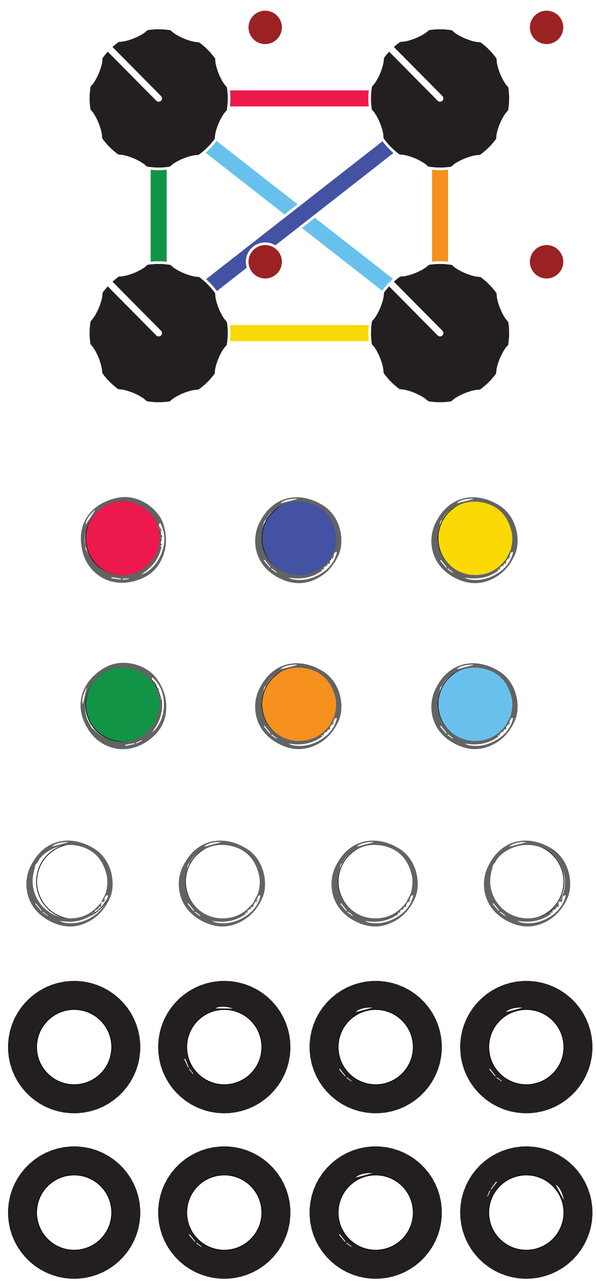
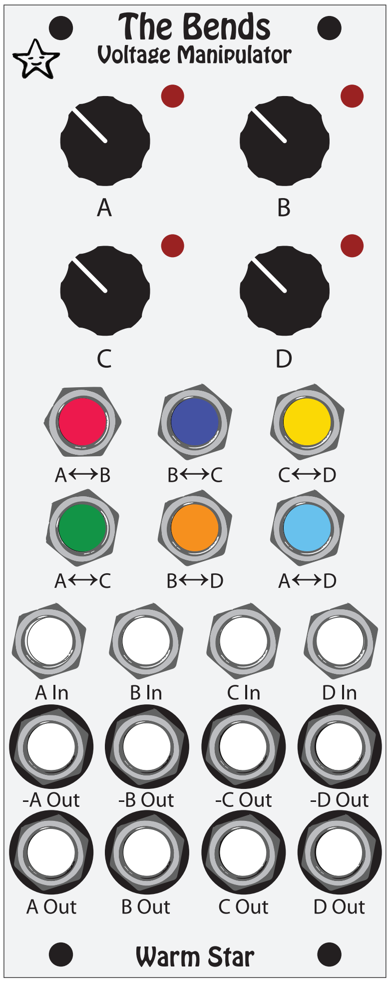
The Bends

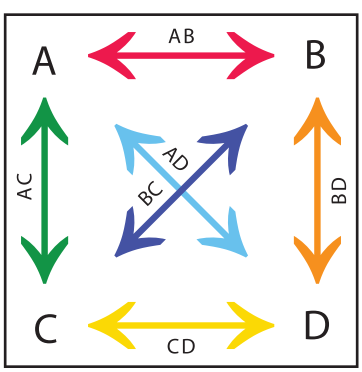


by

Warm Star Electronics

Welcome to The Bends





Welcome to a new and squishy world of vactrol-driven signal and voltage interaction! Congratulations on being the sort of person who reads manuals!

