Sequencer 1 User's Guide

Audio Damage, Inc.
For Firmware Version 1.2.3
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1. Introduction

Sequencer 1 is a pattern-oriented control-voltage step sequencer with the Eurorack form factor. Inspired by the control-voltage sequencers from the dawn of modular synthesizers and the pattern sequencers of more recent drum machines and tabletop groove boxes, Sequencer 1 provides a flexible and powerful control center for generating melodic and rhythmic patterns with your Eurorack system. Here are its main features and attributes:

- Live editing of all pattern and step data—change everything without stopping.

- Four banks of 16 patterns each, for a total of 64 patterns.

- Each pattern can have one to 64 steps. Steps can optionally repeat up to 8 times.

- Multiple stepping modes providing various forms of forward, reverse, bidirectional, and random behavior.

- One pitch control-voltage output with a range of zero to +5V, with either 1V/Oct or Hz/Volt scaling.

- Over 40 musical scales and modes and eight user-programmable scales.

- Diatonic transposition for in-key improvisation.

- Three control voltage outputs, programmable per step, with a range of ±5V.

- Gate and accent outputs with inverse and S-trig modes, output length programmable per step.

- Multiple gate cycles per step to reproduce the "ratcheting" effect of a custom sequencer built for and used by a famous pioneering German ensemble.

- Live "repeat" functions for improvisational edits and remixes of patterns.

- Three tempo-synced low-frequency oscillators (LFOs) with 25 waveforms, three output ranges, adjustable phase, random amplitude, and periods of one to 256 steps.

- Two control-voltage inputs for modulating current step, step mode, gate length, current pattern, transpose, repeat mode, ratcheting, and scale/mode.

- Transport output jacks, for use as a master tempo source.

- Transport input jacks, for slaving to other tempo sources.

- Micro SD card for pattern storage and firmware updates.

Sequencer 1 is suited to both methodical composition and live improvisation. We've designed it so that the most often-used functions are only a button press or two away. At the same time, the numerous step and pattern settings enable you to craft intricate, evolving patterns. We hope you'll enjoy using Sequencer 1 as much as we enjoyed creating it.

2. If You Don't Like Reading Manuals, At Least Read This

If you'd rather dive in and explore Sequencer 1 without reading a boring manual, we completely understand. We've designed Sequencer 1 to be as easy and immediate to use as possible, but it's a powerful module, and the price of that power is complexity—there's no getting around that. If you can at least skim the two introductory sections, Terminology and Tour of the Panel, you'll be well-equipped to mess around with Sequencer 1 and discover what it does. You'll want to come back to this manual eventually, but the material in those two sections will get you started.

There's one important thing which you need to know before you start: Sequencer 1 does not automatically save the patterns you program. Like most computers, you have to tell it explicitly when you want it to save your work. If the power goes off before you save it, your carefully crafted pattern will vanish. To save the current pattern, press and hold the ALT button, then press the button with the word SAVE underneath it.

3. Terminology

For the sake of clarity, we'll explain what we mean by a few specific terms. Sequencer 1 operates by playing *patterns*. Only one pattern is active at any time, but Sequencer 1 stores up to 64 patterns, arranged in four *banks*, 16 patterns per bank. Each pattern consists of up to 64 *steps*, which are grouped into 16-step *measures*. A step usually corresponds to a single audible note or a rest. Each step has several pieces of information, such as what pitch output it generates (i.e. what note it plays) and whether or not the Gate and/or Accent outputs turn on when the step is played. Each pattern also has several pieces of information which govern how the pattern plays, such as the number of steps in the pattern and the order in which the steps are played. Borrowing a term from computer geeks, we refer to these pieces of information as *parameters*.

3.1.   Typographical Conventions

In an attempt to more deeply engage the visual portion of your brain, we've chosen typefaces in this manual which match those used on the Sequencer 1 panel.

PANEL – for labels near the buttons and jacks

RED PANEL – for secondary labels below some buttons

LCD – for text that appears on the liquid-crystal display (LCD)

4. What's New in Version 1.2.3

Version 1.2.3 is a minor update, released in late March 2015. It corrects a bug with the pattern-reload feature introduced in version 1.2, and adds two new features:

4.1.   Live CV Outputs

The Pitch and CV1-3 outputs now change value immediately when you change the corresponding parameter (either the step's note or one of its CV values). Previously the CV outputs changed only as the sequencer played.

4.2.   New CV Mapping: Pulses per Step

A new CV-input mapping allows you to change the number of pulses per step with a control voltage.

5. What's New in Version 1.2

Here's what's new and different in version 1.2 of the system software, released in March 2015:

5.1.   Multiple Pulses per Step

Steps can now be programmed to repeat up to eight times. The Gate output can either fire on each repetition, or only once.

5.2.   Random LFO Amplitude

A new LFO parameter makes the output levels of the LFOs to vary randomly, by an adjustable amount.

5.3.   Two New Stepping Modes

Two new Stepping modes, Random Even and Random Odd, provide quasi-random variations of the pattern.

5.4.   CV Hold Options

To relieve the tedium of having to set CV values for every single step, each auxiliary CV output now has a Hold parameter. This parameter has several different options which affect whether the CV output holds its current value or changes to a new one as the sequencer advances.

5.5.   New CV Mapping: User Scales

A new CV-input mapping allows you to switch between the pattern's programmed scale/mode and the eight user-programmable scales.

5.6.   Reload Pattern

You can now reload a pattern from the Micro SD card, reverting to the version of the pattern you last saved.

5.7.   UI Tweaks

We made a couple of small but helpful changes to the user interface. The rotary encoders have a smoother response, making it less fiddly to reach the value you're trying to dial in. When switching between different edit modes, the page within each mode is remembered and restored. Some editing pages have been rearranged slightly to accommodate new parameters, and the LFO wave shape formerly known as Random Ramp has been renamed Random Triangle. (Put to a fine point, this shape is now superfluous because of the new Random Amplitude parameter, but we left it in so that existing patterns which use it would not be affected.)

6. What's New in Version 1.1

If you're familiar with the first version of Sequencer 1's system software, here's a list of what was added with version 1.1, released in December 2014:

6.1.   Scales, Modes, and Keys

Each pattern can now have its own scale or mode and root pitch (tonic). There are over 40 preset scales to choose from, and eight user scales for programming your own.

6.2.   Intelligent and Live Transpose

A pattern can be transposed in one or all of three ways: with a new parameter in the SEQ menu, by pressing the Note buttons while the pattern is playing, and/or with an appropriate CV-input mapping. Transposition observes the pattern's scale, keeping the transposed notes in key.

6.3.   New Pitch CV Mode

As another new pattern-level parameter, the Pitch CV output now has a mode in which its value does not change when playing steps whose gate is off. If you've been annoyed by having to set the notes of all otherwise-empty steps, you're not alone. However, if you happened to have made use of this behavior, setting the Pitch CV parameter to "Free" will make the Pitch CV output behave as it did with previous versions of the firmware.

6.4.   More Blinky Lights

The Note buttons now light up while Sequencer 1 is playing, indicating the note of each step as it plays.

