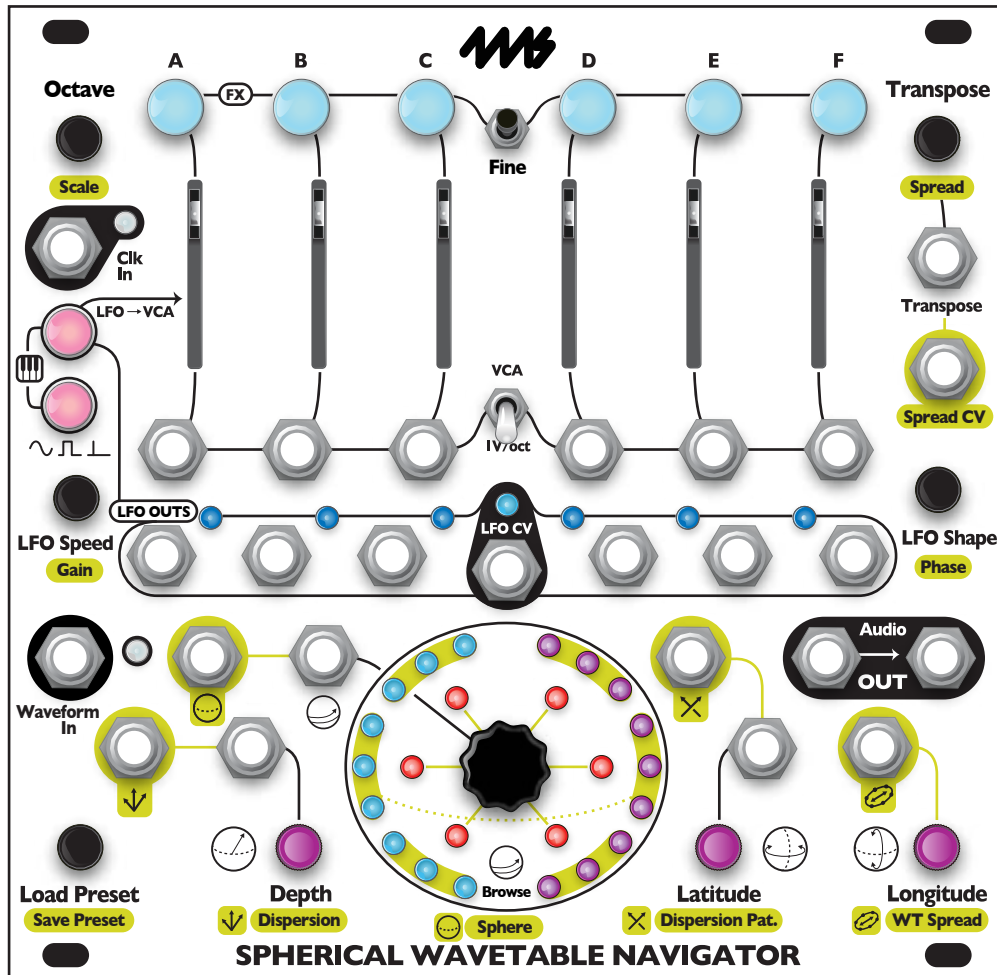


Spherical Wavetable Navigator

4ms Company

User Manual 1.0 – May 3, 2019



The **Spherical Wavetable Navigator (SWN)** is a six-channel synthesizer that makes it easy to create slowly morphing drones, polyphonic melodies, evolving sequences, and rich textures. The **SWN** features six wavetable oscillators with independent pitch, level, and waveform controls. Six LFOs (Low Frequency Oscillators) can be used as modulation sources and/or envelopes, making it easy to add dynamic motion to your patch. Each channel is a full voice and can be played using the top row of buttons, the internal LFOs, or note-change detection on the 1V/oct jacks. The **SWN** ships with 12 three-dimensional (Spherical) wavetables and an easy interface which allows you to record and edit custom wavetables from live audio. Open-source software for Mac, Windows, and Linux called SphereEdit can be freely downloaded and allows you to create, edit, and convert .wav files into Spherical wavetables to transfer into the **SWN** with an audio cable.

- Six VCOs (Voltage Controlled Oscillators), each with independent 1V/oct pitch CV and waveform selection.
- Twelve spherical wavetables, plus space for up to 108 user-created wavetables.
- Quickly record, apply effects, and save your own custom wavetables from live audio (or by using free SphereEdit software on a computer).
- Six LFOs/envelopes, each with its own output jack and controls for speed, amplitude, phase, and shape.
- Stereo audio outputs.
- Option to quantize each channel to a scale (major, minor harmonic, semitones).
- Entire state of the **SWN** can be saved into one of 108 Presets and recalled at a later time.
- Temperature-stable, high-quality pitch tracking circuitry is easy to re-calibrate and keep in tune with any sequencer, DAW interface, or keyboard.

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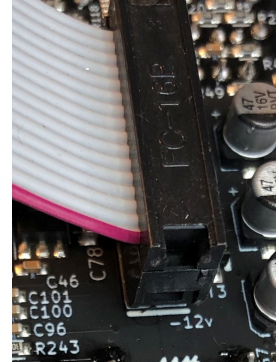
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SECTION I: BASICS

Plugging in your Spherical Wavetable Navigator

1. Power off your Eurorack system.
2. Connect the free end of the included power cable to a 16-pin Eurorack power header on your power supply distribution system. The red stripe should match the white line or -12V marking on the power distribution board. The other end of the power cable is a 16-pin connector which should already be connected to the **Spherical Wavetable Navigator** with the red stripe on the power cable orientated towards the bottom of the module.
3. Using the included screws, securely attach the **Spherical Wavetable Navigator** to the rails of your case.
4. Power on your Eurorack system.



Note: The **Spherical Wavetable Navigator** is reverse-polarity protected, but incorrectly connecting *any* module can damage *any other* module on the power bus.

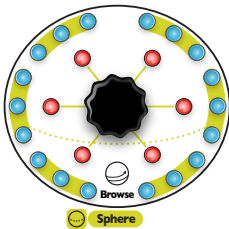
Tutorial 1: Making a Drone

If you've already been playing with the **SWN** and want to get back to a blank slate so you can follow the tutorial, turn the power off and back on again. Or, load a blank preset by double-tapping the **Load Preset** knob.

Making a drone is an easy way to learn about the **SWN**.



- 1) Patch **Audio OUT** jacks to your mixer or speakers. If you have stereo speakers/headphones, use both jacks. If you're working in mono, just use the right **OUT** jack. Stereo is better if you are able to use it!



- 2) Make sure all six sliders are pushed up to around 75%.
- 3) Turn the big center knob slowly and listen to the different sounds (timbres). This knob is called **Browse** because it browses the waveshapes in the Sphere. (We'll talk more about waveshapes and Spheres later).

Sphere

- 4) Find the **Transpose** knob in the upper right corner. Turn this knob to the left and right a bit. Hear how the pitch transposes up and down? Notice a light on the light ring moves around when you change the pitch.

Transpose

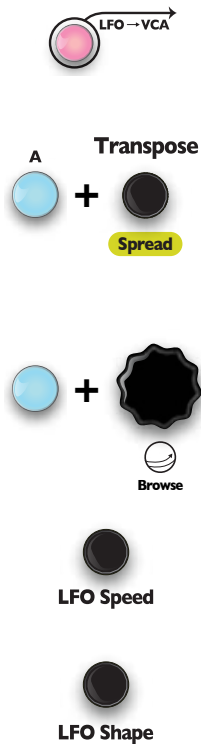


- 5) Now let's make a chord. Press down on the **Transpose** knob and while still pressing it down, turn it a few clicks. This is called **Spread**. Each time you turn another click while pressing down on the knob, the notes of the channels will spread out in a different chord. Watch the light ring to visualize how the pitches spread out. Each channel has a different color associated with it – the button above each slider shows the channel's color, and the same color is shown on the light ring.

- 6) Keep adjusting the sliders, **Transpose/Spread** and **Browse** knobs to play with your drone!

Tutorial 2: Making a Melody

We're going to turn the drone from the last tutorial into a melodic sequence.



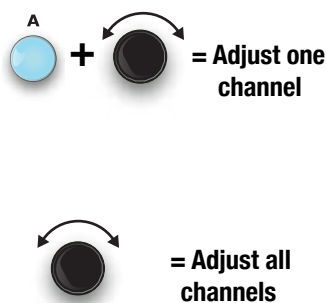
- 1) Start with the drone from Tutorial 1.
- 2) Find the **LFO->VCA** button (the top small button on the left side of the module) and tap it. The notes should start playing one after another (rather than all notes playing constantly). Each slider will flash when its channel plays its assigned note.
- 3) Change just one note in the sequence. Hold down any of the buttons on the top row while you turn the **Transpose** knob. Can you hear how just one of the notes goes up or down in pitch? If you watch the light ring you'll see just one of the lights move up and down (the light has the same color as the button you're pressing). Try transposing another channel. You can tune all six channels this way to make any melody you want! *Note: The Transpose feature defaults to 12-notes per octave quantization. If you hold down the **Fine** button while turning **Transpose** you can adjust the pitch by micro-tonal amounts.*
- 4) Just as you can tune one channel, you also can change the waveshape of only one channel. Hold down one of the buttons on the top row and turn the **Browse** knob. Do this for each channel, finding a timbre you like.
- 5) Let's adjust the tempo. Turn the **LFO Speed** knob one or two clicks in either direction. See how the melody goes faster or slower?
- 6) Now try changing the envelope shape by turning the **LFO Shape** knob one or two clicks clockwise. The notes should get less "drawn out," with a faster decay.
- 7) If you're feeling confident, try adjusting the **LFO Speed** or **Shape** of just one channel at a time!

If you want to learn more about **LFO->VCA**, read the section on **LFOs** (page 15).

What's an LFO?... and a VCA?

An LFO is an oscillator that goes up and down repeatedly at a relatively slow tempo. You can visualize the LFOs on the **SWN** by watching the row of six lights in the center of the module; they get brighter and dimmer as the LFOs go up and down. Usually an LFO is set up to make some quality of the sound go up and down (besides just a light)! In our tutorial we're using the LFOs to make the volume of each channel go up and down: this makes each channel sound like it's playing a note. A VCA (Voltage-Controlled Amplifier) connects the LFO's up and down motion to the loudness (or amplitude) of the sound produced.

Global vs. Local: Controlling One Channel at a Time



In the last tutorial, we held down a **Channel** button while turning a knob (**Transpose** and **Browse**) to change the pitch and waveshape of one channel at a time.

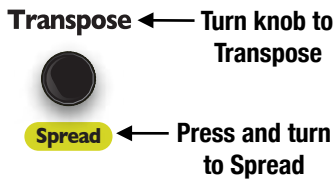
This technique works across almost every feature of the **SWN**. For example, try holding down a **Channel** button while turning the **Octave** knob — just that channel will go up or down by octaves. If you just turn the **Octave** knob by itself, all of the channels will go up or down in octaves.

In Tutorial 2, we pressed the **LFO->VCA** button to make the channels fade on and off instead of being constantly on. If you hold down a **Channel Button** while tapping the **LFO->VCA** button, just that channel will change.

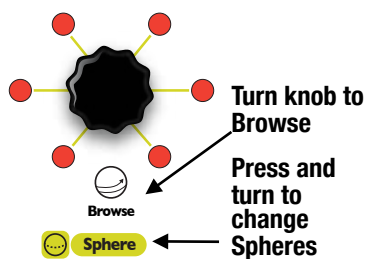
Keep this technique in mind as you play with the **SWN**.

