official user's manual for:

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Mom Jeans

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an oscillator

from **CuteLab**

using pulsar synthesis

and grain width modulation

Rev: 1.1
Nov 2025

Outline

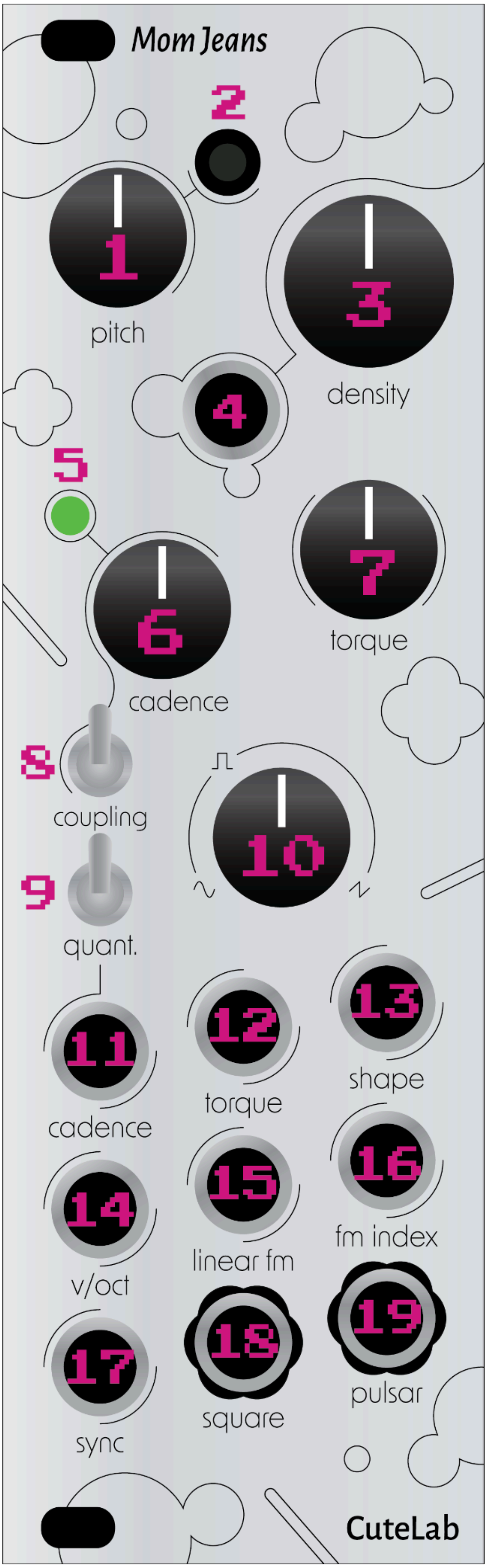
Overview

Mom Jeans is a digital Voltage-Controlled Oscillator (VCO) that blends pulsar synthesis with grain-width modulation. The module generates a train of regularly spaced harmonic grains while varying the width of these grains in a precise and pitch-related way. In hybridizing these two techniques, Mom Jeans opens up a surprisingly varied range of timbres, given a concise set of adjustable parameters.

What makes Mom Jeans distinctive is its ability to create a wide range of digital sounds using a single synthesis method. I think we've all had the frustration of trying to dial in a specific sound using FM. Mom Jeans gives access to sounds similar to FM, wavetable, bitcrushing, and granular synthesis, but it avoids the complex array of parameters you find with some of those methods. This makes it much easier to dial in sounds, and much easier to use CV to modulate between radically different timbres and sonic spaces. Crank all the knobs for a super crispy hard-sync style tone, then dial back density halfway to hear its echos through radio static. Set all the knobs just shy of noon and activate coupling for the varied richness of PWM, but with a rate that follows the oscillator's frequency. Then slowly push cadence further, until the modulation is so intense it somehow creates a suboctave harmony. Then pop on quant to suddenly evoke an old transistor organ… at least until you turn up shape and get lost in the buzz of high frequency transmissions. And that's not even touching on the stuttering swamps that emerge when the module is pushed to its limits.

Technical Stuff

Mom Jeans is powered by the +12V and -12V rails, using a 10-pin (2x5) connector. Please follow the markings on the module to ensure that the red stripe on the ribbon cable is aligned to the -12V rail on both the module and your power supply. The module draws ~80mA from the positive rail and ~2mA from the negative rail.

