intellijel

Cascadia

Advanced, Performance-Oriented, Semi-Modular Synthesizer

Manual (English)
Revision: 2023.04.18

FCC COMPLIANCE STATEMENT

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

EUROPEAN UNION REGULATION COMPLIANCE STATEMENT

This product has been tested to comply with the Low Voltage Directive 2014/35/EU and the Electromagnetic Compatibility Directive 2014/30/EU. The product meets the requirements of RoHS 2 Directive 2011/65/EU.

This symbol indicates that your product must be disposed of properly according to local laws and regulations.

CANADA

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003.

LEGAL DISCLAIMER

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IMPORTANT SAFETY & MAINTENANCE PRECAUTIONS

P**lease read the following instructions carefully, and adhere to the operating advice:**

- Do not use the device in or near water.
- Do not clean the device with harsh chemicals, nor allow moisture or any objects to enter the case through the various jacks, sliders, etc. Remove dust, dirt and fingerprints with a soft, dry and non-abrasive cloth, disconnecting all cables when doing so. Do not spray liquid cleansers onto or into the device.
- Install the device in accordance with the manufacturer's instructions. Make sure you place it on a stable surface before use. If you rack mount the device, be sure to tighten all mounting screws attaching the ears to the unit and to the equipment rack.
- Connect the device to an easily accessible and nearby electrical outlet. Do not put heavy objects on the unit; place it where it might fall; or where you might trip over any connecting cords.
- Use only the factory-supplied power adaptor, and do not pinch the power cable, nor allow it to be walked on. Do not bend or damage its plugs.
- When transporting the device, use only manufacturer approved cases or the original box and padding.
- Do not install the device near any heat sources such as radiators, registers, stoves, heat lamps, or any other equipment (including amplifiers) that produce heat.
- Do not cover the device while it's powered on.
- The device (either via its internal headphones or through external amplification) is capable of producing sound levels that could result in permanent hearing loss. Do not operate the device at excessively loud or uncomfortable volumes.
- Only use attachments and accessories specified by the manufacturer.
- Always unplug the unit during lightning storms, or when it is not used for long periods of time
- Do not open the case. Refer any servicing to a qualified professional. Servicing is required when the unit has been damaged in any way, such as when liquids have spilled on it; objects have fallen into it; it's been exposed to rain or moisture; it's been dropped.

WARNING

To reduce the risk of fire, electrical shock or product damage:

- Do not expose the device to rain, moisture, dripping or splashing. Avoid placing liquid filled objects (such as vases, beverage containers, etc) on or near the device.
- Do not expose the device to direct sunlight, nor use it in ambient temperatures exceeding 35°C. Do not use the device in extremely hot, cold, humid or dusty environments.
- Do not open the case. There are no user repairable parts inside. Refer all service and repairs to trained service technicians only.
- Do not exceed the limitations specified in the Electrical specifications.

HEARING WARNING

- To protect your speakers from damage and/or your ears from permanent hearing loss, always turn down the volume on your amplifier before connecting Cascadia's audio output.
- Do not use headphones in areas where situational awareness is required. Do not use headphones at high volume, or for extended periods of time, and always reduce the volume level when first connecting them.

POWER ADAPTER SAFETY

- The adapter is not safety grounded and may only be used indoors.
- To ensure good ventilation for the adapter, do not place it in tight spaces. To prevent risk of electric shock and fire because of overheating, ensure that no objects prevent adapter ventilation.
- Do not expose the power adapter to direct sunlight•
- Connect the adapter to an easily accessible electrical outlet close to the unit.

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OVERVIEW

Cascadia is a labor of love. A deep and flexible semi-modular mono synth, it was developed by a team of veteran synth aficionados to be the realization of their collective dream. It is a synthesist's synthesizer — a well-considered, finely-honed, stand-alone instrument capable of both nuance and bombast. You are never more than a slider away from turning sweet into raucous; or a patch cable removed from corrupting the virtuous into the wicked.

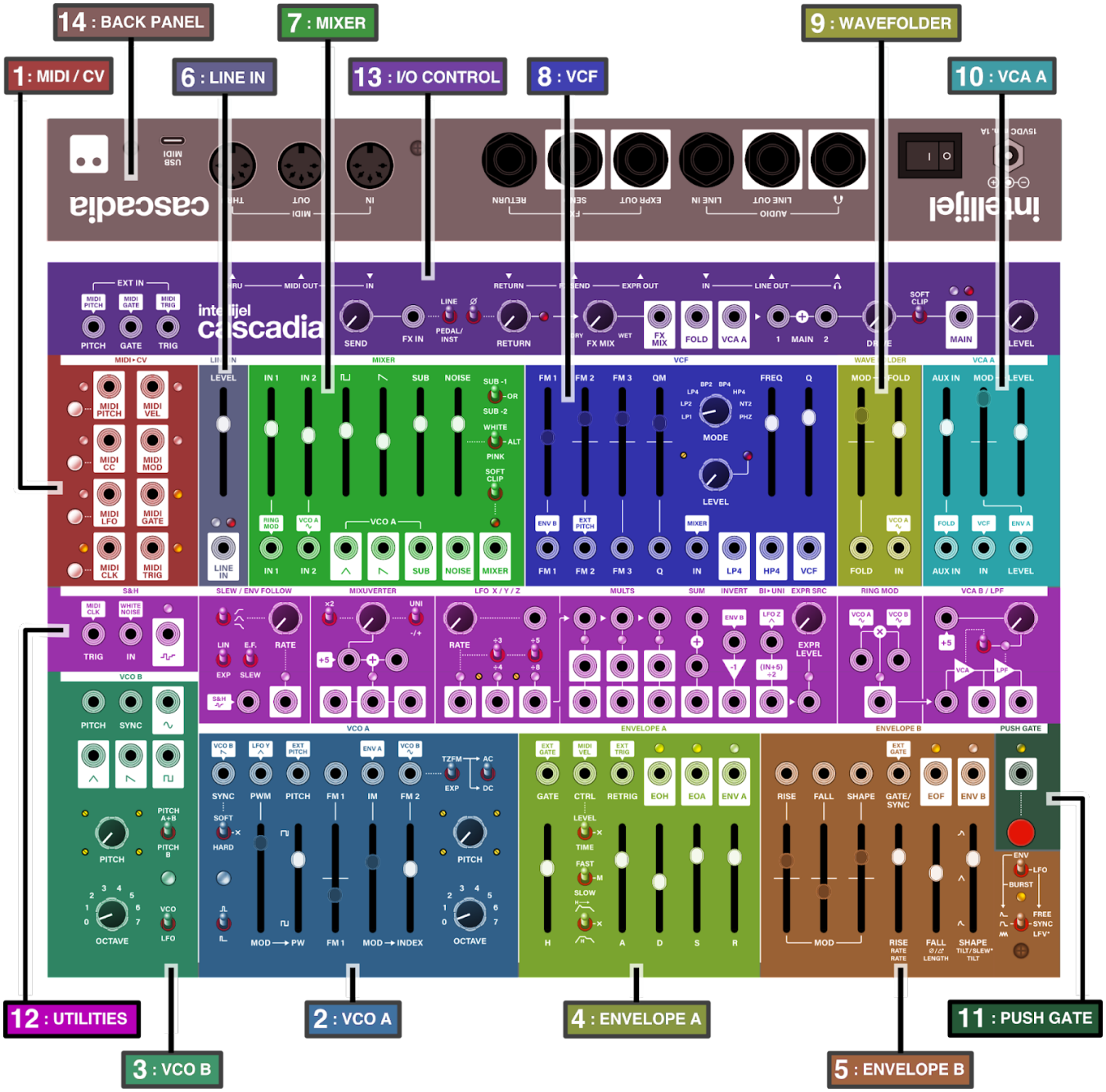
To distill Cascadia into a bullet-list of features does not do justice to the sonic possibilities that lurk just behind the panel. Instead, it's best to imagine the potential of two oscillators (one capable of operating at LFO rates; and one with full TZFM and sync capabilities) — each with multiple independent outputs working as both sound and modulation sources. Think about the possibilities of a fully-modulatable, self-oscillating, multimode filter with numerous modes simultaneously available, or the sonic advantages of having both wavefolding and ring modulation built-in. Envision having a pair of fully-configurable envelopes — one, a take on a classic ADSR with an assignable Hold stage; the other, a powerful multimode function generator, which becomes an Envelope, LFO or Burst generator with the flick of a switch. Picture using either MIDI or CV (or both) to drive your sound and modulation; or using the built-in trio of utility LFOs; an additional VCA/LPF/LPG; slew; sample & hold; multipliers, inverter; and mixuverters to refashion it. Ponder the sonic options of bringing in external audio and using it to either modulate or mix into Cascadia's architecture. Speaking of mixing, consider the fully-featured on-board mixer that blends not only all these internal and external sources, but also features multiple types of noise, a sub-oscillator, and soft clipping. And because we wanted Cascadia to be as flexible as possible, we decided not to hamper it with a limited selection of on-board effects but, instead, imbue it with the capability to fully integrate and control external effects devices — allowing you to incorporate your favorite pedals into your own personal playground of signature sounds, anywhere in the signal chain.

Cascadia is a semi-modular synthesizer, meaning that many of its capabilities reveal themselves to the musician without the need to insert a single patch cable. Cascadia's default signal path is well-conceived and deep. But for those willing to dive even deeper, a plethora of new sounds are possible when you start rerouting signals using the many available patch points. And to allow for the ultimate flexibility, these patch points conform to the Eurorack standard, meaning you can expand Cascadia's capabilities through the use of external modules.

Cascadia leverages Intellijel's long commitment to modular synthesis and coalesces it into a single package of sonic possibility. Whether used stand-alone or as part of a larger system, we at Intellijel believe this is the synth to bridge the past to the future; the novice to the pro; the desktop to the eurorack; and you to your musical goals.

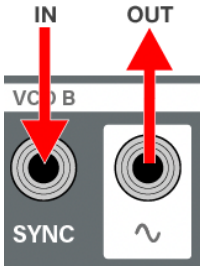
LAYOUT

Cascadia is a standalone semi-modular tabletop synthesizer, encompassing many internally connected synthesis modules, which facilitate deep and complex sound design without requiring a single patch cable. But for those who wish to reconfigure the synth's internal structure, or to augment its architecture with external modules, Cascadia features over 100 eurorack-compatible patch points.



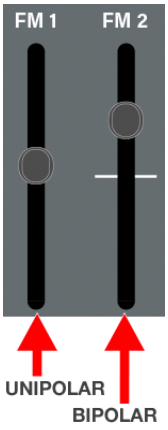
Graphics & Conventions

While Cascadia might appear complicated at first glance, it uses a number of graphical conventions that make it easy to understand exactly what's happening with the signal flow.
Specifically:

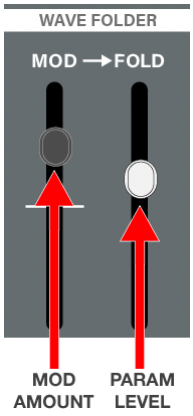


- **OUTPUTS**: Jacks enclosed within a block are outputs.
- **INPUTS**: Jacks not enclosed within a block are inputs.

- **NORMALS**: Text enclosed within a "bubble" that points toward a jack indicates a normalled connection. This identifies the signal that is fed into the jack if nothing is patched into it.



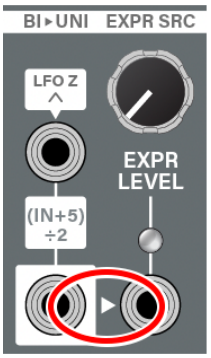
- **UNIPOLAR** vs **BIPOLAR Sliders**: Unipolar sliders produce maximum effect at the top, and no effect (null) at the bottom. Bipolar sliders also produce maximum effect at the top, but have their null (no effect) position in the middle. Below the middle, Bipolar sliders have a negative (inverse) effect on the parameter they're controlling, with maximum negative effect at the bottom. Bipolar sliders are identified by a line through the center of the slider track.

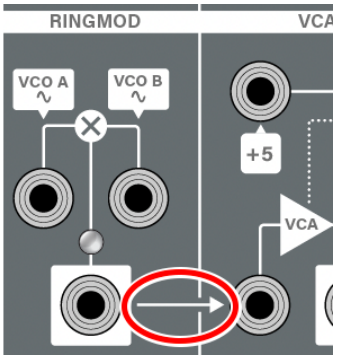


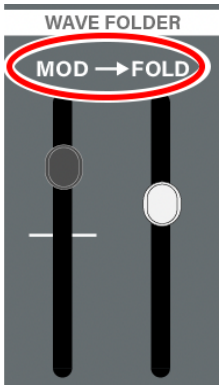
- **CAP COLOR**: Sliders with LIGHT caps are used to set a parameter's initial (pre modulation) value. Sliders with DARK caps are used to set the amount of modulation applied to a destination.

- **ARROWS**: Arrows indicate signal flow. For example:

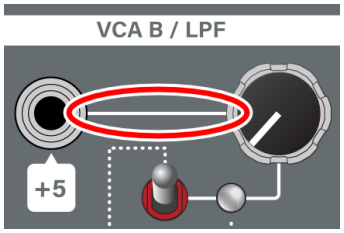
  An arrow between two jacks indicates that the signal present at one jack will be normalled to the other jack to which it points (provided nothing is patched into that jack). If the jacks are far apart, there may be a line that ends in an arrow.







Arrows between labels indicate one control affects the other (for example, in the Wave Folder module, the arrow pointing between the MOD label and the FOLD label indicates that the MOD value affects the FOLD value).



- **SOLID LINES**: Solid lines between a jack and a knob indicate direct attenuation, meaning the knob will increase/decrease the amount of signal appearing at the jack.

- **DOTTED LINES**: Dotted lines between elements indicate a level of additional control. For example, in the VCO A section, a dotted line connects the **SYNC TYPE** selector switch with the **SYNC** input jack. This indicates that the switch has an effect on the way the signal is synchronized. Similarly, the dotted line between the **PHASE** switch and the **FX RETURN LEVEL** knob indicates the switch controls something related to the return (in this case, its phase).

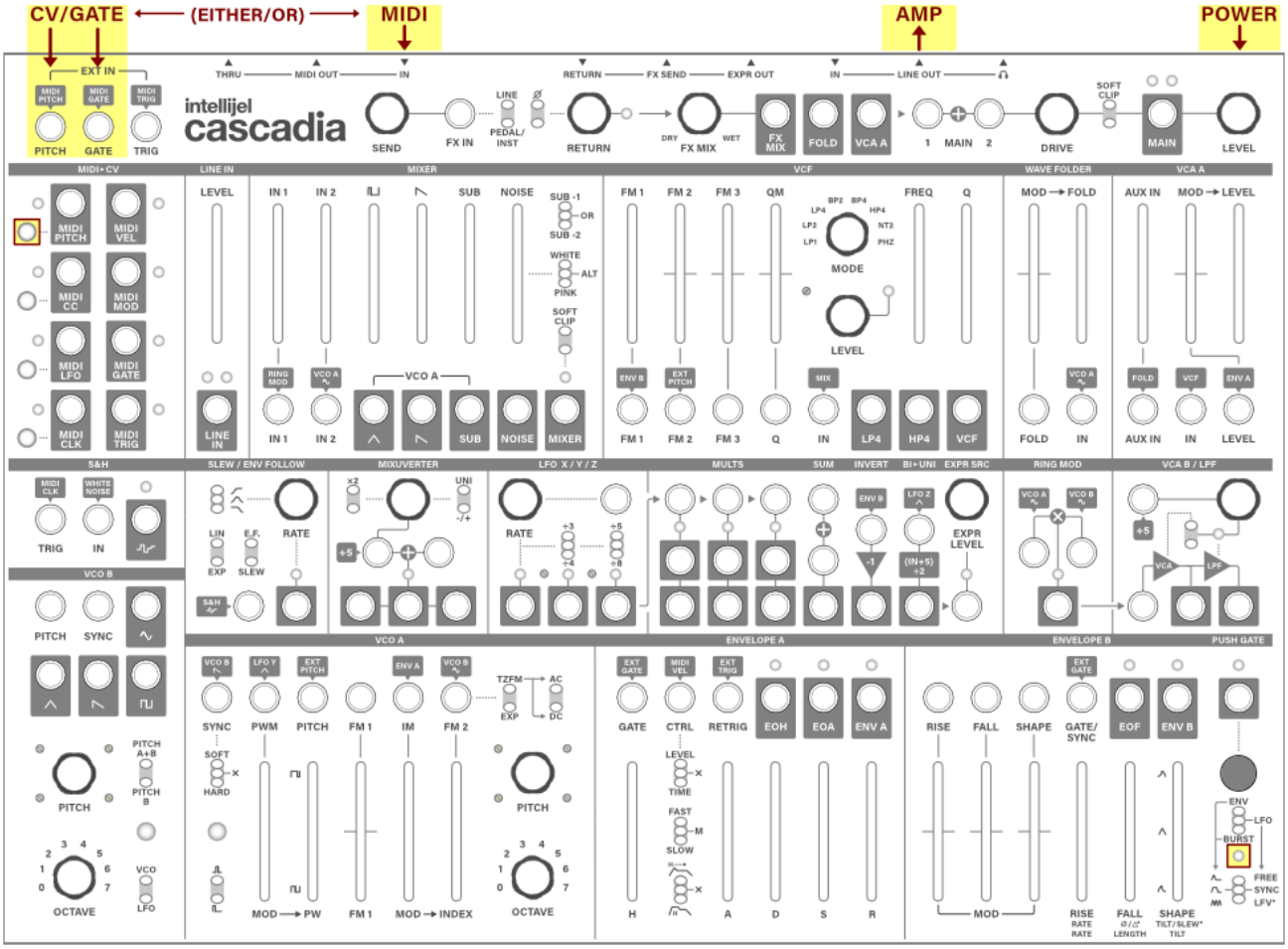
- **LEDs**: Unless otherwise noted, the brightness of an LED indicates the amount of signal present at the corresponding jack. Where appropriate, the color of the LED indicates the signal's polarity (GREEN = positive; RED = negative). Amber LEDS indicate gates or triggers.

As shown in the previous panel diagram, Cascadia's front panel is segmented into a number of sections — each with a complement of related jacks, knobs, sliders and switches. We will discuss each section in detail, and in the numerical order indicated. But first, let's make some sound!

MAKE A SOUND

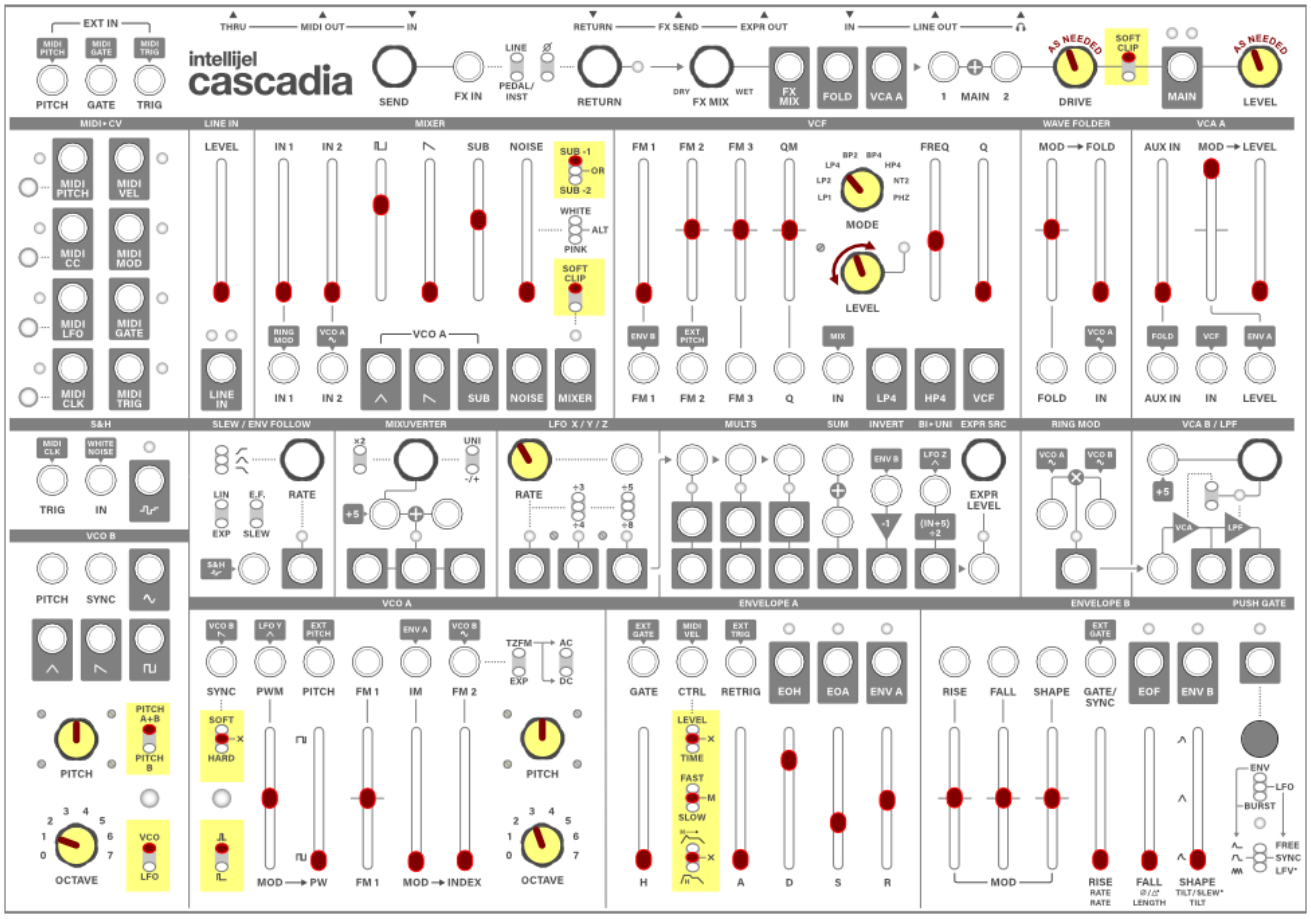
At this point, you're probably anxious to make a sound. Here's a little patch break to get you started. To begin, we'll connect power, audio, and either MIDI or CV/Gate.

1. Make sure Cascadia's POWER SWITCH is turned off; plug the supplied power adapter into a power source; and connect the barrel connector to the POWER input on Cascadia's back panel.
2. Connect the LINE OUT on Cascadia's back panel to your audio system. For optimum performance we recommend using TRS balanced connectors.
3. Turn on Cascadia using the POWER SWITCH on the back panel.
4. If you're playing Cascadia via CV/Gate, connect the Pitch/Gate jacks from your external controller to the EXT IN PITCH and GATE jacks on Cascadia's upper left corner and proceed to the next page.
5. If you're playing Cascadia via a MIDI controller, connect its MIDI OUT to Cascadia's MIDI IN jack (or to its USB MIDI input). By default, Cascadia is set to receive on MIDI Channel 1.
   NOTE: To receive on a different channel, press the button next to the MIDI PITCH jack in the upper left section to put Cascadia into "Channel Learn Mode". Once in Channel Learn Mode, the next MIDI channel message received at Cascadia's MIDI input will set the MIDI channel. Play a note on your MIDI controller to set Cascadia's MIDI channel to match. The SYNC LED (bottom right corner) flashes 3 times rapidly to signify the channel has been set.



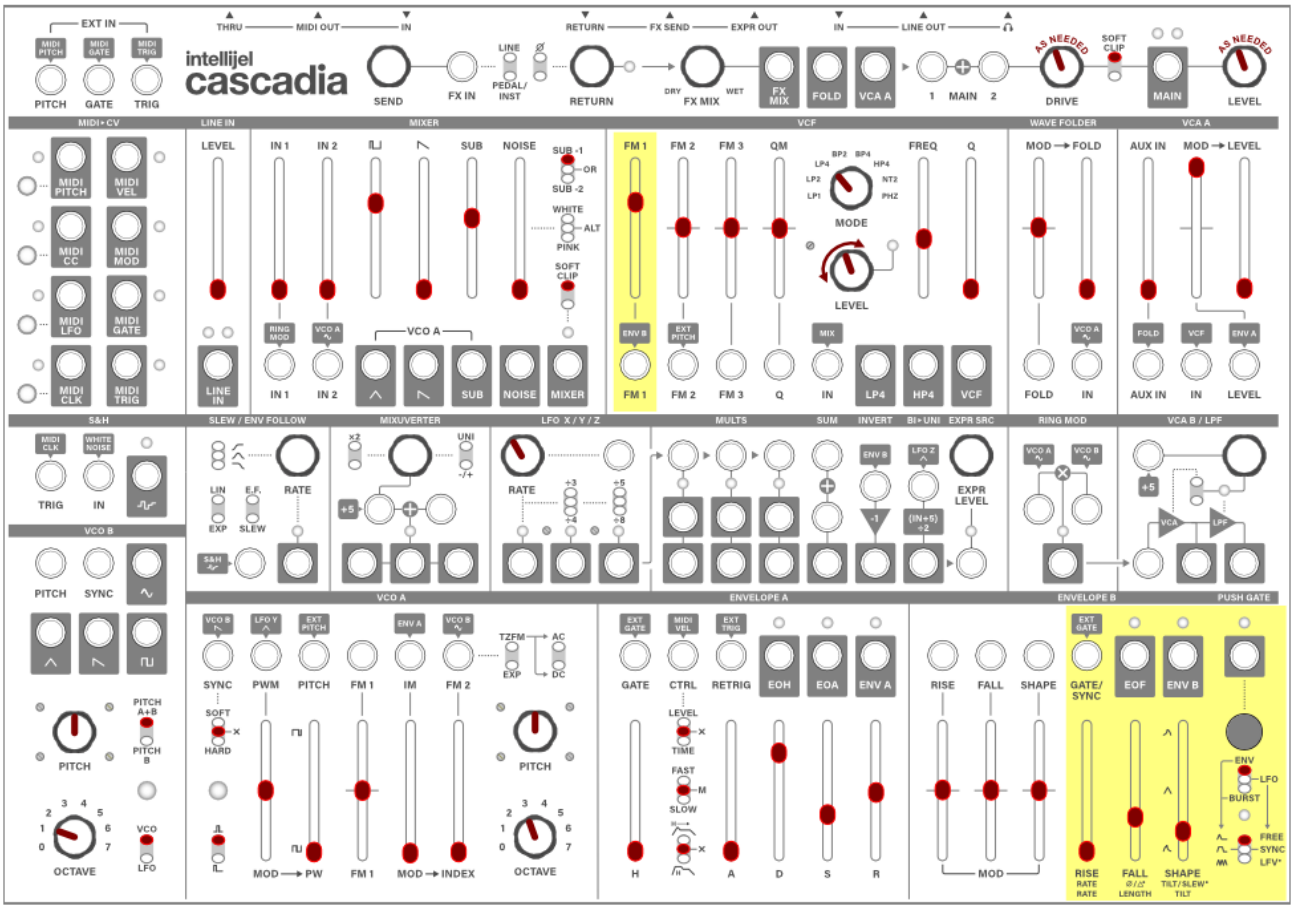
Now, let's start with a simple sound comprising a bit of pulse width modulation, some filtering, and a sub-oscillator.

1. Set all the sliders as shown below.
2. Set the indicated knobs as shown below. Not all knobs will be used in this patch, so you only need to worry about setting those that are marked in the diagram. The DRIVE and LEVEL knobs can be set based on your own volume preferences. Similarly, the exact position of the two VCO PITCH knobs depends on the tuning of your synth.
3. Set the indicated switches as shown below. Not all switches will be used in this patch, so you only need to set those that are highlighted in yellow on the diagram.
4. Play your keyboard or sequencer and you should hear a simple sound.



Next, we'll control the filter frequency with a second envelope to give it some "punch".

1. In the ENVELOPE B section, set the MODE SELECT switch to ENV (up position) and the TYPE SELECT switch to AD (up position).
2. Also in ENVELOPE B, set the RISE, FALL and SHAPE sliders as shown. This will give an envelope shape that's a bit punchier than the one that controls the VCA.
3. In the VCF section, raise the FM1 slider as shown. By default, the output of ENVELOPE B is patched into FM1, so no patch cords are needed.
4. Play your keyboard or sequencer and notice that there's now a bit of extra thump at the beginning of the sound.



Now we'll add a little note-to-note variation to give the sound some life.

1. Patch the ENV B output jack to the S&H section's TRIG input jack.

   This connection is indicated in the diagram as cable "A" — so you can see that one cable connects the two jacks labeled "A."

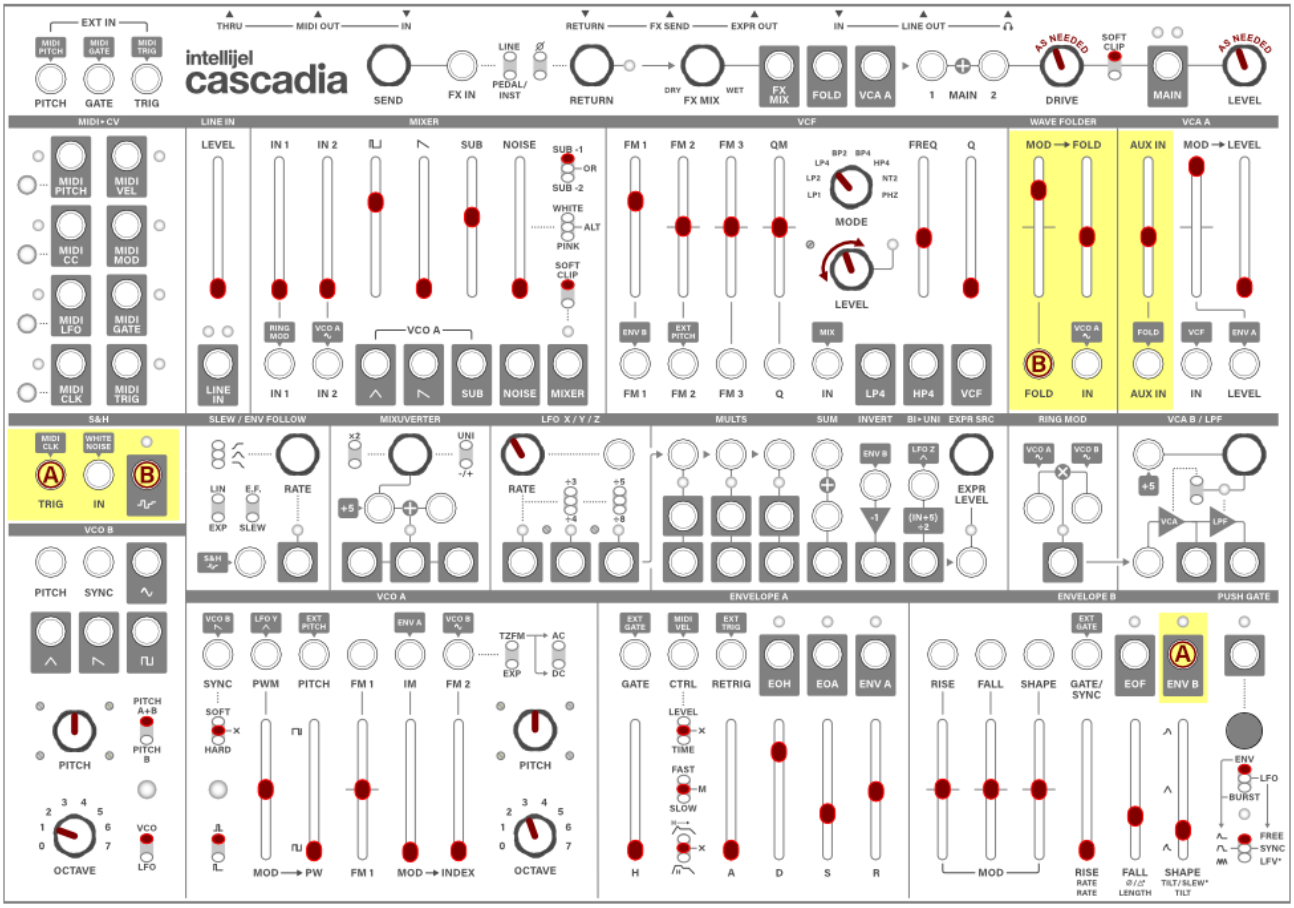
2. Patch the S&H output jack to the WAVE FOLDER section's FOLD in jack.

   This connection is indicated in the diagram as cable "B."

3. In order to hear the wavefolder, we'll need to look in the VCA A section and raise its AUX IN slider (which, by default, is assigned to the Wave Folder).

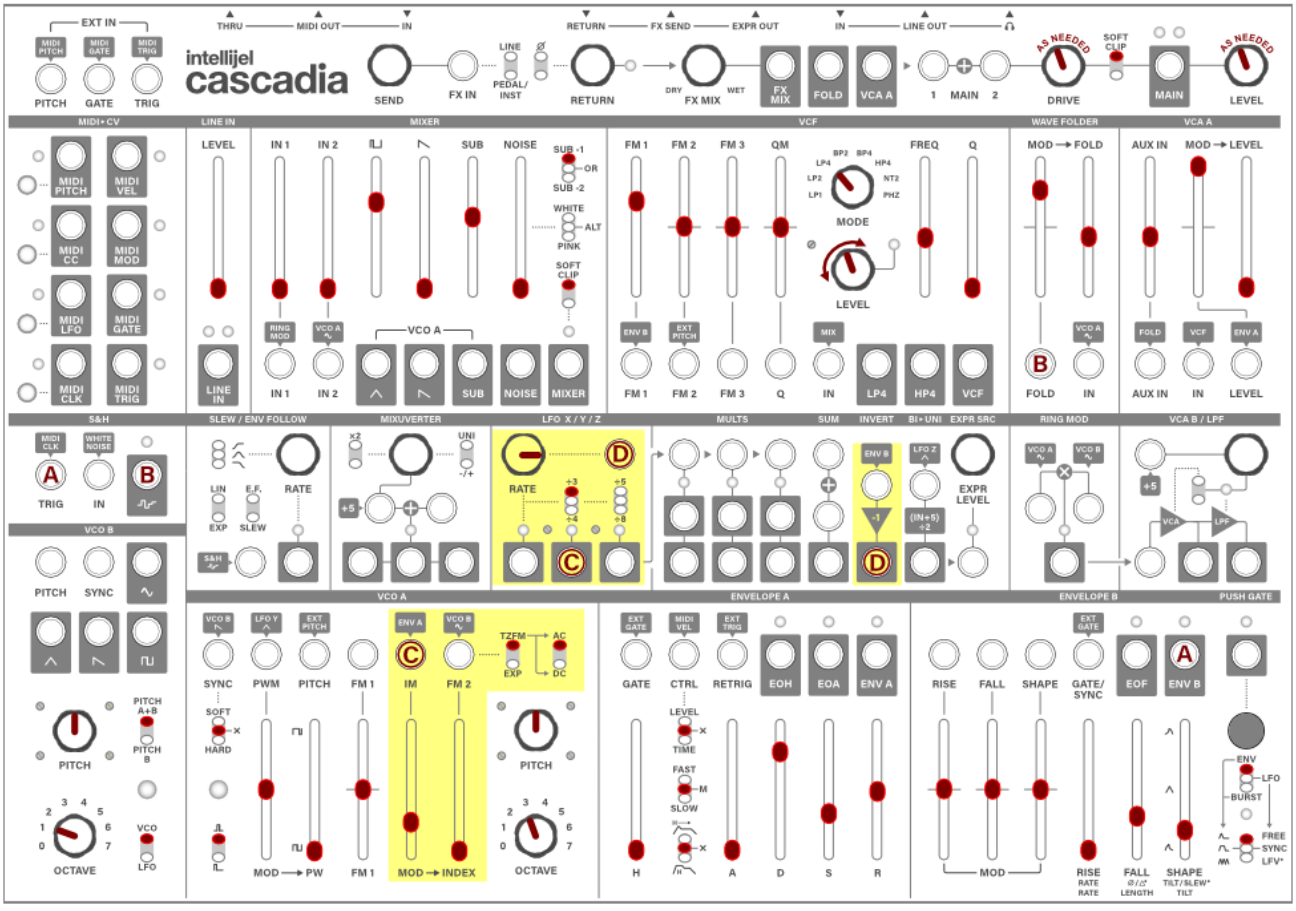
4. Next, in the WAVE FOLDER section, set the FOLD and MOD sliders as shown.