7. Tour of the Panel

We'll start by looking at the knobs, buttons, and stuff on the panel. Here's a drawing of the panel for your reference if you happen to be reading this manual while away from your equipment:
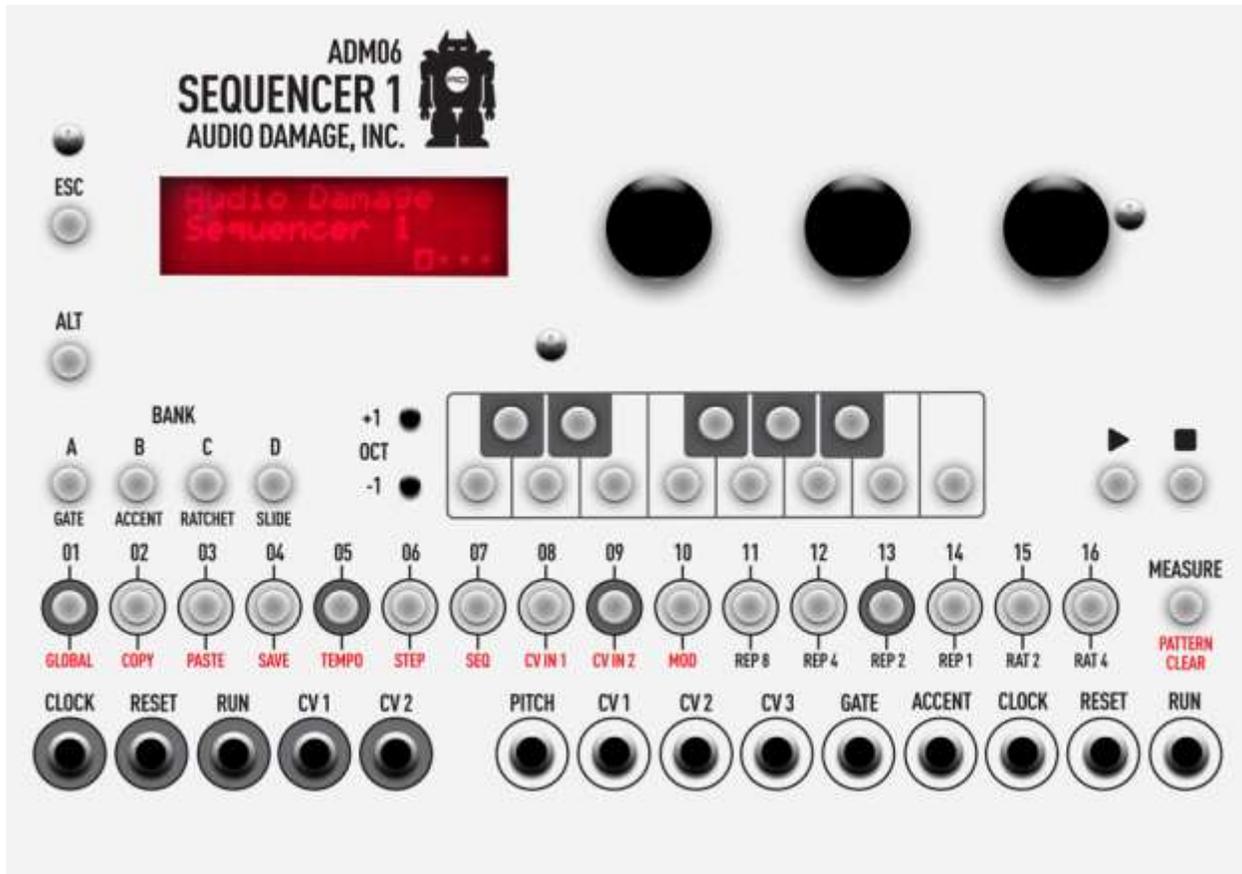
7.1.   Jacks

All of Sequencer 1's jacks lie in a row across the bottom of the panel. The jacks in the group on the left, circled with grey, are inputs; those in the group on the right are outputs.

7.1.1. Inputs

CLOCK, RESET, RUN
These three inputs let you synchronize Sequencer 1 with other modules, so that Sequencer 1 starts and stops upon their command and follows their tempo.

CV 1, CV 2
These inputs receive control voltages from other modules. You can assign these signals to change various things in Sequencer 1, such as using an LFO to modulate the length of the output gates.

7.1.2. Outputs

PITCH
This is the output that you'll use to control the pitch of one or more voltage-controlled oscillators. It supplies a voltage from zero to five volts, proportionate to the note and octave you program for each step. You can choose either of two scaling systems for this output: the 1V/octave convention used by most analog synthesizers and modules, or the Hz/V convention used by Korg and Yamaha synthesizers.

Of course, nothing says that you have to plug this output into a VCO; like any other voltage source in your modular synthesizer, you can connect it to just about anything which expects a voltage.

CV 1-3
These three outputs emit voltages in the range -5 to +5 volts. Usually you'll use them to control things other than oscillator pitch, such as filter frequency, VCA levels, whatever. You can program the voltage level at each output for each step in a sequence. Each of these outputs also has its own low-frequency oscillator which can generate periodic signals in sync with the pattern. The LFOs can replace the voltage value you program for each step, or they can be combined with that value in different ways.

GATE
This output generates a +5V signal for steps which play a note. Usually you'll connect it to one or more envelope generators whose outputs are in turn connected to a VCA's gain-control input and a filter's frequency-control input. When the sequencer plays a note, the gate output goes from zero to +5V, turning on the envelope generators.

The Gate output has several associated features, including the ability to turn on and off several times per step. This allows the sequencer to create the often-coveted "ratcheting" effect heard on early Tangerine Dream albums.

ACCENT
The Accent output is similar to the Gate output. It emits either zero or +5V, and can be programmed independently from the Gate output. Its usual application is to add accents to certain steps (perhaps by triggering a different envelope generator than the Gate output) in the manner of early Roland drum machines. More generally, there's no reason that you can't use it to trigger something entirely independent from the notes generated by the Gate output. For instance, the Gate output (and probably the Pitch output) could control a bass synth patch while the Accent output triggers a drum patch.

The Accent output does not have the ratcheting feature of the main Gate output.

CLOCK, RESET, RUN
These outputs provide timing and control information for synchronizing other devices to Sequencer 1. The Clock output emits a +5V pulse for each step, with a duration equal to half the

time of the step. The Reset output emits a short +5V pulse when you press the Stop button. The Run output is zero when the sequencer is not running, and +5V when it's running.

If you connect these three outputs to the corresponding inputs on a second Sequencer 1, the two sequencers will start, stop, and play in sync. Yes, having two Sequencer 1s is more than twice as fun as having one.

7.2. Knobs

The three knobs on the top right area of the panel are endless encoders for editing parameters. Generally speaking, rotating a knob changes the parameter with the corresponding position in the LCD, e.g. twiddle the right-most knob and the right-most parameter currently shown in the LCD changes. Some features of Sequencer 1 have more than three parameters. The additional parameters are shown on different "pages" of the LCD. To move from one page to the next, simply press any of the knobs.

7.3. Play, Stop Buttons

Hopefully you can guess from their names what these buttons do, although there is one subtlety we'd like to point out. The PLAY button starts the sequencer, and the STOP button stops it. (Yes, you guessed correctly!) When you press the Play button again after pressing Stop, the pattern starts over with the first step. The subtlety is that if you press the Play button again while the sequencer is playing, it acts like a pause button. Rather than starting over with the first step, the sequence will resume with the next step when you press Play once again.

If you're using an external clock source--which we'll discuss in detail later--the sequence doesn't start playing exactly when you press the Play button. Instead, it starts with the next clock pulse received after you press the button.

7.4. Bank Buttons

The four buttons on the left labeled BANK are for choosing patterns. Banks are designated by a letter from A to D. As we mentioned previously, each bank contains 16 patterns; patterns are designated by a number from 1 to 16. We just happen to have a row of 16 buttons right below those Bank buttons, so we use those buttons to choose patterns within a bank. To choose a pattern, first press and release one of the four Bank buttons, then press and release one of the 16 Step buttons. The current pattern is indicated in the lower-left corner of the LCD.

You'll notice that the Bank buttons have these labels below them: GATE, ACCENT, RATCHET, and SLIDE. The Bank buttons are also used to set those four step parameters when editing patterns. Pressing a Bank button toggles the corresponding step parameter on or off. If a parameter is turned on, its corresponding Bank button is illuminated.

7.5. Step Buttons

The 16 buttons above the jacks numbered 01 through 16 are the Step buttons. These buttons have several uses. As described previously, they're used in conjunction with the Bank buttons to

select patterns. When editing patterns, the Step buttons are used to select steps within the pattern; selecting a step lets you alter its parameters such as setting which note it plays.

Step buttons 01 through 10 have additional functions, labeled in red on the panel. To use these functions, press and hold the ALT button, then press one of the Step buttons. We'll describe each of these functions in detail, but here's a quick summary of what they do:

GLOBAL – accesses settings which affect the overall operation of the sequencer

COPY – makes a copy of the current pattern and places it in a special buffer

PASTE – replaces the current pattern with the contents of the special buffer

SAVE – stores the current pattern on the Micro SD card

TEMPO – accesses the tempo setting and related parameters

STEP – accesses individual step parameters, such as note values, CV output values, gate lengths, etc.

SEQ – accesses parameters for the current pattern, such as its length

CV IN 1, CV IN 2 – assigns the two CV input jacks to do different things, such as changing gate lengths

MOD – accesses modulators, namely the LFOs

The Copy, Paste, and Save functions execute commands; pressing the button causes something to happen immediately, and then the system returns to doing whatever it was doing previously. The other functions invoke different system states or modes, which we usually call *edit modes*.

