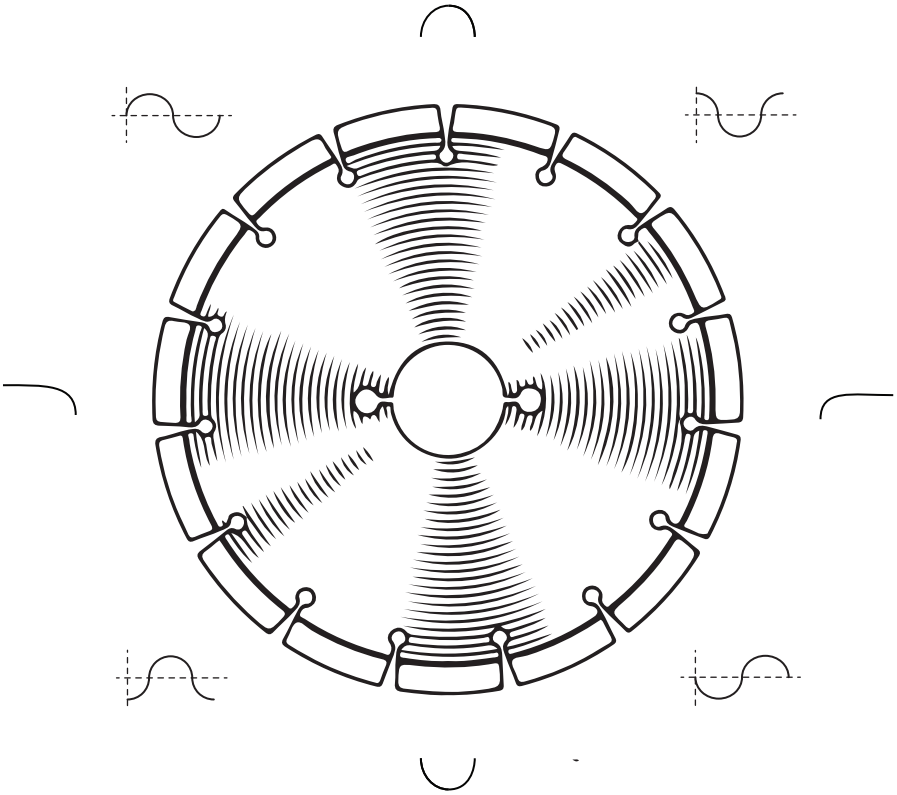
SCHLAPPI ENGINEERING

ANGLE GRINDER



MANUAL

SPECIFICATIONS

SCHLAPPI ENGINEERING

•Quadrature Sine Wave VCO / State Variable Filter

-with four phase related outputs: 0°, 90°, 180°, 270°

-or filter response outputs: LOW PASS, BAND PASS, HIGH PASS, INVERTED BAND PASS

•HIGH range from 10Hz to over 20kHz

•LOW range from 0.3Hz to over 600Hz

•Sine wave outputs are 5Vpp (+-2.5V)

•Grind section is a voltage controlled waveshaping section

-or pole mixing nonlinear feedback network

-GRIND and filter outputs are not limited and can hit 22Vpp (+-11V)

•Tracks 4+ octaves of volts per octave at the V/OCT input

•FM1 is selectable linear or exponential FM via jumper on back

•FM2 is additional exponential V/OCT jack

•Grind section is a voltage controlled waveshaping section

-or pole mixing nonlinear feedback network

-GRIND CV inputs are unipolar 0 - 5V with bias from sliders

•The INJECT jack can be used as a second input for either audio or CV, bypassing GRIND