Turning vs. Push+Turning

You may have noticed that sometimes you simply turn a knob, and sometimes you press down on it while turning it. Different things happen with each type of turn. You may also have noticed that on the faceplate each knob has two names: one is plain and one is on a gold background. Turning the knob (without pushing it down) does whatever is written on the plain background. Turning the knob while pushing it down does whatever is written on the gold background.



For example, look at the **Transpose** knob. The word “Transpose” is written above the knob, and the word “Spread” is written below the knob on a gold background. If you simply turn the **Transpose** knob, you’ll transpose the pitches of the channels. If you push down on the **Transpose** knob while turning it, you’ll spread the channel pitches, creating chords.

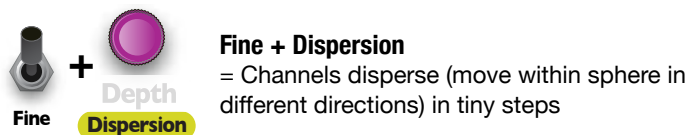
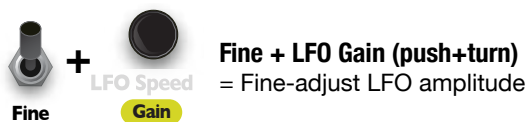
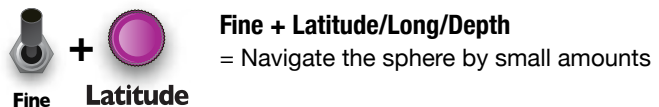
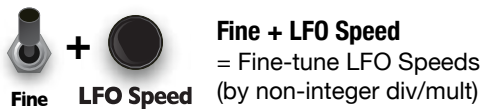
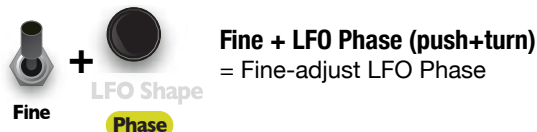
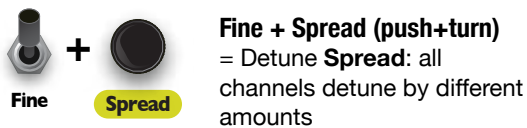
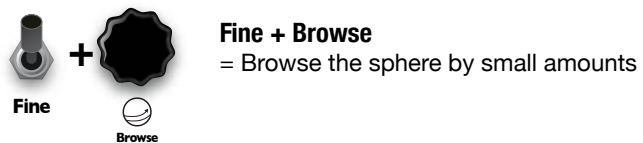


Let’s look at another example (a very important one): The knob in the center of the light ring is called **Browse**. Below it (outside of the light ring) the word “Sphere” is written. If you push and turn the center knob, you can select a different Sphere for any or all of the channels. This can completely change the sound and lets you explore all of the basic waveshapes the **SWN** has built-in. Play with it now!

Note: The main exception to the Gold = Push+Turn rule is the Preset knob. See the [Presets Tutorial](#) to learn how to use this knob.

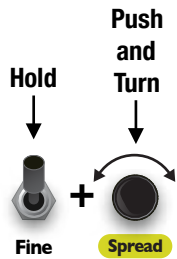
Fine button

You may have noticed the small button at the top-center of the module named **Fine**. When you hold down the **Fine** button you can turn another knob to adjust by small amounts. Most knobs on the **SWN** work with the **Fine** button. Here are some examples:

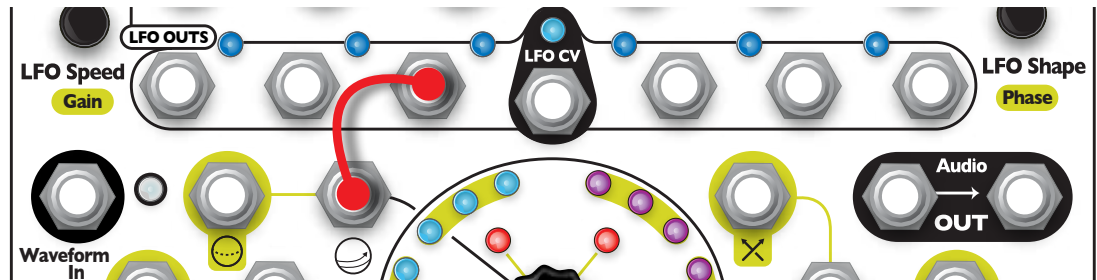


Tutorial 3: Drones Revisited

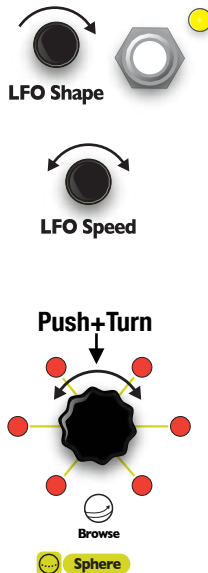
Now we're going to go back to making a drone in order to show off more of the **SWN's** features. You'll be detuning your oscillators and using an LFO to slowly browse through the wavetable.



- 1) Start where you left off at the end of [Tutorial 2 \(page 4\)](#).
- 2) Remember how you changed from a drone to a melody by pressing the **LFO->VCA** button? Press the button again to turn off the VCA and make the channels go back to making sound constantly. *If you played with turning **LFO->VCA** on or off for individual channels, then you may need to turn it off for whichever channels are still on.*
- 3) Now add some depth to the sound. Hold down the **Fine** button with one hand and push and turn the **Transpose/Spread** knob up a few clicks with the other hand. You should see a pattern of flashing red and blue lights at the bottom. If not, make sure you're pushing down on the **Transpose/Spread** knob while turning it. This is called "Detuning Spread", meaning that each of the six channels is detuned by a different amount. You should hear some subtle beating or phasing sounds.



- 4) Patch channel C's LFO to the **Browse** jack (patch the third **LFO OUT** jack to the jack below it: see above). Depending on how much you played with the **LFO Shape** and **LFO Speed** in the last tutorial, you may be hearing anything from a slow sweeping sound to an occasional blip.
- 5) Let's set the LFO shape to something smooth so there aren't any sudden movements in the drone. Turn the **LFO Shape** knob until the light above the **LFO OUT** jacks are yellow (or at least channel C's LFO light is yellow). This selects a sine wave for the LFO shape. *Peek ahead to the color chart of LFO shapes if you want to see all possible shapes.*
- 6) Now let's slow down the speed of the LFO so the drone is morphing very slowly. Turn the **LFO Speed** knob down until you see the light above the **LFO OUT** channel C jack fading very slowly, perhaps taking 5 –10 (or more) seconds to fade from off to on again. You should be hearing a slowly morphing drone.
- 7) Let's go back to working on the timbre. Just like in the [Turning vs Push+Turning](#) discussion (page 5), push down on the **Browse** knob while turning it to change your **Sphere**. The sound should change drastically as you select different sets of waveforms (which we call a Sphere). Keep turning while pushing until you find your favorite drone!
- 8) Want to take it a step further? Here are some ideas:



- Patch one of the other other LFOs to another jack on the **SWN**.
- Turn on **LFO->VCA** for some of the channels and makes sure their LFO speeds are very slow. Drones tend to sound good when sounds slowly go in and out.
- Set each channel to a different Sphere. See the [Global vs. Local](#) section (page 4) to see how to do this.
- Use the **Transpose** feature to tune two channels to the same pitch, and then press **Fine** button while turning **Transpose** to detune them slightly. If they have the same or a similar waveform, the beat frequencies will add another dimension to your drone.

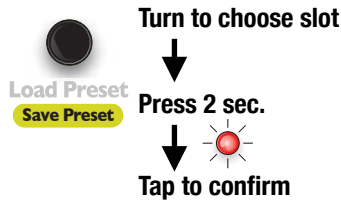
Tutorial 4: Saving your Work with Presets



If you like what you've created on the **SWN**, you can save the state of the module in a preset and recall it later. Almost everything will be saved: the tuning and wave-shape of each oscillator, which sphere is assigned to each channel, mutes, LFO settings, Note Mode, etc. The only things not saved are the positions of the **Level** sliders and the **VCA | 1V/oct** switch (and any other modules you have patched in).

Let's walk through saving and loading presets. First, play around until you get a sound you like from the **SWN**. Perhaps go back to Tutorial 1 or 2 to make a drone or a melody. When you like what you hear, you can save it.

Saving a Preset:

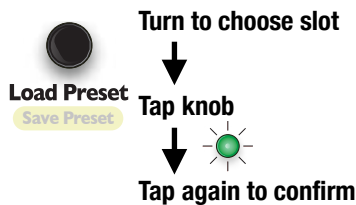


Saving a Preset:

- 1) Turn the **Load/Save Preset** knob to select a slot. A bright yellow light will move around the outer light ring as you turn the knob. Each light represents a slot where you can save a preset. If the light is off, the slot is empty.
- 2) Press and hold the knob down until the slot starts flashing red, then let go.
- 3) Tap the knob again (while the red light is still flashing) to confirm the save; you'll see an animation of red lights while it's saving. (If you change your mind and don't want to save the preset, just do nothing and the light will stop blinking after a couple seconds.)

Now let's learn how to load a preset. Turn some knobs on the SWN so it sounds different. Then we'll load the preset you just saved:

Loading a Preset:

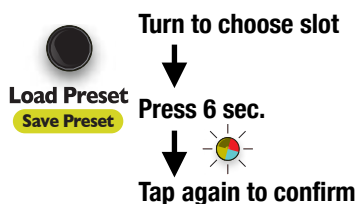


Loading a Preset:

- 1) Turn the **Load/Save Preset** knob to select the slot where you saved the preset. (Slots that have a preset saved in them will glow a dim yellow.)
- 2) Press and release the knob quickly and the slot will flash green.
- 3) Tap the knob again (while the green light is still flashing) to confirm the load; you'll see an animation of green lights while it's loading and the sound will change. (If you change your mind and don't want to load the preset, just do nothing and the light will stop flashing after a couple seconds.)

What if you saved a preset and don't want it anymore? You can clear preset slots like this:

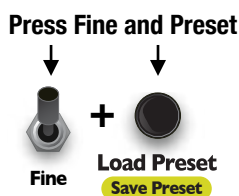
Clearing a Preset:



Clearing a Preset:

- 1) Turn the **Load/Save Preset** knob to select a slot.
- 2) Press the knob for 6 seconds until the light flashes multi-colored, then let go.
- 3) Tap the knob again (while the light is still flashing) to confirm the clear. (If you change your mind and don't want to delete the preset, just do nothing and the light will stop flashing after a couple seconds.)

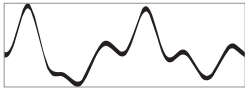
Undo/Redo:



What if you accidentally saved over a preset you wanted to keep? You can undo it! Press the **Fine** button and the **Preset** knob at the same time. When you release, you'll see an animation on the outer light ring. You can undo a save, load, clear, or even an undo (which makes it a "redo").

There are 108 preset slots. If you want to learn more about presets, including how to copy/paste presets, undo and redo, and tips on using presets in a live performance, see the [Presets](#) section (page 14).