5. Play your keyboard or sequencer. Every time you hit a note, ENVELOPE B triggers the S&H module, generating a new random voltage, which will change the amount of wave folding applied to each note — thus giving the sound some dynamic character.



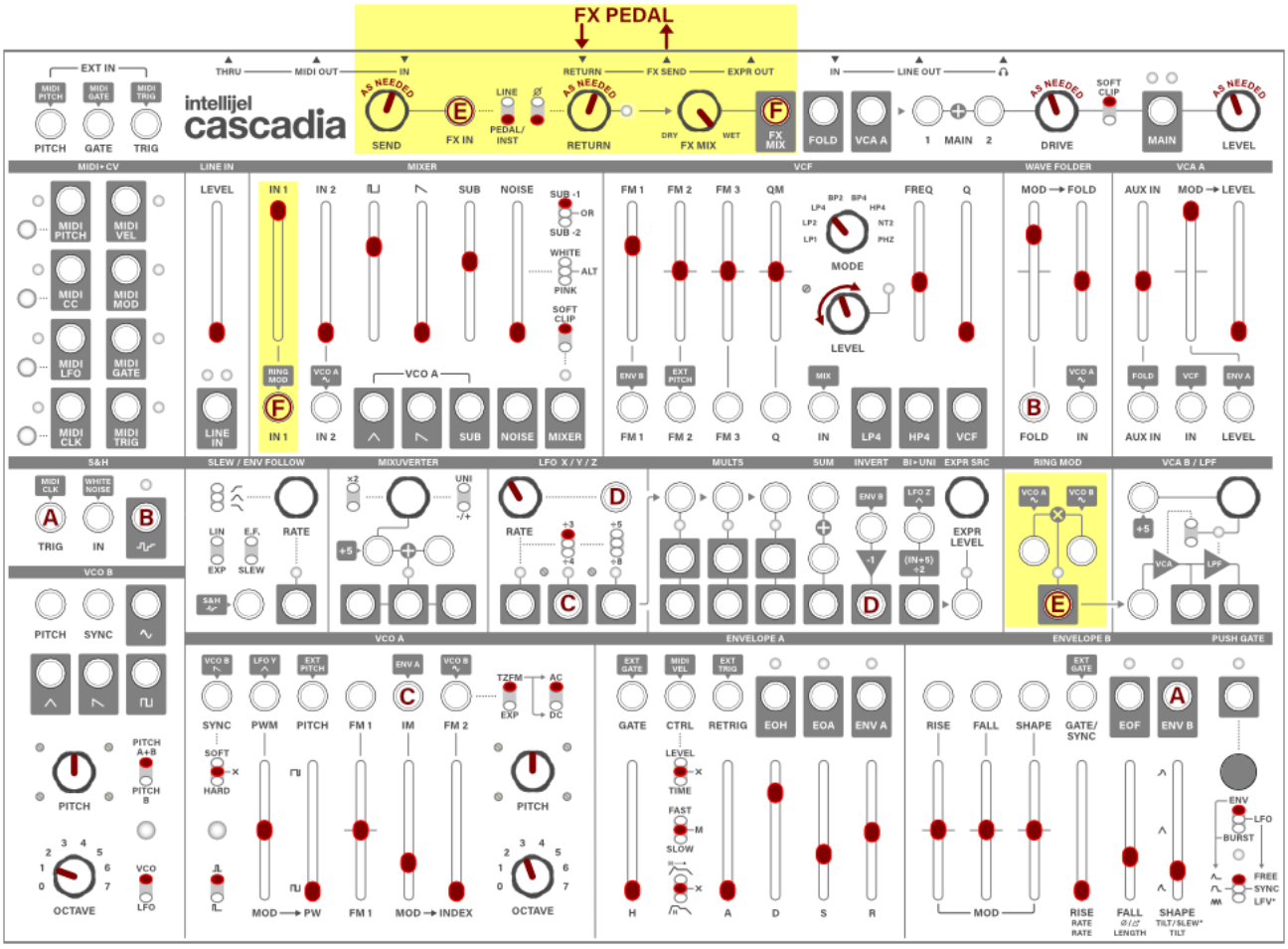
Now let's dirty things up a bit.

1. In the LFO section, set the LFO Y RATE DIVIDER switch to the up position (divide by 3). The switch makes the output oscillate at ⅓ the rate of LFO X (which is currently modulating the VCO A Pulse Width by default).
2. Also in the LFO section, increase the RATE knob to around 3:00 on the dial.
3. Patch LFO Y into VCO A's IM (Index Modulation) jack (as shown by Cable C), and increase VCO A's IM MOD slider as shown. Now you'll be able to hear LFO Y modulate the FM 2 index. Also in the VCO A section, set the TZFM/EXP selector switch to "TZFM" (up position) and the AC/DC selector switch to AC (up position).
4. As shown by Cable D, patch the INVERT out signal into the LFO section's RATE input jack. By default, this varies the LFO RATE by the inverted amount of ENVELOPE B.
5. Play your keyboard or sequencer. The sound is dirtier and wobblier courtesy of the FM applied to VCO A. Adjust VCO A's IM MOD slider to taste, as well as the LFO X/Y/Z RATE knob.



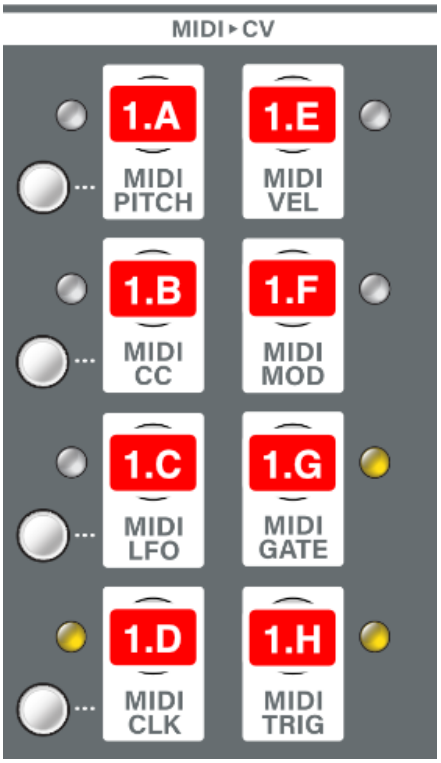
Feeling adventurous? Want to go a step further? Have a few FX pedals strewn about your studio? Let's insert one of them into Cascadia's signal chain. Cascadia is designed to add external effects anywhere in the signal chain you want, not just the output. In this next example, we're going to get even filthier, and use the ring mod — but instead of just mixing it into the signal, we're going to route just the ring mod through an external fuzz pedal, and then bring it back into Cascadia for mixing and filtering.

1. Patch Cascadia's rear panel FX SEND output into your FX PEDAL, then patch the output of your FX PEDAL into Cascadia's rear panel RETURN jack.
2. Patch a cable ("E") between the RING MOD output and the FX IN jack at the top of Cascadia.
3. Patch a cable ("F") between the FX MIX output and the MIXER section's IN 1 input jack, then raise the mixer's IN 1 slider as shown.
4. Set the SEND and RETURN levels, plus the LINE/INST level switch to get the best signal to noise ratio from your effects pedal. Set the Phase switch depending on whether your FX Pedal inverts phase, and set the DRY/WET signal to taste.
5. Play your keyboard or sequencer. A distorted RING MOD is now combined in the MIXER with the SQUARE and SUB waves, along with the folded wave (AUX IN) in VCA A. Adjust those levels to taste.



MIDI / CV

SECTION 1



This section of Cascadia takes MIDI data received at the back panel's **MIDI IN [14.G]** jack (or **USB MIDI [14.J]** port) and extracts 8 user-assignable CV outputs for patching into Cascadia.

1.A : **MIDI PITCH** OUT - 1V/octave CV output with a 10 octave range (±5V). The output voltage is determined by the pitch of the last played note, plus any pitch bend. MIDI note 0 (C-2) maps to -5V; MIDI note 60 (C3) maps to 0V; and MIDI note 120 (C8) maps to 10V. The higher the pitch, the brighter the corresponding LED. Configuration options are as follows:

- **PITCH BUTTON**
    - *PUSH function*: Puts Cascadia into "Channel Learn Mode". Once in Channel Learn Mode, the next MIDI channel message received at Cascadia's MIDI input will set the MIDI channel. If you wish to cancel Channel Learn Mode without sending it a MIDI signal, simply push the PITCH BUTTON again.

      When waiting for a MIDI message, the **SYNC LED [5.9]** in the ENVELOPE B section of the panel will pulse at a rate of about 2x per second. Upon learning the MIDI Channel, the SYNC LED will flash 3 times.
    - *LONG-PUSH function*: Initiates a "MIDI Panic" function, which triggers a MIDI "All Notes Off" message. Should an error occur in your external MIDI controller that results in it failing to send a Notes Off message to Cascadia, long-pushing the PITCH button will silence any notes that are stuck "on." The **SYNC LED [5.9]** in the ENVELOPE B section of the panel will flash 3 times to signify completion of the MIDI Panic message.
- **INTELLIJEL CONFIG APP** - Using the Intellijel Config App, you can configure the MIDI Channel along with several other general device parameters, including: Note Priority; Pitch Bend Range; Coarse Tuning; and Trigger Length.

*DEFAULT ROUTING: Without the use of patch cables, the MIDI PITCH OUT is routed to VCO A's **PITCH input [2.A]**, and the **VCF FM 2 modulation input [8.B]**. Additionally, it's summed with the **EXT CV PITCH input [18.A]** and also feeds VCO B's **PITCH input [3.A]** if its **PITCH SELECTOR switch [3.4]** is in the UP (PITCH A+B) position.*

1.B : **MIDI CC** OUT - CV output derived from a user-selected MIDI CC number (or MIDI aftertouch). By default, this is assigned to "CC 2 (Breath Controller)", though you can select another value. The corresponding LED indicates both the polarity (red = negative; green = positive) and intensity (bright = higher absolute voltage) of the output. Configuration options are as follows:

- **MIDI CC BUTTON**
    - *PUSH function*: Used to designate which CC # (or Aftertouch) is the voltage source for the **MIDI CC [1.B]** output jack. Pushing the button puts Cascadia into "CC Learn Mode." Once in CC Learn Mode, send a MIDI message to Cascadia using the MIDI CC number you want assigned to the **MIDI CC** jack. Alternatively, you could send MIDI Aftertouch. Cascadia will now derive a 0V - 5V unipolar voltage from the learned CC source and send it out the **MIDI CC** jack. If you wish to map the CC value to a bipolar voltage, use the Intellijel Config App.

      When in CC Learn Mode and waiting for a MIDI message, the **SYNC LED [5.9]** in the ENVELOPE B section of the panel will pulse at a rate of about once a second. Upon learning the MIDI CC assignment, the SYNC LED will flash 3 times.
    - *LONG-PUSH function*: Used to designate which CC # (or Aftertouch) is the voltage source for the **MIDI MOD [1.F]** output jack. Long-pushing (>1 sec) the button puts Cascadia into "MOD Learn Mode" Once in MOD Learn Mode, send a MIDI message to Cascadia using the MIDI CC number you want assigned to the **MIDI MOD** jack. Alternatively, you could send MIDI Aftertouch. Cascadia will now derive a unipolar voltage from the learned CC source and send it out the **MIDI MOD** jack. If you wish to map the CC value to a bipolar voltage, use the Intellijel Config App.

      When in MOD Learn Mode and waiting for a MIDI message, the **SYNC LED [5.9]** in the ENVELOPE B section of the panel will pulse at a rate of about once every 2 seconds. Upon learning the MIDI MOD assignment, the SYNC LED will flash 3 times.
- **INTELLIJEL CONFIG APP** - Using the Intellijel Config App, you can configure both the MIDI CC and MIDI MOD jacks, using their respective menus for Output Type (whether the data source is MIDI Aftertouch or MIDI CC); CC Number (the source of the MIDI CC from with the voltage is derived); and CV Polarity (whether the CC value is interpreted as a 0V to +5V unipolar signal, or as a -5V to +5V bipolar signal).

1.C : **MIDI LFO** OUT - Outputs a bipolar LFO of user-selectable shape, with a frequency based on sixteenth note divisions of the incoming MIDI clock. The LED blinks in time with the LFO, with color indicating polarity (red = negative; green = positive), and intensity (brighter = higher absolute voltage) indicating voltage amplitude. Configuration options are as follows:

- **MIDI LFO BUTTON**
    - *PUSH function*: Each push of the LFO button slows the MIDI LFO by dividing its rate in relation to a sixteenth note. At its default value, the LFO cycles every sixteenth note. Each push increases the rate division and slows the LFO. So the first push makes the LFO cycle every eighth note; the next push makes the LFO cycle every dotted eighth note; etc (as shown below):
        - sixteenth note cycle (default)
        - eighth note cycle
        - dotted eighth note cycle
        - quarter note cycle
        - dotted quarter note cycle
        - half note cycle
        - dotted half note cycle
        - whole note cycle
        - dotted whole note cycle
        - breve cycle (double whole note)

      At the end, the next push wraps back to the beginning (sixteenth note) and the SYNC LED flashes rapidly 10x to indicate you're back at the beginning.

      NOTE: Other metric LFO divisions are available using the Intellijel Config app, described later in the manual.
    - *LONG-PUSH function*: Each long-push (>1sec) of the MIDI LFO button selects a different LFO shape, cycling through Sine; Square; Ramp; Saw shapes with each long-push of the button.
- **INTELLIJEL CONFIG APP** - You can also use the Intellijel Config App to customize the **MIDI LFO** jack, using its LFO Shape and LFO Division menus.

1.D : **MIDI CLK** - Outputs a clock signal based either on a user-selectable division of the incoming MIDI Clock (MIDI mode), or on an internally-generated TAP tempo (one of two Tap modes). The LED blinks in time with the jack's clock output.

By default, Cascadia is set to power on using Tap (Auto Detect MIDI) mode. In this mode, Cascadia uses its internal clock (set by tapping the **MIDI CLK** button at the desired tempo). However, if you send MIDI Clock into Cascadia, then it will automatically switch over to MIDI clock mode, and use MIDI Clock (rather than the Tap Clock). Once MIDI is detected, Cascadia remains in MIDI clock mode unless switched manually into TAP clock mode (by long-pressing the **MIDI CLK** button), or by power-cycling back into the default Tap (Auto Detect MIDI) mode.

If you know you'll always be using one clock mode or the other (MIDI vs Tap), you can use the Intellijel Config App to set the MIDI/Tap Clock "Clock Mode" setting to either MIDI or Tap (rather than Tap (Auto Detect MIDI)).

- **MIDI CLK BUTTON**

  The button works as either a TAP TEMPO button (when in either of the two Tap Clock modes), or as a MIDI CLOCK DIVIDER (when in MIDI Clock mode). Specifically:

  - TAP CLOCK MODES

    In the TAP modes, the **MIDI CLK** button acts like a TAP TEMPO button — tap it at the desired tempo and the resulting clock is sent out the MIDI CLK jack. This is particularly useful if you're not controlling Cascadia via MIDI.

  - MIDI CLOCK MODE

    In MIDI mode, pushing the **MIDI CLK** button cycles through the various clock divisions of the incoming MIDI clock. Press the **MIDI CLK** button repeatedly to cycle through the following clock divisions (expressed as a division of 96 pulses):

    - /1 (clock out = 24 ppq)
    - /3 (clock out = 1/32 notes)
    - /6 (clock out = 1/16 notes)
    - /12 (clock out = 1/8 notes)
    - /24 (clock out = 1/4 notes)
    - /48 (clock out = 1/2 notes)
    - /96 (clock out = whole notes)

  You can toggle between MIDI and TAP clock modes by LONG-PUSHING (>1 sec) the **MIDI CLK** button.

- **INTELLIJEL CONFIG APP** - You can also use the Intellijel Config App to customize the **MIDI CLK** button/jack. The app has a Clock Mode menu that lets you set the **MIDI CLK** button to the desired MODE, as well as a Clock Division menu for setting the clock division directly (should TAP TEMPO not be the selected mode).

1.E : **MIDI VEL** OUT - CV output with a range of 0V - 5V. The voltage is proportional to the velocity of the last played MIDI note. The brightness of the corresponding LED indicates the overall velocity level.

DEFAULT ROUTING: The output of MIDI VEL is normalled to ENV A's ***CTRL*** ***[4.B]*** *jack, where (depending on the position of ENV A's* ***CTRL Source*** ***[4.8]*** *switch), it can affect either the overall envelope TIME or LEVEL.*

1.F : **MIDI MOD** OUT - CV output derived from a user-selected MIDI CC number (or MIDI aftertouch). By default, this is assigned to "CC 1 (Modulation Wheel)", though you can select another source. The corresponding LED indicates both the polarity (red = negative; green = positive) and intensity (bright = higher absolute voltage) of the output.

The MIDI MOD out is configured using the MIDI CC button. Specifically, LONG-PUSH (>1 sec) the MIDI CC button to put Cascadia into "MOD Learn Mode" (indicated by a slow pulsing of Cascadia's **SYNC LED** **[5.9]** in the ENVELOPE B section of the pane). Once in MOD Learn Mode, send a MIDI message to Cascadia using the MIDI CC number you want assigned to the **MIDI MOD** output jack. Alternatively, you could send MIDI Aftertouch. Cascadia will now derive a 0V - 5V unipolar voltage from the learned CC source and send it out the **MIDI MOD** jack. If you wish to map the CC value to a bipolar voltage, use the Intellijel Config App.

1.G : **MIDI GATE** OUT - Gate output which is high (5V) when a note is being played. The corresponding LED lights whenever the gate is high.

DEFAULT ROUTING: Without the use of patch cables, the MIDI GATE OUT is routed to both ENV A's ***GATE input*** ***[4.A]****, and ENV B's* ***GATE input*** ***[5.A]****, and is summed with the* ***EXT CV GATE input*** ***[18.B]****.*

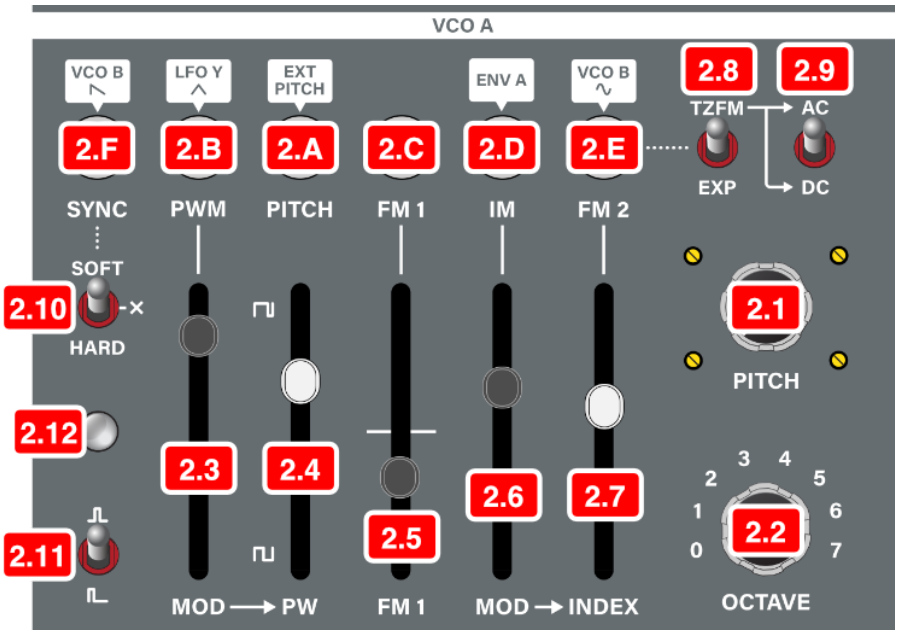
1.H : **MIDI TRIG** OUT - Trigger output which sends a 5V trigger when a MIDI note-on message is received. The corresponding LED lights whenever the trigger is transmitted. By default, the trigger length is 5ms, but this can be changed using the Intellijel Config App.

DEFAULT ROUTING: Without the use of patch cables, the MIDI TRIG OUT is routed to ENV A's ***RETRIG input*** ***[4.B]****, and and is summed with the* ***EXT CV TRIG input*** ***[18.C]****.*

VCO A

SECTION 2

VCO A is Cascadia's primary oscillator and is capable of a wide variety of analog timbres via its extensive sync, FM (frequency modulation) and PWM (pulse width modulation) features.



VCO A Controls

2.1 : **PITCH** knob - This knob finely adjusts the tuning frequency over a range of approximately 12 semitones.

Surrounding the PITCH knob are four trim pots, for calibrating the oscillator. In general, you should never need to touch these, as the oscillator was carefully calibrated before leaving the factory. However, should you need to re-calibrate, the trim-pots serve the following functions:

- Upper Left: Adjusts the pitch offset. It comes factory set with the PITCH knob's "noon" position being standard pitch, allowing for a ±6 semitone sweep.
- Upper Right: Adjusts the oscillator tracking. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.
- Lower Left: Adjusts high frequency compensation. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.
- Lower Right: Adjusts octave tracking. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.

2.2 : **OCTAVE** selector - This 8-position selector knob sets the coarse tuning of VCO A. Each clockwise rotation shifts the tuning up by one octave. Fine tuning adjustment can be made using the **PITCH** [2.1] knob.

2.3 : **PW MOD** (Pulse Width Modulation) slider - You can use a control voltage (CV) to modulate the pulse width amount (as set with the **PW** [2.4] slider). The **PW MOD** slider attenuates the voltage arriving at the **PWM IN** [2.B] jack, which therefor controls the extent to which the PW modulation is heard. PW MOD gives the waveform a sense of "movement." Maximum pulse

width modulation occurs when the slider is at the top, while no modulation occurs when the slider is at the bottom. Depending on the position of the **PW** **[2.4]** slider, it's possible to modulate the overall pulse width to a 100% duty cycle, which effectively silences the oscillator. This can be used to create interesting rhythmic effects.

*DEFAULT ROUTING: If nothing is patched into the **PWM IN** **[2.B]** jack, then the output of **LFO Y** **[12.4.B]** is patched into the PWM input.*

2.4 : **PW** (Pulse Width) slider - Sets the pulse width of the oscillator's PULSE wave output (accessed in the MIXER section on the **PULSE** **[7.3]** slider). Different pulse widths produce different timbres. With the slider at the bottom, the output produces a pulse wave with a 50% duty cycle (a square wave). With the slider at the top, the resulting pulse has approximately a 95% duty cycle, resulting in a thinner sounding pulse wave. You can reach 100% (silencing the oscillator) using **PW MOD** **[2.3]**.

2.5 : **FM 1** (Frequency Modulation 1) amount slider - This controls how much a signal patched into **FM 1** **[2.C]** modulates the oscillator's frequency. When the slider is at the top, maximum positive FM occurs. When the slider is at the bottom, maximum negative FM occurs. With the slider in the middle, no FM is heard. FM 1 uses exponential frequency modulation. For more information about exponential FM, see DETAILS: Understanding FM, later in this manual.

2.6 : **INDEX MOD (IM)** slider - You can modulate the INDEX amount with a control signal patched into the **IM IN** **[2.D]** input jack. The **INDEX MOD** slider adjusts the extent to which that control signal is added to the value set with the **INDEX amount** **[2.7]** slider. With the **INDEX MOD** slider at the top, maximum modulation is applied; with the slider at the bottom, no modulation is heard.

*DEFAULT ROUTING: If nothing is patched into the **IM IN** **[2.D]** jack, then the output of ENV A is used as the index modulation source.*

2.7 : **INDEX** amount slider - Sets the base FM INDEX level, which is the amount that a signal patched into the **FM 2** **[2.E]** input will modulate the VCO frequency. At the highest position, frequency modulation is at its maximum. When the slider is at the bottom, no frequency modulation occurs. Use the **TZFM/EXP** **[2.8]** switch to select between Linear Thru-Zero FM and Exponential FM.

*DEFAULT ROUTING: If nothing is patched into the **FM 2** **[2.E]** jack, then the sine wave output of VCO B is used as the FM 2 source.*

2.8 : **TZFM/EXP** selector switch - Switches between two types of frequency modulation methods for **FM 2** **[2.E]**: TZFM, which is through-zero linear frequency modulation, and EXP (exponential).

The effect is most clearly heard (and understood) when an audio rate signal is sent into the **FM 2** **[2.E]** input. If nothing is patched into **FM 2**, then VCO B's SINE wave output is routed into the FM 2 input.

See DETAILS: Understanding FM to learn more about these two types of frequency modulations, including their sonic characteristics, fundamental differences and sound design uses.

2.9 : **AC/DC** selector switch - Switches between two variations of TZFM: DC (which is the deepest variant, and is ideal for slower modulators, such as LFOs); and AC (which is not as deep, but is more accurate at tracking pitch).

2.10 : **SYNC TYPE** selector switch - Switches between Hard Sync (bottom position); No Sync (middle position); and Soft Sync (top position).

Sync occurs when the periodicity of VCO A is governed by another oscillator (patched into the **SYNC [2.F]** input). Different timbres are produced when the two oscillators run at different pitches. In order to synchronize to the SYNC oscillator, VCO A restarts its wavecycle every time the SYNC oscillator reaches some predetermined point in its cycle. This causes abrupt changes to VCO A's waveform, which results in a harmonically rich sound. For more information, see DETAILS: Understanding OSC Sync.

- **HARD** (down) - This is the traditional VCO sync method. It resets the VCO A waveform each time the **SYNC [2.F]** oscillator crosses zero in the positive direction.
- **X** (middle) - This removes the **SYNC [2.F]** oscillator input, meaning no sync sound occurs.
- **SOFT** (up) – This produces a 'softer' sync sound. It flips the VCO A waveform each time the **SYNC [2.F]** oscillator crosses zero in the positive direction. Waveforms with sharp edges (like square or saw) work best with SOFT sync.

2.11 : **PULSE POSITION** selector switch - Sets whether pulse waves are edge-triggered or center-triggered. Specifically, with the switch in the up position, the pulse wave is center-triggered. With the switch in the down position, the pulse wave is edge-triggered.

Although the two waveforms are essentially the same, they have different phase relationships, so they sound different when blended or synchronized with other waveforms. In general, edge pulses are better for syncing, but center pulses are perhaps more sonically 'pleasing.' Ultimately, let your ears be the judge.

2.12 : **RATE LED** - Visual display of the triangle core's oscillation rate. In general, since VCO A will usually be run at audio rates, the LED will appear orange (rapidly cycling between red and green so fast that the eye does not perceive the individual colors). However, when patched to cycle at LFO rates, one can see the individual colors, with red indicating negative voltages and green indicating positive, while the intensity of the LED indicates the absolute voltage value (the brighter the LED, the higher the voltage).

VCO A Jacks

2.A : **PITCH** IN - This input controls the pitch of VCO A, and is designed to take a 1 V/Oct input, typically generated by the output of sequencers or standard keyboard controllers.

DEFAULT ROUTING: If nothing is patched into the PITCH input jack, then the signal patched into Cascadia's **EXT IN: PITCH** **[13.1.A]** *input (either MIDI or CV) is used as the pitch source for VCO A.*

2.B : **PWM** IN - This input has a range of +/- 5 V, and is used to modulate VCO A's pulse width. The amount of PWM is governed by the **PW MOD** **[2.3]** slider, and the resulting voltage is summed with the current Pulse Width (as set with the **PW** **[2.4]** amount slider), and together they set the width of the VCO A PULSE wave (accessed in the MIXER section on the **PULSE** **[7.3]** slider). Note that external PW MOD allows for pulse widths that extend down to 0% and up to 100%. At these two extremes, the PULSE output is silenced, allowing for pulsing/rhythmic pitches.

DEFAULT ROUTING: If nothing is patched into the ***PWM IN*** *jack, then the output of* ***LFO Y*** ***[12.4.B]*** *is used as the PW modulation source.*

2.C : **FM 1** IN - FM (frequency modulation) input for traditional (exponential) FM. The extent to which this input modulates the frequency (either positively or negatively) is set by the **FM 1** **[2.5]** amount slider.

2.D : **IM** IN - CV input to control the FM INDEX (which is the amount that a signal patched into **FM 2** **[2.E]** will modulate the VCO A frequency). The extent to which this input modulates the INDEX amount is governed by the associated **INDEX MOD (IM)** **[2.6]** slider.

DEFAULT ROUTING: If nothing is patched into the ***IM IN*** *jack, then the output of ENV A is used as the index modulation source.*

2.E : **FM 2** IN - A second FM (frequency modulation) input for VCO A. The amount of frequency modulation is controlled by a built-in VCA, which is governed by both the **INDEX** **[2.7]** amount slider and the **IM IN** **[2.D]** voltage (and its corresponding **INDEX MOD (IM)** **[2.6]** attenuator slider.

Use the **TZFM/EXP** **[2.8]** switch to select whether **FM 2** is Exponential or Linear (TZFM).

DEFAULT ROUTING: If nothing is patched into the ***FM 2*** *input jack, it uses VCO B's Sine Wave output as the FM 2 source.*

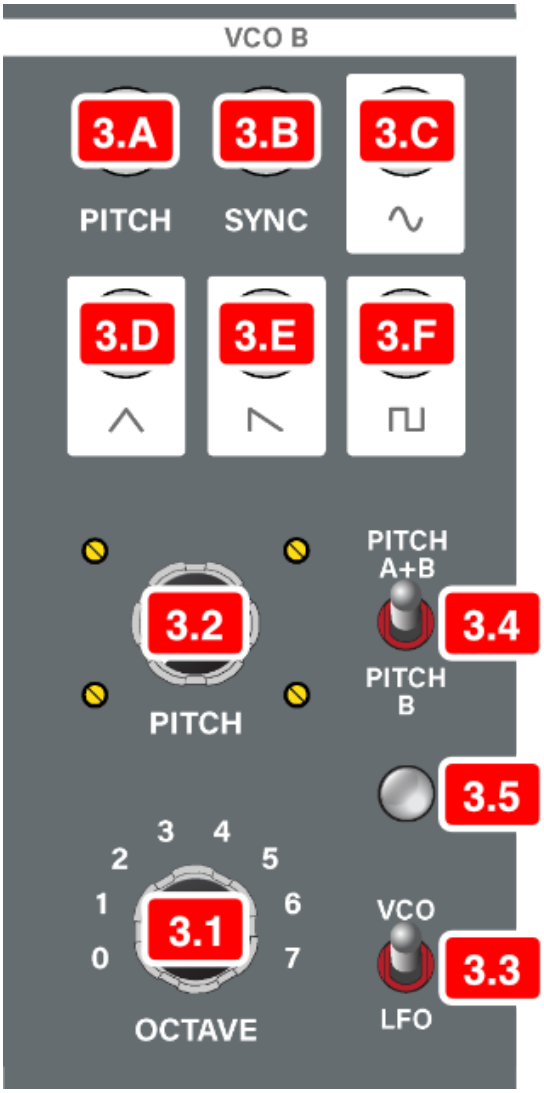
2.F : **SYNC** IN - VCO A syncs to the waveform received at this input.

DEFAULT ROUTING: If nothing is patched into the ***SYNC IN*** *jack, VCO A syncs to the* ***VCO B SAW*** ***[3.E]*** *output.*

VCO B

SECTION 3

VCO B can be used at either audio or LFO rates, making it useful as both a stand-alone audio oscillator and as a modulation source. It can be independently controlled, or synced to another oscillator, and it features four simultaneously-available output waveforms — some of which are normalled to various patch points in Cascadia.



VCO B Controls

3.1 : **OCTAVE** selector - This 8-position selector knob sets the coarse tuning of VCO B. Each clockwise rotation shifts the tuning up by one octave. Fine tuning adjustment can be made using the **PITCH** [3.2] knob.

3.2 : **PITCH** knob - This knob finely adjusts the tuning frequency over a range of approximately 12 semitones.

Surrounding the PITCH knob are four trim pots, for calibrating the oscillator. In general, you should never need to touch these, as the oscillator was calibrated before leaving the factory. However, should you need to re-calibrate, the trim-pots serve the following functions:

- Upper Left: Adjusts the pitch offset. It comes factory set with the PITCH knob's "noon" position being standard pitch, allowing for a ±6 semitone sweep. Offset this is, for example, you'd like the knob's 12 semitone range to allow more variation in one direction than the other (for example, 7 semitones up and 5 semitones down).
- Upper Right: Adjusts the oscillator tracking. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.
- Lower Left: Adjusts high frequency compensation. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.
- Lower Right: Adjusts octave tracking. Needed only if you have a tracking issue and are instructed to tweak this by Intellijel Tech Support.

3.3 : **VCO/LFO** selector switch - This switch changes whether VCO B operates as a low frequency oscillator (LFO) or as an audio rate oscillator (VCO).

- **VCO** - When set to the up position, the oscillator runs at audio rates.
- **LFO** - When set to the down position, the oscillator cycles at 1/1000 the frequency of VCO mode, allowing for cycles as slow as approximately 50 seconds.

3.4 : **PITCH SOURCE** selector switch - This switch selects which pitch input controls VCO B:

- **PITCH A+B** - When set to the up position, VCO B tracks the sum of the VCO A **PITCH [2.A]** input and the VCO B **PITCH [3.A]** input. If nothing is patched into the VCO B **PITCH [3.A]** input, then VCO B follows the pitch of VCO A.
- **PITCH B** - When set to the down position, only the signal patched into the VCO B **PITCH [3.A]** input controls the pitch of VCO B. If nothing patched into that input, then the pitch of VCO B is determined solely by the position of the **OCTAVE [3.1]** selector and the **PITCH [3.2]** knob.

