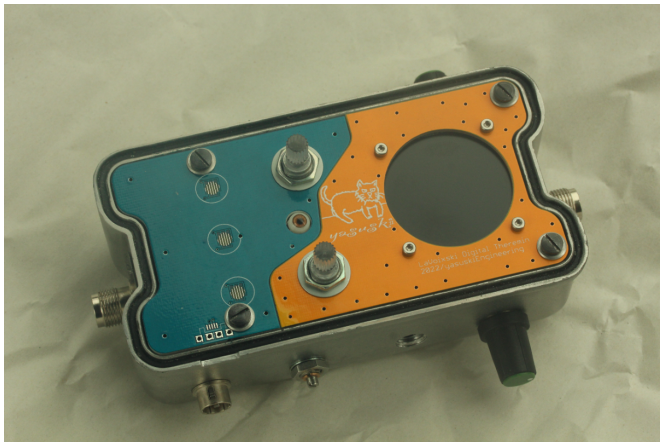
LaVoixski the Digital Theremin



LaVoixski is a digital musical instrument based on the Theremin. It has the RF oscillation circuits “The heart of the Theremin”, but does not have the analog demodulators for produce the audio signals.

The system is programmed by Arduino and is running on the Micro Controller Unit Teensy4.1.

LaVoixski has 5 wavetable oscillators. The 32 wavetables are contained as the text file on the microSD card. The player can modify them by using the math tool like “GNU Octave”.

The pitch and the volume values are sensed from the real RF oscillators by “General Purpose Timer = GPT” inputs on the Micro Controller. The detected values control the pitch of wavetable oscillators and its envelopes.

LaVoixski has the several method for mixing the oscillators.

The first method is named monaural / additive synthesis, the oscillators are driven in the same pitch. The player can select any fundamental and harmonic waves for design the total shape of the waveform.

The second method is polyphonic output. The oscillators are driven in the different pitches and any waveforms. The player can select the pitch combinations from the preset data on the microSD or edit the microtonal pitches in The Chord Edit mode.

The third method is the Transition. The mixed audio output has 2 modes, “Normal “ and “Transition”. In the Transition mode, the output signal levels of the oscillators are controlled by the envelopes in the different phase. (see the section “Transition”)

The system has 3 edit modes: Chord, WaveMix and Exciter.

In the Chord Edit mode, the player can edit 4 microtonal pitches in a chord. The 16 edited pitch groups are stored by CSV formatted text files into the microSD card. (see the section "Microtonal tuning / Chord Edit Mode")

In the WaveMix mode, the player can edit the combination of the 5 wavetables with levels. The edited combinations are also stored into the microSD card. (see the section "WaveMix Mode")

The parameter named "Output 3" selects a signal line from any oscillators for the 3rd audio output. There are 3 modes for the outputs, Transition, Normal and Chebyshev Transfer = Exciter mode.

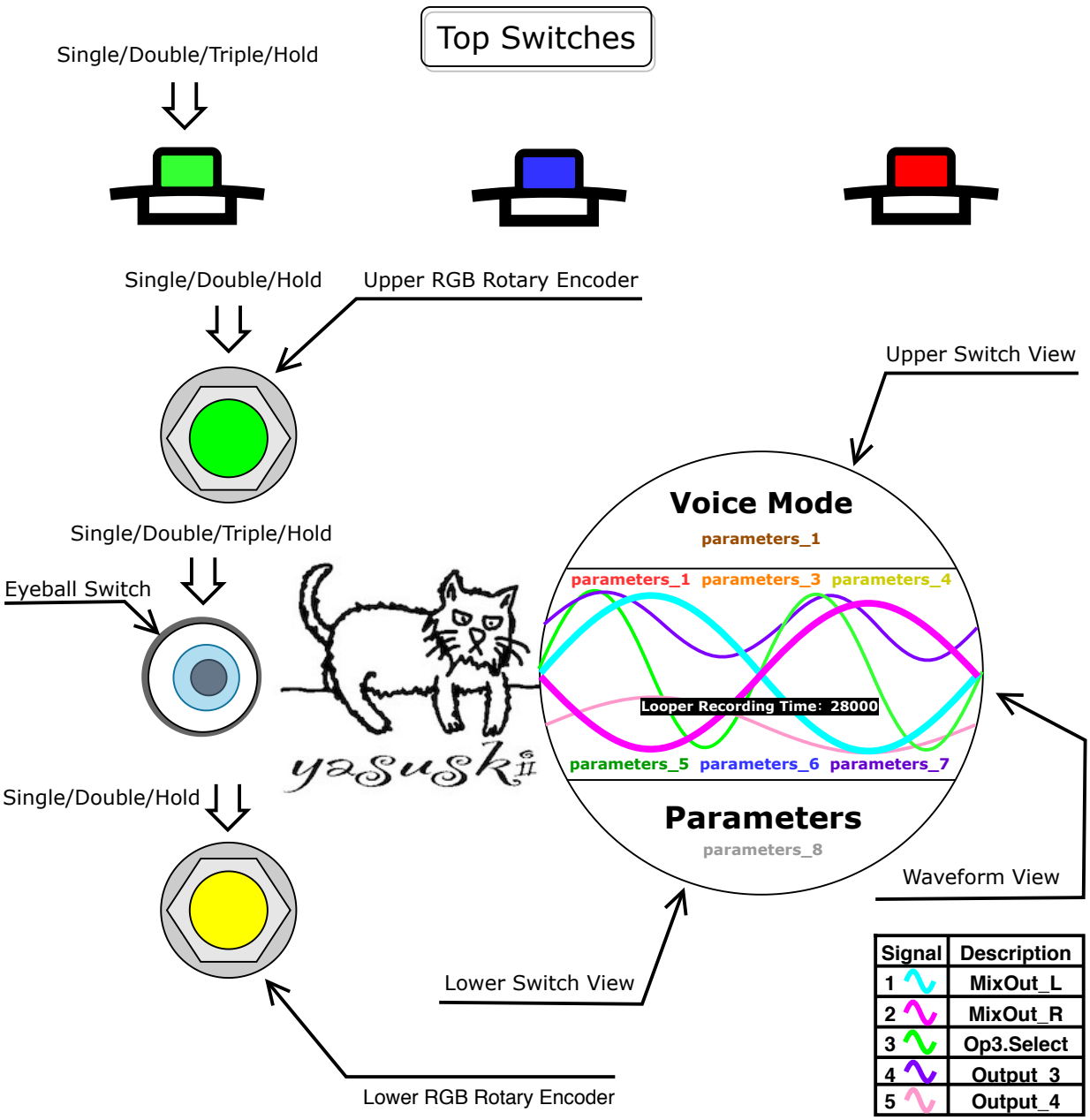
The Chebyshev Transfer mode is specially developed for the Output 3. The Exciter transforms the balance of the harmonics of the input source by using the wavetable for the transformation.

The level editable parameters (fundamental plus 4 harmonics) are available. (see the section "Audio Excitation")

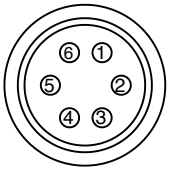
The description about the system

Oscillator	5 individual Oscillators	Reading the waveforms from the files on microSD card
Waveforms	32 wavetables	Written in the 12 * 12 bit CSV format on microSD card
Voicing	2 / 3 / 4 / 5 voice preset and Micro Tonal (user editable)	The every mode has the Arpeggiator on the last address#
Arpeggiator	19 preset pattern with 13 user editable notes (limited in 4 notes)	Up / Down / Alternate / Random pattern selector with Speed
Sequencer	8 sequence	the 1st addressed sequencer controls the Arpeggiator
Waveform Mix	14 preset with 18 editable waveform mix	Fixed and Transition mode is selectable The last 4 address# are tuned for the overload mode
PitchBend / Phaser	Bend Up / Down / Phase Shifter	Phaser is activated when the parameter AtkEnv is set to zero
LFO / AM Modulation	*1 / *2 and High speed	The depth control switches the speed rate across the value zero
Chromatic Tuner	Chromatic or programed scale	32 scale presets
VCF: LPF/WSP/HPF	5 VCFs on the Oscillator outputs	with LFO / Envelope modulation
Delay	6 delays on the audio lines	The feedback loop accept the AM modulation
Comb Filters	Flanger / Chorus / Dub	cut off freq. / LFO rate / mod depth / signal feedback
Looper	30 sec Looper with rev speed	*1 / *2 /* 0.5 with reverse direction
Audio Outputs	L/R mix outputs with individual 3rd / 4th outputs	The 3rd output is selectable The 4th is fixed to OSC3
Output Three selection	solo selection from the oscillator	3 modes are selectable Transition / Normal / Chebyshev Transfer
Chord Sequencer	set the chord sequence in 16 address from 48 patterns	16 Microtonal (editable on local) +16 from microSD (editable) 16 preset patterns

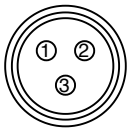
The User Interface



Signal	Description
1	MixOut_L
2	MixOut_R
3	Op3.Select
4	Output_3
5	Output_4

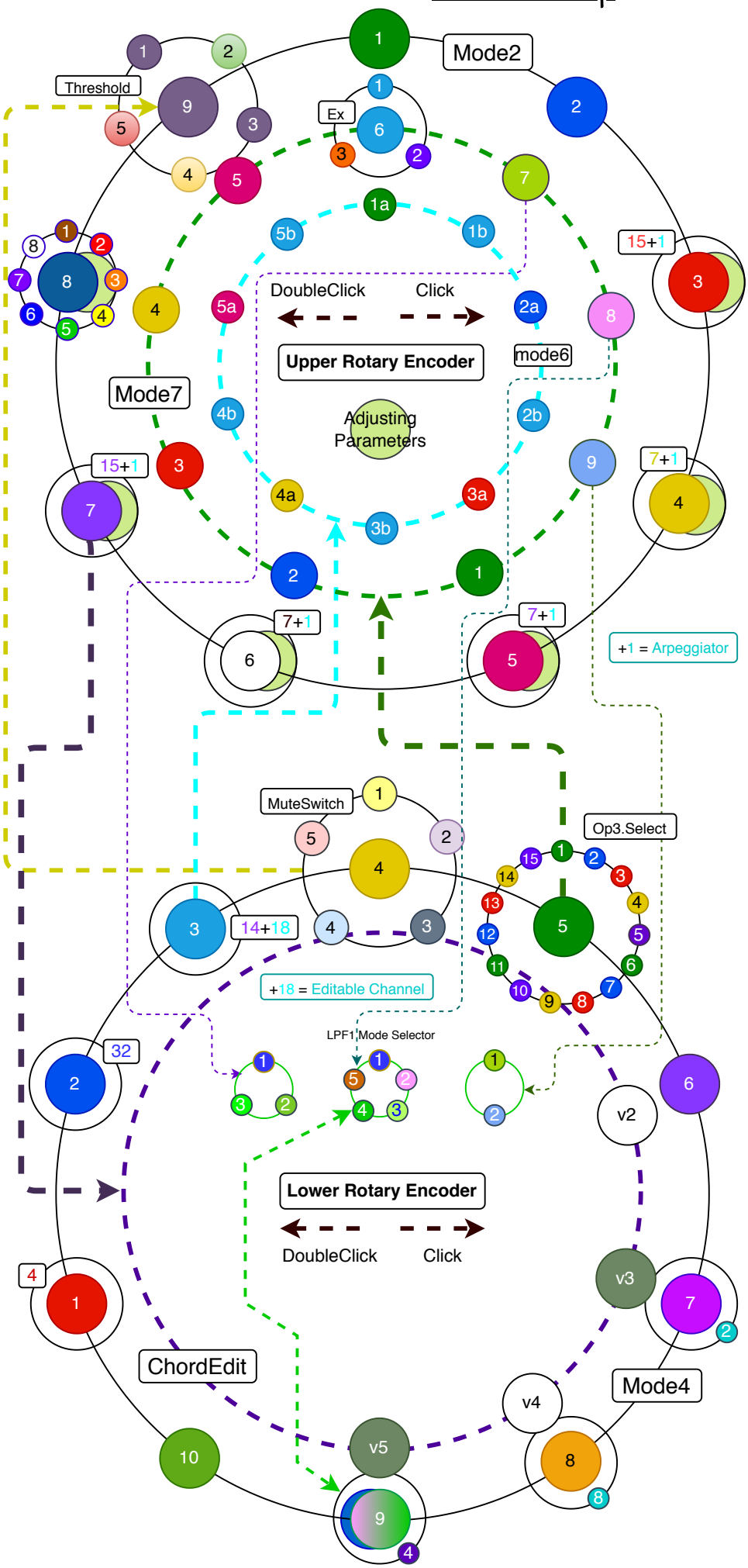


pin#	Description
1	V+
2	GND
3	DAC_OUT_4
4	DAC_OUT_3
5	DAC_OUT_1
6	DAC_OUT_2



pin#	Description
1	Ext.SW_#01
2	Ext.SW_#02
3	GND

Encoder Map



	Click	Long Push
1	Pitch Tune	Pitch Offset
2	Volume Tune	Volume Offset
3	2 Voice Mode	Scene Mem.2
4	3 Voice Mode	Scene Mem.3
5	4 Voice Mode	Scene Mem.4
6	5 Voice Mode	Scene Mem.5
7	Chord Edit Mode	#57 Scene / #42-56 Chord Mem. Scene Memory
8	Sequencer Mode	
9	Threshold Setting Mode	

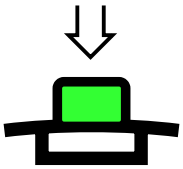
- 6 Chebyshev Transfer Mem. Selector / Long Push -> Mem. Transfer Value
- 7 Dly Fdbk / DlyLevel / CombFdbk
- 8 LPF1 CutOffFreq. Fix / Mod.Spd
- 9 LPF Mod Wave shape / Phaser Mod Speed
- 1 Chebyshev Transfer 1st order
- 2 Chebyshev Transfer 2nd order
- 3 Chebyshev Transfer 3rd order
- 4 Chebyshev Transfer 4th order
- 5 Chebyshev Transfer 5th order

- 1* Detector / Looper Output Selector
- 2* Looper Playback Speed Selector
- 9 3* Setting Rit Value / Pitch Drift Value
- 4* Starting Address for Chord Selector
- 5* Setting Delay Scale

- 4 Output Mode Select
  - 1* Normal Out
  - 2* Phase Shift Out
  - 3* Mute
  - 4* LFO Out
  - 5* Chromatic Out
- 5
  - 1 2 3 4 5 Op3 Selector Normal
  - 6 7 8 9 10 Op3 Selector Transition
  - 11 11 11 11 15 Op3 Selector Chebyshev Out
  - 1 2 3 Delay Param Selector Fdbk / Lev / CombFdbk
  - 1 2 3 4 5 LPF1 Mode Selector Fix / Mod / Flanger / Chorus / Dub
  - 1 2 Modulation Waveform Selector 1/2
- 6 Transition Peak Distance
- 7 Transition Peak Shape
- 8 1 2 4 8 LPF : HPF : Distortion : USB : Data Inputs Selector
- 9 1 2 3 4 5 LPF1 Mode Selector (Lower LED color) / Mod Ctr(1) / Spd(2,3) / Dpt(4) / Fdbk(5) / Sequence Speed (When mode2 = 8)
- 10 Arpeggiator Speed
- 1 Arpeggiator Pattern Select
- 2 Arpeggiator Phrase Select
- 3 Waveform Mix Mode / Long Push -> Mem.Waveform Mix

- v2 Tuning 2nd voice
- v3 Tuning 3rd voice
- v4 Tuning 4th voice
- v5 Tuning 5th voice

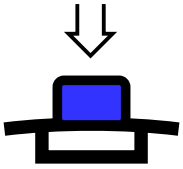
The Switches



The top switch on the left is working as follows:

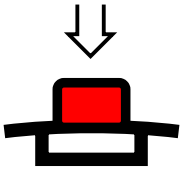
Single click: Start/Stop Arp/Seq/Looper/AutoFade
*Root pitch + 1nn
Double click: Root pitch - 1nn
Triple click: *Set Scale selector in fundamental position
Hold: Skipping to the the THRES mode and back
*Set Root pitch in fundamental position

* When the Chromatic mode is activated



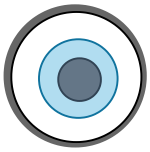
The top switch on the center is working as follows:

Single click: Freez Pitch
*Scale selector--
*Wave Shaper/HPF selector (mod4==8)
*Filter Disable
*Interpolation Type selector (mode4==9)
Double click: Select Note++ (chord sequencer) / PitchDrift-
Triple click: Looper Playback speed--
Hold: Recalling the Scene Memories



The top switch on the right is working as follows:

Single click: Looper Start Rec / inactivate
*Scale selector++
Double click: PitchDrift++
Triple click: Looper Playback speed++
Hold: Start/Stop the Auto Fade mode



The eyeball switch on tne center is working as follows:

Single click: Pitch Tune Normal / -1 oct / -2 oct / +1 oct
Double click: Phase on Ch2 Normal / Negative
Triple click: Reserved
Hold: Start Oscillator Tuning mode.

The signal phase of left output:
Red : Normal
Blue : Inverted

Start flashing when the looper is now on recording .

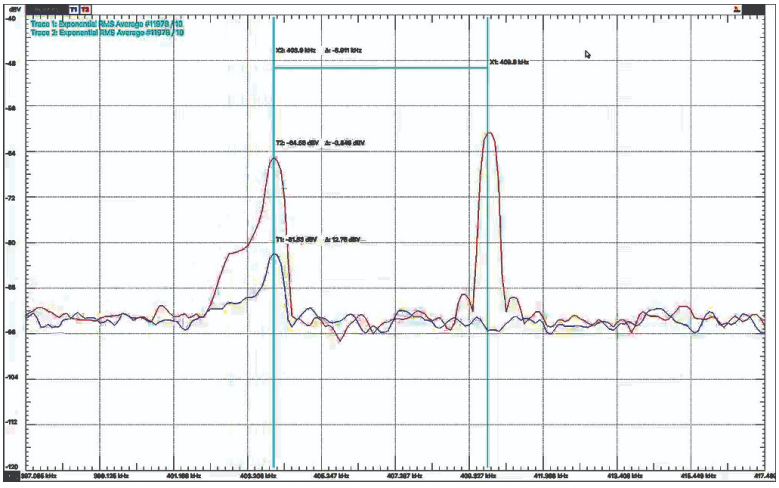
Pitch Drift in Octave:
Red: Normal
Yellow: -1 oct
Magenta: -2 oct
Green: +1 oct

Fixed frequency on the sub oscillators.
White : Normal
Cyan : Activated

Start flashing when the recording time left 8 counts.

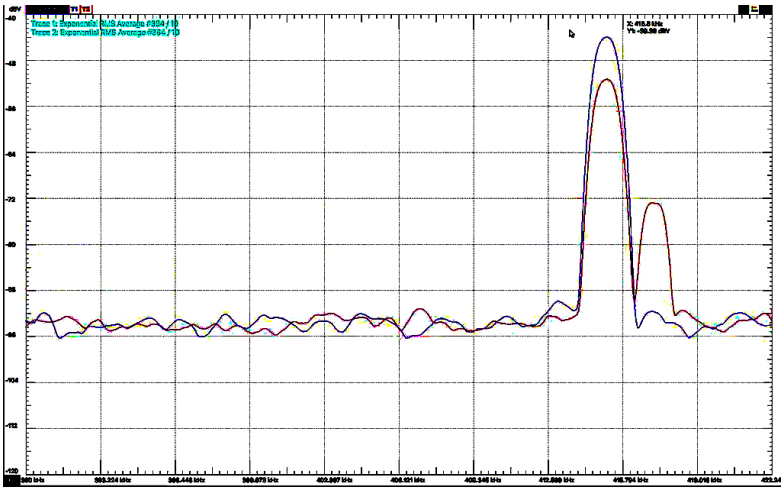
Start flashing when the AutoFade mode is activated.

The Oscillator and the demodulator



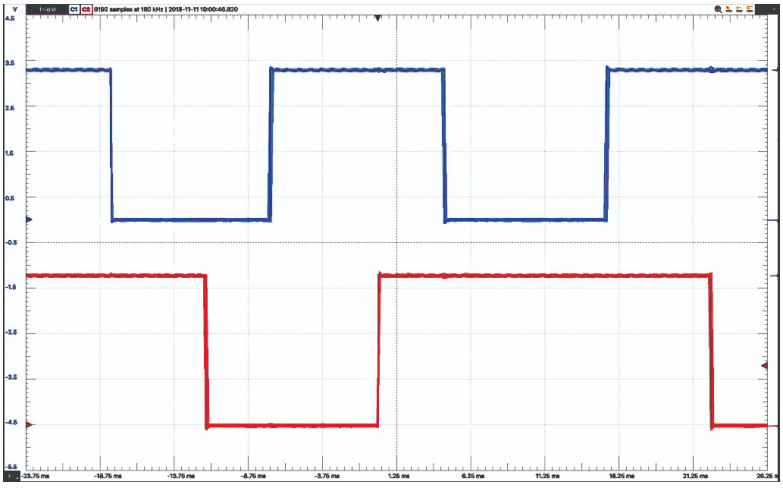
The picture shows the spectrum waveforms of the oscillator pair.

