



# discoDSP Discovery R5 Virtual Analog Synthesizer User Manual

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## discoDSP Discovery



Users Manual  
Virtual Analog Synthesizer  
<https://www.discoDSP.com/>

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## Installation

- Microsoft Windows  
Run the installer and follow the instructions.
- Apple macOS  
Run the installer and follow the instructions.
- Linux

Run install.sh with Terminal or

Place discoDSP folder at /home/username/Documents/

Place Discovery.so at your VST folder, usually /home/username/.vst/

Place Discovery.vst3 at your VST3 folder, usually /home/username/.vst3/

Demo version is able to load presets and banks, however the host will be unable to store current synth state, save banks and use automation functions.

## Description

Discovery is a virtual analog synthesizer emulation featuring multi-layering, parameter morphing, high-quality sound, and a straightforward interface.

## Features

Discovery boasts the following powerful feature set:

- 128 Patch Memories per bank.
- Parameter Morphing.
- 2x oversampling.

- Bank browser (by clicking arrows in display led and bank name).
- More than 3.500 presets in 40 banks (including a percussion set).
- Nord Lead 2 and 2X patch import.
- 4 Layers per Patch, each with:
  - 2 Oscillators (Sine, Saw, Tri, PWM, Square, Noise) with Ring modulation, sync and Frequency Modulation..
  - Resonant Filters (LowPass, HighPass, BandPass, BandReject, Formant, 8 taps phaser).
  - ADSR for Amp & Filter.
  - 2 LFOs.
  - AD Mod Envelope.
  - Arpeggiator.
  - Built-in Chorus, Phaser, Panning Delay and Gate effects.
  - Symmetric, Asymmetric and Asymmetric 2 Distortions.
  - Limiter.
  - Portamento.
  - Poly/Mono/Legato modes.
- MIDI CC control.

## Basic Concepts

### Channel Limiting and Oversampling

You may now determine the number of channels used in the instrument by clicking the “voices” LED or at EDIT > Config.



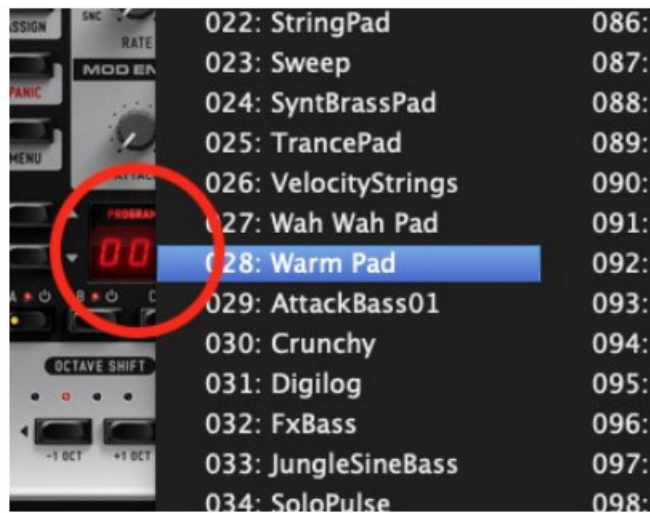
A dialog box will appear with the number of voices you wish to enable. Select the desired voice number.

You can also select the oversampling mode. 2X will make Discovery work internally at 88 kHz when your host is set to 44.1 kHz. 2X oversampling is highly recommended. It will affect all active Discovery instances.

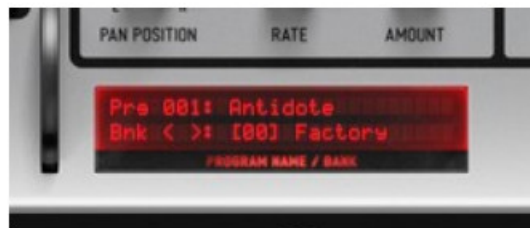
HQ Distortion will duplicate distortion's internal frequency rate, depending of the oversampling mode mode and resulting into 4X in case a global 2X has been configured.

### Quick program select

Click program LED to see a list of available patches.



## Bank browser



All banks can be browsed by clicking the arrows in the status LCD or clicking the bank name to display a drop-down menu. Banks are located at Discovery folder at ~/Documents/discoDSP/. Banks can be added by placing .fxb files there.

## Morphing state knob editing

In normal mode, holding CTRL while moving the knob will modify morph sensibility. The behavior in the knobs will be backwards when Morph mode is on. Use Ctrl+Alt+Left click to reset.

