ERD modular eurorack series ERD/γ manual

micro_research

December 21, 2015

Provide by Arts, for the hardnesse of Nature, for one Sister weepeth without the other.

γ

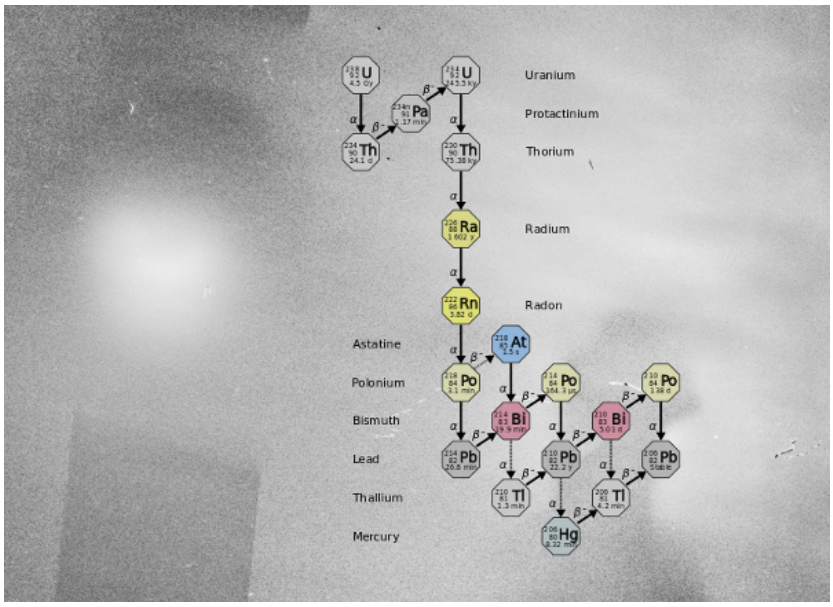
Extending the explorations of material process and ever viral code initiated by the micro_research ERD series, ERD/γ digs the Eurorack synth deep into geological time scales of radioactive decay. The module provides a radioactive source (Uraninite aka. Pitchblende), Geiger counter and processing to deliver both pure random voltages and random timing/triggers.

Given the half life of the isotopes within the active material (Uranium-238 and Uranium-235) the module must be returned for recalibration in perhaps a few billion years.

According to selected mode (four CV modes) ERD/γ outputs a scaled random control voltage (0-5v) either at specific adjusted time deltas, or at scaled random times. A low entropy mode allows for faster random CV out (maximum

100-150Hz as compared to 10-20Hz). A trigger mode supplies the last available random voltage on trigger in (rising edge). A dedicated trigger out provides a 5v pulse (200uS duration) at random scaled intervals (at zero speed scale each pulse mirrors a beta decay event at the geiger tube). Timing and voltage scales are under CV control; local entropy can thus be reduced.

Radioactive background



Uranium-238:

- decays, through alpha-emission, with a half-life of 4.5 billion years to thorium-234
- which decays, through beta-emission, with a half-life of 24 days to protactinium-234
- which decays, through beta-emission, with a half-life of 1.2 minutes to uranium-234
- which decays, through alpha-emission, with a half-life of 240 thousand years to thorium-230
- which decays, through alpha-emission, with a half-life of 77 thousand years to radium-226
- which decays, through alpha-emission, with a half-life of 1.6 thousand years to radon-222

- which decays, through alpha-emission, with a half-life of 3.8 days to polonium-218
- which decays, through alpha-emission, with a half-life of 3.1 minutes to lead-214
- which decays, through beta-emission, with a half-life of 27 minutes to bismuth-214
- which decays, through beta-emission, with a half-life of 20 minutes to polonium-214
- which decays, through alpha-emission, with a half-life of 160 microseconds to lead-210
- which decays, through beta-emission, with a half-life of 22 years to bismuth-210
- which decays, through beta-emission, with a half-life of 5 days to polonium-210
- which decays, through alpha-emission, with a half-life of 140 days
- to lead-206, which is a stable nuclide.

Any atomic or sub-atomic change within materials implies a nuclear transmutation. Radioactive decay, also known as nuclear decay or radioactivity, is the process by which a nucleus of an unstable atom loses energy by emitting ionizing radiation. A material that spontaneously emits this kind of radiation - which includes the emission of alpha particles, beta particles, and gamma rays — is considered radioactive.

