

Title: Suzanne's Buchla Cookbook

Subtitle:

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In cooking, we take many fundamental ingredients and combine them in different ways and amounts and produce endless creations. A little randomness here, a pinch of fm there, a mixing together of voltages and gestures. Voila! A musical souffle! In quadraphonic!

Cooking needs to be done every day and it never turns out the same. That's the fun.

Suzanne Ciani

Providing context: In conversation with Suzanne Ciani

Tell us about the context in which you wrote the Cookbook. Were you documenting for yourself, for a community, or for posterity? What does it mean to you today that it still functions as a reference for Buchla practitioners, fifty years later?

As a "starving artist," I would apply for grants and this paper was written to satisfy a composer grant from the National Endowment for the Arts. I didn't think anyone would ever understand it, but I needed to describe my compositional practice.

Tell us about what drew you to the 248 in the first place. It was a piece of gear unknown to the world, and you may have been among the first users, with the Cookbook written before the release of the official 1977 manual. When did you acquire it? Did you have a working relationship with Don Buchla while developing your approach on the MARF? Did you consider it as a means to realize your musical ideas, or did those ideas emerge from the practice of the instrument?

At the time, I was totally focused on the Buchla. I had come to New York City to give a live performance in the Bonino Gallery for a sculptor friend of mine, Ron Mallory. I wanted to make a career as a Buchla performer. From photographs from this period, I notice that my Buchla system was constantly modifying...the consoles that held it, the road cases that transported it, the ever-increasing number of modules. I imagine that Don would have told me about the MARF, and I always wanted to get the first one of anything that came out. I did have a working relationship with Don, but our thoughts about the MARG were quite different. I adored it and couldn't live without it. He once said to me that it was a "failed" concept. I think we had very different ideas about what it was.

The Cookbook references serialism, acousmatic space, and cybernetic self-playing systems, which were all important matters in 1970s avant-garde music. How did you position yourself in relation to the dominant musical ideologies of the time, and has that positioning changed?

I think that as an artist, I lived in my own world to a great extent. I had studied composition and basically rebelled against the systems I encountered, like serialism. I thought music

should come from an emotional starting point. However, I have to admit that my work with the Buchla does reference some "systems" approach to composition. I once wrote a paper on Boulez and his use of musical note modules. In some ways, those ideas were better manifested by machines than note scribes.

Clearly conscious of these ideas, you may have been the only avant-garde composer making diatonic music with a Buchla 200 in the mid-1970s, and yet that music could not have been performed on a more tonally oriented system such as a Moog or ARP. Did you feel isolated in that practice?

*Yes, it was very lonely to speak a language that no one else was speaking. It was because of that musical loneliness that my first album, *Seven Waves*, was not a pure Buchla album, but a synthesis of my electronic language with my classical root system.*

The four sequencer rows are designed to work melodically and harmonically. Tell us about your composition process and how these sequences came to be. Was there a moment you decided they should not change and follow you throughout your whole career?

Laughing out loud. In those days, I had a great big sequencer with 4 rows of 16 knobs, and I could design the sequences in situ, listening to them as I made them. Because of the National Endowment paper, those particular sequences got documented. Other than that paper, I never documented anything. So, oddly, when I came back to live performance, I referenced the paper and adopted those sequences. I call them "raw material." They get transformed so much in a performance that I've never felt the need to change them. Also, they work really well together.

Buchla was notoriously agnostic about control interfaces, building touch plates, touch keyboards, and mechanical keyboards. As a trained pianist, how did you receive this? What was your relationship with the 237 Polyphonic Keyboard, which is involved in the Cookbook?

Buchla trained me early on that the traditional keyboard was "an inappropriate interface." I took that to heart and hardly touched a piano in those years. I was very conscious of the difficulty he had presenting his ideas to the community...that people didn't understand and you had to be very clear about things. The traditional keyboard was the enemy. I became a staunch proponent of communicating his ideas. The 237 came about, I think, because Buchla wanted to show polyphony...he created the possibility of polyphony, though it wasn't true polyphony. I never used the keyboard to play chords but found other interesting ways to use the design.

The Cookbook is unusual in that it documents patches and transitions between them, as a blueprint for live performance. Was the idea of live electronic performance being discussed in the avant-garde circles around you, or were you working that out largely alone?

There was no awareness of electronic live performance in my "avant-garde circles." I thought Phillip Glass should be using a Buchla to perform his mechanistic patterns that humans played like machines. He wasn't adaptable to it. Steve Reich thought that such electronic instruments should be "sent to the moon." Vladimir Ussachevsky came to my concert at Phil Niblock's loft. Ilhan Mimoroglou gave me my first American record deal at Atlantic/Finnadar. These were both electronic composers, but we were using different media

1976: A Performer's Field Notes

Juan Parra Cancino

By 1976, Suzanne Ciani had been working with Buchla instruments for close to a decade, since meeting Don Buchla as a graduate student at UC Berkeley in the late 1960s. She arrived in New York in 1974 with, by her own account, little more than her Buchla system and a suitcase of cables, and spent her first years there in the city's downtown avant-garde — for a time sleeping on the floor of Philip Glass's studio while moving in circles that included Steve Reich, John Cage, Ornette Coleman and Merce Cunningham. Out of that period came a National Endowment for the Arts Composer Grant, and the document this article concerns — a report Ciani submitted to satisfy it, which over the years has become known as **The Buchla Cookbook**.

The instrument at the center of that report was Don Buchla's Series 200 "Electric Music Box," and in particular its most notorious module: the Model 248, or Multiple Arbitrary Function Generator — the "MARF."

A 16-stage memory that can be approached as a sequencer, an envelope generator, an oscillator, anything in between, addressable in almost any order, the MARF had already acquired a reputation among Buchla owners as the system's most flexible and most unusual tool.

What makes Ciani's cookbook valuable is that it is not a description of the MARF's features in the abstract, but a tested, practical account — tone rows, patch diagrams, and performance actions — of how to actually play it musically. That practice didn't emerge in a vacuum. The Buchla instruments carried a set of assumptions distinct from the East Coast, Moog-associated tradition: touch-plate control rather than piano-style keyboards, a vocabulary built on voltage-controlled processes rather than fixed notes, design suited as much to improvisation as to composition. This "West Coast" sensibility traced back to the San Francisco Tape Music Center and figures like Morton Subotnick and Pauline Oliveros. Ciani's cookbook, written by a classically trained pianist and composer, is in part a negotiation with an instrument that wasn't originally built to favor either of those backgrounds — and the techniques it catalogues, including what she called "Melodic-Rhythmic Reliefs" and the "Vertical Sequencer," read as field notes on the vocabulary she had used the year before in two unissued concerts later reissued as **Buchla Concerts 1975**. Read alongside those recordings, the cookbook functions almost as a score after the fact, in a practice — live modular improvisation — that otherwise left little paper trail

2026: A Living Manual

Ciani's relationship to the document didn't end with its submission in 1976. When she returned to live Buchla performance in the 2010s, after decades largely spent in commercial sound design and recording, she has said in interviews that she went back to this same paper to relearn her own techniques and to adapt them on modern Buchla 200e Instruments — still calling it, fifty years on, "a cookbook for how to play the Buchla." That makes it a rare case of a historical document remaining, for its author, an instruction manual rather than only an artifact.

The MARF itself has had a comparable afterlife. Scarce even in its own era, the original Model 248 existed for decades mostly as a catalog item among Buchla owners, until Tiptop Audio — working from schematics and Buchla's 1977 manual, in the absence of a working original, and in official partnership with Buchla USA — released a Eurorack recreation, the 248t, in early 2026, marketed around its reputation as "the holy grail of West Coast signal creation." Its return is one sign of a larger shift: much of the 200 series is now available again, original and clone alike, to a generation of musicians who never had access to it the first time. That generation is the reason this document matters now.

The modular synthesis "renaissance" of the past decade, driven by Eurorack but returning again and again to Buchla's ideas about voltage control and live-generated form, has revived exactly the questions this report was written to answer — not what a patch sounds like, but how to build one, live inside it, and move between musical ideas in front of an audience. Ciani has been an essential, active part of that revival rather than a distant reference point for it: For the last 10 years she has been performing regularly on Buchla modular systems, giving workshops around the world, after-shows Q&A with the audiences, being involved in academia as a visiting scholar at Berklee College of music, releasing quadraphonic LPs, and collaborating with younger Buchla-identified artists such as Kaitlyn Aurelia Smith, thus becoming, for a new wave of musicians discovering non-keyboard instruments for the first time, something closer to a living bridge to the scene the cookbook came out of. Written forty years before that scene existed, **The Buchla Cookbook** already answers many of its open questions. Part of this edition's purpose is simply to make that visible.

