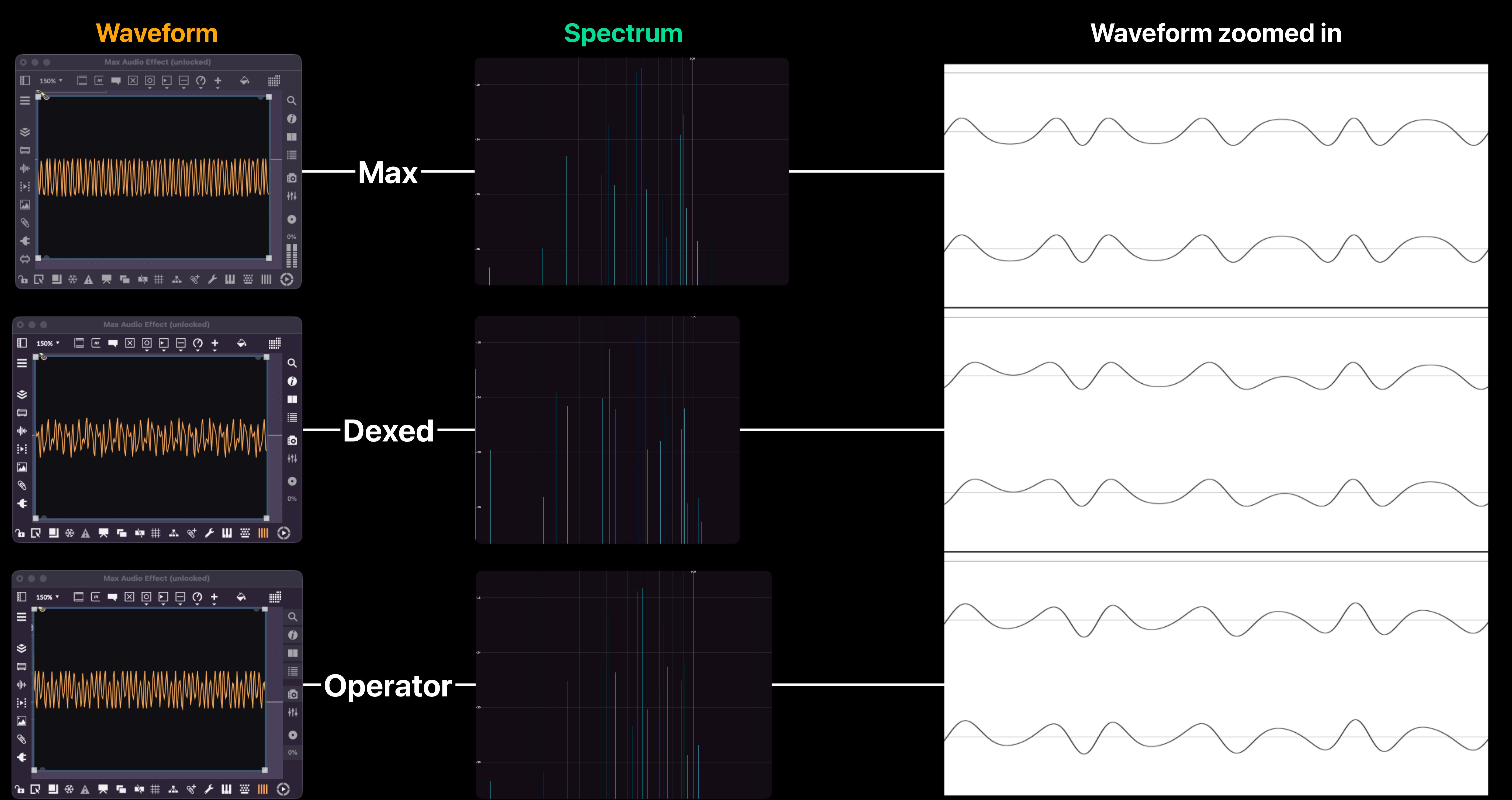


# FM Comparison - Fabian Dekker

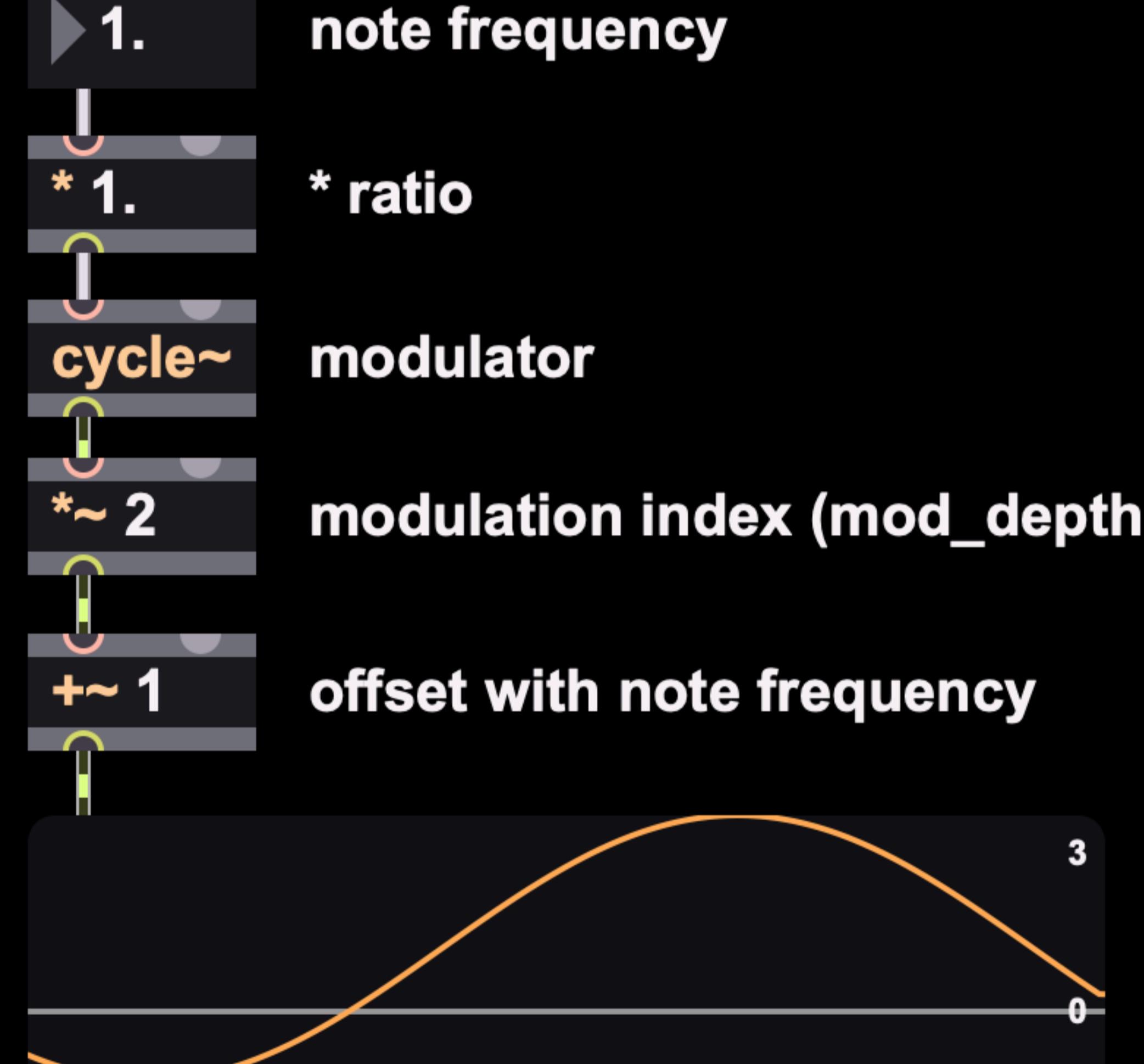
Phase matched as close as possible.  
This proofed difficult because both Dexed and Operator have built in filters to prevent Aliasing. These filters can't be turned off and introduce phase shift which is inaudible but changes the frequency spectrum and waveform. Especially at very low frequencies.