3.5 : **RATE LED** - Visual display of the triangle core's oscillation rate. When the oscillator is used as an LFO, the LED cycles between red and green, with green indicating positive voltages, and red indicating negative. The intensity of the LED indicates the absolute voltage value (the brighter the LED, the higher the voltage). At audio rates, the oscillations occur too rapidly, and the LED appears orange.

VCO B Jacks

3.A : **PITCH** IN - This input controls the pitch of VCO B, and is designed to take a 1 V/Oct input, typically generated by the output of sequencers or standard keyboard controllers.

*DEFAULT ROUTING: If nothing is patched into the VCO B PITCH input and the **PITCH SOURCE [3.4]** switch is in the down "PITCH B" position, then the pitch of VCO B is determined solely by the position of the **OCTAVE [3.1]** selector and the **PITCH [3.2]** knob. If nothing is patched into the VCO B PITCH input and the **PITCH SOURCE [3.4]** switch is in the up "PITCH A+B" position, then VCO B follows the pitch of VCO A.*

3.B : **SYNC** IN - VCO B syncs to the waveform received at this input, using hard sync. For more information about oscillator sync (and the meaning of "hard" sync), see DETAILS: Understanding OSC Sync, later in this manual.

3.C : **VCO B SINE** OUT - Sine wave output of VCO B.

3.D : **VCO B TRIANGLE** OUT - Triangle wave output of VCO B.

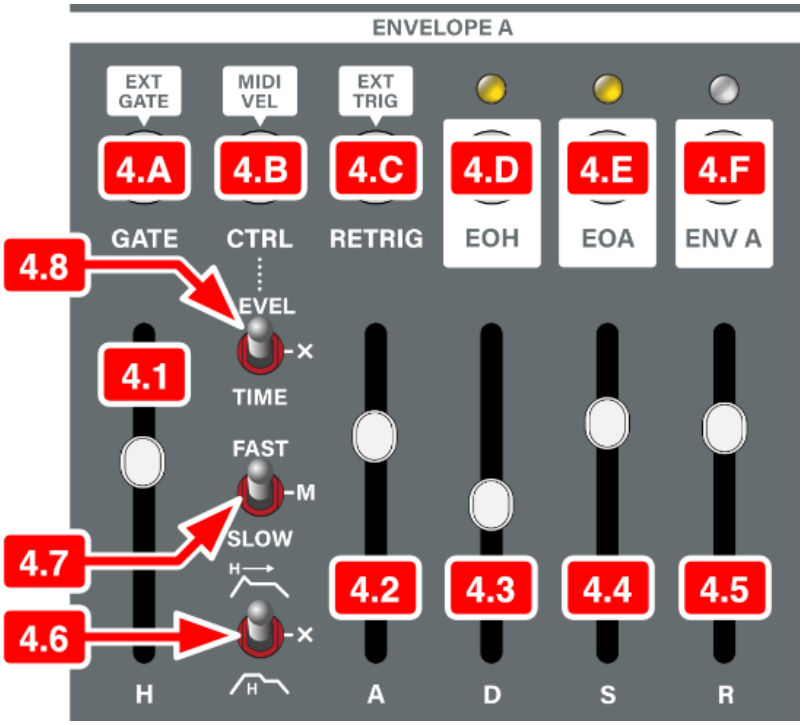
3.E : **VCO B SAW** OUT - Saw wave output of VCO B.

3.F : **VCO B SQUARE** OUT - Square wave output of VCO B.

ENVELOPE A

SECTION 4

Envelope A is a traditional ADSR (attack, decay, sustain, release) envelope generator, with an additional HOLD time control, which can modify the envelope in a couple of different ways. In addition, Envelope A features several different triggering options and can, itself, be tapped at various points within the envelope to trigger other synchronized events.



ENVELOPE A Controls

4.1 : **H (Hold)** time slider - This slider sets the Hold time duration. Use the **HOLD POSITION** [4.6] switch to determine if and how the Hold time affects the envelope, meaning it could function as a Gate extender; an additional envelope stage after the Attack stage; or disabled entirely. The higher the slider, the longer the hold time (which is scaled via the **ENVELOPE SPEED** [4.7] switch.

4.2 : **A (Attack)** time slider - This slider sets the duration of the envelope attack stage. This is the time it takes for the envelope level to go from zero to its maximum level, and is further affected by the **ENVELOPE SPEED** [4.7] switch. Fast attacks are at the bottom of the slider; slower attacks at the top.

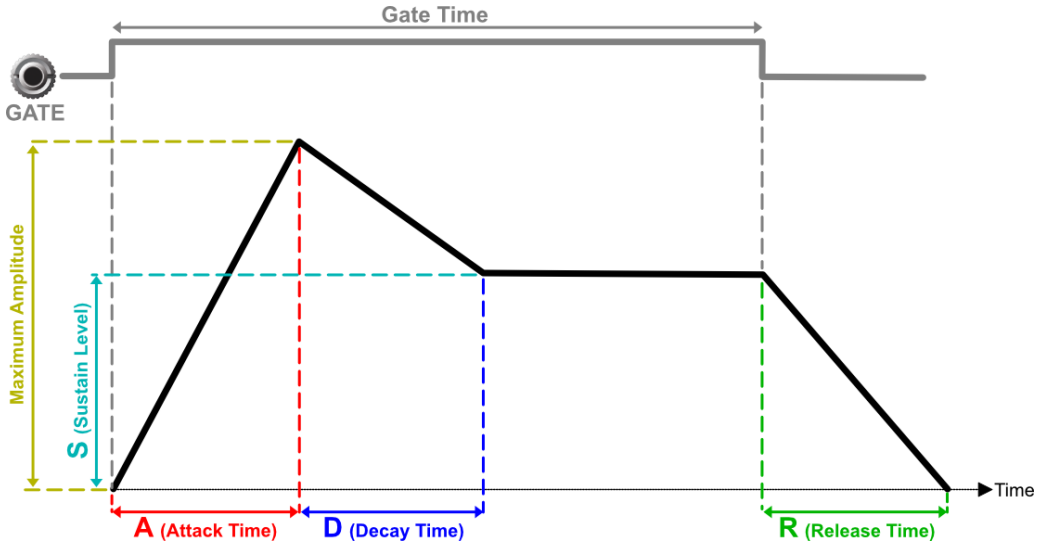
4.3 : **D (Decay)** time slider - This slider sets the duration of the envelope decay stage. This is the time it takes for the envelope level to go from its maximum level to the sustain level, and is further affected by the **ENVELOPE SPEED** [4.7] switch. Fast decays are at the bottom of the slider; slower decays at the top.

4.4 : **S (Sustain)** level slider - This slider sets the level of the sustain stage. It is 0 V at the bottom and 5 V at the top.

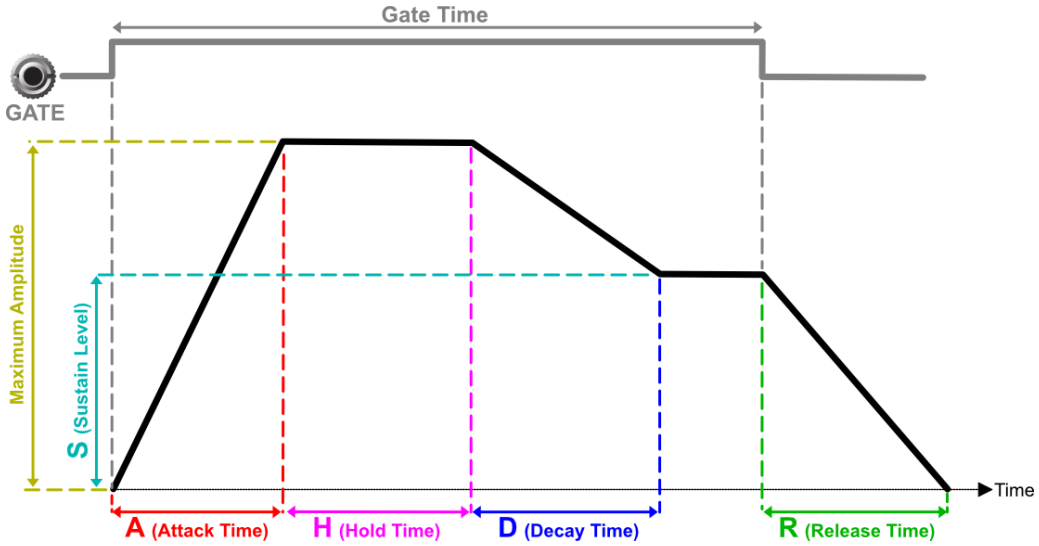
4.5 : **R (Release)** time slider - This slider sets the duration of the envelope release stage. This is the time it takes the envelope to return to 0V when the **GATE** [4.A] voltage goes low, and is further affected by the **ENVELOPE SPEED** [4.7] switch. Fast releases are at the bottom of the slider; slower releases at the top.

4.6 : **HOLD POSITION** selector switch - This switch determines if and how the HOLD time affects the envelope:

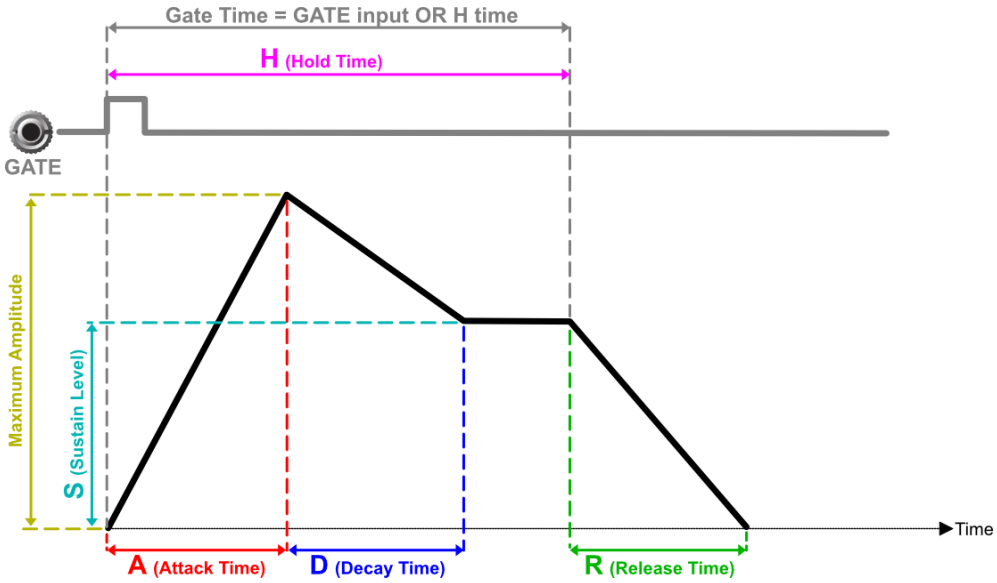
- **X** (Off) - The HOLD stage is ignored by the envelope (but not by the **EOH [4.D]** jack, allowing you to use HOLD as a delayed trigger source). In this position, a typical ADSR envelope is achieved, and is gated by the voltage present at the **GATE [4.A]** jack.



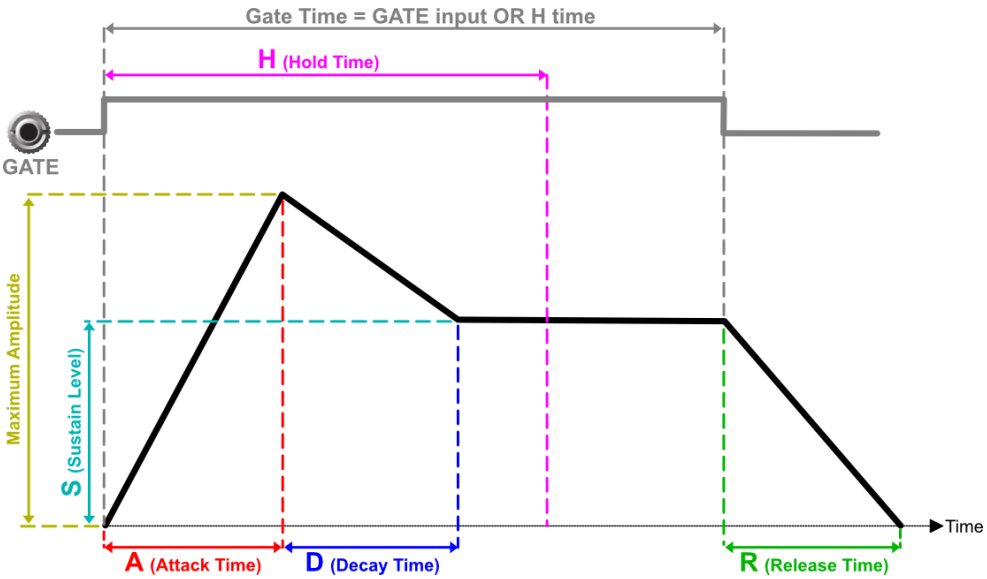
- **AHDSR** (bottom) - The HOLD time is used, and is applied *after* the ATTACK stage. So, when triggered, the ATTACK stage will play immediately, but then the amplitude will remain at its maximum level for the duration of the HOLD stage, before entering the DECAY stage.



- **Gate Extender** (top) - The HOLD time is used to set a secondary GATE time, which is OR'd with the **GATE IN [4.A]** jack. In this position, the envelope acts the same as a typical ADSR envelope, except *BOTH* the **GATE IN [4.A]** and the **HOLD [4.1]** time slider work together to determine the overall length of the envelope. The **GATE [4.A]** input and the **HOLD [4.1]** times are compared, and whichever is the longest time will gate the envelope. This is particularly useful as a gate extender, since even a short trigger input (patched into the **GATE [4.A]** jack) can generate a gate long enough to produce a full envelope.



If the **HOLD [4.1]** time is shorter than the length of the high gate patched into the **GATE [4.A]** input, then the envelope essentially functions the same as a basic ADSR.



4.7 : **ENVELOPE SPEED** switch - Selects the overall scaling of the envelope times, with FAST envelopes on top, SLOW envelopes on the bottom, and MEDium envelopes in the middle. Specifically:

- **FAST** Fastest overall envelope, good for percussive sounds. Slider-controlled ranges are as follows:

  H : 0.001 ms - 2.5 s
  A : 0.2 ms - 1.5 s
  D/R : 0.6 ms - 2.5 s

- **MED** Medium speed envelope, good for most sound design duties. Slider-controlled ranges as follows:

  H : .001 ms - 10 s
  A : 2 ms - 10 s
  D/R : 3.5 ms - 10 s

- **SLOW** Long, slow envelope good for pads, drones, and evolving sounds. Slider-controlled ranges as follows:

  H : .001 ms - 60 s
  A : 9.3 ms - 60 s
  D/R : 30 ms - 60 s

*NOTE: The length of each envelope stage can be extended via a control voltage patched into the **CTRL IN** [4.B] jack, and the **CTRL SOURCE** [4.8] switch set to the TIME position.*

4.8 : **CTRL SOURCE** switch - Sets how a signal patched into the **CTRL IN** **[4.B]** jack scales the envelope. Specifically:

- **LEVEL** - A signal patched into the **CTRL IN** jack governs the maximum output level of the envelope. Sending +5V into the **CTRL IN** jack ensures that the end of a full Attack stage will result in a +5V (full amplitude) envelope. Values below +5V that are applied to the CTRL IN jack will decrease the envelope's maximum value proportionally.

  DEFAULT ROUTING: If nothing is patched into the **CTRL IN** **[4.B]** jack, then **MIDI VELOCITY** **[1.E]** is used, meaning the softer you strike a note, the lower the envelope's amplitude — much like an acoustic instrument behaves.

  *NOTE: Keep in mind, if the switch is set to LEVEL, and the last input (**MIDI VELOCITY** **[1.E]**, by default) received at the **CTRL IN** **[4.B]** jack had a value of zero, then the envelope will also have a maximum level of zero — meaning it will have no audible effect until a higher voltage is patched into the jack.*

- **X** (OFF) - The envelope ignore any signal present at the **CTRL IN** jack, and always outputs a full (+5V) envelope, whose time is fixed by the front panel sliders.

- **TIME** - A signal patched into the **CTRL IN** jack governs the overall envelope time, by scaling the time of each envelope stage proportionally — i.e. Attack, Decay, Release, and Hold (if engaged) times are all scaled. If 0V is applied to the **CTRL IN** jack, each envelope stage uses the time values set by the front panel sliders. Voltages above 0V shorten the time of each stage proportionally, resulting in a shorter envelope.

  DEFAULT ROUTING: If nothing is patched into the **CTRL IN** **[4.B]** jack, then **MIDI VELOCITY** **[1.E]** is used, meaning the softer you strike a note, the slower its envelope — much like an acoustic instrument behaves.

ENVELOPE A Jacks

4.A : **GATE** IN - The gate signal patched into this jack is used to gate the envelope. Specifically, if the GATE IN is high, the envelope moves through its stages until it hits the sustain stage, and remains there until the gate goes low — triggering the release stage. If the gate goes low before the sustain stage is reached, then the release stage begins immediately (without the envelope completing its earlier stages).

*DEFAULT ROUTING: If nothing is patched into the **GATE IN** jack, then the signal patched into Cascadia's **EXT IN: GATE** **[13.1.B]** input (either MIDI or external CV) is used to gate the envelope.*

4.B : **CTRL** IN - A control voltage patched into this jack will control either the envelope's overall amplitude; it's overall length; or nothing at all — depending on the position of the **CTRL SOURCE** **[4.8]** switch.

*DEFAULT ROUTING: If nothing is patched into the **CTRL IN** jack, Cascadia's **MIDI VELOCITY** [1.E] output is used to control the envelope.*

4.C : **RETRIG** IN - A positive voltage trigger patched into this jack resets the envelope, and re-starts the attack stage from the current envelope level.

*DEFAULT ROUTING: If nothing is patched into the **RETRIG IN** jack, Cascadia's **EXT TRIG** [1.8] output is used to retrigger the envelope.*

4.D : **EOH** (End of Hold) OUT - By default, it operates as a trigger output. The output stays at 0V, but outputs a brief +5V trigger pulse only when reaching the end of the HOLD stage. The LED above the jack lights when the voltage is high.

NOTE 1: Using the Intellijel Config App, you can globally change this (and all other envelope stage outputs) to operate as gates, rather than triggers. When configured as a gate output, the jack outputs a 0V signal at the beginning of the HOLD stage, and stays at 0V until the end of the HOLD stage — jumping back to +5V when the stage ends.

*NOTE 2: if the **HOLD POSITION** [4.6] switch is set to the '**X**' position (meaning the HOLD time is ignored by the envelope), the **EOH** jack still transmits an output following the time set by the **HOLD** [4.1] time slider. This lets you send delayed triggers without affecting the actual envelope.*

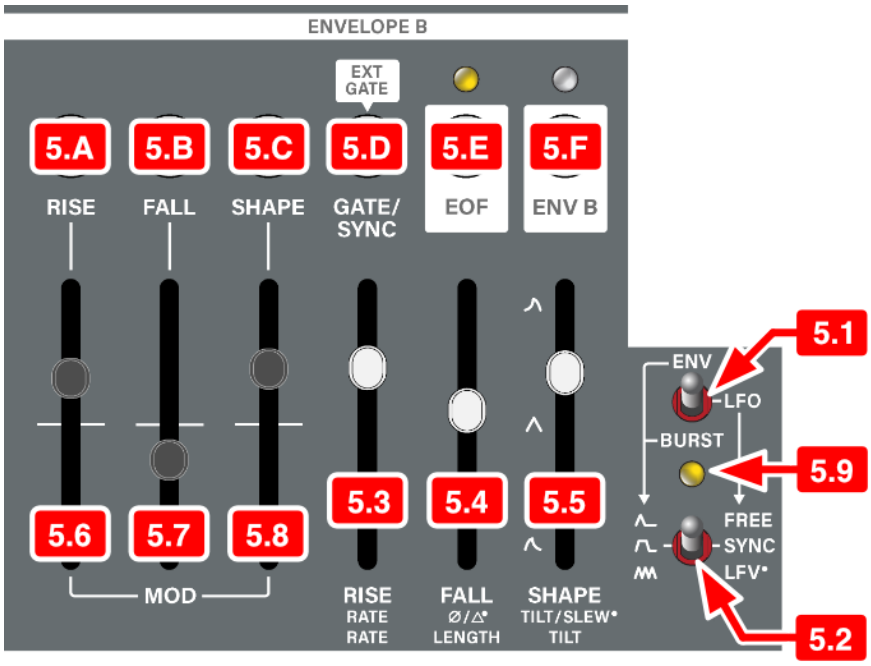
4.E : **EOA** (End of Attack) OUT - By default, it operates as a trigger output. The output stays at 0V, but outputs a brief +5V trigger pulse only when reaching the end of the ATTACK stage. The LED above the jack lights when the voltage is high.

NOTE: Using the Intellijel Config App, you can globally change this (and all other envelope stage outputs) to operate as gates, rather than triggers. When configured as a gate output, the jack outputs a 0V signal at the beginning of the ATTACK stage, and stays at 0V until the end of the ATTACK stage — jumping back to +5V when the stage ends.

4.F : **ENV A** OUT - Output of the envelope, which travels between 0V and 5V throughout its duration. The LED above the jack changes in intensity over the course of the envelope — the brighter the LED, the greater the output voltage.

ENVELOPE B

SECTION 5



In spite of its humble name, Envelope B is an advanced, multifaceted function generator. Use the **MODE SELECT** [5.1] switch to specify whether Envelope B acts as an ENVELOPE, LFO, or pulse BURST generator.

The selected mode impacts the way in which the various sliders, switches and jacks operate, as indicated by the alternate panel labels.

The following section provides only a generic overview of this section's controls. Each mode is discussed, in detail, later in this manual. Specifically:

- BURST mode is discussed in Details: Envelope B as Pulse Burst Generator
- ENVELOPE mode is discussed in Details: Envelope B as Envelope
- LFO mode is discussed in Details: Envelope B as LFO

ENVELOPE B Controls

5.1 : **MODE SELECT** switch - Sets the function type of Envelope B. There are three positions, corresponding to the three function modes:

- **ENVELOPE MODE** (top position) - Envelope mode functions like a 'typical' envelope generator, the type of which (AD; AHR; Cycling) is set with the **TYPE SELECT [5.2]** switch. In this mode the **RISE [5.3]** slider sets the attack time; the **FALL [5.4]** slider sets the Decay (AD) or Release (AHR) time; and the **SHAPE [5.5]** slider determines the envelope's curvature. This mode is discussed thoroughly in Details: Envelope B as Envelope, later in this manual.
- **LFO MODE** (middle position) - In LFO mode, the section functions either as a bipolar, free-running or beat-syncable LFO that tilts from saw-to-triangle-to-ramp, and which can be phase offset; or as a Low Frequency Vacillator (LFV) that meanders through a sort of randomly chaotic series of oscillations. LFO mode is discussed thoroughly in Details: Envelope B as LFO, later in this manual.
- **BURST MODE** (bottom position) - Burst Mode generates a series of pulses that repeat at a variable rate (set by the **RISE/RATE [5.3]** slider) within a length of time (set by the **FALL/LENGTH [5.4]** slider), whose pulse shapes and overall amplitude curve are defined with the **SHAPE/TILT [5.5]** slider. Various triggering options are available with the **TYPE SELECT [5.2]** switch. Burst Mode is discussed thoroughly in Details: Envelope B as Pulse Burst Generator, later in this manual.

5.2 : **TYPE SELECT** switch - works in conjunction with the **MODE SELECT [5.1]** switch to define the function of Envelope B.

If the **MODE SELECT** switch is set to either BURST or ENVELOPE, the switch selects between CYCLE, AHR, and AD modes, as indicated by the labels on the left. If the **MODE SELECT** switch is set to LFO, the switch selects different LFO options, as indicated by the labels on the right.

See the DETAILS section of the manual for a deep dive into each of the Envelope B modes, and how the **TYPE SELECT** switch functions.

5.3 : **RISE** slider - The function of the RISE slider changes depending on the setting of the **MODE SELECT** **[5.1]** and **TYPE SELECT** **[5.2]** switches.

- **ENV** mode: The slider controls the rise time (attack) of the function (rising from zero to the maximum level). Slower times will create a fade-in effect while faster times are used for snappy percussive sounds.
- **LFO** mode: The slider sets the LFO/LFV rate or, if set to SYNC mode, multiplies/divides a clock patched into the **GATE/SYNC** **[5.D]** input. See “DETAILS: Envelope B as LFO” later in this manual for more details.
- **BURST** mode: The slider sets the rate at which pulses are generated within the burst envelope.

5.4 : **FALL** slider - The function of the FALL slided changes depending on the setting of the **MODE SELECT** **[5.1]** and **TYPE SELECT** **[5.2]** switches.

- **ENV** mode: The FALL slider sets the amount of time it takes for the function to fall from its maximum value back to zero. With an AHR type envelope, this will act as the release time. With a CYCLE type envelope, the total time of RISE plus FALL sets the frequency of the cycle.
- **LFO** mode: If the **TYPE SELECT** **[5.2]** switch is set to either SYNC of FREE, the slider offsets the LFO’s phase — from 0° at the bottom, to 360° at the top. If the **TYPE SELECT** **[5.2]** switch is set to LFV, the slider sets the maximum amount that each vacillation is allowed to vary from the previous.
- **BURST** mode: The FALL slider sets the overall length of the pulse burst envelope.

5.5 : **SHAPE** slider - The function of the SHAPE slider changes depending on the setting of the **MODE SELECT** **[5.1]** and **TYPE SELECT** **[5.2]** switches.

- **ENV** mode: The SHAPE slider varies the shape of the RISE and FALL curves.
- **LFO** mode: If the **TYPE SELECT** **[5.2]** switch is set to either SYNC of FREE, the slider tilts the waveshape from saw (bottom) to triangle (middle) to ramp (top). If the **TYPE SELECT** **[5.2]** switch is set to LFV, the slider slews the waveform for smoother vacillations.
- **BURST** mode: The slider tils the overall burst envelope plus the waveform of each pulse within that envelope.

5.6 : **RISE MOD** slider - You can modulate the RISE time by patching a control voltage into the **RISE MOD** **[5.A]** jack. The RISE MOD slider sets the polarity and amount by which that input voltage modulates the RISE time (as set with the **RISE** **[5.3]** slider).

Settings above the centerline affect the RISE time in a positive direction. The higher the position, the greater the input voltage's effect.

Settings below the centerline affect the RISE time in a negative direction. The lower the position, the greater the input voltage's effect.

When set at the center line, the voltage patched into the **RISE MOD** **[5.A]** jack has no effect.

5.7 : **FALL MOD** slider - You can modulate the FALL time by patching a control voltage into the **FALL MOD** **[5.B]** jack. The FALL CV slider sets the polarity and amount by which that input voltage modulates the FALL time (as set with the **FALL** **[5.4]** slider).

Settings above the centerline affect the FALL time in a positive direction. The higher the position, the greater the input voltage's effect.

Settings below the centerline affect the FALL time in a negative direction. The lower the position, the greater the input voltage's effect.

When set at the center line, the voltage patched into the **FALL MOD** **[5.B]** jack has no effect.

5.8 : **SHAPE MOD** slider - You can modulate the SHAPE by patching a control voltage into the **SHAPE MOD** **[5.C]** jack. The SHAPE MOD slider sets the polarity and amount by which that input voltage modulates the SHAPE (as set with the **SHAPE** **[5.5]** slider).

Settings above the centerline affect the SHAPE in a positive direction. The higher the position, the greater the input voltage's effect.

Settings below the centerline affect the SHAPE time in a negative direction. The lower the position, the greater the input voltage's effect.

When set at the center line, the voltage patched into the **SHAPE MOD** **[5.C]** jack has no effect.

5.9 : **SYNC** LED - This LED has a dual purpose:

- *As an indicator LED for ENVELOPE B.*

  In this scenario, the LED is used only when the **MODE SELECT [5.1]** switch = ”LFO” and the **TYPE SELECT [5.2]** switch = ”SYNC”. In this scenario, the LED flashes in time with the SYNChronized LFO. No other ENVELOPE B modes will cause the SYNC LED to light.

- *As an indicator LED for MIDI configuration*.

  In this scenario, the LED is used to provide feedback when learning or modifying **MIDI / CV** settings. Specifically:

  - Fast Pulse (twice a second) : Indicates that you have pressed the ***PITCH [1.A]*** *button to put Cascadia into “Channel Learn Mode,” and Cascadia is waiting for you to send it a MIDI message. Upon learning the MIDI Channel, the LED will flash to confirm.*
  - Medium pulse (once a second) : Indicates that you have pressed the ***MIDI CC [1.B]*** *button to put Cascadia into “MIDI CC Learn Mode,” and Cascadia is waiting for you to send it a MIDI CC message. Upon learning the MIDI CC, the LED will flash to confirm.*
  - Slow pulse (once every two seconds) : Indicates that you have long-pressed the ***MIDI CC [1.B]*** *button to put Cascadia into “MIDI MOD Learn Mode,” and Cascadia is waiting for you to send it a MIDI CC message. Upon learning the MIDI MOD CC, the LED will flash to confirm.*
  - *3 Flashes : Indicates that you have made a configuration change in Cascadia’s **MIDI / CV** section.*
  - *10 Flashes : Indicates either that 1) the MIDI CLOCK division has been changed back to its default value (16th notes), or 2) the MIDI LFO division has been changed back to its default value (/1).*

ENVELOPE B Jacks

5.A : **RISE MOD** IN - A voltage patched into this jack varies the RISE time from the value set by the **RISE** **[5.3]** slider. The input voltage (and thus, the amount by which the RISE MOD input is allowed to affect the RISE time) is attenuverted by the **RISE MOD** **[5.6]** slider.

5.B : **FALL MOD** IN - A voltage patched into this jack varies the FALL time from the value set by the **FALL** **[5.4]** slider. The input voltage (and thus, the amount by which the FALL MOD input is allowed to affect the FALL time) is attenuverted by the **FALL MOD** **[5.7]** slider.

5.C : **SHAPE MOD** IN - A voltage patched into this jack varies the SHAPE from the value set by the **SHAPE** **[5.5]** slider. The input voltage (and thus, the amount by which the SHAPE MOD input is allowed to affect the SHAPE) is attenuverted by the **SHAPE MOD** **[5.8]** slider.

5.D : **GATE/SYNC IN** - Patch a trigger or gate signal here to initiate the function selected with the **MODE SELECT** **[5.1]** and **TYPE SELECT** **[5.2]** switches.

*DEFAULT ROUTING: If nothing is patched into the **GATE/SYNC** **[5.D]** jack, Cascadia's external Gate is used (which can be derived either from the **MIDI GATE** **[1.G]**, the **GATE CV** **[13.1.B]** input, or the front panel **MANUAL GATE** **[11.1]** button.*

*NOTE: With the **MODE SELECT** **[5.1]** switch set to LFO and the **TYPE SELECT** **[5.2]** switch set to SYNC, you will probably want to patch a clock into the GATE/SYNC IN jack, since that particular mode is designed to synchronize Envelope B's LFO to an external clock seen at the GATE/SYNC IN jack.*

5.E : **EOF** (End Of Fall) OUT - By default, operates as a trigger output. The output stays at 0V, but outputs a brief +5V trigger pulse only when reaching the end of the FALL stage. The LED above the jack lights when the voltage is high.

NOTE: Using the Intellijel Config App, you can globally change this (and all other envelope stage outputs) to operate as gates, rather than triggers. When configured as a gate output, the jack outputs a 0V signal at the beginning of the FALL stage, and stays at 0V until the end of the FALL stage — jumping back to +5V when the stage ends.

5.F : **ENV B** OUT - Output of the envelope, which travels between 0V and 5V throughout its duration. The LED above the jack indicates both the polarity and amplitude of the output signal — positive voltage light the LED green; negative voltages light it red; and the brightness of the LED indicates the amount of voltage.

LINE IN

SECTION 6

LINE IN enables you to patch an external audio signal into your synthesizer and process it with Cascadia's filter, wavefolder or envelopes; or to use it as a modulation source for Frequency Modulation, Ring Modulation, Sample & Hold, and so on.

6.1 : **LEVEL** slider - Attenuates the signal arriving at the back panel's ¼" **LINE IN [14.C]** jack. The attenuated signal is then routed to the **LINE IN [6.A]** output jack for patching into Cascadia. Pay attention to the two LEDs to assist with the level setting.

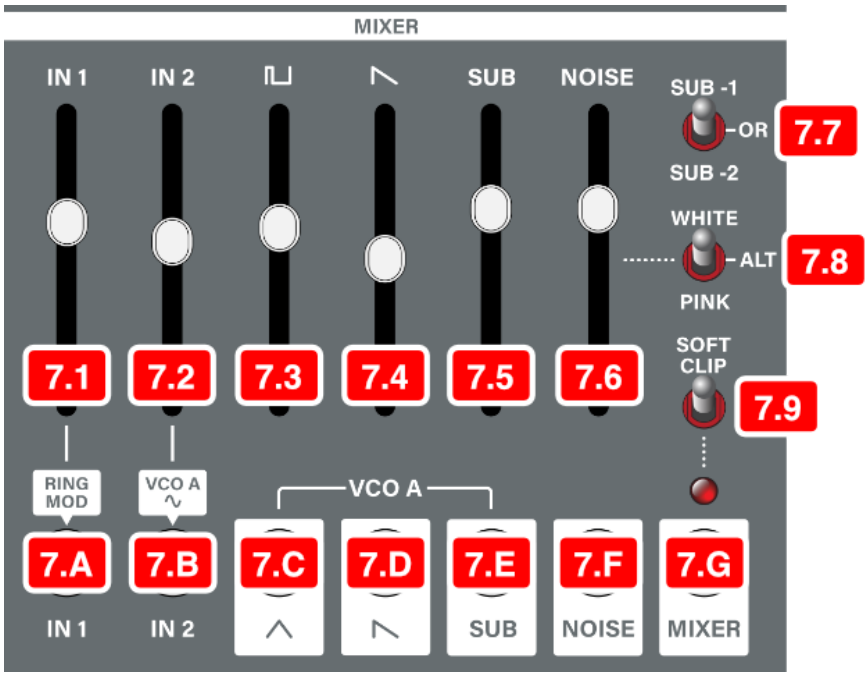
6.A : **LINE IN** output - This output lets you tap into the signal injected into the back panel's ¼" **LINE IN [14.C]** jack after it's been attenuated by the **LEVEL [6.1]** slider. Use it to patch an external signal into the Cascadia signal flow.