SUZANNE CIANI**REPORT TO NATIONAL ENDOWMENT
RE: COMPOSER GRANT**

June 1976

Following is an outline of a "Basic Performance Patch" which I designed for Buchla Series 200 instrument, and a brief description of some of the musical ideas that evolved as a result of working with this patch.

For the sake of clarity, I give each of the musical ideas a distinct and descriptive name: "Keyboard Rotations," "Melodic-Rhythmic Reliefs," "Vertical Sequencer," and "String Patch." The first three of these are concerned primarily with permutations of given ordered sets of pitches, accomplished either by means of the sample and hold of the polyphonic keyboard, or by means of a matrixing of the sequencer rows by the AFG: (Multiple) Arbitrary Function Generator. The "String Patch" illustrates a completely different use of the AFG.

Also given are step by step examples of how to go from one of these ideas to another in a performance situation. These are only rough maps, but they do illustrate the characteristic facility for musical metamorphosis that the instrument possesses; and they also show the kind of playing technique that one has to develop for live performance. In the practiced performer, a kind of instinct comes into play, and making a transition from one musical idea to another is almost a matter of reflex — and somewhat difficult to describe in detail.

Also given are a few techniques for rhythmic improvisation, which I generally keep for the "climax" of a performance, and some techniques for discrete spatial rhythms.

I find that the best performances combine the competence of pre-planned and well-rehearsed playing with the magic of being able to follow one's inspiration when inspired by the audience and the moment. To do the latter, a performer must be familiar with his patch to the point of not having to "think twice" (at least not more than once) about what effect or series of consequences will be produced by a given action.

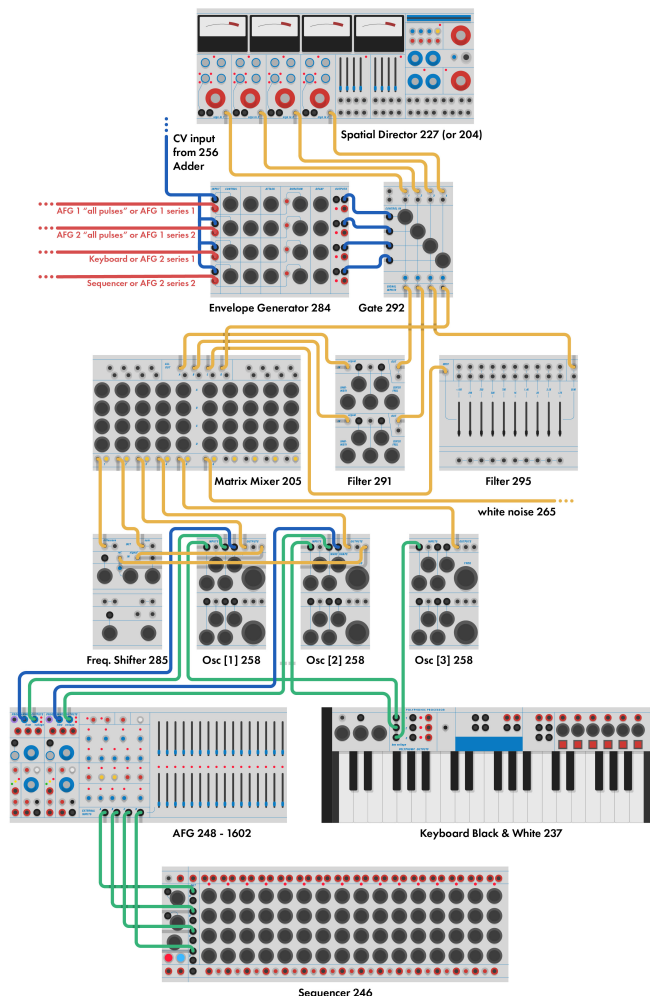
Note on the M.A.R.F.

Every mention of the "AFG" in this document refers to Buchla's Model 248 Multiple Arbitrary Function Generator, or M.A.R.F. This module holds an unusual interface and feature set, directly derived from computer music thinking. Back in 1971, the Buchla 500 system was controlled by a minicomputer in which one could program "stages" as sets of data: voltage, duration, interpolation, and a role within a sequence. This could be seen as a sequencer, a complex envelope, a low-frequency oscillator, or an addressable memory. The 248 came in 1974 as a more commercially viable alternative: a module based on newly available C-MOS components to replace the software, with a bank of faders and spring-loaded switches with LEDs to replace the keyboard and screen. After a few years, and probably fewer than 10 units built, the project was abandoned due to component failure, and the rise of the microcomputer opened up new technical possibilities. Future iterations of the MARF concept found their way into the Buchla 300 series as software-controlled hardware devices. Yet this

"in-between solution" produced a unique situation: for once, a sophisticated sequencer was both programmable and performable. It is no wonder it found its most important representative in Suzanne Ciani, who focused her use of the MARF on live performance. In recent years, the 248 has enjoyed an interesting afterlife: surviving units were, per owners' testimonies, recovered from dumpsters, garage sales, or music centers. Technicians such as Marc Verbos, Richard Smith, and members of the M.E.M.S. project have documented their restoration work. Clone builders, such as Roman Filippov, based their versions on schematics and former users' testimony. These new units are now used live by Suzanne Ciani. Buchla USA has since announced on social medias an official reissue, and the Eurorack adaptation by TipTop Audio, in partnership with Buchla, is now in commercial production.

At the center of Suzanne Ciani's practice of the MARF is one feature: any fader value for each stage could be replaced by 4 different external voltage sources, making the 248 a highly sophisticated sequential switch even by today's standards. This is the core idea behind her use of the MARF: a performable processor for pitch CV signals from a 4-row sequencer. She would later name her performances "improvisation on 4 sequences." While the 246 sequencer holds the 4 invariable sequences at the heart of her career, improvisation is carried through the MARF.

THE BASIC PERFORMANCE PATCH

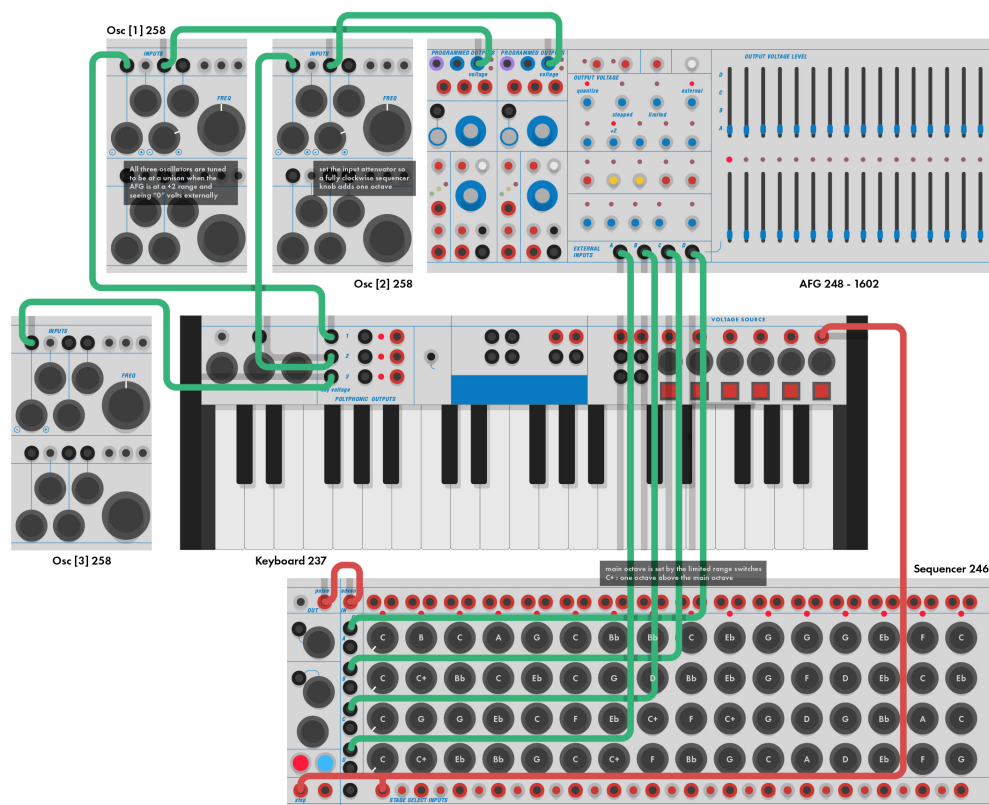


The "Basic Performance Patch"* outlined describes the fundamental signal and control voltage routing for a patch which I have used in performance. The following is a general survey of features of this patch and the considerations taken in designing it.

The signal sources are primarily two oscillators, with a third oscillator available for the part of the performance called "Keyboard Rotations" (described later), and a white noise source used mainly in the percussion improvisation. One of the frequency control voltage inputs of each of oscillators 1, 2 and 3 is controlled by the keyboard – all tuned in unison, diatonically. Oscillators 1 and 2 are also frequency controlled by the AFG 248-1602 outputs 1 and 2 respectively, so that the limited range intervals are octaves. These two oscillators are also controlled, via the AFG "external" mode, by the 246 16-stage sequencer.