7.5.1. Repeat Buttons

Step buttons 11 through 14 have a second function while Sequencer 1 is playing and is *not* in any edit mode. This function, inspired by Replicant, our wildly popular beat-repeater plug-in, causes the sequencer to repeat some of the steps it played just before you pressed the button, for as long as you hold the button. How many steps it repeats depends on which button you press, as reflected by the labels. The button labeled REP1 repeats just the last step played, for as long as you hold the button. REP2 repeats the last two steps, and REP4 and REP8 repeat the last four and eight steps respectively.

When you release the button, the pattern resumes playing at the step it would next play if you hadn't pressed the button at all. In other words, you can freely repeat any number of steps within the currently playing pattern, at any time, and the repetitions will enhance the pattern rather than disrupting it. This makes the Repeat function ideal for improvisation, either live or in the studio.

Repeats can also be activated with one of the two control-voltage inputs, so you can use voltage sources like LFOs to trigger repeats in predictable or random ways.

7.5.2. Ratchet Buttons

Step buttons 15 and 16 also have a second performance-oriented function: ratcheting. Pressing RAT 2 or RAT 4 while the sequencer plays causes the Gate output to fire twice or four times per step, rather than once.

7.6. Measure Button

If you've been paying close attention, you may be wondering how Sequencer 1 lets you work with patterns of up to 64 steps if there are only 16 Step buttons for working with those steps. The answer is the button on the far right labeled MEASURE. For patterns with more than 16 steps, pressing this button flips from one measure of 16 steps to the next. The current measure is indicated in the LCD.

The Measure button has a second function labeled CLEAR PATTERN. Pressing and holding the ALT button, then pressing the Measure button erases the current pattern, setting all of its parameters and steps back to default values. Obviously you should use this button with caution, which is why we put this function on the far side of the panel away from the other command buttons.

Finally, when the sequencer is playing, the Measure button blinks when every fourth step is played. This provides visual reassurance that the sequencer is in fact playing when the current step is not in the currently visible measure, and hence you can't see the Step LEDs merrily blinking along.

7.7. ESC, ALT Buttons

We've already mentioned that the ALT button is used in conjunction with the Step buttons to execute commands and change edit modes. Pressing the ESC button, short for Escape, takes you out of whatever edit mode Sequencer 1 is currently in, returning you to the default mode that Sequencer 1 starts in when powered up.

8. Making Patterns

So far we've been waving our hands a little bit in that we haven't really described how Sequencer 1 makes music. Making music with Sequencer 1 boils down to making patterns, and making patterns means adjusting the parameters of the pattern and the parameters of the individual steps within the pattern. You do this by selecting different edit modes with the ALT functions of the Step buttons. Each edit mode displays one or more pages of parameters in the LCD. You change the parameters by turning the knobs. Since Sequencer 1 lets you switch modes and change parameters while it's playing a pattern, you can create patterns in an improvisational manner, which means it's a lot more fun than it sounds like when it's written down in gory detail. Nonetheless, we'll plow through the gory details because we promised you

that we'd explain everything so that you don't have to figure out how to use Sequencer 1 all by yourself.

The three edit modes you'll use most are Tempo, Step, and Seq. We'll look at each in turn, but first we'll describe some features which apply to all three modes.

8.1. Entering Notes, Gates, Etc.

When Sequencer 1 is in any of the three pattern-editing modes (Tempo, Step, or Seq), you can do several things with the Note, Step, and Bank buttons. The Step buttons let you choose which step is the *selected* step. To select a step, press and hold the appropriate Step button; its LED will illuminate brightly. If the pattern has more than 16 steps, press the Measure button to switch from one measure of 16 steps to the next.

The note that the selected step plays is indicated by two things: one of the Note buttons illuminates, and an octave indicator appears in the lower-left corner of the LCD. Press one of the Note buttons to change which note the selected step plays. Press the OCT +1 and -1 buttons to change the note's octave. The octaves are numbered from 1 to 5. You will of course have to tune your VCOs appropriately. Sequencer 1 puts out appropriate voltages for playing notes chromatically, but your VCO has to be adjusted by hand so that it generates a frequency which corresponds to the note shown by Sequencer 1's Note buttons.

The four Bank buttons control four parameters of the selected note, as follows. Press the buttons to toggle the corresponding parameter on or off.

GATE – if illuminated, the Gate output jack will turn on when the selected note plays.

ACCENT– if illuminated, the Accent output jack will turn on when the selected note plays.

RATCHET- if illuminated, the selected step's Gate output jack will turn on and off two to four times when the step plays, rather than just once. How many times is specified by the Ratchets parameter discussed below.

SLIDE – if illuminated, the Pitch output voltage will move smoothly from the previous note's value to the selected note, rather than jumping. This recreates the pitch-sliding effect made immortal by Roland's TB-303 bass synthesizer/sequencer.

The Gate parameter for each step is also reflected by the Step button LEDs. If a step's Gate is on, the Step LED will be dimly illuminated. You can toggle the step gates on/off by tapping the Step buttons. You can even toggle a bunch of step gates in succession by dragging your thumb along the Step buttons.

To reiterate, a long press means select that step, and a quick tap means toggle that step's gate on or off. The selected step's parameters are altered by the Note buttons, the Bank buttons, and the knobs when you're in the Step edit mode. We'll look at the three editing modes next.

8.1.1. Tempo Mode

This mode, as you can almost certainly guess, access parameters related to how fast Sequencer 1 plays. There is only one page of parameters in this mode, which are:

```
Tempo Swing Slid
133.7  12%   5
Oct:2        +o-_
```
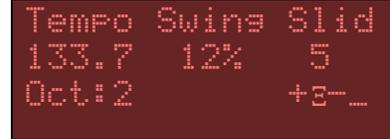
Tempo

Determines how fast the sequencer moves from one step to the next. This value is expressed in beats per minute, and ranges from 10 to 240. (Since a beat is assumed to be a quarter note, and Sequencer 1 organizes patterns into measures of 16 steps, four steps usually correspond to one beat.) Note that the tempo setting applies to all patterns. This parameter has no effect if Sequencer 1 is using an external clock source.

Swing

Alters the rhythmic feel of the pattern by delaying every other step relative to the clock. This value is expressed as a percentage, and ranges from 0 to 99%. 0% means straight timing, i.e. no swing. 50% means that every other step is delayed by half of a step's nominal duration. This parameter has no effect if Sequencer 1 is using an external clock source. Note, however, that Sequencer 1's Clock output *is* affected by this parameter, so you can pass the ability to swing on to other modules.

Slide

For steps with the Slide setting turned on, this parameter sets how quickly the slides happen. This value is expressed in arbitrary units ranging from 1 to 20. It has no effect if none of the steps in the pattern have Slide turned on. Adjust it to taste after you've changed the tempo.

8.1.2. SEQ Mode

This edit mode accesses parameters which apply to the current pattern. There are four pages of parameters.

```
Len   Mode   Trans
37   <--->    +12
Oct:2        +o-_
```

Len

(Short for Length) Sets the number of steps in the pattern. Patterns can have 1 to 64 steps. This setting does not include extra steps created with the Pulses setting for individual steps (described later). Extra pulses will extend the length of the pattern. For instance, if the Length is set to 8 and two steps have Pulses settings of 3 and 4 respectively, the pattern will effectively be 13 steps long.

Mode

(Short for Stepping Mode) Determines how the sequencer moves from one step to the next, and what it does when it reaches the last step in a pattern. The usual behavior is to progress from one step to the next, from left to right, and start over with the leftmost step. Use the other modes to generate melodic and/or rhythmic variations from one pattern. In the following descriptions,

we'll use N to designate the number of steps in the pattern. (Thus the "Nth step" is the highest-numbered step in the pattern.) The modes are indicated in the LCD in a somewhat pictorial manner:

Symbol	Meaning
--->	The sequencer moves from left to right, one step at a time. After it plays the Nth step, it jumps back to step 1.
<---	The sequencer moves from right to left, one step at a time, starting with the Nth step. After it plays step 1, it jumps back to the Nth step.
<--->	The sequencer starts with step 1, moves from left to right until it reaches step N, then moves from right to left back to step 1. On each cycle, it plays steps 1 and N once.
<<->>	The sequencer starts with step 1, moves from left to right until it reaches step N, plays step N again, then moves from right to left back to step 1. On each cycle, it plays steps 1 and N twice.
skip	Starting with step 1, the sequencer plays every other step, i.e. steps 3, 5, 7, etc. If the pattern's length is an odd number, it will play step 2 after playing step N (and then play steps 4, 6, etc.).
walk	The sequencer moves in a manner described as a *random walk* by math geeks. It moves to either the next step or the previous step, choosing its move randomly. If it reaches the Nth step, it will either play the (N-1) step next, or the first step next. Similarly, after playing the first step, it might jump to the Nth step or it might play the second step.
jump	The sequencer picks the next step completely at random. It may or may not play the same step more than once.
halt	The sequencer just sits on the first step, playing it over and over again. There's probably some IDM sub-genre in which unvarying single-note sequences are compositionally useful, but the real intent behind this mode is using it in conjunction with the Step Position CV assignment, described later under "Control Voltage Inputs".
rndEv	(Short for Random Even) The sequencer starts with step 1 and plays the odd-numbered steps from left to right. It chooses even-numbered steps at random. For example, in an eight-step pattern, it might play 1, 4, 3, 6, 5, 4, 7, 2 followed by 1, 2, 3, 8, 5, 4, 7, 2 etc.
rndOdd	(Short for Random Odd) The sequencer starts with step 1 and plays the even-numbered steps from left to right. It chooses odd-numbered steps at random. For example, in and eight-step pattern, it might play 1, 2, 5, 4, 3, 6, 5, 8 followed by 1, 2, 3, 4, 7, 6, 5 etc.