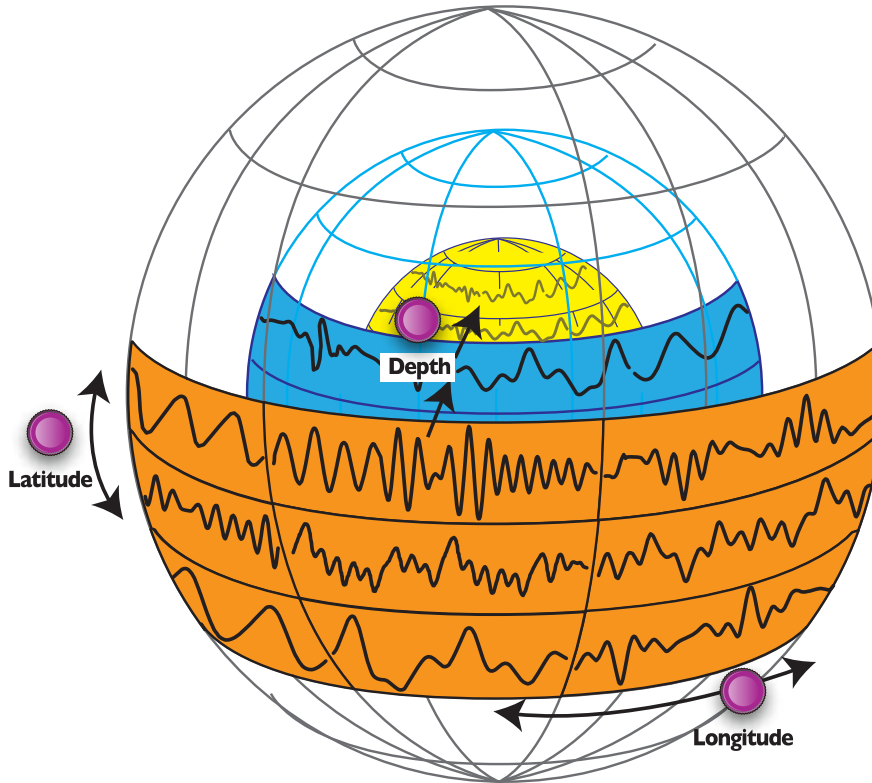
What's a Spherical Wavetable?



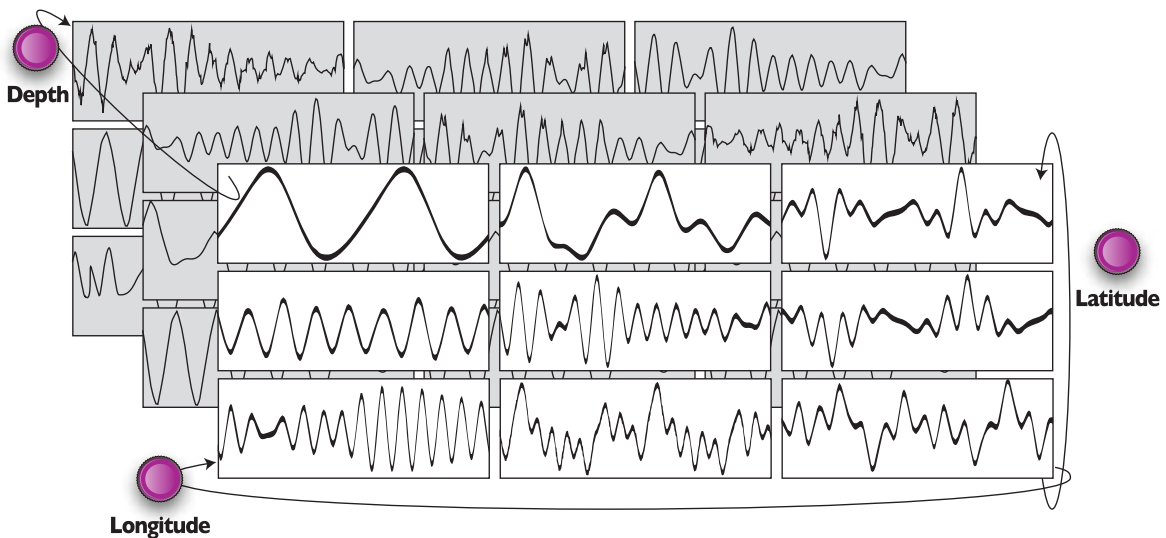
A waveform

A Spherical wavetable (or “Sphere” for short) is a group of waveforms. Think of a waveform as a timbre, or how an instrument “sounds”. A Sphere is a collection of 27 waveforms. As you turn any of the navigation knobs on the **SWN** (**Latitude**, **Longitude**, **Depth**, or **Browser**) you select which of the 27 waveforms to play. The **SWN** smoothly morphs between waveforms as you navigate, thus creating new waveforms on the fly. A

Sphere is so-named because you move between the waveforms in three dimensions (Latitude, Longitude, and Depth), and each dimension wraps around to the beginning when you reach the end. (The analogy to a sphere is not perfect, see the [Mathematical Note](#) page 11 if you're curious about the true geometry of the **SWN**.)



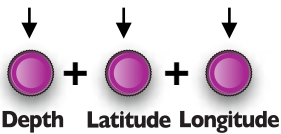
SWN's wavetables visualized as concentric spheres



SWN's wavetables visualized as a 3 x 3 x 3 matrix

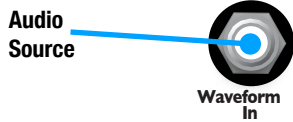
Tutorial 5: Creating Your Own Spherical Wavetables

Push all three knobs to enter Sphere Recording Mode



A powerful feature of the **SWN** is its ability to create wavetables from any audio source. The **SWN** can record 2.5 seconds of audio and splice that up into the 27 waveforms needed to create a Sphere. You can add effects, change where the waveforms are spliced, normalize, smooth the seams, and save your custom sphere. Up to 108 custom spheres can be saved!

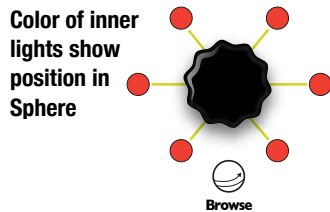
1. Press the **Depth**, **Latitude**, and **Longitude** knobs at the same time to enter Sphere Recording Mode. When you're in this mode, the knobs you just pressed will glow orange.



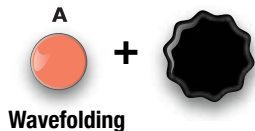
2. Patch an audio source into the **Waveform In** jack. You'll get better results with something dynamic and recognizable such as a sample of a human voice, or a percussive patch you've made. Make sure the **Audio OUT** jacks are patched into speakers or a mixer, so you can hear the **SWN**.



3. When your audio source is playing and you're ready to record it, press the small red button that's flashing (it's normally the **LFO->VCA** button). The **SWN** will record for about 2.5 seconds. You should hear the audio play out the **OUT** jacks and see an animation of red lights on the light ring.



4. The **SWN** will pull 27 waveforms from the recorded audio and create a Sphere. You should hear the first waveform in the Sphere. Turn the **Browse** knob slightly until you hear the **SWN** jump to the next waveform in your Sphere. (In Sphere Recording Mode, browsing jumps immediately to the next waveform instead of morphing; this allows you to hear the distinct waveforms.) If you want to hear morphing, just hold down the **Fine** button while you turn the **Browse** knob. Keep turning **Browse** to hear all the waveforms. *Tip: The inner ring of lights shows your position in the Sphere. You can always find the first waveform because inner ring lights will glow dim gray.*



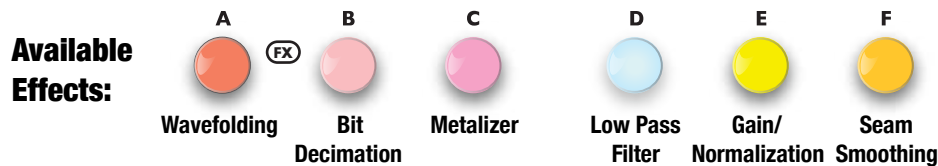
5. Now, add some effects (FX). Each of the buttons at the top of the **SWN** is an FX. For example, channel A's button is a wavefolding effect. See *diagram below for all the FX*. Hold down one of the FX buttons while you turn the **Browse** knob. You should hear the sound change as the FX is added, and you should see the light ring display how much is being applied. By turning **Browse** while holding down the FX button, the effect will only be applied to the current waveform.

Turn to select Sphere slot
Press+hold to save
Tap to confirm



6. To apply FX to all 27 waveforms in the Sphere, push down on the **Browse** knob while you turn it (still holding down the FX button). Keep browsing through your Sphere and apply effects to waveforms as you wish.

7. Once you like all of the waveforms, you can save your work. Turn the **Load/Save Preset** knob and watch how a light goes around the ring. Each spot has a slightly different color. Pick any spot and then hold down the knob until the light starts flashing. Release it, and then press it again to confirm. When you save a Sphere, the **SWN** will immediately exit Sphere Recording Mode and start using the new Sphere. Remember that pushing and turning the **Browse** knob will select which Sphere is active, so you can always come back to the Sphere you just created.



There are many more features in Sphere Recording Mode! For instance, you can spread the waveforms throughout the recorded audio, stretch them, and move them around. Read the [Sphere Recording Mode](#) section (page 25) for more details.

Creating Spheres with SphereEdit on a Computer



SphereEdit is free, open source software compatible with Mac, Windows, and Linux. SphereEdit allows you to create, edit, import and export waveforms and Spheres and then load them into the **SWN** using an audio cable. You can download SphereEdit from the 4ms Company website: <https://4mscompany.com/SWN>.

SphereEdit is heavily based on Synthesis Technology's WaveEdit open-source software written by Andrew Belt. More information about WaveEdit can be found here: <http://synthtech.com/waveedit/>. Synthesis Technology: <http://www.synthtech.com/>.

The Quick Start section from the SphereEdit User Manual is below (please read the entire SphereEdit manual if you want to learn more):

Creating a Sphere with SphereEdit

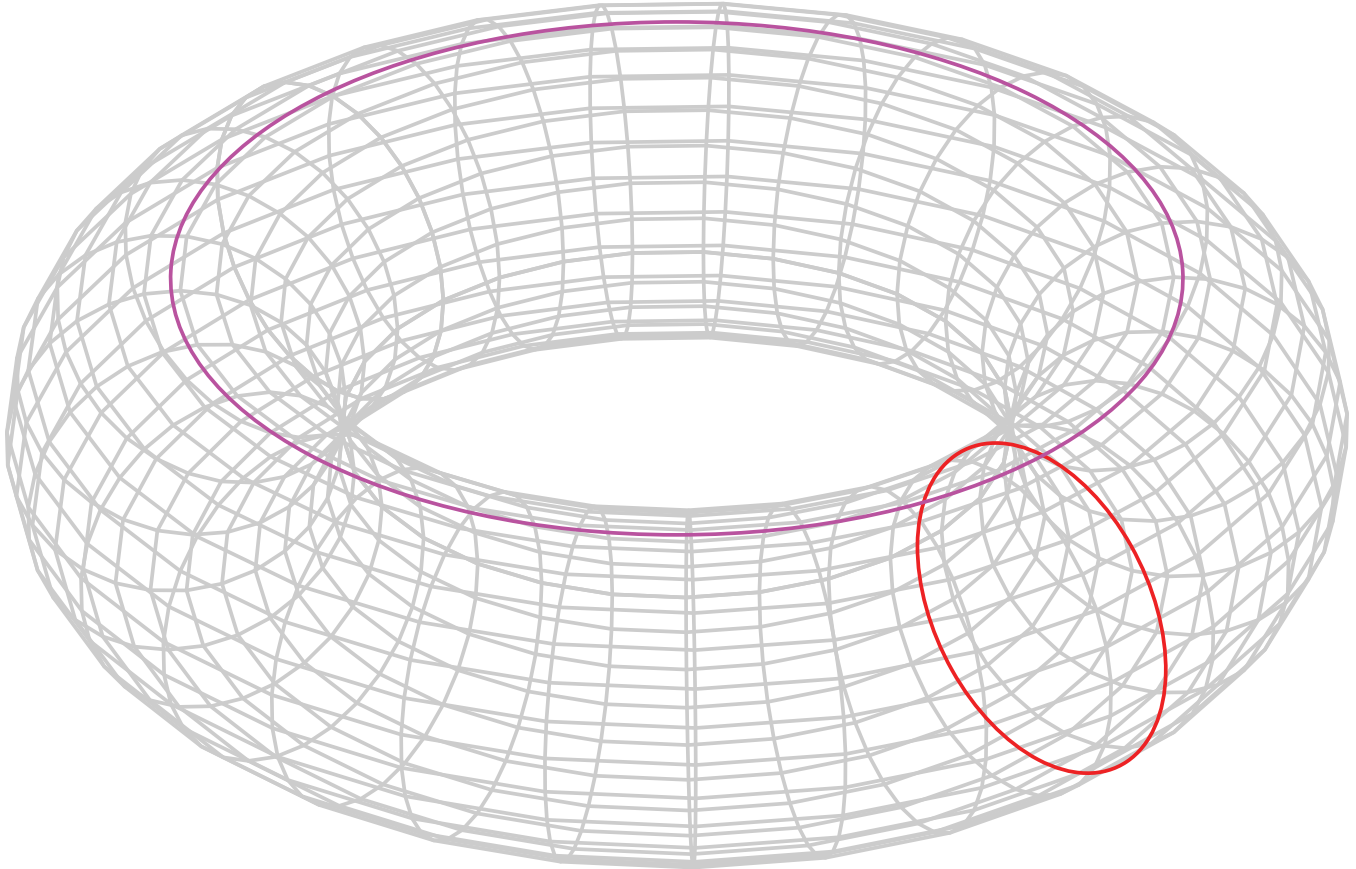
1. Create a new Sphere by selecting **New Sphere** from the **File** menu, or load a previously saved Sphere.
2. Create 27 waveforms using the SphereEdit tools:
 - Draw and edit waveforms with the Pencil, Brush, Grab, Line, and Eraser tools.
 - Draw and edit harmonics (using the same tools).
 - Import existing .wav files.
 - Load primitives from the Digital/Analog/FM/Glitch categories.
 - Apply Effects to waveforms, individually or spread across multiple waveforms.
3. Save your work by selecting **Save Sphere** from the **File** menu.

