



# MANUAL V 1.01

update from 1.0: hyperlinks fixed

# CONTENTS

<b>Section 1 Introduction. . . . .</b>	<b>4</b>
What is Waaave Pool Hd? . . . . .	4
A note on tone . . . . .	4
VSEJET Community Support. . . . .	4
<b>Section 2: Quickstart. . . . .</b>	<b>7</b>
What Is All Of This stuff? . . . . .	7
How Do I Plug All This Stuff In? . . . . .	8
How to Power On and Get Started . . . . .	9
How to Control This Thing . . . . .	9
What Video Inputs Are Supported? . . . . .	9
Common Video Input Issues. . . . .	9
Quirks and Other Things to Look Out For . . . . .	10
Framebuffers, Video Delay Lines, and Feedback. . . . .	11
<b>Section 3 Controls . . . . .</b>	<b>12</b>
1. Luma Key Level . . . . .	13
2. Mix level . . . . .	13
3. Fb0 Hue Attenuation . . . . .	14
4. Fb0 Saturation Attenuation . . . . .	14
5. Fb0 Brightness Attenuation . . . . .	14
6. Temporal filter mix . . . . .	14
7. Temporal filter strength . . . . .	15
8. Sharpen . . . . .	15
9. X displace. . . . .	15
10. Y displace. . . . .	15
11. Z displace. . . . .	16
12. Rotate. . . . .	16
13. Chaotic Hue mod. . . . .	16
14. Chaotic Hue LFO . . . . .	16
15. Chaotic Hue Offset . . . . .	16
16. Delay time (U) (1-240). . . . .	17

A. Fb0 Brightness Invert . . . . .	17
B. Fb0 Saturation Invert . . . . .	17
C. Fb0 Hue Invert. . . . .	17
D. Fb0 Horizontal Mirror. . . . .	17
E. Fb0 Vertical Mirror . . . . .	18
F. Toroidal Universe . . . . .	18
G. Luma key switch. . . . .	18
H. Mirror Mode . . . . .	18
I. HD/SD aspect ratio switch . . . . .	18
J. Framebuffer Reset . . . . .	18
K. Parameter reset. . . . .	19
L. Feedback/Feedforward delay shift. . . . .	19
M. Motion recording. . . . .	19
N. Video Reactive Mode . . . . .	19
Default midi ccs. . . . .	20
<b>Section 4: Extras. . . . .</b>	<b>24</b>
Master Boot . . . . .	24

# Section 1 Introduction

## What is Waaave Pool Hd?

From here on out lets just call it WPHD! WPHD can be described as

- a dual digital video delay processor with delay time up to 4 seconds.
- the second VSEJET (Video Synthesis Ecosphere Jetson) video processing tool
- a video synthesizer based entirely around using video feedback
- a video processor & clean delay when in feedforward mode.
- and probably more things that all of you will figure out through your personal usage.

## A note on tone

I have a habit of writing manuals in the first person and abstaining from the usual dry and detached tone that most manuals have. If this is a huge problem for you all I can say is, such is life. At least I gave you a heads up.

## VSEJET Community Support

Also please get involved in the various online discussion groups available for working with WPHD and the VSEJET! If you like message boards, check out [scanlines.xyz](https://scanlines.xyz) and you'll find folks working with WPHD as well as other VSE synths. If you visit [andrijaycreativecoding.com](https://andrijaycreativecoding.com) you can find many various invite links to join the VSE discord if you are more of a fan of that kind of interactions.

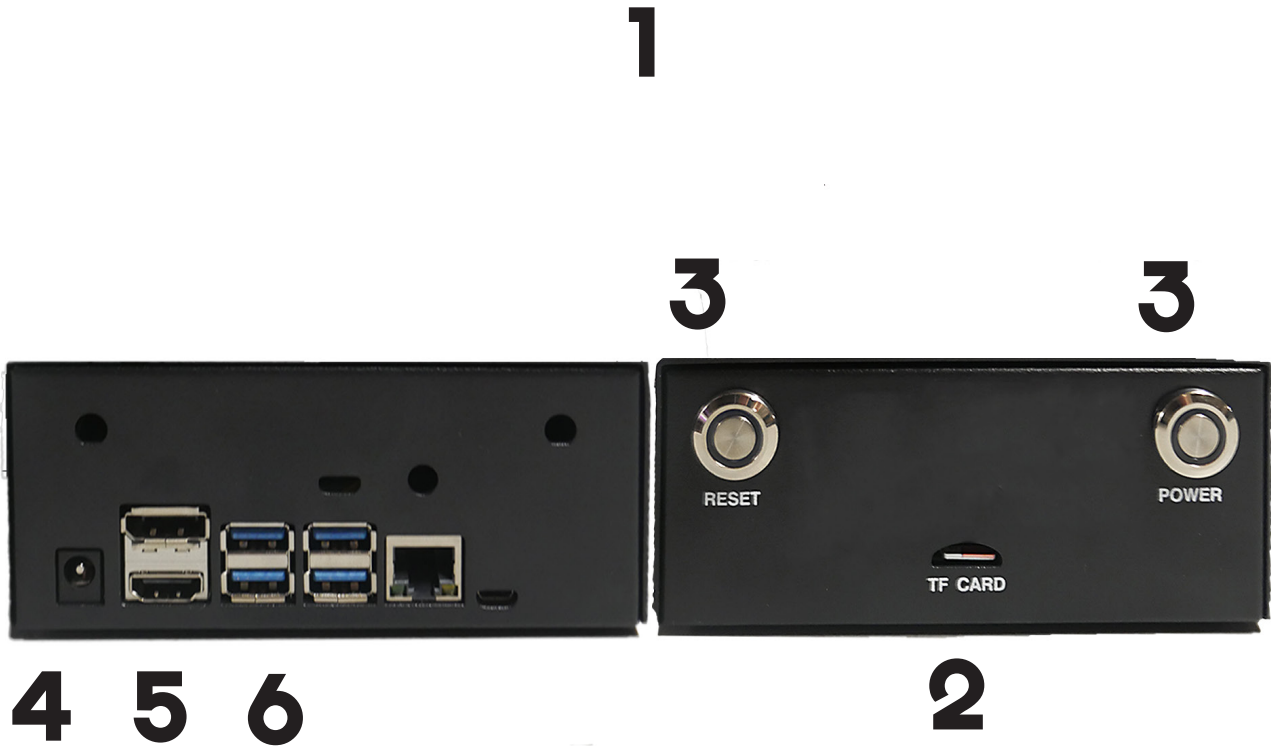
This manual can provide you with many things, but it can't replace the experience of actually working together with a large group of like minded folks. Abstaining from participating in the community will only be a handicap to your WPHD experience. Plus if you email me directly for any help with WPHD, 99.99 percent of the time I will respond with "Please re-read the manual" or "Ask around in the forums first," so probably just a good habit to get in no matter what.

