

Quanta User's Guide

Audio Damage, Inc.

Release 1.0

The screenshot displays the Quanta software interface with the following components:

- Header:** QUANTA logo on the left, PRESET: True Lover's Knot in the center, and SETTINGS button on the right. The AUDIO DAMAGE logo is in the top right corner.
- Waveform:** A large central display showing a red waveform. On the left, there are four smaller waveform icons labeled SAMPLE, FEG, FLFO, and MATRIX.
- File Information:** A file icon and the text FILE: CCG5.wav.
- OSCILLATOR:** Includes a SHAPE knob, TUNE (12.00), PULSE WIDTH (65.66), FINE (0.00), and LEVEL (0%) knobs.
- NOISE:** Includes a RAND knob, COLOR (0.01), LEVEL (0%), WIDTH (34%), and FINE (0.00) knobs.
- GRAINS:** Includes a # GRAINS knob (11.20), a SHAPE knob, a LENGTH knob (245.76), a POSITION knob (0.49), and a RAND knob. There are also buttons for RANDOM and DIRECTION, and knobs for OSC IN, NOISE IN, and LEVEL (88%).
- FILTERS:** Features a frequency response graph with two peaks labeled 1 and 2. It includes FILTER ONE and FILTER TWO sections, each with OFF, 2P, and 4P options. At the bottom, there are SERIAL and PARALLEL mode buttons.
- OUTPUT:** Includes a LEVEL knob, a UNISON button, and a # VOICES knob (3). There is also an ALL STOP button.

6 July 2018

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Granular Synthesis: A Brief Introduction

First proposed by the 20th-century composer Iannis Xenakis, granular synthesis considers sound—any sound—to be made up of a large number of short, simple sounds, called `_grains_`. By combining a sufficient number of grains with varying characteristics, such as pitch, timbre, loudness, and spacial position, sounds of any timbre and complexity can be created.

In addition to synthesizing sounds from scratch, granular-synthesis techniques can be used to deconstruct an existing recorded sound and reconstruct it with a change in some characteristic such as pitch or timing, or to alter it beyond recognition. Imagine listening to an isolated, short fragment of a sound, only a hundredth of a second long or less. That single fragment probably wouldn't contain enough information for you to recognize it as part of the original sound. However, if you were to play many of these fragments of sound in rapid succession, each one taken from a little further along in the original sound, you'd reproduce the original sound.

Here's where the magic comes in: suppose you choose the starting location of each grain such that the grains overlap by half. You'd hear the original sound (or something close), but it would last half as long as the original. Or, instead, play each grain twice: the result would be a stretched version of the original, lasting twice as long. Play a few grains repeatedly, and you'd hear a little snippet of the sound frozen in time. Then suppose you could manipulate the pitch of the grains and combine this with how fast you move through the original sound as you play the grains. You could change pitch without changing the duration of the sound or do something like playing the sound transposed up an octave but lasting three times as long as the original. There's also no reason you must play through the original recording in a linear fashion. You could go back and forth or jump around at random.

That's the theoretical view. The practical reality of granular synthesis is that describing all of the necessary changes in characteristics of a large number of grains, and then somehow creating and arranging all of these little bits of sound, exceeded the capabilities of audio technology that Xenakis had at his disposal. He conducted granular-synthesis experiments by cutting up and splicing magnetic audio tape. Eventually computers could synthesize sounds digitally, but not in real time: the synthesis parameters were described with text files, which were interpreted by the computer which eventually produced the sound as a static recording. (It was a little bit like painting by writing out a list of instructions telling which colors you wanted where on the canvas, giving that list to someone else, waiting while they put the paint on the canvas for you, and then looking at the result. If you didn't like the results, you revised the list and handed it back to the

painter.) Decades later, computers are much faster and real-time granular synthesis is entirely viable. However, the problem of how to describe the evolution of the characteristics of the grains remains.

Quanta solves this dilemma by presenting a granular synthesis engine in the form of a classic subtractive synth, with an oscillator, filters, envelope generators, low-frequency oscillators, and a routing system to tie it all together. All the control parameters for grains are presented with knobs and other screen controls. LFOs, envelope generators, MIDI controllers, and your DAW's parameter automation let you manipulate sound in ways not possible with either a standard sampler or synthesizer. With an MPE controller, you can push, pull, and bend sounds as you play. Quanta harnesses the power and flexibility of granular synthesis, turning it into an eminently playable instrument.

System Requirements

Quanta is provided as 32- and 64-bit VST2 and VST3, and 64-bit AAX plug-ins for Windows. On macOS, Quanta is provided as 64-bit AudioUnit, VST2, VST3 and AAX plug-ins.

Quanta is a plug-in, not a standalone application. To use it, you'll need a host application such as Ableton Live, Steinberg Cubase, Apple Logic, Avid ProTools, etc¹. Obviously you'll also need a computer capable of running one of these applications. We assume that you are familiar with using plug-ins with your host. If you have general questions about using plug-ins with your host, please refer to its documentation.

We support the use of Quanta under Microsoft Windows 8 or newer, and Apple macOS version 10.9 or newer.

Installation

To install Quanta, double-click the Quanta Installer icon, and follow the instructions. You can choose which plug-in formats to install and, for some formats, the plug-in destination folder.

¹ Product names are copyrighted by their respective owners.

Demonstration Version

We encourage you to download and try the demonstration version of Quanta before purchasing it. The demo version of Quanta is the same as the regular version, but has the following limitations:

- Presets cannot be saved, nor can parameter values or other settings. This includes the information usually stored by your host DAW. If you save a DAW session with an instance of the demo version of Quanta, Quanta will revert to its default state when you reload the session.
- Only a subset of the factory presets is provided.
- Quanta will cease to generate audio at all 20 minutes after you add it to your DAW session. You can remove it and add it again, but it will revert to its default state.

Quanta Overview

Before we dive into the details, we'll describe Quanta's overall architecture and introduce a few terms.

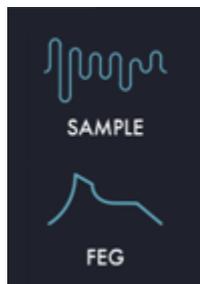
Signal Flow

Quanta's signal flow is pretty simple. Quanta can load a single sample file from which the grain-synthesis engine (hereafter referred to as the *granulator*) generates grains. The signals from the granulator, an oscillator, and a noise source are mixed together and fed into a pair of filters, and the output of the filters passes through a gain stage before emerging from the plug-in. The oscillator and/or noise source can also be fed into the granulator, and the filters can be arranged in series or in parallel.

User Interface

Quanta uses knobs for most of its controls. Click and drag either vertically or horizontally to manipulate the knobs. Double-clicking a knob will return it to its default value, which will usually be the parameter's most neutral setting. Hold down the CTRL or Command key while clicking and dragging to adjust a knob by small amounts.