Loading a Sphere into the SWN

1. Plug your computer's audio/headphone output jack into the **SWN's Waveform In** jack. Use a mono 1/8" (3.5mm) cable to plug into the **SWN**.
2. Enter Sphere Recording Mode on the **SWN** and press the record button. The SWN will start recording when it detects a signal. See [Tutorial 5: Creating Your Own Spherical Wavetables](#) (page 9).
3. Click the **Play into SWN** button in SphereEdit. The computer will play your Sphere and the light ring on the **SWN** will fill up with red lights to show the progress. It should stop playing after 2.5 seconds.
4. When it's done, turn the **Browse** knob to hear your new Sphere.
5. Save the Sphere on the **SWN** if you want to keep it. See [Tutorial 5: Creating Your Own Spherical Wavetables](#) (page 9).

SECTION II: REFERENCE

The Geometry of a “Sphere”

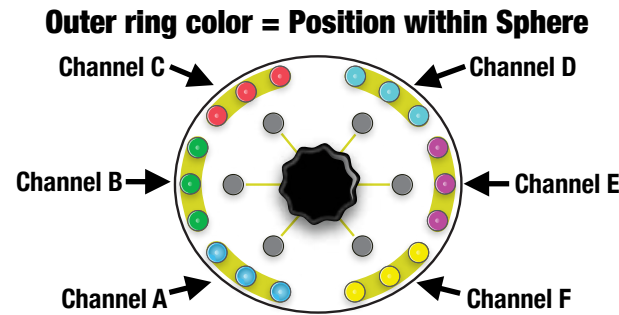


A torus

While we use the term “Sphere” when talking about the wavetables in the **SWN**, the structure of each wavetable is actually a 3-torus. *What’s a 3-torus?* It’s a three-dimensional structure existing in a four-dimensional space. To understand what a 3-torus is, first think about a circle. A circle is a single dimensional object that wraps around to its beginning point as it reaches its end point. Any point on the circumference of a circle can be specified by a single number (by an angle from 0° to 360°), so a circle is one-dimensional. However, in order to draw a circle you need a two-dimensional space such as a piece of paper. So, a circle is a one-dimensional object existing in a two-dimensional space. Now, think about a doughnut (a torus, see picture above). You can make a doughnut if you extrude a circle into a cylinder and then bend the cylinder around so the top and bottom faces are touching. You can specify any point on the surface of the doughnut with just two numbers (an angle of the original circle and a position along the extruded cylinder), so the torus surface is two-dimensional and clearly exists in a three-dimensional space.

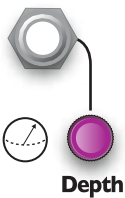
The next step is not as easy to visualize — imagine you took a doughnut and extruded it through a fourth dimension, and then connected the beginning to the end. This is a 3-torus. It’s a three-dimensional object that exists in a four-dimensional space. If you happened to be on the surface of a 3-torus and you looked far enough in any direction you’d see the back of your own head! If you walked far enough in any direction you’d end up exactly where you started, facing the same direction. The same is true for the **SWN**’s wavetables: if you navigate far enough in any direction, you end up back to where you started.

Sphere Navigation – Depth, Latitude, Longitude, Browse, Dispersion



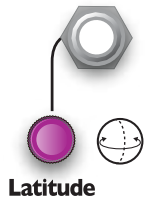
A Sphere is a collection of 27 waveforms arranged in a 3x3x3 shape. A Sphere can be navigated in three directions: Depth, Latitude, and Longitude. Navigating in a direction “wraps” around to the beginning when it reaches the end. Each direction has three waveforms, and navigating in any direction morphs between whatever waveforms are passed. Although a Sphere contains 27 waveforms, there are virtually infinite number of waveforms you can create just by navigating.

The position of each channel is roughly shown by the color of the lights in the outer light ring. The diagram on the left shows which group of lights correspond to each channel. The amount of red hue indicates the position in the Depth direction; the green hue corresponds to the Latitude; the blue hue corresponds to the Longitude. For example, if your SWN’s lights matched the diagram, then each channel will be playing a different waveform since each color is different. If you held down Channel A’s button while turning the Depth knob, Channel A’s lights would become more red and begin to match the purple color of Channel E. This would indicate that Channels A and E were playing similar waveforms.



Depth (knob and CV jack)

The **Depth** knob and CV jack control the position within the Sphere in the Depth dimension. The red hue of the lights in the light ring will change as Depth changes. Applying CV from 0V to +5V will offset the position selected by using the knob. Holding the **Fine** button while turning **Depth** will adjust the **Depth** by small amounts. Holding down one or more **Channel** button(s) while turning **Depth** will adjust only those channel(s).



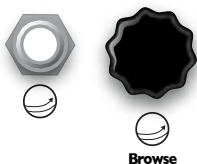
Latitude (knob and CV jack)

The **Latitude** knob and CV jack control the position within the Sphere in the Latitude dimension. The green hue of the lights in the light ring will change as Latitude changes. Applying CV from 0V to +5V will offset the position selected by using the knob. Holding down the **Fine** button while turning **Latitude** will adjust the Latitude by small amounts. Holding down one or more **Channel** button(s) while turning **Latitude** will adjust only those channel(s).



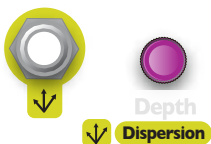
Longitude (knob only)

The **Longitude** knob control the position within the Sphere in the Longitude dimension. The blue hue of the lights in the light ring will change as Longitude changes. Holding down the **Fine** button while turning **Longitude** will adjust the Longitude by small amounts. Holding down one or more **Channel** button(s) while turning **Longitude** will adjust only those channel(s).



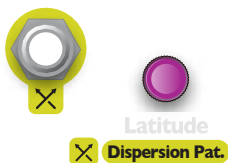
Browse (knob and CV jack)

The **Browse** knob navigates in a zig-zag (or “snake”) pattern that covers the entire Sphere. Applying CV from 0V to +5V will offset the position selected by using the knob. Holding down **Fine** while turning **Browse** will adjust the pattern by small amounts. Holding down one or more **Channel** button(s) while turning **Browse** will adjust only those channel(s).



Dispersion (knob and CV jack)

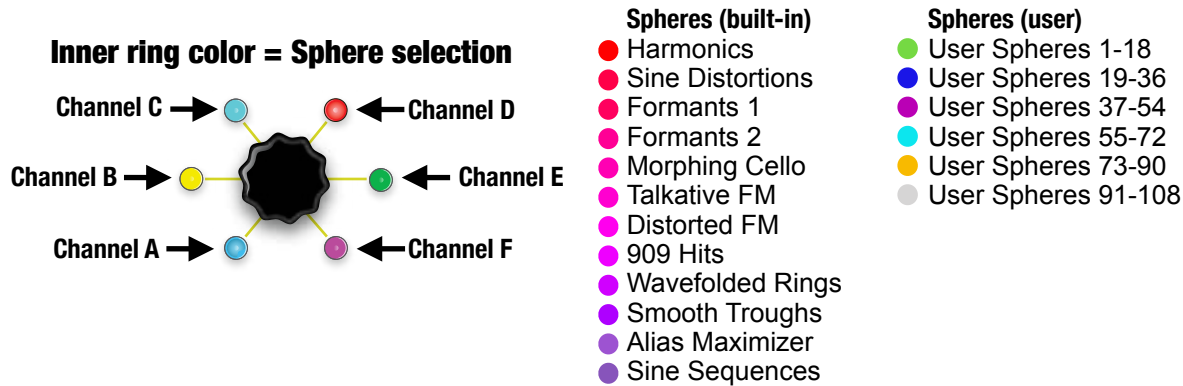
Dispersion is controlled by pushing and turning **Depth** knob. It effects all channels by navigating each channel in a different combination of directions, as if all the channels were moving away from a central point on the Sphere. **Dispersion** wraps around the Sphere, so if you keep turning the knob, all the channels will start moving towards each other. Applying CV from 0V to +5V will offset the amount of dispersion. Holding down **Fine** while turning **Dispersion** will adjust the Dispersion by small amounts.



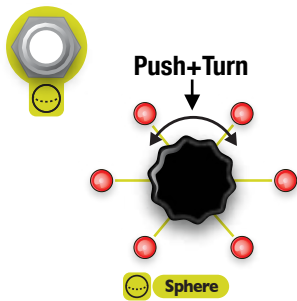
Dispersion Pattern (knob and CV jack)

Dispersion Pattern is controlled by pushing and turning **Latitude** knob. It selects one of several patterns of directions that **Dispersion** moves the channels. Applying CV from 0V to +5V will offset the pattern selection.

Sphere Selection and Wavetable Spread



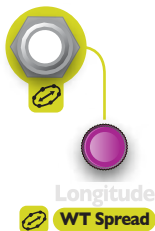
The **SWN** allows you to select different Spheres for each channel to navigate. The inner light ring indicates which Sphere is selected for each channel (see the diagram above). The color of the light corresponds to a particular Sphere. There are twelve Spherical wavetables built into the **SWN**, and you can create and import up to 108 custom Spheres of your own.



Sphere (knob and CV jack)

To select a Sphere, push down on the **Sphere (Browse)** knob while turning it. The colors of the lights in the inner ring will change to indicate which Spheres are selected for each channel. Applying CV from 0V to +5V will offset the position selected by using the knob. Holding down one or more **Channel** button(s) while turning **Sphere** will adjust only those channel(s).

When selecting a Sphere, the **SWN** will scroll through the twelve built-in Spheres and then any User Spheres which are saved. User Sphere slots that are empty will be skipped. After reaching the last User Sphere, the selection will wrap around to the first built-in Sphere.