If you would like to assist in funding any future development or upgrades to this instrument you should also consider joining [my Patreon](#). Aside from tiny bugfixes, any future updates to WPHD are contingent upon community funded support. Any folks who support my patreon for longer than 6 months will be able to vote on what kind upgrades happen as well. Currently (april 2024) there does exist the possibililty of adding save states to WPHD in the future but only if there is community support for such a thing.



# Section 2: Quickstart

## What Is All Of This stuff?



### 1. Waaave Pool Processing unit

This is the main brain doing all the video processing and whatnot.

### 2. SD card slot

This contains the firmware that WPHD runs on. You can update WPHD by removing the sd card and reflashing it with a new image. The SD card is mounted in a spring loaded slot so a gentle but firm push is how to remove the card. DO NOT try to pry the card out, it is very likely you will damage the card and/or the card reader if you do so.

### 3. ON/OFF and RESET switches

These do pretty much exactly what you

would expect

### 4. PSU jack

Plug the Power Supply into here

### 5. Displayport and HDMI video output

WPHD has only 1 active video output. You can use either but realistically you are only going to use the HDMI one. If you plug two both video outputs into monitors you will still only have one video output.

### 6. USB ports

this is where you plug in most all of your peripherals

7



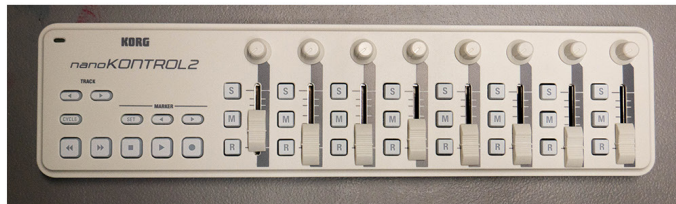
8



9 10



11



## PERIPHERALS

### 7. Power supply

### 8. Usb Extension

### 9. Analog Video Adapter

Use with Usb Extension. Plug either Composite (yellow RCA) or S-Video (6 pin din) cables in for input. GW completely ignores all audio so the red and white jacks do nothing. Do not connect yellow RCA and S-Video at the same time.

### 10. Digital Video Adapter

Use with usb extensions. you can plug hdmi

digital video cables in here.

### 11. Midi Controller

Plug into Usb Hub.



**How Do I Plug All This Stuff In?**





## **How to Power On and Get Started**

1. Plug everything in. Only 1 video adapter (analog or digital) can be used at one time, so make a choice there.
2. Press the ON button. You will see various boot screens, text, and the WPHD logo and then a desktop with master boot folder briefly before the output video appear.
3. There will be one strange moment about 3-5 seconds after WPHD loads up that the output video will freeze up for a second. This is bizarre but seems to happen pretty regularly. Try not to be concerned.

## **How to Control This Thing**

Use the midi controller! Theres a full list of controls later on in the manual, but the main one you need to know right away is the knob on the top left, which controls the key level between input video and the video delay. If you don't have this turned up at all then you won't see much happen when you mess around with most any of the other controls.

## **What Video Inputs Are Supported?**

### **Analog video:**

NTSC or PAL video signals sent through the yellow rca cables or s-video. You will probably not have great luck sending analog video in directly from circuit bent/glitch video devices. It is also not impossible that you can damage GW with circuit bent/glitch video signals. Best practice is to send the circuit bent/glitched video signal through a Time Base Corrector (TBC) before going into GW.

### **Digital video:**

Most any RGB/YCbCr signal up to 4k (3840×2160 at 30Hz). 8/10/12bit color. Unlike analog composite video, there is a very wide range of possible different video digital video signals that can be sent over HDMI, and there always exists the outside chance that some piece of video gear can have an HDMI video output that is not supported by GW.

## **Common Video Input Issues**

### **Analog Video**

#### **Black and White Video, Strange Rainbow Banding, No Video At All**

Either you aren't sending in an NTSC or PAL signal, or the NTSC/PAL signal you are sending is underpowered, out of range, or otherwise not a strong enough signal to work. Most often this will happen with a VCR. Best solution is to use a VCR that has a TCB built in or to use an external TBC. Other issues can occur with poorly built video encoders that don't work up to video standard specs.

