

ISSUE 13

WAVEFORM

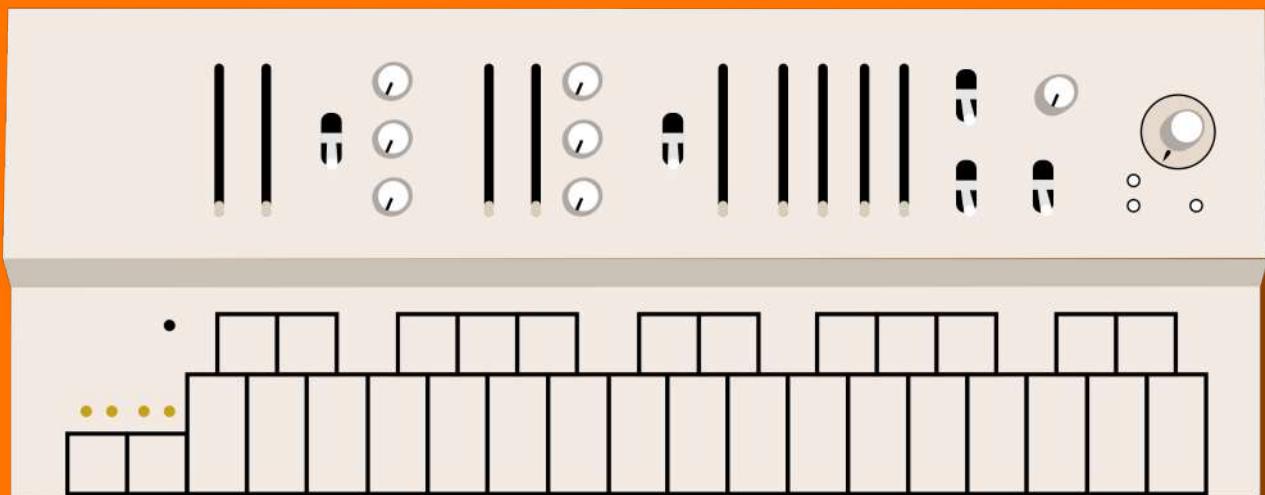
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Pianophonic



Poly
Cinematic

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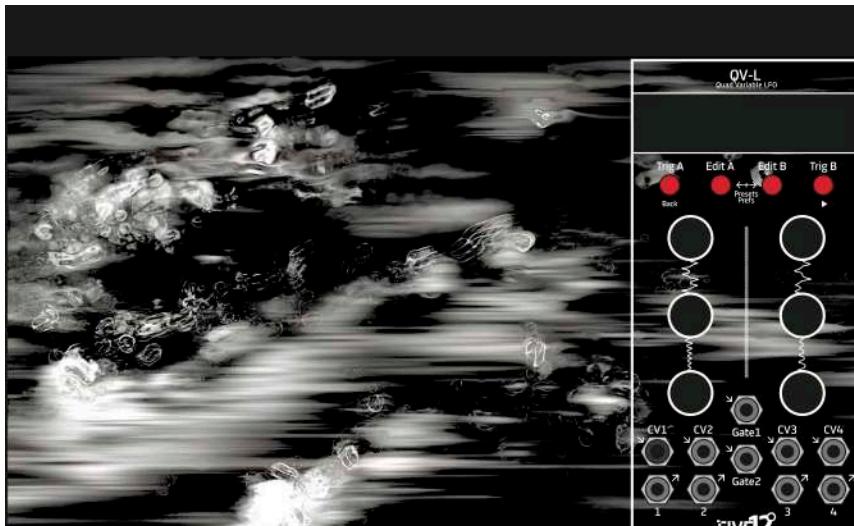
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ON THE COVER: THE VONGON REPLAY SYNTHESIZER

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The QV-L is a quad low-frequency oscillator with a variety of waveforms, flexible modulation options, clock sync and presets. Waveform rates can be set via two wide-range logarithmic modes, or beat-sync'd via tempo based rate modes. Sync via clock in or backplane to Vector Sequencer. The QV-L supports extensive modulation via 8 modulation busses. Sources include 4 CV inputs, all 4 LFOs, and two internal envelope generators. Waveform shapes include: Lorenz attractor and Logistic Map chaotic waveforms • Sine, Triangle, Saw Up/Down, Shark Left/Right, and Square, all with variable shape controls • Sample & Hold with selectable source • Stair-step up/down/up-down • Three morphing waves: Sine/Tri, Saw/Tri, Saw/Square.

FIVE12

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therevox.com

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TOM OJENDYK likes music. He is co-owner of the Seattle, Washington record shop Hex Enduction, and also owns the record label Dirty Knobby.
discogs.com/seller/HexEnductionRecords/dirtyknobby.com

EVAN MORROW got his pilot's license before he was twenty five and took up fly fishing right after. His first synth was a Realistic Moog that an ex-girlfriend left behind when they broke up, and he still has it. He's currently trying to combine two of his top hobbies; RC planes and modular, by building a modular that flies. It's proving to be more difficult than he initially thought.

ELLISON WOLF likes words, cold water swimming, and making pottery. He aspires to be a minimalist. He plays in the band Secretary. secretaryband.bandcamp.com

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GRAIG MARKEL is a multi-instrumentalist, producer, and electronic instrument designer in Seattle, Washington. He owns and operates Recovery Effects and Devices, the Recovery Room recording studio, and records music under the moniker The Animals at Night. His music can be found at theanimalsatnight.com and his instruments at recoveryeffects.com.

The advertisement features four modular synthesizer modules from Weston ΠΠ Precision Audio. From left to right: 1) SV1 Stereo/Dual VCA, featuring knobs for Level CV, L Vintage R, L Clean R, and In. 2) SE1 Shaped VC Envelope, featuring knobs for Decay, Sustain, Hold, and In. 3) Weston ΠΠ, featuring a complex array of knobs, switches, and CV inputs for various parameters like Filter Cutoff, Resonance, and Modulation. 4) Weston ΠΠ, identical to the third module but with a different background graphic featuring large white text. The text reads: "Precise. Musical. Beautiful." followed by "Weston ΠΠ" in large yellow letters, and "Precision Audio" in smaller yellow letters below it.

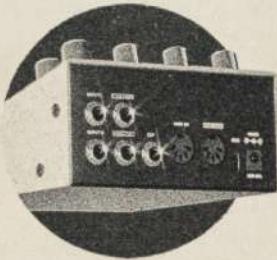
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Chroma Console is a tribute to the messy, chaotic, but always exciting things that happen when you allow yourself to experiment. You might not know what you're looking for until you hear it, but Chroma Console will help you find it.

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 HOLOGRAM

EDITOR'S LETTER

I recently moved to a new part of Seattle within walking distance of a 534 acre park on the Puget Sound. The area has a lighthouse, a lot of wooded paths, birds, mushrooms, and a rocky beach. The move has increased my appreciation for this part of the country and specifically Seattle, an area rich with natural beauty. One of the great things about this part of town is the fact that there is less traffic; there just aren't as many cars here, which makes walking a nicer experience, and has inspired me to purchase a bike to ride around town. I love the freedom that getting on a bike offers; check the tires, put on a helmet, take the bike out of the garage and off I go. There's a bike path that I can take almost all the way to our postal box, and on a sunny day, it's become one of the highlights of my afternoon: riding over and dropping off and picking up packages. I even bought some waterproof saddle bags to carry Waveform kit and module orders destined for all parts of the globe. Thank you to all who purchase and enjoy them!

While the bike was purchased secondhand at a local thrift shop, I needed to get a new tube and a helmet before I could ride it. Normally, I jump on the computer, head over to the global "sell everything" super mega-corp's website, do a quick search for "the best whatever" and "buy it now," with my purchase/s to arrive usually the next day. I was really itching to take the bike for a spin and decided to walk the four blocks to a local, very small, bike shop in my neighborhood instead. I went in for the new tube and wound up spending almost an hour talking to the two guys working there about bikes, Seattle, and mutual acquaintances. They found the right tube for me and offered tips on easy bike maintenance, and I also got a cool bike helmet. It's great knowing that such a shop is nearby.



ELLISON AT DISCOVERY PARK, SEATTLE, MAY 2024.
PHOTO BY EM MASLICH

When I decided to get panniers and a rack, I again started looking on that giant website (the local shop didn't carry any), but remembered that someone I'd recently met owned a bike shop across town. I decided to ride the nine miles to see if he could help. The ride was beautiful. There's a bike path that goes from my house all the way to downtown Seattle, with a good portion of it along the water where cruise ships, herons, and seals can be found. I spent almost two hours at the shop where my friend found a rack that fit, a pannier that worked

perfectly for my needs (waterproof and highly visible) and put it all together for me. He and I, along with his co-worker, chatted about everything from bikes to France to MarketSpice Tea (a local specialty). My friend has been working with bikes for decades, and when he saw that my bike (a late 90s Specialized Stumpjumper) still had the sticker of the shop where it was purchased back in the 90s, he told me he worked there back then, and there was a good chance that he put this particular bike together.

On the ride home, I stopped off downtown at another friend's shop where they sell art and goods (including pottery that I make) and have community dinners every week. It's a really inspiring place.

Once home, I reminisced about the day, realizing how enjoyable it had been riding around, experiencing the natural beauty of the city and seeing friends. It felt good to shop locally and support small businesses, and I am constantly being reminded of the many benefits of getting out from behind the computer and being part of this great city and the community within it.

- Ellison Wolf, June 2024

The advertisement features the text "LA CIRCUITS" in large, stylized, glowing letters at the top. Below the text are seven different analog synthesizer modules, each with various knobs, buttons, and displays. The modules are labeled: TOWER PARK, SUNLESS CITY, APPLES INC., BAUHAUS, TECHNOLOGY, MOON JUNK, and MACHINIST. At the bottom left is the text "SHOP | CIRCUITS.LA" and at the bottom right is the Instagram handle "@LACIRCUITS".

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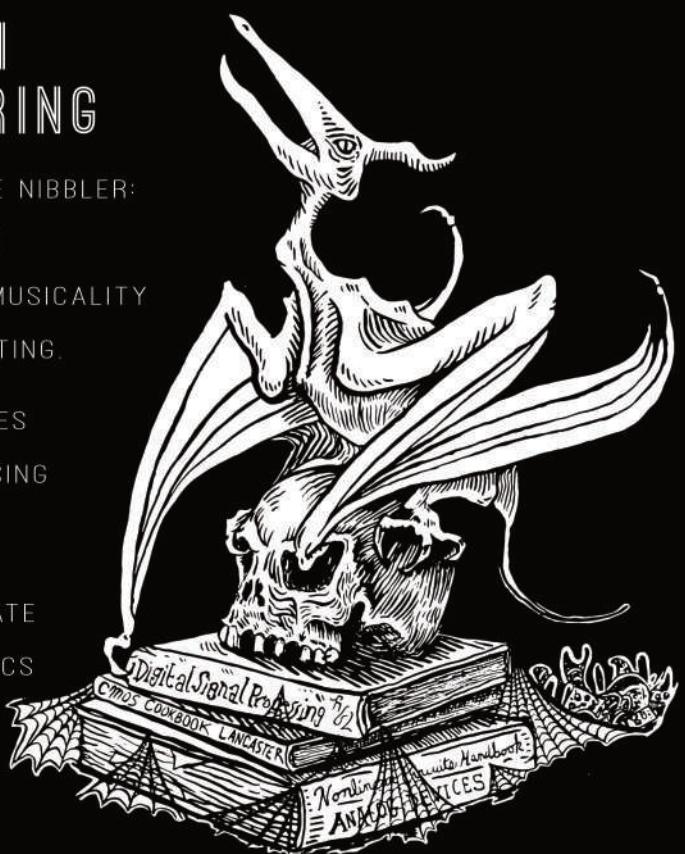
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AND NOISE.





While it's debatable whether time moves in a linear fashion, there's no question that Mike Beauchamp's Therevox moves as such. It's a trajectory mirrored in a solo bike trip across Canada that he undertook in 2005, and chronicled in the documentary, *The Cross Canada Project*. Moving from left to right—the way most languages are read, the way most historical timelines are recorded, and the way most musical instruments are pitched from low to high—Beauchamp biked and camped from Vancouver, BC to the Eastern Canadian Seaboard. The trip, while initially intended as an exploration of the limits of cameras and technology, would ultimately prove to be life-altering.

Since releasing the first version of the Therevox, the ET-1, in 2005, Beauchamp has been honing and perfecting his continuous pitch instrument with each new iteration, now up to the ET-5. Whether he's building robots to test the limits of the instrument or, say, throwing one out of the back of a moving car, Beauchamp is relentless in his pursuit of refining the Therevox, his homage to the ondes Martenot, the beloved French instrument created by Maurice Martenot in the 1920s.



thererevox



Once I realized that Maurice Martenot had solved that problem in that way, I absolutely fell in love with the instrument.

Waveform: I just watched your movie, *The Cross Canada Project*, and it was really impressive...and entertaining. Why did you want to ride your bike from one side of Canada to the other? It seems like one of those things where you say, "Wouldn't it be cool if...," but you don't actually do it. But you did actually do it.

Mike Beauchamp: A year before I graduated from university in computer science, I had this weird idea of riding my bike across Canada and filming it. I started to get attracted to that as a project because I liked the idea of building the camera system that I was putting on the bicycle, but once it came time for the ride I realized I hadn't ridden my bike to get in shape for the trip.

How did your body handle the lack of preparation? Did that turn out to be a problem?

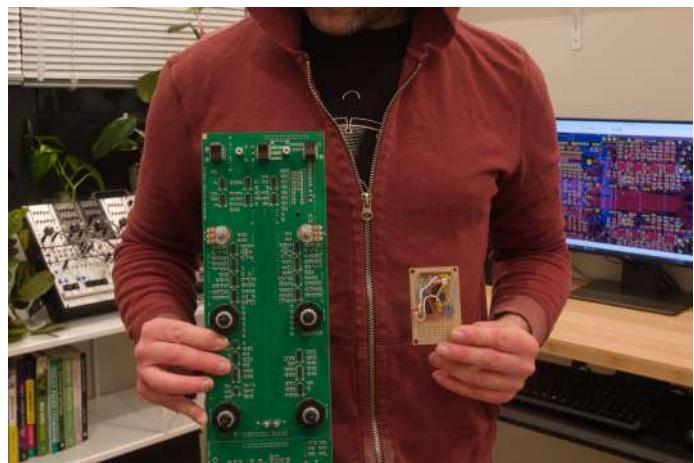
In the first few weeks, I dropped twenty pounds before I was even out of the Rocky Mountains. There were climbs that lasted for days; I'd never seen anything like it. I also wasn't carrying enough

food with me and I was pretty worried, actually, but I got taken in by a large group of cyclists that were on the same route fundraising for something. They had arrangements with churches in every town, and were given huge buffet dinners everywhere they went. I pretended to be with them for a few days and ate as much as I could.

That sounds like some kind of "bike trip life hack!" Did you feel a huge sense of accomplishment once the trip was over?

The trip really changed me in a lot of ways. Biking across that 7000 kilometers or whatever was a really good lesson in the fact that there are projects that can span a really long time to get to the end of, and you're going to hit moments of massive discouragement. Each one of those hurdles is something that you have to jump over to keep going. Also, during the trip I registered on a site called couchsurfing.com to find people to stay with during the trip. Two years after I got back, I got a message on couchsurfing from somebody in Japan looking for someone to hang out with when they were in Canada, and that was Melissa,

Photo Spread: Mike Beauchamp in his workshop.
 Previous Page: Mike riding his bike across Canada, 2005.
 This page: The Therevox ET-5 and ET-1 circuit boards.
 Page 12: Homemade testing robot.
 Page 13: Mike and Melissa working.
 Page 14: The evolution of the Therevox: 1st prototype, ET-1, ET-3, ET-4.
 Page 15: The Therevox ET-5.
 All photos provided by Therevox



who is now my partner. So in that regard the trip led me to finding her.

So you met her because of the trip, indirectly...Are there any highlights or interesting stories from the trip that you can share?

Everyone that took me in through couchsurfing were solid; they fed me and gave me a place to stay. Strangers let me camp in their backyards without hesitation, and people pulled over to give me Gatorade on hot days. I was mostly on my own in a tent somewhere hidden in the woods, but every time I needed help someone was there. I think long distance hikers and bikers call this "trail magic," but I think it just speaks to the fact that humans are mostly pretty awesome to each other when we're face-to-face.

When you were riding on your trip did you think about the design of the Therevox at all? That's a lot of solitary time with nothing to do but iterate on synths and watch out for cars.

We built a testing robot using a salvaged motor from a car seat...and attached it to the robot and...left it on 24 hours a day, seven days a week.

...and bears! I did a bit of sketching, mostly mechanical linkages that could work as exponential converters. In 2010, Melissa and I went on a bicycle trip around the island of Savai'i in Samoa. About halfway in, we both got really ill, near-death experience type shit complete with hallucinations, after eating some barracuda. We were really messed up for days and during that time I sketched out a lot of features that became the ET-4 and ET-5. Little design things, like how the waveform and octave knobs should look and work, but also important synth architecture and workflow. When we got back to New Zealand, the doctors said we likely had Ciguatera, which is a pretty intense neurotoxin.

So some of the design elements were brought about by hallucinatory visions...Is Melissa a business partner in Therevox as well as your life partner? It sounds like you've been through a lot!

She is a big part of Therevox. I'm really engaged in the designing of the circuitry and she is able to see a larger picture and help out

with the aesthetics of the instrument. I'll design something and then take it to her as a second set of eyes. She's better at noticing things like the subtleties of colors, and the rhythm and the spacing of certain things, like how far knobs should be away from each other and how much whitespace things have around them. She's got a really good eye for design and she helps me see from a different perspective.

Why did you make the Therevox?

I was in an indie rock band in the early 2000s and I had a small theremin that I'd run through all my effects pedals and stuff. Once I wanted to play some melodies on it, I realized how hard it was, but also how amazing continuous pitch instruments were. From the unhinged theremin solo in "Whole Lotta Love," to the pedal-steel on Jason Molina's Magnolia Electric Co. that can just tear your heart out, to Jonny Greenwood and Radiohead, I really appreciate the emotion that can be conveyed when you're not limited to twelve predetermined pitches. That ability to slide

between notes, to bend notes, and get everything in between is really special. My friend Patrick McMaster in Montreal sends me rare recordings (of the ondes Martenot) to check out and I'm always amazed that the instrument can sit so well with a traditional orchestra or hold its own in a totally wild experimental piece. I wanted to design something that did that, but had reference keys on it so you could actually point to the pitch. The first prototype that I made used string from some window blinds going right across a hand drawn keyboard with a rubber washer from a garden hose as the finger ring. I put that up on my personal website in 2001 and somebody emailed me and told me it looked like an Electro-Theremin (Ed. - also known as the Tannerin, after inventor Paul Tanner), and so I did a deep dive into that instrument. It's what was used in the Beach Boys "Good Vibrations," and was just an off-the-shelf oscillator with a frequency knob where you're sliding something that has a pointer on it, and you're lining that pointer up with the reference keyboard. In 2004, I made the first one that I actually called the

Therevox and after I put that online, people found it and ordered it. I made six of the ET-1s in 2005 and used the money to do the bicycle trip across Canada. When I came back from the trip I built a single ET-2 using a mechanical linkage to approximate an exponential pitch response, but shortly afterwards I switched to using an electronic exponential converter, so that model never went into production. I did the ET-3 before moving to New Zealand.

What made you want to move there?

When I met Melissa she had already planned to move there for a year and had a ticket and her work visa all lined up. I was like, "Well, I'm going to have to go with you." I'd finished the ET-3s days before we moved, the timing was really tight on that one. After that, I put a message on the Therevox website saying I was done making instruments. Then, when I was in New Zealand, somebody emailed me and said the instrument kind of looked like an ondes Martenot. I had no idea what an ondes Martenot was and so I did a deep dive into that and realized that that interface was better for controlling a continuous pitch

your finger exactly like you would on a guitar. So you get tactile feedback from the intensity key and the fingerboard, and I think that's super important for playing and connecting with a musical instrument. Later, I was sitting at my computer programmer desk job, still in New Zealand, and I got an email from somebody who's in the band The Besnard Lakes, up in Montreal, saying he wanted an instrument. I really love that band so we decided maybe we should move back to Windsor, Ontario and start the business again, basically because the Besnard Lakes were interested in a Therevox. We thought we'd make a prototype, see what they thought, and kind of go from there. That wound up being the ET-4.

You're now up to the ET-5, so how long was the ET-4 in production?

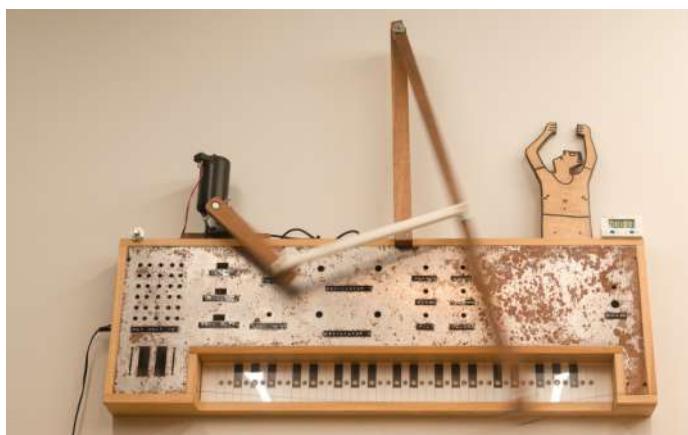
We did the ET-4 for seven years and then I started working on the prototype for the ET-5. That took about three years. It's funny, because the ET-5 looks almost exactly the same as the ET-4 but I first spent a lot of time redesigning the aesthetics for the ET-5. Totally different wood, totally different colors, different



Am I happy with the sound of the oscillators? Do there need to be more waveforms? What filter topology sounds the best?

instrument, especially the amplitude part, because the Electro-Theremin was just a knob that you had to turn for amplitude and the ondes Martenot had a pressure-sensitive intensity key. The thing I love about the intensity key is that it actually moves up and down so you're not just pushing on something that doesn't move; there's muscle memory associated with how far down it goes, but then there's resistance that you get, so the farther down you get the harder it is to push down, and that's really important. You can play it just a little harder to get a bit more volume at any time. That sets it apart from other electronic instruments where it's just whatever volume it is at all times. Once I realized how Maurice Martenot solved these problems, I absolutely fell in love with the instrument. For pitch, you have a ring around your finger and you point to the notes on the reference keyboard that has divots and bumps, so the muscle memory is a lot easier; you just move a finger right to where you want it, land your finger in the divot and then you can get that natural vibrato by wiggling

fonts...a way different look. I got about a year into that and realized that redesigning the aesthetics wasn't the most important thing; it's the inside, the features of the instrument, and the playability and reliability. I was happy with the aesthetic and ergonomics of the ET-4, but everything inside needed to change. I breadboarded every single circuit from scratch. Am I happy with the sound of the oscillators? Do there need to be more waveforms? What filter topology sounds the best? With the ET-4 it was just taking my favorite circuits and putting them all together, and that became the instrument. With the ET-5 I knew that I already had a concise instrument, and it was about designing things that worked together as well as possible. Also, I wanted the ring to feel a lot smoother and in a way that wouldn't move out of alignment with notes. I wanted to use a small string to reduce friction, and you have to design it so that it won't slip so that somebody can play it as aggressively as possible. So that was a complete redesign, and we built a testing robot using a salvaged motor from a car seat. I took an old ET-5 prototype and attached it to the robot and that swung the ring back and forth. I left it on 24 hours a day, seven days a week. It stressed the whole system: the string, the bearings, the potentiometer—everything inside. I wanted to run this stress robot in the shop and see if it came to a point where anything failed. I was worried about the string itself, like what happens if the string rubs against something back and forth a million times? We did the same thing with the intensity keys, and took the same approach with the circuits, the patch panel, the jacks...I didn't want to make something and then find out that all of those new (design elements) only last six months or one year, that there's a problem down the line. The ondes Martenot has a reputation of being a fragile and delicate instrument—there are stories of people trying to fix the instrument hours before going on stage for a big







production. I wanted the Therevox to come with the nuance of how you play it, but not with the fragility. It was one thing when we were making a few, but when we started to get customers that were using them on tour night after night...Somebody's packing this thing, throwing it in a road case, tossing in the back of a truck and going to the next venue, and they're doing that for months at a time and then flying to Europe and doing the same thing there.

There's nothing worse than scrambling to fix some piece of equipment right before a show. How did your testing robot do? How long did you end up running it?

That robot ran in the shop continuously for the better part of a year—over thirty million complete back and forth cycles—testing all of the internal mechanisms for the ring. I was also running a different robot testing three different string materials for abrasion resistance. We finally settled on a string that's the same material that NASA uses in parachutes for reentry, some really high-tech, synthetic stuff. My friend saw the robots tucked away in the shop and was fascinated by them, so I ended up hanging them prominently on the shop walls as kinetic art sculptures.

What changed because of the testing?

We had one bearing that became squeaky so we went back to the bearing manufacturer and made sure that they put the adequate grease in all the bearings. We've done some other fun testing, too. Once we got our custom shipping boxes made, we packaged the instrument every way that we could think of to try to find out what the weak spot might be either in the packaging or the design of the instrument itself, and then drove around in our Subaru. Melissa drove and I would kick the box with the instrument in it out the back and watch it tumble. We'd then open it up, take it apart, and do a bit of an autopsy to see if anything broke or came loose.

That sounds kind of fun. You mentioned the three years of development between the ET-4 and the ET-5. What did you wind up changing in the circuit that made it into the ET-5?

When we were at Knobcon in 2018, some people playing the instrument were wondering what the fingerboard did. On the ET-4, it's just there for tactile reference, but on the ET-5 we made it pressure sensitive and added a new duophonic mode where the second oscillator's pitch can be controlled by pushing down on the keyboard. We also took the old filter and started from scratch, trying pretty much every filter topology. We ended up using a three-pole resonant filter and I absolutely love the sound of it. I also came up with a saturation circuit to kind of emulate how a vacuum tube guitar amp works, so it's not just an overdrive that is overdriving the signal at all times, it only distorts if you play loudly into it above a certain threshold.



If you play harder into a tube amp, it's going to start to distort, but there are other instruments, like string instruments, where if you just dig into it harder the resulting waveform has a different shape to it.

How did you pull that off? Is there a VCA going into the saturation circuit to kind of control the intensity of that?

Yeah, exactly. We also added two controls underneath the left side whose function is defined through the new patch panel, so the user can decide what these two controls should do. Adding the patch panel meant that people could get creative with signal flow or control assignments, but it also meant that all of the circuits inside the ET-5 had to have voltage control, so that was also part of the redesign. We even redesigned the spring reverb so it sounded fuller. Sometimes I play the ET-5 where the signal is 100% wet so you're only hearing what comes through the reverb tank and I wanted all of the bass and as much

The model seven was when they went to transistors, and I've played a few of those before but I'd never played the vacuum tube version. So me, Patrick McMaster and Daniel Áñez—two friends from the Synthesizer Society of Montreal—went to admire this instrument and we also had the chance to play it. The week after, I messaged Jean and asked if I could show up with my oscilloscope and some test equipment to take some measurements. It was a once in a lifetime opportunity to play this instrument that might be the only perfectly working version of it that isn't behind glass in a museum.

What do you think about playing it?



It felt familiar, but I was also nervous playing a priceless instrument. With the ET-4 and ET-5 I made sure the spacing between every note was the exact same as the original ondes Martenot, so the scale length was exactly the same. We did a lot of research on exactly how the intensity keys feel on the ET-5 to get that to be similar to the ondes

I would kick the box with the instrument in it out the back and watch it tumble.

as the treble as possible coming through. We also added a feature that alters the filter's frequency cutoff depending on where the ring is, so the filter opens up as the pitches get higher—or does the opposite—so the low notes are really bright and the high notes are really mellow. That's exactly how the tube ondes Martenot sounded, you'd see the timbre change in relation to pitch.

So it's basically like keyboard tracking...I guess you'd call that ring tracking! You talked about how digging into a tube amp is when a signal can start to distort and I know that working tube models of the ondes Martenot are hard to come by. Have you ever played one to see if it reacts this way?

Yes, my friend Jean Landry lives about an hour from here and I met him when I was designing the Ondes VCO, our Eurorack module. He used to be a repair tech in Montreal, keeping the ondes Martenots at the Conservatoire in running order. They had four or five of them and a few stopped working so he reverse engineered the ondes Martenot and developed new drop-in replacement circuit boards for them because the parts that blew up are no longer made, and you can't get them anymore. He's a really knowledgeable guy and he was one of the reasons Melissa and I moved to Quebec. We came up here and he showed us around the area and we loved it, so the idea of moving somewhere and knowing somebody close by made moving much easier. A while back he emailed me about a woman who was selling an original vacuum tube ondes Martenot, the model six.

Martenot as well, so that also felt really familiar. The strangest thing was that I'm used to playing the ET-5, which has two oscillators and two intensity keys, so I'm always doing something that requires both oscillators; either one oscillator is a drone note, they're complementary in pitch, or they're different timbres and I'm switching between them. But the ondes is just a single oscillator and one intensity key so it felt limited. Still, it felt totally smooth and the tone was magnificent. It was a real privilege.

What kind of information were you able to gather from your testing to help you with the Therevox?

I wanted to see what the waveforms coming out of it looked like, and they actually change in relation to amplitude. I think that's because the output section is also a tube amplifier so as your volumes are getting louder, you're saturating these waveforms and they're changing, compressing, and other harmonics are coming up. You get this tone that changes in proportion to amplitude, but also in proportion to pitch. Even though it's set to the same setting, as you go up or down in pitch, new harmonics show up, which was something we added to the ET-5 with the saturation circuit.

There's so much that you're talking about in designing the Therevox, from circuit design, to communicating with parts manufacturers, to the aesthetic considerations, not to mention the actual manufacturing of the instrument, building robots to test it... that's a lot of skill sets you need to inhabit.

You've been making these for around twenty years now—which seems incredible, and constantly refining the design along the way. What was the circuitry of the early models like when you first started out?

The first Therevox's circuit board was about one and a half inches by one and a half inches with a single chip on it. It was right off the datasheet, but it did just what it needed to do. It was hand-wired on perfboard. This was way before I learned how to design circuit boards. One of the things I like doing when I'm designing is to (gather) all of the options possible, and to choose the best one. So something like a potentiometer, I order every single one available, design a process to test it, and choose the best one. We use a one hundred dollar potentiometer that's specced for as many rotations as possible and we've never had one of those fail. It's been like this even when we're designing the aesthetics. What is it going to be made out of? Show me all of the available woods, show me every knob...I have a box full of every knob that every manufacturer makes...hundreds of knobs.

What were some of the early challenges with building this instrument when you started? What was your engineering level?

In the early instruments like the ET-1, the hardest thing was getting the note spacing to be completely even. You need an exponential conversion from your control voltage to match the exponential nature of musical instrument pitches. That wasn't something that was known to me back then. Some guy heard that I was building these instruments and left a few books at my house. It was all the printouts of the *Electronotes* series, which I

I'm always hesitant to get somebody else to do something because I want to be the person that's building these instruments; I love doing it.

had never heard of before, and also a copy of Horowitz and Hill's, *The Art of Electronics*. I didn't realize that those were such huge missing pieces that I needed. I'd always loved synthesizers, but I never thought what I was building was a synthesizer, I thought it was just an electronic instrument. Delving into all of those printouts were solutions to all of the problems I was facing with the Therevox—they had all been solved before. That was one of those weird moments where somebody just came out of the woodwork and gave me something that helped me for twenty years onward. I don't know how long it would have taken me to find those resources or to think I even needed those on my own. I wish I could remember this person's name because he definitely changed my life with those books.

It's all out there, it's just having the exposure. Were there any circuits, or any features that were hard or tricky to develop?

Getting the response curve of the intensity keys to feel natural. You've pushed the key 50% down and you've also used 50% of your force to push it down—that's a physical thing. There's also circuitry for the response curve of that, a curve that's neither linear nor exponential, sort of in-between in certain sections.

That took a long time to get working to where it felt transparent, where you didn't even think about it. And then to put a spring reverb unit inside of an instrument with all of the interference and everything as well, that's always a little tricky to do. We ordered reverb tanks from every known manufacturer, inspected them for build quality, banged them around...

In terms of design, I totally understand most of the design elements, they make sense to me, but how did you figure out how you wanted the velocity keys to work? I would think that'd be hard to get right.

Yeah, the original ondes Martenot had a leather bag with some powder inside and as you push those two things together there's an anode and a cathode that get closer and the powder becomes conductive. There was also a cork in the powder for some squishing. It's a whole complicated thing and each musician had their own special recipe of what should be in this bag because some of them preferred it to be looser and some of them preferred it to be tauter, and also, they wore down over time so their characteristics would change over time as well.

That is as archaic sounding as it gets. It might as well have some mice in there turning a wheel or something.