•All analog OTA based design

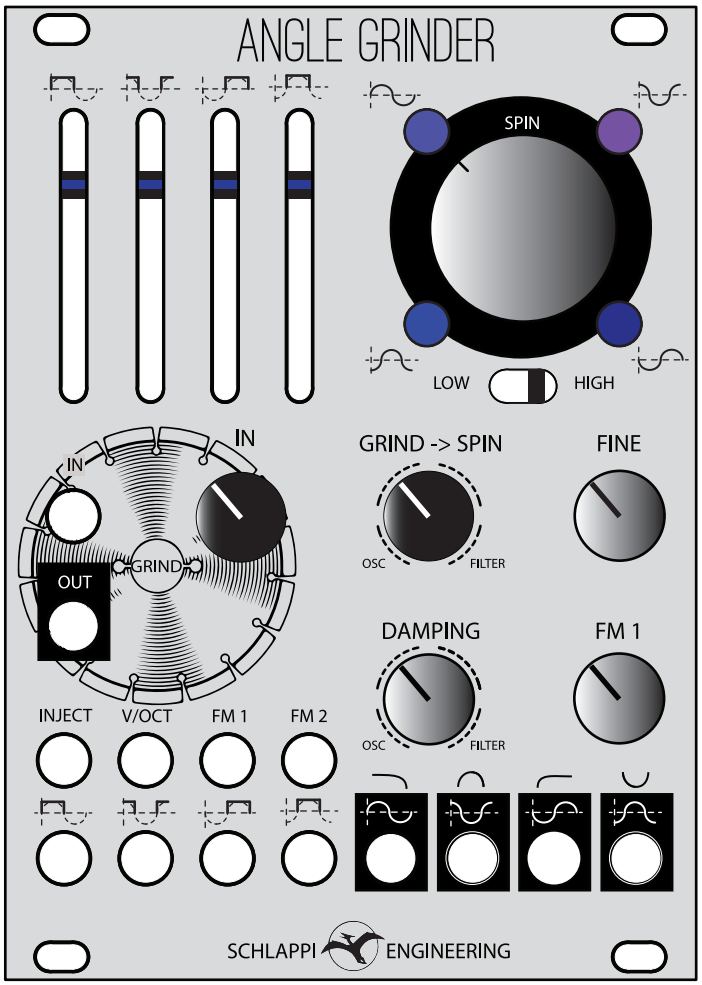
•18 HP

•Power requirements :+12V 81mA, -12V 78mA

Please address questions or issues to: eric@schlappiengineering.com

PANEL CONTROLS

Angle Grinder is a quadrature sine wave oscillator, filter, and waveshaping effect.
The SPIN section is a quadrature sine wave oscillator.
The GRIND section compares each phase against input signal, then subtracts the result from the input signal.
If the spin section is either damped enough or enough signal is fed into it from the grind section
then it will stop oscillating and become a state variable filter (of sorts).
Lorem ipsum



GRIND SLIDERS
Mixes the amount of signal to grind from the associated SPIN output
Feedback playground

IN
Insert audio or cv here

OUT
Output from GRIND

INJECT
Direct input to SPIN
AC coupled on header
for soft sync-like effect

V/OCT
Volts per octave cv control over SPIN

FM 2
Exponential CV control over SPIN

GRIND CV
CV control added to associated GRIND SLIDER

SPIN
Coarse tuning control

RANGE SWITCH
LOW 0.1 Hz to 500Hz
HIGH 10 HZ to over 20kHz

GRIND -> SPIN
Feeds the output of GRIND into SPIN (filter/osc)

