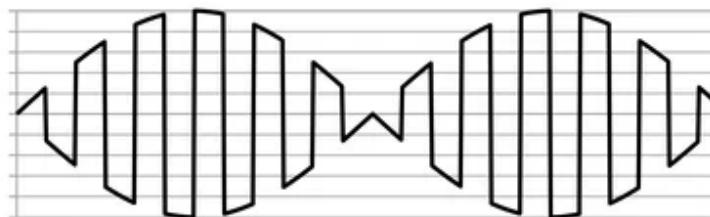
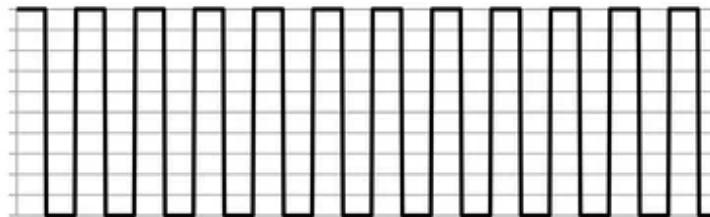
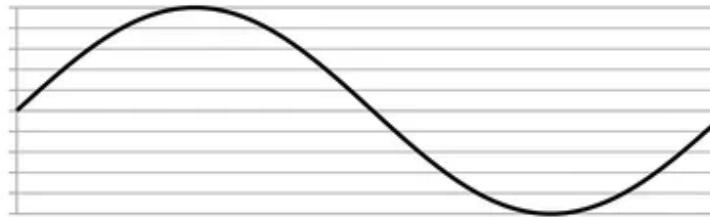


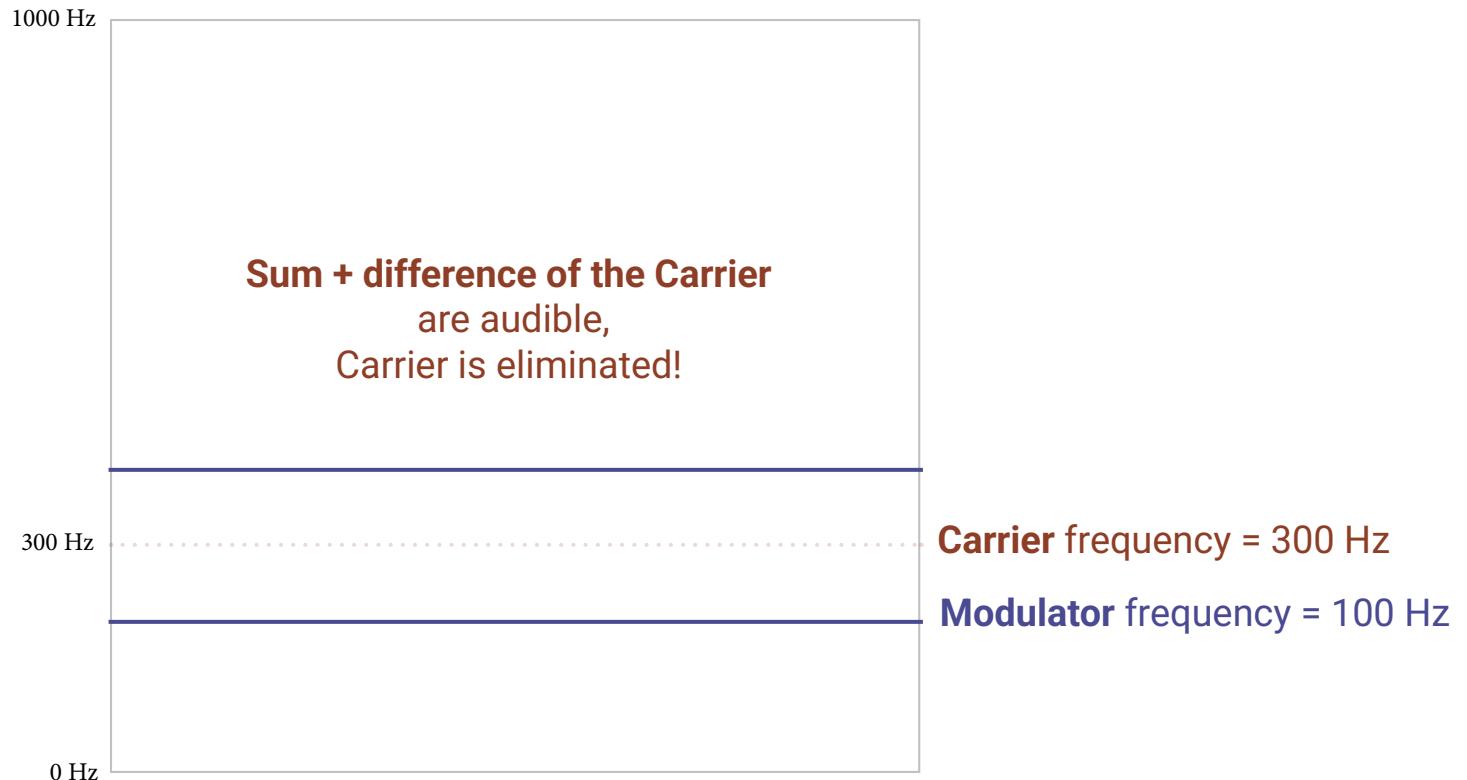
DIGITAL SOUND SYNTHESIS

05_B

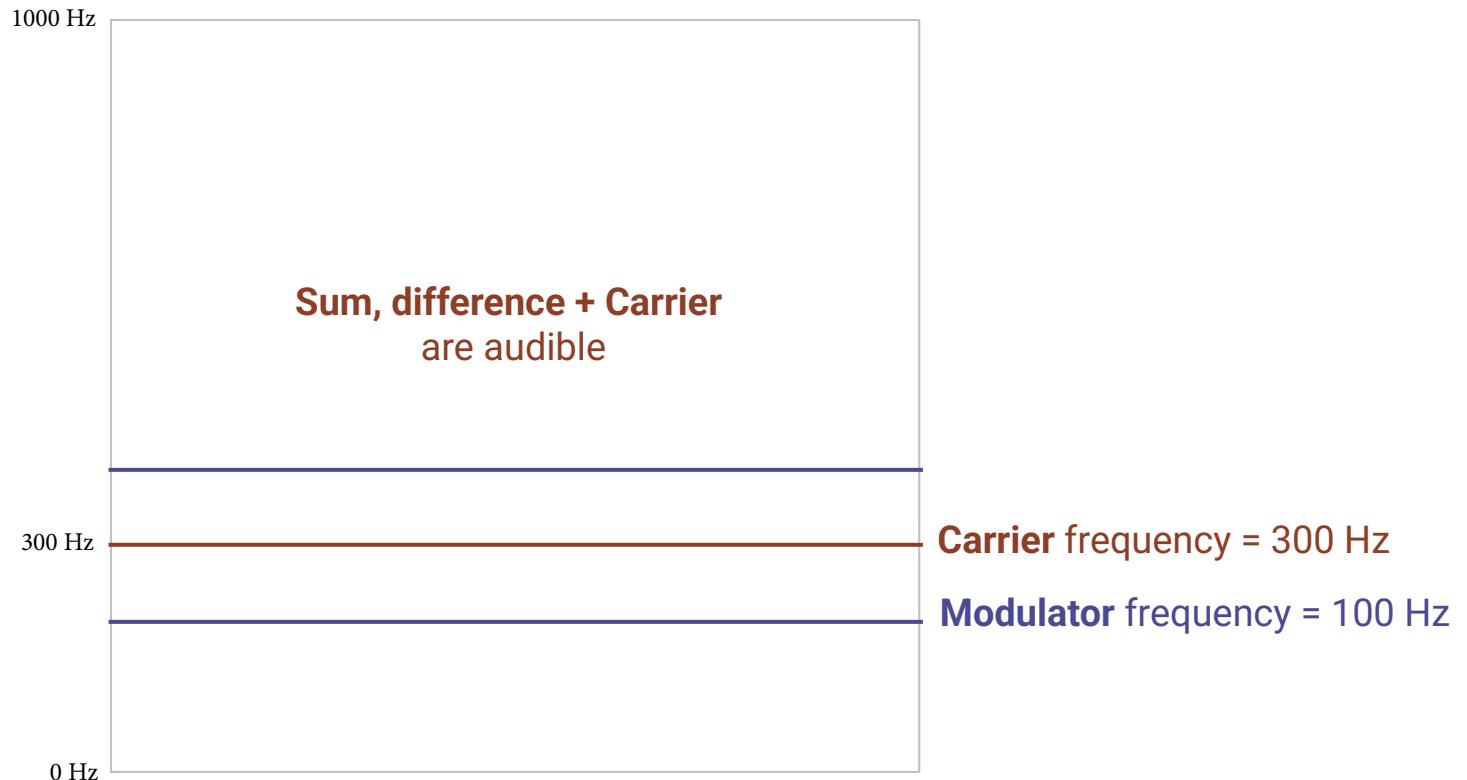


MODULATION EXTENDED

RING MODULATION



AMPLITUDE MODULATION



180.1 modulator frequency

osc~

r~ env_index

*~ 3000

138.5 carrier frequency

+~

osc~

r~ env_volume

*~

dac~

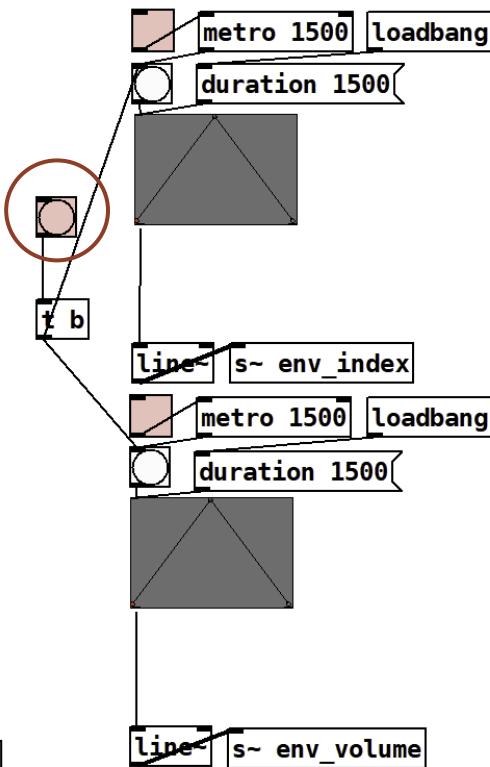
Loadbang

metro 100

metro 100

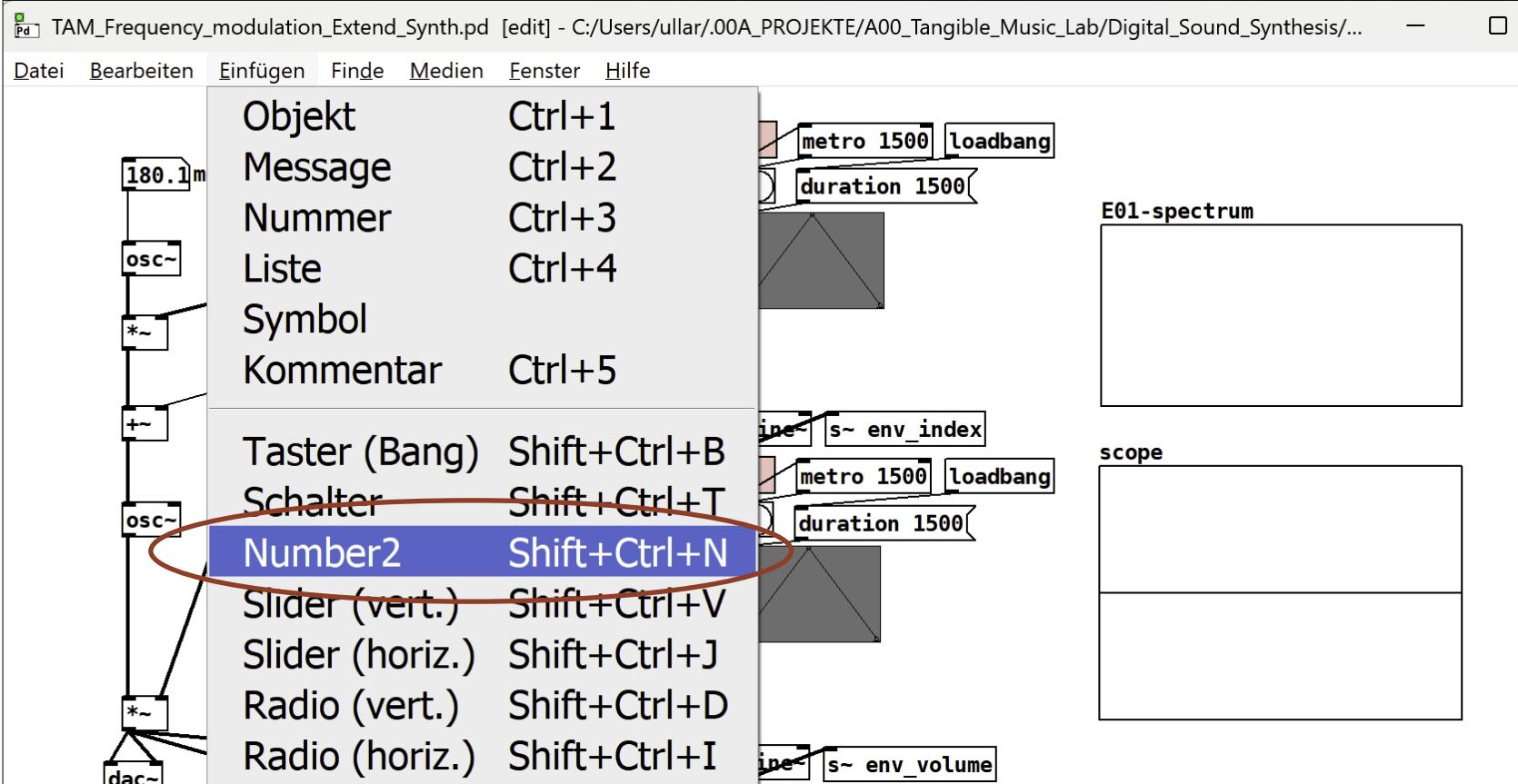
pd fft

tabwrite~ scope

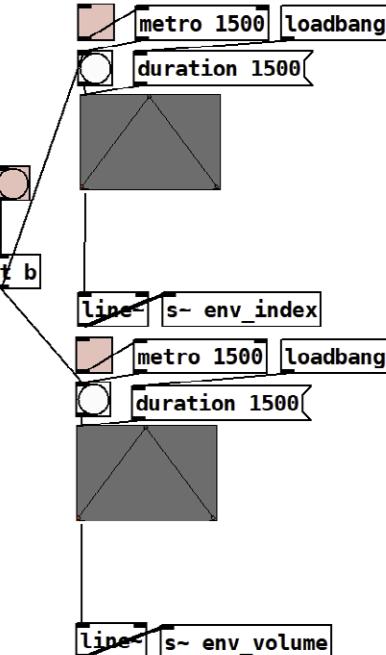
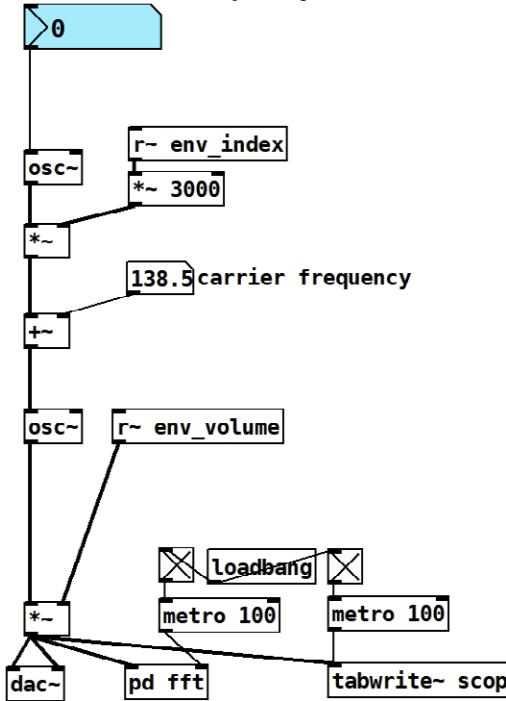


E01-spectrum

scope



Modulator frequency

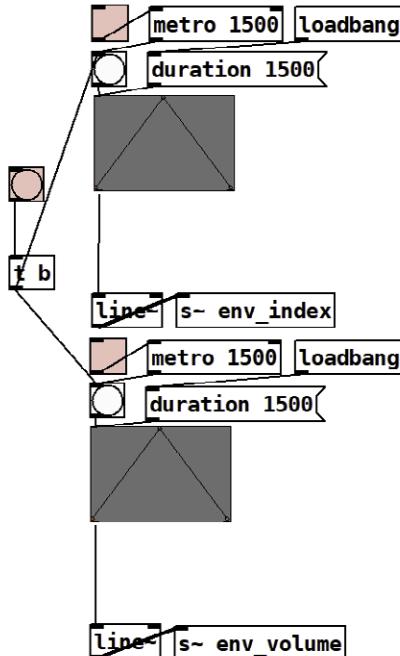
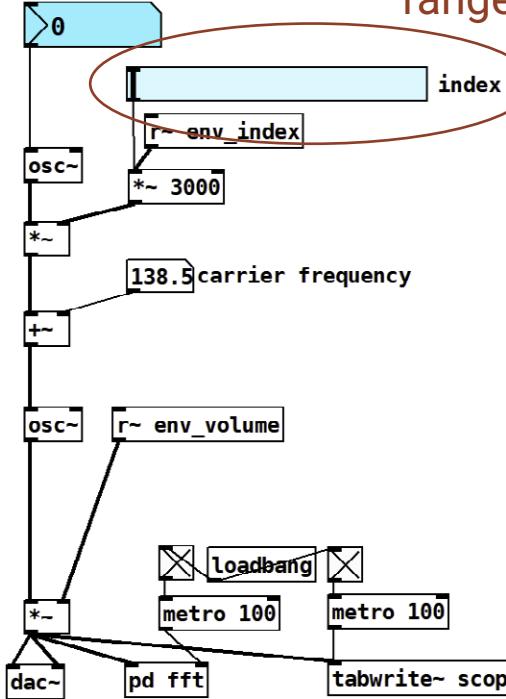


E01-spectrum

scope

Modulator frequency

range: 0-1



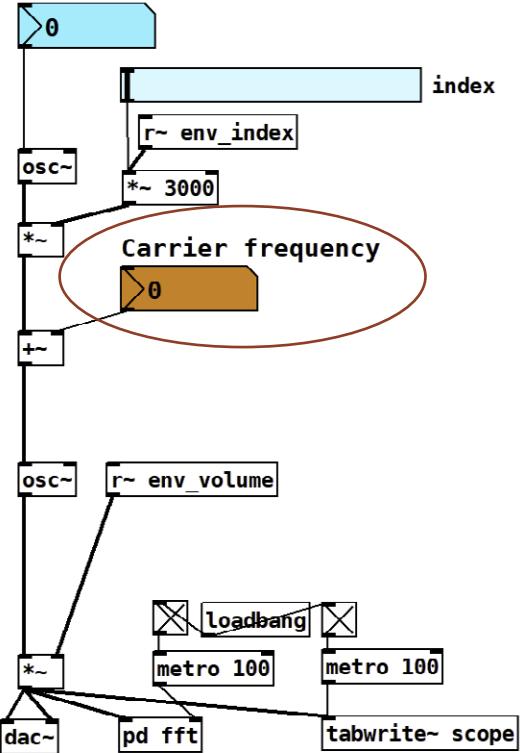
E01-spectrum



scope



Modulator frequency



index

Carrier frequency

`r~ env_volume`

`Loadbang`

`metro 100`

`metro 100`

`dac~`

`pd fft`

`tabwrite~ scope`

`metro 1500` `loadbang`

`duration 1500`

`t b`

`line~` `s~ env_index`

`metro 1500` `loadbang`

`duration 1500`

`line~`

`s~ env_volume`

E01-spectrum

scope

Modulator frequency

> 0

index

osc~

r~ env_index

*~ 3000

Carrier frequency

> 0

++

osc~

r~ env_volume

osc~

Loadbang

metro 100

metro 100

dac~

pd fft

tabwrite~ scope

range: 0.1-10

metro 1500 loadbang

duration 1500

line~ s~ env_index

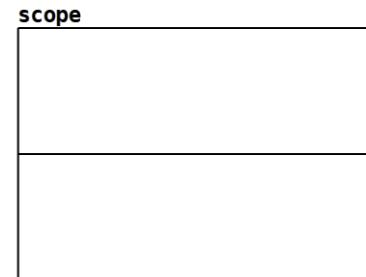
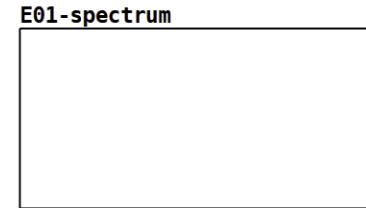
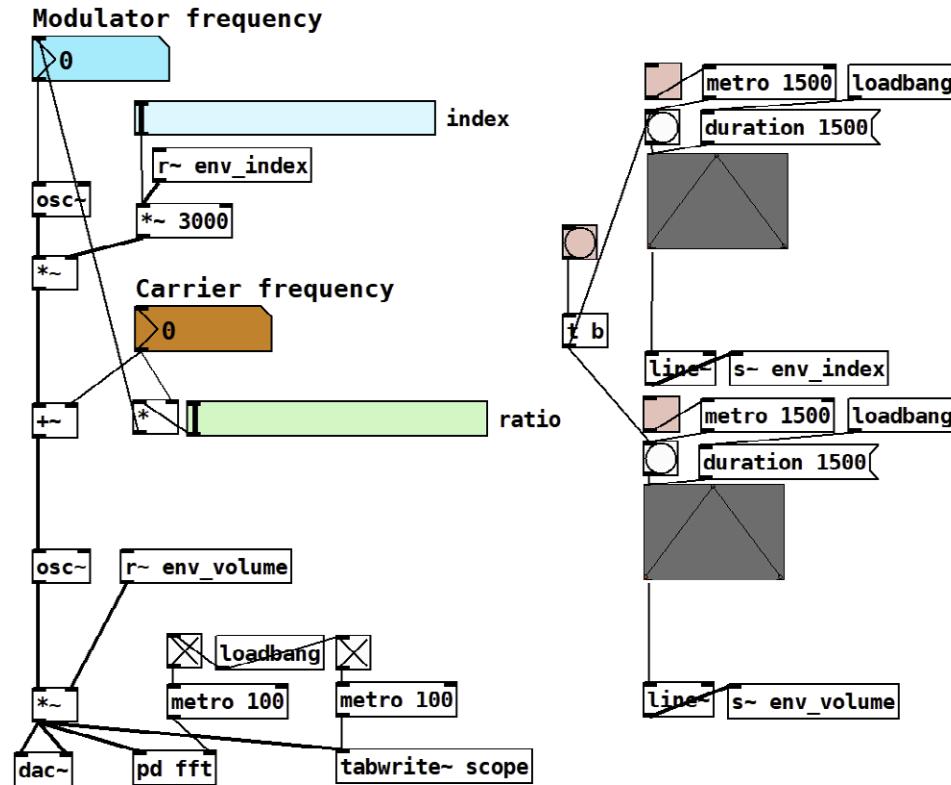
metro 1500 loadbang

