Welcome to the Pendulum/Ratchet

Thanks for getting on board the S.S. Pendulum/Ratchet. It's something that I really wanted, and I'm gratified that other people thought it was worthwhile, too. This is less of a manual, and more a collection of thoughts and information. It's one of those things that I realized needed to be done at the last minute. I'm sorry to say that it suffers from an almost total lack of organization.

First, some non-obvious things:

CV NULL - Ever notice that it can be hard to find the "off point" of center-off CV attenuators? This is largely because there is a fairly large variation of resistance in potentiometers, as well as minor differences in power supply voltages. There is a "secret" key press when powering on that can make this better. If you hold the sync button while powering on, the current position of the four CV attenuator knobs is stored as the center position. To use this feature, make sure the knobs are well centered, then power on holding sync. This "null point" will be used from here on as the mid-point of travel. Modules are shipped with a reasonable null point set, but you might want to fine tune it in your particular system.

BLINKING LIMIT LEDS - You may be wondering why the blue limit LEDs blink when you turn the knob or have a control voltage coming in to select the division. Some of the number sets are fairly sparse, so it may take a few degrees of rotation of the knob to actually get to a new divisor. The LED will blink every time a new divisor is selected.

LONG PRESS - The limit switch setting in the Division A and Division B sections can be set back to no limit (all LEDs off) by a "long press" on a limit switch.

BURST GENERATOR - A "burst generator" emits some number of pulses at some frequency, for each input trigger it receives. The way to set this up with the Pendulum/Ratchet uses one of either Division A or Division B to set the length of the burst. For this example, let's use Division B. Patch the Division B output into the stop jack, and the source of triggers for the bursts into the start and sync jacks. Now, for each pulse into the start & sync jacks, the Pendulum/Ratchet will do its thing until the length that is set on Division B is reached, then the system stops. Note that the normal /2 through /24 outputs cannot be used to set the length, as they fire when synced.

Pendulum Section

The Pendulum section consists of:
- a wide range VC pulse clock which shows up on the tick output
- a random pulse density filter, which takes its input from the Pendulum clock
- transport controls that stop, start & sync the clock, and their associated jacks

The main clock has a range of about eleven octaves. It goes from about ten seconds per tick up to

about 5 ms per tick (approx. 180 Hz) The clock rate can be driven into slower rates through voltage control. I tried to make the CV input attenuator feel smooth, but keep in mind that it is controlling roughly twenty-two octaves of travel. (+/- 11)

With the Density control all the way up, the "tock" output is the same as the "tick" output. Turning Density down creates a pulse train that randomly picks pulses from the clock to send out the tock output. There are a couple of options available for the tock output: see DIP switch options