Trans

(Short for Transpose)

Transposes all of the notes in the pattern. This value is set in semitones and can be either positive or negative. The notes are forced into the current key after this transposition is applied, so that transposition always occurs diatonically. In other words, you can twiddle this knob and the results will stay in key. Note, however, that this control has a range of ±48, or up and down four octaves. Since the Sequencer 1 Pitch CV output has a range of five octaves, it's entirely possible that extreme settings of the Transpose parameter would push your pattern outside of the available pitch range. Nothing bad will happen if you do this, but the results might not be particularly musical.

CV1, CV2, CV3 Output Modes

The Pitch CV output always generates voltages based on the note values programmed for each step in the sequence. The other three CV outputs can each operate in one of several different modes, as follows:

```
CV Output Modes
CV1   CV2   CV3
Lin   LFO+  LFO
```

Lin (short for Linear) – The CV output voltage depends on the corresponding CV values for the steps in the sequence. What you set is what you get.

LFO – The CV output voltage comes directly from the corresponding LFO. CV1's voltage is set by LFO1, CV2's voltage by LFO2, etc. This mode is the simplest way to make use of an LFO, since it connects the output of the LFO directly to the CV output jack.

LFO+ – The CV values in the pattern are added to the LFO; their sum sets the CV output voltage.

LFO× – The CV values in the pattern are multiplied by the LFO to determine the output voltage.

We'll have more to say about the LFO-related modes later, when we talk about the LFOs themselves.

Scale and Tonic

This page shows you the scale and tonic for the pattern, which together make up the musical key. The notes of the pattern are constrained by the key. If you enter notes which are not in the current key, those notes will be moved to the nearest in-key notes when played. This process is "non-destructive" in that the pattern itself is not altered.

```
Scale        Tonic
Dorian         F
```

This has several useful implications. Transposition happens intelligently. You can transpose a pattern both manually and with an appropriate CV-input mapping (as described in the Control-Voltage Inputs section) and the notes of the pattern will stay in key. You can experiment by

changing the scale and/or tonic to create different melodies from the same set of notes. If you're bravely editing your pattern in front of a live audience, the key settings will greatly reduce the hazard of playing the wrong notes.

Scale

The *scale* is the set of semitones, out of the twelve which make up an octave, which define the intervals present in the key. We use the term "scale" to include both that general notion as well as the more specific term *mode*. Browsing through Sequencer 1's list of scales, you'll find entries which are usually referred to as modes.

The default scale is the chromatic scale, which contains all 12 notes in the octave. If you use this scale, the notes of each step in the pattern will play exactly as you entered them. Any transposition you apply will move the notes by half steps.

You can see the notes in the scale by looking at Note buttons. If a note is present in the scale, its Note button is illuminated. The lighted buttons also reflect the setting of the Tonic parameter. For example, if the Scale is set to Major and the Tonic is set to C, the Note buttons corresponding to the white keys on a piano will be illuminated. Change either the Scale or the Tonic and you'll immediately see the notes present in the resulting key. You'll hear the effects as well, if the sequencer is playing.

There are over 40 different preset scales available. Since you can see what they do by looking at the Note LEDs, we won't list them here[1]. If you can't find one that suits your needs, there are eight slots for user scales. These work in the same manner as the preset scales, but you can choose which notes are present in the scale by pressing the Note buttons. The eight user scales are saved on the Micro SD card, and are shared by all patterns. You'll find the user scales at the end of the scale list. User scales are saved automatically when you save your pattern or leave the Scale and Tonic editing page.

Tonic

The Tonic is the first (lowest-pitched) note in the key. Usually you'll set this parameter to the note corresponding to tonal center of the pattern, since this will probably produce the results you expect if you transpose the pattern. On the other hand, setting it to something else might produce interesting results, too. Since the Scale and Tonic parameters don't actually alter the notes you enter, you can experiment with them without fear of doing irreparable harm to the pattern itself.

You may be wondering about the relationship between the Tonic and the Transpose parameter we mentioned previously. One way to think about it is this: the Tonic, together with the Scale, determines the series of intervals as you play upwards from the tonic note. A Major scale, to pick an easy example, has a series of two whole steps, a half step, three more whole steps, and

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[1] The scale presets were drawn from Wikipedia's "List of musical scales and modes," found here: http://en.wikipedia.org/w/index.php?title=List_of_musical_scales_and_modes&oldid=634940322 Sequencer 1's complement of scales includes every entry on that list which can be expressed as a subset of the chromatic scale.

one half step. The key of C Major starts with C and uses that series, playing the notes C, D, E, F, G, A, B. If you set your pattern to use C Major, it will always play those notes, regardless of how you transpose it. If you change the Tonic to D, the same series of intervals will be used and your pattern will play the notes D, E, F#, G, A, B, C#, regardless of how it is transposed. The Tonic, together with the Scale, determines a set of *which notes* will be played. Transposing moves your notes up or down within that set.

Pitch Hold

The Pitch CV operates in one of two modes which determine what happens when the sequencer plays steps whose gate is *off*. The two modes are:

```
Pitch Hold
Hold
```
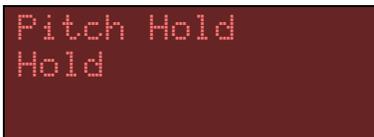
Hold – The Pitch CV output retains the voltage it generated the last time it played a step whose gate was on. This is the default mode, and usually the one you'll use. It prevents the pitch of the note from changing unexpectedly when the sequencer advances to an empty note, particularly if the sequencer is driving a patch with envelopes long enough to create a legato effect.

Off – The Pitch CV output always changes to whatever note value is programmed for each step. This mode may be useful if you're using the Pitch CV output for something other than controlling the pitch of the oscillator(s) in your patch.

CV Hold Modes

The CV Hold parameters are similar to the Pitch Hold setting; they determine when the CV 1-3 output voltages actually change as the sequencer moves from one step to the next. A traditional analog sequencer always changes its voltage

```
CV Hold Modes
CV1   CV2   CV3
Off   Gate  Acc
```

output(s) as the step advances. However, this is not necessarily a desirable behavior in a digital sequencer, since it may that every single step's voltage needs to be set explicitly in order to produce the desired result. The CV Hold parameters let you tailor the CV output behavior to your needs. The following table describes the different options

Mode	Behavior
Off	Nothing is held; the CV output's voltage always reflects the value set in the step. This is the default setting, and was the behavior in Sequencer 1 prior to version 1.2 of the software.
Gate	The CV output retains the voltage it generated the last time it played a step whose gate was on. In other words, the CV output changes only on steps when the gate turns on. It prevents the CV output from changing unexpectedly when the sequencer advances to an empty note.
Acc	This is similar to the Gate setting; the CV output changes only on steps when the Accent is turned on.

Non0   The CV output changes only when the step's CV value is set to something other than zero volts.

Note: The Pitch Hold and CV Hold parameters affect the Pitch and CV outputs even when the sequencer is not playing. When you change the step's note or one of its three CV values, the output jack changes its voltage immediately if the corresponding Hold parameter permits it. For example, if the CV Hold mode for an output is set to Gate and the step's gate is not turned on, then the CV output will not change when you adjust its parameter.

8.1.3. Step Mode

This edit mode accesses parameters for each step. The parameters shown in the LCD are for the *selected* step. To select a step, press and hold the appropriate Step button. Its LED will light up brightly. You can select steps freely while the sequencer is playing.

