test each of the outputs separately. Left and Right inputs are normaled so patching into the Left input routes the signal to the Right input unless a patch cable is patched into the Right input of the Outs.



Bad Jazz Patch

Description - Bad Robot Jazz Guitarist Jamming With Itself
Notes - Self-generating patch in honor of noodlers everywhere.



Stereo Synthesizer Patch

Description - Stereo Synthesizer With An Oscillator For Each Channel
Notes - Sending each oscillator to a separate output channel and controlling them with the same envelope.



Panning VCA Patch

Description - A Single Oscillator Panning Left To Right
Notes - Using a single oscillator and 2 envelopes to pan a sound left to right.



Filter Oscillator/Distortion Patch

Description - Example Of The Quirks And Noises Available From The Filter In Oscillator Mode
Notes - Adjust the Filter Q and Frequency to test the limits of the Filter in self-oscillation mode.



INSTALLING MODULES

Adding new modules to the case is a simple process. Please follow the instructions below to ensure that new modules are installed safely and correctly.

Experiment with system layout by resting a few modules in the case before installation.

1. Switch the power off and unplug the power adapter from the back of the case.
2. The red stripe on the ribbon cable marks -12v. This stripe needs to line up with the -12v pins on the module. Failure to match up the pins correctly can result in damage to one or all the modules connected to the power supply.
3. Use a small tool to line up the needed sliding square nuts close to where the module will be mounted.
4. Attach the module to the sliding nuts using the included panel screws. If installing more than 1 module, do not tighten down the panel screws until all the modules are installed. This will allow some room to shift the modules as needed.
5. Once all the new modules are installed, plug in the power adapter and switch on the case. Carefully test each module to ensure it is working as expected.









TRIMMING PLASTIC BLANK PANEL

The Plastic Blank Panel included with the Foundation 3.1+ is meant to be trimmed as modules are added to the case. Use an X-ACTO or utility knife to cut the panel to fit around the added modules. A ruler or straight edge can be used to ensure a clean line.



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 Contact Information

Please contact us for service or other information.

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Pittsburgh Modular Synthesizers



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