Firstly, a user should set the frequency distance between the antenna and reference oscillators around 4 to 5 kHz, then tuning the frequency of the reference oscillator side getting closer to the antenna side.



The difference of the frequencies are converted to the beat by the demodulator made from the D-FF.

The micro controller measures the time between the up-edges of the demodulator outputs.



The frequency drifts by the moving hand toward the antenna.

The distance decrease, the demodulated tone is down.

When the frequency is almost same, the beat will stop.

The setup method after turning on the LaVoixski

After turn on the LaVoixski, player must tune the oscillators. The tuning work is a little bit difficult for the first time.

Firstly player have to understand the construction of the Theremin itself.

- The system has 2 oscillator pairs in different working style, fixed and variable.
- The 2 antennas connected to the oscillators are working in variable frequency.
- The antenna sens the magnetic field drifting by hands.
- The demodulator outputs the beat made from the difference of the frequency on the oscillators by running in the variable / fixed frequency.
- The up-edges between the waveform of the input signal is measured the time duration by the counter in the micro controller and converted to the pitch / volume values.
- The oscillators must be tuned to almost the same frequency.
- The tuning is done by the combination of 2 methods, adjusting the frequency on hardware oscillator then adding the offset value on software.

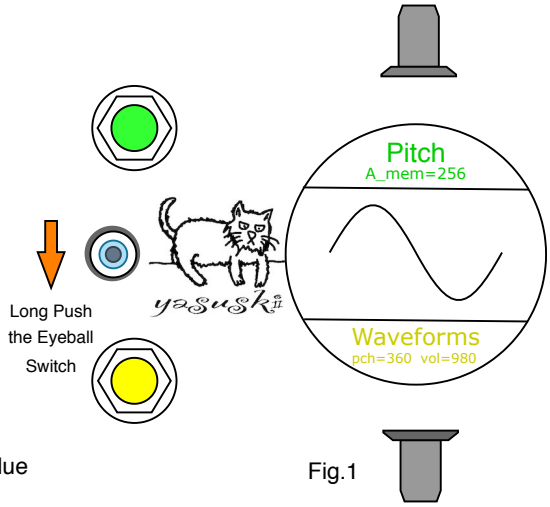


Fig.1

- Firstly, player has to search for the best tuning point by the trim pot. Player can hear the demodulated sound from the oscillator on the pitch side while long holding the eyeball LED switch. Then, player finds out where the beat appears and can check the direction of appearing in the difference.
- Tune the oscillators where the pitch turns higher while moving a hand toward the antenna. The upper knob color turns in RED when the frequency of the pitch oscillator has been tuned to the lower limit. (Fig.2) pch < 350

  Tune the frequency just above the knob color turns in GREEN. (Fig.1) pch > 350

- The top switch #01 (on the left side) must be tuning "OFF" while the tuning work has been completed.

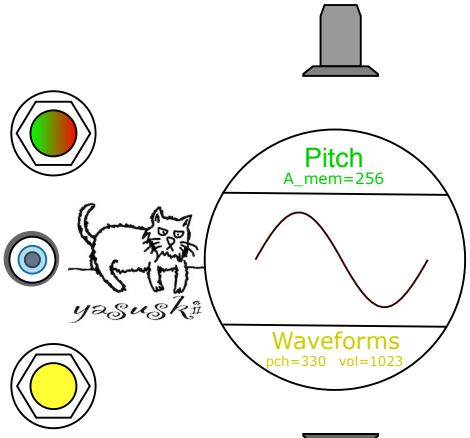


Fig.2

- The tuning method for the volume side is almost the same (ckick the top switch and holding the eyeball switch again over 1 second), but the setting is in the different manner. Player has to find out the best position for getting the widest working area while the left hand is moving toward near by the volume antenna. (Fig.3) pch = 35
- Pushing the eyeball switch again over 1 second, then tuning mode is moved to Tuner for setting the fundamental frequency (LAVENDER).
- Finishing the tuning mode with holding the Eyeball switch then the top LED turns back to BLUE.
- Selecting the upper knob in GREEN again, then tune the offset of the pitch side. And pushing the upper knob over 1 second for memory the offset value to the EEPROM.
  (The LED color turns on 0.9s in Magenta)
  After recording the value, player do not have to do this step again.
- Selecting the upper knob in BLUE, then tune the offset of the volume side. And pushing the upper knob over 1 second for memory the offset value to the EEPROM.
  (The LED color turns on 0.9s in Orange)

  After recording, player do not have to do this step again, too.

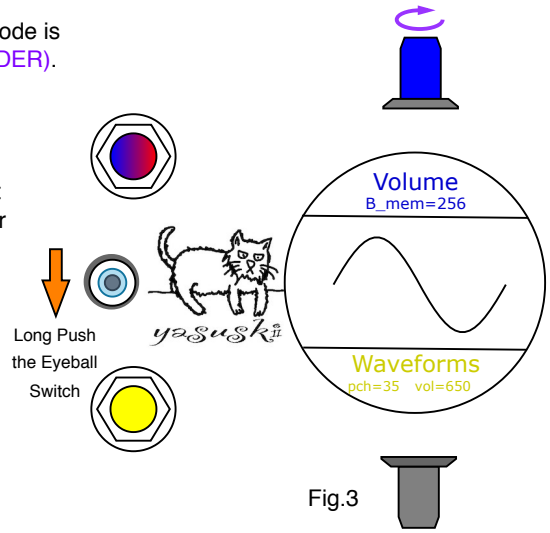
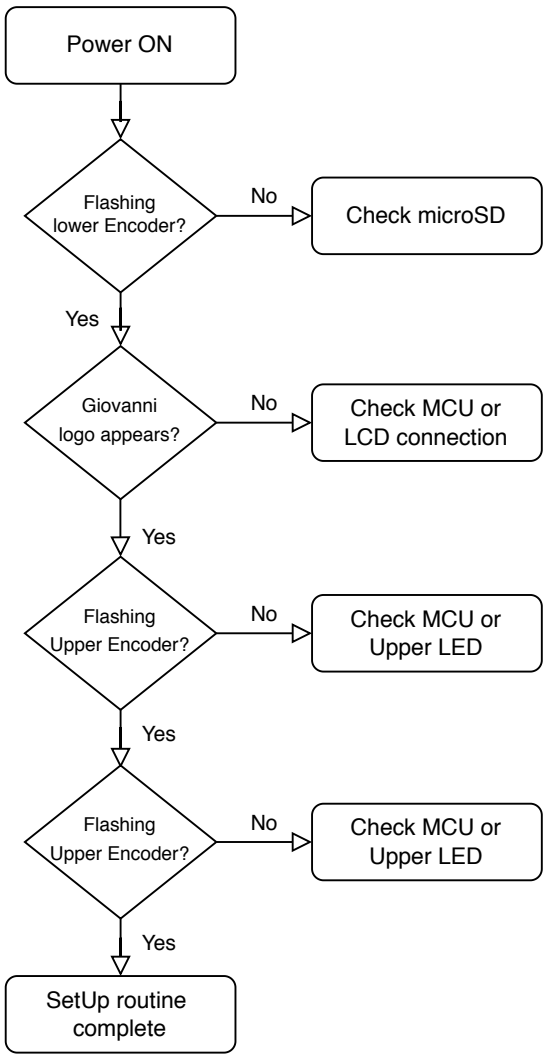
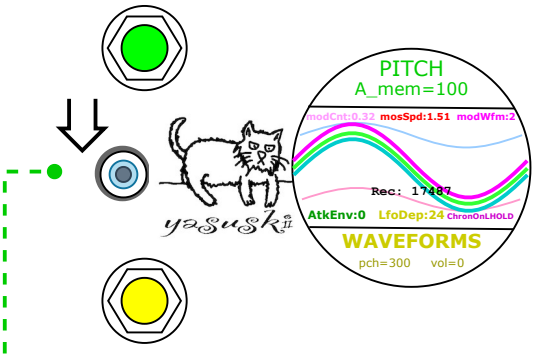


Fig.3


Power ON
Flashing lower Encoder?
No
Check microSD
Yes
Giovanni logo appears?
No
Check MCU or LCD connection
Yes
Flashing Upper Encoder?
No
Check MCU or Upper LED
Yes
Flashing Upper Encoder?
No
Check MCU or Upper LED
Yes
SetUp routine complete



Select: the 1st position in Upper Encoder Mode2

Long Push the EyeBall Button

Moving the right hand toward the near position

Yes

GRN Top Konb turns RED when in range

No

Adjust the Bottom Pot till the LED turns RED

Yes

Adjusting the Upper Rotary Encoder For getting the precise control area

Recheck the sensing area of the Pitch ANT. until getting the best position

Long Push the Upper Encoder Top for saving the offset value

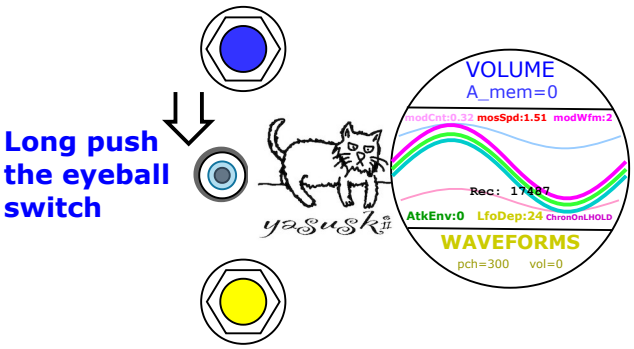
Offset Setting Work Complete

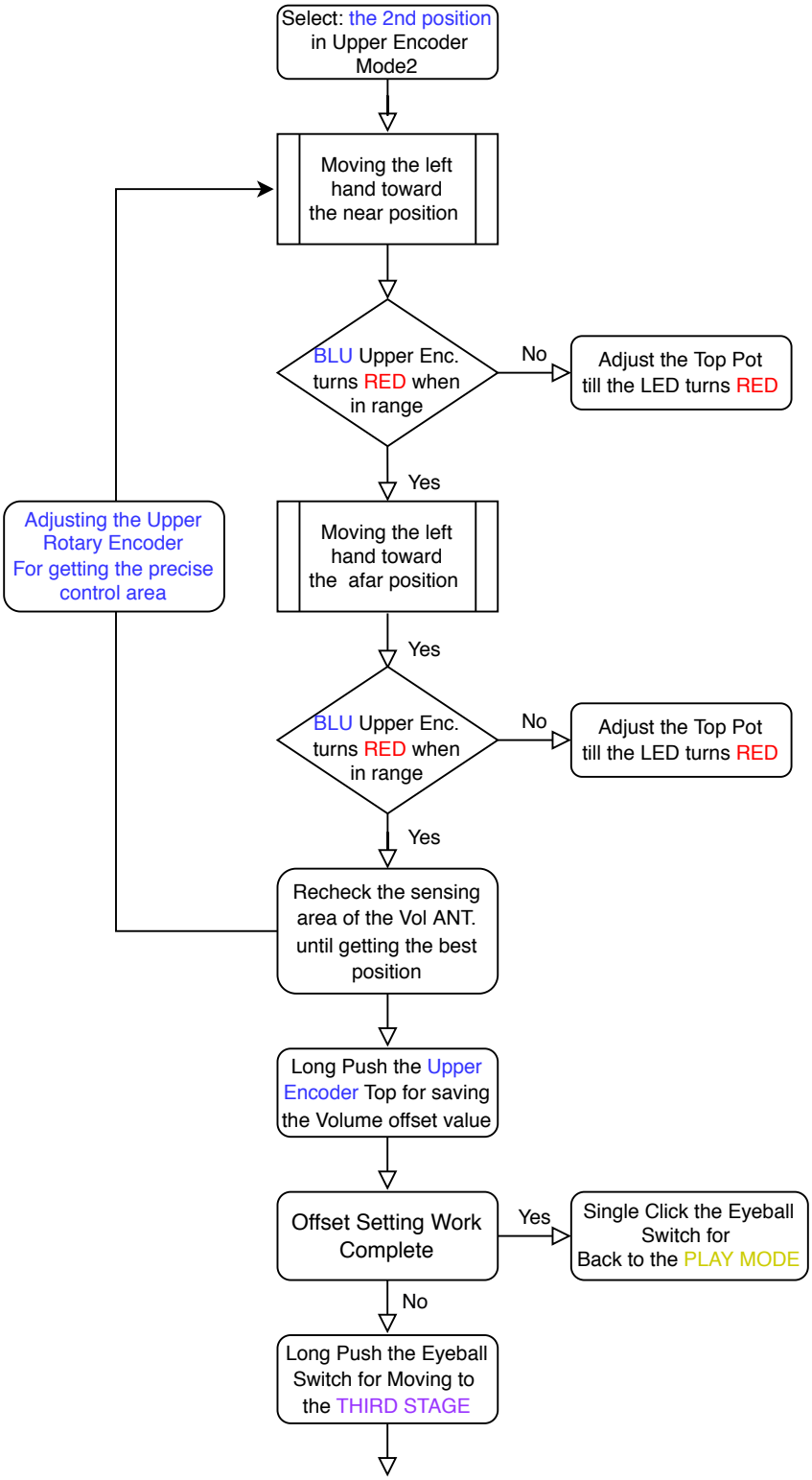
Yes

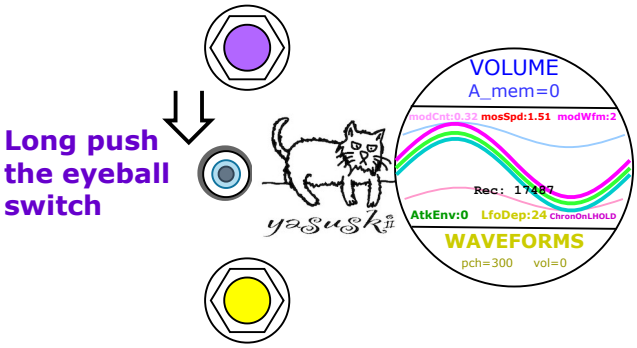
Single Click the Eyeball Switch for Back to the PLAY MODE

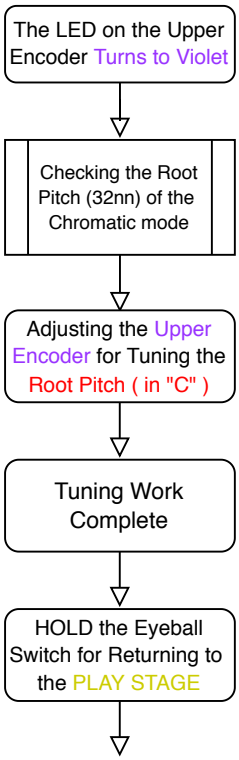
No

Long Push the Eyeball Switch for Moving to the SECOND STAGE

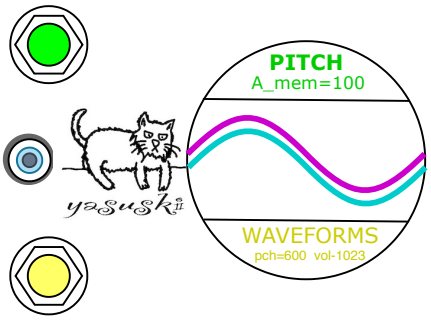

Long push
the eyeball
switch
VOLUME
A_mem=0
modCnt:0.32 mosSpd:1.51 modWfm:2
Rec: 17487
AtkEnv:0 LfoDep:24 ChronOnLHOLD
WAVEFORMS
pch=300 vol=0


Select: the 2nd position in Upper Encoder Mode2
Moving the left hand toward the near position
BLU Upper Enc. turns RED when in range
No
Adjust the Top Pot till the LED turns RED
Yes
Moving the left hand toward the afar position
Yes
BLU Upper Enc. turns RED when in range
No
Adjust the Top Pot till the LED turns RED
Yes
Recheck the sensing area of the Vol ANT. until getting the best position
Adjusting the Upper Rotary Encoder For getting the precise control area
Long Push the Upper Encoder Top for saving the Volume offset value
Offset Setting Work Complete
Yes
Single Click the Eyeball Switch for Back to the PLAY MODE
No
Long Push the Eyeball Switch for Moving to the THIRD STAGE


Long push
the eyeball
switch
VOLUME
A_mem=0
modCnt:0.32 mosSpd:1.51 modWfm:2
Rec: 17487
AtkEnv:0 LfoDep:24 ChronOnLHOLD
WAVEFORMS
pch=300 vol=0
yasuski

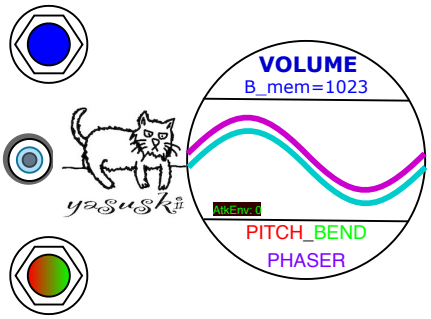

The LED on the Upper Encoder Turns to Violet
Checking the Root Pitch (32nn) of the Chromatic mode
Adjusting the Upper Encoder for Tuning the Root Pitch (in "C")
Tuning Work Complete
HOLD the Eyeball Switch for Returning to the PLAY STAGE

The Voice & Playback Mode



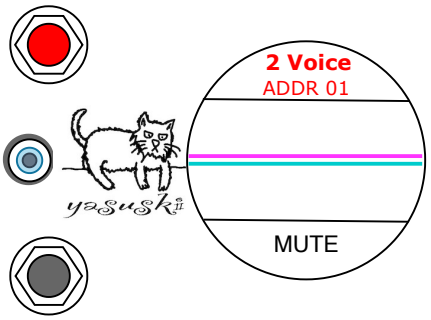
The default position is PITCH offset mode.

The lower knob shows the PB mode is in NORMAL mode.



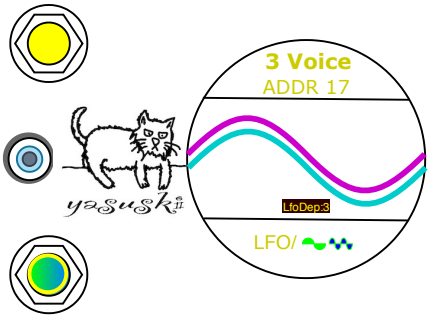
Click the upper knob then move to VOLUME offset mode.

Turn Right the lower knob then the PB mode is move to PitchBend / Phaser mode. When the voice modes are selected, the upper knob accepts the parameter input.



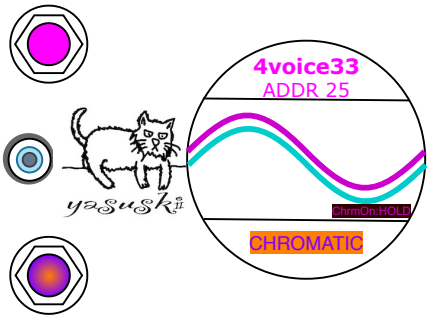
Click the upper knob then move to 2 voice mode.
The 15 pitch combination is available in this mode.
The last one is assigned to the Arpeggiator.

Turn Right the lower knob then the PB mode is move to MUTE mode.



Click the upper knob then move to 3 Voice mode.
This mode has 7 presets with the Arpeggiator.

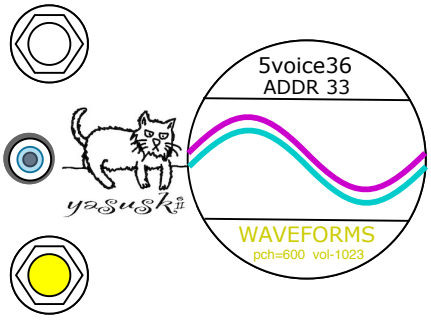
Turn Right the lower knob then the PB mode is move to LFO mode. When the voice modes are selected, the upper knob accepts the parameter input.



Click the upper knob then move to 4 Voice mode.
This mode has 7 presets with the Arpeggiator.

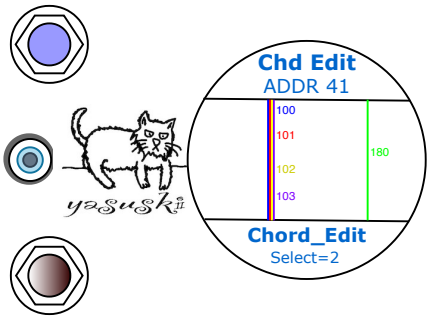
Turn Right the lower knob then the PB mode is move to Chromatic mode. When the voice modes are selected, the upper knob accepts the parameter input.

The Voice & Playback Mode (contin'd)



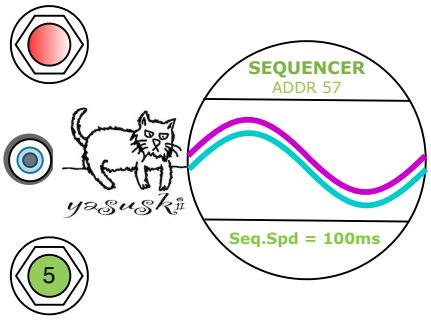
Click the upper knob then move to 5 Voice mode.
This mode has 7 presets with the Arpeggiator.

