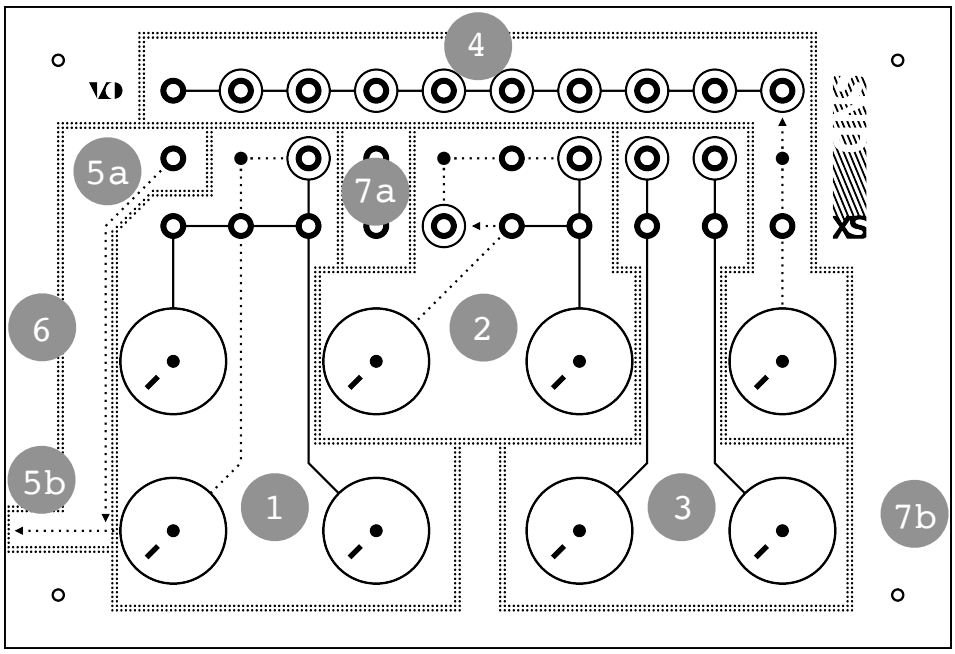
VARIABLE OSCILLATIONS

Sinusoidal Numeric
Incremental Device

user manual version 1.2
written and illustrated
by researcher 1 1 2 5 3

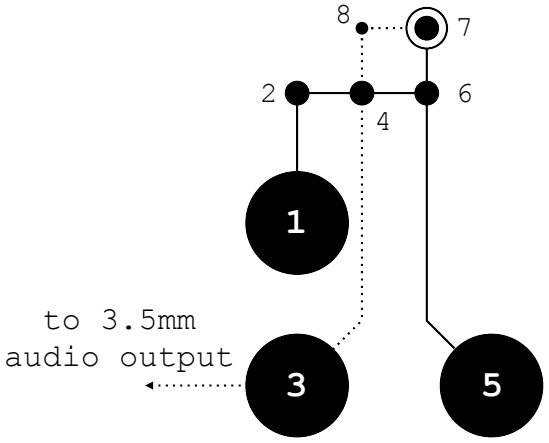
SNIDxs is a semi-modular patchable synthesizer meaning it is made up of submodules which can be connected in a combination of ways to produce a wide array of sounds. This is done using patch cables to send control voltage (CV) signals through the patch points along the top of the instrument from the outputs of one submodule to the inputs of another. Patch points that are outputs emit a voltage and are denoted by the circle outline while those without a circle are inputs. The exception to this being the two CV jacks **(7a)** which can be used to connect to external devices through the right side 3.5mm jack **(7b)**. Their directionality is determined by what sort of device they are interfacing with. **SNIDxs operates on 0 to +5 volts and signals outside this range should not be connected to the patch points.**



Submodules

1 Wave Multiplier Oscillator
2 Sine Wave Oscillator
3 Attenuators
4 Clock Divider
5a Audio Output Patch Point
5b 3.5mm Headphone Audio Output
6 Mini USB / Coin Cell Battery Power
7a Mini Banana CV Patch Points
7b 3.5mm TRS CV Jack

Wave Multiplier Oscillator



1 Frequency Control Knob
2 Frequency Input Patch Point
3 Amplitude Control Knob
4 Amplitude Input Patch Point
5 Comparator Control Knob
6 Comparator Input Patch Point
7 Unattenuated Output Patch Point
8 Power Indicator LED

The wave multiplier oscillator is the main sound generator of SNIDxs. It outputs a sine wave that is multiplied back onto itself and is capable of producing a wide range of tones. The frequency of the oscillator is controlled by both the frequency knob **(1)** and the corresponding patch point **(2)**. The multiplication amount is determined by the level of the comparator knob **(5)** as well as the voltage level into the comparator input patch point **(6)**. If the comparator is turned down (knob fully counter clockwise and no signals into the patch point) the oscillator will generate a sine wave. Slowly increasing the comparator value will result in the sine wave changing to a ramp wave and then changing to various complex waveforms **(figure 1)**.

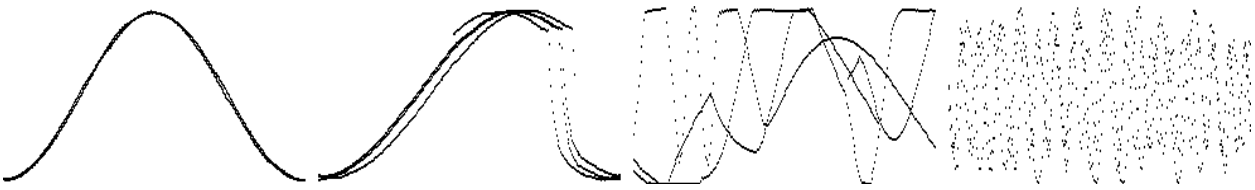
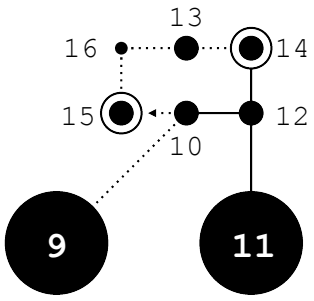


Figure 1: Wave multiplier waveform with different comparator values

The oscillator has two outputs, the 3.5mm headphone jack on the left side of the instrument and the output patch point **(7)**. The volume of the signal routed to the headphone jack is controlled by the amplitude knob **(3)** and patch point **(4)**. The output from the patch point **(7)** is the full range unaffected by the amplitude controls.