## Fine tune knob editing

To have more detailed parameter adjustments, hold your Shift key while moving the knob to edit both states. Shift and Ctrl keys can be used at once too.

## LFO Sync to host tempo



Discovery's LFO1, LFO2 / Arpeggiator, Delay and Panning LFO can be synced your host tempo. To enable it, just click the led located next to the LFO knob or Delay amount.

## Edit operations

There are several of editing operations available by clicking EDIT button on Discovery GUI.

## Layers

Discovery can hold 128 patches at any one time. Each patch may contain up to 4 layers. Combining layers can be used to create complex sounds that simple subtractive synthesis cannot achieve.

Discovery supports up to 32 polyphonic voices. If all 4 layers are enabled, a single note will count as 4 individual voices, reducing the actual polyphony to 8 in these instances. Fortunately, these are 8 extremely powerful sounds.



To select a layer, simply left-click the A, B, C, D buttons below the Program and Voice number LEDs. A is the default layer. When a layer is active the BUTTON directly above it turns highlighted. Select any layer (B, C, D) to activate it. When a program includes 2 or more layers, the selected layer button turns highlighted and other active layers turn YELLOW. If you wish to disable a layer simply click it twice. Discovery allows you to copy and paste between layers or programs by using EDIT menu. The following documentation applies to a single layer unless otherwise noted. This means feature (LFO's, Envelopes, Oscillators) are potentially quadrupled for each Discovery patch.

## Parameter Morphing

Each layer contains two internal states: morph source and morph sensibility. Each state contains a unique set of all values. Morphing allows you to easily glide between these values.



Morph sensibility state is seen using alpha blend, and can be modified by using CTRL key while adjusting the knob. A 32-bit video mode is required to display this transparency. You can easily toggle between both morph states by left-clicking the ASSIGN button, located in the top left of Discovery under the "Morph" label. When the ASSIGN led is active, all parameter modifications are being made to the MORPH state. Once both states have been defined, you can easily morph between them by assigning the Wheel MOD to MORPH mode. Once set, moving your mode wheel will morph between both states.



RESET button below ASSIGN will set MORPH sensibility state zero. A confirmation dialog box will appear before applying the reset.

#### TIPS

- Reset knob morph state by using Ctrl+Alt+Left Click.
- MIDI velocity to Morph can be disabled by clicking the led below modulation wheel or using EDIT > Swap > MIDI Velocity to Morph.
- Knobs from four layers at once can be moved using Alt+Mouse, but if you don't want to apply maximum and minimum value limits use Shift+Alt+Mouse
- Four layer edit shortcuts can be applied to Morph values by enabling Morph Assign button.

#### Global Layer Options



- Oct Shift: Used to shift the pitch in octaves of the layer.
- Pitch Bend – The pitch bender allows you to drastically change the pitch of the current patch in real-time. You can modify the pitch bend range from 1 to 24 semitones by clicking the LCD arrows or clicking numbers for a drop-down menu.
- Modulation Wheel: Can be assigned to modulate the following parameters:
  - FLTR – Filter cutoff frequency.
  - FM – OSC2 to OSC1 frequency modulation amount.
  - OSC2 – OSC2 pitch.
  - LFO1 – LFO1 amount.
  - MORPH – Morph between source and destination morphing states.



- CHR: Left-click the CHR button to enable Chorus, Phaser or both modes at once.
- Play Modes:
  - MONO: Only 1 voice of the synthesizer is used for the layer. In this mode any note played will discontinue the previous note.
  - LEGATO: A monophonic mode in which envelopes are not restarted when new keys are played.
  - POLY: Polyphonic mode allows multiple notes to be played at once.
- Portamento: Portamento glides the pitch between the current note and a newly played note. The higher the value, the slower the transition progresses.
  - Auto: When enabled, glide/portamento will be only applied if overlapping notes are played (legato).

## Oscillator Section

Oscillators are the basis of sound generation in subtractive synthesis. Discovery includes two primary oscillators, each with various modes and waveform types.