## **Lines and/or Noise at the Top and Bottom of the Video**

This happens most often with signals from VCRs, but you can also notice some strange business at the top and bottom borders of any analog video signal. This is because most every monitor that displays analog video signals uses Overscan to automatically crop the boundaries of any video signal. The only solution is to use the input adjust controls inside of GW to crop these parts of the video.

## **Horizontal/Vertical sync**

Distortion in the horizontal/vertical directions is usually a sign that you are using glitch/circuit bent video inputs, a VCR playing a degrading VHS tape, or have an issue with the RCA cable. Occasionally it is a sign that there is something going extremely wrong with whatever video device you are sending video out from. There is nothing within GW that can fix issues with Horizontal/Vertical sync in a signal, your best bet is to use a TBC.

## **Digital Video**

### **Inconsistent Signals from Laptop/Desktop Computers**

Taking video out from laptops or desktop computers into WPHD can be inconsistent. The best way to prevent this is to figure out how to force your laptop/desktop to send out a fixed signal, like 1280x720p at 60hz. Please consult documentation for your operating system on the best way to achieve this.

If you are regularly trying to work with prerecorded clips I would highly recommend avoiding laptops and instead invest in building your own [R E C U R](#), [Mp4 Museum](#), or just learn how to use VLC or omxplayer on a raspberry pi to have a dedicated clip launcher on hand.

## **Analog and Digital Video**

### **Video Freezes**

This usually happens when the Usb connectors of the Video Adapter become dislodged. You can hot swap video cables but you cannot hot swap Usb Video Adapters. Make sure that the Usb connectors all have plenty of slack and are unlikely to get pulled or detached while WPHD is running. You will have to either power cycle WPHD or exit and start over from the master boot folder file with the Usb cables plugged in firmly and with plenty of slack.

Long video cables can also be an issue. It is usually not recommended to run a Composite, S-Video, or HDMI cable longer than 50 feet without some kind of active amplification of the the signal. Depending on the shielding and quality of the cable you can sometimes run into issues over 15 feet.

## **Quirks and Other Things to Look Out For**

### **If WPHD stalls out with a text crawl when powering down**

This seems to be an issue with certain usb extension cables and/or video adapters. Unplug the usb cable and it will chill out.

**Some of the parameter controls are bipolar, some are unipolar**

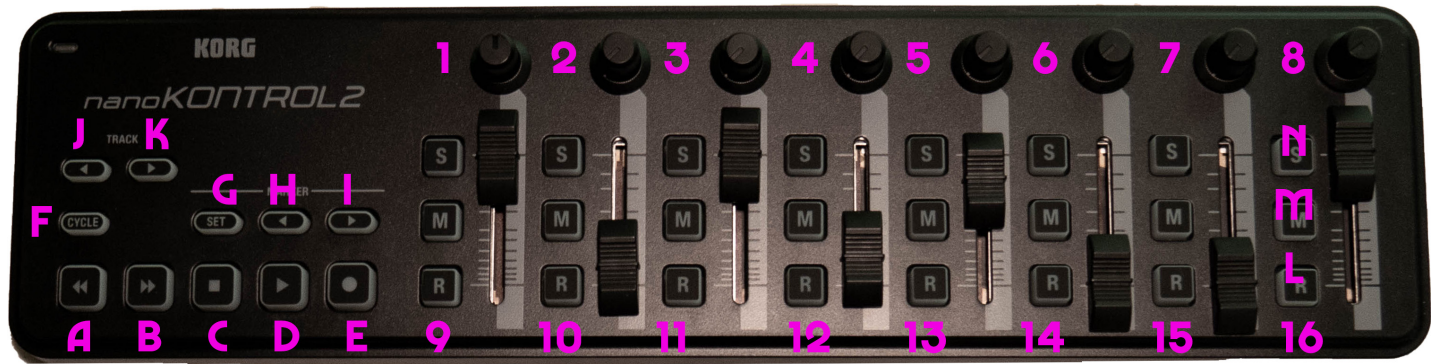
Example: Lumakey is Unipolar and has no effect when turned all the way to the left and is all the way on when turned to the right. Mix on the other hand is bipolar, has no effect when pointing straight in up and is negative mix to the left and positive mix to the right. Check the controls section for information on all control polarity.

## **Framebuffers, Video Delay Lines, and Feedback**

A Video Delay Line works very similar to an Audio Delay Line. A running buffer of the past 8 seconds of Video Frames is being constantly stored and updated with every new frame. The main difference between Audio and Video Delays is that Audio Delays are typically used primarily for generating effects that only use a limited & filtered amount of feedback to prevent harsh and unpleasant sounds, whereas Video Delays are best used with generous amounts of feedback in order to get the most dynamic and aesthetic results.

A Feedback Video Delay Line is one in which the output of what you see on your video output is used as an input to the delay line. Video Feedback is a powerful and dynamic form of video synthesis that allows for a wide range of organic textures and patterns, especially when paired up with live video inputs and keyers.

A Feedforward Video Delay Line simply has 1 running echo of whatever is coming in through the input.



