DiGiTAL Synthesizer
by Max for Cats

Operation Manual

![DiGiTAL]

"Then we slooshied."
— Anthony Burgess, A Clockwork Orange

Thank you for purchasing the DiGiTAL Max for Live Synthesizer.
DiGiTAL is a unique 8-Voice polyphonic software Synthesizer for Ableton Live / Max for Live.

DiGiTAL is full of sonic possibilities and I hope you have a lot of fun unveiling and (mis-)using those for your musical ambitions!

I. System Requirements

You'll need a copy of Ableton Live 9.0.1 or higher and Max for Live 6.1.6 or higher to use this synthesizer. Any 'modern' computer will do. If Live 9 runs fine on it, you won't have problems with DiGiTAL.

II. Installation:

Double click the .alp file to open it, or if Ableton is already running then just drag it onto the Ableton window. Click on install, and the live pack will be added to Ableton.
Browse to Max Instruments in the Live Browser and you should see
your new Synthesiszer and it's presets. Simply drag and drop DiGiTAL to a new MIDI Track and it's ready to go.
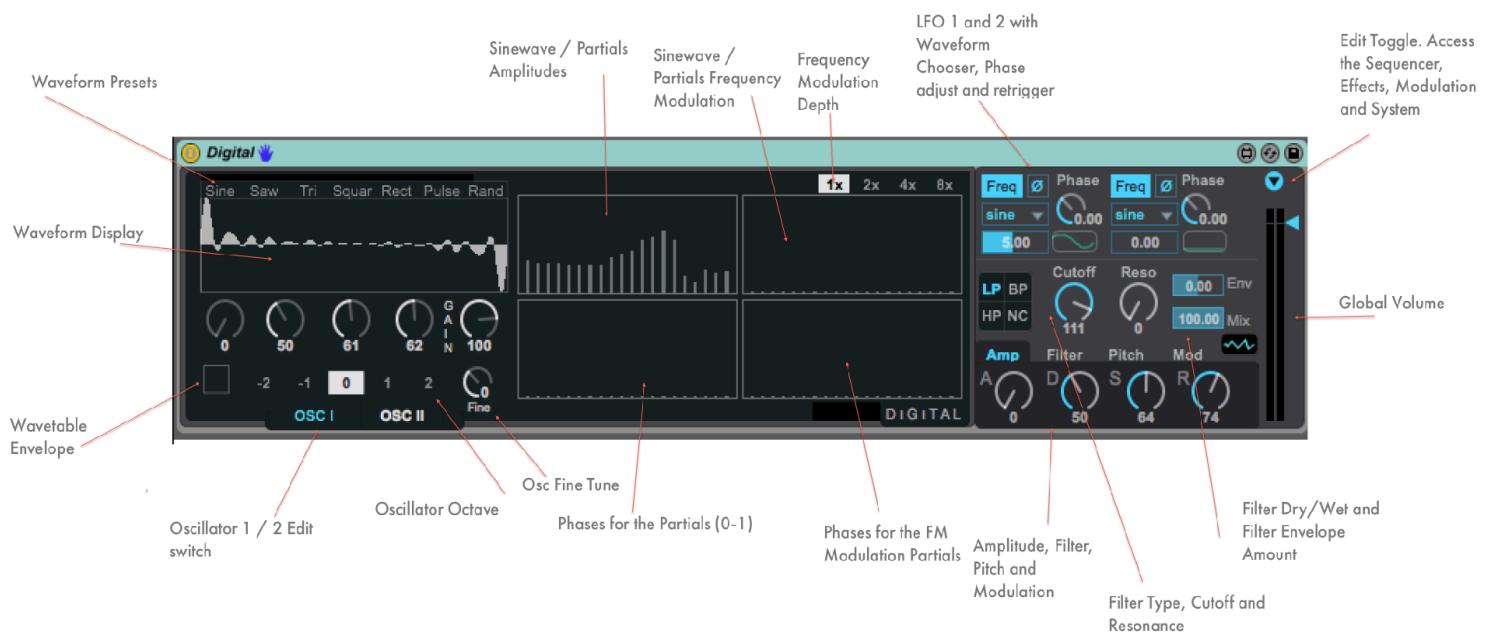
III. How does it work?