I'm a pretty avid researcher on the ondes Martenot, and I have volumes of translated books and translated academic papers that were done in French and I've done research on the exact displacement and force required for that. With the ET-5 I had the ondes Martenot specifications in mind, but I tweaked it to see what felt the best. The process of doing that, to adjust every

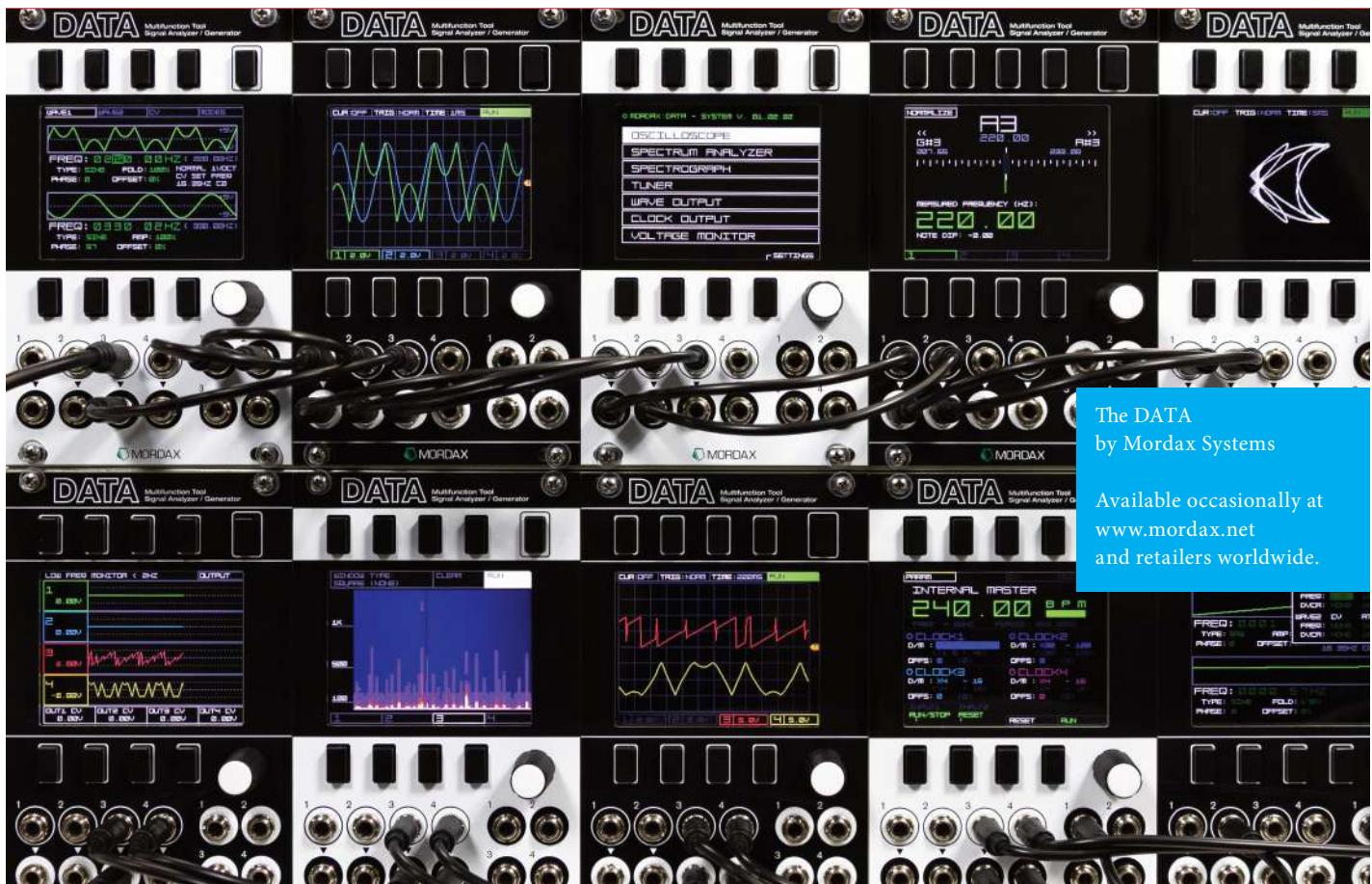
parameter and make notes on what feels good and what doesn't feel good, informs the physical design of it, and that's informing the electronics as well.

What you're describing, I would think to design it like some kind of key, where you'd have a hinge at the top, and you'd have spring that would give physical resistance, but I understand that a spring's resistance might remain too constant for the level of precision and control that you might want. I would never think of using a bag filled with powder.

Ok, but how long is that key from the hinge? That dictates the angle that it bends down. How stiff is that hinge? Is that hinge wanting to return itself to its original position? And how fast does it want to do that? Is there damping, like does it return quietly? And where does the physical resistance come from when you push it down?

There are so many considerations for every feature, every aspect of the design for an instrument like this. You talked about using wood for the enclosures. Was woodworking another skill that you had to learn, or did you have experience with it beforehand?

CONTINUED ON PAGE 74



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weston precision audio

When Devin Weston was a kid, he used to design synths on his computer, way before he was aware of any limitations—whether they be mechanical, electronic, or aesthetic. With knowledge and experience comes wisdom; stemming from Weston's background as a musician and his career as a mechanical engineer, he started Weston Precision Audio in 2019 with a clone of the Sequential Circuits Pro One as his first release.

Weston has since focused most of his attention on Eurorack modules, with each release solidifying a reputation for rock solid builds and no-nonsense features that mix modern components with timeless design; his black and gray aesthetic with the occasional burst of yellow really stand out amongst a sea of black.

A long time drummer, Weston's musical worlds have run parallel and in tandem with one another, each informing the other, crystallizing his awareness of the importance of the human-instrument connection in music making, an ethos that runs through everything he does.



Photo Spread: Devin Weston holding the WPA PRO2021.
This Page: Devin at Superbooth, Berlin, Germany 2023.
Next page: Weston Precision Audio modules: AD110 Analog Drum Synthesizer, PA0 Phase Animated Oscillator, H1 Analog Harmonizer, SF-1 Dual/Stereo Filter.
Page 22: Handmade bender assemblies for the PRO2021, DIY kits.
Page 23: Devin playing drums in Argyle, 2019.
Page 24: Devin's replacement PCB-B for the ARP Odyssey.
All photos provided by Weston Precision Audio

I would use computer software to design make-believe samplers and synthesizers.

Waveform: I know you're a drummer and that you started pretty young. I always wanted to play drums but my parents didn't want me bashing stuff in our basement, not that I can blame them...How did you find your way into electronic music and synths?

Devin Weston: I played drums as a kid and I've always done synths and production stuff. I went to this high school in Colorado, about a half hour out into the farm fields from Denver where I played drums in jazz and symphonic band. It was a tiny school and I had one friend that had a guitar and some keyboards. We would get together sometimes and jam, but when I found tracker programs and other sampling and computer music software, where I could just play on my own, I started making all this music on a 486 computer and other things kind of fell by the wayside. I used to make a ton of hip hop and electronic music back in the day, and I would read about all these cool synths and samplers that were coming out, but I was twelve or thirteen and I didn't have any because I couldn't afford it. I would use computer software to design make-believe samplers and synthesizers, and draw the panels, kind of like what I'm doing now, but it was all random stuff going around in my head—the technical know-how didn't exist yet. The idea of designing the UI and UX of music machines had appealed to me already at that point.

When did you start playing with other people where you were able to put your computer and synth skills to use?

We moved to Oregon in '99, when I was a junior in high school, which is kind of a rough time to transfer, but it worked out, and that's when I got into making hip hop music. I'd produce beats

and DJ'd for this group called The Phormula, and we would do all kinds of shows in the Eugene area. It was pretty cool. They were all a little older than me, but I was the guy that could geek out...I had an Emu sampler and this little Boss Dr. Groove drum machine and a Roland D-20 that I still have. I used Cubase for the software but you couldn't do much in the box at that point. You would get a plugin loaded up and it would just destroy your CPU, so you could basically only use it as a MIDI sequencer, but I made a ton of cool stuff that way. Just having the MIDI going to the samplers and the keyboards...so that was my musical arc; listening to a bunch of hip hop music that I liked and learning where they pulled samples from. That kind of flipped me back into analyzing and listening to older music and being more interested in drums and keyboards.

What kind of music were you listening to?

I've always had a fairly wide-ranging musical taste, but I really enjoy stuff that is groove-focused and has synthesizers in it, a statement that I'm sure surprises very few! My favorite synth players are definitely the late, great Chick Corea, George Duke, and Herbie Hancock. Lately I've been especially digging Herbie's late 70s and early 80s stuff like the album "Mr. Hands." He was really cutting edge with his stuff, using computers and synths when very few people in the jazz world were doing so. A lot of his music includes one of my favorite drummers, Mike Clark. That guy can really groove. Lately I've also been listening to a lot of classic electronic albums: Polygon Window's (early Aphex Twin) "Surfing On Sine Waves" in its entirety twice on the plane ride to SuperBooth this year. It's really cool to listen back to electronic stuff from twenty or thirty years ago and see how it holds up.



I'm a hands on dude, let me look at the oscilloscope, at what's coming out.

So was analyzing and listening to music what got you back into drumming?

Yeah, later on I started playing drums again. It was so nice to have that human-instrument connection and to sit down at the kit and let out some creative energy. It felt really good. When I finished college, I came to Portland to work, but I didn't bring drums. Then I went down to my parents' house for Christmas and me, my brother, and some friends were drinking beer and I got on the drum kit that was in the basement and was tearing it up and I was like, "This is awesome. Why don't I play anymore?" So I hauled the kit back up to Portland and hit up Craigslist.

I've met plenty of bandmates from Craigslist, too many to count, and I still have friends from over twenty years ago that I met through there.

I actually met my wife on Craigslist. It was in 2008. You could date people on there; it was not as sketchy as it is now.

Did you have multiple ads running on Craigslist simultaneously, or did you just pack it all into one, like, "Drummer who likes kicking back with a few beers and good friends looking to start a jazz band. Bonus points if you're my soulmate!"

I think there was the "Seeking Friends" section or whatever. I made a post around late January, early February, and I was like, "Are you sick of the rain?" Because I hate when Portland gets all dreary for months and months and months. I posted a picture of me standing in the street in Tokyo because I thought that was cool and unique.

What responses did you get? Was it easier to find bandmates or dates on Craigslist?

There were some okay replies and some odd ones, and then this one girl was like, "Hey, yeah, me too." We met up at a bar and it just clicked when I asked what music she was listening to and she said De La Soul and A Tribe Called Quest. So yeah, Craigslist totally worked.

I have a soft spot for Craigslist. Do you still use it?

I do, but people laugh at me. They're like, "What are you ninety? Nobody uses that anymore!" But it can work. I feel like you can still meet people to play music with on there. You get a couple of real weirdos, but then you bring some people over and have a few awkward rehearsals and give them a couple songs... It's stressful in a way, but it's fun. You don't know what kind of people are going to come over, but they can end up being longtime friends or bandmates.

So are you playing in a band now?

Yeah, I've got an instrumental jazz funk type thing that I play drums in called Argyle. It's fun. (Recently) we had this random gig at a winery where the head winemaker wanted to do an event where we'd do a setlist of tunes to go along with the wines that people were tasting. He was super serious about it. The whole idea was incredibly abstract to me, which is a very hard thing for my logical, engineering brain to deal with. I approached it by thinking of terms that people use to describe flavors and how that might apply to our music. For example, we tried one of the Pinot Noirs that had a certain "earthy" flavor, which the winemaker actually described as "the forest floor!" I thought immediately of an Afrobeat-based 5/4 tune of ours, "Ginger," which feels very "earthy" to me. Also, it's named after a root, so that's what we went with. It's hard to quantify exactly how successful the pairings were, I don't know how you pair a wine with a song, but it was a lot of fun and the band got to try some very fancy wine, so we were happy.

What kind of drums do you play?

Late 70s and early 80s Yamaha recording customs. Yamaha stopped making any drums in Japan in about 2014 or so, and they're great; it's one of the easiest kits to tune up, all the edges are super straight. I like the smaller sizes because I tend to play a lot of funky and jazzy stuff and I've also got an Oriollo kit that I gig with. Oriollo is this guy in Turkey that spins the drums out of aluminum, so it's a process like the way that you would make a

big soup pot. All of the shells are pretty light and they sound great. I bought those when he had only been in business for a couple years and he didn't have any sparkle colors. I wanted gold sparkle so he whipped up a batch of paint and I have the only kit that's in that color.

As a drummer, how do you feel patching up modular beats compares to sitting behind a kit? Is there ever any cross pollination of ideas? Do you ever create beats on your modular that you transfer to the drum kit?

I'm still trying to figure out how to combine the two, but when I come up with some new ideas for us to try as a band, I'll usually have my modular rig fired up, along with Logic Pro and I'll use some combination of those to get some sounds going. In general, I tend to approach all music very rhythmically, with drums as a core element, and that includes modular. I'm really excited to develop more drum-based modules in the future.

The first Weston Precision Audio product wasn't a module, it was your Sequential Circuits Pro One clone. Why did you make that first?

Mechanical engineering is my background, that's what I do for regular work. I was getting into making circuits and DIY stuff, and I was always on the Mod Wiggler forums. There's a DIY sub-forum that's a very interesting place and sometimes people just post things like, "How to replace this capacitor," or "this old synth..." or whatever, but there's a handful of people that are super knowledgeable and you can have some really great in-depth discussions. I had been on there for a while and got into

reading books about analog circuits and I really wanted to make a synth, so I made the Pro One clone. I started with the chassis, because that was my wheelhouse, modeling it in SolidWorks.

But why that particular synth? Why not a Minimoog or a module or something?

I thought I would do something from Sequential because I figured it would be pretty doable as far as finding accurate schematics. My buddy Mike has a Pro One and I borrowed it for a while and thought it sounded great, but the build wasn't so good...so I made my own and put it out as a kit. I sold the boards, the metal, the wood ends, and the bender assemblies and shipped twenty.

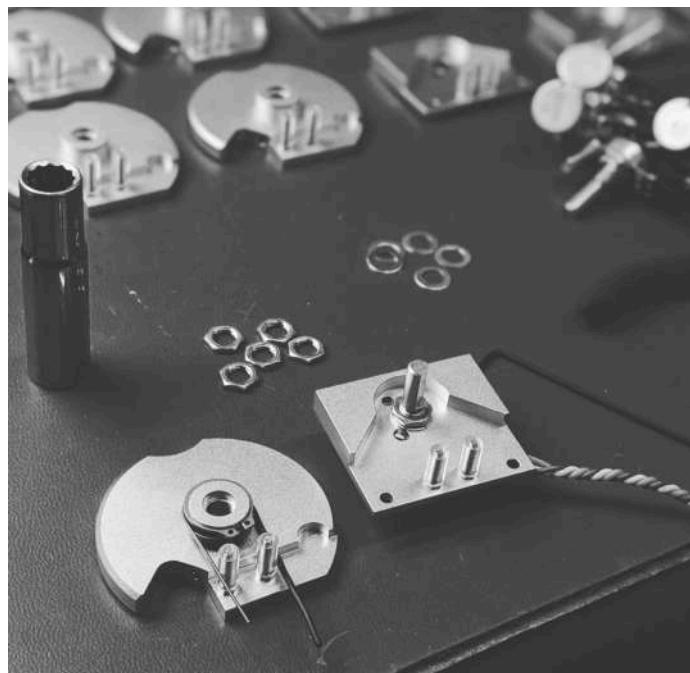
Was it a worthwhile venture? How much were you selling the kits for?

I don't even remember, but probably not enough. I wasn't losing money, but it takes a while to really learn about how to factor in margins and all that stuff.

And your time and effort, too.

Yeah. I had to hand solder all these wires for the bender assemblies, and I didn't want to ever do that again, so in my free time I started doing a Mark II version of it that should make some of that stuff easier for me as I'm going to do another run of the Pro One clones. I didn't know as much at the time when I did the first run; I have a lot more experience now. I don't need to have this hand-wired pot; instead, I can make a little PCB that

I did their math, and I got the degree and then years later, I'm looking at an ARP schematic trying to fix my Odyssey's filter and oscillator and there were op amps. Right, now I care!



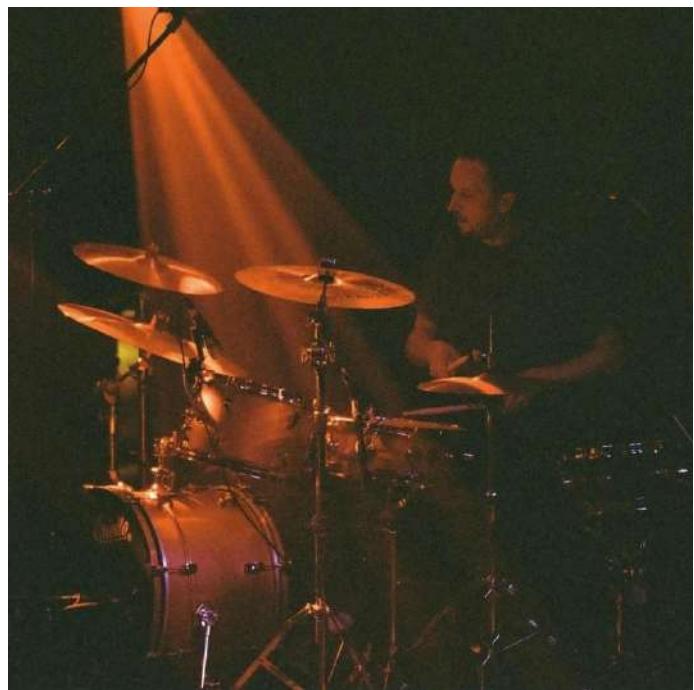
solders to it and a connector and all this will go together super quick.

That's what comes with the experience that you can't really teach.

Totally. That's how all engineering is, refinement and the experience, and real world stuff versus book stuff. It's all important, but you whittle down what is actually useful.

I'm surprised how many people we've interviewed for Waveform that have talked about going to engineering school, and how they feel that a lot of what they learn in school isn't practical for real-world applications, for building things.

I feel it's like a feedback loop in a way, because the theory stuff is really important, it lets you more expediently refine things. Especially with computers. I mess with circuit simulator software like LTspice all the time and you can tweak anything, like changing a resistor, without having to mess with anything physical. When I was going to school for mechanical engineering, they had us take two circuit classes: Electrical



We live in such a throw-away culture that I like to try and fight against that.

Fundamentals I and II. I was learning all this op amp theory, and was just like, "Why are they teaching this? I don't care. What am I doing with an op amp?" I could do all the math and it was fine, but I'm a hands-on dude, let me look at the oscilloscope, at what's coming out. I feel teachers should be like, "Here's what you would do with it," and that's my beef with 80% of the engineering courses I took through my whole degree. They analyze this, like, "Here's a pump connected to a turbine, and then that goes into this and that," and I'm like, "What is this thing? What does it do? Why do I care?" It didn't even enter their intellectual academic minds about what this system that they're analyzing was. We were grinding equations to find the outlet velocity and temperature at point P1, and I'm just sitting back there like, "Why?" But I did their math, and I got the degree and then years later, I'm looking at an ARP schematic trying to fix my Odyssey's filter and oscillator and there were op amps. Right, now I care!

I read that you got your Odyssey from a planetarium, is that right? What wound up being the issues with it that needed fixing?

My dad got it from the Denver Museum of Natural History. They used it in the planetarium in the 70s for spacey sounds. It had probably been just sitting around and maybe abused throughout its life. One of the oscillators was dead and there were soldering problems with the filter, so I went at it. There are three boards: A, B and C, and the B board has both the oscillators on it. Other people had messed with it before and there was trace lift on there that was screwed up so I ended up making a whole replacement PCB for that board. It gave me an excuse to get good at KICAD, which I still use to this day, so I did that and replaced all of the electrolytic capacitors, but I wound up blowing up the VCA. The whole top of the Odyssey comes off and it was flipped around

and I bumped it and it shorted out. It was one of those 3080 chips that you could still get though, and I finally got the thing all booted up. With all the oscillators working and tuned up, it was magic; it sounded so good.

Your board worked the first time?

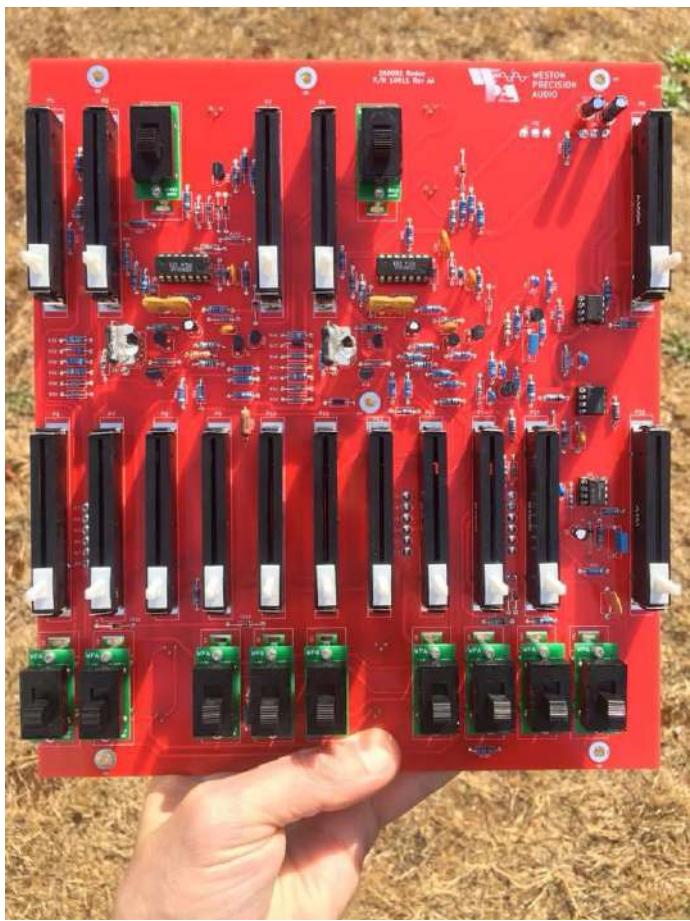
It did, and that's when I realized the value of carefully checking over all of the electrical stuff. When you're looking over a schematic or debugging a problematic circuit, there's a lot you have to be very diligent about. It's like bookkeeping: every little detail matters. If you have one op amp that is supposed to be hooked up with a resistor in a negative feedback configuration and you put it as positive, you just ruined that circuit; you just changed it from an inverting summing amplifier to a comparator with hysteresis. They're completely different things.

Of course! What was your process for building that replacement PCB?

I printed out the schematic from the ARP service manual and put that on a big 11x17 paper and got a highlighter and just went node to node, and checked to make sure that everything was good. When the board came in, it worked fine and the rest was just soldering everything in.

You mentioned that your dad got that ARP for you. Was he a musician? Did he turn you on to music?

My dad always played music throughout his life. He was always a bass player, and I remember some early drumming days where we jammed together. I wish I had played music with him more while he was with us. It's one of the things in life I regret. He and my mom were always incredibly supportive of my musical



advanced technology at all. Here we are, a quarter of the way through this modern century and I hear recordings that sound amazing where they actually went out of their way to record it on analog tape. There is just some special sauce to that two-inch magnetic tape. There are plugins that do that, and you can do everything in Logic or Ableton or whatever, but if you're recording on a reel of two-inch tape that costs three hundred bucks, you need to get a good take. Yeah, and all of those are important aspects. I feel like they get lost and we have to think about things like that.

It's printed, it's physical, it's there. It's not necessarily easy to edit on tape, though, and like you said, it is expensive, so there's that. How in-depth do you get with the DIY builds that you offer? Do you have good interactions with your customers?

Mostly. I get people who email me with their build issues and I always ask if I can see pictures of their build—I want to see how much of a train wreck it is! Some of the soldering is not good; it looks like metallic chewing gum all over the back of a board and I get people that are almost apologetic about it. I like to gently push people to go and watch some videos, to learn how to solder properly. There's a technique and there are the tools. You see people that have way too hot of an iron, or they don't have any flux, or enough flux, or the right kind of flux, but if you just have the right stuff and you watch some videos, you'll be okay. I feel like things can only get so complex from a DIY standpoint. Hand soldering high pin count microprocessors and stuff like that, the

Through hole is dying...whether we like it or not.

endeavors, and I am grateful for that. His mother, Adele, was also good on the piano, and when I was little I used to play around on the piano with her.

Playing music with other people is such a special connection, especially with family. You mentioned being hands-on, do you try to give your modules a nice tactile experience?

Yeah, that's what I think modular is about: being hands-on. It's like vinyl records. As an engineering-minded person, I know that vinyl doesn't sound very good compared to 24-bit digital audio, but I don't care. It sounds good enough, and there's this beautiful jacket, you can slide it out, and maybe there are liner notes so you can see who's in the band. It's hands-on and I love that.

You think about a record versus a stream and you can have the same album, song, or music for each format, but it's a completely different process of the listening experience. I feel like so much of the time when it comes to technology, people only see the efficiency or the apex of the technology and they don't see the big picture, the actual quality of the experience of it: What you're getting as opposed to what you're missing out on.

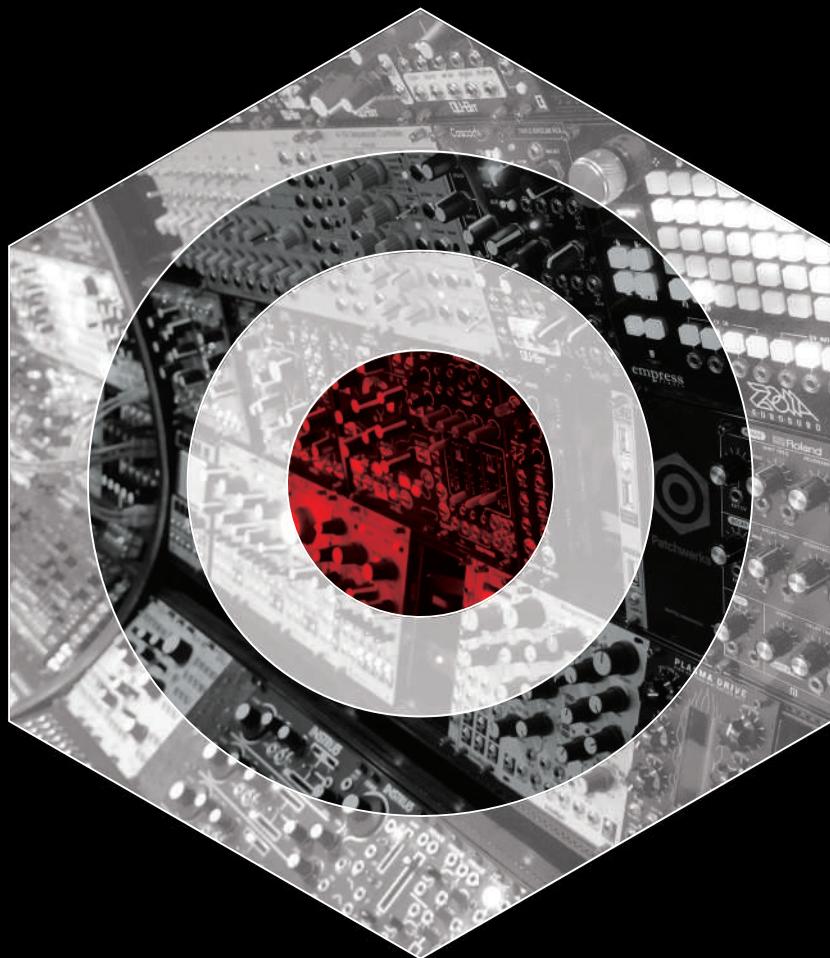
Totally, and it's huge. A lot of the best things aren't the most

success rate is not good. It takes a lot of time and experience to get good at really complicated builds and I feel like the pick and place machine is better at this than I am. These parts were made for robots to put down—just let them do it. Some companies have done DIY builds that have a really highly technical daughterboard that's pre-soldered, but I don't want to offer anything like that because then the builder is just soldering on pots and jacks; it's taking so much of the value that I offer out of my hands; all the pre-populated boards that I bring in, assembling the module, calibrating it and making sure it's all spic and span; boxing it up and getting it sent out. What am I getting out of that? It doesn't make much sense. Some of the modules have boards that are so chock full of surface mount parts anyway, that you can't even make a through-hole version because the parts don't even exist as through-hole. Let's face it, through hole is dying, it really is, whether we like it or not. New chips come out, and they might only come in a TSSOP-16, a little guy, and I can't do a DIY of that with through-hole.

I steer clear of soldering SMD stuff. Some of those resistors and capacitors are smaller than an ant. You need a microscope and steady hands. A lot of your modules are symmetrical with two sides that interact with each other. Are you attracted to symmetry? Is it fun to iterate on ways that two of the same function can interact?

CONTINUED ON PAGE 75

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DIY SPOTLIGHT: SEBSONGS MODULAR

BY WILLIAM STOKES

Sebastian Hastrup is the man behind Sebsongs Modular, based in Malmö, on the southern tip of Sweden. “Electronics came into my life quite early,” he reflects. “My dad had an electronics workshop at home for repairing stuff and I was always interested in unscrewing things, taking things apart and seeing how they worked, though I could never get them to work again after taking them apart.” Like a growing list of DIY kit developers, it was with support from Thonk that Sebsongs was able to launch, debuting with a modest run of Euclidean, their algorithmic gate sequencer. Now Hastrup has eight modules in the Sebsongs range, with more to come.

How did you get started in the DIY world?

I started out making some guitar pedals and doing a bit of circuit bending while I was still in school, and I got into synthesis and modular over ten years ago. I’ve been working at the Blekinge Institute of Technology for quite a while, teaching sound design and things like that, and we had this course which had to do with modular sound design. It wasn’t really about modular synthesis, it was more about creating interactions between the body and sound—spatial experiences—and that became a kind of segue into modular synthesis for me. I was doing a lot of Arduino stuff, and I found YuSynth (Yves Usson) who did his own modular stuff and had this big 5U system that was totally DIY; he even made his own PCBs. I started building his stuff; oscillators, Moog and Arp filter clones...I started in the Eurorack format back in 2015.

I had this problem when developing it, where I would just keep getting lost, having fun with the module.

When did you start selling Sebsongs modules?

I reached out to Thonk and we released four modules in September 2022: the Euclidean gate sequencer; the Odds, a random probability sequencer; a stereo mixer (ST Mixer); and a six-in-one attenuverter (Attenuvert x 6).

Why do you think modular attracts people who have experience in platforms like Max MSP or Arduino?

That’s a good question. For me, it’s the journey of exploration, of actually building stuff, of understanding how things work. That’s what also really attracted me to Pure Data. I can build my own bare bones software, where I have to understand the math if I am to do stuff with it that’s interesting. It’s the same with modular. I have to understand how each component works and how to put stuff together. I do both hardware and software, and do these kind of digital and analogue hybrid modules. It’s very inspiring to be able to combine my tech background, my musical interests, and also my interest in building stuff.

It feels more and more like Eurorack is expanding outwards, facilitating so many different approaches.

I don’t get very inspired in front of a screen anymore when I’m making music, that’s why I’m sticking with modular; I find a lot of inspiration within it. I didn’t start this endeavor with the idea of big success in mind; I started it because I wanted specific modules in my system that didn’t exist, or that I couldn’t afford, and I knew that I could do a lot of this myself.

Tell me about the Sampler. I don’t think I’ve come across a DIY sampler like this before, let alone one with an onboard microphone.

I had been building samplers in Pure Data a lot because it’s a nice environment to do crazy granular stuff. I’ve also been deploying that on mobile devices because it’s easy to have a Pure Data patch on your phone. I had a working prototype back in 2020 on a different infrastructure, a different processor to the one I’m using now, just to see how it would sound and what could I do with it. I put it on the back burner and concentrated on other stuff for a couple of years, but last year I picked it up again. I was getting into the Raspberry Pi Pico with the RP2040, an (inexpensive) powerful processor. I tried live recording into the RAM memory and playing it back, and it worked quickly and sounded pretty good. It’s not 24-bit 96kHz, but that’s what I like about it, although with a good signal going into it, it can still sound really good.

I had this problem when developing it, where I would just keep getting lost, having fun with the module.

It feels very quick, very intuitive to use.

My design philosophy is that I really like having very clean panels with very simple interfaces that are that are logical and intuitive. It’s about hitting that sweet spot and not being too too complex with too many controls. I had this problem when developing it, where I would just keep getting lost, having fun with the module. I think that’s a good indicator that something will be successful.

Can you tell us anything about what might be coming with Sebsongs?

I’m aiming for a small synth voice of some kind, and also a drum machine. There are a lot of drum modules in the market, but there’s no sequencer built into those, so there’s kind of a gap. I have some fun stuff on my bench right now, but exactly how it’s going to sound and what the technology is based on, I’m keeping to myself for now, so we’ll see.

BUILDING THE SEBSONGS MODULAR SAMPLER

BY WILLIAM STOKES



Above: **Sebsongs Modular Sampler**
Photos provided by Sebsongs Modular

This is the fifth edition of this DIY column (*if I can do it, so can you!*) and this time around is the Sebsongs Modular Sampler, a digital module, but one that somehow feels so at home in the analog modular domain as to eschew all associations with computing in favor of that most overused but highly redundant term: old-school. Perhaps it's the module's no-nonsense look, with sober lettering on an otherwise blank silver faceplate, or it's the fact that it's literally just called "Sampler." Either way, sonically, Sampler's 12-bit processor, which samples between 10 and 40 kHz (depending on the pitch setting) carries an unmistakable lo-fi character, similar to the likes of the Boss SP-202, an association buttressed by its bipolar pitch knob's ability to have a sound turn on its heel and reverse.

You won't find any onboard effects or USB-C ports for endless firmware updates here; this is a healthy slice of classic sampling, packaged up in a neat 8HP. Sampler has an upper limit of just three-and-a-half seconds of audio at maximum sample rate. This

...there are a few tricky twists and turns to navigate; not least of which is the all-important mounting of the microcontroller, which I very nearly bungled thanks to a poorly mounted header.

is a limitation for sure, but I already have a litany of small boxes offering endless sampling capacity in pristine quality, so it's absolutely nothing to complain about. Plus, limitations such as these are healthy, and can even be essential for creativity.

Sampler is built around the Adafruit ItsyBitsy RP2040 microcontroller, which comes pre-programmed for computer-free building. The module is slated as an intermediate build, which I'd say is accurate, given that while most components are fairly straightforward, there are a few tricky twists and turns to navigate; not least of which, is the all-important mounting of the microcontroller, which I very nearly bungled thanks to a poorly mounted header. It's always harder working with two PCBs than with just one, mainly because each step becomes more and more of a commitment as you proceed, and with a final step of carefully soldering the microphone in place (taking care to both maintain some pressure on its rubber grommet while aligning it with the faceplate), this isn't a kit that will easily forgive mistakes.

Thankfully, the build instructions are straightforward and clear, which really does make a world of difference, no matter how experienced one is.

