RABBIT HOLE

MANUAL V1.2

APOLLO VIEW

WARNING!

THIS MODULE GETS

LOUD

RABBIT HOLE IS CAPABLE OF PRODUCING 24Vᴘᴘ

TOTAL MAXIMUM GAIN OVER 1000

ENSURE INPUT AND OUTPUT GAINS ARE TURNED DOWN BEFORE USE

(Note: Output Gain is an attenuverter, the minimum Output signal is achieved by setting the knob to the 12 o'clock position)

Nominal Eurorack audio levels are 10Vpp. Rabbit Hole can produce peak-to-peak voltage 2.4 times greater than standard Eurorack audio levels. This could potentially damage your speakers and ears. Please exercise caution, and use the Output Gain attenuverter. Even when the Tube stage is not used, the Dry signal can reach an Output voltage of 15Vpp. Specifically, an input audio signal of 10Vpp with maximum Input Gain on the Vintage VCA and maximum gain on the Output attenuverter will produce an output signal of 15Vpp. This additional gain is available to balance the output signal for lower Tube and Drive settings.

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SPECIAL THANKS

LIMITED WARRANTY

Apollo View Modular Ltd warrants this product to be free from defects in materials or construction for a period of one year from the date of purchase (proof of purchase/invoice required).

This warranty does not cover any damage caused by misuse of the product, or any unauthorised modification of the product.

Apollo View Modular Ltd reserves the right to determine what qualifies as misuse at their discretion. Examples of misuse include, but are not limited to:

1. Exposure to extreme heat or moisture
2. Malfunction resulting from wrong power supply voltages, backwards or reversed eurorack bus board cable
3. Issues related to third party products
4. Any condition resulting from incorrect or inadequate maintenance or care.
5. Damage resulting from misuse, abuse, negligence, accidents or shipping damage.
6. Dissatisfaction due to buyer's remorse
7. Normal wear and tear
8. Damage to the product caused by excessive physical force or abuse of the product, removing knobs, changing faceplates

This warranty does not cover any other causes determined by Apollo View Modular Ltd to be the fault of the user, and standard service rates will apply.

Apollo View Modular Ltd agrees, at its option during the warranty period, to repair any defect in material or quality or to furnish a repaired or refurbished product of equal value in exchange without charge (except for a fee for shipping, handling, packing, return postage, and insurance which will be incurred by the customer). Such repair or replacement is subject to verification of the defect or malfunction and proof of purchase as confirmed by showing the model number on the original dated sales receipt.

Apollo View Modular Ltd implies and accepts no responsibility for harm to person or apparatus caused through the operation of this product.
Please contact info@apolloviewmodular.com with any questions, requests for a return to the manufacturer, or any needs & comments.

https://www.apolloviewmodular.com/

INTRODUCTION

ORIGIN

I would like to shout out to Look Mum No Computer who first drew my attention to the Matsumin Valvecaster distortion pedal, through his Safety Valve module.

It is from experimenting with LMNC Safety Valve 2.0 design that Rabbit Hole developed. The aim was two-fold. Firstly, to have more accurate CV control over the gain/distortion of the system and secondly, to create a broader range of tube effects, from subtle saturation through to total audio destruction. On this journey of experimentation and discovery of tube circuitry and different tube characters, I truly fell down a Rabbit Hole. The module took on a life of its own, revealing more inherent features, namely sub-harmonic generation and self-oscillation.

Special mention also needs to go to Tom Wiltshire (Electric Druid). While designing a suitable VCA circuit to complement the characteristics of the vacuum tube circuit, I discovered Tom's design-a-eurorack-vintage-vca-with-the-lm13700 design. I didn't want any old clean sounding VCA. I had already made the LM13700 datasheet VCA and found it was indeed too clean for my purposes. With permission from Tom, his design has been implemented for all the VCAs in Rabbit Hole and Curiouser, and they sound fantastic. To quote Tom, "Since I was designing something that was specifically intended as a "vintage VCA" and because I like the soft differential-pair distortion of the chip, I deliberately tolerated several percent of distortion in the circuit. It adds character! Anyway, if you want a really clean VCA there are lots of other better options than the LM13700. It should be used for its strengths, I reckon."

WHAT IS IT?

Rabbit Hole is a 16HP summing mixer with characterful valve saturation & distortion. It is a hybrid solid-state and vacuum tube design. It has two input channels with independent vintage VCAs. The outputs of the VCAs are summed and passed to a solid-state Drive circuit which at higher gain settings hard clips the signal before entering the starved cathode dual-triode vacuum tube. The OWTH - Off With Their Heads diode LED clipping circuit can be engaged for further distortion.

Rabbit Hole is capable of adding subtle warmth or total audio destruction. The Curiouser expander module adds an additional 2 inputs. Multiple Curiouser modules can be daisy-chained to suit your mixing requirements.

- Expandable audio mixer
- Glue for your drum mix
- VCA to a synth voice
- Add subtle warmth and character or total audio destruction
- Capable of generating Subharmonics
- Self oscillates with extreme settings

BLOCK DIAGRAM
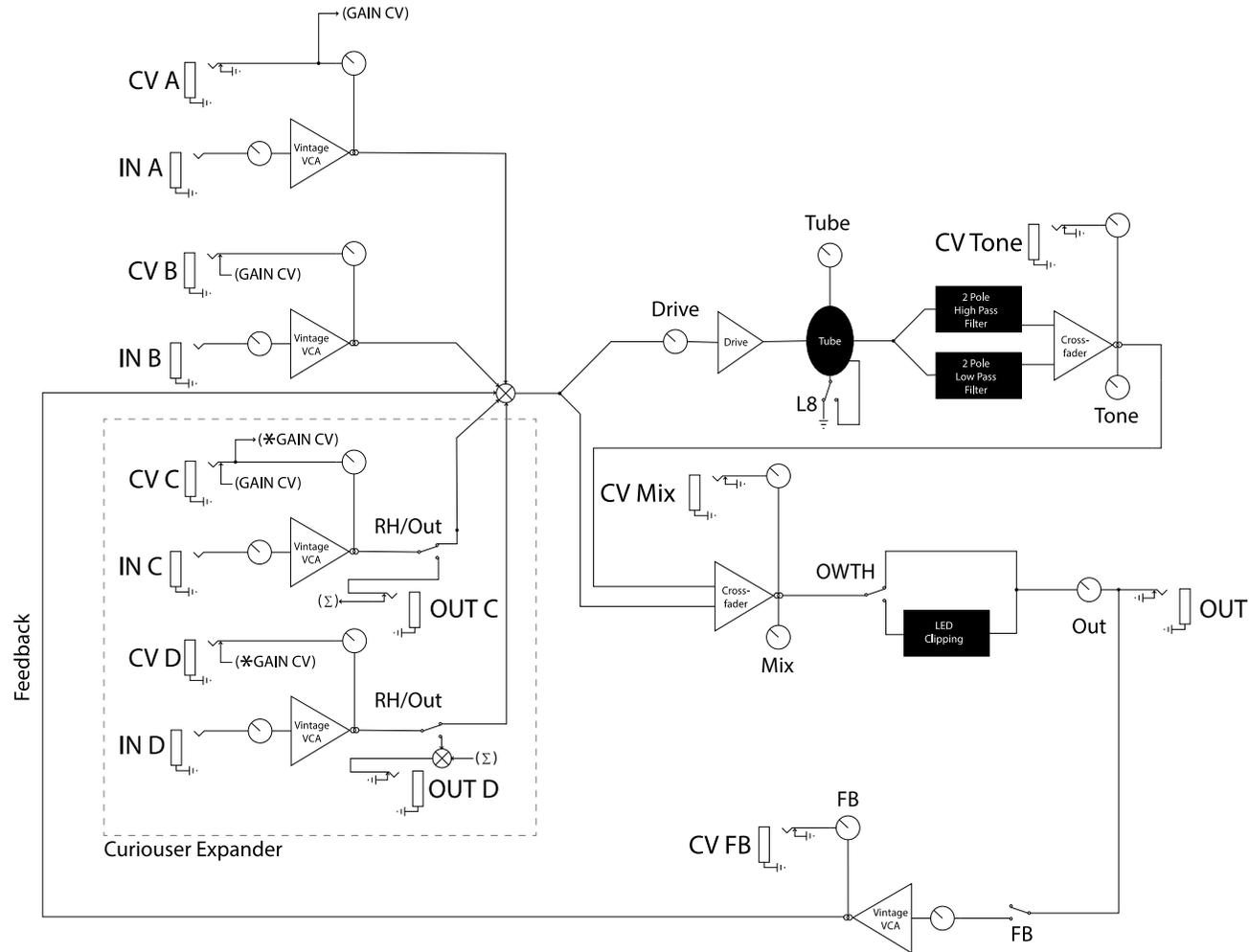
INSTALLATION RABBIT HOLE

POWER
Rabbit Hole is supplied with a 10-pin power cable already placed in the keyed 10-pin shrouded socket. Should the power cable become disconnected, simply reconnect into the shrouded socket using gentle pressure, ensuring correct alignment of the 'key and lock' the red stripe should be to the left when looking at the back of the module.
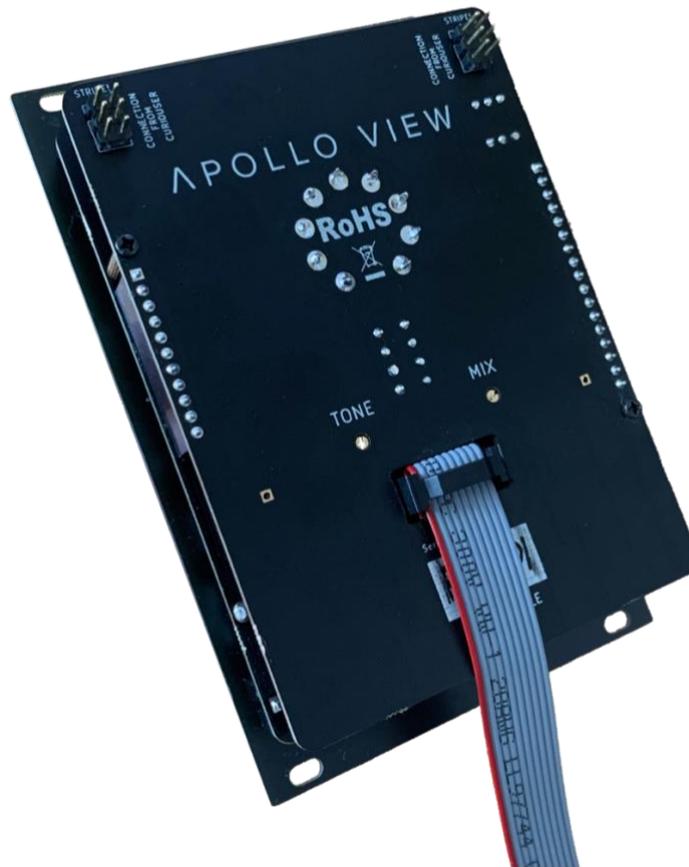
The module has reverse protection diodes, which will simply divert the reverse current to ground in case of incorrect installation.

TUBE
Rabbit Hole comes with a 12AU7 tube already installed, which might require re-centring after shipping. The gain factor of the 12AU7 is 20. This has been selected for its specific headroom and characteristics to produce the widest range of tones from saturation through to total distortion. If you fancy participating in some tube sniffing or need to replace the tube due to wear, it might help to unscrew and separate the PCBs. Then gently lift off the old tube holding near the base, then replace it with a new tube using gentle downward force into the tube socket with a slight circular rocking motion, ensuring the pins are aligned correctly with the socket. The Tube typically reaches a maximum operating temperature of approximately 45°C (113°F).