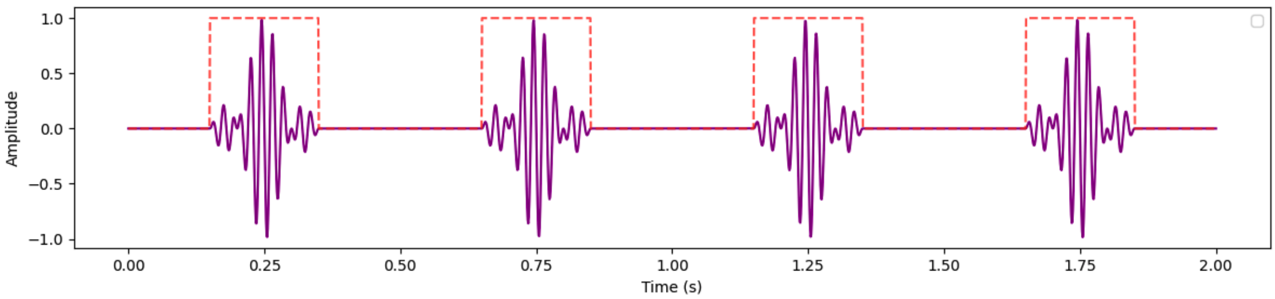


Parameters

1. Pitch knob
2. Range button
3. Density knob
4. Density CV input
5. Cadence rate indicator
6. Cadence knob
7. Torque knob
8. Coupling toggle
9. Quantization toggle
10. Shape knob
11. Cadence CV input
12. Torque CV input
13. Shape CV input
14. V/Oct CV input
15. Linear FM audio input
16. FM Index CV input
17. Sync audio input
18. Square audio output
19. Pulsar audio output

How it works

Many of the parameters on Mom Jeans can also be found on a basic VCO. The Pitch, V/Oct, FM, and Sync parameters all work in the usual way. By using only these parameters, one can use Mom Jeans as a traditional square wave oscillator by taking audio from the square output. However, Mom Jeans also exposes parameters that function in the context of pulsar synthesis. Instead of conventional pulse-width modulation, Mom Jeans offers a density control and a unique grain-width modulator. These pulsar parameters give access to the huge range of surprising and unique timbres that can be created by this unique form of granular synthesis.



The pulsar technique was written about extensively by Curtis Roads in a number of books and essays, a notable one being *Introduction to Pulsar Synthesis*. The diagram above shows what a Pulsar oscillator is doing from a signal processing point of view. The oscillator creates a periodic waveform by generating a train of short waveforms called *pulsarets*. Traditionally, the waveform is a sinc function, represented above in purple. The width of each grain is shown in red. Changing the rate at which pulsarets are generated changes pitch. Changing the width of each pulsaret—what we call density—affects both formant and timbre. In a sense, the Density is similar to pulse-width modulation: it controls how much of the duty cycle is filled by a waveform. However, density stretches or compresses the pulsarets to fit the specified proportion of the duty cycle.

In our implementation, pulsarets are free to overlap, which can lead to all kinds of interesting and subtle changes to the sound. We also give the ability to crossfade from the original sinc function to four additional wave functions, moving from quasi-wavefolded sinc sounds, through hyper-rich nested-squares, all the way to super complex ladders of sawtooths.

Basic Oscillator Parameters

❶❷ Pitch

The **pitch** control on Mom Jeans selects the base fundamental frequency of the oscillator. In standard mode, it ranges from 220Hz to 880Hz. Pressing the Range button will enter extended mode, giving a range of 27.5Hz to 3520. In extended mode, the button's LED is illuminated. Note that pitches lower and higher than these are attainable with voltage control, but more info on that in the next entry.

⓮ V/Oct

The **V/Oct** input changes the oscillator's fundamental frequency (set by the Pitch knob) in increments of one octave per each 1 volt increase in voltage. This allows for precise integration into musical scales and pitch tracking. The input accepts both positive and negative voltages. A 1V input will increase the pitch by one octave, and a -1V input will decrease the pitch by one octave. Note that the module's outputs are AC coupled, so although sub-audio frequencies are possible and useful, they may not behave in a way you'd initially expect.

⓯⓰ Linear FM

Similar to the V/Oct input, the **linear FM** input allows you to modulate the pitch using an external audio signal or voltage source. However, it responds linearly rather than exponentially. This means modulation is applied symmetrically in Hz, rather than in semitones. The amplitude of the modulating signal presented at the **linear FM** can then be attenuated or amplified using the **FM index** input. When the **FM index** jack is not patched, it is normalized to 1V for unity gain.