duration 1500

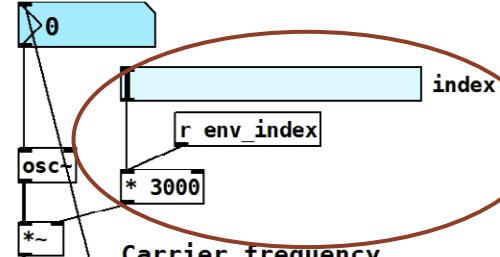
line~ s~ env_volume

E01-spectrum

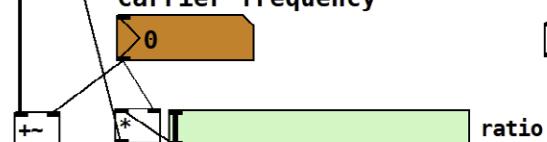
scope



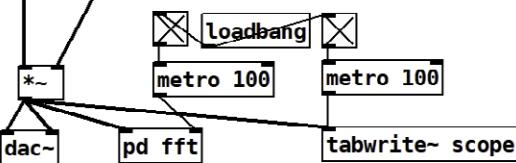
Modulator frequency



Carrier frequency



osc~ r~ env_volume



pd fft

tabwrite~ scope

metro 1500 loadbang
duration 1500

line~ s~ env_index
metro 1500 loadbang
duration 1500

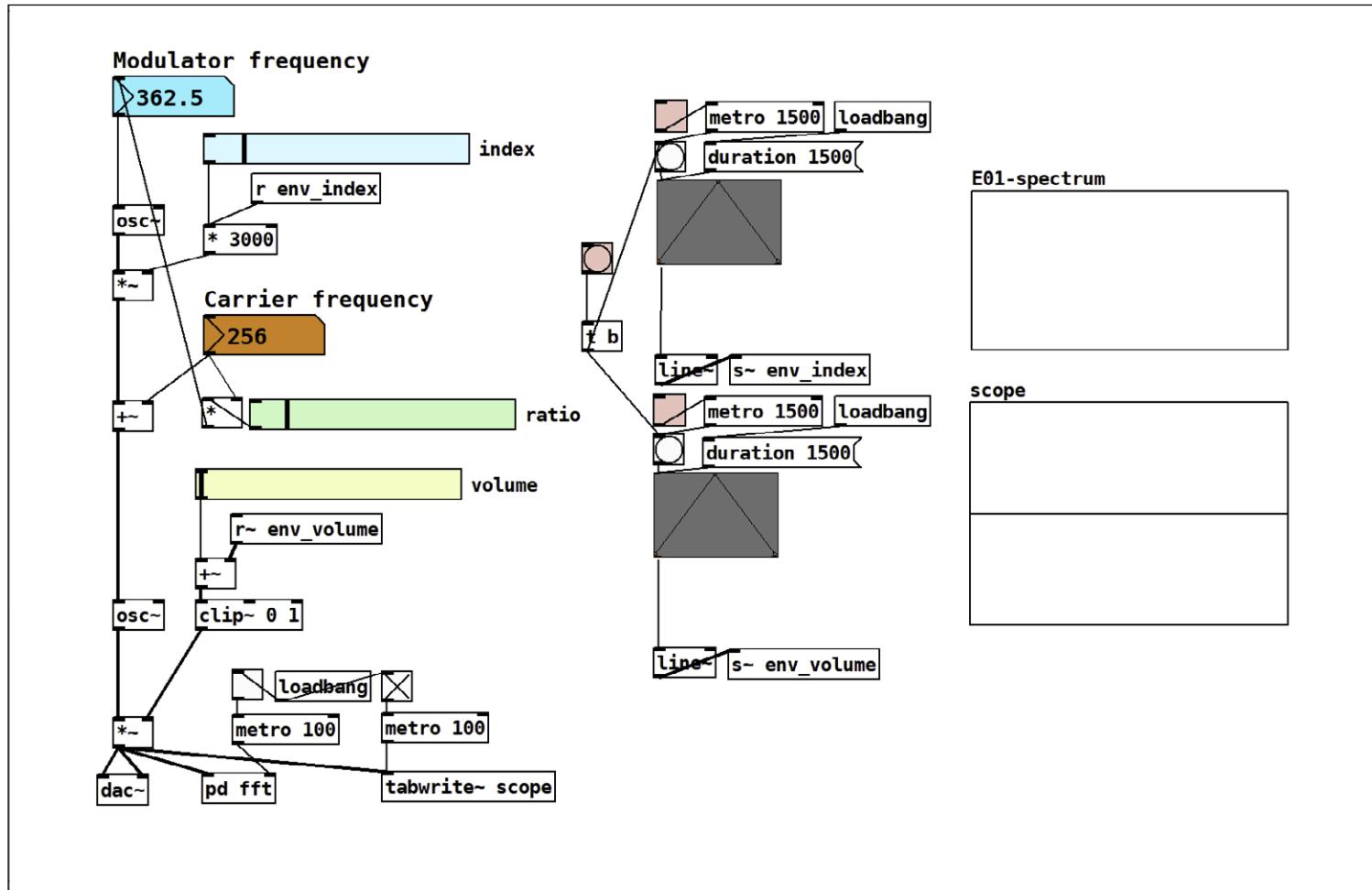
line~ s~ env_volume

E01-spectrum



scope

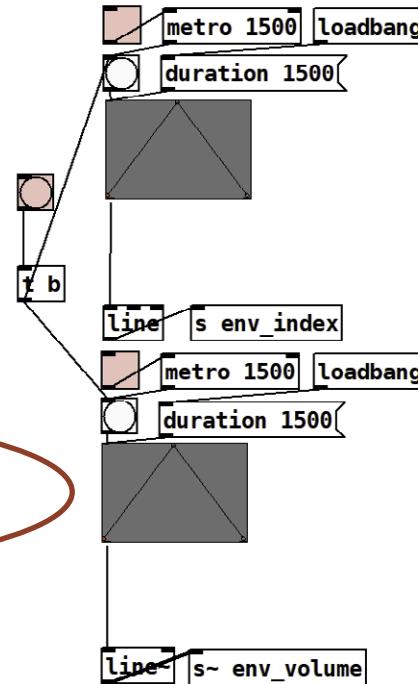




Datei Bearbeiten Einfügen Finde Medien Fenster Hilfe

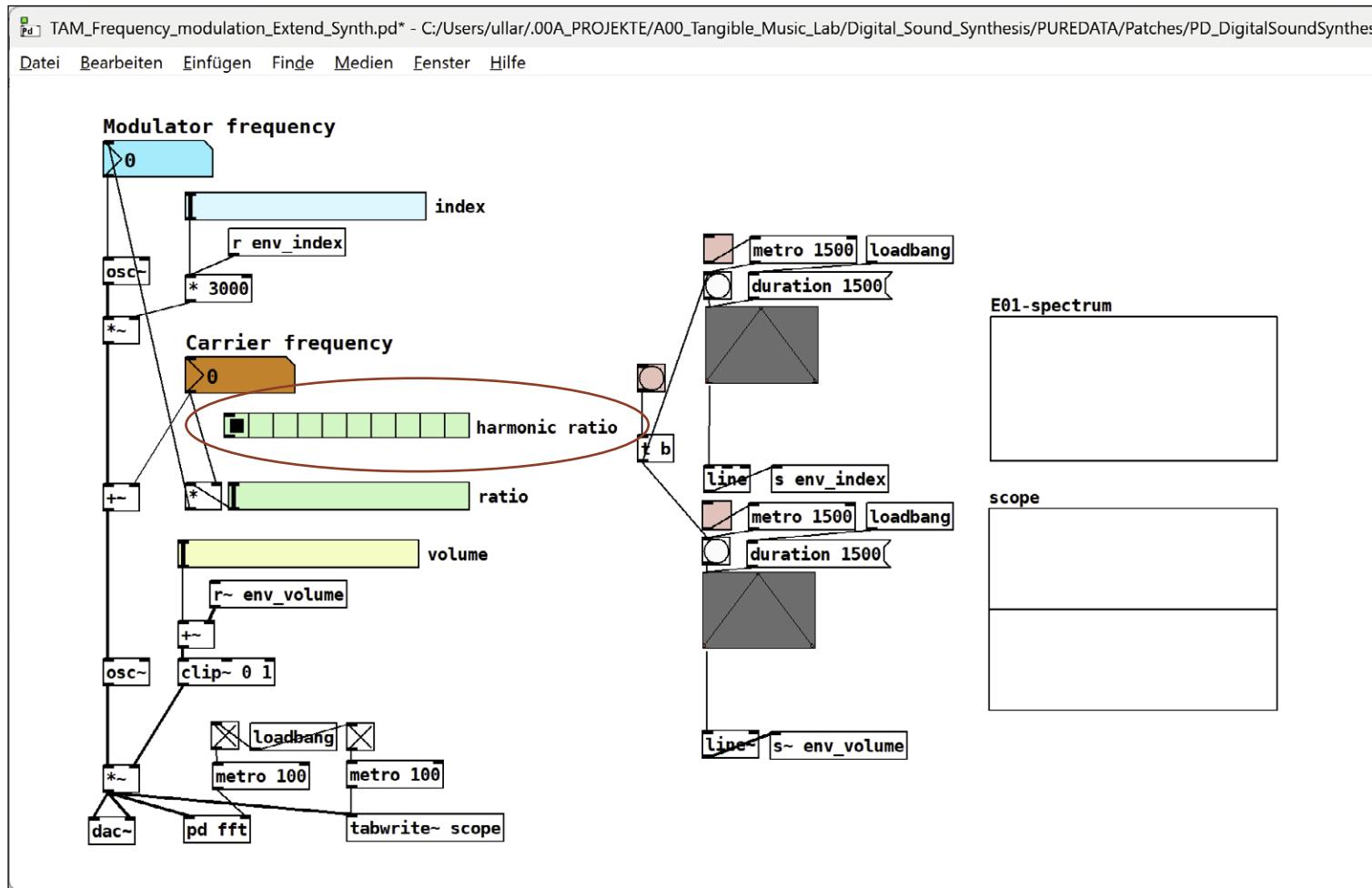
Modula
306.

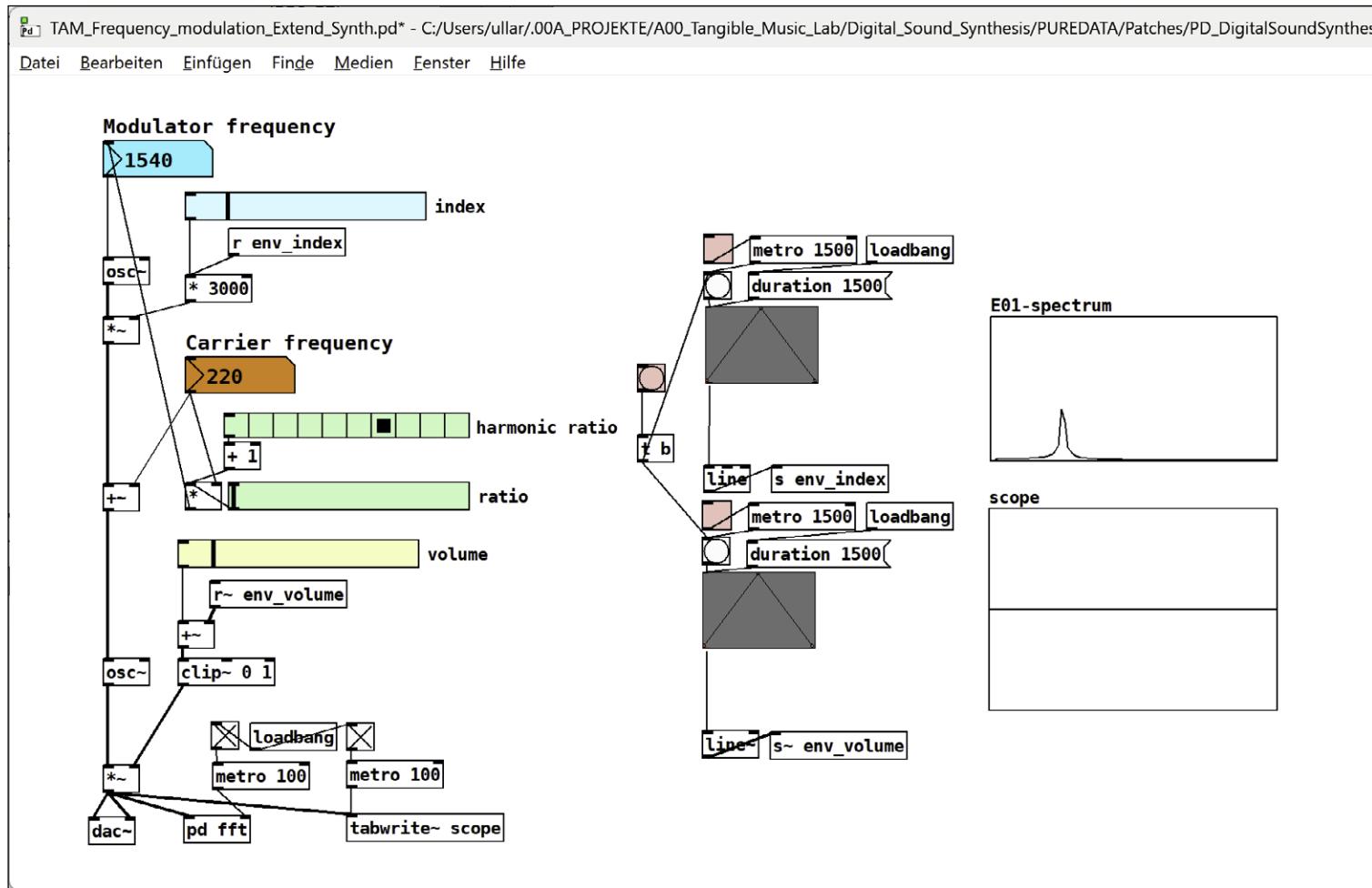
Objekt	Ctrl+1
Message	Ctrl+2
Nummer	Ctrl+3
Liste	Ctrl+4
Symbol	
Kommentar	Ctrl+5
Taster (Bang)	Shift+Ctrl+B
Schalter	Shift+Ctrl+T
Number2	Shift+Ctrl+N
Slider (vert.)	Shift+Ctrl+V
Slider (horiz.)	Shift+Ctrl+J
Radio (vert.)	Shift+Ctrl+D
Radio (horiz.)	Shift+Ctrl+I
VU-Meter	Shift+Ctrl+U
Canvas	Shift+Ctrl+C
Graph	Shift+Ctrl+G
Array	Shift+Ctrl+A



E01-spectrum

scope





TAM_Frequency_modulation_Extend_Synth.pd* [edit] - C:/Users/ullar/00A_PROJEKTE/A00_Tangible_Music_Lab/Digital_Sound_Synthesis/PUREDATA/Patches/PD_DigitalSoundS

