

CAIN CZ2

A two line PD-synthesis user oscillator for the KORG multi-engine.

Version 1.0.1

Overview

The **CAIN CZ2** user oscillator is an oscillator, which is strongly inspired by the CASIO COSMOS synthesizers, which were first introduced in the early 80s as an answer to Yamaha's FM synthesizers.

The oscillator adds a digital form of synthesis, called phase distortion (PD) to your Prologue, Minilogue XD or NUTEKT NTS1. It is a very close relative of the FM synthesis, where a signal is created using a carrier and a modulator. In the case of PD, a simple sine wave is transformed into a different shape, by varying the read-out speed.

It features

- 100 combinations of phase distortion waveforms
- Resonance like amplitude modulation for each combination
- 100 envelope or loop presets for the 8-step envelope generator with loop, sustain and end points or the dedicated BPM looper patterns
- Control for the amount of phase distortion, resonance and the envelope depth
- Control for the envelope or pattern speed

Phase Distortion in a Nutshell

The concept of phase distortion can easily be understood when looking at a saw phase distortion. Instead of using a constant read out speed (blue), the initial speed is higher until it reaches a threshold and then slowed down to complete the cycle (orange).



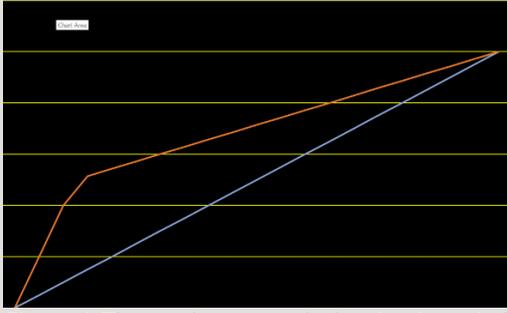


Figure 1 The read out speed of a sine is varied.

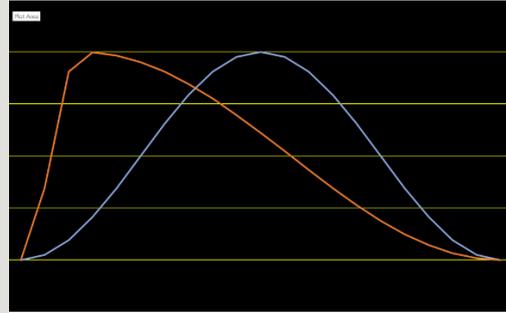


Figure 2 Resulting wave after distortion.

The intensity of the phase distortion defines the deviation from a linear read out to the distorted read out. This has a similar effect as if a filter was opened or closed on a signal with a complex wave form.

Line combinations

CAIN @Z@ now features two audio lines, with the possibility to detune the lines and to apply a ring modulation to the lines.

See reference table for the 'Mode' parameter in the appendix.

Phase Distortion Shapes

For the **CAIN @Z@** user oscillator, nine different basic phase distortion curves are implemented.



