SDS_VCO
ALTERNATE FIRMWARE:
DELAY/FX/DISTORTION
USER'S GUIDE

Foreword:

This firmware will convert your SDS_VCO into an audio processing module that you may find useful. It offers a lot of functionality that emulates several expensive modules but in a unique and compact way. The modules resources are limited, so don't expect 24 bit audio quality or a stereo signal to spring forth! The sample rate is near CD quality, but DC input and 12 bit resolution isn't what we're accustomed to. I think you will enjoy this firmware though as it can modify audio (from VCO pre or post envelope) and offer more timbral variety in a tight skiff. Have fun!   s*

I.   Inputs & Outputs

With this Firmware alternate, the MOD jack in audio input always. The OUT jack is audio output always. Some Modes (selected with WAV knob) use the T/G input, and others don't. The CV input is mostly sample rate control and is mostly associated with the DECAY knob as an offset.

II.   The 16 Modes

The Modes are selected simply by turning the WAV knob. The LED's will indicate in the same way they do with the original firmware. "Zero" is always all LED's off, and the +8 LED adds 8.
The Modes are divided into two halves:
0 to 7:   Non-Distortion FX & Delays
8 to 15: Distortion FX

[0]   LoFi 3 Tap Delay
This is an 8 bit delay that uses the top 3 knobs as taps across the delay. There is no feedback so is purely a 1-Shot, but can be multed back from a variable level control to feedback. The primary use for this is to create a stereo signal from a mono signal.
The CV Input varies the sample rate: 0V fastest through to 5V slowest.
The T/G input, if used, cuts audio when low

[1]   Phase Shift
This is a simple phase separator/inverter with Rate control and CV offset for both Shift and Rate.
The ATK knob controls the phase, getter tighter as turned CW, while the DCY knob sets the rate.
The Release knob does nothing at this time, but may in future revisions
The T/G input, if used, cuts audio when low

[2]   Freeze Gate
This is a fun mode that will freeze any audio that is playing through the module on a Gate input. It will hold for as long as the Gate input remains high.
The ATK knob sets the buffer size, which partially controls the Freeze Loop speed without rate change.
The DCY knob sets the Sample Rate. This is offset upwards via CV input so "notes" can be played.
The REL knob adjusts the Level of mix of the incoming audio. Turned down, only freezes are heard.
The T/G input must be plugged in or will remain "Frozen" on the buffer. (Internally pulled high)

[3]   Karplus Strong Delay
Of the 3 delays, this one may be the more popular. The quality is really good and there's a variable buffer size that can be changed over a large range without affecting the Rate Offset.
The ATK knob sets the Buffer size, tighter is CW
The DCY knob sets the sample rate. CW is faster. CV input offsets this knob (at 1V/Oct)
The REL knob set the Karplus Feedback. Turning CW increases.
The T/G input resets the Play Buffer so may have affect on slower sample rates

[4]   Pitch Doubler
This mode is a fixed pitch doubler but with a variable buffer size and rate shift. As the same rate is used for sampling and output, the two lock together but can vary with changing CV input as a rate offset.
The ATK knob sets the Buffer size, tighter is CW
The DCY knob sets the sample rate. CW is faster. CV input offsets this knob (relatively)
The REL knob and T/G input do nothing at this time.

[5]   Tremolo -Clock Synced
This soft tremolo varies the level of the audio as it passes through the module. The variation is an internal sine LFO (real VCA) that can be synced to a clock in singles, doubles, triples, skips, etc.
The ATK knob sets the speed of the tremolo
The DCY knob sets depth of the tremolo
The REL knob turns off sync (full CCW) and CW sets the phase angle/steepness of the clock lock.
The T/G input is for clock or trigger/gate input for sync locking and/or sync variation.

[6]   HiFi Delay
This is a standard Delay but with a very long echo decay time, even at high sample rates, allowing new sounds to be carefully added to a thick soundscape. Sample Rate can be slowed significantly also.
The ATK knob sets the Buffer size, tighter is CW
The DCY knob sets the sample rate. CW is faster. CV input offsets this knob
The REL knob sets the Feedback. Turning CW increases up to 99.99%
The T/G input resets Play Buffer so will momentarily shift delay

[7]   Compressor/Expander
This mode is primarily for bringing up signals that are low without overdriving or distortion. When used with vocals it produces a pleasing "up front" phat effect, while with percussion can bring up lesser sounds into a brick wall/wall of sound. The increase in gain (make-up gain) is automatic.
The ATK knob sets the post compression / pre-limiter gain limit
The DCY knob sets the compression Ratio CCW→CW: 1:1, 2:1, 4:1, 8:1, 16:1
The REL knob sets the Threshold edge for compression. Fully CCW is off.
The CV input does nothing at this time.
The T/G input, if used, cuts audio when low