Step mode has three pages of parameters.

CV1, CV2, CV3

These three parameters set the voltages generated at the three CV output jacks. The values are displayed in 100ths of a volt, and range from -500 to +500. For instance, setting CV2 to -123 means that the CV 2 jack will output -1.23V when the step plays.

GtTim

Sets how long the Gate output jack will turn on when the step plays. This value is expressed as a percentage of the duration of the step, and ranges from 1% to 100%. Since 100% means that the Gate stays on for the entire duration of the step, the LCD displays Tie rather than 100%, indicating that the step is effectively joined to the next one.

AcTim

Same as the Gate setting, but for the Accent output jack.

Rats

Short for ratchets, this sets how many times the Gate output turns on and off if the Ratchet Bank button is illuminated for the step. You can select 2, 3, or 4. If the Ratchet button is not turned on, this parameter is displayed with parentheses around it because it has no effect.

Pulses

Usually each step plays once, i.e. the Gate and/or Accent outputs turn on and off once as the sequencer moves from one step to the next. The Pulses parameter lets you make steps that repeat or play more than once. Pulses can be set from 1 to 8, so for example a step with a Pulses setting of 4 will persist for 4 clock cycles.

```
Pulses Retrig
2       Yes
Oct:2        +8-_
```

Retrig

The Retrig parameter controls how the Gate output behaves when a step's Pulses value is greater than one. If Retrig is set to Yes, the Gate output turns on and off each time the step repeats. If it is set to No, the Gate output turns on and off only the first time the step is played. Hence if Retrig is set to No, the Pulses setting creates a rest for one or more steps.

Also, if Retrig is set to Yes, the Gate Time parameter can be set to Tie to make the Gate output stay on continuously for as many clock cycles as the Retrig setting.

9. Low-Frequency Oscillators (LFOs)

Lurking within Sequencer 1 are three low-frequency oscillators. Like other LFOs, these oscillators generate periodic voltage signals which can be used to control other modules. Sequencer 1's LFOs have a wide variety of wave shapes and are synchronized with the pattern, regardless of whether you're using internal or external clocking. At the risk of getting carried away with ourselves, we'll mention that you'd pay a substantial fraction of Sequencer 1's price if you purchased LFOs this powerful as separate modules.

9.1.   Selecting LFOs

Press and hold ALT then press MOD to access the LFO edit pages. Pressing Mod again while holding ALT advances the LCD from one LFO's parameters to the next. The LCD indicates which LFO is currently selected. Each LFO has two pages of parameters.
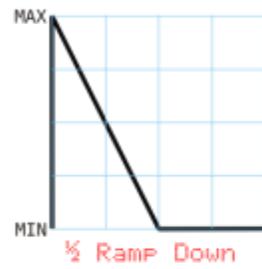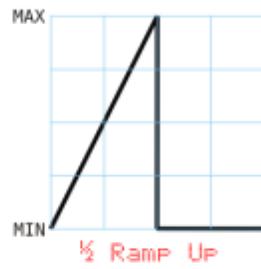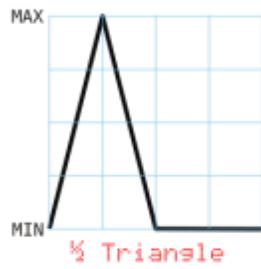
9.2.   LFO Parameters
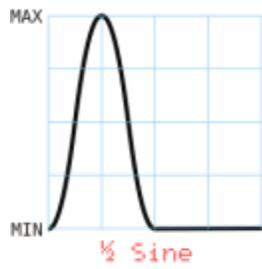
Shape

The Shape parameter lets you choose one of many different shapes for the LFO. The shape describes how the LFO's output changes over time. Usually we speak of the LFO's shape in terms of what its output does in one *cycle;* most shapes operate in a predictable manner, generating an output signal which repeats over and over, once per cycle. (The randomly generated shapes are the exception.)

```
Shape     Len Amp
Rect3/8    12 97%
LFO 2
```

The available shapes are shown in the following illustration. Each drawing represents one cycle of the LFO. The actual output voltages from the LFO depend upon the settings of its Amplitude

and Range parameters, which we'll describe shortly. In the drawings we've labeled the scale with arbitrary values of MIN and MAX representing the LFO's minimum and maximum output voltages.

Sine	Triangle	Ramp Up	Ramp Down
Spike	Shark Fin	Curve Up	Curve Down
Rect 1/8	Rect 1/4	Rect 3/8	Rect 1/2
Rect 5/8	Rect 3/4	Rect 7/8	
½ Sine	½ Triangle	½ Ramp Up	½ Ramp Down
½ Curve Up	½ Curve Down		
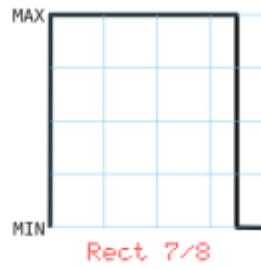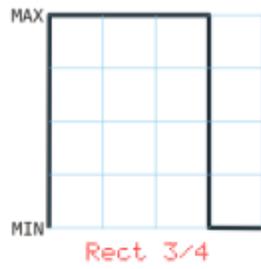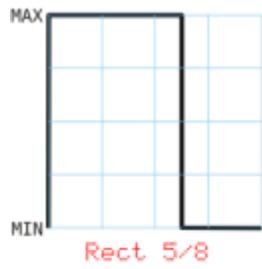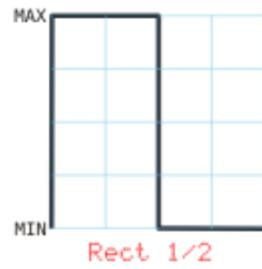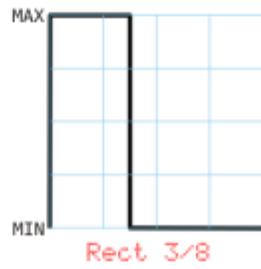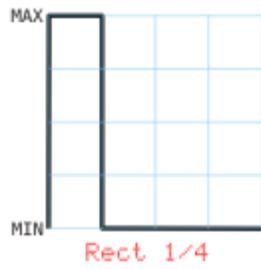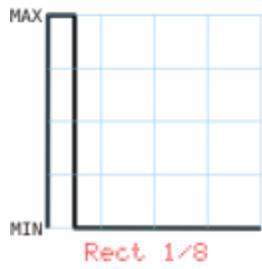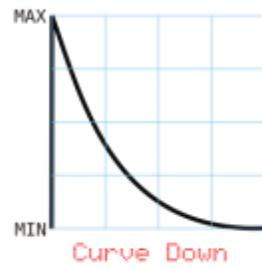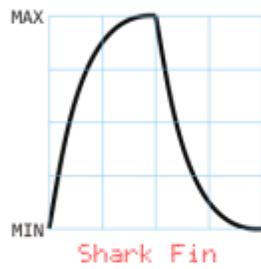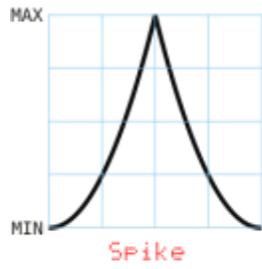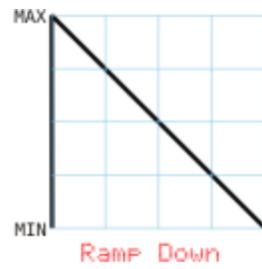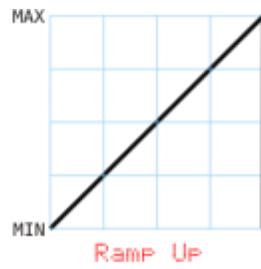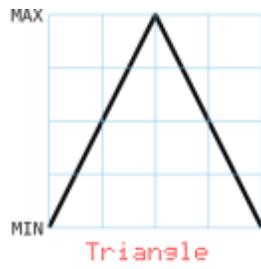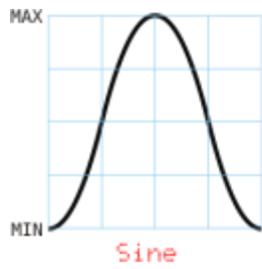
There are some randomly generated shapes which don't lend themselves to drawings. They are:

Shape	Behavior
RndStep	(Short for Random Step) At the beginning of each cycle, the LFO's output jumps to a randomly chosen value and stays there for the duration of its cycle.
Rnd Tri	(Short for Random Triangle) At the beginning of each cycle, the LFO chooses a new value at random and moves to that value in a linear manner over the duration of its cycle.
Rnd +/-	Same as Random Step but the value is always either MIN or MAX.
Rnd +0-	Same as Random Step but the value is always MIN, MAX, or halfway in between.