The automatic chord changer is assigned to;
ADDR 36 to 39 in 5 Voice mode.



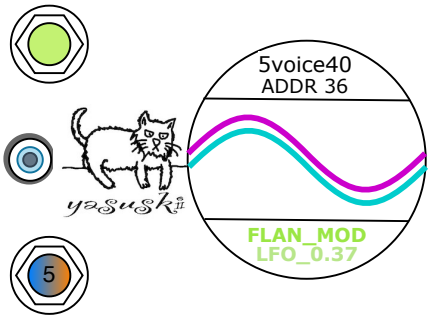
Click the upper knob then move to chord edit mode.
This mode has 16 presets with the Arpeggiator.

Click the lower knob 2~5 times from the fundamental position then the tuning knobs are activated.



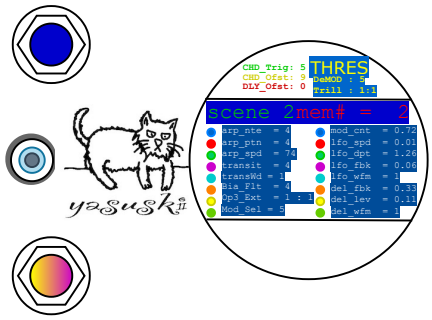
Click the upper knob then move to SEQUENCER mode.
This mode has 8 sequence files.

Click the lower knob 5 times from fundamental position then the SEQUENCER SPEED parameter is activated.



When the Modulation Controller mode (Click the lower knob 5 times from the fundamental) is selected in the VOICE/ChordEdit modes,

The upper knob turns to the selector of the Modulation, (VCF frequency/VCF Mod Rate/FLANGER Mod Rate/ Chorus Mod Rate/Dub Mod Rate) then the lower knob is working as VCF COF/LFO SPD/DPT/FBK controller.



Click the upper knob (or long push the top switch in the voice modes) then mode2 is moving to THRES mode.
This mode set the several parameters as the threshold point of the effects/Looper Playback Speed/Looper Output Switcher/Demodulator setup/Starting address of the Chord Sequencer.

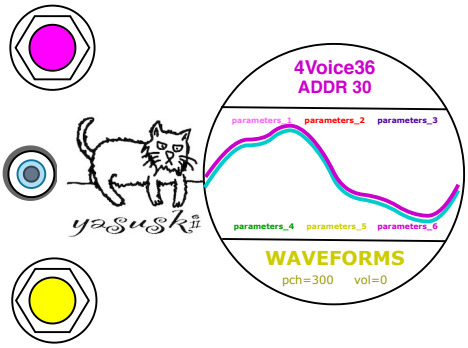
Turn right the lower knob then switching the PB mode then changing the threshold point and The parameter of the Looper/Chord Switcher.

WAVEFORMS

pch=600 vol-1023

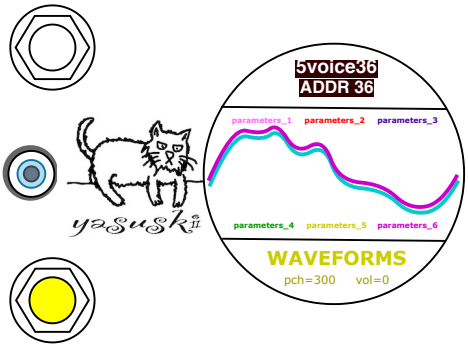
The Chord Sequencer

The Chord Sequencer is a 16 step Cyclic Harmony Generator driven by a left hand or BPM clock.



In 4 voice mode (Magenta), ADDR #30 and #31 are reserved for the Chord Sequencer.
The Chord Sequencer switches 16 chord address selected from the chord library set of 56. The assignment of the starting address of the chord group (of 16) is set in the THRES mode. The address assignments are switched in #30 forward or #31 random by entering the threshold point on the volume value.

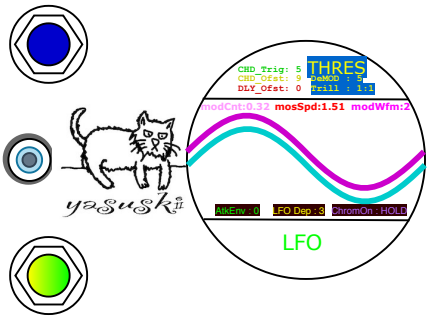
In 2 voice mode (Red), ADDR #15 is added for the Chord Sequencer. The Chord Sequencer switches 8 chord address selected from the chord library started from #32.



In 5 voice mode (White), ADDR #36 to #39 are reserved for the Chord Sequencer.
The Chord Sequencer switches 16 chord address selected from the chord library set of 56. #36 (forward) and #37 (random) works as same as 4voice mode, and #38(forward) and #39(random) switching the chord works like a 16 step Sequencer.

The Chord Library from address #01 to #56							
ChordEdit42	ChordEdit43	ChordEdit44	ChordEdit45	ChordEdit46	ChordEdit47	ChordEdit48	ChordEdit49
ChordEdit50	ChordEdit51	ChordEdit52	ChordEdit53	ChordEdit54	ChordEdit55	ChordEdit56	ChordEdit57
Chd01 = D#D#G#G#	Chd02 = G,G,B,B,	Chd03 = E,G,B,E,	Chd04 = E,G,A,B,	Chd05 = E,G,2,E,	Chd06 = D#F#A,0,	Chd07 = D,E,G,2,	Chd08 = F,G,A#,3,
Chd09 = F,G,B,D,	Chd10 = D,G,A,B,	Chd11 = D#G,B,D,	Chd12 = a,C,E,G#	Chd13 = C#D,F,A,	Chd14 = D,F,G,A,	Chd15 = C,D#F#A,	Chd16 = A@C,E,G#
Chd17 = x,x,x,x,	Chd18 = x,x,x,x,	Chd19 = x,x,x,x,	Chd20 = x,x,x,x,	Chd21 = x,x,x,x,	Chd22 = x,x,x,x,	Chd23 = x,x,x,x,	Chd24 = x,x,x,x,
C,As,Ds2,G2	C,Ds,As,D2	C,As,E2,G2	C,F,As,Ds	C,F,As,D	C,D2,F2,AA2	C,D2,E2,G	C2,F2,G2,AA2
B,D2,E2,G2	C,E,F,A	C,F,A,As	C,E,F,A	C,E2,G2,B	C,Ds2,Gs2,As2	C,D2,G2,AA2	C,Cs,Fs2,Gs2

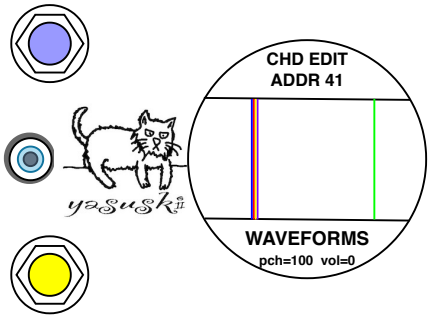
*The C#SV chords are read from the text file on the micro SD card.
*The C#SV chords from Chd17 to Chd 24 are suited for 8 step sequencer on 2voice mode.
*The C#SV chords are stored on the ROM.



Click the upper knob 8 times (or double click once} from the fundamental position or "HOLD" the top switch on the left side at the Playback mode position on the lower knob, then the voice mode is moved to the THRES mode.

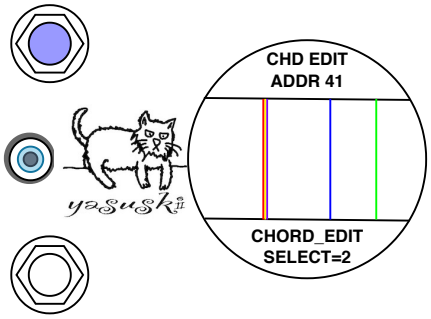
Turn the lower knob clockwise to enter LFO mode. At this time, the upper knob is assigned to a parameter that sets the starting address for the Chord Sequencer, CHD_Ofst = pot0.

Microtonal Tuning / Chord Edit Mode



In the Chord Edit mode, the user can tune 4 individual pitches. The tuning rules are not depend on the Equal temperament. Firstly, the user start the edit work by accessing to the neutral position of the Chord Edit mode. At the neutral position, the user can hear the fixed pitch (Green line) which is reserved for the marker for start tuning.

There are 16 editable channels. (ADDR #42 to #57)
The example shows the first step for editing the pitches.

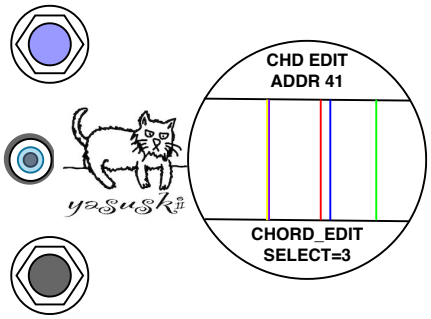


Access to the Chord Edit mode on the lower knob by clicking (forward) 2 times from the neutral position(Yellow turns White).

After selecting the neutral position of the Pitch Edit mode (ADDR #41), moving to the parameters for controlling the pitch of the oscillators.

When the user access to the tuner for 2nd OSC, LED on the lower knob turns from Yellow to White. For accessing to the next pitch (Red line), click the lower knob once. (White turns to Black)

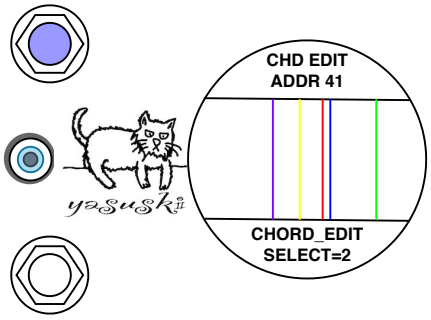
**If the mixout with transition mode is selected as the audio source, the user can not able to hear the desired pitch for tuning.



For checking the sound, move the left hand position towards the antenna for searching the peak level or re-select the mixed signal with equal audio output levels without the transitions.

Click the top of the lower knob and Moving to the next parameter (Yellow). The LED color on the lower knob changes from Black to White.

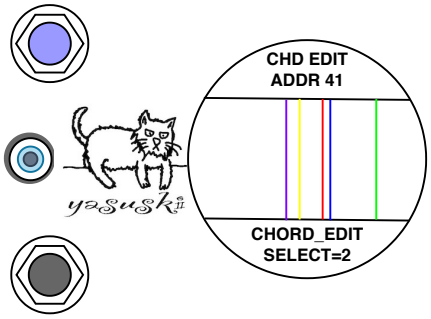
The combinations of the pitches in Chord Edit mode also be the resources of the chord book for the arpeggiator. (see the chapter “Arpeggiator”)



Turn the lower knob for tuning.

After complete the tuning work, click the knob for moving to the next pitch (Magenta). The LED color changes from White to Black.

The next stage is the final tuning point.



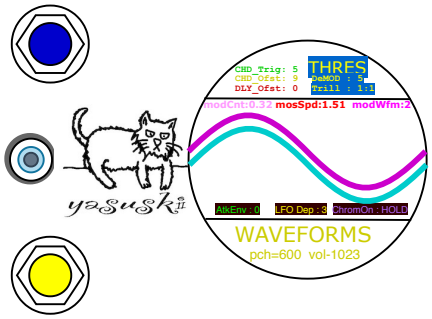
After the tuning work is completed, select the desierd recording position on the upper knob.

If you want to re-check the sound, turn back to the neutral position by rotating the knob.

After deciding the recording position, push the top of the lower knob over 1 second for storing the data onto the microSD card.

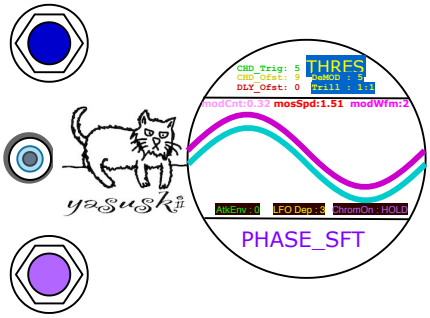
Move to the desierd position you want to edit.

THRES Mode



Click the upper knob 8 times (or double click once} from the fundamental position or "HOLD" the top switch on the left side at the Playback mode position on the lower knob, then the voice mode is moved to the THRES mode.

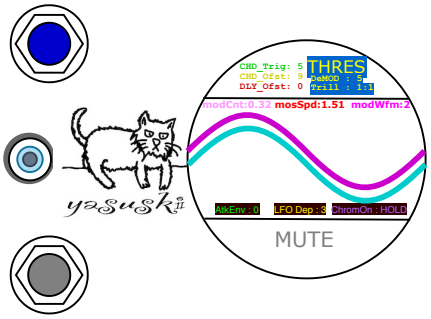
At this time, the upper knob is assigned to the DeMOD parameter for switching the FVC absorber / Looper output selector, DeMOD = pot00z.



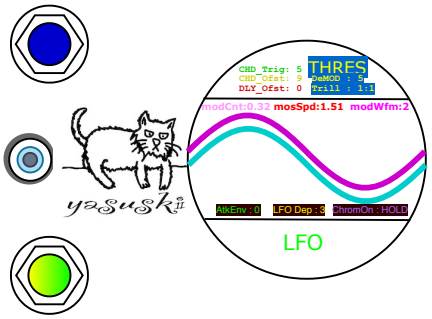
Turning the lower knob clockwise will enter pitch bend/phase shift mode.

If the PHASE_SFT is selected, the upper knob is assigned to a parameter that sets the looper playback speed = pot00q.

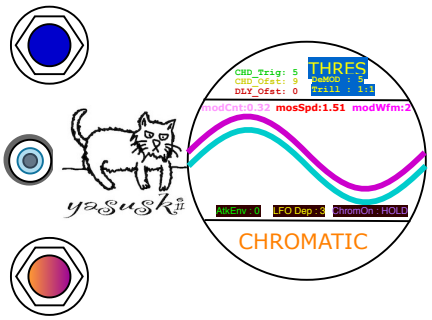
If the PITCHBEND mode is selected, the upper knob is assigned to a parameter CHD_Trig = pot00a.



Turn the lower knob clockwise to enter MUTE mode. At this time, the upper knob is assigned to the trill note pattern selector pitch_drift = pot00v.

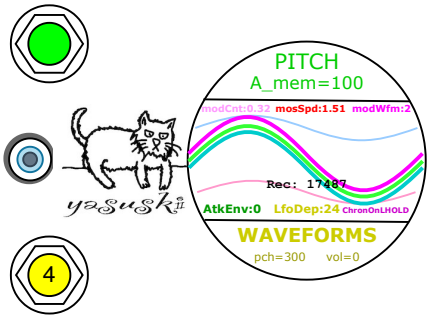


Turn the lower knob clockwise to enter LFO mode. At this time, the upper knob is assigned to a parameter that sets the starting address for the Chord Sequencer, CHD_Ofst = pot0.



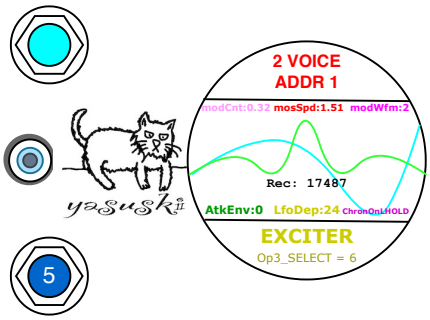
Turn the lower knob clockwise to enter CHROMATIC mode. At this time, the upper knob is assigned to a parameter that sets the delay time magnifier, DLY_Ofst = pot00g.

The Parameters on the lower knob



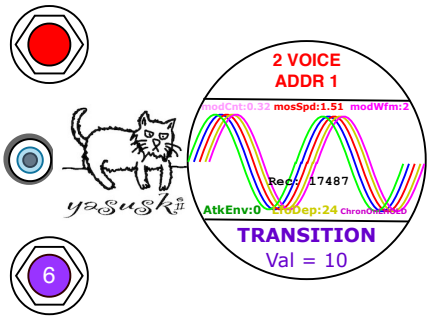
The lower knob is mainly assigned to the selectors for the audio source or the parameters for the sound effect controllers.

The fundamental position is the normal playback mode.



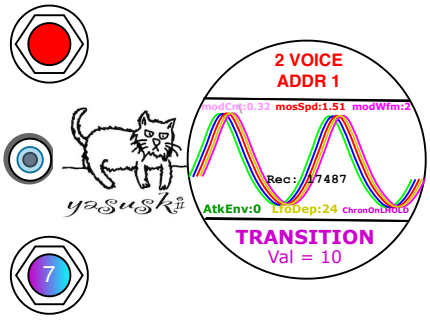
Click the lower knob then the parameter is moved to : Op3 / Exciter mode.

The function is switced by clicking the upper knob.



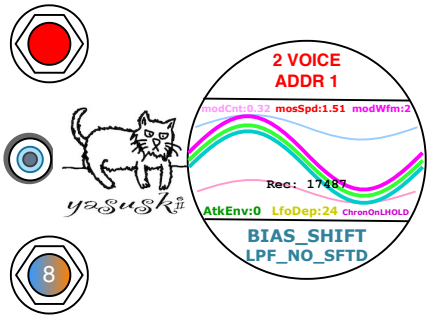
Click the lower knob then the parameter is moved to : the Transition Distance controller.

The value is changed by turning the lower knob.



Click the lower knob then the parameter is moved to : the Transition Waveform switcher.

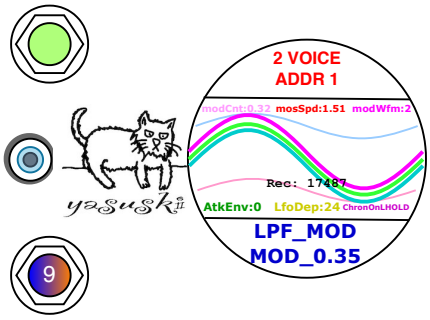
The waveform is switched by turning the lower knob.



Click the lower knob then the parameter is moved to : the LPF / HPF / Distortion / USB_MIDI selector.

The status is switched by turning the lower knob.

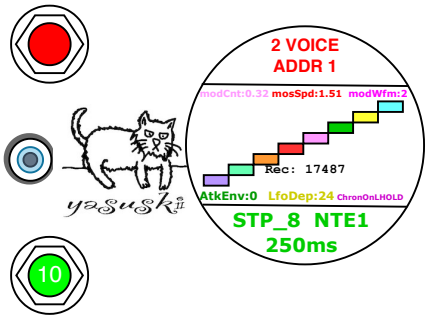
The Parameters on the Lower Knob (contin'd)



Click the lower knob then the parameter is moved to : LPF Frequency / LPF Modulation / Flanger / Chorus / Dub Rate controller mode.

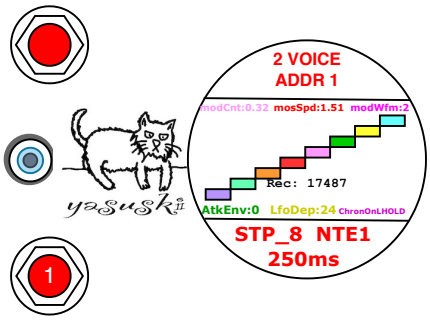
The function is switched by turning the upper knob.

***When the Sequencer mode is selected, this stage is assigned to the parameter "Sequence Speed".**



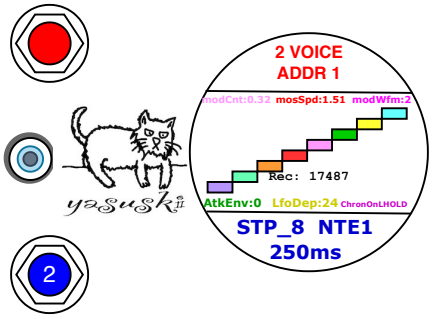
Click the lower knob then the parameter is moved to : speed control for the Arpeggiator.

The arp speed is controlled by turning the lower knob.



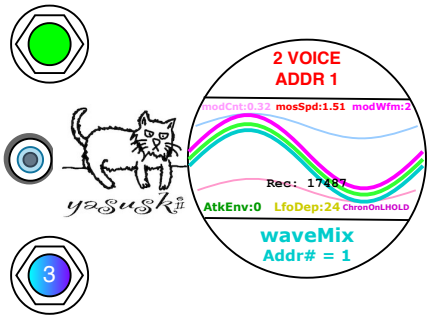
Click the lower knob then the parameter is moved to : Pattern selector (Up / Alternate / Down / Random) for the Arpeggiator.

The arp pattern is switched by turning the lower knob.



Click the lower knob then the parameter is moved to : Note pattern selector (17 preset with 15 editable notes) for the Arpeggiator. The preset notes are written in the file by the C#SV format on the microSD.

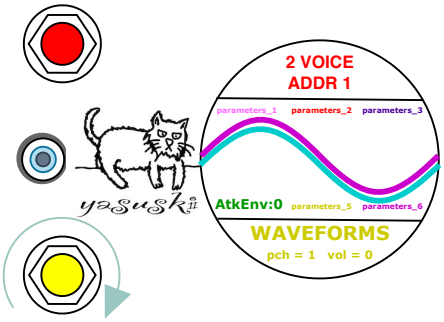
The arp notes is switched by turning the lower knob.