Quanta's user interface is presented in one resizable window. The upper half of the window can display one of several views. The views are selected by clicking the labeled symbols on the left, and are as follows:



An overview of the sample used by the granulator, and indicators of its activity

Flexible Envelope Generator (FEG) display and controls



Flexible Low-Frequency Oscillator (FLFO) display and controls

Modulation matrix, where all of Quanta's modulation routings are established and changed

We'll describe each view in detail in the following sections.

Polyphony

Quanta is fully polyphonic, which is to say that it can play several notes simultaneously. The sound for each note is created by what we call a *voice*. The voices have a common set of controls and parameters, shown by Quanta's window. As you'd expect, turning one of Quanta's knobs changes that setting for all the voices. Quanta has ten voices, and hence can play up to ten notes simultaneously. Quanta also has a unison mode which causes some or all of the voices to play the same note, creating a thicker sound.

Sample



This view displays the sample loaded into the granulator. You can load files by clicking the anachronistic icon² in the lower left, or by simply dragging a file onto Quanta's window (as cunningly suggested by the "DROP AUDIO FILE" inscription). Loading another file replaces any previously loaded file. You can remove the sample from Quanta (without deleting the file itself) by clicking the icon with the X in it. The name of the sample file appears near the bottom left.

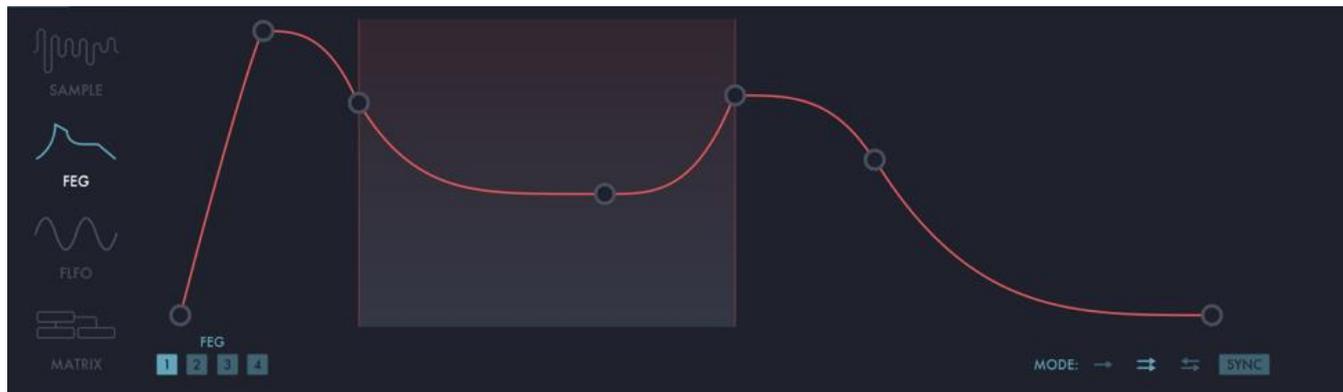
² If you don't recognize this icon, ask someone over 40.

Quanta will load files in the following formats: WAV, AIFF, MP3, Ogg, and FLAC. It should accept files of any sampling rate and bit depth. If the file has more than two channels, only the first two will be loaded. If the file's sampling rate does not match your DAW's sampling rate, the file will be resampled at your DAW's rate to eliminate unwanted pitch shifts. Also, the sample is normalized upon loading; that is, its volume is adjusted to maximize its loudness.

Once you load a sample file into Quanta, its audio data is stored within the data that your host DAW retains for Quanta. It is also saved within preset files. Hence those preset files can be moved to a different computer without requiring you to also copy the original sample files.

The curvy red line depicts the sample data in the usual manner: time runs from left to right, and higher peaks indicate louder parts of the sound. A vertical line indicates the position within the file from which grains will be sampled; you can change this position by clicking in the view, or by twiddling the **POSITION** knob in the **GRAINS** section (more about this section later).

Flexible Envelope Generator (FEG)



This view presents Quanta's four envelope generators, displayed one at a time. The four FEGs have identical features and controls but operate independently. Click the numbered boxes at the lower left to switch between the envelope generators.

Unlike the standard ADSR-style envelope generators found in many synthesizers, Quanta's Flexible Envelope Generators (FEGs) can create modulation signals of almost any shape and description. Each FEG has an arbitrary number of *breakpoints*, that is, points with a specific level and a specific time relative to the previous breakpoint. When you play a note, the FEGs start at the first breakpoint, which always has a level of zero, and move from one breakpoint to the next. The last breakpoint also always has a level of zero. You can add any number of breakpoints between the first and last. A single breakpoint produces a simple attack/release envelope; adding two breakpoints emulates an ADSR (one point for the initial peak, another after it to define the sustain level).

The breakpoints are represented by the small circles joined by lines. We refer to the lines as *segments*. Click and drag a breakpoint vertically to adjust its level; drag it horizontally to adjust the duration of the segment, that is, the time between the breakpoint and the previous breakpoint. As you move a breakpoint, the breakpoint's level and the segment's duration appear below the FEG. Double-click a breakpoint to delete it. To add a new breakpoint, double-click on a segment. To change the curvature of a segment, click and drag vertically on or near the segment.

If you drag a breakpoint past the right edge of the window, the FEG's drawing will be rescaled so that it fits within the window. Conversely, if you make the envelope short enough, it will be expanded to fill the window. Note that the time scale is non-linear: a segment which appears twice as long as another segment will have an actual duration that's more than twice as long as the other. The actual duration is displayed at the bottom of the view. Segments have a maximum duration of ten seconds.

The FEGs can also be synchronized to the host DAW's tempo and transport; click the **SYNC** button on the right to activate this synchronization. When sync is on, the segment durations are expressed in multiples of 1/32nd of a beat and can be as long as a full measure. Note that when sync is on, the time scale within Quanta's window is linear.

The FEGs can loop over any number of adjacent breakpoints while the note sustains. A pair of vertical lines and a shaded rectangle indicate the start and end points of the loop. Move the loop points by clicking either of the vertical lines and dragging them horizontally. If you set the start and end points to the same breakpoint, the FEG will simply stay at that breakpoint while you hold the key down.

The FEGs have three different looping modes: one-shot (i.e., no looping), forward looping, and bidirectional looping. Click the arrow symbols near the lower-right corner of the FEG view to switch modes. The modes operate as follows:

One-shot: the FEG runs from start to finish, without looping or sustaining.

Forward: the FEG runs to the right-hand loop point, jumps back to the left-hand loop point, runs forward to the right, etc. until the note event ends. Upon note-off, the FEG runs from its current position to the end.

Bidirectional: same as Forward, except that the FEG runs backwards from the right-hand loop point to the left, rather than jumping, then forwards to the right, etc., looping back and forth until the note ends.

Note that the jump from the right-hand loop point back to the left will likely produce some sort of click or other discontinuity, depending on what the FEG is modulating. To avoid this click, you have two options: 1) set both loop points to the same level, so that the jump doesn't create a change in output level; 2) use the bidirectional looping mode—that's what it's there for.