Datei Bearbeiten Einfügen Finde Medien Fenster Hilfe

Modulator frequency

481

index

osc~

* 3000

r env_index

Carrier frequency

450

harmonic ratio



+-

*

ratio

osc~

clip~ 0 1

volume

+-

r~ env_volume

osc~

*~

loadbang

metro 100

metro 100

dac~

pd fft

tabwrite~ scope



metro 1500 loadbang

duration 1500

line~ s env_index

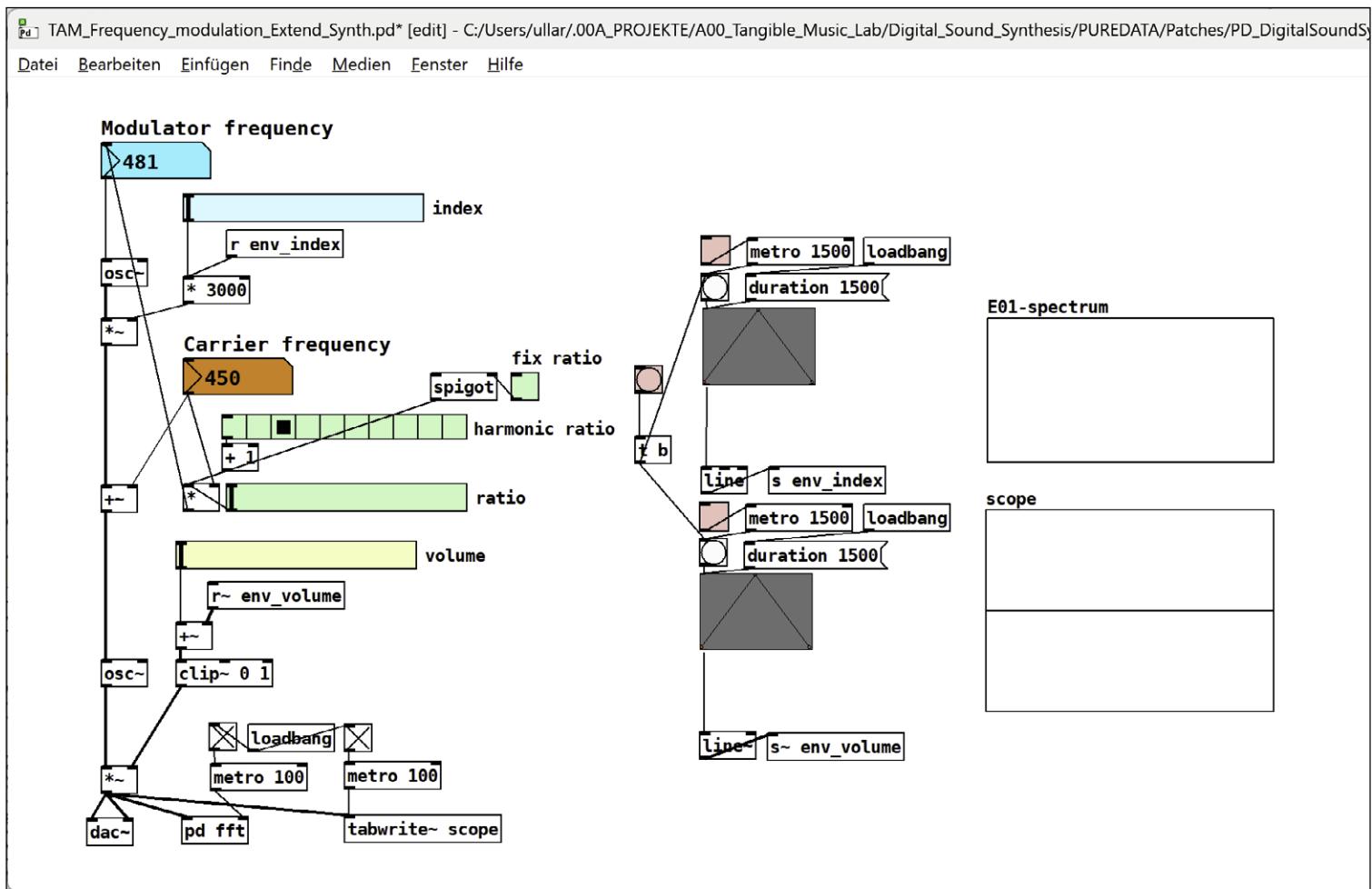
metro 1500 loadbang

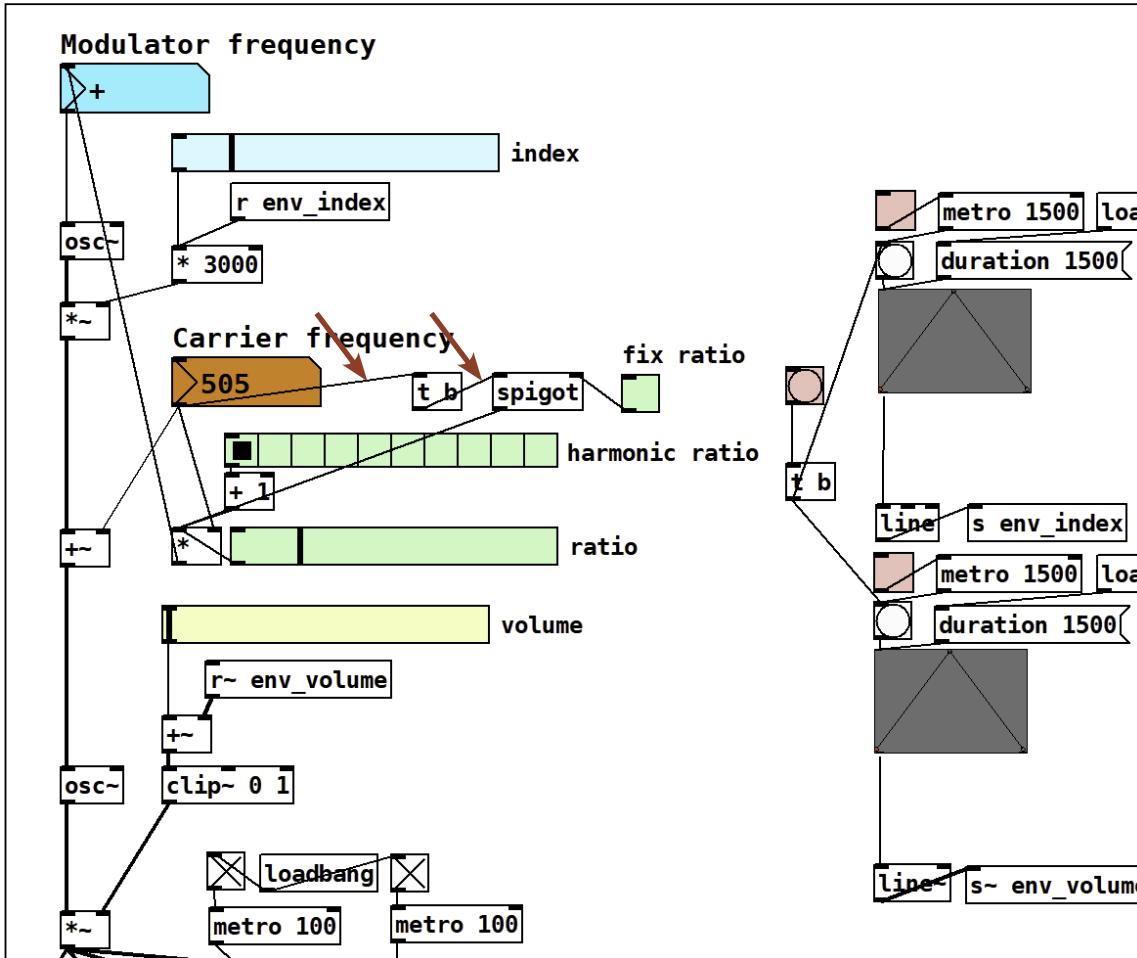
duration 1500

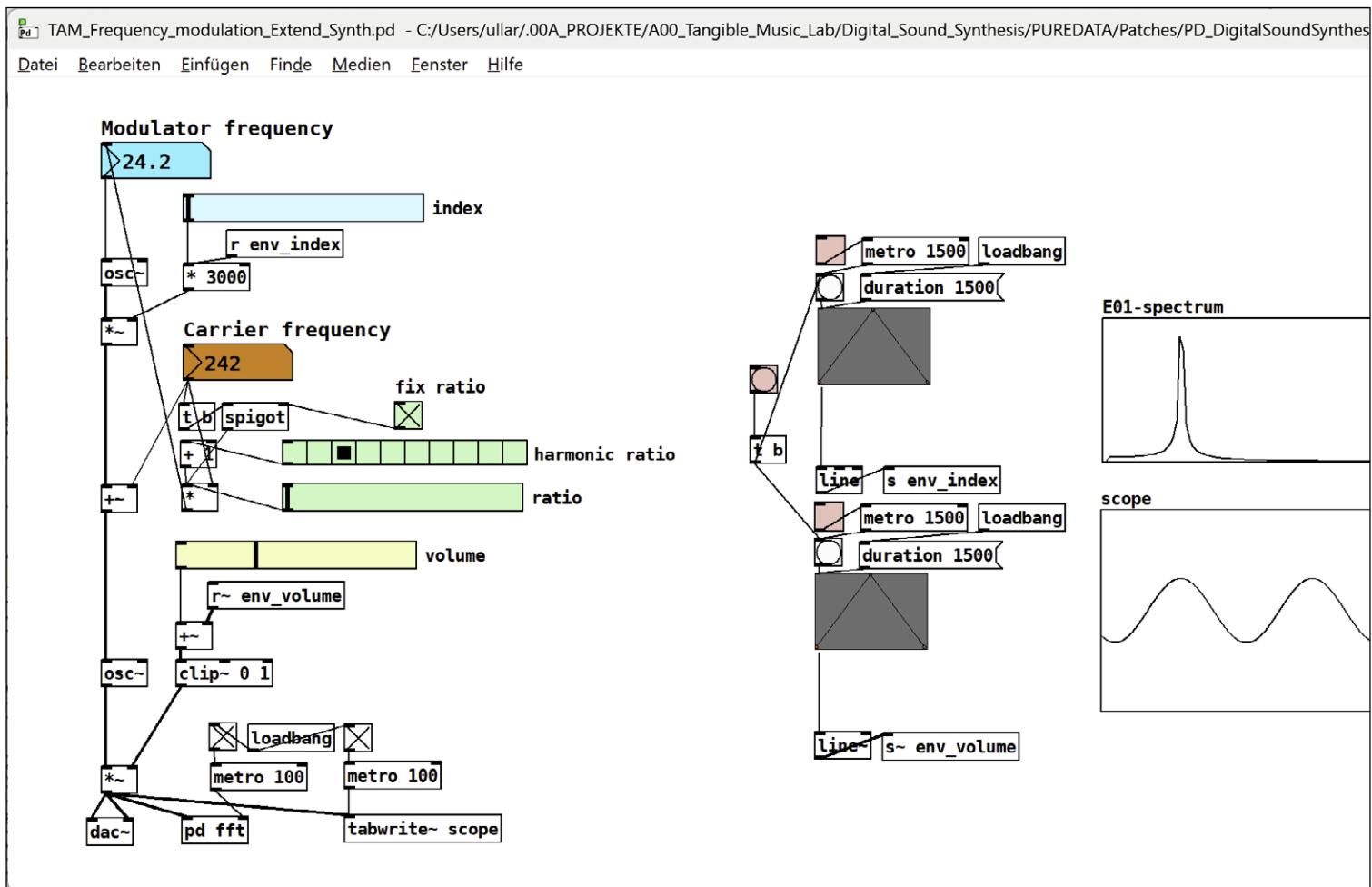
line~ s~ env_volume

E01-spectrum

scope

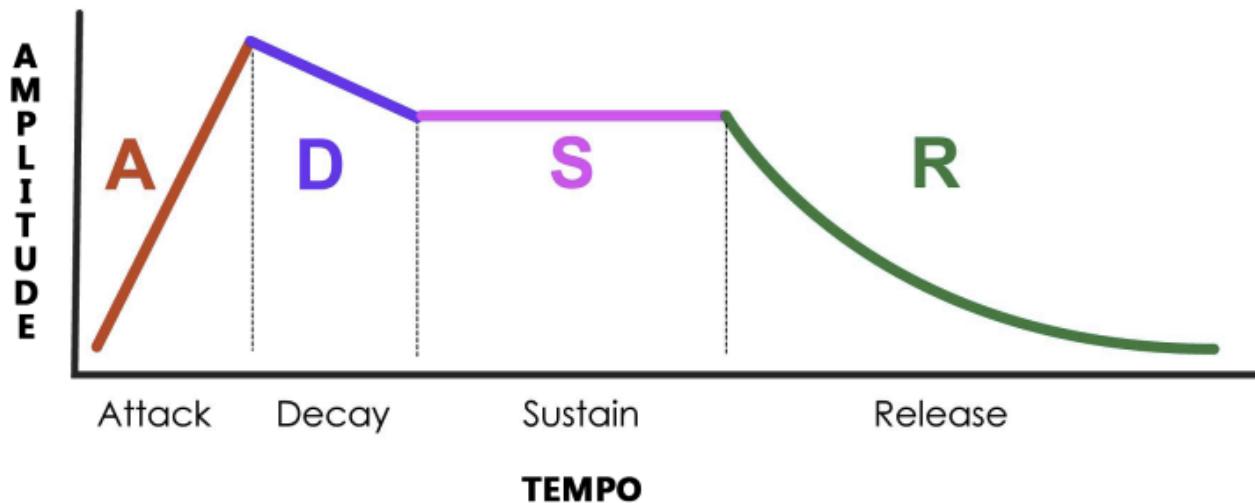


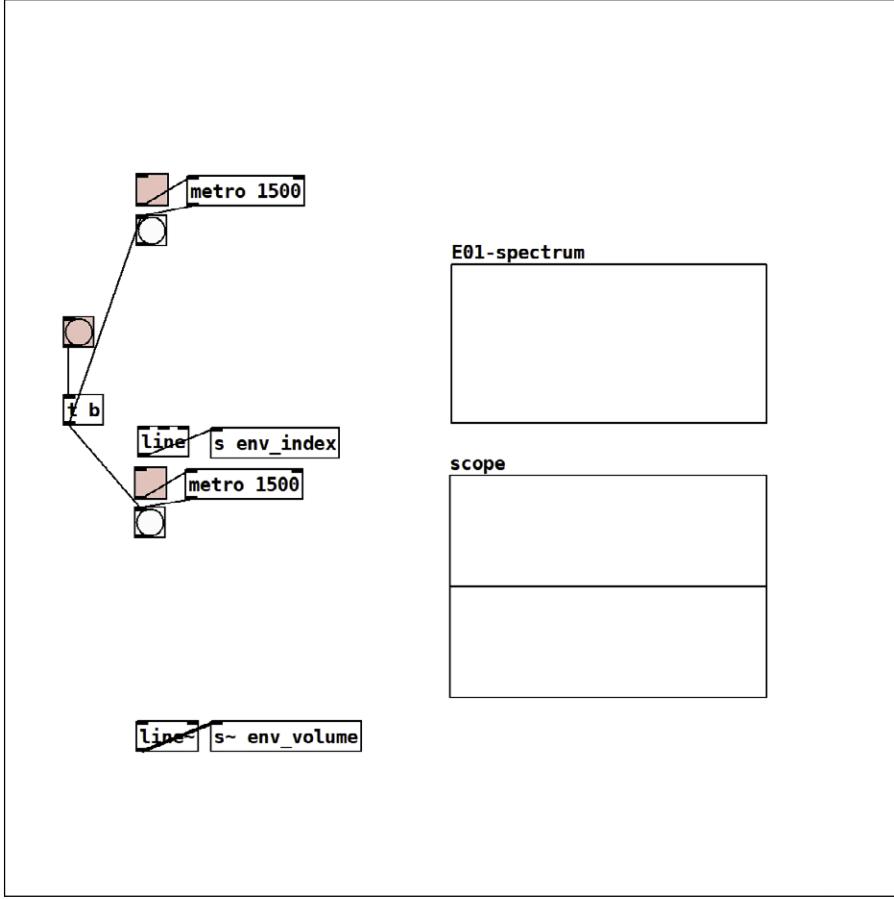




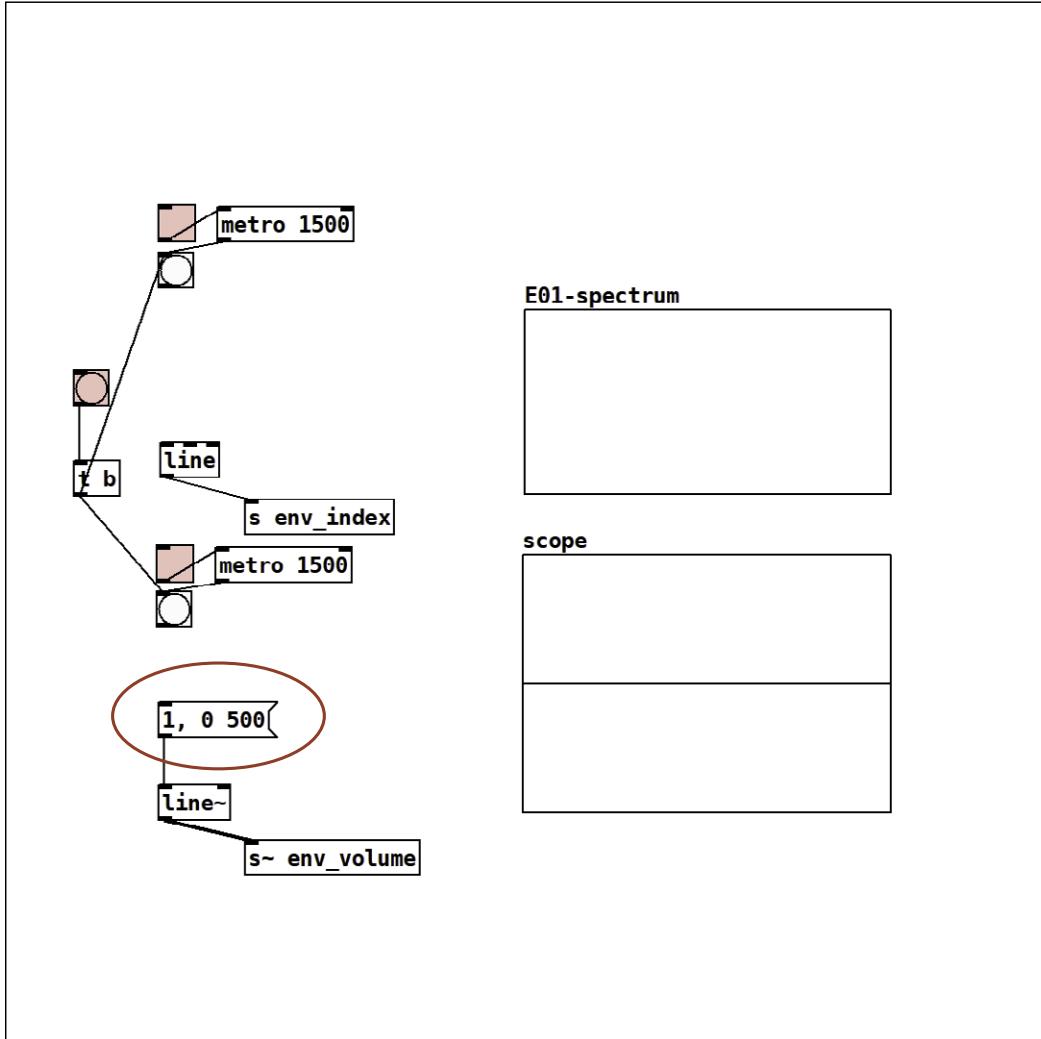
CREATING ENVELOPES

ADSR – Attack, Decay, Sustain & Release

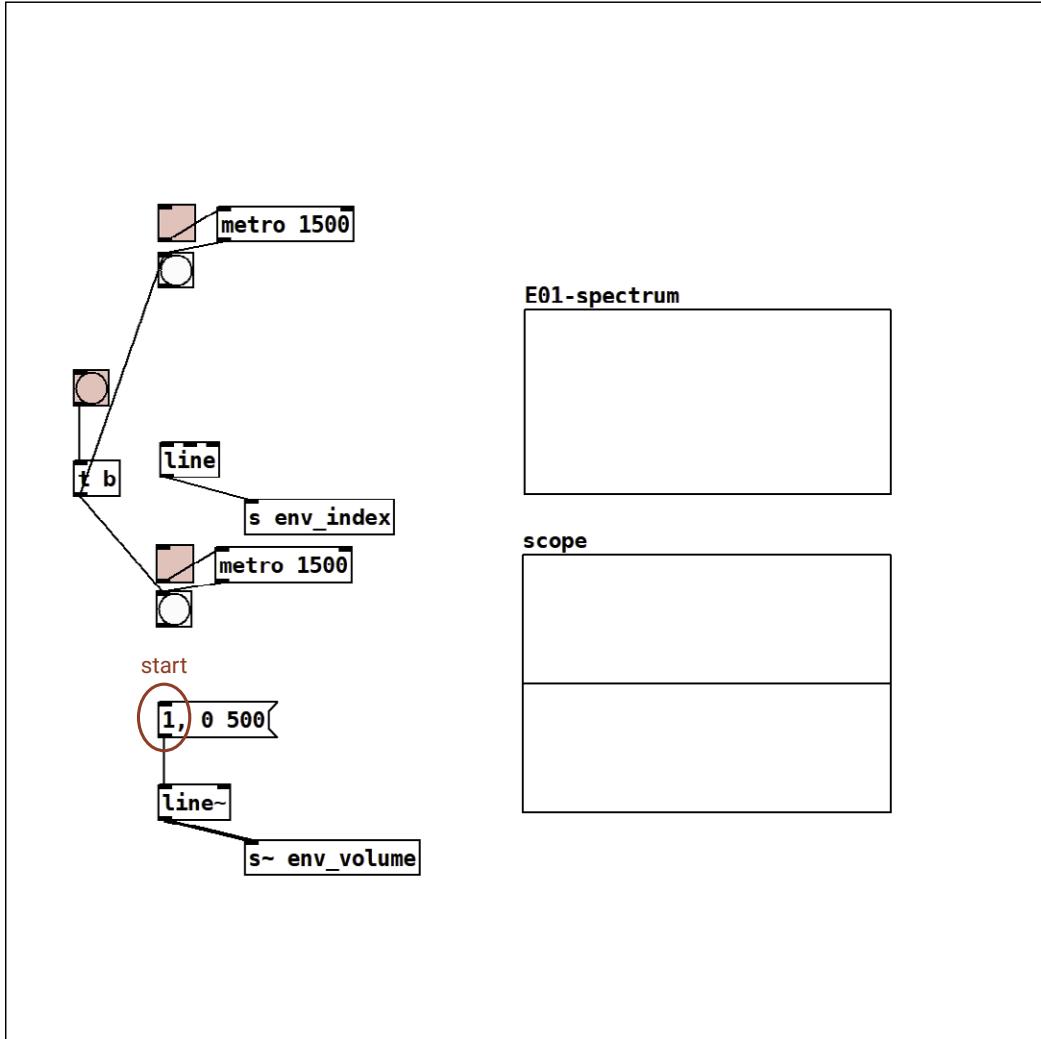




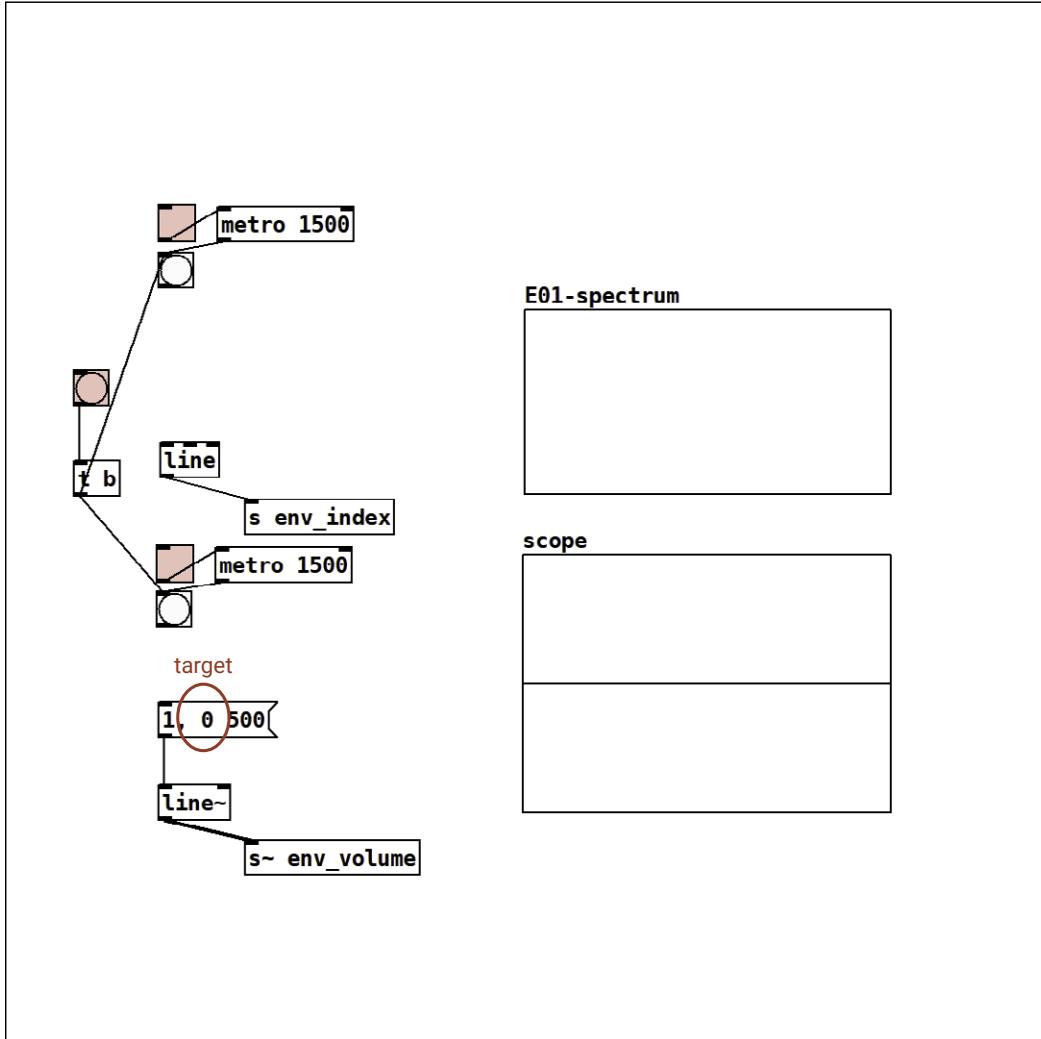
start with 1,
go to 0 in 500 ms