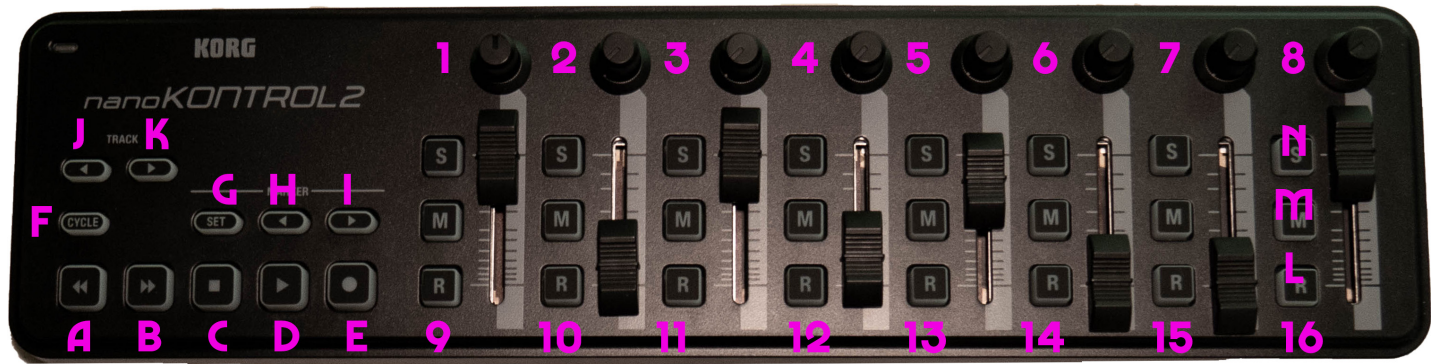
## Section 3 Controls

Parenthesis (U) and (B) after the controls means Unipolar and Bipolar respectively. Unipolar means that values go from 0-1, Bipolar means that values go from -1 to 1. This means that if you want to set values to 0 on a unipolar knob then you turn it all of the way to the left and if you want to set values to 0 on a bipolar knob you set it at 12 o'clock. Unipolar 0 on a slider means all of the way down, bipolar 0 means exactly in the middle.

Most of these parameters we will assume are normalized, which means we will think of 0 as being all of the way off and 1 as being 100 percent on. This can get a little strange because some values are set so that they actually go from like -200 percent off to +200 percent on but bear with me, it is all happening for reasons! If the default parameter set is anything other than (0,1) or (-1,1) it will be shown in parenthesis as well. The framebuffer delay channel will be henceforth referred to as fb0

Each slider and knob (1-16) are continuous controls. A-I are all toggle switches with on and off states that directly affect the video output in some way. J and K are momentary resets for continuous parameters. L changes the video delay from feedback to feedforward mode. M and N each work as layer shifts

Since there are multiple layers of controls (video reactive mode, motion control mode, and regular parameter mode) each set of parameters uses midi latching. What this means is that the knobs and the sliders won't do that thing where they suddenly jump to a value when you first boot in or when you hit the reset switch and then start adjusting values. Test this out by booting up with the lumakey control twisted all the way to the right and the x displace control all the way



slid down. once you have booted up slowly turn the lumakey knob over to the left and then back to the right. you'll notice that nothing happens til you get over to 0 on the knob, which is all the way to the left bc lumakey is a Unipolar control. next try moving the x displace slider up slowly. you'll notice no effect until you get through 0, which is midway up the slider bc x displace is a Bi-polar control. when you reset the controls or switch in or out of videoReactive mode midi latching will reset as well.

\* The S, M, and R buttons next to most all of the sliders change the range of their corresponding parameter, except for L, M, and N. More info on all of this later on.

## **1. Luma Key Level**

(U)

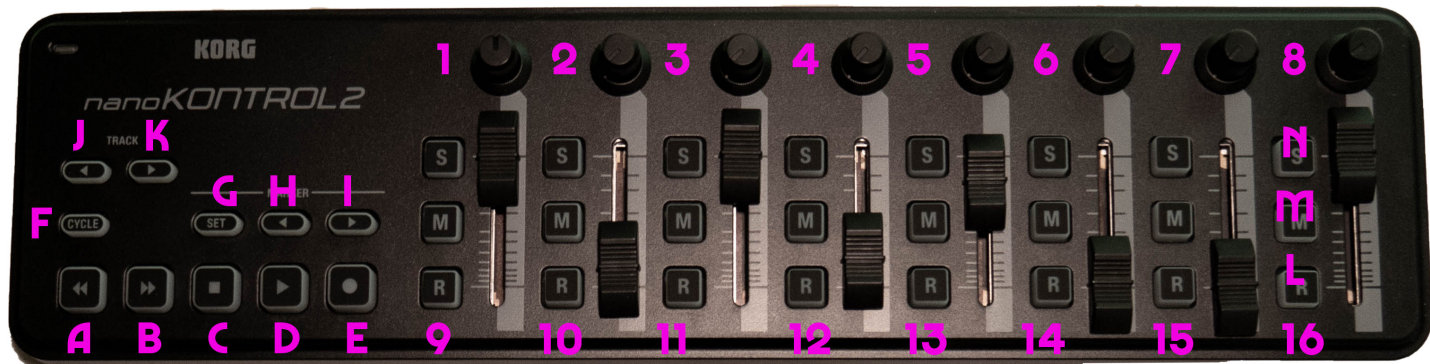
This selects a brightness value in the video input channel to key fb0 into. For example, if I turn my Luma Key Level knob to 12 o clock, that means everything in the input channel with brightness less than 50 percent will be replaced by fb0. 0 means that none of fb0 is keyed in, 1 means that none of the input channel will be visible. When the luma key switch is flipped it just reverses the operation here so that if knob is at 12 o clock everything with brightness more than 50 percent will be keyed out.