The two LEDs indicate the signal level being sent out the **LINE IN [6.A]** jack. Watch them to determine how much to attenuate the external **LINE IN [14.C]** signal with the **LEVEL [6.1]** slider. The brighter the green LED, the hotter the signal being sent out the **LINE IN [6.A]** jack. When the right red LED lights, the external input is clipping the circuit.

MIXER

SECTION 7

This section is used to mix levels from numerous sources, including: two user-selectable inputs; the PULSE and SAW waveforms generated by VCO A; a SUB oscillator pitched either 1- or 2-octaves below the pitch of VCO A, and one of three different NOISE sources. In addition, there are several direct outputs available, including SAW and TRI waves from VCO A.



MIXER Controls

7.1 : **MIXER IN 1 amount** slider - Controls how much of the signal patched into Cascadia's **MIXER IN 1** **[7.A]** jack appears at the **MIXER** **[7.G]** output.

7.2 : **MIXER IN 2 amount** slider - Controls how much of the signal patched into Cascadia's **MIXER IN 2** **[7.B]** jack appears at the **MIXER** **[7.G]** output.

7.3 : **PULSE amount** slider - Controls the amount of VCO A PULSE wave output present in the **MIXER** **[7.G]** output.

7.4 : **SAW amount** slider - Controls the amount of VCO A SAW wave output present in the **MIXER** **[7.G]** output.

7.5 : **SUB amount** slider - Controls how much of the SUB OSC appears in the **MIXER** **[7.G]** output. The SUB OSC is derived from the VCO A pulse wave, with its pitch and shape determined by the **SUB TYPE** **[7.7]** selector switch.

7.6 : **NOISE amount** slider - Controls how much of the NOISE source appears in the **MIXER** **[7.G]** output. The NOISE source can be either WHITE, PINK or ALT, depending on the position of the **NOISE TYPE** **[7.8]** selector switch.

7.7 : **SUB TYPE selector** switch - Determines the pitch and shape of the SUB oscillator mixed into the **MIXER [7.G]** output and also available at the **SUB [7.E]** output jack. Specifically:

- **SUB -1** (top) - The SUB Oscillator outputs a square wave exactly 1 octave below the pitch of the other VCO A waveforms.
- **SUB -2** (bottom) - The SUB Oscillator outputs a square wave exactly 2 octaves below the pitch of other VCO A waveforms.
- **OR** (middle) - The SUB Oscillator is the logical OR of SUB -1 and SUB -2, which results in a PULSE wave 2 octaves below the pitch of the other VCO A waveforms, but with a 75% pulse width (rather than a square wave).

7.8 : **NOISE TYPE selector** switch - Switches between one of three colors of noise: WHITE, PINK and ALT.

- **WHITE**: White noise is the brightest sounding, since it contains equal energy at every frequency. This gives more energy to the higher frequencies.
- **PINK**: Pink noise is 'darker' than white, since it contains equal power per octave — giving more energy to the lower frequencies.
- **ALT**: Uses the currently loaded ALTernative digital noise source. To select which ALT noise to load, set the switch to `ALT`, then hold down the **MANUAL GATE [11.1]** button while pressing one of the four **MIDI/CV section** buttons:
  - `Cymbal noise` : Hold **MANUAL GATE [11.1]** and press **MIDI PITCH [1.A]**. Cycle through three different Cymbal tuning options by repeatedly pressing **MIDI PITCH [1.A]** with the **MANUAL GATE [11.1]** held.
  - `Crunch noise` : Hold **MANUAL GATE [11.1]** and press **MIDI CC [1.B]**. Cycle through three different downsampling variations by repeatedly pressing **MIDI CC [1.B]** with the **MANUAL GATE [11.1]** held.
  - `Crackle noise` : Hold **MANUAL GATE [11.1]** and press **MIDI LFO [1.C]**. Cycle through three levels of crackle chaos by repeatedly pressing **MIDI LFO [1.C]** with the **MANUAL GATE [11.1]** held.
  - `Velvet noise` : Hold **MANUAL GATE [11.1]** and press **MIDI CLK [1.D]**. Cycle through three different densities of Velvet noise by repeatedly pressing **MIDI CLK [1.D]** with the **MANUAL GATE [11.1]** held.

  NOTE: switching to a new noise type will always select the first variation.

7.9 : **SOFT CLIP** switch - Enables soft clipping of the MIXER Out signal, which rounds off ("softens") any clipped signal, creating a 'warmer', less aggressive form of distortion. Use the corresponding LED to monitor the signal level coming out of the mixer. Adding together many waveforms will often overdrive the output (red LED). Engaging SOFT CLIP will soft clip the signals (reducing peak-to-peak voltage) prior to leaving the mixer (LED goes out).

MIXER Jacks

7.A : **MIXER IN 1** - Input for bringing an additional signal into the Mixer — either one generated external to Cascadia, or one created within Cascadia itself (such as the many available VCO B output waveforms). The signal patched into this input is attenuated by the **MIXER IN 1 amount** **[7.1]** slider.

*DEFAULT ROUTING: If nothing is patched into the **MIXER IN 1** jack, then the output of the **RING MOD** **[12.6.C]** is used as the channel source.*

7.B : **MIXER IN 2** - A second input for bringing an additional signal into the Mixer (either from an outside source or from one of Cascadia's many internally-generated sources). The signal patched into this input is attenuated by the **MIXER IN 2 amount** **[7.2]** slider.

*DEFAULT ROUTING: If nothing is patched into the **MIXER IN 2** jack, then a **SINE** wave, generated by **VCO A**, is used as the channel source.*

7.C : **VCO A** TRI OUT - Triangle wave output of VCO A.

7.D : **VCO A** SAW OUT - Direct, unattenuated Sawtooth wave output of VCO A.

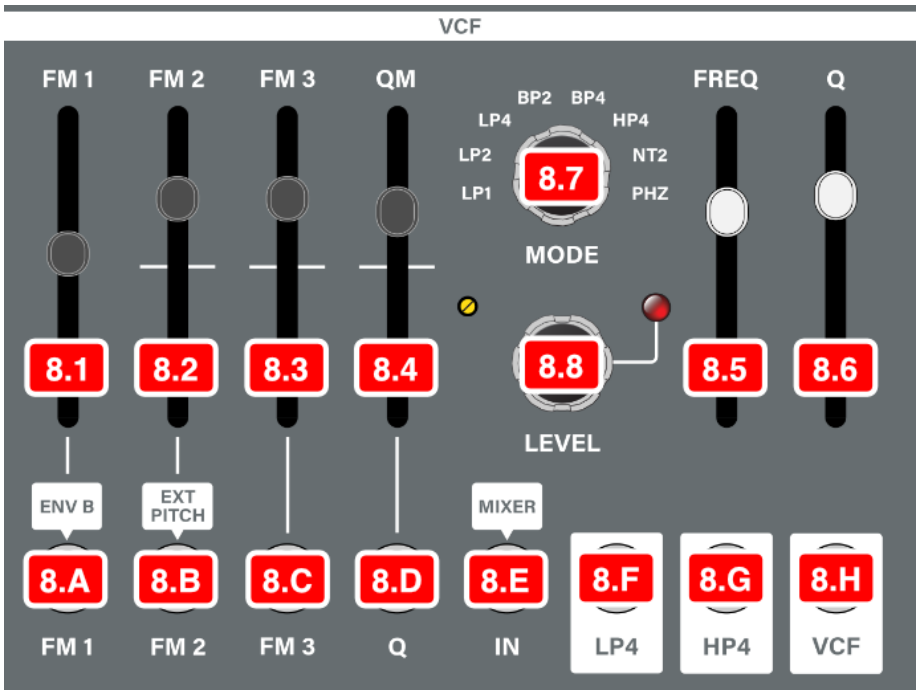
7.E : **VCO A** PULSE OUT - Direct, unattenuated Pulse wave output of VCO A.

7.F : **NOISE** OUT - Direct, unattenuated output of the Noise generator.

7.G : **MIXER** OUT - Output of the Mixer.

VCF

SECTION 8



Cascadia features a multimode, multiple out voltage controlled filter, featuring three types of Low Pass; two types of Bandpass; plus a Highpass, Notch and Phase filter. It offers three simultaneous outputs: a 4-Pole lowpass filter; a 4-Pole highpass filter; and a selectable output with eight filtering options. An input level knob provides grittier and more characterful waveforms to the filter, while three dedicated FM CV inputs and a resonance CV input allow both nuanced and dynamic VCF control.

VCF Controls

8.1 : **FM 1 amount** slider - Controls the amount of attenuation applied to the **FM 1** **[8.A]** CV input.

At its highest position, twice the range of the voltage present at the **FM 1** **[8.A]** input jack modulates the filter's **FREQ** **[8.5]** value. When the slider is at the bottom, none of the **FM 1** input modulates the filter **FREQ**. This allows for full range control of the filter frequency with the **FM 1** **[8.A]** input.

*DEFAULT ROUTING: If nothing is patched into the **FM 1** **[8.A]** jack, then the output of ENV B is used as the FM 1 modulation source. This lets you control the filter's frequency response with an envelope, creating 'plucky' sounds that are 'brighter' in the attack stage, or slow 'bow like' attacks that gradually increase in frequency as one leans into the 'bow.'*

8.2 : **FM 2 amount** slider - Controls the amount of attenuation applied to the **FM 2** **[8.B]** CV input.

With the slider at the very top, the filter's **FREQ** **[8.5]** value increases as the **FM 2** **[8.B]** voltage increases, using a 1V/oct scaling. With the slider at the very bottom, the filter's **FREQ** **[8.5]** value decreases as the **FM 2** voltage increases, using a -1V/oct scaling. With the slider in the middle, none of the **FM 2** input modulates the filter **FREQ**.

*DEFAULT ROUTING: If nothing is patched into the **FM 2** [8.B] jack, then the **EXTERNAL PITCH** [13.1.A] (either MIDI or CV) is used as the modulation source. This enables the filter's frequency to track the note values from a keyboard or sequencer, and is also useful when the filter self-resonates since full 1v/oct tracking allows you to play the filter like an oscillator.*

8.3 : **FM 3 amount** slider - Controls the amount of attenuation applied to the **FM 3** [8.C] CV input.

With the slider at the very top, the filter's **FREQ** [8.5] value increases as the **FM 3** [8.C] voltage increases, using a 1V/oct scaling. With the slider at the very bottom, the filter's **FREQ** [8.5] value decreases as the **FM 3** voltage increases. With the slider in the middle, none of the **FM 3** input modulates the filter **FREQ**.

*DEFAULT ROUTING: If nothing is patched into the **FM 3** [8.C] jack, then there is no normal routing, and **FM 3** will simply have no effect.*

8.4 : **QM** (resonance modulation) slider - Controls the amount of attenuation applied to the **QM** [8.D] CV input.

At its highest position, the full range of the signal present at the **QM** [8.D] input jack modulates the filter's **Q** [8.6] value. When the slider is at the bottom, none of the **QM** input modulates the filter's **Q** (resonance).

*DEFAULT ROUTING: If nothing is patched into the **QM** [8.D] jack, then there is no normal routing, and **QM** will simply have no effect.*

8.5 : **FREQ** slider - Sets the cutoff frequency of the filter.

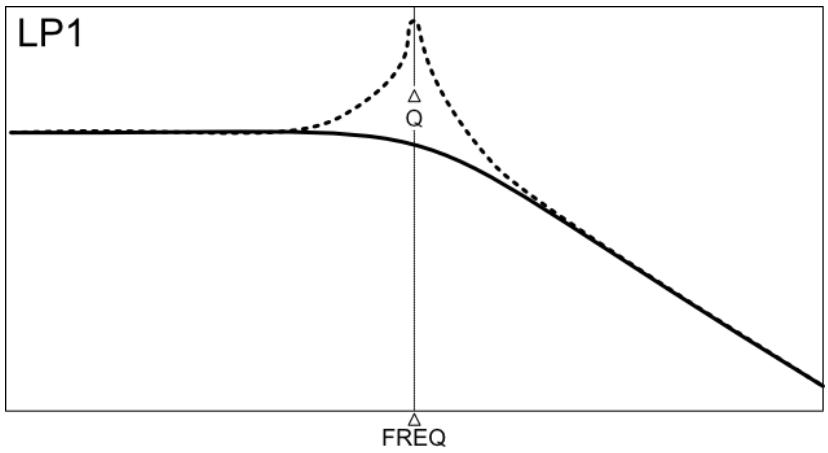
The filter's actual frequency is a combination of this setting and the **FM 1** [8.A], **FM 2** [8.B] and **FM 3** [8.C] modulation inputs (as attenuated by their corresponding sliders: [8.1], [8.2] and [8.3]).

8.6 : **Q** (resonance) slider - Sets the resonance of the filter.

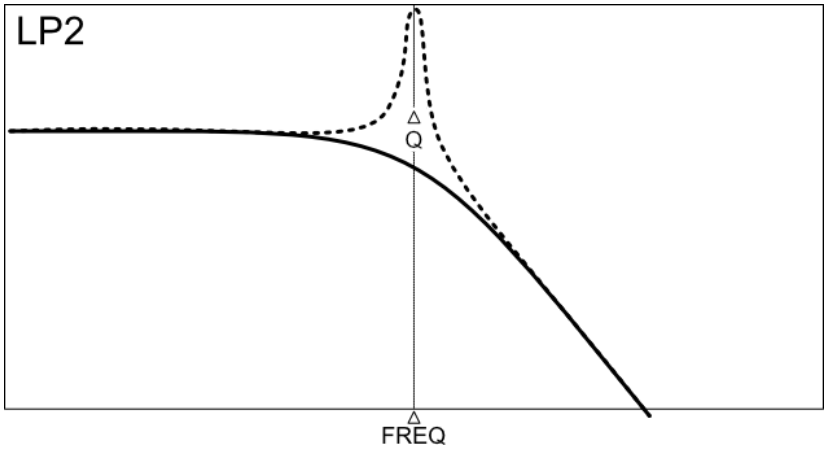
The filter's actual resonance is a combination of this setting and the **QM** [8.D] modulation input (as attenuated by the **QM** [8.4] slider).

8.7 : **MODE** selector - Rotate this selector knob to choose which of six possible filter types appears at the **VCF** **[8.H]** output. The choices are:

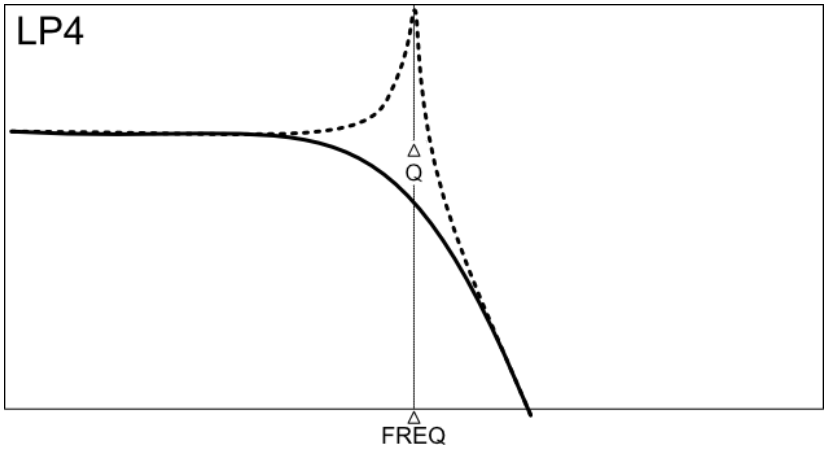
- **LP1** - 1-pole, 6 db/oct lowpass - Frequencies higher than the modulated cutoff **FREQ** **[8.5]** are attenuated at the rate of 6 db per octave. This is a more gentle rolloff than either the LP2 or LP4 filters. As **Q** **[8.6]** increases, the cutoff frequency becomes becomes emphasized, growing in amplitude until it self oscillates.



- **LP2** - 2-pole, 12 db/oct lowpass - Frequencies higher than the modulated cutoff **FREQ** **[8.5]** are attenuated at the rate of 12 db per octave. As **Q** **[8.6]** increases, the cutoff frequency becomes becomes emphasized, growing in amplitude until it self oscillates.

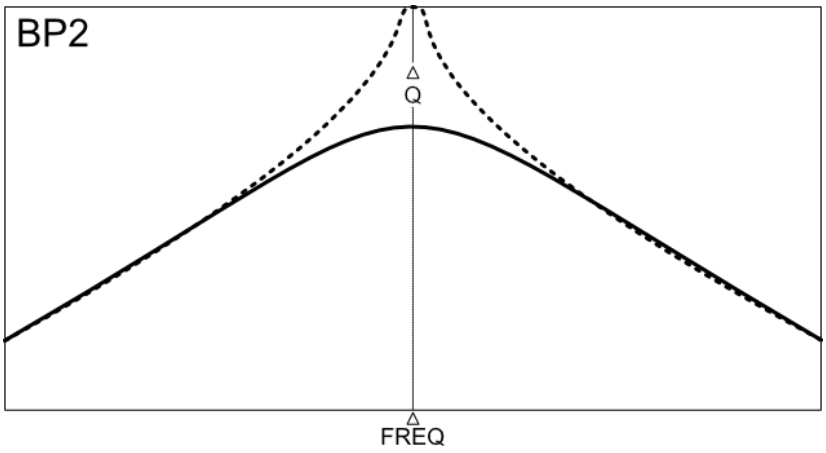


- **LP4** - 4-pole, 24 db/oct lowpass - Frequencies higher than the modulated cutoff **FREQ** **[8.5]** are attenuated at the rate of 24 db per octave. This is a steeper, and more pronounced rolloff than either the LP1 or LP2 filters. As **Q** **[8.6]** increases, the cutoff frequency becomes becomes emphasized, growing in amplitude until it self

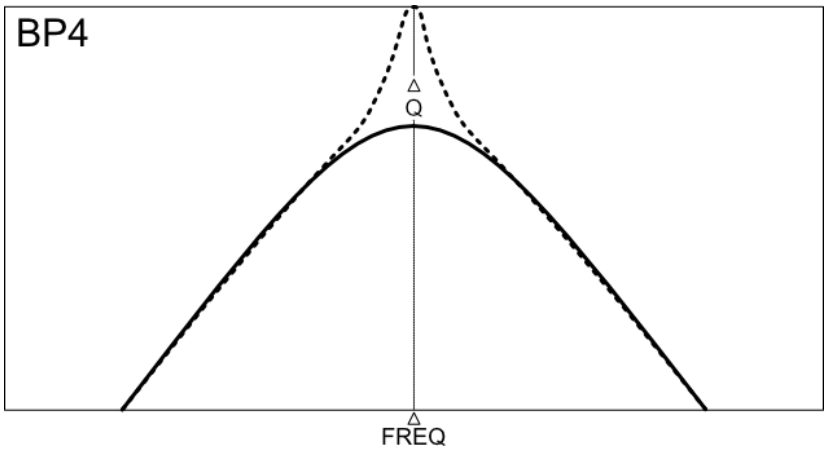


oscillates. This filter is always available via the **LP4** **[8.F]** jack, even if the MODE selector is set to a different type of filter.

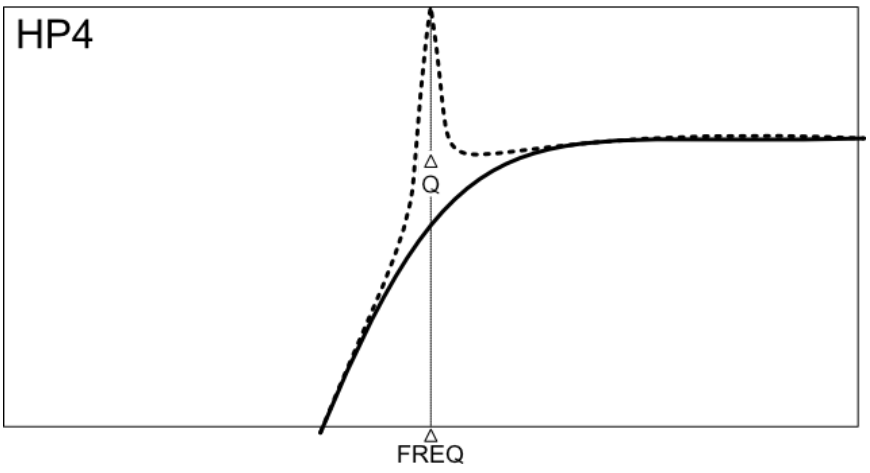
- **BP2** - 2-pole, 12 db/oct bandpass - Frequencies both above and below the modulated cutoff **FREQ** **[8.5]** amount are attenuated at the rate of 12 db per octave. As **Q** **[8.6]** increases, the cutoff frequency becomes becomes emphasized, growing in amplitude until it self oscillates.



- **BP4** - 4-pole, 24 db/oct bandpass - Frequencies both above and below the modulated cutoff **FREQ** **[8.5]** amount are attenuated at the rate of 24 db per octave. As **Q** **[8.6]** increases, the cutoff frequency becomes becomes emphasized, growing in amplitude until it self oscillates (see illustration above).

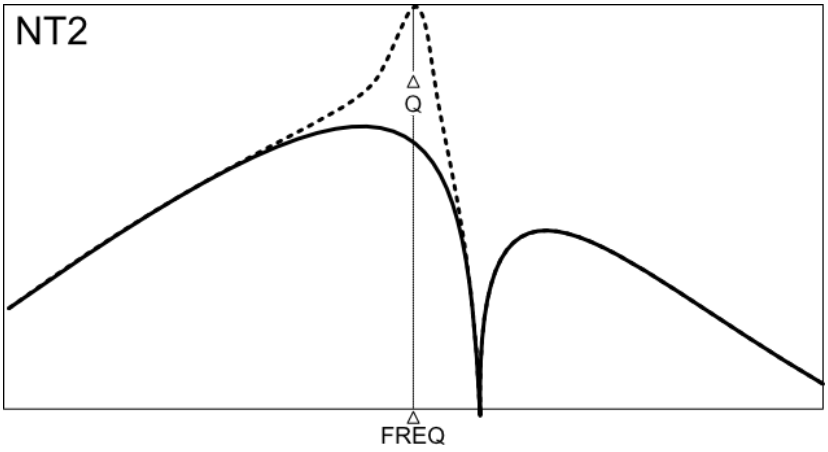


- **HP4** - 4-pole, 24 db/oct highpass - Frequencies lower than the modulated cutoff **FREQ** **[8.5]** amount are attenuated at the rate of 24 db per octave. As **Q** **[8.6]** increases, the cutoff frequency becomes emphasized, growing in

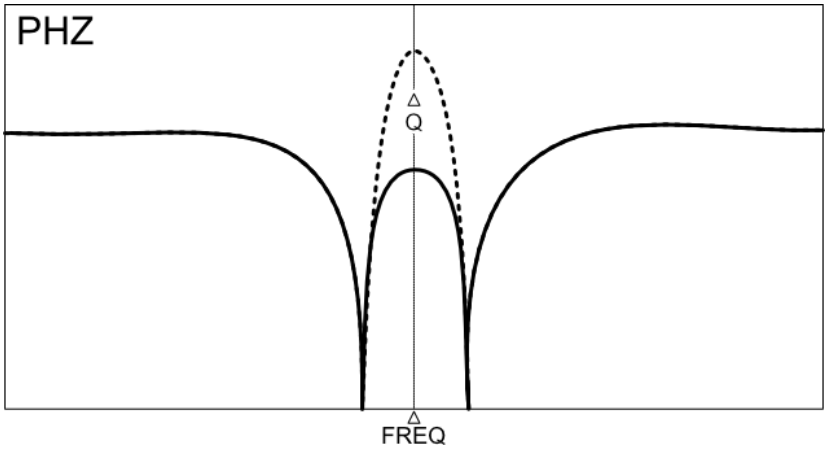


amplitude until it self oscillates. This filter is always available via the **HP4** **[8.G]** jack, even if the MODE selector is set to a different type of filter.

- **NT2** - 2-pole, 12 db/oct bandpass band reject (aka, “notch”) - The actual notch occurs approximately an octave above the cutoff **FREQ** **[8.5]**, while the **Q** **[8.6]** emphasizes the actual cutoff frequency — growing in amplitude until it self oscillates.



- **PHZR** - The Phaser filter is a double notch with some particularly interesting phase shifting characteristics. As such, it responds particularly well to sweeping the cutoff frequency, since the phase changes sweep across the frequency band accordingly.



8.8 : **LEVEL** knob - Sets the level, or amplification, of the signal feeding the filter. High values increase the gain beyond unity, causing the input filter to clip — thus providing more ‘grit’ for the filter, which yields a different sound. The corresponding LEVEL LED begins to light red as the input clips — growing brighter as the signal gets more distorted.

VCF Jacks

8.A : **FM 1** IN - First of three CV inputs for controlling the cutoff frequency. The voltage arriving at this jack is attenuated by the **FM 1 amount** [8.1] slider, making it ideal for envelopes or other such modulation sources.

*DEFAULT ROUTING: If nothing is patched into the **FM 3** jack, then the output of Envelope B is used as the FM 3 modulation source.*

8.B : **FM 2** IN - Second of three CV inputs for controlling the cutoff frequency. This jack accepts 1 V/oct signals, and is attenuverted by the **FM 2 amount** [8.2] silder, making it ideal for tracking keyboards, sequencers or other pitch-based inputs.

*If nothing is patched into the **FM 2** jack, then the **EXTERNAL PITCH** [13.1.A] (either MIDI or CV) is used as the modulation source.*

8.C : **FM 3** IN - Third of three CV inputs for controlling the cutoff frequency. Unlike FM 2, this is linear (rather than 1 V/oct) modulation. The voltage arriving at this jack is attenuverted by the **FM 3 amount** [8.3] slider, making it ideal for LFOs and other modulation sources.

*DEFAULT ROUTING: If nothing is patched into the **FM 3** jack, then there is no normal routing, and the **FM 3** [8.3] slider will have no effect.*

8.D : **Q MOD** (Resonance MOD) IN - CV input for controlling the resonance (Q). The voltage arriving at this jack is attenuated by the **QM** [8.4] slider.

*DEFAULT ROUTING: If nothing is patched into the **Q** jack, then there is no normal routing, and the **QM** [8.4] slider will have no effect.*

8.E : **VCF IN** - Audio Input to the filter.

*DEFAULT ROUTING: If nothing is patched into the **VCF IN** jack, then the output of MIXER feeds the VCF.*

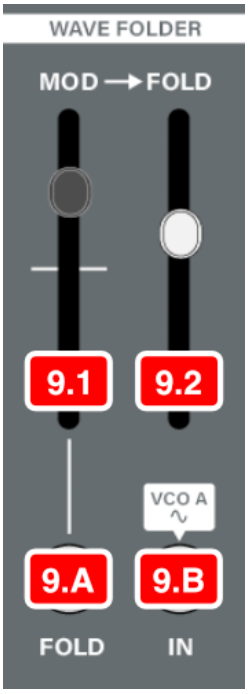
8.F : **LP4** OUT - Dedicated 4-pole (24 dB / oct) low pass filter output. This output is always available regardless of the setting of the **MODE** [8.7] selector.

8.G : **HP4** OUT - Dedicated 4-pole (24 dB / oct) high pass filter output. This output is always available regardless of the setting of the **MODE** [8.7] selector.

8.H : **VCF** OUT - Configurable filter output, as selected by the **MODE** [8.7] selector.

WAVE FOLDER

SECTION 9



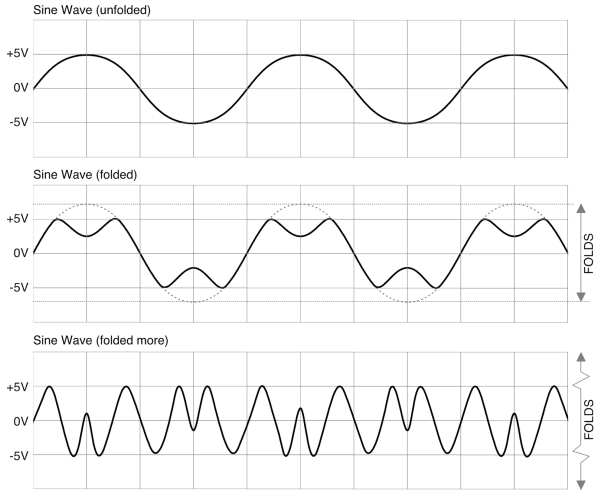
Wave folding is a technique for reshaping waveforms. As its name implies, it involves folding the highest and lowests peaks of a waveform back toward the center whenever those peaks exceed a certain threshold. Unlike a typical distortion circuit that simply clips any waveform that exceeds some threshold (resulting in increasingly harsh and uniform timbres), wave folding creates all manner of complex waveshapes with rich, subtle, intertwined harmonics. The addition of modulation over the folding amount yields a shifting, otherworldly sweep of sonic texture that is both musical and richly complex.

WAVE FOLDER Controls

9.1 : **MOD amount** slider - Controls the amount of attenuation patched into the **FOLD MOD IN [9.A]** jack.

At its highest position, the full range of the signal present at the **FOLD MOD IN [9.A]** jack modulates the Wave Folder's **FOLD amount [9.2]**. When the slider is at the bottom, none of the **FOLD MOD input [9.A]** modulates the FOLD amount.

9.2 : **FOLD amount** slider - By controlling the gain of the signal present at the **IN [9.B]** jack, this slider controls how much (and how often) the input waveform is folded.



With the slider at the bottom, no folding occurs. So the output and input waveforms are the same (as shown in this illustration's top example.

As you increase the FOLD amount slider, you increase the amount of signal being fed into the fold circuit. But instead of simply clipping the signal, it folds the input wave back onto itself (as shown in the illustration's middle example).

As you continue to increase the FOLD amount slider, you further increase the amplification of the input wave, and thus the amount that's folded back. Eventually, it will fold back so much that even the folded waveform needs to be folded (as shown in the bottom example).

*NOTE: The Wave Folder's output is normalled to the **VCA A IN 1 [10.A]** jack. It's also available directly via the **FOLD out [13.3.A]** jack in the OUTPUT CONTROL section.*

WAVE FOLDER Jacks

9.A : **FOLD MOD IN** - CV input for controlling the **FOLD amount [9.2]**. The voltage arriving at this jack is attenuated by the **MOD amount [9.1]** slider.

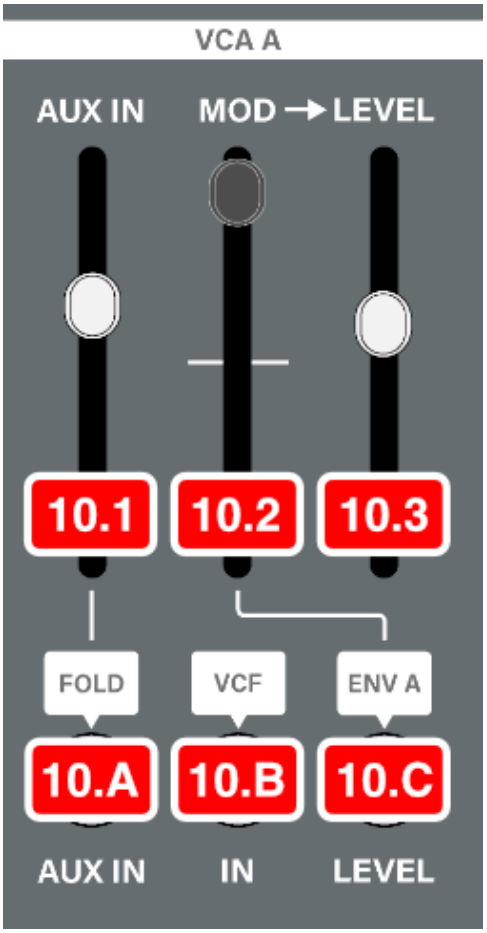
9.B : **IN** - Input to the Wave Folder circuit. The waveform patched into this jack is folded by an initial amount set by the **MOD amount slider [9.2]**, and sent to *the **FOLD out [13.3.A]** jack in the OUTPUT CONTROL section. It's also normalled to the **VCA A IN 1 [10.A]** jack.*

*DEFAULT ROUTING: If nothing is patched into the wave folder's **IN** jack, then VCO A's Sine Wave output is used as the input waveform.*

*NOTE: The Wave Folder's output is normalled to the **VCA A IN 1 [10.A]** jack. It's also available directly via the **FOLD out [13.3.A]** jack in the OUTPUT CONTROL section.*

VCA A

SECTION 10



This is a unity-gain linear voltage controlled amplifier that shapes the amplitude of any signals passing through it. It's one of Cascadia's two dedicated VCA's, the other being VCA B (which has a different feature set, and is described later).

*NOTE: Unlike most of Cascadia's synthesis sections, VCA A's output does not appear grouped with these controls. Instead, it appears via the **VCA A** [13.3.C] output jack located in the OUTPUT CONTROL section at the top of the synth. From here, it's normalled to the **MAIN 1 IN** [13.3.C] jack and passed along to the final **MAIN OUT** [13.3.E] jack.*

VCA A Controls

10.1 : **AUX IN** slider - Sets the amount of attenuation for **AUX IN** [10.A]. When set to the top, the full amount of **AUX IN** feeds into the amplifier. When set to the bottom, none of the signal appearing at **AUX IN** Is sent into the amplifier.

10.2 : **LEVEL MOD** (Amplitude Modulation) slider - You can use a control voltage (CV) patched into the VCA's **LEVEL MOD IN** [10.C] jack to modulate the overall **VCA LEVEL** [10.3] over time. This slider attenuates the extent to which this modulation occurs.

At its highest position, the full range of any CV patched into the **LEVEL MOD IN** [10.C] jack will be used to modulate the VCA's overall **LEVEL**. When the slider is at the bottom, none of the CV patched into the **LEVEL MOD IN** jack will modulate the overall **LEVEL**.

*NOTE: Although this is designed as a unity-gain VCA, it's possible to get a bit of boost by feeding a control signal greater than 5V into the **LEVEL MOD IN** [10.C] jack. Such voltages can be patched in externally, or achieved by running a 5V signal run through Cascadia's built-in MIXUVERTER with the **x2 SWITCH** [12.3.2] in the "x2" position and its knob turned up.*

10.3 : **LEVEL** slider - Sets the initial base level (or "bias") of the amplifier before any external modulation is applied. The higher the slider, the higher the base level (with unity gain at the top).

VCA A Jacks

10.A : **AUX IN** - Auxiliary VCA input. This level of this input (and thus its presence in the mix) is set using the corresponding **AUX IN** **[10.1]** slider.

DEFAULT ROUTING: If nothing is patched into AUX IN, then Cascadia's Wave Folder output is used as the AUX input.

10.B : **VCA IN** - Main VCA input, which is fed into the VCA where it's summed with the signal present at **AUX IN** **[10.A]** (and attenuated by the **LEVEL** **[10.3]** slider).

DEFAULT ROUTING: If nothing is patched into VCA IN, then Cascadia's ***VCF OUTPUT*** *[8.H] is used the VCA input.*

10.C : **LEVEL MOD IN** (Level Modulation) slider - CV input for controlling the overall amplifier LEVEL. The voltage arriving at this jack is attenuated by the **LEVEL MOD** **[10.2]** slider, and summed with whatever bias level is set by the **LEVEL** **[10.3]** slider.

