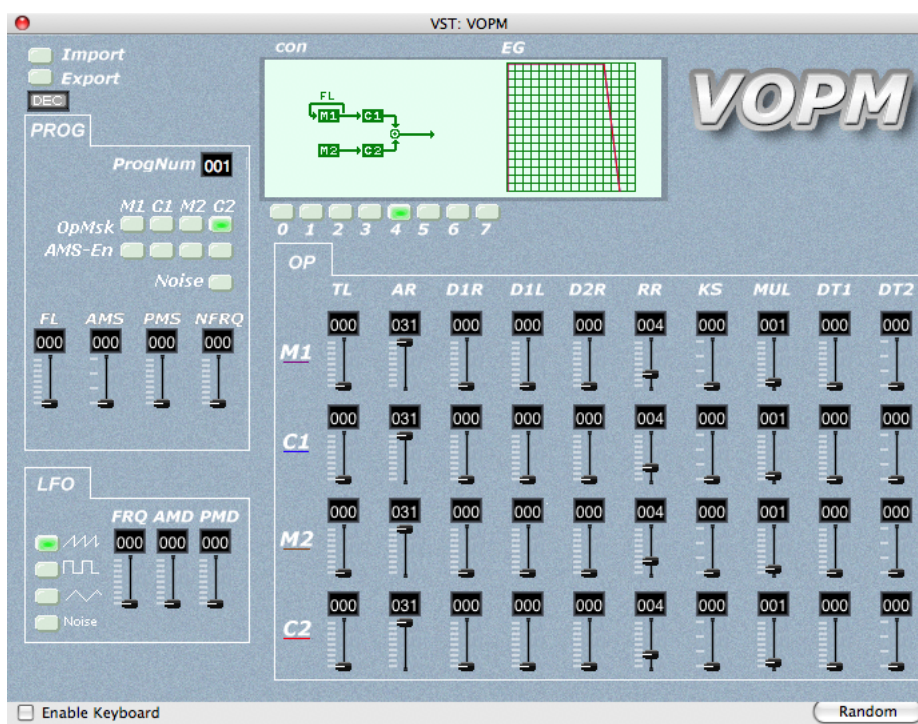


VOPM: The Unofficial Manual

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VOPM Introduction

Summary

VOPM is a VST which emulates the OPM (Yamaha 2151) chip. It was written by Sharp X68000 home computer enthusiast Sam. VOPM has been used in such high profile releases as the Darius Remix album and Omega Five soundtrack disc.

About the Yamaha OPM

The OPM, or Yamaha 2151, is a four-operator FM chip which was popular in the 1980s and early '90s. American and European videogame fans will most likely be familiar with the Sega Genesis (Megadrive), whose sound chip is a slight variation on the OPM (the OPN). The chip has also been used in countless arcade games including Paperboy, Outrun, Metal Slugs 1-5, and Street Fighter II. MIDI fanatics may remember the Yamaha OPM from entry-level Yamaha gear such as the FB-01 and DX100— the latter which was used with a talkbox for some of Zapp and Roger's hits.

Editing Patches

VOPM Layout

The OPM features four oscillators. As in other Yamaha synthesizers, these are referred to as operators. They are labeled C1, C2, M1, and M2, and each produce a sinewave output and feature an ADSR envelope. There are eight different ways in which the operators can be hooked together, which are referred to as connection algorithms and abbreviated "Con".

The output of each individual operator may be amplitude modulated by the LFO, which features four different waveforms. In addition, the pitch of every operator can be frequency modulated by the LFO. Operator M1 can also modulate itself, while operator C2 can produce pitched noise output instead of a sinewave. The synthesizer's features are discussed in more detail below.

Envelopes

Envelopes in VOPM are a variation on the ADSR (attack-decay-sustain-release) envelope. The volume of an operator will start at 0 and rise to the maximum volume (TL) in a time specified by the attack rate (AR). It will then decay to the sustain level (D1L) in a time specified by the first decay rate (D1R). As the note is sustained, it decays to 0 at the rate specified by the second decay rate (D2R). When the note is released, it immediately decays at the rate specified by the release rate (RR). The graph to the right of the algorithm display (EG) shows a graphical representation of the envelopes.