Waveforms available in Discovery are:

Wave Type	Kind of sounds
Sine	FM, Leads, Percussion, Organs
Triangle	FM, Smooth Sounds, Bass, Flutes
Square	Smooth Basses, Leads, Synced Waves
Noise	Ambient FX, Percussion
Saw	Rough Bass, Edgy Leads
Pulse	Vintage Synths, Pads

### Oscillator 1 (OSC1)

OSC1 is the primary sound source in Discovery. This oscillator uses the pitch of the incoming note and plays it in the specified waveform type. OSC1 can be one any of the following waveform types (shown from the top down):



- Sine.
- Triangle.
- Saw tooth.
- PWM (Pulse Width Mod).
- Square.

You can quickly switch between any waveform by simply left-clicking the button below the waveform list. A BLUE LED indicates the currently enabled waveform.

Frequency Modulation: Discovery features a true frequency modulation (FM) engine, allowing the OSC1 carrier wave to be modulated by frequency of the OSC2 output.

FM Amount: Sets the amount of FM used to modulate OSC1 frequency.

### Oscillator 2 (OSC2)

Discovery offers a second oscillator, which adds additional sound design capabilities to your patches.



The second oscillator may be used in various ways such as mixing with, or modulating the frequency of OSC1. OSC2 can be set to any of the following waveforms:

- Triangle.
- Saw.
- PWM (Pulse).
- Noise.
- Square.

#### Controls for oscillator 2 are:

- Semitones: This knob allows you to shift the pitch of OSC2 from -60 to +60 semitones. The following features apply:
  - When in use, a BLUE LED will activate at full scale values: -60, -48, -36, -24, -12, 0, 12, 24, 36, 48, 60
  - When OSC SYNC mode is active OSC2 will reset each time OSC1 finishes a cycle. (Explained below).
  - When noise wave is selected, this control is used to determine the frequency range of the noise (from low frequency to high frequency noise).

If noise wave is selected and OSC SYNC mode is active, the semitones control is a digital noise wave selector, from a table of 8 different random sound shapes.

- Fine Tune: Fine-tuning of OSC2 from a range of -0.5 to +0.5 semitones.
- KBD Track switch: When on, the OSC2 will track pitch of incoming note.

#### Oscillator Modes



- Pulse Width: Determines the de-phasing amount between the two saw tooth waves that build up the Pulse

wave. This results in the pulse width of BOTH oscillator pulse wave shapes (only works for PWM).

Lesser values (turned left) result in a square formed PWM. Higher values result in a train of small pulses.

- OSC SYNC: OSC2 phase will reset each time OSC1 completes a cycle, giving harsh and fuzzy effects on the OSC2 sound. In this mode the OSC2 semitone control will not determine the pitch shift, but rather the harmonic content of the wave that will modify the pitch of the OSC1.
- RING MOD: OSC1 output will multiply the OSC2 output. When this mode is turned on, the FM control in the OSC1 will work as pitch tune (in the range of 0 to +12 semitones) for the OSC1. This mode can be used for special effects and ambience sound shapes.
- OSC MIX: Used to mix both oscillators output. Knob values follow:
  - Left: 100% OSC1 Signal
  - Middle: 50% OSC1 Signal, 50% OSC2 Signal
  - Right: 100% OSC2 Signal

## Filter Section



Once the oscillators are mixed, sound is next routed through the Discovery filter section.

This section will transform the frequency response of the signal.

A filter is a unit that changes the magnitude of a range of frequencies of the sound, boosting or cutting these frequency values.

### Basic Filter controls

The two most common filter parameters are the Frequency and Resonance controls.



### Filter Types

Discovery has 8 filter types. You may toggle through these types using the buttons below the LCD Filter Type section or by clicking filter name LED to make a drop down menu appear. The active filter is also showed in the display.



#### Available filter types follow:

- LowPass 12db: This 2 pole Lowpass filter will cut all spectrum range above the Cutoff frequency, with a rolloff of -12dB per octave.
- BndRjct 24: The Notch filter will cut the frequency range surrounding the Cutoff point, and will be processed thru the 24dB Lowpass filter explained above, but using a slightly shifted Cutoff frequency. Using this with high Resonance amounts will result in interesting vocal formants effects.
- LowPass 24db: A 4 pole Lowpass Filter with -24dB per octave rolloff. This functions similar to the LP 12db, but with a steeper frequency curve response.
- BndPass 24: A Bandpass Filter, which allows only the frequency range surrounding cutoff point to pass through. Resonance controls the size of this bandwidth.
- HghPass 24: The opposite of the Lowpass filters, the Highpass will pass frequencies above the cutoff point and will cut all range below. This filter type has a rolloff of -24dB per octave.
- HghPass 12: Will pass frequencies above the cutoff point and will cut all range below. This filter type has a rolloff of -12dB per octave.
- Formant: 2 bandpass parallel filters tuned in vocal formant frequency range. Resonance modifies both filters resonance.
- 8 Tap Phaser: 8 tap allpass filters phaser. You can assign a LFO to this filter in order to get a nicer effect.