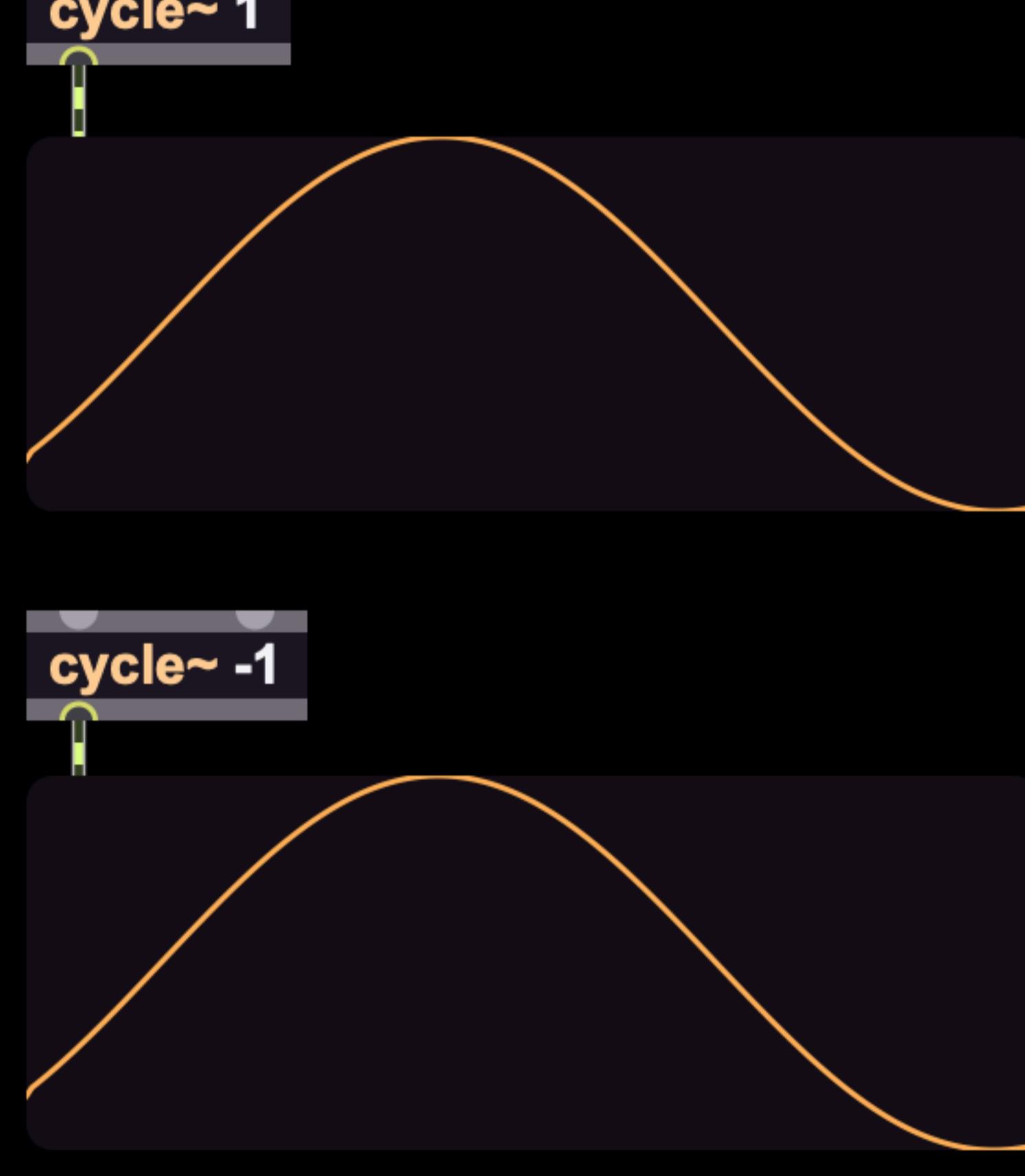
`carrier_frequency = note_frequency + ( modulator_signal * ( mod_depth * ( note_frequency * ratio ) ) )`

Because `note_frequency` is added to the `modulator_signal` as an offset, the resulting signal will have an asymmetrical output.

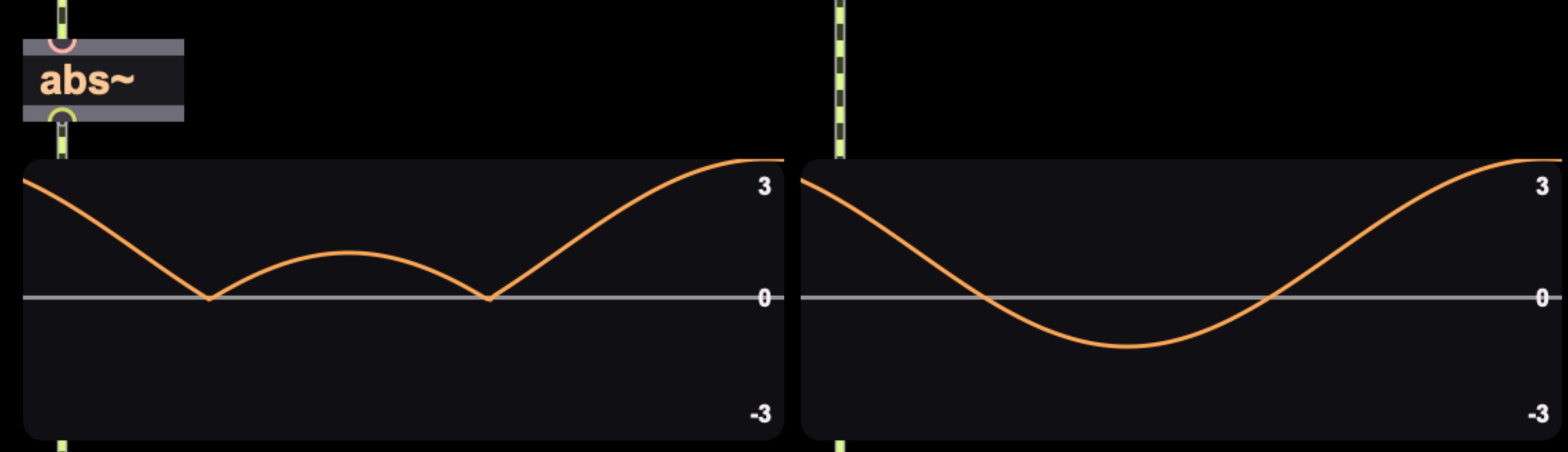
In the example below: `low = -1` and `high = 3`. This is needed because sound is logarithmic. (Otherwise the synth would produce non-harmonic overtones)