KNOBS

Gain A - Volume control for channel A vintage VCA. **Gain A** also affects the saturation/distortion of the signal through the Tube circuit.

Gain B - Volume control for channel B vintage VCA. **Gain B** also affects the saturation/distortion of the signal through the Tube circuit.

Tube - Tube bias voltage control. When **L8** is switched **Off,** it is the bias for just PIN 3; when **L8** is switched **On,** it is the bias for PIN 3 & PIN 8

Drive - Adds more gain to the mixed signal A+B (+C+D with Curiouser) by an operational amplifier (op-amp) before the tube stage. It has a maximum gain of x 32. Medium settings can cause the op-amp to clip, and higher settings cause asymmetrical wave folding. The hard-clipping of the op-amp is smoothed out by the **Tube** stage, which follows. **Drive** should be used in tandem with the **Gain A** & **Gain B** to achieve the required amount of saturation/distortion. In practice, Drive sets the upper limit of saturation/distortion of the Tube circuit, and **Gain A** & **Gain B** are the finer CV-able control of the **Drive**/saturation/distortion.

FB - This is a VCA placed in the feedback path. This control works in tandem with **FB** switch, which needs to be switched on (down). It has two functions, feedback duties and tuning when the module is used as a VCO.
- **FB** knob has an interesting range of effects over the timbre and is highly interactive with other settings.
- Inverting the Output attenuverter's polarity (ACW from the mid-point) has a significant effect on the Feedback timbre.

Tone – This is an overall tone shaping circuit for the 'wet' Tube signal. After the Tube circuit, the signal is split and passes in parallel through an active 2-pole low pass and high pass filters. These are then recombined through a crossfader. **Tone** is the crossfader control for blending between the high passed and low passed signals. (For further info, see [TRIMMERS](#))

Mix – After the two vintage VCA channels are mixed and before the **Tube** stage, the signal is split into Dry and Wet. Wet then goes through the **Tube** and **Tone** stages; Dry goes direct to **Mix**. At this point, the signals are recombined through the **Mix** crossfader, blending between Dry and Wet signals. It should be noted that Dry is exactly the signal that arrived at the inputs. The vintage VCAs impart some colour on the sound, and the **Gain** of the VCAs will obviously affect the amplitude of the Dry signal at **Mix**. (For further info, see [TRIMMERS](#))

Out – Attenuverter for more flexibility. This is perfect when using Rabbit Hole as a drum voice mixer and plan to mix with a bassline. The phase of Rabbit Hole's output can be flipped to fix kick/bass phase issues. Additionally, this has an effect on the timbre when using the **FB** feedback circuit. Clockwise from 12 o'clock, the output signal is in the same phase as the input signal. Anticlockwise from 12 o'clock, the output signal phase is rotated 180° with respect to the input signal.

CV CONTROL

Rabbit Hole has CV control for:

- **Gain A**

- **Gain B**

- **FB**

- **Mix**

- **Tone**

CV control has been optimised for a 0-5V control voltage. Each CV input has an attenuator to scale the response to the incoming control voltage. 0-5V was selected as this is the lowest possible CV signal in Eurorack; if using 0-8V or 0-10V simply use the built-in attenuverters to achieve the optimal range. Attenuverters have been used for total flexibility. This is especially useful for creating ducking effects, e.g., drums against a bassline. The Gain CV has been normalled. A CV signal present at CV A is passed through a switching jack to CV B and then on through any connected Curiouser Modules. Therefore, using one CV signal, it is possible to control the gain of all channels at once, and each channel's gain will be dependent on its attenuverter setting. Inserting a patch cable into a channel will break the normalled CV connection.

SWITCHES

Switches are **Off** when up, **On** when down.

L8 (Pronounced **Late**) – This affects the point of connection for Pin 8 of the vacuum tube (cathode of triode 2). In the **Off** position (up), Pin 8 is in its default connection direct to ground. When **On** (down), it is connected to the same node as Pin 3 through the **Tube** Knob circuit. This has the effect of changing the character of the valve and, at lower gains, can produce subharmonics.

> **NOTE:** At some settings (mainly when **OWTH** is **On**), switching between **L8 On/Off** can cause momentary audio dropouts. This is normal behaviour due to the change in voltage at Pin 8.

FB – Feedback Switch. Changes the timbre/character of the signal and should be used in tandem with the **FB** knob when engaged can cause sub-harmonics. **FB** must be switched on when Rabbit Hole is used as a VCO.

OWTH – Off With Their Heads. This engages the LED Diode Clipping Circuit and hard-clips the output signal.

RABBIT HOLE FUNCTIONALITY

EXPERIMENTATION
The best way to achieve results with Rabbit Hole is through experimentation. That said, for specific results, the following approaches can be taken.

WARMING
To warm a signal, D**rive** should be at a minimum. **Gain**, **Tube** & **Mix** knobs to taste. Using this technique can bring warmth and phatness to any sound but is particularly useful for drums.

DISTORTION
Drive should be set anywhere from 12 o'clock to fully CW. The **Drive** will hard clip the signal but the subsequent Tube circuit will round this off. If hard clipped tones are required, the **OWTH** switch should be **On**

SUBHARMONICS
To achieve sub-harmonics with Rabbit Hole, the **L8** switch must be engaged, and various knobs tweaked to find the sweet spot.

Switch **L8 On, OWTH On, FB Off**. Patch an Oscillator to **IN A**, and set **Gain A** to its midpoint (12 o'clock). Turn **Drive** fully anticlockwise; Tube should be set to the 3 o'clock position. You can set **Tone** to taste, **Mix** fully clockwise for just sub-harmonics, or you can choose to mix the root note back in. Altering **Gain A** then affects the interval of the sub-harmonics generated. Rabbit Hole will step down octaves, and related intervals with some fine-tuning around the above settings.

TIP: Sending CV modulation to the **Gain A** allows you to 'play' these sub-harmonics. **Mix** & **Tone** can be CV modulated too. It is glitchy, weird and wonderful. Try adding a second oscillator to **In B** for even more complex and glitch tones**.**

> **NOTE:** If **FB** feedback is switched **On**, you can still achieve subharmonics. However, the resulting subharmonics are not as stable/reliable as the previous method, but it can be fun nonetheless.

WONKY VCO
1V/OCT input to CV TONE (scaled using the TONE CV Attenuator), FB switch in ON (down position), Tune pitch with TONE Knob. 1V/Oct tracking over a few octaves is achievable with some fine-tuning. Play around with all the knobs, at this point, they all affect the pitch. The frequency of this can be slowed right down to LFO territory, and the OWTH can be used to create square waves.

FEEDBACK
FB will add additional timbres to colour the sound further. It is interdependent on the polarity of the **Output** attenuverter.

TRIMMERS

The two trimmers on the back PCB control the centre point for the crossfade for both Mix & Tone; these have been 'Factory Set' but can be tweaked to adjust the crossfade point if desired. These are 25 turn Bourns trimmers; making adjustments will change the centre point for the crossfade away from the knob's initial 12 o'clock position. If you experiment with this setting and find you wish to reset to a factory setting, it will require a voltmeter. The Test Points near Mix and Tone should be used for their respective setting. They need to be referenced to ground. The connection pins to Curiouser can be used to access a ground pin. The middle two pins of the Curiouser connection pins are both ground. The 'Factory Setting' voltage for each Test Point is -4.00V with respect to ground.

On the side of the module are an additional two trimmers for ensuring the vintage VCAs don't leak/bleed signal through. These should not require any adjusting. Each vintage VCA has its own requirement due to slight differences in the chips arising from manufacturing tolerances.

CURIOUSER

DESIGN

Curiouser is essentially a duplicate of the two input channels of Tom Wiltshire's vintage VCA from Rabbit Hole. When connected to Rabbit Hole, these extra inputs are fed to the mixer before the **Tube** stage. Curiouser's VCAs can also be used Standalone. This enables Curiouser to be used as the final VCA for a synth voice which has been patched through Rabbit Hole; see '3 Oscillator Synth Voice With Tone Animation' in Patch Ideas.


CURIOUSER SWITCHES

When the switch is in the **Up** position, the signal is fed to the mixer on Rabbit Hole. When the switch is **Down**, the signal is fed to the direct **Out** on Curiouser.

INSTALLATION CURIOUSER

POWER
Curiouser is supplied with a 10-pin power cable already positioned in the keyed 10-pin shrouded socket. Should the power cable become disconnected, simply reconnect into the shrouded socket using gentle pressure, ensuring correct alignment of the 'key and lock'. The Shrouded pin header is on the inside of the rear PCB panel. When correctly orientated, the red stripe should be to the bottom when looking at the back of the module.
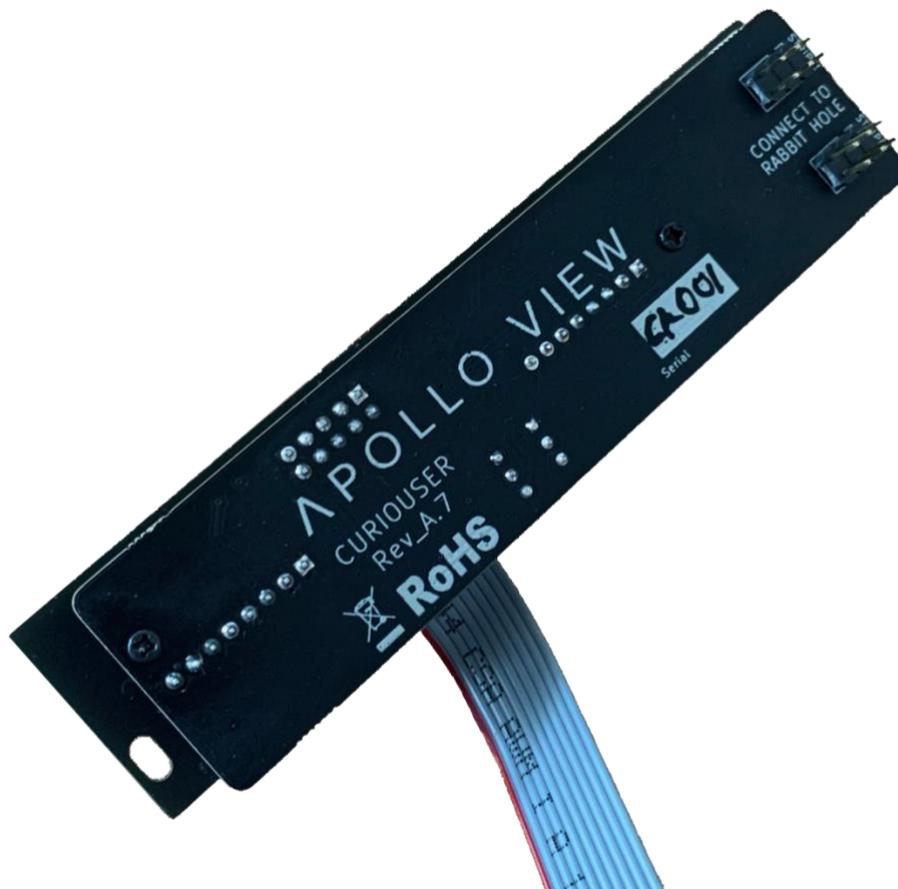

TRIMMERS
The two trimmers on the side of the module are for ensuring the vintage VCAs don't leak/bleed signal through. These should not require any adjusting. Each vintage VCA has its own requirement due to slight differences in the chips arising from manufacturing tolerances.

