

Spherical Wavetable Navigator — Firmware v2.0

Addendum to User Manual 1.0, July 10, 2019

Firmware Version 2.0

Firmware version 2.0 adds some exciting new features the SWN, allowing you to better connect to sequencers, share, backup, and manage your Spheres, create new Spheres in new ways, lock channels, and much more!

CV/Gate Mode

Press both buttons to toggle modes



Channel buttons are dim red in CV/Gate Mode



CV/Gate Mode lets you use up to seven CV and seven gate signals to control the **SWN's** voices. CV/Gate mode is designed for use with a keyboard or sequencer.

When a gate or trigger is received on a channel's gate jack, the channel's envelope will fire and the channel will play a note. Each of the six channels can be triggered independently and have an independent envelope shape and speed.

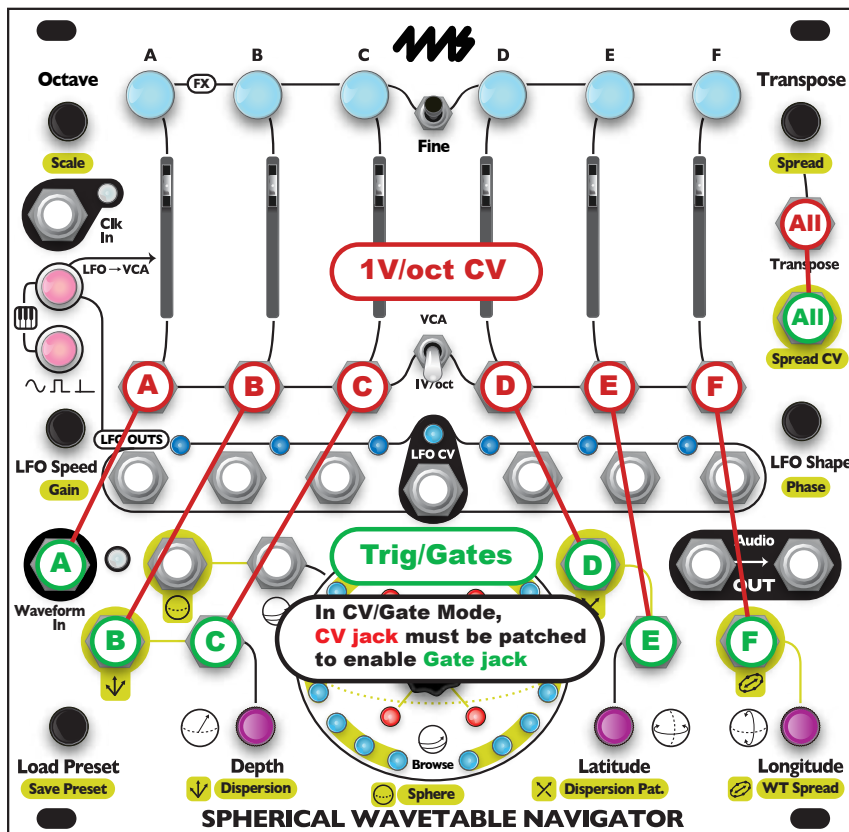
Entering CV/Gate mode

Firmware version 2.0 adds CV/Gate Mode as the fourth button mode. Press the **LFO->VCA** and **LFO Type** (~ ∟ ∟) buttons at the same time to toggle between the four modes in this order: Mute -> Note -> Keyboard -> CV/Gate. When CV/Gate Mode is active, the **Channel Buttons** will be dim red and no sound will play unless a channel is triggered by a gate/trigger or a button press.

Using CV/Gate Mode

Each channel is assigned a gate jack. See the diagram below. **Channel A** uses the **Waveform In** jack for its gate jack, **Channel B** uses the **Dispersion CV** jack, and **Channel C** uses the **Depth CV** jack, etc.

To use CV/Gate mode, patch the 1V/oct (CV) and gate/trigger output of a keyboard or sequencer into any channel's 1V/oct jack and gate jack. You can patch any number of channels, even all six channels if you have a six-channel sequencer. You can also control all six channels together with a single CV/gate source using the global CV and gate jacks (**Transpose** and **Spread CV**). Any unused channel can be played with the global gate jack or used in a different mode (see Multiple Modes paragraph below).