Once assembled and mounted, in practice it quickly becomes clear that the limitation in sampling power need not mean limitation in functionality. As well as an audio input, its onboard electret omnidirectional microphone has a frequency response ranging from 20 Hz to 15 kHz, and sits next to a nice big Sample button and two sliders for adjusting the start point and length of your sample. This not only makes for quick and supremely enjoyable glitching and stuttering of recorded sounds, it also means any percussion sounds (including simply tapping the module) can be truncated in seconds to have its transient hit

perfectly in time with a trigger sent to the Reset input. Beneath the Pitch knob, which in the same gesture also handles speed and playback direction, is a Loop button for toggling between one-shot and looping playback, as well as a Clear button for clearing the buffer of audio. This—or, its associated trigger input—is incredibly useful when used in the context of a patch. Send alternating gates to the Sample jack and the Clear jack to create repeating, self-renewing samples of your live audio, like some kind of small-scale, lo-fi iteration of Frittertronics, or use in conjunction with a shorter, looping sample for generating strange, glitchy flavors of percussive digital delay.

The Sebsongs Sampler is a beautifully balanced module: it combines simplicity and complexity—in both building and playing—not to mention limitation with flexibility; lo-fi with high-quality. It being mono, I'm very interested to see how it performs on both sides of a stereo image. I guess I'll be getting myself another.

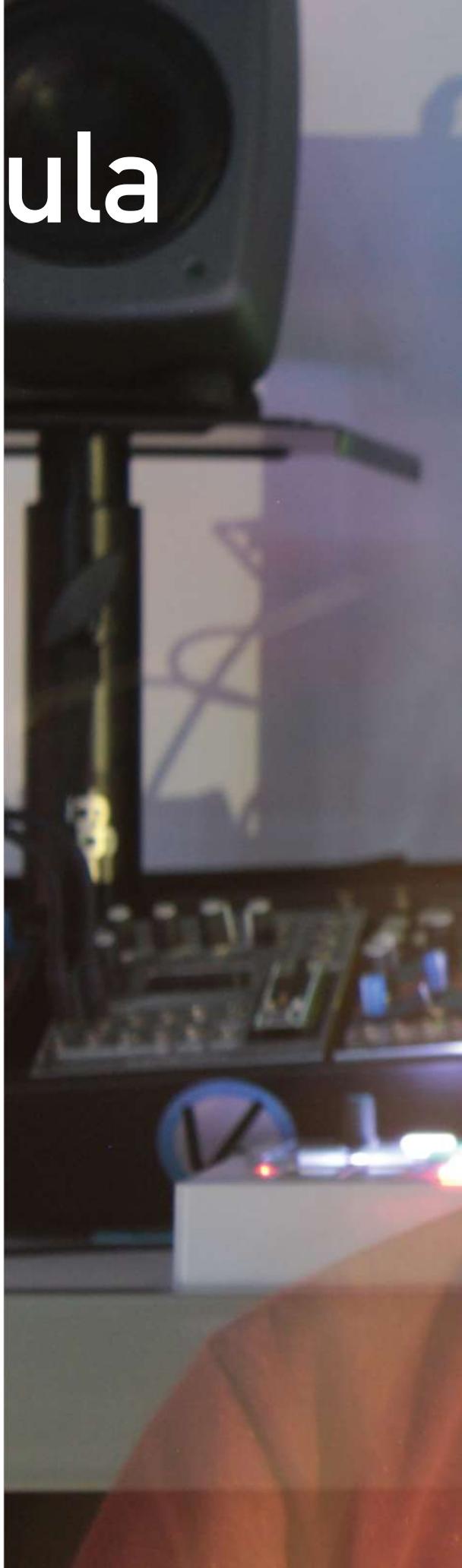
knobula

A "reality threshold" within the field of psychophysics is an intersection of perception and imagination, where the brain determines the level of realness of an item or situation. It's a system built on internal and external signals that run through similar and simultaneous neural mechanisms that allow us to differentiate something real from something imagined. It's constant and it's always in tension. You'd think that the closer something is to that threshold, the better, like how real tape flutter is better than a simulated version, or how a digital creation that can seem more lifelike is better than one too steeped in its own digital-ness, but that's not necessarily the case: there's a needed balance. Too much tape flutter means something is out of alignment, the randomness of which can be utterly charming, but also incredibly annoying. Take away the arbitrary element—make it digital so you can control every aspect of it—and the stumbled-upon magic is gone, replaced with something calculated, simulated.

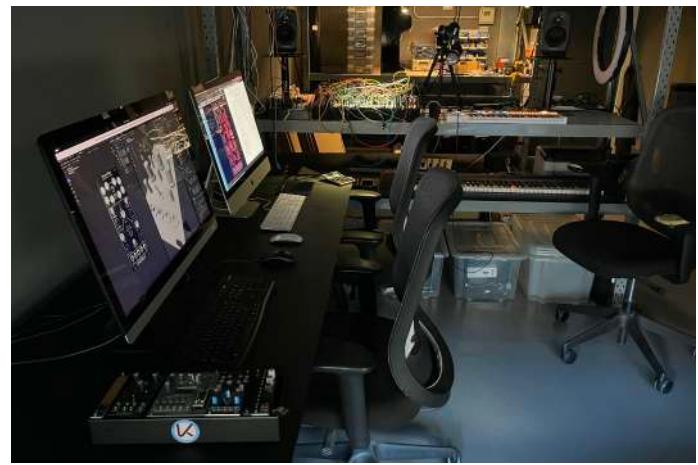
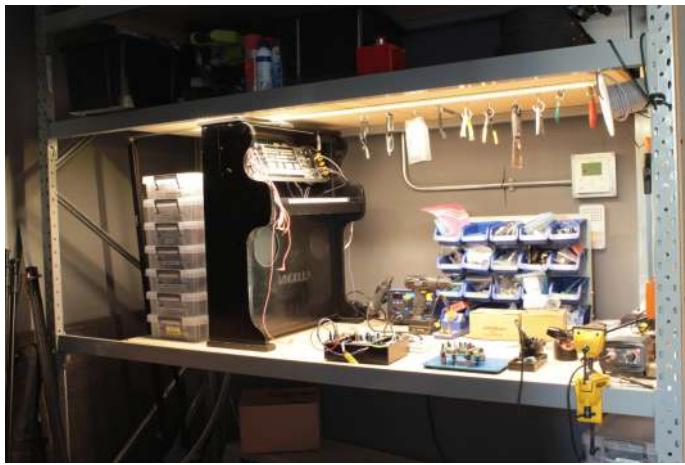
Jason Mayo was making tape loops and building synths as a kid, and had a BBC top five hit at twenty-two, which launched him into a career in music production. He would later go on to have careers in Foley and digital effects, where he was, "trying to make fake things real, or fake things sound real." With his modular company Knobula, he's been driven to find that balance of real vs. fake.

Embracing MIDI to more easily implement polyphony in modular, Knobula practically burst on the scene with the release of their first module in 2020, the pink and blue hued Poly Cinematic. It instantly spoke to MIDI/polyphony deprived modular users who might not have even known what they were missing. Knobula modules are deep, but also tactile, and combine real-world playability with impossible, otherworldly features, like the crazy chord formations capable in Knobula's second release, Chord Pilot.

A study in the balance of perception vs. imagination; precision vs. random; realness vs. unrealness, Knobula strives to make the impossible, not just possible, but believable.







I could solder before I could walk.

Waveform: Way before Knobula, you were a music producer and had a bona fide hit with a remix of the *Thunderbirds Are Go!* theme. I sort of knew about the show growing up and I listened to your remix and realized that there were a few different versions released, one of them being a somewhat sexually explicit 12" version. What's the story with that?

Jason Mayo: *Thunderbirds are Go!* was a TV show that was made in England in the 1960s and I watched it as a kid. When I was older, I worked for a sound effects company doing Foley, making a lot of radio ads and things. One day somebody came in and said they'd just acquired the rights to *Thunderbirds* and wondered if the theme tune could be remixed. I was the junior guy at the studio who had my own kit, samplers and stuff, and I was like, "Mate, just give me the tapes." So they gave me this whole catalog on VHS and I went through it and picked out all the interesting dialogue. There's a character, Parker, who's a chauffeur, who drives around in his pink Rolls Royce for Lady Penelope, who's kind of a rich aristocratic lady, and he had this catchphrase, "Yes M'lady." There was an episode where Lady Penelope gets tied to a chair and she asks the villain with the rope, "Are you going to tie me up?" I cut it so that it was sort of playing on the sexual tension, which was actually in the original series between the chauffeur and Lady Penelope. I built the whole track up using an Atari and an Akai S1000 and delivered a finished mix, which ultimately reached number five on the BBC Top of the Pops chart. I was only twenty-two, and that launched me into being a music producer.

Did people start hitting you up for music production work once that happened?

I made two albums of remixed TV themes off the back of it and began helping out some of the sound dubbing clients who needed more advanced sound design work until I left to set up on my own. One thing I got into was musical idents—channel IDs—pieces of music that lasted just a few seconds long, like "Dong dong bang!" Sometimes they're longer, but they're really short pieces of music that you play under a logo; that's an ident. I began to work with a guy who did loads of them, and he famously did

the two-note ident for BBC Two. But it wasn't just two notes, it was the way they presented those two notes, you just got really into the detail of it, and it was at that time I got introduced to various product branding agencies.

I see a similarity, a continuation of an idea with the idents, to your Foley work, in that you're creating a short sound representation. Some people think Foley is just sound effects, but it's really the physical manifestation of making a sound match something that might or might not actually be happening, to make it seem believable. What were some challenges you faced back then with sound representation work?

In the early days of Foley we'd occasionally be sent down to the canteen to record sizzling sausages or something for a radio ad; we even had one client that requested the sound of snow falling. If we didn't have it in our library, then someone would have to make it up. Of course, snow doesn't make sound when it falls, but walking on snow is just the twist of a cotton ball; it makes a kind of squeaky snow sound. It was so long ago that the effects were stored on 8-track cartridges, so that was a challenge, because the carts were so unreliable, but everything else was reel-to-reel tape. There was something lovely about the tactile experience of listening and finding, of marking tape with white chalk, and putting it on blocks and cutting it with a razor, and then putting it around your neck and finding the next bit. That pretty much died out by the time I'd learned to do it, but I'm glad I did it; it's good training, learning those fundamentals. I was doing tape loops when I was twelve with my dad's tape recorder, recording Kraftwerk off the radio and transferring it to a two-track, trying to cut it into a loop, sticking it together with sticky tape, and playing it back. That was the drum loop sample. I thought that was quite a cool thing to do, but at the time, everyone was like, "Jason, that's just weird. Why would you want to listen to the same sound over and over again?"

I remember those early years of experimenting with tape. You mentioned that you had a sampler and some synths. What kind of equipment did you have in your studio back then?

I had the Akai S1000, an Atari ST running Creator, a Roland SH-101 and a Moog Prodigy that I bought secondhand for £40. Having a studio also meant people loaned synths to me, and I had an ARP 2600 for a while, which introduced me to modular. Originally, I started with a Tascam 4-track cassette recorder, which although limited, I could bash together tunes on like a dream; it was an instrument that I understood. Then I got a Fostex half-inch 16-track, and that was a pain in the ass. Everything would just take so long to set up. I was obsessed with the idea of having lots of different tracks with the drums, and having this opportunity to layer and mix, and it just got in the way of the creativity. That was actually a bit of a dark period. I got burnt out from having my recording studio and doing music, and I made the decision to stop. I had kids, the studio was getting harder to run, work was getting harder to find, it was much more competitive, and I was smoking far too much weed.

I think it's really easy to get carried away with this idea that more is better, or that you need a specific thing to bring about certain results or opportunities. I've been thinking a lot lately about not just the end result of things, but the process itself, how that's maybe more important. It seems like you take this aspect to heart with your modules: they're deep, but immediate. It's interesting that you had an experience pretty early on that sounds like it helped create your vision for Knobula, even before you knew you were going to make instruments and start a company.

You're absolutely right. In fact, that kind of realization happened a bit later when I got into direct-to-disk recording with Logic Audio. When I got into DSP, all of a sudden I went from having very limited resources to having 48-track recordings, more power than a professional recording studio of the time. It had a Sample Cell sampler and loads of amazing plugins all running on DSP cards with zero latency. It was great for commercials and things where people wanted to do a recall because we could bring the whole track back to how it was, things that we now take for granted, but it got to a point where I was having this recurring dream—or more of a nightmare—where I was in this perfect

recording studio but I couldn't actually touch anything, and instead of glasses, I had binoculars. It was just me having audio dreams about operating a computer and plugins using a mouse. I had the realization that although, yes, you had access to amazing virtual equipment and you could save and load anything, there was something that I was really missing. I was very conscious on the one hand of chasing this leading edge of technology, while also hugely aware of the world that I'd left behind, where you could touch and interact with both hands.

It's just another step removed from the physical interaction of hearing, watching, or playing music. When you stopped doing music, where did you go from there?

My other passion was visual effects and computer graphics, something I learned to do in 2002, and I made a short CGI film called *Hoverbike*. I also did the sound effects and the soundtrack for it, and showed it to two people in the visual effects industry. The following week I was employed, working on *Troy*, the Brad Pitt movie; a thousand ships and thousands of little motion captured people. I went from having a recording studio to doing a short film to working on a Hollywood movie. I did that for ten years and that was a pretty cool career; most of the time I was doing creatures and dinosaurs. I was bringing up three boys at the time, and they'd come home from school, and be like, "Daddy, what dinosaur were you doing today?" It was like I had the best job a dad could have. I did a lot of work with digital dogs for Disney on the film *Underdog*. I spent about a year of my life doing digital Alsatians that were stand ins for real Alsatians, digital stunt dogs that got thrown against the wall and kicked. When Disney tested the film, the audience was really upset when they saw our dogs being thrown against walls and taking punches, and so all the shots I had worked on for a year were cut. I guess they looked too real, but at least no animals were hurt.

I really can't imagine working on something for so long only to have it be scrapped. I know it happens all the time, but still... Were you doing anything creative outside of that to balance the digital Alsatians? Were you making music at all?

I still get a buzz when I see one out in the wild.





Photo Spread: Jason Mayo in his studio.

Page 30: Knobula workbench, studio workshop.

Page 31: Knobula modules: Poly Cinematic, Chord Pilot, Kickain, Pianophonic, Echo Cinematic.

This Page: Jason Mayo.

Page 33: Poly Cinematic prototypes.

All photos provided by Knobula

I've spent my whole life trying to make fake things look real, or make fake things sound real.

By that time I'd sold all my synth gear, so I spent about ten years not making any music. I'd had it with media composing and I didn't enjoy using DAWs. I wanted to concentrate on other things, and also, as we were moving a lot, we didn't have the space. It's quite a recent thing that I got back into it. I spent my teenage years in Toronto, and I still have a lot of friends, two sisters, and my mother over there, so I go there all the time. I used to live on Queen Street; it's my favorite place. I was back there in 2019, just before COVID, and one day I stumbled across the Moog Audio store and it was one of those life-changing moments. I had always wanted a Doepfer system back in the 90s and seeing how Eurorack had evolved just blew my mind. I'd been trying to avoid it for years because I knew what a distraction it would be, but it came at the perfect time. When I got back to London, I bought a whole load of modules and started making my own.

That's a fast progression. How aware were you of modular and synths before? Did you play any instruments?

I was a totally obsessed synth kid growing up, but I never learned any (instrument) formally. Somebody tried to teach me the piano when I was at school, so I can sort of play, and I suppose I did get the rudiments of music, but I can't read music. I can hold a beat on the drums; I do like a drum kit. Those are the only things I play, but my synth history goes way back to when I was twelve years old. My father was an electronics engineer and also a violinist when he was younger, and he knew I was interested in synths. He was the one who explained to me how it all worked, with envelopes and oscillators and all of that. He was a good mentor. I was building synthesizers, keytaras, drum kits...I built a Powertran Transcendent DPX, which was designed by Tim Orr

(Ed. - Tim worked at EMS). It had a fixed divide-down oscillator that produced the polyphony and I had to solder this one massive circuit board with thousands of components. Months later, when I finally plugged it in and got maybe fifty of the sixty-one keys to work, it was a disappointment. It just didn't have the richness of the two-oscillator synthesizer sound that I was so into. When you played an octave—two notes an octave apart—it still sounded like one note because it was a dividing oscillator; there was no kind of intermodulation anywhere, which is why when I designed Poly Cinematic, I made sure that it was going to have a lot of intermodulation.

So that's why you designed Poly Cinematic? Was there anywhere in the back of your mind that you might start a proper company at the time?

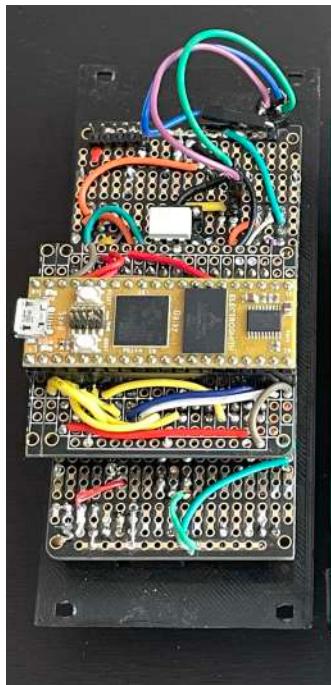
I designed Poly Cinematic because there was no simple compact polyphonic voice in Eurorack at the time. The octave stretching and intonation features were also important to me because I knew that without them, digital oscillators could produce very dead sounding chords. The idea of producing Poly Cinematic commercially was always in my subconscious, as electronics manufacturing was the family business when I was growing up—that's what took us to Canada; my father made machines and metal detectors with microprocessors for the food industry—so it felt natural to one day do something similar. I always used a polysynth alongside my modular, usually an Access Virus, but it took up a lot of room. It had hundreds of presets and I would just use the same three sounds and only change the attack, decay and filter, and I thought, "This is stupid, carrying this massive machine around with all these redundant knobs and buttons. I don't really even know what they all do. Wouldn't it be nice to

have a minimal modular version of that?" I immediately went on Modular Grid to find something that fit the description, but there was nothing there—no polyphonic synth module. I'd been working with the Electrosmith Daisy platform, and discovered you can get eight-voice polyphony out of a Daisy, so I knew it was possible. I needed something where I could just go "bish bash bosh" and get my sound like I did with the Prodigy, or my SH-101; no presets. That's how I used to use those synths. I don't know whether it's because I knew them so well or they were just perfectly formed synthesizers, but I wanted something like that, and polyphonic. When COVID happened I had all this time, and that was my way of getting through it. I got out my 3D printer and my computer and made stuff. Once I'd finished Poly Cinematic I thought if I sold twenty, then that would kind of pay for itself. So I built a website, put my Computer Generated renders on it, posted it on Instagram, and then went on holiday. A few days later I was on a beach in Ibiza when I started getting all these emails, one after the other. "Where can I get one? How much is this?" That sort of stuff. I said to my wife, "I think something's happening here." Not only were customers contacting me, but also manufacturers and distributors. These people were coming to me, and so I could just cherry pick who I wanted to work with. In the end I made 250 units which sold out straight away and that basically launched the company.

Chord Pilot came out pretty soon after Poly Cinematic, and the two definitely work well together—it almost seems like one is lost without the other. Was it something you'd been thinking about for a while, or did the surprise success of Poly Cinematic and the need to add to your product line get you to the drawing board quicker?

I was told that if I wanted to do a Eurorack company, I had to have a stable of products, so that was the first mission: to get four strong products. The whole birth of Knobula was just a rare moment where everything perfectly came together; the planets had aligned for me. There was a certain amount of pressure to produce a follow up module after Poly Cinematic, and a chord generator was quite high on my list. I was surprised how many people use modular without a MIDI keyboard, and I was having many conversations with users—even accomplished musicians—who never liked using keyboard controllers. It seemed like a good idea to develop some kind of CV-to-chord expander for Poly Cinematic, but also to make it synth agnostic, so it could play well with others, which is why Chord Pilot came out. I'd always had this novel idea of creating chords by describing the shape of your fingers on the keys rather than describing the name of a specific chord. It resonates more with the way I play music, so I started working on this idea in Python, a language I'd learned through doing computer graphics. I saw that everyone was doing these kinds of typical chord generators, like, C major, minor, diminished seventh, first inversion, that kind of classic sort of musical theory way of playing a chord, but when I play the piano, it's more of a finger thing. I'm not really aware of what I'm doing on a musical level, it's more about placing my fingers like this or that. Narrower, further...it's just a shape. I started thinking about how I could do this digitally and how to then use CV to control that. So the idea was to imagine you had a pair of robotic hands and you could just describe how you wanted that hand shaped, where you could spread out really wild chords across the whole keyboard. I worked it all out on the screen with the Python script so it was basically a computer program with a MIDI output, and then I handed it over to Tyler (Coy), a developer based in Austin

I'd been trying to avoid it for years because I knew what a distraction it would be, but it came at the perfect time.



who does Alright Devices, and suddenly we had the prototype. As ever, you get the prototype and think, "Wouldn't it be great if we made the CVs assignable? And what if we could switch between arpeggio and a straightforward chord?" My friend Freddy took one look at it and said, "How do I make it sequence through the eight chords," and that's how Orbit mode was conceived. Some of the names of the parameters could have been more conventional, but I'm not sticking strictly to musical theory; these things operate in their own space, and I like to give them kind of weird names. My son came up with the name Chord Pilot because it navigates you through a musical journey.

As someone whose hands barely cover an octave on a piano, it's nice to be able to make chords with a much bigger wingspan. Chord Pilot affords the opportunity to create chords in a way I'd never even fantasized about, let alone realistically considered. On a similar note, another interesting feature on one of your modules is the hammer parameter on Pianophonic, the fixed attack envelopes that simulate different instruments. You can get really unique configurations mixing and matching the different hammers with the different sounds on that module.

With the hammer, the original brief was for a 90s wavetable sampling piano like the KORG-M1, or the (Roland) D-50, but with knobs on it. There wasn't enough RAM to sample like we do nowadays, so they would just use wavetables; they'd sample an individual wave and move through the wavetable for each piano note. But wavetables don't work well for transients and so they would start with a really short sample of a piano—a massive compromise—but that also gave it a certain sound. Pianophonic

Everyone was like, "Jason, that's just weird. Why would you want to listen to the same sound over and over again?"

wavetables have enough resolution to negate having a short sample, so mostly we just extracted the non-harmonic 'thud' from the sound and that's why it was called a hammer. Having the sixteen presets on Pianophonic I thought, "Why don't we have it so that you can use the hammer from one sound and the wavetable from another?" In the end, the hardest thing about Pianophonic was what features to omit from the design, and what to leave in. I enjoy the process of defining a product, understanding its purpose, and therefore what controls are essential to make it work, and since I don't have screens and menus, I really have to nail that aspect of the design. Subtle things like octave stretching or micro detuning are always active by default, not hidden away as options. This harkens back to when I built that Transcendent DPX. Because of the disappointment with the divide-down oscillator, I prioritized octave stretching into all my synths by adding dynamic temperament. The intervals between the notes are not actually equal temperament, they're slightly bent towards "just" temperament, which is based on natural harmonic intervals—perfect harmonics that you get on a string or a brass instrument. The module listens to what you're playing and micro tunes each note accordingly. It's always there, even if you don't notice it.

That must have to be processed so quickly. When you're designing something like that, are you coding for each different spatial range between every set of notes, like if it's this many notes for a distance, this is the kind of temperament change that I want?

There are two ways you can do it and I'm actually switching to a different way on future modules, but on Poly Cinematic and Pianophonic it looks at what you play, and the first note you play is always in tune; it's always equal temperament when you're playing monophonically, but as soon as you play two notes, the second note comes in and it checks to see if any notes already playing are related to the one that you've just pushed down, and if it is, then it will tweak the one you just played, up or down, depending on what's already playing. It works really well, and it's such a subtle thing. You can turn it off, or also program it to have more or less of it, to the point where you can make it sound like it's completely out of tune for certain sounds, like if you want it to sound more honky tonk or like an amateur youth orchestra. I'm doing another technique on the next module that does chord detection; it detects what chord is playing and adjusts it. The difference with that is that it adjusts notes that are already playing, which can sound weird. If you're playing similar notes and then play a new note, your first note will pitch slightly. If you're doing it subtly, and with a bit of portamento, you don't really hear it; it sounds right, like a real orchestra. They play a note and listen to each other and make adjustments all the time. That's what makes it sound rich and natural.

I love the minutiae of those interactive adjustments between orchestra players, that communication. It feels like a secret

club of sorts. Pianophonic was Knobula's fourth release, and you just released Echo Cinematic, so you've now got plenty of modules in your stable. Why did you call it Echo Cinematic? Is there something "cinematic" about it, or was that the best way to make it more of a known pair with Poly Cinematic?

Funnily enough, the original Echo Cinematic predates Poly Cinematic. In 2019 I had wanted a dub delay with a resonant filter, but again, I couldn't find one. In the middle of the development of the dub delay, I discovered that the same platform could be made into a poly synth and I diverted all of my attention to bringing the synth to market, which ultimately became Poly Cinematic. The name Echo Cinematic is really a nod to its origins as a delay that became a synth, although they do share the same stereo reverb algorithm. Echo Cinematic was later redesigned from the ground up so I could add things like the knob recorder and jack sensing CV assignment.

I know that one of Knobula's core philosophies, along with your polyphonic bent, is to help MIDI be more accessible in modular. Do you have a real affinity for MIDI, or did you just realize that was the way

CONTINUED ON PAGE 76

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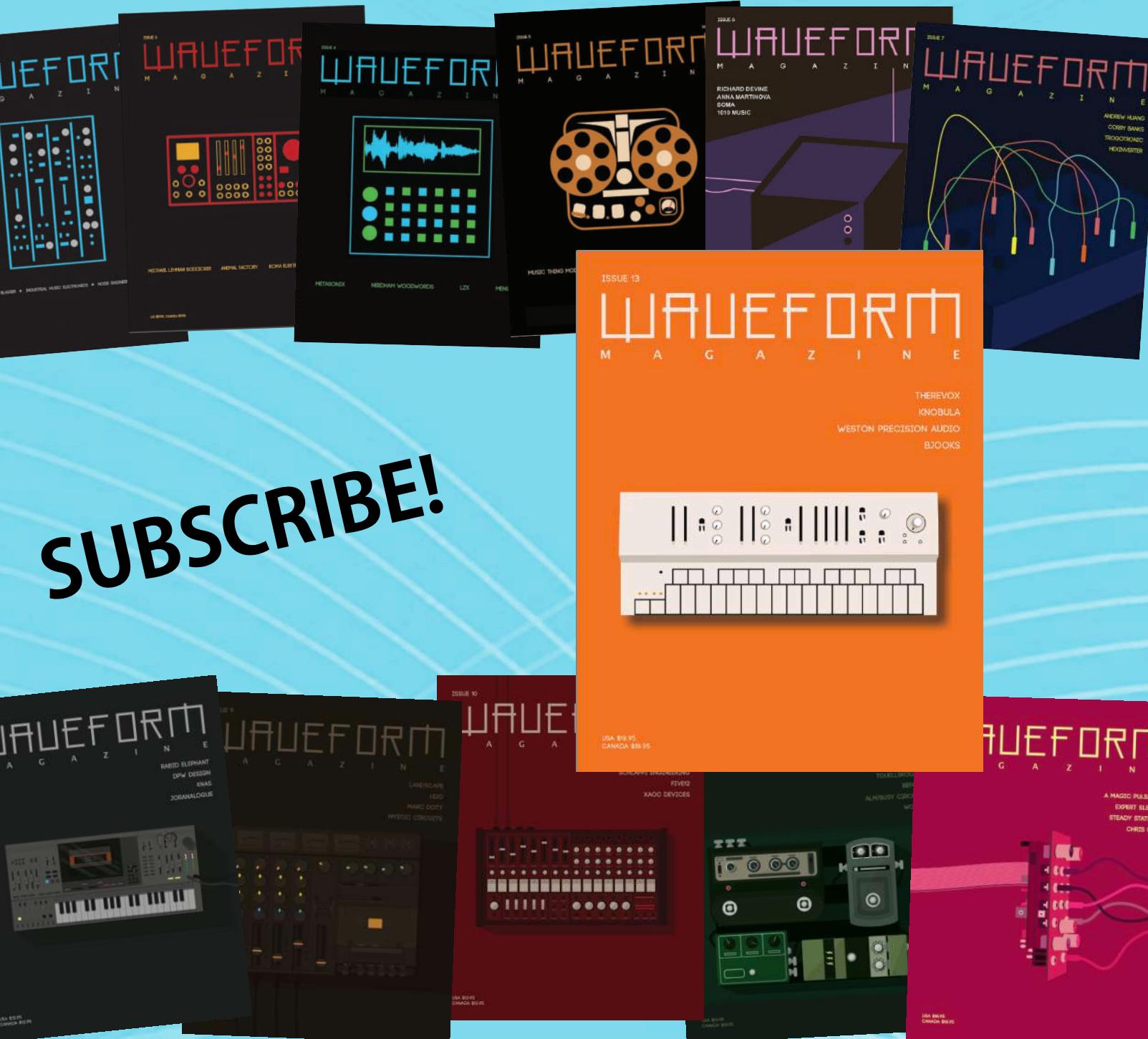
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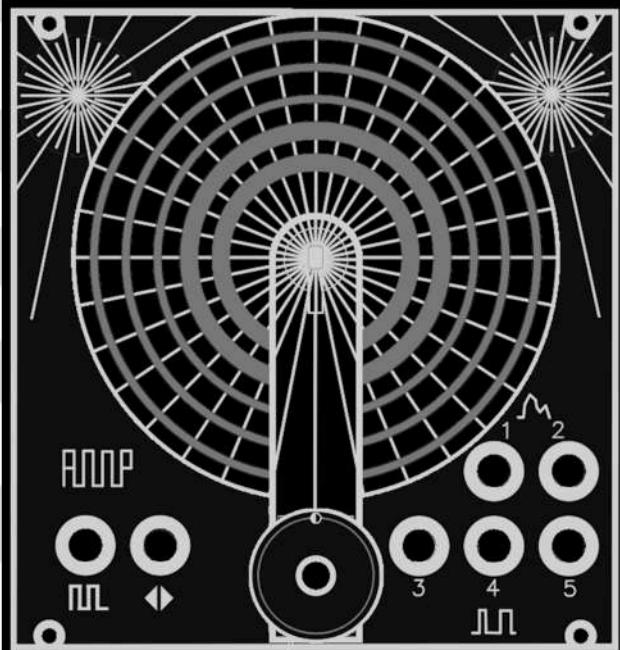


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ORBITER

A photograph of a man with dark hair and a beard, wearing a dark long-sleeved shirt, sitting at a keyboard in a studio. He is looking down at the keys. The background is filled with bright, colorful, abstract lights in shades of green, blue, and yellow, creating a dreamlike atmosphere. In the foreground, a microphone stand and some equipment are visible.

bjooks



One of Kim Bjørn's earliest musical memories was when his stepbrother played John Williams' *Star Wars* soundtrack, and described what was happening as the music played, before Bjørn had seen the movie: "This is Darth Vader...he's in all black...he's walking into a spaceship and everybody's afraid of him..." Bjørn was left trying to picture it all in his head, creating his own movie to the music, piecing together images he had seen from a magazine article and the *Star Wars* album cover. Having spent a good portion of his youth reading science fiction novels, it was easy for Bjørn to imagine the sinister energy emanating from Darth Vader, especially once "The Imperial March" started playing in the background.

This curiosity and imagination would lead Bjørn to study design, feeding his interest in UX, UI, and electronic music interfaces, and ultimately to start Bbooks, a book publishing company with a focus on music, technology, artists, and makers.

While there are different modes of learning that Bjørn's books tap into, it's the visual that remains an integral component in his design approach, as evidenced in his books, which line up on a shelf like well-curated art, and are the culmination of his studies, curiosities, and philosophical approaches.



It's about finding that commonality between yourself and those people you talk to, that kind of a connection.

Waveform: There is a distinct creative ethos that runs throughout your books that seems like something that was formed over time and through experience. Did you have an idea of what you wanted to do early on or was it something that opened up to you?

Kim Bjørn: A variety of different things led to this. I started playing music when I was young, learning the piano and getting my first electric organ. I was attracted to the more creative side where you could create your own output...I started out wanting to be an electromechanical engineer, but I chose the creative design path. Today, we use computers, but back in the day, you had film, and it was a very manual process. I learned to prepare something that was better for the next person taking over in the process, and that's a deep part of my philosophy: if you get your hands into something, if you get your mind into something, then leave it in a better state than it was. It's been interesting to transfer that idea to what I do now. I think I do it unconsciously.

That's a good guiding principle. It suggests a broader sense of

creative scope and responsibility.

I learned that very early. A former mentor once said, "It's not supposed to be art; it's supposed to be finished." There's a deadline to what I do these days, but I can't help but make it art. That's one thing that I also learned: that it takes the same time to do something badly as to do it great. It just takes previous experience, education, or thought.

When we spoke to Chris Meyer (Waveform, Issue 12), he talked about your process of working on the books, that you had cards laid out on tables and that's how you did all the organization of the chapters.

I started teaching design when I was twenty-four. I had a mentor when I started teaching, and he did his books that way: he laid out the pages first and then wrote the words. So that's how I go about it: in a more visual manner: "This is going to be a spread; that's going to be four pages; there's going to be one page here..." That's the way I've worked ever since. Maybe that's why when

you look at the (Bjooks) books, new topics mostly start on the left page, because that's the intended reading experience; you flip the page, and there's new stuff. You could also call it "the experience of taking knowledge in." I believe it has to be as inviting an experience as possible and a motivating experience, even. I often hear that people think our books are beautiful and occasionally say they have really good information, too. (laughs) I think it's one of our greatest accomplishments, that we can make something people cherish as an item and not just read. It's not just knowledge, it's how you interact with the knowledge, how you get invited into that world of creativity, modular synthesis, or whatever we write about.

Was *Push Turn Move* the first book that you wrote?

No. When I was a student at the design school, we did an extra year where you could study something deeply, and I focused on typography and readability—the reading experience. We did a report, which was published as a book called *In Black and White*. Since then I did a handful of other titles in the area of graphic design, typography, and interaction design, all in Danish.

Your books do strike a nice balance between the way they look and the information they contain. Do you feel your background allowed you to tap into a different perspective?

I never thought I'd end up doing books. I started out wanting to learn everything I could about the internet back when I started studying, in 1993 or so. After my studies, the internet was on the rise, and that's when I got into UI and UX, which was really interesting. How do we interface with these machines in front of us, especially now that it's just a mouse or our finger on a surface? What do we need for visual clues to get it? All of this design, a curiosity of humans, and how we respond to things eventually manifested in *Push Turn Move* in 2017.

