

■■■■■■■■■ **Modular Synthesizer**

I grew up during the early 70's as a technically-minded kid who liked to build things. Much as today's youth is encountering the revolution of media convergence and social computing brought by cheap computing devices and widespread internet penetration, my generation was inspired by the rise of consumer electronics, as transistors and integrated circuits redefined radio, television, hi-fi, and musical instruments. As long as I can remember, I'd had an interest in electronic audio, perhaps because my parents were always playing music and my dad had an ancient Revere open-reel, monaural, tube-driven tape recorder, which offered endless fascination in my toddler days. When I was old enough to get my own library card, these interests expanded upon checking out the wonderfully strange electronic music LP's on the Folkways label, which somehow had infiltrated their collection. I promptly took possession of my dad's old Revere, and had a great time exploring the sonic possibilities when it was operated outside of its normal bounds. In 1968, an uncle gave me a copy of *Switched on Bach*, and from then, life was never the same again. The sounds were fascinating, but after the Folkways records, that wasn't too unusual. The image of the Moog modular on the cover is what did it. All those knobs and phone jacks sprouting from an ominous black cabinet out of a telephone operator's nightmare, with the musical keyboard totally out of place below ... The liner notes were fascinating, but after having read them a dozen times (and squinted at the blurry labels on the modules in attempts to decipher them), I had little idea of what this device actually was. My high school and early college years heralded the dawn of prog rock and fusion jazz, both of which were quite experimental back then and fuelled by the still-novel sounds that analog electronics and audio processors could make. This is the period that essentially clinched it for me; I needed one of these things.

Buying a synthesizer was out of the question. MinMoogs and Arp Odysseys were costing well over a thousand dollars, and modular systems ran to at least ten times that amount. I had no choice but to build one. I was hardly alone in that aspiration; music synthesizers had supplanted ham radios in those days as lightning rods to absorb the lives of technically-inclined tinkerers.

There wasn't much literature on the innards of synthesizers back then. Manufacturers tended to protect their secrets, as the competition was fierce. Don Simonton's low-budget PAIA kits were the exception, however, as he published the circuitry across several issues of *Radio and Electronics*. Likewise, Don Lancaster (author of the famous TTL and CMOS cookbooks) published some great articles in the popular electronic press about very interesting ways to use common IC's in musical contexts, and Walt Jung's *Op-Amp Cookbook* was a bible full of synthesizer-relevant circuitry. "Electronotes" was fantastic, but I didn't discover it until later.

I started my first modular in a room in my parent's basement when I was a freshman in college, back in 1974. The room was painted totally black. It had served as a canonical psychedelic dungeon and hangout in my high-school days (a few of the flashing lights and 6' x 8' color organs still worked), and functioned part-time as a darkroom (setting the ambient odor), as I was also an avid photographer. I started with the wooden synth cabinet, which measured 3' x 3', and had four rows waiting for modules. As I had only a vague idea of what to put in there, I wrote to every synthesizer manufacture I knew of for brochures to get an idea of what to build. I also called every university around my home town of Boston to see if I could visit their electronic music studio (we had nothing of the sort at Tufts then). Phoning MIT led me to my present colleague at the Media Lab,

Barry Vercoe, who said, "MIT only does digital synthesis." I hit the gold mine though when phoning Harvard, where I got connected to Serge Tcherepnin's brother Ivan, who ran their electronic music program and invited me over to see their facility. Ivan took me right past the rows of hulking, dark Buchlas in their attic studio, and over to a small Serge that he had in the center of the room. He went through his brother's masterpiece module-by-module in the hour that ensued, and I soaked the experience up like a sponge. The Serge's revolutionary concepts, such as the interchangeability of control and audio signals, cast long shadows onto my evolving plans.

My original modules began with ideas from the Simonton and Lancaster articles. The oscillators weren't very stable and the filters were somewhat dull, but it was a start. I had little money at the time, and had to really scrounge for parts. The potentiometers came from old TV monitors that were being thrown away at a nearby company that made computer terminals, where I worked during high school.

I had a part-time job during college writing software at Draper Laboratory, an MIT spin-off famous for designing guidance systems for missiles and spacecraft. I befriended the technicians and engineers there, who gave me old panels full of pin jacks (the patch cord standard that I adopted from the PAIA designs), provided me with resistors and capacitors, and let me sneak into their printed-circuit facility to make my boards. I bought my semiconductors at "Eli Heffron's," an infamous surplus electronics store in Cambridge full of the electronic effluent cast out of the Rt. 128 and Cambridge establishments (it was rumored that some of the junk on Eli's floor could compromise America's best military secrets if it fell into the wrong hands).