CONNECTING CURIOUSER TO RABBIT HOLE

Curiouser and Rabbit Hole both have two sets of 2 x 3 connecting pins. This is so multiple Curiouser modules can be daisy-chained into one Rabbit Hole, and the pin's positions provide flexibility to choose which side of Rabbit Hole to place Curiouser module(s). **The only important thing is the orientation of the cable.** Please use the 6-core cable provided, with the red stripe at the top edge of the modules.
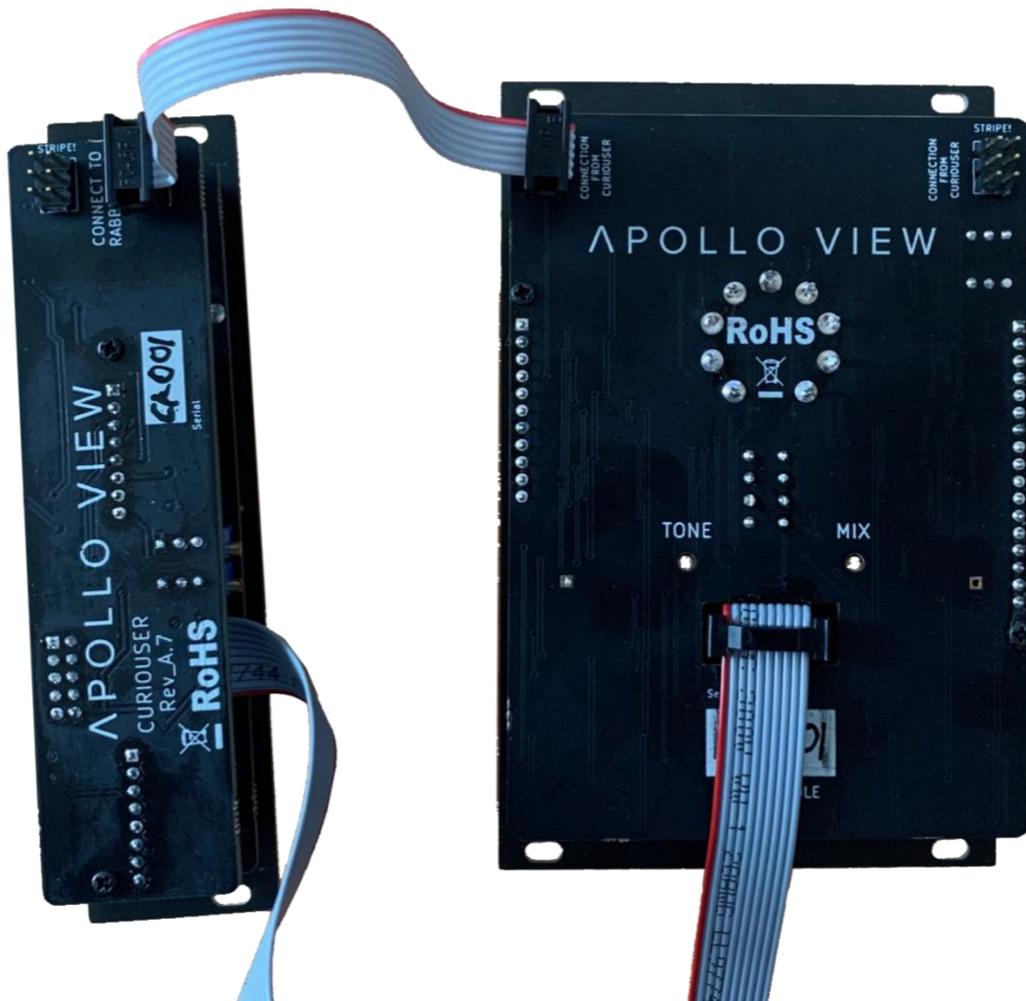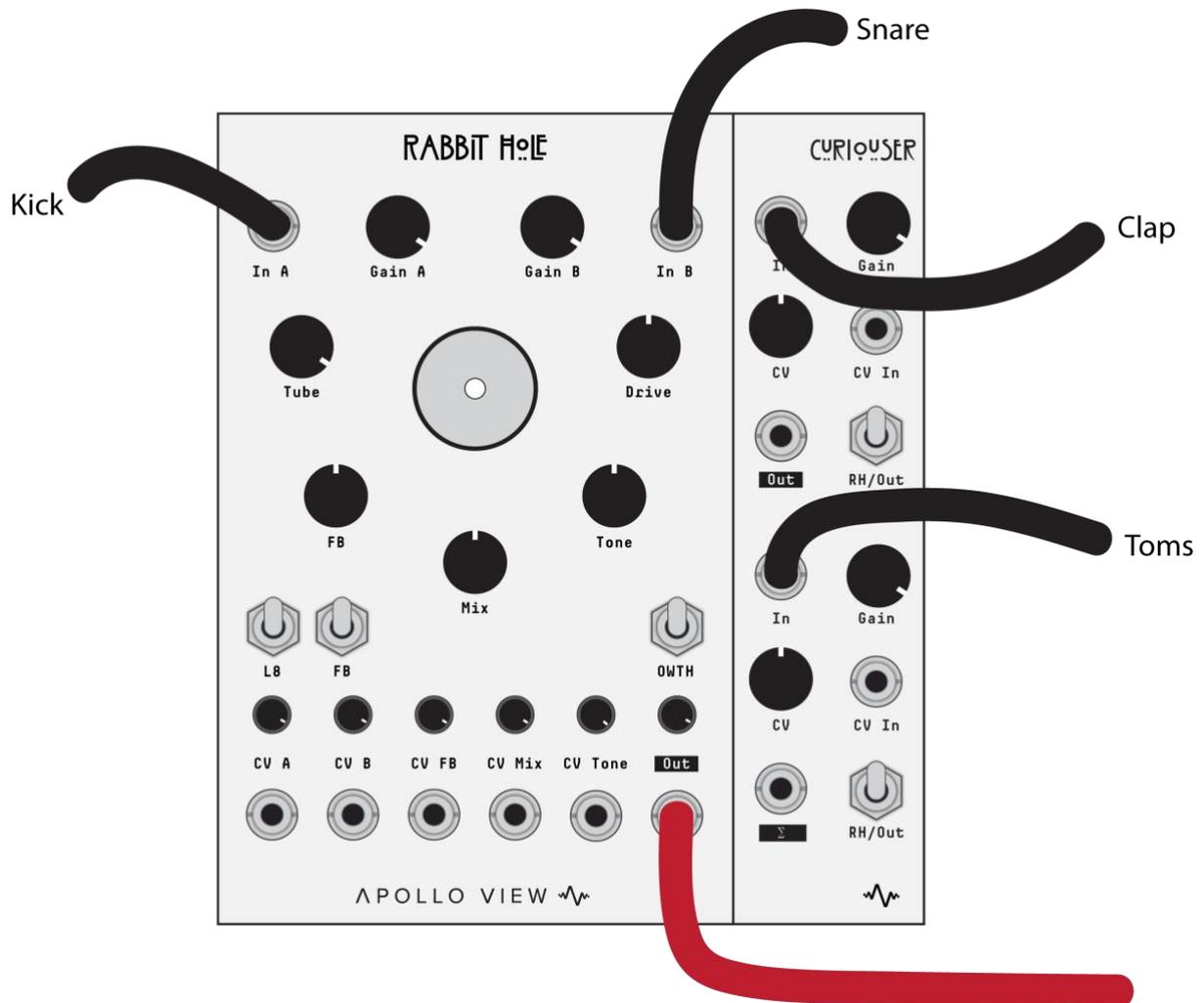

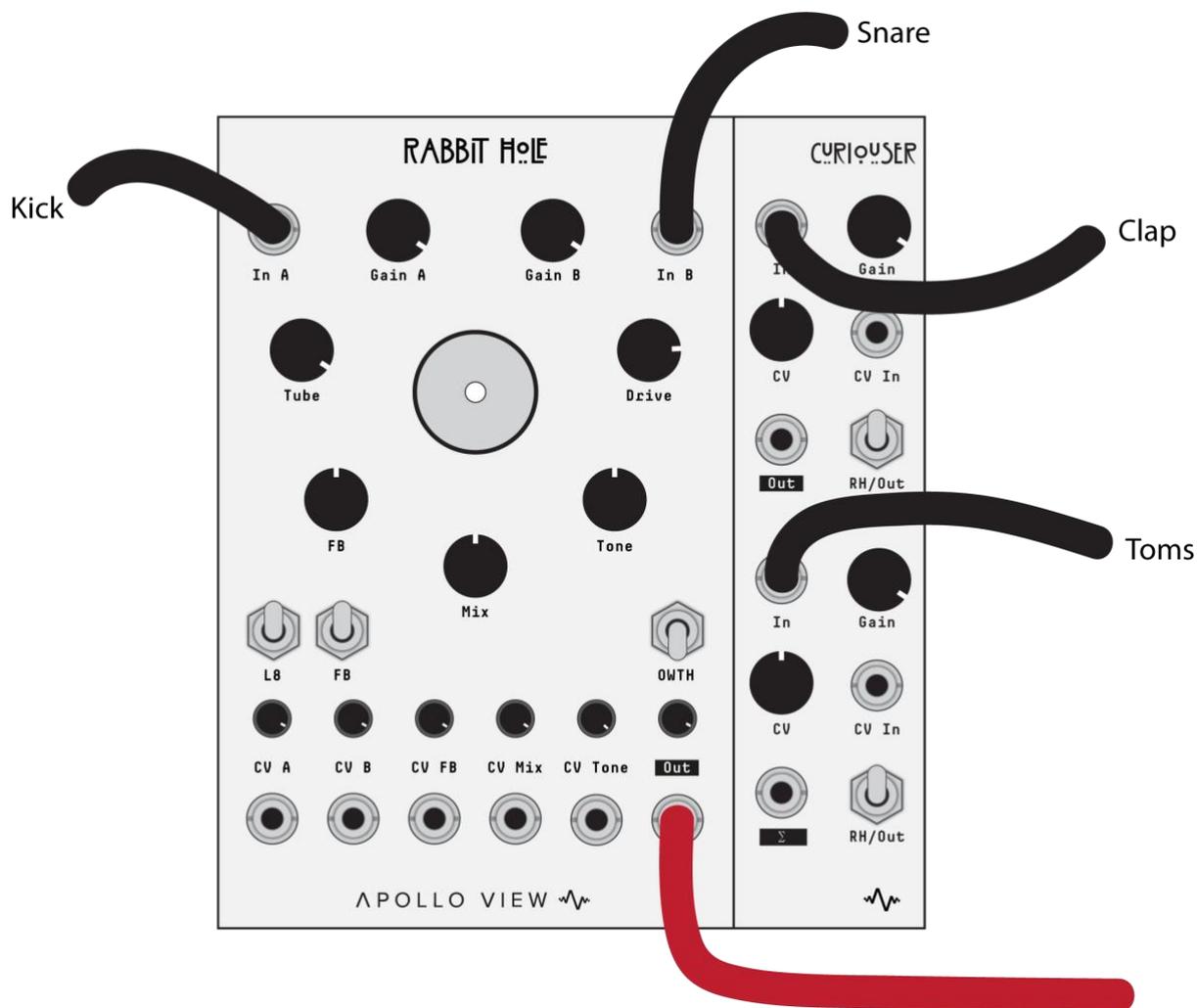
DON'T GET TOO LOST DOWN THE RABBIT HOLE...