The geiger counter tube and circuit registers and makes audible and visible the local presence of this beta and gamma ionising radiation caused by forms of radioactive decay within active materials such as Uraninite embedded within the ERD/γ crystal cube. Each flash of the LED, and accompanying trigger pulse (before any division) means that a particle has been intercepted by the geiger tube, causing a pulse of electricity to flow through the tube, and triggering an event.

The interval between detected decay events presents a high entropy source of randomness. Although we know that in 24 days half of our stock of Thorium-234 atoms (itself a decay product of Uranium-238 in our sample with a half-life of 4.5 billion years) will have decayed into Protactinium-234, we have no way of knowing exactly when an atom will decay, producing as part of this energetic transformation a beta particle which will strike our geiger tube and trigger a musical (or otherwise) event. We can see the natural decay chain of our Uranium-238 above.

However we need to accumulate entropy to avoid any baising from the physical characteristics of the tube or circuit. To do this, the digital part of the

module accumulates random bits from the low bits of each interval into bytes and uses these as the source for the random voltages.

Layout

Modes from selected switches (0 is switch up):

4 CV modes: CV out (0-5v):

- 00- Scaled random voltage every speed (discrete) delta T time = from 10Hz to 120 seconds
- 01- Scaled random voltage every random emission scaled by speed time = 10Hz to approx 120 seconds
- 10- Low entropy every divided emission by speed time = 100Hz to approx 80 seconds

- 11- Trigger in produces last random voltage (note that if triggers are too fast entropy is severely reduced)

2 trigger modes: trigger out (5v, 200 uS) on random time interval/pulse divider:

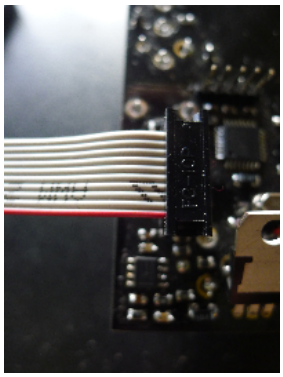
- 00/01- Random time scaled by random scale scaled by speed scale = 100Hz to approx 30 seconds
- 10/11- Random time scaled by speed scale = 100Hz to approx 80 seconds

Also note that the delay/timing for each mode is only reset on the end of each pulse, random voltage (so you may have to wait until the next event in the sequence). All CV inputs are scaled by the corresponding pots. If speedscale pot is set to zero (far left) CV in will have no effect. If it is set far right it will effect across the whole speed range

Tech specs

12HP, 35mA at +12V, 4mA at -12V, 0mA at 5v. 2 CV inputs(0-5v), 1 trigger input(edge trigger), 1 CV output(0-5v), 1 trigger output (5v at 200uS), 35mm deep.

Suggested uses and notes



red stripe or -12V DOWN towards the bottom of the unit

Simply wire up the power connector (red/-12V to the bottom of the unit when facing the back) and connect CVs and trigger as necessary. Do not touch the Geiger tube (the long bronze cylinder) or move fingers very close as this will effect the entropy readings.

ERD/γ is suited for envelopes, filters and all manner of modular re-entropising. The non-deterministic nature of the module also renders it suitable

for both EVP (Electronic Voice Phenomena) experimentation (pair one or two with a Grendel Formant or forthcoming ERD/WORM for example) and advanced psychic and parapsychological research (Global Consciousness project, pre-sentiment).

Further reading

http://en.wikipedia.org/wiki/Radioactive_decay
http://en.wikipedia.org/wiki/Beta_particle
http://en.wikipedia.org/wiki/Gamma_ray
https://www.fourmilab.ch/hotbits/how3.html
http://www.ciphergoth.org/crypto/unbiasing/

Risks and disclaimer

In regular use, the ERD/γ module presents no health hazards. The radioactive source is small and encased in resin to prevent any contamination by way of dust. It is also of reasonably low decay activity and the distance of operator from the source reduces considerably an already very minor radiation dose. The embedded radioactive source should not be removed from the device or tampered with in any way. The geiger tube requires a very low current, high voltage power supply which is not in any way dangerous but contact should be avoided with the back of the board.

Despite the lack of any health risks associated with the normal use of this device, the manufacturer accepts no responsibility for any health issues associated with both the regular or un-anticipated uses of this module.

Credits

With thanks to Erich Berger, Daniel Belasco Rogers, Otto Mikkonen and Dirk Dunkelberg. Geiger power supply design is based heavily on mightyohm's design which was based on Tom Napier's article in issue 184 of Circuit Cellar (Nov. 2005).

Edition

This ERD/γ module is numbered .... in a strictly limited edition of 60.