The main sound source,the two Oscillators, can produce countless different waveforms and therefore produce a vast variety of different sounds.
This is possible because the waveforms for each Oscillator are mathematically created by additive synthesis and frequency modulation. The results of this operations are stored in a wavetable and this wavetable can be modulated again. As you see, it's slightly difficult to put a specific label on the this synth. Is it additive? Is it Wavetable? Is it FM or subtractive synthesis?

It's all of the techniques above! The main difference to other additive synthesizers is that the waveform is not created by 'real' sinewave oscillators but by a mathematical equation which is then again used to create the waveform itself.
Any operation on the individual partials can be seen and heard in realtime in the waveform display.
Before we dig deeper into the sound creation, here's the

IV. Overview

Waveform Presets

Sinewave / Partials Amplitudes

Sinewave / Partials Frequency Modulation

Frequency Modulation Depth

LFO 1 and 2 with Waveform Chooser, Phase adjust and retrigger

Edit Toggle. Access the Sequencer, Effects, Modulation and System

Waveform Display

Global Volume

Wavetable Envelope

Oscillator 1 / 2 Edit switch

Oscillator Octave

Osc Fine Tune

Phases for the Partials (0-1)

Phases for the FM Modulation Partials

Amplitude, Filter, Pitch and Modulation

Filter Type, Cutoff and Resonance

Filter Dry/Wet and Filter Envelope Amount

V. Using the DιGιTAL Synthesizer

V.1. The Oscillators

I usually recommend to take a little time to explore the basic features of an instrument - spending this time will later pay off when you have a sound idea in your head and need a tool to make it reality.

A good way to learn DιGιTal is this:

- Open the 'Sine' Preset.

This preset has the volume for Oscillator II turned down and no modulation etc. is active. What you hear is a pure Sine Wave tone, produced by the first partial of Oscillator I.
Now click through the Waveform Presets of Oscillator I (saw, tri, square, rect, pulse, random) and watch/hear the shape of the partial edit sections.

Osc. I with the Square Waveform Preset:

Now start drawing your own waveshapes with the mouse in the 4 partial windows and watch/hear the change of the sound. The lower Square sections for the phases will change
the sound only slightly while the upper Square edit sections will produce drastic sound changes.
Especially the Frequency Modulation section will strongly change the waveform (you can even choose the depth of the Modulation (1x, 2x, 4x, 8x)).

Turn on the Waveteble Envelope switch (see the Overview) and notive the difference. The more overtones your waveform has, the more drastic the effect will be.
What's going on? Turning on the Wavetable Envelope switch means that you apply the ADSR to the Oscillator Wavetable read out. The result is a (in my opinion) very musical and slightly morphing sound which recalls memories of the Wave PPG synthesizers. The way how the waveform is read back can be
adjusted in the system section of DιGιTAL - we'll come to that...

If you now switch to OSC II (turn up its GAIN knob!) and mix OSC I and II together, you'll realize the sonic potential of this sound creation method...

V. Using the DıGıTAL Synthesizer

V.2. The Filter

In the middle section, just below the two LFO's you'll find the Filter
section:

The Filter is built around the great "Linear Trapezoidal Integrated State Variable Filter With Low
Noise Optimisation" model by Andrew Simper. You can read all about it here:

http://www.cytomic.com/files/dsp/SvfLinearTrapOptimised.pdf

The Filter section offers four different Filter types:

1. LP = Lowpass Filter
2. BP = Bandpass Filter
3. HP = Highpass Filter
4. NC = Notch Filter

The 'Mix' parameter lets you mix in the dry (unfiltered) signal - which is especially nice if you use
e.g. the HP Filter but still want to add some low frequencies.
The 'Env' parameter adjusts the amount of the Envelope affecting the Filter.