Note on the Range switches and Buchla tuning:

This document often refers to the MARF's "range" feature. The 2 AFGs voltage outputs have a full range of 0 to 10V for both sliders and external sources. The "limited" range switches compress this to a 2V band. The quantize switch divides this range into 12 equal intervals. Though never stated on the panel or manual (in keeping with Don Buchla's well-documented agnosticism on musical genres), this allows diatonic playing on a 2V/octave norm. The 248 may thus be among the first tools to offer live diatonic pitch quantization outside computer music. This 2V window is then offset by the switch used: 0 to 2V (+0), 2 to 4V (+2), and so on. In a diatonic context, these switches act as octave transposition. This is why the labels +2, +4, +6, +8 read as +1 oct, +2 oct, +3 oct, and +4 oct, respectively. While Buchla instruments are best known for a 1.2V/oct norm, exceptions and variations abound. The 258 oscillators in this system have an input attenuverter, so the difference between the +0 and +2 switches can be tuned to an octave.

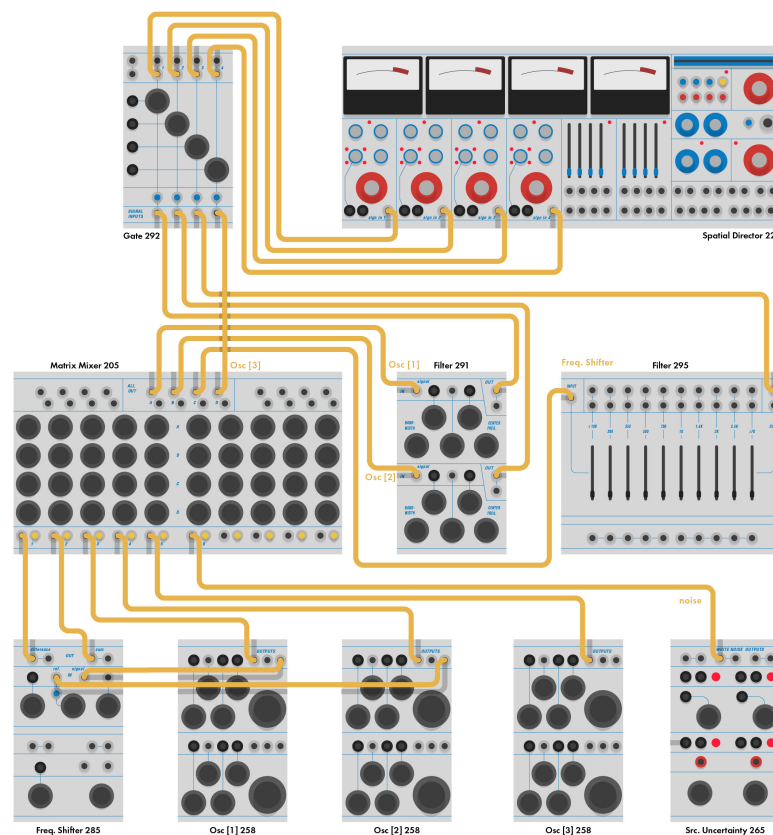


The AFG in “external” mode and the sequencer are a powerful combination for pitch control. First, the AFG allows quantization of the sequencer voltages via the “quantize” mode of the AFG, for easy setting of pitches. Note that the first stage of each sequencer row is set at the lowest note of the row, or “0” volts, to provide a tuning convenience as well as a stopping position in order that the keyboard can take over as sole pitch controller. (To take advantage of this, a single pulse from the subsection of the keyboard can be assigned to both stop the sequencer and select stage 1.) Second, the AFG allows a totally flexible matrixed access to the sequencer voltages, horizontally, vertically, and obliquely, and the rows have been designed with that consideration: to work in any direction and combination, melodically, harmonically, and contrapuntally.** Third, the AFG allows instant octave transposition of any row or any part of any row.

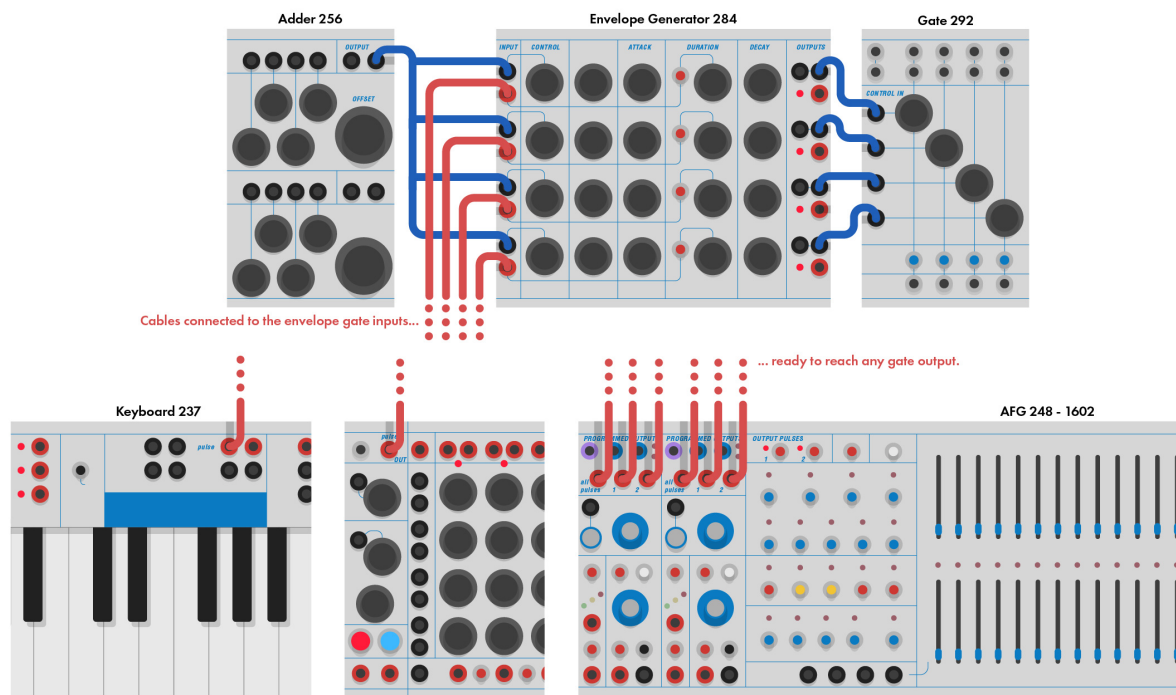
** See Musical Illustration 1 (ONLINE ONLY)

The rhythmic possibilities of this combination will be discussed later.

All of the oscillators are routed directly to a matrix mixer, oscillators 1 and 2 detouring as well through a frequency shifter. At times in the performance when oscillators 1 and 2 are tracking at a unison or an octave, the frequency shifter provides a timbral enrichment, as in the “String Patch,” for instance, which we will look at later. At other times, non-harmonic sonorities are produced, which I use percussively. (In some cases, I can get an immediate cue as to whether the two oscillators are on the same stage of the AFG, being able to display visually only one at a time, because of the dramatic difference between shifted unisons or octaves and any other intervals.)

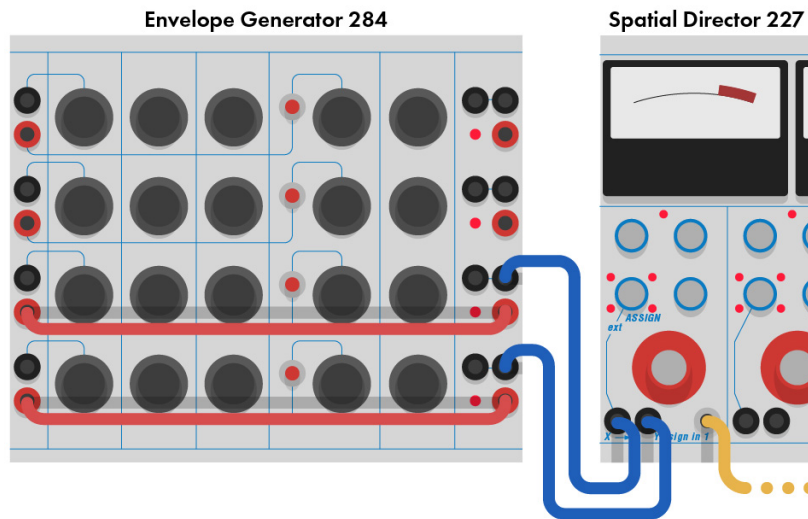


All of the signals are routed through a matrix mixer for distribution to any of three filters or no filter. Since the filters are tied to gate positions, selection of a filter also selects a gate. The envelope control for the gate is a quad V.C. 284. In a performance, I choose freely among trigger sources for each envelope by having at least three banana patch cords already plugged into the pulse input, and then making the connection to the pulse output of the AFG, sequencer, or keyboard — or looping back to the envelope pulse output — depending on the needs of that part of the performance. In general, with this patch, I use the pulse outputs of the AFG series 1 and 2 because of the rapidity with which they can be programmed or “played,” and because of the rhythmic possibilities and combinations available. Sometimes no envelope is used, the gate simply opened. For quick variation of the envelope, I bridge all of the control voltage inputs and route an offset voltage from the 256 Adder (which gives me the option of adding in other or varying control voltages as well). This one offset voltage allows me variously to shrink or expand any envelope very quickly in a performance, the direction and amount individually controlled by each of the four control voltage input knobs.