Sine Wave Oscillator



9 Amplitude Control Knob
10 Amplitude Input Patch Point

11 Frequency Control Knob
12 Frequency Input Patch Point

13 Sync Input Patch Point

14 Unattenuated Output Patch Point
15 Attenuated Output Patch Point

16 Wave Indicator LED

The sine wave oscillator can act as an audio source like the wave multiplier oscillator or as a modulation source for controlling the parameters of other submodules. If used as an audio source the signal must be patched from one of the outputs **(14 / 15)** to the main audio output patch point. Like the wave multiplier, the sine wave oscillator has controls for its amplitude **(9 + 10)** and frequency **(11 + 12).**

If a voltage is applied to the sync input patch point **(13),** the sine wave becomes synced to the wave multiplier oscillator **(figure 2).** When the sine wave is set to LFO rates and the sync input is high the oscillator will generate slow saw waves.

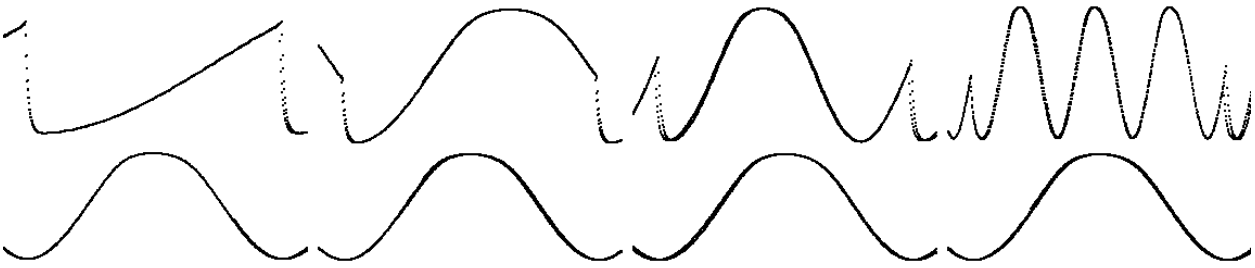
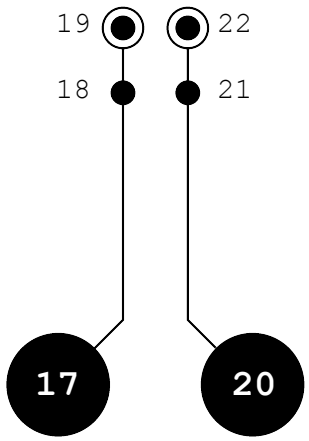


Figure 2: Wave multiplier (bottom) and sine wave at audio rates (top) which resets when the wave multiplier waveform completes a cycle

Attenuators



17 Attenuator 1 Control Knob
18 Attenuator 1 Input Patch Point
19 Attenuator 1 Output Patch Point

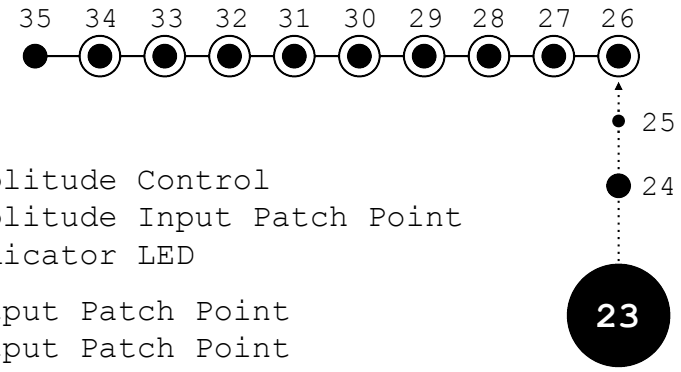
20 Attenuator 2 Control Knob
21 Attenuator 2 Input Patch Point
22 Attenuator 2 Output Patch Point

The attenuators are used to scale signals down before they reach their destination. By patching a signal in to an attenuator's input patch point **(18 / 21)** the signal's amplitude at the output patch point **(19 / 22)** is controlled by the position of the attenuator's control knob **(17 / 20).** When the attenuators are turned down fully they allow no signal to pass through.

If attenuation is applied to audio sources, this results in decreasing the volume of the waveform before going to the output and is useful for mixing multiple audio signals together.

If applied to signals used for modulation, the attenuation will decrease the effect the modulation has on the parameter it is then routed to.

Clock Divider



23 Division 2 Amplitude Control
24 Division 2 Amplitude Input Patch Point
25 Division 2 Indicator LED

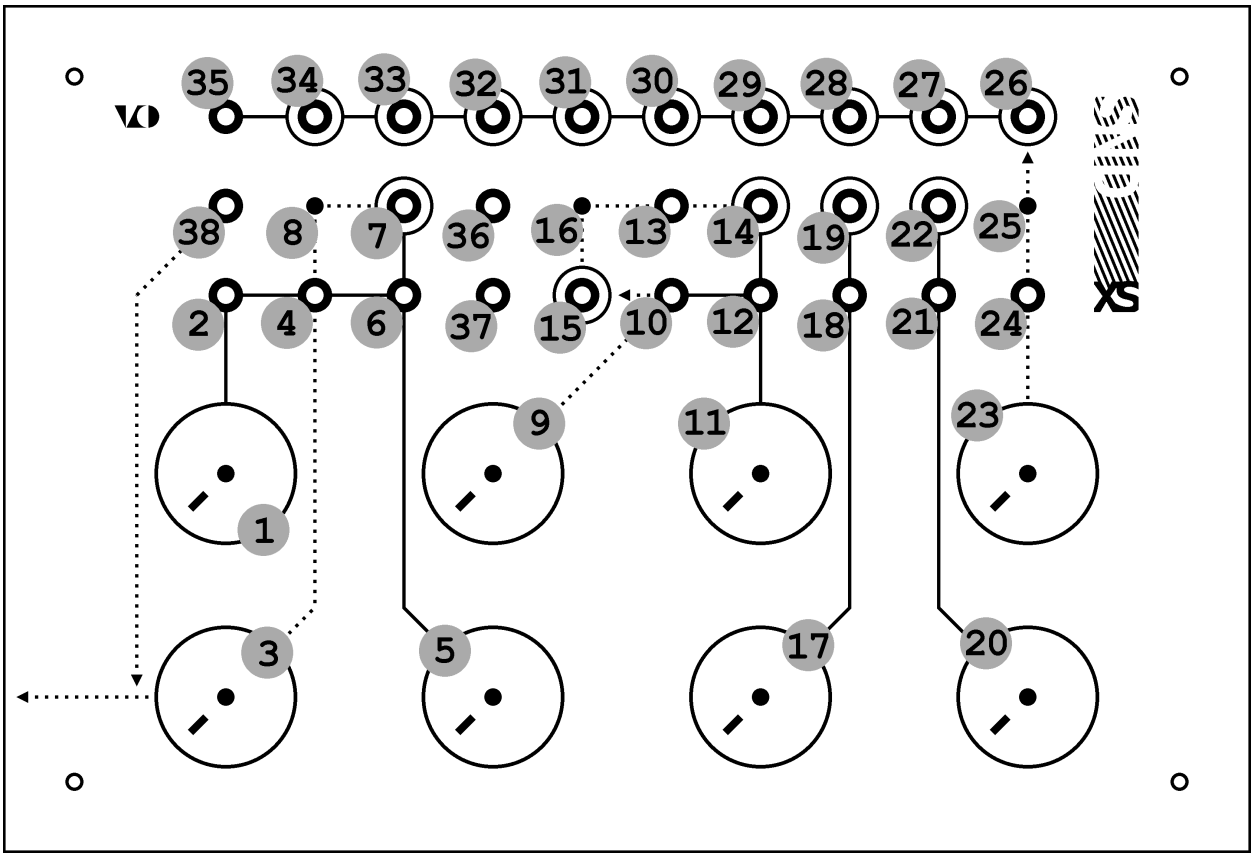
26 Division 2 Output Patch Point
27 Division 4 Output Patch Point
28 Division 8 Output Patch Point
29 Division 16 Output Patch Point
30 Division 32 Output Patch Point
31 Division 64 Output Patch Point
32 Division 128 Output Patch Point
33 Division 256 Output Patch Point
34 Division 512 Output Patch Point