Gate Jacks

Each gate jack is enabled only if the associated channel's **1V/oct** jack has a cable plugged into it. If the **SWN** does not detect a cable in the **1V/oct** jack, then the gate jack will revert to its normal function. For example, if you patch a cable into **Channel B's 1V/oct** jack in CV/Gate mode, then the **Dispersion CV** jack will stop modulating the dispersion amount and instead will be a gate/trigger jack for **Channel B**. If you unpatch the **1V/oct** jack or change **Channel B's** mode to Mute, Note, or Keyboard Mode, then the jack will change back to being **Dispersion CV**.

Multiple triggers before the envelope finishes will re-trigger the envelope. Incoming gates are treated as triggers: the gate length or pulse width is ignored.



No quantization
(light blue)

No Quantization

When a channel enters CV/Gate mode, its **Scale** selection will be set to No Quantization. When leaving CV/Gate mode, the scale will be set back to its previous setting. Turning off quantization on the **SWN** is done automatically because it's a highly recommended setting. The reason is that typically you'll be using a keyboard or sequencer which already quantizes to a scale or to semitones. Glide (portamento/glissando) and pitch-bend and vibrato effects work well with the **SWN's** No Quantization setting.

If you're using a continuous CV source such as a waveform or LFO patched into the **1V/oct** jacks on the **SWN**, then changing the **Scale** to a quantized scale may be appropriate. Otherwise, it's not recommended to quantize both on the **SWN** and on the 1V/oct source, since false notes may occur.



LFO Speed



LFO Shape

Envelopes

The envelope for each channel can be controlled using the **LFO Speed** and **LFO Shape** knobs. This works in the same way that it does in every other mode: turning the **LFO Speed** or **Shape** knob by itself will adjust all six channels, and holding down a **Channel Button** while turning a knob will adjust just that channel.

If you're using a sequencer, you might want to patch its clock out into the **SWN's Clk In** jack so the envelope timings will be synced.

Global 1V/oct



Transpose

Global CV/Gate

All six channels of the SWN can be triggered at once using the **Spread CV** jack as the global gate/trigger jack. When the **Transpose** jack is patched and at least one channel is in CV/Gate Mode, then the **Spread CV** jack becomes a global trigger jack that fires all six envelopes at the same time. As in other modes, the **Transpose** jack controls the pitch of all the channels.

Global Gate/Trig



Spread CV

The global CV/Gate jacks can be used at the same time as the individual channel CV/Gate jacks: a trigger on either will fire the channel's envelope.

Buttons

The **Channel Buttons** at the top can be used to manually fire a channel. This works similarly to Note and Keyboard Modes, but with a slight difference: pressing the buttons in CV/Gate mode will play the entire envelope even if you let go of the button before the envelope finishes. Holding down the button will not sustain the envelope like it does in Note Mode.

Multiple Modes

Like Note/Keyboard/Mute modes, you can have some channels in CV/Gate mode, and some in other modes. Holding down a **Channel Button** while pressing the two LFO buttons will change the mode of just the selected channel. At least one channel has to be in CV/Gate mode to use **Spread CV** as a global trigger (and **Transpose** has to be patched).

Export Sphere

In order to backup, share, and use SphereEdit with your Spheres, you can export Spheres from your SWN as audio files. Before using this feature, make sure you understand how to record your own Spheres in Sphere Recording Mode. If you need a refresher, see the User Manual, *Sphere Recording Mode Overview*, page 25.

Export a Sphere: Tap to Monitor...



In Sphere Recording Mode, tap the green button to enable Monitoring. This makes the SWN go silent (make sure nothing is patched in the **Waveform In** jack). Then tap the center knob and the **SWN** will play the current Sphere. Each of the 27 waveforms of the current Sphere will be played eight times, for a total length of 2.5 seconds.

...then tap to Export

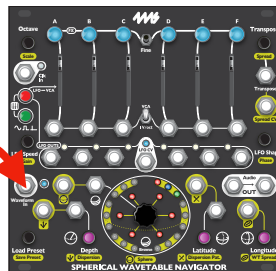
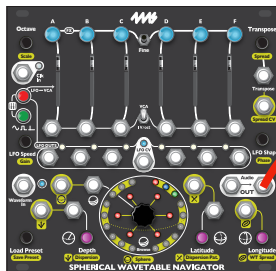


Backing up a Sphere

By patching the **SWN**'s audio jacks to a recording device such as a **WAV Recorder** module, a sampler, or a computer that can record audio, you can save a copy of your Spheres. Save the file in a lossless format such as .wav. Both left and right channel outputs from the **SWN** are the same, so it's OK to set your recording device to record in mono or stereo. To restore a Sphere, simply play the audio file into the **SWN** as you normally would to record a new Sphere (see User Manual, *Tutorial 5: Creating Your Own Spherical Wavetables*).