## **2. Mix level**

(B) (-1.1,1.1)

For values between 0 and 1 this functions as a fade between the input channel and fb0. For values outside of this range interesting distortions can happen. Strobing can occur when there are very short (less than 5 frames) delay times and negative mix values. Mix is downstream from Key so you can key and mix at the same time, the mixing will only affect the unkeyed part of the input channel though! The actual mathematics being performed is a linear interpolation (aka lerp in many programming languages) between each pixel. Let Input pixel be I, Mix level be M and fb0 pixel be F, then the value of each pixel will be set by  $I*(1-M)+F*M$ .





### **3. Fb0 Hue Attenuation**

*(B) (.25,1.75)*

This is a multiplier for fb0 hue. Because of the feedback loop involved, multiplicative operations have exponential effects so it is sometimes best to play around with very small changes with a very small delay time to get a feel for what kind of patterns and behaviors can emerge. Attenuating hue will often want to cycle through all the values in the spectrum so if you do not want your screen to be just rainbow zones 24 hours a day try playing around with the hue chaos controls as well.

### **4. Fb0 Saturation Attenuation**

*(B) (.5,1.5)*

This is a multiplier for fb0 saturation. Turn all the way off for greyscale feedback, crank it up for supersaturated feedback, play around with small shifts for soft pastel trails

### **5. Fb0 Brightness Attenuation**

*(B) (.5,1.5)*

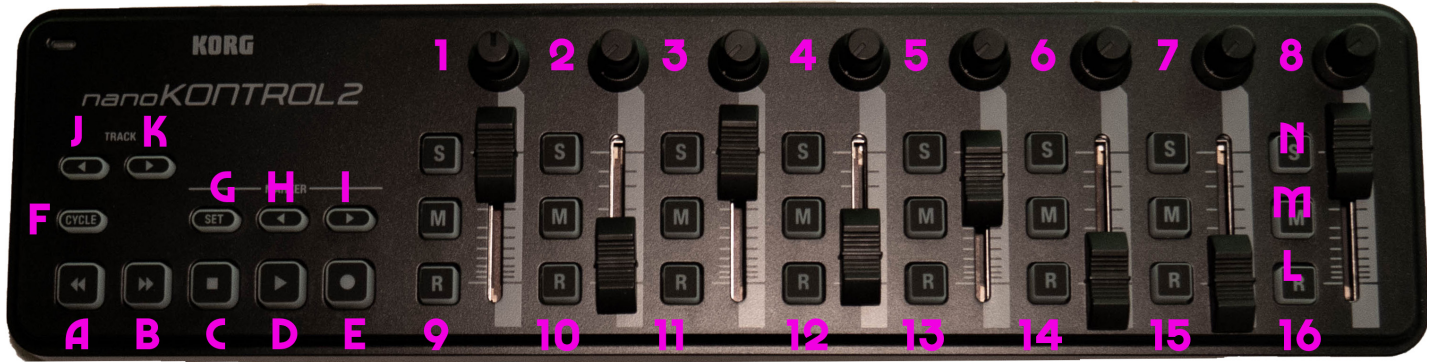
This is a multiplier for fb0 brightness. Values around .8 or .9 will result in trails that fade away softly, values above 1 will clamp out and fill the screen.

### **6. Temporal filter mix**

*(B) (-1.1,1.1)*

For values between 0 and .99 the temporal filter can help smooth out some of the potential harshness, business, and/or strobing that can very often occur when using this system. For values over 1 the temporal filter goes into a fairly pure digital feedback mode and can slow things down considerably while still oozing along like a wet digital oil painting. For values less than 0 many interesting patterns can occur as well as some amount of strobing. The temporal filter is a linear interpolation with the previous frame performed downstream from the keying and fb0 mixing.





## **7. Temporal filter strength**

(U)

This attenuates the brightness and saturation of the temporal filter to enhance complex pattern formation if desired.

## **8. Sharpen**

(U) (0,1)

Applies a sharpening filter to the feedback, resulting in lots of crazy worms.

\*\*\*interlude to explain a couple things\*\*\*

if you are using the nanokontrol2 controller then you will notice for the sliders 9 through 16 there are 3 buttons next to each slider. for sliders 9 through 15 what these buttons do is control the total range for each corresponding slider. so for example no button pressed is a pretty small range, S toggled on means a Slightly larger range, M toggled is a Medium larger range, R toggled is a completely Ridiculous range. Larger range buttons bypass smaller range buttons so if M is toggled on and then R is toggled on then only R is active. I didn't really write this part of the code so well so I'm not exactly positive what the actual scaling factors are for X, Y, and Z in this version but I'm pretty sure that doesn't actually matter to anyone.

## **9. X displace**

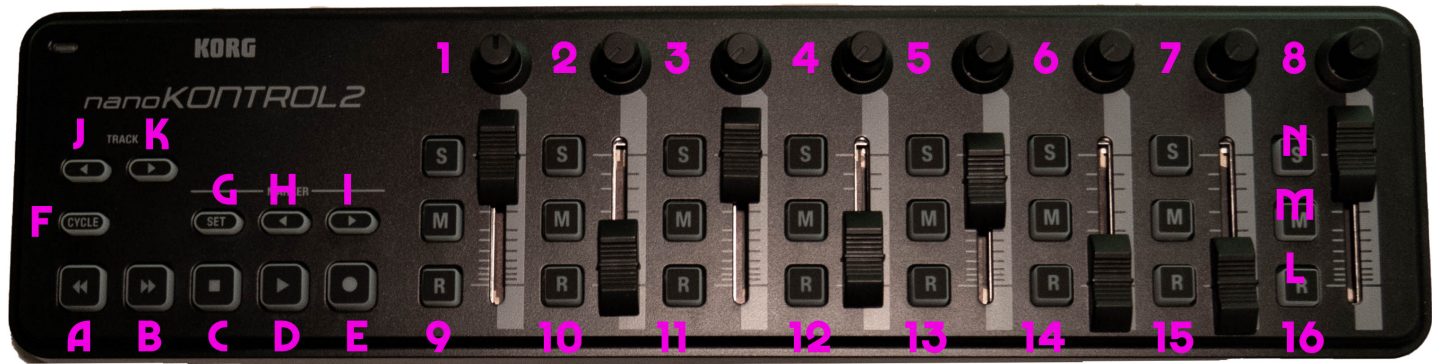
(B)

Displace the X position of fb0, resulting in trails if in feedback mode.