#### Filter Envelope

Filter Envelope allows easy filter Cutoff ADSR (Attack, Decay, Sustain, Release) envelope based modulation.



- Attack: Controls for the time in which the filter envelope moves from 0 (note play) to full filter (based on the Envelope Amount, below).
- Decay: Controls the time length between the end of attack and the sustain level.
- Sustain: Sets the filter point at which envelope stays while note is continually pressed, once attack and decay have completed.
- Release: Begins once the note is released, controlling the time the gain will fall from current envelope point (Sustain) until complete.
- Env Amount: The Envelope Amount option controls the amount of the Filter envelope applied to the Cutoff

frequency.

- Vel: When enabled, the Envelope Amount will be scaled with the incoming note based on velocity. This results in more dramatic envelopes for harder hit notes.

## Additional Filter Options

- Kbd Track: When active, Keyboard Tracking will increase the filter cutoff frequency based on incoming note pitch. Higher notes will add higher frequencies to the current filter cutoff point. Tracking can be 1/2 (minor), 2/3, or Full (very drastic).
- DIST: Distortion effect with dual modes.
  - Asymmetric Distortion: This will apply saturation to the negative field of the signal. This will generate side harmonics, useful for tube distortion effects.
  - Symmetric Distortion: Saturation will be applied symmetrically, resulting in odd harmonics, useful for grunge or distortion effects.
  - Asymmetric Distortion 2: A variation of first asymmetric distortion.2X oversampled distortion can be used at Edit > Config > HQ Distortion.

## Modulation Section

### Low Frequency Oscillator 1 (LFO1)

Discovery includes two LFO's (Low Frequency Oscillators), and a Modulation Envelope (with 2 stages and state variable amount control). LFO oscillators operate much like the basic Discovery oscillators, only at much slower speeds



Rate: This control sets the speed (frequency) of LFO1. Smaller values result in slower oscillations, larger values in faster oscillations.

LFO1 can use various waveforms (from top to bottom):

- Lowpass Random: Like random waveform, but the value is a smooth curve.
- Square: If LFO1 phase is above the half of the period length, the LFO will take the highest value, otherwise the lowest.
- Triangle: Also a ramp, but moves down to up, then back to down in a single cycle. Primarily used for sweep effects.
- Saw Tooth: Ramp shape; will move up to down, then instantaneously up when cycle is completed.
- Random: Each time LFO1 completes a cycle, it will select a new random value.

Retriggered LFOs: By cycling through LFO waveform options a second time you can enable Retriggered LFO's. This means that the LFO will be restarted each time a note is played. Retriggered LFO's are indicated by RED LEDs.

Destination: To the left of the waveform selector is the LFO1 Destination selector. This feature allows you to choose which control(s) this LFO will modulate. The following LFO1 modulation destinations are available:

- FM: OSC2 OSC1 FM (Frequency Modulation) amount.
- FILTER: Filter cutoff frequency.
- OSC2:  
OSC2 pitch.
- OSC1+2: Both OSC1 and OSC2 pitch.
- PW: Width of the pulse of PWM waveforms.

Amt: LFO1 Amount control determines the amount of LFO output to use on the destination control(s). Higher values will result in a more dramatic modulation.

### Low Frequency Oscillator 2 (LFO2) and Arpeggiator (ARP)



The second LFO operates much like the first, yet without a selectable waveform. LFO2 is always a pure sine wave. In addition LFO2 has a powerful Arpeggiator (Explained below).

Rate: Controls the speed (frequency) of LFO2.

Destination: The following destinations are available to LFO2:

- OSC1+2: Both OSC1 and OSC2 pitch
- AMP: Amplitude (Creates a Tremolo effect)
- FILTER: Filter cutoff frequency

Amt: LFO2 Amount control determines the amount of LFO output to use on the destination control(s). Higher values will result in a more dramatic modulation.

### LFO2 Arpeggiator

ARP: You can enable Discovery's Arpeggiator by left-clicking the ARP button in the LFO2 section. When active, LFO2 operates in ARP (Arpeggiator) mode.