PATCH IDEAS

Warm Drum Mix

Route drum mix to inputs of Rabbit Hole and Curiouser. Ensure RH/Out switches are UP to send the audio to Rabbit Hole. Adjust the Gain controls to get the mix you desire. Set the Tune bias high and a moderate amount of Drive. Adjust the Tone and Mix controls to suit.

This will give a warm, phat drum mix full of character.

Aggressive Drum Mix

Kick

Snare

RABBIT HOLE

CURIOUSER

In A   Gain A   Gain B   In B

Gain   Clap

Tube   Drive

CV   CV In

Out   RH/Out   Toms

FB   Tone

In   Gain

Mix

L8   FB   OWTH

CV   CV In

CV A   CV B   CV FB   CV Mix   CV Tone   Out

Out   RH/Out

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Drum mix routed the same as the previous example. This example has increased solid state Drive, and the OWTH hard-clipping circuit is engaged. This will deliver a much more aggressive sound.

Exploring further, try experimenting with the L8 and FB.

Note: Hi-hats and cymbals don't sound great with heavy distortion. It is best to mix hi-hats/cymbals to the drum mix after Rabbit Hole has processed the other voices.

Warm Drum Mix with Accents
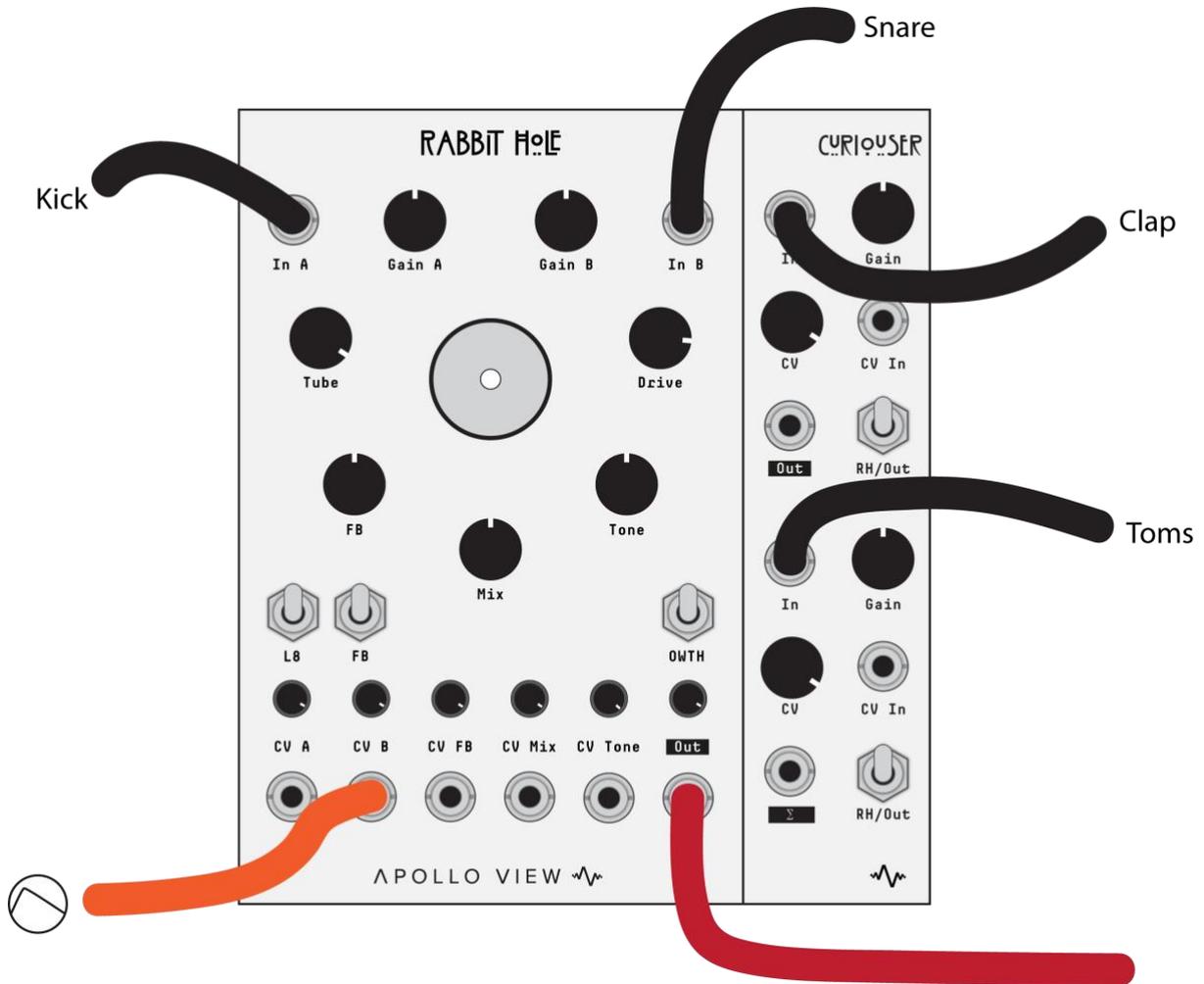
This patch extends on the Warm Drum Mix Patch to include accents. The example here uses the snare, but you could send accents to any or all of the inputs as each channel has its own VCA. The Gains have been reduced, and the Drive knob turned up to compensate. A periodic accent (attack decay AD envelope) is occasionally being sent to accent the snare. Increasing the Gain of the snare drives it into the Tube harder and gives a more characterful tone when the accent is present.

Sidechained Bassline
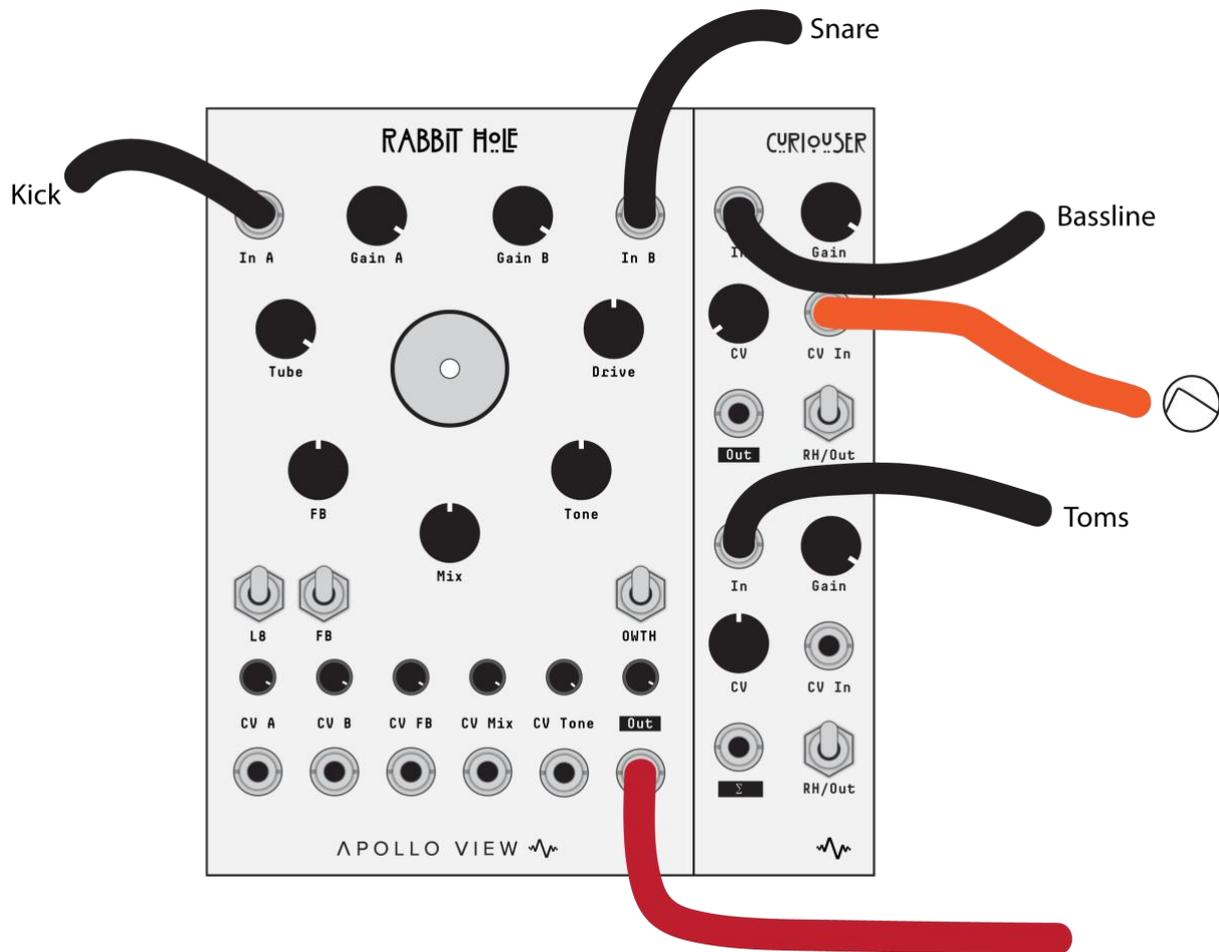
In this patch, we take advantage of the CV attenuverters. A warm drum mix has been achieved. A bassline is patched into an input on Curiouser. The trigger signal from the kick drum is used to generate an AD envelope using other modules. This AD envelope is then sent to the CV input for the basslines Gain. The bassline's CV attenuverter is in the anticlockwise position, which means it is inverting the incoming AD envelope CV signal. Therefore, when the Kick drum hits, the Gain of the bassline is reduced, creating a sidechain ducking effect.

Note: The CV signal from Curiouser's top channel is normalled to the bottom channel (check the block diagram for a visual guide). The bottom channel's CV attenuverter is set to zero (12 o'clock position), so this normalled CV signal does not affect the Gain of the Toms.