Flexible Low-Frequency Oscillator (FLFO)



Quanta sports two low-frequency oscillators. Unlike simpler LFOs found in many synthesizers, the output of these oscillators varies smoothly through an almost endless number of shapes. Hence we call the Flexible Low-Frequency Oscillators, or FLFOs. The two FLFOs have identical features and controls but operate independently.

Four knobs control the shape and behavior of the FLFO's output. The effects of these three knobs are related, and it's far easier to understand what they do by seeing them in action than by reading a description. To that end, the wiggly red line on the left displays one cycle of the FLFO, reflecting the combined effects of the **SHAPE**, **PHASE**, **SKEW**, and **WARP** knobs. We'll describe each of these in turn, but you may find it just as illuminating to twiddle them and watch what happens as to read about them.

The **FREQ** (short for frequency) knob controls determine how fast the output of the FLFO varies over time. They operate either in units of frequency (Hertz, or cycles per second), or in metrical units (fractions of a measure). Click the **SYNC** button to switch between the two modes. The FLFO's rate can be set from one cycle every 10 seconds (or 0.1 cycles per second, abbreviated 0.01 Hz) to 10 cycles every second (10 Hz). When **SYNC** is turned on, the rate ranges from 2/1 (one cycle every two measures) to 1/32 (32 cycles per measure). A "D" or "T" after the number indicates dotted and triplet values.

The **PHASE** knob positions the FLFO's wave relative to either the start of the note, or to the host DAW's transport position. The setting of the **PHASE** knob corresponds to the left end of the wiggly red line. If **RETRIG** is turned on, the FLFO will start its cycle at this point on the wave when a note starts. If **SYNC** is turned on, the FLFO's cycle will align with the DAW's transport such that the cycle always starts at this point (at metrical intervals set by the **FREQ** knob). If neither **SYNC** nor **RETRIG** is turned on, the **PHASE** control isn't particularly relevant because the wave's alignment will vary from one note to the next, since it will cycle independently of the notes. Sometimes you want modulation that varies predictably with each note, sometimes you want modulation that evolves independently of the notes. The **RETRIG** switch gives you both.

The shape of the FLFO's output is controlled with the **SHAPE**, **SKEW**, and **WARP** knobs. The **SHAPE** knob adjusts the basic shape of the signal, morphing it smoothly through four standard shapes: a double sine wave (i.e. a sine wave with twice the frequency set by the **RATE** knob), a sine wave, a triangle wave, and a square wave.

The **SKEW** knob adjusts the horizontal symmetry of the wave, and has a different effect depending on the wave's initial shape. For example, if the **SHAPE** knob is set to produce a triangle wave, the **SKEW** knob varies the wave from a downward-sloping ramp to a rising ramp. If the **SHAPE** is set to a square wave, the **SKEW** knob varies the duty cycle of the wave.

The **WARP** knob applies an adjustable curvature to the wave, changing its vertical symmetry. It can bend a triangle wave into a sharp spike and change a sine wave into a rounded pulse.

Here's a quick walkthrough: start by double-clicking both **SKEW** and **WARP** to set them to their center (neutral) positions. Turn **SHAPE** all the way clockwise and you'll see a simple square wave. Turn **SHAPE** down slowly and you'll see the wave change into a triangle, then a sine, then a double sine. Set **SHAPE** back to 0.75 to get a triangle wave, then play with the **SKEW** and **WARP** knobs to **EXPLORE** their effect.

Sample and Hold

Also present in the FLFO view, the Sample and Hold modulator reproduces a classic feature of analog synthesizers. It acts like a simple memory for modulation signals. When triggered, it samples its input signal, and holds that value at its output until it is triggered again. It's something of an electronic sound-effects stereotype to feed a sample and hold module with a random signal (noise) and use its output to control the pitch of an oscillator, creating a series of random notes. Quanta's sample and hold, like the other modulators, can control any of the modulation targets in the matrix—filter frequencies, grain position, whatever.



The **SOURCE** popup menu chooses the sample and hold's input signal, either a source of random numbers, or the outputs of any one of the four FEGs or two LFOs.

The **FREQ** (short for frequency) knob controls determine how often the sample and hold is triggered. It operates either in units of frequency (Hertz, or cycles per second), or in metrical units. Click the **SYNC** button to switch between the two modes. The trigger rate can be set from once every 10 seconds (or 0.1 cycles per second, abbreviated 0.01 Hz) to 10 times every second (10 Hz). When **SYNC** is turned on, the rate ranges from 2/1 (one trigger at the beginning of every two measures) to 1/32 (32 triggers per measure). A "D" or "T" after the number indicates dotted and triplet values.

If the **RETRIG** button is turned on, the sample and hold triggers at the beginning of every note.

The **SMOOTH** knob applies an adjustable amount of smoothing to the sample and hold's output. If SMOOTH is set at zero, the output jumps from one value to the next. If you turn the knob all the way up, the output moves in a linear ramp between values. Intermediate settings provide a linear ramp followed by a flat spot until the next trigger, producing something one might call a ramp and hold.

Matrix

	FEG 1	FEG 2	FEG 3	FEG 4	FLFO 1	FLFO 2	S&H	NOTE	VEL	AT	BEND	MOD	CC 74	T-RND
SAMPLE									20					
FEG							53							
FLFO			-42					100	20		20			3
MATRIX					54									

All of Quanta's modulation routing is done with the modulation matrix, or matrix for short. Modulation sources—things that generate modulation signals, i.e., FEGs, FLFOs, and MIDI messages—are listed across the top. Modulation destinations—things that receive modulation signals and in turn change the sound produced by Quanta—are listed along the left side. Almost all of the parameters present in the lower half of the screen are available as modulation destinations. In addition, there are destinations which affect the FEGs and FLFOs, so that modulators can modulate each other, or even themselves. We'll describe modulation connections, sources, and destinations in detail. In some cases we're necessarily going to get ahead of ourselves a little and mention parameters for the oscillator, granulator, and filters, even though we haven't described these things yet. Fear not, we'll discuss those after this section.

Connections

Connections between sources and destinations are made at the intersection of a row and a column in the matrix. The "gain" of the connection is shown numerically and with a small bar at the bottom of each cell. Negative values invert the modulation signal. To make or change a connection, click and drag vertically within a cell at the intersection of a source and a destination. Double-click a connection to zero it.

Modulation signals are added together for each destination; you can connect several modulation sources to one (or more) destinations, with varying weights. Most modulation signals are unipolar; that is, they always

increase the parameter that receives them. In other words, a modulator has the same effect as turning one of Quanta's knobs clockwise.

Most modulation destinations are scaled such that if you set the connection to its maximum setting of 100, the source can change the parameter across its entire range. So, for example, if you want a FLFO to sweep the oscillator pulse width across its entire range, turn the **PULSE WIDTH** knob all the way anti-clockwise and set the connection between the source labeled **FLFO** and the destination labeled **OSCILLATOR PULSE WIDTH** to 100. If you want the pulse width to vary just a little bit around the center of its range, set the knob at 45% and the modulation connection to 10.