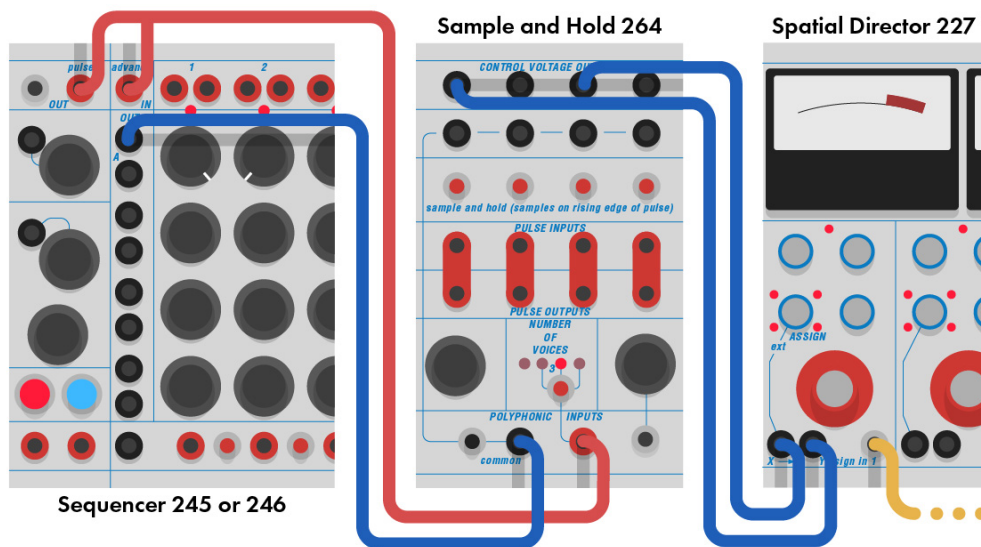
Finally, the signals are routed to a spatial locator and then out to four amplifiers and four speakers. (Use of a voltage-controlled reverb is optional.) I consider the spatial characteristics — where a sound is placed and the way it moves — to be an integral part of the music, and I plan and “play” the space of each part of the performance. In the future, I expect that this will be one of the most refined aspects of electronic music; but given the present state of electroacoustics and the deficiencies of performance halls in this regard, I find it most effective to use clearly delineated types of spaces such as the following:

A continuous curved space.



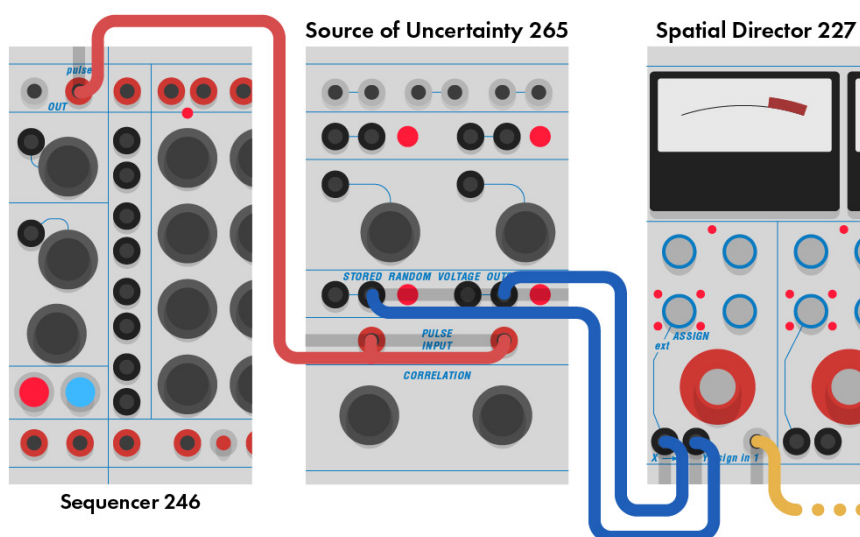
I use a slow continuous curved space for the “String Patch,” the arc related to the “bowing” envelope.

A discrete spatial rhythm.



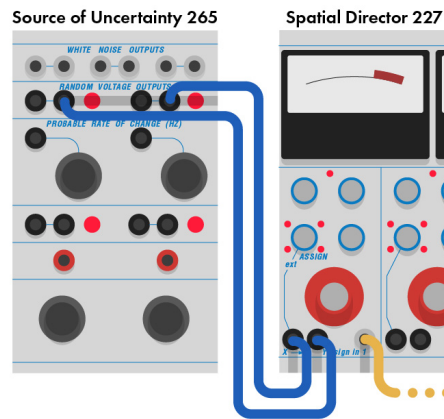
(Please see the graphic description.) In this type of space, the sound comes very precisely from one speaker at a time, the duration in each speaker precisely controlled. Two features of this type of space are: firstly, continuous tones can be given rhythmic impulse defined solely by spatial placement (I use this with sequencer Row A alternate, for instance, where there is little melodic rhythm); and secondly, there is no masking effect for the audience since the sound is completely in only one given speaker at a given instant.

A random discrete location.



In percussive passages, I route the trigger pulses to a 265 stored random voltage source pulse input and drive the X and Y C.V. inputs of the 227 with the resultant control voltages.

A continuous random space.



Use the 265 continuous random voltage source.

Any combination of the above.

I think of these as spatial phrases or sentences, and find the 257 Dual Control Voltage Processor very useful.

Sound Spatialization in Electronic Music, 1958–2026

Juan Parra Cancino

Ciani's live, gestural approach to spatial control sits within a much longer history of composers treating sound placement as a musical parameter in its own right. — from Stockhausen's rotating-speaker *Kontakte* through John Chowning's computed quadraphonic trajectories at Stanford, to Ambisonics, 5.1, Wave Field Synthesis, and today's object-based formats — Ciani's real-time approach remains a pioneering reference point in its performative, live approach to this sonic, technical parameter.

Multichannel sound was not a peripheral concern in early electronic music — for several of the field's founding figures, it was close to the point of the enterprise. Stockhausen's *Kontakte* (1958–60) is often cited as the first fully quadraphonic composition, its four-channel image built by physically rotating a loudspeaker on a turntable, ringed by microphones, to capture sounds orbiting the listening space — spatial movement produced mechanically, by hand, before any electronic means of doing so existed. By the early 1970s, quadraphonic playback had also become a short-lived consumer format, and this is the moment both Chowning and Ciani enter the picture, from very different directions.

At Stanford, John Chowning's 1971 paper "The Simulation of Moving Sound Sources" set out an algorithmic method for placing and moving sounds within a quadraphonic field using amplitude panning, simulated Doppler shift, and the ratio of direct to reverberant signal — the last of these being, at the time, a genuinely novel insight: that a listener's sense of a sound's *distance* depends less on its loudness than on how much of what they hear is early reflection versus room reverberation. His 1972 composition *Turenas* was the demonstration piece, its sound trajectories entirely computed and fixed onto tape in advance, note by note and path by path, on a PDP-10 at Stanford's Artificial Intelligence Lab. It is spatialization as composition: precise, mathematically derived, and — crucially — decided once, off-line, before anyone hears it.

Ciani's approach in this document could hardly be more different in method while pursuing a strikingly similar goal. Where Chowning computes a trajectory, Ciani *performs* one, live, with her hands, using the Buchla 227 Spatial Locator and a vocabulary of "continuous," "discrete," and "random" spatial types that she can mix and cross-fade in real time, the same way she treats pitch or timbre. There is no notation, no offline pass, no fixed path to be reproduced identically twice — spatialization here is a musical parameter, played with the same reflexes as the oscillators and filters, and subject to the same demand for improvisational fluency she asks of every other part of the patch. It's telling that she considered a quadraphonic PA a precondition for performing at all, to the point of refusing at least one prominent engagement without one: for Chowning, quad was a canvas for a fixed piece; for Ciani, it was closer to a fourth instrumental voice.