The Bends is a four channel averaging matrix. A voltage source. A voltage manipulator. A hub of voltage interaction. A voltage-controlled cross-mixer. A space for your signals to bounce off of one another.

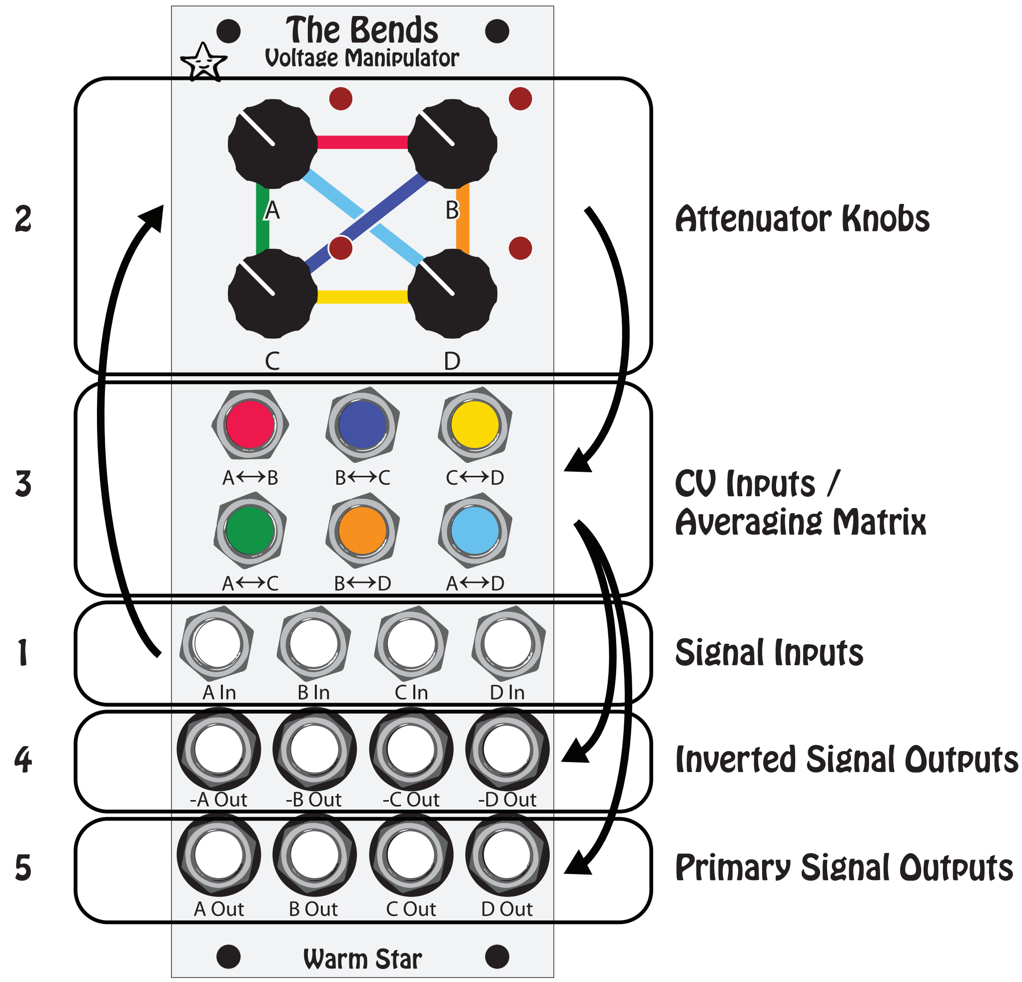
Among other things, The Bends can be used to:

• Combine CV signals, resulting in multiple different simultaneous outputs based on their intersection / interaction
• Control the mix of audio or CV signals with CV
• Control the routing of signals with CV
• Provide positive and negative fixed offset voltages, and manipulate those voltages with CV
• Attenuate and / or invert audio or CV
• Control the offset of a signal with CV
• Control the amplitude of a signal with CV (similar to a VCA), including "ducking" (inverse VCA behavior)
• Turn triggers into snappy lil' percussion envelopes
• Confuse your friends when explaining your patch

It's also possible to combine several of the above functions in such a way that turning the knobs on The Bends controls complex and simultaneous results throughout your patch! Though it can be a link in a relatively linear flow of audio or CV, The Bends shines as a central hub of a CV web, where a large number of control voltages interact with each other, but can all be manipulated or reduced to nothing by twiddling The Bends' four knobs.