V. Using the DıGıTAL Synthesizer

V.3. The LFOs

DıGıTAL offers 2 Low Frequency Oscillators to modulate various
parameters. The two LFOs are identical in their feature set. They
offer:

- a FREQ / SYNC switch to change from tempo locked to free
running mode. In FREQ mode, the LFO ranges from 0 to 40 Hz
and in SYNC Mode the fastest speed is 1/48 while the slowest
is 16 - this means it takes 16 bars to make a full LFO Cycle (nice
for super-slow modulations).

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V. Using the DıGıTAL Synthesizer

V.3. The LFOs

- Waveform Chooser
Each of the LFOs offers the following waveforms:
1. Sine
2. Up
3. Down
4. Tri
5. Rect
6. Rand
7. S&H

- PHASE

In FREQ Mode, you can adjust the Phase of the LFO with the Phase knob. The Ø (Phase Symbol) lets you retrigger the LFO from the adjusted phase position when activated. This means you can use the LFO also as a small Envelope if needed.
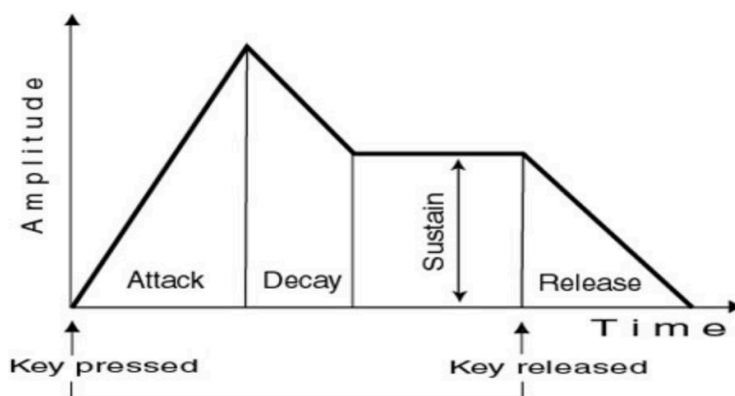
V. Using the DıGıTAL Synthesizer

V.4. The Envelopes

DıGıTAL offers four Envelopes to shape the Amplifiaction, the Filter, Pitch and an additional Modulation Envelope.
The Envelopes ar classic Attack, Decay, Sustain, Release Envelopes.

The Pitch Envelope has the special feature to inverse it's action to achieve a falling or rising Pitch Modulation

V. Using the DıGıTAL Synthesizer

V.4.

The Pitch Envelope can affect OSC I, II or both at the same time - simply activate the labeled switches. The green number lets you adjust the desired amount of the Pitch Envelope Modulation.

V.5. The Edit Section

You probably have seen the little icon in other Max for Live devices before (e.g. in the Max essentials pack). Clicking the arrow, icon, the width of the device increases and opens the access to additional parameters. In DıGıTAL, you'll find quite a lot of features here!
These are:

1. MOD   = The Modulation Matrix
2. FX   = Built-in Effects (Chorus and EQ)
3. SUB/FM   = A special Sub-Oscillator, FM-Modulation and global Saturation/Distortion
4. SQ   = A 16-step note and modulation sequencer
5. SYSTEM   = Global parameters

EDIT Section Details:

The MOD Section:

In the MOD (Modulation Matrix) Section you choose a selectable Source and route it to a fixed target. The Sources are usually:
- LFO 1
- LFO 1 + 2 (the summed output of the two LFOs)
- LFO 1 x 2 (the multiplied output of the two LFOs)
- LFO 2
- Env (The modulation envelope)
- SQ (the Parameter Sequencer)

Note that some source chooser have additional options such as AT (Aftertouch) or VEL (Velocity).
The Modulation amount is adjusted with the slider. If see buttons with the labels 1 or 2 - these active or deactivate the modulation for each Oscillator individually.