Both belong to a wider mid-century turn — running through Stockhausen, the Groupe de Recherches Musicales' multichannel diffusion practice in Paris, and Chowning's own later founding of CCRMA — toward treating spatial position as a compositional parameter in its own right, on equal footing with pitch and timbre, rather than as a mixing decision made after the music itself was finished. What's specific to Ciani's contribution is doing this *live and gesturally*, inside a performance practice, at a moment when almost everyone else working seriously on spatialization — Chowning very much included — was doing so through offline computation.

The subsequent history of multichannel sound largely continues to split along that same line. Michael Gerzon's Ambisonics, developed in the UK in the early-to-mid 1970s, offered a format-independent, mathematically rigorous model of a full sound field — closer in spirit to Chowning's precision than to Ciani's gesture, though eventually adaptable to live use. Commercial quadraphonic hardware collapsed by the late 1970s under competing incompatible formats, but the underlying idea resurfaced repeatedly: 5.1 surround for cinema in the 1990s, Wave Field Synthesis research at IRCAM and TU Delft in the 2000s aiming to physically reconstruct a sound field rather than simulate one psychoacoustically, and, in the past decade, object-based formats like Dolby Atmos and Ambisonics-native tools that finally let a sound's position be authored as an independent, movable parameter rather than baked into a fixed channel — which is, in effect, the studio finally catching up to what a spatial locator let a Buchla performer do live in 1976. The current boom in Ambisonics-based live-performance tools and immersive-venue systems (bringing real-time, gestural spatial control back into modular and hybrid performance setups) makes Ciani's approach in this document feel less like a historical curiosity and considerably more like an early instance of where the field was eventually headed.

MELODIC-RHYTHMIC RELIEFS (“Prism Melody”)

Diagram 2, Musical Illustration 2, Example 3 on tape

Although a single row of 16 ordered pitches is the basis for this idea, the constant shifting of emphasis as it moves along creates an “aural illusion” that conceals its simple origin. A constant pulse is the basis for the rhythm, and larger rhythmic units are created by timbral emphasis and registral displacement. In some ways this musical technique is related to serialism; however, it was actually born from the seemingly inevitable consequences of an Arbitrary Function Generator meeting a Sequencer.

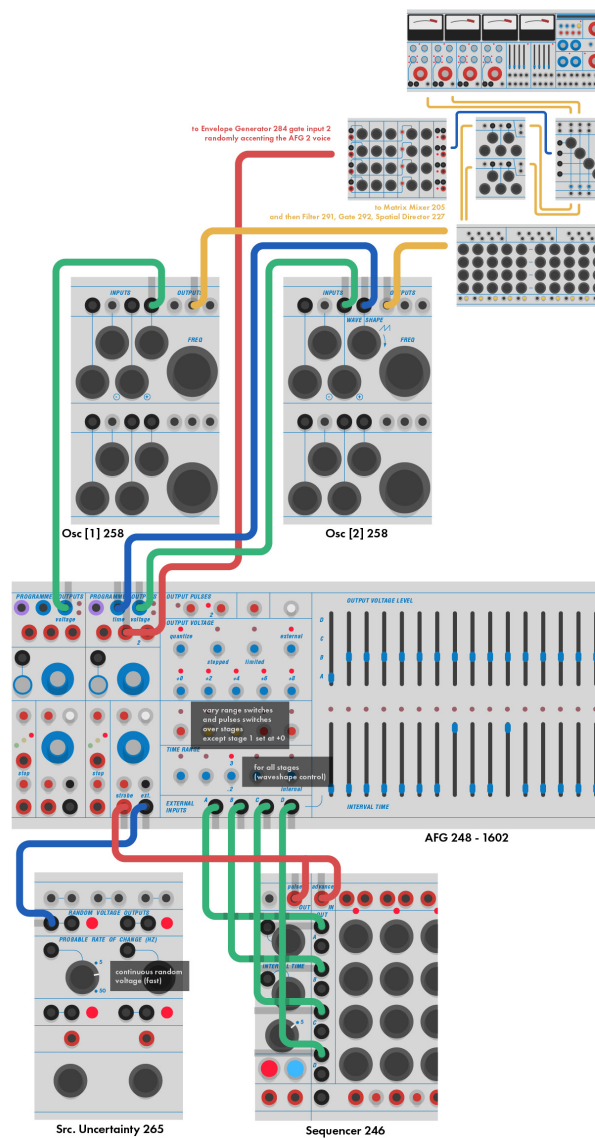
AFG Output 1 (Osc. 1) is set on External Row A (alternate) at +0 range. (Usually I would give this simple alternation of pitches a “spatial rhythm” by routing the pulse output of the 246 to the 265 stored random voltage input, and the 265 output to a spatial locator. Or I might give it a more discrete and regular rhythm by using a 264 Sample and Hold and a small sequencer, as described in attached Diagram 5.)

AFG Output 2 (Osc. 2) is being strobed by the sequencer pulse, and with an external control voltage from the 265 Uncertainty Source such that a new stage of the AFG is jumped to with each pulse. By driving the AFG in “strobe” mode, I free the “Interval time” output to be used for other than timing control, in this case, for waveshape control. Since all of the AFG voltage sliders except the first one are set at External Row B, AFG 2 will be for the most part looking at a regularly recurring pitch sequence: no matter which stage is strobed to, AFG 2 will see the next pitch of Sequencer Row B. But other variables can be individually programmed at each stage, such as octave transposition, waveshape, or output pulse, resulting in registral, timbral, and rhythmic variations upon the given pitch sequence. The effect is to produce an illusion of several lines going on at once, each one with its own perceived continuity.

* The tape example includes a white noise “click track” and gated/filtered white noise on the 11th pulse of the sequencer.

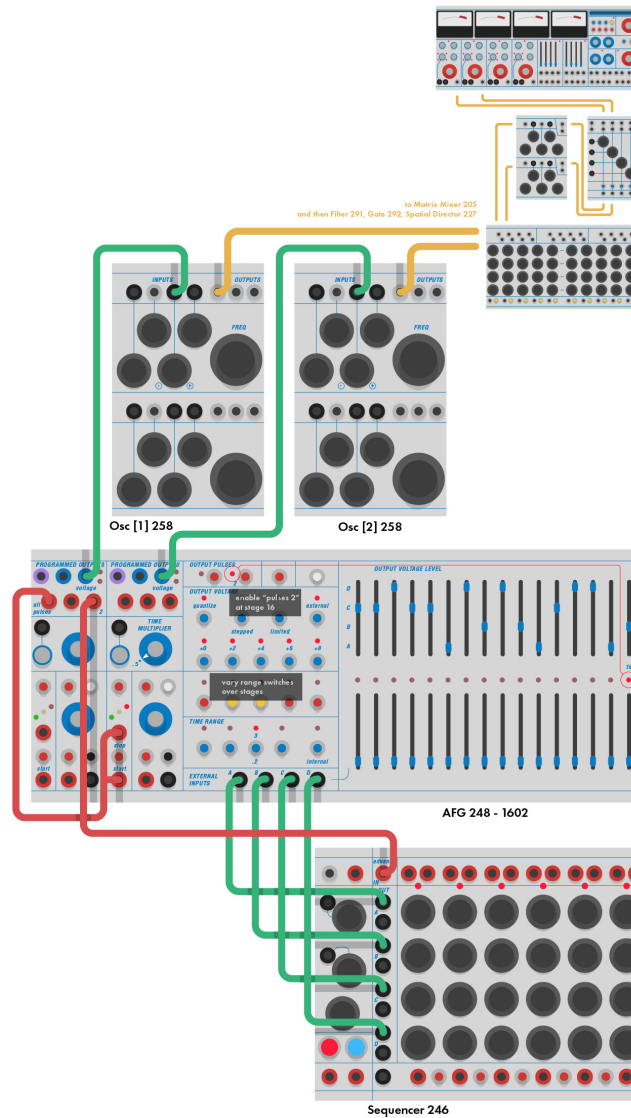
Note On pre-digital randomness:

This setting allows Suzanne Ciani to set a random probability of accenting a note, using a smooth random voltage sourced from noise to address a stage reading. This analog process lies outside the scope of calculated algorithms based on seeds or pseudo-randomness, which would later become commonplace in software. With each stage having a virtually equal chance of being addressed, the probability of an accent equals the number of stages holding this accent data, out of the total number of stages. A single stage carrying accent data therefore gives a probability of 1-in-16 chance of an accented note. It is worth noting that this randomness is sampled and strobed to the rhythm of the melody, not generated continuously: the result is closer to a shuffled deck than to noise, which is exactly what gives it musical shape rather than chaos.



THE VERTICAL SEQUENCER

Diagram 3, Musical Illustration 3, Tape Example 2



This idea is also the product of the AFG and the Sequencer. The four pitches at each stage of the sequencer are arpeggiated by the AFG, which then advances the sequencer to its next stage, and so on. This produces a regular harmonic rhythm and a musical texture characterized by an interweaving of melodic lines.