Figure 3 Saw PD

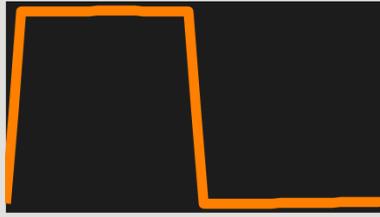


Figure 4 Square PD

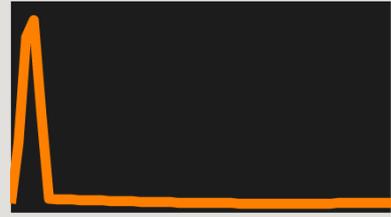


Figure 5 Pulse PD

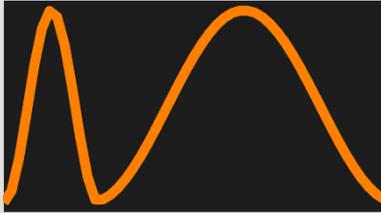


Figure 6 Double Sine PD

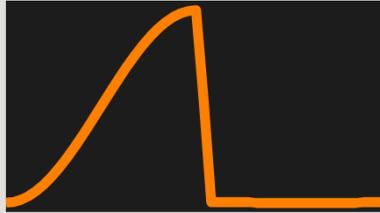


Figure 7 Half Sine PD

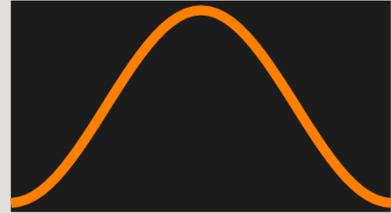


Figure 8 Linear Sine PD

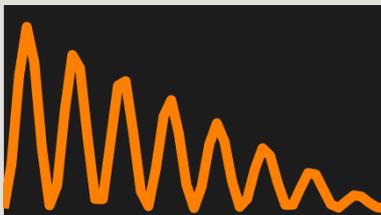


Figure 9 Resonant Saw PD

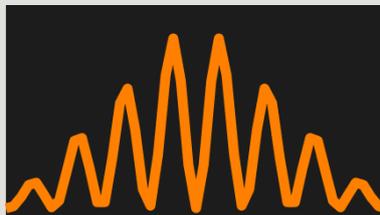


Figure 10 Resonant Triangle PD

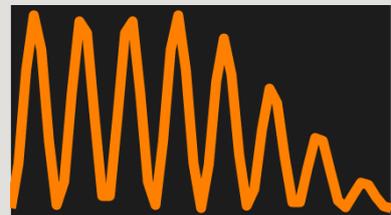


Figure 11 Resonant Trapezoid PD

Each line of the **CAIN GZ2** has the possibility to have two basic PD algorithms shaping the waves in an alternating mode. So a total of 45 combinations is available for one line.

In addition, there are some special waveform modes available, which provide different combinations on each of the lines.

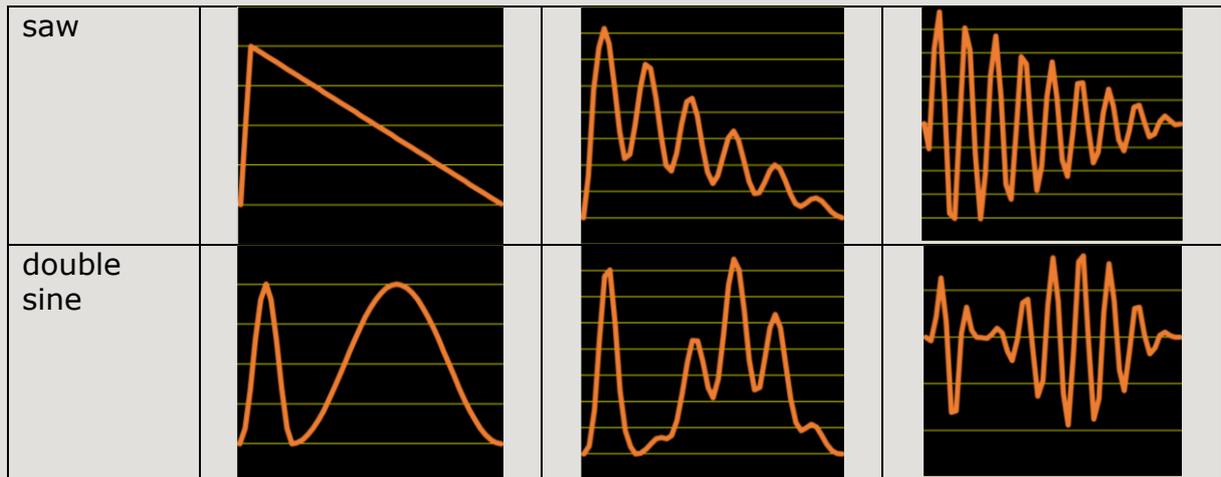
Please refer to the appendix section for the 100 available waveform combinations.

Amplitude Modulation

Since the synthesis does not use filters, but changes the number of overtones via phase distortion, there is no resonance available for the shapes. The three 'resonant' shapes already use that principal and will not be affected by this parameter.

In order to compensate that a resonant like sound can be applied to the resulting waves, which is based on an amplitude modulation.