Len

 (Short for Length) The Length parameter determines how long it takes for the LFO to complete one cycle; in other words, how fast it runs. The LFO Length is expressed in steps. For example, if Length is set to 3, the LFO will complete one cycle every time the sequencer plays three steps. Note that Length can be higher than the number of steps in the pattern, and has an upper limit of 256, meaning that you can set up the LFO so that the pattern repeats several times before the LFO completes one cycle.

Amp

 (Short for Amplitude) The Amplitude and Range parameters work together to set the voltage range of the LFO's output. The Range parameter (described below) chooses the minimum and maximum output voltages for the LFO, that is, the range of voltages it can generate.The Amplitude parameter sets how much of that range the LFO actually produces, and is expressed as a percentage from zero to 100%. 100% means that the LFO's output will swing between the minimum and maximum values set by the Range parameter. 50% means that the output will cover half of that range, starting at zero volts, and 0% means 0V comes out. For example, a Range setting of + and an Amplitude of 40% will make the LFO's output vary between 0V and +2V. A Range of +/- and an Amplitude of 70% will produce output voltages from -3.5V to +3.5V.

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AmpRnd

(Short for Amplitude Randomization) The AmpRnd setting introduces random variations in the LFO's output level, and has a range of zero to 100%. If set to zero, the LFO's output will travel predictably across the voltage range set by the Amplitude and Range parameters. As you increase AmpRnd, the maximum level of the LFO's output will start to vary randomly. The amount of variation is proportionate to the AmpRnd value. For example, if the Range setting is + and the Amplitude setting is 50%, the LFO's output will swing from 0V to 2.5V. If you set AmpRnd to 25%, the LFO's output will vary by up to 25% of the maximum value of 2.5V, which means that the LFO will reach voltages randomly varying between 1.875V and 2.5V. No, you don't need to pull out your calculator when using the LFO; just remember that the Amplitude parameter always sets the *highest* output voltage, and the AmpRnd parameter introduces random variations which will produce output voltages less than that highest value.

The AmpRnd parameter affects all LFO wave shapes. Dialing in a small amount of randomization can make a simple pulse wave unpredictable and more interesting.

Range

The Range parameter chooses the minimum and maximum output voltages for the LFO, that is, the range of voltages it can generate. There are three choices, as shown in this table:

Range	MIN	MAX
+/-	-5V	5V
+	0V	5V
-	-5V	0V

Phase

The Phase parameter determines where the LFO starts within its cycle when the pattern starts playing. Thanks to the LFO's roots in mathematical functions, the phase value is expressed in degrees, where a complete cycle consists of 360 degrees. The following diagram shows how the phase parameter controls where the LFO's cycle starts, for several different shapes:

MAX

Sine

MIN

MAX

Ramp Up

MIN

MAX

Rect 1/8

MIN

MAX

½ Ramp Down

MIN

Phase: 0   Phase: 90   Phase: 180   Phase: 270
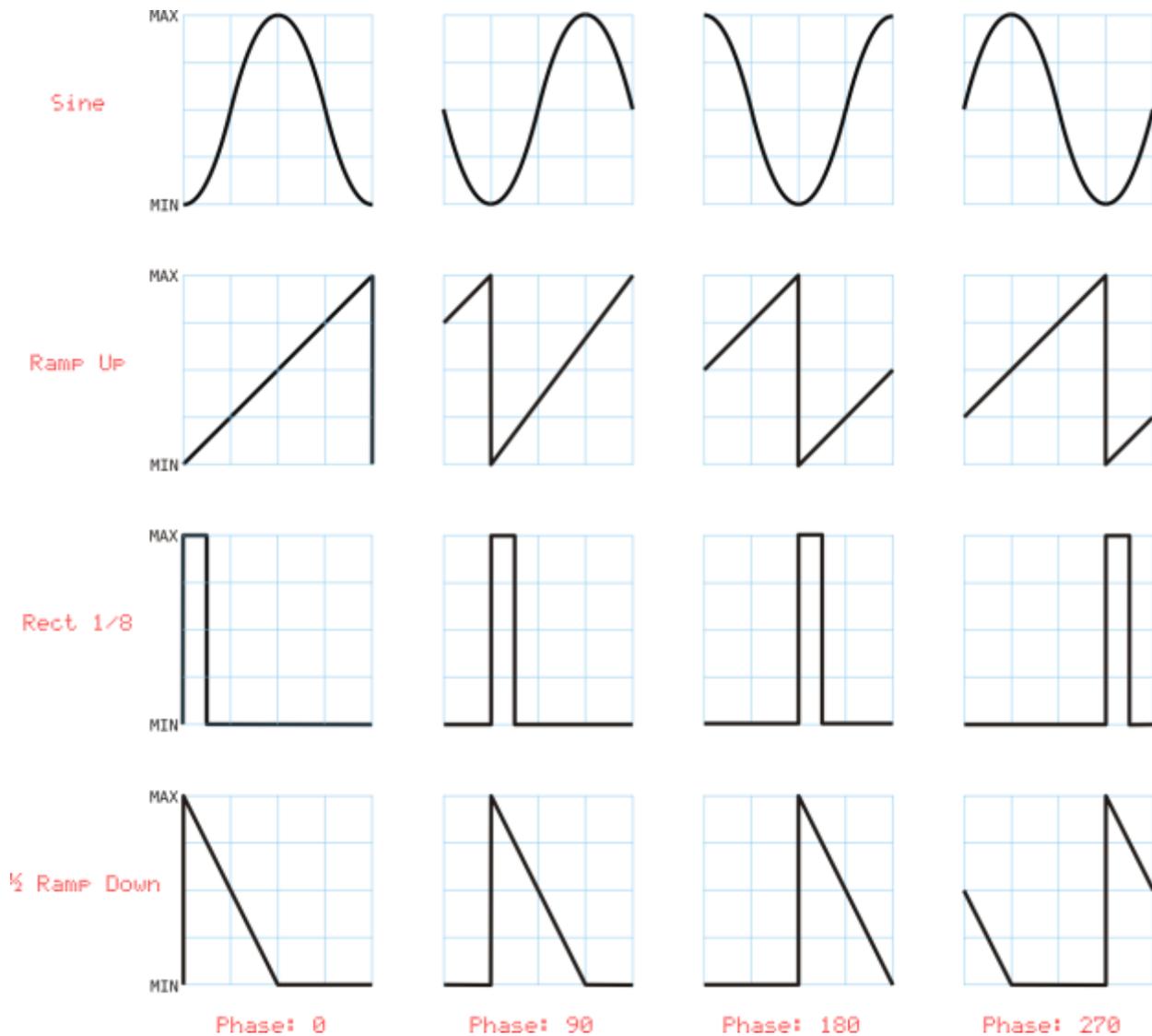
9.3.   Using LFOs

Now that we've described the LFO parameters, we'll point out some subtleties which may help you make the most of the LFOs.

9.3.1. Pattern Synchronization

Each LFO's cycle is always reset to the beginning when Sequencer 1 starts playing a pattern. This means that the LFOs are always synchronized to the pattern, so that their effect on other modules is predictable and repeatable. However, once started, the LFOs can cycle independently of the pattern. For instance, if the pattern is 16 steps long and an LFO's Length setting is 64, the pattern will play four times before the LFO completes one cycle. Conversely, if the pattern's length is 64 and the LFO's is 16, the LFO will complete four cycles while the pattern plays once. This can become more interesting if the pattern length and LFO length aren't simple multiples of each other. If the pattern is 16 steps long and the LFO's length is 15,

for example, the LFO will move out of phase with the pattern as the pattern plays, eventually lining up again with the beginning of the pattern. Consider also that each LFO can have a different length, and hence can drift in and out of phase with the pattern (and with the two other LFOs) in its own way.

9.3.2. LFOs As Simple Envelope Generators

The LFOs are very tightly synchronized to the sequencer. LFOs start exactly in sync with steps. This means that you can use a LFO with a length of 1 as a simple envelope generator. The Ramp Down and Curve Down shapes work particularly well for this. Set a CV's Output Mode to LFO and presto, you've got a simple decay envelope which can drive a VCA or a filter's frequency input directly. If you use one of the half-cycle shapes (designated by a ⸎ at the beginning of their names) and set the LFO's length to 2, you'll get an envelope which fires on every other step.