⓱ Sync

The **sync** input can be used to synchronize the rate of pulsarets to the frequency of an external signal. A square wave will provide the most accurate results, but waveforms with softer edges can create interesting effects.

⓲⓳ Outputs

Mom Jeans has two outputs: the **pulsar** output and the **square** output. The **pulsar** output provides the rich, crispy goodness of pulsar synthesis that you know and love. The **square** output simply provides a square wave, ignoring the shape control. The main pulsar output can produce a lot of high overtones, so blending it with the square can help to reinforce the fundamental and lower overtones. This can be especially useful for bass sounds. The square wave is also useful for syncing other oscillators to Mom Jean's current frequency.

Pulsar Parameters

❿⓭ Shape

Changing the **shape** knob on Mom Jeans will crossfade between a range of timbres, increasing in richness as the knob is turned clockwise. This will feel familiar to other oscillators. However, rather than simply changing the output shape like on other oscillators, the shape control changes the waveform embedded within each pulsaret grain. There are a total of seven waveforms that can be used as a pulsaret: sinc, soft triangle, triangle, rectangle, soft sawtooth,

sawtooth, and stepped sawtooth. Some of these waveforms have a ton of high-frequency partials, resulting in a really bright timbre, but the overall timbre depends on the setting of density in combination with shape. At extreme values of density, these waveforms overlap and cross-modulate in unpredictable and interesting ways. The shape parameter is continuous, allowing for smooth crossfading from one waveform to the next.

You can modulate shape with CV by patching a signal into the input jack directly below the knob. The external signal will add the to the current position of the knob.

❸❹ Density

The **density** parameter is the most expressive parameter on Mom Jean, with a huge influence on the overall timbre. Put simply, it controls the width of each pulsaret, changing how much of the duty cycle it fills. Because the density parameter is always coupled to the frequency of the pulse train, changing the density affects the perceived formant of the fundamental tone in a distinctive and satisfying way. Extreme values of the density parameter can push the module into interesting noisy and rhythmic sonic territory. The Density value is set with the knob, and can be offset using the CV input.

❻⓫ Cadence

While density can be modulated directly by an external source, it can also be modulated internally using an internal modulation source. The cadence parameter controls the frequency of that modulation source. Cadence can be independent of pitch, or it can be made related to pitch using the "coupling" and "quantization" switches. The Cadence value is set with the knob, but can be offset using the CV input. You can also tune this parameter to low values for vibrato-like effects, or much larger values for textural control.

⓬ Torque

Torque controls the amplitude of the internal modulation source that modulates density. Torque can be made proportional to pitch using the coupling parameter. The Torque value is set with the knob, and can be offset using the CV input.

❽ Coupling

The coupling toggle will quantize the rate of the internal modulation source to integer ratios of the oscillator's frequency. This will ensure that the perceived fundamental frequency of the oscillator will remain consistent, no matter how torque and cadence are configured. It is active when the toggle is set to the down position.

❾ Quantization

The **quantization** toggle quantizes the cadence parameter to a ratio proportional to the oscillator's pitch. In this configuration, modulating cadence and torque will create effects that sound more like timbre changes than vibrato. This also discretizes the cadence parameter, resulting in sudden steps between timbres, with an interesting, rhythmic sound. It is active when the toggle is set to the down position.