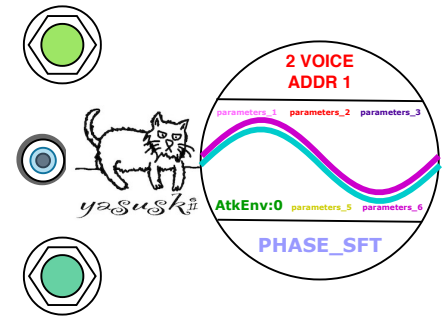
Click the lower knob then the parameter is moved to : Waveform Mix Selector / Edit mode. (the 14 preset with 18 editable waveform mix) The parameters (32 wavetables with 5 levels) controlled by the upper knob is changed by clicking the upper knob, then turning the knob for selecting / changing the values.

The waveform mix memory address is switched by turning the lower knob.

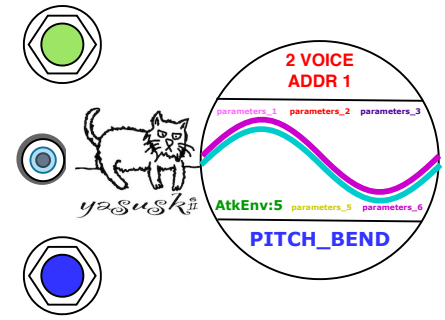
Pitch Bend and Phase Shifter



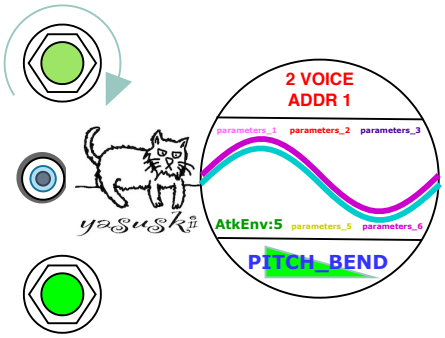
The PitchBend mode is available on all voicing modes.
The Up/Down direction is selectable by the border point of zero value on the pot.
Attention: “Bend Down” means “up bended pitch turns to equal to the un-bended pitch” in decided time.
“Bend Up” do the alternative work. Please imagine the sound of the guitar playing method named as “Harmonized choking”.



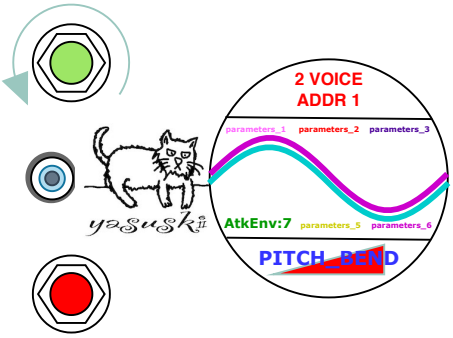
Access to the parameter “MUTE Switch” on the lower knob as the power-on neutral position(Yellow).
Rotate the lower knob clockwise then the LED color on the lower knob turns Indigo showing at the zero point.
Then the LED on the upper knob turns a color in LEAF.



In the PitchBend mode, the upper knob accepts the value for controlling the bending direction and depth.
The gating point is related with the Volume value and is set by the parameter in the Threshold mode.
At this time, the effect mode is set as the "PHASER".
When the zero value is varied, the LED turns in BLUE.



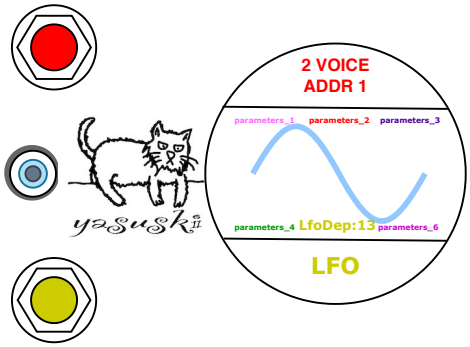
The value of the bending direction is switched by the border of the “zero” value on the upper knob.
Turning clockwise, the LED turns Green when the bend down action is activated and increasing the value of the bending time.



Turning counter clockwise select the bend up mode and increasing the value of the bend depth. The LED turns Red when the bend up action is activated.

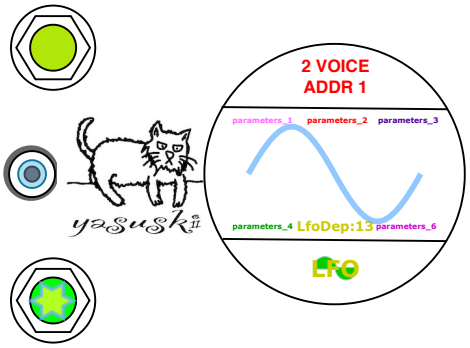
After complete the editing work, push the top of the knob over 1 second for recording the values of the parameters on the scene memory on the Voice Mode.

The Tremolo Mode

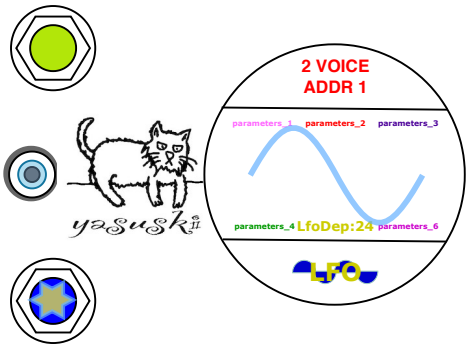


The Tremolo mode is available on all voicing modes. The shape of the LFO signal is editable by the value on the pot.

Access to the parameter "Mute" on the lower knob as the power-on neutral position(Yellow). Rotate the lower knob clockwise in 2 steps then the LED color turns Green/Blue.



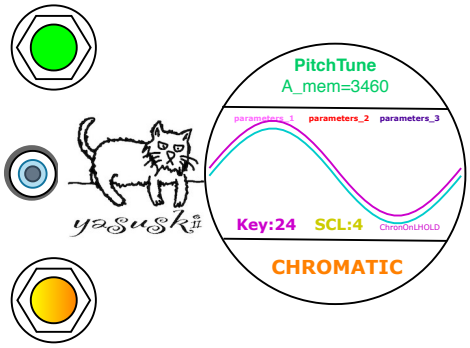
In the Tremolo mode, the upper knob accepts the value for controlling the shape of the LFO signal and speed magnification (x 1 / x 2). The LED turns Green when the upper knob is rotated in clockwise.



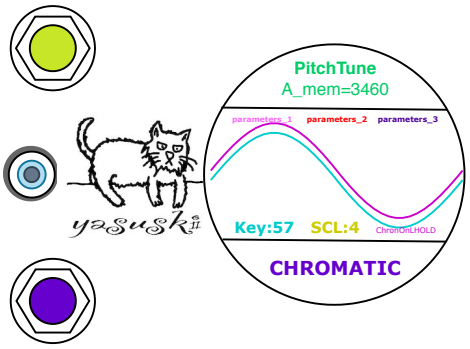
The LED turns Blue when the upper knob rotates in clockwise. and the LFO is working on x2 speed.

Rotating action increases the value of the depth. After completing the edit work, push the top of the knob over 1 second for recording the values of the LFO depth parameter.

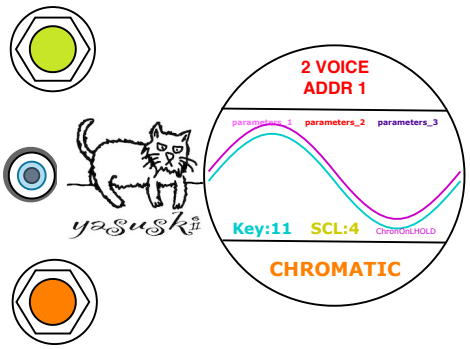
The Chromatic Mode



The Chromatic mode is available on all voicing modes. Access to the parameter "MUTE Switch" on the lower knob as the power-on neutral position(Yellow). Rotate the lower knob clockwise 3 notches then the LED color on the upper knob turns Leaf and lower knob turns Orange.

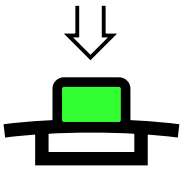


When the PitchTune mode is selected with the upper knob, the upper knob is assigned to the parameter that sets the activation time of the chromatic mode. Then the LED color on the upper knob turns to Leaf. When the Chromatic mode is inactivated, the LED on the lower knob turns Purple.



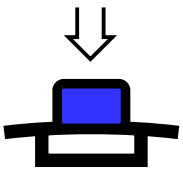
Click the upper knob twice, then moving to the 2 voice mode. The upper knob has been working for the scale selector at this time. The color of the upper knob is still colored in Leaf. The 32 preset scales are available.

The 3 top switches are working in the special tasks when the Chromatic mode is selected.



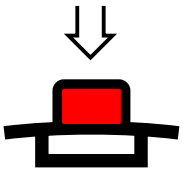
The top switch on the left is working as follows:

Single click: noteNumber++
Double click: noteNumber--
Triple click: Scales is in the neutral position
Hold: noteNumber is in the neutral position.



The top switch on the center is working as follows:

Single click: Scales--
Double click: PitchDrift--
Triple click: Playback speed on the Looper--
Hold: Recalling the Scene Memories



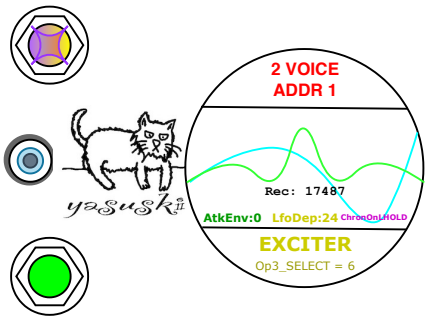
The top switch on the right is working as follows:

Single click: Scales++
Double click: PitchDrift++
Triple click: Playback speed on the Looper--
Hold: Activating the Auto Fade mode

The Chromatic Mode (Continue'd)

SCALES												
	C	**C#**	**D**	**D#**	**E**	**F**	**F#**	**G**	**G#**	**A**	**A#**	**B**
1	X	X	X	X	X	X	X	X	X	X	X	X
2	X		X				X		X			
3	X		X			X		X	X	X		
4	X		X		X			X		X		
5	X		X			X		X		X		
6	X		X	X				X		X		
7	X			X			X			X		
8	X		X			X			X	X		
9	X		X		X		X		X		X	
10	X	X			X	X		X	X			X
11	X		X				X	X		X		
12	X	X			X		X		X		X	
13	X		X	X			X	X		X	X	
14	X		X		X	X			X	X		
15	X		X	X			X	X		X		X
16	X		X	X			X	X		X		
17	X		X		X	X		X		X		X
18	X		X		X		X	X		X		X
19	X		X		X	X		X		X	X	
20	X		X			X				X		
21	X					X		X				X
22	X		X		X			X				
23	X		X	X		X		X		X	X	
24	X		X	X			X		X	X		X
25	X	X		X		X		X	X		X	
26	X			X		X	X		X		X	
27	X		X	X		X	X		X		X	
28	X		X	X			X	X		X	X	
29	X	X	X	X			X		X	X	X	
30	X		X	X			X		X		X	
31	X			X	X		X		X	X		X
32	C	C#			E	F	F#		G#	A	A#	

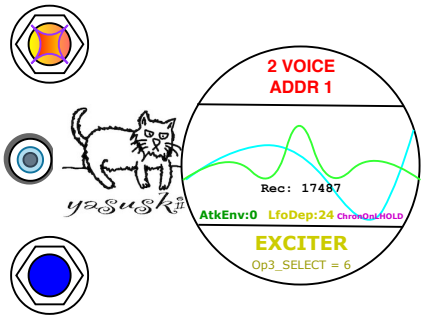
The Exciter



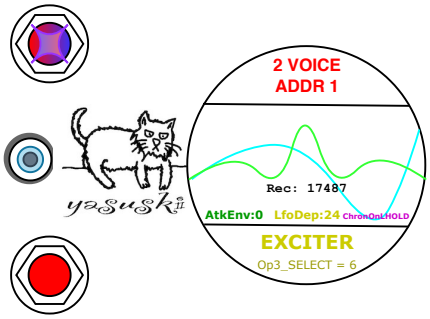
The "Op3" has the selector for the output source, Transition / Normal envelope and Exciter.

In Exciter mode, the input signal is reading out the wavetable which is generated for trans- forming from by Chebysheve's polinominal expressions.

The 5 parameters as the fundamental and 4 harmonics levels are available for generating the wavetable. Fig.6 shows the generated wavetables by different parameter settings. The user can edit the mixing level of the harmonics by the following steps.

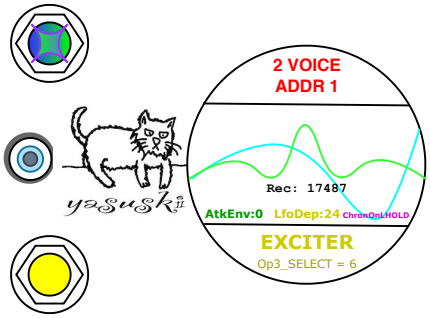


1) Double click the upper knob then select the Harmonic Level 5 (Magenta)
2) Turn the upper knob for setting the Harmonic Level 5.
3) The Blinking speed of the upper LED show the values of the parameters.



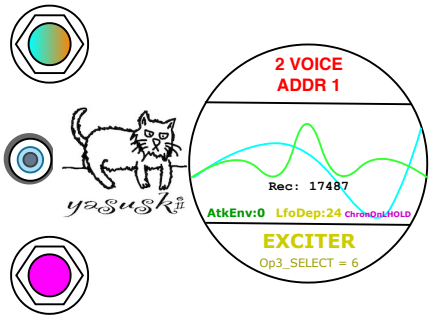
1) Double click the upper knob then select the Harmonic Level 4 (Yellow)
2) Turn the upper knob for setting the Harmonic Level 4.
3) The Blinking speed of the upper LED show the values of the parameters.

1) Double click the upper knob then select the Harmonic Level 3 (Red)
2) Turn the upper knob for setting the Harmonic Level 3.
3) The Blinking speed of the upper LED show the values of the parameters.



1) Double click the upper knob then select the Harmonic Level 2 (Blue)
2) Turn the upper knob for setting the Harmonic Level 2
3) The Blinking speed of the upper LED show the values of the parameters.

1) Double click the upper knob then select the Harmonic Level 1 (Green)
2) Turn the upper knob for setting the Harmonic Level 1.
3) The Blinking speed of the upper LED show the values of the parameters.



1) Double click the upper knob 4 times then return to the starting point.
2) Turn the upper knob for selecting the Memory Bank (3) of the Exciter.
3) Hold the top knob for recording the parameters to the Memory Bank. then the LCD shows the details of the parameters.

The lower knob is assigned to the output selector for CH.3.
Turn the knob for selecting a signal from 5 oscillator output.
The first group of 5 set the output level with transition.
The second group of 5 set the output level with normal envelope.
The last group of 5 set the transfer output with normal envelope.
The LED on the lower knob shows which oscillator is assigned from.

Audio Excitation

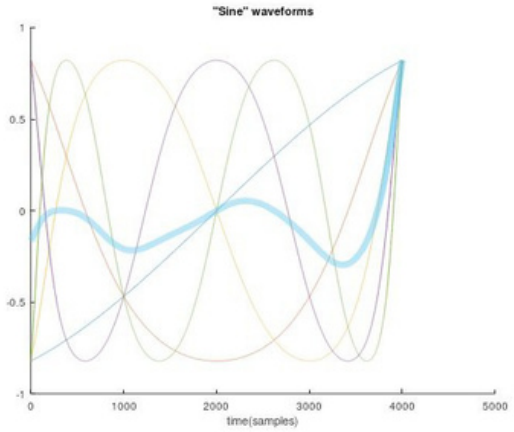


Fig.5 Transformation example 1

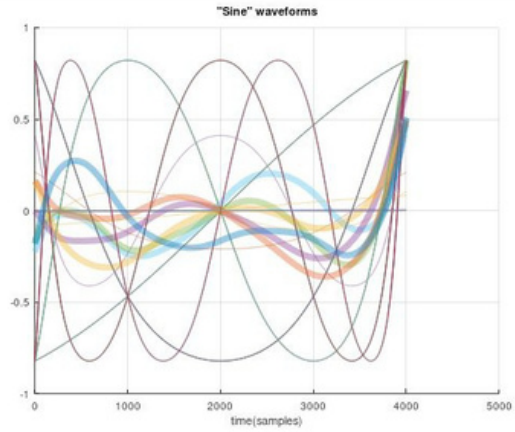


Fig.6 Transformation example 2

The player can select 3 output mode, Transition / Normal envelope and Exciter on Op3.
In Exciter mode, the input signal is reading out the wavetable which is generated for transforming from by Chebysheve's polinominal expressions. (see Fig.5)
The 5 parameters as the fundamental and 4 harmonics levels are available for generating the wavetable.
Fig.6 shows the generated wavetables by different parameter settings. The user can edit the mixing level of the harmonics by the following steps.

1) Select the Exciter mode on the lower knob.
2) Select the OSC levels (Green, Blue,Red,Yellow and Purple) on the upper knob and edit the harmonic levels.
3) Push the upper knob on the memory bank for saving the parameter setup.
4) The Blinking speed of the LED shows the values of the parameters.

The method of the audio excitation is inspired from the "Arduino Music and Audio Projects" by Mike Cook.

The Exciter generates the extra harmonics from the pure sine wave input. This is a helpful effects for enhancing the audio character from the single waveform output.

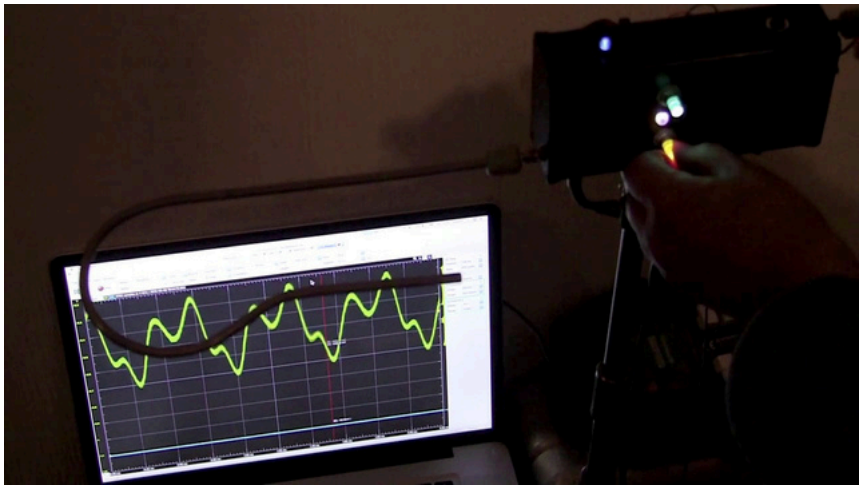


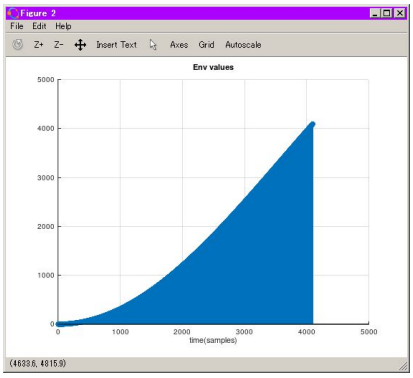
Fig.7 Setting the wavetable for transformation

The picture (Fig.7) shows a transformed sine input in Exciter mode.

Unfortunately, the parameters cannot change in the real time because it takes over 2 second for generating the wavetable.

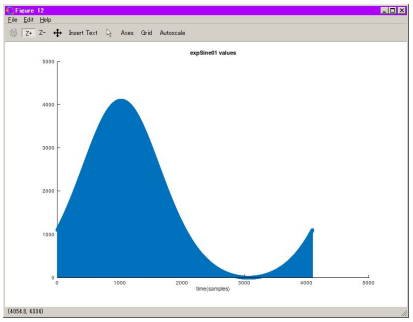
The parameters are stored into microSD card when the edit work has been completed.

The Transition



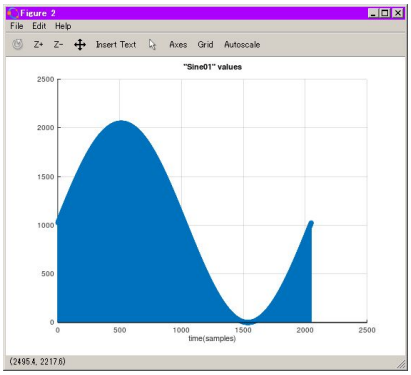
The audio output levels from the oscillators are controlled by the envelope wavetables read out from the text file in the microSD card.

There are 2 types of the control envelopes available, for total volume control and transition control. The data format of the total volume is 12 bits depth with 11 bits length.



In the Transition mode, the audio output level from the oscillators are controlled by the envelopes which are in the different phase. The phase of the each envelopes are set by the parameter named “Transition” which adds the offsets of the readout points to theeach waveforms.