35 Clock Divider Input Patch Point

The clock divider takes a signal at its input **(35)** and outputs square wave divisions from its outputs **(26 - 34).** It can be used for creating different rhythms when using slower input signals or, if using faster audio signals at the input, can be used as a square wave oscillator that outputs sub octaves.

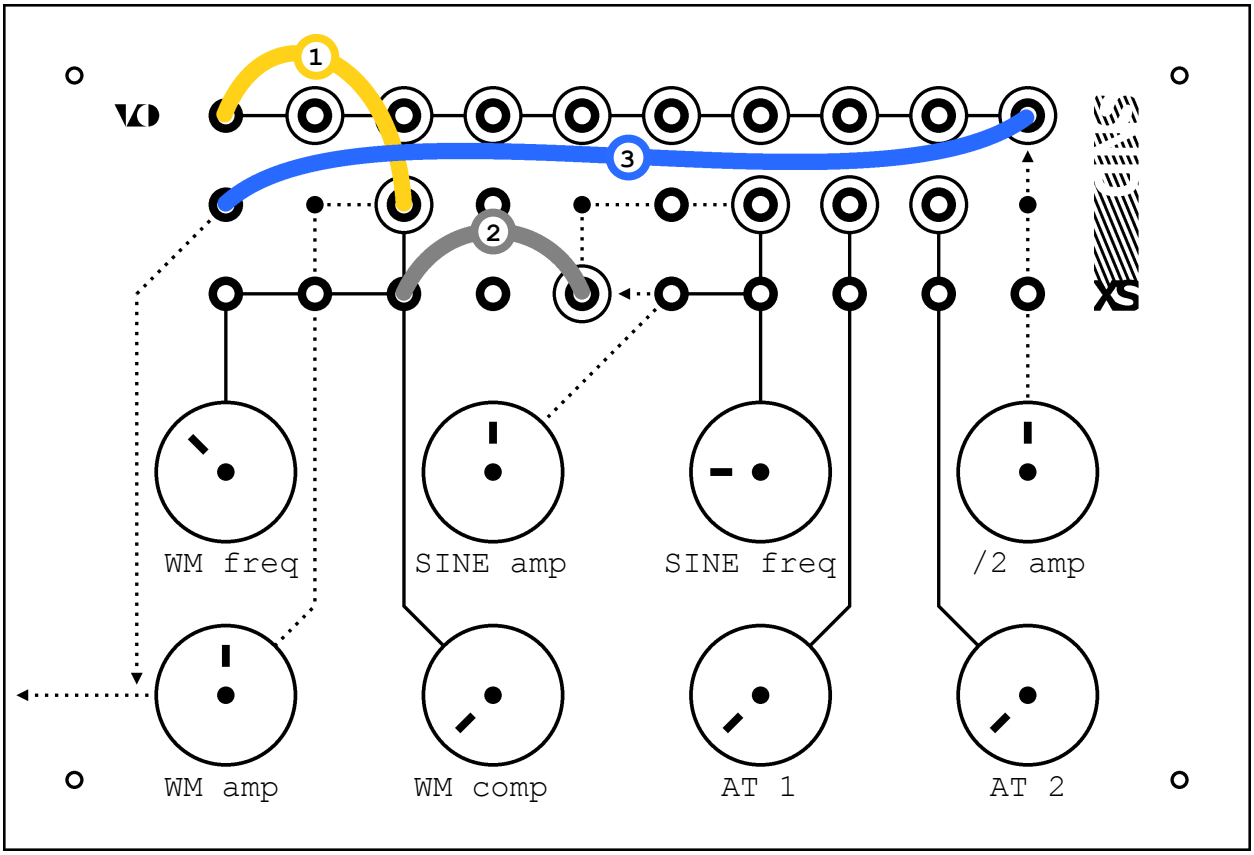
If a sine wave with a frequency of 440 Hz (a typical tuning of the note A4) is patched into the clock divider the first division **(26)** will output a square wave with a frequency of 220 Hz (one octave down: A3) and the second division **(27)** will be 110 Hz (two octaves down: A2).

The first division also has an amplitude control knob **(23)** and amplitude input patch point **(24)** which are useful if using the clock divider as a sub oscillator for mixing the output square wave with other audio signals.



	parameter name	patch point
WAVE MULTIPLIER	**1** Frequency Control	
	2 Frequency Mod	(WM freq)
	3 Amplitude Control	
	4 Amplitude Mod	(WM amp)
	5 Comparator Control	
	6 Comparator Mod	(WM comp)
	7 Out Full	(WM)
	8 Power Indicator LED	
SINE WAVE	**9** Amplitude Control	
	10 Amplitude Mod	(SINE amp)
	11 Frequency Control	
	12 Frequency Mod	(SINE freq)
	13 Sync In	(SINE sync)
	14 Out Full	(SINE f)
	15 Out Attenuated	(SINE a)
	16 Wave Indicator LED	
ATTENUATORS	**17** Attenuator 1 Control	
	18 Attenuator 1 In	(AT 1)
	19 Attenuator 1 Out	(AT 1)
	20 Attenuator 2 Control	
	21 Attenuator 2 In	(AT 2)
	22 Attenuator 2 Out	(AT 2)

	parameter name	patch point
CLOCK DIVIDER	**23** /2 Amplitude Control	
	24 /2 Amplitude Mod	(/2 amp)
	25 /2 Indicator LED	
	26 Division 2 Out	(/2)
	27 Division 4 Out	(/4)
	28 Division 8 Out	(/8)
	29 Division 16 Out	(/16)
	30 Division 32 Out	(/32)
	31 Division 64 Out	(/64)
	32 Division 128 Out	(/128)
	33 Division 256 Out	(/256)
	34 Division 512 Out	(/512)
	35 Clock Divider In	(CD)
I/O	**36** CV In / Out 1	
	37 CV In / Out 2	
	38 Audio Output	(AUDIO)