What was the final push to where you realized that you had to make that book? It's an undertaking.

I think that has to be as inviting an experience as possible, and a motivating experience, even.

It really is. I first realized I had to make it when I couldn't find a book about the design of musical interfaces. The first ideas for *Push Turn Move* were seven years before the book came out. It was simply, "Why do instruments look the way they do?" That's something I was super curious about. With something like a violin or guitar, there's a long history, but with electronic

instruments, there is a much newer history. Where did the 4x4 grid come from? Why sixteen steps? I was curious and started collecting interfaces. How would we react to a circular sequencer versus a linear, horizontal, or even a tracker, which can be a vertical one? I started collecting these ideas. I looked into the UI world, looked into the music tech world, and I couldn't find anything that had an overview of these topics. I also wanted to implement the knowledge from the UX and UI worlds. There were theories and research about workflow, about how we perceive physical objects, for example, something being "cute." What does size mean in terms of how we interact with an instrument? The practicalities, the psychological aspect...I think this is super interesting.

What type of design interfaces do you like to play the most?

I've always been interested in interfaces other than just the keyboard, especially the grid interface like the one on the Monome Grid, Oxi One sequencer, and the like, where you have a certain degree of freedom to configure your interface. I also really get along well with the Polyend Tracker, and also something like the Make Noise Strega, as you can interact with the electricity of your body by connecting points with your fingers.

Who would you say are your design influences?

Obviously, I'm influenced by Danish design; there are some Danish furniture designs that I absolutely love, and industrial designers like Jakob Nielsen, who was one of the first ones to talk about UI and the Human-Machine Interface or Interaction. But since in my earlier career I was active in the news design world, I've also been inspired by work and methodologies from the likes of David Carson, Paula Scher, Milton Glaser, Herb Lubalin, and everything in between.

What other types of design do you find yourself pulled towards?

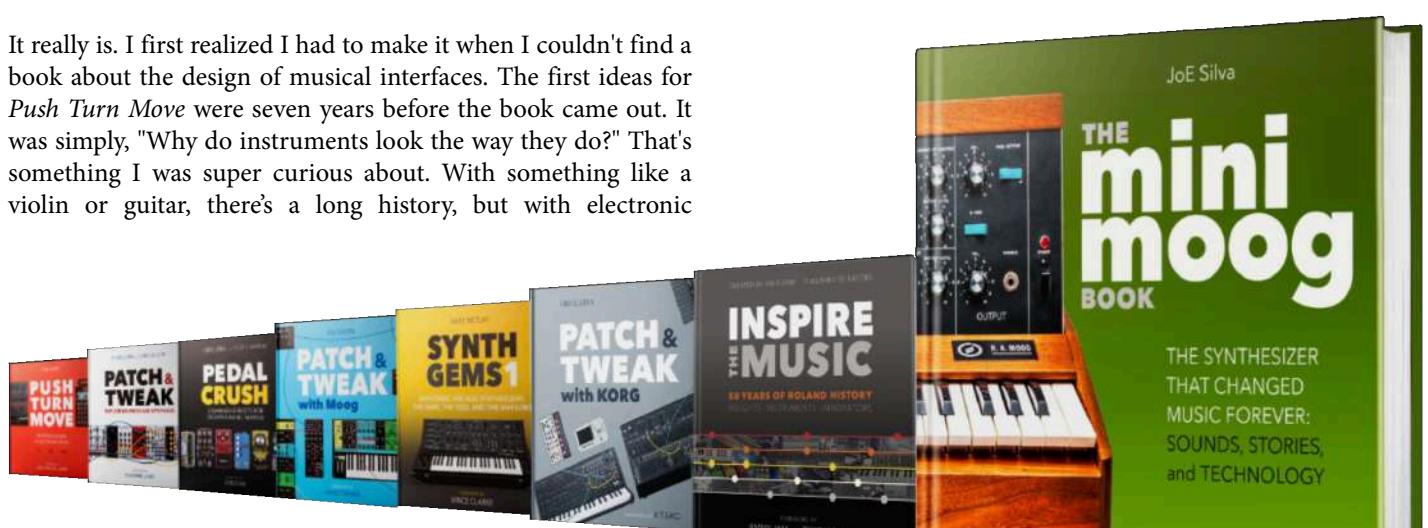




Photo Spread: Kim Bjørn playing at Mountain Skies Festival, Black Mountain, NC, 2019.

Photo: Otso Pakarinen

Page 40: Jean-Michel Jarre and Bjørn.

Page 41: Bjooks books: *Push Turn Move*, *Patch & Tweak*, *Pedal Crush*, *Patch & Tweak with Moog*, *Synth Gems 1*, *Patch & Tweak with KORG*, *Inspire the Music*, *The Minimoog Book*.

Page 42: Bjørn performing in 1987.

Page 43: Suzanne Ciani and Bjørn, Bjørn and Junichi Miki.

All photos provided by Bjooks unless noted.

You really have to know what you're not, and then work into, around, or with it, to grow by challenging it.

It can be something like Bang & Olufsen, with how they have designed things throughout their history, creating a brand for themselves that way. I think maybe the most ingenious design is the Lego bricks. If you line up my books, as people do on their shelves, you'll see why I love Lego: it's colorful, it fits together. People collect the books now because they fit nicely together. They look alike, but they're different, and I think that's part of a good design: it makes you want to pick something up and engage with it. If you create a great instrument, you really need to make it appealing to people to use daily, to even cherish the item. Sometimes, you see things that look really great visually, but then when you start using it, the interaction design doesn't work, or the sound is not good. I think different things tick different boxes for people. There are many problems that design solves. I learned early on when I was in design school that you have the aesthetics, you have the functionality, and then you have the technological and economical side of things. When those four aspects come together in the best way possible, you've hopefully made a home run.

Push Turn Move brings together so many elements. How did you manage that?

Push Turn Move was mainly me, but I had a core team that helped me with the editing. I couldn't have done it without my editor, Mike Metlay, and Paul Nagle, a friend of mine, looking through all this. None of the books have ever just been me. *Inspire the Music* is a good example of this. I only wrote little bits of that book, most of it was written by other people who are experts in their fields. With *Patch & Tweak*, when I saw Chris' (Meyer) videos (learningmodular.com), I knew it would be a good match,

and *Synth Gems 1* was written by Mike (Metlay), and on that project I had more of a design and editor role. I'm really fortunate to have a team that wants to help me fulfill my dreams of making great, inspirational books, and I'm forever grateful to them.

You mentioned that when you first thought of *Push Turn Move* it was a response to not being able to find the book that you wanted. Is that a recurring motivation for the subsequent books?

With *Patch & Tweak*, I wanted to have a book for when I tried to learn modular, that would break things down and make it understandable. All the books that were about modular at that time weren't inviting, they weren't colorful, and they weren't easy to get into; they were also not up to date. I wanted to explain visually how the anatomy of synths work, going inside and exploring, and then zooming out again and putting it into context. However, I've never considered myself a modular wizard, and that's why I onboarded Chris in the role of the experienced co-author for *Patch & Tweak*. You want people who are more experienced than you, who can understand your ideas and help make the best of them. I think that's another important philosophy: you really have to know what you're not, and then work into, around, or with it, to grow.

How did you learn about synthesis? What synths did you learn on?

I'm not sure I ever fully "learned" it (laughs). I read some stuff, I tried to learn from manuals, and Keyboard Magazine. Being Danish, I had to look up a lot of English words in my teen years'

Fiddling around with various synthesizers in Copenhagen's local music instrument stores also added to my knowledge. I don't believe I fully understood Subtractive analog synthesis until I worked with some early Roland synths at the local secondary school, where I studied photography, music, and art as a teenager. Synths like the (Yamaha) DX-7 and (KORG) M1, I recall mostly using as "preset-machines," and I was always naively amazed by how you could create your own virtual orchestra or band with all these sounds. The variety, amount, and selection of sounds was something I enjoyed exploring a lot.

How did you make learning about synths and synthesis accessible in your books, so readers wouldn't feel the way you did when you were learning?

I think the question I asked myself the most was, "How can we best teach and inspire people in this format?" We needed to create a language that was not too academic, not too sophisticated but was still expressive. It's a bit like music sometimes; if it gets too academic and you have to think about where that sound came from or read all these pages about why the artist chose to do it this way, it just becomes boring to me; I lose interest. At Moogfest in 2019, I exhibited with *Push Turn Move* and *Patch & Tweak* and was giving some modular introduction lectures and the room was packed! I was super anxious because it was my first time teaching modular live, but I loved it. I loved how you could break these things down and make them understandable to people. We all learn in different ways. The whole idea of making things visual to explain to people how something works, that's what I think is great about all of our books. We did almost a "patch language" for *Patch & Tweak*, with symbols based on previous work, and in *Pedal Crush*, I worked with Scott Harper on how we could illustrate the different effects, like bucket brigade delay, chorus, reverb, etc. With *Patch & Tweak with Moog* and *Patch & Tweak with KORG*, I did a lot of patch diagrams, and had fun coming up with the patch names. In the end, it's all about being able to create a meaningful visual language.

There are many problems that design solves.



I think about titles all the time. You didn't call *Push Turn Move* something like *The Official Electronic Musical Instrument Interface Design Book*. It's really important in the creation of the atmosphere, so when you're looking at the book, you're not thinking of it as a reference, you're thinking of it as something that is creative and informative, and you do cherish it, like you said.

I wanted to name it *Push Turn Move*, because it needed to be active—something that would draw you in and say, "This is something I can do. I can push something, turn something, move something." I learned a lot from the old publisher of my early design books, and one point he often made is that at the end of the day it's the author that has to hold the book in their hands and feel good about it. When you look at the cover from one of your favorite albums, you have this memory of the image, or the typeface, or the back cover and liner notes—the visual experience. I think that's how people think of our books. The great synth designer Axel Hartmann, who I interviewed for *Push Turn Move*, said something that has since stuck with me: that the great thing about a hardware synthesizer is that even if it's turned off, it still reminds you that you can make music, simply because it's there. It's a physical thing that's reminding you of your dreams, aspirations, or your career, the things you could or can do. "What can this do for me," or "what can I do with this?" That's what intrigues us as curious, creative human beings.

What was the initial period like when you were trying to get *Push Turn Move* made? Did you have contacts in the industry at that point?

I didn't at that time. No one knew me at that point. I was at Ableton Loop in 2016 and simply had to tap some people on the shoulder and say, "Excuse me, I'm from Denmark, I'm doing this book. Would you like to be interviewed for it?" Suzanne Cianni was one of these people, and she was super friendly, such a wonderful human being.

I had a similar experience with Suzanne. We interviewed her



for our first issue and she really couldn't have been more gracious. Sometimes it's just about reaching out to people.

Yeah, a lot of people I just emailed. I've learned that people love that it's a book, something that is around and on people's shelves for a long time. Sometimes, the ideas for books or topics have been with me for a long time before they manifest. You must give such things space and time to marinate. Then, when things align, you get the possibility, and you have to be ready. With *Push Turn Move*, a friend of mine who did Jean-Michel Jarre's website said that JMJ was coming to town, and that he could get tickets if I wanted to meet him. I said, "He's the guy I want to write my foreword for this book!" The stars aligned, and it just happened. Sometimes, you just have to wait for the right moment.

What was it like when you finally met him?

I was nervous as hell. First, I had to put together something that looked like a book in just one week. I worked 24/7 on it and I was so tired when we finally met. I was told I only had fifteen minutes after the sound check, and other journalists were queuing up, so it was a make-it-or-break-it moment. However, Jean-Michel was super friendly and down to earth. That was the first time I experienced one of the things that I've always appreciated and recognized with many people I've talked to: when you start talking gear, sounds, inspirations, and the creative process, we all have similar thoughts. We're all nerds and artists, and it's about finding that commonality between yourself and those people you talk to, that kind of a connection.

We all learn in different ways.

How do you forge that same type of connection with larger companies? With the company-based books like the ones you did with KORG, Roland, and Moog, did they approach you or did you go to them and say, "Hey, this would be a great idea. Let's work together."

When I did *Patch & Tweak*, it was obvious to me that we needed to do something with semi-modular, to break it down a bit more, so it's not this whole plethora of modules where you mix and match and get confused. That's how I came up with the idea to expand on the *Patch & Tweak* series: *Patch & Tweak with Moog* and *Patch & Tweak with KORG*.

What about the Roland book, *Inspire the Music?*

That idea and the conversation for it started in 2018 when I sat down with Mr. Miki (Junichi Miki, the Former Chairman/President/CEO of Roland) at the Roland headquarters in Japan. Also, a few engineers showed me around the Roland museum, where I saw this amazing collection of historical instruments and the stories behind them.

What about *Pedal Crush*? You mentioned that you've played organ and piano since a young age, but do you play guitar as well? Is that why you wanted to do a book about guitar pedals, or was it just something where you saw this hole and were like:

"There's not a pedal book like this out there. We should do it."

Yeah, exactly. I've tried learning the guitar, but that's not in this life! (laughs) Many modular artists use effects pedals and I wanted to explore that topic more as well as make it approachable for all types of musicians. I enjoyed Scott's (Harper) videos (youtube.com/c/Knobs), and I really admired his way of visually making them interesting to watch and listen to. I got the idea that maybe he could be my co-author on *Pedal Crush* as he seemed to know a lot of different pedals and how things work. My responsibility on that project was largely the interviews, structuring all the other stuff, and doing some research and editing.

You said before you started writing *Push Turn Move* you were playing live a bit. Is this still the case? What are your live sets like in terms of the music itself, but also the gear that you use?

I started around 2009 by playing long, ambient sets using Ableton Live. The main reason for using Live was the ability to record and perform different lengths of loops in various combinations. I used both plugins and hardware instruments - I still do. These last seven years since I started Bbooks, I've not had much time to sit down and do proper music - it's mostly been patching, experiments, hardware jams, and an occasional live performance here and there. However, I definitely have plans in this regard, but it's just been a rough couple of years in terms of workload and the whole situation since COVID-19.

Has writing the books influenced your own music at all?

I've definitely been more comfortable using modular when playing live. I've also constantly been trying to minimize the amount of gear I use live. One of my favorite combinations is just a looper and a semi-modular, for example, the Octatrack and 0-Coast, or the Monome Norns and an iPad.

I spoke to Mike Metlay at Knobcon 11 and he mentioned something about putting a lot of the Bbooks interviews on the internet.

Yes, I would like to create more of a conversational space, an online universe, so far called "Bbooks Club," where some of the content from the different books will be online, but we will also provide a lot of extra content in terms of new interviews, new patches, and dynamic content like podcasts, video, and audio. For example, we'll do online sessions where you patch something up and people can ask questions, or there'll be audio examples from the synths in *Synth Gems 1*, or maybe even software instruments. There's also a really personal project I've wanted to do for several years, what you would maybe call a notebook, sketchbook, and patchbook: creative strategies, prompts, ways to get further with patching, how to flip things around, to take steps into new ground with a modular system or synth...things like that. Hopefully, it will be **CONTINUED ON PAGE 77**

(RECOVERY) EFFECTS AND DEVICES

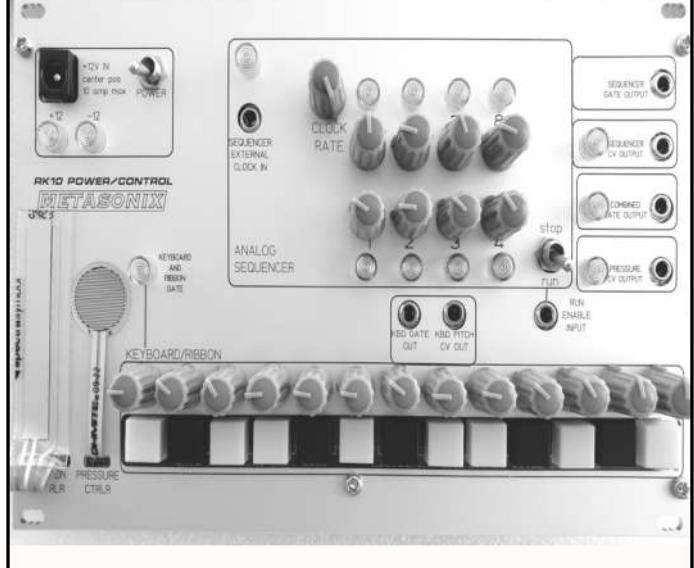
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GEAR REVIEWS



Buchla Retro and Modern Music Easel buchla.com

In today's synthesizer world, there's an overwhelming amount of new products dropping into the marketplace daily. If you can keep up, it's an exciting time for musicians to expand the boundaries of their creativity with new instruments, and designers to get into the "maker" game and be innovative. As stimulating as this all is, the truth is that the basic ingredients of synthesis were created by a handful of companies about fifty years ago, and still hold sway today. There's a ton of great new Eurorack and semi-modular gear out there to get you moving into the modular world, but a lot of artists are often drawn to the original 5U Moog and 4U Buchla and Serge formats because these instruments contain most of the basic synthesizer elements embedded into machines that are distinctive and pay homage to the original designers.

To understand the importance of the Music Easel to the music world is to understand some Buchla history.

Every analog synth, at least in some part, was designed on technology that was pioneered by Bob Moog and Don Buchla, each with their approach to synthesizer design that has become known today as East Coast and West Coast style synthesis. Don Buchla released his first significant instrument in 1966, known as the 100 series, and those synths are not only the basis for components or modules used in today's Buchla systems, but for

synthesizers in the broad general term. While Moog's designs relied greatly on filtering to achieve subtractive synthesis, Buchla used an approach known as additive synthesis, a technique that uses complex oscillators and wavefolding to shape sound.

By the early 1970s, Moog had implemented a keyboard interface, and it was at this point that Buchla also modified his approach with the capacitive-touch-based Music Box, whereupon the Music Easel as we know it was born. This was also the beginning of the Buchla 200 series, which includes modules such as the Source of Uncertainty, Quad Function Generator, as well as the 208C flagship module that is housed with the Music Easel. In the last two decades, Buchla has developed a reputation as being a mysterious and esoteric hallmark of the synthesis world.

The Music Easel and 200 series modules were re-issued by Buchla Electronic Musical Instruments (BEMI) in the 2010s, which ended in legal entanglement. After the death of Don Buchla in 2016, Buchla U.S.A. was founded. For the most part, the 200e modules and the flagship Music Easel have remained the same; however, Buchla U.S.A. has recently released two versions of the Music Easel: the Retro and Modern. These releases are a benchmark of quality; a proper tribute to the originals. To understand the importance of the Music Easel to the music world is to understand some Buchla history.

For the purists who want the distinctive feel of the original Music Easel, the Retro version does not disappoint. It includes basic modern features, such as expanded MIDI and USB functionality (as compared to basic MIDI features on the earlier BEMI models) for both the 208C synth and 218E Music Box controller, which are the modules that make up the Easel. It's housed in a rounded aluminum enclosure padded with the brown vinyl interior that we've all come to know and love, and includes the signature silver-capped red and blue Rogan knobs.

As far as playing, the first thing you are struck by is the raw, yet sophisticated character that comes from its complex oscillators. It's a combination of this electronic design integrated with the interface layout and quality workmanship that gives this instrument such soul. It's a delight to look at and play, as you feel you're experiencing something very special, similar to what the artists of the 1970s who played a Buchla must have felt.

Cosmetically, the Modern Easel differs in that it's housed in a sleek, black briefcase instead of the rounded aluminum case. While still having a "retro" feel, the absence of the rounded edges frees up more real estate and there is now space for two new modules. One of these spaces houses a brand new module called the Electric Music Box I/O (EMBIO). This module adds an additional LFO, CV-to-pulse conversion, slew in and out, and a CV mix/crossfade. It provides MIDI out for the 218C (accessible

via 3.5mm jack [type A] or USB) and it transmits velocity data. Both the Retro and Modern Easels include a sustain port for the 218C, and main audio outs, in addition to the mix audio outs on the module. There is a slot for expanding the unit with either the 200E USB Utility and Firmware Card or the 200E Memory Card (both sold separately), and there is also an interesting feature called the EMBIO Wildcard Window. This feels like a work in progress, as the manual addresses the interface as an opportunity for developers to implement their own ideas. Details on this are not yet available, but there is a schematic in the manual that gives information on the connection. The single supported use of the Wildcard Window at this time is to alternatively mount the Embed Kit for the Program Manager. My guess is that we'll see all sorts of third party auxiliary devices being developed for the Wildcard Window, adding all types of features and functions in the way that so many different makers have made tools for the Program Manager over the years.

The other module space is filled with a blank panel and allows you to fill it with any of the Buchla 200e series modules of your choice, adding a bit of customization and further functionality to your Easel. I've been daydreaming about what I'd fill that space with, but it's proven difficult, considering there are twenty-six modules to choose from that will fit the footprint, though the 267E Uncertainty Source/Dual Filter sure would be a great choice, adding voices, voltage sources, and filters, making a powerful synth in a very compact footprint.

The 218C controller, or "Music Box," has a standard piano-style layout, with its iconic unconventional touch capacitance sensors; instead of depressing a key, it's touched to trigger voltage. I can envision how this could be frustrating for those who are accustomed to a more traditional keyboard or piano with weighted keys, but this unconventional approach adds unique features and expands the definition of a keyboard controller, allowing several parameters to be controlled by a single key. It's possible to create complex patches integrating the sequencer at various points, controlling parameters such as timbre, modulation or pitch; injecting it into the keyboard by sliding your fingers up and down while holding down a chord. The same can be done with velocity, adding, for example, a filter that can be controlled with pressure. A unique Buchla example is patching the controller's Pressure into the Complex Oscillator's Timbre CV Input and tweaking that while simultaneously varying pressure on the controller. Simply holding a chord and moving

your fingers within that configuration can produce an array of sounds, making it very fun for exploring.

So much of the magic comes from keeping your hands on the touch surface that changing pressure and moving your hands around the controller can enable you to express yourself in ways that just can't be done with a traditional keyboard.

The 218C also features an arpeggiator with four voltage presets, enabling the ability for chord and key changes, and there's even a latch feature for the arpeggiation (something earlier versions of the Easel were sadly missing), by holding down pads 2 and 3 for a few seconds whereupon the currently held notes will latch.

Pairing the arpeggiator with other features such as random, octaves, and ascending modes, adds another resource for creating complex and interesting patches, and finding an imaginative way to include the sequencer in this,

whether it be with pitch or modulation, adds to further the richness.

As for the 208C module itself, the first thing you'll notice is how good it feels to patch with banana cables if you're not used to it. When patching 3.5mm or $\frac{1}{4}$ " cables, there is a push to "snap" the cable solidly into the jack in order to get a good connection. Banana cables only require a "touch" to make a connection; you can push it in all the way for long-term patching, but it's also possible to tweak patches by simply touching the tip of the cable into the destination jack, allowing creative adjustments on the fly. Once you get used to this, it's very hard to switch back to 3.5mm cables. Along with the capacitive touch keyboard, this is another way that the Music Easel creates a unique playing experience.

As for the overall sound of the Music Easels... they are unmistakably Buchla-esque: beautiful and rich, complex and satisfying, with the signature Complex Oscillator, Lo Pass Gates and Pulser—emblematic of the Buchla sound. Whether you're looking to explore West Coast synthesis or just want a complete compact system that encapsulates the most iconic Buchla experience, either Easel will suit you well. At this time, Buchla offers both models for the same price, but whichever you choose, you can rest assured of buying a high-quality, iconic instrument that will bring you years of learning, creativity, and enjoyment.

- Graig Markel*

Price: \$4,990 each



...beautiful and rich, complex and satisfying, with the signature Complex Oscillator, Lo Pass Gates and Pulser—emblematic of the Buchla sound....

*To hear a record that I made using only the two Easels visit <https://theanimalsatnight.bandcamp.com/album/easel-sketches>



4ms Catalyst Sequencer Catalyst Controller 4mscompany.com

4ms loves symmetry, and quite a few of their modules, like the Shaped Dual EnvVCA, Stereo Triggered Sampler, Dual Looping Delay, among others, are beautifully symmetrical (I heart symmetry). Well, they've taken this concept to a new level where one module can be two, with their new Catalyst module, based off of the emblematic Catalyst. With just a quick three-button press and a flip of the faceplate, you can switch between the Catalyst Sequencer (CatSeq) and the Catalyst Controller (CatCon).

With just a quick three-button press and a flip of the faceplate, you can switch between the Catalyst Sequencer and the Catalyst Controller.

Starting with CatSeq, the first thing you notice is that it doesn't look like your traditional sequencer. With its multi-color light up potentiometers, a bunch of buttons, and a big ol' crossfader smack dab in the middle—but no screen—CatSeq eschews the look and workflow of most modern Eurorack sequencers. A clock-based (with tap-tempo) eight-channel sequencer, where each channel can output either CV or Gates, CatSeq sports a crossfader that can scrub through the steps in a sequence, with up to sixty-four steps available. You can customize each of the channels in terms of start point, direction, length, phase, voltage range (-5V to +10V), BPM/clock division, transposition, and per-step probability with per-channel randomization. Each

sequence can be quantized to various scales, and you can also add glide to each step. In short, you can have eight independent channels of CV or gate running at different lengths, in different scales (for CV), in different directions, with randomization/chance for each, and at different divisions of a given clock, with all options signified by the multitude of colors of the illuminated potentiometers. If outputting gates, each channel can be customized for gate length, +/- swing, glide, ratcheting, probability, and randomization. Some of these are global parameters—like phase, start point, and length—but all can be customized/overridden for each channel with a button combo. You even have CV control over the reset and can do the cut/paste thing to make longer sequences easier to create. It's easy to save and recall sequences (up to eight of them) as well. The world of CatSeq is your oyster, and you can customize until your heart's content.

Getting started with CatSeq is pretty quick. Figuring out the editing structure so that you know what channel you're on, and what page in that channel you're editing is fairly painless, though it did take me a minute to get it straight initially. I didn't have an Aha! moment so much as I had a No Duh! moment, as once I found my way around, it more than made sense and was easy to navigate; 4ms has done a good job with making this intuitive. For example, when you're adjusting the amount of something, the brighter that the potentiometer lights up, the stronger the signal: a faint glow when you're adding glide to a step means a subtle slide, but a brightly lit pot means you've got your glide on full-strength. That's pretty easy to remember. Even for things like the amount of ratcheting for a gate, where you can't quite tell how many ratchets are there, you can still see via the pot brightness more or less where you're at. In a dense patch, it would be nice to be able to view the levels more precisely, but part of the fun of CatSeq (and CatCon) is the ease at which you're able to move around, play, change things up, and go from part of a sequence to another; in terms of pages via the page buttons, and with the crossfader in terms of steps. It's not that you can't dial in something specific—you most definitely can—it's just that what CatSeq offers in the ease of real-time performability, it loses in the ease of specificity, and dialing in specifics without a screen can take more time.

I use sequencers a lot in three different scenarios: as a set-and-forget tool, as a performance-based tool, and for drums. CatSeq works great as all three. In the case of the first two uses, there is plenty here for

using CV for melodies and parameter changes, gates for triggering an event or effect, and a ton of hands-on (or off) controls to tweak, with the crossfader being the most interesting and obvious one. As an instrument, I would tweak, change, and just mix things up, moving around steps and changing direction, scale, glide....I love sliders already and found the physicality and instant gratification of the crossfader to be fun, fast, and furious. This phasing of the sequence can even be CV controlled for some hands-off jumping around. Using CatSeq as a drum sequencer, triggering percussion-based modules, pinging filters, or using it to trigger an EG or VCA to craft drum sounds was excellent, though I found CatCon to be more of my liking for this use, but

more on that in a bit.

Once you understand the navigation, CatSeq becomes an incredibly playable sequencer and nothing can hold you back. It might take more time to dial in the minutiae due to not having a screen, but in no way do I miss looking at a screen to figure out what the voltage range is or to figure out what scale I've chosen. For example, in Lydian Dominant mode, the pot lights up a salmon color. Salmon-colored LEDs? Who even knew a pot could light up salmon?!

As mentioned, take off the faceplate, flip it around, and hold down the three buttons on the right side of the module (Shift + Tap Tempo + Channel) and you've transformed your module into the Catalyst Controller, an eight-output macro controller. I really thought the CatCon would be something fun to try before going back to the CatSeq, but with that phase scrubbing crossfader and eight outputs of CV or gates to control parameters in a patch, CatCon was way more fun and useful than I'd anticipated.

Both modules share a lot in common aside from their layouts being the same: they have the same number of channels (eight), both can output CV or gates, both can be quantized in the same way and with the same scales (remember...salmon for Lydian Dom!.) and both can scan or scroll through the steps (or scenes, in the case of CatCon) of a channel with the crossfader or patched in CV. There are other similarities as well,

but the differences here are more important, with CatCon being kind of like a preset/scene manager where you configure a certain amount of voltage (or a gate) to control part of a patch like filter cutoff, VCA CV amount, turning an effect on and off, etc.

However, CatCon is kind of like a sequencer, where the eight channels output an amount of CV or gate, but instead of steps, you can configure up to sixty-four scenes on what's called the "pathway." It's like steps on a staircase: sometimes there are eight steps, sometimes fifty-two—however many you'd like—but no matter how many steps there are, at each step you can set a new CV or gate value to change up any given parameter in another part of your patch. Like the CatSeq, you can scroll through the various scenes, and this movement is where you can get bonkers. You can get as detailed as doing a sixty-four-scene frequency "sweep" of your favorite filter; or do the opposite: only open and close that filter in a two-scene path, with just the fully opened and fully closed CV values as the output of a given channel. You can trigger something with some gate action for turning off and on a particular parameter (like reverb) and you can add slew (up to two minutes!) to delay those transitions. In a big patch, you can change a whole lot at one time with little effort. Whether it's

moving from one point on the pathway via the Scene buttons or the crossfader (or CV) to another for an immediate and lasting change, or non-stop motion of the scenes to create frenetic movement, it's hard to overstate how powerful this can be. You can add and subtract scenes, copy and paste them into other slots, and save and recall them as well, with the same operational techniques as CatSeq. The real kicker is that you can record up to ten seconds of the crossfader and CV motion to create unique modulation. This recording can be triggered manually,

randomly, or be synced to divisions of a clock input for more (dis) orderly fun. CatCon also lets you configure how it morphs between scenes, so you can have a sharp change from one scene to the next, or move along the pathway with interpolation between scenes for smoother transitions.

None of the macro controllers I'd previously played around with have near the capabilities that CatCon has, and it's a lot of fun to pile it on; controlling cutoffs, triggering effects, switching waveforms...there's no end to what you can control. And with eight channels, eight things you can control at once, you can be subtle with the crossfader, inducing multiple tasteful changes with one slide, or chaotic, constantly jumping around to the point of indistinguishability. Using it to

control a drum voice, in my case a combination of Modbap's Trinity and Winter Plankton's ZAPS, was amazing. Using some channels on CatCon for gate duties

and others to alter the sounds of the two modules, the variations on both rhythms and sonics were vast, and recording the movement of the crossfader and looping it, with the ability to re-record a different movement on the pathway on the fly, was nothing short of scene-stealing. I found myself so enamored using CatCon for drums it was easy to see how two or more of this module in a big patch, with one dedicated to drum/percussion use, and another to control other patch parameters, could be really valuable.

Both the Catalyst Sequencer and Catalyst Controller are good fun, and man, there is so much that lies beneath the surface of each. 4ms have hit this one out of the park, over the lights, and beyond the parking lot. What we've got here is a dual threat that is hard to decide how to use, because both modules are so versatile. Lucky for us, we don't really have to make the hard choice since we have the ability to change from Catalyst Sequencer to Catalyst Controller, or the other way around, or you know...just grab two of them.

- Jason Czyeryk

Price: \$395 each



None of the macro controllers I'd previously messed around with have near the capabilities that CatCon has...



Knobula Chord Pilot Poly Cinematic knobula.com

Knobula excels at shortcuts; those well-placed, efficient, very nearly cheating—if you will—pathways to complex features when it comes to modular. If this sounds like a slight, it isn’t, it’s a compliment, and perhaps it’s no more apparent than in Chord Pilot, their module that easily brings chords (some that would either be impossible or a major pain in the Eurorack) to modular—all with no keyboard required, through the magic of MIDI.

Knobula’s focus is on performative modules, and when it comes to chords in Eurorack, usually there’s not a whole lot of

Knobula excels at shortcuts; those well-placed, efficient, very nearly cheating—if you will—pathways to complex features when it comes to modular.

performing that happens, but definitely a lot of planning and patching, along with handfuls of cables and a mountain of modules. Chord Pilot changes all that, giving users the ability to create complex chords and chord patterns, and even sequence those, with enough knobs to tweak them, so that chord generation and manipulation in modular is fast and fun.

Chord Pilot has 192 chord memories and includes an arpeggiator, a strummer (for strumming the notes in a chord), and even an 8-step chord progression sequencer. With some initial twisting of the knobs, it’s easy to get Chord Pilot to generate chords, chord patterns/progressions, and to experiment with all sorts of abstract and esoteric chording/harmonizing. For those of us piano/keyboard players with small to normal sized hands who’ve always dreamed of having an eagle’s wingspan to stretch that barely octave reach to two or three octaves with one hand (or wing), Chord Pilot makes this easy—along with the resulting ability to create bizzaro chords—all without the need for some medieval hand-stretching device, wizardry, or some friends to literally lend a hand or finger. Of course, you can also play “normal” chords with Chord Pilot, but who wants that?

The controls that shape the chords do so in various ways; Note Count, Interval, Bias, Modal, Conform, Strum, Bass Note (which takes a selected note from the given chord and drops it an octave below), and Circle (a push encoder), all of which have a hand in how many notes are in a given chord, how spread out the notes are from each other, what notes are played, etc. There are only three CV inputs (Bias, Buttons, Gate) for modulation—who wouldn’t love to modulate more aspects of the chords?—but it keeps things fast and simple, and easy to navigate.