FINE
Fine tuning control

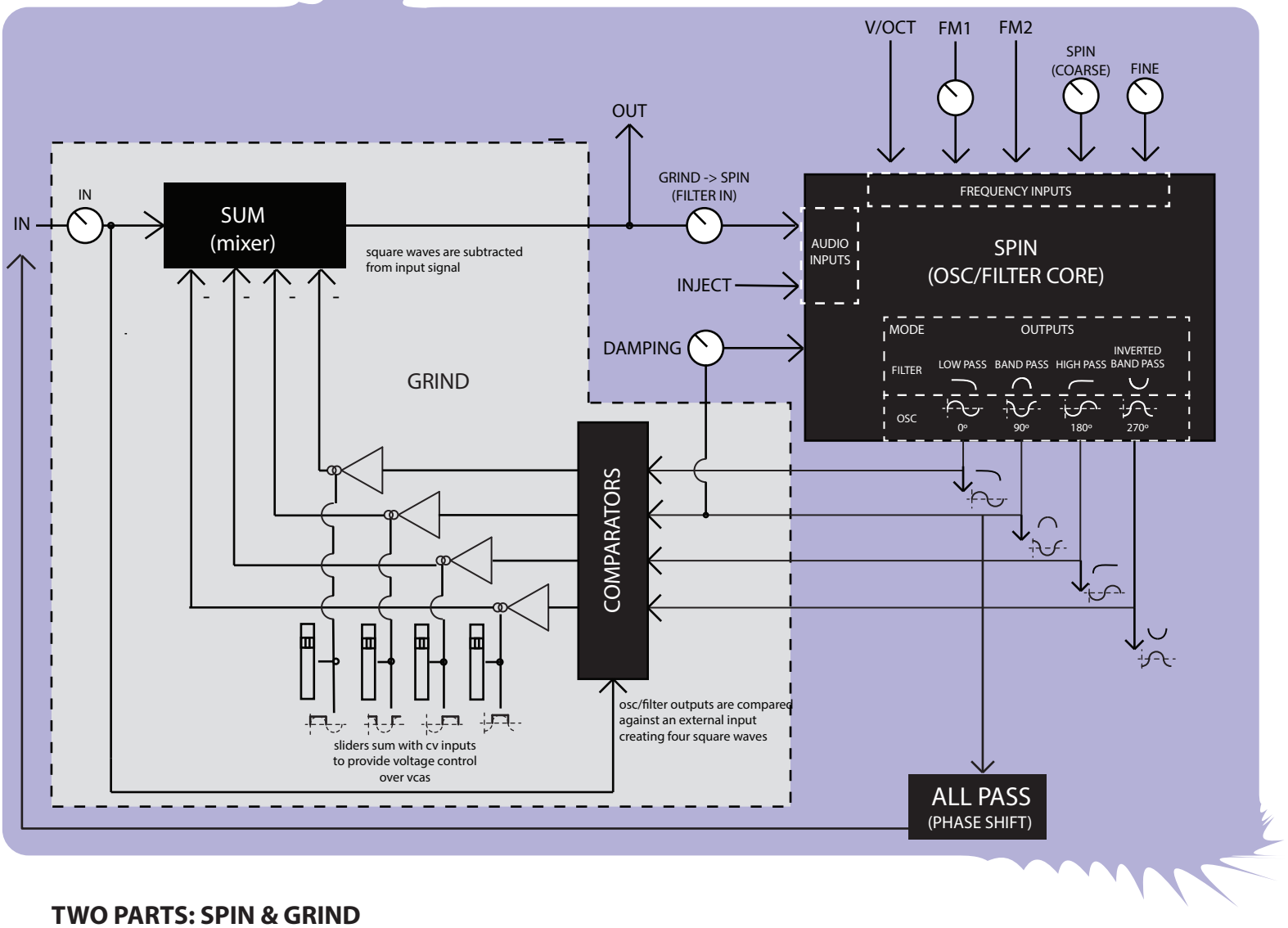
DAMPING
Counteracts oscillations

FM 1
CV attenuator
switchable betwean linear and exp by header on rear

SPIN OUTPUTS
Four phase related outpus
0°, 90°, 180°, and 270° if oscillating
LOW PASS, BAND PASS, HIGH PASS, and INV BAND PASS if filtering

*FM1 is normalled to GRIND OUT for easy noise making
but you will want it turned down for tracking pitch if there
is no cable plugged into it

HOW IT WORKS



TWO PARTS: SPIN & GRIND

SPIN

This is a quadrature sine wave oscillator. That means it is as oscillator that outputs four sine waves ninety degrees out of phase with each other as shown:

Internally the circuit is very similar to a state variable filter except there is an always-on positive feedback path optimised for clean oscillation. We can cancel the positive feedback with a negative feedback path (this is what the DAMPING knob does) and stop it from oscillating.

When enough of the grind signal is fed into the SPIN section it overwhelms the oscillations and starts to filter (it will do both at the same time sometimes.) The SPIN outputs then become the familiar LOW PASS, BAND PASS, HIGH PASS, and an INVERTED BAND PASS.