EXAMPLE PATCH 1

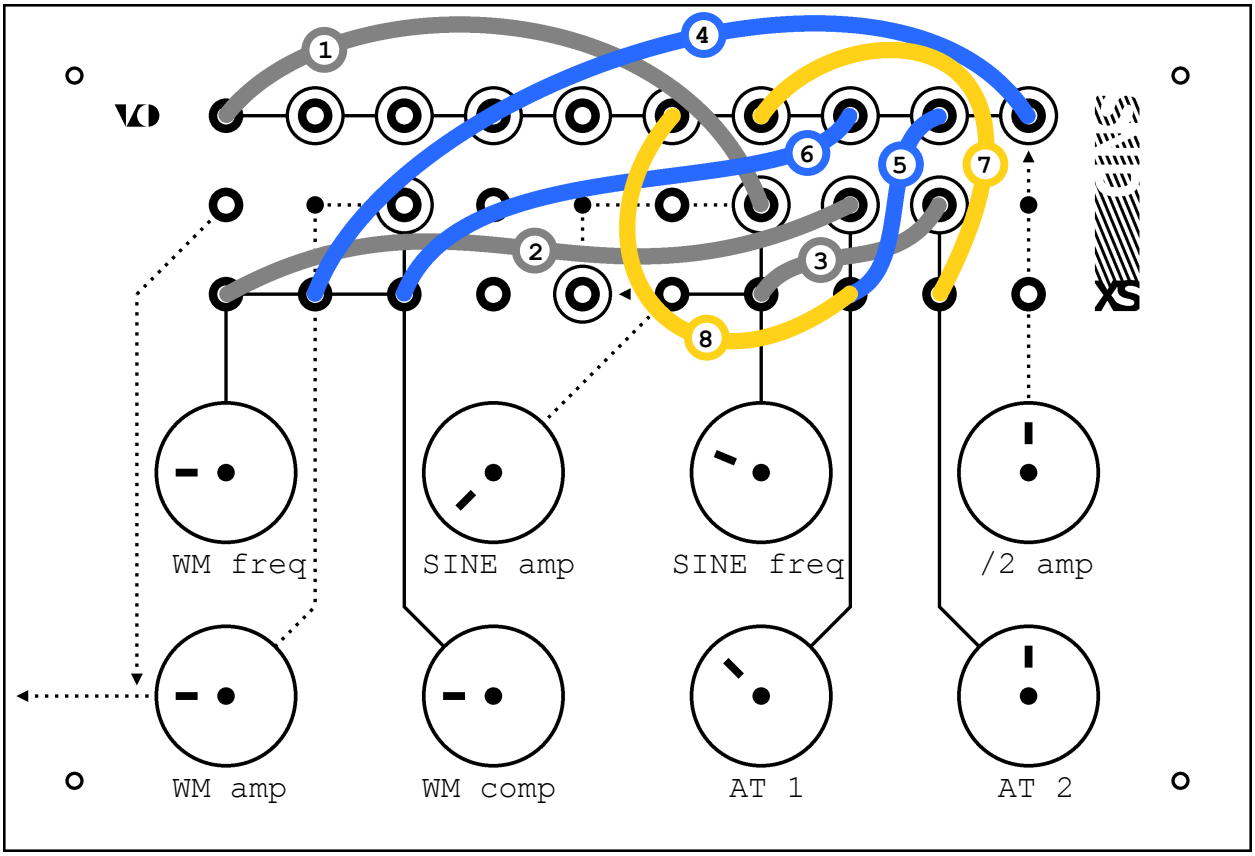
Comparator Sweep

This patch uses the sine wave's attenuated output (SINE a) to modulate the wave multiplier comparator value (WM comp). The wave multiplier output (WM) is patched into the clock divider input (CD) and uses the first division (/2) as a square wave sub oscillator.

The mix between the wave multiplier and sub oscillator is controlled with the respective amplitude controls (WM amp and /2 amp in the patch chart).

Comparator Sweep

OUT	CONNECTION	IN	KNOB
WM	1	WM freq	30%
SINE f		WM amp	50%
SINE a	2	2 WM comp	0%
AT 1		SINE amp	50%
AT 2		SINE freq	15%
/ 2	3	SINE sync	
/ 4		AT 1	-
/ 8		AT 2	-
/ 16		1 CD	
/ 32		/ 2 amp	50%
/ 64		3 AUDIO	
/ 128		- Tempo: **SINE freq**	
/ 256		- Volume: **WM amp** + **/2 amp**	
/ 512		- Tune: **WM freq**	