The External Output Voltage Levels of the AFG are distributed among Rows A, B, C and D at various octave levels.

A series 2 pulse is programmed at stage 16 of the AFG to advance the 246 Sequencer. (The pulse "2" output of AFG 1 is patched into the "advance" input of the sequencer.)

AFG 1 is driving AFG 2 from its "all pulse" output. At first the two AFG output units track the 16 stages in unison. Then AFG 2 is manually advanced to separate from AFG 1, producing a distinctly separate voice.

At each pass of the 16 stages, a different set of four pitches from Rows A, B, C and D of the sequencer will be played at various transpositions resulting in a harp-like melodic-harmonic texture.

Feel free to change the limited range switches and the output voltage sliders to different external positions, or to manually advance the AFG 2 output in order to bring out different melodic contours in this texture.

Diagram 3 : Vertical Sequencer

THE STRING PATCH

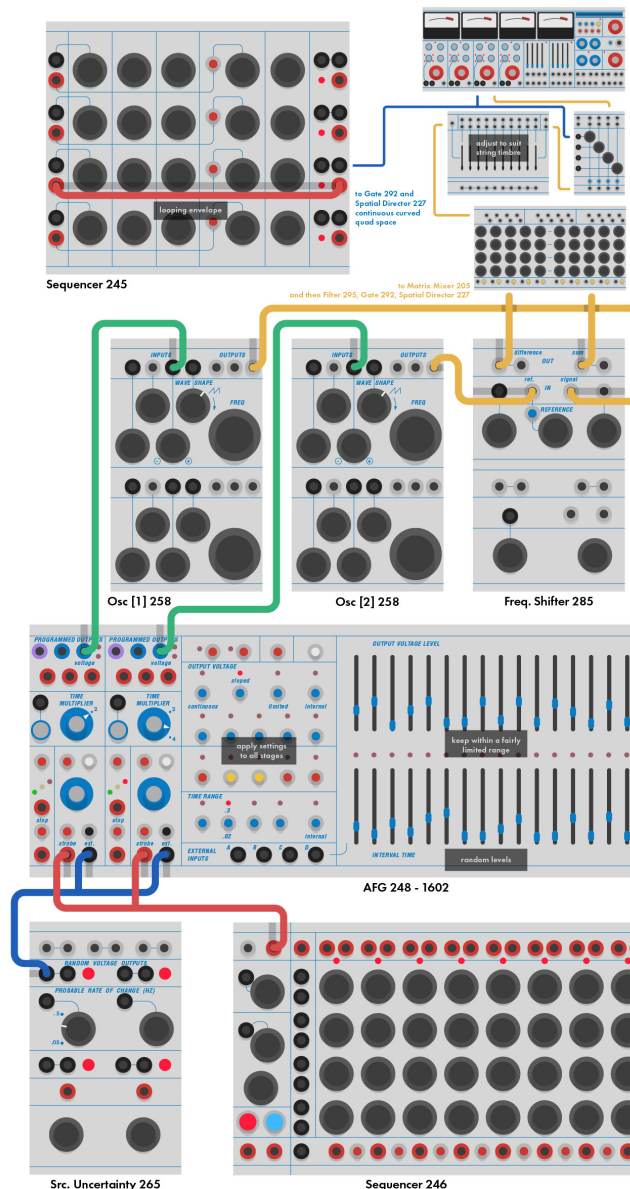


Diagram 4, Tape Example 1

This patch produces extremely rich string-like tones and a distinct impression of “bowing.” It is also an example of a patch that “plays” itself.

The two AFG outputs work together, at a unison or an octave, being strobed simultaneously by a rapid pulse from the sequencer, along with a very slowly changing external control voltage. Since the “sloped” function, however, is at slightly different rates in AFG 1 and 2, every time there is a movement, always to an adjacent stage, left or right, the frequencies of the two oscillators separate somewhat, and the frequency shifter for a moment sees two signals not in integral relationship and produces a timbral or “bowing” inflection.

In a performance, I will change the overall range of the “strings,” finding that the sound works equally effectively from bass to violin range.

Diagram 4: String Patch

KEYBOARD ROTATIONS

Musical Illustration 4 (ONLINE ONLY)

The Black and White Keyboard gives an illusion of polyphony — up to three voices — by means of a sample and hold circuit, but rather than use this feature to play chords, I prefer to use it as a contrapuntal device, by gating all three oscillators together, to produce shifting melodic patterns.

The basic patterns I show in the illustration are produced by playing an ostinato figure on the keyboard, which is controlling the three simultaneously-gated oscillators, and changing the “number of voices” to 1, 2 or 3.

In our basic Keyboard-AFG-Sequencer Patch, if the sequencer is stopped on stage one, where all the rows are conveniently set at “0” volts, and the AFG is in “external” mode, then the keyboard alone can control the frequency of the oscillators. By taking advantage, however, of the potential control of Osc. 1 and 2 by the AFG-Sequencer combination (waveshape, transposition), further developments of this idea are easily achieved in a performance situation, as we will see in the following performance example.

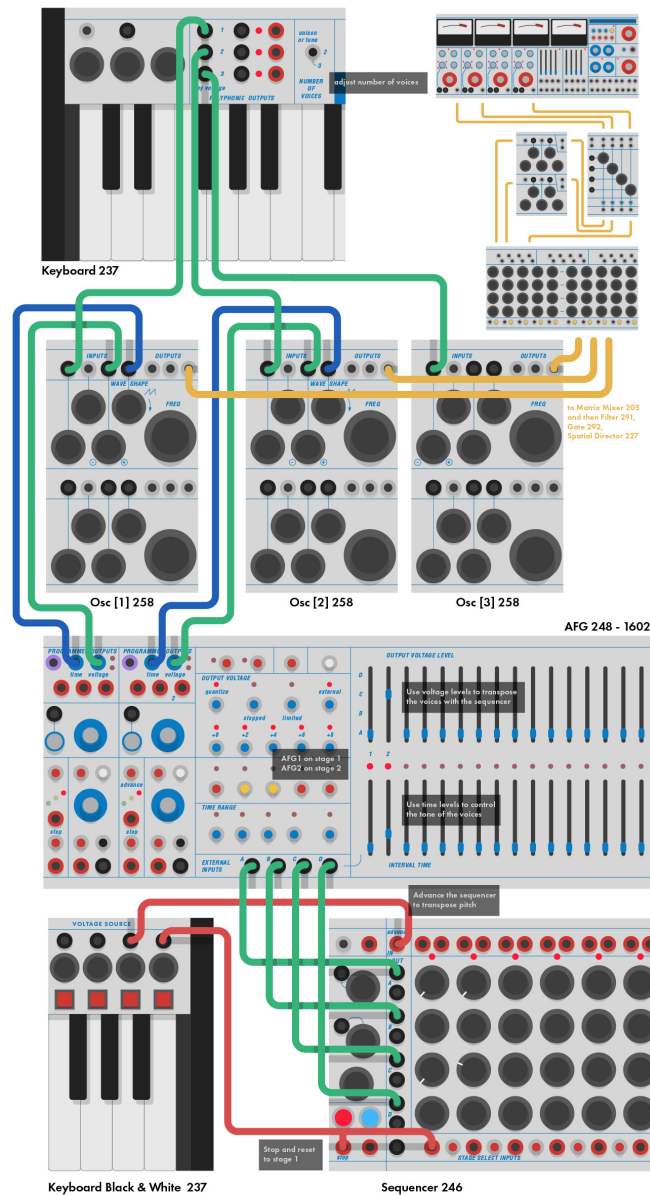
* The Keyboard Rotations idea could also be accomplished with a monophonic keyboard and a sample and hold or with a sequencer and a sample and hold.

Note On early polyphony in Buchla systems:

The early 1970s saw several attempts at polyphonic keyboards, mainly relying on early digital solutions for voice distribution, before Sequential Circuits proposed a compelling solution in 1977 with the Prophet 5. Most of these attempts are predated by the rather elegant solution of Don Buchla: the 237 keyboard used in this patch was equipped with a set of 3 parallel Sample & Hold systems, each sourcing the same CV from a mono keyboard. When set in unison, they are sampled with the same trigger from the mono keyboard. The

polyphony happens when, by activating a switch, this trigger gets distributed in a sequential way to the 3 circuits, so each circuit holds the note attributed by the trigger distribution, while also making its trigger available for each voice's envelope. A similar effect can be achieved with 4 voices using the 219 keyboard, or a mono keyboard combined with the 264 quad Sample & Hold. While this solution lacks flexibility, its limitations are put to musical use in this specific patch.

Additional Diagram 6 : Keyboard Rotations



TO GO FROM “MELODIC-RHYTHMIC RELIEFS” TO “KEYBOARD ROTATIONS” AND BACK AGAIN

As a performance example, let's assume we are going from the “Melodic-Rhythmic Reliefs” patch to the “Keyboard Rotations.”