DEFAULT ROUTING: If nothing is patched into the LEVEL MOD IN jack, then the output of ***ENV A*** *[4.F] is used as the modulation source.*

NOTE: VCA A has a dedicated output ***VCA A*** *[13.3.C] output jack located in the OUTPUT CONTROL section at the top of the synth. From here, it's normalled to the* ***MAIN 1 IN*** *[13.3.C] jack and passed along to the final* ***MAIN OUT*** *[13.3.E] jack.*

PUSH GATE

SECTION 11

11.1 : **MANUAL GATE** button - Press this button to send a gate signal to the **GATE OUT** **[11.A]** jack. As long as the button is held down, the gate is high (+5V), as indicated by the LED above the **GATE OUT** jack.

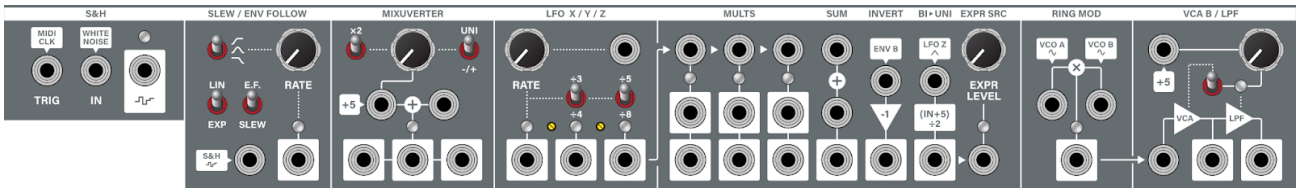
*DEFAULT ROUTING: This button will, by default, gate both Envelope A and Envelope B if nothing is patched into either of their **GATE IN** jacks.*

11.A : **GATE OUT** - Outputs a gate signal generated by the **MANUAL GATE** **[11.1]** button.

*NOTE: Inserting a cable into this output prevents the **MANUAL GATE** **[11.1]** button from automatically triggering the two envelopes.*

UTILITIES

SECTION 12

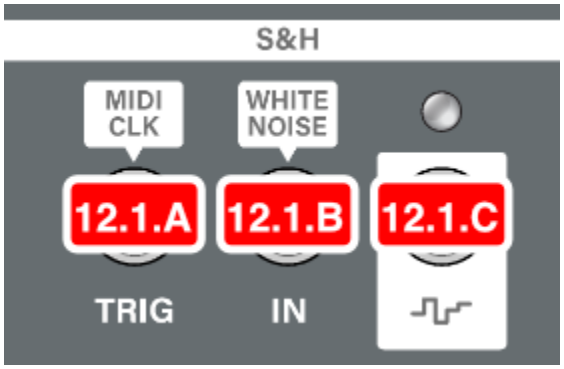


The Utilities strip contains numerous routing and processing tools, designed to increase the sonic flexibility of Cascadia. From left-to-right, the Utilities strip contains the following elements, each of which are described in their own sections:

- S&H - sample & hold circuit
- SLEW / ENV FOLLOW - smooths out (slews) fluctuations in incoming voltages by slowing down the rate at which an incoming voltage affects the output voltage. Can be used as an envelope follower for extracting an envelope from an input signal.
- MIXUVERTER - enables voltages to be mixed, doubled, attenuverted, and offset
- LFO X / Y / Z - three bipolar, rate-offset, triangle-wave LFOs
- PATCHBAY - Various patching tools, including MULTS, a SUMMER, an INVERTER, A BI-to-UNI POLARITY converter, and an EXPRESSION PEDAL input and level control.
- RINGMOD - takes two source waveforms and generates a third waveform that contains the sum and difference frequencies of the inputs
- VCA B / LPF - a second Voltage Controlled Amplifier (VCA) and a second Low Pass Filter (LPF), which can be combined to function as a Low Pass Gate (LPG).

S&H

SECTION 12.1



Sample & Hold (S&H) is a technique most commonly used to generate stepped, random voltages. The circuit works by sampling the S&H input voltage each time the TRIG input goes high.

Two of the most common destinations for the S&H output are a filter's cutoff frequency (creating stepped, clocked timbral changes), and the VCO frequency (which produces random notes at clocked intervals).

In Cascadia's default configuration, the input signal is a dedicated digital noise source, independent of the **NOISE TYPE [7.8]** selected in the MIXER section. You can, of course, patch one of those other **NOISE OUT [7.F]** sources from the MIXER into the S&H section, or any other source you wish to sample.

12.1.A : **TRIG IN** - Each time the **TRIG** input voltage goes high, the S&H circuit samples the value of the voltage present at the **S&H IN [12.1.B]** jack and sends it to the **S&H OUT [12.1.C]** jack.

*DEFAULT ROUTING: If nothing is patched into the **TRIG** IN jack, then the **MIDI CLK** [1.D] output is used as the trigger input.*

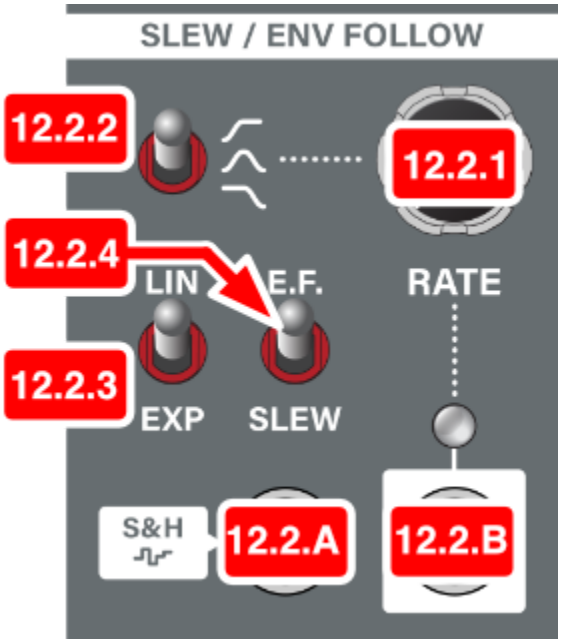
12.1.B : **S&H IN** - The value of the voltage patched into this input is sampled each time the **TRIG IN [12.1.A]** voltage goes high.

*DEFAULT ROUTING: If nothing is patched into the **S&H IN** jack, then* a built-in digital noise generator is used as the input.

12.1.C : **S&H OUT** - Output of the sample & hold circuit (mention LED)

SLEW / ENV FOLLOW

SECTION 12.2



A slew circuit smooths out fluctuations in incoming voltages by slowing down the rate at which an incoming voltage affects the output voltage.

Slews are commonly used to create portamento effects (making pitches glide between notes rather than switch instantly) or for “rounding off” sudden voltage changes in a gate to create a more gradual envelope.

Another common use for the Slew circuit (and the normalled operation of Cascadia’s) is to patch the output of a S&H circuit into it, then use the rate control to slur the instantaneous voltage changes to create a more meandering, slowly fluctuating voltage.

This particular slew circuit can also double as an Envelope Follower, which is used to extract an envelope from any external signal.

12.2.1 : **SLEW RATE** knob - Sets how quickly (or slowly) the output voltage responds to a change in input voltage, thus converting any instantaneous voltage changes appearing at the **SLEW/FOLLOW IN** **[12.2.A]** jack into a gradual “slewed” voltage change at the **SLEW OUT** **[12.2.B]** jack.

Slew rates range from nearly instantaneous at the knob’s minimum (counter-clockwise) position to a clockwise maximum of about 1 second (if **SLEW SHAPE** **[12.2.3]** = ”LIN”) or 5 seconds (if **SLEW SHAPE** **[12.2.3]** = ”EXP”) for a 5V change.

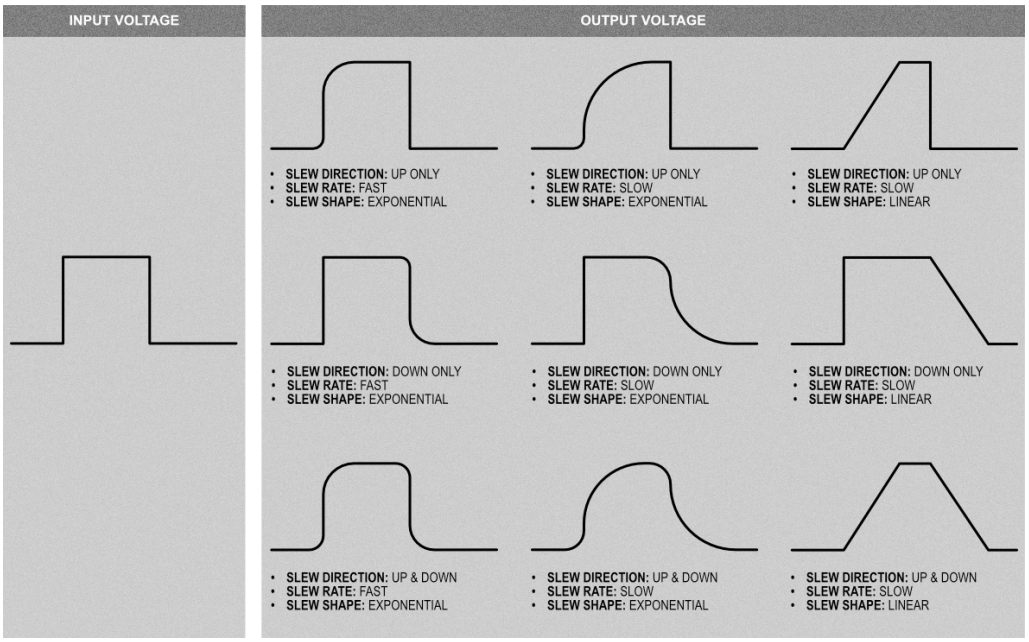
12.2.2 : **SLEW DIRECTION** switch - This 3-position switch determines whether voltage changes are slewed only when they increase in value (top position); decrease in value (bottom position); or if slew is active in both directions (middle position). Specifically:

- TOP Position = slews UP ONLY
- MIDDLE Position = slews both Up & DOWN
- BOTTOM Position = slews DOWN ONLY

The rate of change is determined by the **SLEW RATE** **[12.2.1]** knob.

12.2.3 : **SLEW SHAPE** switch - This toggles the slew's response curve between **LIN**(ear) and **EXP**(onential).

The following diagram shows how **SLEW DIRECTION [12.2.2]**, **SLEW RATE [12.2.1]** and **SLEW SHAPE [12.2.3]** work together to transform the input voltage.



12.2.4 : **ENV FOLLOW** - Turns on the envelope follower function, which is basically a full-wave rectifier applied to the source, and low-pass filtered to approx 70 Hz. Use this to extract an envelope from any signal patched into the **SLEW/FOLLOW IN [12.2.A]** jack.

The envelope follower is particularly useful for patching in an external signal (such as a kick drum or punchy bass track), since the circuit will then output an envelope that follows the timing of the input. **SLEW RATE [12.2.1]**, **SLEW DIRECTION [12.2.2]** and **SLEW SHAPE [12.2.3]** all affect the shape of the envelope derived from the input.

12.2.A : **SLEW/FOLLOW INPUT** - Input for the signal you wish to slew (or follow).

DEFAULT ROUTING: If nothing is patched into the SLEW/FOLLOW input, then the output of Cascadia's Sample & Hold circuit feeds into it, allowing you to use the Slew circuit to create a more subtly varying (smoother) version of the S&H.

You can achieve a portamento effect if you plug any of Cascadia's pitch outputs into the SLEW/FOLLOW IN, then adjust the SLEW TIME knob to achieve the desired portamento speed.

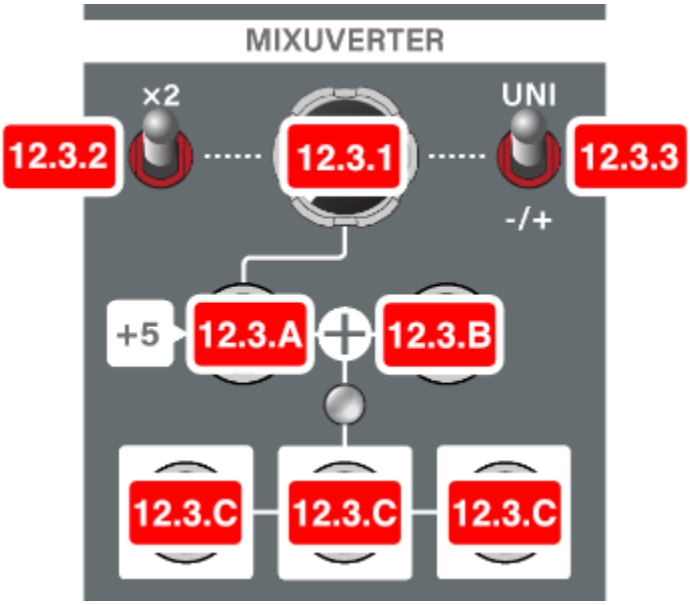
12.2.B : **SLEW OUTPUT** - Outputs the slewed version of the signal appearing at the **SLEW/FOLLOW IN [12.2.A]** jack.

The corresponding LED lights green if the slew voltage is positive, and red if it's negative. The brightness of the LED indicates the value of voltage, with a brighter LED denoting a greater absolute output voltage.

MIXUVERTER

SECTION 12.3

Cascadia's mixuverter is a deceptively powerful little tool that enables voltages to be mixed, doubled, attenuverted, and offset.



12.3.1 : **ATTENUATOR** - This knob linearly attenuates the voltage present at the Mixuverter's **MAIN INPUT [12.3.A]**. If no voltage is present at the input, the knob attenuates an internally generated +5V DC voltage.

The **x2 SWITCH [12.3.2]** and **POLARITY SWITCH [12.3.3]** determine the range and behaviour of the knob.

12.3.2 : **x2 SWITCH** - In the up (x2) position, this switch doubles the voltage appearing at the **MAIN INPUT [12.3.A]**.

For example: leave the MAIN INPUT unconnected; set the channel's POLARITY SWITCH to - / +, turn the channel attenuator fully clockwise; and set the x2 SWITCH to the down (off) position. The mixuverter will internally send 5V to the MAIN INPUT. Flip the x2 SWITCH to the up (x2) position, and the mixuverter now sends 10V (5V x 2) to the MAIN INPUT. Rotate the knob fully counterclockwise, and the mixuverter sends -10V (-5V x 2) to the MAIN INPUT.

The x2 switch is a convenient way to double the input voltage, or to set a full +10V or -10V DC offset to the signal patched into the **SECONDARY INPUT [12.3.B]**.

12.3.3 : **POLARITY SWITCH** - This switch sets the polarity of the signal sent into the mixer.

- **UNI** : With the switch in the up **UNI** position, the **ATTENUATOR [12.3.1]** functions as a standard attenuator. With the knob fully clockwise, the full value of the **MAIN INPUT [12.3.A]** is sent into the mixer, where it's summed with the **SECONDARY INPUT [12.3.B]** and sent to the **OUTPUTS [12.3.C]**. With the knob fully counterclockwise, none of the MAIN INPUT voltage (0 V) enters the mixer; and with the knob at the 'noon' position, half the MAIN INPUT voltage enters the mixer.

- **- / +** : With the switch in the down **- / +** position, the **ATTENUATOR [12.3.1]** acts as a bipolar attenuverter. With the knob fully clockwise, the full value of the **MAIN INPUT [12.3.A]** is sent into the mixer, where it's summed with the **SECONDARY INPUT [12.3.B]** and sent to the **OUTPUTS [12.3.C]**. The inverse of the MAIN INPUT voltage is sent to the mixer when the knob is fully counterclockwise; and none of the MAIN INPUT voltage (0 V) enters the mixer when the knob is at the 'noon' position.

12.3.A : **MAIN INPUT** - This is the first of two inputs into the Mixuverter. Unlike the **SECONDARY INPUT [12.3.B]**, the MAIN INPUT voltage can be attenuated (*using the **ATTENUATOR** [12.3.1] knob*); inverted (*using the **POLARITY** [12.3.3] switch*); or doubled (*using the **x2** [12.3.2] switch*).

After being attenuated, inverted and/or doubled, the voltage appearing at the MAIN INPUT is summed with any voltage appearing at the **SECONDARY INPUT [12.3.B]**, and sent to the **MIXUVERTER OUTPUTS [12.3.C]**.

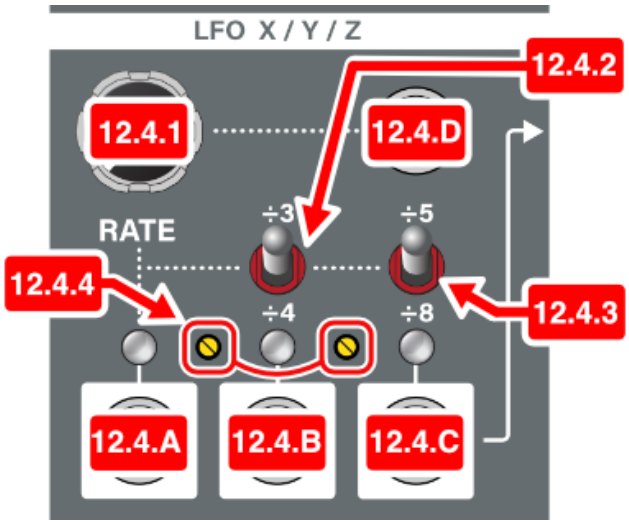
*DEFAULT ROUTING: With no cable plugged in, Cascadia sends a 5V DC voltage to the MAIN INPUT, which you can double to 10V (5V x 2) with the **x2** [12.3.2] switch on*.

12.3.B : **SECONDARY INPUT** - Any voltage patched into this jack is summed with the attenuverted voltage patched into the **MAIN INPUT [12.3.A]**, and sent to the **MIXUVERTER OUTPUTS [12.3.C]**.

12.3.C : **MIXUVERTER OUTPUTS** - (3x) Multed output of the summed value of the attenuverted **MAIN INPUT [12.3.A]** and the **SECONDARY INPUT [12.3.B]**.

LFO X / Y / Z

SECTION 12.4



These three bipolar, rate-linked, triangle-wave LFOs (Low Frequency Oscillators) are excellent modulation sources for many Cascadia parameters. The rate of LFO X (left-most output) is set by the **RATE** knob, and can be CV controlled. LFO Y and LFO Z are phase-shifted variants of LFO X, though each can be set to a different rate using its corresponding trimmer, along with its dedicated divider switch.

12.4.1 : **RATE KNOB** - Sets the rate at which all LFOs oscillate. It governs the rate of **LFO X [12.4.A]** directly, plus the rates of **LFO Y [12.4.B]** and **LFO Z [12.4.C]** — both of which are further offset by their corresponding **RATE DIVIDER switches [12.4.2]** and **[12.4.3]** and **RATE TRIMMERS [12.4.4]**. The knob sets the LFO X rate from approximately 15s (fully counterclockwise) to approximately 75 Hz (fully clockwise), and can be modulated via the **LFO RATE CV [12.4.D]** input.

12.4.2 : **LFO Y RATE DIVIDER SWITCH** - This switch sets the divided base rate for **LFO Y OUT [12.4.B]**.

- CENTER : In the center position, the LFO Y runs at the rate set by its corresponding **RATE TRIMMER [12.4.4]**. This is factory set to approximately the same base rate as LFO X, but phase-shifted.
- UP : In the up (**+3**) position, LFO Y runs at 1/3 the rate set by its corresponding **RATE TRIMMER [12.4.4]**.
- DOWN : In the down (**÷4**) position, LFO Y runs at 1/4 the rate set by its corresponding **RATE TRIMMER [12.4.4]**.

12.4.3 : **LFO Z RATE DIVIDER SWITCH** - This switch sets the divided base rate for **LFO Z OUT [12.4.C]**.

CENTER : In the center position, the LFO Z runs at the rate set by its corresponding **RATE TRIMMER [12.4.4]**. This is factory set to approximately the same base rate as LFO X, but phase-shifted.

UP : In the up (**+5**) position, LFO Z runs at 1/5 the rate set by its corresponding **RATE TRIMMER [12.4.4]**.

DOWN : In the down (**÷8**) position, LFO Y runs at 1/8 the rate set by its corresponding **RATE TRIMMER [12.4.4]**.

12.4.4 : **RATE TRIMMERS** - Use the left trimmer to change the frequency relationship between LFO X and LFO Y. Use the right trimmer to change the frequency relationship between LFO X and LFO Z. From the factory, both trimmers are set to cause LFO Y and LFO Z to run at approximately the same rates as LFO X, but with shifted phase.

12.4.A : **LFO X OUT** - Bipolar, ±5V Triangle Wave LFO output, whose rate is set by the **RATE KNOB [12.4.1]** and/or the **RATE CV [12.4.D]** input. The color of the corresponding LED indicates polarity (green is positive voltage, and red is negative), while the intensity of the LED indicates the absolute voltage value (the brighter the LED, the higher the voltage).

12.4.B : **LFO Y OUT** - Bipolar, ±5V Triangle Wave LFO output. It's rate is governed by a combination of the **RATE KNOB [12.4.1]**, **RATE CV [12.4.D]** input, **RATE TRIMMER [12.4.4]** and **LFO Y RATE DIVIDER SWITCH [12.4.2]**. As with LFO X, the corresponding LED indicates both polarity and voltage level.

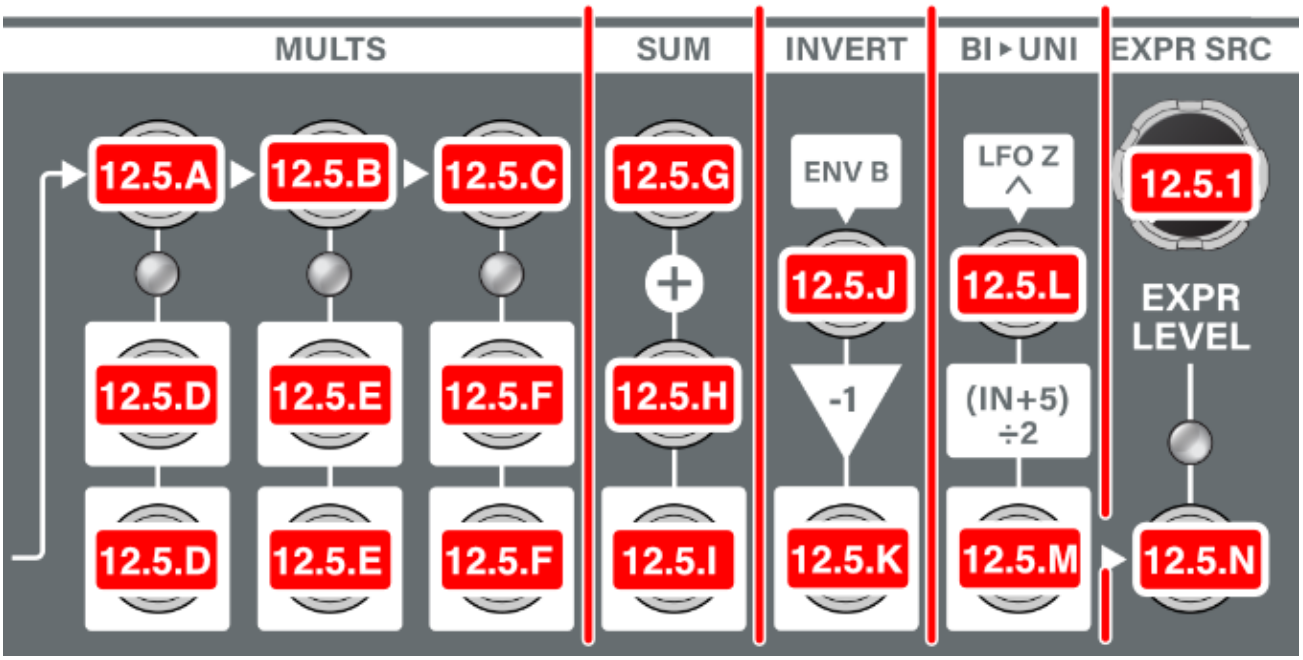
12.4.C : **LFO Z OUT** - Bipolar, ±5V Triangle Wave LFO output. It's rate is governed by a combination of the **RATE KNOB [12.4.1]**, **RATE CV [12.4.D]** input, **RATE TRIMMER [12.4.4]** and **LFO Z RATE DIVIDER SWITCH [12.4.3]**. As with LFO X, the corresponding LED indicates both polarity and voltage level.

12.4.D : **LFO RATE CV** - Control Voltage input for varying the LFO rate set by the **RATE KNOB [12.4.1]**. Positive voltages increase the rate as set by the knob; negative voltages decrease the rate. RATE modulation affects all three LFO outputs.

PATCHBAY

SECTION 12.5

The patchbay contains various patching tools, including MULTS, a SUMMER, an INVERTER, A BI-to-UNI POLARITY converter, and an EXPRESSION PEDAL input and level control. Each of these sections is detailed below.



MULTS

This section provides Cascadia with two separate (but chainable) buffered mults.

A buffered mult takes an input signal and routes it to multiple outputs simultaneously. Unlike a passive mult, which merely splits the incoming signal and shares it across multiple outputs (much like a Y-cable), buffered mults make electrical copies of an input voltage and duplicate that voltage at the outputs. This is particularly important for duplicating voltage-critical functions (such as multiplying a 1V/oct signal for the purpose of driving multiple oscillators).

12.5.A : **MULT IN 1** - First input into the Multiplier. A signal patched into this input is multiplied, and an exact copy is sent to both **MULT OUT 1** **[12.5.D]** jacks. The intensity of the corresponding LED indicates the voltage level, while the color indicates the polarity (**green** = positive voltage, **red** = negative voltage).

Additionally, if nothing is patched into **MULT IN 2** **[12.5.B]** then the signal appearing at MULT IN 1 is normalled to MULT IN 2, where it is further multiplied and sent to both **MULT OUT 2** **[12.5.E]** jacks.

Likewise, if nothing is patched into both **MULT IN 2** **[12.5.B]** *and* **MULT IN 3** **[12.5.C]**, then the signal appearing at MULT IN 1 is further normalled into both MULT IN 2 and MULT IN 3, where its then multiplied again and sent to all six MULT OUT jacks.

By cascading mults in this way, it's possible to patch a signal into MULT IN 1, and have it duplicated to either two, four, or six separate outputs.

DEFAULT ROUTING: If nothing is patched into the ***MULT IN 1*** *jack, then the output of* ***LFO Z*** ***[12.4.C]*** *is normalled to MULT IN 1.*

12.5.B : **MULT IN 2** - Second input into the Multiplier. A signal patched into this input is multiplied, and an exact copy is sent to both **MULT OUT 2** **[12.5.E]** jacks.

If nothing is patched into **MULT IN 3** **[12.5.C]**, then the signal appearing at MULT IN 2 is normalled to MULT IN 3, where it is further multiplied and sent to both **MULT OUT 3** **[12.5.F]** jacks, as well.

By cascading mults in this way, it's possible to patch a signal into MULT IN 2, and have it duplicated to either two or four separate outputs.

DEFAULT ROUTING: If nothing is patched into ***MULT IN 2****, then the signal patched (or normalled) into* ***MULT IN 1*** ***[12.5.A]*** *is used as MULT IN 2.*

12.5.C : **MULT IN 3** - Third input into the Multiplier. A signal patched into this input is multiplied, and an exact copy is sent to both **MULT OUT 3** **[12.5.F]** jacks.

DEFAULT ROUTING: If nothing is patched into ***MULT IN 3****, then the signal patched (or normalled) into* ***MULT IN 2*** ***[12.5.B]*** *is used as MULT IN 3.*

12.5.D : **MULT OUTS 1** - This pair of outputs duplicate the signal at **MULT IN 1** **[12.5.A]**.

12.5.E : **MULT OUTS 2** - This pair of outputs duplicate the signal at **MULT IN 2** **[12.5.B]**.

12.5.F : **MULT OUTS 3** - This pair of outputs duplicate the signal at **MULT IN 3** **[12.5.C]**.

SUM

A summer takes two input signals and adds them together, creating an output that is the sum of the two voltages.

12.5.G : **SUM IN 1** - A signal patched into this jack is summed with the signal patched into **SUM IN 2** **[12.5.H]**, with the result sent to the **SUM OUT** **[12.5.I]** jack.

12.5.H : **SUM IN 2** - A signal patched into this jack is summed with the signal patched into **SUM IN 1** **[12.5.G]**, with the result sent to the **SUM OUT** **[12.5.I]** jack.

12.5.I : **SUM OUT** - Outputs the summed voltage of **SUM IN 1** **[12.5.G]** and **SUM IN 2** **[12.5.H]**.

INVERT

An inverter takes an input signal and inverts it, such that negative voltages become positive; and positive voltages become negative. This is particularly useful for inverting envelope shapes or LFOs (i.e. turning a saw into a ramp).

12.5.J : **INVERTER IN** - A signal patched into this input is inverted and sent to the **INVERTER OUT** **[12.5.K]** jack.

*DEFAULT ROUTING: If nothing is patched into the **INVERTER IN** jack, then the **ENV B** **[5.F]** output is used as the inverter input.*

12.5.K : **INVERTER OUT** - Outputs the inverted version of the signal arriving at **INVERTER IN** **[12.5.J]**. That is, positive voltages become negative; and negative become positive.

BI > UNI

This utility converts a bidirectional input (such as an LFO) and converts it into a unidirectional signal.

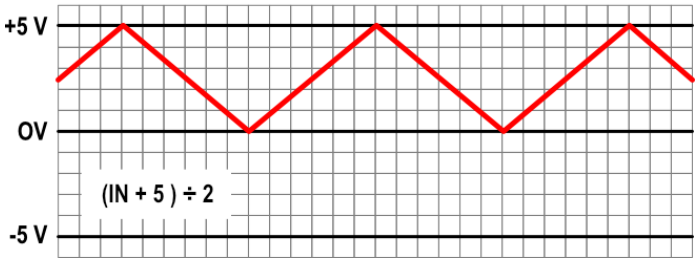
For example, LFO's are bidirectional (meaning they output positive voltages at the peaks and negative voltages in the valleys). If you use an LFO to modulate a parameter, then the LFO will both increase and decrease that parameter's value around it's base level. This is sometimes desirable, and sometimes not. For example, if you use an LFO to modulate pitch, you might prefer the modulation to only raise (or lower) the pitch from its base level, and not fluctuate on either side. You can do this by first running the LFO through the BI > UNI converter.

12.5.L : **BI IN** - A bidirectional voltage patched into this input is converted to a unipolar voltage and sent to the **BI OUT** **[12.5.M]** jack.

*DEFAULT ROUTING: If nothing is patched into the **BI IN** jack, then the **LFO Z** [12.4.C] output is used as the input signal.*

12.5.M : **UNI OUT** - Outputs a unipolar version of the signal arriving at **BI IN** **[12.5.L]**. Specifically, the output adds 5V to the input signal, then divides the voltage by 2.

For example, assume you feed a ±5V bidirectional LFO into the **BI IN** jack. The BI > UNI circuit adds +5V to this signal (making it a 0 - 10V signal), then divides it by 2, making it a 0 - 5V LFO, which it then sends to the **UNI OUT** jack.



NOTE: The **UNI OUT** signal is normalled into the EXP SRC utility, as described in the next section. *Cascadia's back panel **EXP OUT** [14.D] jack supports pedals that operate on a typical 3.3V expression circuit. While most pedals operate at 3.3V, some operate at 5V. Many of these 5V pedals will also accept CV. Review your pedal's documentation, and if this is the case, you can patch the output of the **UNI OUT** [12.5.M] jack directly to the pedal with an 1/8" to 1/4" cable/adaptor.*

EXP SRC

To allow maximum flexibility and sonic variation, Cascadia features built-in integration with external stomp boxes. This lets you place your desired effects devices optimally within the signal path, while allowing any of Cascadia's on-board modulation sources to access your stomp box's expression pedal input.

The EXP SRC section is where you patch in (and attenuate) the CV signal you wish to use for controlling your stomp box's Expression Pedal input.

12.5.N : **EXP SRC IN** - A control voltage patched into this jack passes through the **EXP LEVEL** **[12.5.1]** attenuator and out the TRS ¼" **EXP OUT** **[14.D]** jack on the back panel.

This lets you modulate an expression pedal parameter on an external stomp box, exactly as you would modulate a parameter within Cascadia.

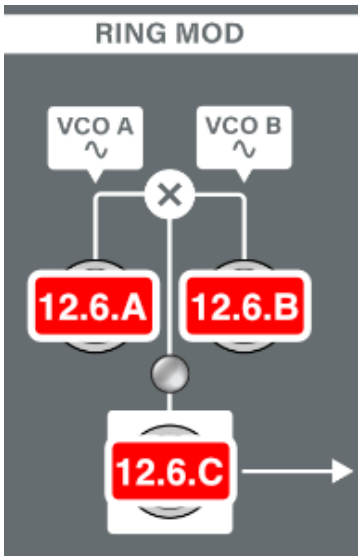
*DEFAULT ROUTING: If nothing is patched into the **EXP SRC IN** jack, then the **UNI OUT** **[12.5.M]** signal is used as the EXP SRC. Note that the UNI OUT carries a unipolar version of **LFO Z** **[12.4.C]**, if the normalled routing is used.*

*NOTE: Cascadia's back panel **EXP OUT** **[14.D]** jack supports pedals that operate on a typical 3.3V expression circuit. While most pedals operate at 3.3V, some operate at 5V. Many of these 5V pedals will also accept CV. Review your pedal's documentation, and if this is the case, you can patch the output of the **UNI OUT** **[12.5.M]** jack directly to the pedal with an 1/8" to 1/4" cable/adaptor, bypassing the EXP SRC section entirely.*

12.5.1 : **EXP LEVEL** knob - Attenuates the control voltage present at **EXP SRC IN** **[12.5.N]**, prior to passing it through to the TRS ¼" **EXP OUT** **[14.D]** jack on the back panel. This gives you control over how much you want the EXP SRC control voltage input to affect the Expression Pedal input on your external stomp box.

RINGMOD

SECTION 12.6



Ring Modulation is a classic synthesis technique that takes two source waveforms and generates a third waveform, which contains the sum and difference frequencies of the two inputs.

At audio rates, ring modulation creates a fairly inharmonic and 'metallic' sound. At LFO rates, ring modulation can generate interesting, complex modulation shapes.