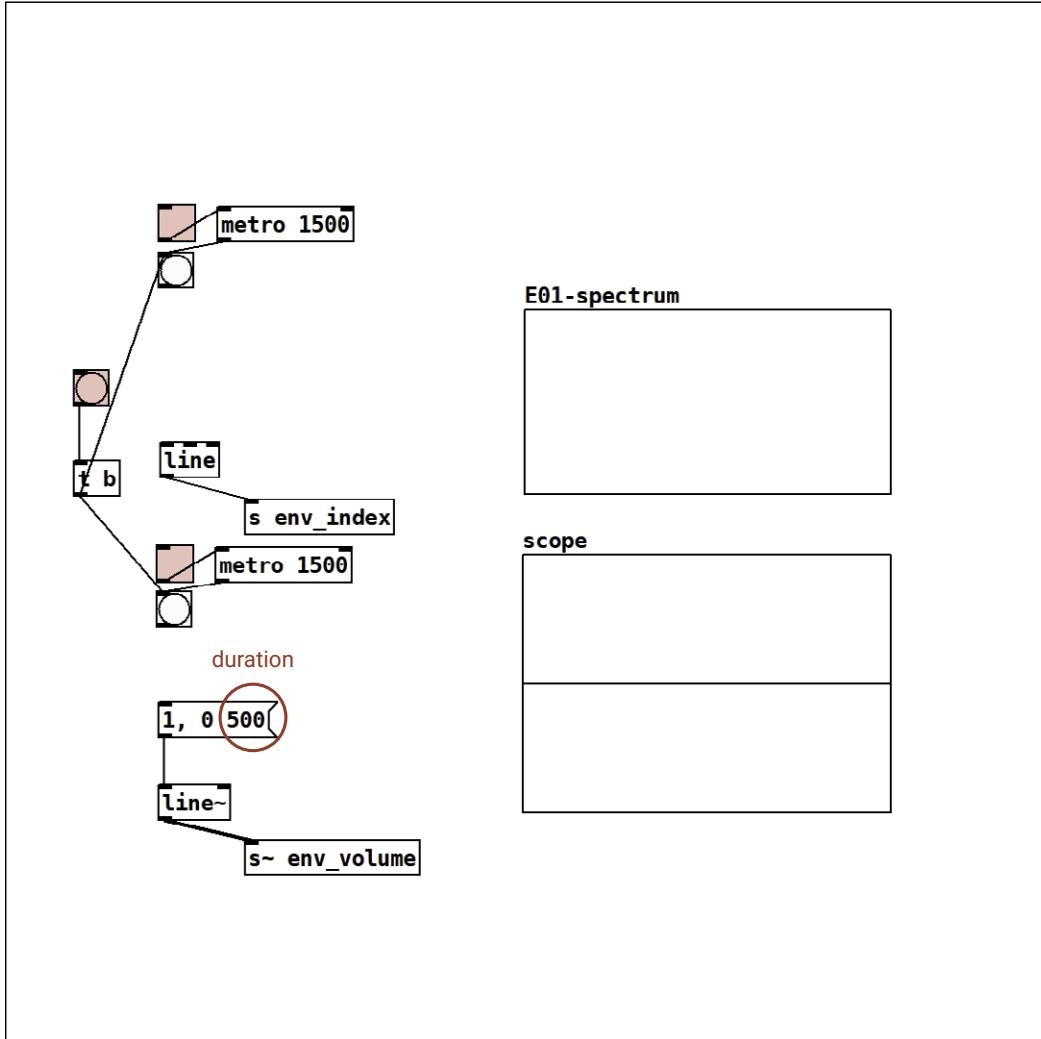
start with 1,
go to 0 in 500 ms



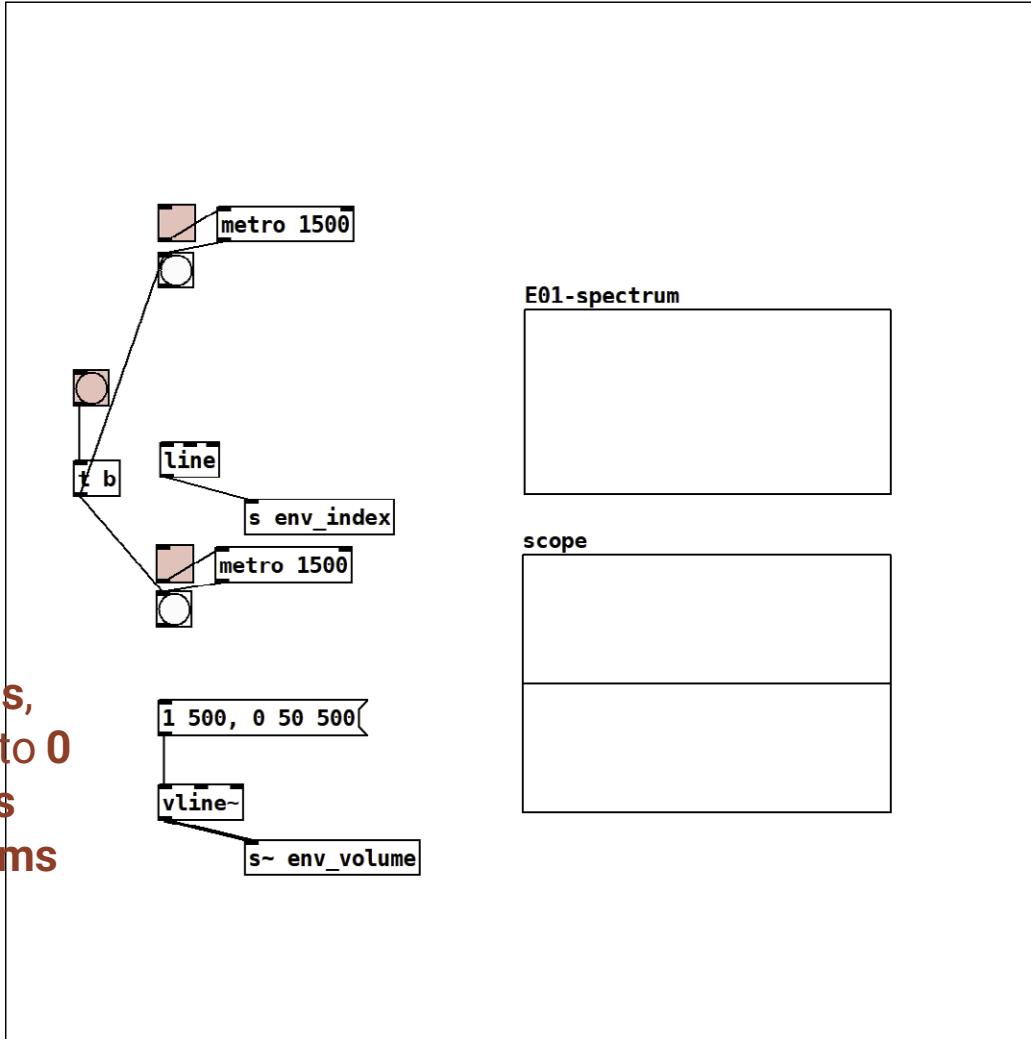
start with 1,
go to 0 in 500 ms

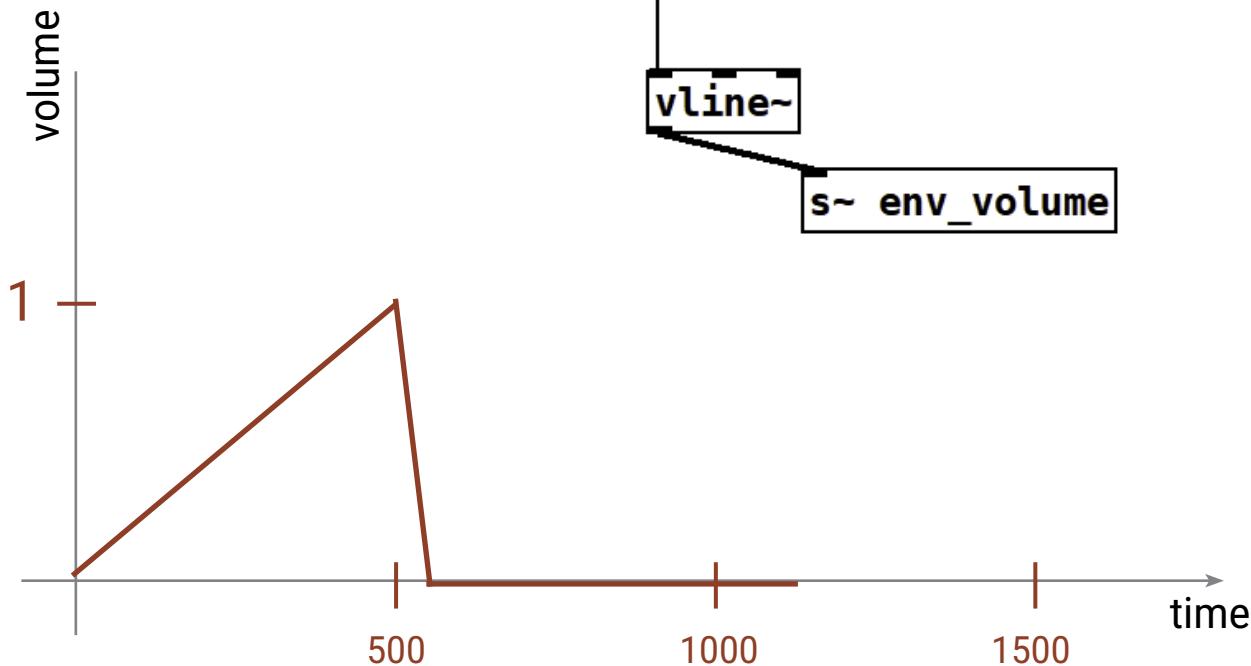


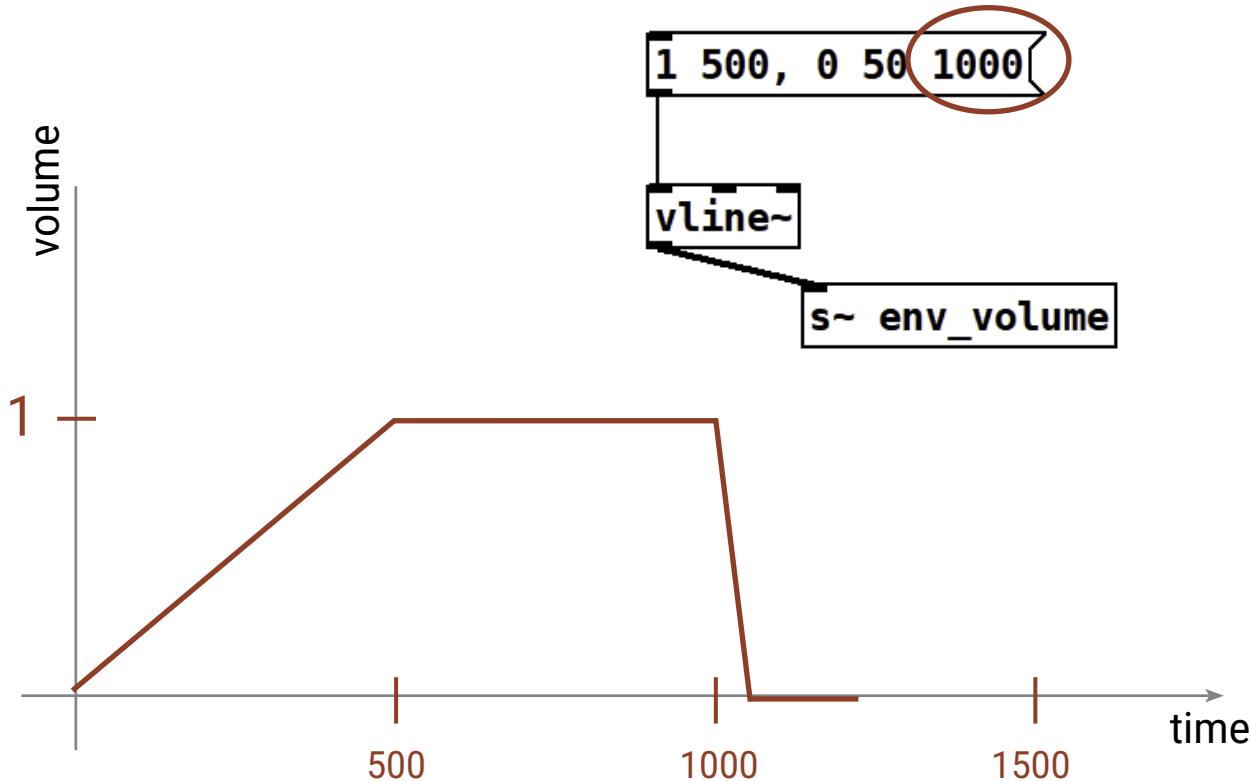
start with 1,
go to 0 in 500 ms

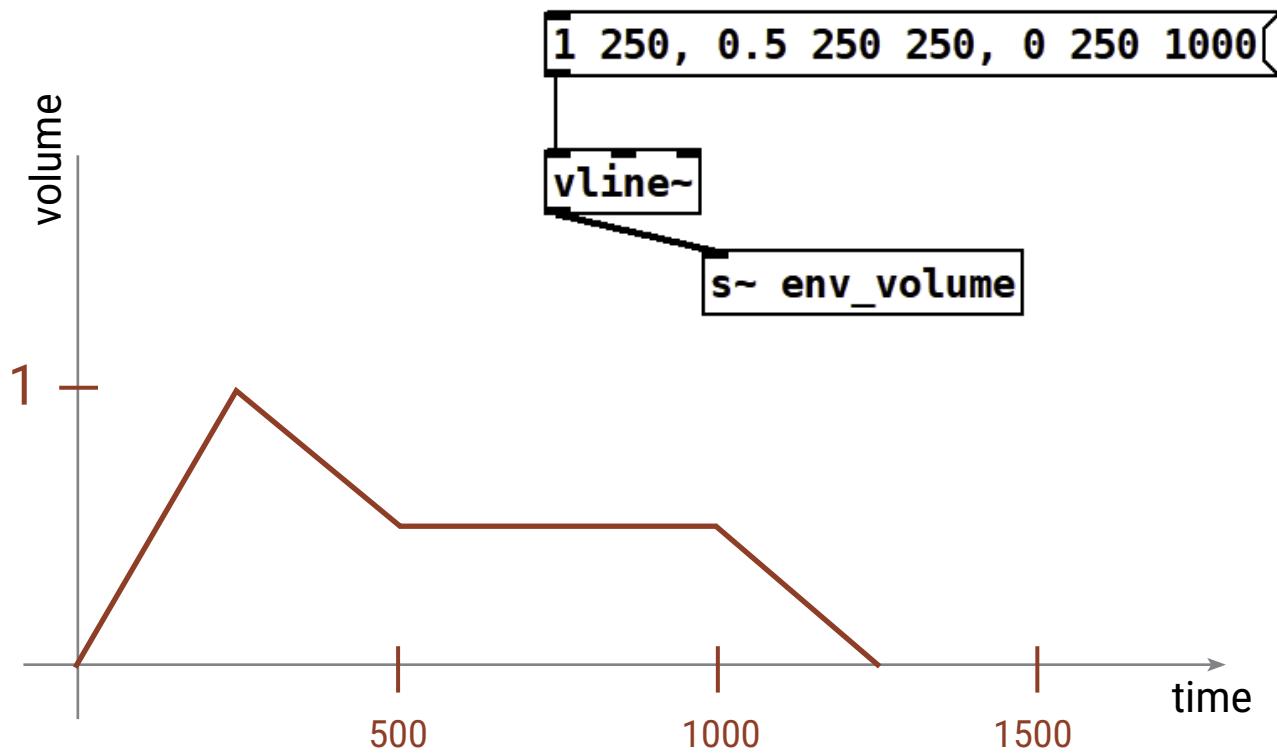


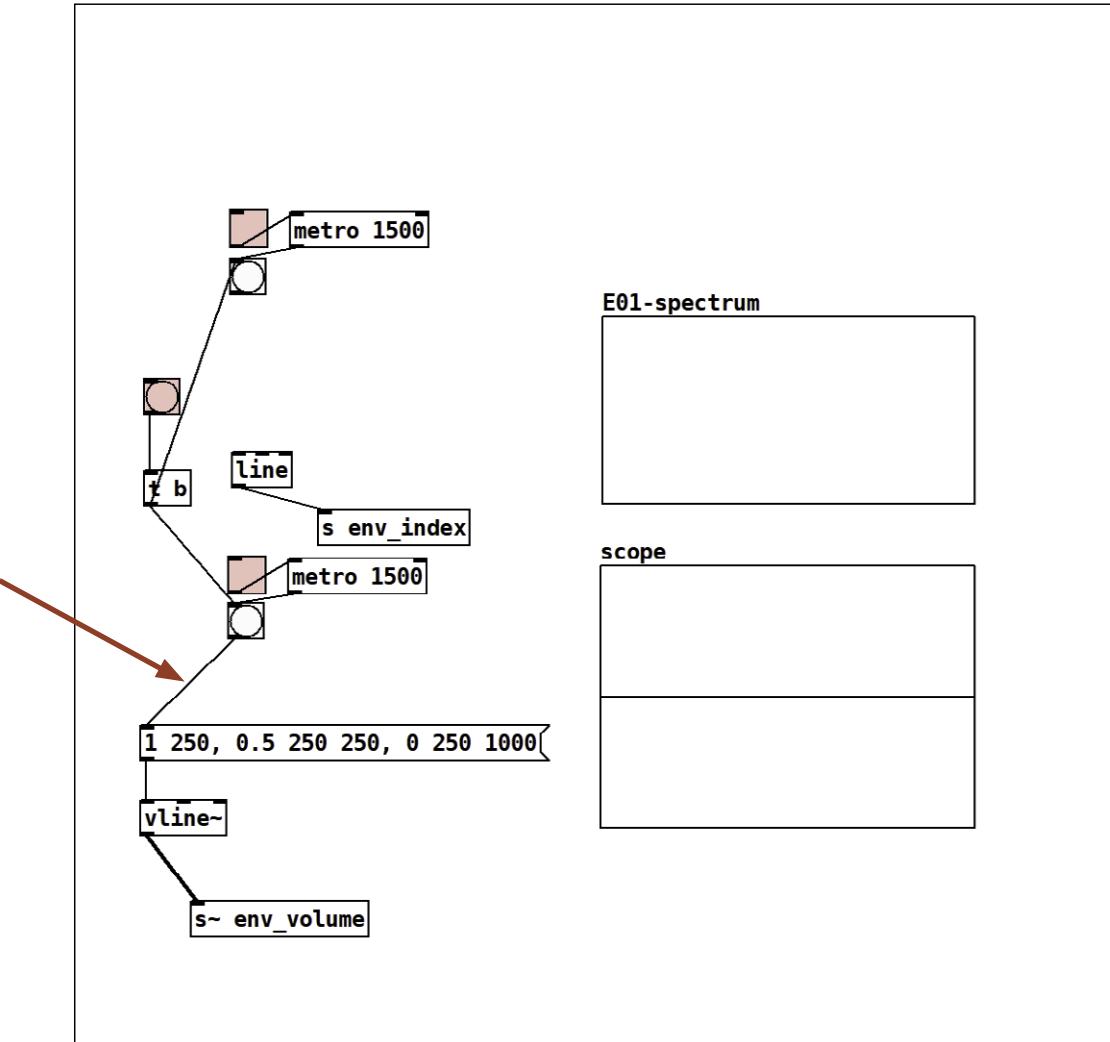
Go to 1
in 500 ms,
then back to 0
in 50 ms
after 500 ms

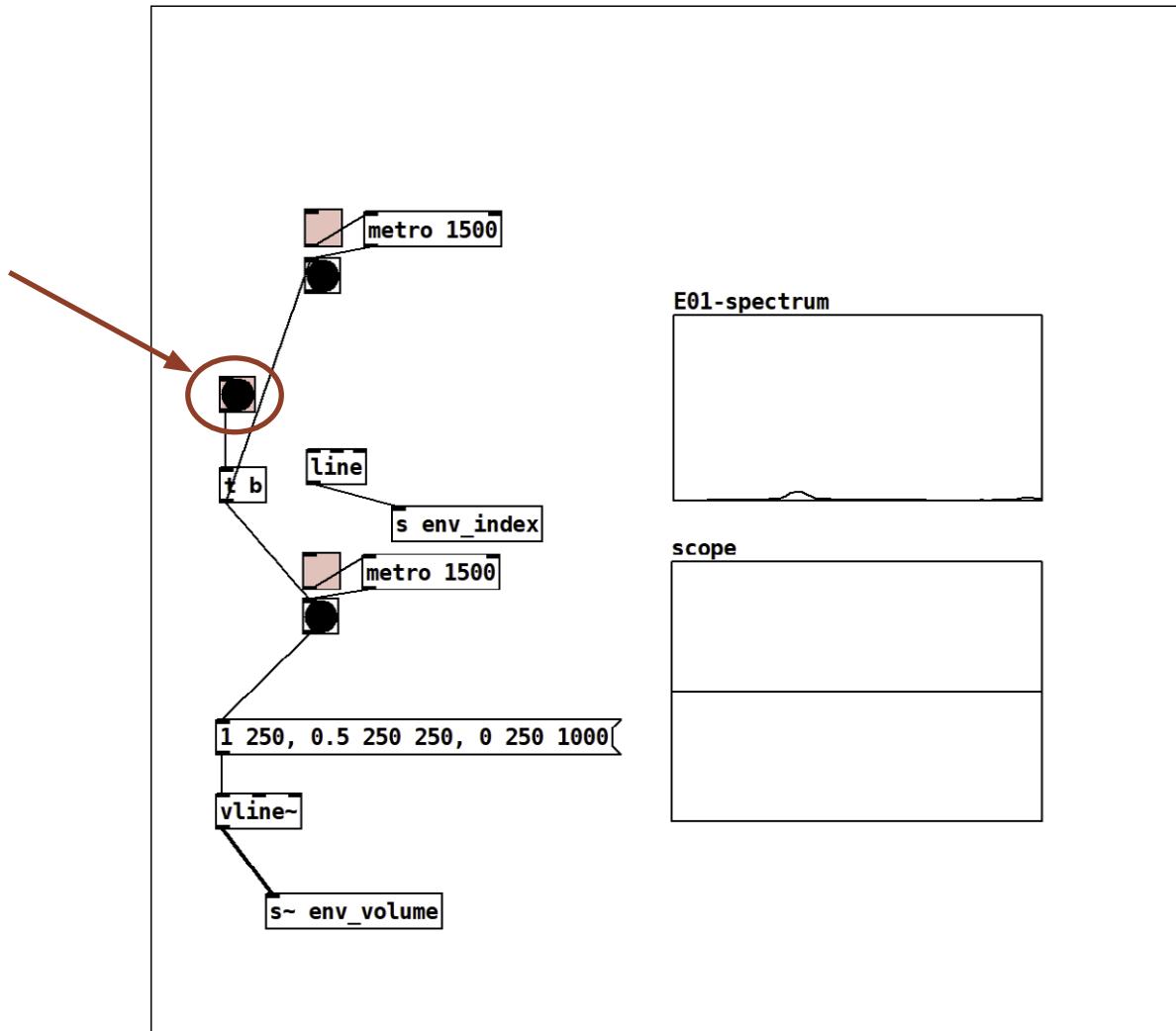


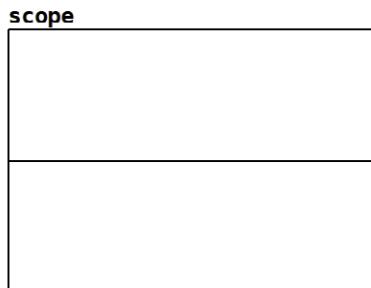
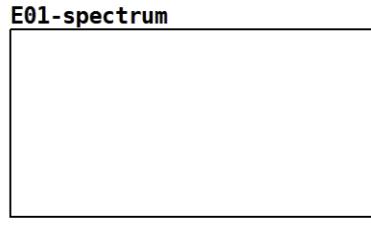
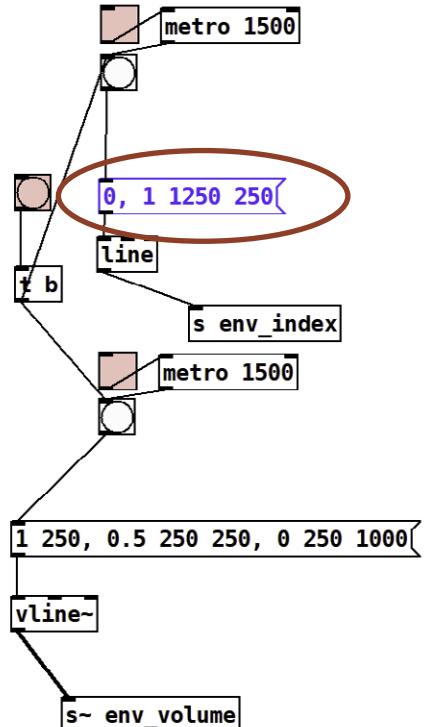


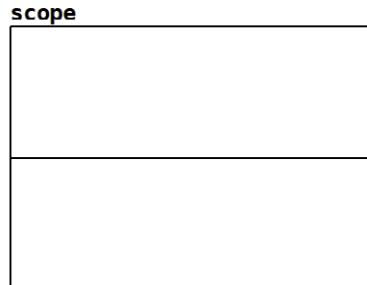
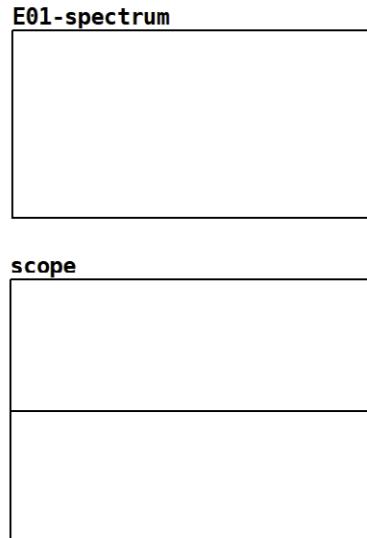
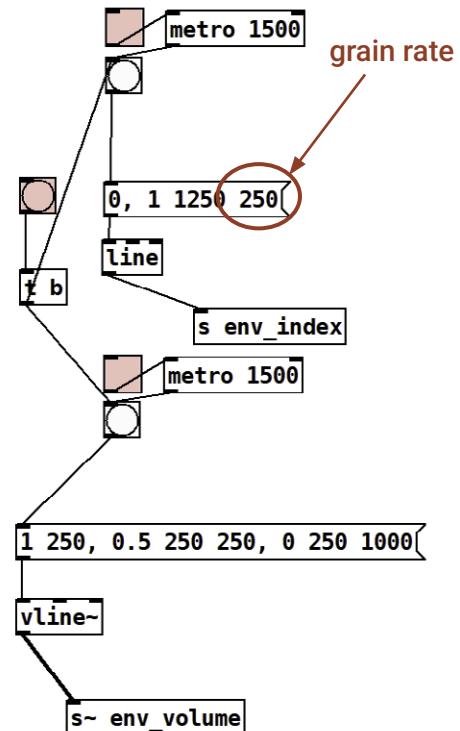


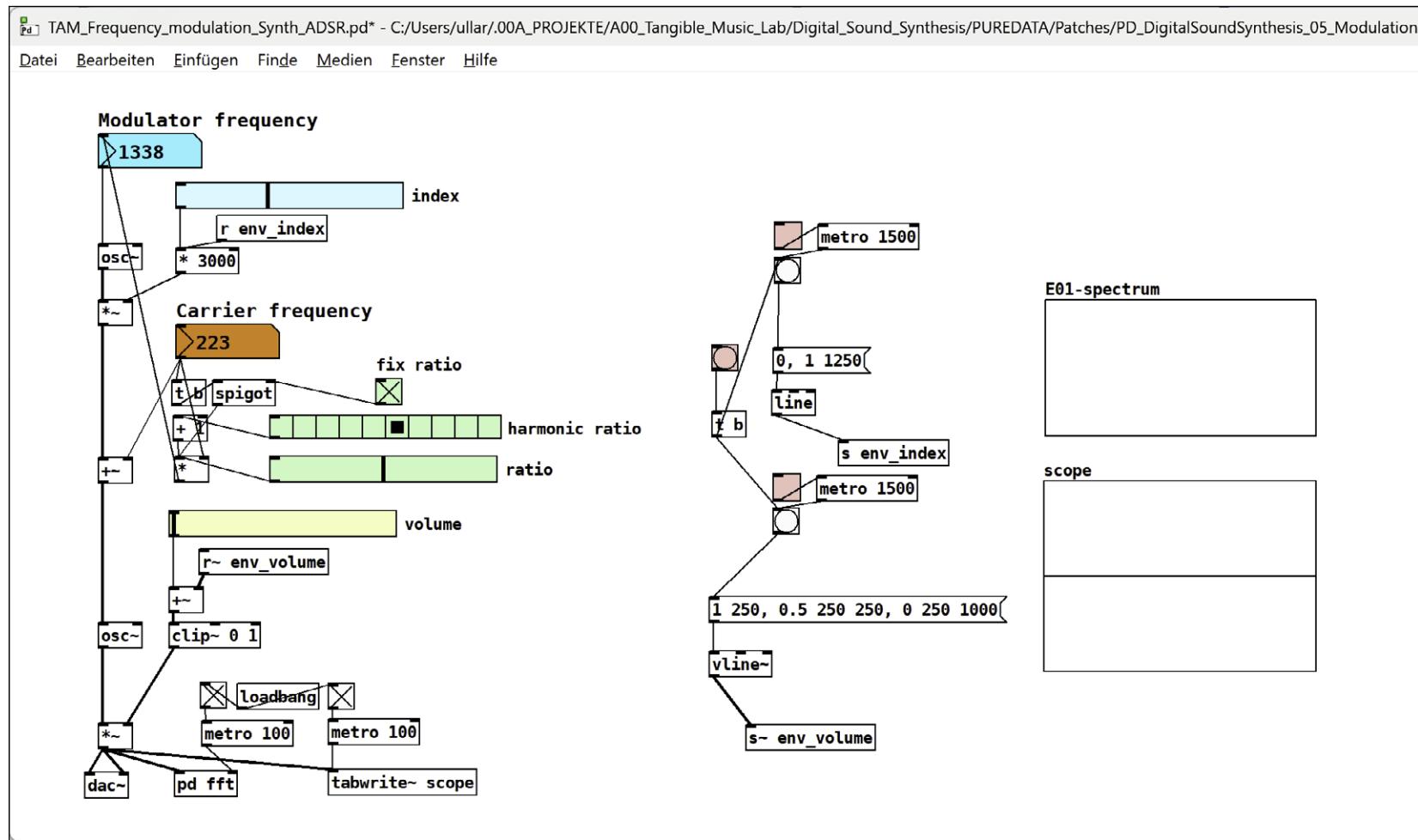


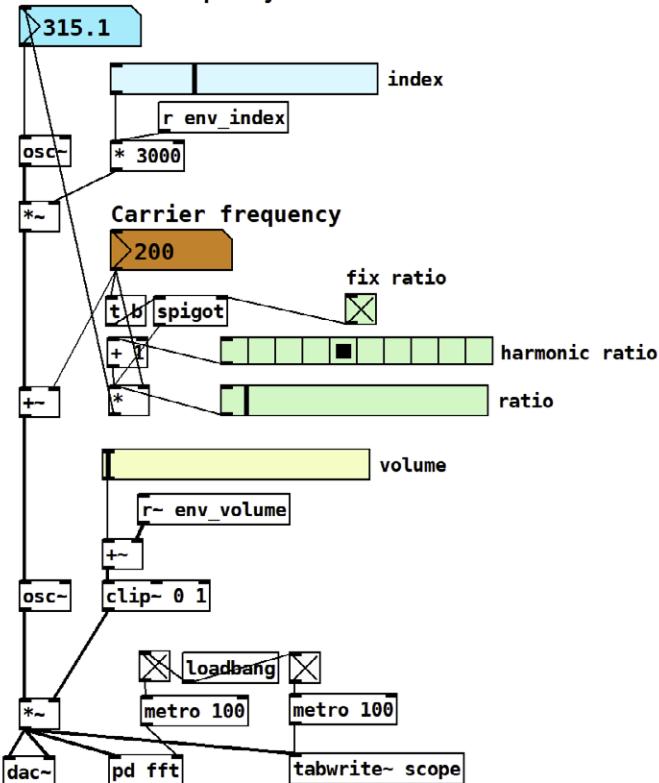
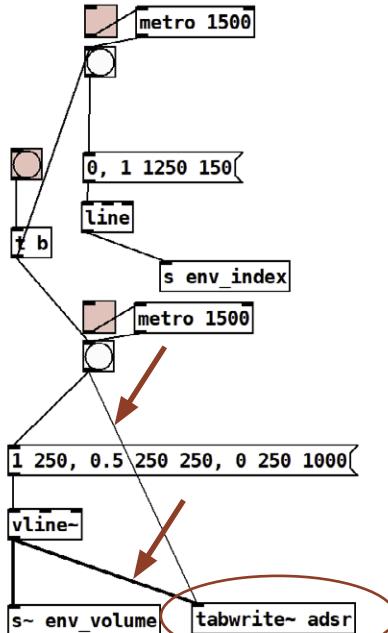
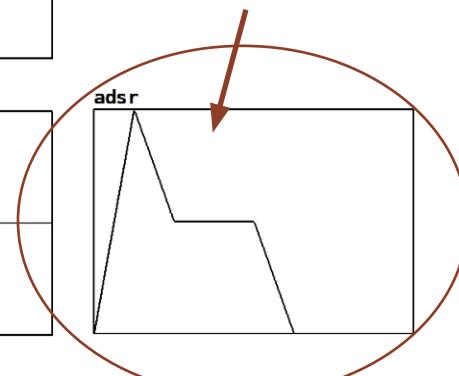