	0.0 modulation	0.5 modulation	1.0 modulation
sine			



The modulation can be applied from 0.0 to 1.0

Envelopes

There are 16 envelopes and 8 loops implemented. They can be applied in combination to either one of the lines. Refer to the appendix for details.

Key Tracking

CAIN ©Z2 version 2.0.0 and higher has a key tracking implemented. The amount of phase distortion, which is applied to a note, depends on the key which was pressed.

This feature can be used to emulate the dampening of high notes, as it can be heard on natural instruments.

Implemented Controls

Parameter	Function
Shape	Controls the amount of phase distortion.
Shift Shape	Adds a pseudo resonance to the wave forms or mixes the volumes of line1 & line2. Both, the distortion as well as the resonance amount affect both alternating slots.
User Parameter 1 Mode	Selects the mode of the two synthesis lines. There are options for single line, or two lines with detune, octave, 5 th , or 7 th . In addition, the lines can be either mixed or a ring modulation can be applied between the two. In addition the modes starting with 48 and higher switch the shift-shape knob from resonance to volume mix.
User Parameter 2 Waveform	Selects the wave shape from a total of 100 available phase distortion combinations, or different wave shape combinations for each of the two lines.
User Parameter 3 Envelope	Selects envelope- or loop combinations to be used on the oscillator.
User Parameter 4 Intensity	Defines the envelope depth (-100% to +100%)
User Parameter 5 Speed	Defines the speed of the envelopes or loops. For loops the basic speed at 0% is 100 bpm. It can be varied between ~0 and 200 bpm.
User Parameter 6 Key Track	Defines the key tracking behavior of the phase distortion

If you find the oscillator useful and want to support my work then feel free to visit www.cain-synthesizer.com to donate.





Mode – Parameter 1

Value Range for Resonance	Value Range for Volume Mix	Mode Type	Description
1		1	Only line 1 is used
2	50	1+2	Line 1+2 without detune
3 – 10	51 – 58	1+2 Detune	Line 1+2 detuned in cents, following Fibonacci (1, 2, 3, 5, 8, 13, 21, 34)
11 – 13	59 – 61	1+2 Octave +1	Line 2 is one octave higher with detuning in cent (0, 3, 13)
14 – 16	62 – 64	1+2 Octave +2	Line 2 is two octaves higher with detuning in cent (0, 3, 13)
17 – 19	65 – 67	1+2 Octave +3	Line 2 is three octaves higher with detuning in cent (0, 3, 13)
20 – 22	68 – 70	1+2 Fifth	Line 2 is 5 semi tones higher than Line 1. The octave of Line 2 is between 0 and 2 octaves higher.
23 – 25	71 – 73	1+2 Seventh	Line 2 is 7 semi tones higher than Line 1. The octave of Line 2 is between 0 and 2 octaves higher.
26	74	1x2 (Ring Mod)	Line 1x2 without detune
27 – 34	75 – 82	1x2 Detune (Ring Mod)	Line 1x2 detuned in cents, following Fibonacci (1, 2, 3, 5, 8, 13, 21, 34)
35 – 37	83 – 85	1x2 Octave +1 (Ring Mod)	Line 2 is one octave higher with detuning in cent (0, 3, 13)
38 – 40	86 – 88	1x2 Octave +2 (Ring Mod)	Line 2 is two octaves higher with detuning in cent (0, 3, 13)
41– 43	89 – 91	1x2 Octave +3 (Ring Mod)	Line 2 is three octaves higher with detuning in cent (0, 3, 13)
44 – 46	92 – 94	1x2 Fifth (Ring Mod)	Line 2 is 5 semi tones higher than Line 1. The octave of Line 2 is between 0 and 2 octaves higher.
47 – 49	95 - 97	1x2 Seventh (Ring Mod)	Line 2 is 7 semi tones higher than Line 1. The octave of Line 2 is between 0 and 2 octaves higher.