An Arpeggiator is basically a simple sequencer which continually plays notes automatically as a note or notes are held. The notes played depend of the keys currently pressed and the arpeggiator range.

Rate: When in ARP mode, the Rate control sets the arpeggiator tempo. Faster values may be achieved with greater values (turning the knob to the right).

Destination: In Arp mode, direction in which the Arpeggiator will play notes.

**They can be:**

- DWN: Plays notes from highest to lowest, then restarts.
- U&D: Repeats playing highest lowest, then back from lowest to highest.
- UP: Plays lowest to highest, restarts.
- RND: Plays any random note from the arpeggiator range.
- RND2: Play to the next or the prior note in the arpeggiator range randomly.

Arp Rng: Sets range in octaves for the arpeggiator, from 1 to 5 octaves.

### Modulation Envelope

The modulation envelope is a simple envelope which includes 2 stages, attack and decay.



**Attack:** Changes the value of the destination (based on the Amount) from the time a key is pressed until its highest point.

**Decay:** Changes the value of a destination (based on the Amount) from the highest point until the sustain level is reached.

**Destination:** The following destinations are available to the Mod Envelope:

- FM: Frequency Modulation Amount
- PW: Pulse Waveform Width
- OSC2: OSC2 Pitch

**Amount:** Sets modulation. This modulation can be positive, negative, or anything in between. Three basic settings include:

- Negative: All the way to the left, reduces the destination
- No Amount: Center, disabled.
- Positive: All the way to the right, increases the destination.

## Amplifier

Discovery's Amplifier applies an envelope to the output gain of the current layer of sound.

This is the final stage of synthesis. The following controls apply:



- **Attack:** Controls for the time that envelope moves from note press (0) to full volume. (Does not apply to legato mode).
- **Decay:** This knob controls the time length between envelope gain goes from upper point (end of Attack) to Sustain level.
- **Sustain:** Sets the point at which the envelope stays while note is held. This state is held until the note is release.
- **Release:** Once the note is released, this knob will control the time in which the gain will fall from current envelope point (Sustain) into complete silence, finishing the voice use.  
Longer releases can result in many simultaneous voices, resulting in high CPU usage.
- **Gain:** Adjusts the overall volume for the current layer. Use morphing to add dynamics.
- **Limiter:** Applies a compressor with  $-\infty:1$  ratio for the current layer.

## Panning, Delay/Echo and Gate

Discovery has built in stereo delay, panning and gate effect units.

### Panning



This effect can be used to widen a sound or give it interesting panning effects per layer. You can sync Mod Rate to host tempo by clicking the led located next to Mod Rate knob.

- Position: Position in the stereo field.
- Mod Rate: Controls rate of the stereo modulation.
- Mod Amount: Controls depth of the stereo modulation.

### Delay/Echo



This effect can be used to add spacey echo effect, or widen a sound. You can sync Left/Right Delay to host tempo by clicking the led located between Left and Right knobs.

- Level: Controls the amount of the delay effect. No Level value (knob turned completely to the left) will disable the delay effect. This control is morphable as well.
- Left / Right Delay: Controls delay time of the unit for each channel.
- Left / Right Feedback: Controls time of delay tail. Moving this knob to the right will increase the tail.
- Cross switch: Adds a cross-feed to the feedback output, resulting in a stereo bouncing delay. Useful for 3d effects.

### Gate



If you want to enable Gate page effect, you can do so by clicking the small led next to GATE.

**NOTE:** Enable and disable multiple gate steps by left clicking and dragging the mouse while moving on the pattern.

- Level: Controls amount of the gate floor effect. No Level value (knob turned completely to the right) will disable the effect.

This control is morphable and layer independent, suitable for complex sound textures.

- Copy: Copies current gate pattern to memory.
- Paste: Dumps gate pattern on memory to current gate.
- Gate pattern: Controls gate triggering.