Sharing Spheres

Once you've recorded the output of the **SWN** while exporting a Sphere, you can share that file with other **SWN** owners. Save the file in a lossless format such as .wav. If there is any silence at the end or beginning of the file, you can safely trim it with an audio editor to reduce file size.



Sharing Spheres SWN to SWN

You can directly copy a Sphere from one **SWN** to another by exporting from the first **SWN** and recording into the second **SWN**. Simply enter Sphere Recording Mode on both **SWNs** and patch the right **Audio OUT** jack from the first **SWN** into the **Waveform In** jack on the second **SWN**. Then arm recording on the second **SWN** by pressing the flashing red button, and begin exporting on the first **SWN** by tapping the green button and then tapping the center knob. In 2.5 seconds you'll have a copy of your Sphere on the second **SWN**.

Editing Exported Spheres in SphereEdit

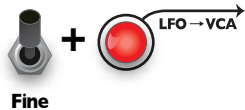
If you save an exported Sphere as a .wav file, you can use SphereEdit to edit the Sphere. SphereEdit version 1.0 cannot directly import recordings from the SWN. You must first open the audio file in any audio editing software, trim any silence at the beginning of the file, and save the file as a 44.1kHz mono .wav file. You can then open the file in SphereEdit using the "Open Sphere..." menu item. A future version of SphereEdit will have the ability to trim beginning silence automatically.

The SWN automatically shifts each waveform to center around 0V, so AC-coupled audio interfaces will not experience any DC drift. This makes audio editing much easier.

Record Single Waveform

Record One Waveform

Press Fine and Record



In Sphere Recording Mode, you can record your own Sphere by inputting an audio source and pressing the record button (see the User Manual if you need to learn how to do that). Firmware version 2.0 adds the ability to create a Sphere by recording each of the 27 waveforms separately. This allows you to create sophisticated wavetables by giving you time to prepare your audio equipment before recording each waveform. You can also record an entire Sphere all at once and then record over individual waveforms.

To record a single waveform, enter Sphere Recording Mode as normal. Then, use the **Browse** knob or **Latitude/Longitude/Depth** knobs to navigate to the waveform you want to record over. Input your audio source into the **Waveform In** jack. Hold down the **Fine Button** and press the flashing red **Record** button (**LFO->VCA** button) to start recording. The **SWN** will replace the current waveform with a waveform from the audio input.

Mini-tutorial using Record Single Waveform feature:

1. Enter Sphere Recording Mode.
2. Patch a complex VCO or a continuous sound that you like into the **Waveform In** jack. Optionally, you can tune the VCO to the **SWN**'s test tone output (see User Manual, page 25).
3. Press **Fine + Record** to record that waveform.
4. Turn the **Browse** knob clockwise to advance to the next waveform.
5. Change the settings on the VCO, perhaps pick a different waveshape output jack (saw/tri/square/etc), or add some modulation or otherwise change the timbre.
6. Repeat steps 3–5 until you've recorded all 27 waveforms. When you turn **Browse** after you record the 27th waveform, you'll be back at the first waveform you recorded.
7. Apply effects if you wish and re-record any waveforms you don't like. When you're done, save the Sphere as normal using the **Preset** knob (see User Manual page 28).

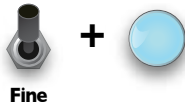
Duration of Single Waveform Recording

You may be curious exactly how long of a record the SWN makes when recording just a single waveform. The **SWN** records as much audio data as it can without overwriting the next waveform in the audio buffer. This duration depends on the amount of **Waveform Spread**. The User Manual has a series of diagrams on page 27 illustrating this parameter. By default, the waveforms are spread a distance of eight waveforms apart, so the **SWN** will record 4096 samples, or about 93ms. Since a waveform on the **SWN** is only 512 samples long, this extra data allows you to use the Seam Smoothing effect and small amounts of the **Waveform Shift** feature while still keeping the waveforms distinct.

Locking Channels

Lock/Unlock Channel

Fine + Channel Button



Firmware v2.0 adds the ability to lock each channel. Locked channels will not respond to any global parameter changes from either CV or knobs. You still can adjust a locked channel individually by holding down its **Channel Button** while adjusting a knob. You also can use a locked channel's **1V/oct** jack, level slider, and **Channel Button** in the same way as when the channel is unlocked.