All this diverse functionality arises from a few central functions; once you understand the basics, the advanced functionality is surprisingly intuitive. So, here they are:

The Basics



Black arrows indicate signal flow.

1. Patch input signals here.
• All inputs which do not have a signal patched to them are provided a 10V fixed voltage source.

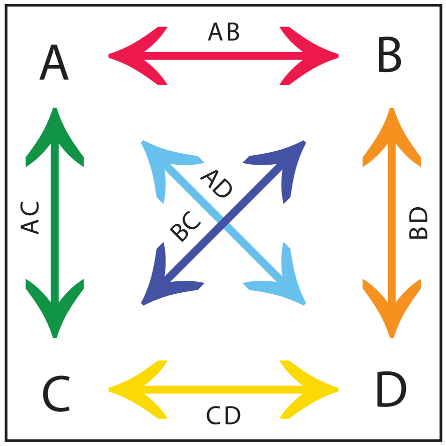
2. Attenuate (reduce the level of) signals on each channel.
• When no input is patched to the Signal Input of a channel, use the Attenuator Knob of that channel to adjust the fixed voltage sent to the outputs of that channel.

3. Use voltages to control the averaging, or cross-mixing, between the channels, in six pairs (illustrated here with matching-color connection lines).
• These inputs are responsive to positive CV up to 5V.

4. The signals of each channel are inverted across the 0V line on these outputs.

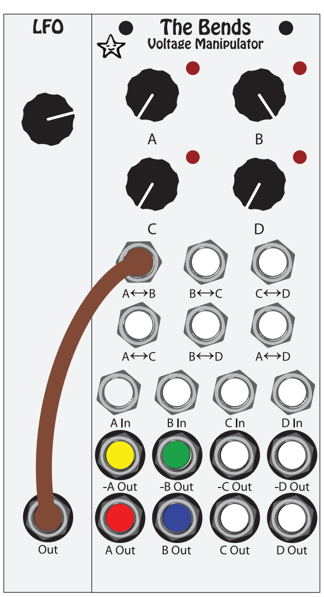
5. These are the main outputs of the module.
• All Signal Inputs and Outputs on The Bends are bipolar, and capable of processing any signal in your modular, whether audio or CV.

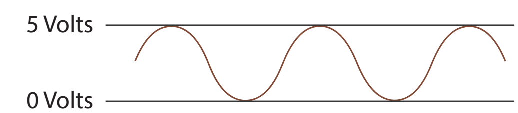
The Matrix



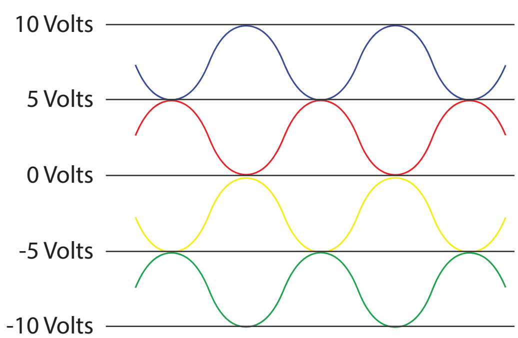
The core of The Bends is its six Voltage Controlled Averaging inputs (*A↔B, B↔C, C↔D, A↔C, B↔D, and A↔D*). Each CV Input controls the averaging between a pair of channels. As the voltage into one of these CV inputs rises, the two channels associated with that CV input are mixed into one another, or averaged with each other. Electronically, it's the same thing, but in application, CV is averaged, audio is mixed. The input range of the CV inputs is 0V-5V, so when 5V of CV is applied, the two associated channels meet at their mutual average (or come close to doing so; vactrols are not terribly precise).

The mixing / averaging is bi-directional, so if 1V of CV is patched to the A↔B CV input, some of channel B is mixed into channel A, and some of channel A is mixed into channel B . If the voltage of the CV input rises, the amount of channel B that is mixed into channel A will rise, and the amount of channel A that is mixed into channel B will rise.