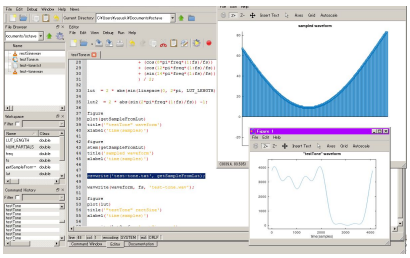
There are 2 cotrol waveforms available. The 1st one is Exp.Sine curved waveform. It has narrower shape on the peak side than the normal sinewave.



The 2nd is Sine curved waveform. It has the wider peak shape than the Exp.Sine curve. It means that the Sine wave has the wider mixing area around the peak level than Exp.Sine wave. On the other hands, wider mixing area makes the distorted signals when the peak points are getting closer to closer.

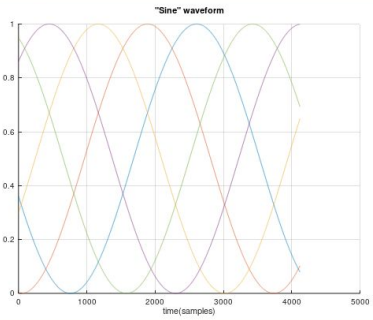
The narrow peaked envelope has the better separation with less distortion.

The file format of both waveforms is 11 x 11 bits.



The waveforms are generated by the GNU Octave in CSV format. GNU Octave is a free math software which is downloadable from: https://www.gnu. org/software/octave/

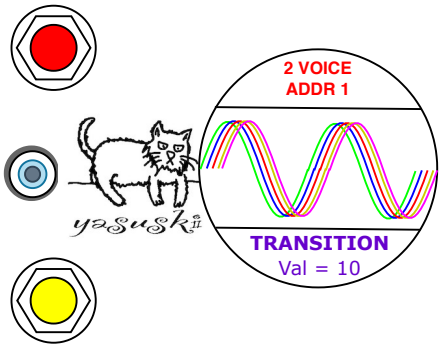
The software works on the Windows and Linux. Unfortunately, the Mac version needs a little bit complex works for the installation.



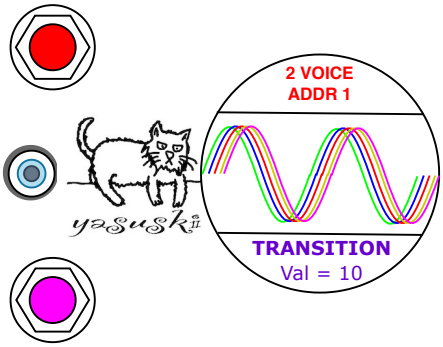
The reading point of the envelopes which controls the audio output levels between the oscillator outputs are varied by the position of a left hand towards the Volume antenna.

The parameter “Transition” controls the distance / phase between the envelopes.
The parameter “Transition Selector” switches the wavetables for the envelopes.

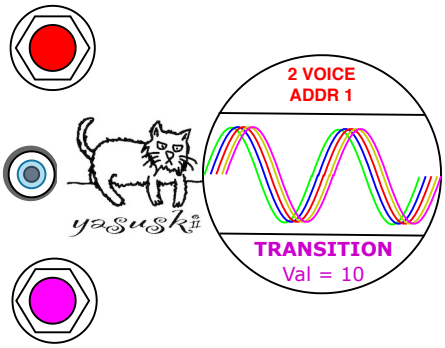
The Transition (continue'd)



Click the lower knob twice from the neutral position (yellow) to enter TRANSITION mode. The LED on the upper knob lights up in Magenta color, which means the knob is accessing to the parameter of the TRANSITION.

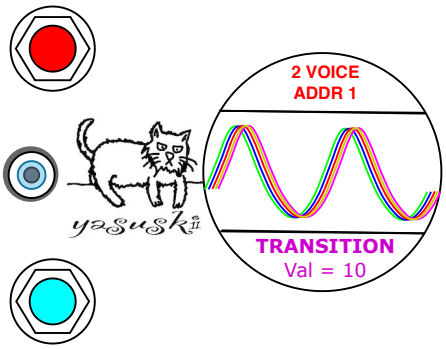


Turn the clockwise lower knob for setting the Transition. Then the distance between the waveforms are changed.



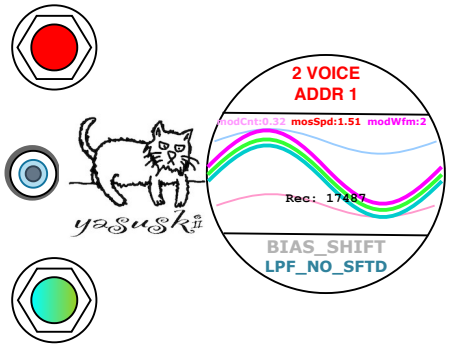
Click the lower knob then the parameter is moved to : the Transition Waveform switcher.

The waveform is switched by turning the lower knob.

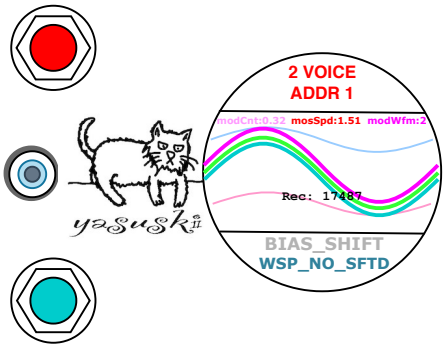


Turn the lower knob for switching the Transition Waveform. Then the LED color on the lower knob lights up in Cyan .

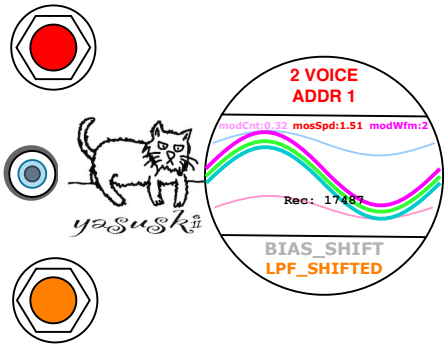
The Filter Selector / BIAS_SHIFT # 1



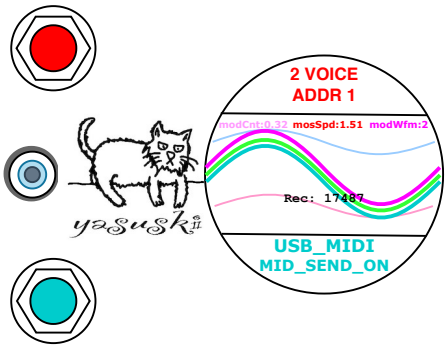
Click the lower knob 4 times from the neutral position (yellow) to enter BIAS_SHIFT mode. The LED on the lower knob lights up in Cyan, which means the knob is accessing to the mode selector of the LPF / HPF/ BIAS_SHIFT / USB_MIDI / Input Selectors.



Turn the lower knob clockwise from the neutral position "LPF with NO_BIAS_SHIFT". The LED on the lower knob still lights up in Cyan, which means the knob is activating the mode Wave Shaper "WSP with NO_BIAS_SHIFT". At this time, the center of the top switch accept the selector for the mode WSP or "HPF with NO_BIAS_SHIFT.

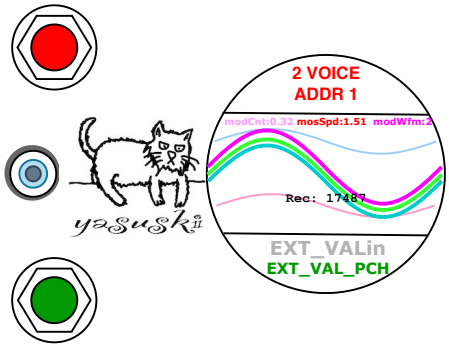


Turn the lower knob clockwise then the LED on the lower knob lights up in Orange, which means the knob is activating the mode "Distorted signals with BIAS_SHIFT". The BIAS_SHIFT is analog circuit not coding on the software, which is activated by the analog switches.

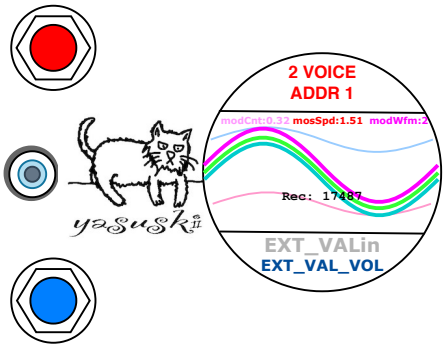


Turn the lower knob clockwise then the LED on the lower knob lights up in DarkCyan, which means the knob is activating the mode "USB_MIDI_OUT with NO_BIAS_SHIFT".

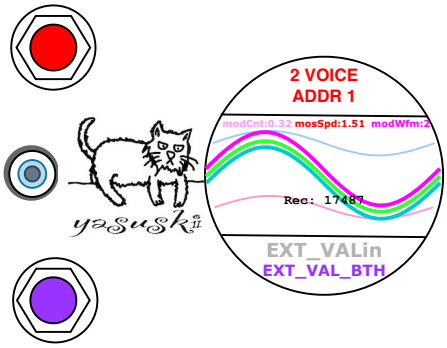
The Filter Selector / BIAS_SHIFT continue'd



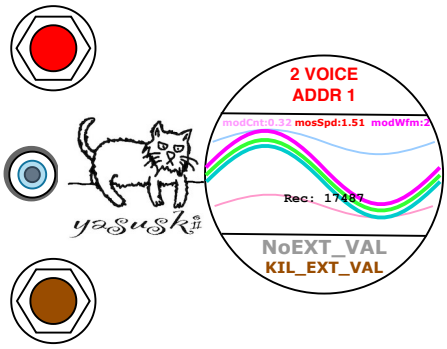
Turn the lower knob clockwise then the LED on the lower knob lights up in DarkGreen, which means the knob is activating the mode "EXT_VALin with EXT_VAL_PCH".



Turn the lower knob clockwise then the LED on the lower knob lights up in Indigo, which means the knob is activating the mode "EXT_VALin with EXT_VAL_VOL".

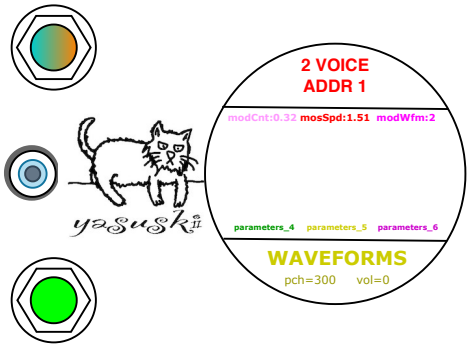


Turn the lower knob clockwise then the LED on the lower knob lights up in Violet, which means the knob is activating the mode "EXT_VALin with EXT_VAL_BTH".

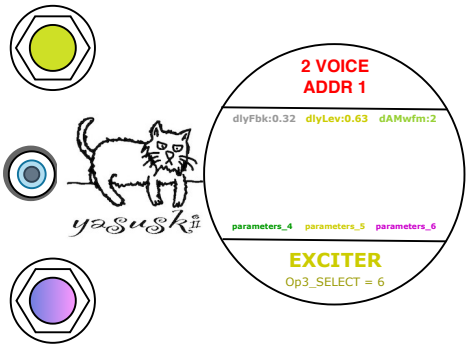


Turn the lower knob clockwise then the LED on the lower knob lights up in Brown, which means the knob is activating the mode "NoEXT_VAL with KIL_EXT_VAL".

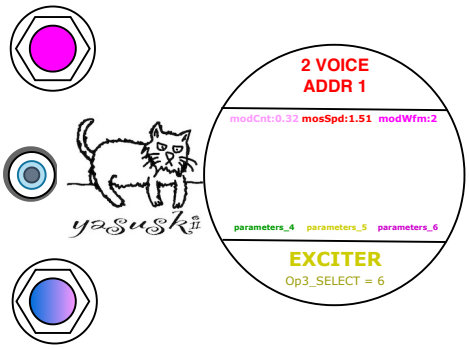
The Delay & LPF controller



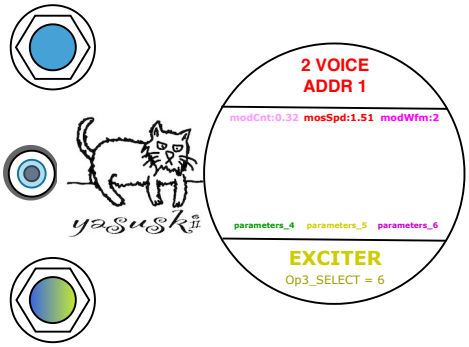
Click the lower knob once from the neutral position (yellow) to enter EXCITER mode. The LED on the upper knob lights up in SkyBlue / DarkCyan / Orange color, which means the knob is accessing to the preset selector of the EXCITER.



Click the upper knob to move to the Delay controller (color changes to Leaf). The lower knob changes to the parameter selector. The fundamental is switching to the Delay feedback (Indigo). Then the upper knob accept to set the values. The next, turn the lower knob until the LED turns to Leaf to select the level controller for the Delay units. Then the upper knob accepts to Delay Level .

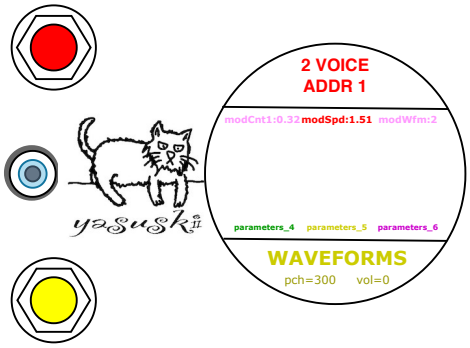


Click the upper knob to move to the LPF controller (color changes to Magenta). The lower knob changes to the effect mode selector. The fundamental is switching to the LPF cut off frequency (Indigo). The next, turn the lower knob until the LED turns to Pink to select the modulator for the LPF. Then the upper knob accepts to LFO speed.

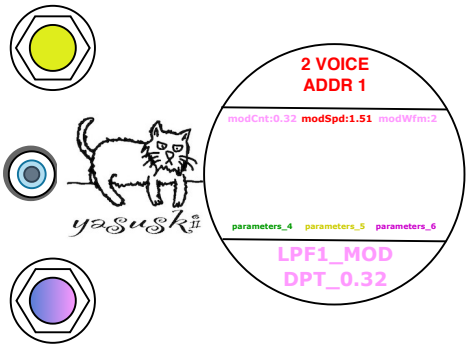


Click the upper knob to move to the LFO1/2 controller (color changes to DarkCyan). The lower knob changes to the selector for LFO1/2. The fundamental is switching to the LFO1 waveform selector (Indigo). The next, turn the lower knob until the LED turns to Leaf to select the waveform selector for the LFO2. The upper knob is reserved for the LFO waveform selectors (4 types).

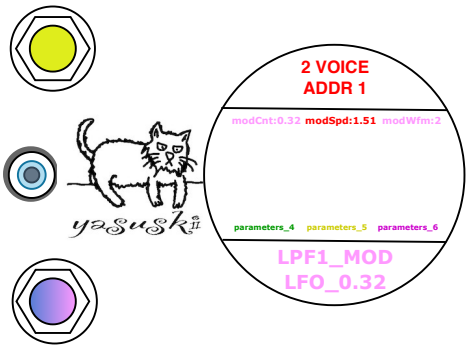
The LPF



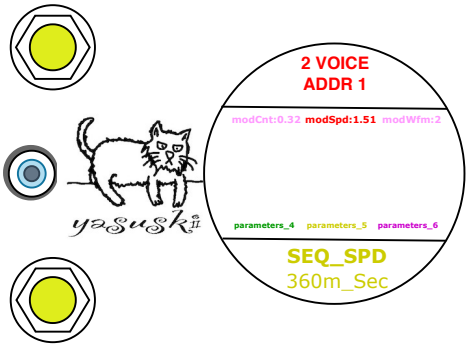
For easy accessing, the LPF has the another controllers. Click 5 times the lower knob from the neutral position (Yellow) to enter LPF_MOD mode. The LED on the upper knob lights up in Leaf, which means the knob is accessing to the parameters for the FILTERS.



The fundamental position of the upper knob is switching to the LPF cut off frequency (Indigo). The lower knob accept the parameter of the cut off frequency for the LPF. The next, turn the upper knob until the LED turns to Pink to select the modulator for the LPF. Then the lower knob accepts to LFO1 speed.

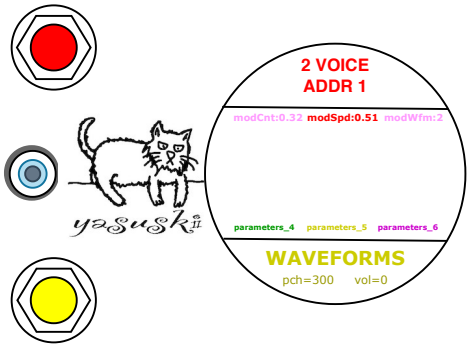


In this mode, the upper knob do not accept the address assignment and switching the voice mode. At this time, the center of the Top Switch accept the in/activation switch for the modulator for the LPF.



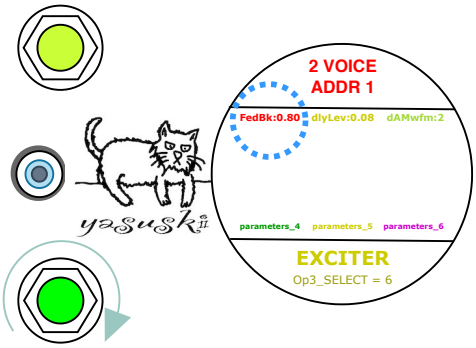
If the SEQUENCER mode is selected, this page is assigned to SEQ_SPD. Move to EXCITER page for access to the filter controllers.

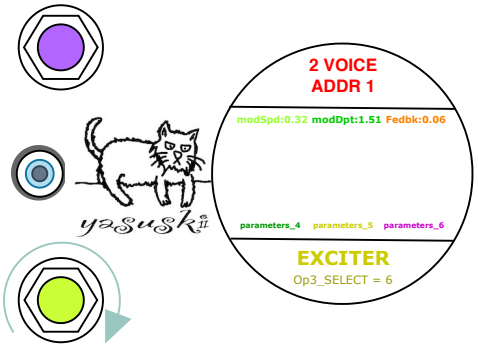
The CombFilter



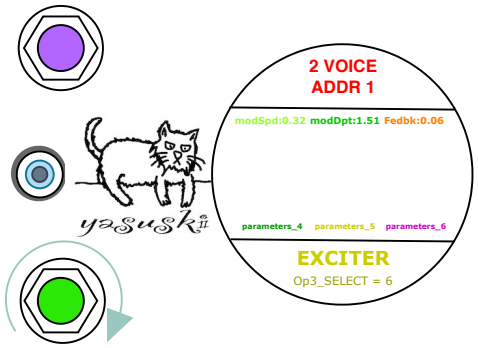
Click the lower knob from the neutral position (yellow) to enter EXCITER mode. The LED on the upper knob lights up in SkyBlue / DarkCyan / Orange color, which means the knob is accessing to the preset selector of the EXCITER.

Click the upper knob to move to the Delay controller (color changes to Leaf). The lower knob changes to the effect mode selector. Turn the knob until the LED turns to Green to select the Feedback control for the comb filter. Then the upper knob accepts to feedback level for the comb filter.

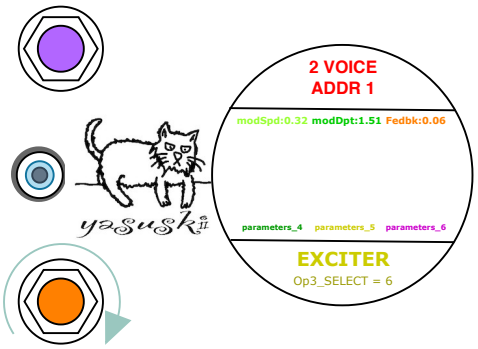




Click the upper knob to move to the LPF controller (color changes to Magenta). The lower knob changes to the effect mode selector. Turn the lower knob until the LED turns to Leaf to select the flanger. Then the upper knob accepts to LFO speed.

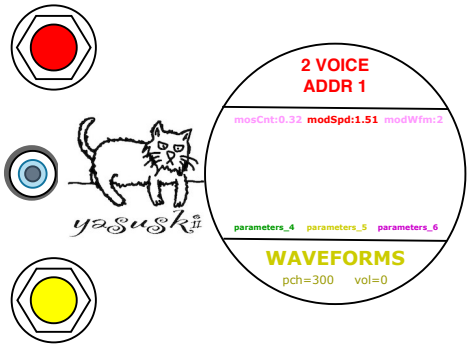


Turn the lower knob until the LED turns to Green to select the chorus. Then the upper knob accepts to LFO depth.

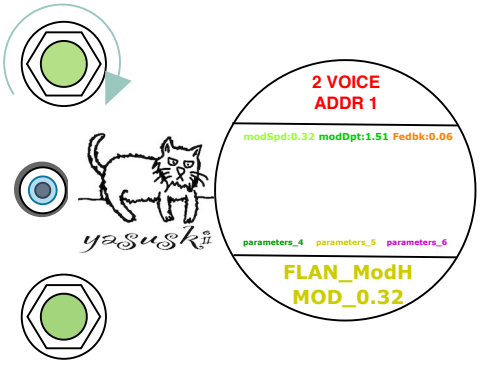


Turn the lower knob until the LED turns to Orange to select the chorus. Then the upper knob accepts to feedback of the combFilter.