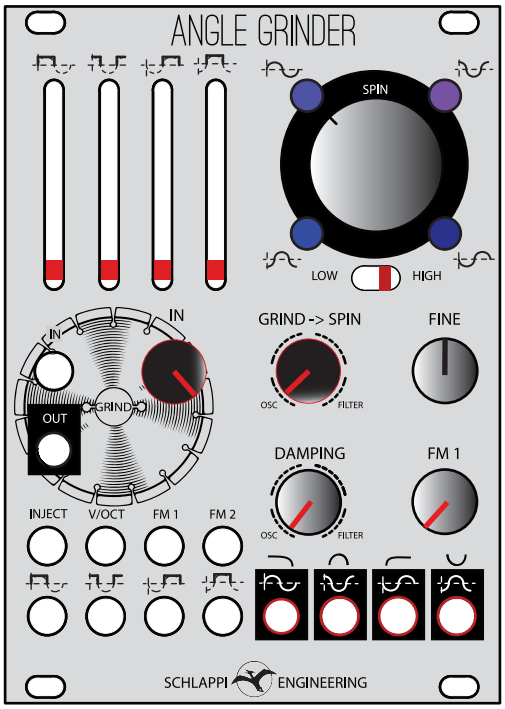
GRIND

This section consists of four comparators, four vcas, and a mixer. Each SPIN output is compared against the input and depending on which one is higher in value a square wave is created. These square waves are fed into the VCAs and their amplitude is controlled by a sum of the GRIND CV INPUTS and the GRIND SLIDERS. These signals are then subtracted from the input signal creating waveforms like these:

As the GRIND -> SPIN knob is turned clockwise these forms paths will transform into voltage controlled nonlinear feedback paths and by mixing them together unpredictable shapes are formed.

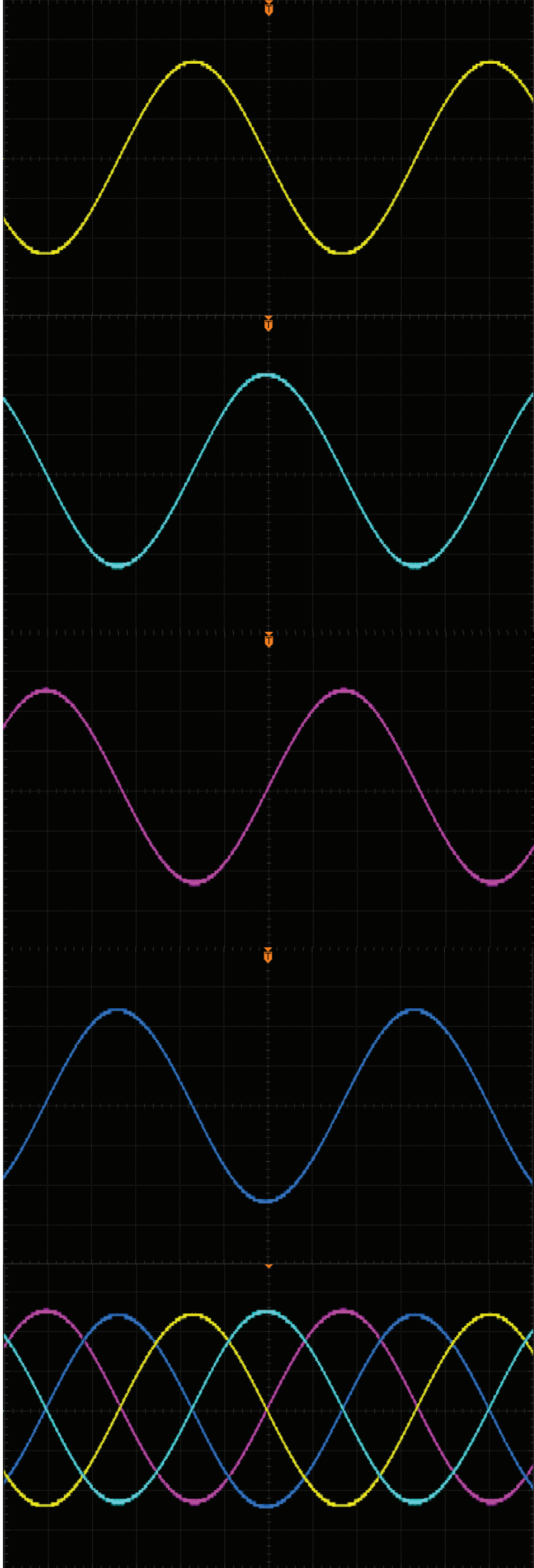
SPIN

-With GRIND->SPIN and DAMPING fully CCW the four SPIN outputs will have phase-related sine waves
-These all come from the same oscillator and will be at the same frequency
-This will track v/oct (check that FM1 is down)
-At audio rate you can process them seperately to create stereo effects or mix them together
-At LFO rate you could use them for quad panning by sending one audio signal to four VCAs and control each vca with one phase