The FX Edit Section

Here you'll find a 3 band full parametric EQ and a Chorus to thicken the sound.
The EQ:
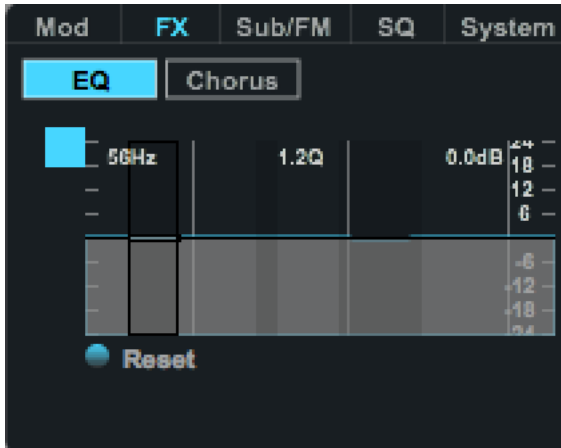
If you 'mouseover' the EQ, the Hz, Q and dB scales will magically appear. The mouse cursor will change to a cross and you can adjust each band of the EQ to your needs.
The RESET button lets you straighten out the EQ again. Of course all settings of the EQ are stored with your presets - so are all other adjustments in the Digital.

The Chorus:
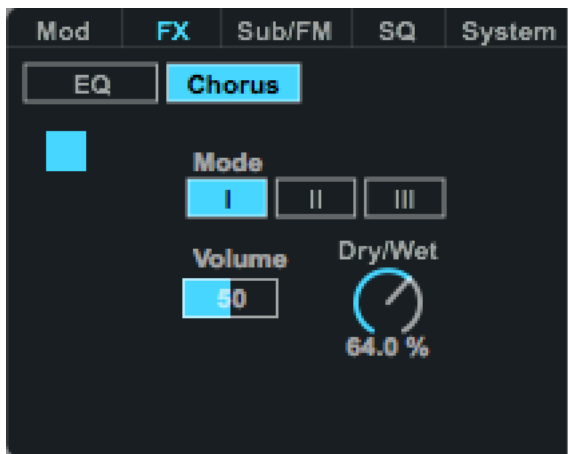
 The Chorus offers a on/off switch, 3 Presets, a Volume and a Dry Wet Mix.
 The Chorus is a 3 - Phase Ensemble Chorus. (This means it has 3 phase-shifted Delay lines)

The SUB/FM Section

The Sub-Oscillator is a special beast: It offers a sort of Super-Saw Waveform which can be heavily (heavenly?) detuned.
Please note that it eats up quite some CPU power when activated so it's recommend to turn it off when it is not used (instead of just turning down its SubGain knob.)

The FM section is next:
DıGıTAL lets you Frequency Modulate the 1st oscillator either with a an additional sine wave oscillator or with the output of oscillator II.
Additionally you can modulate the FM either via Modulation Envelope or via LFO 1 - just tick the appropriately labelled boxes.

The Saturation parameter lets you add some gain to the overall amplifier and it starts to add distortion if you increase it's amount.

The SQ Section (Note and Parameter Sequencer).
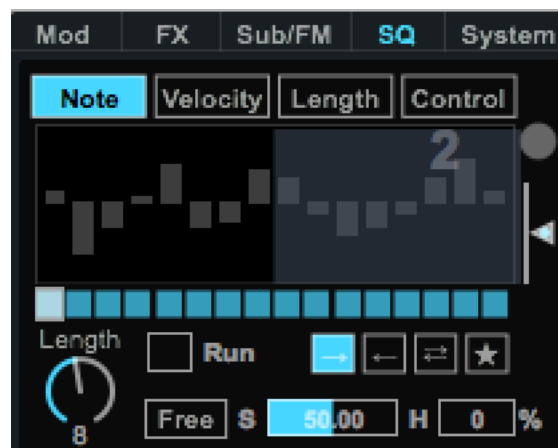
The SQ (Sequencer) section is a very powerful addition to the character and playfulness of the DɪGɪTAL Synthesizer. Max for Cats is quite fond of the vintage Oberheim 2-Voice Synthesizer so you see where the inspiration comes from...