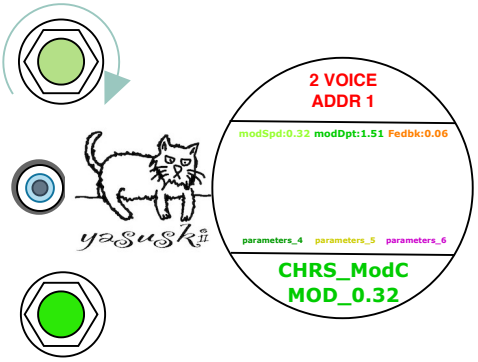
The CombFilter (contin'd)



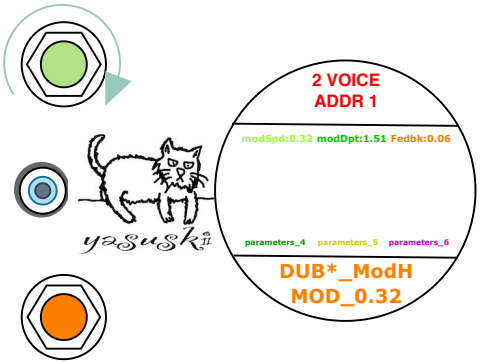
For easy accessing, the comb filter has another controllers. Click 5 times the lower knob from the neutral position (Yellow) to enter LPF_MOD mode. The LED on the upper knob lights up in Leaf, which means the knob is accessing to the parameters for the FILTERS.



Turn the upper knob until the LED on the lower knob turns to Leaf to select the flanger. Then the lower knob accepts to LFO speed. At this time, the center of the Top Switch accept the selector for the interpolation type of the Comb Filter.

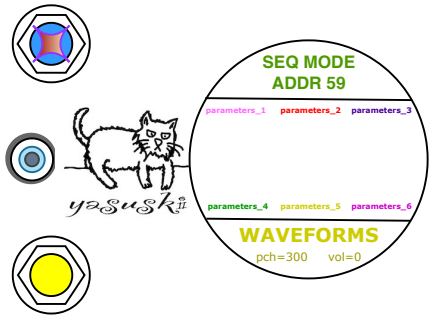


Turn the upper knob until the LED on the lower knob turns to Green to select the Chorus. Then the lower knob accepts to LFO depth. "ModC" means selecting the Cubic Interpolation.



Turn the upper knob until the LED turns to Orange to select the Dub Mode. Then the lower knob accepts to feedback of the comb filter. "ModH" means selecting the Hermite Interpolation.

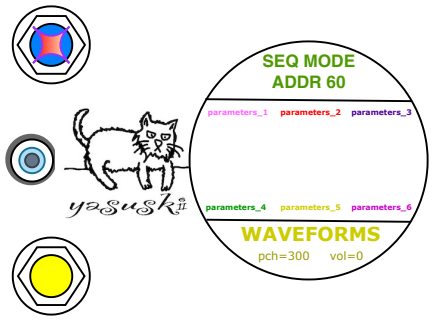
The Sequencer



Click the upper knob 7 times from the fundamental position then the voice mode is moved to SEQUENCER mode.

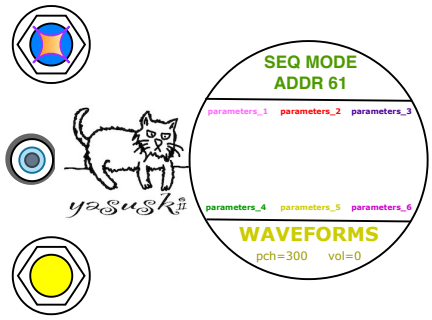
This mode has 8 sequence files.

Click the lower knob 5 times from fundamental position then the SEQUENCE SPEED parameter is activated.



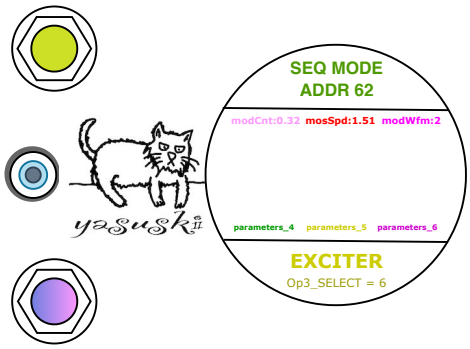
The sequencer has eight readout channels. Each channel stores 1024 to 4096 steps of notes. The first three sequence channels have sequential arpeggiators.

The sequence channel ADDR# 59 has a 1024-step sequential arpeggiator. The root note of the arpeggiator is driven by the pitch oscillator value.

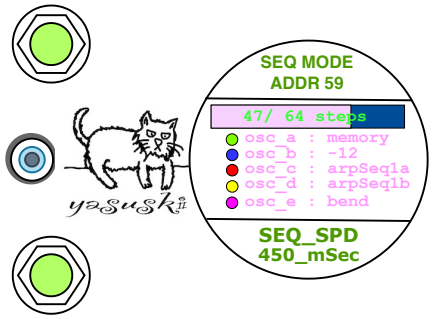


The ADDR# 60 & 61 have a 4096-step sequential arpeggiator with a different structure. The root note of the arpeggiator is driven by the pitch note described in the sequence file.

The ADDR# 63 is a simple 4096-step sequencer.
The ADDR# 64 & 65 is 4096-step 3 voice chord sequencer.
The ADDR# 65 & 66 is 4096-step 3 voice chord sequencer with random note selection. *See the programming method of the sequencer.



The controller for the filters are placed in the Exciter mode. Click the lower knob to move to Exciter mode and move to the filter controllers by clicking the upper knob (color of the LED on the top knob changes to Leaf or Magenta). Then the lower knob changes to the effect mode selector.



Click 5 times on the lower knob from the neutral position (Yellow). The LED on the lower knob lights up in Leaf, it means the knob is accessing to the parameter for the Sequence Speed.

After complete the editing work, push the top of the knob over 1 second for recording the values of the parameters.

C#SV File Format

LaVoixski uses the original data format named the "C#SV" comma and sharp separatd values.

Normally the system uses the CSV for storing the values of the parameter settings except for memory of the musical notes and HEX code.

Comma Sharp Separated Value			
c,	C,	1,	8,
c#	C#	1#	8#
d,	D,	2,	9,
d#	D#	2#	9#
e,	E,	3,	0,
f,	F,	4,	h,
f#	F#	4#	h#
g,	G,	5,	i,
g#	G#	5#	i#
a,	A,	6,	j,
a#	A#	6#	j#
b,	B,	7,	k,

char to HEX		
0~f = 0x00~0x0F		
g~p = 0x10~0x19	A~F = 0x1A~0x1F	
G~P = 0x20~0x29	v~z & "-" = 0x2A~0x2F	
q~u = 0x30~0x34	Q~U = 0x35~0x39	V~Z & "+" = 0x3A~0x3F

Sequence File HEX Format

The first 3 address on the sequencer mode has the sequential arpeggiator.

The characters on the sequence file "SequenceXXA" are addressed to the value of the controller for the Arpeggiator.

The characters are converted to the HEX numbers.

The system reads the HEX numbers then select the status of the Arpeggiator.

HEX to Arpeggiator control	
0xX0 ~ 0xXF	ARP_NOTE #1 ~ 16
0x0X	UP count
0x1X	UP/DOWN count
0x2X	DOWN count
0x3X	RANDOM

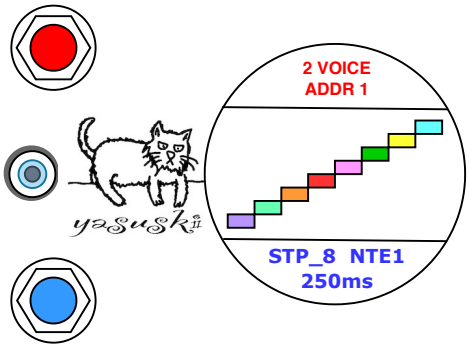
The Arpeggiator

LaVoixski has the Arpeggiator with 32 readout channels.

The first 5 address have 32 memory steps, the second 5 have 64 steps and the next 9 have 128 steps for the arpeggio notes, and they are read from the microSD card on the Teensy .

The other notes from address #20 to 31 have 4steps and they are picked up from the memorized chord edit #1 to #12.

The last address #32 is reserved for the random notes.

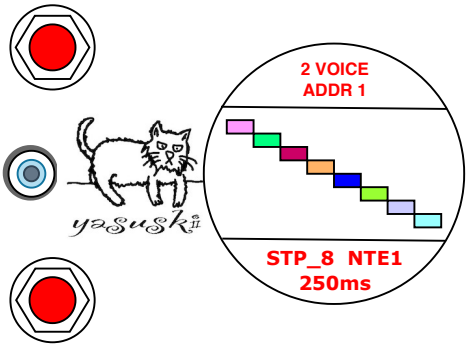


Access to the parameter “ArpNotes” on the lower knob by double clicking (Backward) 2 times from the neutral position (Yellow).

The LED on the lower knob turns Blue and ready for access to 32 note patterns. (19 preset with 13 editable notes from Chord Edit mode)

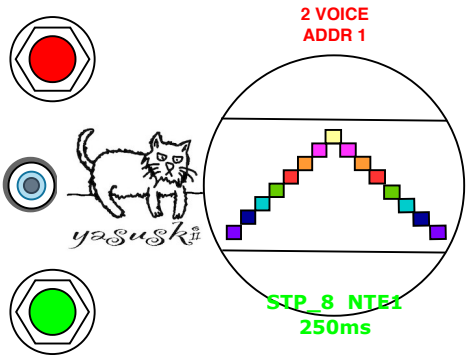
Moving to (Backward) the next parameter “ArpPtn” for selecting the playback pattern (Rise / Down / Switchback / Random) of the Arpeggiator.

The LED turns Red and ready for access to the ArpSpd controller.

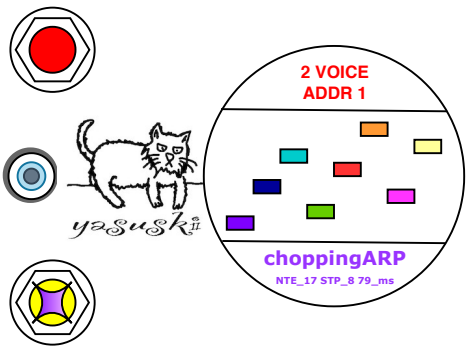


After selecting the ArpPtn for the Arpeggiator, moving to the next parameter “ArpSpd” for controlling the playback speed of the Arpeggiator.

The LED turns Green and ready for access to the speed controller.

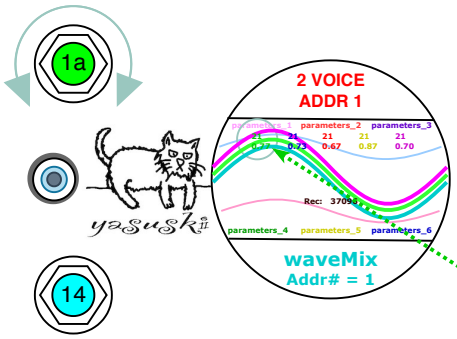


After complete the editing work, select the desired position of the scene memory of any voice mode and push the top of the knob over
1 second for recording the values of the parameters.



The Chopping Arpeggiator mode is available on address # 17 to #20.
The mute actions are shown by the flick of the LEDs in violet.

The WaveMix Mode



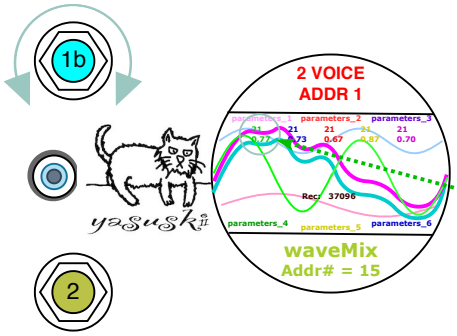
The Mix Out is a selector for the memory set which contains the combinations of the parameters, waveform selector and output level controller for the Oscillators.

The Mix Out has 32 address. The first 14 is the "Preset" group (LED = SkyBlue). Access to the Mix Out Selector on the lower knob by double clicking (backward) from the neutral position(Yellow) .

There are 17 editable channels (LED color = 2 YellowGreen / 3 Olive / 14 Purple / 4 Lavender) after the "Preset" group. The example shows the first step for editing the Oscillator group.

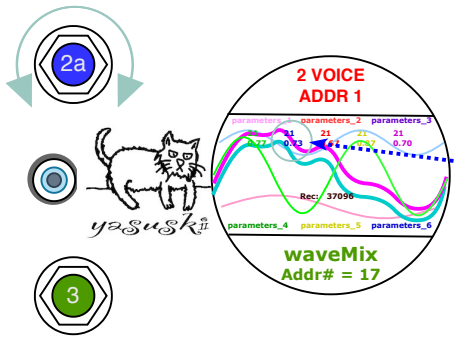
After selecting the writable address on Mix Out by the lower knob, moving to the next parameters for controlling the oscillator outputs.

Access to the parameter "OSC1 output level" appears on the upper knob (Green)
then turn the knob for getting the desired volume level.

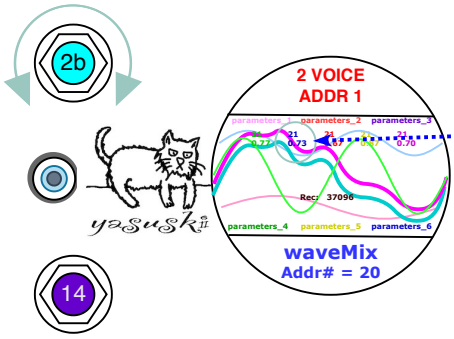


Access to the parameter "OSC1 waveform selector" by clicking the upper knob (forward) once. The LED truns to SkyBlue.

After selecting the waveform, forward the next step (Blue) by clicking the upper knob.

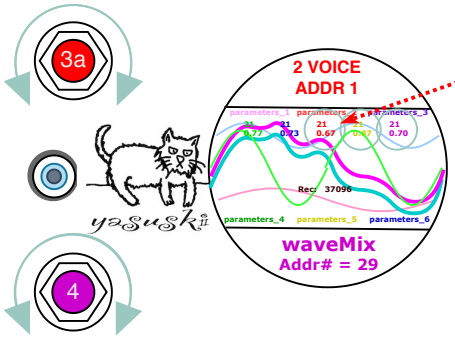


Access to the parameter "OSC2 output level" appears on the upper knob (Blue)
then turn the knob for getting the desired volume level.



Access to the parameter "OSC2 waveform selector" by clicking the upper knob (forward) once. The LED truns to SkyBlue.

After selecting the waveform, forward the next step (Red) by clicking the upper knob.



Access to the parameter "OSC3 output level" appears on the upper knob (Red) then turn the knob for getting the desired volume level, and move to the next.

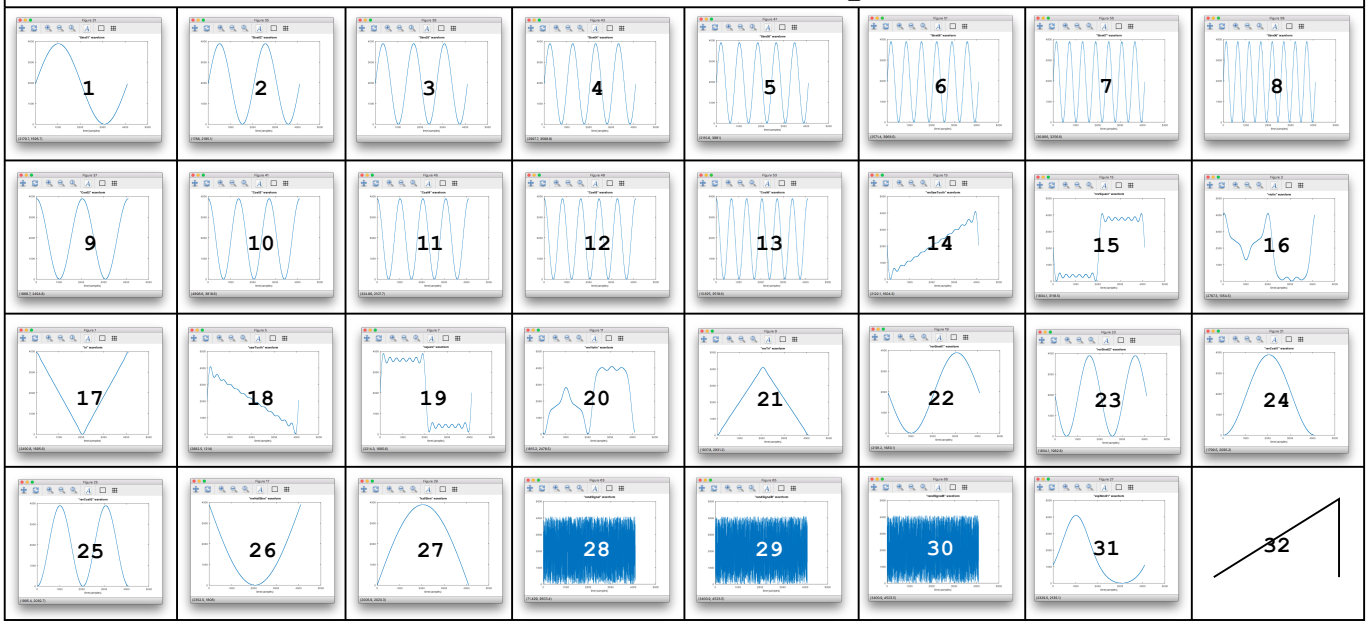
After the editing work on the other oscillators (#4 and #5) is complete, then push the lower knob over 1 second for storing the parameters.

Then move to the desiered position you want to edit.

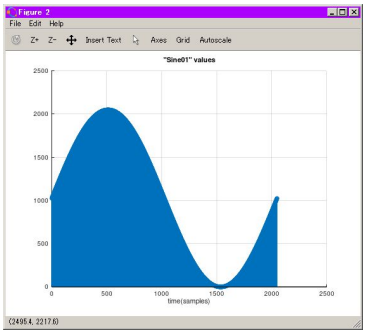
Although the "Presets" cannot edit the combinations in a realtime, the parameters are editable by rewriting the CSV in the text file.

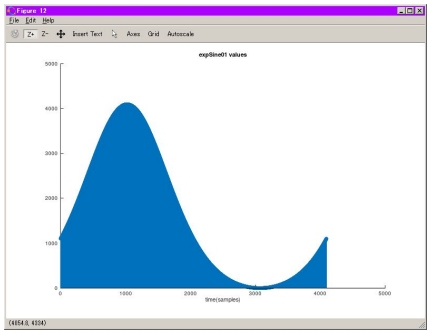
On the other hand, Wavetable itself can edit by the GNU Octave, too. (See the chapter The Wavetables)

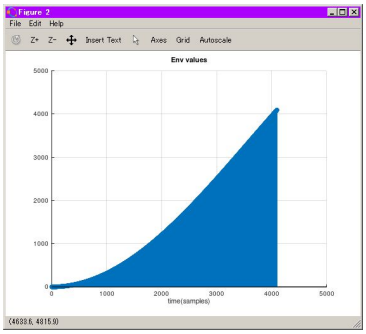
Wavetable Library

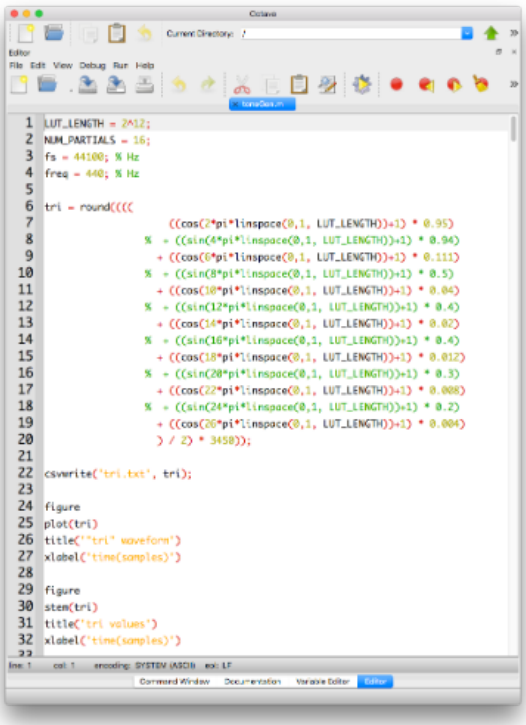


Envelope Library



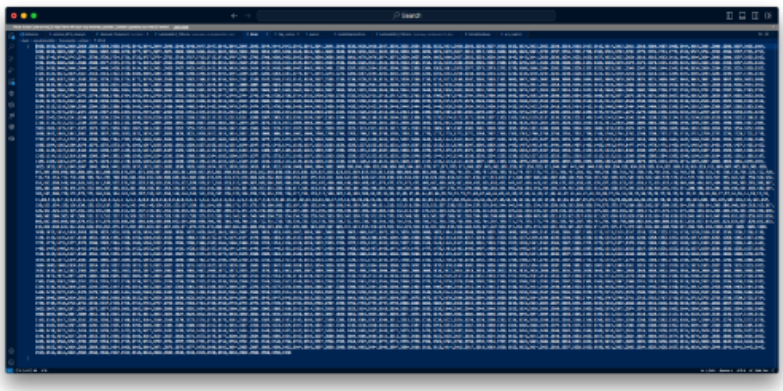




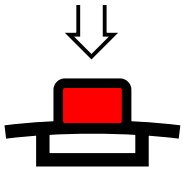


The waveforms are generated by the GNU Octave in CSV format. GNU Octave is a free math software which is downloadable from: https://www.gnu. org/software/octave/

The software works on the Windows and Linux. Unfortunately, the Mac version needs a little bit complex works for the installation.