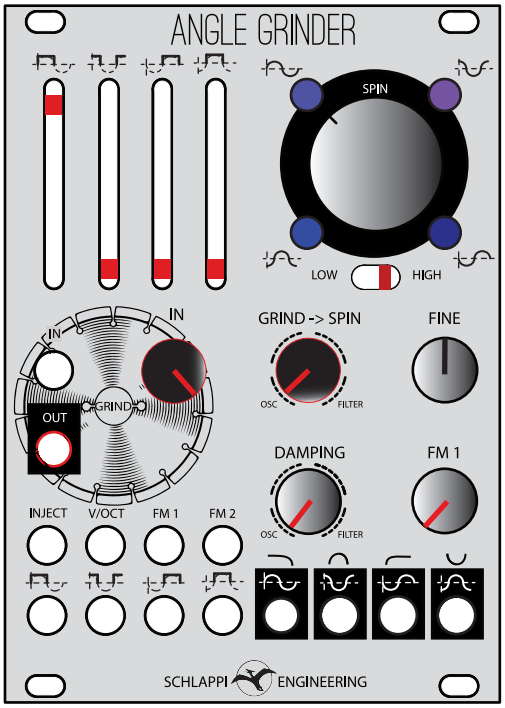
OSCILLATE
KNOB POSITIONS

IN	FULL CW
GRIND -> SPIN	FULL CCW
DAMPING	FULL CCW
FM 1	FULL CCW



GRIND - OSCILLATE

-With GRIND->SPIN and DAMPING fully CCW
-With nothing plugged into the input*
-Turn GRIND IN clockwise to feed the SPIN section into the GRIND section
-Try listening to the GRIND OUT and exploring the sliders one at a time
-The 90° output is normalled through an ALL PASS (phase shift) filter to the GRIND IN
-These oscilloscope traces were taken at 1kHz but the wave shapes will vary by frequency
-These traces are representative of the waveforms that you can find as the outputs are compared against and subtracted from the input