Three gate modes—Chord, Orbit, and Arpeggio—determine how Chord Pilot plays. There are three preset banks to choose from with a toggle selector, and a Button selector switch for going between Modal, Circle, and Preset for the eight round-robin buttons at top. There are also buttons for saving and recalling presets (with all knob settings saved) and bank selection, and you can upload presets of chords/progressions (as well as arpeggiated MIDI sequences) manually or with CV/Gate control, which is pretty cool.

Tweaking the Conform control can get all sorts of chords; everything from perfect 5ths to what sounds like a random ham-fisted pounding of the keybed. While there is no text to denote whether you’re playing that B major 5th or a D minor 7th—it really makes you have to listen without relying on any sort of theory training, and it keeps things fresh. You can even do chord inversions, via the Modal control, which one of my old piano teachers, Gary, would always make me practice. He seemed very focused on those, and needless to say, if I have any strength at all in my piano playing, it would be my ability to play inversions.

Patch in some Gate CV or a MIDI in, or just push a chord button, connect it to a corresponding poly module via the TRS

MIDI output and you’re good to go. It’s brilliantly simple, and you can create or load any chord you can think of, and you can easily edit each chord by entering the edit mode (hold down a chord button and push the Circle encoder), where each chord is broken down into its

individual notes, which you can then change by tweaking the other controls. While it’s easy to get overwhelmed with button combos and menus, Knobula keeps this type of stuff to a minimum, and it’s intuitive enough to navigate without driving one mad. Again, you have to use your ears or patch into a tuner to know precisely what you’re doing as there is no screen, so if

you are of the particular type who wants to know specifically what notes you're choosing, you might want to use a tuner. As Chord Pilot is a polyphonic MIDI producing module that makes no sound on its own, it needs a partner, a polyphonic sound source to team up with, and wouldn't you know, Knobula's 8-voice polyphonic module Poly Cinematic is just that. That doesn't mean that Chord Pilot can't go outside the Knobula family to control other multi-voice synths—it can—it's just that Poly Cinematic and Chord Pilot are a darn good pairing.

Poly Cinematic is a pretty self-contained 56-oscillator stereo synth voice with four distinct sections. First, is an Envelope section that has Attack, Decay/Sustain, and Release controls with a CV Trigger input. This section also houses the blinky Trigger/(Save Chords) button. There's a multimode Filter section with LP, Notch, or an HP filter (there's even a hidden filter mode to choose three other special filter types), a Frequency control, Resonance, Envelope Depth, and a Key Follow toggle for configuring the filter cutoff with the note being played. An Oscillator section contains all the necessary tuning controls (Pitch, Fine Tune, etc.), including Detune, which shapes how the notes in a chord are tuned harmonically. There are three waveforms on order—supersaw, square, and tonewheel—and there's a Mode selector, which, depending on the waveform selected, performs different functions. Lastly, there's a nice sounding DSP reverb section that can go from subtle to super shimmery.

A lot of the controls on PC are dual function, when held in conjunction with the Shift button, such as Shift+Frequency, which controls the width of the Stereo Voice Spread, Shift+Reverb to customize the reverb size, and Shift+Trigger to save chords to a preset memory or to toggle Chord Mode. There is no indication on the front panel for most of these secondary functions, so you'll probably be referencing the manual for these like I did. As on Chord Pilot, there are some CV inputs (Chord Select, 1V/Oct, Trigger, and Filter Frequency), which is enough to get some decent modulation going with neighboring modules, but the name of the game here is to patch CP and PC together and get to work.

I ran pitch and gate out on various sequencers into Chord Pilot and via the included light blue MIDI TRS cable, I connected it to Poly Cinematic and put on my space helmet and oxygen tank and went exploring. It's impressive how much ground just these two modules can cover. From slow-clocked ambient interstellar pulses to shifting sequenced atonal chord progressions, to

massive swirls that would make you swear you were wearing Organmaster church shoes, these modules really lend themselves to soundtracking, soundscaping, and songwriting.

It's pretty easy once you set things up with both modules to explore textures and sounds, and for this I opted for CV instead of MIDI in for triggering. As per Knobula's penchant for the performative, I wanted to do more hands-on exploration to correlate my tweaks to change in sound. This was a great approach, as some controls, like Strum on CP get tripped up on themselves in really interesting and unexpected ways, depending on a few factors (mode, gate/clock tempo, etc.), kind of eating themselves, almost like in a feedback loop of functions that I'm not sure I would have figured out if I was focusing on changing MIDI values instead of turning a knob.

Other than needing the manual for deeper functions, I did run into something that took a minute to figure out operation-wise, namely that if I wanted to CV Chord Pilot's Gate and 1V/Oct, so that in Arpeggio mode I could arpeggiate the whole chord and not just the initial note on each trigger, I needed to use ratcheting so I could arpeggiate the entire chord.

There's so much at play between the two modules—chord shaping and sequencing and tone shaping—that just a subtle change

in a given parameter setting can yield a completely different sound and feel. I also patched in Knobula's Pianophonic (reviewed in Waveform, Issue 12) and really enjoyed that as well, just scrolling through the sounds on

hand. Pianophonic is a really incredible module and some of the sounds (toy piano hammer with synth drone body?) you'd be hard-pressed to find anywhere else. Both Pianophonic and Poly Cinematic are very self-contained (onboard EG, VCF, and reverb) which makes it really easy to focus on either module while sculpting. It's this MIDI or CV hands-on ease of use (minus the "hidden" type of alternate features) along with the scope of sounds available that have gained Knobula a loyal following in just a few years.

Polyphony and chord creation in Eurorack may have been here for a while, but not like this. There are definitely longer-winded ways to get there that offer more control over any/every aspect of chording, but Knobula has weeded out a lot of the hassle of doing so, adding some improbable and interesting features with both Chord Pilot and Poly Cinematic.

- Ellison Wolf
Price: \$399 each



There's so much at play between the two modules—chord shaping and sequencing and tone shaping—that just a subtle change in a given parameter setting can yield a completely different sound and feel.



Plasma Voice Gamechanger Audio gamechangeraudio.com

If you're not familiar with Gamechanger Audio, they've been messing around with using plasma in distortion/overdrive pedals and modules for a while now. Suffice it to say that it seems they have a pretty good bead on merging gas, electrons, and patch cables, but still, Plasma Voice is the first of their plasma devices that makes sound on its own. So what exactly does plasma sound like? That is and was a burning question in my mind. According to the Plasma Voice manual, it:

"...generates sounds through the manipulation of high-voltage electrical discharges between two electrodes on a specially designed xenon-filled gas tube. These discharges are converted to analog audio using a specialized rectifier circuit."

Maybe plasma doesn't make any detectable sound itself. Maybe that's not possible without some help or conversion. As such, Plasma Voice is preset based, as there's seemingly no way to build a sound from scratch, from a plasma-made waveform. For a farm to table person like me, it's a bit of a bummer, but you know what's not a bummer? The sounds you can get out of Plasma Voice. No bummer there, quite the opposite. Plasma Voice is gritty, aggressive, crunchy, and really unique. It actually sounds how I picture that glowing tube would sound: strained, stretched, electric, fritzy, tough...

Plasma Voice is organized into seven banks (Bass, Lead, Pluck, Drum, Metal, Static, and Spark) with seven sounds per bank, selectable by a pushbutton encoder

with the selections being viewed via a small screen, which serves multiple duties. Just by looking at the names of the preset banks, you can kind of see how the forty-nine embedded sounds form Plasma Voice's aesthetic in terms of flavor; a flavor that you can both see (via the tube and by viewing the waveforms through an oscilloscope), and most definitely hear. You further shape each preset with six light-up sliders to control Pitch, Time, Mod(ulation), Harm(onics), Flux, and Filter. Each of these parameters has a CV in with an attenuverter control, and each parameter also sports an alternate function. There's a Drive and EQ section (with Bass and Treble controls) to further hone in on your desired sound, and there are inputs for Trigger, Accent, MultiCV (all with multiple modes), a 3.5mm MIDI input, and a main Output along with a couple of light up push buttons; one for trigger functions, one for Clutch (which, when held down, allows you to change settings without affecting the outputted sound, so long as the button is held), and an Alt button for accessing alternate functions.

Plasma Voice is an attractive module, what with the tube, light up sliders, and black faceplate, and while I find it appealing in terms of the way it looks, at first it seemed slightly clunky in operation as it took me a second to figure out how to navigate everything. I'm not a fan of the Bank/Sound display with its tiny rectangles for selection, and since the banks are written out above the screen (with corresponding numbers next to them) anyway, it seems a bit redundant to have both. A more streamlined approach would have been nice. Navigation-wise PV is intuitive in some parts (move a slider, hear the change!), and not so in others, like the alternate functions (multi-button presses + encoder to select modes on the small screen...), but once I became familiar with it I realized that everything is labeled on the faceplate pretty well, and there's no real deep diving needed. Truly, once you patch the Output and trigger the input (or get into Oscillator mode—more on that later), you're off and running and Plasma Voice sounds nothing short of stellar.

The preset names are accurately described, which makes it easy to find the right starting point. There's movement in

the sounds no matter what you do, and seeing the tube change and light up like a bug zapper also contributes to the feeling of Plasma Voice being truly alive. Using the Accent control, in the various modes, adds some extra oomph, extending the palette of sounds and giving sequences or percussive hits more of an emotional feel. Actually, "emotion" is a great way to describe Plasma Voice; it has a real personality: it's vulnerable, scared, broken, angry...but strong, persistent, and defiant. I really grew to love its character the longer I played with it. I especially loved the Drum, Pluck, and Spark sounds and exploring further from the presets and creating odd sounding rhythms. I'm a freak for short, stuttery sequences, and so I spent much time manipulating the Time/envelope slider in the Trigger or Gate mode along with the resonant Filter before moving on to the Harm, Mod, and Flux parameters, which directly control the part of the digital engine that shapes the sound, the part that has the most human interaction with the tube/plasma itself. I found the multiple trigger modes to be really valuable and by entering Oscillator mode in the Trigger settings, you can get a continuous sound and turn Plasma Voice into a typical (more like atypical) oscillator for creepy, gnarly sequences or drones. Recording/layering sounds on top of and along with other Plasma Voice sounds was a treat and sounded unlike any other VCO or sound source in my arsenal. The closest I could think of were some granular samples I've been collecting of coughing, scraping, and radio fuzz, but none had the body or heft that I was getting from Plasma Voice.

This is a wild module, unhinged yet controllable, with sounds that will appeal to those who like distortion, grime, and teeth. And while it's a shame that there's no way to hear what the raw tube/plasma sounds like, the real shame about Plasma Voice is that it's singular. Plasma Voice. Not "voices." Only one. Having four PVs to use for a drum track would be killer—a true game changer for rhythm tracks. Ditto for stacking multiple PVs for a lead line in real time. There are so many great and unique sounds in Plasma Voice that it's destined to reveal the portal to a promised land; the darkest of dark clubs, the sinisterist of the most sinister. If you like drums (ummm....), if you like the

color black, and you aren't fearful of plasma in any form, you'd do well to grab one, if not a few. At least until Gamechanger Audio makes a Plasma Multi-Voice synth. Oh, how sweet that would be.

- Ian Rapp

Price: \$499



Cosmos
SOMA Laboratory
somasynths.com

SOMA calls Cosmos a "Drifting Memory Station," and this intrigued me, this idea of drifting memories. Are memories tangible things? Where do lost memories go? Do they ever fully disappear? I had these thoughts linger in the back of my mind when I turned on SOMA's Cosmos for the first time. It wasn't long until I realized these questions would probably not be answered by Cosmos or SOMA, even when Cosmos was entrancing me with its sublime, sometimes perplexing, yet luxurious winding down and intermingling of sound. Cosmos is an instant magic machine, and it can transfix; you can lose yourself in it.

Yes, Cosmos is a looper, but it's not a looper in the traditional sense. It's one whose goal is to not repeat itself; to not make the same mistakes over and over or re-live its glory days over and over. Mistakes and highlights merge, combine, blur into one. Cosmos makes beautiful mistakes; gems, like birdsong, floating in the air, suspended, diminishing with distance, hopeful. Cosmos can also make walls of noise, annoying rhythmic bursts, and indecipherable mishmashes of sonics. But I like to stay glued to the beauty it creates.

Cosmos is a well-built tank of a machine, housed in a solid metal housing (the one sent for review was pink) where the main control is a switch that selects one of four algorithms, of which have three variations each: Two Delay, which has two delay lines of either 2.5, 9.5, 22 seconds of delay; Four

Delay, with four delay lines of 2.5, 8.5, or 11.5 seconds available; Giant Reverb with Huge hall, Super-huge hall, and Insanely-super-huge hall options (their titles, not mine); and Granular Delay that has small, medium, and large grain sizes. Blur, Drift, Drive, Sup|Com (Suppressor, Compressor), Feedback, and Mix shape your sound while Input and Output level controls help to keep things in check.

Since it's designed as a pedal, there are footswitches (with secondary functions) for HPF, LPF, Erase, Reverse (Select), and Record (Erase All). LEDs throughout Cosmos signify level amounts, on/off status, and parameter settings, such as which filter is active. The back panel has mono/stereo ins and outs, a headphone out, a flash drive USB port for updates, and a DC plug and on/off switch.

Recording a loop is as simple as hitting the Record button and playing something. There are four different record modes: Off, First delay group recording, Second delay group recording, and All delay group recording. I won't go into detail of the differences between the three, but I kept it at All-group almost the whole time as that's where the most cosmic of Cosmos' highlights happen. Cosmos creates its effect by recording multiple loops at the same time at different lengths, so that there is offset in the playback of each delay, with more and more offset as time goes along; the drifting part. Even though the delay times are fixed—which might seem strange since we're all used to being able to adjust that aspect at will—it works perfectly fine as Cosmos isn't really for syncing or traditional looping or delay use, anyway. Not to mention that part of Cosmos' charm—SOMA's charm, really—is that they impose their will on you. They are the inventors; you are the user. You have no choice but to play along with what they give you. As with much of the design of their instruments (like TERRA, for example, review in Waveform, Issue 12), they hardwire their designs so that more focus can be spent on creating and playing and not endlessly tweaking or programming by the user. SOMA love fixed systems, and you have to a) respect that, and b) tip your cap to SOMA. It's not like it's a "my way or the highway" mindset, so much as it is that they want you to submerge yourself in their creation so that you can create and experience their

vision. Their instruments are truly unique, as is their mindset. Everything in its right place, according to SOMA, and in this vein there is no undo button or going back, so it's almost as if SOMA is doubling down on their stance, to where if you record something you don't like, you need to learn to live with it, or start from the beginning. That is as much of an earthly ideology as it is a cosmic one.

Living with something, not being able to undo, is interesting in that you have to consider what you have and whether it's worth pursuing further. In Cosmos you can change the direction of a loop, control its dynamics using things like the compressor (which adds gain and gets noisier without getting louder) or the suppressor (which acts more like a sidechain compressor, so that old sounds/loops make way for new recorded sounds), and keep things under control in terms of frequency with the filters. The filters? Again, fixed. Love it or leave it. Both filters do have three modes each for sculpting tone, and again, they might be fixed instead of having variable cutoffs, but they're very serviceable. Further sculpting can be had through the Drive, which adds a little push to the sound, as do Blur and Drift. The latter two are interesting in that Blur is a destructive effect, so it changes the recorded audio (remember, there's no undo function!), which means you can change your looped signal via Blur to create lusher textures, melding and combining, to create some drowsiness, and then once you find what you like, turn Blur off to stop affecting your loop, while still retaining what you've just done. Drift is similar, and lives up to its namesake where things drift apart, get loose, stumble around, and distort timelines. Both Blur and Drift operate differently, whether you're in a delay mode or granular (again, they have no effect in Reverb mode), but it sorta feels the same in either for the most part, and Cosmos is all about the feels.

The Erase button is interesting in that it erases recorded parts in the delay line, so you can use this like a stutter effect, cut, slice, and erase large swaths of your recorded delays. It's a pretty interesting effect, constantly cutting out your loop, until you think there's nothing left, and then BOOM! it comes around again, this tiny snippet you didn't erase, didn't know was left. I was always surprised by erasing

in Cosmos. You can easily erase the entire loop at once by pressing Erase and Record/Erase All simultaneously.

Vocals, guitar, modular...everything and anything that I put into Cosmos, in any of the algorithms, turned into, at the very least, something interesting, and at the best, wonderfully loose and dreamy, if given enough time to mature, to develop. Some of the percussive nature of the input signal and repetitions would often threaten to overpower, but engaging the filtering, adjusting the feedback and compressor or suppressor, as well as the output level, worked wonders to tame the signal and keep things in check. Vocals were a revelation, perhaps my favorite use of Cosmos, and something of a secret weapon that I'm almost reluctant to put in print, as it worked so well for unique background tapestries. Mostly I was singing oohs and aahs, but spoken word was a trip, and when I would add Drift and mess with Blur, the monologue turned into a rant which metamorphosed into a buzzing din, which is what my head usually sounds like internally, anyway. It was nice to finally have an outside example with which to explain myself to others. Feel the help.

Playing guitar into Cosmos and you felt the Frippertronics influence, one of the inspirations for the device, taking place. Modular was similarly frippered, but I tended to notice when I'd put a sequence into Cosmos that it was best to not overdo it, to keep it light. Cosmos is very easy to get too loose, and with no turning back, it took—and takes—a subtle and elegant touch to maintain some sonic dignity. At the same time, dignity is way overrated, which is why I liked to obliterate a souped up frenetic sequence into Cosmos and watch as the world lost control and burned to the ground. In this way, you can both a) live with it until it burns, and then b) start over from the beginning. Very biblical.

I mostly lived in the delay algorithms, but using the Reverb algo brought more girth, and the Granular did somewhat the opposite, which I suppose isn't so strange, but it feels so writing it now. Either way, the grainy sounds produced by Cosmos were really interesting and, adding reverb after, was like dropping stones into a well that led to the other side of the world, with repeats like stars; what you're hearing is already gone; the light shined millions of

years ago. You're hearing something that no longer exists. How is that possible? With Cosmos, it is.

There are a few caveats with Cosmos. First, as mentioned, it's not designed to be a normal looper or delay pedal, though SOMA has released several different types of firmware, one of which makes it more syncable, so it's easier to use it in a more traditional manner. And while Cosmos is an effect in pedal form, I hesitate to call this a pedal. You're not going to get the most out of it using your feet, so really, despite the way it looks, it's more a desktop device that you'll use with your hands.

Whatever it is, Cosmos is a wonderful machine. A textural instrument, a layering device, an ethereal backdrop creator, Cosmos is something you can lose yourself in, in the most beautiful way.

- Ellison Wolf

Price: \$699



Ottobit Jr.
Meris
meris.us

Quarters were an asset in my adolescent years and during lunchtime at school, I would load up my pockets with a few handfuls of them and walk—pants sagging—several blocks to the convenience store. Beyond the junk food aisle, well past the rows of expired cans of tuna, and by the corner window, I would sink quarter after quarter into the arcade game, Narc. Trying to take out bad guys as the rogue narcotics officer cost me about fifty cents a minute—a lot of money in those days. My games didn't last long, but still, although I never possessed the funds (or the skill) to advance to the end stages and unseat the drug kingpin, using a

rocket launcher to vaporize my enemies was cathartic. I am more well-adjusted these days, and my interests have shifted; however, when I pass those grimy, beat-up machines with their vibrant, pixelated displays bearing chicken-scratched graffiti, and see kids chuckling at the downsampled rumbles of rocket bombs, I get nostalgic. Some things never change.

The Ottobit Jr. by Meris is an auditory tribute to those years, an homage in stombox form that offers a sample rate of 48Hz-48kHz, bit-crushing between 1-24 bits, with a low pass filter of 96Hz-24kHz and a sequencer with up to six customizable steps. There's tap-tempo, a configurable expression jack, and a "stutter," all of which make Ottobit Jr. incredibly versatile and accessible for live performance, recording, or just messing about. If you are an avid string player like myself, Ottobit Jr. might make you think less like a guitarist than you're used to, which I greatly appreciate. Think less Malmsteen and more Metroid.

The upper three knobs of Ottobit Jr.—Sample Rate, Filter, and Bits—are the primary articulative palette, operating in reverse conventionality. Fully clockwise for each provides a 48kHz sample rate, no filter sweep, and 24 bits, disengaging Ottobit's features. Proceed counterclockwise, and the samples and bits begin dropping off while the ladder-style filter takes effect. While feeding Ottobit a hastily-made loop of Chic's "Le Freak," I sat amidst a siren's song of industrial disco breakbeats and crushing arcade fuzz emanating from my confused amp.

Ottobit's lower three knobs—Stutter, Sequencer, and Sequencer Multiplier—allow you to take the crushed tones you've created and sequence, multiply, and endlessly manipulate them. Stutter is a riot, playing back slices of audio in rapid repeats of full, double, and half-speeds of the tapped tempo, creating that famous "stuck buffer" sound from the eighties, popularized by 80s stalwarts like Max Headroom. Dialed fully clockwise, the stutter randomizes while including a reverse variant, and you can also freeze the stutter by holding down the Tap footswitch. As "Le Freak" raged on under the influence of the stutter, I worked the dials like a mad DJ, unable to contain my laughter and knob tweaking.

The Sequencer and Multiplier knobs control the number of repeats and multiples of the original sequence speed. When the sequencer is active, the six operational knobs become fully customizable sequence steps for the three sequence modes—Sample rate, Filter, and Pitch. Holding the ALT button allows you to program the sequence steps, each taking the setting of its respective dial. For example, in Pitch Sequence mode, by setting each knob to gradually increase (dials at 1, 3, 5, 7, 9, 11), and with a bit of C minor noodling, I became shipwrecked, destroyed in a fog of gravelly bit-crushing sizzle. Lowering the bit and sample rates in Filter Sequence mode created everything from fuzzed-out sounds reminiscent of My Bloody Valentine to expansive chordal synthwave sounds like FM84 and The Midnight. A little exploration and I was creating cascading Mogwai-esque shoegaze electronica, with single-note lines becoming orchestral and mesmerizing. Entering Sample Rate mode let me relive my convenience store glory days, making those classic arcade game sounds that brought me back to my penchant for being annihilated by those digital drug dealers in Narc. Increasing the sequencer multiplier here and we ventured into friendlier video game turf, the sound of Mario shooting fireballs and laser beams, and entering warp zones with slower settings. Sequence speed can be changed via MIDI or the tap tempo footswitch, which is excellent for live performances and getting ideas out quickly.

You'll need an external footswitch to access Ottobit Jr.'s sixteen MIDI channels, preset banks, and save settings, and connecting an expression pedal will allow you to save/recall two presets. The expression feature is one of my favorite aspects of Ottobit Jr., allowing transition between two unique settings of all the knob values (yes, even the stutter!). For example, by tying the filter and bit depth to the expression pedal, you can create a wah effect while closed that blooms into bit-crushing fuzz when opened. Likewise, morphing between sequencer settings gets wild with the expression pedal as well. Super fun!

Meris has a unique black box here. Ottobit Jr. is a refreshing change of pace that makes me uncomfortable in all the

right ways, a real inspiration I'm glad to have stumbled upon. Although I didn't pick up a musical instrument until well after my Narc playing days were over, if I had, I would have been stoked to have Ottobit Jr. along for the ride.

- Coire Walker
Price: \$299



Chroma Console Hologram Electronics hologramelectronics.com

Usually, reading a manual for a piece of gear is utilitarian and not much more, a way to glean the intended way to operate something. It was a nice surprise to open Hologram's Chroma Console Multi-Effector manual and find a note by the two designers of the pedal detailing their inspiration for making it, that being the magic that can happen when a device is used not quite in the way it was intended. It makes the reasoning a bit clearer, and elevates this multi-effects pedal into something more; something with obvious passion.

Chroma Console is built on four different categories (called Modules) of effects, each with five different types: Character (Drive, Sweeten, Fuzz, Howl, Swell), Movement (Doubler, Vibrato, Phaser, Tremolo, Pitch), Diffusion (Cascade, Reels, Space, Collage, Reverse), and Texture (Filter, Squash, Cassette, Broken, Interference). The names of the effects—as opposed to the categories—spell out pretty well what each Module has to offer, and you can use anywhere from one effect to four, and put them in any order you'd like.

How many times have you wondered what it would sound like to do the

unthinkable and run your reverb first in your effects chain, then through a tremolo and a monster fuzz? I find that it's easy to get set in my ways when it comes to my effects chain and a lot of times I'm more willing to spend hundreds on a new pedal hoping for some magic than doing a bit of rearranging. I lose interest. But what I really lose interest in is the endless scrolling of menus. Chroma Console is different. You can tell it was made for experimentation and quick changes.

Each Module has an Amount/Effect Volume control and a Button to switch its given effect or bypass it altogether, which from left to right are A, B, C, and D buttons used for secondary controls and other functions. Character, Movement, and Diffusion each have a dual-function control to further sculpt (Tilt/Sensitivity, Rate/Drift, TimeDrift) with an overall Mix/Output Level control above the Texture module. There's a Bypass/Preset (save up to eighty presets) footswitch, and a Tap/Capture (for tap tempo or recording knob movements in Gesture mode) footswitch, and also the Hologram four-color menu. Chroma Console can be used in mono or stereo, has an input for a configurable expression pedal, and has a MIDI in and out.

Since Chroma Console goes without a screen, that means deeper menus/parameters are reached with some button combos/menus, and the four-color menu and the light up control buttons are used here. It's all pretty easy to do, with no balancing act or extra hands/fingers required. Naturally, the secondary control for a given effect depends on which effect is selected in a given module, but it's a quick thing to dial in an effect to your liking.

First, I wanted to just hear each effect by themselves. Sometimes (read: a lot) multi-effects units offer a lot of options to the detriment of the quality of what's on offer. I've used Hologram's Microcosm, which has great effects, so I was expecting more greatness and I wasn't disappointed. I tested the effects with both my electric guitar (a vintage Japanese Gibson SG copy) and my modular, and it worked well in both worlds. It's too laborious to go over each effect here, but overall the effects sounded excellent, were very usable on their own, and could be tweaked and configured quite a bit: from tone to type,

each of the effects can be customized. The Character module supplied everything from subtle drive to nasty fuzz and rivaled the numerous pedals I have for those duties. I wouldn't hesitate to use Chroma Console as a standalone fuzz/distortion/OD pedal, and that might be the highest compliment you can give a pedal like this, since guitarists can be so tone-picky (guilty as charged!). I found the Character effects to work well with modular, too; really versatile, with enough shaping capabilities for everything from blowing out a kick drum to pumping up a bassline.

The Movement module was the one I was most curious about, as I'm really picky about tremolo and phaser pedals. I love optical tremolos and am pretty partial to my homebrew Small Stone (with Uni-Vibe mods) clone that I built many years ago. I was able to dial in the tremolo on Chroma Console to be super smooth and pleasing, and the phaser was pretty perfect right from the get go as well. The Diffusion effect was surprising, offering BBD-style delay, a pretty nice Space Echo emulation, and a simple, beautiful reverb, as well as a spontaneous looping delay (love it!) and a reverse delay. In my modular world, reverb is king, and there really isn't a one-size-fits-all for me, and I'm more picky than guitar tone purists in this regard. It can take me a lot of time and even more modules and pedals to find what I'm looking for, and I found Chroma Console's reverb—simple as it may be in terms of control—lovely. The final Module, Texture, is mostly concerned with filtering and intermittent working and interruption; random pitch drops (Broken), telecom disturbances (Interference), and a requisite broken cassette player. I'm very familiar with broken equipment that you need to smack to get working, and this is one thing Chroma Console offers that you really can't find anywhere else: emulation of broken gear other than tape wow or flutter. In fact, it's this random working probability—chance ops, if you will—that harkens back to the manual's inspired introduction. It's funny to find magic in ill equipment, but it's also not surprising that the surprises are what we sometimes seek in a world full of reliability. Yeah, right!

Gesture recording, recording of the knob movements, is easy to enter and exit simply by pressing down C and D together,

and you can overdub knob movements as well as speed or slow the gestures with the Tap Tempo button (or by using MIDI). I love being able to automate things like trem rate, reverb size, and fuzz amount, and while I wasn't able to clock it in a patch, I gotta say this feature is a damn good time. In the same vein, you can enter Capture mode and loop/sustain up to thirty seconds of recording. Hold down Tap/Capture and you're off. Again, super easy to do, and incredibly fun. For guitar this was pretty cool, but for modular...truly something spectacular. Hands-on looping+gesture recording+parameter tweaking? Yes, please. Moving the effects around in terms of order was pretty interesting (press A+D to enter that mode) and made me wish doing so with a pedal board was just as easy. It does cut your sound while rearranging, so I had to try and remember what a previous setting sounded like to do a real time comparison test, but again—it was fast, easy and effective.

Setting up an expression pedal was simple as well, and it's nice to be able to use your foot to control something like filter cutoff (when's the last time you did a filter sweep with your foot?) or reverb amount in the modular realm, as both hands are usually busy patching/tweaking and this offers another way to control and modulate things. I didn't get into using MIDI with Chroma Console, but you can pretty much MIDI control anything that Chroma Console has to offer.

There is a lot at play here with the effects themselves being only part of the fun. With the ability to quickly change the order, automate the parameter changes, and loop/record, Chroma Console is most definitely versatile. I was really appreciative of the mode diagram on the pedal itself, freeing me of what would have been necessary manual referencing, and making Chroma Console so easy to understand, navigate, and enjoy—for both guitar and modular. The Texture module, in particular Cassette, Broken, and Interference, were really the stars for me with their intended intermittent functionality, adding a lot of flavor and randomness to sounds, and I thought the Character options on guitar were superb. I lost a lot of time in that realm looping some reverb and phasey texture while noodling fuzz heavy single-note solos on

top of it. Capture mode was great, for both near granular looping, to spacey droning to longer, more performance-based snippet recordings. It was immediate and rewarding, and with so many textures available coming from just the pedal itself, the only learning curve was dialing in the perfect pre and post recording levels.

Whether working simply as a single effect, in a slightly more complex way as a multiple effect unit, or being used in full effect with all guns a-blazin', Chroma Console is a ton of fun. Way more than just some effects box, the multi-color LEDs and overall look give insight to what Chroma Console really is; an artist's palette that can be configured to fit your needs, and can wow (and flutter!) and surprise.

- Ian Rapp

Price: \$399



**Grainity
Klavis**
klavis.com

You've gotta give kudos to Klavis for Grainity, their granular VCF, which combines a selectable multi-mode filter with a granular filter, all digitally controlled with an all-analog signal path. It's a unique idea, and Grainity brings forth new sounds, while still offering traditional filter qualities.

Grainity's signal path starts with the input going through Frequency and Q (resonance) controls (sliders, in this case), before that signal gets separated into the multi-mode and granular filter sections. There are separate outputs for each section, but you can also mix to taste, and CV that mix as well. The multi-mode section has seven options: 2-pole Low

Pass, 4-pole Low Pass, High Pass, Band Pass, Band Rejection (notch), and In (unfiltered input). There are CV inputs and attenuverters for modulation of FM, Q, V/Oct, and Phase/Frequency.

The granular section sports a large Structure control, and a smaller Division control, with CV inputs for both, a Detect input for the input of audio or trigger/gates, and a numerical display, which gives all the granular section information.

Grainity can be used as a sound source, and with the V/Oct input, it does a nice job at this once the filter starts resonating. But let's be honest, we're not here for the regular filter qualities, we're here for the granular ones. Most granular synths sample/record a snippet and then use that snippet as a sound source. Grainity doesn't do that, instead using preset sequences of filtering options called "structures," that can be controlled by their loop length and variation. Unlike a traditional filter, the end result is that this doesn't subtract from the sound, but rather adds all sorts of harmonics to it. Damn if we aren't all addicted to harmonics. What is distortion, saturation, "warmth," etc., but harmonics? Bring on the harmonics! Well, Grainity does just that and really operates kind of like a wavetable with switching/cycling through the various structures. I can't say that I fully understand 100% how it operates, but ultimately the sound matters more than the theory, so on to knob twisting and slider sliding!

While I messed with the filter-only output quite a bit, it was kind of in a utilitarian way, just to see how far it would stretch as a typical filter. I found it very usable in every mode, and it operated as a well-designed filter should in each. It was the granular aspect that I really wanted to explore and understand further, however.

The way this works is that you're able to add harmonics to create chords from single notes if you use a VCO as your input, but what about if you use audio? Singing into a mic, then going through Grainity? Playing back samples? Drums?

Patching in a sawtooth waveform from a VCO into the Input with the G.VCF (the granular only output) and comparing the original waveform with the output from Grainity, and there's no end to the indescribable shapes and sounds that come out, from distorted, yet recognizable from the original, to anything but.

Tweaking the Structure and Division controls, going through the filter presets and divisions available, and altering the Frequency and Q, with the Q up high so that the filter was resonating, I got what amounted to quickly stepping filter sweeps with a hint of formants. Switching to some sort of curved triangle wave thing with sloping steps on the rising edge and the feel completely changed from the sawtooth, a welcomed surprise. I love the fact that Grainity isn't taking over the sound or input, but reacting to it, and I was initially concerned that no matter what you called it, Grainity would not be adding harmonics so much as acting like a hyperfuzz pedal that obscures your guitar's tone. This wasn't the case, and patching in a sequence first to my VCO, and then to Grainity, it was pretty interesting to compare the differences between the before and after signals. Multing that same sequence patching into both V/Oct inputs on the VCO and Grainity brought another level of complexity, and even more so when I would invert either of the signals. Sometimes I would change the Division and Structure settings and the sound would go from distorted to warbly, almost like a two-stage phaser, which was pretty cool. Add modulation of any sort to cycle through Division and Structure, and all bets are off. In one patch, I had the same sequence running through my source VCO, Grainity's V/Oct input, and the same for the CV input on a resonating 24dB filter that I was using as my FM source on Grainity. Granted, I normally don't like this level of uncontrolled modulation on one source as it does obscure so much, but it was a fun exercise and switching to the Mix output to mix in some of the multi-mode filter, and tweaking the mix amount delivered a lot of sweet spots. Grainity never got too out of control, and never did it get so distorted as to be nasty; you could still hear the source signal coming through.

