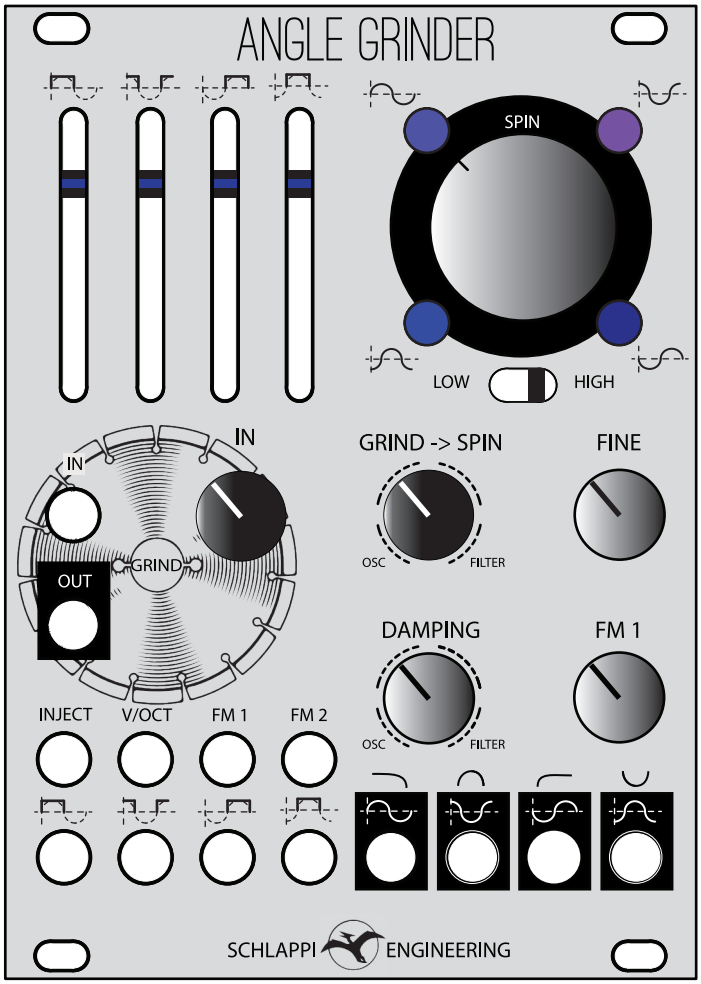
SCHLAPPI ENGINEERING

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).



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

IN
Insert audio or cv here
(Saw, sine, tri is best)

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 0.15 Hz to 200Hz
HIGH 15 HZ to over 18kHz

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

FINE
Fine tuning control

DAMPING
Counteracts oscillations

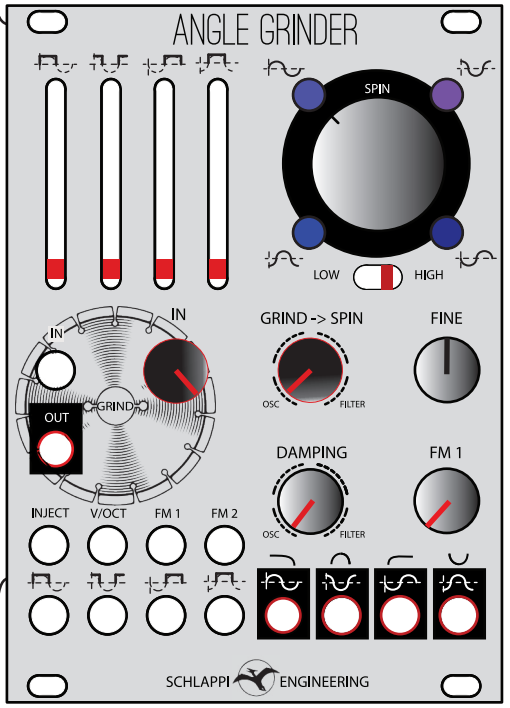
FM 1
Linear FM CV input
Grind out is normalized to this input, make sure it is down for V/OCT tracking