Graph 1



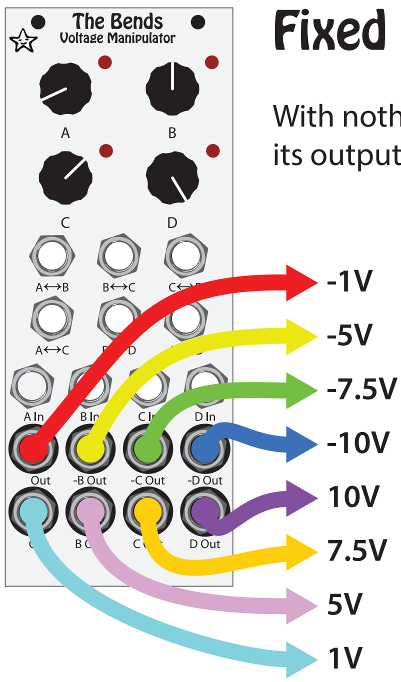
Graph 2

For a visual example, say you patched an LFO to the A↔B CV input, and that LFO was a sine wave, shown in graph 1. With the A and B knobs set to the positions shown (0V and 10V, since no inputs are patched), the CV-controlled averaging of those channels' values would result in four simultaneous outputs, shown in graph 2 (values shown are approximate).

So already you can make one wave into four! Let's talk about other applications.

Uses & Patch Possibilities

Illustrated here are some of the ways to use The Bends to perform various tasks in your system. Consider these a starting point. Many of these tasks can be accomplished several different ways, and all can be adjusted and combined for a huge variety of outcomes.

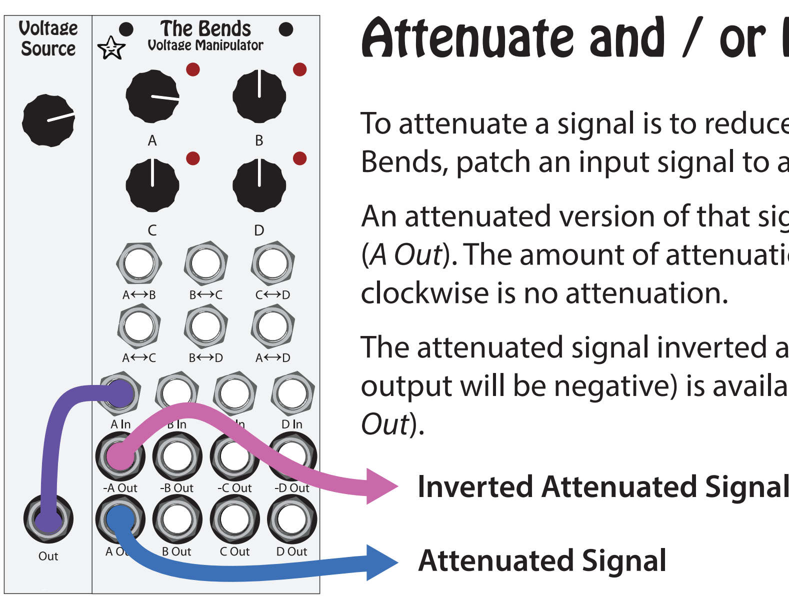


Fixed Voltage Source

With nothing patched to any input, The Bends provides fixed voltages from its outputs.

- The voltage from the positive outputs is 0V to 10V, adjusted by the position of the channel's knob.
- The voltage from the inverted outputs is 0V to -10V, adjusted in the same manner.
- CV applied to any of the CV inputs will result in the associated channels' voltages moving toward one another.

Illustrated values are approximate, based on knob position.

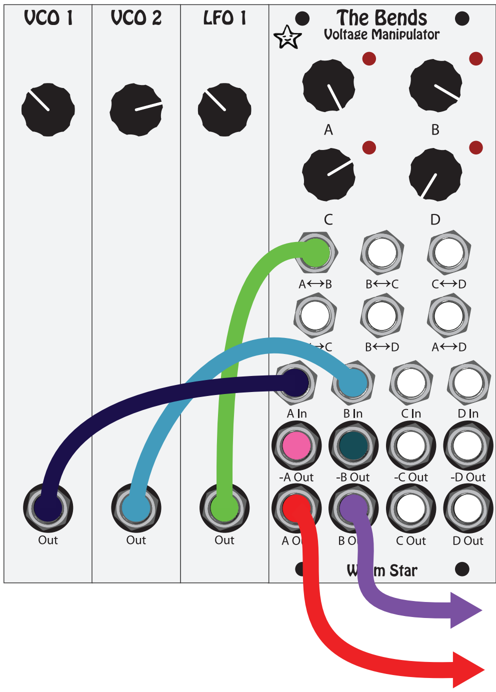


Attenuate and / or Invert

To attenuate a signal is to reduce it in scale. To attenuate a signal with The Bends, patch an input signal to an input (*A In*).