Figure 12 Oscillator Modes (Parameter 1)

Waveform – Parameter 1

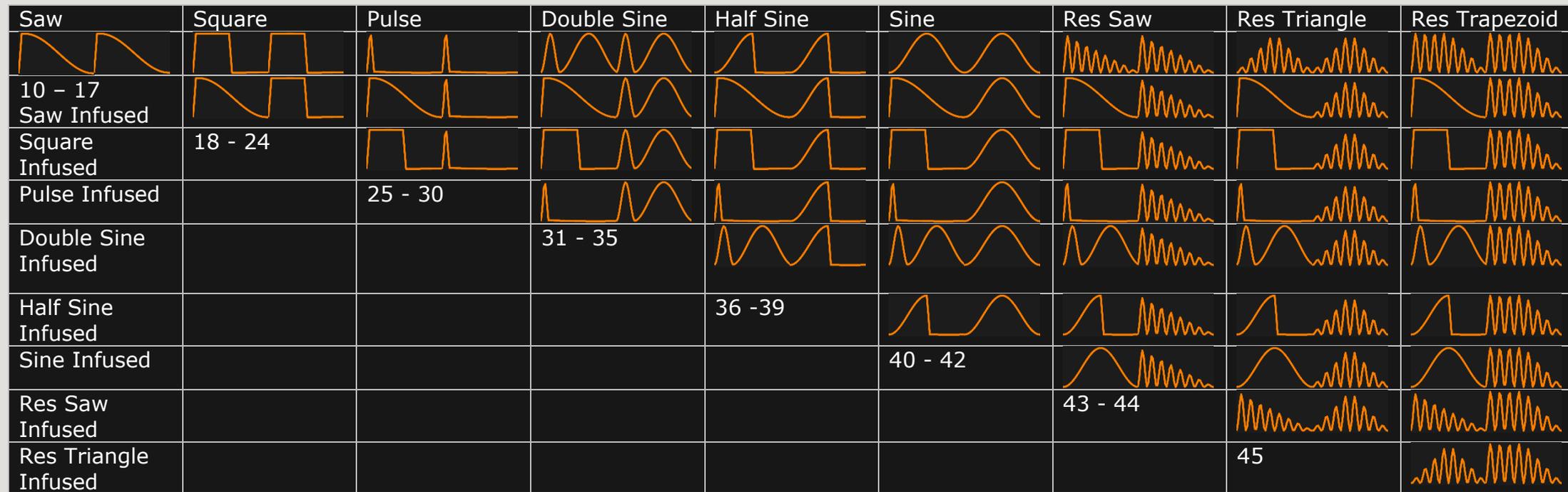


Figure 13 PD Waves and Single Combinations (Parameter 2 'wave')