The Sequencer basically has two purposes: To act as a note sequencer and to act as a parameter sequencer. While the parameter sequencer is always active (and selectable as source in the MOD section), you explicitly have to click the RUN button to use the SQ as a Note sequencer. If you click this button, each incoming note value will be transposed up or down with the adjusted values. The note range is +/- 12 semitones.

Here's an example:

The SQ is set to run and its step length is eight steps.
If you'd play e.g. a C2 Note on your Keyboard/Push, you'd hear a note sequence of
C3, C1, C3, C1, C2, C2, C2, E2 for the eight steps. If you adjust the note value for a step, a little number will tell you how many semi-tones you are "away" from the played notes. In the picture above the player adjust the 8th step, which is indicated with the number 5 - thjis means if he played his C2 originally the 8th step will play a note, which is 5 semitones higher than the C2 = a E2. Of course the whole sequence shifts according to the played note, similar to an arpeggiator.

For each step you can also adjust the velocity and note length and you can mute/unmute every step by clicking on the little step toggle. In the above picture, the 6th step is muted.

Furthermore the sequencer offers Forward, Backward, Alternate and Random Step Playback modes.
Similar to the LFOs you can choose free running mode, or sync it to the global Live tempo.
Note that you can access a humanize parameter in FREE running mode which randomizes the trigger accuracy - like a drunk drummer would.

For each of the SQ sections (Note, Velocity, Length and Control) you'll find a value randomize function with amount slider. While the step mute, play direction, speed, sync and step length parameters are global to the SQ, the parameter edit sections and the randomize functions are only affecting the current visible step-edit panel.
Please Note:
When the SQ is in Note sequence aka RUN mode, a little lock icon will appear next to the edit arrow

The SYSTEM Edit Section:
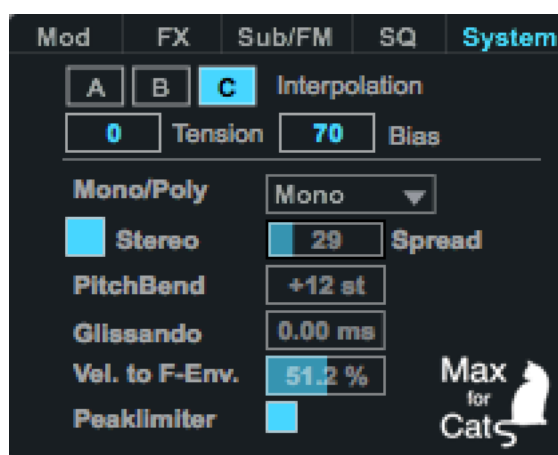
In this section, DıGıTAL offers some global adjustments:

- Interpolation settings: This lets you define how the Wavetable readout is interpolated.
Choose between
A = No interpolation
B = High Quality Linear Interpolation
C= Hermite Interpolation with BIAS and TENSION parameters

Choosing either A or C will usually result in a slightly more harsh sounding character of the Oscilllators. The additional parameters of algorithm C can create some artifacts which may be desired to achieve certain musical results.

Next you can choose the voice count from MONO up to 8 Voices and adjust the STEREO SPREAD. When activated, each note on message randomly distributes a voice in the stereo field.
Hint: The little visualizer next to the DıGıTAL letters will indicate if the synth is in MONO or POLY mode.

The PITCHBEND range can be adjusted from 0 - 24 semitones.
The GLISSANDO section offers (a stepped!) glide from 0 - 2 seconds.
The PEAKLIMITER will avoid volume peaks (but reduce dynamic).

V. Using the DıGıTAL Synthesizer

VI. Scope

DıGıTAL also offers a usefull Waveform Scope, which can be activated with its little icon next to the Envelope section:

You can adjust the Trigger level, the Gain and the Display size.
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M4C /2014