An attenuated version of that signal will be available from that channel's output (*A Out*). The amount of attenuation is adjustable by that channel's knob; fully clockwise is no attenuation.

The attenuated signal inverted across the 0 line (if the input is positive, the output will be negative) is available from that channel's inverted output (-*A Out*).



Blend One Signal Into Another

To control the blending of one signal into another with CV, or the "bleed" between two channels:

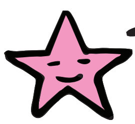
• Patch signals to two channel inputs (*A In and B In*).
• Patch a modulation signal to the CV input associated with those two channels (*A↔B*).

When the voltage of that modulation rises, the two signals will blend into one another (*some of the signal patched to A In will be mixed into the B channel, and some of the signal patched to B In will be mixed into the A channel*).

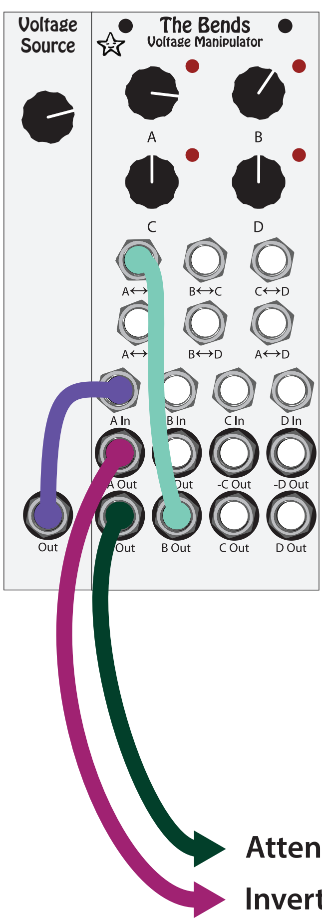
This can be used to blend CV signals as well as audio.

VCO1 with VCO2 mixed in when LFO1 rises

VCO2 with VCO1 mixed in when LFO1 rises



Output jacks whose output is being affected by an input, but whose output signal flow is not illustrated, are colored in!



Offset

To Offset is to add or subtract voltage to a signal. One way to add an offset to a voltage:

• Patch a signal to a channel input (*A In*).
• Optionally, adjust that channel's knob to attenuate the input signal.
• Patch the output of a second channel to the CV input that averages the two channels (*B out to A↔B*).
• Adjust the knob of the second channel (*Knob B*) to adjust positive offset.

Alternatively, the example illustrated on page 3 can be used to accomplish a clumsy-but-pliable approximation of an offset.

• Patch an input signal to one of the CV inputs (*A↔B*).
• Turn one of the associated knobs (*Knob A*) fully counterclockwise and the other associated knob (*Knob B*) fully clockwise.
• Patch the output associated with the counterclockwise knob (*Knob A*) out to another module.
• Adjust the counterclockwise knob to adjust the lower boundary of the output wave. Adjust the clockwise knob to adjust the higher boundary.
• -A Out, B Out, and -B out will provide variations of the same output.