## **10. Y displace**

(B)

Same as X displace but Y instead.



## **11. Z displace**

(B)

Adjusting Z "Blows Up" or "Shrinks" the framebuffer creating a zooming in or zooming out effect in feedback.

## **12. Rotate**

(B)  $(-.1*PI, .1*PI)$ ,  $(-.2*PI, .2*PI)$ ,  $(-PI/2, PI/2)$ ,  $(-PI, PI)$

Rotations are measured in radians here. PI is 180 degrees and so on.

## **13. Chaotic Hue mod**

(U)

Chaotic Hue Mod sets a limit on the range that hue can cycle through. Very high values for this will result in monochrome or very minimal color spaces. Wildly different behaviors can happen depending on the settings of HSB attenuation and Chaotic Hue LFO and Chaotic Hue Offset

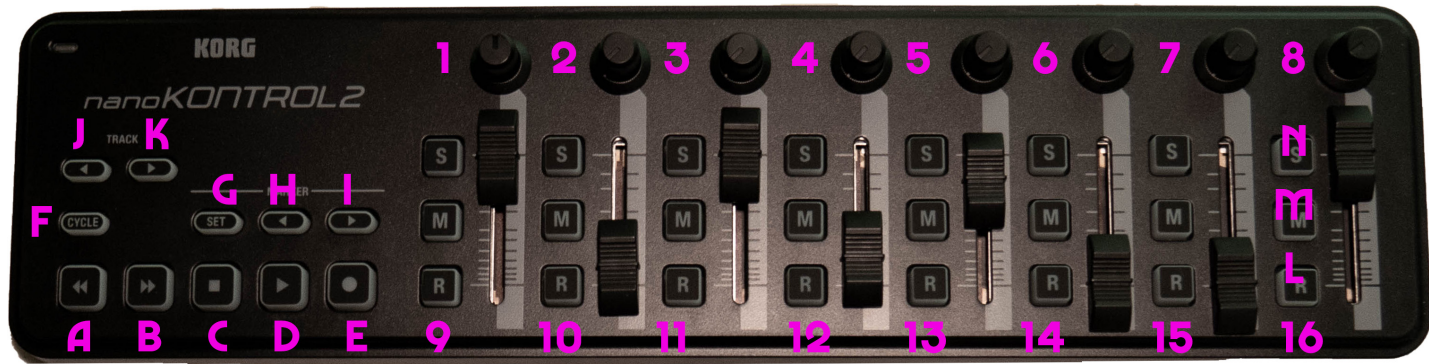
## **14. Chaotic Hue LFO**

(U)

This is not exactly an LFO in the traditional sense of audio signal processing but it tends to feel like one in operation. This can be used to change the rate, texture, and patterns of hue cycling. For very small values smooth shifts occur. For larger values intense hue strobing can happen. Some certain settings can cause both saturation to drop out as well as brightness as well. If you are curious as to why messing around with hue values can affect saturation and brightness it is because HSB is not the native color space, RGB is. When RGB gets mapped into HSB and then we do very chaotic things to hue before mapping back into RGB, the effects can be unpredictable and can actually make the maps from HSB to RGB and back 'glitch out' a bit.

## **15. Chaotic Hue Offset**

(U)



This adds an offset to the hue. When Chaotic Hue Mod is set to very high values resulting in a very restricted palette one can use the offset to choose the color. When Chaotic Hue LFO is running and you would like to mix up the cycling you can use this as well. Really the only way to get a handle on these 3 parameters is to use them heavily and changing them only in the default small ranges at first. Each parameter will have different effects depending on where the other two parameters are at. One very fun technique to use with these 3 parameters is to turn off keying, turn out mix to about .5, turn temporal filter to about .25 and temporal filter strength to about .5 and then experiment with different combinations of the Chaotic Hue parameters to use them as a kind of chaotic colorizer on your input!

## **16. Delay time (U) (1-240)**

Delay time is measured in Frames. Waaave\_pool operates at 30 frames per second so there is a total of 8 seconds of delay to draw from. Delays will behave quite differently depending on if the framebuffer is fed from the input or from the final output using the L button.

### **A. Fb0 Brightness Invert**

Switches on and off Brightness Inversion on fb0.

### **B. Fb0 Saturation Invert**

Switches on and off Saturation Inversion on fb0.