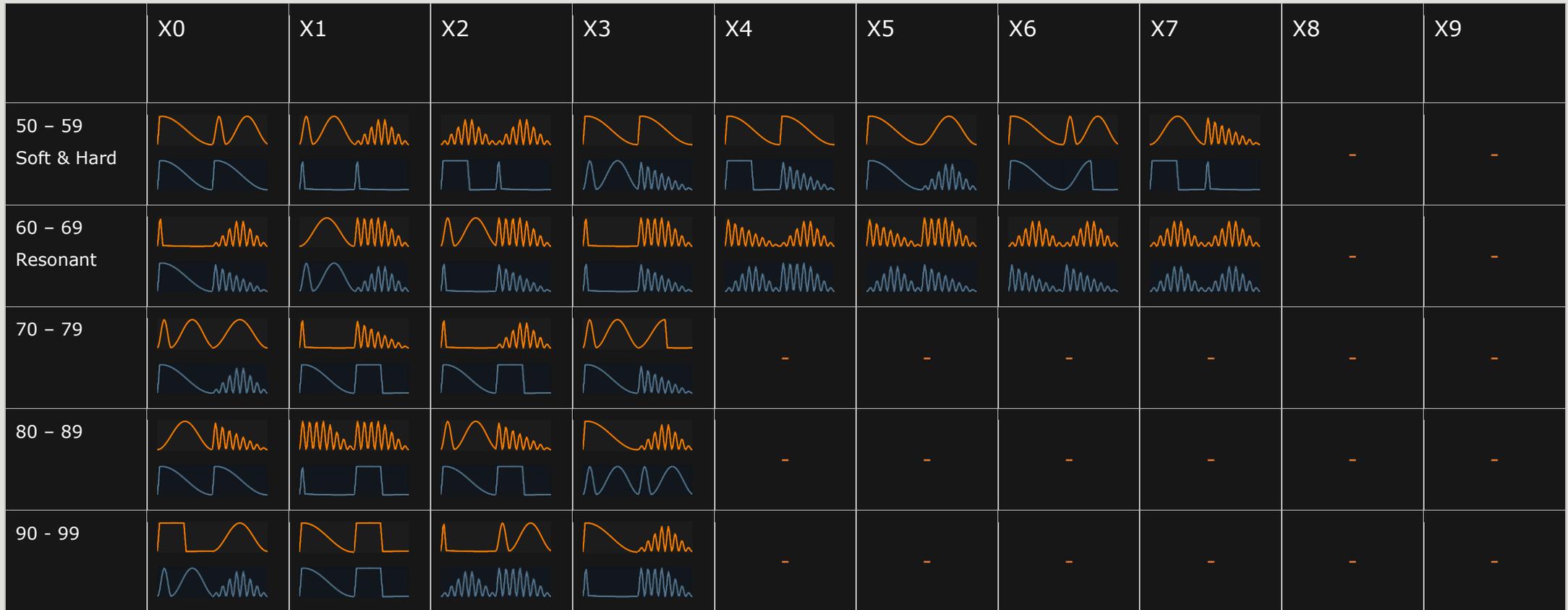


Figure 14.2 Line PD Combinations (Parameter 2 'wave' continued)

Number Range	Description	Comment
1 – 15	Basic envelopes	<ol style="list-style-type: none"> 1. Fast Attack 2. Medium Attack 3. Slow Attack 4. Pluck (one shot) 5. Swell 6. Long Swell 7. Bass 8. Pad 9. Trumpet 10. Echo (one shot) 11. Whoop 12. Whoop (one shot) 13. Echo Faint (one shot) 14. Reverse 15. Reverse (one shot)
16	Speed envelope	Fast Attack (speed only affects falling slopes)
17 – 24	Basic loops	<ol style="list-style-type: none"> 1. Triangle 2. Saw Down 3. Square 4. Rhythmic Saw Ups (1) 5. Rhythmic Saw Ups (2) 6. Rhythmic Saw Ups (3) 7. Rhythmic Rnd (1) 8. Rhythmic Rnd (2)
25 – 38	Envelope combinations	A number of combinations of envelopes, where different envelopes are applied to Line1 and Line2
39 - 49	Speed envelopes continued	<ol style="list-style-type: none"> 1. Medium Attack (speed only affects falling slopes) 2. Slow Attack (speed only affects falling slopes) 3. Pluck (one shot) (speed only affects falling slopes) 4. Swell (speed only affects falling slopes) 5. Long Swell (speed only affects falling slopes) 6. Bass (speed only affects falling slopes) 7. Pad (speed only affects falling slopes) 8. Trumpet (speed only affects falling slopes) 9. Echo (one shot) (speed only affects falling slopes) 10. Whoop (speed only affects falling slopes)
50 – 64	Envelope and loop combinations	A number of combinations, where a loop is assigned to Line1 and an envelope is assigned to Line2 Currently slots 50 – 52 are filled with combinations. (If you have input for the free ones, then drop me a note)
65 - 74	Loop combinations	A number of combinations, where different loops are assigned to Line1 and Line2 Currently slots 65 – 68 are filled with combinations. (If you have input for the free ones, then drop me a note)
75 – 100	Special combinations	A mix of envelope and loop combinations, where one or both of the envelopes or loops do not only influence the DCW (digitally controlled waveform) but also the DCA (digitally controlled amplitude) Currently slots 75 – 93 are filled with combinations. (If you have input for the free ones, then drop me a note)

Figure 15 Envelope and Loop Combinations (Parameter 3 'Envelope')