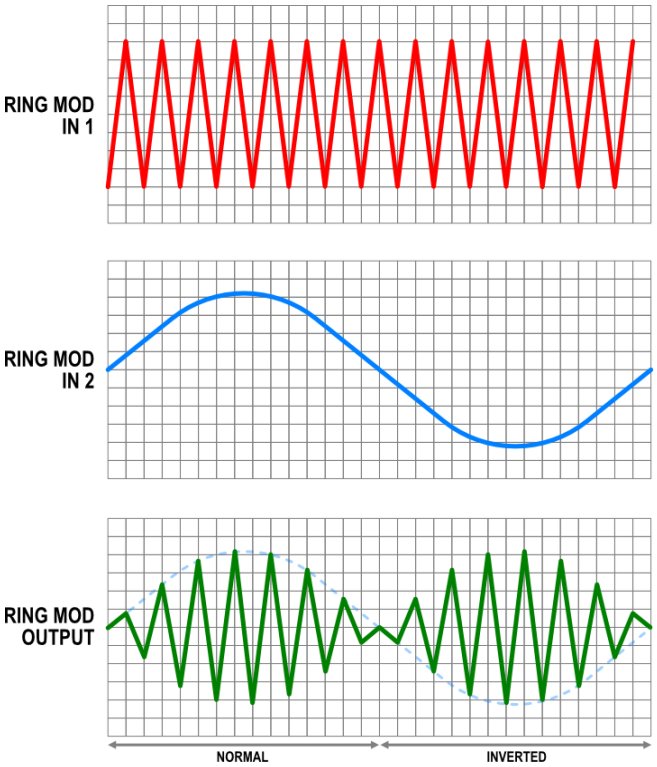
12.6.A : **RINGMOD IN 1** - First of two Ring Modulator inputs. The input is DC coupled, so you can patch in slower modulation sources (like LFOs), as well as audio rate signals.

*DEFAULT ROUTING: With nothing patched in, a SINE WAVE output generated by **VCO A** is normalled to the jack.*

12.6.B : **RINGMOD IN 2** - Second of two Ring Mod inputs. This, too, is DC coupled.

*DEFAULT ROUTING: With nothing patched in, a SINE WAVE output generated by **VCO B** is normalled to the jack.*

12.6.C : **RINGMOD OUT** - Output of the Ring Modulator, which is a waveform containing the sum and difference frequencies of the two input waveforms, as shown in the illustration to the right.

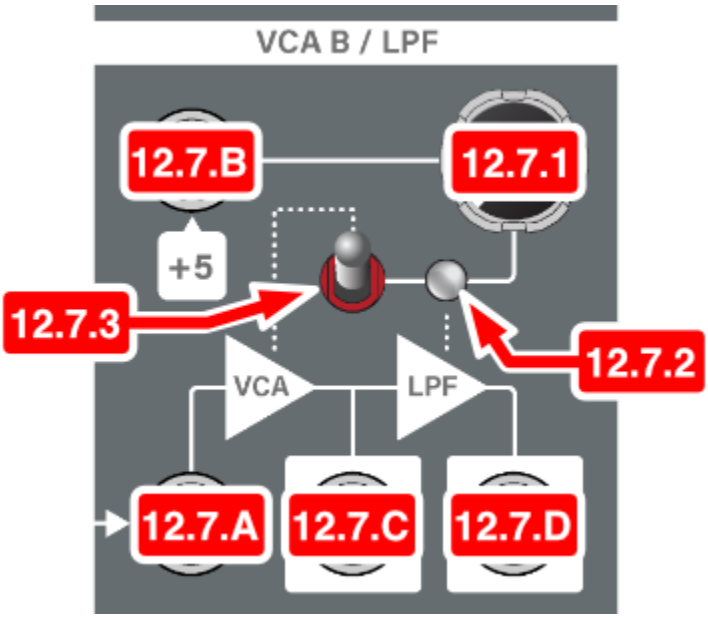


*DEFAULT ROUTING: By default, the output of the ring modulator is routed to **MIXER IN 1** [7.A] where it can then be blended with other waveforms. You can patch it elsewhere if you prefer.*

The associated **LED** indicates the polarity (green = pos; red = neg) of the RINGMOD output, while the LED's intensity indicates amplitude. At audio rates, the cycle is too high to see the individual peaks and troughs (meaning it acts mostly as an output indicator). But at LFO rates, the LED provides a visual representation of the complex LFO shape being generated by the ring mod.

VCA B / LPF

SECTION 12.7



This section provides both a second linear Voltage Controlled Amplifier (VCA) and an additional 4-pole, ladder-type Low Pass Filter (LPF), which can also be combined to function as a Low Pass Gate (LPG).

LPGs control the amplitude and timbre of a signal by simultaneously opening and closing both an LPF and a VCA. When the filter's cutoff frequency lowers, the VCA amplification also lowers — meaning sounds get duller as they get quieter; and brighter as they get louder — much like a traditional acoustic instrument.

12.7.1 : **CV amount** knob - Attenuates the amount by which a voltage patched into the **VCA/LPF B CV IN [12.7.B]** jack controls the cutoff frequency of the LPF, and (if enabled by the **VCA CONTROL [12.7.3] switch**) the amplitude of the VCA. Specifically:

- Fully **CLOCKWISE** : The full amount of the voltage appearing at the **CV IN [12.7.B]** jack is used to modulate the LPF frequency. Also, if the **VCA CONTROL [12.7.3]** switch is in the UP position, the full amount of the **CV IN** signal modulates the amplitude of VCA A.
- Fully **COUNTERCLOCKWISE** : The **CV IN** voltage is fully attenuated, which closes the LPF and silences output from the **LPF B OUT [12.7.D]** jack. Also, if the **VCA CONTROL [12.7.3]** switch is in the UP position, it reduces VCA B's gain to zero and silences the output from the **VCA B OUT [12.7.C]** jack.

*DEFAULT ROUTING: If nothing is patched into the **CV IN** jack, then +5V DC is normalled to the jack. This makes the **CV amount** knob act as a manual VCF frequency control, and (if the **VCA CONTROL switch** is UP) as a manual volume control for VCA B.*

12.7.2 : **CV LEVEL LED** - The brightness of this LED indicates the amount of Control Voltage (post CV amount knob) that controls the amplitude of the VCA and the cutoff frequency of the LPF. The brighter the LED, the higher the absolute voltage level. Color indicates polarity, with a green LED used for positive voltages, and a red LED used for negative voltages.

12.7.3 : **VCA CONTROL switch** - This switch determines whether or not the attenuated control voltage patched into the **CV IN [12.7.B]** jack controls the amplitude of VCA B.

- **UP** position : The attenuated voltage at the **CV IN [12.7.B]** jack controls *both* the amplitude of VCA B and the frequency of LPF B. In this position, the circuit acts similar to a Low Pass Gate (LPG), and the output of that LPG is sent to the **LPF B [12.7.D]** jack.
- **DOWN** position : The attenuated voltage at the **CV IN [12.7.B]** jack controls *only* the frequency of LPF B. The amplitude of VCA B is unaffected. In this position, the circuit acts similar to a Low Pass Filter (LPF), where the **CV IN** controls only the cutoff frequency of a signal patched into the **VCA B IN [12.7.A]** jack.

12.7.A : **VCA B IN** jack - Input to VCA B. The signal inserted here is amplified by VCA B and then split. One split sends the amplified signal directly out the **VCA B OUT [12.7.C]** jack, and the other split sends the amplified signal through a 4-pole ladder diode filter (LPF) and out the **LPF B OUT [12.7.D]** jack.

The LPF cutoff frequency is controlled by the signal patched into **CV IN [12.7.B]** and the **CV amount [12.7.1]** knob. The same CV circuit can control the amplitude of the VCA if the **VCA CONTROL [12.7.3]** switch is in the UP position.

*DEFAULT ROUTING: If nothing is patched into the **VCA B IN** jack, then the **RINGMOD OUT [12.6.C]** is normalled to the jack.*

12.7.B : **VCA/LPF B CV IN** jack - The CV input for controlling the cutoff frequency of the LPF and, if the **VCA CONTROL [12.7.3]** switch is in the UP position, the amplitude of VCA B.

*DEFAULT ROUTING: If nothing is patched into the **CV IN** jack, then +5V DC is normalled to the jack. This makes the **CV amount** knob act as a manual VCF frequency control, and (if the **VCA CONTROL switch** is UP) as a manual volume control for VCA B.*

Common CV sources include envelope/function generators (for shaping the frequency response and volume of the signal patched into **VCA B IN [12.7.C]**) or LFOs (for generating tremolo and/or wah pedal effects).

12.7.C : **VCA B OUT** jack - The output of Voltage Controlled Amplifier B.

12.7.D : **LPF B OUT** jack - The output of the 4-pole, ladder-type, Low Pass Filter B.

I/O CONTROL

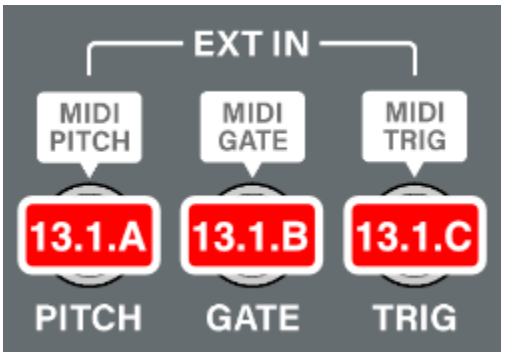
SECTION 13

The I/O CONTROL strip contains several circuits to bring external audio and control voltage signals into Cascadia; route them throughout the synthesizer; and facilitate their output.

From left-to-right, the I/O CONTROL strip contains: EXT CV IN; FX SEND/RETURN; and a MASTER OUTPUT CONTROL section. Each of these are discussed, below:

EXTERNAL CV IN

SECTION 13.1



Not only can you control Cascadia's pitch, gate and triggering with MIDI, but you can also use CV. Cascadia features dedicated PITCH, GATE and TRIG CV inputs for playing the synth.

13.1.A : PITCH CV IN - Connect this to the 1V/oct PITCH CV output of whichever external controller, sequencer, or modular gear that you'd like to use to control Cascadia's pitch.

Anything patched in here will be sent to the **MIDI PITCH [1.A]** output in the MIDI / CV section, plus the **VCO A PITCH [2.A]** and **VCF FM 2 [8.B]** inputs (via normalling).

*DEFAULT ROUTING: Any pitch information arriving via either the **USB MIDI [14.J]** or 5-pin **MIDI IN [14.G]** jacks is internally routed to the PITCH CV IN, whether you connect CV to this jack or not. If you do send CV to this jack, then the data received at this jack is summed with the MIDI PITCH data — it does not override it, the way typical jack normalling would.*

13.1.B : GATE CV IN - Connect this to the GATE CV output of whichever external controller, sequencer, or modular gear that you'd like to use to control Cascadia's gating.

Anything patched in here will be sent to the **MIDI GATE [1.G]** output in the MIDI / CV section, plus the **ENVELOPE A GATE [4.A]** and **ENVELOPE B GATE [5.D]** inputs (via normalling).

*DEFAULT ROUTING: Any gates arriving via either the **USB MIDI** [14.J] or 5-pin **MIDI IN** [14.G] jacks are internally routed to the GATE CV IN, whether you connect CV to this jack or not. If you do send CV to this jack, then the data received at this jack is summed with the MIDI GATE data — it does not override it, the way typical jack normalling would.*

13.1.C : **TRIG CV IN** - Connect this to the TRIG CV output of whichever external controller, sequencer, or modular gear that you'd like to use to control Cascadia's gating.

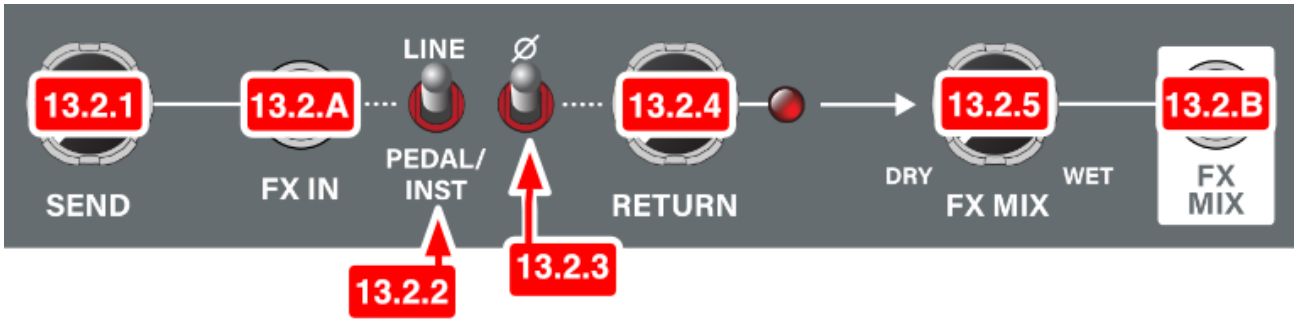
Anything patched in here will be sent to the **MIDI TRIG** [1.H] output in the MIDI / CV section, plus the **ENVELOPE A RETRIGGER** [4.C] input (via normalling).

*DEFAULT ROUTING: Any triggers arriving via either the **USB MIDI** [14.J] or 5-pin **MIDI IN** [14.G] jacks are internally routed to the TRIG CV IN, whether you connect CV to this jack or not. If you do send CV to this jack, then the data received at this jack is summed with the MIDI TRIG data — it does not override it, the way typical jack normalling would.*

FX SEND / RETURN

SECTION 13.2

This section lets you patch external effects devices or stompboxes anywhere in the Cascadia signal chain — controlling both the send and return signal levels, the return signal phase, and the dry/wet mix.



FX SEND / RETURN Controls

13.2.1 : **FX SEND LEVEL** knob - Controls the level of audio (patched into the **FX SND** [13.2.A] jack), which is sent out the back panel's ¼" **Pedal I/O SEND** [14.E] jack for processing with an external effects device or stompbox.

13.2.2 : **SEND LEVEL** switch - Sets whether the audio patched into the **FX SND** [13.2.A] jack should be sent out the back panel's ¼" **Pedal I/O SEND** [14.E] jack at LINE level (required by pro-level effects devices) or at PEDAL/INST level (required by many guitar effects pedals).

13.2.3 : **PHASE** switch - In the UP position, the return signal is in phase. In the DOWN position, the return signal is 180 degrees out of phase. Some pedals invert phase, so this switch is useful when balancing the dry (send) and wet (return) signals with the **DRY/WET FX MIX** **[13.2.5]** knob.

13.2.4 : **FX RETURN LEVEL** knob - Controls the level of the audio being returned to Cascadia via the back panel's ¼" **Pedal I/O RETURN** **[14.F]** jack. The corresponding LED lights when you're overdriving the return input.

13.2.5 : **DRY/WET FX MIX** knob - Mixes the dry signal patched into the **FX SND** **[13.2.A]** jack with the processed (wet) signal being returned via the back panel's ¼" **Pedal I/O RETURN** **[14.F]** jack. This mixed signal is then made available at the **FX MIX** **[13.2.B]** jack to be patched back into your Cascadia signal flow.

When the **DRY/WET FX MIX** knob is fully counterclockwise, only the DRY signal is heard. When it's fully clockwise, only the WET (fully effected) signal is heard. In the noon position, the WET and DRY signals are mixed equally.

FX SEND / RETURN Jacks

13.2.A : **FX SEND** input - Any audio patched into this jack will be sent out the ¼" **Pedal I/O SEND** **[14.E]** jack on the back panel, for processing with an external effects device or stompbox. The level of this audio is determined by the **FX SEND LEVEL** knob.

The audio will be returned from the stompbox via the back panel's ¼" **Pedal I/O RETURN** **[14.F]** jack and made available at the **FX MIX** **[13.2.B]** jack (where its mixed with the dry signal via the **DRY/WET MIX** **[13.2.5]** knob).

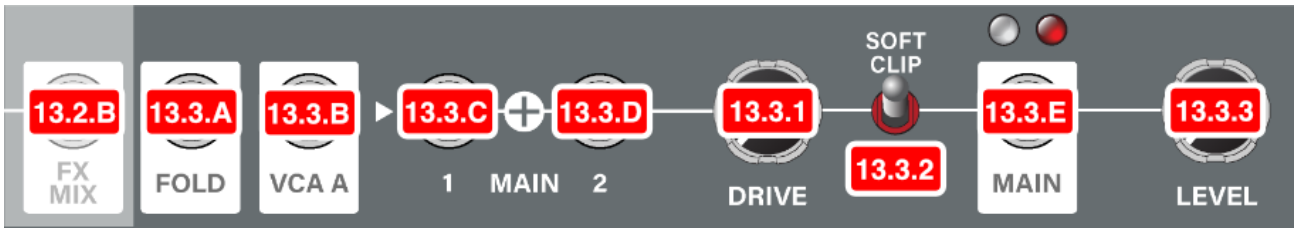
13.2.B : **FX MIX** output - This jack contains a mix of the DRY signal patched into the **FX SND** **[13.2.A]** jack (and sent out to an external stompbox), with the signal returned from the external stompbox via the back panel's ¼" **Pedal I/O RETURN** **[14.F]** jack. The mix of WET and DRY signal levels is set by the **DRY/WET FX MIX** **[13.2.5]** knob.

This mixed signal can then be patched back into your Cascadia signal flow for additional on-board processing or mixing.

OUTPUT CONTROL

SECTION 13.3

This section controls the final output stage of Cascadia — allowing you to access both the FOLD and VCA A outputs directly, and to mix two signals for feeding into the MAIN output. A final gain stage is provided via a DRIVE knob and a SOFT CLIP switch, and a LEVEL control governs to output level.



OUTPUT CONTROL Jacks

13.2.B : **FX MIX** output - This jack was described in the previous section, and it carries a WET/DRY mix of a signal that's been processed through an external effects device. Its presence overlaps with the OUTPUT CONTROL section, where it is another primary output source, along with **FOLD**, **VCA A** and **MAIN**, described below.

13.3.A : **FOLD** output - Direct output of the Wave Folder section, discussed earlier.

13.3.B : **VCA A** output - Direct output of the VCA A section, discussed earlier. By default this output is normalled into the **MAIN 1** **[13.3.C]** jack.

13.3.C : **MAIN 1** input - A signal patched into this jack is summed with an optional signal patched into **MAIN 2** **[13.3.D]** and sent to both the **MAIN OUT** **[13.3.E]** jack and the back panel's ¼" **LINE OUT** **[14.B]** jack.

*DEFAULT ROUTING: If nothing is patched into the **MAIN 1** input jack, then the output of **VCA A** **[13.3.B]** is normalled to the jack.*

13.3.D : **MAIN 2** input - A signal patched into this jack is summed with the signal patched into **MAIN 1** **[13.3.C]** and sent to both the **MAIN OUT** **[13.3.E]** jack and the back panel's ¼" **LINE OUT** **[14.B]** jack.

13.3.E : **MAIN OUT** - Outputs the sum of the **MAIN 1** **[13.3.C]** and **MAIN 2** **[13.3.D]** input signals after routing it through the **DRIVE** **[13.3.1]** and **SOFT CLIP** **[13.3.2]** circuits, and attenuating it with the **LEVEL** **[13.3.3]** knob.

OUTPUT CONTROL Controls

13.3.1 : **MAIN DRIVE** knob - Increases the Level of signal being sent to the MAIN output. This can be used to make up for a low level signal, or it can be used to drive the MAIN output into distortion.

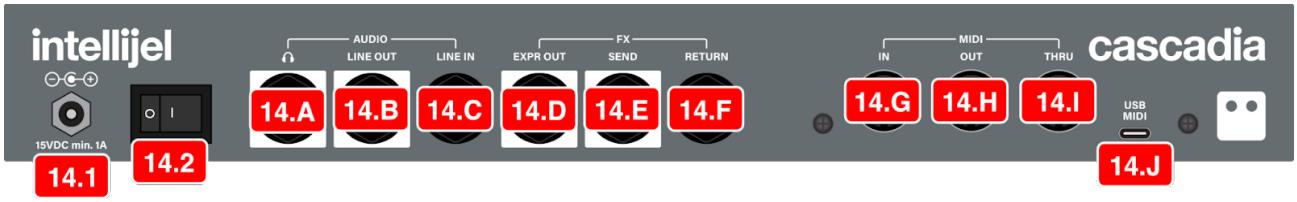
13.3.2 : **SOFT CLIP** switch - Enables soft clipping, which rounds off (“softens”) any clipped signal, creating a ‘warmer’, less aggressive form of distortion.

13.3.3 : **MAIN LEVEL** knob - Controls Cascadia’s output volume, as sent to the **MAIN OUT** **[13.3.E]** jack, as well as the back panel ¼” **PHONES OUT** **[14.A]** and ¼” **LINE OUT** **[14.B]** jacks.

BACK PANEL

SECTION 14

The back panel contains all the jacks necessary for connecting Cascadia to other devices, including a mixer/amplifier/DAW; headphones; an external audio source; an effects pedal; MIDI (both 5-pin and USB); and a power source.



POWER

14.1 : **POWER JACK** - Connect the supplied power transformer here. Intellijel recommends using only the factory authorized transformer. However, if you use a third party transformer, ensure that the center pin is positive and that it produces 15V with a *minimum* of 1A.

14.2 : **POWER SWITCH** - Power switch to turn Cascadia on/off.

AUDIO

14.A : **PHONES OUT** - ¼" headphone output jack. The PHONES OUT level — just like the **LINE OUT [14.B]** level and the front panel **MAIN OUT [13.3.E]** level — is controlled by the front panel's **MAIN LEVEL [13.3.3]** knob. For this reason it is advisable to NOT use headphones while using the **LINE OUT [14.B]** jack, since unreasonable headphone volume could occur. In general, do not use headphones in areas where situational awareness is required. Do not use headphones at high volume, or for extended periods of time, and always reduce Cascadia's volume level when first connecting them.

14.B : **LINE OUT** - ¼" balanced output jack. It's level is controlled by the front panel's **MAIN LEVEL [13.3.3]** knob.

14.C : **LINE IN** - ¼" balanced line input jack. The signal patched into this jack is made available to Cascadia's front panel via the LINE IN section (**section 6**) where the signal (as attenuated by the **LEVEL [6.1]** slider) appears at the **LINE IN [6.A]** output jack for processing by Cascadia.

LINE IN enables you to patch an external audio signal into your synthesizer and process it with Cascadia's filter, wavefolder or envelopes; or to use it as a modulation source for Frequency Modulation, Ring Modulation, Sample & Hold, and so on.

FX

14.D : **EXP OUT** (Expression Pedal Output) - ¼” TRS jack for patching into a ¼” TRS Expression jack on an external FX Pedal.

*NOTE: Cascadia’s Expression Pedal Output supports pedals that operate on a typical 3.3V expression circuit. While most pedals operate at 3.3V, some operate at 5V. Many of these 5V pedals will also accept CV. Review your pedal's documentation, and if this is the case, you can patch the output of the **UNI OUT** [12.5.M] jack directly to the pedal with an 1/8" to 1/4" cable/adaptor.*

14.E : **SEND** - Connect a ¼” instrument cable from this jack to the input of your external FX pedal. The audio coming out the **SEND** jack is at either line level or pedal level (based on the setting of the front panel’s **SEND LEVEL** [13.2.2] switch), and is an impedance-matched version of the modular-level audio signal patched in to **FX SEND** [13.2.A] input on the front panel (and which is attenuated by the corresponding **FX SEND LEVEL** [13.2.1] knob).

NOTE: This is an unbalanced TS cable (standard for guitars and FX pedals), though you can use TRS cables — you just won’t get any benefit from doing so.

14.F : **RETURN** - Connect a ¼” instrument cable from the output of your external FX pedal to this jack. The arriving audio is then impedance-matched and converted to modular-level, where it can then be phase inverted (using the **PHASE** [13.2.3] switch), attenuated (using the **FX RETURN LEVEL** [13.2.4] knob) and mixed with the dry, pre-FX audio signal (using the **DRY/WET MIX** [13.2.5] knob) before being made available at the front panel’s **FX MIX** [13.2.B] jack.

NOTE 1: This is an unbalanced TS cable (standard for guitars and FX pedals), though you can use TRS cables — you just won’t get any benefit from doing so.

*NOTE 2: You can also plug a guitar or other instrument directly into the **RETURN** jack and process it with Cascadia. This is a high impedance input, allowing Cascadia to act as a piezo pickup preamp for acoustic instruments. Audio arriving at the **RETURN** jack passes through a Class A triode emulator (enabling anything from clean to tube-like distortion) and an impedance converter and level shifter to insure full integration within Cascadia’s signal flow environment.*

MIDI

14.G : **MIDI IN** jack - Connect this to the 5-pin MIDI output of whichever controller, sequencer or MIDI interface you'll use to play Cascadia.

14.H : **MIDI OUT** jack - If enabled in the Intellijel Config app, the MIDI OUT jack transmits Cascadia's internal MIDI Tap Clock (as generated by Cascadia), meaning you can use Cascadia as a master clock in a DAW-less setup. Tap Clock output is enabled, by default, in the factory settings.

14.I : **MIDI THRU** jack - All MIDI data appearing at the **MIDI IN** **[14.G]** jack is transmitted out this jack, enabling MIDI devices to be daisy chained. MIDI data arriving at the **USB MIDI** **[14.J]** port is not thru'd.

14.J : **USB MIDI** port - Connect this to computers, tablets, smart-phones, or to any other device that's capable of performing as a USB MIDI host. In addition, if enabled in the Intellijel Config app, the USB MIDI port can transmit Cascadia's internal MIDI Tap Clock (as generated by Cascadia), meaning you can use Cascadia as a master clock in a DAW-less setup. Tap Clock output is enabled, by default, in the factory settings.

DETAILS

The following sections expand upon various aspects of Cascadia's architecture — sometimes elucidating on a particular synthesis technique, and sometimes providing additional details about a specific operation or feature.

DETAILS: Understanding FM

Frequency modulation is a classic synthesis technique in which you modulate the frequency of one waveform (the carrier) with a second waveform (the modulator).

It's easiest to understand FM if you first think about what happens when you use a Low Frequency Oscillator (LFO) as a modulator: For example, assume your carrier oscillator is tuned to middle-C, and that you connect an LFO into its FM input. The result, obviously, is vibrato: the carrier oscillator slowly rises and falls in pitch at a rate set by the LFO.

So what happens if you speed up the modulating waveform to audio rates? The pitch rises and falls so quickly that the ear no longer perceives the modulation as vibrato. Instead, it hears new frequencies (called sidebands), which are mixed in both above and below the carrier frequency, resulting in a harmonically complex waveform of fixed pitch. Changing the ratio between the modulating and carrier frequencies alters the quantity, spacing and amplitude of these sidebands. When the modulator and carrier are pitched at simple evenly-divisible multiples of one another (for example, the modulator is 2x or 1/4x the frequency of the carrier), then the sidebands accentuate the natural harmonics. When the pitch ratio between modulator and carrier is no longer evenly divisible (for example, the modulator is 1.618 times the carrier frequency), then inharmonic sounds are produced.

It's not just the difference between the modulator and carrier frequencies that shape your sound. The waveforms you use for both modulator and carrier also impact the harmonic structure, as does the amplitude difference between the waveforms (which is called FM INDEX).

Exponential vs. Linear FM

In general, there are two distinct types of FM, both of which are supported by Cascadia:

- **EXPONENTIAL FM** is the type found in many vintage analog mono synths of the 1970's. When you change the frequency of the modulator, you change the perceived fundamental pitch that emerges from the carrier oscillator. Furthermore, because the harmonic ratio of modulator-to-fundamental changes from note-to-note, neither the resulting pitch nor the timbre track chromatically. This makes Exponential FM ideal for clangorous, atonal sound effects. It's a great source for experimental sounds, particularly when the modulating pitch is, itself, modulated.
- **LINEAR FM** is the type more commonly associated with digital synths in the 1980's, although the linear FM circuitry in Cascadia is purely analog. When you change the frequency of the modulator, you alter a note's timbre without affecting its perceived pitch. Furthermore, because

the harmonic ratio of modulator to fundamental remains consistent from note-to-note, both the resulting pitch and timbre track chromatically. This makes Linear FM potentially more “musical” than exponential FM, and it’s ideal for creating harmonically complex waveforms that track across a range of notes. Cascadia uses a special variant of Linear FM, called **TZFM** (discussed below).

Thru-Zero FM (TZFM)

When you frequency-modulate an oscillator, you cause its pitch to go up and down. In a typical (non TZFM) linear FM circuit, the oscillator is biased such that, no matter how great the modulation, the output pitch never dips below 0 Hz. Makes sense, right? After all, who ever heard of a negative pitch?

A TZFM oscillator is one that allows the FM input to modulate pitch into negative territory (i.e. “Through Zero”). It does this by reversing the direction of the oscillator whenever it’s asked to produce negative frequencies. This ensures that the oscillator will continue to produce sound even when modulated into negative frequencies.

TZFM oscillators can produce “deeper” and “richer” timbres than standard, positive-only FM’d oscillators, and Cascadia supports two flavours of TZFM: DC (which is the deepest variant — ideal for slower modulators, such as LFOs); and AC (not as deep, but more accurate at tracking pitch variations).

DETAILS: Understanding OSC Sync

Sync occurs when the periodicity of one oscillator (the parent) governs that of another (the child). In other words, when two oscillators are synchronized, the pitch of the parent oscillator forces the child oscillator to cycle at some whole number multiplier of that pitch.

Different timbres are produced when the child oscillator runs at a different pitch than the parent oscillator. In order to synchronize to the parent oscillator, the child oscillator must restart its wavecycle every time the parent oscillator reaches some predetermined point in its cycle. This causes abrupt changes to the child oscillator's waveform, which results in a harmonically rich sound.

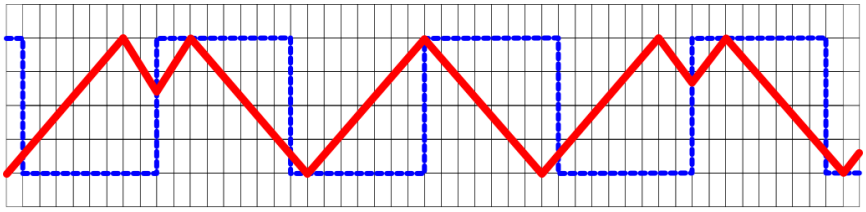
There are various ways to define precisely when and how the child oscillator should reset itself, and as you might expect, each results in a different timbre. Cascadia's VCO A supports two such synchronization options (HARD and SOFT) when employed as the child oscillator, while VCO B supports one sync method (HARD).

- HARD SYNC - This is the traditional VCO sync method, and is used by VCO B (always) and by VCO A (only when its SYNC TYPE selector switch is set to "HARD").

Triangle Wave Hard Sync'd to Pulse Wave

Hard sync always resets the child oscillator waveform to ground on the parent oscillator's rising edge. Due to the (potentially) more ragged waveshapes that result, hard sync can result in a fairly aggressive timbre, and is the type usually associated with "the sync sound" in classic synths.

- SOFT SYNC – This is an alternate VCO sync method (available only on VCO A if its SYNC TYPE selector switch is set to "SOFT."). Cascadia uses a form of soft sync known as "flip" sync, which reverses the direction of the triangle core wave, rather than resetting it. Additionally, sync occurs only when the triangle core is falling and close to ground (rather than at any point in the waveform, as Hard sync does). This results in a "softer," less aggressive waveform.



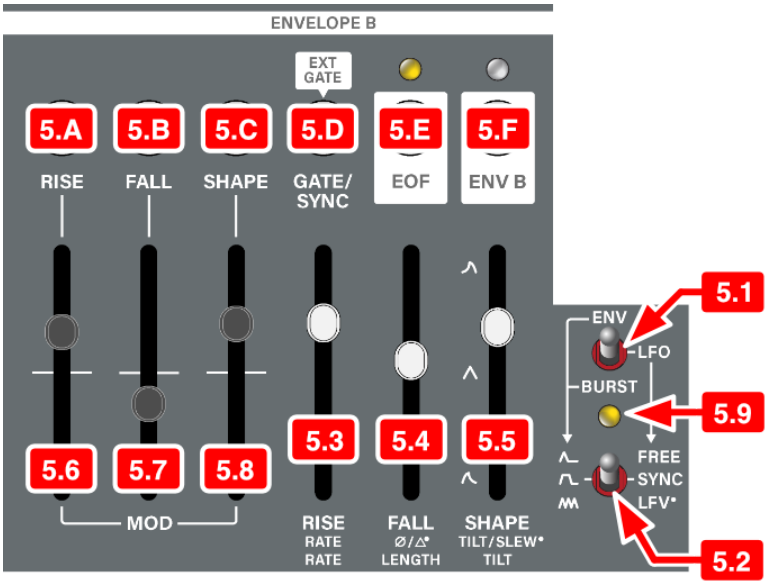
Triangle Wave Soft Sync'd to Pulse Wave

DETAILS: Envelope B as Envelope

To use ENVELOPE B as an envelope, set the **MODE SELECT** [5.1] switch to the top position.

The **RISE** [5.3], **FALL** [5.4] and **SHAPE** [5.5] sliders control the Attack time; Decay/Release time, and envelope curvature, respectively.

Envelopes are triggered with a signal applied to the **GATE/SYNC** [5.D] input, and the envelope's output appears at the **ENV B** [5.F] jack. Additionally, an **EOF** [5.E] gate or trigger signal (configured in the Intellijel Config App) is output whenever the envelope reaches the end of it's FALL stage.



Specifically, when in ENVELOPE MODE (i.e. the **MODE SELECT** [5.1] switch is in the up position), then the ENVELOPE B controls work as follows:

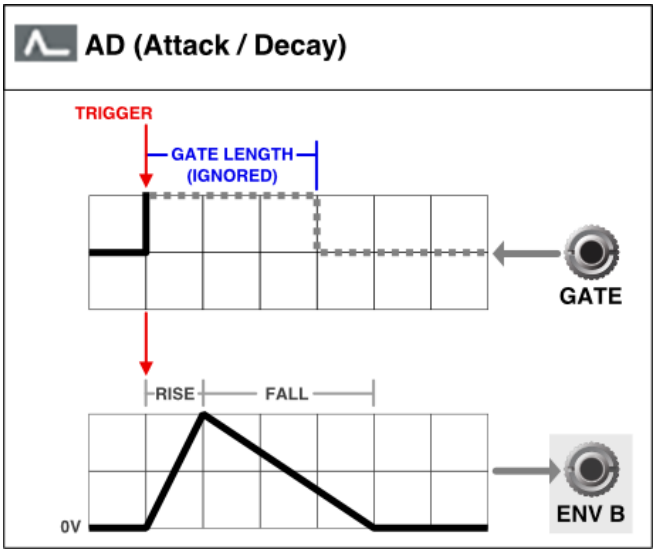
Controls & Jacks

5.1 : **MODE SELECT** switch - must be in up position for ENV B to function as an Envelope.