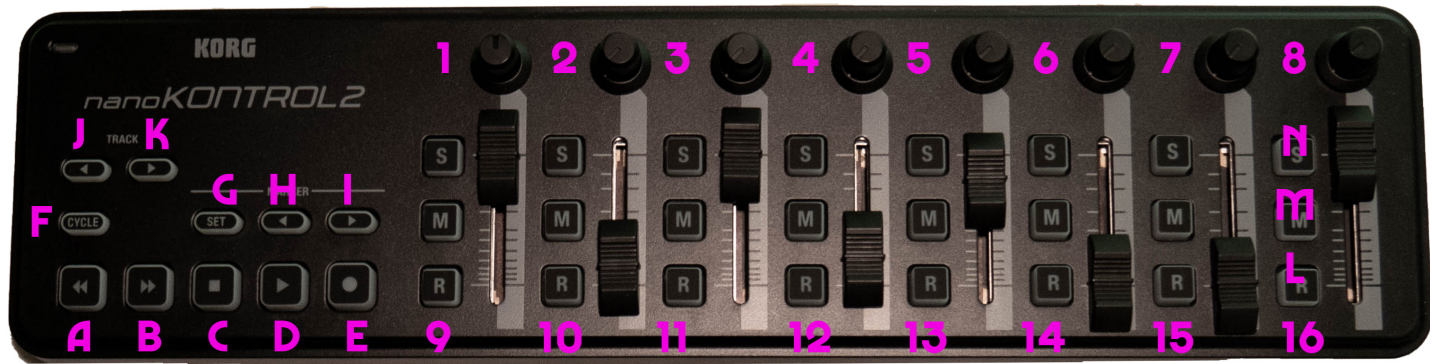
### **C. Fb0 Hue Invert**

Switches on and off hue Inversion on fb0

### **D. Fb0 Horizontal Mirror**

Reflect the left side of Fb0 on the right side





## **E. Fb0 Vertical Mirror**

Reflect the top of Fb0 on the bottom.

## **F. Toroidal Universe**

Ok this is worth getting into a little bit. When you switch the feedback wraps around the screen in various ways. If something goes off the left side of the screen it will pop back over on the right side and vice versa. Same thing for top and bottom edges. When you zoom out super far the toroidal universe will fractalize everything. When you rotate in toroidal various kinds of mirrorings and wrapping swill happen at the edges. Lots of Fun!

## **G. Luma key switch**

This switch toggles back and forth between luma keying into the whites and luma keying into the blacks.

## **H. Mirror Mode**

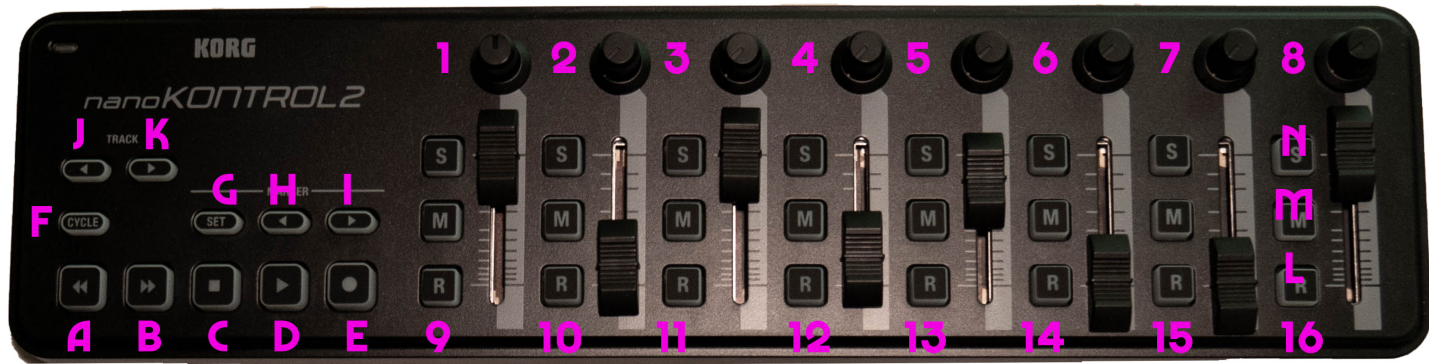
this switch toggles on off mirror wrapping around the edges when you rotate, zoom, or displace the framebuffer.

## **I. HD/SD aspect ratio switch**

For use with the Capture Bundle supported HDMI usb input, this will switch the aspect ratio of the captured video to support 16:9

## **J. Framebuffer Reset**

Clear everything in the framebuffer. This will cause your frame rate to slow down until you move another midi control so if yr doing this live make sure to wiggle another knob real quick so that you don't get some stutter strobing going on



## **K. Parameter reset**

Resets all regular and video reactive parameters to defaults and clears all motion recording.

## **L. Feedback/Feedforward delay shift**

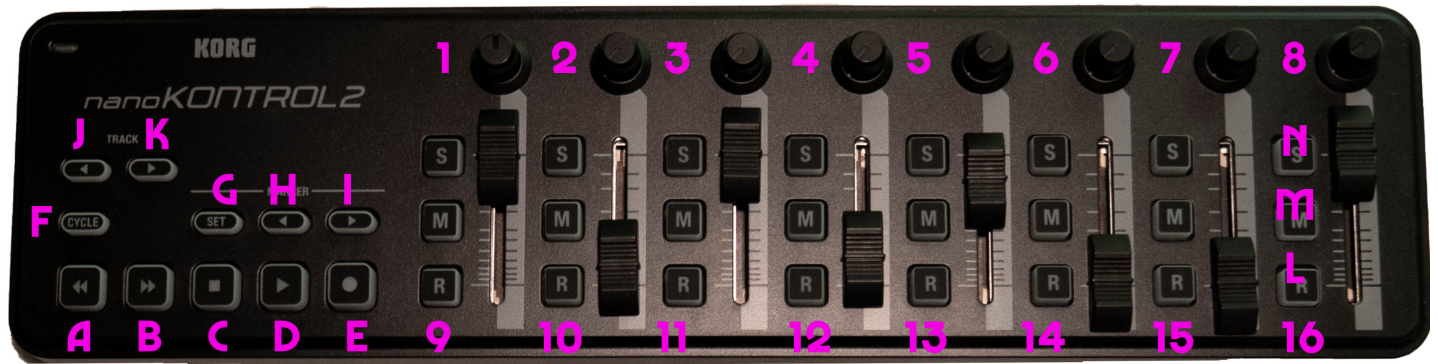
The default for delay is feedback, meaning that the delay buffer is fed from the final output and that you get crazy video feedback happening all over the place. However if you hit this switch the delay buffer instead gets fed directly from the input which means that you can use WPHD as a powerful video processor. Simply key out the input and then you will be able to use all of the knobs to process the input directly. Zoom, rotate, displace, attenuvert HSB, do some crazy colorizing, delay the feed by 2 seconds, turn on mirror mosaic mode with the toroid switch, add more h and v mirrors to stuff!