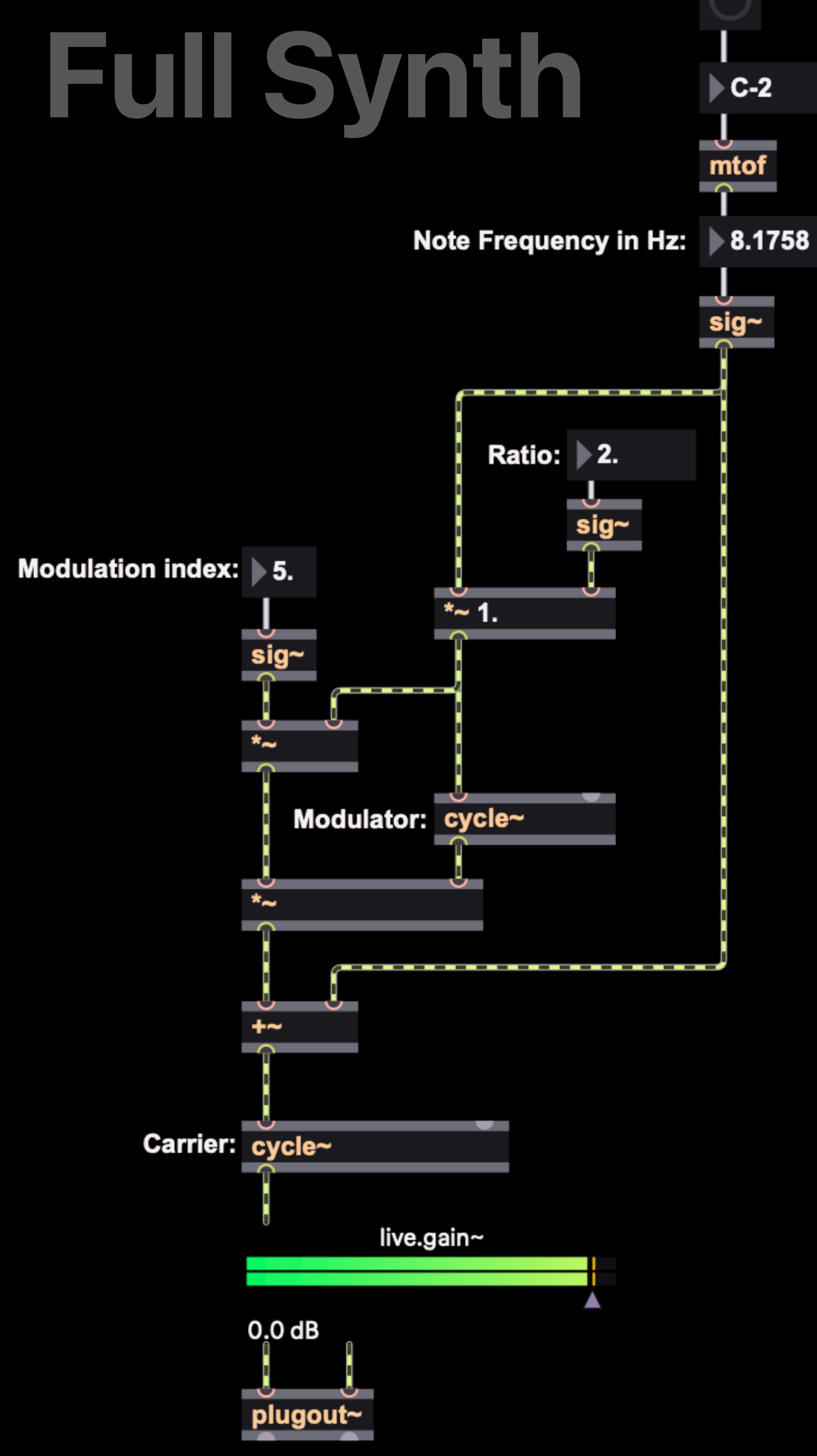
If `mod_depth > 1` `carrier_frequency` can have a negative value. This won't cause any issues because both a negative and positive frequency, when used as input for an oscillator, will output the same waveform.



It's important to note though that the `cycle~` object does not take the absolute value of the input frequency. Because this will lead to a different waveform.



## Full Synth



Negative values, when not static, seem to invert the phase of the sinewave. This might be weird Max specific behaviour. This example shows that negative values change the direction of the waveform.