3 Oscillator Synth Voice With Grouped VCA Accents
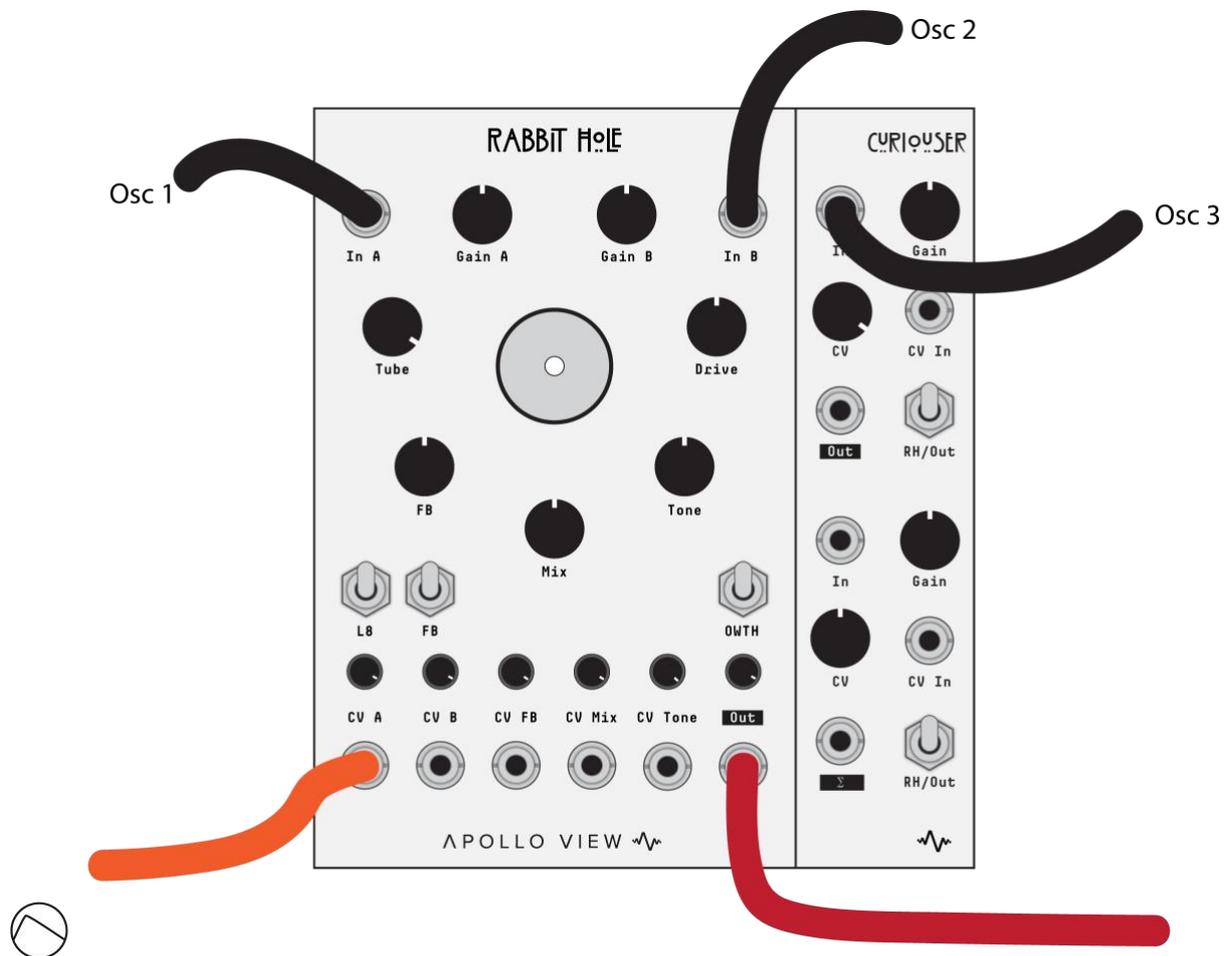
This patch again takes advantage of the CV normalling through Rabbit Hole and Curiouser (check the block diagram for a visual guide). 3 oscillators have been mixed to make a voice, e.g. Osc 1 and Osc 2 triangle waves tuned to the same pitch but detuned from each other by a few cents. Osc 3 a sine, tuned one octave down.

The Gains are all set to their midpoint at 12 o'clock, and each channel's CV attenuverters are clockwise. We have patched an accent AD envelope to CV A; due to the CV normalling, this CV signal is sent to the CV for each channel (a patch cable at a CV jack would break the normalling). When the AD accent is present, each channel's Gain will increase, adding more character to the mix.

Note: this normalling could be utilised with all the Gains turned completely down and ADSR envelope patched to CV A to control the whole Rabbit Hole & Curiouser system as an end of voice VCA.

3 Oscillator Synth Voice With Tone Animation
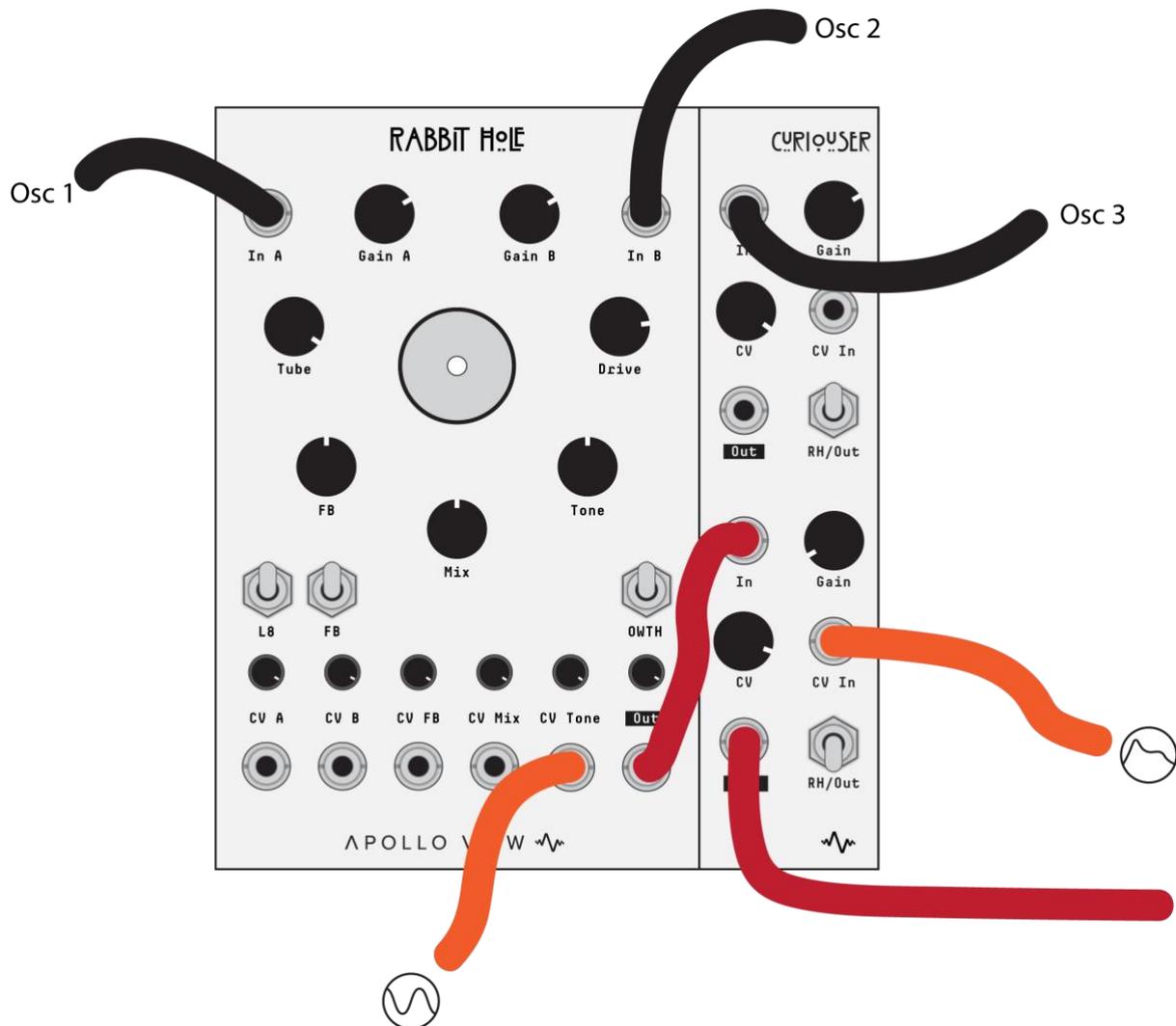
This patch has the same oscillators patched to the inputs as the previous patch. The difference is that we are using the bottom Curiouser channel as the end of voice VCA. Therefore, we patch the Out of Rabbit Hole to the In of the bottom channel of Curiouser, which is being used independently of Rabbit Hole; notice the RH/Out switch is in the DOWN position. The Gain of the bottom Curiouser channel is fully down. The VCA is being opened by the ADSR signal present at the CV input; the CV attenuverter is in the clockwise (positive) position.

For fun, a bipolar LFO is being used to modulate the Tone control.

Exploring further, we could modulate the FB & Mix with additional LFOs or envelopes.

Crossfading Arp Vs Drone
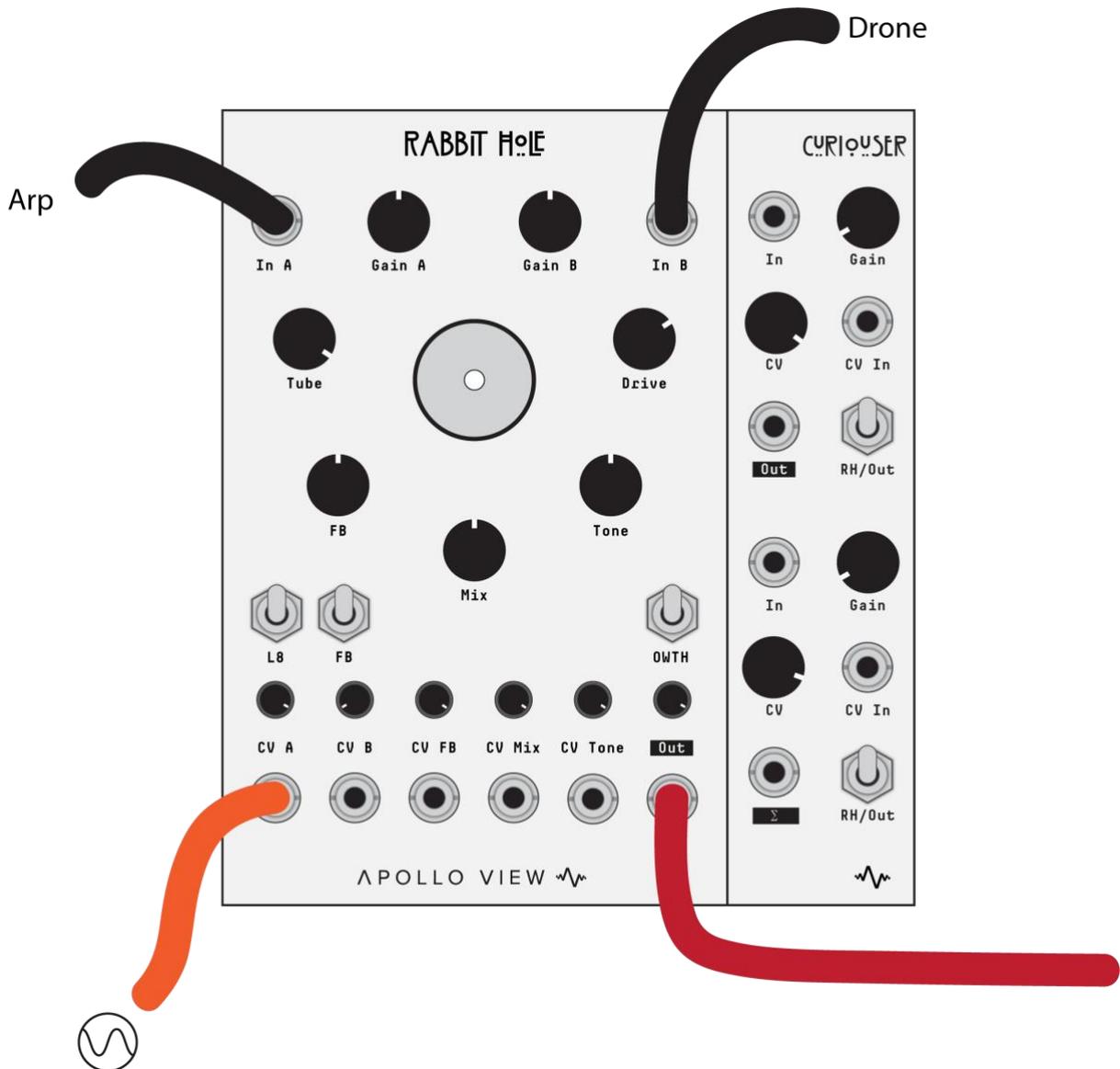
Credit for this patch goes to DivKid.