[8]   Bit Crusher
This mode is as it suggests, a bit crusher, but with a thrown in sample rate variation with CV offset and an auto leveler follower so isn't constant noise in coarser settings
The ATK knob sets the bit width from 10 bits down to 1
The DCY knob sets the sample rate to further crush the audio. CV input offsets this knob.
The REL knob set level. In coming audio will add to this setting so is a "level floor"
The T/G input, if used, cuts audio when low

[9]   Stutter
This mode is similar to the phase shift (#1) except the Release knob XOR's data over the sample's address causing subtle jumps in the waveform that are enough to enhance it.
The ATK knob sets the Phase towards original signal
The DCY knob sets the sample rate. CW is faster. CV input offsets this knob
The REL knob sets the XOR data (Turn this slowly to select a sound)
The T/G input, if used, cuts audio when low

[10]   Cube Distortion
This is the most "gainy" distortion. It is the input cubed. Please note this mode isn't so fine with square waves as 1*1*1 = 1 and 0*x*x = 0 but it can be interesting on the slew point.
The ATK knob does nothing at this time
The DCY knob sets the sample rate. CW is faster. CV input offsets this knob
The REL knob sets floor level to "quieten" low levels
The T/G input, if used, cuts audio when low

[11]   Wave Folder

This mode is Multi Function. These functions can be selected via the REL Knob and are in pairs:
Half wave and full wave. They are identical except Half wave leaves original on bottom of wave.
* T/G input Cuts output audio on low state on all 8 Wave Folder functions.
When the Decay knob is moved, the corresponding LED will flash a few times indicating 1-8

REL KNOB	Desc.
1-FOLD HALF WAVE	Folds the input waveform at a set level on one or both sides: ATK does nothing
2-FOLD FULL WAVE	DCY knob sets fold point level CV input does nothing.
3-FOLD REGION HALF	Folds the input waveform only when within "window" set by ATK and DCY : ATK knob sets upper limit of fold region. If less than DCY then no fold occurs
4-FOLD REGION FULL	DCY knob sets lower limit of fold region CV input does nothing.
5-FOLD VECTOR HALF	Vector re-assigns the incoming waveform's time/level factor (X/Y) ATK knob draws vector: turn fully left first, then right to draw vector
6-FOLD VECTOR FULL	DCY knob does nothing at this time (see more below) CV input does nothing.
7-SQUARE FILL HALF	"Fill" fills the waveform to zero in a similar way to a ring modulation. ATK knob sets the frequency of the square wave (mostly high freqeuncy)
8-SQUARE FILL FULL	DCY knob sets the "grunge" level. (Great for percussion) CV input offsets both the square wave frequency and the sample rate *Input Level has VCA follower to cancel chatter during silence.

"Vector Mode" can be best explained with an X/Y graph where X is the input waveform and Y is the
pattern drawn by you. Drawing makes a "map" for the input waveform to follow. A 3rd dimension, time,
has the frequency of this new waveform presented at the output. The input waveform's amplitude will
drastically alter the timbre and harmonics of the output which makes it ideal for VCO post envelope use.

[12]   Hi-Pass Distortion

This mode is a brick wall high-pass that places a level of distortion on only the higher frequencies. This
is great for spicing up audio percussion as a mix, or spiking a VCO saw/square waveform.
The ATK knob sets the filter frequency (CCW lowest)
The DCY knob sets the distortion amount
The REL knob sets floor level to "quieten" low levels
The T/G input cuts audio when low, CV input does nothing in this mode

[13]   Sub Follower

This bizarre yet subtle mode follows input frequencies and tries to lock a VLF oscillation to it producing
a complexity of bass/sub mix with rate distortion. It operates like a PLL in many ways.
The ATK knob controls the XOR distortion level
The DCY knob does nothing.
The REL knob sets sub locking ability
The T/G input cuts audio when low, CV input does nothing in this mode

[14]   Phase*N Distortion

This Mode uses a multiple of phase accumulations in a buffer to get a final result. The DCY knob
controls the sample rate and is offset @ 1V/Oct by CV in. Keep in mind at lower rates there will be a
substantial delay as the phases are all added together.
The ATK knob sets the spacing in buffer between phase samples (Touchy at low end)
The DCY knob sets the sample rate that can be offset by the CV input @ 1V/Oct
The REL knob sets the number of phase samples taken. "N" is +1 to +8 phase iterations,
The T/G input, if used, cuts audio when low

[15]   FM LFO

This Mode FM's the incoming audio with an internal LFO. The gain of this LFO's affect is offset by the
CV in. The buffer is fairly tight but the REL knob will vary the delay somewhat for stereo FX.
The ATK knob sets the frequency of the LFO up to about 30 Hz
The DCY knob sets the intensity of the FM and is additively offset by CV in (if used)
The REL knob sets the record/play head spacing for delay FX
The T/G input, if used, cuts audio when low

Enjoy!! SDS*   March 30 2018