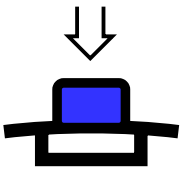


The Looper



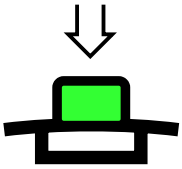
The top switch on the right is working as follows:

Single click: Looper Start Recording / inactivate
Double click: PitchDrift--
Triple click: Set Playback speed on the Looper++
Hold: Start/Stop the Auto Fade mode



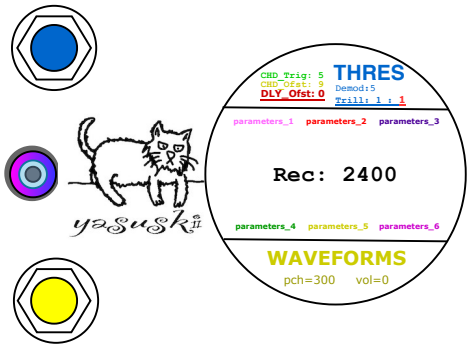
The top switch on the center is working as follows:

Single click: Freez Pitch
Double click: PitchDrift--
Triple click: Playback speed on the Looper--
Hold: Recalling the Scene Memories



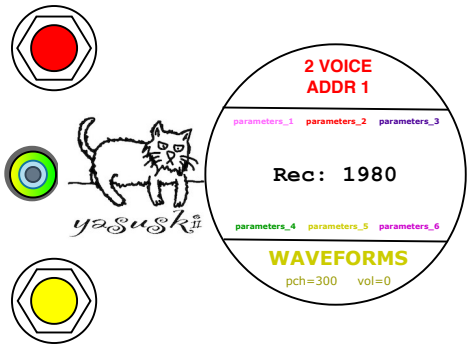
The top switch on the left is working as follows:

Single click: Start/Stop Arp/Seq/Looper
Double click: noteNumber --
Triple click: Set Playback speed on the Looper --
Hold: Skipping to the the THRES mode and back



The looper capture time follows the tempo and steps of the Arpeggiator. For example, 25ms * 4steps * 24(magnification) = 2400ms. The magnification is set by DLY_Ofst in TRES / CHROMATIC mode. The recording duration is shown at the center of the LCD, then start count down after the Looper start recording.

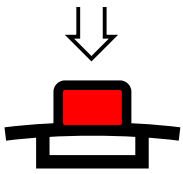
The Looper can change the 6 playback speeds by the parameter on TRES / PHASE_SHIFT mode : Normal Norm*2 Norm*1/2 Reverse Revs*2 Revs*1/2.



The top switches have the "jumping" actions in this mode. For example, jump to the THRES mode when Holding the left side switch or jump back to the Voice mode.

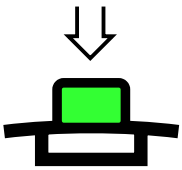
After sound recording begins, the LED on the centerpiece flashes Magenta and Blue in tempo. On the last 8 counts, the LED changes color to Yellow & Green.

AutoFade Mode



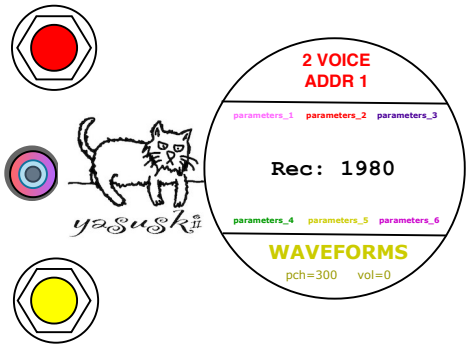
The top switch on the right is working as follows:

Hold: **Start/Stop the Auto Fade mode**



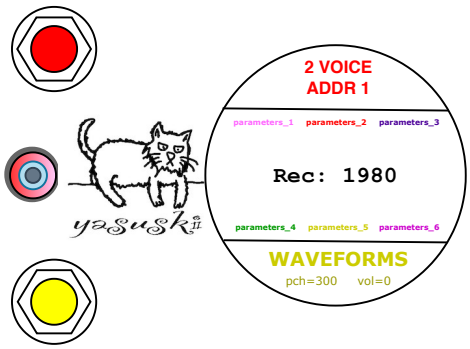
The top switch on the left is working as follows:

Single click: **Start/Stop AM modulation**



The AutoFade mode is activated by HOLDING the top switch on the right side. The fundamental status of the AutoFade is Fixed output level. Then click the top switch on the left side start AM modulation. The modulation speed is varies from the distance between the "left hand position" and the Volume antenna.

In the Chromatic mode, the top switch on the left side does not working as start/stop switch for AM modulation.



The LED on the eyeball switch start flashing when the AM modulation is activated.

The AM modulation is stopped when the top switch on the left side is clicked. The output level is fixed as the value of the AM modulation in the moment.

i2c Address list

LaVoixski receives the i2c data stream via WIFI in ESP_NOW format or direct connection to the i2c port of the MCU.

The data stream is the group of the bite data packed in 2, 3, 4, 7, 29 bites.

The mapped index numbers are changed by how many bites are grouped with.

The 2 bites group is reserved for the simple switch, selector or values in low resolution.

The 3 bites group is reserved for handling the values in high resolution.

The 4 bites group is reserved for handling the mode/parameter selector with the control values.

The 7 bites group is reserved for the global controller which changes several parameters at the same time.

The 29 bites group is reserved for driving the scene memory.

2 bites			
Description	**Parameter**	**1st bite**	**2nd bite**
Arp Patern	arp2a to arp2e	0x00, 0x10 ~ 0x50	value % 4
Arp Notes ADDR	arpNotes_aa to mode3b	0x01, 0x11 ~ 0x51	value % 32
Waveform Selector	addr1aa to a1	0x02 ~ 0x52	value % 32
muteSwitch Selector	muteSwitchBa to Bf	0x03 ~ 0x53	value % 5
output#3 Selector	op3SelectBa to Bf	0x04 ~ 0x54	value % 15
output level switch	vcs	0x06 ~ 0x56	value % 2
BIAS_SHIFT switch	dst	0x07 ~ 0x57	value % 2
LPF1 Mod Speed	pot00na to nf1	0x08 ~ 0x58	value
Arp Speed	arpSpdBa to Bf	0x09 ~ 0x59	value
Waveform Edit ADDR	addr2b,pot19a~22a,26a	0x0A ~ 0x5A	value % 17
Mod Feedback	pot00ra to f1	0x0B ~ 0x5B	value
LPF2 Mod Speed	pot00oa to f1	0x0C ~ 0x5C	value
Looper Playback Spd	pot00q	0x80	value % 6
Octave Tuning	octDown	0x81	value % 3
Chord Group ADDR	chordSeq	0x82	value % 48
Chromatic Root Tuning	pot00x	0x83	value % 12
Pitch Drift Selector	pitch_drift	0x84	value % 12
Mode2 Selector	mode2	0x85	value % 9
Scale Selector	pot00y	0x86	value % 32
Lch Out Neg "ON"	neg_Flag	0x87	bool
Start SEQ/ARP/Looper	state4	0x88	bool
Parameter Selector	mode4	0x89	value % 10

i2c Address list (continue'd)

2 bites			
Description	**Parameter**	**1st bite**	**2nd bite**
Voicing Selector	addr2q	0x8A	value % 66
Auto Fade mode	flag_Fade	0x8B	bool
LFO activation / Offset ADDR on Chord group	pot0	0x8C	value (% 35)
Freez Mode Activation	flag_Freez	0x8D	bool
Looper Start REC	looperSW	0x8E	bool
Waveform Edit Parameter	mode6	0x8F	value % 10
Exciter Parameter Select	mode7	0x90	value % 9
Pitch Shift Switch1	up_shift	0x91	bool
Pitch Shift Switch2	up_shift2	0x92	bool
Pitch Shift Switch3	up_shift3	0x93	bool
Pitch Shift Switch4	up_shift4	0x94	bool

3 bites			
Description	**Parameter**	**1st bite**	**2nd & 3rd bite**
Transition Control	transition_aa to ae	0x05~0x45	value
Transition Control	**transition_a1 to a8**	0x55	value
LPF1/2 Modulation Depth	pot00ha to hf1	0x0B~5B	value & 0x03FF
LPF1/2 Modulation Speed	pot00ia to if1	0x0A~5A	value & 0x03FF
Delay Modulation Depth	**pot00j**	0x8B	value & 0x03FF
Delay Modulation Speed	**pot00k**	0x8C	value & 0x03FF
LPF1/2 Mod Waveform	**pot00l**	0x8D	value (% 4)
Delay Mod Waveform	**pot00m**	0x8E	value (% 4)
CombFilter Feedback	**pot00r**	0x8F	value & 0x007F
Pitch Value	**add_val_f**	0x80	value & 0xFFFF
Volume Value	**vol_16a**	0x81	value & 0xFFFF

***Global Controller**

Transmit 2 bites

```
uint8_t data[2]{};
data[0] = 0x00;  // transmit data
data[1] = arp2a; // transmit data
esp_now_send(slaveAddress, &*data,
sizeof(data));
```

Transmit 3 bites

```
uint8_t data[3]{};
data[0] = 0x05; // transmit data
data[1] = (transition_3 & 0x0700) >> 8;
data[2] = transition_3 & 0x00ff;
esp_now_send(slaveAddress, &*data,
sizeof(data));
```

i2c Address list (continue'd)

4 bites / mode2 & 2 bite Parameters Address Direct					
Description	Parameter	1st bite	2nd bite select Voice mode	3rd bite select 2bite parameter	4th bite
Voice mode Direct	mode2	0x85	value2 % 9	0x03 = addr1q 0x04 = muteSwitchB 0x05 = op3SelectB 0x07 = transitionSelB 0x08 = BIAS_SHIFT 0x09 = flag_LPF_mod 0x01 = arpPtnB 0x02 = arpNoteB	Value4 % 32 Value4 % 5 Value4 % 15 Value4 % 2 Value4 % 4 Value4 % 5 Value4 % 4 Value4 % 32

5 bites / mode2 & 3 bite Parameters Address Direct					
Description	Parameter	1st bite	2nd bite select Voice mode	3rd bite select 2bite parameter	4/5th bite
Voice mode Direct	mode2	0x85	value2 % 9	0x06 = transitionB 0x0A = arpSpdB	Value4/5 Value4/5
Pitch Volume Value set	add_val_f vol_16a	0x80	add_val_f MSB	add_val_f LSB	vol_16a MSB+LSB

7 bites / Global Controller			
Description	Parameter	1st bite	2nd to 7th bite
Delay Feedback GC	pot00oa pot00ob pot00oc pot00od pot00oe pot00of1	0xFC	bool
Mute Switch GC	muteSwitchBa muteSwitchBb muteSwitchBc muteSwitchBd muteSwitchBe muteSwitchBf	0xFA	Values + 1

*Global Controller

Transmit 5 bites

```
uint8_t data[5]{};
data[0] = 0x85;       // transmit data
data[1] = mode2;
data[2] = 0x06;
data[3] =(transition_4 & 0x0700) >> 8;
data[4] = transition_4 & 0x00ff;
esp_now_send(slaveAddress, &*data,
sizeof(data));
```

Transmit 7 bites

```
uint8_t data[7]{};
data[0] = 0xFC;  // transmit data
data[1] = HIGH;
data[2] = HIGH;
data[3] = HIGH;
data[4] = HIGH;
data[5] = HIGH;
data[6] = HIGH;
esp_now_send(slaveAddress, &*data,
sizeof(data));
```

i2c Address list (continue'd)

Receive 29 bites for Recalling the Scene Memory

```
case 0xF0:  // 2 voice mode
      transition_aa = (value2 << 8)  + value3;  // tra_a     = transition_aa;
      attack1       = (value4 << 8)  + value5;  // atk1      = attackB1;
      LFO1          = (value6 << 8)  + value7;  // lfom1     = LFOB1;
      pot00ha       = (value8 << 8)  + value9;  // lpf_a     = pot00ha;
      pot00ia       = (value10 << 8) + value11; // lpfSpd_a  = pot00ia;
      pot00ja       = (value12 << 8) + value13; // lpf2_a    = pot00ja;
      pot00ka       = (value14 << 8) + value15; // lpf2Spd_a = pot00ka;
      pot00la       = (value16 << 8) + value17; // lpfWf_a   = pot00la;
      pot00ma       = (value18 << 8) + value19; // lpf2Wf_a  = pot00ma;
      pot00ra       =  value20;                 // fdbk_a    = pot00ra;
      pot00sa       =  value21;                 // cdpt_a    = pot00sa;
      pot00na       =  value22;                 // lpfSW_a   = pot00na;
      pot00oa       =  value23;                 // lpf2SW_a  = pot00oa;
      exB1          =  value24;                 // ex1       = exB1;
      op3SelectBa   =  value25;                 // op3_a     = op3SelectBa;
      arp2a         =  value26;                 // arptn_a   = arp2a;
      arpSpdBa      =  value27;                 // spd_a     = arpSpdBa;
      arpNotes_aa   =  value28;                 // apnote_a  = arpNotes_aa;
      addr1aa       =  value29;                 // waves_a   = addr1aa;
      break;

case 0xF1:  // 3 voice mode
      transition_ab = (value2 << 8)  + value3;  // tra_b     = transition_ab;
      attack2       = (value4 << 8)  + value5;  // atk2      = attackB2;
      LFO2          = (value6 << 8)  + value7;  // lfom2     = LFOB2;
      pot00hb       = (value8 << 8)  + value9;  // lpf_b     = pot00hb;
      pot00ib       = (value10 << 8) + value11; // lpfSpd_b  = pot00ib;
      pot00jb       = (value12 << 8) + value13; // lpf2_b    = pot00jb;
      pot00kb       = (value14 << 8) + value15; // lpf2Spd_b = pot00kb;
      pot00lb       = (value16 << 8) + value17; // lpfWf_b   = pot00lb;
      pot00mb       = (value18 << 8) + value19; // lpf2Wf_b  = pot00mb;
      pot00rb       =  value20;                 // fdbk_b    = pot00ra;
      pot00sb       =  value21;                 // cdpt_b    = pot00sa;
      pot00nb       =  value22;                 // lpfSW_b   = pot00nb;
      pot00ob       =  value23;                 // lpf2SW_b  = pot00ob;
      exB2          =  value24;                 // ex1       = exB2;
      op3SelectBb   =  value25;                 // op3_b     = op3SelectBb;
      arp2b         =  value26;                 // arptn_b   = arp2b;
      arpSpdBb      =  value27;                 // spd_b     = arpSpdBb;
      arpNotes_ab   =  value28;                 // apnote_b  = arpNotes_ab
      addr1ab       =  value29;                 // waves_b   = addr1ab;
      break;
```

i2c Address list (continue'd)

Receive 29 bites for Recalling the Scene Memory

```
case 0xF2:  // 4 voice mode
      transition_ac = (value2 << 8)  + value3;  // tra_c     = transition_ac;
      attack3       = (value4 << 8)  + value5;  // atk3      = attackB3;
      LFO3          = (value6 << 8)  + value7;  // lfom3     = LFOB3;
      pot00hc       = (value8 << 8)  + value9;  // lpf_c     = pot00hc;
      pot00ic       = (value10 << 8) + value11; // lpfSpd_c  = pot00ic;
      pot00jc       = (value12 << 8) + value13; // lpf2_c    = pot00jc;
      pot00kc       = (value14 << 8) + value15; // lpf2Spd_c = pot00kc;
      pot00lc       = (value16 << 8) + value17; // lpfWf_c   = pot00lc;
      pot00mc       = (value18 << 8) + value19; // lpf2Wf_c  = pot00mc;
      pot00rc       =  value20;                 // fdbk_c    = pot00ra;
      pot00sc       =  value21;                 // cdpt_c    = pot00sa;
      pot00nc       =  value22;                 // lpfSW_c   = pot00nc;
      pot00oc       =  value23;                 // lpf2SW_c  = pot00oc;
      exB3          =  value24;                 // ex3       = exB3;
      op3SelectBc   =  value25;                 // op3_c     = op3SelectBc;
      arp2c         =  value26;                 // arptn_c   = arp2c;
      arpSpdBc      =  value27;                 // spd_c     = arpSpdBc;
      arpNotes_ac   =  value28;                 // apnote_c  = arpNotes_ac;
      addr1ac       =  value29;                 // waves_c   = addr1ac;
      break;

case 0xF3:  // 5 voice mode
      transition_ad = (value2 << 8)  + value3;  // tra_d     = transition_ad;
      attack4       = (value4 << 8)  + value5;  // atk4      = attackB4;
      LFO4          = (value6 << 8)  + value7;  // lfom4     = LFOB4;
      pot00hd       = (value8 << 8)  + value9;  // lpf_d     = pot00hd;
      pot00id       = (value10 << 8) + value11; // lpfSpd_d  = pot00id;
      pot00jd       = (value12 << 8) + value13; // lpf2_d    = pot00jd;
      pot00kb       = (value14 << 8) + value15; // lpf2Spd_d = pot00kd;
      pot00ld       = (value16 << 8) + value17; // lpfWf_d   = pot00ld;
      pot00md       = (value18 << 8) + value19; // lpf2Wf_d  = pot00md;
      pot00rd       =  value20;                 // fdbk_d    = pot00ra;
      pot00sd       =  value21;                 // cdpt_d    = pot00sa;
      pot00nd       =  value22;                 // lpfSW_d   = pot00nd;
      pot00od       =  value23;                 // lpf2SW_d  = pot00od;
      exB4          =  value24;                 // ex4       = exB4;
      op3SelectBd   =  value25;                 // op3_d     = op3SelectBd;
      arp2d         =  value26;                 // arptn_d   = arp2d;
      arpSpdBd      =  value27;                 // spd_d     = arpSpdBd;
      arpNotes_ad   =  value28;                 // apnote_d  = arpNotes_ad
      addr1ad       =  value29;                 // waves_d   = addr1ad;
      break;
```

i2c Address list (continue'd)

Receive 29 bites for Recalling the Scene Memory

```
case 0xF4:  // Chord Edit mode
      transition_ae = (value2 << 8)  + value3;  // tra_e     = transition_ae;
      attack5       = (value4 << 8)  + value5;  // atk5      = attackB5;
      LFO5          = (value6 << 8)  + value7;  // lfom5     = LFOB5;
      pot00he       = (value8 << 8)  + value9;  // lpf_e     = pot00he;
      pot00ie       = (value10 << 8) + value11; // lpfSpd_e  = pot00ie;
      pot00je       = (value12 << 8) + value13; // lpf2_e    = pot00je;
      pot00ke       = (value14 << 8) + value15; // lpf2Spd_e = pot00ke;
      pot00le       = (value16 << 8) + value17; // lpfWf_e   = pot00le;
      pot00me       = (value18 << 8) + value19; // lpf2Wf_e  = pot00me;
      pot00re       =  value20;                 // fdbk_e    = pot00ra;
      pot00se       =  value21;                 // cdpt_e    = pot00sa;
      pot00ne       =  value22;                 // lpfSW_e   = pot00ne;
      pot00oe       =  value23;                 // lpf2SW_e  = pot00oe;
      exB5          =  value24;                 // ex5       = exB5;
      op3SelectBe   =  value25;                 // op3_e     = op3SelectBe;
      arp2e         =  value26;                 // arptn_e   = arp2e;
      arpSpdBe      =  value27;                 // spd_e     = arpSpdBe;
      arpNotes_ae   =  value28;                 // apnote_e  = arpNotes_ae;
      addr1ae       =  value29;                 // waves_e   = addr1ae;
      break;

case 0xF5:  // Sequencer mode
      transition_a1 = (value2 << 8)  + value3;  // tra_a1     = transition_af1;
      attack6       = (value4 << 8)  + value5;  // atk6       = attackB6;
      LFO6          = (value6 << 8)  + value7;  // lfom6      = LFOB6;
      pot00hf1      = (value8 << 8)  + value9;  // lpf_f1     = pot00hf1;
      pot00if1      = (value10 << 8) + value11; // lpfSpd_f1  = pot00if1;
      pot00jf1      = (value12 << 8) + value13; // lpf2_f1    = pot00jf1;
      pot00kf1      = (value14 << 8) + value15; // lpf2Spd_f1 = pot00kf1;
      pot00lf1      = (value16 << 8) + value17; // lpfWf_f1   = pot00lf1;
      pot00mf1      = (value18 << 8) + value19; // lpf2Wf_f1  = pot00mf1;
      pot00rf1       =  value20;                // fdbk_f1    = pot00ra;
      pot00sf1       =  value21;                // cdpt_f1    = pot00sa;
      pot00nf1      =  value22;                 // lpfSW_f1   = pot00nf1;
      pot00of1      =  value23;                 // lpf2SW_f1  = pot00of1;
      exB6          =  value24;                 // ex6        = exB6;
      op3SelectBf1  =  value25;                 // op3_f1     = op3SelectBf1;
      arp2f1        =  value26;                 // arptn_f1   = arp2f1;
      arpSpdBf1     =  value27;                 // spd_f1     = arpSpdBf1;
      arpNotes_af1  =  value28;                 // apnote_f1  = arpNotes_af1
      addr1af1      =  value29;                 // waves_f1   = addr1af1;
      break;
```

i2c Address list (continue'd)