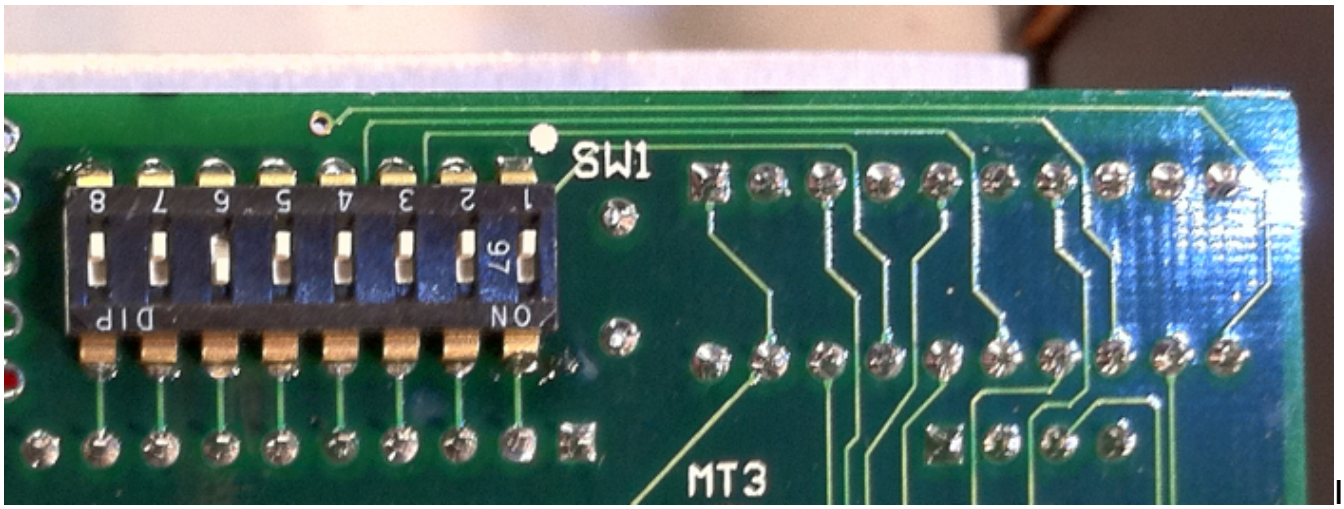
Ratchet Section

The Ratchet section consists of:
The Ratchet input jack. This can be clocked from any pulse source; I've included a shorting plug which will enable you to route either tick or tock to the Ratchet input.
In fact all the pulse inputs can be clocked from just about any CV source. There is a comparator on the inputs which will "snap" whenever the voltage crosses a threshold. This threshold is set on the "Thresh 1" trimmer (VR1), and comes set to 7.5 volts. This trimmer is one of two on the back of the module.

The right-hand fixed divisors section has a column for multiples of 2 and a column for multiples of 3. These get reset with the sync control.

Division A & Division B are free-running divisors that can be voltage controlled to select the divisor. These divisors "roll phase," which means that they can be coaxed into unusual phase relationships with the fixed divisor section. For example, you could have three divisors, all dividing by the same number, but occurring on different beats. Whenever the divisor changes, it starts counting up to the new count from the last time it fired. The sync control brings everything back to normal, in the rare case that that might be desirable. The divisors can be limited to various number sets. The limit options are arranged in decreasing density:
limit off (1 2 3 4..128)
odd (1 3 5 7..127)
even (2 4 6 8..128)
primes (2 3 5 7 11 13 17 19 23 29 31 37 41 43 47 53 59 61 67 71 73 79 83 89 97 101 103 107 109 113 127)
trip (1 2 3 4 6 8 12 16 24 32 48 64 96 128)
Fibonacci (1 1 2 3 5 8 13 21 34 55 89 144)
^2 (1, 2, 4, 8, 16..128)
There are a couple of options for the Disable jacks that can be set via the DIP switch. See DIP switch options. There is an independent threshold set for these jacks via the "Thresh Dis A/B" (VR2) trimmer. This comes set to 2 volts. This trimmer is one of two on the back of the module.

DIP switch options for firmware version 1.03 (June 2011)



In an ideal world these options would all have front panel controls to enable them, but there just wasn't room, so think of them as custom modifications that you can enable or disable via the dip switch. You never have to use any of these options, but a couple of them were user requested, and I figure that if one person wants this functionality, others might too. The dip switches are only read when the module is powered up, or when the reset button is pressed. Off is closest to the edge of the board. The above picture of the dip switch has all switches off, except switch 6.

Switch 1 – Tock in Ratchet.

The Pulse Density Tock section is not driven directly from the Pendulum clock, but rather from whatever pulse train is coming in the Ratchet Jack.

Switch 2 – Tock / 2.

Tock is driven from its own divide-by-two pre-scaler. This can be combined with Tock in Ratchet.

Switch 3 & 4 – These two switches set options for the Div A & B disable jacks

Sw3 off & Sw4 off • Disable jack is Disable

This is the default state

Sw3 ON & Sw4 off • Disable Jack Advances Phase

For each pulse into the Disable Jack, the phase is incremented by one. If you start off with Division A and Division B in sync at the same divisor, and patch the output of one divisor into its Disable jack, each incoming pulse will push the divisor ahead one beat.

SW3 off & Sw4 ON • Disable Jack Advances Divisor

For each pulse in the Disable jack, the divisor is advanced one entry in the current limit number set. The CV inputs are still active, so they can set/reset the divisor independently. Last one in wins.

SW3 ON & SW4 ON• Disable Jack Steps Limit Mode

Each pulse advances the Limit Mode, just as if you had pressed the limit switch.

Switch 5 – Div A & B Fire on Sync Pulse

Normally, the Div A & B outs don't fire when the module is Synced. This is good if you're using the module as a burst generator, with A or B as the end of burst pulse to the stop jack. But there are times when you want Div A & B to fire on sync like all the other pulse output jacks, so set this switch to get them to fire on Sync.

Switch 6 – Longer pulse outputs

The normal pulse length out of the Pendulum/Ratchet is roughly 1ms (for reference the pulse out of a 281e is half of that: 500µs.) Setting this switch makes the pulses about 5ms long (which is the same length as the 250e.) Note that the Tick out is always 1ms, and the Div A & B fall back to 1ms at their faster divisors. Also, the Tock output falls back to 1ms at faster Pendulum rates.