Detuning

Sometimes it is useful to detune the operators, either to add roughness to the sound or a chorusing effect. There are two kinds of detuning on the OPM: coarse (DT2) and fine (DT1). DT2 produces the most obvious effects, and will add either a rough tone or a gong-like tone to the sound when used as a modulator.

Fine detuning is more useful for carriers than coarse detuning is, and can also add a sharp and interesting texture when used with a modulator. This setting works in an unusual way on the OPM. The fine detune amount ranges

from 0 to 7. Values 1 through 3 cause the pitch to bend upwards, while values 5 through 7 cause the pitch to bend downwards. Values 0 and 4 are equivalent—they produce no change in pitch. Therefore, to achieve the maximum amount of fine detuning between two operators, set one to 3 (maximum positive value) and the other to 7 (maximum negative value).

Algorithms and Operator Masking

When editing patches, users can choose from 8 different connection algorithms. These are selected by clicking on the numbered buttons (0-7). The current algorithm is shown graphically in the space immediately above the buttons (con).

The graph describes the connection algorithm as follows: where operators modulate another's phase, an arrow is drawn from one operator (the modulator) to another (the carrier). Where operators mix (add), a (+) symbol is shown. The last operator, M1, is the only one with feedback, and this is shown by a feedback loop path labeled "FL". Finally, an arrow going to the right into blank space is shown to represent output. Operators may be turned on and off by using the operator mask found right underneath the "ProgNum" display.

LFOs

VOPM has a single LFO which can be used to modulate pitch, amplitude, or both. Users can choose between a saw, square, triangle, or noise waveform. The saw is a ramp-up when used for pitch modulation and a ramp down when used for amplitude modulation. Similarly, the triangle starts as a ramp up in phase modulation mode and starts as a ramp down in amplitude modulation mode.

The LFO runs at the rate specified by FRQ, and the maximum depths for pitch and amplitude modulation are set by PMS and AMS respectively. Amplitude modulation may be enabled or disabled for each operator by setting the AMS Enabled parameter (AMS-En), found immediately below the operator mask (OpMsk). The current depth of the amplitude or pitch modulation may be set either as part of the patch (AMD or PMD), or set via a MIDI CC message. The coarse amplitude modulation level is set by sending CC #1 or #12 and the fine amplitude modulation level is set with CC #33 or #44. Similarly, the coarse pitch modulation level is set by sending CC #2 or #13, and the fine pitch modulation level is set by sending CC #34 or #45.

An LFO delay may also be set by sending MIDI CC #78. When this delay is set, the LFO will not kick in for a period of time after the note-on event. This is useful for writing leads in a tracker or step sequencer without manually entering CC data for each note's AMD or PMD.

Key-Rate Scaling

To simulate the behavior of a musical instrument, it is sometimes useful to have the envelopes speed up as the pitch played is higher. For example, string

instruments decay more quickly the higher the note played. In VOPM, this is done by setting an operator's Key Scaling (KS) amount.

Noise Generation

VOPM, in addition to being able to generate noise with high feedback levels, also has a noise generator. If "Noise" is enabled, operator C2 will generate noise instead of a sinewave. The frequency of the noise generated can be set with the NFRQ slider found immediately beneath the "Noise" button.

Hex view

One feature of VOPM is that the parameters can be displayed in hex rather than decimal (the default). This is changed by clicking on the "dec" button directly under the Import/Export buttons.

