Wiard Model 1210 "Noise Ring" Data Resonator

Faceplate of the Model 1210
3" Frac-Rac compatible module with Blacet power connector
A source of random voltages and noise-tone hybrid sounds

Introduction:

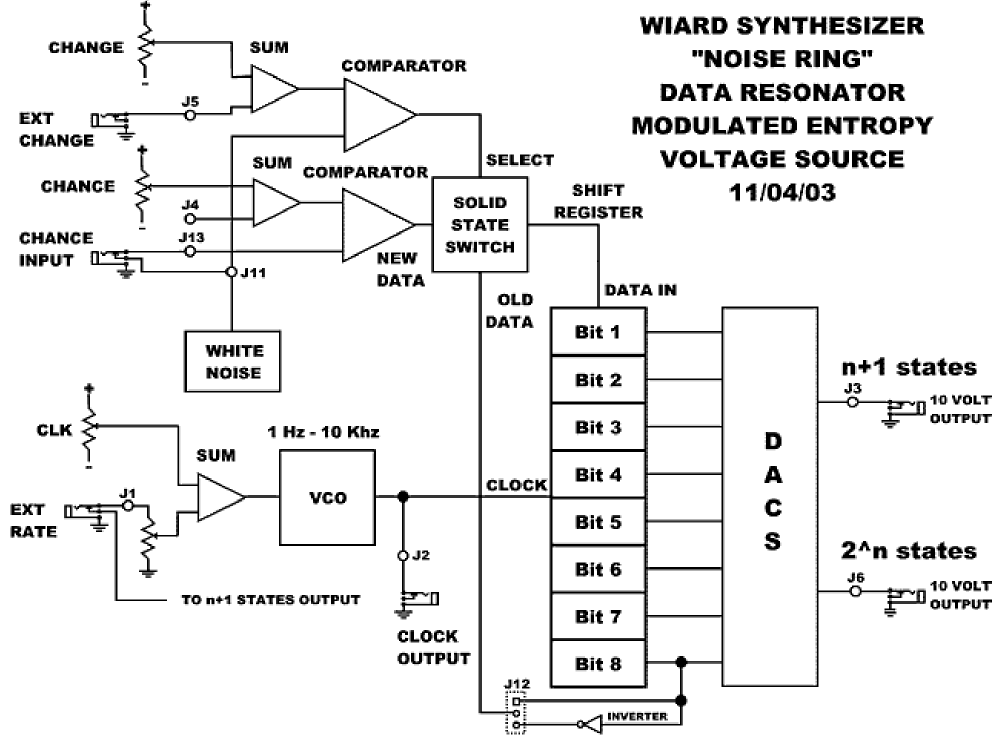
NOTE: The empty socket on the PCB is for test or expansion. It is normally empty! The pinout for the socket J10 is at the end of the manual.

In latter model synthesizers, digital noise sources began to appear in place of analog ones. Traditionally, a psuedo-random shift register set up for optimal length. By optimal length, it is meant that every state of all available bits will appear at some time, but the order is unknown. Essentially a counter that counts in an unknown order. This represents the maximum state of information "entropy" available for that number of bits.

But music has close self-similarity over short periods of time. That is, it repeats itself with changes appearing slowly. This shift register generator is designed to give control of the rate of appearance of new information. It has a tight set of controls over how random it actually is and how fast change occurs.

Knob Twiddling:

A longer sample involving just adjusting the various settings on the module by itself: Playcontrol1.mp3



Block Diagram of the Model 1210

Tone Wheels and Noise Rings:

Clocked at audio rates, the shift register forms a kind of synthetic "tone wheel", similar in idea to the electromechanical tone wheels in organs. But with very crude quantization, and hence very "noisy". To some extent you can visualize the resistor summers (DACS - digital to analog converters) like the lines of magnetic force around a metallic tone wheel. Different summers form different kinds of pickups. It is actually a digital transversal filter, but the "pickup" idea is helpful.

All voltage ranges are from 0 to 10 volts. The Aux Output (n+1) will change between one of 9 voltage levels. The Output (2^n) will change between one of 256 voltage levels.

Noise Source:

The module contains an internal analog white noise generator. Random digital data is generated by using two comparators to compare the noise voltage against two DC voltages. One comparator generates a controllable density of zeros or ones. The second comparator controls the solid state switch which which selects between recycling old data in the shift register, or getting new data from the outside. If the "CHANGE" control is set to 100%, ALL new data is shifted through the register. With the "CHANGE " control set to 0%, only old data is recycled through the shift register without change.