Here we have an arpeggio patched into In A of Rabbit Hole and a drone into In B. The attenuverters for the CV for A & B are opposing A in positive (clockwise) and B is negative (anticlockwise). The bipolar LFO patched to CV A is normalled to CV B. As the LFO goes high, it increases Gain A. Because the CV signal is inverted through the attenuverter to CV B, Gain B is decreased. As the LFO goes low, Gain B increases and Gain A decreases. Therefore, utilising the CV normalling and the attenuverters, we can create a crossfader between In A and In B.
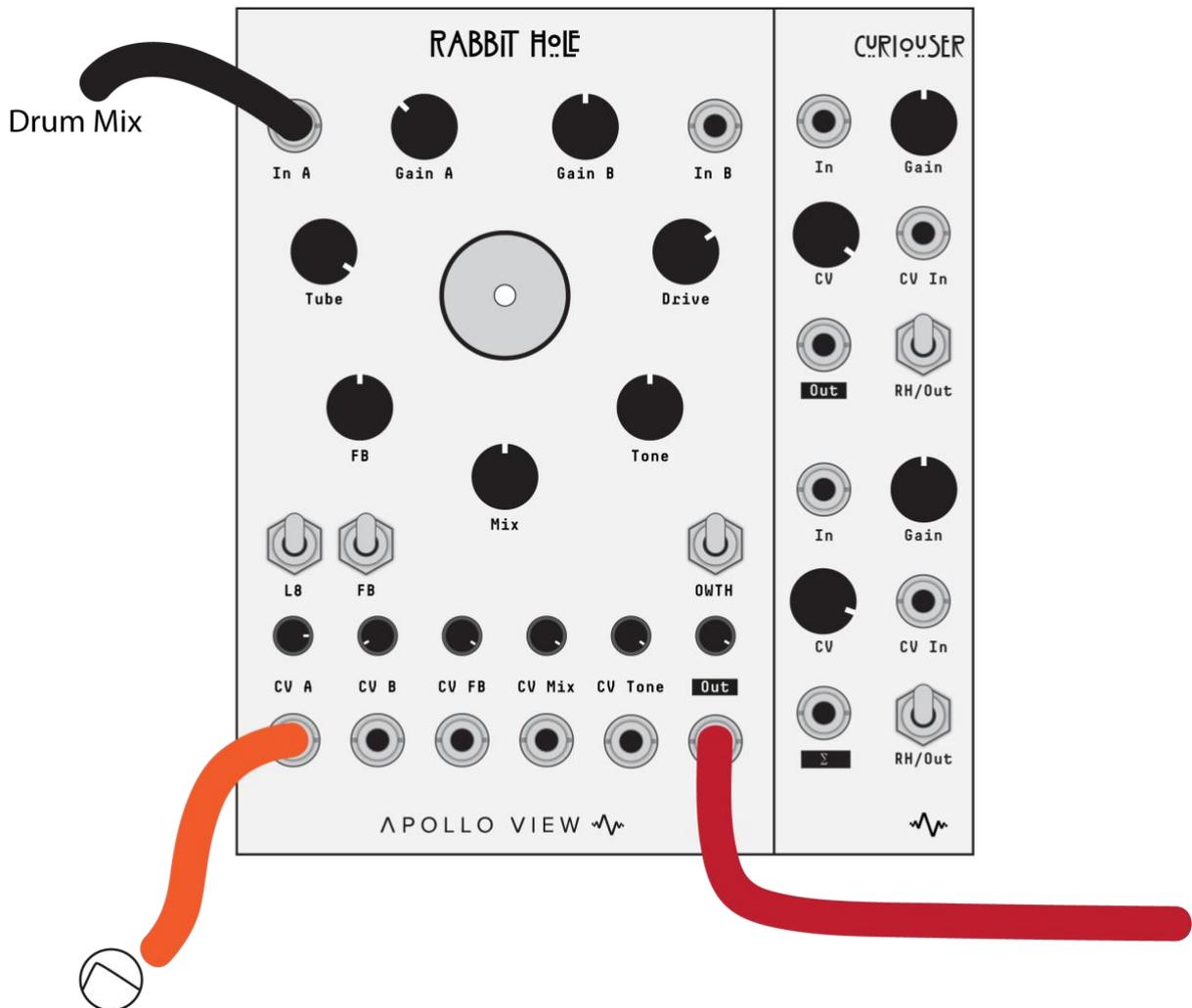
Compression of Drum Mix
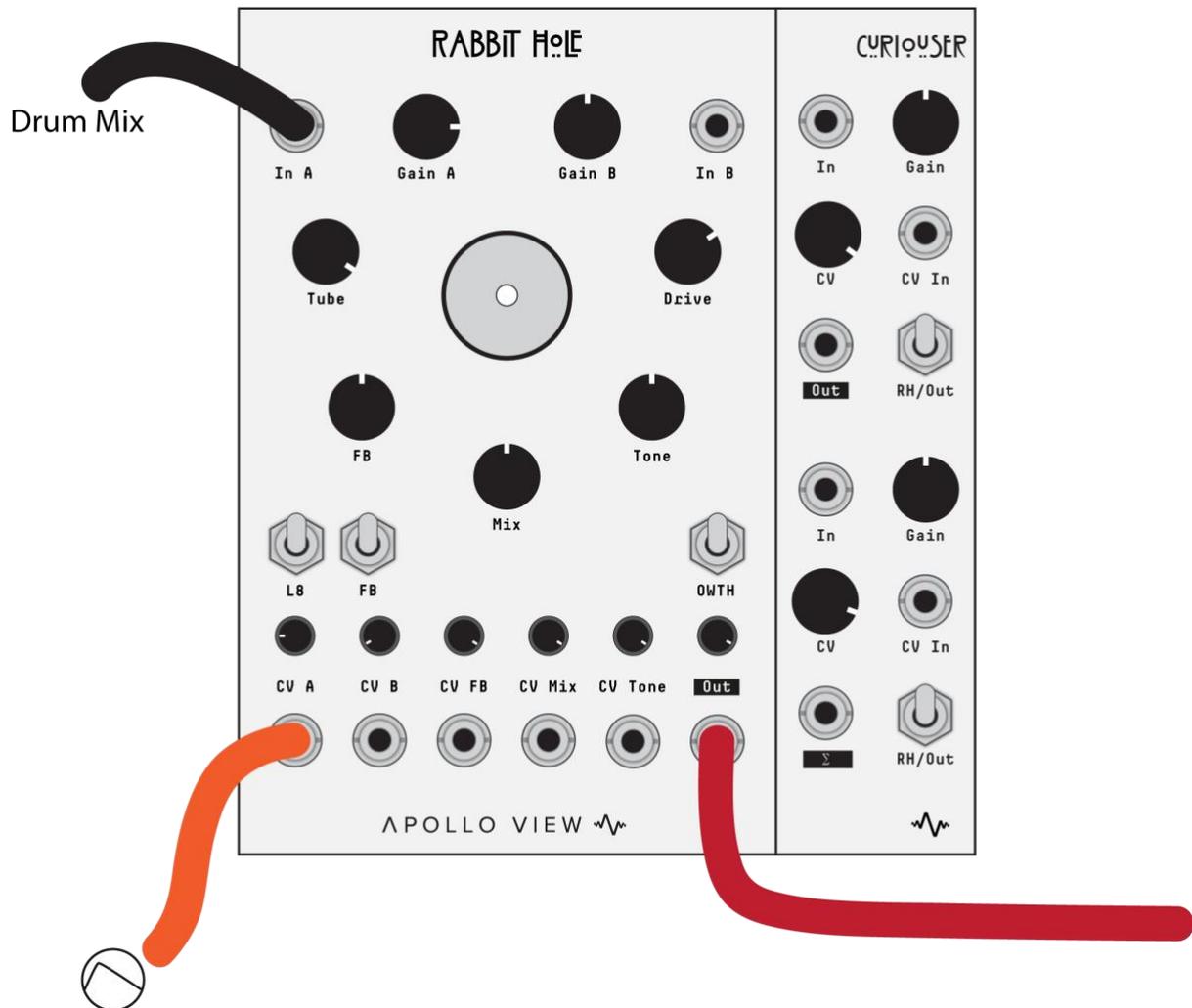
Drum Mix

Credit for this patch goes to DivKid.

The drum mix audio is split, it is patched to the In A of Rabbit Hole, the drum audio signal is also passed to an envelope follower using another module and the resulting CV signal is patched to CV A. CV A's attenuverter is in the negative/inverted (anticlockwise) position and scale back from its maximum setting. As the CV signal goes high, it causes the Gain of the Drum Mix to be reduced, creating a compression effect.

Expansion of Drum Mix

Drum Mix

Credit for this patch goes to DivKid.

This is the inverse of the compression patch. The drum mix audio is split, it is patched to the In A of Rabbit Hole, the drum audio signal is also passed to an envelope follower using another module, and the resulting CV signal is patched to CV A. CV A's attenuverter is in the positive (clockwise) position and scale back from its maximum setting. As the CV signal goes high, it causes the Gain of the Drum Mix to be increased, creating an expansion effect.

Subharmonic Generation
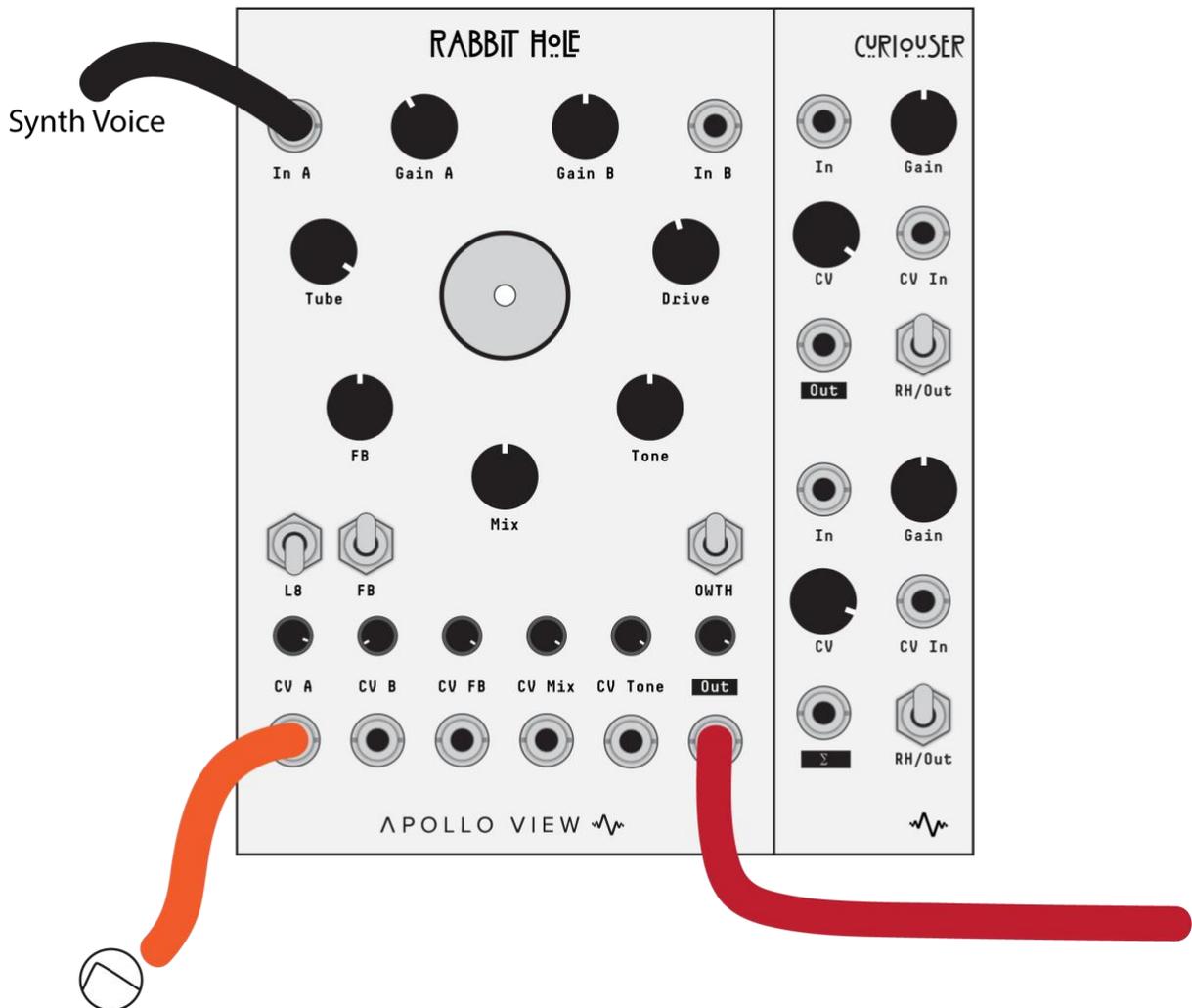
Subharmonics can be generated when the L8 switch is ON (down position) and Drive is below its midpoint. Playing with the Gain of A will adjust the interval of the subharmonic. It is possible to get Rabbit Hole to track 1 octave below the incoming audio signal. CV signals can be sent to CV A to 'play' these intervals. With Mix set in the middle, you get a blend of the incoming signal and subharmonic; if set fully Wet (clockwise), you can obtain only the subharmonics.