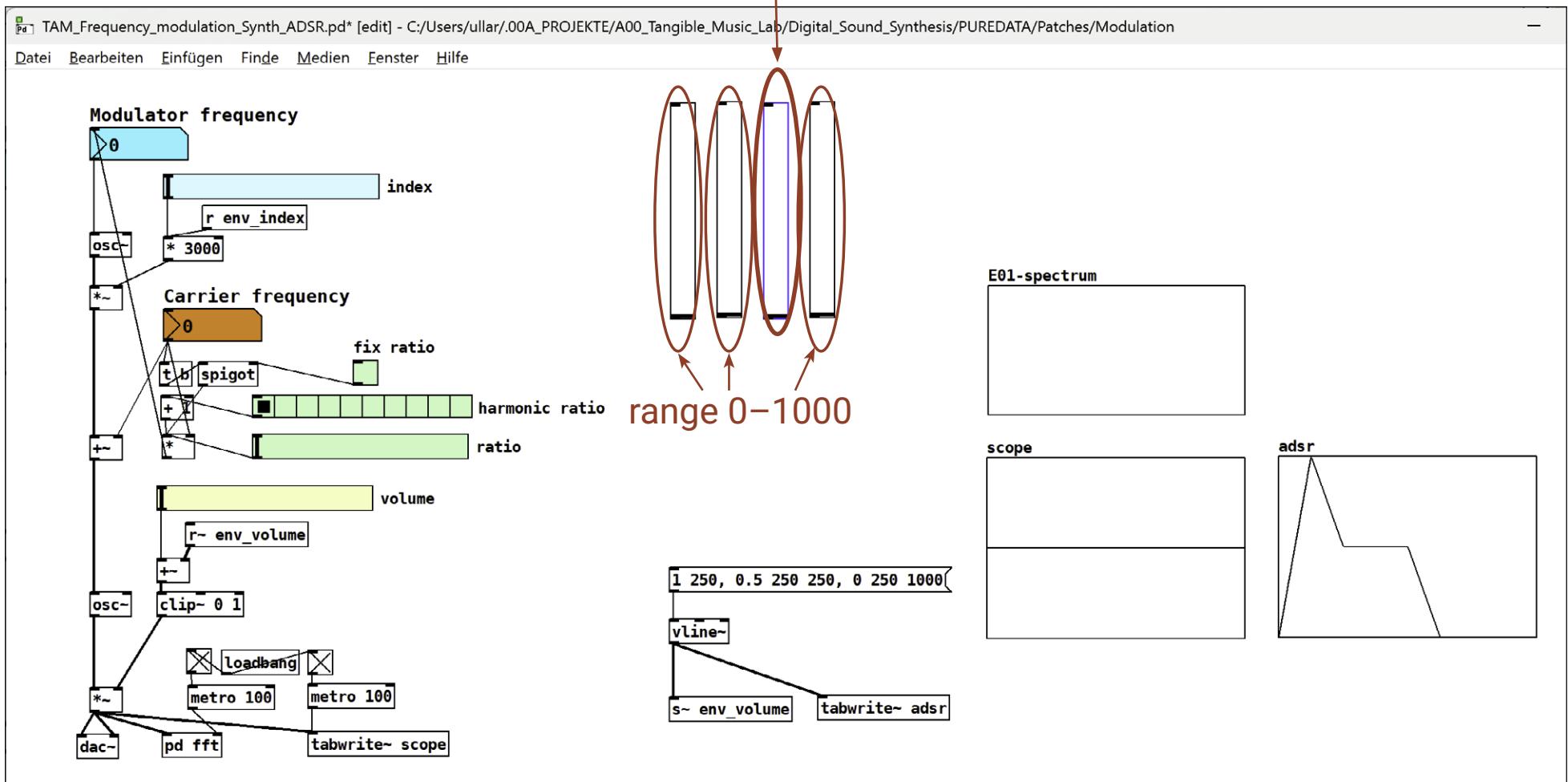


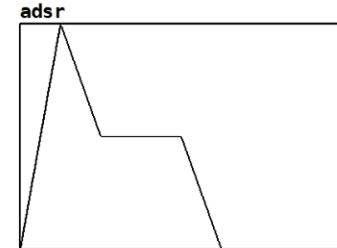
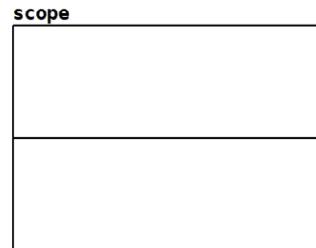
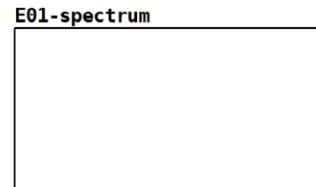
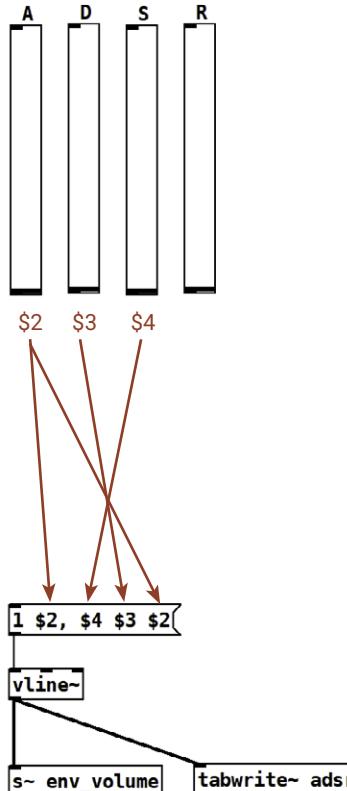
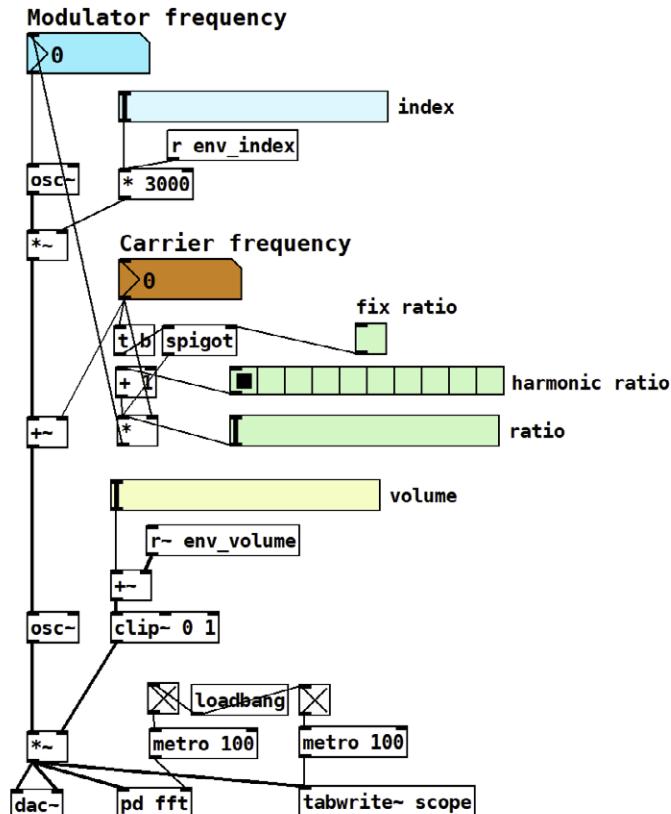


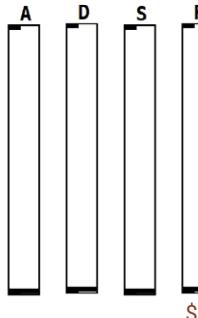
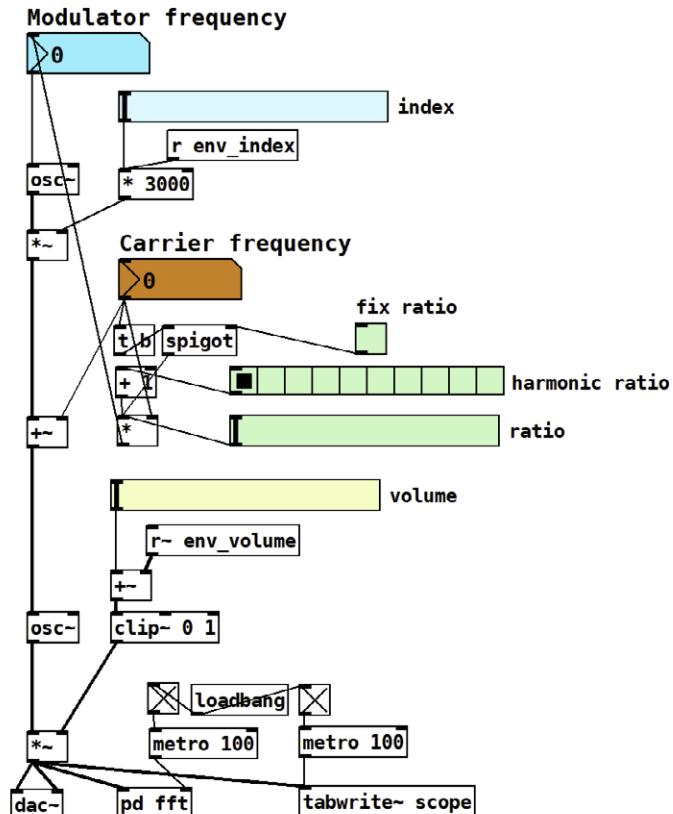




Modulator frequency**Carrier frequency****E01-spectrum****scope**

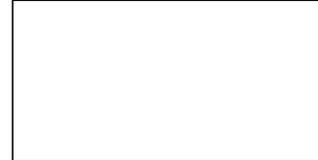




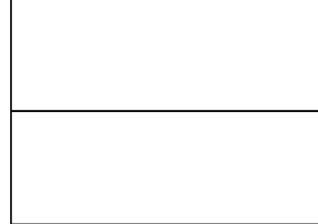


\$2

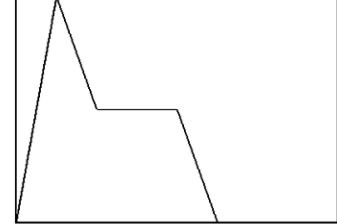
E01-spectrum

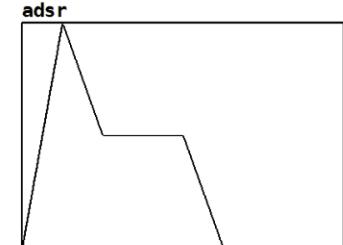
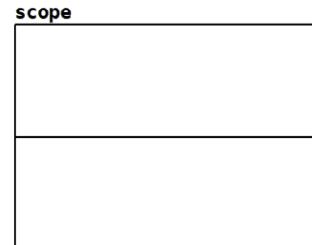
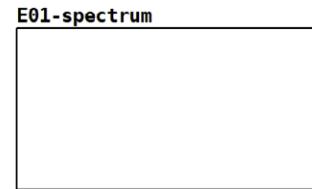
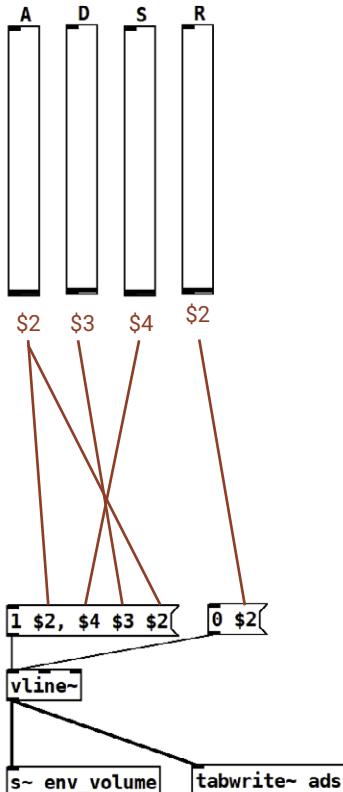
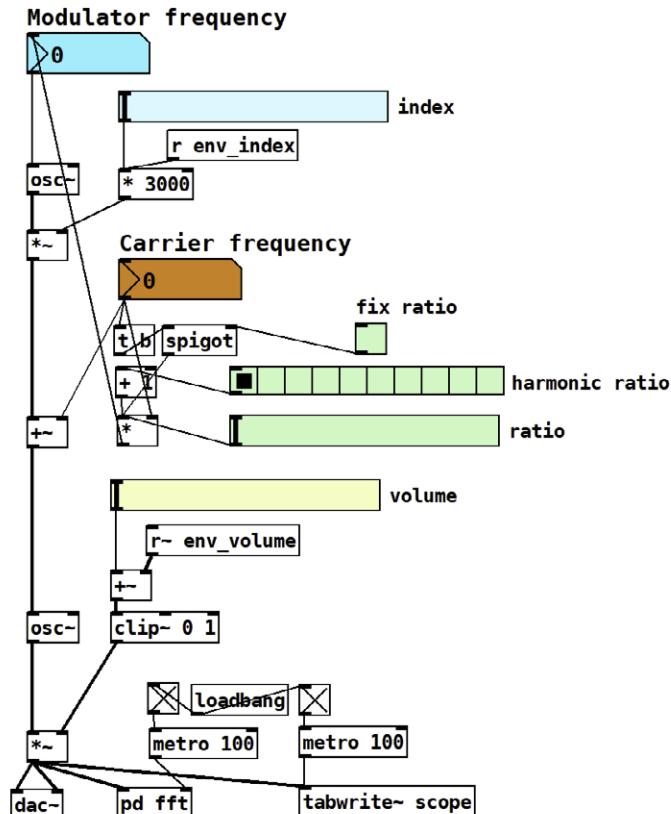


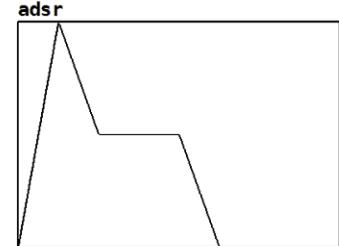
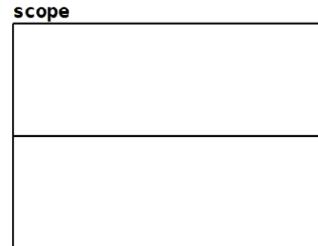
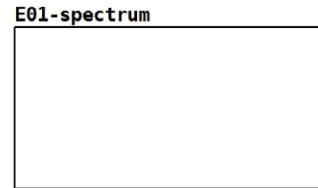
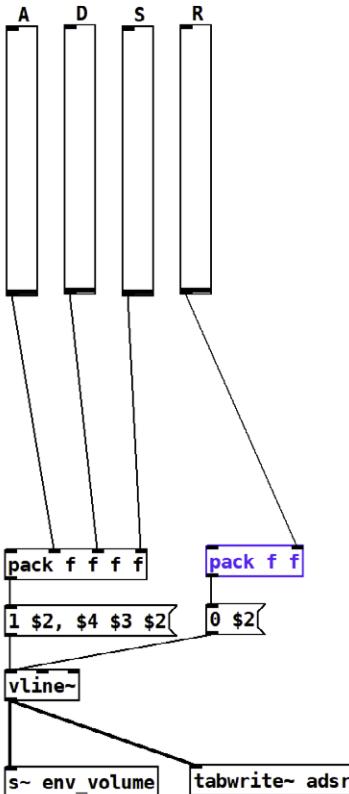
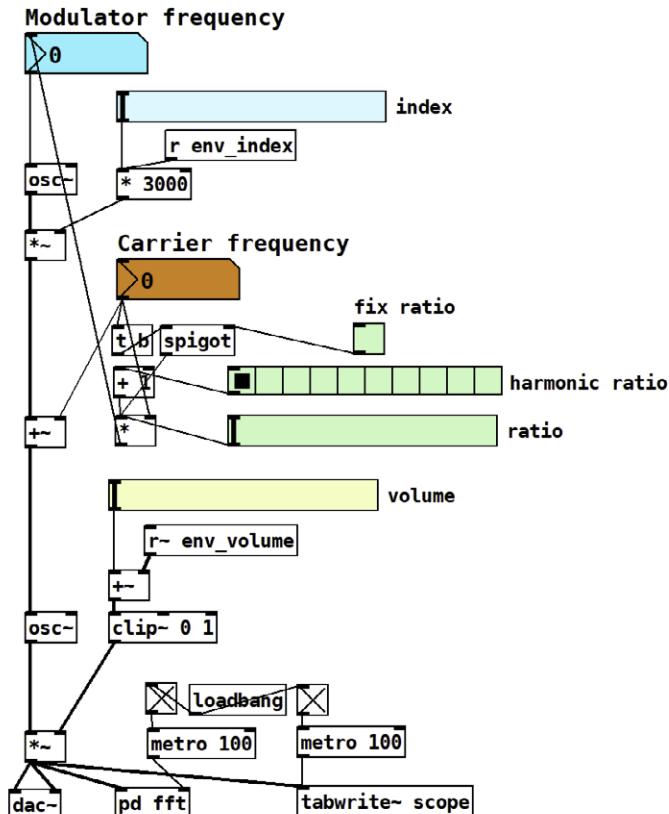
scope

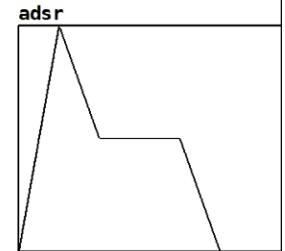
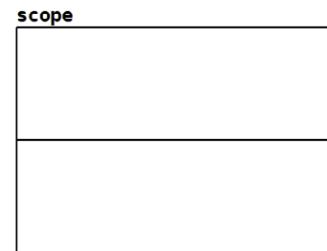
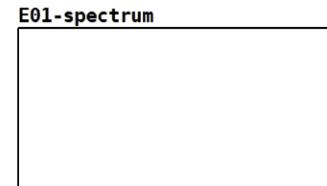
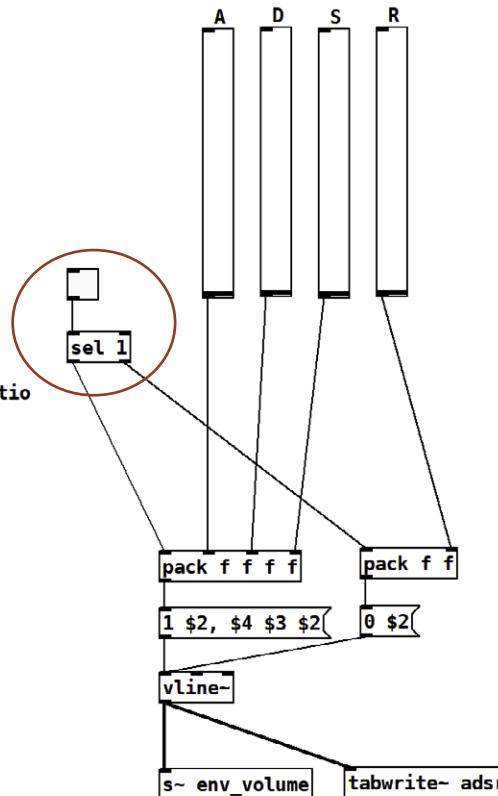
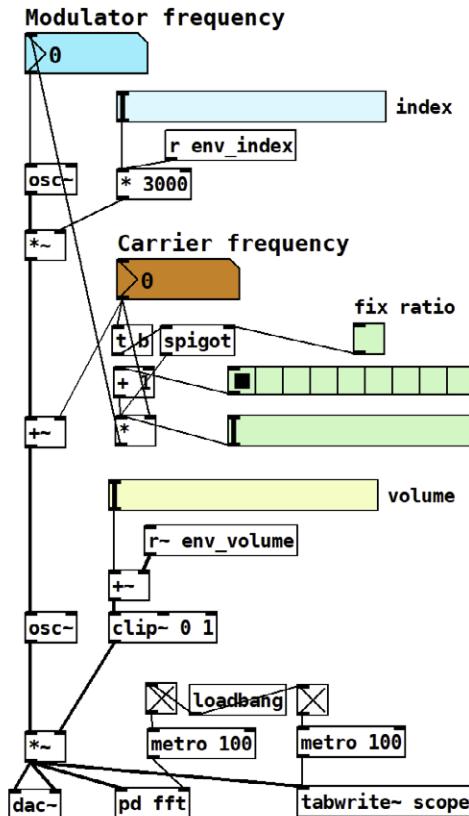


adsr









TAM_Frequency_modulation_Synth_ADSR.pd* - C:/Users/ullar/00A_PROJEKTE/A00_Tangible_Music_Lab/Digital_Sound_Synthesis/PUREDATA/Patches/Modulation

Datei Bearbeiten Einfügen Finde Medien Fenster Hilfe

Modulator frequency

```

2431. --> r env_index
osc--> *~ 3000
*~ --> tb spigot
tb spigot --> +/
+/-> fix ratio
fix ratio --> *
* --> ratio
ratio --> volume
volume --> r- env_volume
r- env_volume --> ++
++ --> osc-
osc- --> clip- 0 1
clip- 0 1 --> *
* --> dac-
* --> pd fft
pd fft --> tabwrite~ scope
    
```

```

2431. --> r env_index
osc--> *~ 3000
*~ --> tb spigot
tb spigot --> +/
+/-> fix ratio
fix ratio --> *
* --> ratio
ratio --> volume
volume --> r- env_volume
r- env_volume --> ++
++ --> osc-
osc- --> clip- 0 1
clip- 0 1 --> *
* --> dac-
* --> pd fft
pd fft --> tabwrite~ scope
    
```

sel 1 (circled) is connected to four vertical boxes labeled A, D, S, and R. Each box has a small horizontal bar at its top.