EXAMPLE PATCH 2

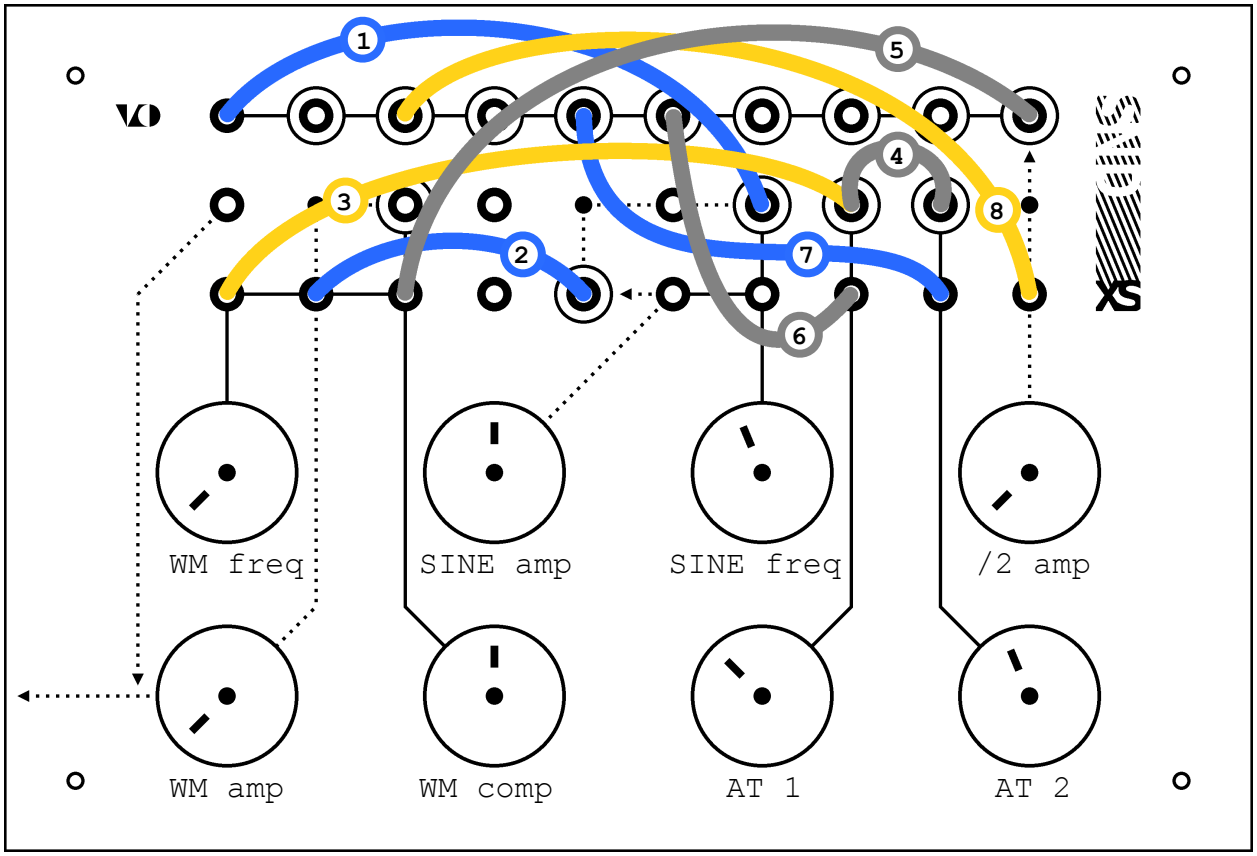
Asymmetric Rhythm

In this patch the sine wave (SINE f) sets the clock divider rate (CD). The fourth division (/ 16) is then passed through the second attenuator (AT 2) which then modulates the sine wave frequency (SINE freq).

This causes the modulation of the wave multiplier frequency (WM freq) to speed up and slow down. Changing attenuator 2 will change the speed when it is higher and changing the sine wave frequency will change the speed when it is lower.

Asymmetric Rhythm

OUT	CONNECTION	IN	KNOB
WM		2 WM freq	20%
SINE f	1	4 WM amp	20%
SINE a		6 WM comp	20%
AT 1	2	SINE amp	-
AT 2	3	3 SINE freq	25%
/ 2	4	SINE sync	
/ 4	5	5 8 AT 1	30%
/ 8	6	7 AT 2	50%
/ 16	7	1 CD	
/ 32	8	/ 2 amp	50%
/ 64		AUDIO	
/ 128		- Tempo: **SINE freq**	
/ 256		- Volume: **WM amp** + **/2 amp**	
/ 512		- Tune: **WM freq** + **AT 1**	
		- Stutter Rate: **AT 2**	



EXAMPLE PATCH 3

Amplitude Modulation

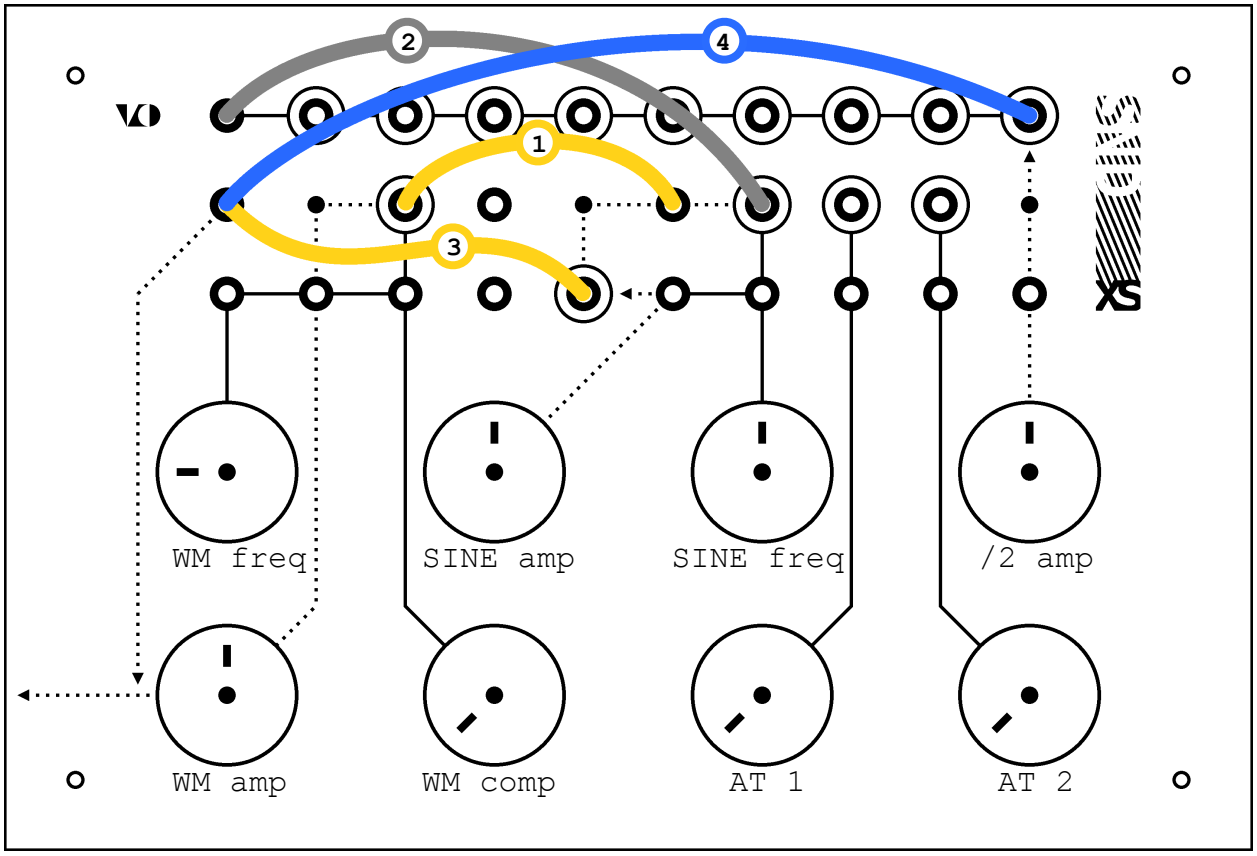
This patch uses the sine wave (SINE a) to modulate the wave multiplier amplitude (WM amp)along with the eighth division (/ 256) to modulate the amplitude of the first division (/ 2 amp) which is routed to the multiplier comparator (WM comp).