Now, suppose you want that envelope to fire only on certain steps. This is where the LFOx (multiply) CV Output Mode comes into play. This mode multiplies the LFO's level by the CV level set in each step. If the step's CV level is zero, the CV output will be zero (since zero times anything is zero). If the step's CV level is, say, +4.0V, and you're using the Ramp Down LFO shape and a LFO Length of 1, you'll get an output voltage that sweeps from +4V to 0V for that step. This means that you can program different peak values for the sweep for each step in the sequence—including zero values and negative values. You can also scale the peak values all at once by adjusting the LFO's Amplitude parameter.

9.3.3. Creating Accents

Imagine you're using one of the CV outputs to control a filter's frequency by entering different values for each step's CV parameter. Now suppose you'd like to add an accent to every eighth step by opening the filter more. You could use the ACC output, or you could enter new CV values for the appropriate steps. You could also use the LFO. Set the LFO's Shape to Rect 1/8 and its Length to 8. Then set the pattern's CV Output Mode to LFO+. This will add a rectangular pulse to the CV output on every eighth step, starting with the first step. If you change the LFO's Phase parameter, you'll change the steps, relative to the beginning of the pattern, which the accents fall on. If you change the Shape to Rect 2/8, you'll get the accent on pairs of steps: every eight step and each immediately following step. Finally, change the LFO's Amplitude parameter to change the height of the pulse.

10. Other Pattern Commands

There are a few utility commands for working with patterns. You can duplicate entire patterns, or individual measures within a pattern, with copy and paste commands. You can also erase entire patterns and save them to the Micro SD card.

10.1. Copy & Paste

You can copy patterns from one place to another, so that you can create patterns similar to one another without creating each one entirely from scratch. You can also copy and paste single measures (of 16 steps) within the same pattern.

10.1.1. Copying Entire Patterns

Press and hold ALT, then press COPY, to make a copy of the current pattern, placing it in a temporary buffer. If you switch to a different pattern, pressing ALT and PASTE places the contents of this buffer into the pattern, erasing anything that was there previously. So, to make a copy of a pattern in another pattern slot:

- Press one of the Bank buttons, then one of the Step buttons, to select the source pattern.

- Press and hold ALT, then press Copy, to make a copy the source pattern.

- Press one of the Bank buttons, then one of the Step buttons, to select the destination pattern.

- Press and hold ALT, then press Paste, to place a copy of the source pattern in the destination.

10.1.2. Copying Measures

Copying and pasting measures within one pattern works much the same as copying and pasting entire patterns, except that you change measures within the current pattern rather than switching patterns. For example, to copy the first measure to the third measure:

- If necessary, press the MEASURE button one or more times to switch to the first measure.

- Press and hold ALT, then press Copy, to make a copy of the first measure. (This actually makes a copy of the entire pattern, which obviously includes the first measure.)

- Press the MEASURE button twice to switch to the third measure.

- Press and hold ALT, then press Paste, to overwrite the third measure with a copy of the first measure.

Copying and pasting measures affects only the information in the steps of the measure. Information which affects the whole pattern (such as the scale, LFO settings, etc.) is unchanged.

10.2. Saving Patterns

Patterns exist in RAM as you create and play them. RAM is a quaintly imprecise acronym, but what it means in practical terms is that anything stored there is lost when the power goes off. Sequencer 1 uses a Micro SD card to store patterns and other information so that you don't have to leave your modular synth turned on 24/7. (Maybe you do that already. That's fine, but you should save your patterns anyway, just for safe keeping.)

To save the current pattern, press and hold ALT, then press SAVE. This saves only the currently active pattern; you have to explicitly save each pattern individually. Saving is quick and easy and can be done at any time without interrupting anything. Saving frequently is a good habit to cultivate.

10.3. Clearing Patterns

If you want to erase everything in the current pattern, press and hold ALT, then press PATTERN CLEAR (the MEASURE button). This resets every parameter and step in the current pattern to their default values. Yes, you should exercise caution when using this command; there is no undo, although if you accidentally erase a pattern which you have previously saved, you can restore that pattern by power-cycling your system, causing Sequencer 1 to reload all patterns.

10.4. Reloading Patterns

If you've changed a pattern and decide that you prefer how it sounded when you last saved it, you can reload it from the Micro SD card. This erases whatever changes you've made since you last saved it. To reload a pattern, press one of the Bank buttons as usual to select a pattern, then hold the ALT button when pressing one of the Step buttons. This action does not switch the sequencer to that pattern, so you can reload patterns other than the one you're currently playing.

11.   External Clocking

Sequencer 1 can use signals from other modules to control its tempo, start and stop patterns playing, and reset the pattern to its first step. These external clocking features can be used to make Sequencer 1 behave in a predictable manner in conjunction with other devices, such as another Sequencer 1 (hint, hint). They can also be used to make Sequencer 1 behave in an unpredictable manner. Read through the following descriptions of the input jacks and then imagine patching three different unsynchronized LFOs into these three jacks.

To use these features, you must first change one of Sequencer 1's Global settings, as described under Clock Source, Patterns Switch. The Clock and Reset input jacks are mostly interested in when their signals that go from 0V or less to some positive value--a *rising edge* as it's known in engineering circles.

CLOCK
This jack sets Sequencer 1's tempo based on the frequency of the incoming signal. For instance, you could plug the output of an LFO into the Clock jack, and change Sequencer 1's

tempo by changing the LFO's frequency. Sequencer 1 uses each complete cycle to determine the duration of one step; for instance, if the hypothetical LFO's signal has a frequency of 10Hz, then each step will last 1/10th of a second.

RESET

A rising edge on the Reset jack will make Sequencer 1 reset the step index back to the first step of the pattern (where the first step is determined by the pattern's cycle mode). The index changes in sync with the incoming clock signal; that is, the pattern will jump to the first step upon receiving a rising edge at the Clock jack *after* receiving a rising edge on the Reset jack.

RUN

The Run jack makes Sequencer 1 play or stop. A positive input voltage makes it play, zero volts or less makes it stop. Note that the Run jack is not what makes Sequencer 1 play the next step--that's the job of the Clock jack.

12.   Control-Voltage Inputs

Sequencer 1 has two input jacks, labeled CV 1 and CV 2, which accept control voltages. They expect voltages in the range of -5V to +5V, although in most instances negative voltages are ignored. Each CV input can be independently assigned to one of

CV1 Assignment
Step Position

several functions. These assignments are made globally, that is, they apply to all patterns. The available functions for CV control are as follows:

(Nothing)

If you're a Nihilist, this is the assignment for you. The control voltage has no effect. This setting can be handy if you need to temporarily disable the control voltage input and you've already got a bunch of patch cords connected at only one end dangling from your modular.

Gate Length

The control voltage changes how long the gate output stays on, relative to its per-step setting. Positive voltages increase its length, up to a maximum of twice its programmed length. Negative voltages decrease the gate length, down to a minimum of one-fourth its programmed length.

Step Position

The control voltage sets the current step position, overriding the behavior set by the pattern's Stepping Mode. A positive voltage sets the step position relative to the length of the pattern and proportional to the voltage level. In other words, zero volts sets the position to the first step, a maximum voltage of +5V sets the position to the last step in the pattern, and any other voltage will select a step somewhere in between. Negative voltages are ignored. The step position is updated in time with the clock (either internal or external).

Stepping Mode

The control voltage sets the Stepping Mode, overriding the pattern's Stepping Mode setting. A positive voltage is linearly mapped to one of the many stepping modes. 0V chooses the first mode, +5V chooses the last mode, a small voltage chooses the second mode, etc. Negative voltages are ignored.

Repeats

The control voltage triggers step repeats in the same manner as the step buttons, as described under Repeat Buttons. Positive voltage inputs activate repeats, negative voltages are ignored. There is a dead zone near zero so that a small voltage won't park Sequencer 1 in an endless series of repetitions. A voltage of 1V to 2V causes one step to be repeated, 2V to 3V repeats the last two steps, 3V to 4V repeats the last four steps, and above 4V repeats the last eight steps.

The panel buttons get priority over this control-voltage assignment. In an argument over who gets to say which steps repeat and when, you'll always win.

Ratcheting

The control voltage triggers ratcheting in the same manner as the step buttons, as described in the Ratchet Buttons paragraph. Positive voltage inputs activate ratcheting, negative voltages are ignored. There is a dead zone near zero so that a small voltage won't make every step ratchet. A voltage of 1.25V to 2.5V triggers two gate pulses per step, 2.5V to 3.75V triggers three pulses per step, and above 3.75V triggers four pulses.