Locking and Unlocking

Hold down the **Fine Button** and press a **Channel Button** to lock or unlock a channel. You can hold multiple **Channel Buttons** down at the same time to toggle the state of a group of channels.

When you lock a channel, the following parameters will be immediately frozen:

- Sphere selection due to **Sphere** or **WT Spread** knobs
- Transposition amount due to the **Transpose**, **Spread**, and **Octave** knobs
- Navigation position within the Sphere due to **Browse**, **Latitude**, **Longitude**, **Depth**, and **Dispersion** knobs
- LFO parameters as determined by **LFO Speed**, **LFO Phase**, **LFO Gain**, and **LFO Shape** knobs
- Adjustment to the LFO Speed as set by the **LFO CV** jack

All CV jacks will be ignored and treated as if they were unpatched, except for the channel's **1V/oct** jack and the global **LFO CV** jack.

When you unlock a channel, it will immediately start responding to global CV. Any adjustments you made globally using the knobs while the channel was locked will not be retro-actively applied.

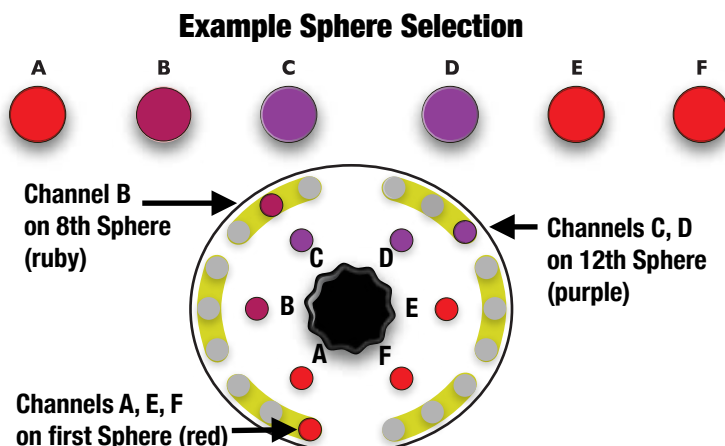


1V/oct | VCA switch

When a channel is locked, it will not respond if you flip the **1V/oct | VCA** switch, since this switch is a global parameter. This means you can set some channels to VCA mode and other channels to 1V/oct mode. At least one of the two groups must be locked.

Sphere Selection Display

Firmware v2.0 has an improved method of displaying each channel's Sphere whenever you are pushing and turning the **Sphere** knob or turning the **WT Spread** knob. Each **Channel Button** turns the color of the channel's Sphere, and the lights on the outer ring display the selected Spheres clockwise in order from the first to the last available Sphere. The display is similar to the Octave display. The inner ring display is the same as in previous versions (each channel A-F has a light on the inner ring which turns a color to indicate which Sphere is selected for that channel).



To view the Sphere Selection without changing the current Sphere, tap the **Sphere/Browse** knob.

Note that there are 12 factory Spheres, so if you haven't added any User Spheres, only lights 1-12 in the outer ring will be active. User Spheres are added to the end of the list of Factory Spheres. Since there can be up to 108 User Spheres and there are only 18 lights on the outer ring, the outer ring display will wrap around to the first light every 18 Sphere. If multiple channels end up on the same spot on the light ring, but are in different Spheres, the light will blink between the color of each channel's Sphere.

Enable/Disable Spheres

Since you can have up to 120 total Spheres (12 factory + 108 User), using **WT Spread** and **Sphere CV** can be very difficult to select particular groups of spheres. To help with this, firmware v2.0 adds the ability to disable Spheres, and to save the enabled/disabled state of each Sphere in a Preset. Each Preset can have a different group of enabled Spheres. You also can disable or enable Spheres quickly without using the Preset feature. In normal operation, disabled Spheres act like they aren't there: they will be skipped when using **Sphere** knob or CV, or the **WT Spread** knob or CV. However, they can still be accessed from Sphere Recording Mode (exporting, editing, or re-enabling).



Enable/Disable a Sphere

To disable a Sphere, you must be in Sphere Recording Mode (see User Manual, page 25 for details). Turn the **Preset** knob to select which Sphere you want to disable. The currently selected Sphere will be flashing brightly on the light ring. Tap the **Longitude** knob to disable this Sphere. When a Sphere is disabled, it will flash dimly on the light ring. Tapping **Longitude** while a disabled Sphere is selected will enable the Sphere.