Sources

The modulation sources—things that generate modulation signals—appear across the top of the matrix. The first seven columns, shown in blue, should be self-explanatory. They correspond to the four FEGs, the two LFOs, and the Sample and Hold. The remaining sources, shown in orange, represent MIDI messages as follows:

NOTE - a modulation value representing the MIDI note number, i.e., which note you're playing on your keyboard. Unlike Quanta's mod sources, the **NOTE** value is bipolar, that is, both positive and negative. It is centered on MIDI note C3, so that playing up from C3 means the mod value increases above zero, and playing down from C3 means the value decreases below zero. Generally you don't have to think about this. If you set the note mod value to +100 for both the **GRAIN TUNE** and **OSCILLATOR TUNE** destinations, Quanta will respond to MIDI notes as you'd expect. Also, the filters track this signal in the same manner as the oscillator and granulator: if you set the note mod value to +100 for **FILTER 1 FREQ** and/or **FILTER 2 FREQ**, the filter(s) will track the keyboard also. If you're familiar with the half-tracking feature found on some synths, you can set the mod value to +50 to get the same result.

VEL - short for Velocity, this signal represents how hard you initially hit your keyboard, drum pad, whatever. Connect this signal to the filter frequencies to make notes sound brighter when you play harder.

AT - an abbreviation of Aftertouch, this signal is generated by pressure on your keyboard as you hold down notes.

BEND - the signal for the MIDI pitch-bend wheel. This signal is bipolar; pulling the wheel towards you generates negative values, so that you can bend note flat by connecting this mod source to GRAIN TUNE and/or OSCILLATOR TUNE. A modulation setting of 10 will give you a pitch bend range of two octaves, one octave in either direction.

MOD - the signal for MIDI Continuous Controller #1 messages. These messages are usually transmitted when you move the mod wheel on your keyboard.

CC 74 - the signal for MIDI Continuous Controller #74 messages. Originally these messages were somewhat hazily defined as "Brightness" in the MIDI specification, but now they are commonly used by MPE controllers to transmit position information.

T-RND - generated internally by Quanta, this is a triggered random signal. Its value is randomly generated every time a note-on event is received, and is different for each voice.

Destinations

The modulation destinations—things that receive modulation signals—appear along the left edge of the matrix. There is one destination for almost every parameter visible in the lower portion of Quanta's window. Since there are many of these destinations, there is a scroll bar on the right edge of the matrix so that you can bring each destination into view as needed. To alleviate some of the tedium of scrolling, the matrix automatically scrolls itself when you manipulate one of Quanta's knobs or other controls, bringing the corresponding modulation destination row into view.

Most of the destinations are self-evident since they have the same name as their corresponding controls. For example, the destination labeled **OSCILLATOR PULSE WIDTH** corresponds to the Pulse Width knob in the Oscillator section. There are some special destinations at the bottom of the list. They are:

OUTPUT LEVEL - this destination does bear the same name as the Level control in the Output section, but its roles bears special mention. It is the means for controlling the overall amplitude of the voice. If you're familiar with analog or analog-like synthesizers, it is analogous to the control input of the final VCA in a patch. Usually you'll connect one of the FEGs to this destination; by default, FEG1 is connected.

FEG 1-4 TIMES - these destinations affect how fast the corresponding FEG moves from one segment to the next. Positive modulation values make them run faster and affect all segments in the envelope. For instance, you could connect the Velocity mod source to an FEG to make it run faster when you hit notes harder, thus shortening the FEG's attack. Or you could connect it to the **MOD** source, allowing you to make a looping FEG run faster when you push the mod wheel forward.

FEG 1-4 AMPLITUDE - these destinations affect the amplitude of the corresponding FEG's output. They act in a multiplicative manner, with larger modulation values causing a greater range of variation in the FEG's output level. In other words, if you make a connection to an FEG amplitude destination with only a small setting, there will be only a small variation in the FEG's output level. If you set the connection to 100, the modulation source signal will completely control the FEG's output level, scaling it all the way from zero to its usual maximum. Thus, for example, you can use a small setting with the **T-RND** modulation source so that the FEG's output varies by a small, random amount with each note. Or, you could use a setting of 100 with the Velocity source so that how hard you strike a key completely controls the FEG's output level.

FLFO 1-2 AMPLITUDE - these destinations operate in the same manner as the **FEG 1-4 AMPLITUDE** destinations but affect the levels of the FLFOs.

Modulation Matrix Examples

On the next page we'll present a couple of examples of how the modulation matrix works. Consider the following screenshot of the matrix:

	FEG 1	FEG 2	FEG 3	FEG 4	FLFO 1	FLFO 2	S&H	NOTE	VEL	AT	BEND	MOD	CC 74	T-RND
FILTER 1 FREQ			70									50		
FILTER 1 RES										60				
FILTER 2 FREQ			35									-50		
FILTER 2 RES										30				
OSCILLATOR TUNE								100			20			
OSCILLATOR FINE TUNE														10

What's going on here?

- The two numbers in the **FEG 3** column show that the third FEG is modulating the frequencies of both filters, with twice as much effect on the first filter as the second.
- The two numbers in the **MOD** column show that both filters are also being controlled by the MIDI mod wheel, but the control signal going to the second filter is inverted. Pushing the mod wheel forward will raise the frequency of the first filter and lower the frequency of the second. The MIDI data from the mod wheel will be added to the FEG's signal; you'll still hear the FEG controlling the filters as you manipulate the mod wheel.
- Similarly, the two numbers in the **AT** column mean that MIDI Aftertouch messages—pressure on your keyboard—will affect the resonance of the filters. The effect on the first filter will be twice that of the effect on the second filter.
- Two things will control the pitch of the oscillator: the MIDI note, and the pitch-bend wheel. The values of 100 and 20 respectively mean that Quanta will respond as you would expect: the oscillator's pitch will change by an octave for each 12 MIDI notes, and the pitch-bend wheel will give you a bend range of two octaves in either direction.
- Finally, the oscillator's pitch will change by a small, random amount with every note, thanks to the number in the **T-RND** column.

Here's another example which demonstrates how modulators can influence each other. Note that the images of the matrix have been sliced up and rearranged so that we can show all relevant connections together:

	FEG 1	FEG 2	FEG 3	FEG 4	FLFO 1	FLFO 2	S&H	NOTE	VEL	AT	BEND	MOD	CC 74	T-RND
OUTPUT LEVEL	100													
FEG 1 AMPLITUDE									50					
OSCILLATOR TUNE					10			100						
FLFO 1 AMPLITUDE												100		

With these connections:

- FEG 1 is controlling the overall output level of the voice. The value of 100 means that it will vary the loudness from completely off to its maximum output.
- FEG 1's amplitude is partly controlled by MIDI Velocity. The value of 50 means that FEG1's output will vary from half of its maximum level up to maximum, depending on how hard you strike your MIDI controller.
- The oscillator's pitch is affected by two things: the MIDI note value, and FLFO 1. The setting of 100 under **NOTE** means that the oscillator will respond in a normal manner, tracking MIDI notes as usual. The setting of 10 under **FLFO 2**, by itself, means that FLFO 2 will raise the oscillator's pitch by up to one octave. Also, the MIDI pitch-bend wheel will *not* do anything to the oscillator, since there's no entry in the **BEND** column for **OSCILLATOR TUNE**.
- FLFO 1's amplitude is completely controlled by MIDI Modulation control messages. If the mod wheel on your keyboard is at zero, the **MOD** modulation source will send zeros and reduce FLFO 1's output to zero. As you push the wheel forward, the amplitude of FLFO 2 will increase, and you'll hear a vibrato or trill as FLFO 1 affects the pitch of the oscillator.