CLOCK:

A wide range voltage controlled oscillator is used to clock the shift register. The 4 decade range from 1 Hertz to 10 Kilohertz, allows the generation of audio rate sound and also control voltage sequences. The VCO has a coarse set front panel control and an external control voltage input with attenuator.

With the "CHANGE" control set to 100% and the "CHANCE" control set to 50%, sweeping the clock from high to low sounds like this at the 2^n output: Clocksweep1.mp3
With the "CHANGE" control set to 100% and the "CHANCE" control set to 50%, sweeping the clock from high to low sounds like this at the n+1 output: Clocksweep2.mp3

Clock controls on the Model 1210.

Clock frequency is nominally 1 Hz to 10 kHz. 0 to +10 V square wave.
Green "CLK" LED flashes when "CLOCK OUT" jack is at +10V.
The "n+1" output is normalized to the "EXT RATE" input. Increasing the "EXT RATE" control randomizes the clock time.
If an external voltage source is connected to the "EXT RATE" input jack, the "n + 1" connection is broken.

"CHANCE" Control

Controls the balance between ones and zeros in the new data. With the "CHANGE" control is set to 100% (all new data), sweeping the "CHANCE" control sounds like this at the 2^n output: Prob1sweep.mp3
With the "CHANGE" control is set to 100% (all new data), sweeping the "CHANCE" control sounds like this at the n+1 output: Prob1sweep2.mp3

Chance controls on the Model 1210.
Chance controls the number of zeros and one extracted from the noise source.
At 7 o'clock position, all zeros are output and the "Chance indicator" LED is always off.
At 5 o'clock position, all ones are output and the "Chance indicator" LED is always on.
At 12 o'clock position, equal numbers of zeros and ones are output and the "Chance indicator" LED flickers.

Processing External Data

Oscillator:

Another oscillator can be used to supply data into the shift register. Connect any waveform into the "CHANCE INPUT" jack. In this case we hear the familiar "phased" sound of a swept shift register: Phaseshifter.mp3

At ultrasonic frequencies the heterodynes do a good approximation of a shortwave radio: ShortWave.mp3

Drum Machine:

Using the Envelope Follower from an ARP 2600 controlling a Borg Filter. The drum machine input is processed through the noise ring, then has the envelope reapplied by the Borg Filter.
drum1.mp3
drum2.mp3
drum3.mp3
drum4.mp3

"CHANGE" Control

With the VCO set to the audible range, sweeping this control from 100% to 0% sounds like this at the 2^n output: Prob2sweep.mp3
With the VCO set to the audible range, sweeping this control from 100% to 0% sounds like this at the n+1 output: Prob2sweep2.mp3

Change controls on the Model 1210.
Change controls the number of new zeros and one which are let into the ring.
At 5 o'clock position, all old data is used and the "Change Indicator" LED is always off.
At 7 o'clock position, all new data is used and the "Change Indicator" LED is always on.
At 12 o'clock position, equal numbers of old and new data are used and the "Change Indicator" LED flickers.