My next task was to see how Grainity did with samples and a little bit of crooning. With a microphone patched into Joranalog's RX2 to get my voice into the modular realm, I then made several multiples of that signal—some attenuverted—and patched those into the V/Oct, Input, Structure, and Division CV inputs. There was an interesting proximity effect happening, in that the closer I sang

into the microphone, the stronger the signal, and the more that Grainity was pushed. I've never sounded so harsh! Some of it reminded me of a toy megaphone that I used to have (and annoy people with) that had a "robot" setting. Glitchy, digital, and broken. I found that the lighter my touch, the subtler, the granularity of it all was, and I really appreciated the dynamic control of it all. A lot of what resulted was less than pleasant, but I must put more of the blame on my singing than Grainity.

Patching a drum track from Winter Plankton's ZAPS into Grainity, and I was able to destroy the drums just so. I really wanted to hide the incoming drums to see how Grainity could color it, and I wasn't disappointed. I was able to find what I was looking for, using setting 3L4 to get a blotchy, digitized—but a still in time—rhythm track. This was with an inverted multed drum track and a PWM'd VCO both going into the FM input on Grainity, and it was impressive and reminded me of a scene in the original Star Wars where they're listening to robots or Jawas or something talk over the radio. Self-patching was totally worthwhile, such as taking the M.VCF (multi-mode only) output and patching that into the Structure CV input. Initiating the Track heightened the glitchiness, but surprisingly, patched to the hilt, the original drum sound was still present. I realized that I had the Q pretty cranked, and when I brought that down, I was able to suffocate the drums a bit. Setting it on RL1 and each kick drum hit turned into a distorted blast.

Grainity is a really fun sculpting tool. The concept is interesting enough, but more impressive are the results and scope of grainy buzzy digitized sounds you can get. Not to mention just using it as a really versatile multi-mode filter that sounds great. I really enjoyed modulating the granular parameters and multing signals and patching them into various inputs and CV ins, with inverted copies of original signals flying around. Even more so, just patching a sound source into the Input and seeing what I could get, keeping it simple, but altering the original signal, brought great results. Like I said, kudos to Klavis for the idea of Grainity, but even more kudos for turning this idea into a great module. Loads of fun here.

-Ellison Wolf

Price: \$324



Route 4 Dim 2 Joran analogue jorananalogue.com

When I think of signal routing, I view it as a utility, something functional, to plan and figure out. Lately, I've come around to thinking of it more creatively, of what one can do with routing in terms of musicality, performance, or both. Joran analogue's Route 4 is one reason why. It's one of those modules that can do a lot; it can be sort of a gate/pulse controlled mixer, a gate sequencer (with a little help from some LFOs/clocks/etc.), and a contour-less VCA—either opening or closing a channel—along with some other uses.

Comprised of two sections with the top half of Route 4 being a 4-to-1 router and the bottom half a 1-to-4 router, each section contains four Routing Inputs (top section) or Outputs (bottom section) with a corresponding Control Input, which enables the channel when a trigger or gate signal is present. All inputs can handle audio, CV, or gates, and each channel has a Gate/Latch switch and a SOLO/Multi switch for determining if only one channel/input can be triggered at a time, or all channels triggered. There is also a normalised Input and an Output jack running across the middle of the module, separating the two halves in terms of layout, but connecting them, with the top portion of Route 4 flowing into the bottom if the normalization is unbroken. LEDs throughout Route 4 show the status of each channel.

Depending on the switch and gate settings, Route 4 can be used as a 4-step sequencer, and you can easily stretch those 4-steps into ever-evolving melodies. Mix a

constant voltage in a channel or two (so that they're perpetually "on") with some gate or trigger signals for other channels, and you can get a lot more variation. Whether that's rhythmically or not-so, this opens up all sorts of opportunities for melodies when audio signals are present at the inputs, or modulation opportunities when CV

is patched into the inputs (and the Control inputs as well). Changing a channel from SOLO to Multi, and/or Gate/Latch unleashes all sorts of rhythmic variations, and for me, that's where the fun was had after Route 4 was patched up. Changing the switch settings, especially going from Gate to Latch or vice versa was a cool way to change things up, and while I was focused on testing out Route 4, in a broader patch—with a lot going on and using a lot of modules—I found the switching in Route 4 to be a very cool way to shift the feel of a rhythm or melody line, while in the midst of tweaking other parameters and controls in the patch.

While the top part of Route 4 is normalled into the bottom half, and it makes sense to use this module as one thing, I actually found myself using the two halves separately most of the time. I do like the fact that you can have four separate inputs on the top half and combine them into the input for the bottom half, and split out four of the same combined signal to different outputs, but that can be done with a mult pretty easily, anyway.

Running four channels of audio rate on the top portion of Route 4 with various degrees of synced, or semi-synced CV trigger for each channel was pretty interesting, and using audio rate for the CV brought about some cool AM tones. Using the bottom half to mult and distribute an audio signal to four different effects in a clocked manner was really interesting, especially when the four channels were mixed to a mono track where you could then sync the effects, filters, and whatever else, to turn off and on, creating rhythmic effects patterning. With Route 4, Joran analogue has turned yet another utility into so much more.

Joran analogue also sent over Dim 2, their two-channel CV or manual-controlled dimmable lighting module. Packaged with two short gooseneck BNC LED lamps, the lights offer a nice pleasant and diffused illumination, and dim nicely with no seizure inducing flickering. Sure, they're lights, no big deal, but the goosenecks actually held pretty well vertically with minimal amount of sag during a recent three-hour session—longer than most modular gigs will be running—which puts it above some of the other lighting I've tried out in the past. The lights feel very secure in their BNC locking slots, and with the ability to CV the lighting, you're even able to bring a little performative juice to your visuals. Dim 2 is built so that if your modular's power supply can handle the load, you can also plug 12V LED strips into it by removing the detachable Joran analogue light heads, and plugging them into the standard 2.1mm DC plug. After having this for a while, I can say that I didn't realize how helpful it is to have such good lighting in my rack. It's a relief on the eyes, and I'm able to decrease the amount of room lights I'd been using, creating some extra ambience in my space. I wish the accompanying goosenecks were just a little bit longer, as my 150HP rack is pretty big, but angling them a certain way I was still able to hit pretty much every module with light, making patching and reading the text on them a lot easier. Very cool indeed.

- Jason Czyeryk

Price Route 4: \$214

Price Dim 2: \$179





Otterley Expert Sleepers expert-sleepers.co.uk

Maybe it's my love for all things LFOs, maybe it's just that the number nine is my lucky number, or maybe it's just because Otterley is the ninth and newest module in Expert Sleepers superb all-analogue series of modules, the titles of which come from the wonderful Cocteau Twins album, *Treasure*.

I know the common modular refrain, "you can never have enough VCAs," is true, but I feel that way about EGs, VCFs, and, well...attenuators, too. Can't have enough of those. But I definitely feel that way about LFOs, and Otterley has five of them in one compact 8HP space.

Otterley is pretty straightforward; it's got three inputs (Speed CV, Spread CV, and Reset), and those five LFO outputs. The first four LFO outputs have a range of 150 seconds/cycle to 75Hz and share controls for Speed, Speed CV amount, and Spread. There's a three-position +/-5V toggle for range selection (all-negative, bipolar, or all-positive voltage), a three-position Sine/Square toggle (middle position off) for LFO shape selection, and a Speed control for the fifth LFO, which is independent of the first four and is a fixed sine wave with a range of 50 seconds/cycle to 50Hz. All the output jacks have Expert Sleepers' signature light up jacks for distinguishing between positive (red) and negative voltages (blue), and if the Shape toggle is in the middle position (off) there is no illumination, a nice visual indicator. I love that you can effectively mute the LFOs. It's a brilliant feature that I'd love to see on more modulation modules.

Right away, I'm digging the Spread

function. I mean, having four synced modulators is cool, but not always called for, and conversely, having four random LFOs also has a place, but...Spread takes care of that conundrum, providing the best of both worlds, and literally everything in between. You can adjust (and CV control) the amount of timing between each of the LFOs from one another, and this is valuable and interesting in so many different ways, with phase exploration being the most interesting to me. The speed—the frequency—increases with each successive LFO so that they aren't identical shifting LFOs, with LFO1 being slower than LFO2, LFO2 being slower than LFO3, etc., which is really helpful for creating quick, interesting modulation in any patch.

At its most basic, by patching up those first four outputs into whatever parameters (filter cutoff, 1V/Oct on a VCO, filter resonance, distortion/saturation amount...) and increasing/decreasing the Spread amount you can hear the relationship the changes caused by the as time goes on, giving your patch a nice, organic quality.

Due to it being analogue and the fact that the frequencies of each oscillator aren't calibrated (it's a random module, after all!), out of the box Otterley's four top LFOs were not the same frequency, and even with Spread fully off and no Spread CV, there was always a slight separation from each other. I thought it could be interesting to have those four LFOs perfectly synced until the Spread was activated so that you could hear the full evolution of the spreading effect, from zero to wild nirvana, and well, lo-and-behold, a quick peruse of the manual and it details exactly how to do this via trim pots on the back of the module. Nice! Also on the back of the module are other trim pots to change the shape of the sine waves for each LFO into a near-triangle, if you want to do that sort of thing. I wouldn't mind this to be on the front of the panel, or with jumpers on the back to make it a bit easier, as the trim pots are tiny, but either way, it's great to have these options.

You can also sync the four top LFOs by patching into the Reset, and then have them drift from each other, by a little or a lot—depending on the Spread setting and length of time before Reset is triggered

again. This sort of musicality reminds me of musicians playing together in different time signatures where they meet up briefly, where the universe aligns and the math makes sense, before slinking away into their own distinct corners of the galaxy again.

Doing exactly this, and patching into percussion modules to create a rhythm track, with the LFOs set to square wave for triggering drum hits, was pretty great. You could feel the anti-rhythm taking hold more and more right until the moment that the clock I'd patched into the Reset brought it all back together, stacking everything on top of each other into one sound, only to drift away again and start to become a sorta-rhythm. It's pretty interesting to make a random, ever-changing loose-grooving patch, something I almost never do, as everything is usually synced to a T in my patches. This is a great module to help break away from that rigidity of time structuring, and with the Spread up high and the LFOs inserted all around a dense patch, you have the ability to add plenty of unpredictability into an otherwise predictable patch. Oh, that balance of consistency and unpredictability...the key to life, right? Maybe. Even if that's not your cup of tea, Otterley can heap loads of spice into a needy patch.

Patching into four different VCOs pitched similarly, where Otterley was modulating the 1V/Oct inputs, was a good time, as was when I used the same configuration to modulate the cutoff of four different VCFs, using the same input signal for each before stereo mixing them for some weird comb-filtering effects. It was so often beautiful and mesmerizing—especially with a slower overall pace for the LFOs, and adjusting the Spread really highlighted the various frequencies that were poking through in mind-altering ways. This generative way of creating movement brought a lot of dynamic change and worked really well in creating dense backgrounds on which to build off of—blankets of mutating sound. Patching into four different VCOs pitched similarly, where Otterley was modulating the 1V/Oct inputs, was a good time, as was when I used the same configuration to modulate the cutoff of four different VCFs, using the same input signal for each before stereo mixing them for some weird

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Otterley's fifth independent LFO allows for some pretty neat self patching—whether of the Spread or the Speed—to modulate the other four LFOs, and it's pretty cool to have this—what I'd call extra or bonus—LFO onboard with which to do so. You can also do the same with any of the other LFOs—this self patching bit—for similar effect. You can get a lot of weird stutters and irregular modulation, and with a little time spent lining things up just right (especially if using the fifth LFO), you can control more of the randomness than you'd think, for semi-controlled quasi-pseudo-random-changiness.

If you're looking for more than square or sine waves and are into construction, you just need to go a little old school and cook that up yourself by mixing the LFOs together. With the differences of the separate times and shapes—if you use the first four as square waves; the fifth is always a sine—you can create your own complex, random LFOs for even more randomness. Plugging this through the trusty Mordax DATA to see the mix progress, it was interesting to patch/unpatch the LFOs and study the effects one wave—at a different rate and intensity (due to the location of its cycle)—would have on the entire mix.

Otterley is maybe my favorite blend of attributes on a module; simple to operate, but offering up a lot of complexity, mostly user-created. Five plug and play random LFOs are always appreciated, and it was really interesting to explore in various ways the interconnectivity that the Speed and Spread controls had on the various LFOs. It's just one of the unique features and interesting possibilities that Otterley offers up here, and is another win for Expert Sleepers.

- Ellison Wolf

Price: \$199



Neo Trinity Bastl bastl-instruments.com

It's hard not to think of the brain trust behind Bastl as geniuses. I'm extremely fond of their whole Pizza series of modules, as well as the same-sized VCF Ikarie. They're staples in my travel case, packing much versatility in 8HP, while still being very playable. These are deep modules, and their size belies their vastness. Neo Trinity is another; a modulation masterpiece offering six channels (A-F) of configurable LFO, envelope, or CV recorder per-channel. By patching out of a channel of NT and into a CV input of another module, you can add uni or bipolar modulation to any parameter that will accept it, similar to a lot of other modulation sources. But there are some major, major things that set Neo Trinity apart from the rest of those modulation sources going about their normal modulating operations (Agent Smith voice here), the biggest one being that you can record (and overdub!) and loop these dynamic changes with six different fixed record lengths that go from short, quick loops (two steps) to long recorded changes (sixty-four steps).

CV mode, which seems kind of like a “free mode,” is where you can make and record CV changes of frequency speed/pitch with the Rate knob, and insert triggers (quantized to a clock or not) to make all sorts of complex modulation or pitch CV. You can make the output stepped or smooth and create your own LFOs or melody lines. Neo Trinity can also be quantized for this, with eight different types of scales (chromatic, minor blues, major/minor diatonic, major/minor

pentatonic, and simply major and minor). This can span up to five octaves (10V peak to peak) and be uni or bipolar.

For LFOs there are five uni or bipolar shapes (triangle, ramp, saw, pulse, and random) to choose from covering pretty much everything you need, and you can set the frequency with the Rate knob, which can go up to audio rate. The shapes change depending on whether you opt for smooth or stepped output, and it stretches those five shapes to more like ten, which is how you get a sine wave from the triangle setting, or smooth randomization.

For envelope mode, there are four shapes (Decay, Variable, Attack, and Pulse) with the Rate knob controlling the overall duration of the shape, affecting both the attack and decay, though which is more affected depends on the chosen shape. You can further affect the operation—adding slew, turning on/off retrigerring—to add more variation, but for an easy source of envelopes without taking up a bunch of space, I'd say you can get what you're looking for in most normal modulation circumstances here. Even though there isn't a control for each stage of an envelope, you can still customize quite a bit, and the onboard shapes are what I use probably 90-95% of the time in a typical patch, anyway.

You can also sync to an external clock, bypassing Neo Trinity's internal one, as well as divisions within that clock, and patch in a gate to reset your modulation, which can lead to some really interesting modulation when everything is synced together. Adding a delayed, synced trigger to the reset can get some really cool stuttery triggering—perfect for designing unsatisfying rhythms, something I love. Give the crowd the easy dance track they want? I say no! Tease, annoy, frustrate...

Channels E and F have their own assignable inputs with seven different modes for this, so you have two independently configurable modulation sources not tied to the Meta input, which itself is very configurable, with the same seven modes that can be synced to any or all of the channels. All channels can easily be muted as well, so you can turn on or off modulation, one of those things that is often overlooked (if considered at all), but I find vital in some circumstances, like in my frustrating rhythm campaign.

Bastl also has included some pre-defined

trigger patterns—kick, snare, and hat, for example—that worked well for fast patching rhythms. Too well perhaps, as during my testing, my partner commented that what I was doing sounded really good, that she was digging the rhythmic drum pattern (Bastl's, really!) that I had going on. I mean...I did physically patch it up, so I do need to take some credit, but it was nice having those trigger patterns as starting points. There are some other patterns (a divider, random pattern generator, and a Euclidean pattern generator) that I also found useful. I almost always have a clocked smooth random LFO modulating something in a given patch, and I almost always keep one channel of Neo Trinity for this use.

Neo Trinity offers eleven banks of preset storage, so you have plenty of saved modulation programs for different situations. There's no screen, so you'll have to write down or remember which bank is for what scenario, if need be. I have a system where anything like this always has presets numbered as (1) vocal/melody use, (2) bass, (3) percussion, (4) random. Anything beyond that and I might lose my marbles.

Neo Trinity is nothing short of amazing. I have all sorts of LFOs, envelopes, and other modulation sources in my rig, but having six channels in such a small package—with recordability and recall—is no joke. Neo Trinity can easily take the place of three modules more than double its size (do the math!)—most likely with those not being able to record and play back modulation changes, or even having so much possible customization.

One thing that was sometimes interesting in terms of the timing, and yielded surprising results, was recording modulation in one length and switching to another for playback. A lot on Neo Trinity is surprising. Patching a sawtooth LFO that I recorded some automation into (fast knob twist to fully CW) with a short record time (four steps) and then turning the Rate fully CW into audio rate, I modulated the Fold CV in on the Zlob Foldiplier and I got a really nasty, short, partially melodic sequence of sorts. Shortening and lengthening the loop time was a cool way to get more out of it as well, while keeping everything in sync. You can even switch modes to random and go back to the sequence to warp things up, and

there is much warping to be had here.

I only have one critique, and that is with the fixed record lengths. Six options are nice, they cover a lot, but there were times it took a little guesswork—a few stabs at the rates—to get the right length for what I was looking for. I would have loved to be able to start looping the automation right when I was done recording it, by letting go of the Record button, instead of (sometimes) needing to wait until the fixed step time ran out, if the time selected was longer than I'd recorded for. Conversely, if I chose a time that wasn't long enough, my tweaking would be cut off before I was finished and I'd have to start over and choose another length. Also, as with any module this size that has no screen, sometimes it was hard to remember the various button presses for how to do everything: quantize, scale, rate, clock divisions, Meta modes, etc...there's a lot on hand here. And while I found the most basic functions, the most-often used ones (channel select, shape, recording, etc.) easy to remember, I still had to reach for the manual from time to time for the deeper operations. Overall though, learning the ropes on Neo Trinity was not too much of a challenge, especially considering what's packed in here, and navigation was easy to recall, a joy, actually, and I felt somewhat proud of myself for how quickly I was able to use Neo Trinity in the ways I wanted.

I don't want to use the word "genius" here, but Neo Trinity is one of the best automation modules (again, in only 8HP) I've come across; hands-on, recordable, set-and-forgettable...I'll always want a few envelopes with controls for each stage in my rig—I'm not giving those up—but in the same breath, I'll always make room for Neo Trinity in whatever case, for whatever situation I find myself in. Bastl, they've done it again.

- Evan Morrow

Price: \$320



Ghost Pedal
Endorpin.es
endorphin.es

We reviewed Endorpin.es' Ghost, their excellent multi-dimensional effects module, a collaborative effort with Youtuber/musician Andrew Huang, just last issue, and they're back, this time in pedal form. Ghost Pedal is 24-bit, 96 kHz with 32-bit floating point internal processing, a stereo-enabled pedal/tabletop version (whew!) of the module featuring delay, reverb, bitcrushing, an amp simulator, a filter, and some other bits and bobs. It can save and recall up to nine presets, connect via MIDI, and easily take line or instrument levels. Ghost Pedal retains the superb sounds of the module, and while it has much in common with the Euro version, it also breaks from it in some pretty key ways.

Ghost features a very flexible delay with controls for Time and Repeats/Taps and a 2.5 second max delay time. You can use the Tap button to tap tempo (or MIDI clock the tempo), and there are three different delay settings (RLRL, LRRL, and STEREO). There are nine different time divisions (and a looper) to choose from, and you can opt to have repeating tails or no tails when the delay is turned off. It's a really flexible delay, clear sounding and pretty, and even morphing the time division produces a satisfying speed catchup with no nastiness, a necessity for delay tweakers like me.

I liked the reverb sound on the Ghost module, and naturally, as it's the same algorithm, I like it here as well. Three different types are available: Hall/Shimmer, Reverse, and Spring, and they cover a ton of ground. You can get the bathroom tile springy slapback thing or get lost in a siren-y vastness of outer space. With a Tone control—a tilt EQ—that enables you to tame your incoming signal, dialing in a perfect—and many times an

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absolutely beautiful—reverb is easy to do using just the Reverb, Decay, and Pre-delay controls. You can also add more flavor to each setting by programming the Tap button (more on this) to mode 3; Hall/Shimmer has a Freeze function, Reverse adds some shimmer, and Spring has a Spring Excite, so that when Taps is pressed and held, you get a reverb swell. Watch out here; it can get loud fast. The Freeze function is great, looping your reverb and quickly enabling you to play on top of that repeating blanket of sound is a lot of fun.

The delay and reverb are the biggest effects on Ghost, creating most of the magic, but there's a nice supporting cast of other effects here, too. The selectable HP/LP, BP, or Comb Filter with Resonance control is versatile and quick to use, and the Distortion (with a Tone control for taming the high-end, post-distortion) adds some nice crunch to a signal, and along with the guitar cab simulator, added flexibility to an electric guitar. I'm not sure I'd give up your Kemper (or whatever) amp simulator just yet, but maybe...The Bitcrushing is also a very cool addition, and combinations of all the various effects—as it was with the module version—is a treasure trove of sound sculpting tools. Add in some easily assignable onboard LFO/envelope following modulation (with control over Shape and Speed), for any/all the parameters, and six different routing possibilities to choose the path of the effects that you want to feed your signal through, and you've got a ton at your foot/finger tips. As for those feet/fingers, three easily pressed footswitches (Preset/Save, Bypass/Load, Taps/Assign) are found at the bottom of Ghost to turn things on and off, save/recall, etc.

Every parameter on Ghost has an accompanying LED to show the level strength, lighting up blue for the main parameter and positive modulation amount (when bi-polar voltage is available), and red for the alternate parameter and negative modulation. Switching from the main to the alternate parameters is easily reached by pressing the Shift button, which can be momentarily held for quick changes, or latched to stay in the alternate mode. This is super fast and easy to do, and the LEDs do a good job of keeping track of levels and real-time action of the modulation, and

makes Ghost easy to configure and read—there's no guesswork here—and going from state to state or parameter to parameter really couldn't be easier. A small nine-LED grid at the bottom does the same for signifying preset information.

Right off the bat when comparing the two versions, the biggest difference between the Ghost Pedal and its Eurorack counterpart is that there are no CV inputs for modulation on the pedal. Still, there is still plenty of opportunity for modulation control. Ghost is MIDI capable, and any parameter can be controlled by that, along with—naturally—using your hands or feet. There's also the onboard modulation and the option for using an expression pedal to enable some morphing from state to state—something you can't do on the module version without some additional help and a bit more hassle. The expression pedal morphing is a true star, where you can go from a small change like a delay time change with the push of the pedal, to changing everything completely—going from something like a reverb heavy saturated delay effect to a bitcrushed filtered squirm of a sound. Whatever two settings you can think of, you can morph between them with an expression pedal, and setup for this is easy. If you have two saved presets you like, you can morph from one to the other, and depending on the settings and all that, the in-between interpolations between the two settings can be bizarre and priceless. This really is such a cool feature.

While the Euro version sports a compressor and sidechain control, neither is found on Ghost Pedal. This seems like it'd be a bit of a bummer, but I can't say I missed or needed it in this configuration, and if you're using it as more of a desktop controller and using MIDI with it, there's a good chance your computer is nearby, and adding compression in that realm is more flexible than a pedal would be, anyway.

I was surprised how much the different form factors between the two Ghosts resulted in different musical output—it is one of my key takeaways from having spent much time with both—and a different experience overall. I played Ghost Pedal like an instrument at times, but also as a set-and-forget effect, too. I noticed that because of the size and space, I spent more time honing in on a sound or feel than when I used the modular version.

And I found Ghost worked just as well for guitar as for modular/synth and was also great on a recorded drum track and vocals, too. On vocals, with a little freeze loop going and some delay, I modulated the filter cutoff with the resonance cranked and got some pretty cool wah vox out of it. Setting the delay in loop mode on top of this and the cacophony of voices reached Meredith Monk-like proportions. In another instance, attempting to simulate the huge reverb of an enormous airplane hangar for a modular drum track, with a touch of delay and bitcrushing, produced some interesting results, perfect for adding underneath a parallel compressed clean version of the same track to add girth.

There are a couple of things I wish were a bit easier. In order to clear the delay buffer (necessary at times for longer delays) you need to turn both the Time and Repeat knob fully CCW, which resets those controls. A long button press or button combo would work better, so you wouldn't need to get those two controls back to the desired position, especially if you're using Ghost with your feet. Also, the Tap settings for the Delay take a little getting used to. Once you choose your Tap setting (Shift + Tap) the Tap button blinks one to four times to signify mode, but after that (don't miss it!) there's no visual indicator of what mode you're in and sometimes it can be hard to tell (especially at a quick glance) if Tap is engaged or not. This became less of an issue the more familiar I became with Ghost Pedal.

Those small things aside, I gotta say that Ghost Pedal delivers. I'm not surprised at all by the quality of the effects, I would have expected nothing less, but I think Endorphin.es have done a great job all around, especially holding back—putting just what's needed into the pedal without overdoing it—making it easy and enjoyable to use. The effects available, and the breadth of each is impressive; you sure do get a lot from a little here (in terms of controls for each), and the way the effects play with each other—easily heard by changing the routing—can be surprising and drastic, fun to experiment with. Ghost Pedal won't be disappearing from pedal boards and desktops anytime soon; it's an apparition that is going to stick around for a while.

- Jason Czyeryk

Price: \$519



BTMX

Schlappi Engineering
schlappiengineering.com

It used to be that when it came to logic functions and logic-based modules, I just didn't get it. I really couldn't understand why something called "logic" made me feel so stupid. I'm logical, I like efficient, sensible, reliable and predictable thoughts and things. Well, I am still by no means an expert at logic functions, I think I've finally started to crack the code, at least I hope.

Logic modules take a binary gate signal (1s and 0s; logic-ally termed "high" or "low") on a given input channel. When certain combinations are met with multiple input channels simultaneously, you can get an output. This depends on the selected logic mode (there are many of them, and each mode acts differently), and is determined by what's called a "truth table," which lays out the requirements, the rules, for each logic mode. For example, if you have two inputs, one high (1) and one low (0) in AND mode, then the output is "low," meaning that it's off, meaning that there is no voltage at the output. AND mode needs both inputs to be high (1s) for the output to be high. If you're in OR mode with the same situation for those two inputs (one high, one low), the output will go high, there will be voltage other than 0 at the output. OR just needs one channel, it doesn't matter which, to be high, to have the output go high. You can see these requirements in the logic truth table to understand it a bit more, so grab a coffee, we're just beginning...

The more channels, the more inputs, and the more modes there are available, the more potential variation, the more potential for complexity there is. Add

some switches to the inputs for a little hands-on experience, and add the ability to quickly switch logic functions with those very same hands, and you've got a little say in the matter, where the potential is at your fingertips. Potential for rhythmic mayhem, melodic mayhem, and modulation mayhem. Or no mayhem at all. Or maybe just a little mayhem; it's your choice. That's what we're getting with BTMX, Schlappi Engineering's latest logic module: the potential for mayhem.

In BTMX, there are four logic modes: ADD, AND, OR, and XOR. With eight input channels (1-8) and four paired Gate output channels (1+5, 2+6, 3+7, 4+8), and a Stepped output (the summed culmination of the Gate outputs), BTMX has (potentially) a lot going on. Basically, BTMX is four channels of two-input logic gates, where the logic function is selectable. Conversely, another way one can view BTMX is that of a variably configured logic module that will take two nibbles for its input.

For a bit of clarity, courtesy of Sparkfun:

"Each 1 or 0 in a binary number is called a bit. A group of four bits is called a nibble, and eight bits makes a byte."

It definitely does get confusing, but it's possible to get comfortable with both the operation of logic, and its terminology, though in all honesty, it's a lot easier to use logic than it is to understand it. At least I found this to be the case in the beginning.

A trigger, gate, bit, byte, nibble, or having the toggle switched up for a given channel's input, gets that channel to go high at the input, and emits a fixed output voltage (channels 1+5 = +5.3V, 2+6 = +2.64V, 3+7 = +1.32V, and 4+8 = +0.66V) at its corresponding output. When it comes to each channel outputting a voltage at the Stepped out, that's determined by whether or not the requirements are met via the truth table, which depends on the logic function. The Stepped output is the heart of BTMX, and is good for pitching a VCO, harsh modulation CV for whatever use you can think of, and creating changes that can go from nice and smooth to chaotic and haywire. The Gate outputs are great for creating rhythms, triggering external parameters/effects off and on, and so on.

Most logic modules are pretty hands off;

patch things in, patch things out, slowly walk away, usually confused. This brings up the sweet thing about BTMX, the thing that sets it apart; the ability to switch modes and mute channels with the toggles—the ability to muss things up by hand. Even when I had little to no idea what I was doing, and had to play catch-up to figure out the reason why something was happening (or not), it was pretty easy to get funky rhythms, robotic melodies, or anything where stepped voltages and oddly timed gates could wreak havoc. Sometimes I would patch things up without changing the logic function until I got good movement, and only then would I switch functions to see how things changed, how the modes determined each output's on/off status.

For basic melodic-ish function, patching the Stepped out into a 1V/Oct input of a VCO gets a repeating sample and hold type of functionality, similar to what you'd get with a mutating step sequencer with just a few steps. This all depends on what is patched into each input, what mode is selected, and how the toggles are and all that, but that's par for the course. The resulting personality of the melody reminded me of what an 80s IBM mainframe would sound like if it could talk. It's more than just 1s and 0s (well, technically...), but not much more; maybe throw in a few fractions (nibbles, really) and you'd be there. Patch this same thing into a CV input to modulate a filter cutoff or resonance or something, and the results can be harsh, armed forces type of regimentation. Remember, there's no smooth transitioning—no slew or glissando—for the changes in voltage; it's abrupt! You can do things with BTMX like burst generation and trigger/gate combiners, creating what sounds like semi-random triggering, but where BTMX really shines is when used for drum/percussion duties.

Patching each Gate output into percussion-based modules can, and will, yield some crazy off-rhythms. Add in some twitchy toggling, and variations on the rhythm abound. It's good fun to patch BTMX all up with LFOs, Schlappi's Nibbler, etc., for triggering, and patching the Gate outs into a kick, hat, snare, clap (?) and with the Stepped out going into some sort of melodic module. Mutating beats and melodies, yet still somewhat

rhythmic and in cahoots with each other, will keep you on your toes. One thing to note: individual output voltages aren't summed to the Stepped output, no output on BTMX will ever exceed +10V: You won't blow anything up.

With status LEDs for each input and output, letting you know if it's being triggered (flashing LED with the triggering), or just on (LED is constantly on), and LEDs that light up for each Gate output when they pass voltage, there are good visual indications throughout, which is really helpful.

I mentioned using BTMX with Schlappi Engineering's Nibbler, and it really seems these two are meant to be neighbors, borrowing sugar, lawn tools, and helping each other fix broken stuff. Inputs, outputs, the RESET button on Nibbler...it's good fun to pair the two modules up, flip some toggles, and smash that RESET on Nibbler. A word of caution: a lot of the time when switching things around you'll be just as likely to halt the whole shebang—no sound or movement at all—as you will be to stumble onto something super cool and intriguing. It's all in the name of experimentation, so buckle up and enjoy the ride.

- Ellison Wolf

Price: \$193



Gliss
Bela
bela.io

Bela's Gliss is not a large module, only 4HP, but there was some sizable buzz at the Bela table during Superbooth in 2023. It's not hard to see why. A capacitive touch controller, Gliss has a myriad of uses: LFO, VCO, sequencer, modulation source,

recorder, keyboard. Basically, anything you can do with control voltages, whether it's generating them or managing them, is what Gliss can do.

With only the PCB touch surface, a light up button, an Input and two Outputs, there's not a lot to navigate here. This doesn't mean that Gliss isn't deep, or that there isn't a lot to figure out; there is, and without a doubt, you will need the manual to know all the capabilities that Gliss offers. Since it's created on the Github open source software platform, it's potentially forever-evolving and can be customized to suit your needs.

Multi-color LEDs illuminate the touch surface to show both placement and "pressure" when touched, and it's cool looking. In fact, Gliss is really nice looking and its simple layout, unencumbered by too many controls, which makes it great to use in real time, but a little challenging to set up or configure, since it can do so much. There's just a lot to remember to get the most out of it, though if you're like me and are planning on mostly set-and-forget scenarios for the most part, after initial setup you'll only need to read the manual if you want to change things or need to re-familiarize yourself with its functionality. There are all sorts of global mode type of settings; range, brightness, modes, etc., and with no screen and just the one pushbutton, it's left to the color of the LEDs to do the heavy lifting. Actually, the manual does the heavy lifting, but the colors and location of LEDs let you know what's going on. One thing I noticed was that when I would be playing, my finger would obscure the LEDs from being seen. Whether this is the result of some fingers that need to lay off the pastries, or my inability to keep said fat finger from the middle of the module, if the lights are important to you, you'll need to practice playing Gliss a bit off-center for best results.

Gliss has four Performance modes: Control, Record, Signal, and Notes. Control is maybe the most obvious mode as it outputs CV corresponding to the touch location and how much "pressure" you put on the touch strip, though "pressure" is a bit of a misnomer as instead of physical pressure Gliss determines how much skin one puts on the touch surface, and translates that into "pressure." With location and pressure, you can use the two

outputs to control both a 1V/Oct input on a VCO and the CV input (pressure) on a VCA simultaneously to get some dynamic control. You can also configure it to respond and output CV for two fingers, and latch the voltage to hold notes, or just have it be momentary. Using Gliss in this fashion, and it's surprising just how expressive it can be. Note changes register with no perceptible lag, twitchy fingers can create beautiful vibrato, and laying a big fat finger on the touch surface can quickly open a filter or VCA all the way. It's good fun.

The next mode is Record, and this lets you use your gestures to create and record up to seventy-five seconds of your own custom melodies, LFOs, or envelopes, and then loop, trigger, and play them back. Record mode is where my Gliss lives most of the time. I just think it's so cool to be able to draw LFOs that change shape, time, and intensity (pressure) at my whims.