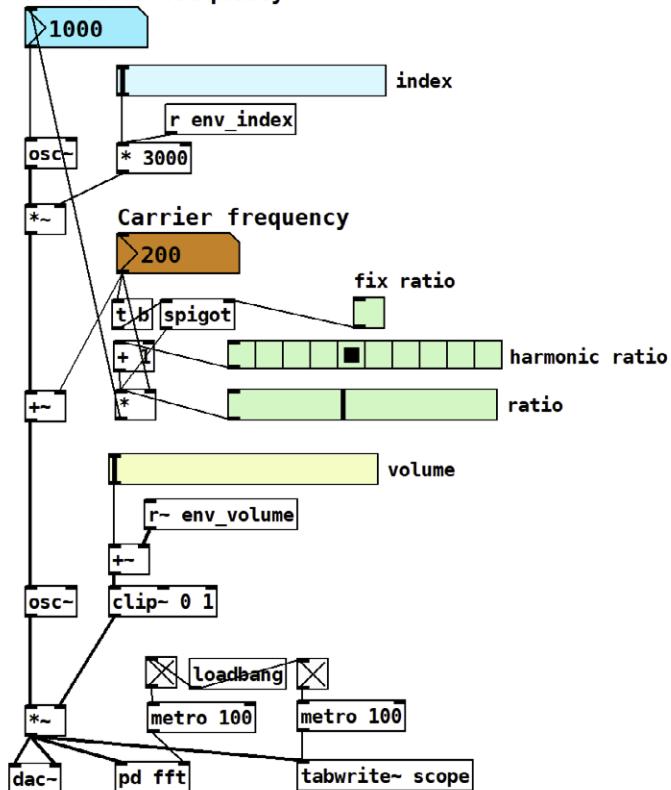
```

sel 1 --> pack f f f f
pack f f f f --> 1 $2, $4 $3 $2
1 $2, $4 $3 $2 --> vline-
vline- --> s~ env_volume
s~ env_volume --> tabwrite~ adsr
    
```