Attenuated Offset Signal

Inverted Attenuated Negatively Offset Signal

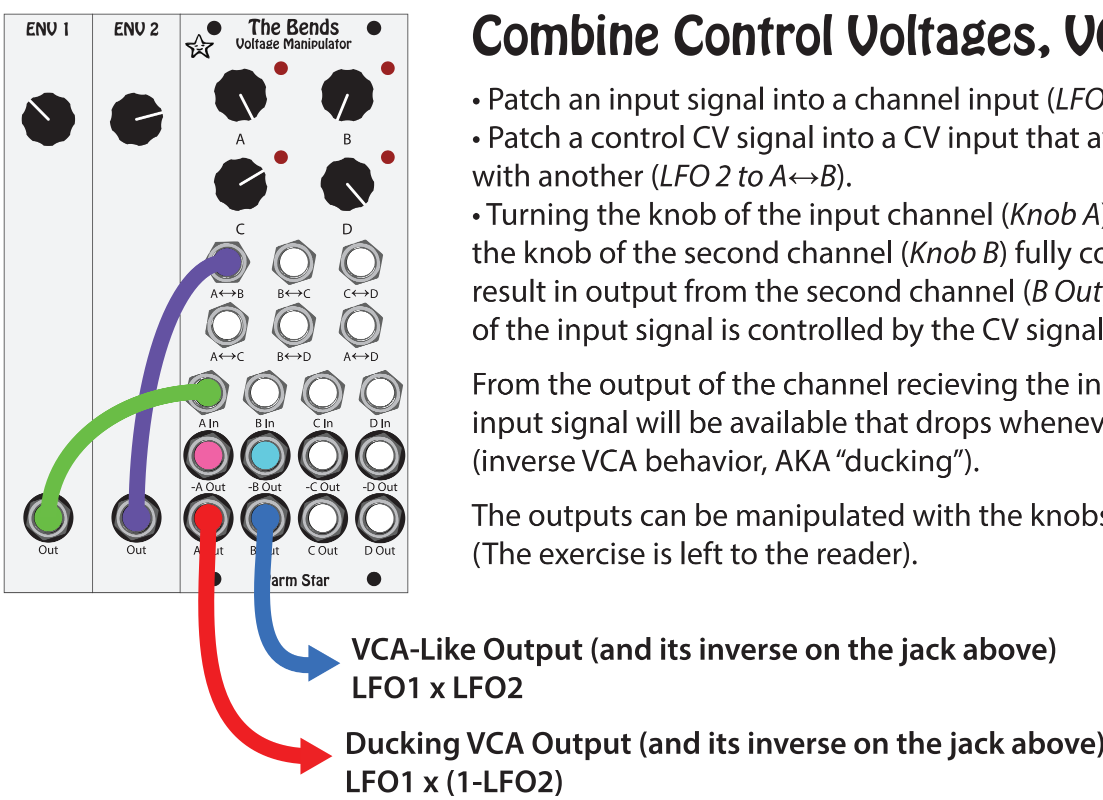
Combine Control Voltages, Intersecting Offset Squiggle Style

• Patch a modulation source to a CV input (*LFO 1 to A↔B*).
• Patch a second modulation source to another CV input that shares a channel with the first (*LFO 2 to B↔C*).

This will result in six different combinations of the two CV waves (*available from outputs A, B, and C, and their inverse outputs*), with heights determined by the relative positions of the knobs associated with the three channels covered by the chosen CV inputs. The output waves will be taller if the knobs positions are farther apart from one another, and shorter if the knob positions are closer together.

The position of each knob will determine the "center" from which that channel's output deviates, as well as the value toward which the other channels are "pulled" when the voltage at the Mix CV crossing the two channels rises.

For many users, this is the most practical use of this module, as it generates several complex outputs from a few input CV signals.

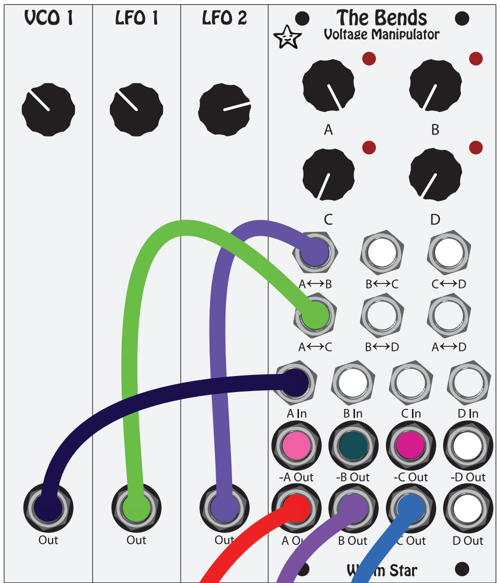


Combine Control Voltages, VCA Syle

• Patch an input signal into a channel input (*LFO 1 to A In*)
• Patch a control CV signal into a CV input that averages that channel with another (*LFO 2 to A↔B*).
• Turning the knob of the input channel (*Knob A*) fully clockwise and the knob of the second channel (*Knob B*) fully counterclockwise will result in output from the second channel (*B Out*) where the amplitude of the input signal is controlled by the CV signal.

From the output of the channel recieving the input, a copy of the input signal will be available that drops whenever the CV signal rises (inverse VCA behavior, AKA "ducking").