If you want to hear the Sphere before enabling or disabling it, double-tap the **Preset** knob and the **SWN** will load it. This is the only way to listen to a disabled Sphere because in the normal SWN mode (not Sphere Recording Mode) you can't access disabled Spheres.

Keep in mind that you don't have to load a Sphere to disable or enable it. When you change the selected Sphere by turning the **Preset** knob, nothing will change in the sound, you're just moving a cursor through the list of Spheres. You can rapidly disable or enable a large number of Spheres by turning the **Preset** knob with one hand and clicking the **Longitude** knob with the other hand.

Tip: If you've found a Sphere you want to enable or disable but the Sphere display has already switched off, tap the **Preset** knob to bring back the display of Spheres before tapping **Longitude** to enable/disable the selected Sphere.

Saving a Group of Enabled/Disabled Spheres

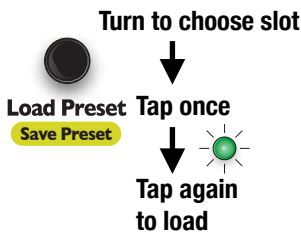
Once you've picked a group of Spheres to be enabled, you can save your work in the same way that you save all other settings on the SWN: by saving a Preset. You must exit Sphere Recording Mode to save a Preset (because when you're in Sphere Recording Mode, the **Preset** knob functions as a Sphere Save/Load control). Once you've exited Sphere Recording Mode, you can verify you enabled the right Spheres by pushing and turning the Sphere knob or by using the WT Spread feature: Spheres that you disabled won't be played.

When you save a Preset, the enabled/disabled state of each Sphere is saved along with the Preset. When you load a Preset, the same information is loaded. If you load a blank Preset, all Spheres will be enabled. Any Presets created in an earlier firmware version will have all Spheres enabled. There is no way to globally disable a Sphere across all presets. Instead, if you created a Sphere you no longer want to hear, you can delete it (and export a back-up copy first, if you wish).

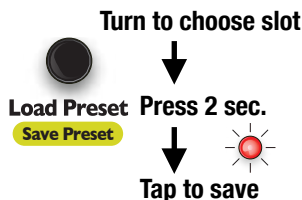
Load and Delete Spheres

The **Preset** knob allows you to load, save, and clear Spheres in Sphere Recording Mode. In early firmware versions, only saving was allowed. Firmware version 2.0 allows you to load and delete (clear) Spheres as well. The functionality is identical to the way you save, load, and clear Presets outside of Sphere Recording Mode. Simply turn the **Preset** knob to select the Sphere you want to load or delete. To load the selected Sphere, tap the knob twice. To save the selected Sphere, press and hold the knob for 2 seconds until the light flashes red, and then tap the knob. To delete the selected Sphere, press and hold the knob for 6 seconds until the light flashes multi-color rapidly, and then tap the knob to delete.

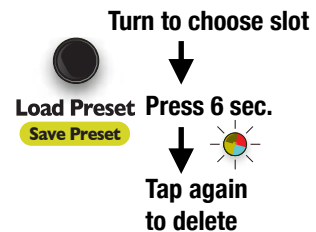
Load a Sphere: (in Sphere Rec mode)



Save a Sphere: (in Sphere Rec mode)

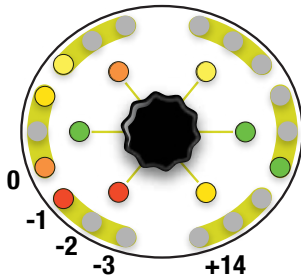


Delete a Sphere: (in Sphere Rec mode)



If you accidentally delete a Sphere, you can restore it by moving the flashing light to the empty Sphere slot and pressing and holding **Fine** + **Preset** for six seconds. If the light flashes multi-color rapidly, then a deleted Sphere has been found. Un-delete the Sphere by releasing **Fine** and **Preset** and then tapping **Preset**. If you save over a deleted Sphere, or if you power the SWN off, the Sphere cannot be un-deleted.

Other Improvements



Wider Octave Range

The octave range is now -3 octaves to +14. In previous firmware versions, the range was 0 to +14. Also, channels maintain their octave relationships if the **Octave** knob is turned all the way down or up, and then back the other way.

Faster Envelopes

The LFO Speed in Note, Keyboard, and CV/Gate mode can now be set much shorter than in previous firmware versions.