Grains



The section labeled **GRAINS** contains the controls for the granulator. We're going to skip around a little bit in the following descriptions, rather than strictly following the order that the controls appear in the window.

The **# GRAINS** knob controls the rate at which new grains are generated, that is, it sets the number of new grains created per second. It has a range of one to 100 grains per second.

The duration of each grain is governed by the **LENGTH** knob. The length is expressed in milliseconds (thousands of a second) and ranges from 1 millisecond to one second. Traditionally, granular synthesis uses grain durations of 100msec or less, but we extended the available duration out to one second so that Quanta can create glitchy delay-like effects.

Note that the number of grains you'll hear at one time depends on the settings of both the **# GRAINS** and the **LENGTH**. For example, if **LENGTH** is 100msec (a tenth of a second) and **# GRAINS** is 5, you'll hear only one

grain at a time because the interval between grains is $1/5$ of a second, or 200msec. If you listen while turning the **LENGTH** up to 200, you'll hear the grains lengthen and eventually overlap and blend together.

You can think of the **SHAPE** control as applying a volume envelope to each grain, or as creating a fade-in and fade-out at the beginning and ending of each grain. The setting of this control affects the resulting loudness contour of the grain. Change it by clicking and dragging vertically. The graphic inside the control illustrates the loudness shape, but we'll list them here for completeness:

Rectangle - no shaping at all, just instant on, instant off, with full signal amplitude. Yes, this will almost certainly create clicks in the resulting audio. Sometimes clicks are what you want.

Triangle - a linear ramp from zero to maximum, followed immediately by a linear ramp back to zero. This creates smooth grains without clicks, but with a somewhat attenuated level. This shape can be useful if you're using many grains at once.

Trapezoid - like a rectangle, but with short linear ramps at the ends. This shape is a compromise between the full-signal level of a rectangular envelope and the smoothness of a triangular envelope.

Sine Squared - created by multiplying the mathematical sine function by itself, this is like a triangle with the corners rounded off. It is click-free and has a slightly higher signal level than the triangle envelope.

Half Sine - another shape based on the sine function, this produces a rounded envelope with a higher average level than the sine squared shape.

Rounded Rectangle - a rectangle with its corners rounded off, i.e. a slightly smoother version of the trapezoid shape.

Curved Up, Curved Down, Ramp Up, Ramp Down - these shapes, unlike the preceding ones, are asymmetric. The Curved Up and Ramp Up shapes start at zero, reach maximum amplitude at the end of the grain, and then fall to zero. The Curved Down and Ramp Down do the opposite: they jump from zero to maximum at the beginning of the grain, then fade to zero. The Ramp shapes move in a linear manner, while the Curved shapes have an exponential curve.

Traditionally, granular synthesis uses symmetric grain shapes since the intent is to make the grains blend together seamlessly, creating a cohesive sound. If you're interested in a more pointillistic result, the Curved Down and Ramp Down shapes provide percussive or plucked-sounding grains. On the other hand, the Curved Up and Ramp up shapes, particularly when applied to grains with a long duration, can create the impression of a sound being played backwards, even though the sample is played forwards.

The length and shape of the grains can affect the very beginning, or attack, of the overall sound. Consider, for instance, a grain with a length of one second and a triangular shape. Regardless of whatever the source sample contains, the attack of any notes will be a half-second ramp, that is, the first half of a one-second triangular envelope.

The **DIRECTION** popup menu chooses the direction that samples are read as the grain plays; that is, it determines whether the grain plays forwards or backwards, relative to the sample file. There are several choices, as follows:

FORWARD, REVERSE - these do what you'd expect: the grain plays samples forwards or backwards.

PLAY DIR - in this mode, Quanta watches for changes in the grain source position—that is, modulation of the Grain Position value—and notes whether it is moving forward, towards the end of the sample file; or backward, towards the beginning of the file. It then plays the grain in the same perceived direction.

-PLAY DIR - this is the same as the PLAY DIR mode, but the grain plays in the direction opposite the direction of the motion of the grain position.

RANDOM - the direction of the grain is chosen randomly.

The **POSITION** control sets the location within the sample file at which grains start playing. Grains play from this point forwards. You can also set this location by clicking and/or dragging within the Sample view; the vertical blue line indicates the position.

However, if the grain plays in reverse, it does not start at this location. Instead, it starts later in the file, by the duration of the grain, and plays backwards to the location set by **POSITION**. In other words, grains always play the same chunk of the file regardless of whether they're playing forwards or backwards.

When you play a note, a blue dot appears in the sample display at the source location. This may be somewhere other than the blue line if the granulator's source position is modulated. The blue dot is animated, i.e., it will move to indicate any modulation, showing you where the granulator is reading samples. If the source position is randomized, either with the **POSITION RAND** knob or the corresponding modulation destination, an oval shows the range over which samples will be read randomly.

The number beneath the **POSITION** knob expresses the position as a number in the range 0-1; e.g. 0.5 means the midpoint of the sample file.

The **TUNE** knob adjusts how fast the grains play samples from the sample file, which usually changes their perceived pitch. Turning the knob clockwise from its center position makes the grains play faster, raising the pitch; turning it anti-clockwise makes the grains play slower, lowering the pitch. The value of this knob is expressed in cents, from -2400 to +2400, providing a four-octave range.

If you want the granulator to respond in the usual manner to MIDI notes—that is, playing up the keyboard makes Quanta play successively higher notes—set the modulation routing of **NOTE** to **GRAIN TUNE** to 100. This provides a standard scaling of one semitone per MIDI note. This modulation is provided by default in a new instance of Quanta.

Note that the perceived pitch of the granulator depends on several things, including the **TUNE** control. The apparent pitch of the source sample itself, the grain length, and changes in the grain source position can all influence the apparent pitch.

The **FINE** knob does the same thing as the **TUNE** knob but has a smaller range to allow more precise adjustments in pitch, and/or more subtle modulation. It has a range of -100 to +100 cents, or two semitones.

The **LEVEL** knob simply adjusts the granulator's output level, before it is sent to the filters. You may need to turn this knob down from its maximum setting if you're using a high grain density.