ESP_NOW Transmitter

```
#include <esp_now.h>
#include <WiFi.h>
esp_now_peer_info_t peerInfo;

void setup()
{
  WiFi.mode(WIFI_STA);
  if (esp_now_init() != ESP_OK) {
    Serial.println("Error initializing ESP-NOW");
    return;
  }
  memcpy(peerInfo.peer_addr, slaveAddress, 6);
  peerInfo.channel = 0;
  peerInfo.encrypt = false;

  if (esp_now_add_peer(&peerInfo) != ESP_OK){   // Add peer
    Serial.println("Failed to add peer");
    return;
  }
}
```

Additional 2 bite address			
Description	**Parameter**	**1st bite**	**2nd bite**
combFilter depth	pot00sa to f1	0x0D ~ 0x5D	value % 127

i2c Address list (continue'd)

ESP_NOW Receiver / i2c Transponder

```
#include <esp_now.h>
#include <WiFi.h>
#include  // Include the Wire library for I2C communication
#define WIFI_CHANNEL 0

volatile uint8_t addr01[128] = {};
volatile uint8_t addr02[128] = {};
uint8_t buffer[128] = {};
uint8_t bites = 0;

void onReceive(const uint8_t * mac, const uint8_t *data, int len) {

  Wire.beginTransmission(0x8);

  memcpy(&buffer[0], data, len);

  for (int i = 0; i < len; i++) {
    Wire.write(data[i]);
    addr01[i] = data[i];
    addr02[i] = addr01[i];
  }

  Wire.endTransmission();

  delay(1);
}

void setup()
{
  Wire.begin(PIN_SDA, PIN_SCL);

  Wire.setClock(1000000); // fSCL = 1MHz

  WiFi.mode(WIFI_STA); // Set ESP32 as a Wi-Fi Station

  if (esp_now_init() != ESP_OK) { // Initilize ESP-NOW
    return;
  }

  esp_now_register_recv_cb(onReceive); // Register callback function

  delay(1);
}
```

*Program works only with Teensyduino 1.57 and ESP tools 2.0.5.

i2c Wireless Remote Controller

parameter switch 7			
Description	**i2c address**	**HOLD**	**i2c address**
1st: Chromatic Mode %32	0x86	**NORM/CHRM**	**0xFA**
2nd: Root Note Set %12	0x83	Set to "0"	0x83 = 0;
3rd: Mode 2 Selector %9	0x85	AutoFade	0x8B = bool
4th ReadOffset for ChordSeq %16	0x82	Bank Change with no offset	+0/+16/+32;
5th: Loop Record / PbSpd %6	0x8E/0x80	PbSpd = Normal	0x80 = 0;
6th: Arp/Seq/Lpr: Start/Stop / delayFeedbackLoop: ON/OFF	0x88/**0xFB**	LchNegative	0x87 = bool
7th: octDown %5	0x81	PitchFreez	0x8D = bool
8th: pitchDrift(Bender) %12	0x84	set to "0"	0x84 = 0;

voice mode switch 9			
Mode 2	**i2c address**	**2nd bite (value)**	**Range**
#1 Pitch	none	none	none
#2 Volume	none	none	none
#3 2 voice	0x0A	addr2b	1~16
#4 3 voice	0x1A	pot19a	17~24
#5 4 voice	0x2A	pot20a	25~32
#6 5 voice	0x3A	pot21a	33~40
#7 Chord Edit	0x4A	pot22a	41~58
#8 Sequencer	0x5A	pot26a	59~66
#9 THRES mode	none	none	none

***Global Controller**

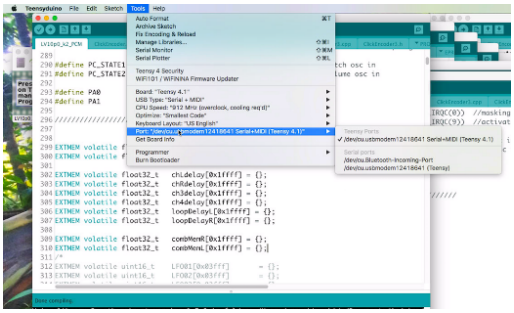
Transmit 2 bites

```
uint8_t data[2]{};
data[0] = 0x83;  // transmit data
data[1] = pot00x; // transmit data
esp_now_send(slaveAddress, &*data,
sizeof(data));
```

Transmit 7 bites

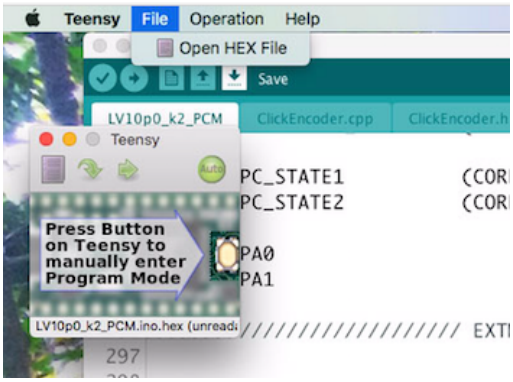
```
uint8_t data[7]{};
data[0] = 0xFA; // transmit data
data[1] = 5;
data[2] = 5;
data[3] = 5;
data[4] = 5;
data[5] = 5;
data[6] = 5;
esp_now_send(slaveAddress, &*data, sizeof(data));
```

Uploading the new firmware



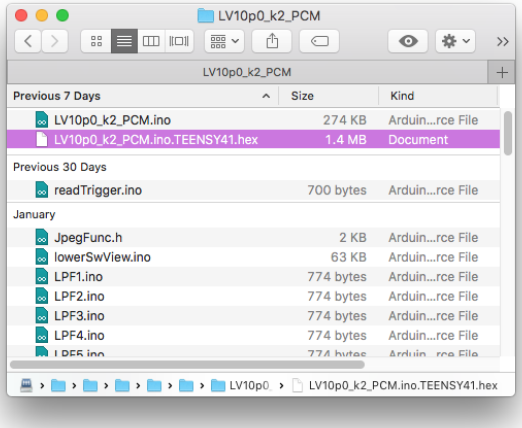
The picture shows the usb device selector on Teensyduino.

Firstly, user start Teensyduino then open the tools tab and select port: Teensy is connected.



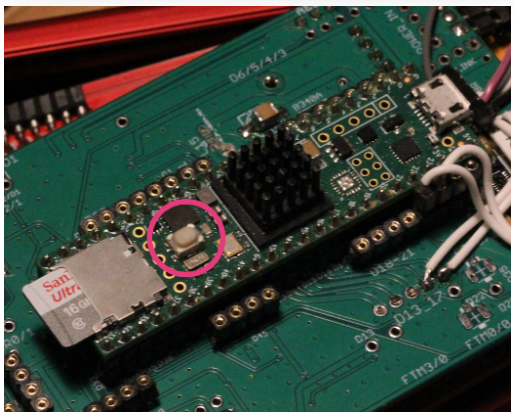
Secondly, start Teensy loader then open the File tab and select the HEX file.

At this time, Teensy loader is waiting for the signal from Teensy on the musical instrument.



The .hex file is generated by opening the sketch tab and selecting Export compiled library.
The firmware is sitting nearby the main.ino file.

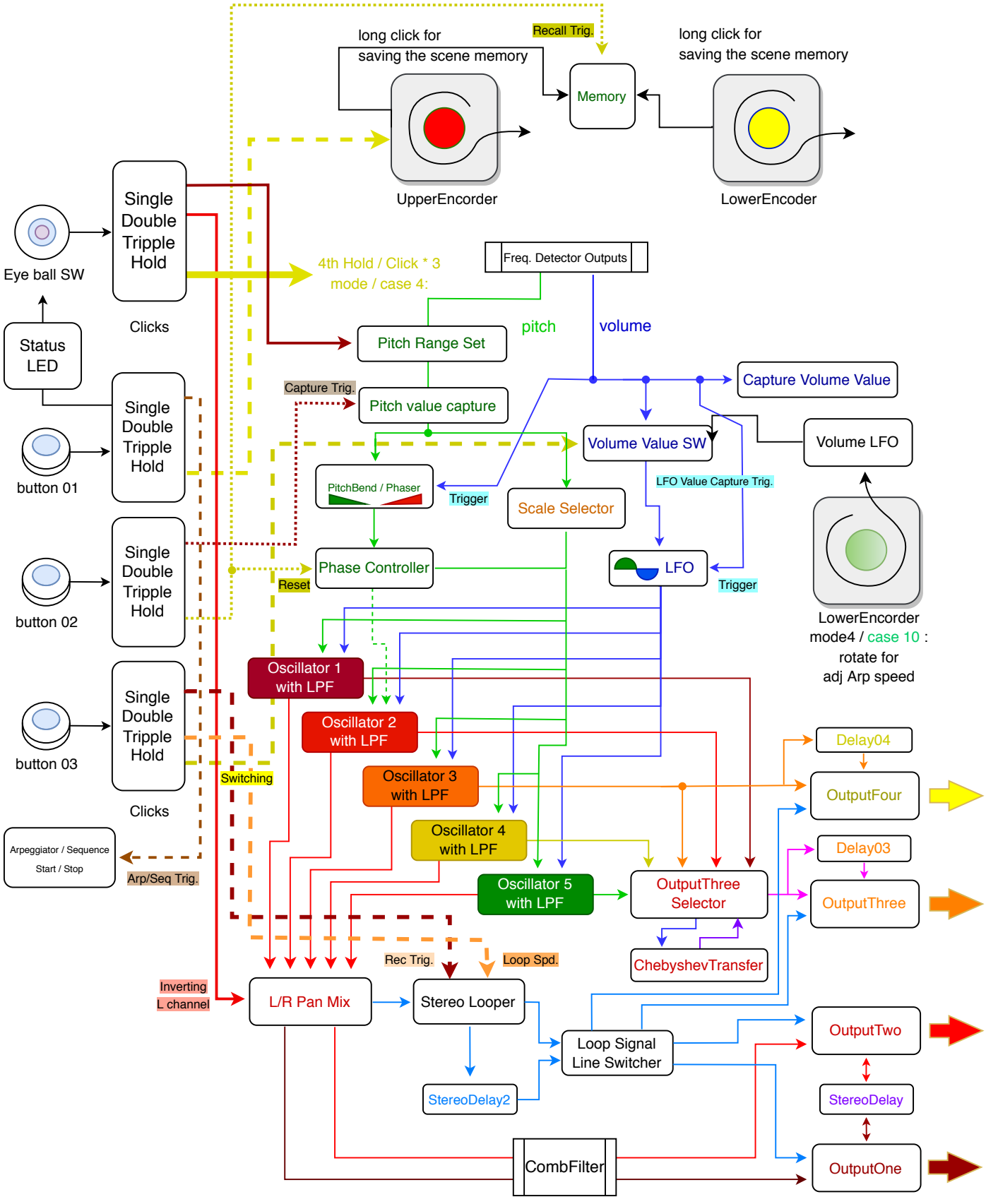
User do not need to generate it. The file is already sit inside the folder which you have downloaded.



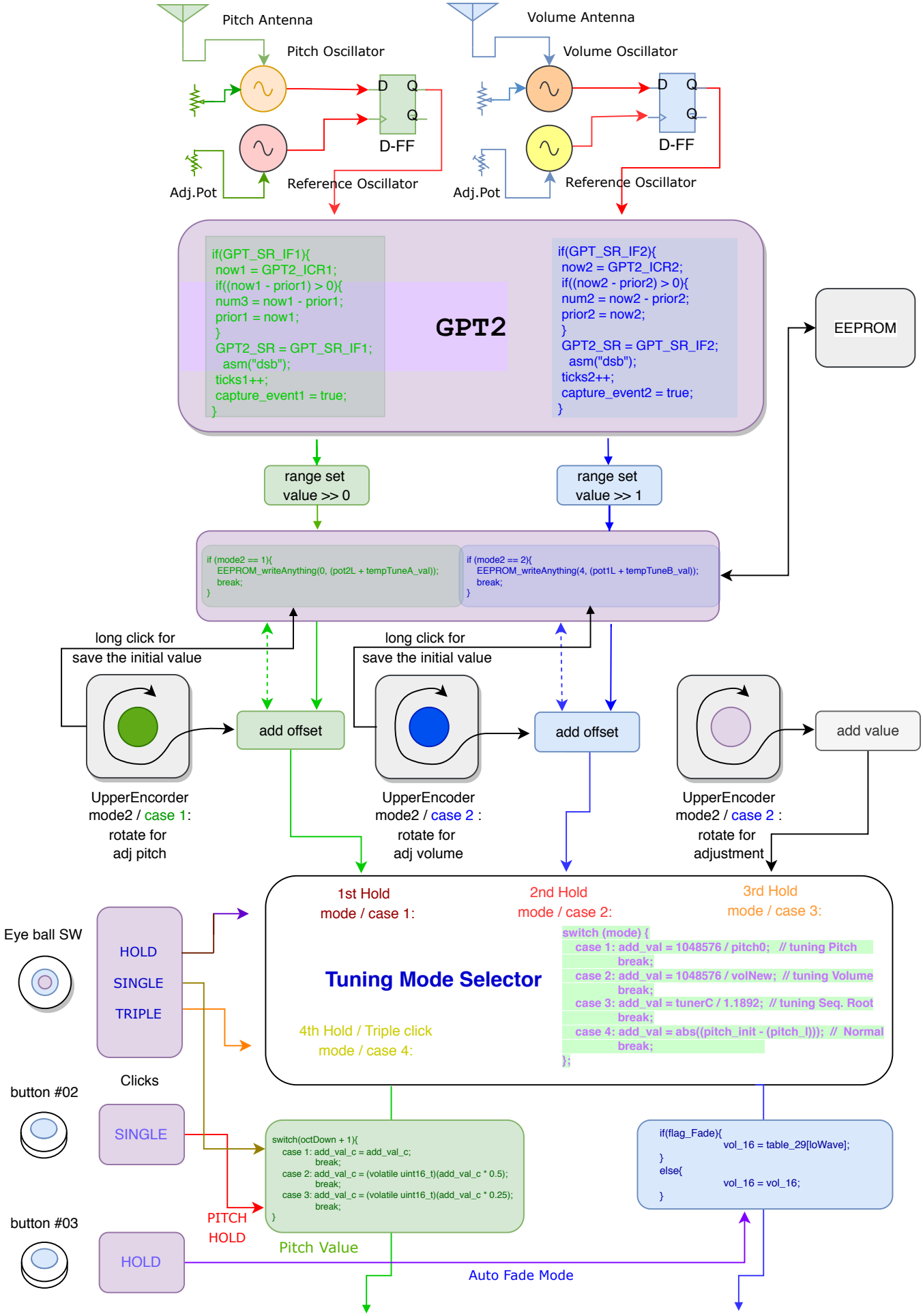
The final step is pushing the reset button on the Teensy 4.1 for start uploading.

Please note, you never take off the USB cable while the firmware uploading is not complete.

After writing firmware is complete, the system is automatically rebooting.

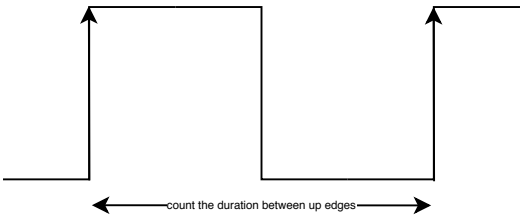


The signal flow around the audio & parameters (1st Layer)



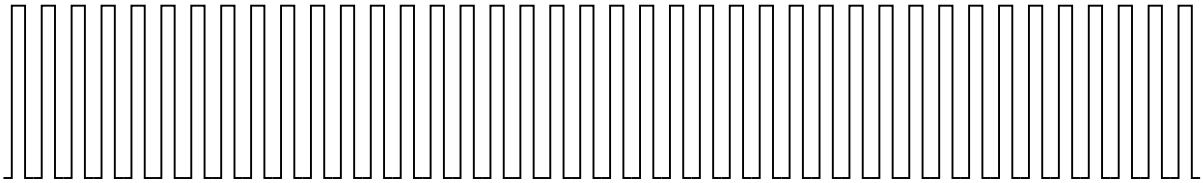
The signal flow around the Pitch/Volume Tuning System

Linear interpolation

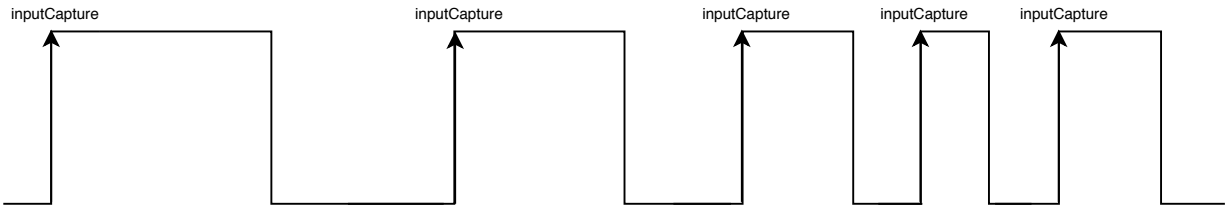



```
if(capture_event1){                          // inputCpture GPT2-1
    cli();
    pitch0 = num3;
    pitchNew = ((pitch0 >> b_shift_p) & 0xffff)   ;    // divide here
    average += pitchNew;
    pitchNew = (int32_t) average();
    flag_pitch2 = true;
    flag_pitch();
    asm("dsb");
    capture_event1 = false;
    sei();
}
```

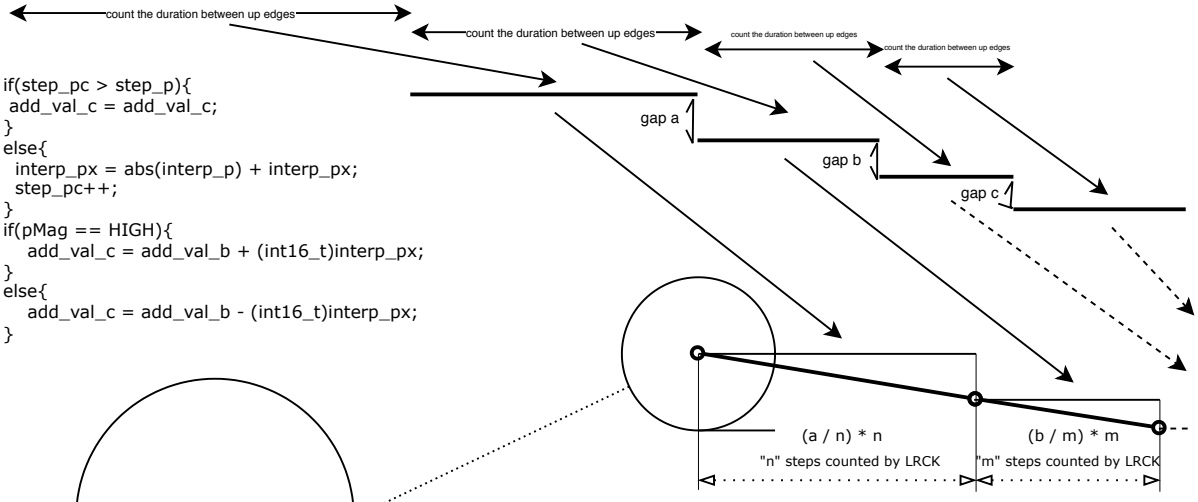
Sampling Clock
(LRCK)



Demodulated
signal source



Results from
inputCapture




```
if(step_pc > step_p){
 add_val_c = add_val_c;
}
else{
  interp_px = abs(interp_p) + interp_px;
  step_pc++;
}
if(pMag == HIGH){
    add_val_c = add_val_b + (int16_t)interp_px;
}
else{
    add_val_c = add_val_b - (int16_t)interp_px;
}
```

Linearized
signal


```
interp_p = ((int16_t(add_val_b - add_val_a) * 1000) / step_p) * 0.001;
 if(add_val_b < add_val_a){
  pMag = HIGH;
}
else{
  pMag = LOW;
}
```