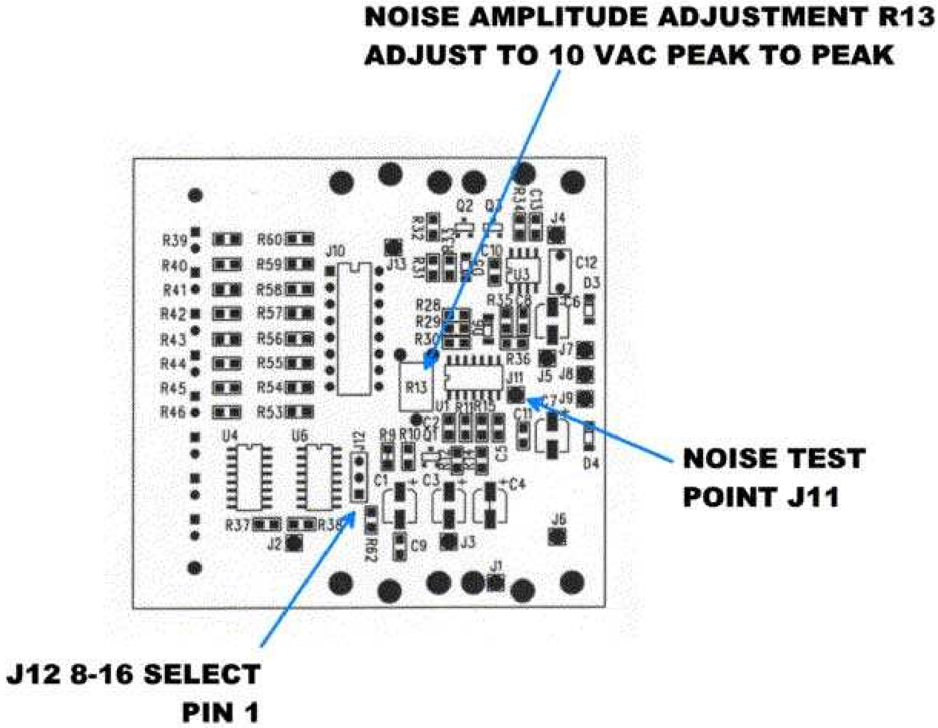
The "n" ring lights flicker red and green as data passes through the ring.
The orange "OUT" LED will change brightness with the 2^n output voltage.

Used with a Sequencer

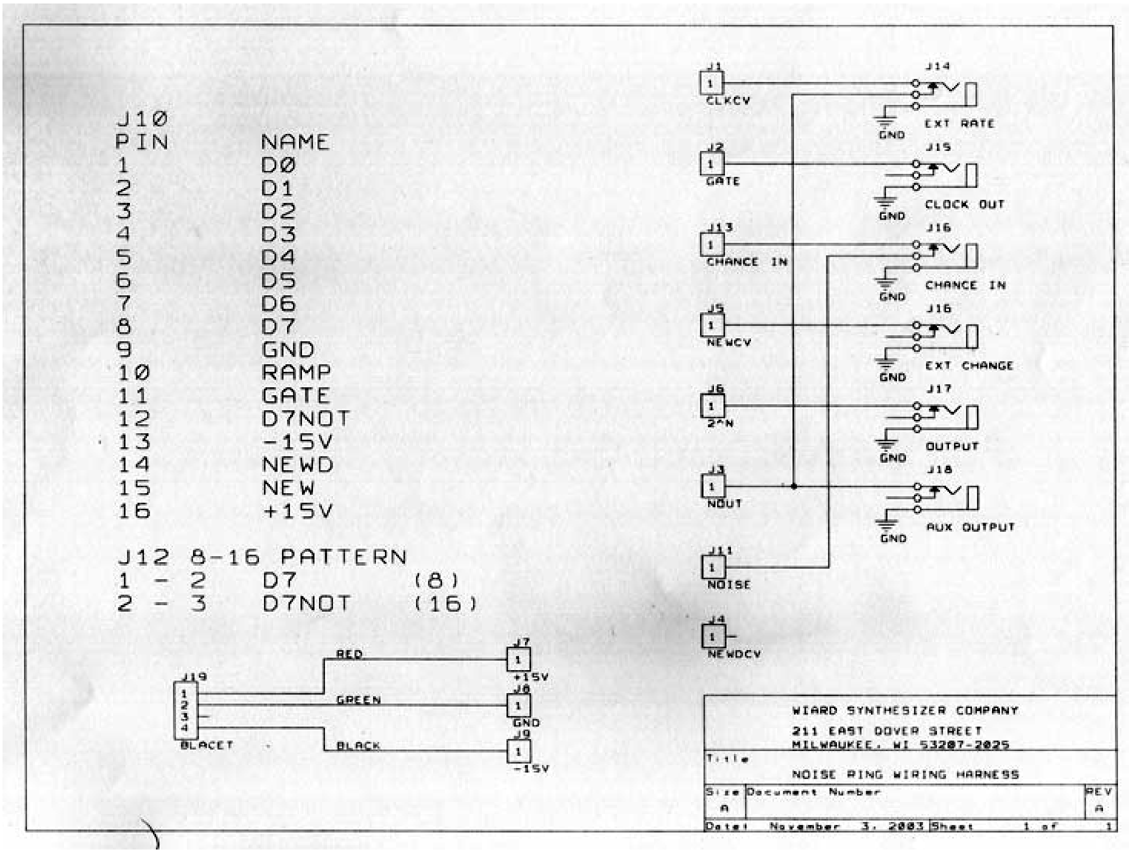
The following mp3s all use the same patch. The Noise Ring is used as an audible source while the parameters are varied in real time by a multi-rank sequencer. A Wiard Borg filter module is used as VCF and VCA swept by an Wiard Envelator module. This demonstrates the mixture of noise and tone that can heard coming from the hybrid oscillator.