1. Stop the sequencer at stage one with a command from the sub-section of the keyboard. Two of the oscillators (Osc. 1 and 2) are potentially controlled from the AFG. Since the sequencer is stopped and it was driving the AFG, the AFG is now stopped, and I can now position the output stages of the AFG manually. I can do this even while I've begun to play the keyboard ostinato.
2. Leave AFG output 1 at stage 1, External Row A (alternate), set +2 range (this will change the range of what you're playing, but it can be done tastefully), and note that the “internal time” slider, still controlling waveshape, is all the way down.
3. Display AFG output 2, reset it, and then advance it to stage 2. Raise the output voltage level slider to External C position, in anticipation of future needs (step 8) which of course results in no change of pitch since all rows of the sequencer are the same at sequencer stage 1. Hit the +2 interval, and check that the “interval time” slider, controlling waveshape, is down. N.B. All three oscillators are tuned to be at a unison when the AFG is at a +2 range and seeing “0” volts externally.
4. Continue to play the keyboard ostinato in unison, with all three oscillators sinusoidal in waveshape... then you might develop the idea in the following way:
5. Switch to “two voices” on the keyboard, and bring the new melodic line (see illustration 4) into relief by raising “internal time” slider of AFG 1 to enrich the waveshape.
6. Display AFG output 2 and switch the range of the output down one octave (hi+0) and raise “internal time” slider at stage two as well.
7. Switch to “three voices” on the keyboard: the imitations (see illustration: the registral change is not shown) will be clear since there are registral and timbral distinctions amongst the voices.
8. Advance the sequencer one stage manually while continuing to play the same notes on the keyboard and a completely new set of imitations will result, one voice up a fifth.
9. Go to other combinations of sequencer stage and “number of voices” which you choose.
10. Return to a unison position, as in the beginning and return AFG output voltage level stage 2 to External position B.
11. Start the sequencer (perhaps with a command from the subsection of the keyboard). You are now back at the Melodic-Rhythmic Reliefs patch and, with the keyboard at “unison” position, you can transpose the Reliefs in Oscs. 1 and 2 and the sustained pitch of Osc. 3, which will sound somewhat like a tonic.
12. Oscillator 3 can be faded out, and you can turn your attentions to developing the Melodic-Rhythmic Reliefs idea.

I have said nothing about the gating and filtering possibilities available in this patch, which is not meant to imply that they are not an important aspect of the musical treatment of any idea. The matrix mixer is a handy routing network that I “play” constantly to get timbral multiples of individual voices and an ever-changing variety of amplitude shapes. These methods of differentiating a sound source from itself are in large part responsible for the illusion that “so much is going on” when in fact the actual sound sources are few.

TO GO FROM "MELODIC-RHYTHMIC RELIEFS" TO "VERTICAL SEQUENCER"

1. Start distributing the AFG output voltage sliders from External B position to various external positions.
2. Clear all pulses, first making sure that the gate is open so that the sound does not disappear, and then program in one pulse in series 2 pulse output at stage 16 by using the "stage no" control to get to stage 16.
3. Take the pulse 2 output of AFG 1 and patch it into the "advance" input of the sequencer.
4. Remove the strobe input pulse from AFG 2, "display" and "reset" AFG 2, patch the "all pulse" output of AFG 1 into AFG 2 bridged "start" and "stop" pulse inputs, stop the sequencer and start AFG 1 (which will drive AFG 2).
5. Now the harp-like melodic-harmonic patterns of "vertical sequencer" are playing.
6. Change the limited range switches either while in "display" mode or via the "stage no" control to change the contours of the texture.
7. Hit "display" and "advance" on AFG 2 to separate it by at least one stage from AFG 1, introducing a distinctly separate voice (see illustration).
8. You could limit the number of stages of the sequencer to change the harmonic movement, or change the harmonic rate by adding additional pulses in the second output pulse series, which is advancing the sequencer.

TO GO FROM "VERTICAL SEQUENCER" TO THE "STRING PATCH"

1. Set the internal rate of the sequencer at .005. (At present, in the "vertical sequencer," the sequencer is being advanced externally.)
2. Patch from the sequencer all pulse output to the strobe inputs of AFG 1 and 2. This will have no noticeable effect since the sequencer is not on, only a response when a series 2 pulse advances sequencer.
3. Set the probable rate of change on the 265 Uncertainty Source between .05 and .5Hz. and patch the continuous random voltage into the "ext" inputs of AFG 1 and 2, if not already there. *
4. Transpose the sound to an upper range by sweeping through all 16 stages with the "stage no" control while holding up the +6 or +8 limited range switch. And similarly, add a "sloped" function all the way across. These movements result in a birdlike sound which obliterates precise melodic shape to facilitate moving from the external to the internal frequency control. It is a transitional device which can be musically interesting if "played": for instance, by adding series 2 pulses.
5. Program "internal" mode across the AFG by holding down the "internal" switch while sweeping across with the "stage no" control.
6. Remove all series 2 pulses.
7. Adjust the output voltage levels to a limited range around "0" level to provide a reference from which you can develop the melodic shape.
8. Check the waveshape settings on the oscillators. (The "time" output of the AFG's should not be controlling waveshape in this patch as it is in "Melodic-Rhythmic Reliefs".)
9. Since the sound will be passing through the comb filter, which is tied to gate 3 and envelope 3, loop the pulse output of envelope 3 to its input, setting a slow attack and decay, and open gate 3 enough so that the sound does not completely disappear after the decay.
10. Start the sequencer and stop AFG 1. AFG 1 and 2 will work in unison since their "strobe" and "ext" inputs are bridged.

11. Adjust the range down to a suitable area. These “string” timbres work well from the bass to the violin ranges, and set the output voltage levels where you want them while the patch is playing, developing the melodic contours of this slowly changing line. Other transitional approaches would be possible, but this one works very smoothly.

* I find that I have to limit the voltage range of this output somewhat, by detouring it through an Adder.

RHYTHMIC IMPROVISATION

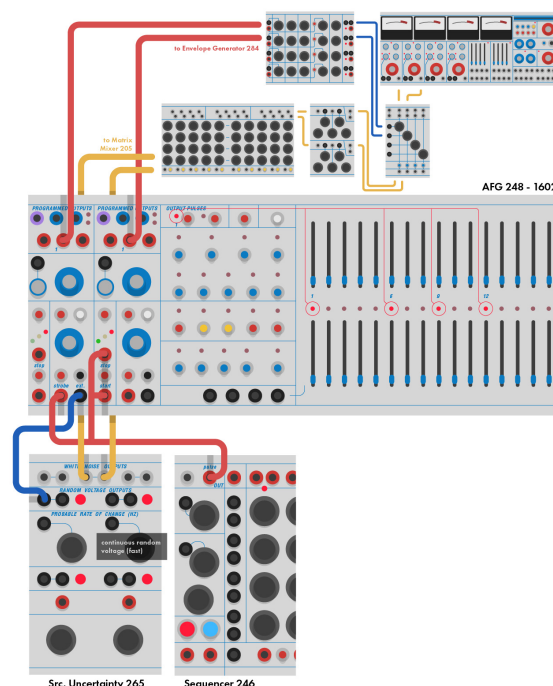
I find that because of the degree of rhythmic responsiveness afforded by the AFG, both alone and in combination with the sequencer, as in our basic patch, a rhythmic improvisation or “cadenza” will be the climax of a performance. Basically, one must be completely familiar with the rhythmic options of a patch before being able to extemporize. With practice, one can develop the mental and physical reflexes to “stay on top” in a performing situation and to play the sound and the space with total control and expressiveness.

The following is a list of some of the rhythmic possibilities of our AFG-Sequencer patch, which are so numerous that I mention only a few:

Example 1

Program pulses on four stages of AFG series 1 pulse output: stages 1, 6, 9 and 12, for instance. Strobe AFG 1 with a regular pulse from the sequencer and with a randomly changing external control voltage fast enough to cause movement on each pulse. Drive AFG 2 with a regular pulse from the sequencer by bridging the “start” “stop” pulse inputs with the sequencer pulse output. The result will be a regularly repeating rhythmic pattern in one voice with random metrical accents in the other.