The fifth and sixth divisions (/ 32 and / 64) are routed through the attenuators and to the multiplier frequency (WM freq). Adjusting the two attenuators as well as the comparator causes drastic variation in the sound.

Amplitude Modulation

OUT	CONNECTION	IN	KNOB
WM	3 4	WM freq	0%
SINE f	1	2 WM amp	0%
SINE a	2	5 WM comp	50%
AT 1	3	SINE amp	50%
AT 2	4	SINE freq	40%
/ 2	5	SINE sync	
/ 4		6 AT 1	40%
/ 8		7 AT 2	45%
/ 16		1 CD	
/ 32	6	8 / 2 amp	0%
/ 64	7	AUDIO	
/ 128			
/ 256	8		
/ 512			

- Tempo: **SINE freq**
- Volume: **SINE amp**
- **WM comp, AT 1** and **AT 2** adjust tones produced



EXAMPLE PATCH 4

Oscillator Sync + Sub Osc

Here the sine wave is set to sync by patching the wave multiplier waveform (WM) to the sync input (SINE sync) and the sine wave (SINE f) is then going to the clock divider input (CD).

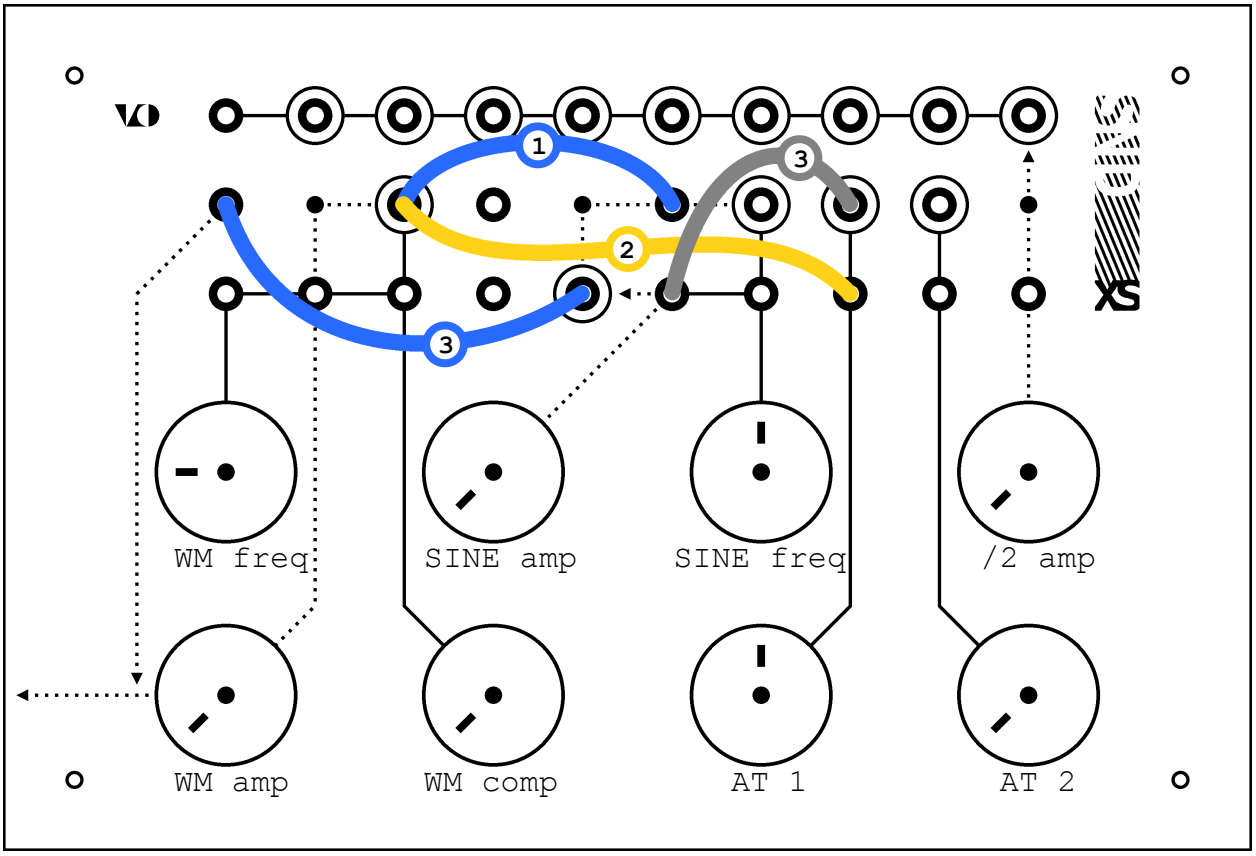
The tone produced can be adjusted by changing the amplitude controls of the three sources (WM amp, SINE amp, and / 2 amp).

By changing the sine wave's frequency the output of the clock divider (/ 2) will step through octaves based on the frequency of the wave multiplier oscillator.

Oscillator Sync + Sub Osc

OUT	CONNECTION	IN	KNOB
WM	1	WM freq	20%
SINE f	2	WM amp	50%
SINE a	3	WM comp	0%
AT 1		SINE amp	50%
AT 2		SINE freq	50%
/ 2	4	1 SINE sync	
/ 4		AT 1	-
/ 8		AT 2	-
/ 16		2 CD	
/ 32		/ 2 amp	50%
/ 64		3 4 AUDIO	
/ 128			
/ 256			
/ 512			

- Pitch + Shape: **WM freq** + **SINE freq**
- **SINE freq** at LFO rates produces plucks and at audio rates makes formants