## Midi CC table

CC#	Controller
1	Wheel Mod
7	Amp Gain
5	Portamento
8	Oscillator Mix
15	Playmode Mono/Legato/Poly
16	Unison On/Off
17	Oct Shift
18	Wheel Mod Mode
19	LFO1 Rate
20	LFO1 Waveform
21	LFO1 Destination parameter
22	LFO1 Amount
23	LFO2 Rate
24	LFO2 Arp/Dest switch
25	LFO2 Amount
26	MOD ENV Attack
27	MOD ENV Decay
28	MOD ENV Destination
29	MOD ENV Amount
30	OSC1 Waveform
31	OSC2 Waveform
33	OSC2 Fine Tune
34	OSC2 Kbd Track On/Off
35	OSC2 None/Sync/Ring/Both
36	Amplifier Decay

37	Amplifier Sustain
89	Controller Filter Attack
39	Filter Decay
40	Filter Sustain
41	Filter Release
42	Filter Resonance
43	Filter Env amount
44	Filter Type
45	Filter Velocity
46	Filter Kbd Track
65	Portamento Auto On/Off
70	OSC FM Amount
72	Amplifier Release
73	Amplifier Attack
74	Filter Cutoff
78	OSC 2 Semitones
79	Pulse Width
80	Filter Distortion
81	Delay Level
82	Left Delay Amount
83	Right Delay Amount
84	Left Delay Feedback
85	Right Delay Feedback
86	Panning Position
87	Panning Mod Rate Amount
88	Panning Modulation Amount
120	All Sounds Off
123	All Notes Off

## Importing SysEx

Discovery can import SysEx patch dumps from using software able to record MIDI SysEx data dumps.

On Discovery GUI, press Edit > Import > Nord Lead 2 SysEx

A popup menu appears, then press Import NL2 patch dump, and select your .syx or .ngf file (Both are MIDI

unformatted Sysex data dump).

## NOTES:

- Full bank patch dumps will be done into current selected layer.
- Nord Lead 2 sounds may sound slightly different.
- Performance and Percussion Kits dumps are not supported.

## Unison Edit

Unison is a pretty simple edition command, able to be customized. It takes the values from the first layer (A) and applies it over all of them (A, B, C and/or D) depending of the preset.

If we open unison.cfg located at ~/Documents/discoDSP/Discovery to a text editor we can see a list of default presets and the way how new ones can be made. Let's take a look at the first one: Double.

Double 1 1 0 0 0.5 0.5 0 0 0.2 0.8 0 0 0 0 0 0.3 0.7 0 0

- First four values mean that only Layers A and B will be affected 1 1 0 0 where A (1) B (1) C (0) D (0).
- Second values are gain. 0.5 in a 1 to 0 range means Layers A and B will have 50% gain each.
- Third values are panning. Layer A will be panned about 25% Left and Layer B 25% right.
- Fourth values are osc2 octave pitch shift. Since values are 0 they will all remain in the same octave.
- Fifth values are the osc2 fine-tune. As we can see Layer A and B will be detuned about 25% up and down respectively.

Adding and removing presets is as simple as removing or copy/paste a line and saving.

Edited Unison presets will take effect next time Discovery is instanced.

## Version History

### Release 5.3

- Resolved an issue with the VST2 build that caused the plugin state to reset after saving a project.

### Release 5.2

- Framework update.
- Fixed the incorrect binding of the Delay Mix knob to Pitch Bend on the VST3 build.
- Fixed the reset behavior Layer function.
- Fixed the reset of the bank on BitWig Studio with the VST3 build.

### Release 5.1

- Added multi-size GUI 1x, 1.5x and 2x including Retina HiDPI displays.
- Updated framework.
- Fixed VST3 delay mix and pitch bend issue.
- Fixed bank and preset recall.

## Release 5.0

- New Silver Haze GUI.
- Updated framework.
- Fixed Logic Pro Audio Unit plug-in error after opening an existing project.
- Revised PDF manual.

**Thanks to David Smith valuable help on this release.**

## Release 4.5

- Updated framework fixing VST3 parameter issues and greater stability.
- Fixed AAX init patch bug.
- Linux VST3 build.
- Removed Linux curl dependency for greater compatibility.
- macOS Universal 2 Binary compiled with XCode 12.4 and new build system.


## Release 4.4

- ProTools AAX plugin format support for Windows and macOS.
- macOS Universal 2 Binary builds for Apple Silicon chips.
- macOS system minimal requirement is now 10.9.

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## Documents / Resources

	<p><a href="#">discoDSP Discovery R5 Virtual Analog Synthesizer</a> [pdf] User Manual Discovery R5, Discovery R5 Virtual Analog Synthesizer, Virtual Analog Synthesizer, Analog Synthesizer</p>
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## References

-  [Discovery](#)
-  [discoDSP - News](#)