The outputs can be manipulated with the knobs of the two channels (The exercise is left to the reader).



Voltage-Controlled Routing

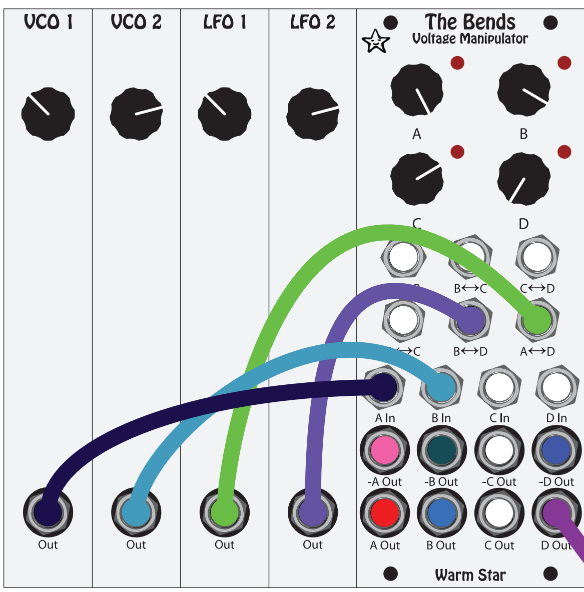
• Patch a signal to a channel input (*A In*).
• Patch modulation sources to CV inputs that cross that channel to other channels (*LFO 1 to A↔B and LFO 2 to A↔C*).
• Turn the knob of the input channel fully clockwise, and the knobs of the output channels fully counterclockwise (*Knob A clockwise, Knobs B & C counterclockwise*).

The source signal will be mixed into each output as the CV associated with the crossover to that output rises (*LFO 1 sends VCO 1 to B Out, LFO 2 sends VCO 1 to C Out*). The output of the input channel will drop whenever either CV signal rises.

Output that is normally low, rises when LFO2 rises

Output that is normally low, rises when LFO1 rises

Output that is normally high, drops when either LFO rises



Voltage-Controlled Mixing

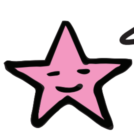
• Patch audio or CV input signals (*VCO 1 and VCO 2*) to up to three channel inputs (*A In and B In*).
• Patch modulation to the CV inputs that cross those channels with an empty channel, which becomes the mix channel (*A↔D and B↔D mix A and B into the D channel, which has no other input*).
• Turn the mix channel knob (*Knob D*) fully counter-clockwise.

The mix channel now has the signals mixed into it in proportion to the CV voltages. The mix levels will rise and fall as the voltages at the CV inputs rise and fall.

Main Mix

The input channels' knobs (*Knobs A and B*) can be used to adjust the input levels of each signal.

Outputs are also available from all other output jacks associated with channels A, B, and D.
• -D Out provides an inverted copy of the mix.
• A out and -A Out provide versions of signal A, which are intermingled with signal B whenever both modulation voltages are sufficiently high.
• B out and -B out provide versions of signal B which are intermingled with signal A whenever both modulation voltages are sufficiently high.



Have Fun!

You're an expert now! Though the applications of this module are diverse, hopefully this manual has helped explain the mechanisms from which all this functionality arises. Of course, modular is all about using your system creatively, and you'll likely discover and invent uses for The Bends that are unique to your system and your needs (and if you do, please drop us a line and tell us about them). We can't wait to hear what you do!

This manual by Bradford Kinney
with help from Ben Scheffler
& several other friends.

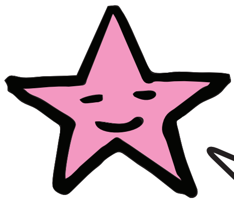
Limited Warranty:
Warm Star Electronics warrants this product to be free of defects in materials or construction for a period of five years from the date of purchase (proof of purchase/invoice required).

Malfunction resulting from wrong power supply voltages, abuse of the product, removing knobs, changing face plates, or any other causes determined by Warm Star Electronics to be the fault of the user are not covered by this warranty, and normal service rates will apply. During the warranty period, any defective products will be repaired or replaced, at the option of Warm Star Electronics, on a return-to-us basis with the customer paying the transit cost. Warm Star Electronics implies and accepts no responsibility for harm to person or apparatus caused through operation of this product.