## **M. Motion recording**

Turn on and off motion recording! When motion recording is enabled there will be an 8 second buffer that will record and loop all continuous input! Use this to sequence and automate every parameter to your hearts content!

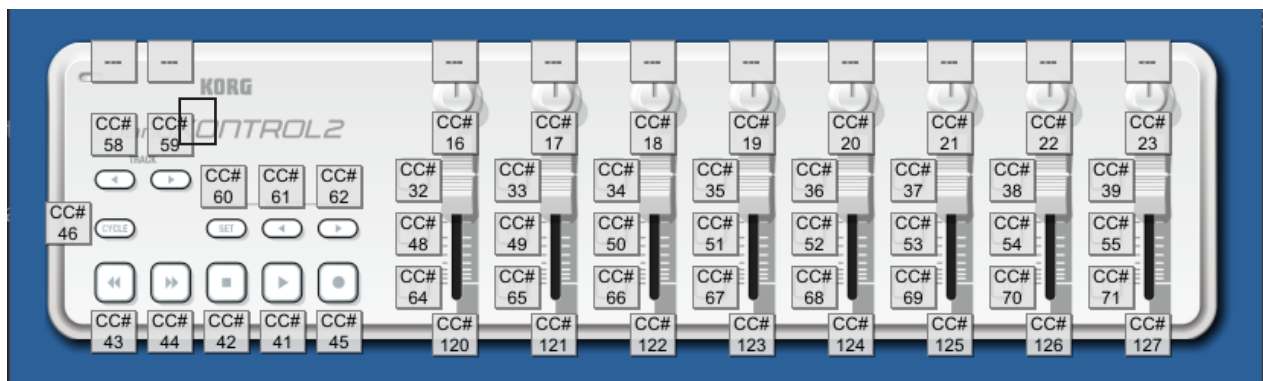
## **N. Video Reactive Mode**

Turn on and off video reactive mode! When activated, all of the sliders and knobs will, instead of directly affecting their respective parameters, control how much the Brightness of the input video affects said parameters. To test this out make sure to lumakey out at least 75 percent of the input video so that theres lots of feedback happening, then slide x-displace up a little bit. press the video reactive button and then go back over to the x-displace slider and move it in the opposite direction (remember to go through 0 the first time b/c midi latching applies to video reactive controls too!). You should notice that the x displacement will be different depending on how bright the input video is at that point.



## Default midi ccs

If you'd like to use any other kind of usb midi controls with WPHD here are all the ccs in a graphic and in a list format. It will probably be quite annoying to use any other midi controller to be honest, the main reason I can think of for needing these is for using some kind of midi sequencing.



## Continuous Controls

Luma key - 16  
 Mix - 17  
 Hue\_x - 18  
 Sat\_x - 19  
 Bright\_x - 20  
 Temporal filter mix - 21  
 Temp filter Q - 22  
 Input boost - 23  
 X displace - 120



**Y displace** - 121  
**Z displace** - 122  
**Rotate** - 123  
**Chaotic hue mod** - 124  
**Chaotic hue lfo** - 125  
**Chaotic hue offset** - 126  
**Delay time** - 127

## **Toggle Switches**

**bright invert** - 43  
**saturation invert** - 44  
**hue invert** - 42  
**H mirror** - 41  
**V mirror** - 45  
**Toroidal Universe** - 46  
**luma key swap b/w** - 60  
**framebuffer reset** - 58  
**parameter reset/motion recording clear** - 59  
**feedback/feedforward mode switch** - 71  
**motion recording on/off** - 39

on the nanokontrol for each of the sliders (midi cc values 0 through 6) there are three buttons alongside which I have programmed to change the total range of what each slider does. I will list those cc values here in the order (S, M, R ) (small is default setting. the larger buttons override smaller buttons so if medium, large, and ridiculous are all toggled then only ridiculous is actually enabled. ridiculous settings for the xyz and rotate plus toroidal universe is where very ornate fractal painting mode gets started

**x displace** (32,48,64)  
**y displace** (33,49,65)  
**z displace** (34,50,66)  
**rotate** (35,51,67)  
**chaotic hue mod** (36,52,68)  
**chaotic hue lfo** (37,53,69)  
**chaotic hue offset** (38,54,70)





## **Section 4: Extras**

---

### **Master Boot**

If you would like to play with WPHD, or Artificial Life HD, Temporal Vortex HD, or Chromatic Aberration: The Search For Sasquatch HD without creating an additional SD card image you can access these video synths from the master boot folder on the desktop. Plug a usb keyboard and mouse into your WPDH and press ESC or CTRL+c to exit WPHD and open up the master boot folder on the desktop and run any of the .sh files you see to use that particular instrument.