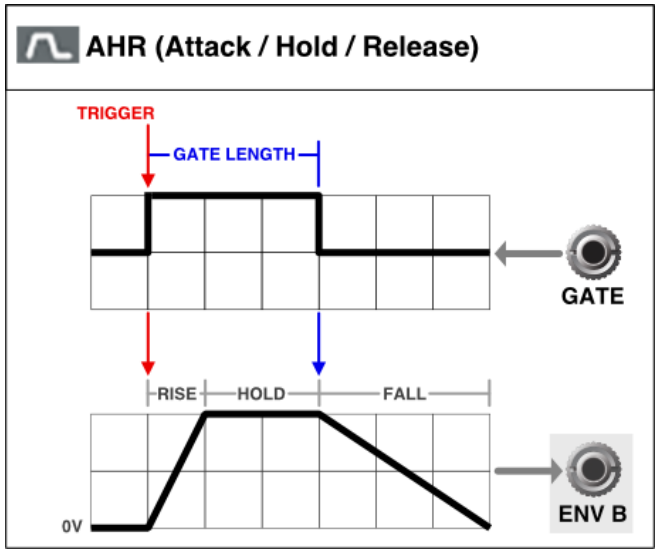
5.2 : **TYPE SELECT** switch - Specifies the type of envelope:

- **AD** (top) : When the switch is in the top position, Envelope B is a classic, 2-stage Attack/Decay envelope, where **RISE** [5.3] controls the envelope's attack time and **FALL** [5.4] controls the decay time.

  AD envelopes complete their entire cycle upon receiving a trigger at the corresponding **GATE/SYNC** [5.D] input. AD envelopes ignore the gate time of the incoming signal. The **SHAPE** [5.5] slider sets the envelope's curvature.

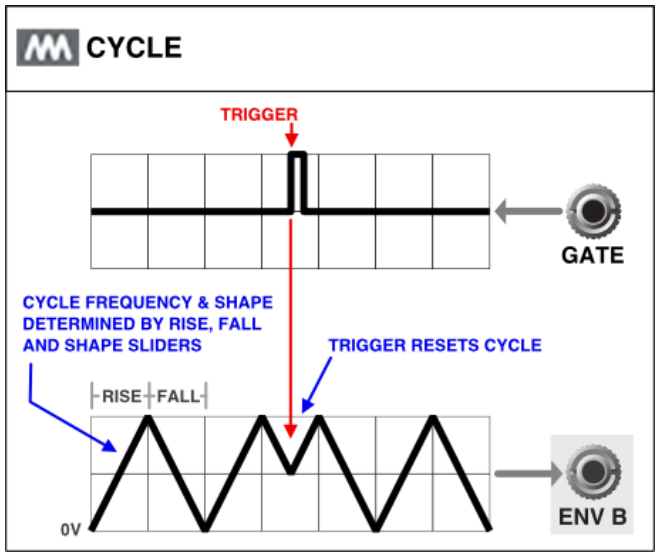


- **AHR** (middle) : When the switch is in the middle position, Envelope B is an Attack/Hold/Release envelope, where **RISE** [5.3] controls the envelope's attack time and **FALL** [5.4] controls its release time.



  The attack portion of the envelope is triggered by the rising edge of a gate signal sent to the **GATE/SYNC** [5.D] input. The envelope holds (sustains) its maximum value for as long as the gate signal is high, then triggers the release stage when the gate signal goes low. If the gate length is shorter than the rise time, the envelope will begin to fall before reaching its maximum value. The **SHAPE** [5.5] slider sets the envelope's curvature.

- **CYCLE** (bottom) : With the switch in the down position, Envelope B is a cycling AD envelope, which behaves like a unipolar LFO. The frequency of the cycle is determined by the overall sum of the **RISE** [5.3] and **FALL** [5.4] times. The skewing of the cycle is determined by the relative amounts of RISE and FALL, while the curvature is selected by the **SHAPE** [5.5] slider.



  The cycle is free running, and does not require a **GATE** [5.D] input. However, if a TRIG input is detected, then the Cycle resets, as illustrated.

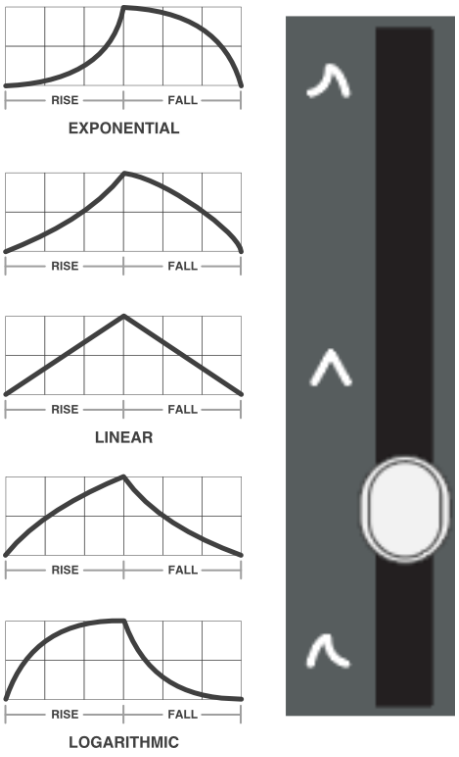
5.3 : **RISE** slider - Controls the rise time (attack) of the function (rising from zero to the maximum level). Slower times will create a fade-in effect while faster times are used for snappy percussive sounds.

The slider adjusts the RISE time from 2ms at the bottom, to 5 seconds at the top. You can extend the time range by patching CV into the **RISE MOD** [5.A] input and attenuverting it with the **RISE MOD** [5.6] slider.

5.4 : **FALL** slider - Controls the time it takes for the function to fall from its maximum value back to zero. With an AHR type envelope, this will act as the release time. With a CYCLE type envelope, the total time of RISE plus FALL sets the frequency of the cycle.

The slider adjusts the FALL time from 2ms at the bottom, to 5 seconds at the top. You can extend the time range by patching CV into the **FALL MOD** **[5.B]** input and attenuverting it with the **FALL MOD** **[5.7]** slider.

5.5 : **SHAPE** slider - Varies the shape of the RISE and FALL curves, as illustrated to the right.



At the midway point, the curves are linear. Below center, the shapes become increasingly logarithmic. Above center, the shapes become increasingly exponential. Exponential shapes tend to have more of a plucked character.

5.6 : **RISE MOD** slider - You can modulate the RISE time by patching a control voltage into the **RISE MOD** **[5.A]** jack. The RISE MOD slider sets the polarity and amount by which that input voltage modulates the RISE time (as set with the **RISE** **[5.3]** slider).

Settings above the center line affect the RISE time in a positive direction. The higher the position, the greater the input voltage's effect. Settings below the center line affect the RISE time in a negative direction. When set at the center line, the voltage patched into the **RISE MOD** **[5.A]** jack has no effect.

RISE MOD is v/oct — so every 1V increase doubles the RISE time, and every 1V decrease halves it.

5.7 : **FALL MOD** slider - You can modulate the FALL time by patching a control voltage into the **FALL MOD** **[5.B]** jack. The FALL CV slider sets the polarity and amount by which that input voltage modulates the FALL time (as set with the **FALL** **[5.4]** slider).

Settings above the center line affect the FALL time in a positive direction. The higher the position, the greater the input voltage's effect. Settings below the center line affect the FALL time in a negative direction. When set at the center line, the voltage patched into the **FALL MOD** **[5.B]** jack has no effect.

FALL MOD is v/oct — so every 1V increase doubles the FALL time, and every 1V decrease halves it.

5.8 : **SHAPE MOD** slider - You can modulate the SHAPE by patching a control voltage into the **SHAPE MOD** **[5.C]** jack. The SHAPE MOD slider sets the polarity and amount by which that input voltage modulates the SHAPE (as set with the **SHAPE** **[5.5]** slider).

Settings above the center line affect the SHAPE in a positive direction. The higher the position, the greater the input voltage's effect. Settings below the center line affect the SHAPE time in a negative direction.

When set at the center line, the voltage patched into the **SHAPE MOD** **[5.C]** jack has no effect.

5.9 : **SYNC** LED - The SYNC LED is not used by ENVELOPE mode. However, it still functions as a status display indicator when configuring Cascadia's various MIDI functions, as described in the **MIDI / CV** section of this manual.

5.A : **RISE MOD** IN - A voltage patched into this jack varies the RISE time from the value set by the **RISE** **[5.3]** slider. The input voltage (and thus, the amount by which the RISE MOD input is allowed to affect the RISE time) is attenuverted by the **RISE MOD** **[5.6]** slider.

5.B : **FALL MOD** IN - A voltage patched into this jack varies the FALL time from the value set by the **FALL** **[5.4]** slider. The input voltage (and thus, the amount by which the FALL MOD input is allowed to affect the FALL time) is attenuverted by the **FALL MOD** **[5.7]** slider.

5.C : **SHAPE MOD** IN - A voltage patched into this jack varies the SHAPE from the value set by the **SHAPE** **[5.5]** slider. The input voltage (and thus, the amount by which the SHAPE MOD input is allowed to affect the SHAPE) is attenuverted by the **SHAPE MOD** **[5.8]** slider.

5.D : **GATE/SYNC** IN- A trigger or gate signal patched in here triggers the envelope in AHR and AD modes; or resets the cycle in CYCLE mode. Specifically:

- **AD**: Triggers the AD envelope (gate time is ignored).
- **AHR**: Gates the AHR envelope. When the signal goes high, it triggers the attack phase (RISE) of the envelope. The envelope will then hold its maximum level for as long as the signal remains high, then trigger the release phase (FALL) when the signal goes low. If the gate goes low before the attack stage reaches maximum amplitude, then the release stage interrupts the RISE and begins to FALL from that point.
- **CYCLE**: Resets the Cycle.

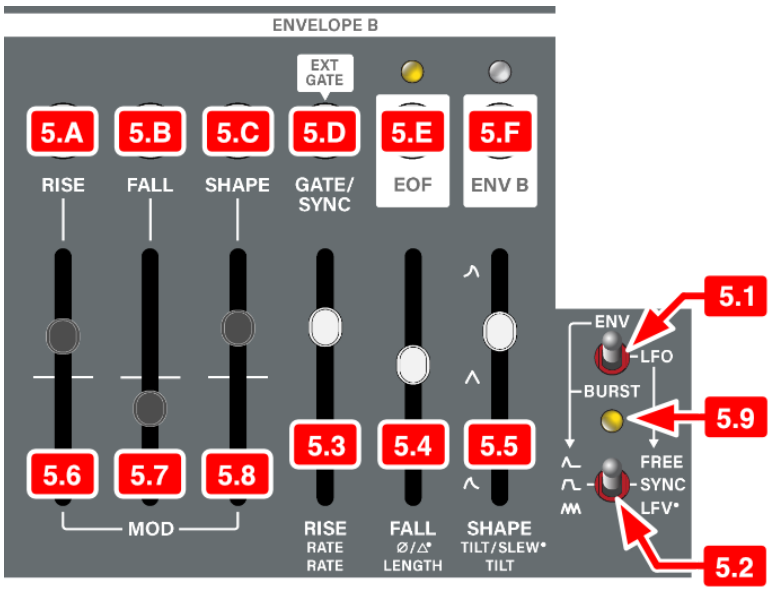
*DEFAULT ROUTING: If nothing is patched into the **GATE/SYNC** **[5.D]** jack, Cascadia's external Gate is used (which can be derived either from the **MIDI GATE** **[1.G]**, the **GATE CV** **[13.1.B]** input, or the front panel **MANUAL GATE** **[11.1]** button.*

5.E : **EOF** (End Of Fall) OUT - Outputs a 0V signal at the beginning of the FALL stage, and stays at 0V until the end of the FALL stage — jumping back to +5V when the stage ends. The LED above the jack lights when the signal is high, and goes out when the signal is low (i.e. during the FALL stage).

NOTE: Using the Intellijel Config App, you can globally change this (and all other envelope stage outputs) to operate as triggers, rather than gates. When configured as a trigger output, the jack stays at 0V, outputting a short +5V pulse only when reaching the end of the FALL stage.

5.F : **ENV B** OUT - Output of the envelope, which travels between 0V and 5V throughout its duration. The LED above the jack changes in intensity over the course of the envelope — the brighter the LED, the greater the output voltage.

DETAILS: Envelope B as LFO



To use ENVELOPE B as an LFO, set the **MODE SELECT** [5.1] switch to the middle position.

This causes ENVELOPE B to operate either as an LFO that tilts from saw-to-triangle-to-ramp (and which can be phase offset); or as a Low Frequency Vacillator (LFV) that meanders through a sort of randomly chaotic series of oscillations.

In LFO Mode, the input jacks and sliders take on functions specific to the LFO. These are labeled by the middle row of text beneath the RISE, FALL and SHAPE sliders (corresponding to LFO mode being the middle position on the **MODE SELECT** [5.1] switch)**.** Specifically:

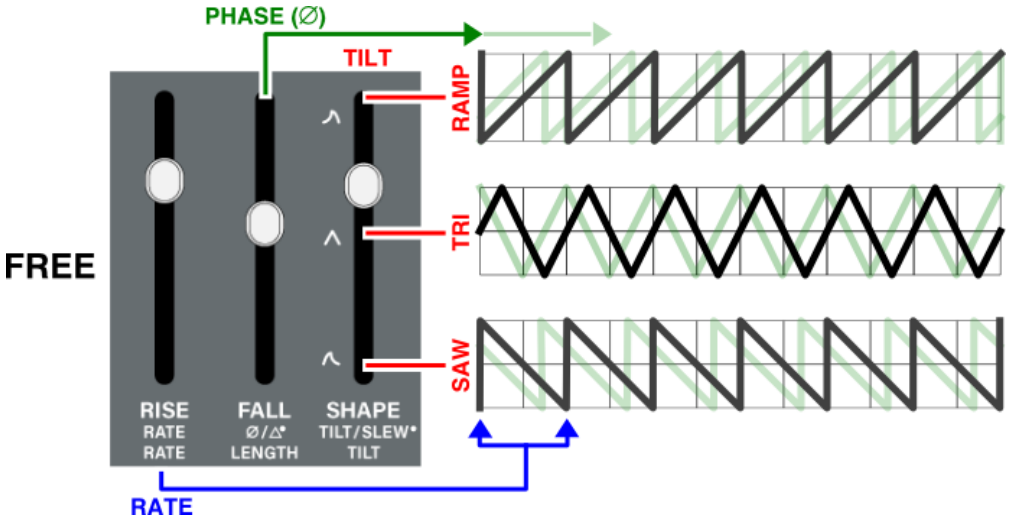
In LFO (FREE or SYNC) mode:

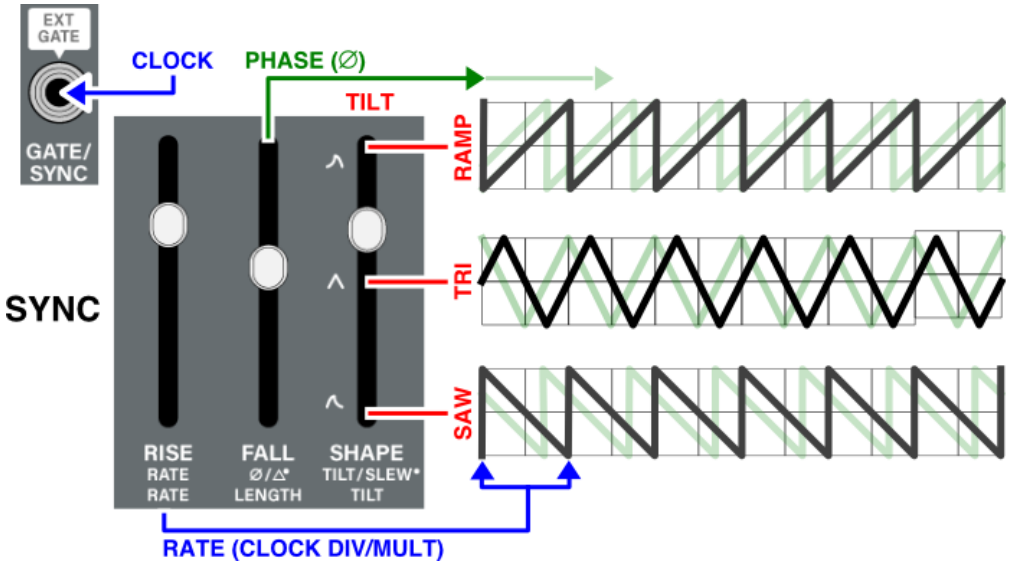
- All RISE functions become **RATE** functions. So slider [5.3] becomes a **RATE** slider; input [5.A] becomes a **RATE MOD INPUT**; and slider [5.6] becomes a **RATE MOD ATTENUVERTER**.
- All FALL functions become **PHASE (∅)** functions. So slider [5.3] becomes a **PHASE (∅)** slider; input [5.A] becomes a **PHASE MOD INPUT**; and slider [5.6] becomes a **PHASE MOD ATTENUVERTER**.
- All SHAPE functions become **TILT** functions. So slider [5.3] becomes a **TILT** slider; input [5.A] becomes a **TILT MOD INPUT**; and slider [5.6] becomes a **TILT MOD ATTENUVERTER**.

In LFO (LFV) mode:

- All RISE functions become **RATE** functions. So slider [5.3] becomes a **RATE** slider; input [5.A] becomes a **RATE MOD INPUT**; and slider [5.6] becomes a **RATE MOD ATTENUVERTER**.
- All FALL functions become **DELTA (Δ)** functions. So slider [5.3] becomes a **DELTA (Δ)** slider; input [5.A] becomes a **DELTA MOD INPUT**; and slider [5.6] becomes a **DELTA MOD ATTENUVERTER**.
- All SHAPE functions become **SLEW** functions. So slider [5.3] becomes a **SLEW** slider; input [5.A] becomes a **SLEW MOD INPUT**; and slider [5.6] becomes a **SLEW MOD ATTENUVERTER**.

The interplay between these controls, and the type of LFO generated, becomes quite evident when visualized graphically, as seen on the following page.


FREE
PHASE (∅)
TILT
RAMP
TRI
SAW
RISE
RATE
RATE
FALL
∅/△*
LENGTH
SHAPE
TILT/SLEW*
TILT
RATE


SYNC
EXT GATE
GATE/ SYNC
CLOCK
PHASE (∅)
TILT
RAMP
TRI
SAW
RISE
RATE
RATE
FALL
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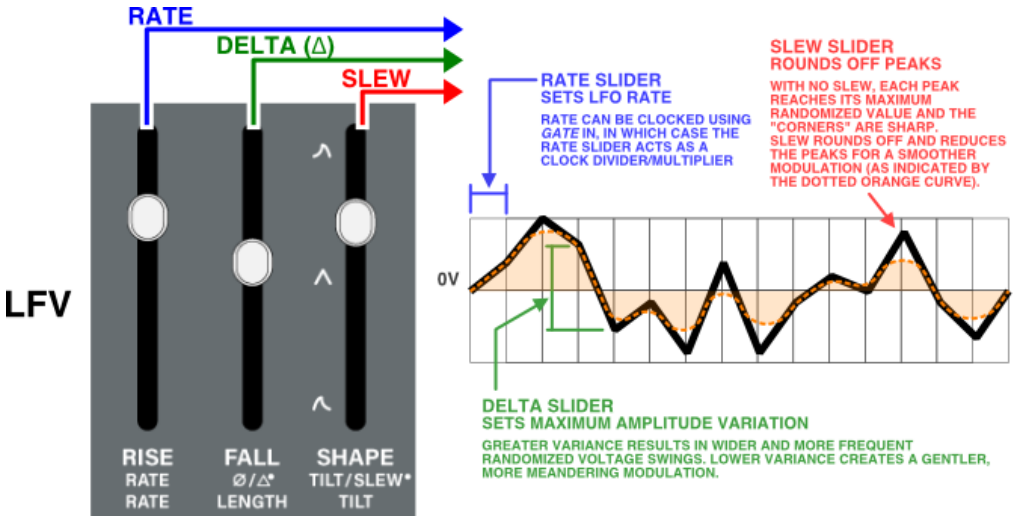
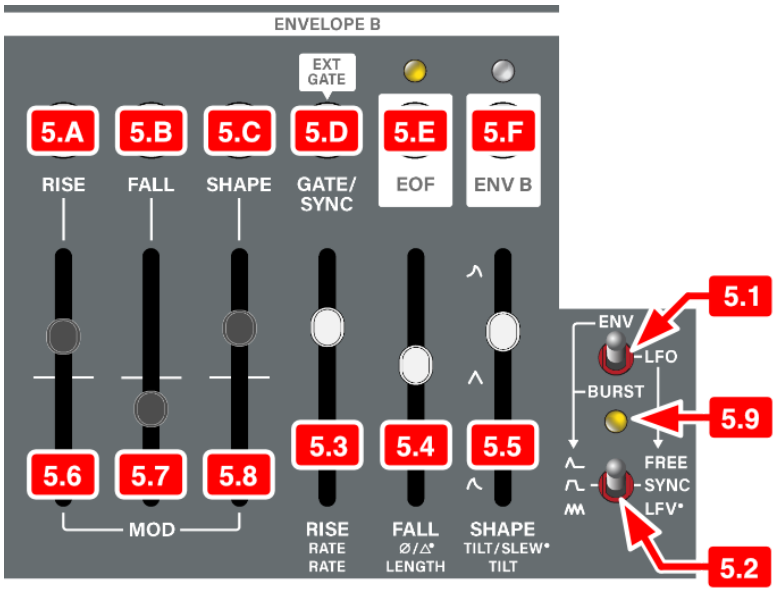
TILT
RATE (CLOCK DIV/MULT)


LFV
RATE
DELTA (Δ)
SLEW
RATE SLIDER
SETS LFO RATE
RATE CAN BE CLOCKED USING
GATE IN, IN WHICH CASE THE
RATE SLIDER ACTS AS A
CLOCK DIVIDER/MULTIPLIER
SLEW SLIDER
ROUNDS OFF PEAKS
WITH NO SLEW, EACH PEAK
REACHES ITS MAXIMUM
RANDOMIZED VALUE AND THE
"CORNERS" ARE SHARP.
SLEW ROUNDS OFF AND REDUCES
THE PEAKS FOR A SMOOTHER
MODULATION (AS INDICATED BY
THE DOTTED ORANGE CURVE).
0V
DELTA SLIDER
SETS MAXIMUM AMPLITUDE VARIATION
GREATER VARIANCE RESULTS IN WIDER AND MORE FREQUENT
RANDOMIZED VOLTAGE SWINGS. LOWER VARIANCE CREATES A GENTLER,
MORE MEANDERING MODULATION.
RISE
RATE
RATE
FALL
∅/△*
LENGTH
SHAPE
TILT/SLEW*
TILT

Controls & Jacks



5.1 : **MODE SELECT** switch - Switch must be in the middle position for ENVELOPE B to function as an LFO.

5.2 : **TYPE SELECT** switch - Selects between three types of LFOs (which are illustrated in on the previous page):

- **FREE** : Works as an LFO, whose waveshape tilts from Saw, to Triangle, to Ramp (or anywhere in between) depending on the position of the **TILT** [5.5] slider. The **PHASE (⌀)** [5.4] slider offsets the LFO's phase, and the **RATE** [5.3] slider sets the rate of oscillation. A trigger patched into the **GATE/SYNC** [5.D] input will RESET the LFO.
- **SYNC** : Works as an LFO, whose waveshape tilts from Saw, to Triangle, to Ramp (or anywhere in between) depending on the position of the **TILT** [5.5] slider. The **PHASE (⌀)** [5.4] slider offsets the LFO's phase, and the **RATE** [5.3] slider sets the LFO rate by either multiplying or dividing the rate of a clock signal patched in to the **GATE/SYNC** [5.D] input. When the LFO is set to "SYNC," the **SYNC LED** [5.9] will flash in time with the sync rate of the LFO.
- **LFV** : Works as a Low Frequency Vacillator (LFV). LFV oscillations are not repeatable, but chaotic — where each cycle targets a different voltage level (positive or negative), resulting in a staggering, "vacillating" modulation source. The **RATE** [5.3] slider sets the rate of vacillation. The **DELTA (Δ)** [5.4] slider sets the amount of allowable random variance; the **SLEW** [5.5] slider slews the changes for a smoother modulation. The **GATE/SYNC** [5.D] input resets the LFV.

5.3 : **RATE** slider: The operation changes slightly depending on which type of LFO is used. Specifically:

- **FREE** : If the LFO is free-running, then its base rate is set directly by the RATE slider, and any signal patched into the **GATE/SYNC** **[5.D]** input simply resets the LFO's phase to the beginning. At the bottom of the slider, the LFO runs at 0.05 Hz (20 s). At the top, the rate is about 800 Hz. Using CV patched into the **RATE MOD IN** **[5.A]** jack extends the range even further.
- **SYNC** : If the LFO is synced, then its base rate is set by a clock signal patched into the **GATE/SYNC** **[5.D]** input. The RATE slider is then used to either divide or multiply that clock rate, allowing for beat-synchronized LFOs. With the RATE slider in the middle, the LFO oscillates at the same rate as the clock patched into the **GATE/SYNC** **[5.D]** input, Moving the slider below center divides the clock rate (making the LFO run slower), while moving it above center multiplies the clock rate (making the LFO run faster). By default, the slider moves through multiplication/division rates of 2, 3, 4, 5, 6, 7, and 8. However, you can assign different multiplication/division functions using the Intellijel Config app.
- **LFV** : If the LFO is set to function as an LFV (Low Frequency Vacillator), then the RATE slider sets the rate of vacillation.

5.4 : **PHASE/DELTA (⌀/Δ)** slider: The operation changes depending on which type of LFO is used. Specifically:

- **FREE** : If the LFO is free-running, then the slider offsets the **PHASE** of the LFO, from 0° at the bottom, to 360° at the top. The phase can be modulated by patching a control voltage into the **PHASE/DELTA (⌀/Δ) MOD IN** **[5.B]** jack.
- **SYNC** : If the LFO is synced, then (like the **FREE** LFO type) the slider offsets the PHASE of the LFO, from 0° at the bottom, to 360° at the top. The phase can be modulated by patching a control voltage into the **PHASE/DELTA (⌀/Δ) MOD IN** **[5.B]** jack.
- **LFV** : If the LFO is set to function as an LFV (Low Frequency Vacillator), the slider sets the **DELTA** (variance) of vacillation. That is, it sets the extent to which the voltage target for each cycle changes from the previous cycle. High variance (top of the slider) creates a fairly random vacillation centered around 0V. Low variance (bottom of the slider) creates a more meandering 'drunken walk' through the voltage range. The variation amount can be modulated by patching a control voltage into the **PHASE/DELTA (⌀/Δ) MOD IN** **[5.B]** jack.

5.5 : **TILT/SLEW** slider: The operation changes depending on which type of LFO is used. Specifically:

- **FREE** : If the LFO is free-running, then the slider smoothly *TILTS* the LFO's waveshape from sawtooth (at the bottom); to triangle (in the middle); to ramp (at the top). The tilt can be modulated by patching a control voltage into the **TILT/SLEW MOD IN [5.C]** jack.
- **SYNC** : If the LFO is synced, then (like the **FREE** LFO type) the slider smoothly *TILTS* the LFO's waveshape from sawtooth (at the bottom); to triangle (in the middle); to ramp (at the top). The tilt can be modulated by patching a control voltage into the **TILT/SLEW MOD IN [5.C]** jack.
- **LFV** : If the LFO is set to function as an LFV (Low Frequency Vacillator), the slider *SLEWS* the directional changes, resulting in increasingly smoother modulations. With the slider at the bottom, the sharp peaks of each directional change are unaffected. The further up you push the slider, the more you'll round off these peaks (reducing both their amplitude and sharpness), which is ideal for creating slowly changing or evolving modulations.

5.6 : **RATE MOD** slider - You can modulate the RATE time by patching a control voltage into the **RATE MOD IN [5.A]** jack. The RATE MOD slider sets the polarity and amount by which that input voltage modulates the LFO RATE (as set with the **RATE [5.3]** slider).

Settings above the centerline affect the RATE time in a positive direction. The higher the position, the greater the input voltage's effect. Settings below the centerline affect the RATE time in a negative direction. At the center line, the voltage patched into the **RATE MOD IN [5.A]** jack has no effect.

RATE MOD is v/oct — so every 1V increase doubles the RATE, and every 1V decrease halves it.

5.7 : **PHASE/DELTA (⌀/Δ) MOD** slider - You can modulate the waveshape's phase/delta by patching a control voltage into the **PHASE/DELTA (⌀/Δ) MOD IN [5.B]** jack. The slider sets the polarity and amount by which that input voltage modulates the LFO's Phase (**⌀**) or Delta (**Δ**) value (as set with the **PHASE/DELTA (⌀/Δ) [5.4]** slider).

When set at the center line, the voltage patched into the **PHASE/DELTA (⌀/Δ) MOD IN [5.B]** jack has no effect.

5.8 : **TILT/SLEW MOD** slider - You can modulate the LFO tilt/slew by patching a control voltage into the **TILT/SLEW MOD IN [5.C]** jack. The slider sets the polarity and amount by which that input voltage modulates the TILT or SLEW of the LFO/LFV (as set with the **TILT/SLEW [5.5]** slider). At the center line, the voltage patched into the **TILT/SLEW MOD IN [5.C]** jack has no effect.

5.9 : **SYNC LED** - When the LFO is set to “SYNC,” the **SYNC LED** **[5.9]** will flash in time with the sync rate of the LFO. The LED also doubles as a status display when configuring the **MIDI / CV** options on Cascadia’s front panel.

5.A : **RATE MOD IN** - A voltage patched into this jack varies the LFO/LFV rate from the value set by the **RATE** **[5.3]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the rate) is attenuverted by the **RATE MOD** **[5.6]** slider. The input CV tracks 1V/Oct.

5.B : **PHASE/DELTA (⌀/Δ) MOD IN** - A voltage patched into this jack varies the LFO/LFV’s Phase/Delta from the value set by the **PHASE/DELTA (⌀/Δ)** **[5.4]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the Phase/Delta value) is attenuverted by the **PHASE/DELTA (⌀/Δ) MOD** **[5.7]** slider. The input CV tracks 1V/Oct.

5.C : **TILT/SLEW MOD IN** - A voltage patched into this jack varies the LFO/LFV’s tilt/slew value from the amount set by the **TILT/SLEW** **[5.5]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the Tilt/Slew value) is attenuverted by the **TILT/SLEW MOD** **[5.8]** slider. The input CV tracks linearly.

5.D : **GATE/SYNC IN** - Patch a trigger or gate signal here to either reset the LFO (TYPE = FREE or LFV), or clock it (TYPE = SYNC).

*DEFAULT ROUTING: If nothing is patched into the **GATE/SYNC** **[5.D]** jack, Cascadia’s external Gate is used (which can be derived either from the **MIDI GATE** **[1.G]**, the **GATE CV** **[13.1.B]** input, or the front panel **MANUAL GATE** **[11.1]** button.*

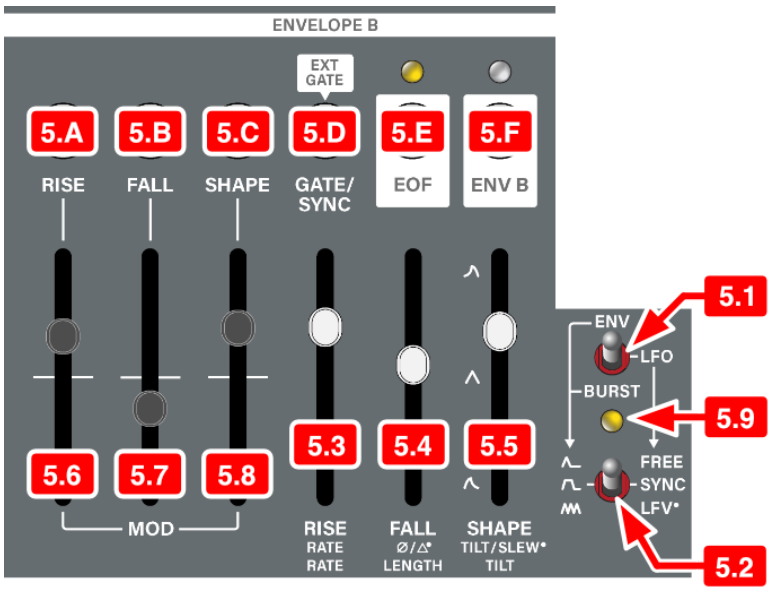
5.E : **EOF** (End Of Fall) OUT - Outputs a gate that goes high (+5V) at the beginning of the LFO cycle (as set with the **PHASE/DELTA (⌀/Δ)** **[5.4]** slider), and remains high for a quarter of an LFO cycle. The LED above the jack lights when the EOF signal is high, and goes out when the EOF signal is low.

5.F : **ENV B** OUT - Output of the LFO, which oscillates between -5V and 5V. The LED above the jack indicates both the amount and polarity of ENVELOPE B’s output voltage, where green indicates positive voltages; red indicates negative voltages; and brightness indicates absolute voltage level.

DETAILS: Envelope B as Pulse Burst Generator

To use ENVELOPE B as a pulse Burst generator, set the **MODE SELECT** [5.1] switch to the bottom position.

This causes ENVELOPE B to generate a burst of pulses, at a user-defined frequency, that lasts over a prescribed length of time. Pulse bursts can produce everything from slow and rhythmic pulses to ratcheting bursts of noise — and since the burst RATE, LENGTH and TILT can all be modulated, Burst Mode makes for a very dynamic and unique function generator.



In Burst Mode, the input jacks and sliders take on functions specific to the mode. These are labeled by the bottom row of text beneath the RISE, FALL and SHAPE sliders (corresponding to Burst Mode being the bottom position on the **MODE SELECT** [5.1] switch)**.** Specifically:

In Burst Mode:

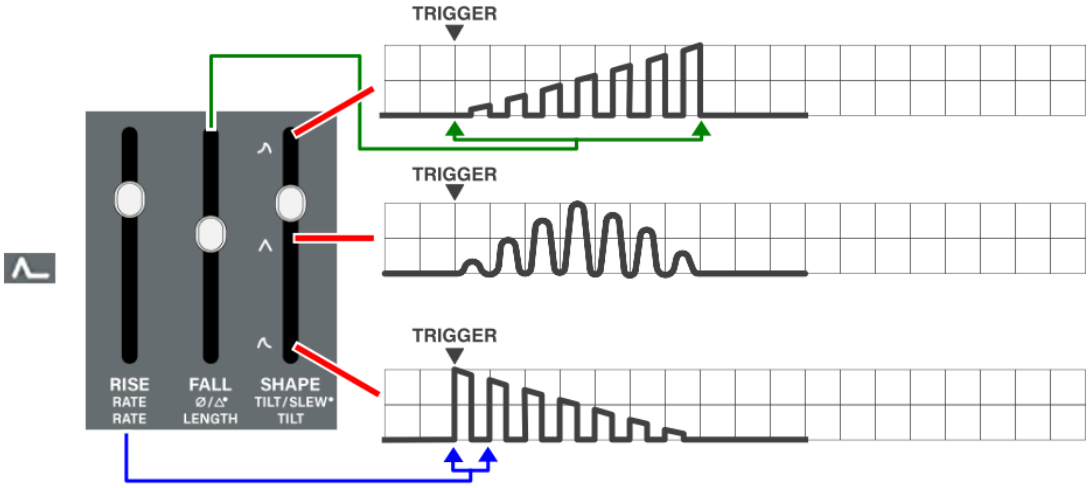
- All RISE functions become pulse **RATE** functions. So slider [5.3] becomes a **RATE** slider; input [5.A] becomes a **RATE MOD INPUT**; and slider [5.6] becomes a **RATE MOD ATTENUVERTER**.
- All FALL functions become burst **LENGTH** functions. So slider [5.3] becomes a burst **LENGTH** slider; input [5.A] becomes a burst **LENGTH MOD INPUT**; and slider [5.6] becomes a burst **LENGTH MOD ATTENUVERTER**.
- All SHAPE functions become **TILT** functions. So slider [5.3] becomes a **TILT** slider; input [5.A] becomes a **TILT MOD INPUT**; and slider [5.6] becomes a **TILT MOD ATTENUVERTER**.