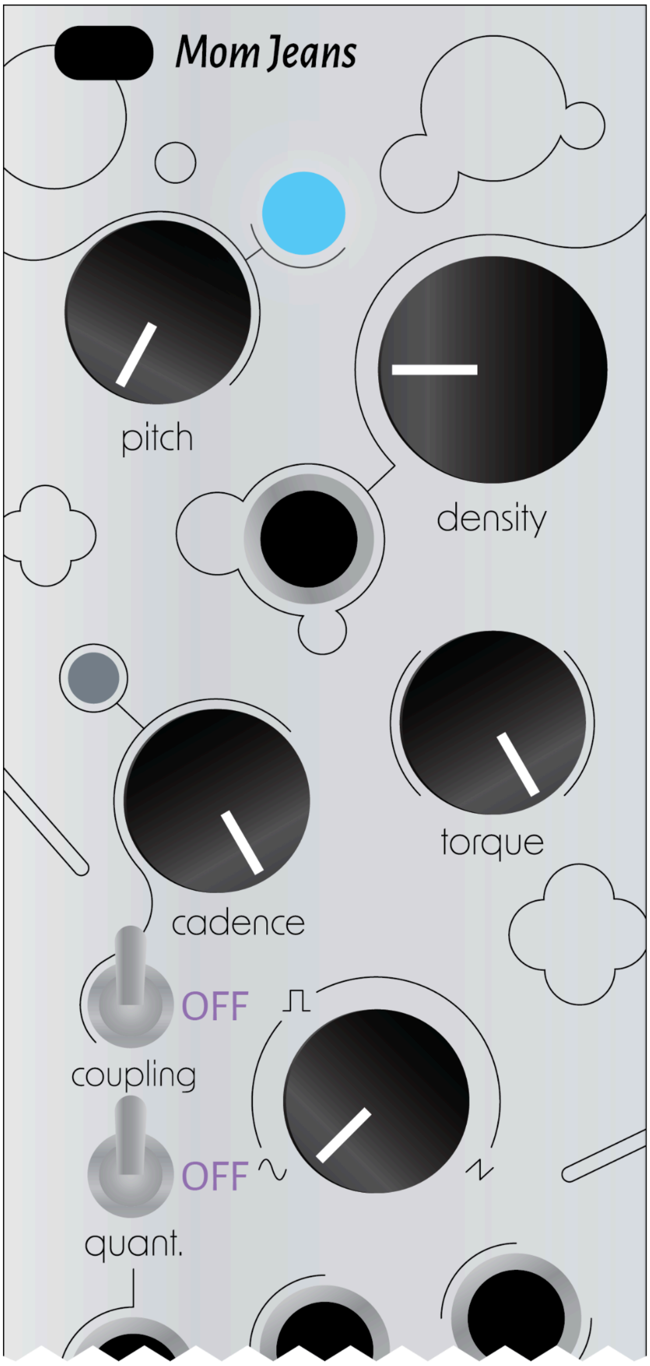
Patch Examples

Example 1: Super PWM

Creates a sound similar to a conventional square wave with PWM modulation, but with greater richness and variation. Excellent for lead sounds.

Example 2: Pocket Monsters

By playing with the pitch knob, coax out snarls and shrieks. Cadence may need to be set carefully to land on a harmonic with intense motion.