The **OSC IN** and **NOISE IN** knobs route audio signals from the oscillator and noise source, respectively, into the granulator. Essentially these signals are mixed with the samples read from the sample file, if there is one, and the combined signal is chopped up into grains. Thus, Quanta's granulator can generate sound even without a sample file. Judicious adjustment of the **GRAINS** controls will turn the simple wave from the oscillator into a thick, "super-saw" layer of sounds. Applying granular synthesis techniques to noise generally just produces

more noise, but you might find that the **NOISE IN** control is useful for adding a subtle thickening to a sample file, or for synthesizing percussive sounds.

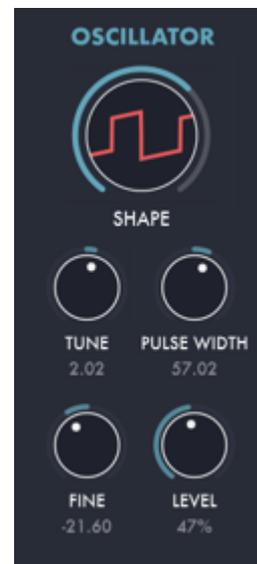
The **WIDTH** knob adjusts the apparent stereo width of Quanta's output. Quanta's granulator is a "true stereo" processor: there are actually two granulators, one for each output channel, with a common set of controls. If your source sample has two channels, each channel will be processed independently by one of the granulators. If your source file has only one channel, both granulators will still run, each reading from the file. The two granulators generally produce decorrelated signals—that is, signals without much information in common—particularly if one or more of the grain parameters are randomized or modulated. This produces a wide stereo image from even a mono file. However, sometimes that image can be a bit too wide, since it will span your entire mix. The **WIDTH** knob provides an adjustable amount of cross-mixing between the channels, which reduces the apparent stereo width. A setting of zero percent produces a mono output; turning the knob up widens the output signal, all the way up to its maximum possible channel separation.

RAND Knobs

Most of the Grains controls have an associated knob labeled **RAND**. These knobs introduce random fluctuations of the parameter; the more you turn up the **RAND** knob, the more randomization you get. Even a small amount of randomization of any one of the parameters will create slight differences between one grain and the next, resulting in a much more animated and interesting sound. Turning any of the **RAND** knobs all the way up usually ends in chaos, so the happy medium probably lies somewhere in between zero and maximum—unless, of course, chaos is your goal.

Oscillator

In addition to the granulator, Quanta's main sound generator, there is a simple but versatile oscillator. This oscillator can be used to augment the granulator, for instance to provide a solid fundamental or a sub-octave tone. It can also be used independently of the granulator, effectively turning Quanta into a one-oscillator subtractive synth. Finally, the oscillator's signal can be injected into the granulator, whether or not there is a sample loaded. The grains create copies of the oscillator's wave; with some modulation or randomization, combining these copies creates thick, "super-saw"-like timbres from the single oscillator. Despite its secondary role, Quanta's oscillator features sophisticated anti-aliasing, pulse-width modulation, and continuous waveform



mixing to provide a very competent virtual-analog signal source.

Quanta's oscillator has five controls, as follows:

The **SHAPE** control both changes the oscillator's wave shape and displays it. Click and drag vertically to change the shape. The wave shape changes smoothly from a sinusoid to a rectangle to a ramp wave.

The **TUNE** knob changes the oscillator's basic pitch or tuning. Turn it clockwise to raise its pitch, anti-clockwise to lower it. Its value is shown in semitones and has a range of -24 to +24 (i.e. +/-2 octaves).

The **FINE** knob allows more precise adjustments to the oscillator's tuning than the **TUNE** knob. It has a range of +/-1 semitone, expressed in cents (one cent is a hundredth of a semitone).

The **PULSE WIDTH** knob varies the shape of the rectangular wave, which changes its tone. A setting of 50% produces a square wave. Other settings change the symmetry of the wave, making the high portion of its cycle shorter or longer than the low portion. Since most settings of the **SHAPE** knob blend the rectangular wave with either the sine wave or the ramp wave, the **PULSE WIDTH** knob almost always has at least some effect on the oscillator's timbre.

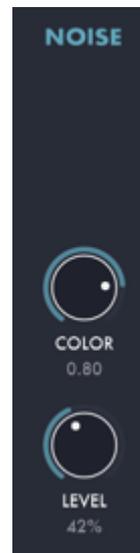
The **LEVEL** knob sets the level of the oscillator's signal that is sent to the filters. The **LEVEL** knob does **not** affect the signal sent to the granulator; the **OSC IN** knob in the **GRAINS** section sets this level. If both knobs are set at zero, you won't hear the oscillator at all.

Noise

Like the oscillator, Quanta's noise generator can be used directly and/or fed into the granulator. Use noise for synthesizing percussion instruments, sound effects, or to add a subtle thickening.

The noise generator has two knobs:

The **COLOR** knob essentially changes the sampling rate of the noise generator, which in turn changes its tone or timbre. At its maximum setting, the noise generator produces a nearly uniform spectrum, i.e., white noise. Turning the knob anti-clockwise makes the noise darker and grittier.



The **LEVEL** knob sets the level of the noise generator's signal that is sent to the filters. The **LEVEL** knob does **not** affect the signal sent to the granulator; the **NOISE IN** knob in the **GRAINS** section sets this level. If both knobs are set at zero, you won't hear the noise generator.

Filters

Each of Quanta's voices has two filters. Each filter can operate in one of eight configurations or be turned off altogether. The filters can be arranged in series, so that the signal first passes through filter one and then through filter two; or in parallel, so that the signal passes through both filters and their outputs are mixed together.

The graphic representation of the two filters contains two little circles, one for each filter. The position of these circles controls the frequency and resonance of the filters. Drag the circles horizontally to change the filters' frequency, drag them vertically to change the resonance. The frequency and resonance of each filter are present as modulation targets in the modulation matrix.

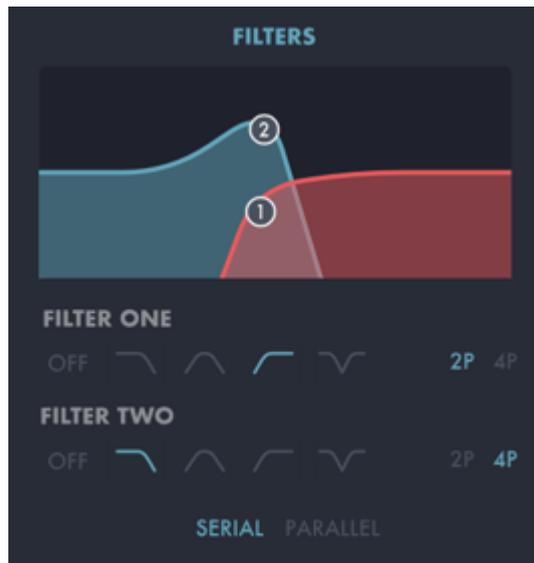
The icons below the graphic display choose the configurations. There are four frequency-response modes and two steepness settings, for a total of eight response characteristics. Click the icons to change the mode. The modes are, from left to right:

OFF - the signal passes through the filter unaltered.

LOW PASS - high frequencies are attenuated while low frequencies pass through.