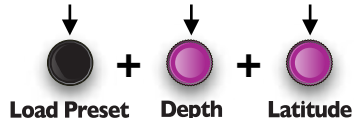
WT Spread (knob and CV jack)

WT Spread (Wavetable Spread) selects a different Sphere for each channel. Changing the **Wavetable Spread** selects one of twelve patterns built into the **SWN**. Each pattern defines an offset for each channel which is added to the Sphere selection from the **Sphere** knob and CV jack. Applying CV from 0V to +5V will offset the position selected by using the knob.

Resetting Navigation and Sphere Selection

Reset Navigation/Sphere

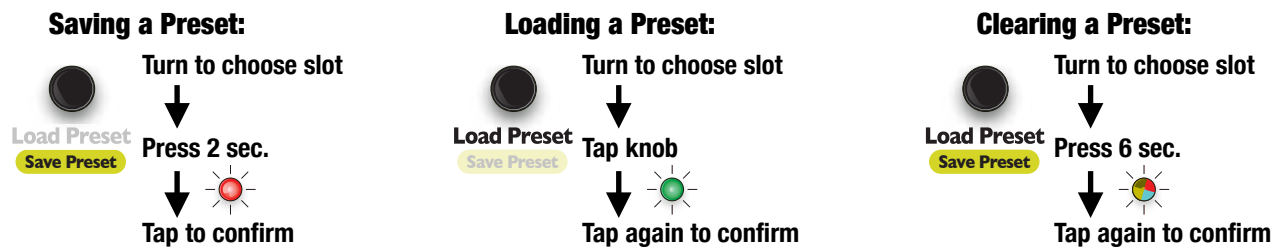
Press Preset+Depth+Latitude



The navigation position and selected Sphere for all channels can be reset by pressing the **Preset**, **Depth**, and **Latitude** knobs at the same time. The **Depth**, **Latitude**, and **Longitude** positions will be reset to the starting position within the Sphere, the first built-in Sphere will be selected, and **Dispersion**, the **Dispersion Pattern**, and **Wavetable Spread** will be cleared.

No other setting (**Octave**, **Transpose**, **LFO Speed**, etc) will be affected.

Presets



See the [Presets Tutorial](#) (page 7) for a step-by-step guide to saving, loading and clearing a preset. All of these actions begin with you turning the **Preset** knob to select a preset slot. Next, tap the **Preset** knob quickly (to load), or hold it down for two seconds (to save), or hold it down for six seconds (to clear/delete). When you release the **Preset** knob, the slot light will flash. While the light is still flashing, tap the **Preset** knob once to confirm that you want to load, save, or clear the preset. If you change your mind, just do nothing and the flashing light will eventually stop and the preset save/load/clear action will be aborted.

If you look carefully at the light ring when you turn the **Preset** knob, you'll see that one of the lights in the inner ring is glowing white. This white light indicates which page you're on. There are 18 preset slots on each page (one slot for each light in the outer ring). If you keep turning the **Preset** knob up past the 18th slot, the white light will go to the next page, and you'll see another 18 preset slots to save into.

There are six pages of presets, and with 18 presets per page, there are a total of 108 preset slots.

You can use the pages to organize similar presets, perhaps to isolate a group of presets that you want to use together.

Using Presets in a Performance

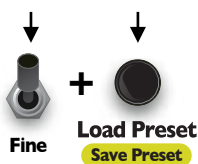
One way to use presets in a performance setting is to stage your next preset before you actually load it, making it easy to transition quickly to a preset even if you can't keep your eyes on the **SWN** when making the transition. To stage a preset, simply turn the **Load Preset** knob to the slot you'll want to load next. Don't tap the knob at this time. When you're ready to load, just double-tap the **Load Preset** knob and it'll load the preset you previously selected. Staging in this way makes it a little easier to do the difficult, multi-handed transitions which are common in modular performances.

Copying and Moving Presets

Another feature of presets (which may not be obvious) is that you can copy presets from one location to another. Just load the preset you want to copy, and then save it into the destination slot. This technique might be useful if you want to save variations of a preset. Another use is to put your presets in a logical order (perhaps in the order they'll be used in a performance). By clearing a preset's original slot after copy/pasting it to a new slot, you can re-order presets and even move them between pages.

Undo/Redo:

Press Fine and Preset



Undo a Save/Load/Clear

If you accidentally overwrite one of your presets, don't worry— you can undo it! Just press the **Preset** knob and the **Fine** button at the same time to undo saving. The former contents of the preset slot you just saved into will be restored. Note that the undo state is cleared when you power the **SWN** off, so you can't undo something that was done before the last time you turned the **SWN** on.

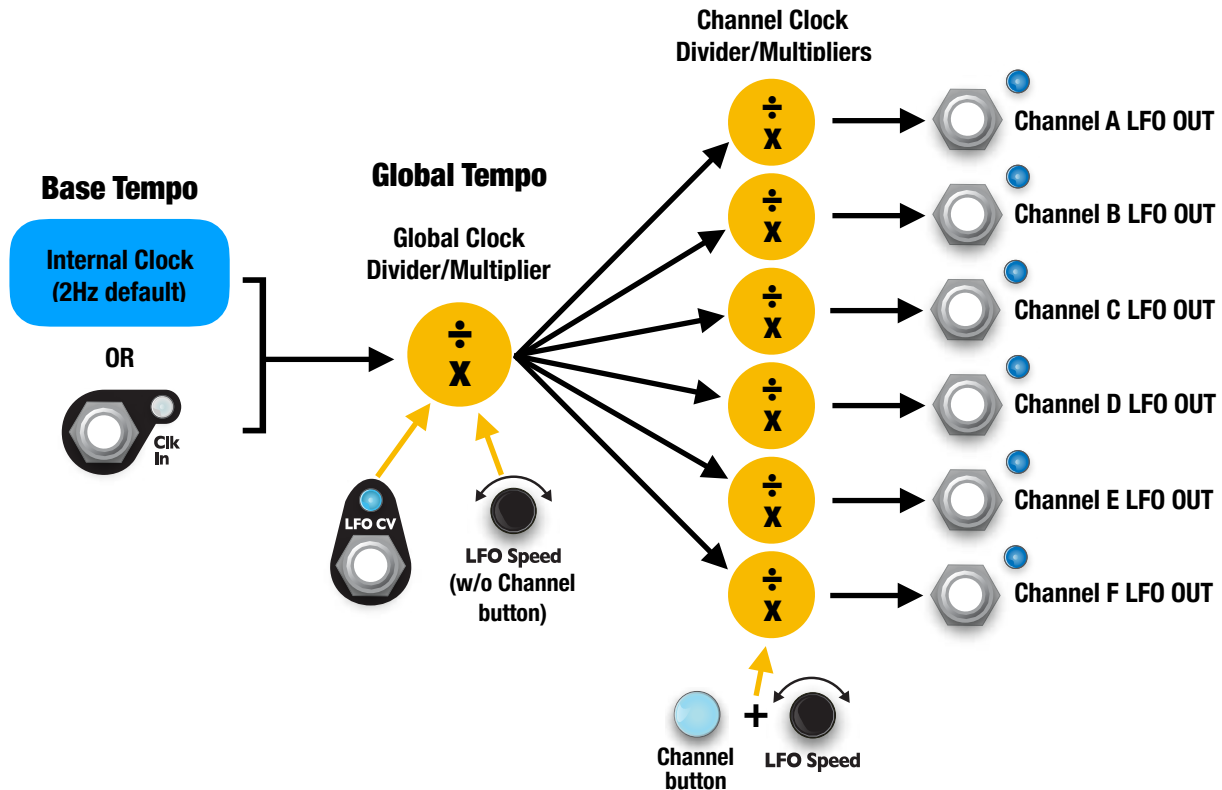
You also can undo loading a preset by pressing the same buttons (**Fine + Preset**). This is useful if you want to compare a preset to your current sound. Just load the new preset, listen to it, then undo to hear your previous sound. "Undoing an undo" will "redo" the undo, so you can keep hitting undo to toggle back and forth between your original sound and the preset.

LFOs Overview

The **SWN** features six LFOs, one for each channel. Each LFO has an output jack which can be patched to CV jacks on the **SWN** or other modules. The speed, waveshape, amplitude, and phase of each LFO can be controlled individually. Typically, the LFOs are constantly running, but there are two modes where they behave like envelopes by firing only when a note is triggered (Note Mode and Keyboard Mode).

Using the **LFO->VCA** button, the LFOs can be internally routed to the channel VCAs to modulate the volume of each channel. Using the $\sim \sqcup \perp$ button (**LFO Type**), each LFO can be set to output its waveshape, a gate, or a trigger.

The LFOs are all synced to a common clock called the base tempo. A global clock divider/multiplier divides or multiplies the base tempo to produce the global tempo. Each LFO also has a clock divider/multiplier that takes the global tempo and produces the LFO's tempo. The base clock tempo is 2Hz by default. Patching a clock into the Ext Clock jack will sync the base clock to the external clock.



LFO Speed



The global clock divider/multiplier is controlled by turning the **LFO Speed** knob without holding down any **Channel Buttons**. Each LFO's clock divider/multiplier is controlled by holding down one or more **Channel Buttons** while turning the **LFO Speed** knob.

Turning **LFO Speed** steps through integer dividers and multipliers of the base or global clock. The sequence of integers is as follows:

$$\div 64 \div 48 \div 32 \div 24 \div 16 \div 8 \div 7 \div 6 \div 5 \div 4 \div 3 \div 2 = \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 12 \times 16 \times 24 \times 32$$

The sequence is infinite in both directions: when slowing the tempo down past $\div 64$ the tempo divides by a factor of eight more than the previous factor ($\div 72$, $\div 80$, $\div 88$, etc...). When speeding the tempo up past $\times 32$ the tempo multiplies by a factor of two more than the previous factor ($\times 34$, $\times 36$, $\times 38$, etc...) Holding down **Fine** while turning **LFO Speed** adjusts by non-integer amounts.

LFO CV jack



The **LFO CV** jack is an input jack which controls the global LFO tempo. Inputting CV in the range of 0V to +5V will increase the global clock's tempo by offsetting what's been set by the knob.

Audio Rate LFOs

If the tempo of an LFO increases into the audio range (above about 20Hz), the **SWN** will apply subsequent speed increments by raising the frequency of the LFO by semitones. This lets you use the LFOs as audio tone generators.

Semitone steps will be applied whether the LFOs go into audio rate because the tempo is increased due to changing the external clock tempo, the **LFO Speed** knob (global or channel), and/or **LFO CV** jack. Each LFO can be in audio rate mode or LFO rate mode independently of the other LFOs.

The maximum frequency for audio range LFOs is about 3kHz, although significant aliasing begins around 500Hz. To achieve frequencies higher than 500Hz, you must

LFO Shapes



Each LFO has a waveshape which is set with the **LFO Shape** knob. Turning **LFO Shape** will select the next or previous waveshape for each LFO. Holding down one or more **Channel** button(s) while turning **LFO Shape** will select the next or previous waveshape for the selected channels. The color of the light next to each LFO OUT jack indicates which shape is chosen. There are 25 possible shapes, shown below:

Saw (Ramp-down)

- Saw 100%
- Saw 75%
- Saw 50%
- Saw 25%
- Saw 12%

Ramp-up

- Ramp-up 100%
- Ramp-up 75%
- Ramp-up 50%
- Ramp-up 25%
- Ramp-up 12%

Utility

- Sine
- Triangle
- Steady DC

Complex Shapes

- Shape 1
- Shape 2
- Shape 3
- Shape 4
- Shape 5
- Shape 6
- Shape 7
- Shape 8
- Shape 9
- Shape 10
- Shape 11
- Shape 12

The saw (ramp-down) shapes are useful as envelopes (sharp attack and variable decay). The ramp-up shapes are also useful as envelopes for a reverse effect (slower attack and sharp decay). The sine, triangle, and DC shapes are typically used as modulation sources. The complex shapes are useful when using the LFOs in the audio range, since each complex shape has a unique timbre. They're also useful in trigger or gate mode to generate complex rhythmic patterns, since each shape has multiple zero-crossings which fire the trigger/gate in complex patterns.