Please contact Bradford@warmstarelectronics.com with any questions, Return To Manufacturer Authorization, needs, wants, comments, or stories. Or neat module ideas. Or pictures of your modular. Or pictures of your cat. Or lists of what modules you like and don't like. Or recordings of tracks you made using this module (we love those).

Tell your friends about The Bends.

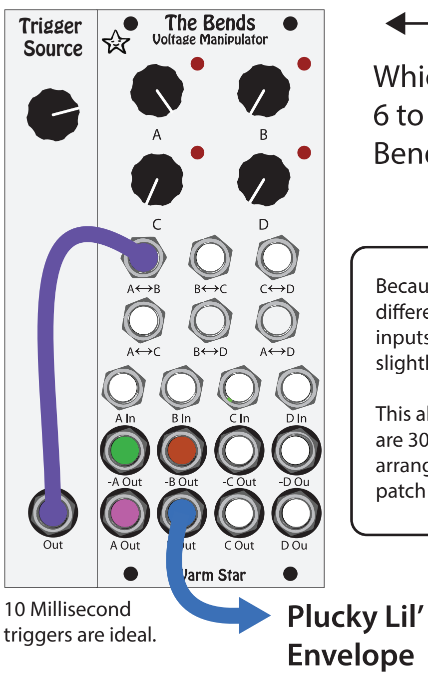
http://www.warmstarelectronics.com



Are the casuals gone? Cool. Let’s talk about **Vactrols**. A vactrol is a neat little electronic part: it’s a light (an LED) that shines on a light-sensitive resistor (a photoresistor) inside of a little plastic shell. You can see them on the back of your module; they’re the biggest part by far! Each module has six of them; one for each averaging CV crossover.

The photoresistor changes its resistance based on how much light is shined on it - but it doesn’t change it instantly. It takes a little bit of time to “open,” and a little bit more time to “close.” This is a limitation, of course, but it can be a very musically useful one. It means that, if you’re using The Bends to mix one signal into another, there won’t be a hard click when the second signal is brought in, even if the CV input is a gate. The Bends softens it ever so slightly, into something a little more natural sounding. If the CV is a trigger, the result will be more of a pluck than a tick.

Another useful vactrol trick, suggested by the pluck example, is to use the slew limiting nature of the vactrols to shape CV envelopes. This is useful for making punchy & plucky percussion sounds! It also takes us back to a variation on the first patch we talked about in this manual:

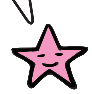


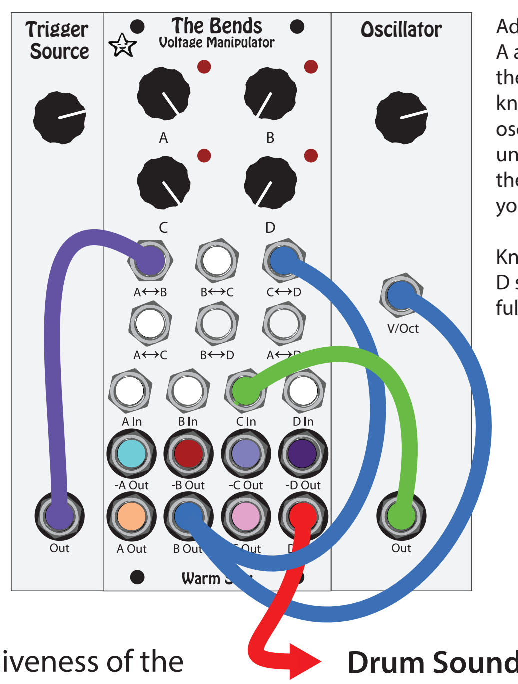
10 Millisecond triggers are ideal.

Which can then be combined with the VCA-type patch from page 6 to make a percussion-generation patch that uses all four of The Bends’ channels:

Because every vactrol is different, each of your CV inputs will produce a slightly different pluck!

This also means that there are 30 different ways to arrange this drum sound patch on your module!





Adjust knobs A and C, and the pitch knob of the oscillator, until you like the sound of your drum!

Knobs B and D should stay fully CCW.

These patches, more than any others illustrated in this manual, are shaped by the specific responsiveness of the individual channels’ vactrols. This means that the same patch will sound different if rearranged to different channels, because every vactrol is a little different! This is the interior magic, the “squish,” we talked about at the very beginning. Now you know! Best of luck. May your sounds make the world a nicer place!