Switch 7 – Gate Run

This mode makes the Pendulum/Ratchet only run when there is a gate at the Run and Stop inputs. With this mode enabled, and a gate signal from something like a 225e or 222e patched into Run AND Stop, the Pendulum/Ratchet will run while a gate is present, and stop when the gate goes away.

If you have a pre-2011 Pendulum/Ratchet, you will have to adjust the "Thresh1" trimmer, VR1, on the back of the module to use this mode. The old threshold on this trimmer was about 6v (1:30 on the clock,) which caught the trigger part of a Buchla "stepped pulse," but did not catch the steady state gate part. With the trimmer set for about 2.5v (9:30 on the clock) It catches the steady state gate, but will miss triggers from legato playing. Appendix 2 shows the trims set to about 9:30

Switch 8 – Send debugging information to host.

From a musician's point of view, this might as well be called "mess up timing." Leave this one off.

DIP switch options for firmware version 1.02 (2009, 2010)

Switch 1 - Tock in Ratchet.

The Pulse Density Tock section is not driven directly from the Pendulum clock, but rather from whatever pulse train is coming in the Ratchet Jack.

Switch 2 - Tock / 2.

Tock is driven from its own divide-by-two pre-scaler. This can be combined with Tock in Ratchet.

Switch 3 - Disable Jack Advances Phase

For each pulse into the Disable Jack, the phase is incremented by one. If you start off with Division A and Division B in sync at the same divisor, and patch the output of one divisor into its Disable jack, each incoming pulse will push the divisor ahead one beat.

This can NOT be combined with Switch 4 or 5.

Switch 4 - Disable Jack Advances Divisor

For each pulse in the Disable jack, the divisor is advanced one entry in the current limit number set. The CV inputs are still active, so they can set/reset the divisor independently. Last one in wins.

This can NOT be combined with Switch 3 or 5.

Switch 5 - Disable Jack Steps Limit Mode

Each pulse advances the Limit Mode, just as if you had pressed the limit switch.

This can NOT be combined with Switch 3 or 4.

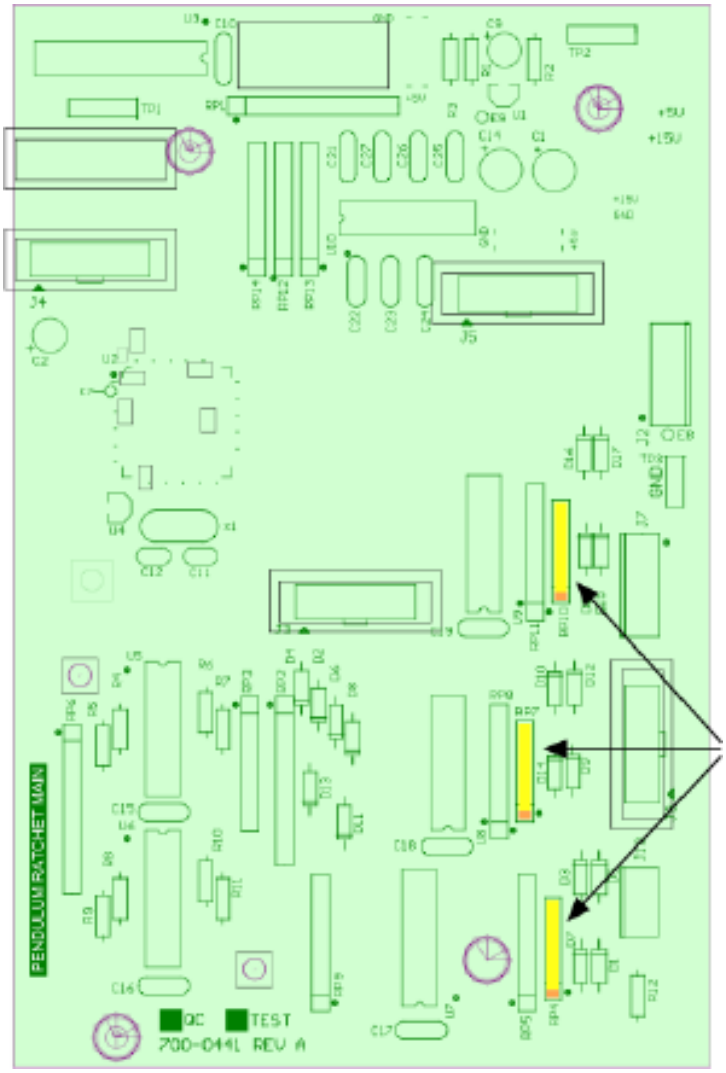
Switch 6 - reserved

Switch 7 - reserved

Switch 8 - Send debugging information to host.