LFO Phase

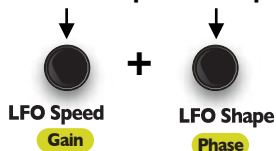


The relative phase of the LFOs can be set with the **LFO Phase** feature (push and turn the **LFO Shape/Phase** knob). Adjusting the phase of a single channel will make it run earlier or later in time relative to the other LFOs. For example, if two LFOs are firing at the same time and you turn the **LFO Shape/Phase** knob up while holding the **Channel** button of one of the LFOs, that LFO will fire a moment later than the other LFO. If you were to set each channel's LFO to fire a moment later than the previous channel, the LFOs would fire in a sequence (read below for the shortcut for this useful feature).

Adjusting the **LFO Phase** without pressing a **Channel** button will adjust the phase of all the LFOs relative to the base clock. When using an external clock, this can be used to shift the "downbeat" of the LFOs relative to the external clock source.

Toggle Phase Pattern

Press **LFO Speed + Shape**



A quick way to set the phase of all the LFOs is to press the **LFO Speed** and **LFO Shape** knobs at the same time. Doing this will toggle the phase of all the LFOs between two states: all LFOs in-phase (all LFOs running), and all phases 60° apart (LFOs firing one after another in a sequence). The effect of having the LFOs in phase or 60° out-of-phase is most apparent if the speeds are the same. This is also discussed in the [Resetting and Resyncing LFOs](#) section (page 19).

LFO Gain



The amplitude of each LFO's output on its **LFO OUT** jack can be set by pushing and turning the **LFO Speed/Gain** knob. Only the amplitude of the output jack is adjusted; this does not affect the amount of LFO internally sent to the VCA when **LFO->VCA** is enabled. By default, the amplitude is 5V, which is suited for modulating any of the CV jacks on the **SWN**. The **LFO Gain** control can boost this up to 8.8V, and as low as 0.4V.

Clock In



The **Clock In** jack is used for synchronizing the **SWN**'s LFOs to external equipment. A clock with an amplitude of at least 1.5V and a pulse width of at least 1ms is required. The light next to the **Clock In** jack will flash blue to the tempo of the external clock when it's detected.

The tempo of the external clock will be used as the base tempo for the **SWN**. See the diagram in the [LFOs Overview](#) section (page 15). If the external clock stops or is unplugged, the **SWN** will switch back to using its internal base tempo, but the internal base tempo will play as closely as possible to the last tempo received.

LFO->VCA




The LFOs can be internally routed to a VCA for each channel in order to modulate the level of each channel. Pressing the **LFO->VCA** button toggles this feature on/off for all the LFOs, while holding down one or more **Channel** button(s) while pressing **LFO->VCA** toggles only those channel(s).

When **LFO->VCA** is enabled, the light on the slider will fade up and down with the tempo of the LFO. You also can view the **LFO->VCA** status by pressing and holding the button: the **Channel** buttons will slowly flash green for channels that have **LFO->VCA** enabled and will glow a dim yellow otherwise. If you keep holding the **LFO->VCA** button down until it turns red, you can safely release it without toggling the state.

LFO Type (Shape/Gate/Trigger)



The small button under **LFO->VCA** marked with  is called the **LFO Type** button. This button toggles between three modes: Shape, Gate, and Trigger.

Shape Mode

Shape Mode is the default mode, where the LFO outputs the waveshape selected with the **LFO Shape** knob. This is often the most useful mode for use with **LFO->VCA**, for patching the **LFO OUTs** to CV jacks on the **SWN**, or for modulating other modules.

Gate Mode

Gate Mode outputs a gate which is high when the LFO's waveshape is above 50% of its amplitude and low when it's less than 50%. This can also be used with **LFO->VCA** mode for a choppy/harsh envelope effect, or for sending gates to other modules.

Trigger Mode

Trigger Mode outputs a trigger each time the LFO's waveshape crosses the 50% threshold while rising. With a simple waveshape (ramp-up/down, sine, triangle), this fires once per period, so can be used as a clock output for syncing to other modules. For example, it could be used to advance a step sequencer. It also can be used to modulate another feature briefly and periodically. With complex waveshapes, Trigger Mode generates rhythmic pulse streams that are complex yet repeat periodically.

You can view the **LFO Type** status by pressing and holding the button. For channels in Shape Mode, the **Channel** buttons will fade on and off with a blue color. For channels in Gate Mode, the buttons will turn on/off sharply with a light blue color. For channels in Trigger Mode, the buttons will briefly blink an aqua color. If you keep holding the **LFO Type** button down until it turns red, you can safely release it without toggling the state.

Note Mode and Keyboard Mode



Pressing both the **LFO->VCA** and **LFO Type** (∩ ∟ ⊥) buttons at the same time toggles between three modes in this order: Mute Mode, Note Mode, and Keyboard Mode. If you hold down a **Channel** button while pressing the **LFO->VCA** and **LFO Type** buttons, only that channel will change modes. Otherwise, all channels will change modes.

A



Mute Mode

Mute Mode is the default mode. The **Channel** buttons mute/unmute the channels, and the LFOs run continuously. When a channel is muted its **Channel** button will be off, otherwise it'll be white.

A



Note Mode

Note Mode is useful when using the **1V/oct**, **Transpose** or **Spread CV** jacks. In Note Mode, the LFOs stop running continuously and instead become envelopes which fire once whenever the channel's note changes.

An example patch would be to patch a 6-channel CV sequencer into each of the **SWN's 1V/oct** jacks. Each channel on the **SWN** would fire its envelope (and thus play a note) only when the sequencer changes its pitch. Each channel can trigger at a different time, so this is an easy way to create polyphonic melodies, with the pitch and rhythm controlled entirely by the sequencer and the envelope and audio waveshape and timbre controlled by the **SWN**.

The **Scale** selection on the **SWN** is important in Note Mode. Only notes in the currently selected scale for each channel will cause the envelope to fire. It's highly recommended to use the semitone quantization scale if you want consistent results with a sequencer that outputs quantized voltages. Double-quantizing (i.e. once on the sequencer and once with the **SWN**) can lead to unpredictable results. If your sequencer or CV source is not quantized, then any scale selection on the **SWN** will work fine.

Notes can also be played by pressing the **Channel** buttons manually. This triggers the envelopes in the same way as changing the CV on the **1V/oct** jack. The envelopes are ASR (attack-sustain-release) in Note Mode, so the note will sustain as long as you hold down the button.

In Note Mode, the **Channel** buttons glow a dim pink.

When switching to Note Mode from Mute Mode, the LFOs reset to a ramp-down envelope with a reasonable duration for playing note, and any channels with quantization turned off are set to a Semitone scale (see [Scale](#) section, page 23). When switching back to Mute Mode, the previous LFO speeds and shapes are restored.

A



Keyboard Mode

Keyboard Mode is similar to Note Mode, but the envelopes will only fire when the **Channel** buttons are pressed. The **1V/oct** jacks can be used to set the pitch of each channel, but changing notes will not cause the envelopes to fire. Only pressing the buttons will play notes. When a button is pressed the current 1V/oct value will be latched, so the note will not change while you hold the button down. This is useful to generate random notes by patching an LFO or sequence into the **1V/oct** jack.

The envelopes are AD (attack-decay) in Keyboard Mode, so unlike Note Mode, the notes don't sustain when you hold the buttons down.

In Keyboard Mode, the **Channel** buttons glow a dim purple.

Resetting and Re-syncing LFOs

Reset LFO Speeds

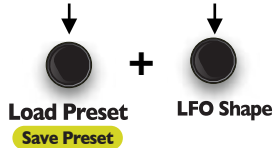
Press **Preset + LFO Speed**



Press **Preset + LFO Speed** to reset the LFO Speeds. All channel clock divider/multipliers and the global clock divider/multiplier will be reset to x1. If you're using an external clock or if you had been using an external clock and stopped or unpatched it, the base tempo from that clock will not be reset. To force the external clock to be re-read or to reset the base tempo, either load a blank preset or do a full LFO reset.

Reset LFO Shapes

Press **Preset + LFO Shape**



Press **LFO Speed + LFO Shape** to reset all channel phase offsets. This toggles between resetting the channels to all be in phase (firing at the same time), versus being 60 degrees out of phase (firing in sequence). The first time you press this button combination, the LFOs will reset to being in-phase. The next time you press it, the LFOs will reset to being 60 degrees out of phase. The next time they will be in-phase, etc...

Downbeat Selection by Re-phasing

You can use the re-phase feature to choose where the downbeat falls when dividing a clock. For example, say you're syncing to an external clock and the channel clock dividers are all set to $\div 3$ (and there's no global clock divider set). Let's say you count the external clock beats 1-2-3-1-2-3-... and the **SWN** LFOs are all starting on the "1". If you pressed the **LFO Shape/Phase** knob right before the "2" external clock pulse, then the **SWN** LFOs would start on the "2" instead of the "1". You could use this to start some LFOs on the "2" and some on the "3" and some on the "1", without having to manually adjust the phase of each LFO. Each LFO has an internal counter that counts up to the number of pulses it needs to see before it resets the LFO. Pressing this knob sets that counter to its highest value so that the LFO will start on the next external clock pulse received.

Re-phase LFOs

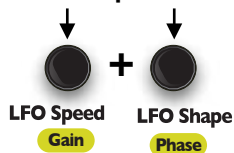
Tap **Preset knob**



Tap the **LFO Shape/Phase** knob by itself to re-sync the phases of all the channels. Any phase offset you've selected (by adjusting the phase for individual channels, and/or by resetting the phase to 0 or 60 degrees) will be applied immediately to all channels. Phase naturally gets out of sync when adjusting the speed of channels individually. Tap the **LFO Shape/Phase** knob while holding down a **Channel** button to reset the phase of just that LFO.

Toggle Phase Pattern

Press **LFO Speed + Shape**

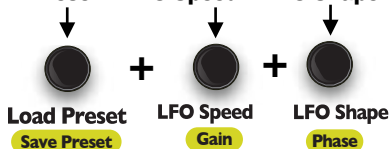


You can reset the phase of all LFOs to 0° (or to 60° later than the previous LFO) by pressing **LFO Speed + LFO Shape**. The first time you press this, all LFOs will be reset to 0°, or in-phase. This means all the LFOs will be starting at the same time. The next time this is pressed, the LFO phases will be set to 0°, 60°, 120°, 180°, 240°, and 300° for each channel respectively. This means the channels will start their waveshape in a sequence. Combined with **LFO->VCA** mode, this can be used to create a melodic sequence (see [Tutorial 2: Making a Melody](#), page 4).

If the LFOs have very different tempos, then the effect of this will not be very distinct.

Full Reset of LFOs

Press and hold for one second:
Preset + LFO Speed + LFO Shape



Press **Preset + LFO Speed + LFO Shape** and hold for 1 second to reset all LFO parameters. This will reset the base tempo, all LFO speeds, shapes, gain, and phase.