Exploring further, experiment with OWTH, FB and Tone for added fun.

Wonky VCO

1V / Oct
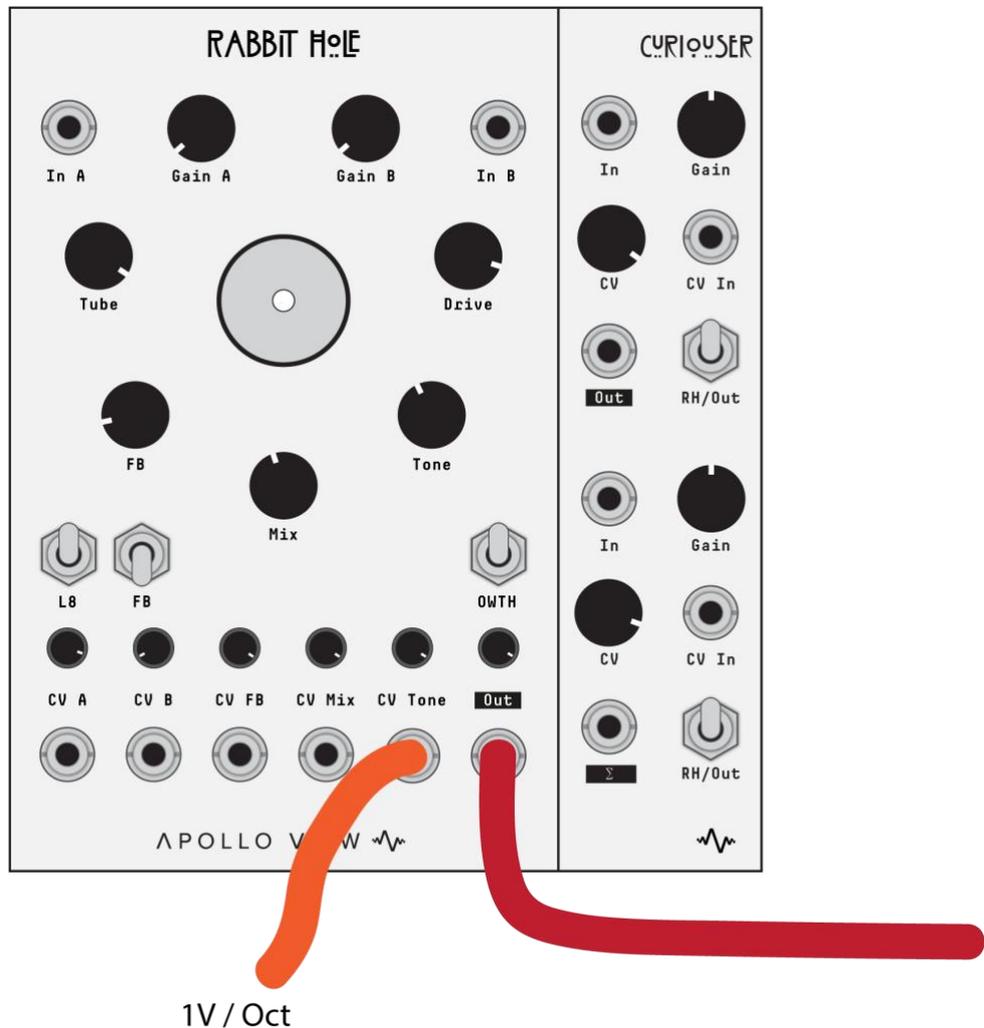
Every tube is different, so setting this up will be slightly different on each module. All knobs affect the pitch, so all can be used to tune the pitch of the self-oscillation. Start with the above settings. Use a tuner and tune to an appropriate note. Send a 1V CV signal to CV Tone. Scale the attenuverter to achieve 1 octave up compared to 0V at CV Tone. This can require many adjustments to find the correct response, be patient; it can be a little fiddly. Once tuned, you can achieve near 1V / Oct tracking over 1-2 octaves.

Exploring further, the OWTH switch can be enabled to square off the waveshape. Additionally, tune the pitch lower for some interesting LFO shapes.

Wavefolding

Sine
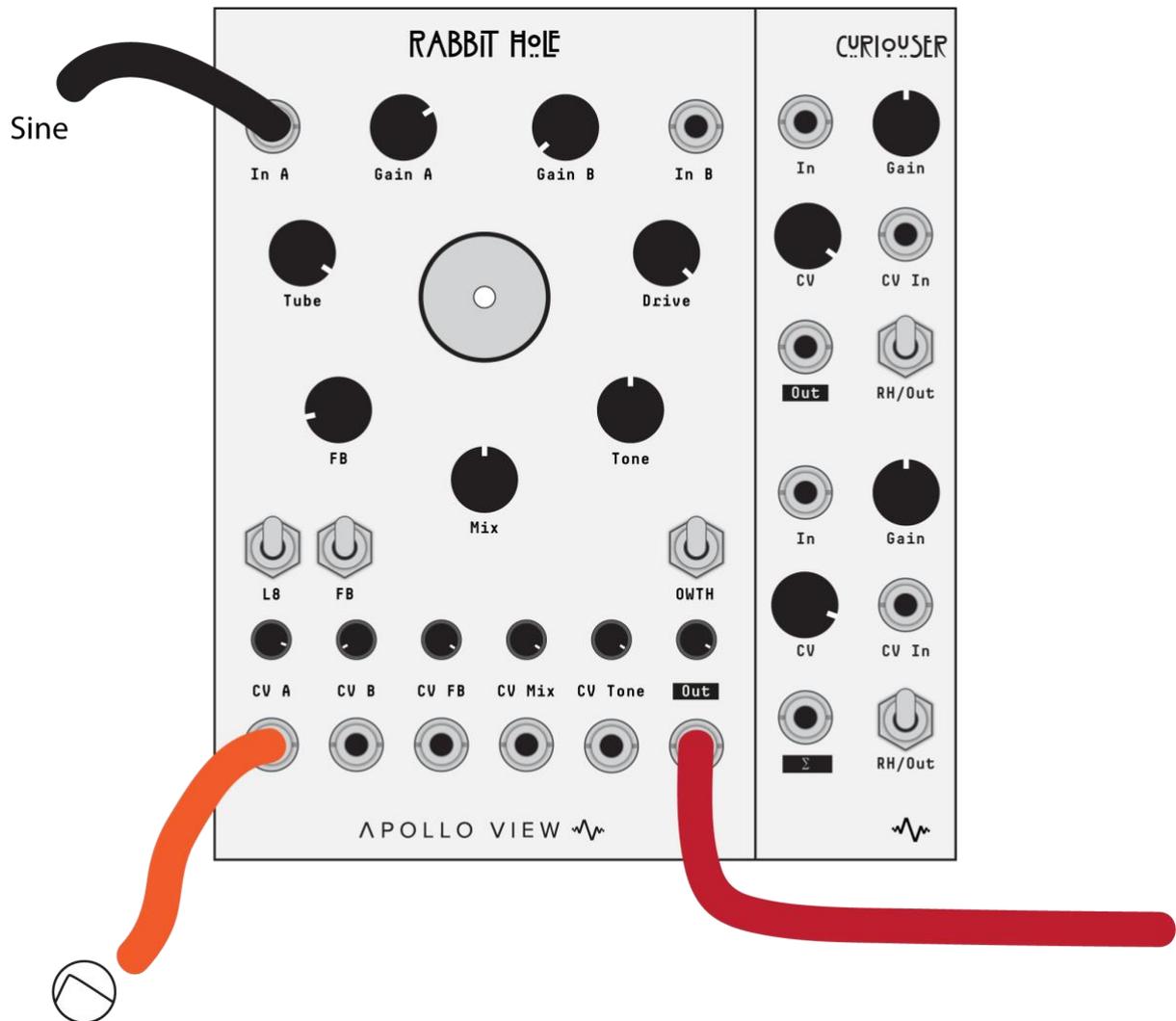
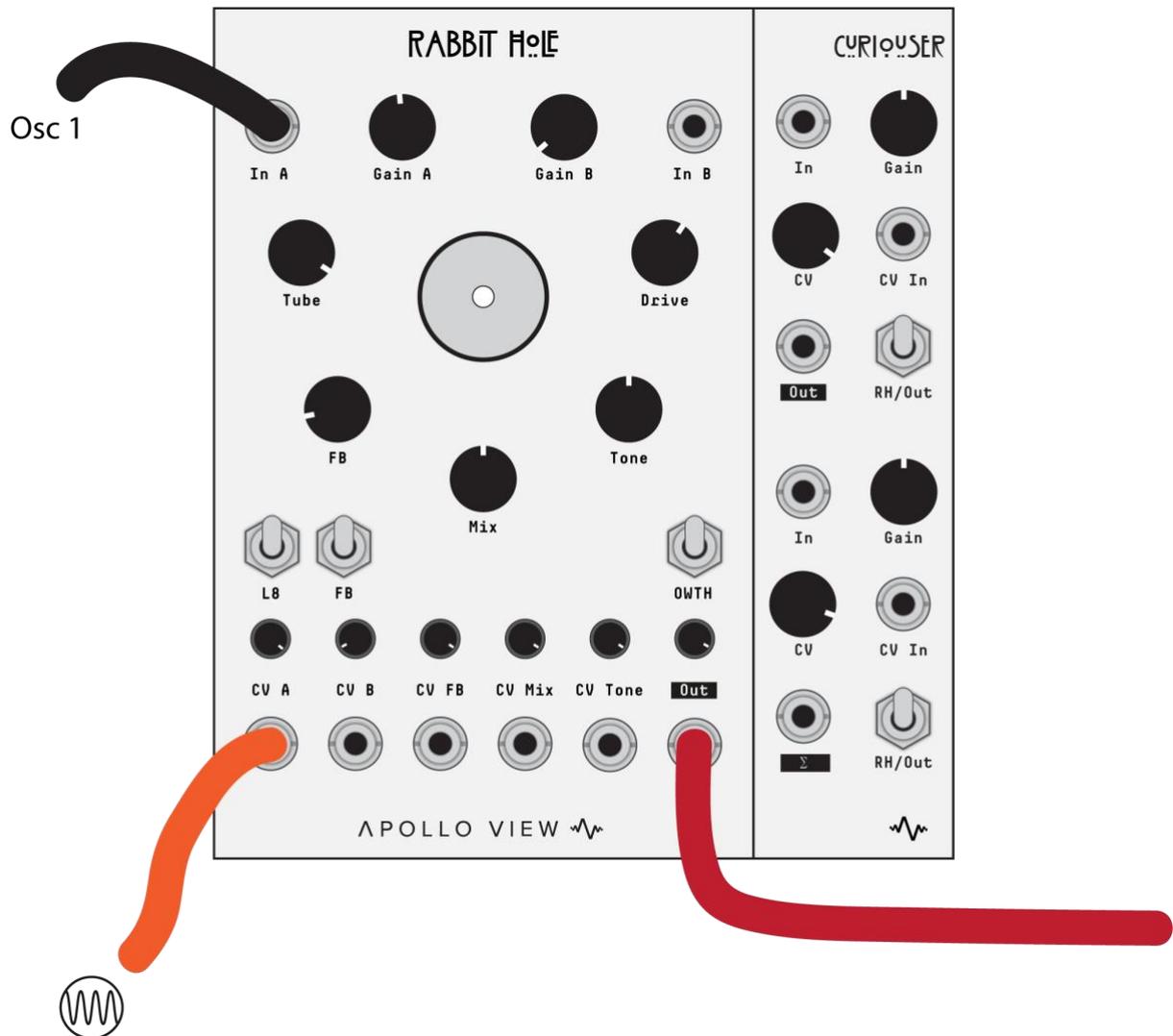Wavefolding can be achieved with high Drive settings. The best wave to observe this is with an oscilloscope to visualise the Out of Rabbit Hole. Increasing Gain A will increase the amount of asymmetrical wavefolding. In this example, Gain A has been reduced slightly so that the wavefolding can be modulated with an envelope patched to CV A.