Noise Seq 1.mp3
Noise Seq 2.mp3
Noise Seq 3.mp3
Noise Seq 4.mp3
Noise Seq 5.mp3
Noise Seq 6.mp3
Noise Seq 7.mp3
Noise Seq 8.mp3
Noise Seq 9.mp3

TECHNICAL INFORMATION

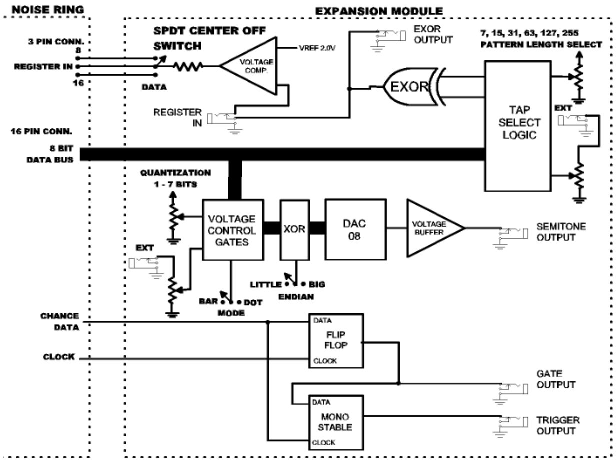


Only 1 trim point on module. Move red jumper on J12 to invert data recirculated through shift register.



Wiring harness of the Noise Ring Module. J10 is test connector.

BLOCK DIAGRAM OF ENTROPY EXPANDER FOR NOISE RING



The reason it exists is because I figured out another algorithm that can run on the same set of hardware. The mathematics of information theory as applied to music predict that it is possible that some portions of this new algorithm MAY have musical usefulness.
That is all we had to go on the first time, so what the heck.
Our story begins with the "Quantized Random Voltages" section of the Buchla Model 266.
http://www.musicsynthesizer.com/Buchla/source_of_uncertainty.htm

It was absolutely essential that the Noisering NOT be a 266, because Mr. Buchla had done that already, so repeating his work would not advance the state of the art. I did however incorporate the 2^N and N+1 output structure. But there is no psuedo-random sequence generator (PRSG) in the Noise Ring currently.

A PRSG is one kind of way to control the contents of a shift register. And if you grew up on Don Lancaster, only a maximal length PRSG is desirable.

Then I find a paper by Ralph Burnams "Harmonic Content of Sub-Optimal Psuedo Random Generator Sequences". And it turns out that that the original CD4006 implementation of an optimal PRSR is only one of a spectrum of solutions, each of which has a unique audio harmonic signature.

So there is one way to spice up Mr. Buchla's original algorithm, add voltage selectable sub-optimal sequence control. So the length control selects sequences of 15,31,63,127,255 under voltage control. They values are shown on LEDs. Don't worry, beat one of the repeat is at 16, 32 etc.

In beta testing the good Dr. Mabuse (aka Mike Murphy) detected that any static sequence sounds, well, static. HOWEVER by dynamically modulating the count length, you got an effect at some settings, that were musical "keepers". That is a good enough recommend to me that I am willing to go ahead with the rest of it. "Sometimes the Universe gives you clues about your destiny, you should listen"- George Clooney

OK, so we have something new for sequence control and animation in the audio domain, what about as a controller?

The "quantization" knob on the 266 is just Shannon's Measure of Information Entropy. Which is just "how many levels in the signal, expessed in bits, dude".

Now if we make each level be the 1 volt per octave voltage of a semi-tone, we have a musically quantized output. But if we copy the 266 design exactly, then we can only control the entropy from big to small. What if we want to control it from small to big, like an expanding range of semi-tones.

So we need an "Endian" control. Technically that is the term for the order of bits. Microsoft being the reverse of MACs (of course).

The "Gate" and "Trigger" circuits came from "Musical Applications of Microprocessors" by Hal Chamberlain.