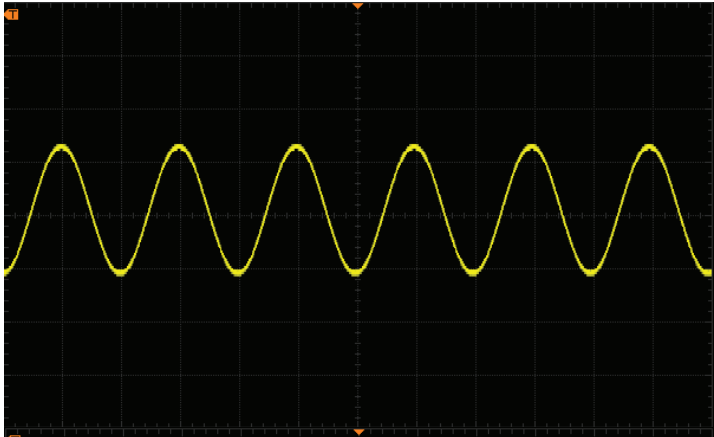


OSCILLATE
KNOB POSITIONS

IN	FULL CW
GRIND -> SPIN	FULL CCW
DAMPING	FULL CCW
FM 1	FULL CCW

*you must turn up the GRIND IN to get any signal out of the GRIND section

GRIND OUT
NO SLIDERS UP



GRIND OUT
ONLY FIRST SLIDER UP

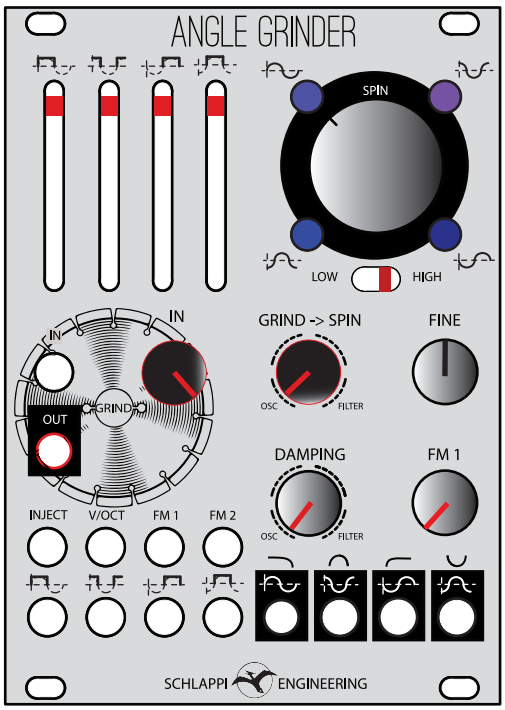
GRIND OUT
ONLY SECOND SLIDER UP

GRIND OUT
ONLY THIRD SLIDER UP

GRIND OUT
ONLY FOURTH SLIDER UP

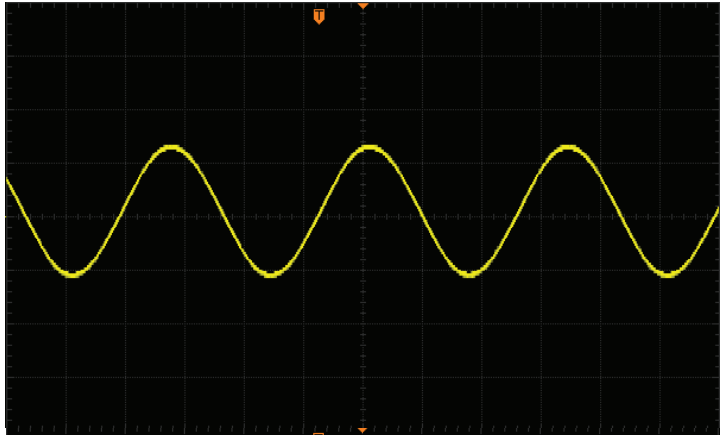
GRIND - OSCILLATE

-Same patch as previous page but raising more than one slider at a time
-Notice how the "one slider up" waveform is different than the one on the previous page?
-This is because these shots were taken at a different frequency
-As more sliders are brought up we converge on a pyramidal shape