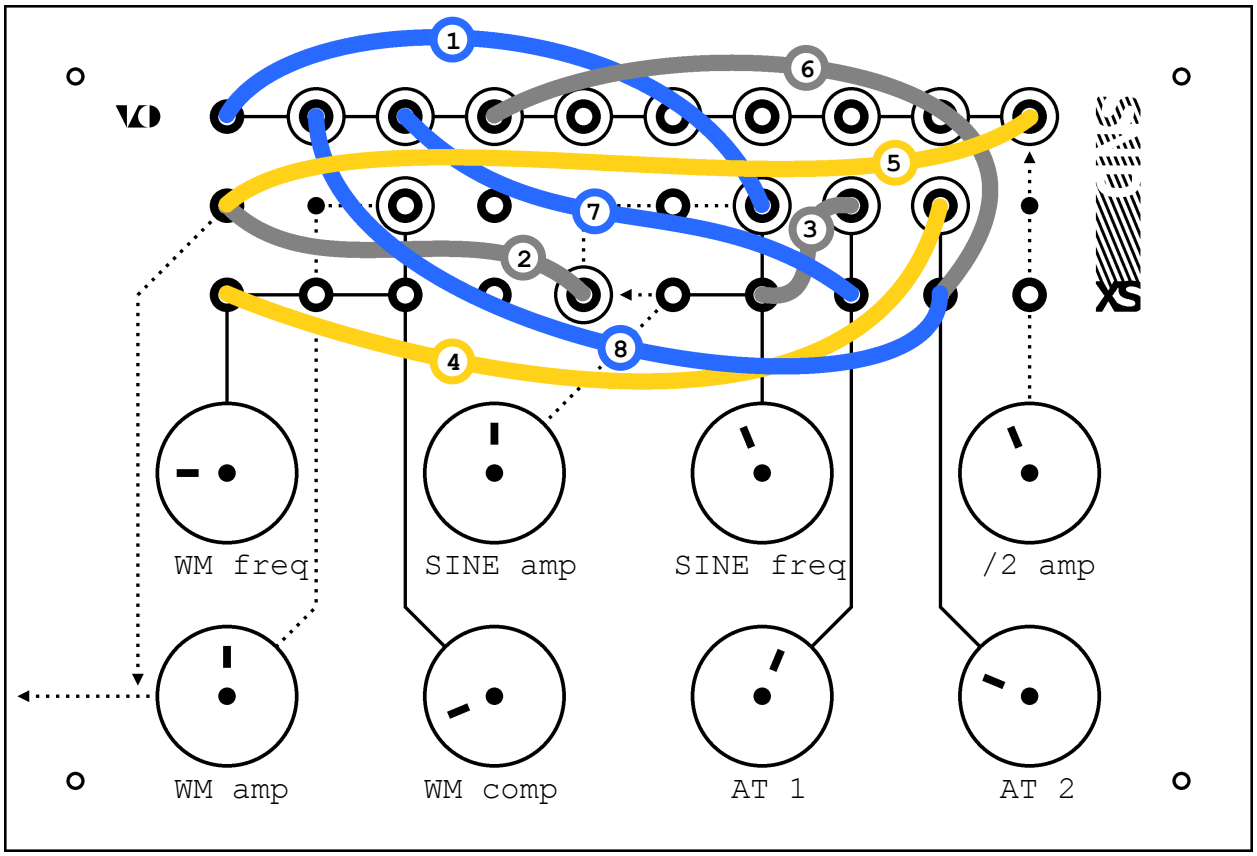
EXAMPLE PATCH 5
Smooth Oscillator Sync

Similar to the previous patch the sine wave is also set to sync but its amplitude is also modulated by the wave multiplier wave form. This causes the amplitude to go low as the wave form is reset and filters out the higher frequencies of the resetting creates.

The volume is set by the attenuator (AT 1) and by bringing up the sine wave amplitude control (SINE amp) the higher frequencies can be reintroduced.

Smooth Oscillator Sync

OUT	CONNECTION	IN	KNOB
WM	1 2	WM freq	20%
SINE f		WM amp	0%
SINE a	3	WM comp	0%
AT 1	4	4 SINE amp	0%
AT 2		SINE freq	50%
/ 2		1 SINE sync	
/ 4		2 AT 1	50%
/ 8		AT 2	-
/ 16		CD	
/ 32		/ 2 amp	-
/ 64		3 AUDIO	
/ 128		– Volume: **AT 1**	
/ 256		– Tone: **SINE amp**	
/ 512			



EXAMPLE PATCH 6

Duophonic Sequences

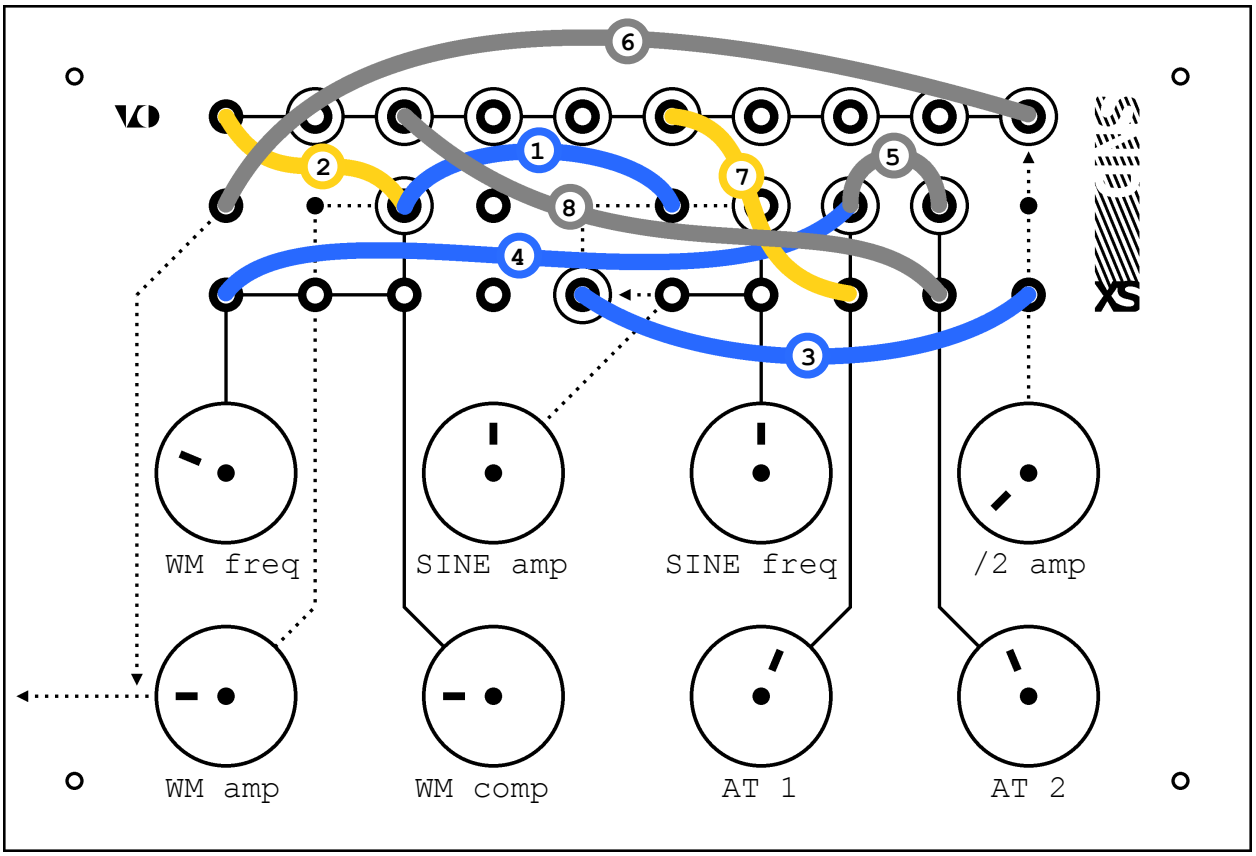
In this example the sine wave, set to audio rates, is patched to the clock divider (CD) as well as to the output. The eighth division (/ 256) is routed through the first attenuator (AT 1) and to the sine wave frequency (SINE freq). The seventh and ninth divisions (/ 128 and / 512) go through the second attenuator to the wave multiple frequency (WM freq).