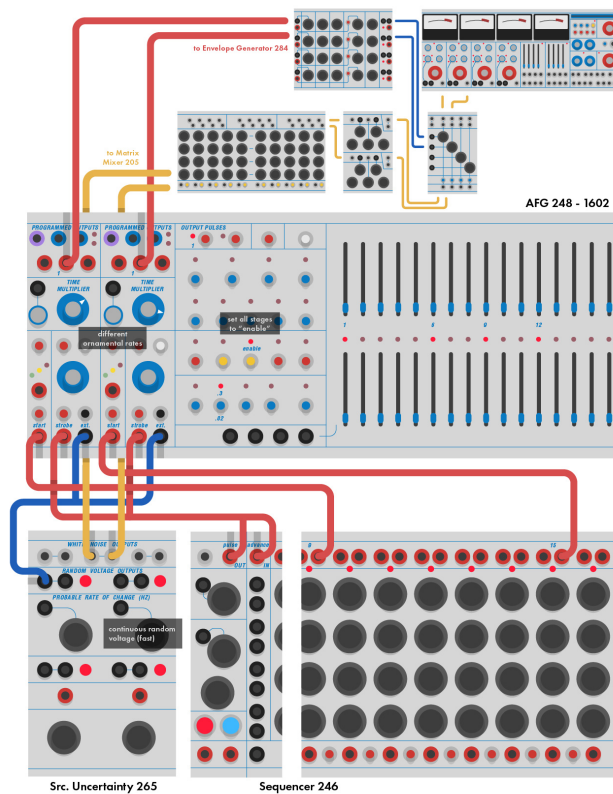
Additional Diagram 7 : Rhythmic Improvisation example 1



Example 2

Strobe both AFG 1 and 2 simultaneously with the sequencer pulse output, both with the same randomly changing external voltage fast enough to cause movement on each pulse. (The two outputs will exactly track each other.) Put the AFG into “enable” mode by holding up the “enable” switch while sweeping across with the “stage no” switch. Take pulses from stages 9 and 15, for instance, of the sequencer and patch into the AFG “start” jacks. If the AFG has an internal rate faster than the sequencer, for instance .02 vs. .5, then the result will be a rhythmic ornament. Different ornamental rates can be set for each of the AFG’s: they will always track each other except when receiving the “start” pulse.

Additional Diagram 8 : Rhythmic Improvisation example 2

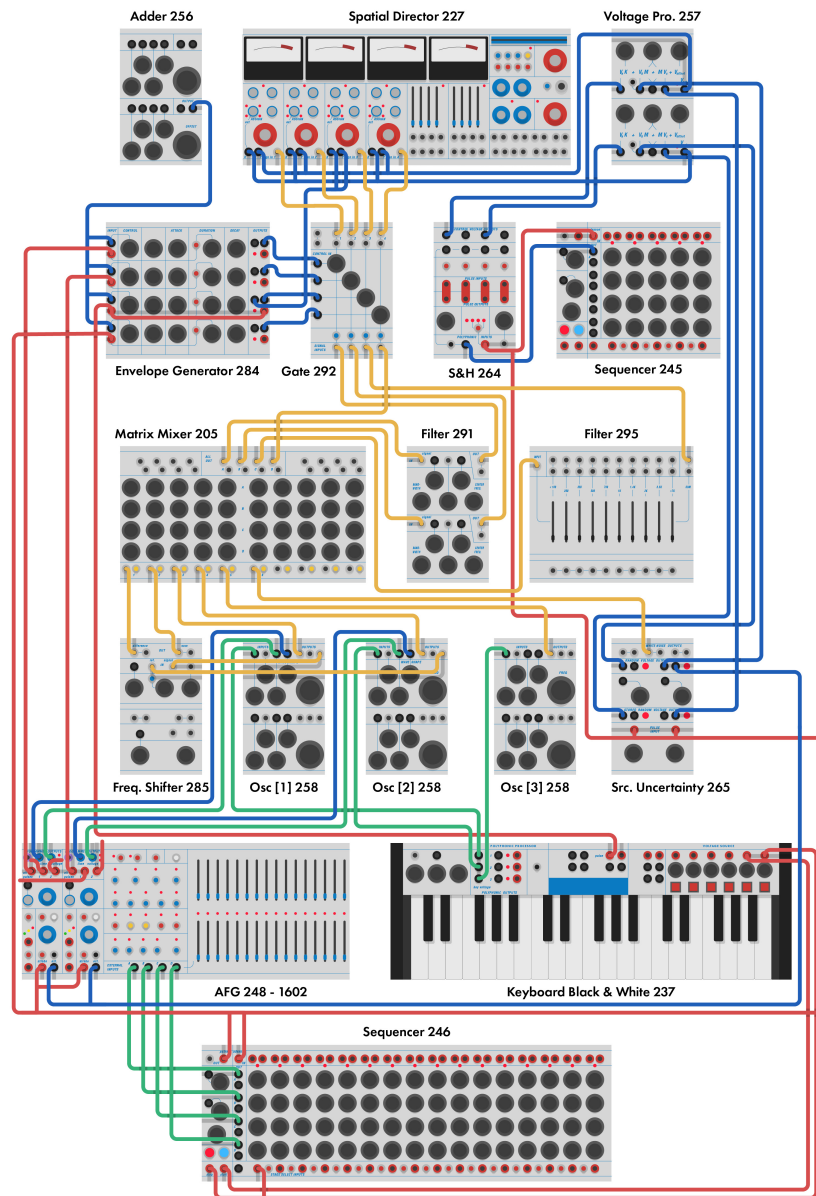


Example 3

Rhythmic functions like the pulse output series can be freely programmed in and out while the AFG is in “display,” or via the “stage no” switch. I find that if I sweep the “stage no” through the 16 stages of the AFG, I am able to “pick off” any stage on which I might want to program a pulse — this can even be done with one hand — or a “sust” or “enable.”

I might also add that the “sloped” function of the AFG is very handy in percussive passages for introducing a tabla-like pitched drum quality, whether in “external” or “internal” modes.

Additional Diagram 8 : "Complete" Performance patch



This diagram extends the Basic Performance Patch to a complete setup allowing to perform all techniques and transitions mentioned in this document

Application in modern electronic music context.

Pierre Collard

One could assume the interest of this document would stop at its historical value, given how rare the instruments involved have become. Yet in recent years I have observed scanned versions of the 1976 grant circulating out of universities circle into electronic music communities. While many of the Buchla modules required are now replicated, I don't think it is enough to explain this renewed interest.

Live electronic music was a genuinely complex task in 1976. It has since become common, thanks to affordable, stable technology and shared synchronization standards. This empowerment came with a highly automated ecosystem in which performers negotiate their own degree of freedom. The practice described by Suzanne Ciani is live-generated electronic music, which has now found new life in the modular synthesis renaissance, reaching audience that seems increasingly drawn to it after years of automated performances. It is no wonder that this document inspires a new generation of performers with years-ahead answers to questions on how to organize and improvise live-generated music, how to build a patch and practice it as a musical instrument.

During my first collaboration with Suzanne Ciani, I replicated the Basic Performance Patch on VCV Rack software. While applying the guidelines on transitioning from one idea to another ([video linked here](#)), I realized the nature of each musical idea was in fact defined by the intent to transition between them in front of an audience, and these metamorphoses were the blueprint of a narrative structure within a live performance.

This is why we would like to propose translations of these musical ideas into modern tools, for anyone to explore and extend. Many of these ideas emerge from combinations of Buchla modules. Transitions depend on features specific to the 248 and would demand a patch too convoluted to remain instructive. We therefore decided to isolate the musical idea on its own, for a better adaptation to the expandable software ecosystem. The following videos treat each idea within VCV Rack 2, a free, open-source platform inspired by the Eurorack paradigm, using open-source third-party modules from the VCV Rack library. The patch files are available to download.

The following patches use a recurring structure revolving around the Sickozell 16-stage 8-track sequencer. Each track has independent reading modes and clock sources. The 4 lower rows of the sequencer behave exactly like the Buchla 246 sequencer, which holds the 4 sequences read in a linear way. The 4 top rows replace the MARF, with varying roles depending on the patch. In many cases, two of them control 2 sequential switches distributing the 4 sequences to the two main voices, to reproduce the behavior of the MARF's external inputs. Any binary data from the MARF are reproduced with the sequences' min and max knob values. Unlike the MARF, the Sickozell sequencer doesn't have multiple playheads. For the sake of exercise, the sequences are duplicated to reach the same result. Readers are encouraged to pass over this fictional limitation with creativity.

Basic Rows for 16-Stage Sequencer

[Patch file download](#)

Melodic-Rhythmic Reliefs

[Patch file download](#)

The Vertical Sequencer

[Patch file download](#)

A16-step sequencer is used to replicate the "pulses2" section of the MARF, advancing the sequencer.

The String Patch

[Patch file download](#)

Keyboard Rotations

[Patch file download](#)

The sequencer can be replaced by a keyboard played by the user, taking the MIDI to CV module V/oct output as source and the gate output as trigger.

Rhythmic Improvisation example 1

[Patch file download](#)

Rhythmic Improvisation example 2

[Patch file download](#)

Quadraphony

[Patch file download](#)

The four channels are rendered binaurally. Please use headphones.
Equipped readers can route the four outputs to a quadraphonic system through the AUDIO 8 module for the intended result.

Acknowledgments

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