LFO Phase Improvements

Adjusting LFO Phase globally does not change the relative phase between channels, so you can sync to an external clock and set any point as the “down-beat” without disrupting the rhythmic pattern. Previously, channels would snap to small integer ratios unless **Fine** was held down while adjusting global LFO phase. In version 2.0, each click of the **LFO Phase** knob adjusts the phase of all channels by 1/24th of the clock. Holding down **Fine** while turning **LFO Phase** adjusts by 1/12th of that amount (1/288th of a measure).

WT Spread Improvements

Adjusting WT Spread now push each channel in a linear fashion rather than using pre-defined patterns. Channels A, B, and C move down in the list of Spheres, and channels D, E, and F move up. Each click of the knob adds one more Sphere between channels, keeping them centered around the same point and wrapping around the list of enabled Spheres.

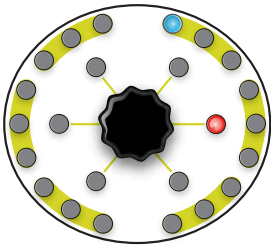
Reset Navigation, Reset Sphere Selection Key Combos

Pressing **Preset** + **Depth** resets the navigation parameters, and pressing **Preset** + **Latitude** resets the Sphere selections.

Bug Fixes and Improvements

- Entering Calibrate 1V/oct mode from Note or Keyboard mode would turn on LFO->VCA.
 - Sometimes one note could be skipped in the semitones scale when using Transpose CV or 1V/oct jacks.
 - Browsing is smoother.
 - Faster memory access techniques allows for more accurately tracking rapidly navigating or changing Spheres.
- As a result, the light ring no longer appear sluggish when using lots of quickly-changing CV.

How to Upgrade Your SWN



If you purchased your **SWN** and a printed copy of this addendum was included in the box, then you have version 2.0 already installed. If you need to double-check, watch the light ring when you power on the **SWN**. Version 2.0 has a red light at the 3:00 position in the inner ring, and a blue light at the 12:30 position on the outer ring (see diagram at left).

If you need to upgrade, download the firmware file from <https://4mscompany.com/SWN>. You also can download the User Manual from the same page, which we recommend.

The following upgrade procedure is copied from page 30 of the User Manual:

1. To enter bootloader mode, first unplug all cables.
2. Power off the module.
3. Connect a computer or phone audio output to the **Waveform In** jack.
4. Connect the right **OUT** jack to an amp/speakers so you can listen. Turn the amp/speaker volume down: this is going to be loud!
5. **Set the computer/phone's volume to 100%** and the audio player software to 100% volume.
6. Press and hold down the center knob (**Browse**).
7. Still holding down the **Browse** knob, power on the module.
8. Release the **Browse** knob when you see channel A's button blink green.
9. Begin playing the firmware file. Immediately you should see the slider lights animate and the lights on the light ring turn on, one at a time. You should be hearing the sounds very loudly out the **OUT** jack.
10. If the sound stops before the file is done playing, there was an error. Some buttons will turn red to indicate the error code.
 - a. Stop the file and rewind to the beginning.
 - b. Check all cables are plugged in tightly.
 - c. Tap the channel A button and it will go back to flashing green.
 - d. Play the file again from the beginning.
11. If the file loads successfully, the **SWN** will do an animation of blue and green lights on the light ring and the top row of buttons will flash green and blue.
12. Press the **Browse** knob to start playing with the new firmware!

Troubleshooting and tips:

- Some audio cards, especially laptops, play a pop when they begin to play an audio file. If this happens, the error lights will turn on as soon as you start playing. One way to overcome this is to let the file keep playing on the computer but hit the channel A button immediately after it turns red and before the noise starts playing (there's a two second lead time of silence). If that doesn't work, use a different device.
- Do not play from advanced audio software like Ableton. We have seen that such software can alter the playback, which can cause problems. Instead, play from basic software such as VLC, QuickTime, Windows Media Player, or Chrome. Turn off any EQ or "Bass Boost" settings.
- Remove your phone case; it may be preventing the cable from fully plugging in.
- Turn off all audio and "vibrate" notifications.
- Close any applications that make notification sounds (such as Facebook or messaging apps).
- Try downloading the .wav file rather than playing it from the browser (or vice-versa).
- Try on your phone if you used a computer (or vice-versa).
- Try adjusting the volume on your device: usually 100% volume is best, but sometimes reducing it will output a more clean signal.

If you're interested in compiling your own modifications, the open-source licensed source files (in C) can be found at <https://www.github.com/4ms/SWN>