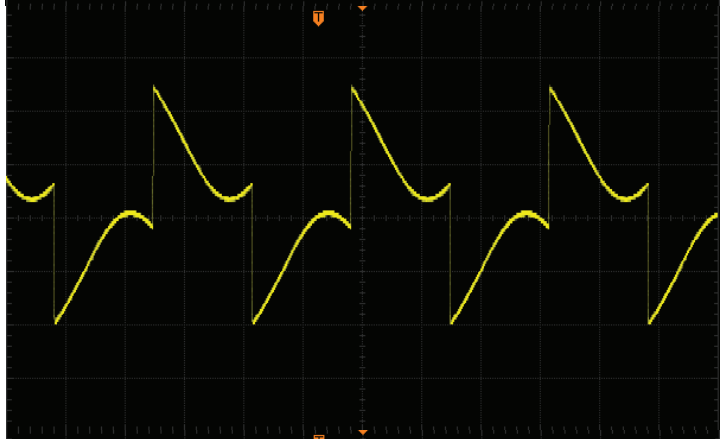


OSCILLATE
KNOB POSITIONS

IN	FULL CW
GRIND -> SPIN	FULL CCW
DAMPING	FULL CCW
FM 1	FULL CCW

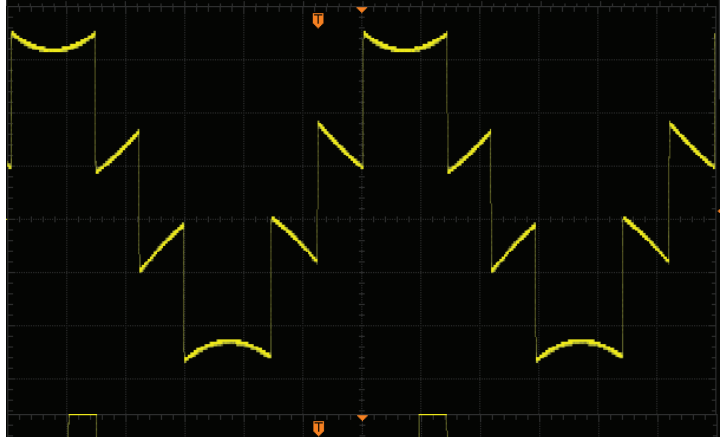


GRIND OUT
NO SLIDERS UP



GRIND OUT
ONLY FIRST SLIDER UP

GRIND OUT
FIRST TWO SLIDERS UP

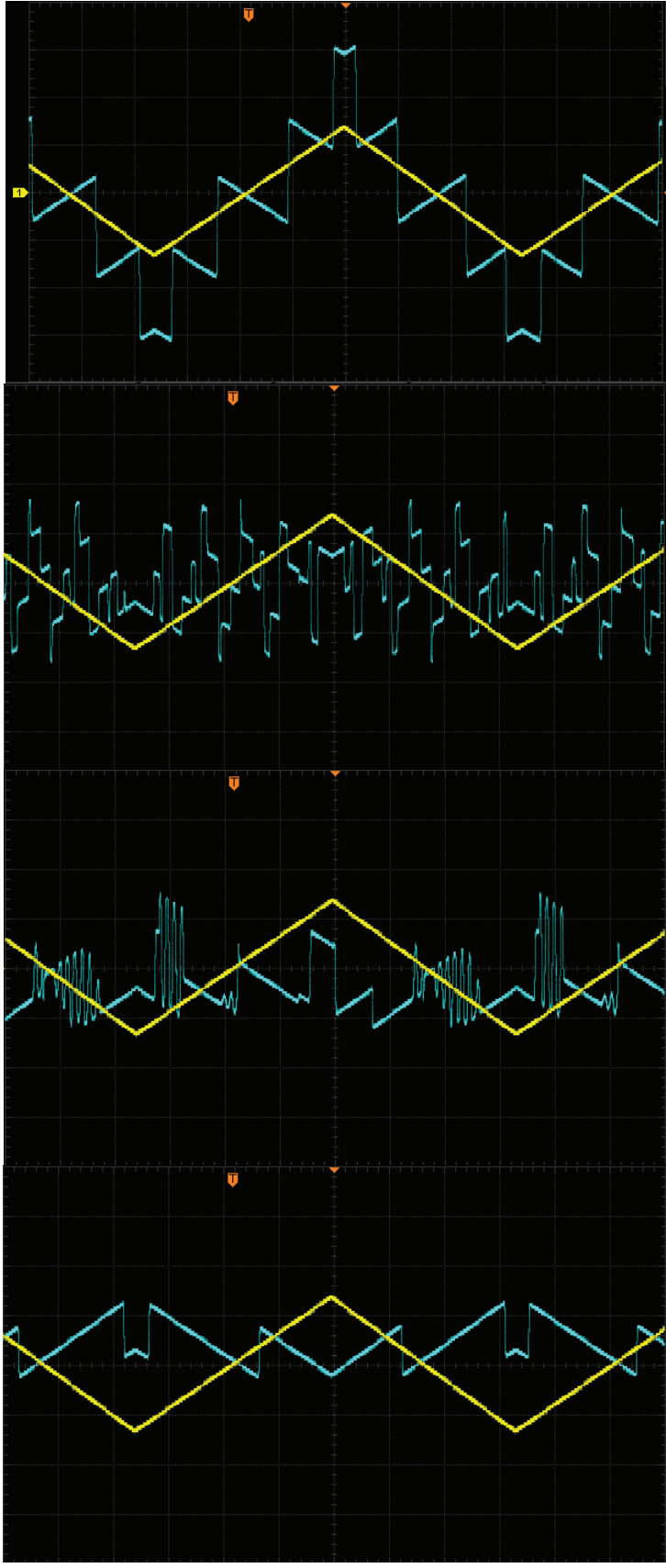


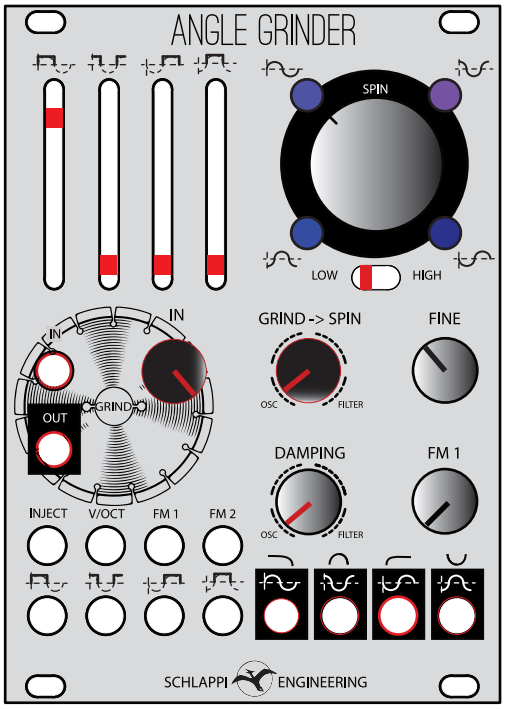
GRIND OUT
FIRST THREE SLIDERS UP

GRIND OUT
ALL FOUR SLIDERS UP

GRIND - EXTERNAL

-With the SPIN section oscillating in LFO mode plug in an external wave form and listen from the GRIND out
-The waveforms to the right show a triangle input in yellow and GRIND out in blue
-Each phase of the internal oscillator is compared against and subtracted from an external signal
-If the internal oscillator is at a low frequency the output with resemble a supersaw
-If the internal oscillator is at audio rate various metallic overtones can be created



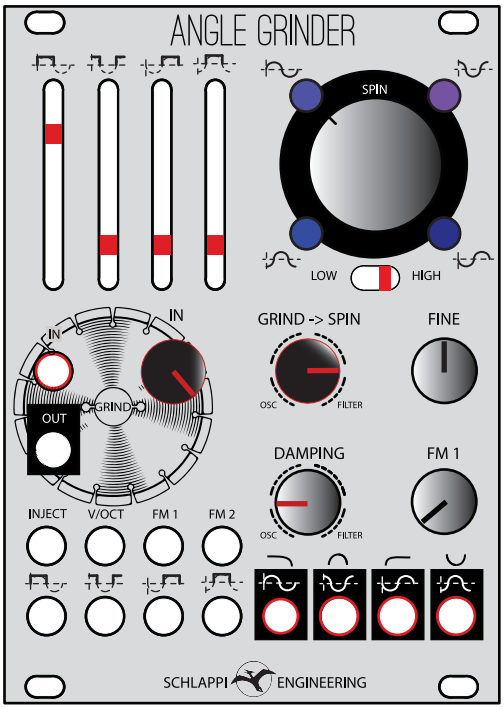


GRIND
KNOB POSITIONS

IN	FULL CW
GRIND -> SPIN	FULL CCW
DAMPING	FULL CCW

FILTER

-With a external signal in the INPUT
and the GRIND->SPIN knob turned CW
the external signal will disrupt the
oscillations
-The outputs will become
LOW PASS, BAND PASS, HIGH PASS,
and INV BAND PASS
-GRIND sliders are now voltage controlled
non-linear feedback paths
Experiment with all controls
-Four outputs responding to a triangle
input at various freuencies are shown to the right



FILTER
KNOB POSITIONS

IN	FULL CW
GRIND -> SPIN	75%
DAMPING	25%

INJECT

-The INJECT jack bypasses the GRIND section as a direct input to the oscillator/filter core
-It is header selectable to be DC or AC coupled on the read of the module
-AC is selected by default
-The AC mode is a high pass set to turn an incoming signal (square or saw preferably) into spikes to reset the oscillator
-This can act as a soft sync
-The top set of scope traces shows this:
YELLOW: input
BLUE: Grind out
PURPLE: Low pass out
BLUE: Band Pass out
-You can see spikes on the band pass on the each reset
-Bottom set of scope traces shows DC coupled with a very large input signal
-The input signal will add to any other signal present and can mix with or clip depending on amplitude