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

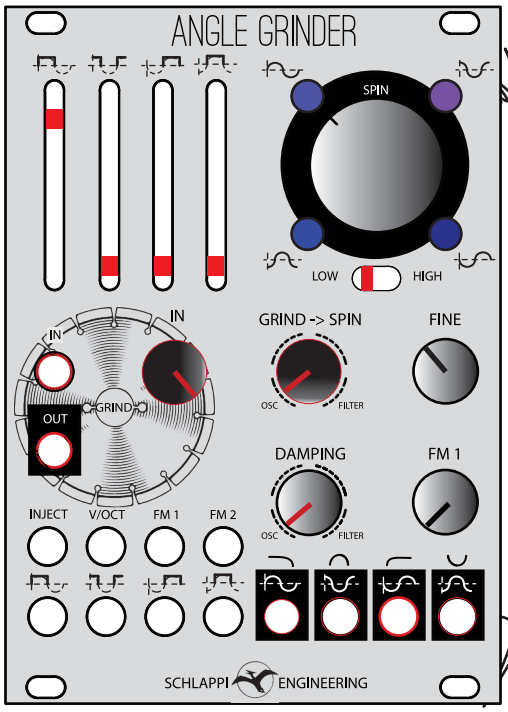
PATCHES TO START WITH

OSCILLATE

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



•No input. Listen to any of the SPIN outputs for pure sine waves 90° out of phase with each other.
•Listen to the GRIND OUT, turn up IN control
•Start with all GRIND SLIDERS down for a sine output
•Experiment with the GRIND SLIDERS and GRIND CV to add harmonics
•Control with V/OCT CV input
•Use RANGE SWITCH to change between LFO and VCO



GRIND

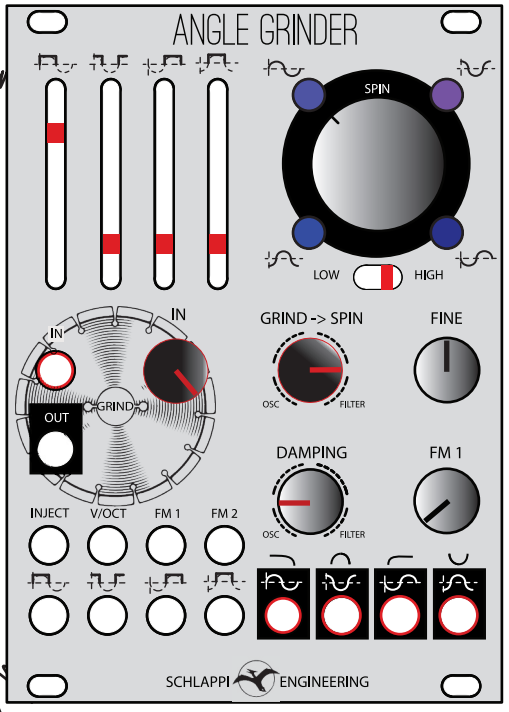
KNOB POSITIONS		
	IN	FULL CW
	GRIND -> SPIN	FULL CCW
	DAMPING	FULL CCW

Input triangle, sine or saw wave
start with RANGE SWITCH on LOW
Listen to the GRIND OUT
With all GRIND SLIDERS down GRIND OUT will be same as IN
Bringing up GRIND SLIDERS to introduce wave shaping
Change RANGE SWITCH to HIGH
Experiment with GRIND CV and SLIDERS to change timbre