BAND PASS - a range of frequencies pass through while higher and lower frequencies are attenuated.
The resonance setting adjusts the width of the range; a higher resonance narrows the range.

HIGH PASS - low frequencies are attenuated while high frequencies pass through.



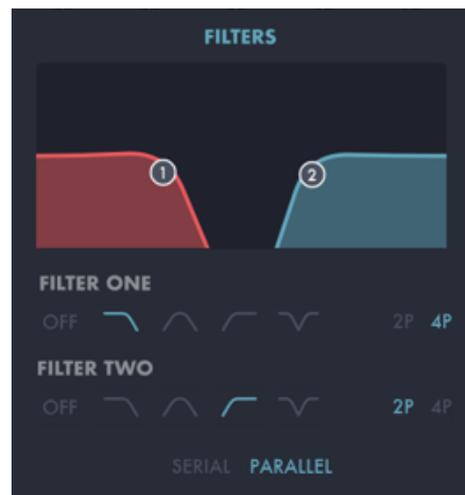
NOTCH or BAND REJECT - high and low frequencies pass through while a range of frequencies in the middle are attenuated. The resonance setting adjusts the width of the range; a higher resonance narrows the range.

The buttons labeled **2P** and **4P** select the steepness of the filter. "2P" and "4P" are abbreviations for "two-pole" and "four-pole" respectively; the four-pole response is steeper than the two-pole.

Finally, the buttons labeled **SERIAL** and **PARALLEL** at the bottom change the filters between the serial routing and parallel routing. Filter two follows filter one when they are connected in series.

There are a couple of subtleties inherent in this routing system. First, it's entirely possible to configure the filters such that nothing passes through them at all, silencing Quanta altogether. For example, consider the arrangement shown on this page. If the routing mode is serial, you won't hear anything because the signal from the oscillator and/or granulator will enter only Filter One. Filter One will attenuate all of the high frequencies, passing only low frequencies on to Filter Two. Filter Two attenuates the low frequencies, and then there's nothing left to hear. However, if you switch the routing mode to parallel, both filters receive the signal from the oscillator and/or granulator. The low frequencies from Filter One's output will be added to the high frequencies from Filter Two, and you'll hear highs and lows but nothing in the middle.

Second, when a filter is turned off, it passes the signal unaltered. If the filters are routed in series, turning off a filter does what you'd expect: that filter has no effect on the signal. However, when the filters are in parallel, the unaltered signal emerging from the inactive filter is added to the signal from the other filter. This can be a bit perplexing at first, since it creates configurations that aren't possible with a single filter. For instance, suppose you put a lowpass filter in parallel with a filter that's turned off. You'll still hear the high frequencies of the original signal, since they'll pass through the off filter and be added to the output of the lowpass filter. As another example, a bandpass filter in parallel with an off filter will give you a sort of peaking EQ, where all frequencies are present in the output with a boost in the middle of the spectrum created by the bandpass filter.



Output

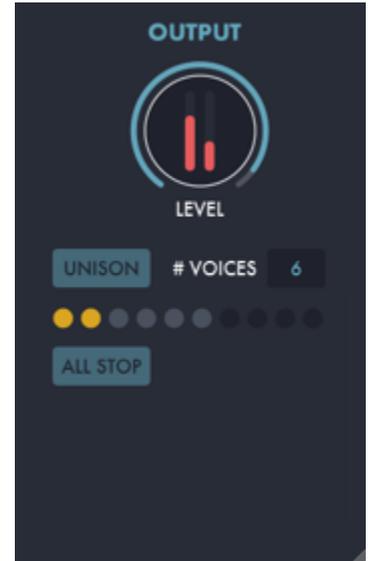
The section at the lower-right corner of Quanta's window has a few controls for Quanta's overall output. They work as follows:

The **LEVEL** control acts like a volume knob, setting the overall loudness of the plug-in. Click on it and drag vertically to change the output level. A pair of meters in the center of the control shows the relative signal strengths of the left and right channels. If these meters are regularly hitting the top of their range and staying there, you probably want to pull the **LEVEL** control down a little.

The **UNISON** switch turns the unison mode on and off. When it's illuminated, Quanta's voices play simultaneously for each note. Turn this switch on to create thick sounds. (You might find it useful to use the **T-RND** modulation source, routed to the **GRAIN FINE TUNE** and/or **OSCILLATOR FINE TUNE**, to create a touch of random detuning between the voices for an even thicker sound.) The number of voices that play at once is set by the **# VOICES** popup menu to the right of the **UNISON** switch.

The **# VOICES** popup menu lets you set the number of voices, with a maximum of 10, that play simultaneously. Besides setting the number of voices that play in Unison mode, you can use this control to reduce the CPU load of the plug-in. The row of circles below this control show how many voices are available, and how many are in use. Grey circles represent available voices, yellow circles represent voices in use, and black circles represent voices that are not available.

Clicking the **ALL STOP** button immediately silences all of the voices. Hit this button if you've somehow managed to create a particularly awful noise and you wish it to cease immediately, or if the FEGs have a very long cycle which is taxing your patience.



Presets



Quanta includes a number of built-in presets to serve as a demonstration of its capabilities and inspirations for your own creations. To access the presets, click the word "PRESET" at the top of the window to open and close the preset browser.

Presets are divided into two groups, designated USER and FACTORY. Click on these words on the left of the preset view to switch between the groups. Factory presets are those provided by us with Quanta, while User presets are those which you create and save.

Each group is further divided into categories. Categories have a triangle to the left of their names; click the triangle to reveal the presets in the category.

The groups and categories correspond to folders and sub-folders within Quanta's own folder. This folder is located at `C:\ProgramData\Audio Damage\Quanta\` on Windows, and `/Library/Application Support/Audio Damage/Quanta/` on OS X. Theoretically you can save your presets anywhere you like, but in order for them to show up in Quanta's User list they must be placed in the User folder within Quanta's folder. Any folders you create within this folder will show up as categories in the User list, but only one level of folders will be recognized—you can't put folders inside folders.

Preset files are plain-text XML files so that you can exchange them online in forums, copy them between a Windows computer and a Macintosh, etc. Note that preset files can be large since they contain uncompressed, text-encoded copies of the sample files.

The scrolling list on the left shows the available presets; click one of the preset names to load its settings. Note that clicking a preset name immediately changes some or all of Quanta's parameters, so if you have created a sound that you want to use again, save it as a new preset before loading another preset. To save your own presets, click the **SAVE** button. Quanta will prompt you to enter a name for the preset with a standard system file dialog box.

You can delete presets from the User list by clicking their name and then clicking the **DELETE** button. Quanta will give you a chance to confirm this action or cancel it. If you confirm, the preset's file will be removed from your storage system and is gone for good.