Pitch Overview

There are many parameters which control the frequency, or pitch, of the **SWN**'s six oscillators:

Knobs:

- **Transpose**: pitch shifts by semitones (12 notes equal tempered notes per octave).
- **Fine + Transpose**: pitch moves by small microtonal amounts (detuning). Detuning is applied after **Scale** quantization.
- **Spread**: selects one of 26 preset chords, which transposes each channel by a different amount.
- **Fine + Spread**: pitch of each oscillator detunes by a different amount (spread detuning). Spread detuning is applied after **Scale** quantization.
- **Octave**: pitch shifts by octaves (12 semitones).
- **Scale**: One of three scales can be selected for each oscillator. The pitch will always be a note in the selected scale. Spread detuning and detuning are applied after quantization. This feature can be disabled for non-quantized pitches or non-western tunings.

Jacks:

- **Transpose CV**: CV on the jack from 0V to +10V shifts the pitch of all six oscillators together with a 1V/oct response.
- **1V/oct channel jacks**: when switch is flipped to 1V/oct, CV from 0V to +10V on the jack shifts the pitch of just one oscillator with a 1V/oct response.
- **Spread CV**: CV from 0 to 5V selects a preset chord which transposes each channel by a different amount.

All nine of these parameters are combined to determine the pitch of each oscillator. The allowed frequency range is from 16.35Hz (C0) to 96.3kHz; past 22kHz only the aliased frequencies will be heard. Note that some of these can be controlled for a single channel or for all channels (**Transpose**, **Fine+Transpose**, **Octave**, and **Scale**) and some only effect all six oscillators (**Spread** and **Fine+Spread**).

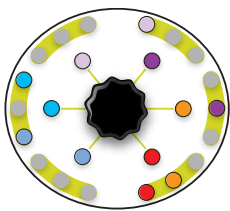
Note that since pitch perception is a function of harmonic content, navigating a Sphere can cause different pitches to be perceived. This effect is usually negligible unless intentionally built into the wavetable, and will not be considered in the following sections on pitch.

Transpose Knob



Turning the **Transpose** knob shifts the pitch of an oscillator up or down by semitones. A common use for this knob is to set intervals between channels, creating chords or melodies. Holding down one or more **Channel** button(s) while turning **Transpose** will shift the pitch of just those channel(s). Holding down the **Fine** button while turning **Transpose** invokes a fine-tuning function, see the [Fine Tuning](#) section on page 22.

Display



The light ring displays the transposition amount of each channel. Each channel is assigned a color, which is shown on the **Channel** buttons. The lights on the outer ring each represent a semitone. As you transpose a channel up or down, a light with the channel's color will move up or down to indicate how it's tuned relative to the other channels. The light ring "wraps" around, so if you were to transpose a channel 18 steps up, it would display in the same spot as it did before the transposition. The inner light ring changes brightness each time a channel goes completely around the outer ring. As a channel gets higher in pitch, the corresponding inner ring light brightens; as a channel gets lower in pitch, the corresponding inner ring light dims.

When you turn the **Transpose** knob, the transposition display automatically appears. You also can tap the **Transpose** knob to view the transposition display.

Preserving Intervals at Extremes

If you've set some intervals and then turn the **Transpose** knob all the way up or down (to its maximum or minimum), the channels' frequencies will be limited to their lowest or highest levels. When you turn **Transpose** back in the opposite direction, the intervals will be restored. This allows you to create chords or melodies and then spin **Transpose** to the most extreme settings without worrying about losing the intervals when you transpose the channels back to normal audio range.

Transpose CV Jack



Applying CV to the **Transpose** CV jack will shift the frequency of all six oscillators by the same amount. The jack responds to CV between 0V to +10V; since **Transpose** has a 1V/oct response curve, its range is ten octaves. The resulting frequency is not quantized by default. However, any channel that has a **Scale** selected will be quantized. The **Transpose** jack responds to any CV signal from DC (0Hz) to 20kHz, but the FM effects are more diverse below 1kHz.

There are many uses for the **Transpose** jack, including:

- Transposing a melody or chord on all six channels using an external keyboard, sequencer, or stair-step waveform.
- Using an LFO (internal or external) to provide vibrato on all channels.
- Creating rich harmonics with FM effects.
- Triggering channels in Note Mode to play notes whenever the CV signal changes.

Spread



Pushing and turning the **Transpose/Spread** knob selects a pattern of transposition amounts which are applied to the channels. This creates a chord, and there are 26 chords (also known as spread patterns). As you push and turn the **Spread** knob, the light ring displays how the pitches spread out in the same manner as when the **Transpose** knob is turned. Any transposition manually assigned to channels by turning the **Transpose** knob or **Octave** knob will be added to the selected spread pattern. Also, any **Scale** that's assigned to a channel will limit which notes can be assigned to the channel.

The first spread pattern has no transposition for any channels. This is the default pattern that's loaded when you first turn the module on. The next spread pattern raises channels C and D by a fifth. The third pattern then lowers channels E and F by a fourth (i.e. five semitones), resulting in a fifth with inversion. The patterns continue in a series listed below:

1:	No transposition	17:	Major ninth chord
2-4:	Fifths	18:	Major eleventh chord
5-7:	Major thirds	19-21:	Minor sixths
8-10:	Minor thirds	22-24:	Minor sevenths
11-13:	Major sixths	25:	Minor ninth chord
14-16:	Major sevenths	26:	Minor eleventh chord

If you transpose one of the channels using the **Transpose** or **Octave** knobs, then that offset will be added to the selected spread pattern.

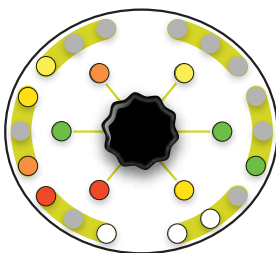


The **Spread CV** jack offsets the selected pattern when CV is received. The jack responds to CV in the range from 0V to +5V. Patching an LFO or sequencer into the **Spread CV** jack will cycle through chords.

Octave



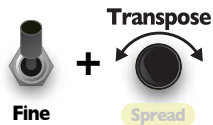
Turning the **Octave** knob will change the pitch of the channels up or down by octaves. Holding down a **Channel** button while turning the **Octave** knob will change just that channel. The **SWN** has a 15 octave range which extends beyond the limits of human hearing and the audio hardware of the **SWN**. This creates aliasing when the upper octaves (green) are selected (which is useful for creating new timbres and textures).



Octave Display

The light ring will display the current octave for each channel from lowest (lower left) to highest (upper right). The color of each channel's button will also display its octave, with red being the lowest octave, yellow being the middle octaves, and green being the upper octaves.

Fine Tuning (Detuning)

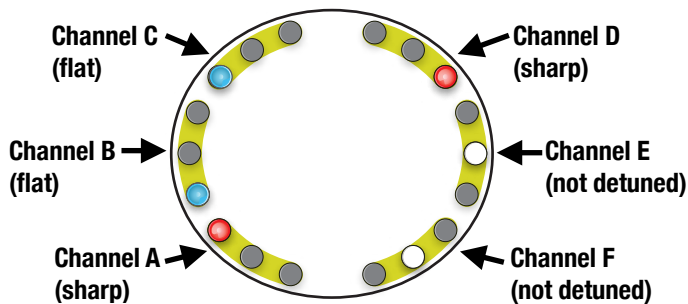


Holding down the **Fine** button while turning the **Transpose** knob will adjust the frequency by micro-tonal amounts, detuning the channel(s). Some common uses for detuning are: to tune the SWN to another instrument, to create beat frequencies and phasing effects, to utilize microtonal scales, or to generate super-saw type waveforms.

The amount of detuning is 1/100th of a semitone (one cent) per click.

Holding down one or more **Channel** button(s), while holding down the **Fine** button and turning **Transpose**, will detune just those channel(s).

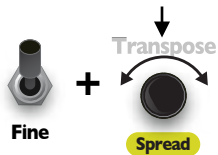
Pressing **Preset**, **Fine** and **Transpose** at the same time will reset all detuning.



Detuning Display

The light ring displays the detuning by using red, white, and blue lights. Each channel uses the same group of three lights as in the Transpose display. A pulsing red light indicates the channel is sharp; a pulsing blue light indicates the channel is flat; a white light indicates it's not detuned. The rate of the pulsing is relative to the amount of detuning: faster pulsing means more detuning.

Spread Detuning

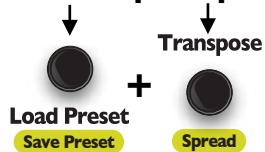


Holding down the **Fine** button while pushing and turning the **Transpose/Spread** knob will detune all six channels by a different amount for each channel. With every click of the knob, the outer channels (A and F) will detune by three cents, the middle channels (B and E) will detune by two cents, and the inner channels (C and D) will detune by one cent. Channels A, B, and C will detune downwards (flat) and channels D, E, and F will detune upwards (sharp).

The end result is that each channel's frequency will detune by a different amount. A common use for this is to start with all six channels in tune; then, using similar waveforms, apply some **Spread** detuning to create a lush, swirling stereo effect from the beat frequencies.

Resetting Pitch

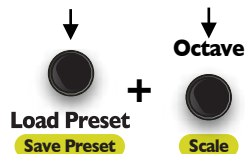
Reset Transpose/Spread



Resetting Transposition and Spread

Press the **Preset** and **Transpose/Spread** knobs at the same time to set the transposition of all channels to the default pitch. All **Spread** offsets will also be cleared.

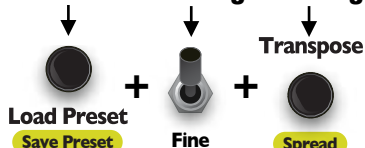
Reset Octave



Resetting Octave

Press the **Preset** and **Octave/Scale** knobs at the same time to reset the octave of all channels to the third octave.

Reset Fine Tuning/Detuning



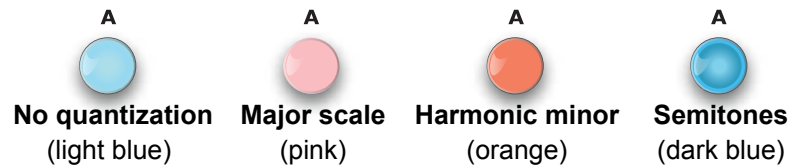
Resetting Fine Tuning (Detuning)

Press the **Preset** knob, the **Fine** button and the **Transpose/Spread** knob at the same time to reset the fine tuning of all channels. All **Spread** detuning will also be cleared.

Scale



Each channel can be quantized to a scale. Pushing and turning the **Octave/Scale** knob selects one of four quantization settings. The **Channel** buttons will turn a particular color to indicate which scale is selected for each channel:



Selecting a scale will force the pitch to fit within that scale regardless of the combination of **Transposition**, **Spread**, **1V/oct CV**, **Transpose CV**, and **Spread CV** that's applied. Detune (**Fine** and **Transpose**) and spread detuning (**Fine** and **Spread**) are applied after quantization, which allows you to tune to another instrument or create phasing effects (without losing the ability to stay in key).

If you're using a quantized CV source (such as a keyboard, sequencer, or DAW) patched into the **1V/oct** or **Transpose CV** jacks, it's recommended to turn quantization off (light blue) on the **SWN** to avoid notes resolving inconsistently.

Using Scales in Note Mode

When changing to Note Mode, any channel that has quantization turned off will automatically set to the semitones scale. This is because Note Mode relies on detecting incoming CV changing notes within a scale – so a scale must be selected. If you manually change a channel's **Scale** to not quantize, then that channel won't be triggered by changes on the **1V/oct** or **Transpose** jacks. This is useful for muting a channel when in Note Mode (manually pressing a **Channel** button will still trigger that channel).

Channel Jacks: 1V/oct and VCA



Each channel has a CV input jack located below the slider which can control the channel's pitch or level. The **1V/oct | VCA** switch selects whether all six jacks control the level (VCA) or the pitch (1V/oct).