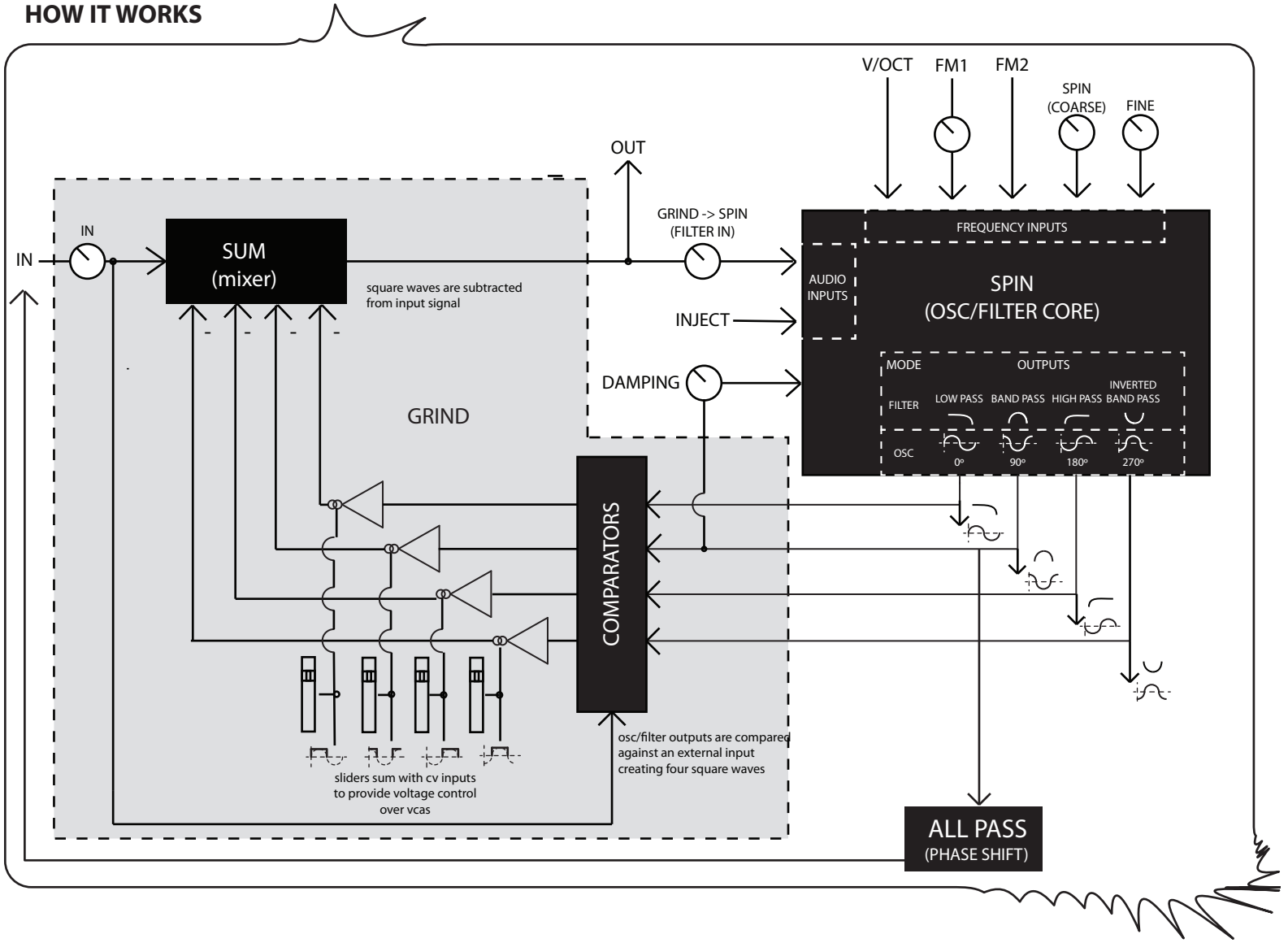
FILTER

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

Start with the above GRIND patch
Listen to the 0° output
Turn GRIND -> SPIN clockwise
The 0° output will become a LOW PASS output
Turn DAMPING clockwise to reduce resonance
SPIN controls filter cutoff frequency
Try other outputs: BAND PASS, HIGH PASS, INV BAND PASS
GRIND sliders are now voltage controlled non-linear feedback paths
Experiment with all controls



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 the always-on positive feedback path is 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 jagged saw-like waveforms.

The GRIND waveshaping will have no effect on a square wave! Use triangle, sine, saw for best effects.

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.