I gradually filled the wooden cabinet up with 37 modules after many dedicated evenings and weekends and countless solder burns and minor injuries from totally improper machining practices. Although I had ideas left for many other modules, I ran out of both space in the cabinet and hours to build more, as from 1977 to 1982 most synthesizer-building activities took a hiatus during my graduate physics studies at MIT.

Things changed at the end of 1982, when I was a postdoc at the Swiss Federal Institute of Technology in Zurich. The music scene was fantastic then; there was an active branch of Recommended Records (later to become RecRec) in town, and I saw countless wonderful concerts from avant-garde musicians who would never make it to the USA. It was also a tense time there, as the youth of the city were erupting in protest against the establishment "opera crowd", and it wasn't uncommon to inhale a bit of tear gas together with the clear Alpine air. But it was a city very difficult to participate in, especially as a foreign, workaholic physicist. Thus it was a dangerous mix: I had access to a fantastic electronics lab, time on my hands, lots of musical stimulation, and countless ideas churning on new synthesizer modules to build.

It started with a fairly simple scheme; I purchased one of those cheap Casio "VL-Tone" toy keyboards that had just come onto the market; this was probably the first "throw-away" digital keyboard. After spending a night probing the circuitry, I found several interesting "hidden" points where strange and delightfully ugly intermediate sounds were produced. This led to my first major "circuit-bending" project, where I replaced the toy keyboard of the Casio with a full-sized organ manual, and brought all of the internal patch points that I'd discovered out to a pin jack panel, so I could process them further with my modular gear. Others in this tradition followed (over the next years, the modular system assimilated a Casio CS-101, a Casio SK-1, a Minimoog, a Moog Satellite, and the Radio Shack/Moog MG-1).

I then started making more modules. During this period of my life, the passion for building synthesizers turned into an obsession. By the time I left Zurich at the end of 1983,

I'd constructed an armada of about 80 modules, most of which were unusual devices (e.g., phoneme synthesizers for computer-generated speech and voltage-controlled chaos generators) not found in common modulators. I packed them up into boxes labelled "domestic equipment," and somehow they slipped through US customs and arrived here unscathed. Together with the modules that I'd built previously (which I've since refurbished), what may have well been the world's largest homemade synthesizer soon dominated my living room.

I don't play this rig any more as a keyboard instrument. My main use for it now is to make gigantic sound installations with huge patches that I continue building over several hours, until I run out of patch cords. The process is perhaps closer to sculpture than music, where one starts with a small "seed" patch that expresses a simple musical process that is progressively augmented and refined as the patch builds. It is a large, complex feedback system, with signals that control the modules fed back to their inputs through a massive network of digital and analog processing. The resulting sounds are mainly autonomous, babbling and droning on for hours and days, as each patch achieves a distinctive groove or atmosphere without really repeating.

Although real-time digital synthesis has matured and certainly has many advantages, behemoths such as the old modulators still have a useful niche, as indicated by the fact that over a dozen small companies are making them again. Patching is a very tactile process, as modular analog synthesis is entirely tangible. Rather than navigating across 2D pages and menus in the digital world, with modulators, your hands are literally on the sound, immediately grabbing any patchcord, knob, or switch that can tweak or radically alter an output. Spatial memory helps a user quickly find the right module or patchpoint to adjust, at least for a week or two, before recollection fades.

Analog electronics can also affect sounds in many complex ways—it's often when one puts a parameter into an unstable or unorthodox state that the most interesting sounds are found (digital synthesis generally doesn't fail as gracefully, hence it's usually not as productive when things go wrong). Once a patch is pulled from a modular synthesizer, it can never really be recreated, since there's no "save" button like in a digital environment. Like a Tibetan sand painting, every patch has its own unique identity that's inevitably torn down when completed, never to return the same way again. Yes, in the old days, musicians would try to jot knob and patch positions down in logbooks with the hope of recreating them, but this is a futile endeavor, given the complexity of the patches that I like to make. Rather than lament this fact, I've come to embrace it—starting with a blank slate is a guaranteed way of always coming up with something new, exploring fresh territory without being biased by your old ideas or a sound designer's concept embedded in presets.



More information on my synthesizer system can be found at <http://www.media.mit.edu/~joep/synth.html>