Transposition

The control voltage is quantized into semitones with the usual 1V/octave convention and added to each step's programmed pitch to transpose the pattern. As you'd probably guess, positive voltages transpose the notes upward, negative voltages transpose them downward. You might also guess that this transposition is constrained by the Pitch CV output's usual range, and you'd be right.

Pattern

The control voltage changes which pattern plays. Positive voltage inputs choose from the (up to) 16 patterns in the current bank. Unused patterns are ignored, as are negative voltages. For example, suppose you've used patterns 2, 3, 5, and 11 in the current bank. An input voltage of zero to 1.25V will select pattern 2, a voltage of 1.25 to 2.5V will select pattern 3, a voltage of 2.5V to 3.75V will select pattern 5, and any higher voltage will select pattern 11.

When the voltage changes, the pattern will change as dictated by the Pattern Switch option described under Clock Source, Patterns Switch. Also, the pattern changes in response to this control-voltage assignment only when the sequencer is in its default, non-editing mode. This is to prevent the confusion which would arise if the pattern switched while you were editing it.

User Scale

The control voltage switches the key between the Scale set for the pattern and any of the eight user scales. A voltage input of about half a volt or less will play the scale/mode currently set for the pattern. Positive voltage inputs choose between the eight user scales, regardless of whether or not you've created your own scales. Since the input range is 5V and there are eight user scales in addition to the currently programmed scale, the 5V gets divided into nine thresholds of about 0.6V each. Negative voltages are ignored.

Pulses

The control voltage sets the number of pulses per step, as described in the Step Mode section. A voltage input near zero has no effect; the sequencer plays the step as many times as set by the Pulses parameter. Positive voltages cause the step to repeat from one to eight times; the higher the voltage, the more repeats. Since the input range is 5V and there are eight different pulse values in addition to the currently programmed value, the 5V gets divided into nine thresholds of about 0.6V each. Negative voltages work the same way, but act as though the Retrig parameter is turned off, so the gate output turns on for only the first pulse. For positive input voltages, the gate output turns on for each pulse.

13.   Measure Display

The LCD displays four symbols in the lower-right corner which indicate the length of the pattern and which measure of the pattern is currently visible on the STEP buttons. If the sequencer is playing, the symbols also indicate which measure contains the step currently being played. There are four distinct symbols:

Symbol	Meaning
▬	Empty measure
▬	Non-empty measure
⊟	Visible measure
✛	Playing measure

Since a pattern has up to four measures of 16 steps, the display always shows four of the above symbols. Here's an example of how the symbols might appear on the LCD:

```
Audio Damage
Sequencer 1
A03              +⊟▬▬
```

This tells you several things:

- The ✛ indicates that the sequencer is playing a step in the first measure

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- The ⊟ indicates that the second measure is displayed on the LEDs. This means that you won't see the step advancing from one LED to the next because that ⊹ told you that the sequencer is playing a step in the first measure, and you're looking at the second measure.

- The – and ⁔ tell you that the pattern is between 33 and 48 steps long: the – shows that the third measure (which starts with step 33) is used, while the ⁔ shows that the fourth measure (which starts with step 49) is unused.

14.   Global Options

There are a number of settings which affect Sequencer 1's operation globally, regardless of which pattern is currently active. You probably won't have to change them very often.

14.1. Clock Source, Patterns Switch

Sequencer 1's tempo comes from one of two reference clocks: its own, or an external signal provided through its CLOCK input jack. Thus, unsurprisingly, the Clock Source option has two settings:

```
Clock    Patterns
Source   Switch
Int      By patt
```

Int (short for Internal) - If you want the sequencer to happily play by itself, using its internal clock source, use this setting.

Ext (short for External) - On the other hand, if you want the sequencer to play in time with some other sequencer, or you want to do something exotic like controlling the sequencer's tempo with an LFO, use this setting.

This option determines whether pattern changes happen at the ends of patterns or between steps. It applies to pattern changes either in response to you pressing the Bank and Step buttons or in response to a CV input.

By patt – the sequencer waits until it reaches the end of the current pattern before switching to the new pattern.

By step – the sequencer changes patterns before playing the next step (but does not interrupt the current step).

Both modes have their uses. Switching by pattern means that you won't interrupt the current pattern, and hence this mode might be considered less risky for live performances.

14.2. Gate/Accent Output Modes, Pitch Output Scale

Mostly for compatibility with older analog synthesizers, the Gate and Accent output jacks can each operate in one of three different modes, as follows:

```
Output Modes
Gate Acc    Scale
Strg Norm   Hz/V
```

Norm (short for Normal) - the output is usually zero, and rises to +5V when the output turns on. Use this setting for most Eurorack modules such as envelope generators and VCAs.

Inv (short for Inverted) – the output is inverted, that is, usually +5V and falls to zero when the output turns on. This mode is useful for many older Korg and Yamaha synthesizers, and also works with the contemporary Korg MS-20 Mini.

STrg (short for S-Trig, which is short for Shorting Trigger) – the output has a high-impedance, open-circuit output which is shorted to ground when the output turns on. This mode may be useful with some older Moog synthesizers and modules.

The Pitch CV output can operate in one of two different pitch-control scaling conventions, labeled Scale in the LCD. They are:

V/oct – This mode is used by most Eurorack oscillators and analog synthesizers, new and old. One volt raises the pitch by one octave.

Hz/V – This mode is used by some Korg and Yamaha synthesizers. Doubling the voltage raises the pitch by one octave.

14.3. Display Contrast

Adjust this setting to make the display most legible from your current seated, standing, or lying position.

Display
Contrast
  12
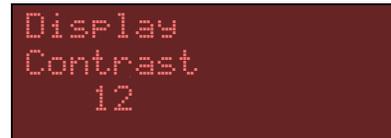
14.4. System Information

This page shows the version number of the software installed in your sequencer. If this number is less than the version number of the software available at Audio Damage's website, you may want to update your sequencer.

System Info
Version
1.2.1.73

15.   Updating the Firmware

Audio Damage will occasionally make available new versions of the Sequencer 1 software in order to add new features and correct defects. You can obtain these updates from our website here: http://www.audiodamage.com/hardware/product.php?pid=ADM06

Updating Sequencer 1's firmware is easy, and any patterns you've stored will load without change. Note that once you *save* patterns with a new version of the firmware, they cannot be loaded by an older version of the firmware. This is highly unlikely to cause problems if you're using patterns with only one sequencer, but could be an issue if you happen to be sharing your patterns with another Sequencer 1 owner. The solution to this issue is simply to update each Sequencer 1 to the same firmware version.

Installing the new firmware is a simple process, as follows:

- Turn off the power to your Eurorack system. Yes, we're sure that you're both intelligent and careful, but nonetheless we'd like to take this opportunity to tell you that working on electrically powered equipment with the power turned on is hazardous to both you and the equipment.

- Remove Sequencer 1 from your cabinet. You may or may not be able to get away with leaving the power cable connected.

- Remove the Micro SD card from its socket on the back of Sequencer 1. The socket has a metal cover which slides slightly and then opens on hinges. Pay attention to the orientation of the Micro SD card before you remove it; obviously you'll have to put it back in the same orientation shortly.

- Using a standard adapter, mount the Micro SD card on a personal computer. Any operating system which can read and write a FAT-formatted removable medium and decompress .zip files will do; this means just about any version of Windows, OSX or Linux.

- Obtain the firmware from our website, and unzip the file. The resulting file will be named `Seq1_fw.srec`.

- Copy the `Seq1_fw.srec` file onto the Micro SD card. While you're doing this you might notice other files on the card. Some of those files are your pattern files. If you'd like to make backup copies of those files, you can do so simply by copying them to some other storage device, such as the main drive in your computer.

- Unmount the Micro SD card, put it back in the socket on Sequencer 1, and reinstall Sequencer 1 in your cabinet.

- Turn the power back on. You'll see a message informing you that the new firmware has been recognized and is being installed. The installation takes a little less than 30 seconds to complete, whereupon Sequencer 1 will restart and be ready to go.

Since parts of this process are easier to demonstrate than to describe, we've provided a video that shows you exactly what happens:

http://youtu.be/UZp8Mi8VdDc

16. And Finally…

Thank you for purchasing Sequencer 1. We make every effort to ensure your satisfaction with our products, and want you to be happy with your purchase. Please write to us at info@audiodamage.com if you have any questions or comments.