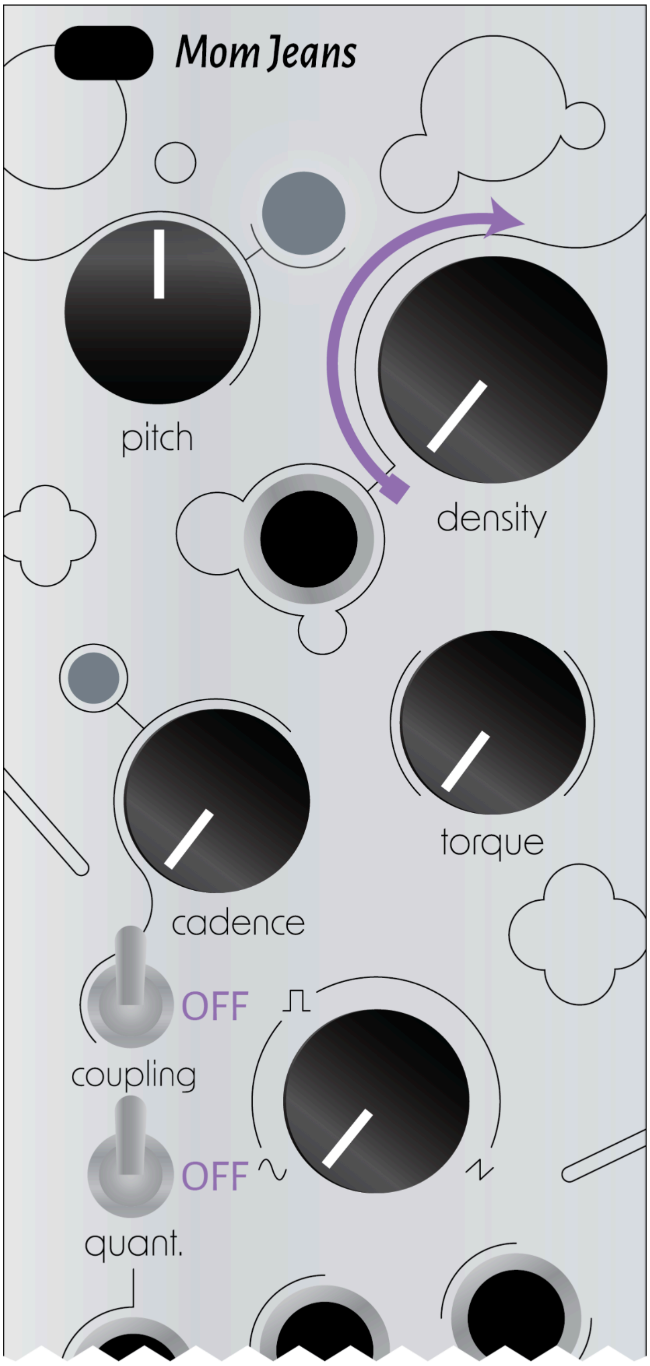


Example 3: Ghost Vibes

Gentle but quick density modulation for a nervous shiver in pitch and timbre. So scawy!

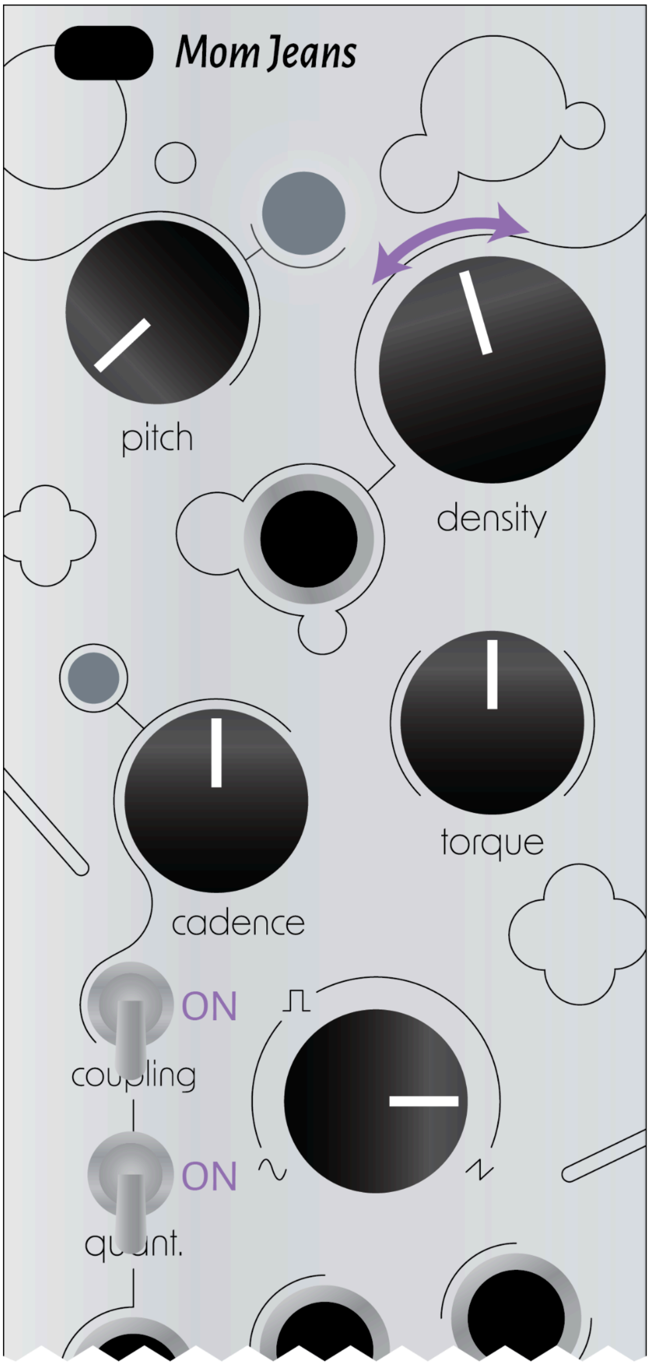
Example 4 : Spelunker

Push density modulation to the limit, generating widely spaced pulsarettes that bubble and chirp. Turn up the **wave** knob for the "8-bit" version. Works best with very low pitch settings.



Example 5 : Simple Sinc

A gentle waveform, reminiscent of a sine wave with mild wavefolding applied. Increase **density** to put an emphasis on higher harmonics.



Example 6 : Captain Crunch

Add an extra crunch to this bell-like wave setting with pitch-tracking audio-rate density modulation. Vary **density** to dial in particular harmonics.