Signal Mode lets you alter CV signals by offsetting, scaling, and otherwise changing voltages. Honestly, while I like the utilitarian aspect of Signal Mode, there's no way I can use Gliss for this. Choosing between creating custom looping LFOs/envelopes/melodies vs. offsetting an existing CV? There's no competition. Bring me the recording gesture controller!

The final mode, Note Mode, turns Gliss into a five-note pressure sensitive keyboard. Again, while this is neat and useful, I just don't see using it this way, unless in a pinch, and I only did so to fully test out Gliss. Even though you can customize those five notes and/or use it as a sequencer—which I do like quite a bit—and even quantize the CV output, I found the other modes (again, mostly Record Mode!) way too enticing to commit to Gliss being in Note Mode.

Even though I spent (and continue to spend) a lot of time with Gliss, without a cheat sheet, I couldn't recall what color or position does what in each mode to configure Gliss. In no way does this limit the fun or usefulness of Gliss, and I've seen a few people with those little 4ms Pods and four or five Gliss modules in there for use as a mixing device or multi-channel controller, and it does look really tempting, though I'd be hard pressed to go away from Record Mode. All in all, Gliss is a great way to add some personalized performance to your setup, and I expect

we'll be seeing these used in all sorts of ways.

- Evan Morrow

Price: \$149



Bonesaw

Animal Factory Amplification
animalfactoryamps.com

State variable filters continue to be one of my favorite creative tools in synthesis, and recently I've been keeping a few modules in a small desktop skiff for processing any given audio source that needs additional shaping and character. During a recent trip to California, I tucked Animal Factory's Bonesaw into my backpack for some much needed creative time while traveling. Stepping away from normal life left some free headspace to dive deep into the module and learn a bit about the company's amazing work. Based in Mumbai, India, founder Aditya Nandwana leads a small team specializing in both Eurorack and pedal designs that "sing, shriek, and wail." I don't usually lean towards this aesthetic in my music, but the more I use Bonesaw, the more I realize what I've been missing. I'm truly impressed with Bonesaw's musicality, build quality, and its ability to express some very serious sonic bliss.

What's so special about Bonesaw? The first thing you notice is the panel design; it's quite striking—really visually interesting—and almost gives the impression of being etched by hand. Behind that faceplate, Bonesaw is a great sounding 6dB state variable filter, with a pre-filter drive control and an interesting FM implementation, which is fairly complex. The layout includes individual outputs for the lowpass, bandpass and

highpass filters (yes!), and modulation inputs are plentiful, allowing for flexible CV control over Filter cutoff, FM amount, and Resonance, with translucent shafted attenuators for each feature for dialing in the perfect amount. The attenuators illuminate white with positive voltages and blue with negative and this is immensely helpful in keeping track of input activity, especially in a live setting.

As mentioned, the FM implementation is unique and one of my favorite features on Bonesaw. With nothing connected to the FM modulation input, the bandpass signal output is normalled to the FM input, creating a brilliant feedback loop. This does need a decent amount of resonance to activate, but once dialed in, raising the FM amount will start to produce a magical, woozy sawtooth that can be tracked with the filter CV input and treated like an oscillator, albeit one with a welcomed instability. The bipolar FM phase attenuator will impact the sound by shifting the phase positive or negative while FM amount is engaged, and the resulting sound...well, it depends! As each filter type has a specific reaction, it's different for each setting, which is where the complexity of this module really starts to register. Listening to the lowpass output while shifting the phase slightly in either direction starts to increase the gain and become slightly more jagged and by two o'clock the glistening metallic onslaught of frequency modulation pierces and flaps

Along with FM, the drive stage helps define the character of Bonesaw. Coupled with resonance and drive, the filter really sings in so many ways, and I was surprised how quickly I landed on an aggressive sounding 303 acid line without even trying, not to mention the thick, menacing bass tones that bloom and contort. I love how it pushes other parameters around in ways that are unpredictable and creative; everything is sympathetic and highly influenced by the drive, there's so much discovery to be had.

Animal Factory's Vivisect, their four-channel CV processor/offset and noise source, connects to Bonesaw via a six-wire cable on the back of the module, expanding the capabilities and value of this filter. I didn't have Vivisect for this review, but in reading the documentation I can see how the pairing would be great for managing gain stages and summing

different filter combinations, helpful for producing a shelving EQ, comb filter and even individually tapping the drive output for straight up distortion. I really appreciate when manufacturers offer stand-alone modules that also pair with others in their line-up as it offers options to either grow or pare down. In this case, I would easily grow my system to fit both.

Bonesaw is another great addition from Animal Factory, who continue to make unique sounding instruments that have immediacy, musicality, and an impressive realm of sonics. Even if distortion is not your thing, the textures it can make are truly vast and inspiring. By the time I was finishing up the review, I had connected multiple gate signals pinging the input, which in turn, produced the coolest murmurs, glitches and fuzz I'd yet to experience with my modular. Moments like that make Bonesaw feel endlessly inspiring, and it's a unique opportunity to place a state variable filter front and center, leading the way.

- Alex Vittum

Price: \$209



ADDAC507
Random Bézier Waves
ADDAC System
addacsystem.com

For the first seven or so years of my modular playing (I just can't use the word "journey," I just can't) I was rigid, even though I thought myself experimental, flowy...loose. While I might have cut it up with 7/6, 5/19, or any other non-traditional rhythms, using all sorts of random-based triggering and gating, almost all of the modulation I used in my patches was synced to a main clock. This

makes sense to me; I'm a punctual person, I like promptness, consistency, rock-solid history. I'm one who rolls clean socks up in their matched pairs, stacked perfectly on the left side of the top drawer of my dresser. But I also like modulation, and for the longest time, I couldn't take randomness that was out of sync. Eventually, I overcame my predilection and now heartily embrace random modulation. And it's a good thing...

ADDAC System's 507 Random Bézier Waves is a collaboration between the Portuguese company and Monotrail (AKA Rijnder Kamerbeek, a Dutch artist based in Berlin), and features two channels—A and B—of, yup, you guessed it, random bipolar CV generation of the smooth kind. Each channel is very nearly a mirror image of the other, as well as independent of the other, with just a few controls overall to tweak to your liking. In some ways, it seems a bit of an oxymoron to have controls over something that's supposed to be random, but modular is all about control, so what's one to do...but join in!

The two main controls are Frequency, which sets the interval time between the random stepping, and Level, which is kind of like a VCA that adjusts the output amount of modulation. Level has a three-position mini toggle (Limit, Thru, Fold) next to it that acts like the threshold of a compressor, determining the behavior of the signal when it passes that threshold. This is a pretty neat and unique feature which offers yet another chance for variation. The Offset control moves the entirety of the modulation range, enabling you to home in on the best parts, and the Curve control is where the shape of the interpolation of the voltage changes is controlled. In Eurorack, we're used to going from linear to exponential, or vice versa, but Bézier curves, popular in computer graphics, are a different breed and look somewhat like tweaked sine and triangle waves; my two favorite shapes for modulation use. Rounding out the controls are bi-polar CV inputs with attenuverters for the Frequency and Level for each section. These CV inputs are normalled to the output of the opposite channel (broken by patching into the inputs), so while each channel is independent of the other, each channel can still affect the other, and this can make for some extra chaotic modulation; there are

jumpers on the back to turn this feature off if you wish. Colored LEDs near the Frequency control show the polarity and strength of the modulation for each channel (red for positive and green for negative), and a yellow LED to show when there's a gate output.

Speaking of outputs...there are three per channel: Gate, Wave, and Inverse Wave, and a center two-output section—AB Average and Inverted Average. The only difference between the two sides is that Channel A's gate output is steady and tied to its frequency setting, triggering with each new voltage change. Channel B's gate output, on the other hand, only outputs when the main output is positive, which is more of a random trigger, so you've kind of got the best of both worlds. Random and consistent!

With six different modulation outputs, there's a lot of opportunity to add some randomness all over a patch; and with the two Gate outputs, it's easy to sync/not sync things up to this randomness, and you can even use the Gate outs as a clock to control a drum module or something with a constant beat, to anchor the patch to 507, as there's no way to clock it from an outside source, which, of course, would defeat the random aspect, right?!

Using one channel to slowly open/close a VCA produces a random and dynamic drone, though I wish there was some way to make the wave unipolar so you don't lose sound when the voltage drops below zero. Oh wait, there is! By using the offset, you can dial in positive-only voltages. Using the other channel for some random pitching of a VCO and adding the inverse output patched into a filter cutoff to effect change, I was able to get some great sci-fi alien type generative stuff when the modulation pace was slow.

507 is more hands-on than the average modulation source, and it's fun to do some self-patching experimentation, as well as change the Limit/Fold/Thru toggle to hear the differences. Using some external LFOs to modulate the Frequency and Level added another level of complexity, though when you're talking about random, it's all complex and simple at the same time.

I found that 507 worked really well as a set-and-forget modulation source (and trigger source). Slowly evolving timbre changes, random drum triggers...anything you want random

modulation for, 507 fit the bill, and I found the onboard attenuators to be really handy—it just makes everything that much easier and more streamlined.

ADDAC System always manages to bring something new to my rack, in this case Bézier curves—something I'd only messed with in graphics programs—and "control" over random elements in a patch. These might seem like small details, but isn't that where the distinctions and beauty of modular lie? I'd say most definitely.

- Ellison Wolf

Price: \$349



P1 Pedal I/O
DPW Design
dpw.se

I've been using a lot of pedals with my modular lately, something I'd not done a whole lot of in previous months. Sometimes it's just laziness—finding the correct power adapter in a pile, the in/out cabling aspect, etc., but ever since we put out the Waveform Cat Powr module to power pedals and devices, it's been a little bit quicker and easier to get things up and running. Now with DPW's P1, their dual-channel Euro to pedal in/out module, my excuses have been running out, so I'll have to find more creative ways to be lazy, which I'm sure I will.

Joking aside, interfacing pedals with modular isn't necessarily cumbersome, but it can be a bit messy and annoying, and even though it seems like it should be pretty straightforward—patch in, patch out, etc.—sometimes levels can be hard to match up correctly, and having yet another set of mismatch cables—3.5mm to ¼" (or vice versa)—or adapters can be an obstacle to fast, and productive music-making.

DPW will have none of that, with P1 supplying two identical channels of interfacing, each with 3.5mm connections for your Eurorack rig and 1/4" jacks for easy pedal connections. There's nothing fancy going on here, nothing to figure out, nothing to control here. P1 does it all for you; it's 100% patch and play. Usable as two single mono channels or for a stereo configuration, P1 gives you 100kHz of bandwidth in both directions (to and fro!) and attenuates your modular signal going into your pedal by 18dB so as not to override the input of whatever pedal/device you're going into. Conversely, what P1 taketh away, it giveth back by amplifying the signal coming out of your pedal with the same 18dBs that were taken away at the input. Could it be any easier? No, it could not. Patch modular signal into P1. Patch P1 into pedal input. Patch pedal output back into P1. Patch P1 into modular. Sprinkle salt to taste and enjoy!

P1 is AC coupled, which isolates your modular from your pedals, so there are no power struggles between the two platforms, and it also limits your input signal, supplying some soft clipping if you're maxing out the input (anything over -4dB) to keep levels and sounds friendly. Exceeding this threshold can push the onboard limiter to get some saturation on your signal, and using P1 as a sort of fixed soft-knee compressor is a pretty nice way to even out fluctuating input levels or squash more extreme sounds. Even though P1 attenuates your signal by a fixed 18dB, I did use a passive attenuator before I patched into it so I could further sculpt the tone, deciding on whether or not I wanted to push the input for compression of a hot signal.

I've been using P1 non-stop for the past two months, and in that time during my testing I never had any problems with interfacing between any of my pedals and my modular. I also never noticed any compression coming from P1 unless I deliberately cranked the input signal (on either end) going into P1 to crush it, and then the clipping could be heard. I also used P1 as a guitar interface/DI and that worked great as well, maintaining my 12-string thrift store 70s unbranded hollow body guitar's cherished boxy tone.

With two channels of great sounding, easy to use modular to pedal I/O, no adapters needed, and nothing to be figured

out in just 4HP, P1 is just the ticket for getting some pedal action in your rig.

- Ian Rapp
Price: \$129



SE1 Shaped VC Envelope SV1 Dual/Stereo VCA Weston Precision Audio westonaudio.com

Just like how I feel that all filters should have a big knob for sweeping, I think the perfect envelope generator is slider-based; I really don't gel as well with knob-controlled EGs, as there's something that just feels right using a slider to control stages of an envelope.

Weston Precision Audio's SE1 is a module after my own heart. It has four stages of control, with those lovely yellow-glowing sliders adjusting the attack, decay, sustain, and release stages of the envelope. Each of these stages also has a CV input for modulation as well as a Gate output that goes high for the entire duration of that stage. On top of this, the Attack, Decay, and Release stages have three switchable slopes to choose from: Logarithmic, Linear, or Exponential. SE1 is highly configurable, and even the Sustain stage, which doesn't have a slope switch (flat, flatter, flatterist?) isn't left out as there's a Sustain Env input, which allows for the sustain stage to have its own dynamics before going to the release stage. This can allow for some really cool, really complex envelope shapes.

There's also a Gate input, a manual Trigger button, and both an Envelope and Inverted Envelope output. A Loop switch lets you use SE1 as an LFO, and there's an end of cycle output that emits a short pulse when the envelope has cycled through.

There's a Level CV input for patching in an external VCA to control the output of SE1, and even a jumper on the back of the module to increase the output from 5V to 8V for those souped up envelope needs.

As I said, SE1 is really flexible. There are so many ways to shape the envelope—on any of the stages—that it goes pretty far beyond what most envelope generators do, especially analog ones. You'd have to go digital and cozy up to a screen to do what SE1 can for the most part, especially when you factor in the Sustain Level Input, as it's really here where SE1 bucks traditional ADSRs and offers up something totally different.

When I was getting the lay of the land, I found it was easy to get lost using the sustain envelope if I tried to patch everything in at once. I got much better results when I configured my basic envelope shape first, and then messed around with the sustain envelope input, trying all sorts of shapes during the sustain stage. On a slow loop I'd patched up, I was able to add a fading triangle-shaped tremolo bouncing-ball type wobble to the sustain stage, kind of like the input signal was losing its balance before fading out. Add a little pinch of pitch variance to the input of my signal, and the effect was even more pronounced. Doing something similar but with a fast array of square waves via the AJH Synth Multi Burst was super cool, like adding machine gun staccato notes to a melody. Of course, using SE1 in a more traditional manner works great also, and again, I do enjoy configuring envelopes with the sliders.

The only bummer with SE1 is that it's only one channel, though you do have the two different outputs, along with each stage's output. Since, like quite a few Weston modules, their new Stereo/Dual VCA SV1, is dual channel, and it'd be nice to be able to pair both modules up perfectly. Naturally, you could always get two SE1s...

As for the SV1 Stereo/Dual VCA, as the name suggests, it is indeed two channels, Left and Right, with two different outputs each; a "vintage" style op amp-based VCA to add a bit of color to your sound, and a cleaner 2164 chip-based VCA. I really like the tone of both styles, and it's great to be able to add a little saturation to your sound without needing to patch into something else.

Speaking of patching, I normally patch my mono outputs into the left channel of whatever module I'm using. It's been ingrained that most L channels = mono, but SV1 has a unique feature where if no cable is patched into either of the left outputs, then the right outs will have a mix of both the L and R out. It's always nice to have a little extra flavor option, and this is just one of the special touches inside of SV1.

For the most part, each channel has what you'd expect from a standard VCA; Input Level control (goes from $-\infty$ to +6dB), Bias Control, and a CV and attenuator control for the Input Level. There are LEDs to denote clip/signal levels, and the left side VCA is normalled to the right. There are also a few flourishes that give SV1 something different than your standard VCA. Situated down the middle of the module between the two channels is a light up Link button for putting the left channel controls in charge of both channels. There are also some switches; one is for overdrive, which adds +6dB to the input of each VCA for a little more saturation, and there's another switch for Zero Cross Detection, which removes clicking on fast envelopes. Clicking is one of the many, many bane of my modular existence and it's nice to not have to incorporate unwanted clicking sounds into my patch when using SV1. I'm not sure the exact circuitry used to carry out this detection, but whatever it is, it works very well and I'm grateful for it.

As a normal, two-channel VCA, you can't ask for much more. No audible clicking, Bias control, and control (and CV control) over the input signal, and the two different flavors of outputs give a lot of flexibility and options for getting the perfect output, both in terms of sound and level. With a few different ways to add some color, with the vintage output and the added distortion, you can fatten up any signal that needs it. It's really nice to be able to choose which of the two outputs suit my needs at any given time, and even better, is using both outputs for a given channel and patching them into a mixer, panning hard L and R after running through effects or a filter.

Weston Precision Audio's SE1 and SV1 are great modules, with everything you need right in front of you. With excellent build quality, classic analog designs and

functionality, and with some very unique flourishes, what more could you want?

- Ellison Wolf

Price: SE1 \$190

Price: SV1 \$220



Ensemble
Morphor
morphor.io

When I was just learning guitar back in the 90s, I quickly discovered the bounty that was the guitar effects pedal world. There was no fuzz, delay, reverb, phaser, or whatever that I didn't think was cool and tried to utilize in my own angsty rock band. Even the lowly DOD FX-80B compressor/sustainer, the first pedal I ever owned—gifted to me by a friend's older brother who probably thought it was boring since it wasn't a tube screamer or something—was enjoyed by me once I figured out what it could do and how to use it. It was interesting and useful, if not overly flashy, and it's how I learned about compression. I really loved all effects, except one—chorus: that phase modulation effect that was so overused, misused, and abused in guitar rock at the time, and popularized by Kurt Cobain's usage in Nirvana. I just couldn't stand grunge and I absolutely hated chorus, wanting nothing to do with it, whether I was playing rock, or when I discovered synths and modular. At the time, I even hated that shade of purple that the Electro-Harmonix Small Clone (Kurt's chorus of choice) employs.

But you know what? I was wrong. My haughtiness and hatred were displaced. It wasn't the chorus I hated. It was the misuse of it. How do I know this? Because Morphor's Ensemble was put upon my

desk for review. Yes, I really have avoided using chorus knowingly (there was that one time I was tricked into it, not realizing what was happening with my signal...) until then. Ensemble's aim doesn't seem to be about freaking out your signal, making it sound queasy, making sure everyone knows you're using it, though it can stand front and center, too. What's so cool about Ensemble is that rather than just one control over the amount of chorus effect, like you have with most guitar-centric pedals, you have control over the stages of chorus as well. You can be tasteful with it. If you so choose.

An all-analog 8-voice BBD mono/stereo chorus, Morphor's given Ensemble a classic all-black, no BS look. There are two mono inputs (summed together if both are used) with an input level control, a dry amount control, and mono or stereo outs. The Slow and Fast LFO controls allow you add triangle wave modulation to the delay times to give it more variation, and you can control the depth and frequency for both. The Slow LFO's frequency is from 0-5Hz and the Fast LFO is 0-20Hz, so there's a little overlap there, which can make for some really groovy effects—even more phasing!—when they're not super far apart. Spread is where the magic can happen, where things can be subtle or crazy by changing the delay times between the eight voices in Ensemble. You can even add a bit o' feedback in your path for more depth, and all these controls (except Feedback) have CV inputs with attenuverters that span +/-5V. A three-position toggle switches from 2, 4, or the full 8 voices. Boom, done!

Ensemble sounds great; warm and vintage-y, and with headphones—so that the chorusing is more pronounced when in stereo—wonderfully enveloping. Using it on a pad to liven the background tapestry of a patch—in any of the voice settings—really brought my patches to life in a way that also did not overtake them. A lot of times it was subtle, but noticeable; more felt than heard, which I love for these pad-type situations. Using it in mono for subtle movement on a bass line was pretty cool as well and helped the bass cut through the mix in a pretty dense drum and bass patch I had going. I was really surprised how much I liked using the full eight voices (and in stereo, no less) for melodic leads. I usually have it in my head

that melodies are mono (sounds like a mantra), but it was cool to experiment with having a highly moving stereo arpeggiated melody envelop a patch. In one instance, I had a three-chord piano sample as the main element of a patch, and adding a modulated amount of four-voiced chorus via Ensemble—slowly spanning from off to on of the Spread effect—all while synced with some external LFOs themselves synced to a main clock, helped the track bellow in a way I hadn't initially imagined. The joys of modular, of CV, of being able to tweak every last thing: this is what it's all about! You can't get that with no 80s DOD pedal.

Ensemble is highly customizable, and it's easy to go small or to go gargantuan. You can get really crazy with the modulation of the Spread and the onboard LFOs, and it's fun to experiment with textures and spatial movement. You can even get Ensemble to self-oscillate and use it as a voice by patching into the Spread to act as a 1V/Oct input. Patch a sequenced VCO into the Spread with the Feedback cranked and you get some really interesting harsh melodies, some buzzy bee sounds.

Ensemble even displaced some of the tried-and-true delays that I would have normally used in some spots, like on a snare drum, to add a little extra to the end of the hit. It was more movement than a continuation of the sound like you'd get with a reverb. Using chorus instead of delay or reverb? What?! While I initially started out using Ensemble with the gentlemanly touch of a reserved two-voice stereo implementation, it wasn't long until my apprehension disappeared and I was going full-on with the entire eight voices of phasing. There I found myself—gasp!—phasing my input signals, chorusing in a way that reminded me of being seasick on a fishing trip years ago.

Ensemble is a really nice effect—there's so much magic here, that I am more than surprised. I can see its use in practically every patch in some form or another; it's that great of a tool. To say that I'm a convert, that I now like chorus, is an understatement. I love it. I even like flannel again, something I thought would never happen.

- Ellison Wolf

Price: \$363



Step Up Explorer's Kit myVolts myvolts.com

There's this thing in drawing, where you add shading and shadows to the "nooks and crannies"—the space between objects—in order to make a drawing come to life. Without good shading, it can look flat and unrealistic, and this technique is more than an enhancement—it's a necessity if one wants to make great drawings. Still, it's never the main focus, nothing you may never even get a compliment for. It's the details that make anything great, and I've always had a soft spot for such details. myVolts must feel the same because they've built a business on the nooks and crannies of electronic instruments; how they're connected, housed, adapted, and powered. As you can guess with the name of their company, the power issue is a big deal, and they have multiple solutions for various needs when it comes to powering devices. Their Step Up Explorer's Kit USB-C Power Supply, what could be considered their flagship product, is perhaps their boldest tool yet, a step out from the nooks and crannies and into the foreground.

The Step Up Explorer's Kit is a portable powering solution that consists of a 65W USB-C power bank, two USB adapter cables, and three Step Up Power Tips (9V center +, 9V center -, and 12V center +) to correctly connect to devices. Each tip has a small LED built into them to show power status, and the USB cables have a built in energy meter, which is pretty handy as well as being quite cool looking. Those three power/polarity options will cover most devices, and is enough to power things like an Elektron device, probably any pedal you can think of, and a smaller synth like an Arturia Microfreak or KORG MS-20 mini: basically any synth, tabletop

instrument, or pedal that takes 12V or less. There is a 15V tip sold separately that will power a Eurorack setup as well, though I wasn't able to test that out to see how well that would work, but I am curious about it. Overall, The Step Up Explorer's Kit is an attractive piece of equipment. Everything feels very well made, with the sleek black battery and colorful cable ends, and silky silicone USB cables all packaged in a streamlined black box.

I plugged in all sorts of pedals and tabletops synths for a bunch of different durations and it worked flawlessly, not just powering them, but without any buzz or added hum. I wanted to see how much I could power and for how long, and though I am deficient in the tabletop device department, I was easily able to simultaneously power a Folktak Resonant Garden and the SOMA Cosmos with the 12V adapter, along with a Meris Mercury 7, the Meris Ottobit Jr., the Hologram Chroma Console, and the Vongon Polyphrase with the 9V- adapter, using both of the included USB cables and some daisy chain cables, one which myVolts had sent along with The Step Up Explorer's Kit, and another which I had on hand. I loved not needing multiple adapters and a power strip (with an extension cord) cluttering up the space, and I actually took this setup outside (with a battery-powered guitar amp) using the Resonant Garden as my sound source, and had a nice little backyard session. Even the birds that were congregating around my feeder seemed to like it, and with no outlet nearby, it was the only way I was able to serenade the house finches and nuthatches without a big old mess of spaghetti cables in my yard. In this configuration, the 12V USB cable was reading about 15W while the 9V pedal USB cable stayed around a 4W power consumption rating. I played with this setup for almost three hours continuously until the battery fully drained and the 12V devices started to go dark. With the power pack on empty, I plugged it in to charge before bed and woke up to a fully charged battery.

I will probably end up ordering the 15V tip as it would be great to power a modular rig outdoors using The Step Up Explorer's Kit. Of course, there are other options to do all of this already, but having a centralized way to power up various pieces of equipment is great. The Step Up

Explorer's Kit is a versatile and reliable way to power many things, a great tool for the mobile musician, whether you want to take your show on the road, the backyard, or to just make it easier to move off the couch to a different part of your synth dungeon.

- Jason Czyeryk

Price: \$149



Wrinkler MKII Noise Lab noiselab.se

Noise Lab's modules have a look that is unmistakable; just that little bit of red on a faceplate sure goes a long way, and with the black and white, it takes me back to the early 80s when that color combination was all the rage thanks to Michael Jordan's antics on the basketball court in his famous sneakers. Wrinkler MKII is the second incarnation of Noise Lab's wavefolding module. Symmetrical and more streamlined than its predecessor, it boasts an all-analog signal and various filter modes and modulation options, making it like a souped up, specced out version of the West Coast classic circuit, with two different types of folders that are laid out in series.

Wavefolders work best with less harmonic information at the input (makes sense if the goal of wavefolding is to add harmonics, right?) so Wrinkler II has a filter at the input to help clean up more complex signals. It has three different types (one of them is 0, no filtering applied) and the other two are mysteriously unspecified in terms of their type or structure, but this just means you need to use your ears to decide what works

best for you. There is a gigantic Fold knob with three available folding modes, A,B, and C, where A is for primary folding of up to seven folds (for the prototypical West Coast wavefolding experience). B is for secondary folding—for adding more folds—controlled by the Gain knob, which can also be modulated with external CV. Mode C is a clipping mode that squares off the top of the wave, creating sharp edges and sharper tones. This clipping mode is really interesting and took me into new wavefolding territory. I can't say I'd never heard the sounds before—how do you differentiate one sharp, buzzy sound from another?—but I'd definitely not seen such harsh spindly waveforms on my oscilloscope by using this method before. MKII also has the Symmetry control, which determines where in the wave the folding takes place. This can have an interesting effect on the folding and the resulting sound, and this can be modulated with CV as well.

You're able to mix the Dry input signal with the folded signal which is another nice touch, as are the two available CV inputs for modulating the foldings of Folds A and B. There is also a Feedback control, rounding out the features on MKII.

The dual folding capabilities of this module make me wonder how far down one could go with wavefolding. Triple folding? Quadruple? More? Eventually I'm sure you would just get some sort of colored noise, but the dual folding-action (it sounds like something a laundry detergent would brag about) when used in a subtle fashion brings a lot of interesting folding. You can get some really nice, soft detuning with a combination of subtle modulation using basic LFOs into both of the CV modulation inputs for the folders, nice for melody lines; drop your input signal into bassline territory and it's instant magic for creating gritty bass lines that cut through a thick mix, and changing from one basic waveform to another at the input can yield dramatically different results, while still retaining the nuts and bolts that make it stand out.

Folding something through the first folder and modulating that wave with some sort of slow-ish moving periodic wave, and patching an audio rate signal into the Gain CV and you can get some nice AM-ring modulation. I used some square wave random LFO for this and that

was pretty great. I realized though that I only liked really minute amounts of periodic (sine, square, etc.) waves for modulating any of the parameters, and really preferred things at audio rate or a random LFO, to bring about changing forms. A lot of the time I spent switching between modes and filter styles just to see what would strike my fancy. It was a lot more experimenting, hoping to stumble on to something, than it was determined, intentional patching. It was especially hard to guess outcomes when modulation amounts were cranked and I was using the aforementioned audio rate and random LFOs, which made for a lot of unique sounds. I also found myself patching a pulse wave into the Gain modulation for use as a VCA, to capture some chaotic noise bursts coming out of MKII. This often resulted in choppy, helicopter-y lines with a flair for formant-like qualities, and this was really exemplified when in C Mode, where the clipping squares the top of the signal.

Wrinkler II is fun to experiment with, with its myriad of ways to shape, shape more, and further shape waveforms. It's definitely easy to lose one's way—as I did many times—and I found that subtlety was the key. As I said before, it's easy to just patch to the hilt and get into noise territory, which can be great, but it's when I showed restraint—not my strong suit—that I was rewarded the most, especially when it came to basslines. As for basslines, MKII has become my de facto bassline generator ever since I racked it up. Either way, whether it's a sine, saw, square, or whatever, there's nothing Wrinkler II can't fold and manipulate into a useful buzzsaw, a squelchy howl, or the best bassline you've ever heard come out of your rack.

- Evan Morrow

Price: \$328

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AI024 X Filter
AI Synthesis
aisynthesis.com

The Curtis CEM3320 IC was a much loved VCF-in-a-chip in its 80s heyday. Known for its smooth operation, it was used in a whole heap of classic synths: Sequential Circuits used it in a bunch of theirs, the Crumar Spirit employed it, the PPG Wave 2, the LinnDrum and Linn 9000, a handful of Oberheims, and on and on. This 4-pole 24 dB/Oct low pass-filter is what gave so many of those synths a large part of their character, their X factor. AI Synthesis has taken that chip, or a modern reproduction of it at least, and followed in their footsteps/circuit paths, with their new AI024 X filter.

AI Synthesis already has one filter in their line, the AI0004 OTA filter (the same structure found in the KORG MS-20), so adding another with a different flavor is a nice addition. Looking at the AI024 X filter and its two PCBs, it would make a great DIY project for a beginner or seasoned pro. There's plenty of space for all the through-hole components without the need to cram anything, and the kit even includes chip sockets for the 3320 IC and the TL074 op amp. If you've ever fried any chips soldering them directly to the board, you too will appreciate these chips, which can save you some heartache. The module I received for testing came pre-built, so there were no tears or wounded chips on my end, but so long as I was even remotely confident with a soldering iron, I wouldn't hesitate to put this one together.

There's not a whole lot to the architecture of 024. There is a single Input and Output, and for controls there's a Cutoff and a Resonance, with CV inputs and attenuators for both. 024 can self-oscillate and you can use it as a trackable VCO with its 1V/Oct input for this purpose, though you may have to calibrate it via a trimmer on the back of the module, as I did. It took a minute to dial this in, as noted in the build guide, but the calibration was pretty simple.

While there's nothing extravagant here—no crazy faceplate design or flashing lights—024 doesn't disappoint with its sound:

it's smooth, like butter. It also seemed to hold on to lower notes better than a lot of other filters, with the low end of my signal being mostly retained. Modulation of the Cutoff CV with a sawtooth wave for both the input signal and modulation signal, and with the resonance high, 024 produced some beautiful filter sweeps, slightly stepped with plenty of character and an overall warm tone. While 024 doesn't necessarily howl, it can definitely produce some nice whining; two words not normally associated with each other, but sonically pleasing in this instance, though if you want a growly, mean filter, you might want to look elsewhere.

I found the controls on 024 to be really responsive, and unlike a lot of unruly filters that are out there, it was very reasonable to handle and satisfying, too. There are a few sweet spots here. My favorite being in the top end of the frequency sweep with the resonance at a moderate amount, at the point where 024 would just start stepping out; literally and figuratively. It steps so nicely, it's no wonder all of those famous synths of yesteryear used the 3320 chip in their designs.

Abe Ingle keeps adding excellent, classic-based modules to his AI Synthesis line. Whether you're just starting out looking to DIY your modular into existence, or you're looking for more flavors in the form of a VCF to add to your rig, the AI024 X filter could be your X factor, too.

- Ellison Wolf
Price: From \$15-\$140

The image features a large, solid black oval watermark in the center. Inside the oval, the text "AISYNTHESIS.COM" is written twice in a bold, white, sans-serif font, once on the left side and once on the right side, with a thin black outline separating them. The background of the entire image is filled with a repeating pattern of the same text "AISYNTHESIS.COM" in a smaller, gray font, creating a dense, textured appearance.

AI Synthesis



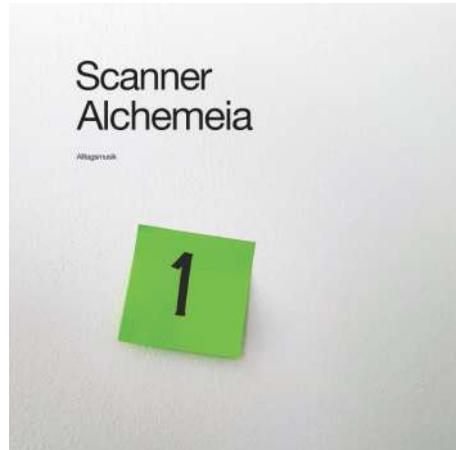
MUSIC REVIEWS

by Tom Ojendyk



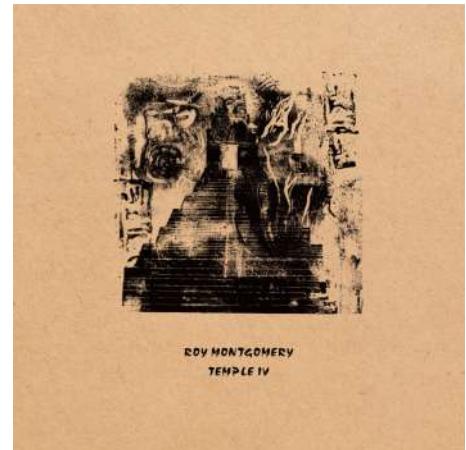
Christina Kubisch & Trondheim Voices *Stromsänger* Important Records

German composer and sound artist Christina Kubisch has been performing since the mid-70s and this collaboration with Norwegian vocal ensemble, Trondheim Voices, was inspired after researching and recording electromagnetic waves in Trondheim. Based on the theme of sounds which travel, Kubisch wore custom made induction headphones and was able to hear the electromagnetic fields of the tram she was riding in. Inspired by the sounds, she recorded them and had the vocal ensemble listen to and respond to those tram sounds and she then mixed everything at her studio. The recordings were played through a church's loudspeakers, recorded, played back, and re-recorded several times, which made the vocals sound ghostly and sublime. Aside from having a fascinating concept, the results on *Stromsänger* are stunning: the music is grand, powerful, and rewarding. The two pieces are around twenty minutes each, but the music is intricate and flows well, which gives it a sense of movement, and is quite gorgeous.