From a musician's point of view, this might as well be called "mess up timing." Leave this one off.

Appendix 1:



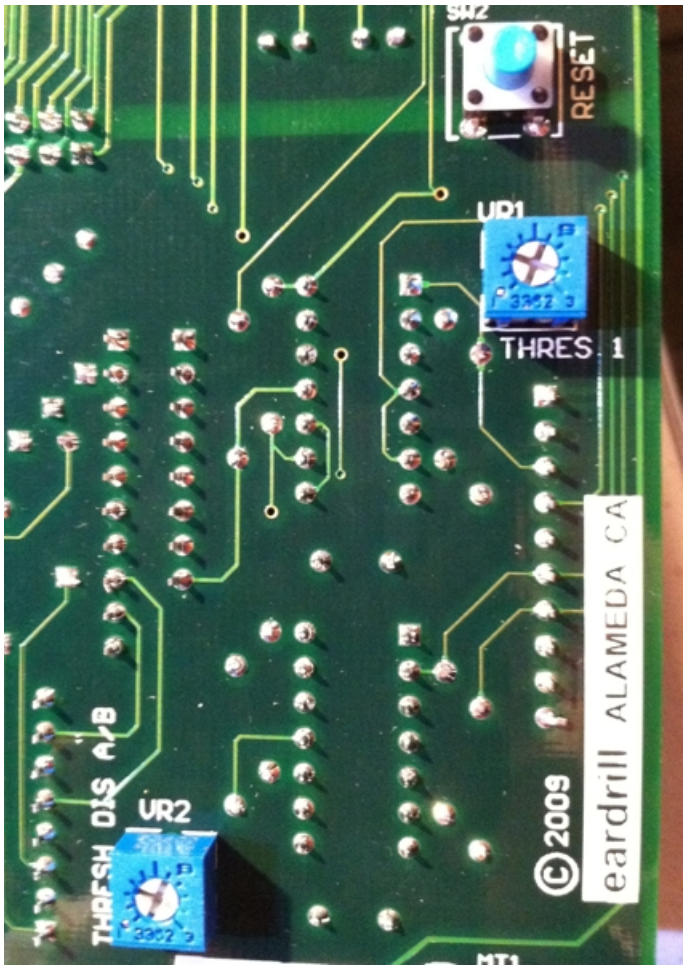
Three resistor packs determine output pulse voltage. This is a drawing of the component side of the main board.

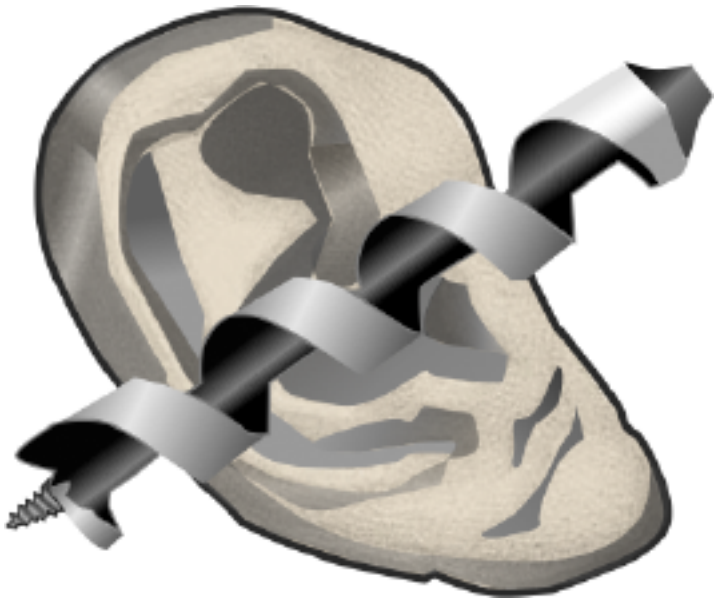
There are three socketed resistor packs that determine the amplitude of output pulse. Pin one is down.

47K for 10 v. pulse
22K for >= 13.5 v. pulse

Mouser numbers:
47K = 264-47K-RC
22K = 264-22K-RC

Appendix 2:
Trimmers set to 9:30–ish





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