Parameter Glossary

AMS	Amplitude Modulation Sensitivity
AR	Attack Rate
C1/C2	Carrier 1, Carrier 2
D1L	Decay Level 1
D1R/D2R	Decay Rate 1/Decay Rate 2
DT1	Fine Detuning
DT2	Coarse Detuning
FL	Feedback Level
FRQ	LFO Frequency
KS	Key Scaling
M1/M2	Modulator 1, Modulator 2
MUL	Multiplier
NFRQ	Noise Frequency
OP	Operator
PMS	Pitch Modulation Sensitivity
RR	Release Rate
TL	Total Level (operator level)

Other MIDI CCs

Monophonic Mode and Portamento

VOPM defaults to polyphonic mode, but can be switched to act as a monophonic instrument. This is done sending MIDI CC #126. The instrument can be set back to polyphonic mode by sending CC #127. During monophonic operation, when two notes overlap, the first note glides to the frequency of the second note at the portamento rate. The portamento rate is set with CC #5. Note that if both notes are not held, one note will replace the other with no portamento.

Portamento can also be used in polyphonic mode. To turn portamento on, send MIDI CC #65 with a value of 64 or greater. In this mode, every note will glide into the next. This only needs to be set in polyphonic mode. The portamento starting note may also be controlled with MIDI CC #84.

A related feature is pitch bending. This is done by sending a pitch wheel signal to VOPM. VOPM defaults to a ± 2 semitones pitch bend range, but this can be set by sending the standard RPN pitch range change. That is done like this: First, send MIDI CC #100 and #101 with a value of 0. This selects the "pitch bend" command. Then, send the "set data (hi)" CC #6 with values in the range from 0 to 96.

OPM Clock

The OPM clock speed may also be set. It defaults to a rate of 3.58MHz, but can be set to 3.57 or 4MHz. This is done via NRPN commands: First, send MIDI CC #98 and #99 with a value of 0. Then, the range of MIDI CC #6 from 0-63 selects 3.58Mhz, 64-111 selects 3.57MHz, and values 112 and greater select a 4MHz clock. Setting the clock speed affects the envelope rates

Output Volume

If VOPM is too quiet, the output volume can be changed with NRPN #1. Be careful with this setting: it bitshifts the output (each value is double the amplitude of the previous one), and only a value of 0 or 1 yields generally unclipped results. Playing with this setting can lead to extremely loud volumes and clipping easily. To set the output volume, first send MIDI CC #98 with a value of 1 and #99 with a value of 0. CC #6 will then set the output volume.

Lowpass Filter

Finally, OPM also has a lowpass filter, which defaults to 'on'. This is set with NRPN #2. Do this by sending MIDI CC #98 with a value of 2 and #99 with a value of 0. Then, CC #6 will turn the filter off with values from 0-63, and on with values from 64-127.

Full CC list

The following is a list of CCs that VOPM will respond to:

Hex	Dec	Operation
\$1	1	AM LFO Depth (hi)
\$2	2	Freq. LFO Depth (hi)
\$3	3	LFO Rate (hi)
\$5	5	Portamento Time
\$6	6	Set Data (hi)
\$7	7	Volume
\$A	10	Panning
\$C	12	AM LFO Depth (hi)
\$D	13	Freq. LFO Depth (hi)
\$10	16	TL0 Volume (hi)
\$11	17	TL1 Volume (hi)
\$12	18	TL2 Volume (hi)
\$13	19	TL3 Volume (hi)
\$21	33	AM LFO Depth (lo)
\$22	34	Freq. LFO Depth (lo)
\$23	35	LFO Rate (lo)
\$2C	44	AM LFO Depth (lo)
\$2D	45	Freq. LFO Depth (lo)
\$30	48	TL0 Volume (lo)
\$31	49	TL1 Volume (lo)
\$32	50	TL2 Volume (lo)
\$33	51	TL3 Volume (lo)
\$41	65	Portamento on/off
\$4E	78	LFO Delay
\$54	84	Portamento Control
\$62	98	NRPN Data (lo)
\$63	99	NRPN Data (hi)
\$64	100	RPN Data (lo)
\$65	101	RPN Data (hi)
\$78	120	Force all off
\$7E	126	Monophonic mode
\$7F	127	Polyphonic mode

Importing and Exporting Patches

VOPM can import patches from MDX files, which is a format designed for the Sharp X68000 home computer. In order to import instruments, these files must be converted to the OPM format by using the MDXPG tool. VOPM will also export patches in the OPM format.