The **TYPE SELECT** [5.2] switch sets how the burst responds to a signal patched into the **GATE/SYNC** [5.D] input.

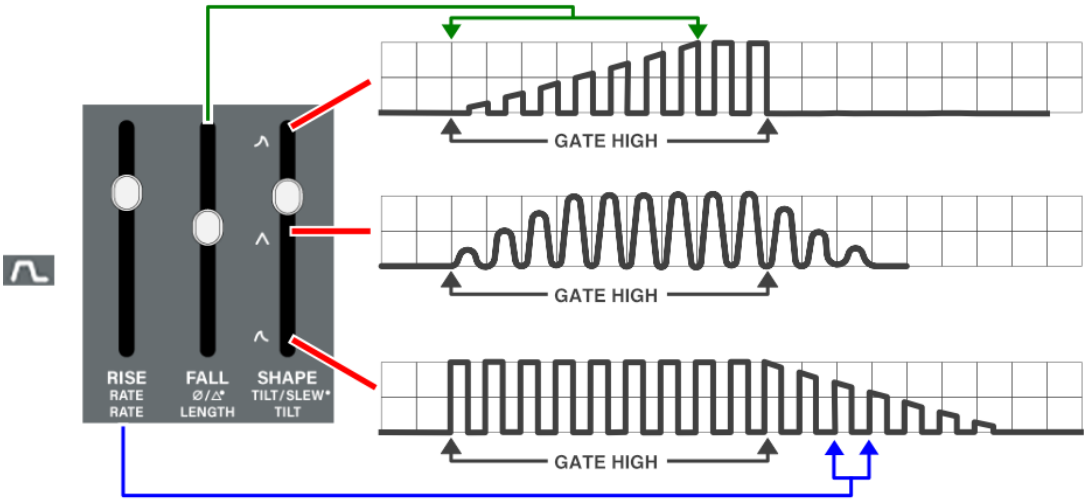
The Burst output appears at the **ENV B** [5.F] jack, and the **EOF** jack outputs a gate that goes low during the entire length of a pulse burst (unless changed to a trigger output using the Intellijel Config App).

The interplay between these controls, and the types of bursts generated, becomes quite evident when visualized graphically, as shown on the following page:

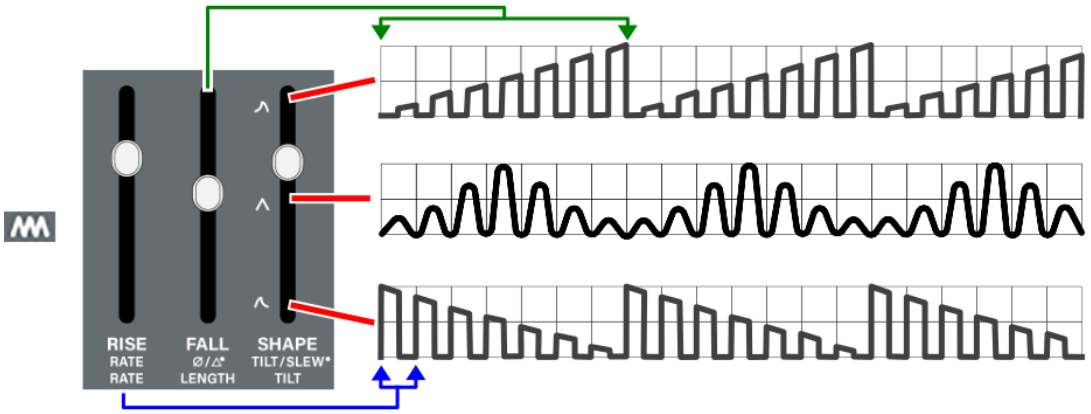
Pulse Bursts with the **TYPE SELECT** [5.9] switch set to the top (**AD**) position:



Pulse Bursts with the **TYPE SELECT** [5.9] switch set to the middle (**AHR**) position:



Pulse Bursts with the **TYPE SELECT** [5.9] switch set to the bottom (**CYCLE**) position:

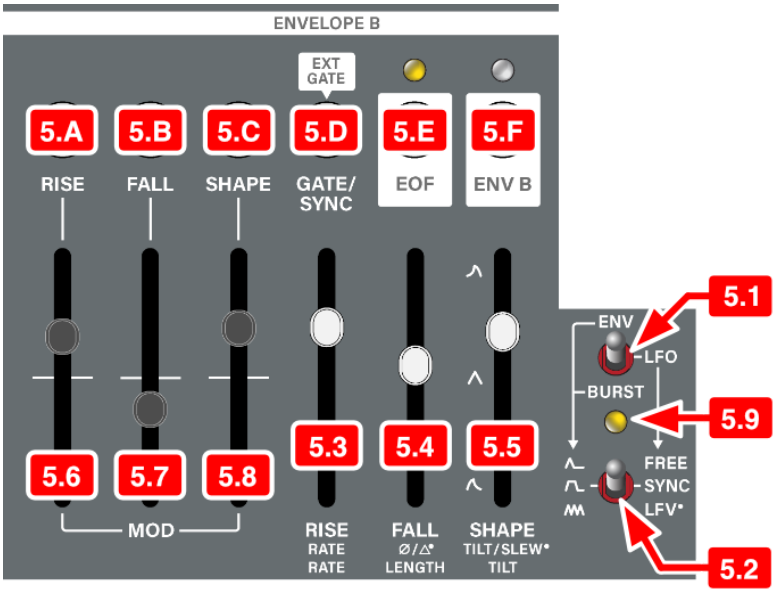


Controls & Jacks

Specifically, when in Burst Mode, the ENVELOPE B controls work as follows:

NOTE: As you read through this section, refer back to the illustrations on the previous page to refresh your understanding of pulse shapes, tilt functions, and the MODE SELECT switch's effect on the overall burst envelope.

5.1 : **MODE SELECT** switch - must be in the down position for ENVELOPE B to function as a Pulse Burst generator.



5.2 : **TYPE SELECT** switch - Defines how the burst responds to a signal patched into the **GATE/SYNC** **[5.D]** input. Specifically:

- **AD** (top): The gate length of the signal patched into the **GATE/SYNC** **[5.D]** input is ignored, and is used only to trigger a single pulse burst, whose length is determined by the **LENGTH** **[5.3]** slider. By default, the shape of each individual pulse morphs from Square>Sine>Square, depending on the position of the **TILT** **[5.5]** slider. This can be changed to a tilting saw/tri/ramp shape using the Intellijel Config App.
- **AHR** (middle): Upon reaching its maximum pulse amplitude, the pulses continue to repeat (at a rate set by the **RATE** **[5.3]** slider for as long as the gate coming into the **GATE/SYNC** **[5.D]** input remains high. By default, the shape of each individual pulse morphs from Square>Sine>Square, depending on the position of the **TILT** **[5.5]** slider. This can be changed to a tilting saw/tri/ramp shape using the Intellijel Config App.
- **CYCLE** (bottom): The Pulse burst (as defined by the **RATE** **[5.3]**, **LENGTH** **[5.4]** and **TILT** **[5.5]** sliders repeats (cycles) for as long as the gate coming into the **GATE/SYNC** **[5.D]** input remains high. By default, the shape of each individual pulse morphs from Square>Sine>Square, depending on the position of the **TILT** **[5.5]** slider. This can be changed to a tilting saw/tri/ramp shape using the Intellijel Config App.

5.3 : **RATE** slider: Sets the rate at which the individual pulses repeat. With the RATE slider at the bottom, Cascadia generates pulses at a rate of one every 20 seconds. When the slider is at the top, the pulse rate is about 1kHz. You can extend the range further by patching CV into the **RATE MOD IN** **[5.A]** jack and attenuverting it with the **RATE MOD** **[5.6]** slider.

*NOTE 1: If the **TYPE SELECT** [5.2] switch is set to the CYCLE (up) position, then the pulse with will continue to repeat (cycle) at a rate set by the RATE slider.*

*NOTE 2: If the **TYPE SELECT** [5.2] switch is set to the AHD (middle) position, then the pulse burst, upon reaching maximum amplitude, will continue to output pulses (at maximum amplitude) until the **GATE** [5.D] input goes low. In this instance, the RATE slider (in conjunctions with the **TILT** [5.5] slider) sets either how long it takes for the pulses to ramp up to maximum amplitude, and/or decay from maximum amplitude.*

5.4 : **LENGTH** slider: Sets the overall length of the pulse burst envelope. With the LENGTH slider at the bottom, the burst envelope lasts for 10 ms; and with it at the top, the pulse burst lasts for 20 seconds. You can extend the range further by patching CV into the **LENGTH MOD IN** **[5.B]** jack and attenuverting it with the **LENGTH MOD** **[5.6]** slider.

*NOTE 1: If the **TYPE SELECT** [5.2] switch is set to the CYCLE (up) position then, the entire LENGTH of the pulse envelope will continue to repeat (cycle) as long as the signal at the **GATE** [5.D] input is high. See the CYCLE illustration, a few pages back.*

*NOTE 2: If the **TYPE SELECT** [5.2] switch is set to the AHD (middle) position, then the LENGTH slider determines the amount of time it takes for the pulse burst to ramp up and/or ramp down from it's maximum level — which is sustained at maximum burst level for as long as the signal at the **GATE** [5.D] input is high. See the AHR illustration, a few pages back.*

5.5 : **TILT** slider: Adjusts the attack and decay of the overall burst envelope (its "Tilt") plus it alters the waveform of each pulse within that envelope.

With the slider at the bottom, individual pulse amplitudes decrease over the burst length. With the slider at the top, individual pulse amplitudes rise over the burst length. In the middle position, maximum pulse amplitude occurs at the midpoint of the burst envelope.

The TILT slider also changes the pulse shape. By default, when the **TYPE SELECT** **[5.2]** switch is set to either the AHR or AD position, then it generates square waves at either end of the slider that morph into sine waves through the middle of the sweep. Using the Intellijel Config App, you can change this, to a tilting saw shape, which starts as a saw at the bottom of the slider, tilts to a triangle in the middle, and tilts further into a ramp at the top of the slider. When the **TYPE SELECT** **[5.2]** switch is set to the CYCLE position, a tilting saw shape is always used.

5.6 : **RATE MOD** slider - You can modulate the pulse RATE by patching a control voltage into the **RATE MOD IN** **[5.A]** jack. The slider sets the polarity and amount by which that input voltage modulates the pulse RATE (as set with the **RATE** **[5.3]** slider).

Settings above the center line affect the RATE in a positive direction — the higher the slider, the greater the input voltage's effect. Settings below the center line affect the RATE in a negative direction. When the slider is centered, the voltage patched into the **RATE MOD IN** **[5.A]** jack has no effect.

RATE MOD is v/oct — so every 1V increase doubles the RATE, and every 1V decrease halves it.

5.7 : **LENGTH MOD** slider - You can modulate the overall burst length by patching a control voltage into the **LENGTH MOD IN** **[5.B]** jack. The slider sets the polarity and amount by which that input voltage modulates the burst LENGTH (as set with the **LENGTH** **[5.4]** slider). When the slider is centered, the voltage patched into the **LENGTH MOD IN** **[5.B]** jack has no effect.

LENGTH MOD is v/oct — so every 1V increase doubles the LENGTH, and every 1V decrease halves it.

5.8 : **TILT MOD** slider - You can modulate the TILT by patching a control voltage into the **TILT MOD IN** **[5.C]** jack. The slider sets how much the envelope tilt (and pulse shape) is affected by the input voltage. When the slider is centered, the voltage patched into the **TILT MOD IN** **[5.C]** jack has no effect.

5.9 : **SYNC LED** - The SYNC LED is not used by BURST mode. However, it still functions as a status display indicator when configuring Cascadia's various MIDI functions, as described in the **MIDI / CV** section of this manual.

5.A : **RATE MOD IN** - A voltage patched into this jack varies the pulse rate from the value set by the **RATE** **[5.3]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the rate) is attenuverted by the **RATE MOD** **[5.6]** slider.

5.B : **LENGTH MOD IN** - A voltage patched into this jack varies the length of the pulse burst set by the **LENGTH** **[5.4]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the burst length) is attenuverted by the **LENGTH MOD** **[5.7]** slider.

5.C : **TILT MOD IN** - A voltage patched into this jack varies the burst envelope and pulse shapes set by the **TILT** **[5.5]** slider. The input voltage (and thus, the amount by which the MOD input is allowed to affect the tilt value) is attenuverted by the **TILT MOD** **[5.8]** slider.

5.D : GATE IN - Patch a trigger or gate signal here to:

- **AD** mode: triggers a single pulse burst envelope, which ignores the gate time and uses the LENGTH parameters to determine the length of the pulse burst.
- **AHR** mode: triggers a single pulse burst envelope; which uses the gate time to determine how long the envelope is held open (during which time it generates repeating pulses).
- **CYCLE** mode: triggers a cycling pulse burst envelope, which repeats for as long as the gate input is high.

*DEFAULT ROUTING: If nothing is patched into the **GATE IN** jack, Cascadia's **MIDI GATE** [1.G] and manual **GATE OUT** [11.A] signals are used to trigger/gate the pulse bursts.*

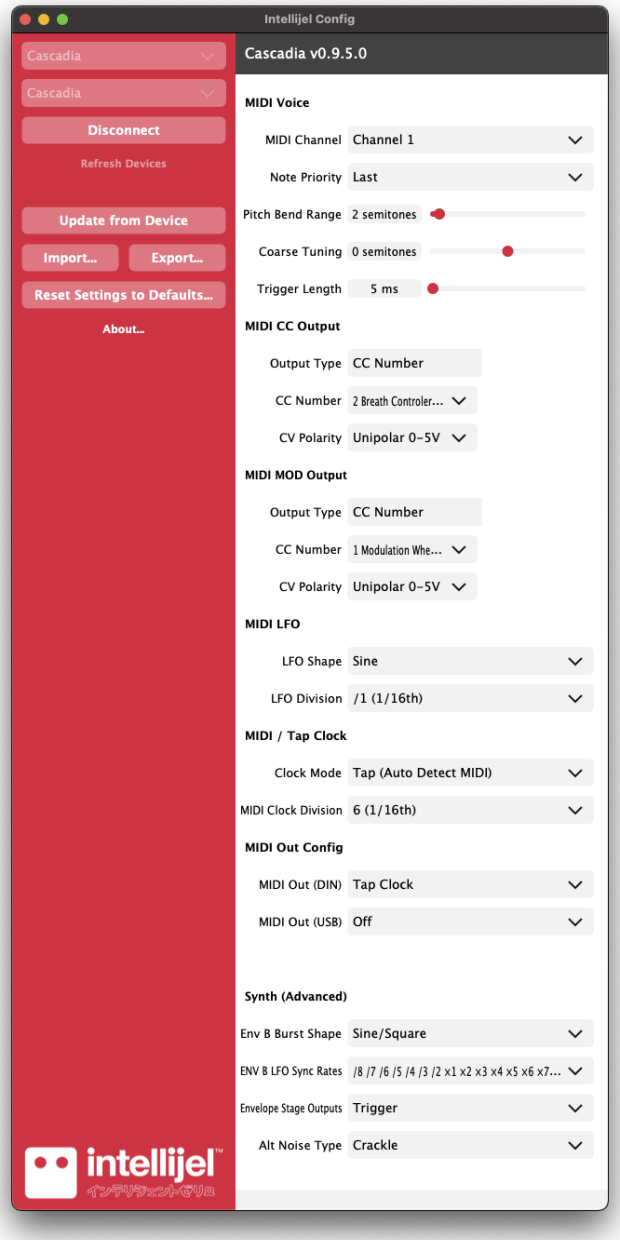
5.E : EOF (End Of Fall) OUT - Outputs a gate signal that is high (+5V) before the pulse burst envelope, goes low (0V) for the duration of the pulse burst, then returns to high at the end of the burst. See the illustration at the beginning of this section.

5.F : BURST OUT - Output of the Pulse Burst Generator. Pulse intensity and rate is monitored using the corresponding LED. The brighter the LED, the higher each pulse's intensity.

INTELLIJEL CONFIG APP

You can customize various aspects of Cascadia's MIDI functions using the Intellijel Config app (available for both Mac and Windows), which is available to download from the www.intellijel.com website.

System Region



The left column (with the red background) is the System Region, which is used to select and connect to the desired Intellijel MIDI Device (either Cascadia or a MIDI 1U system device), and to export and import various saved settings. From top-to-bottom, the following options are available:

MIDI Input — Select the MIDI Device you want to configure from the drop down MIDI Input list.

MIDI Output — Select the MIDI Device you want to configure from the drop down MIDI Output list.

*NOTE: To enable bidirectional communication between the computer and your Cascadia, you must select your Cascadia in both the **MIDI Input** and **MIDI Output** menus.*

Connect / Disconnect — Click this button to connect to the device selected in the **MIDI Input** & **MIDI Output** menus. Once connected, the button becomes a **Disconnect** button.

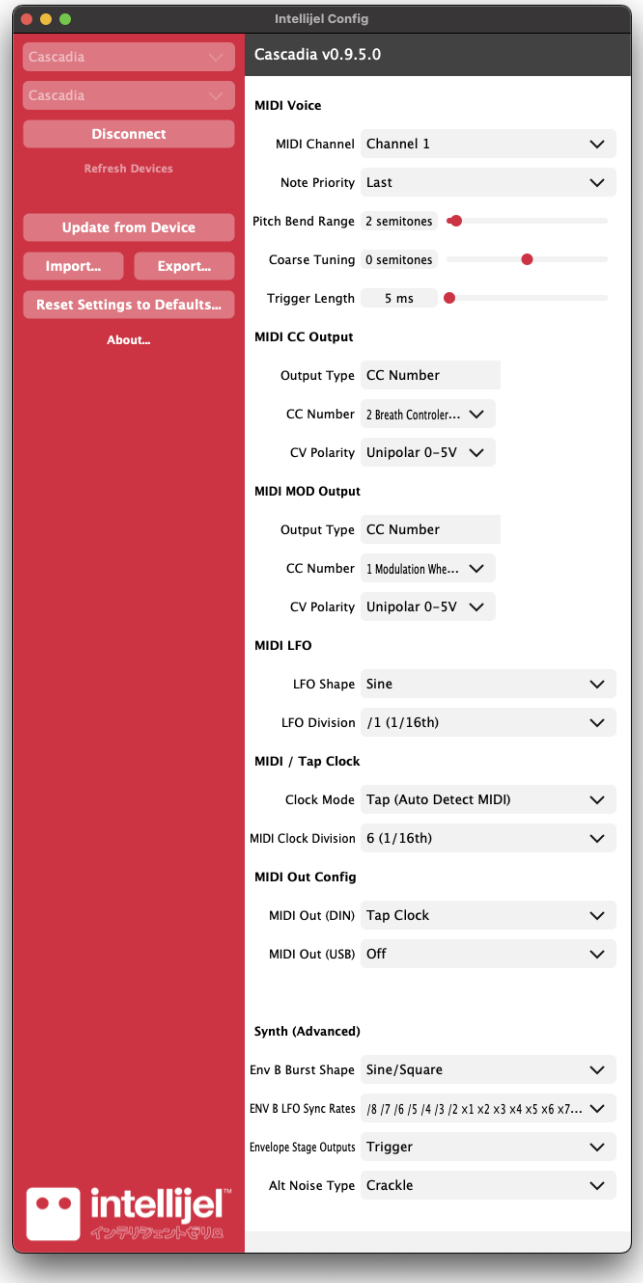
Refresh Devices	With the Intellijel Config app disconnected from any devices, click this to refresh the list of available MIDI devices supplied to the **MIDI Input** and **MIDI Output** columns.
Update from Device	Click to query the device. This is handy if, for example, you configure some MIDI functions on Cascadia itself, while it's connected to the Intellijel Config app. The **Update from Device** button repopulates the *Intellijel Config* app with the latest settings from the device.
Import	Click this button to import (load) a different Cascadia .xml format system configuration from disc. System configurations can be saved to disc via the **Export** button.
Export	Click this button to export (save) the current Cascadia system configuration as a .xml file on your computer.
Reset Settings To Defaults	Click this button to reset Cascadia to the factory default settings.

Cascadia Config Column

Use the Cascadia Config column on the right (white background) to configure various MIDI and synth-related parameters on the Cascadia selected in the System Region's **MIDI Input** and **MIDI Output** menus. At the top of the column is the name of the selected device and its current firmware version. Beneath are all the available parameters, divided into several sections:

- **MIDI Voice**
- **MIDI CC Output**
- **MIDI MOD Output**
- **MIDI LFO**
- **MIDI/Tap Clock**
- **MIDI Out Config**
- **Synth (Advanced)**

Each section is described in the following sections.



MIDI Voice

Use these settings to set Cascadia's MIDI channel, note priority. pitch bend range, tuning, and trigger length. Specifically:

MIDI Channel	(1-16)	Sets the MIDI channel on which Cascadia both receives and transmits MIDI data.
Note Priority		Cascadia is a monophonic device. So if the incoming MIDI stream contains multiple sustained notes, this option determines which of those notes is actually heard.
	Last	The most recently played (last) note will always override the currently playing note, and is always the note you will hear.
	Highest	The highest note currently being held is the note you will hear. Any note you play that is lower will be ignored. Any note you play that is higher will override the previous note.
	Lowest	The lowest note currently being held is the note you will hear. Any note you play that is higher will be ignored. Any note you play that is lower will override the previous note.
Pitch Bend Range	(1 - 24)	Sets the max number of semitones that an incoming MIDI Pitch Bend message will affect the **MIDI PITCH**.
Coarse Tuning	(± 24)	Changes the overall coarse tuning (in semitones).
Trigger Length	(5 - 100ms)	Sets the amount of time that any trigger signal stays 'high' (including the **MIDI CLK** out). The factory default is 5ms.

MIDI CC Output

Output Type

Selects the source from with Cascadia's front panel **MIDI CC** jack's voltage is derived. It can be sourced from a MIDI CC value or from MIDI Pressure (Aftertouch). Specifically, these options are available:

- CC Number — The **MIDI CC** jack outputs a control voltage derived from the MIDI CC # selected in the **CC Number** menu. Voltage polarity is selected by the **CV Polarity** parameter.
- Pressure (Aftertouch) — The **MIDI CC** jack outputs a voltage derived from Channel Aftertouch, rather than from a MIDI CC value.

CC Number

*NOTE: Available only if MIDI CC **Output Type** = "CC Number".*

- (0 - 127) — Selects which MIDI CC# is the source of the control voltage sent out Cascadia's **MIDI CC** jack. For example, if you select `5 Portamento Time`, then the jack will transmit a control voltage based on CC #5 data received by Cascadia.

CV Polarity

*NOTE: Available only if MIDI CC **Output Type** = "CC Number".*

- Unipolar — The **MIDI CC** jack outputs a unipolar signal ranging from 0V to +5V. Incoming MIDI CC data is interpreted as a unipolar signal, meaning a CC value of 0 maps to 0V and a CC value of 127 maps to +5V.
- Bipolar — The **MIDI CC** jack outputs a bipolar signal ranging from -5V to +5V. Incoming MIDI CC data is interpreted as a bipolar signal, meaning a CC value of 64 maps to 0V. Values less than 64 map to negative voltages (with a CC value of 0 generating -5V). Values greater than 64 map to positive voltages (with a CC value of 127 generating +5V).

MIDI MOD Output

Output Type

Selects the source from with Cascadia's front panel **MIDI MOD** jack's voltage is derived. It can be sourced from a MIDI CC value or from MIDI Pressure (Aftertouch). Specifically, these options are available:

- CC Number — The **MIDI MOD** jack outputs a control voltage derived from the MIDI CC # selected in the **CC Number** menu. Voltage polarity is selected by the **CV Polarity** parameter.
- Pressure (Aftertouch) — The **MIDI MOD** jack outputs a voltage derived from Channel Aftertouch, rather than from a MIDI CC value.

CC Number

*NOTE: Available only if MIDI MOD **Output Type** = "CC Number".*

- (0 - 127) — Selects which MIDI CC# is the source of the control voltage sent out Cascadia's **MIDI MOD** jack. For example, if you select `1 Modulation Wheel`, then the jack will transmit a control voltage based on CC #1 data received by Cascadia.

CV Polarity

*NOTE: Available only if MIDI MOD **Output Type** = "CC Number".*

- Unipolar — The **MIDI MOD** jack outputs a unipolar signal ranging from 0V to +5V. Incoming MIDI CC data is interpreted as a unipolar signal, meaning a CC value of 0 maps to 0V and a CC value of 127 maps to +5V.
- Bipolar — The **MIDI MOD** jack outputs a bipolar signal ranging from -5V to +5V. Incoming MIDI CC data is interpreted as a bipolar signal, meaning a CC value of 64 maps to 0V. Values less than 64 map to negative voltages (with a CC value of 0 generating -5V). Values greater than 64 map to positive voltages (with a CC value of 127 generating +5V).

MIDI LFO

LFO Shape	(various)	Sets the shape of the LFO sent out Cascadia's **MIDI LFO** jack. You can select between Sine; Square; Ramp (Rising); and Saw (Falling).
LFO Division	(/1 - /32)	Sets the MIDI LFO rate based on a sixteenth note division of the current MIDI CLK rate. At a value of /1, the LFO cycles every sixteenth note. Each subsequently higher value lengthens the LFO cycle by an additional sixteenth note. So, selecting /2 sets the LFO rate to an eighth note (2 sixteenth notes); selecting /3 sets the LFO rate to a dotted eighth note (3 sixteenth notes); selecting /4 sets the LFO rate to a quarter note (4 sixteenth notes); and so on.

MIDI/Tap Clock

Clock Mode	Tap (Auto Detect MIDI)	Cascadia powers on using its internal Tap Clock (which is set by tapping the **MIDI CLK** button at the desired tempo). However, if you send MIDI Clock into Cascadia, then it will automatically switch over to MIDI clock mode, and use MIDI Clock (rather than the Tap Clock). Once MIDI is detected, Cascadia remains in MIDI clock mode unless switched manually into TAP clock mode (by long-pressing the **MIDI CLK** button), or by power-cycling back into the default Tap (Auto Detect MIDI) mode. This is the factory default.
	Tap	Configures Cascadia to power-on using only the Tap Clock, and ignores any MIDI Clock input. In Tap Clock Mode, the **MIDI CLK** button acts as a TAP TEMPO button — allowing you to tap the desired tempo using the **MIDI CLK** button.
	MIDI	Configures Cascadia to power-on using MIDI Clock only. Cascadia's **MIDI CLK** button acts as a clock divider selector — cycling through various MIDI Clock divisions.

MIDI Clock Division

*NOTE: Available only if **Clock Mode** = MIDI or if **Clock Mode** = Tap (Auto Detect MIDI) and MIDI has been detected (thus setting Cascadia to MIDI Clock mode automatically):*

Selects a clock division to apply to the incoming MIDI clock.

/1	clock out = 24 ppq
/3	clock out = 1/32 notes
/6	clock out = 1/16 notes (default)
/12	clock out = 1/8 notes
/24	clock out = 1/4 notes
/48	clock out = 1/2 notes
/96	clock out = whole notes

MIDI Out Config

MIDI Out (DIN)

Tap — If set to Tap, Cascadia sends its own internal Tap Tempo MIDI Clock to the 5-pin MIDI output on the back panel. This is useful if you want to use Cascadia as a master clock in a DAW-less setup.

Off — If set to Off, Cascadia does not send its own internal Tap Tempo MIDI Clock to the 5-pin MIDI output.

MIDI Out (USB)

Tap — If set to Tap, Cascadia sends its own internal Tap Tempo MIDI Clock to the USB MIDI port. This is useful if you want to use Cascadia as a master clock in a DAW-less setup.

Off — If set to Off, Cascadia does not send its own internal Tap Tempo MIDI Clock to the USB MIDI port. This is the default setting.

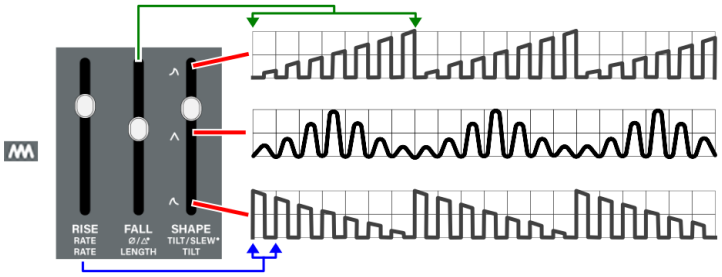
Synth (Advanced)

Env B Burst Shape

Determines the shape of the pulse bursts generated by Envelope B, when its **MODE SELECT [5.1]** switch is set to “BURST”.

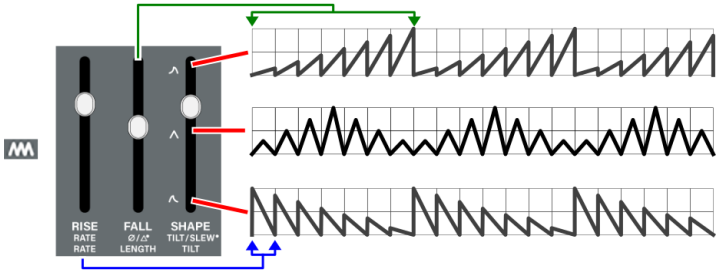
Sine/Square

Pulses generated by any of the three burst types (AD, AHD, or CYCLE) will morph from *square* (at the bottom of the **TILT [5.5]** slider) to *sine* (in the middle of the slider), and back to *square* (at the top of the slider). This is the default option, and is described for all three burst types in “DETAILS: Envelope B as Pulse Burst Generator”. As an example, here’s what the Sine/Square option looks like when Burst = CYCLE:



Tilt Saw

Pulses generated by any of the three burst types (AD, AHD, or CYCLE) will morph from *sawtooth* (at the bottom of the **TILT [5.5]** slider) to *triangle* (in the middle of the slider), to *ramp* (at the top of the slider). This is the default option, and is described for all three burst types in “DETAILS: Envelope B as Pulse Burst Generator”. As an example, here’s what the Tilt Saw option looks like when Burst = CYCLE:



EnvB LFO SYNC Rates (various)

When Envelope B is set to **LFO / SYNC** mode, and a Clock is patched into the ENV B **GATE** input, this determines which clock divisions/multiplications are available on the RATE slider.

1 2 3 4 5 6 7 8 : With ENVELOPE B's **RATE** slider in the middle, the LFO cycles at the same rate (x1) as the input clock. As you move the slider above center, the clock rate is first multiplied by 2, then 3, 4, 5, 6, 7 and finally 8 (at the top). Similarly as you move the slider below center, the clock rate is first divided by 2, then 3, 4, 5, 6, 7 and finally 8 (at the bottom).

1 2 3 4 8 12 16 32 : With ENVELOPE B's **RATE** slider in the middle, the LFO cycles at the same rate (x1) as the input clock. As you move the slider above center, the clock rate is first multiplied by 2, then 3, 4, 8, 12, 16 and finally 32 (at the top). Similarly as you move the slider below center, the clock rate is first divided by 2, then 3, 4, 8, 12, 16 and finally 32 (at the bottom).

1 4 6 8 16 24 32 64 : With ENVELOPE B's **RATE** slider in the middle, the LFO cycles at the same rate (x1) as the input clock. As you move the slider above center, the clock rate is first multiplied by 4, then 6, 8, 16, 24, 32 and finally 64 (at the top). Similarly as you move the slider below center, the clock rate is first divided by 4, then 6, 8, 16, 24, 32 and finally 64 (at the bottom).

Envelope Stage Outputs

Sets whether all the envelope stage outputs are gates or triggers. Specifically, this affects ENV A's **EOH** and **EOA** outputs, and ENV B's **EOF** output.

Gate — Envelope stage outputs are gate signals, meaning the output voltage at each jack goes 'high' and stays 'high'.

Trigger — Envelope stage outputs are trigger signals, meaning the jacks are normally outputting 0V, but will output a short +5V trigger signal when the designated portion of the envelope is reached. Trigger duration is set with the Trigger Length option, detailed earlier in the "MIDI Voice" discussion). This is the default operation.

Alt Noise Type **(various)**

Sets the type of noise generated when Cascadia's NOISE TYPE selector switch (in the MIXER section) is set to ALT. Choices are Cymbal, Crunch (8-bit/8kHz), Crackle, and Velvet, as discussed in the Mixer section, earlier in this manual.

FACTORY RESET

To restore Cascadia to its default factory configuration:

1. Turn off Cascadia.
2. Hold down the **MIDI CLK** [1.D] button while you turn Cascadia back on.

   Cascadia is restored to its factory conditions — resetting all assignable parameter options back to their defaults.

Alternatively, you can restore Factory settings using the Intellijel Config app.

1. Launch the Intellijel Config app on your computer, and select “Cascadia” from the input and output device fields.
2. Click the **Refresh Devices** option in the left column of the Intellijel Config app.

   Cascadia is restored to its factory conditions — resetting all assignable parameter options back to their defaults.

FIRMWARE UPDATES

Firmware updates, if available, are contained within the latest *Intellijel Firmware Updater* application, which you can download from the product's page on the Intellijel.com website. The application is available in both Macintosh and Windows formats, and will install firmware into your module over USB. Use the drop-down lists at the top of the application to select the product you wish to update, and the firmware version you want to install. Click the **Instructions** button to read specific instructions for updating your module.

Cascadia's current firmware is displayed at the top of the Cascadia Config column, when connected to a Mac or PC via the Intellijel Config App.

Firmware Change Log

1.1.0 (18 April, 2023)

Release version

TECHNICAL SPECIFICATIONS

Dimensions	Max Height: 66mm (from rubber foot to top of knobs) Width: 348mm (including wood end cheeks) Depth: 246mm (front to rear jacks).
Power Requirements	15V DC /1.0 A (minimum), center-pin-positive. Cascadia ships with a 15V/1.2A supply.