Exploring further, play with the Tone modulation, L8 and OWTH switch.

Audio Rate Amplitude Modulation

Osc 1

RABBIT HOLE

CURIOUSER

In A   Gain A   Gain B   In B

In   Gain

Tube   Drive

CV   CV In

Out   RH/Out

FB   Tone

In   Gain

Mix

L8   FB   OWTH

CV   CV In

CV A   CV B   CV FB   CV Mix   CV Tone   Out

Σ   RH/Out
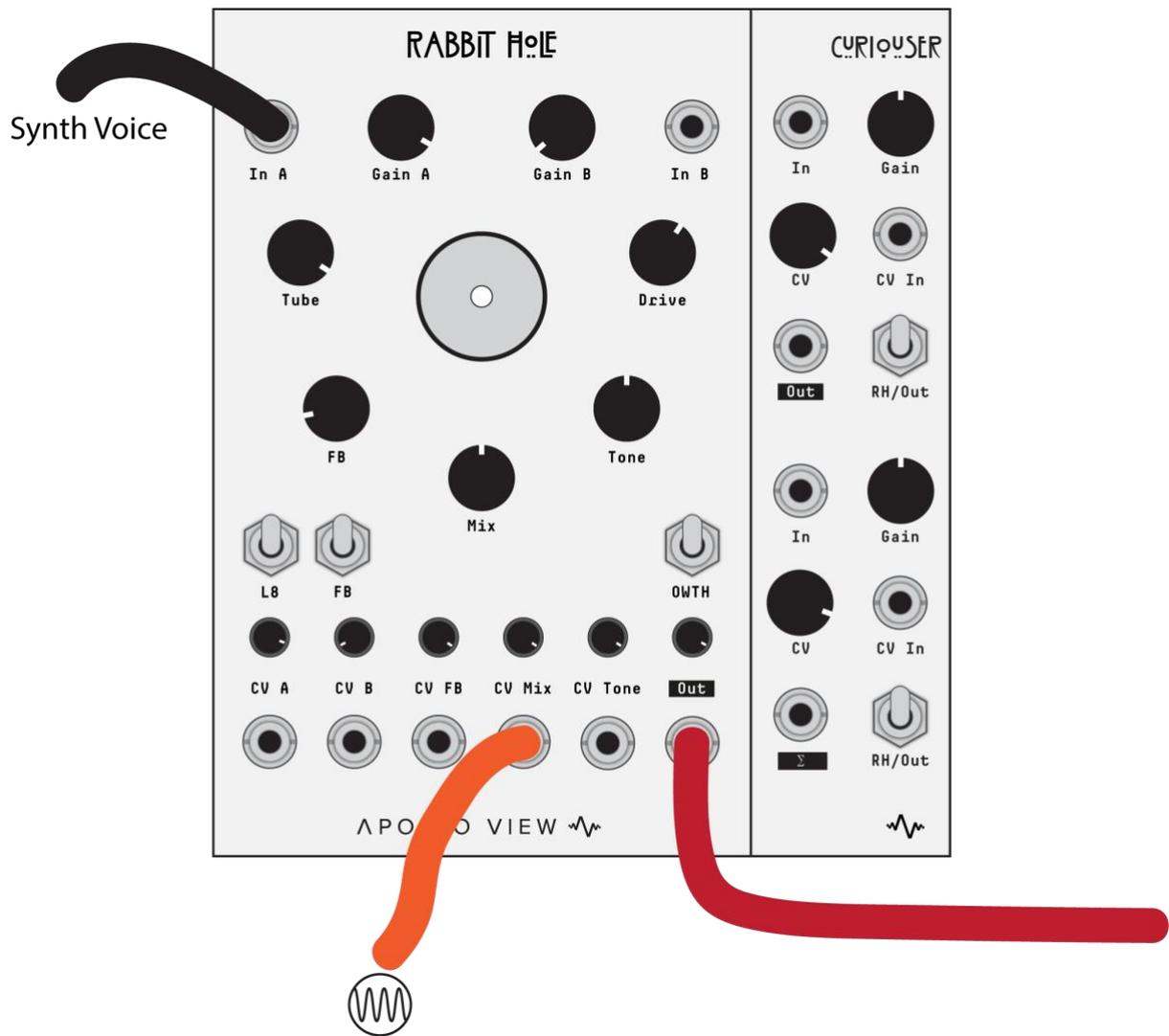
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Patch an oscillator into IN A, and adjust Gain A to its midpoint. An audio rate oscillator (modulator) is patched into CV A; this will amplitude modulate Osc 1 (carrier), multiplying the signals together so both pitches can be heard. Try sending the same 1V / Oct CV to both oscillators.

Audio Rate Amplitude Modulation With Accents

This extends the AM patch idea with an envelope to only allow the modulator to modulate the carrier when the envelope accent is present. To achieve this, we utilise a stand-alone VCA on Curiouser. The modulator is patched to In of Curiouser, Curiouser's Gain is turned down, and the CV attenuverter is in the positive (clockwise) position. The accent envelope is patched to the CV In, and the RH/Out switch is DOWN. Then this output is patched to the CV A input of Rabbit Hole, and the CV attenuverter is in the positive (clockwise) position.
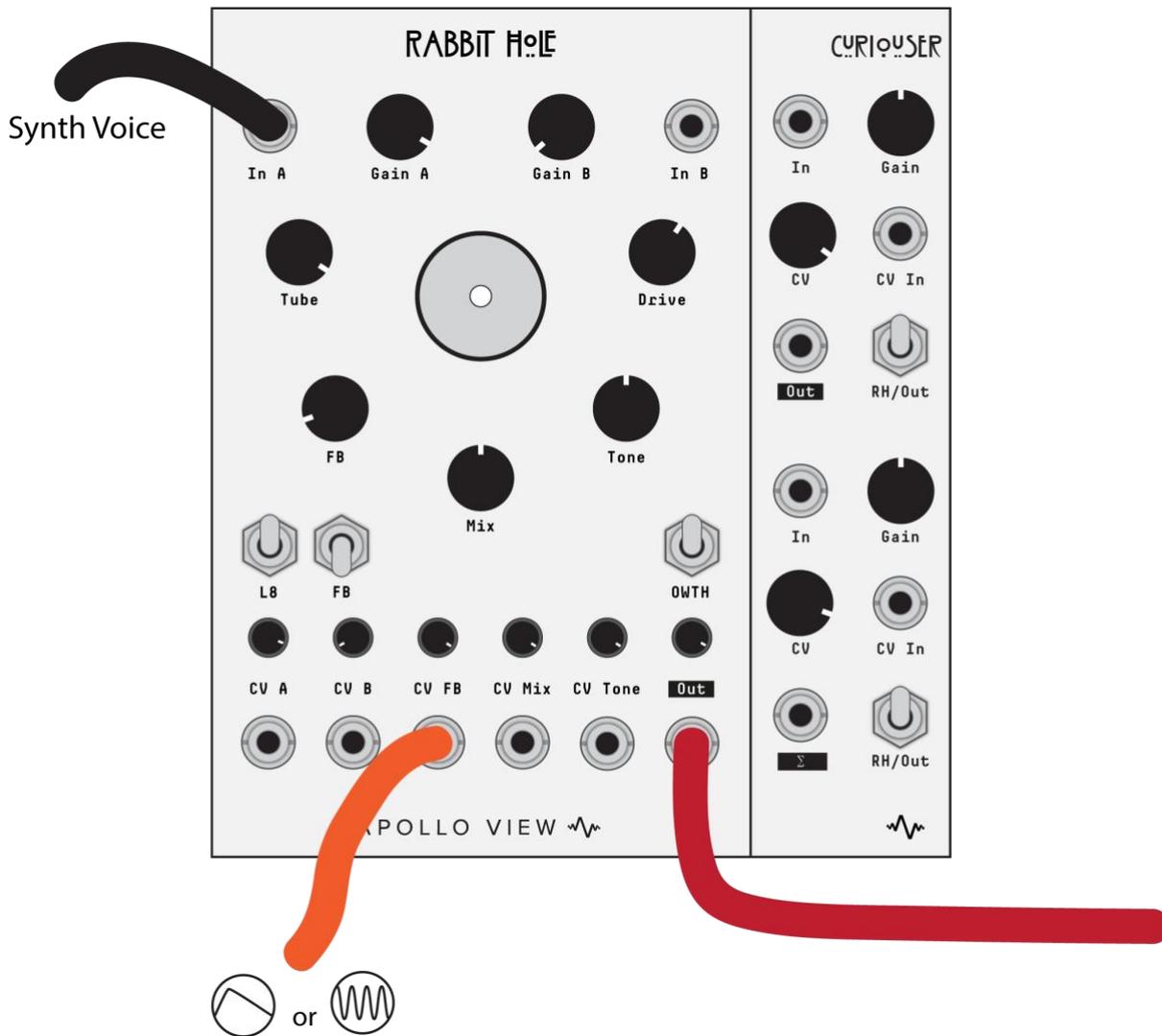
Audio Rate Modulating Mix / Tone

You can have fun with audio rate modulating the Mix, as in this example.

Exploring further, try audio rate modulating Tone or Mix & Tone together. Experiment freely to find unique tones.

Feedback Modulation

Synth Voice

FB switch needs to be ON, in the down position. Then send a CV signal, envelope, LFO, or audio rate, to FB CV with the attenuverter in the positive position. Experiment with modulating the other parameters to find a timbre you like.

Exploring further, invert the polarity of Out; this inverts the signal that is fed to the feedback path and creates a different timbre with much more frazzle.

DON'T GET TOO LOST DOWN THE RABBIT HOLE...

RABBIT HOLE & CURIOSUER
MANUAL V1.2

APOLLO VIEW

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