E01-spectrum

scope

adsr

Modulator frequency**Carrier frequency****volume**

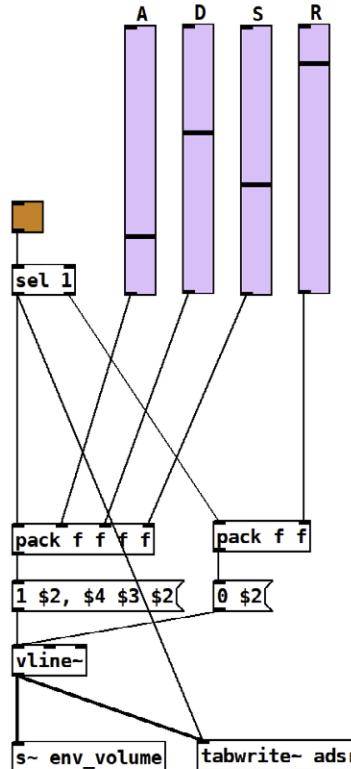
r- env_volume

clip- 0 1

metro 100

metro 100

tabwrite~ scope

**E01-spectrum****scope**;
adsr const 0**adsr**

PHASE MODULATION

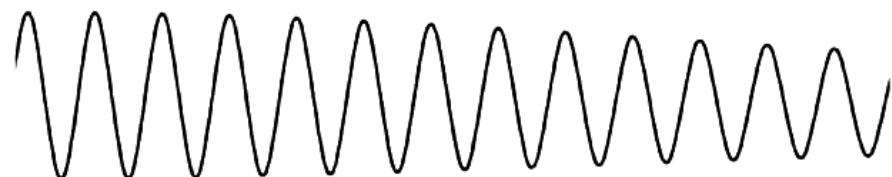
Phase
Modulation



Frequency
Modulation



Amplitude
Modulation



PHASE MODULATION

in DIGITAL SYNTHESIS

- more accurate
- better for feedback loops
- compatible with wavetable synths

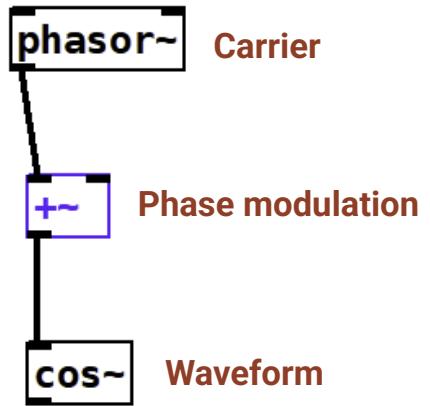
SPLIT THE CARRIER OSCILLATOR INTO ITS PHASE AND WAVEFORM

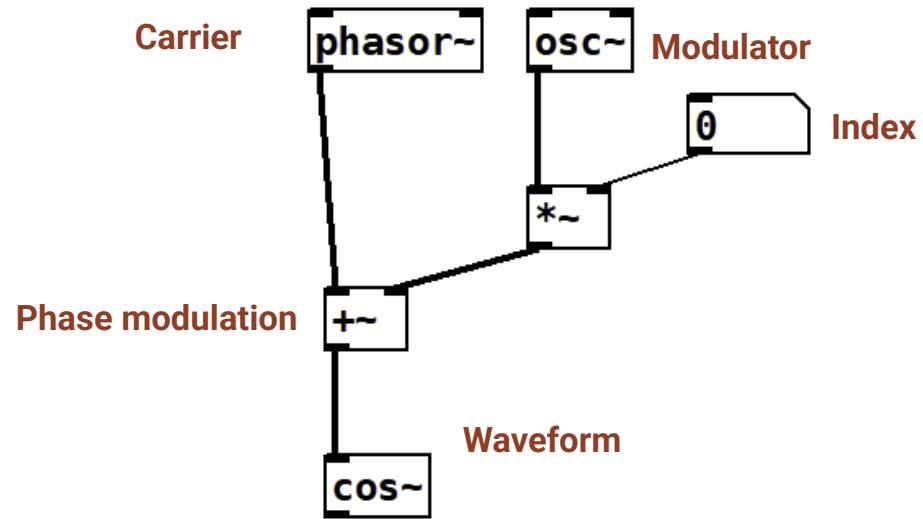
osc~ 300

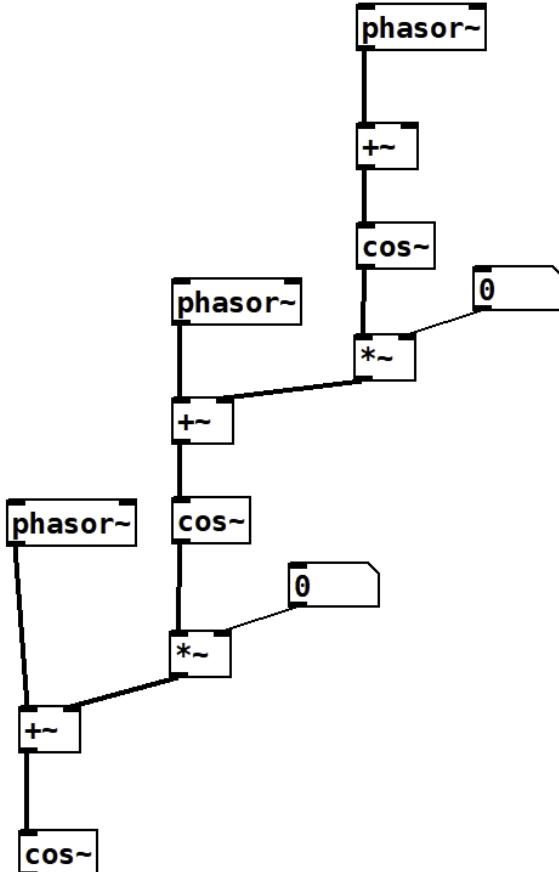
is the same as

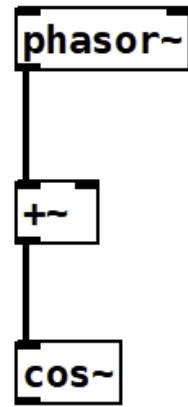
phasor~ 300

cos~



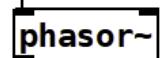






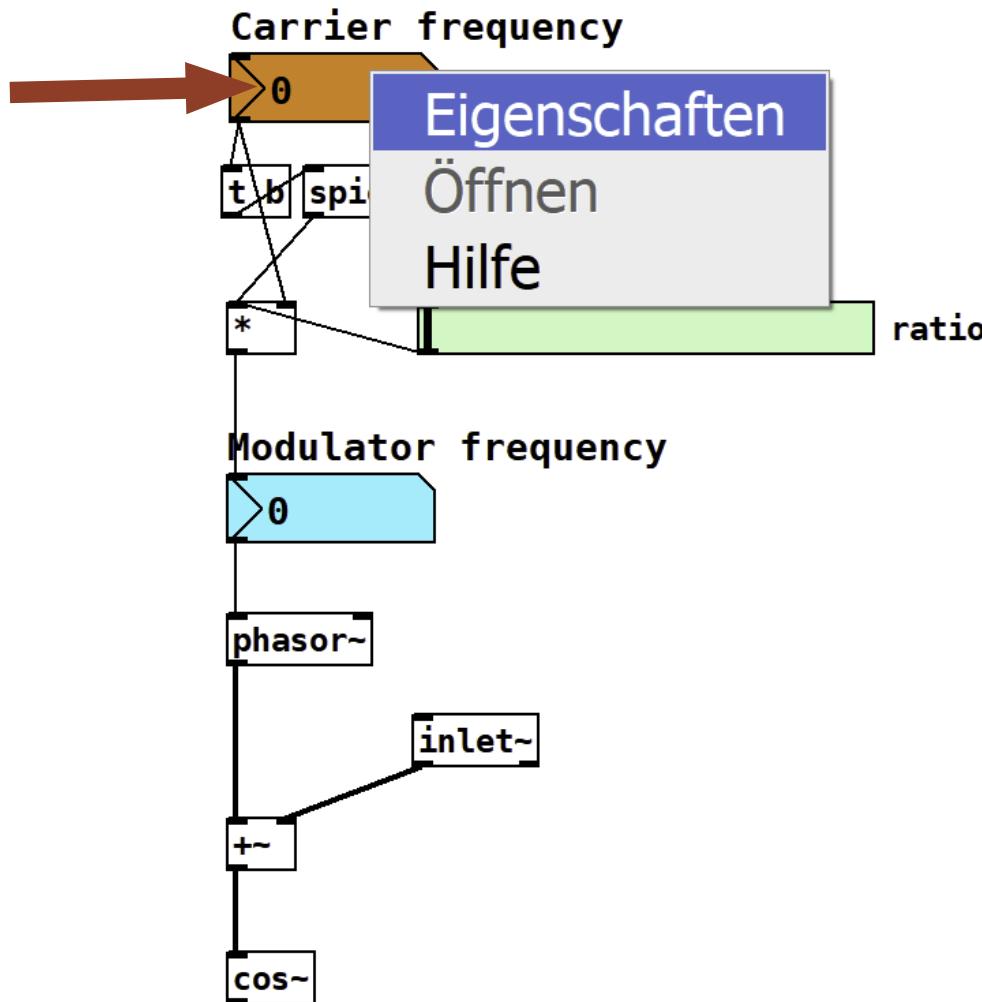
modulator as operator

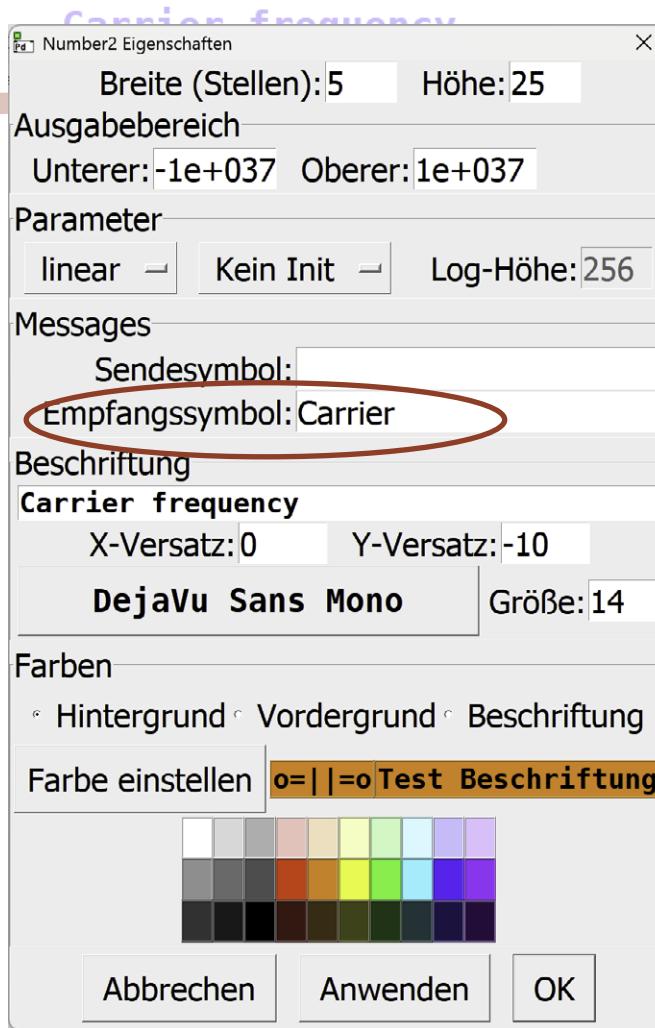
Modulator frequency



Modulation signal







Carrier frequency

> 0

t b spigot

*

fix ratio

Eigenschaften
Öffnen
Hilfe

Modulator frequency

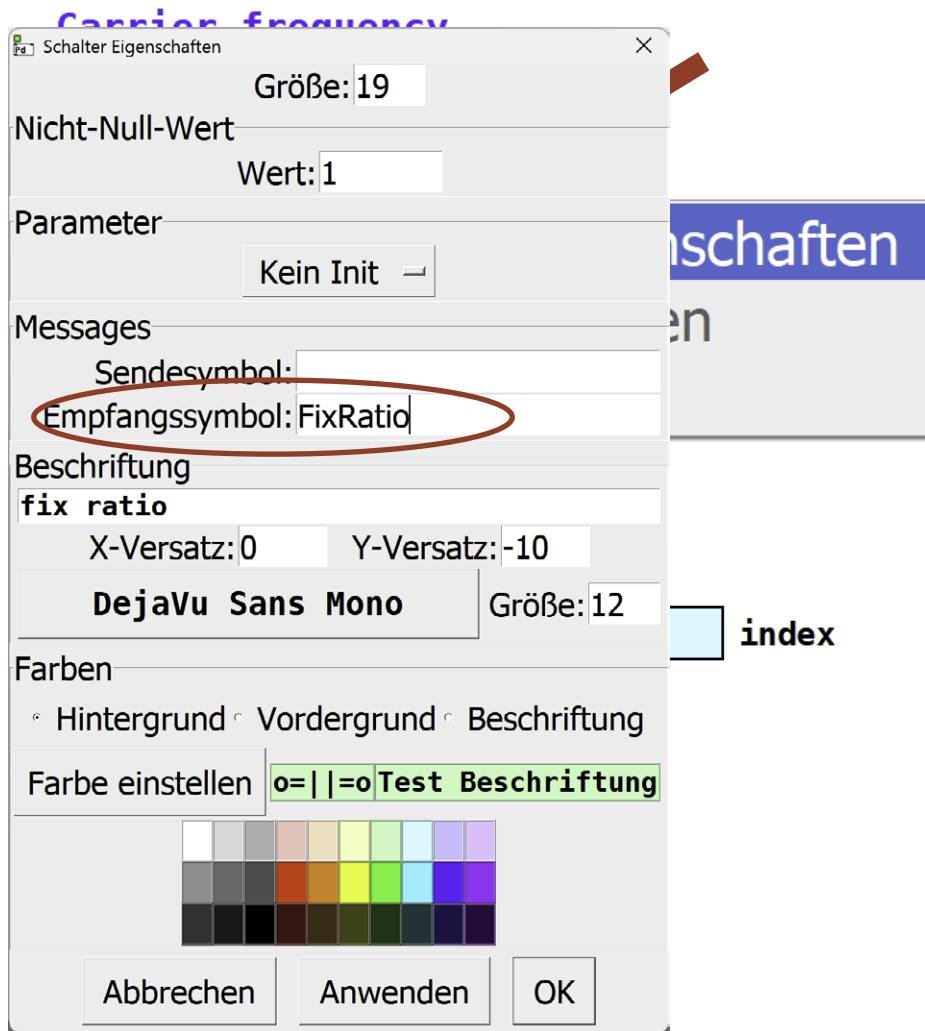
> 0

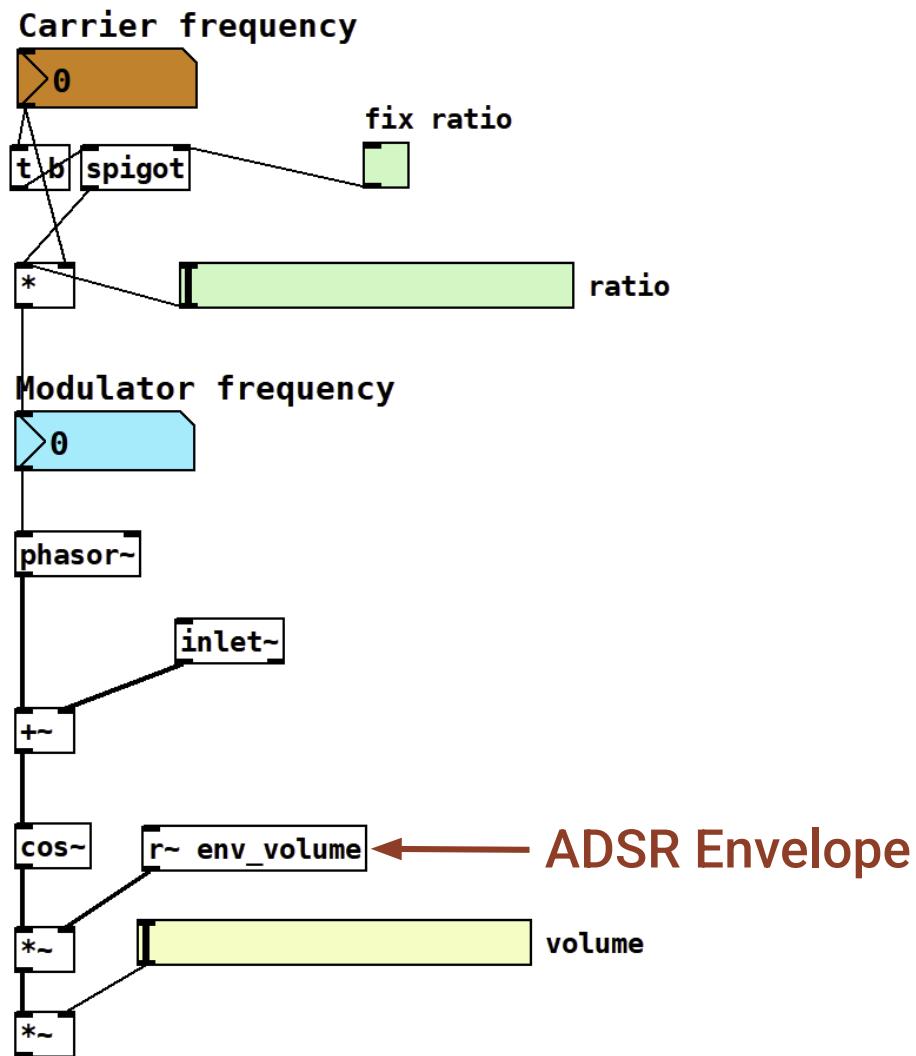
phasor~

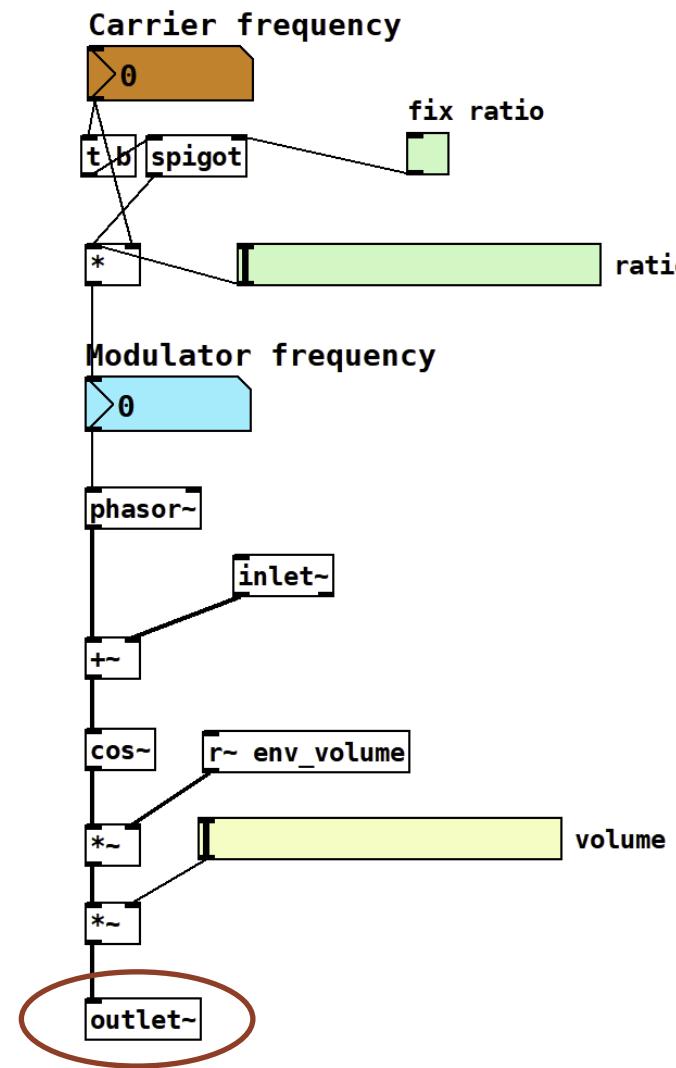
inlet~

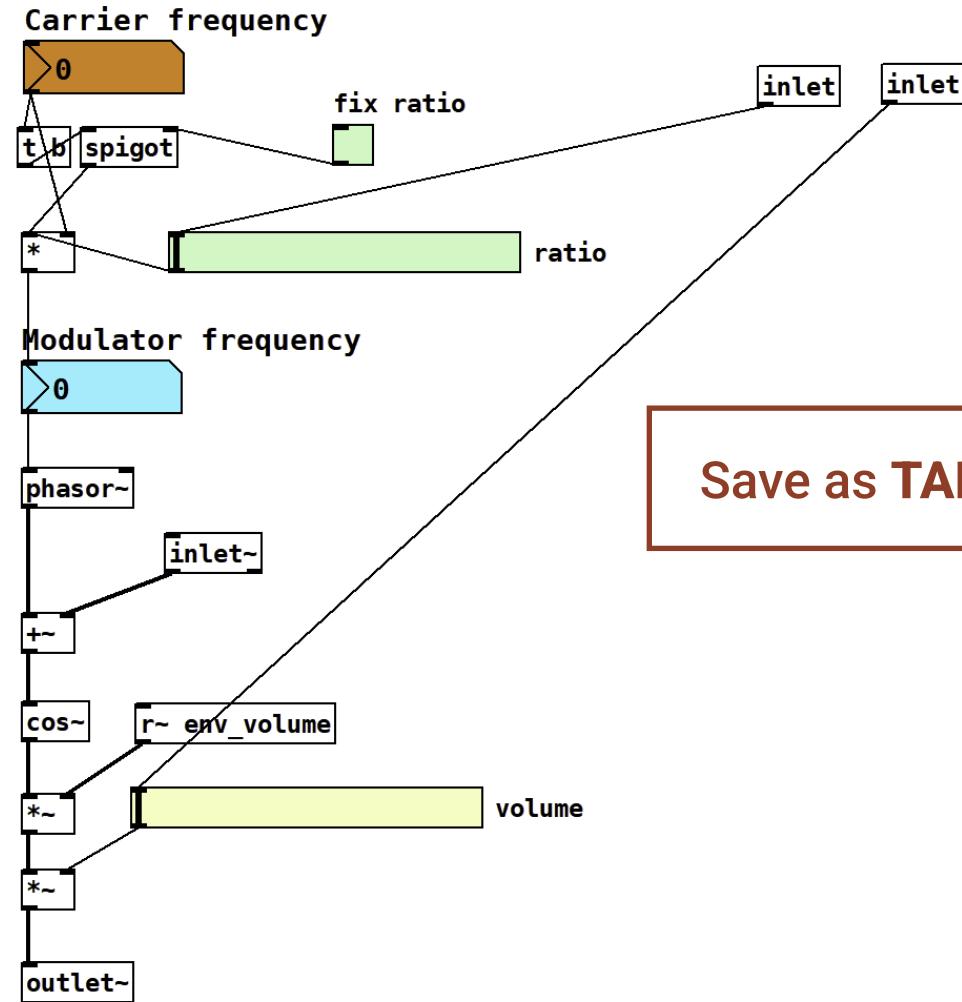
+~

cos~









Save as **TAM_PM.pd**

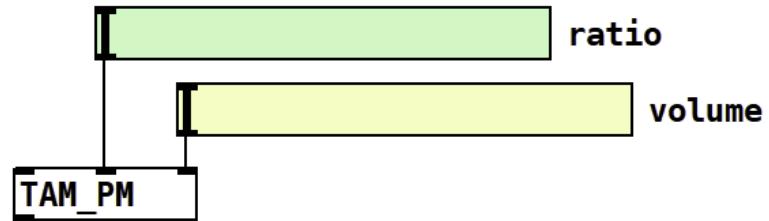
TAM_PM

New Document -
Save as
TAM_PM_Synth.pd

Carrier frequency



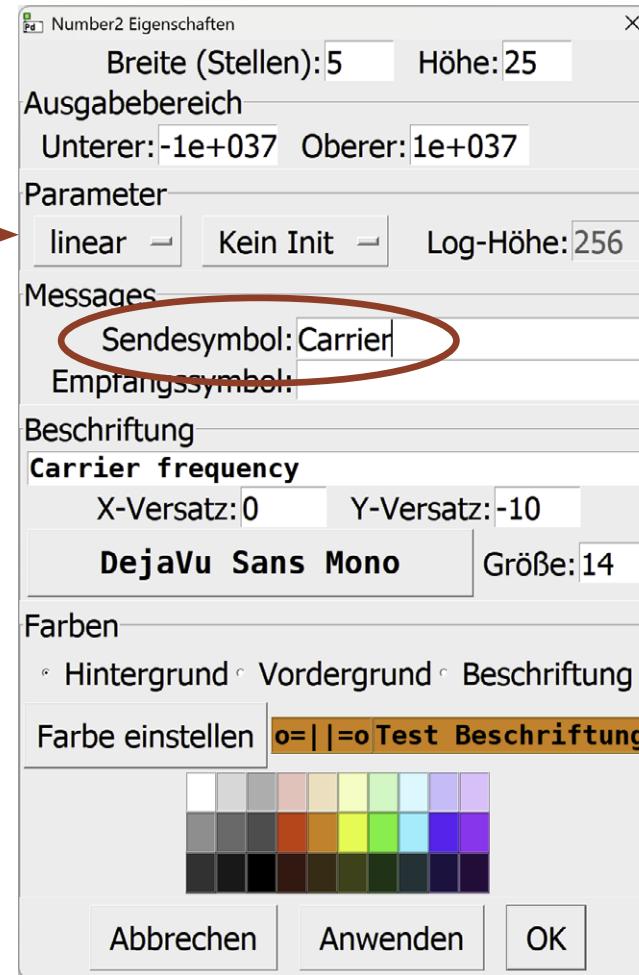
fix ratio



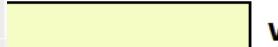
Carrier frequency



fix ratio



ratio

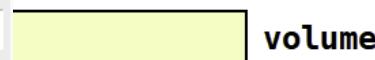
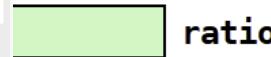
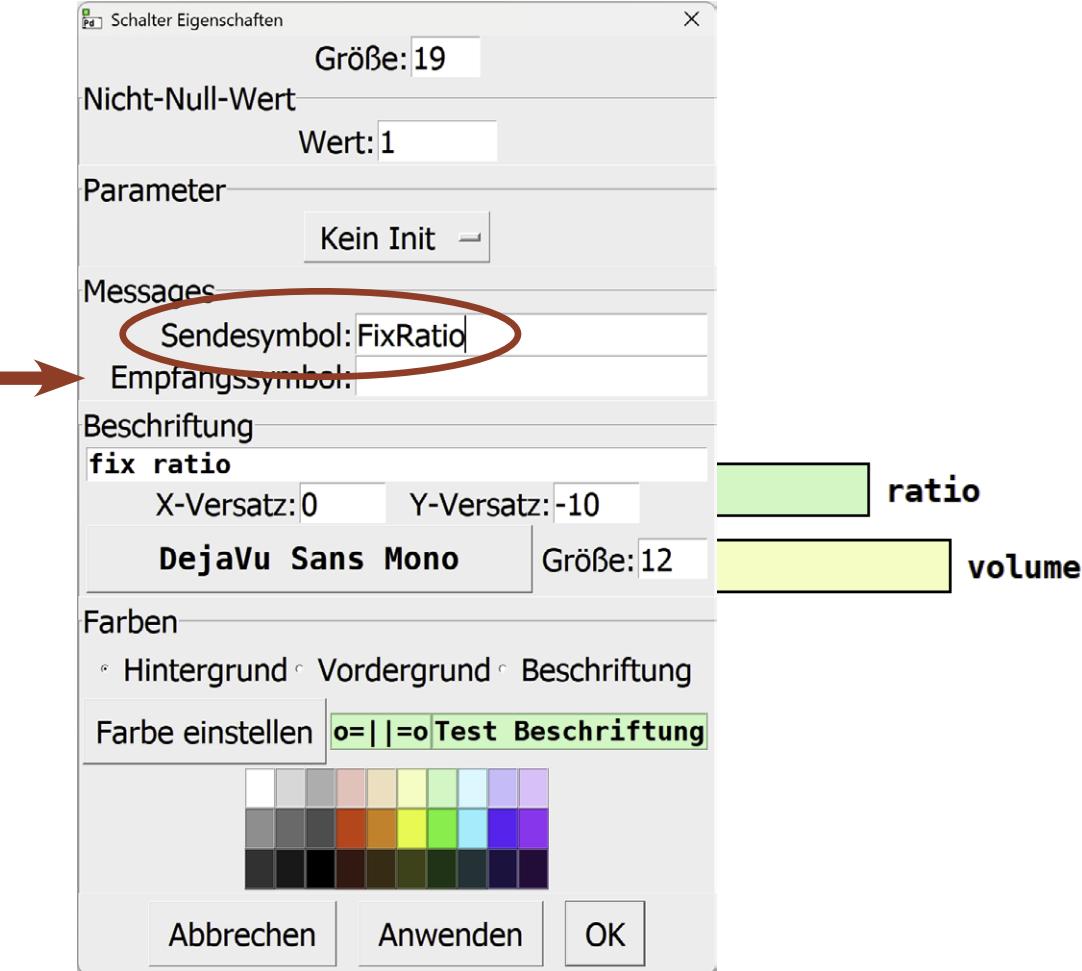


volume

Carrier frequency



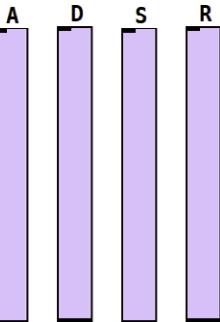
fix ratio



Carrier frequency



fix ratio



sel 1



pack f f f f f



pack f f



1 \$2, \$4 \$3 \$2

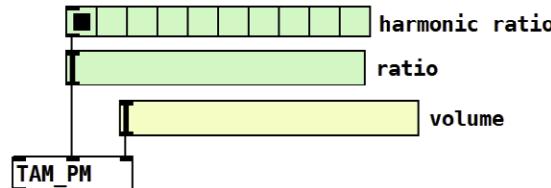


0 \$2



vline-

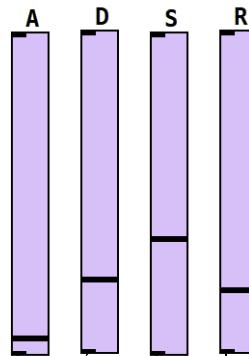
s~ env_volume



Carrier frequency

314

fix ratio



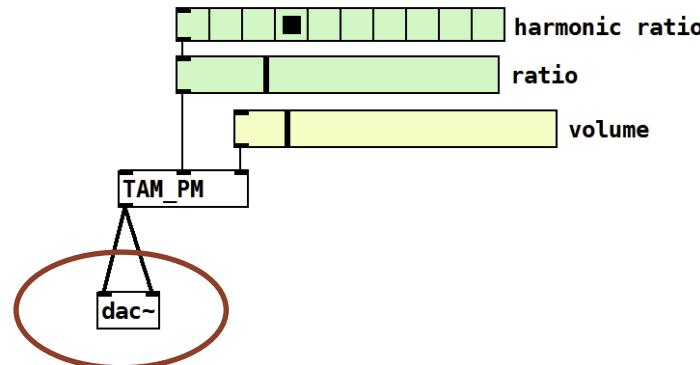
sel 1

1 \$2, \$4 \$3 \$2

vline-

s~ env_volume

0 \$2

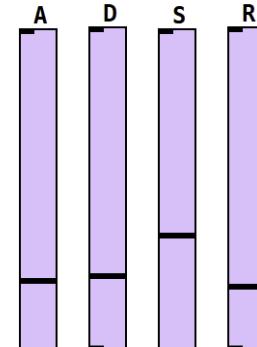


Carrier frequency

>282

fix ratio

[]



[]

sel 1

pack f f f f f

pack f f

1 \$2, \$4 \$3 \$2

0 \$2

vline~

s~ env_volume

harmonic ratio

ratio

volume

TAM_PM

harmonic ratio

ratio

volume

TAM_PM

harmonic ratio

ratio

volume

TAM_PM

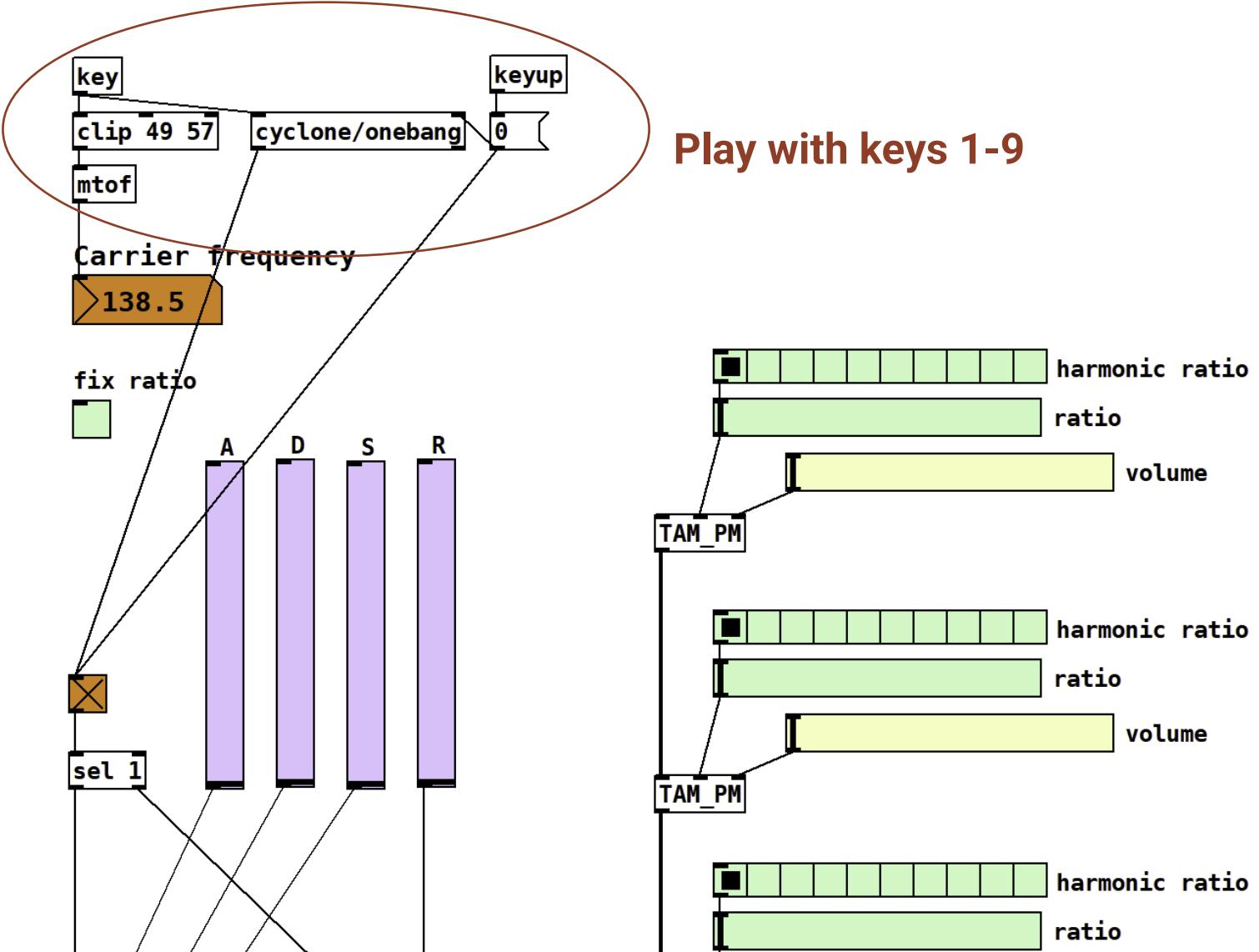
dac~

Operator 3

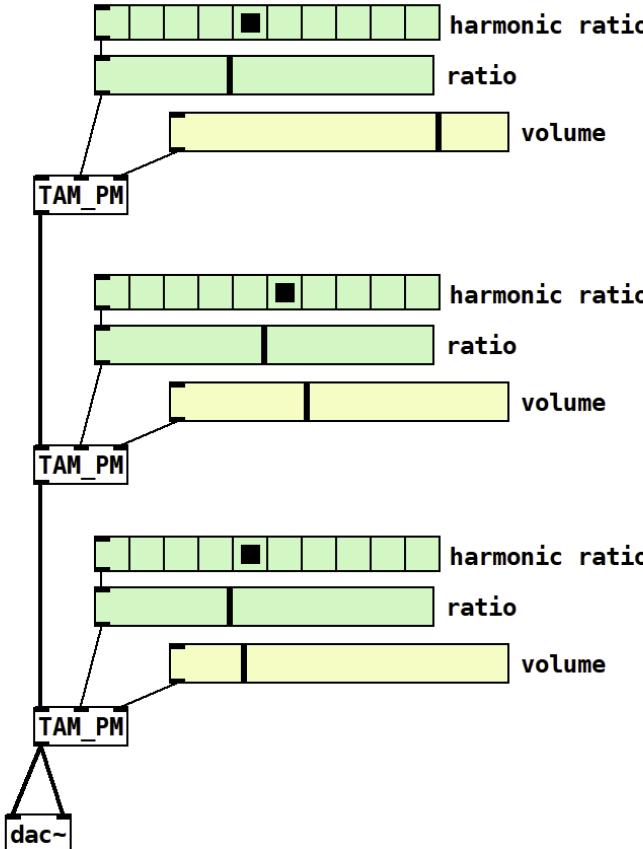
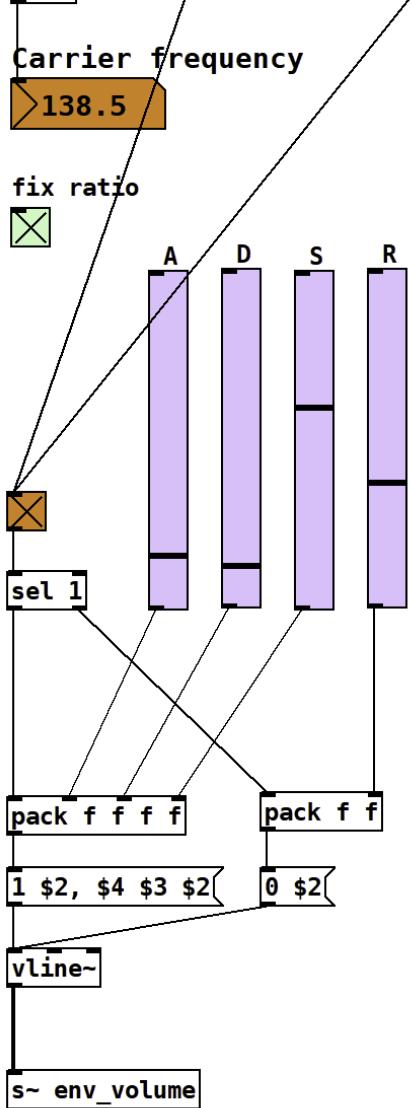
Operator 2

Operator 1

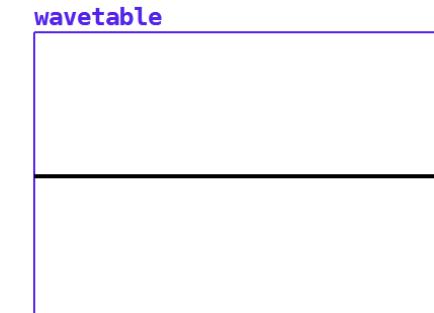
Play with keys 1-9

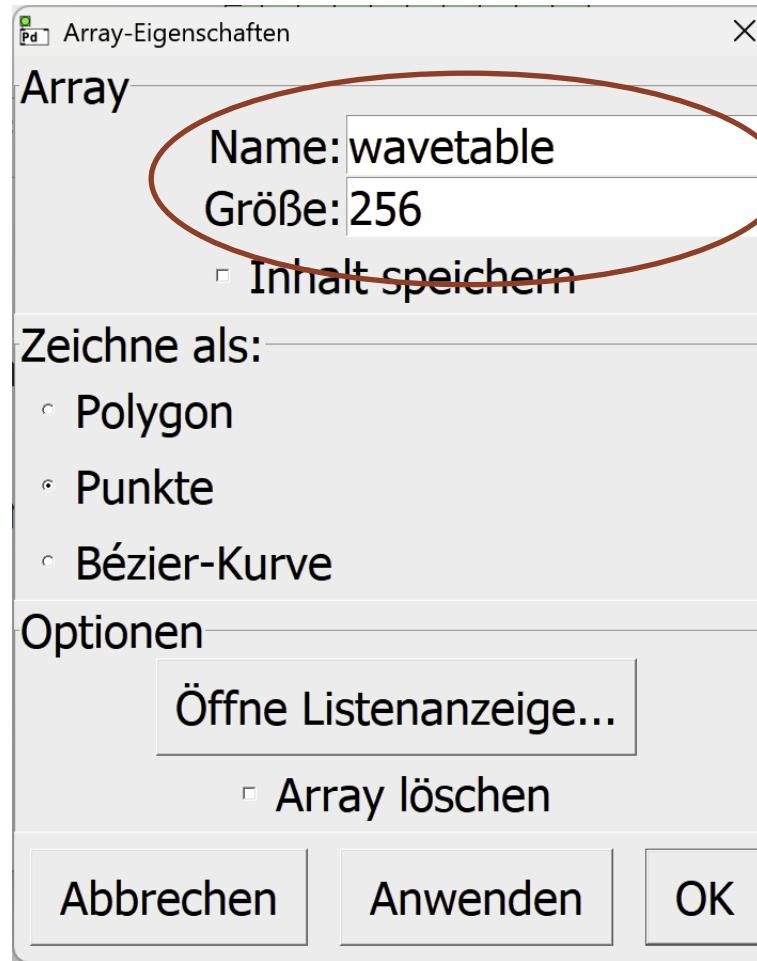
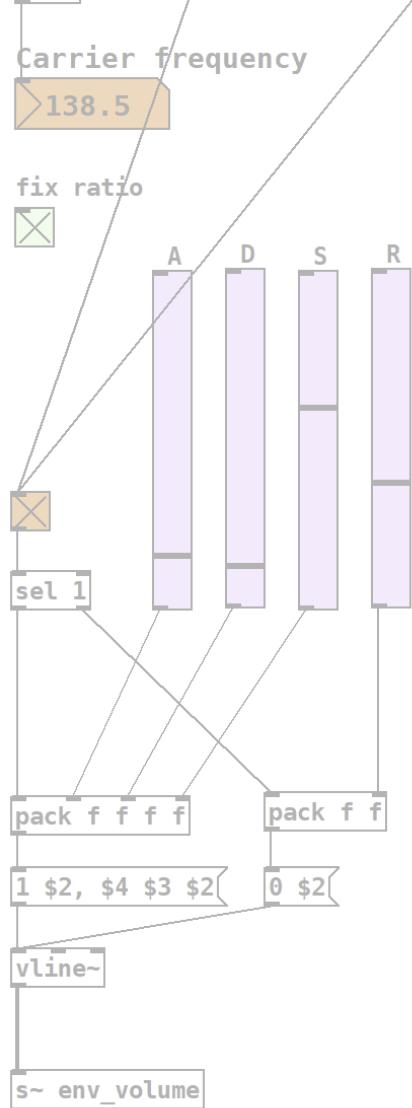


INTEGRATE WAVETABLES

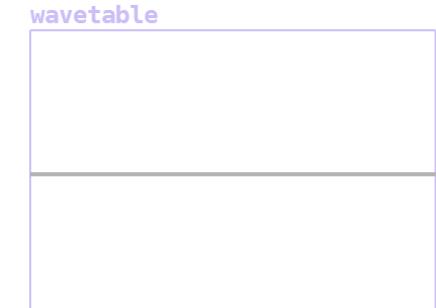


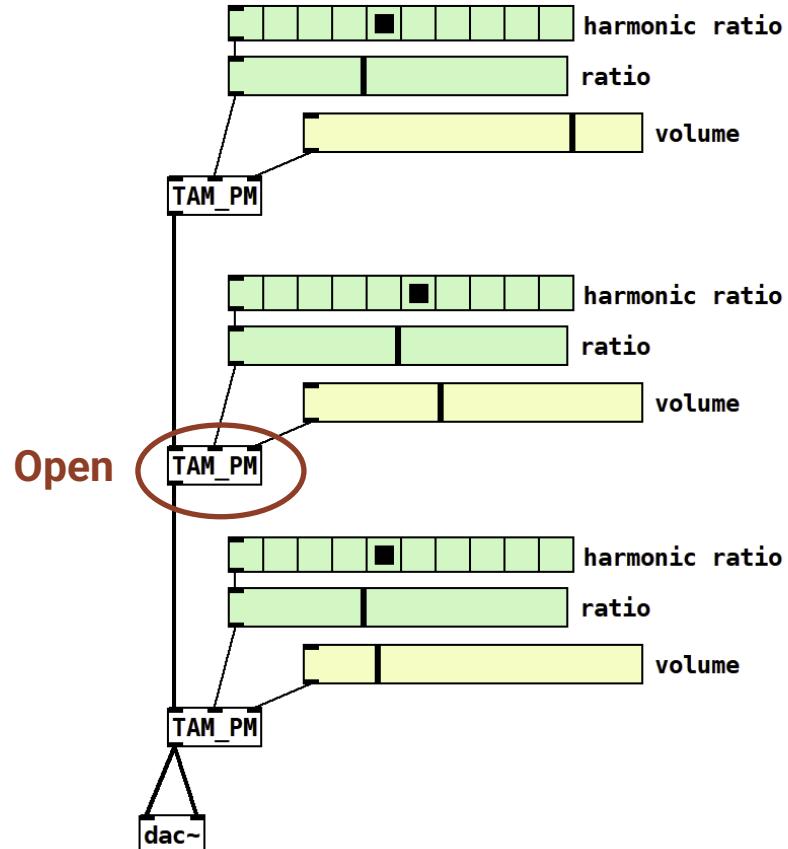
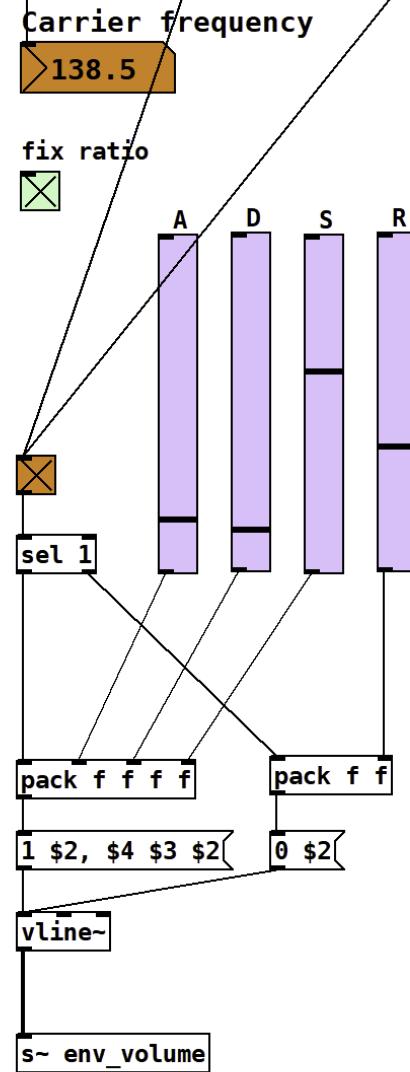
Put array!





Put array!