By tuning the frequencies of the two oscillators and the attenuator positions it is possible to create a two voiced melody.

Duophonic Sequences

OUT	CONNECTION	IN	KNOB
WM	4	WM freq	20%
SINE f	1	WM amp	50%
SINE a	2	WM comp	10%
AT 1	3	SINE amp	50%
AT 2	4 3	SINE freq	45%
/ 2	5	SINE sync	
/ 4	7	AT 1	60%
/ 8	6 8	AT 2	25%
/ 16	1	CD	
/ 32		/ 2 amp	45%
/ 64	2 5	AUDIO	
/ 128	6		
/ 256	7		
/ 512	8		

- Tune: **WM freq** + **AT 2** + **SINE freq** + **AT 2**
- Adjust tuning parameters to create different melodies



EXAMPLE PATCH 7

Synced Amp Modulation

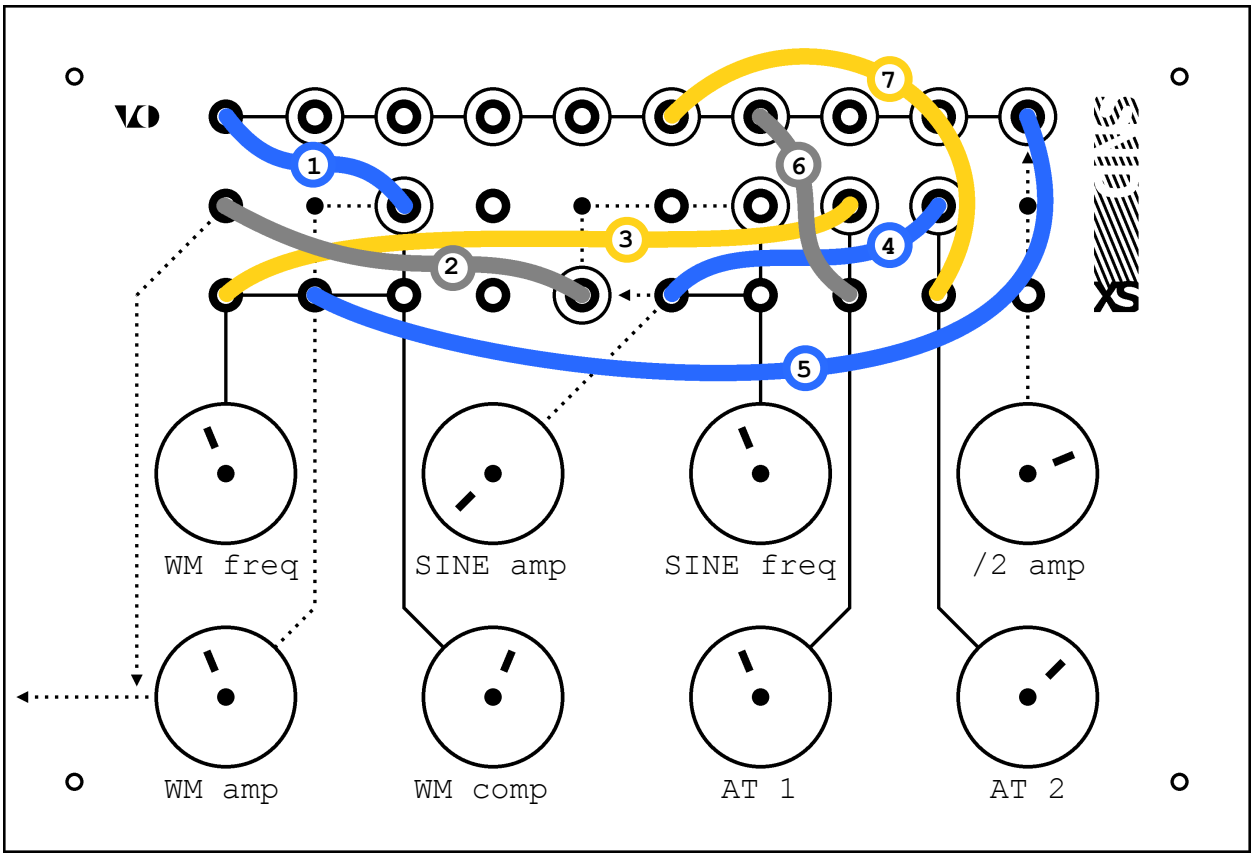
Here the synced sine wave is modulating the amplitude of the first division output. By changing the sine wave frequency the tone produced by the clock divider also changes.

The wave multiplier is controlling the rate of the clock divider and at certain wave shapes the wave multiplier is unable to trigger the clock divider input. As a result at certain positions of the wave multiplier frequency, comparator, and the two attenuators the clock divider can stop cycling.

Synced Amp Modulation

OUT	CONNECTION	IN	KNOB
WM	1 2	4 5 WM freq	25%
SINE f		WM amp	20%
SINE a	3	WM comp	20%
AT 1	4	SINE amp	50%
AT 2	5	SINE freq	50%
/ 2	6	1 SINE sync	
/ 4		7 AT 1	60%
/ 8		8 AT 2	40%
/ 16		2 CD	
/ 32	7	3 / 2 amp	0%
/ 64		6 AUDIO	
/ 128			
/ 256	8		
/ 512			

- Tune: **WM freq** + **AT 1/2**
- Tone: **SINE freq**
- Volume: **WM amp** + **SINE amp**



EXAMPLE PATCH 8

Static and Tone

Like the previous patch the wave multiplier is used to control the rate of the clock divider. Here though it utilizes the fact that at certain waveforms the clock divider does not cycle. By carefully tuning the wave multiplier frequency and comparator parameters the wave form can be made to trigger the clock divider randomly.

The clock divider outputs then are used to control the amplitude of the wave multiplier and sine wave outputs resulting in the tones sounding for random lengths of time.

Static and Tone

OUT	CONNECTION	IN	KNOB
WM	1	3 WM freq	40%
SINE f		5 WM amp	40%
SINE a	2	WM comp	60%
AT 1	3	4 SINE amp	0%
AT 2	4	SINE freq	40%
/ 2	5	SINE sync	
/ 4		6 AT 1	40%
/ 8		7 AT 2	70%
/ 16	6	1 CD	
/ 32	7	/ 2 amp	75%
/ 64		2 AUDIO	
/ 128			
/ 256			
/ 512			

- Tone: **SINE freq**
- Volume: **WM amp + AT 2 + / 2 amp**