Scanner *Alchemeia* Alltagmusik

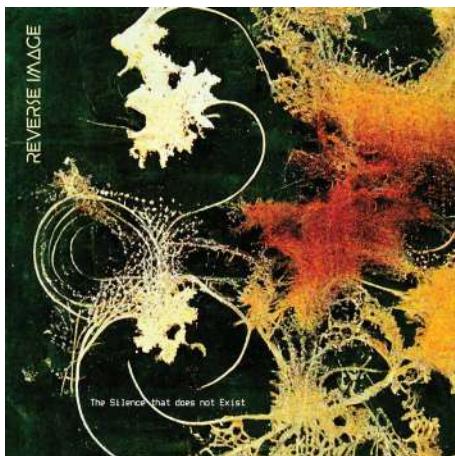
British artist Robin Rimbaud has been creating music under the Scanner moniker since the early 90s and his debut release on the newly formed label Alltagmusik, is a tribute to the whacked out and mysterious sounds of 60s and 70s library music. Library or production music is music of all styles that's produced and owned by music companies with the main purpose for licensing to film, televisions, or commercials. While it's intended as background music, crate diggers and music producers have rediscovered it over the decades, since the music can be extremely listenable; plus, it's fascinating how composers would slip avant-garde ideas into a music piece that would end up in some random commercial. Rimbaud's tribute focuses on the electronic side of library music with mostly short pieces that are reminiscent of something the BBC Radiophonic Workshop would have done decades ago. The music doesn't feel overly nostalgic, though, and the sparse pieces are forward-thinking, tuneful, and create certain moods, which is exactly what library music is supposed to do.



Roy Montgomery *Temple IV* Kranky

Roy Montgomery is one of the initial practitioners of New Zealand post-punk with his early 80s band, the Pin Group, being the first band to release a record on the brilliant Flying Nun record label. After the Pin Group dissolved, he later had the great bands Dadamah and Dissolve as well as other significant projects and solo releases. *Temple IV* was his second solo release that originally only came out on CD back in 1995, and is thankfully finally getting the vinyl reissue treatment. The music is guitar-based hazy and semi-lo-fi instrumentals, recorded on a 4-track with some added monophonic Moog to thicken up the sound. Introspective and almost cinematic, it's often pegged as post-rock even though he doesn't utilize that genre's clichéd overuse of crescendos and decrescendo; instead, this music is thoughtful and full of texture, though minimalist at its core. Montgomery continues to make brilliant music and his catalog is vast, but *Temple IV* is a great place to start.

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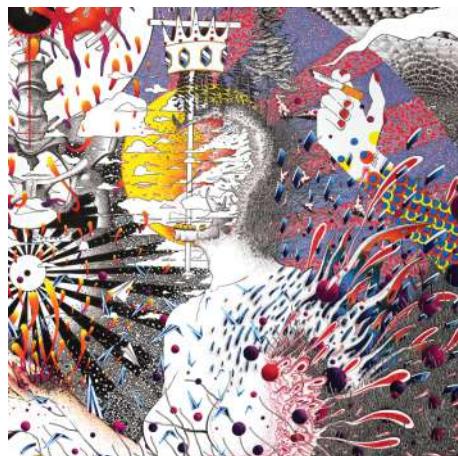
Reverse Image
The Silence that does not Exist
Khatulistiwa

Fascinatingly warped sound blasts from Malaysia, Reverse Image is sound artist Yng-Yin Siew who was previously behind the excellent Mirror Tapes. This is her debut on the Kuala Lumpur-based label Khatulistiwa. Using digital and analog equipment, she deftly mixes ripped experimentalism with pulsating madness that doesn't sound overly busy or convoluted, but instead rich, alien, and at times, a bit creepy. Some of the sounds are quite jarring, but everything is so well-placed that while the sounds may clash, they still sound deliberate and purposeful instead of just random chaos. Besides being a record label, Khatulistiwa is also a music venue and recording space and has released several other cool recordings by underground Malaysian artists like Yong Yandsen, Richard Allan Bates, Yii Kah Hoe, and Topman Chong. Siew also has an intriguing noise/industrial project called Fallen Sun, whose latest release on Fourth Dimension is worth checking out as well.



Lola de la Mata
Oceans on Azimuth
Self-Released

Conceptual sound artist, musician, and composer Lola de Mata developed tinnitus and vertigo and was told to give up music; instead of following that terrible medical advice, she decided to record her tinnitus and use that as the inspiration behind these compelling compositions. I had no idea it was possible to record inner ear ringing but biophysicists did just that, and you can hear it on the tracks "Left Ear" and "Right Ear," which, at least to my ears, sound like pleasant minimalism that's not too far off from a Phill Niblock track. For the other tracks, de Mata used various glass and metal instruments, stringed instruments, a theremin, an ear canal-shaped gong, voice, field recordings, and other gizmos for these deeply exploratory and vibrant soundscapes. Definitely experimental; the detailed sounds on *Oceans on Azimuth* are complex and captivating, making this a very intriguing release.



Adam Wiltzie
Eleven Fugues for Sodium Pentothal Kranyak

Adam Wiltzie co-founded the brilliant ambient duo Stars of the Lid with Brian McBride, who sadly passed away in 2023. Wiltzie's new solo release of magnificent ambience, *Eleven Fugues for Sodium Pentothal*, may result in total relaxation and drowsiness, as its title suggests. Mixed by Robert Hampson from Loop and Main fame, the music may seem familiar to those who have heard Stars of the Lid, but Wiltzie is a master of his craft and the pieces are detailed, concise, and moving. The opening track is the longest—over eight minutes of drone bliss—while the remaining pieces are under five minutes, but still very thoughtful and powerful. The pieces all have their individual sound, but everything flows together well. *Eleven Fugues for Sodium Pentothal* is a reminder of how great Wiltzie is crafting some of the most beautiful ambient music out there.



Albert Yeh
Motors/Pulses
Dragon's Eye Recordings

This is the second album by Bay Area-based Albert Yeh, who also plays in the fine experimental metal bands Lotus Thief, Forlesen, and various other projects. He cohesively blends electronic music, classical, progressive rock, drone, and other styles in this release, which exudes a sort of heaviness that's unique and captivating. Albert noted that the album "explores feelings of dread at the hyper-acceleration in society following the end of lockdown," which explains the darkness in some of the music, but the results are still appealing without sounding overly bleak. *Motors/Pulses* is a very cool release with a nice variety of styles.



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I had some experience before, building things like desks and speaker cabinets. The ET-3s were made out of wood that just came from a big box store, but once the business became my full time job we started doing prototypes where we were staining this cheap wood so it would look like walnut. But there's a truth to the instrument... Melissa wanted to know what was stopping us from using real walnut? It's not much more expensive when you buy nice hardwood from a sawmill, and that's when it comes almost right out of the tree. But it's wavy, it's not guaranteed to be straight, and it's in no particular dimension, so the problem is that you then have to turn it into a perfectly dimensioned board. I didn't know how to do that at the time, and I didn't know what tools were involved, but a friend took me to his shop and ran through the whole process and showed me how to do it. With woodworking you need your own tools, and you need to learn how to fix and adjust them so they're accurate to get them to work properly. I started with a lot of vintage machinery, so those tools all needed to be cleaned and restored before I could even use them. So there are three or four levels of learning until you're actually ready to turn a board into a properly dimensioned piece of wood. When I do it, I'm doing wood for an entire batch of instruments that I'm going to do for that next year or a year and a half, so I'm just in woodworking mode for three months. You put some music on and then you get to use all these tools that you know that you've adjusted to run as smoothly as possible. I love that part.

I saw that you guys have special cases for the Therevox. Did you design those as well? Did you throw them out of the back of the Subaru, too, for testing? (laughs)

With the ET-4 we designed a case that was

a really nice, aluminum, tweed and wood, and I was making those myself. That was a really hard process, a lot of cutting, gluing, and riveting, and it got to the point where, since I was making these cases, I was cutting into time I could be making the instruments. I'm always hesitant to get somebody else to do something because I want to be the person that's building these instruments; I love doing it. But I didn't love building cases, so for the ET-5 we found some people in Quebec that could build a case to our specifications, because we're pretty picky about every little detail.

I'm noticing a certain thoroughness of thought and processes here. (laughs)

I might come across as somebody that does a good amount of planning, and maybe I do with the Therevox, but with other stuff in life...we go somewhere and I don't even know where we're staying. But Melissa, she's one of those...she's a spreadsheet person. If we go on a trip, she's got a spreadsheet that's got the details of our flights, lists of all the cool things that we can do in certain areas...She runs a hospital laboratory in Vermont, and she brings that lab tech attention to detail. It's something that I try to aspire to when I'm in my electronics laboratory. I try to treat it the same way that she might in her medical lab.

I know you mainly build these by yourself. When you do a new batch of instruments do you have an order, steps that you go through? Do you ever look at it like, "Here is the next year and a half of my life all lined up in synth building steps!" Sometimes I find planning in that way absolutely necessary, and other times a bit hard to stomach.

I would have thought by now I'd have this giant checklist for starting a batch with exactly what I need to do in order, and then I'd just go about doing it in that exact order, but there are only some things that need to be done in a certain order. There are a lot of days where I can just say, "Today I want to solder." If I'm getting into a real groove with soldering, then I might be soldering for the next three weeks until I want to go do something else. With the woodworking, the whole shop turns into a woodshop so once that gets started that just keeps going all the way to the finishing

of the instruments. But that actual task, I can slot into whenever I actually feel like it. And then there are some days where I'm just not feeling it. I don't give myself scheduled weekends, so I'll work until I can. That might be eight days in a row, but it might just be one day because I don't feel like it, I just want to go mountain biking because it's gorgeous outside.

You could take some time off and ride across Canada again, but from east to west! You said that you recently relocated to just outside of Montreal. Was it difficult to move the business?

The space is about half the size of what the old shop was, so it took a lot of drawing everything out on the computer and digitally moving every piece of equipment around until we got to a layout that worked in the small space. My last shop was an old welding shop that was abandoned when we got it so there were big puddles of water on the ground. That space was how I learned to do electrical, how to put up lights, and how to put in walls.

How did you learn to do all of that?

I ran a business for six years repairing tube amps and somebody brought me an Ampeg bass amp, which had caught on fire. It was like a 300 watt amp and had six huge tubes in it. This was when I had just got the first shop and I still needed to learn how to do the electrical work, and he was an electrician so I told him, "I'm going to try to fix your bass amp, which has been burnt to a crisp, if you teach me how to do electrical in the shop." So he showed me how to wire a panel, and lights and stuff, and I ended up diving into this amplifier where I had to replace every trace on the circuit board that was burnt off with hand bent wire to get it to work again.

That's a lot of serendipity. What were you repairing for that business?

It was mostly vacuum tube guitar amps, but once you're known as the guy that repairs things, people are coming to you with pedals, keyboards, synthesizers... Every one is a cool learning experience so you don't want to say no to them, and you end up digging into almost anything people bring you. You learn a lot by taking things apart and also seeing how a lot of things fail. That's why I loved running the

repair business. Everything was coming to me and I could see what the designers could have done better.

I saw that your new shop is near an apple orchard, a river and a bike trail.

Yeah, we're pretty lucky. There's some mountain bike trails just on the other side of the border in Vermont so I've been checking those out. All around this area of Quebec, almost all the roads are dirt or gravel roads, and I've been really enjoying those on my bicycle.

I'm a bit of an apple fiend, specifically local and hard to find or older non-grocery store varieties. How are the apples in the orchard near you?

There are seven apple trees behind the shop and every time I walk by I pluck an apple and eat it as I walk. It's so satisfying to do. They might not even be good apples, but in that moment they're amazing.

It's so much more than just the apple. The experience of connecting to the land from the ground up...It's an interesting parallel, picking an apple and eating it from your own backyard, to your process of building a new Therevox almost all by yourself, a lot of it from the ground up.

There's definitely something to it. I don't even know how to describe it, but it's probably baked into our primitive brain to do something like that, to pick a fruit right from a tree and then eat it. But so is making things out of wood. And so is making music, right?

therevox.com



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Symmetry is very appealing to me, and for several modules I've made, there are two channels, so starting with symmetry as the

core of the UI/UX design seems right. Then it's a matter of deliberately moving things out of symmetry that make sense to be that way. But even if the module is not a dual-channel thing, there are still symmetry planes that can be drawn between it and an adjacent module, for example. I'm trying to think about the flow of connecting these things together and the convenience of getting to the patch points that will get used a lot.

Is there anything special about your aesthetic, specifically the yellow knobs?

For me, it's always been about laying out functions so that they are logical, aesthetically pleasing, and so that there's enough room to use the module. I'm a really big fan of classic designs from the 50s, 60s, and 70s, and think that plays into the way I design things. There are a lot of timeless design cues which can be found by looking back at mid-century houses, furniture, and electronics. I like the idea of things lasting and being timeless. We live in such a throw-away culture that I like to try and fight against that by making modules that I hope people will use and enjoy for many decades. As far as knob colors, there is a very general grouping scheme where groups like an oscillator's fine and coarse knob get gray knobs, and the FM or CV attenuators are yellow. The actual color choices come from a simple kind of design school where you choose a base scheme and one accent color, and this can apply when designing a webpage, for example, but it also works for physical products. In my case, black and light gray are the base, and yellow is the accent color and that becomes the palette that constrains the design and ties the look and feel of the product line together.

What is the manufacturing of your modules like? Is it all done in-house?

Right now I'm still bringing in populated PCBs and doing hand assembly and calibration in my little shop behind our house. I'm getting to the point where I need more shelves and space to keep all the parts I have to buy in bulk. I'm also getting to a point where I would like to have more time for new module R&D rather than building products, so this is something I'll have to eventually figure out, but for now it's working OK. I did start training my

wife, Christen, how to solder properly so that she can help me do a larger run of modules if need be.

What is your process for a new module? What's your criteria?

If it's something that interests me and I think has some unique differences from something that's already on the market and could be useful, then I'll try and make it. Sometimes it hits better than others. With SE1, my all-analog envelope with sliders, I kind of stepped back and took a fundamental thing and started messing with the envelope. I wanted to do CV control and be able to change the shape for the attack, decay, and release independently, taking something that exists, and packaging it in my own way and adding something a little different than what's already out there...It's very hard to come up with anything 100% new. It's like music: There are no more original ideas, right? There's only twelve notes.

At least for a Western music scale. That's kind of a depressing thought, in a way. How do you not get bogged down by it? How do you fight through it to still try and bring originality into something you think is already played out, that's been done many times before?

You're rehashing something at some point, but that's okay. It's a circle. Something even slightly new is still new...

What do you think about that idea in terms of drumming? Do you feel like your mindset in that way has changed as you play drums longer? I used to look at bands and musical artists—artists in general—and I would try to glean something that I could use for my own music or art. I don't really do that anymore and I don't know how I feel about that change. Have I grown into myself? Am I jaded? Less passionate? I don't know.

I totally agree with you. In my experience that becomes less important and you get a more holistic view of things. Just because you put a new pedal in your rig or put on new strings really doesn't matter to the overall effect, it's the music that's being created. All of those things have changed over the years, and the same with making modules too. Sometimes I see a new

module come out and it's a shiny thing people want and I don't really understand it. First I want to be like, "That's BS!", but then I sit back and I'm like, "Well..."

I want to talk about the H1 Analog Harmonizer. I feel like it's your first module that actually has functionality behind the faceplate that needs to be figured out. When I was doing my testing of it for issue 12, I realized the harmonizing capabilities are right on the front, but when you get into the quantization stuff, it had things I had to remember or reference the manual for, and it felt like a departure from your previous modules.

I know. It's way more complicated than a lot of the stuff that I've made, maybe even too much. It was the first digital thing that I've done. It's how I feel about digital in general: You think about what you could do with digital that would be difficult or impossible with analog and it just starts rolling. That was a challenge though, because some digital modules have a screen and I didn't want to do that because it would become vastly more complicated. You also don't want to overwhelm the user as far as what options are enabled, so it's something I try to be mindful of, and something that reminds me of my core ethos about being hands-on. You should be able to see what a pot or a switch does and not have it be confusing. That's what modular is really cool for, in that it's all out there and patchable. I think if I do more digital things, which I definitely will, I'm going to try to do it so that you don't even know there's anything digital back there. There's a reason you're not on a computer in the first place. If you're on a Eurorack system hooked to some Junos or some Moogs or something there's probably a reason you're doing that, and it's not to be encumbered by digital complications. I could go down an engineering rabbit hole and think about all these crazy features that could be done, but I have to remember that it's people that are actually using it to make music. That's important.

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that you could make your modules fit in terms of the functions you wanted and available space?

Some people want modular to be experimental. They're happy to spend a month on a patch, with a synth the size of a house, and that's great. For my bit of modular, I think of it as a recording studio in a suitcase—a flexible modular groove box. There's always been CV and gate for mono synths, and then MIDI came along. I have a love/hate relationship with MIDI, in that I think it's over-complicated. If I could write a standard for MIDI in modular, I would just abolish MIDI channels, so you would just need a TRS cable for each part that would send polyphonic messages no matter what. Then you would always get what you expect to get, like with CV/Gate. I believe that for modular we should be dumbing MIDI down instead of reinventing it.

You seem pretty intent on getting MIDI to work well with modular, or at least be easy and play nice with it, and I'd say you've been successful so far, especially when considering features like the dynamic temperament, which adds some humanness to it all.

The original analog synths were real buggers to tune and that's what gave them their sound, their charm. I'm putting back in some of the seasoning, the flavor, that got lost in the pursuit of perfection.

It almost sounds like you're trying to perfect the amount of imperfection in regards to MIDI-derived polyphony in modular.

You want to shine the torch on the bits that are important to you, why you're putting your effort into it. I've grown up in this electronic world where everything I'm doing is digital: digital imagery, digital

music. I've spent my whole life trying to make fake things look real, or make fake things sound real. I suppose maybe that applies to what I'm doing with MIDI.

You seem to be very good about closing one chapter in your life and moving completely on to another one.

Yeah. I think I'm still using exactly the same bits of my media brain. I don't feel like I'm doing anything different, really. The older I get, the more skills I learn; I can do all these things now. It's been quite circular, going from synth building to making music to making film, and now back to building synths again.

I was walking through my neighborhood the other day and the cherry blossoms against the clear blue sky made me think of your modules; it's almost the same pink and blue color scheme that you use, but when I was looking at your lineup of modules I realized that Pianophonic doesn't have that pink and the blue motif. Are you thinking about moving away from that color scheme?

To some extent I am. I'm bringing out black "Dark Mode" versions because they sell more than colored ones. I think the pink and the blue are fun colors, it's part of the look, but when it came to Pianophonic I decided to go for more of a classic feel with triple stripes representing piano strings.

It's important to listen to the market, right? You need to pick your battles.

Yeah, you do, but the original reason I made it pink and blue was because I didn't expect to sell many of these and I thought if I did sell some, then it would be fun to be able to spot them in racks easily. I still get a buzz when I see one out in the wild. Although I've caved to market forces, the colors will always be released first.

You could always do colored knobs, little flashes of pink and blue, something that's easy to replace for people if they're not into that color scheme.

One of my policies is to not encourage people to disassemble my modules because you will get people saying, "This (module) stopped working." It's because they pulled the knobs off and the module

flew across the room and a component fell off or something! I don't want that responsibility. I did, however, just bring out a mirrored Kickain, and treated it like a rare pair of trainers, with a random product drop.

What prompted you to do a kick module?

Kickain is one of those things that you design out of necessity. I couldn't find the right kick drum for my sound, and I was also using up a precious compressor module and I thought, "Why don't we just fuse the whole lot into one?" It seemed to make perfect sense. The name was like, "Should I call it sidekick? Someone's probably already done that." And then it was "kickside, chain kick, kick chain, kickain!" It sort of appeared just like that. Kickain is the first of my drum section; I've got a lot more work to do in the drum area, so those are modules to come.

Back in the 90s in the UK, the rave scene was huge. Were you into it? Has that influenced your module designs at all?

I worked with Tech House and Breakbeat DJs in the 90s and fell in love with the extended 6-8 minute music format. It was a welcome alternative to the 3-second pieces I was writing at the time, but I didn't really get sucked right into the rave scene at that point. My wife and I holiday quite a lot in Ibiza, so throughout the 2000s, we kind of got into the second wave of the rave scene. I absolutely love the whole clubbing sound: the sound systems, the beats, the culture...Back in the day you had a DJ and they would show up with a case of records, but now it's just a thumb drive or microSD card, so small and so easy to lose. The DNA of Knobula is kind of there for the groovebox people, the DJs who show up with some kit, and I think there is a growing trend for a DJ to show up to a gig with more than just a USB stick. It's a bit of a throwback to the old days, only now you have a case and it's got a drum machine and some bass sequences and stuff in it. We're starting to see big DJs like Onyvaa and An On Bast doing these amazing hybrid sets, and working with DJs and artists is a core part of my work at Knobula. I'm less selfish with my product development these days! I've teamed up with synthwave duo Kasablanca on Echo

Cinematic, and also recently released a special version of Kickain for Techno DJ Sarah Sommers that features patch presets. Modular is the perfect way to extend outwards from your twin turntable setup with the mixer, and then expand—to augment it, creating these new instruments that you can perform on. That makes perfect sense to me, and Knobula instruments are very much designed with this in mind.

I want to talk a little bit about manufacturing. Do you handle that entirely?

No, I'm not very good at repetitive tasks, though I could solder before I could walk and I like to build all the prototypes. I don't know whether that's an undiagnosed ADHD thing, but I just get bored easily. Also, I'm quite a forgetful person, so when I'm assembling things I do it in total silence with no distractions, otherwise I make mistakes. Each product requires a time investment, but also you've got to build them, and sell them all, so that's been a whole new process for me as far as running the business. All my life I've provided services for people, I've sold my time on my own, and I've never really sold my wares, sold a product, so I'm learning as I go. Knobula features lots of different people. I coded Kickain and Poly Cinematic myself and I learned a lot from those processes, but some of the heavy lifting, like in Pianophonic, was developed by a team, and Chord Pilot was as well. Packing three wavetable oscillators, a sampler, eight voices, and all of that into a Daisy (for Pianophonic), I had to farm out. It required quite a high-end programmer, and that was actually quite painful to do; it was expensive, took a long time, and I still wound up having to troubleshoot it and do a lot more design work myself. But working with Electrosmith and using their hardware takes a massive weight off my mind. I don't have to worry about how to get the power to the product or getting a processor to run nicely—all the kind of stuff that's got nothing to do with DSP. That's all done by other people, so I can concentrate on the creative side of it. I'm really lucky in that; I couldn't have done it otherwise.

knobula.com



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integrated into the online platform, so there are things to explore and discuss for the members.

I think that sounds nice, a good place where people will be able to connect with one another. You also have *The Minimoog Book* coming out soon as well. Did the author, JoE Silva, come to you and present this idea, to ask if you would publish it?

I was talking with some people at Moog and they connected us. It's the first time we've ever done a book about only one thing. There are many Minimoogs; there's the Model D, the prototypes, the Voyagers...The author has compiled interviews and material from over a decade, and it's super cool to be able to present it together with amazing photography. For example, the Minimoog prototypes have never been photographed in such detail. It is the ultimate Minimoog book with a lot of history and insights and never before seen or heard material. I think it's an important document of music history and I believe we've done our very best work ever with this book.

How do you determine what content to leave out when you're editing? I've always felt that was the hardest part of publishing. Everything seems interesting to me.

There's this quote from a French designer, (Antoine de Saint-Exupéry), something like, "design is not what you put on the page, it's actually what you take away." (Ed. - "A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away.) I think it's super interesting, because that's the thing with music, right? You can overcrowd your piece with sounds and

CONTINUED ON PAGE 78

CONTINUED FROM PAGE 77 frequencies and notes and stuff, but too much drowns the message. That's something I work with a lot in terms of the books—cutting anything unnecessary away; cutting to the bones.

There is an elegance to being as minimal as possible while still getting your point across that I love, and I love the editing process for this reason. Is that the same for the photos in the books? How intense is the photo procuring process for you?

It really differs from project to project. There's two parts to it: there are the product photos like in *Patch & Tweak*, *Pedal Crush*, or *Inspire the Music*, where the manufacturers usually have photos that we can use, but often we need to license or commission photos, which takes time. With *Synth Gems 1*, the EMEAPP (Electronic Music Education and Preservation Project) team did some photos and additionally I traveled to Switzerland with photographer Peter Mahr, where we did most of the photos on colored backgrounds. For the interviews, it's a different game; some artists have press photos, they have a friend who's a photographer, or there's something in an image stock library. It's a puzzle, definitely. *Patch & Tweak* had over 700 modules and *Pedal Crush* had the same amount of pedals, so it's a huge amount to do, and I also spend quite some time in Photoshop.

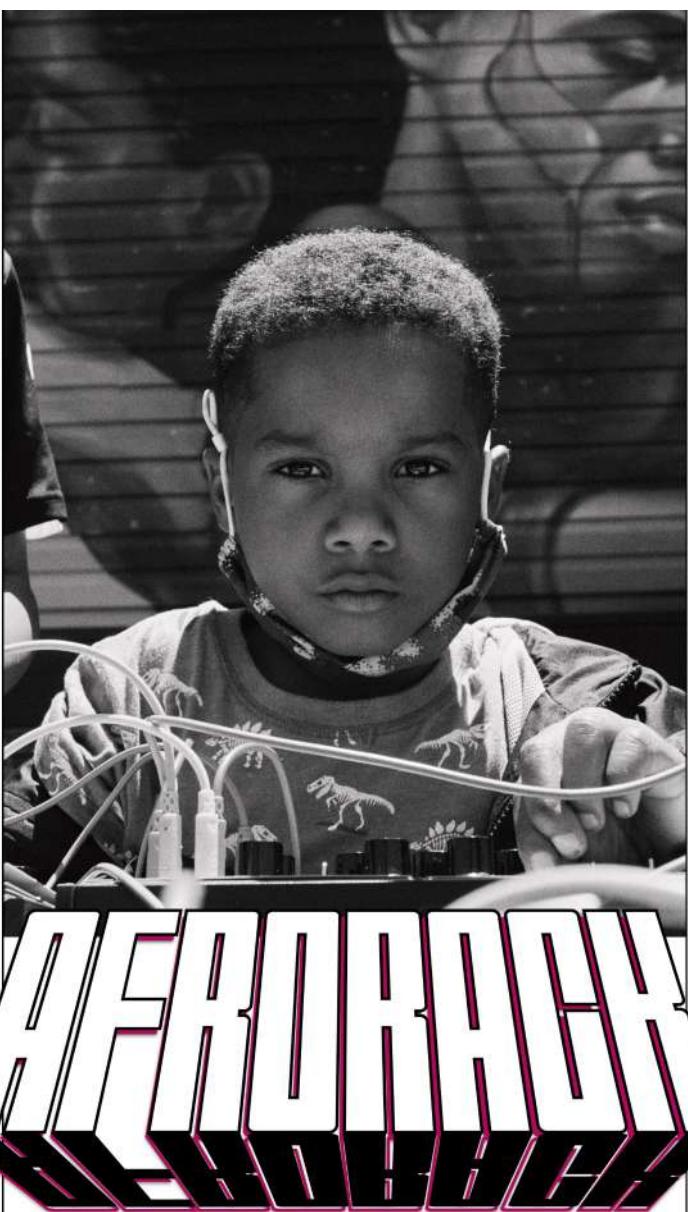
What's the most challenging aspect in producing these books?

It's a balance; you can't head a company and still be down in every detail. However, doing the design, I actually do go through every detail. I go to the printers, proof the colors, and adjust if there is stuff to be adjusted...it's a lot. Getting the Euro pallets of books shipped to different countries, getting the books into stores...I think the most challenging thing for me is doing things that I find boring, like accounting. It's not a walk in the park to do these books, there are challenges all the time, but there's not a lot I don't like about it. People know the books, and they can see the quality. That's super satisfying, and a testament to how we work.

Overall, what aspect of the whole production process do you find the most rewarding?

When pieces start to "fall together," meaning, when we have maybe around 75% of the material in a state where the layout and the structure are starting to make sense. Obviously, when the first paper sheets come out of the printing machine at 10,000 sheets an hour, that's always exciting, but mostly nerve-wracking! The ultimate reward is always when readers come up to us at trade fairs like Superbooth, SynthFest, or Knobcon and tell us how much they appreciate what we do. To me, that just makes me happy to the core.

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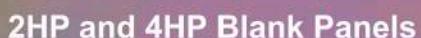
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SYNTH HACKS #13 MINIMO SAYS "I DO" TO THE CRE8AUDIO WEST PEST

BY DAVID BATTINO
BATMOSPHERE.COM

Man, I really like the sound of my Cre8audio West Pest: complex, woody, and alive. Every nudge of the wavefolder knob creates so many spicy variations it's hard to choose where to stop. When I posted a video of my electronic fidget spinner playing a bass line on the Pest (see Synth Hacks, Waveform issue #12), it got a million views on Instagram. But as a former brass player, I really missed having an attack envelope. The Pest makes endless West Coast plucks, but to swell the start of a note, you need to add an external envelope generator.

Enter the Enveloop miniMO, perhaps the world's tiniest modular synth (minimosynth.com). Developed by composer

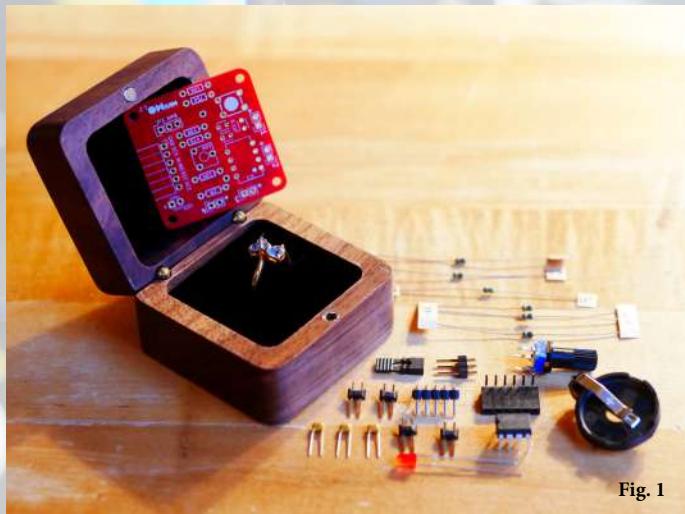


Fig. 1

miniMO modules cost just \$24 shipped, or \$15 in kit form. I mounted mine in a wooden ring box, adding external jacks and USB power, though it runs happily from a 3V coin cell, too.

Jose Luis Gonzalez Castro, each module is small enough to fit inside an engagement ring box (see Figure 1). Jose offers sixteen modules, including oscillators, sequencers, a filter, and effects. Each is physically identical; an ATTiny85 microprocessor determines the function.

I ordered my miniMO programmed as an ADSR envelope generator. With an Arduino interface, you can download code for the other modules and perform a personality swap. The hardware is open-source, so you can even build your own modules from the provided schematics. I bought the kit version, which is so well-labeled that I built and modded it just by looking at the online photos. Getting the bare board made it easier to attach jacks and a larger pot.

MiniMO modules have four sets of I/O ports (each containing



Fig. 2

signal and ground), a header for programming, a button, a pot, and an LED (see Figure 2). In the ADSR configuration, ports 1 and 2 are CV outputs, port 3 is a CV input that duplicates the knob, and port 4 is a trigger input. On power-up, the knob controls attack time. Each time you press the button, it reassigns the knob to control the next envelope segment: decay time, sustain level, release time, and then attack again. (The LED blinks one to four times to show you which segment you're adjusting.) Cleverly, Jose implemented pickup mode, so switching to a new segment doesn't change its value until you twist the knob through the current value. An alternative boot mode turns the envelope into an LFO. You can also trigger it by double-clicking the button.

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I connected the West Pest's gate output to the miniMO's trigger input (see Figure 3) and patched one of the miniMO's outputs into the Pest's dynamic gate input. A twist of the knob, and I had a lovely brass attack. Patching the envelope to the Pest's FM, pitch, and wavefolder mod inputs unlocked all sorts of squawks, air horns, and timbral animation. The maximum time per segment is only about a second and the shape is a bit coarse, but it was more than enough to give my West Pest a whole new personality.

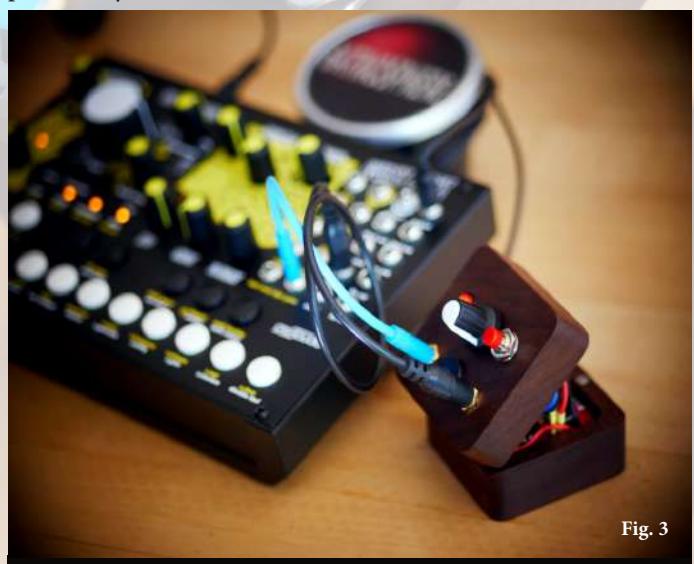


Fig. 3

Engagement ring modulator? Here the gate output of the West Pest (black cable) triggers the miniMO ADSR, which feeds the dynamic gate input (blue cable) to add an amplitude envelope to each note.

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