Carrier frequency

138.5

tb spigot

fix ratio

inlet

inlet

*

ratio

Modulator frequency

692.9

phasor~ inlet~

+-

tabread4~ wavetable

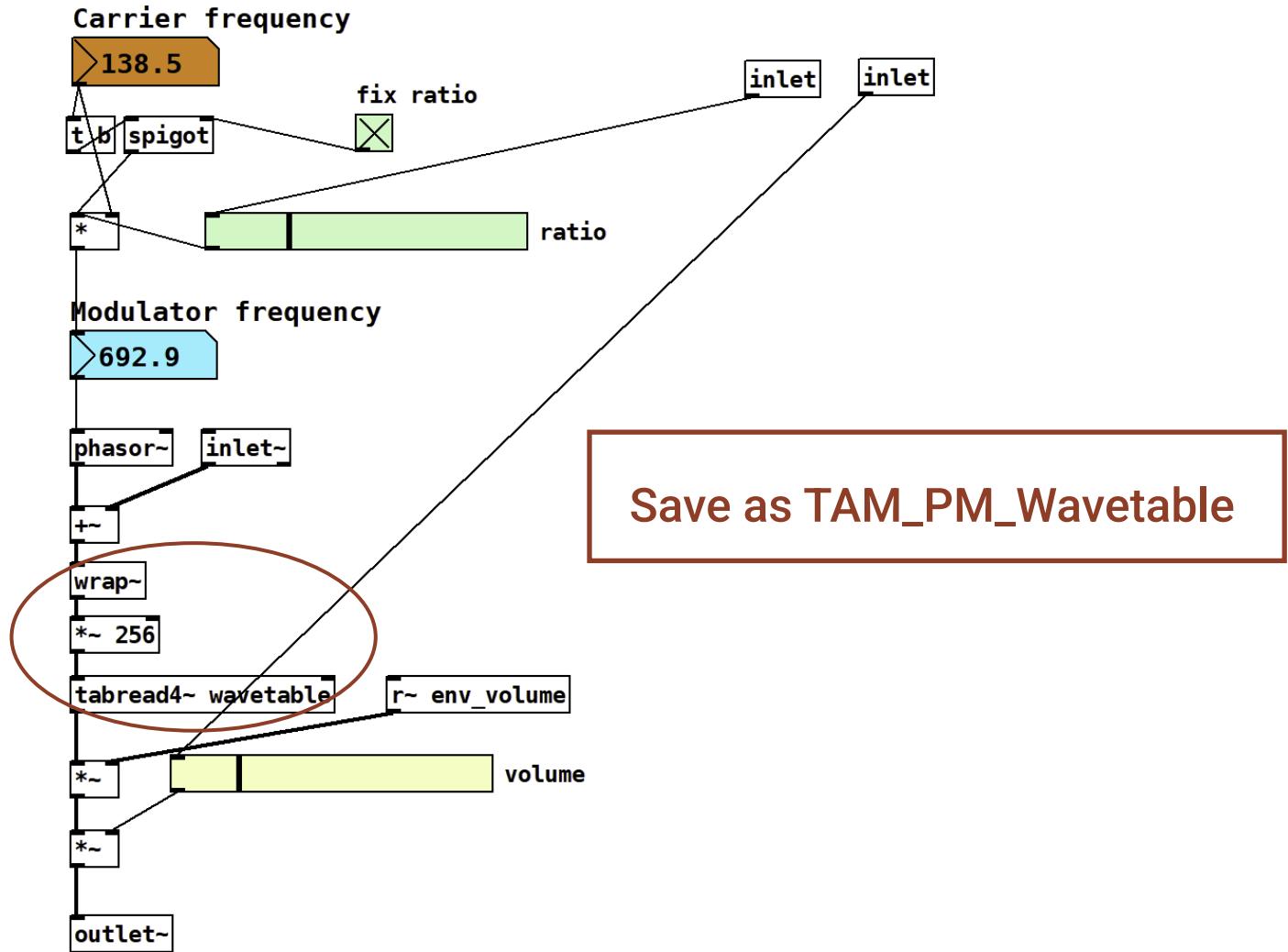
r~ env_volume

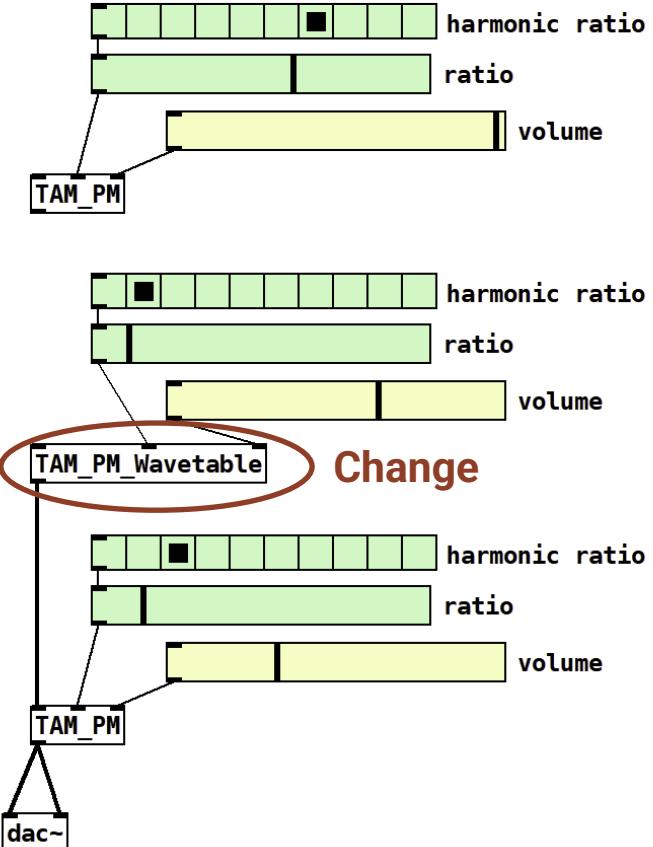
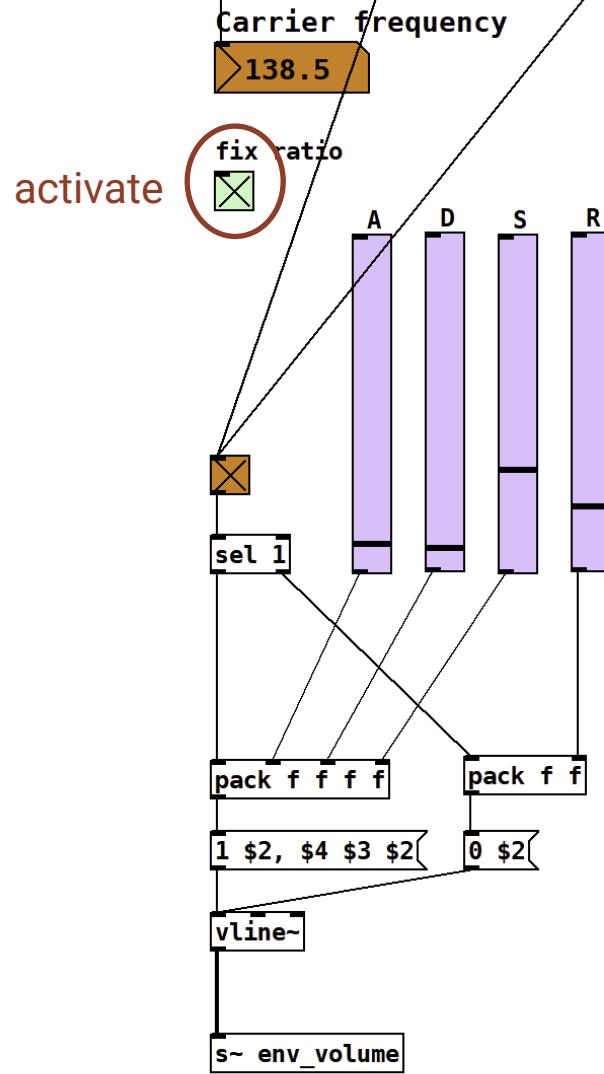
*~

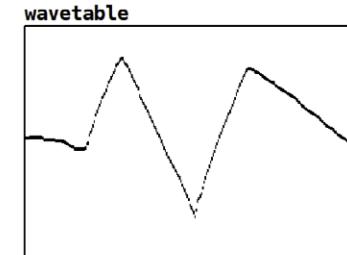
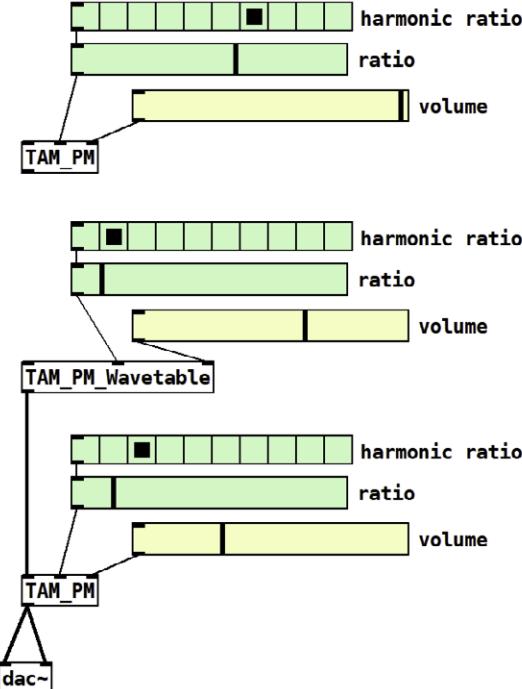
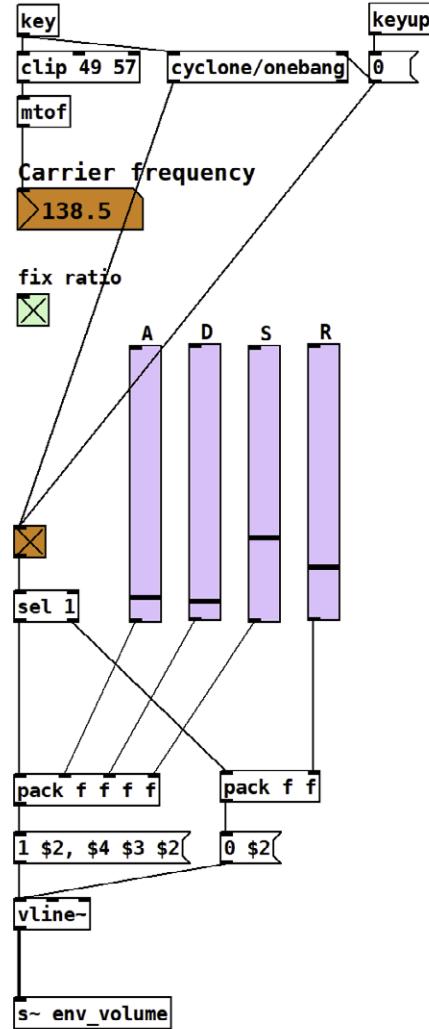
volume

*~

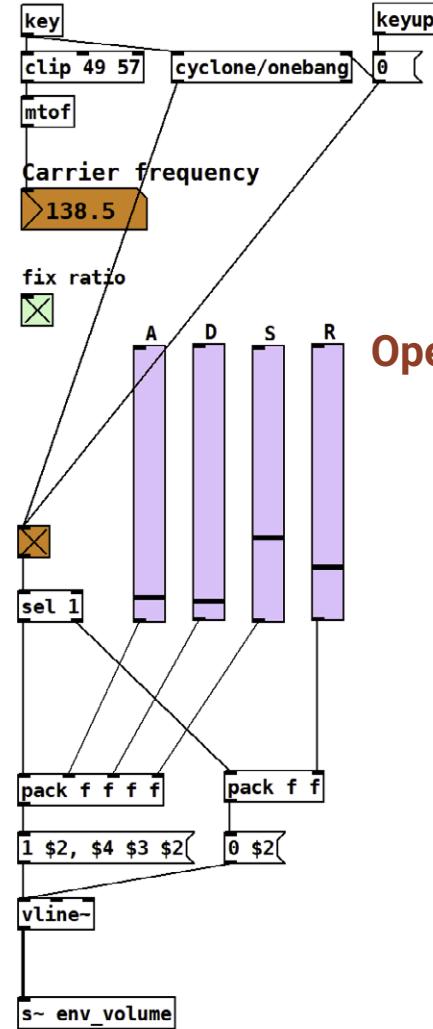
outlet~



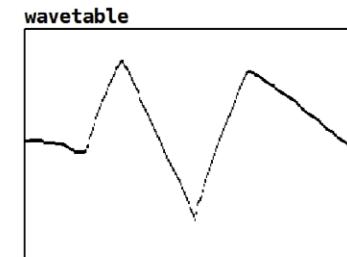
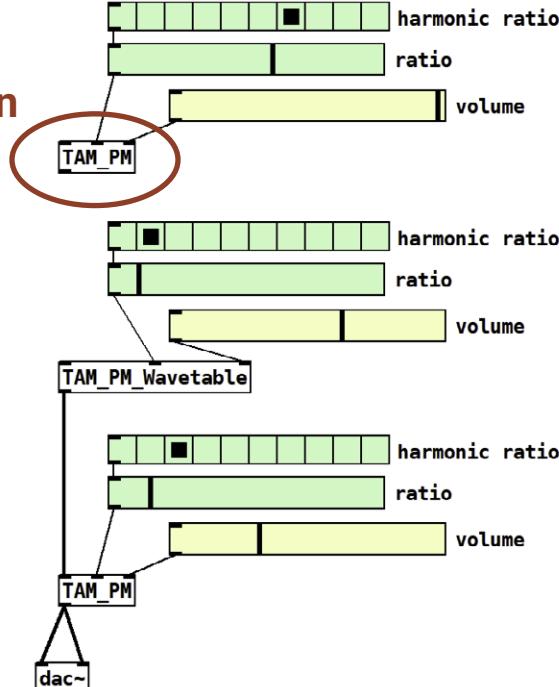


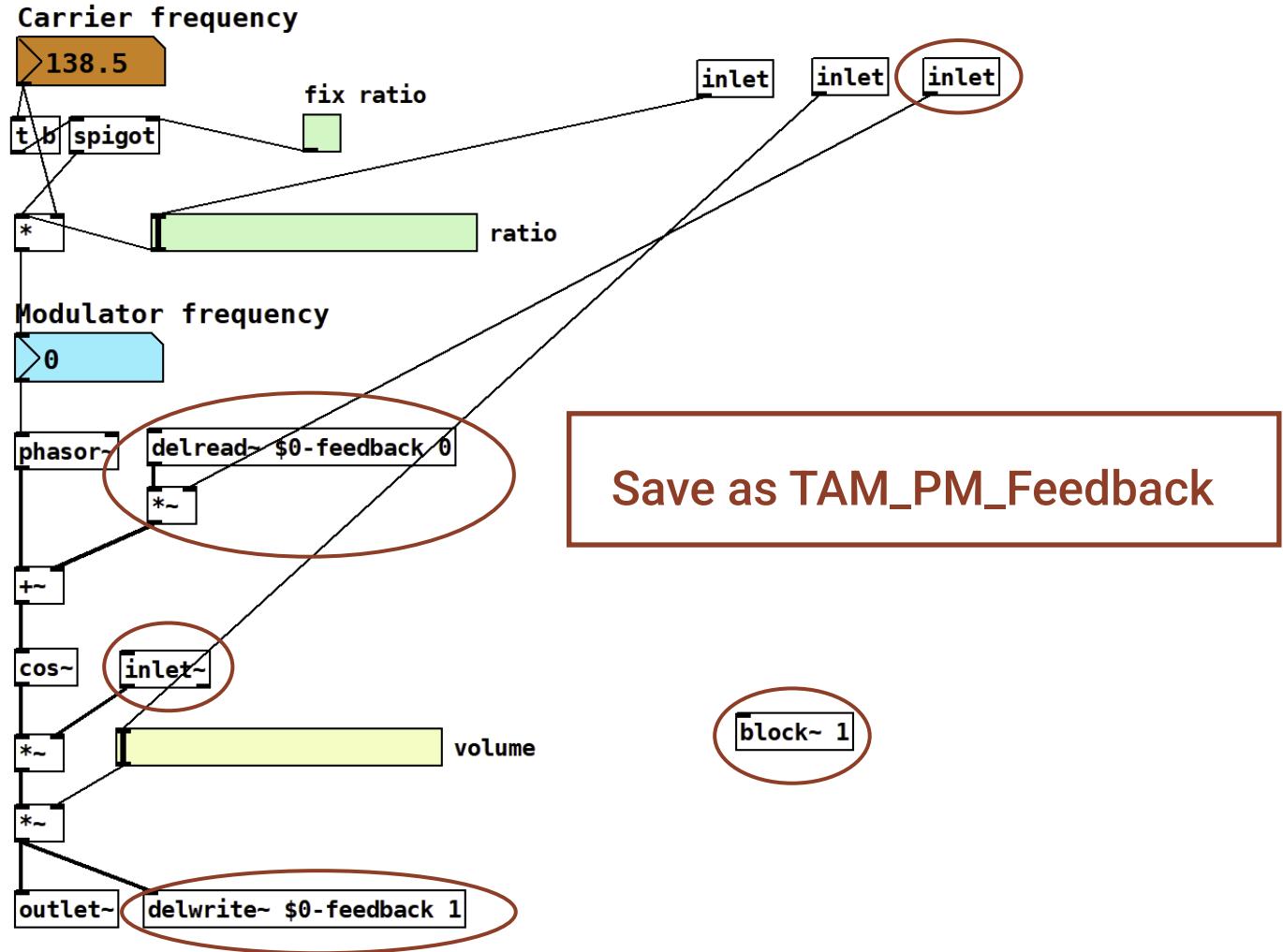


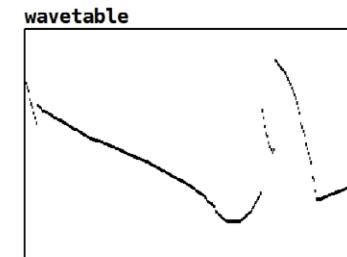
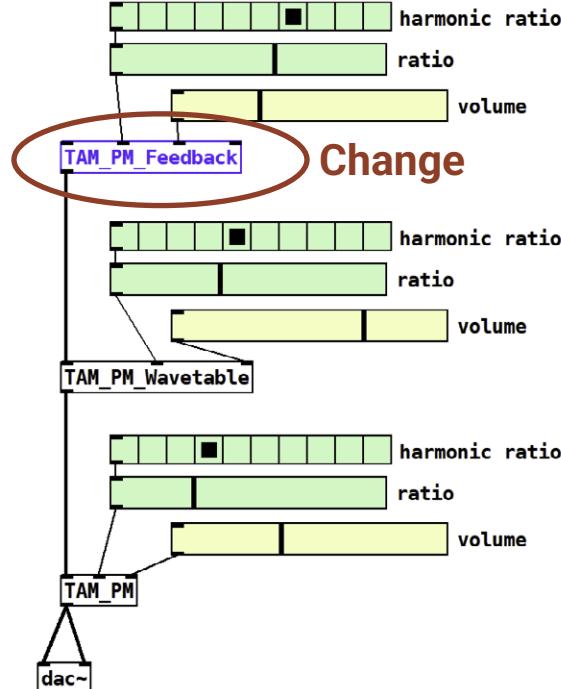
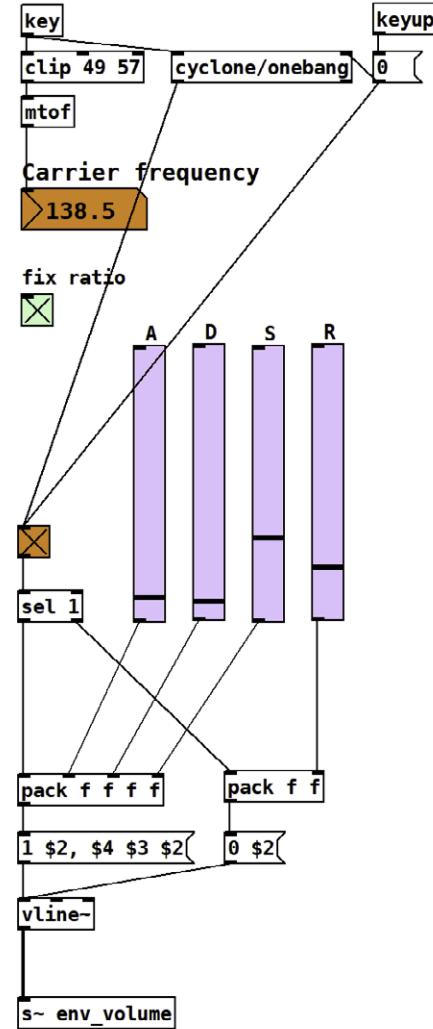
FEEDBACK MODULATION

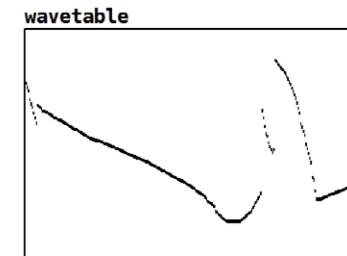
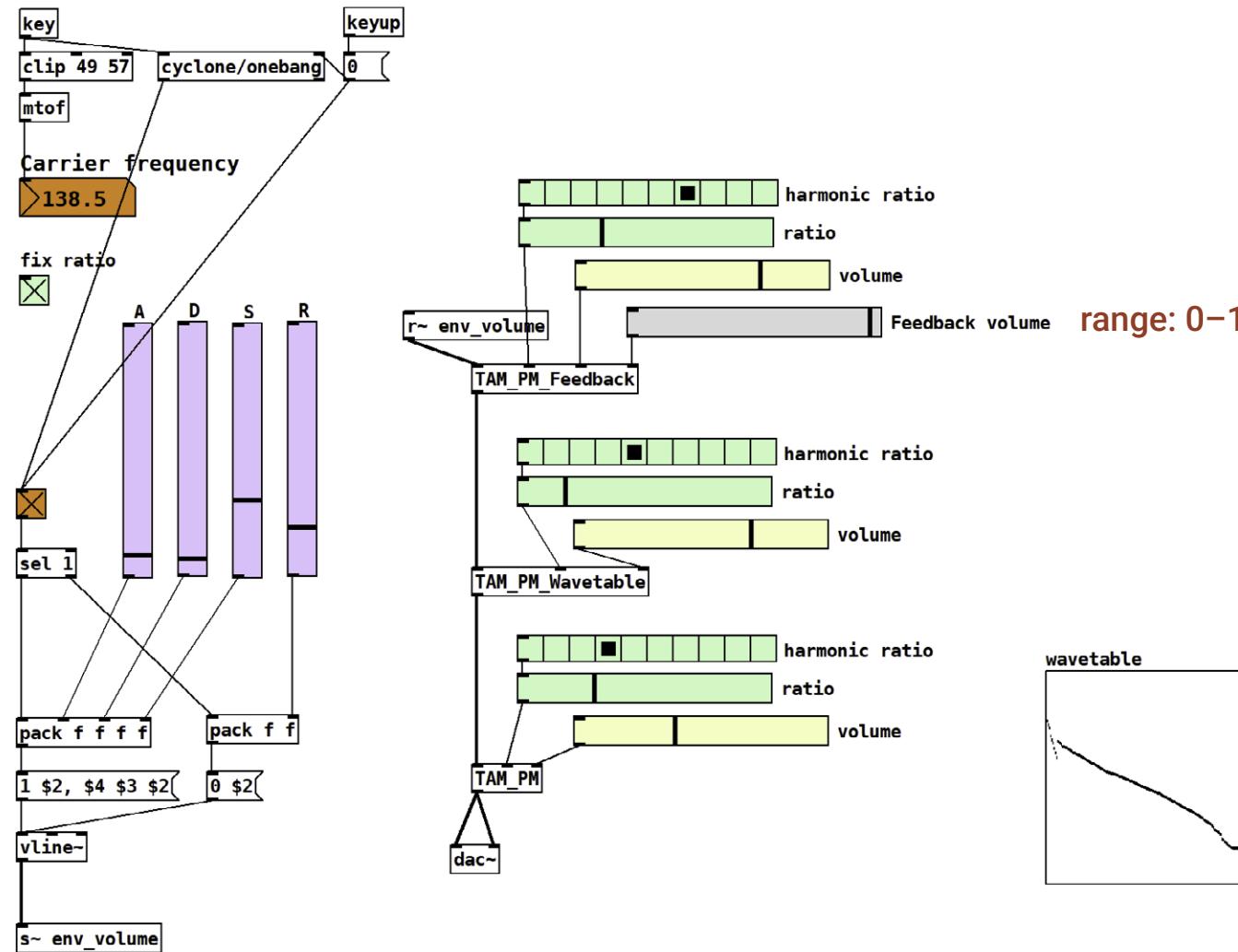


Open









FINAL TASK:
EMBED ONE OF THE SYNTHESIS METHODS
IN YOUR BELA PROJECT