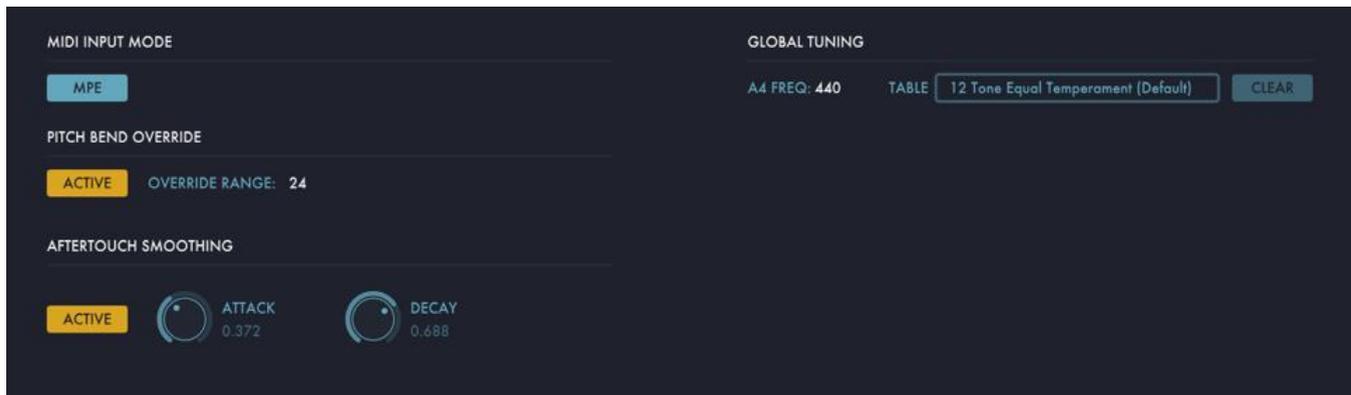
Information about the sample file contained in the preset, if there is one, is shown to the right of the preset list. The information includes the original filename for the sample, the number of channels in the file, and the original sample rate and bit depth. You can hear the sample without alteration by clicking the **PREVIEW** button. This plays the sample directly through Quanta's outputs, bypassing the granulator and filters. To select a different sample, click the **REPLACE** button.

The **COPY** and **PASTE** buttons copy the current settings to the system clipboard and paste settings from the clipboard. You can use the copy and paste commands to transfer settings between two instances of Quanta or paste the settings into an email message or text editor. When copied to the clipboard, presets are presented in the same XML text as used in preset files.

Default Preset

If you save a preset with the special name "Default", new instances of Quanta will load it automatically when you add it to your DAW session. You can use a default preset file to give you the same starting point with Quanta, maybe with a few modulation settings that you always use, maybe a complete sound with a sample included that you find yourself using on every new project.

Settings



The Settings panel contains controls for tailoring Quanta to your MIDI controller and playing preferences. You'll also find controls for manipulating Quanta's pitch standard and tuning. The settings in this panel are stored within your host DAW's session files, rather than within presets. Hence, they do not change when you load a preset file. These settings apply to individual instances of Quanta; two or more instances within one DAW session can have different settings.

MIDI Input Mode

The **MPE** switch, under the heading "MIDI Input Mode", affects how Quanta handles MIDI notes and controller messages. If you have a MPE controller such as a Linnstrument or Roli Seaboard, turn this switch on. Quanta will then process pressure, pitch bend, and position information independently for each note, providing the expressivity that you expect from your controller. If you don't have a MPE controller, leave this switch turned off and ignore it.

As you're probably already aware, you also need a host program that can correctly transmit multi-channel MIDI information from your MPE controller to Quanta in order for Quanta to respond accordingly.

Pitch Bend Override

Quanta's modulation matrix allows MIDI pitch bend messages to control any parameter. The matrix provides default routings such that pitch bend affects the oscillator frequency and the grain tuning in a conventional manner, but any preset can have its own routings and ranges for the pitch-bend messages. Sometimes this flexibility is more than you want or need, such as when you're trying out a new controller or rattling through your presets to find candidates for your new cover of a Jan Hammer song.

If you turn on the Active switch, the pitch-bend range is set by the number shown as **OVERRIDE RANGE**. This value is in semitones; click and drag vertically to change it or double-click it to type a value. The modulation amount shown in the modulation matrix for **BEND -> OSCILLATOR TUNE** and/or **BEND -> GRAIN TUNE** will be overridden by this value, **if** the value in the modulation matrix is something other than zero.

Aftertouch Smoothing

We used a variety of MPE-equipped controllers while developing and testing Quanta. Most (maybe all) MPE controllers on the market provide their own software for adjusting and scaling their response to touch, pressure, position, and so on. We did not see a compelling reason to attempt to supplement or replace this functionality. However, we did find that it is often useful to smooth out the aftertouch (i.e. pressure) data originating from some controllers.

The **ACTIVE** button turns on a simple smoothing filter with a response rather like a lag processor module found in some analog synthesizers. The **ATTACK** and **DECAY** knobs control the amount of smoothing: a higher setting produces more smoothing, that is, a slower change in output for a given change in input. The **ATTACK** knob affects increasing changes in value (more pressure) while the **DECAY** knob affects decreasing changes (less pressure).

Some controllers do not send a zero aftertouch value when you remove your finger from the key or pad. If Quanta's aftertouch smoother is active, the **AT** modulation source will always return to zero after a note ends. How quickly it fades to zero from its current value depends on the setting of the **DECAY** knob.

Global Tuning

Quanta provides facilities for non-standard tuning and intonation. First, the **A4 FREQ** control simply adjusts Quanta's overall pitch. Standard tuning uses 440Hz for A above middle C. If you need to adjust Quanta's pitch slightly to match other instruments or recordings, or if you use a different pitch standard in your music,

simply change the number in the text box, either by clicking and dragging vertically or double-clicking and typing a number.

Second, Quanta's pitch reference, intonation, and/or keyboard mapping can be completely changed with TUN files. TUN files are a standard file for providing tuning information. If you're interested in microtonal music or non-Western musical instruments, you've probably already heard of them. If you're familiar with Scala but not TUN files, Scala can export TUN files. One TUN file contains the information that Scala places in separate SCL and KBM files. A web search will reveal plenty of information about creating TUN files.

To load a TUN file, click on the text field to the right of the word TABLE. Quanta will prompt you with a standard file dialog box; choose your file and Quanta will adopt the tuning and mapping found in that file. Once a file is loaded, Quanta keeps a reference to that file within its settings. If you move the TUN file, you'll have to re-load it into Quanta.

Once a TUN file is loaded, the **A4 FREQ** control is disabled and cannot be changed. The pitch reference in the TUN file always overrides the **A4 FREQ** setting.

To revert to the usual 12-note equal-tempered tuning, click the **CLEAR** button.

Automation

Most of Quanta's controls can be automated using your host's automation features. The most notable exceptions are the FEG breakpoints and the modulation matrix connections. The number of either of these can change, and host DAWs generally don't permit plug-ins to have a changing number of parameters. Consult your host's documentation for information on how to use its automation features.

And Finally...

Thanks again for purchasing Quanta. We make every effort to ensure your satisfaction with our products, and want you to be happy with your purchase. Please write to info@audiodamage.com if you have any questions or comments.