1V/oct

When the switch is flipped down, the channel jacks control the pitch of each channel. The range of the jacks is 0V to +10V, which translates to a 10 octave range. If the channel has a **Scale** set, then the resulting pitch will be quantized to the selected scale. The **Transpose**, **Spread**, and **Octave** settings will offset the pitch determined by the **1V/oct** jack.

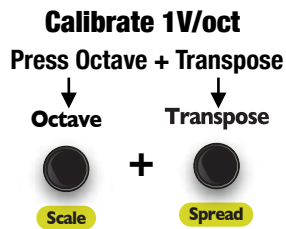
When in Note Mode (see [Note Mode and Keyboard Mode](#) section, page 18), the channel will play a note every time the voltage on the **1V/oct** jack changes to a new note.

VCA

When the switch is flipped up, the channel jacks control the level of each channel. The sliders attenuate the incoming CV before it's applied to the VCA. When 0V is applied to the jack, the channel will be silenced. When +5V is applied, the channel will play at its normal volume (the same level as when the jack is unpatched). When more than +5V is applied to the jack, the channel level will not be boosted; however, the slider will need to be turned down before the volume begins to decrease. For example, if +10V is applied to channel A, then it will be at its maximum volume whenever the slider is between 50% and 100%. If +5V is applied to the jack, then the channel will only be at its maximum value when its slider is all the way up.

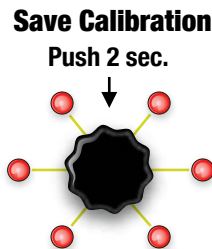
A common use for the channel jacks in VCA mode is to patch envelopes or LFOs from external modules. For example, setting each channel to a different pitch and then running a series of syncopated envelopes can create dynamic melodies with the pitch and timbre being controlled by the **SWN**, and the rhythm and envelopes being controlled by other modules.

Calibrating 1V/oct and Transpose Jacks



The **1V/oct** and **Transpose** jacks are calibrated at the factory to change the pitch by one octave for every 1.000V received. However, due to issues with impedance between equipment, offset and gain errors from using buffered multiples, mis-calibrated or inaccurate outputs from sequencers and keyboards, non-standard tuning systems such as 1.2V/oct, etc., it is sometimes necessary to calibrate the **SWN** to your external equipment. The process is easy:

1. Unpatch all cables in the **1V/oct** and **Transpose CV** jacks. It's OK to listen to the audio, but keep in mind that the pitches may sound out of tune while calibrating.
2. Press the **Octave** and **Transpose** knobs at the same time. The top row of buttons will turn blue. If you make a mistake and want to exit calibration mode without changing anything, press **Octave** and **Transpose** again.
3. Make sure the center switch is flipped to **1V/oct** (not flipped to **VCA**).
4. Patch a cable from the 1V/oct output of the external equipment (e.g. the CV output jack of a sequencer, or the Pitch CV output of a keyboard) into the **Channel A 1V/oct** jack on the **SWN**.
5. Play and hold a C1 on the sequencer or keyboard.
6. Press the **Channel A** button to latch the C1. The button will turn red.
7. Play and hold a C3 on the sequencer or keyboard.
8. Press the **Channel A** button to latch the C3. All six buttons and LFO lights will turn white.
9. To save your calibration values, press and hold the **Browse** knob for three seconds. The **SWN** will return to normal mode and will use these values even after power down. If you want to test the new calibration values, press **Octave** and **Transpose** and the new values will be used, but the old values will be restored the next time you power the **SWN** on.

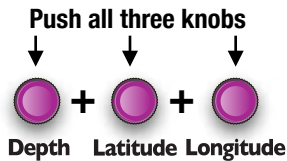


You also can calibrate each jack separately. This is not usually necessary, but could be useful if you want to use multiple tuning systems for each channel. To calibrate each jack individually:

1. Perform steps 1–3 from the above procedure.
2. Perform steps 4–8, but use the **Channel F 1V/oct** jack and the **Channel F** button.
3. Repeat steps 4–8 again using **Channel E's** jack and button.
4. Repeat steps 4–8 again using **Channel D's** jack and button.
5. Repeat steps 4–8 again using **Channel C's** jack and button.
6. Repeat steps 4–8 again using **Channel B's** jack and button.
7. Repeat steps 4–8 again using **Channel A's** jack and button.
8. Repeat steps 4–8 using the **Transpose CV** jack and by pressing the **Transpose** knob instead of a **Channel** button.
9. Save your values by holding down the **Browse** knob for three seconds.

Sphere Recording Mode: Overview

Enter Sphere Recording Mode:



Sphere Recording Mode lets you create new Spheres by recording audio from any modular or line-level signal. You can also edit and apply effects to new or existing Spheres. Only one Sphere can be edited or created at a time.

Entering Sphere Recording Mode

To Enter Sphere Recording Mode, press the **Depth**, **Latitude**, and **Longitude** knobs at the same time. The three navigation knobs will turn orange. The Sphere that you've selected for channel 1 load onto all six channels. Any **Dispersion** in play will clear. **LFO->VCA** will turn off on every channel. The current navigation position of all channels will snap to the nearest waveform. You can immediately begin editing the Sphere by applying effects, or you can start by recording a new Sphere. See [Tutorial 5: Creating Your Own Spherical Wavetables](#) (page 9) for a step-by-step guide to recording a Sphere.

Sphere Recording Mode Controls

Some of the knobs, buttons, jacks, and lights are disabled or change function in Sphere Recording Mode:



Record Button

The **LFO->VCA** button becomes the **Record** button and will flash red. When you push this button, the **SWN** will wait until it detects a signal on the **Waveform In** jack before starting to record. When it's waiting for a signal the button will flashing rapidly and the light next to the **Waveform In** jack will flash red. As it records, the light ring will fill up with red lights. After 2.5 seconds have passed, the recording process will stop automatically; the recorded audio will split up into 27 waveforms and all the channels will play the first waveform.

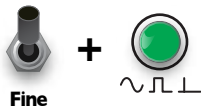
Monitor Input



Monitor Button

The **LFO Type** button becomes the **Monitor** button and flashes green. When you press this button, the audio from the **Waveform In** jack will be routed to the **Audio OUT** jacks. This allows you to monitor or cue your audio input before recording. The button will glow solid green while monitoring.

Tune to Test Tone



Tune to Test Tone

Pressing **Fine + LFO Type** will turn on monitoring while simultaneously outputting a 86.1Hz reference tone. If your audio source is a VCO (or something else that produces waveforms with a definite fundamental frequency), then tuning the fundamental frequency of the audio source to the reference tone will ensure that the recorded waveforms are complete waveforms. Using this feature is optional (and many interesting waveforms and effects can be obtained without tuning).

Browse and Navigation Knobs

The **Browse**, **Latitude**, **Longitude**, or **Depth** knobs will jump between exact waveforms, rather than morphing. By holding down **Fine** while turning any of these knobs, one can temporarily morph between waveforms.

Pushing and turning the **Browse** knob no longer selects the Sphere, but instead changes the **Waveform Shift** amount (see next section). The CV jack for Sphere selection is disabled.

The CV jacks for **Browse**, **Depth**, **Latitude**, **Dispersion**, and **Dispersion Pattern** will snap to exact waveforms but otherwise behave as normal.

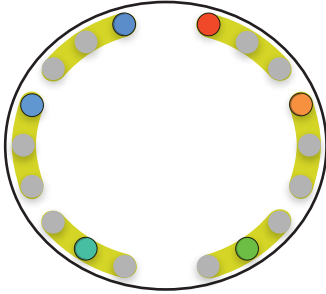
Dispersion, Dispersion Pattern, and WT Spread Knobs

Dispersion and **Dispersion Pattern** can be used as normal, but the dispersion amount will be cleared as soon as the **Browse**, **Latitude**, **Longitude**, or **Depth** knobs is turned. **Dispersion** will snap to exact waveforms unless **Fine** is held down. The **WT Spread** knob and CV jack are disabled.

Preset Knob

The **Load/Save Preset** feature is disabled in Sphere Recording Mode. Instead, the knob is used for saving a Sphere.

Light Ring Display



The outer light ring displays a rainbow of lights to help visualize where the recorded audio buffer is being split to create the 27 waveforms. The entire outer light ring represents the 2.5 seconds of recorded audio, starting at the top right and moving clockwise around the circle, ending at the top left. The red end of the rainbow represents the first waveform, and the blue end of the rainbow represents the last waveform. As you adjust **Waveform Spread**, **Waveform Shift**, and **Waveform Stretch** (see below) the lights will move to help you visualize these processes.

The inner light ring displays the position within the Sphere, using the same color system that the outer light ring uses when not in Sphere Recording Mode. The first waveform is indicated by dim white lights.

Recording Technical Details

Recording is armed when you press the **Record** button, but the **SWN** will not start recording until it detects a signal greater than about 15mVpp on the **Waveform In** jack. The light next to this jack will flash red to indicate it's waiting for a signal. If you press the **Record** button again before a signal is detected, recording will be canceled. Once recording begins, the light ring will fill up with red lights to indicate its progress. The recording sample rate is 44.1kHz and enough audio data to fill eight Spheres worth of waveforms is recorded: 8 Spheres (27 waveforms each) 512 samples per waveform = 110,592 samples recorded at 44,100Hz = 2.508 seconds. An additional 130ms of samples is recorded for padding afterwards, which is required for **Waveform Stretch** to be applied to the last waveform.

While recording, the **LFO OUT** jacks output a series of ramps and pulses (see next section). When recording is done, the audio data is split into 27 waveforms. The **SWN** sets the **Waveform Spread** parameter to maximum in order to maximize the space between waveforms (about 93ms). The **Waveform Shift** parameter will be set so that the first waveform will begin with the first sample of the recording. The **Waveform Stretch** parameter will be set so that no re-sampling occurs. See the [Waveform Spread, Stretch, and Shift](#) section (page 30) for details on these parameters.

The **Gain/Normalization** effect amount will be set to 100% for all waveforms. This normalizes each waveform to its maximum volume. The **Seam Smoothness** effect amount will be set 100%, which attempts to smooth out any discontinuities between the beginning and end of each waveform.

Timing Pulses and Ramps

The **LFO OUT** jacks function as normal in Sphere Recording Mode, except while actively recording. During the 2.5 seconds of recording, the jacks will temporarily output a series of pulses and ramps to help with synchronizing external equipment. The **LFO Gain** control can be used to attenuate or boost the maximum value of the ramp outputs from **LFO OUT A**, **B**, and **C** (default is 5V). The ramps can be useful for modulating a timbral quality of the audio source such as a filter or waveshaper, or for scrubbing a sample. The triggers can be useful synchronizing an envelope or sequencer, or triggering some event.

LFO OUT A outputs a ramp which starts at 0V and rises to its peak voltage at the end of the 27th recorded waveform. It will hold at the maximum value while the padding data is recorded at the end.

LFO OUT B outputs a ramp which starts at 0V and rises to its peak voltage every 313ms (27 waveforms worth of data). Eight full ramps will be output during recording, plus a partial ramp during the padding data.

LFO OUT C outputs a ramp for every 512 samples that's recorded, including the padding phase.

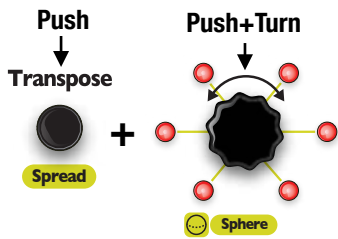
LFO OUT D outputs a 10ms trigger when recording begins.

LFO OUT E outputs a 10ms trigger before every block of 27 waveforms is recorded (512*27 samples).

LFO OUT F outputs a 5ms trigger before every block of 512 samples is recorded.

Waveform Spread, Stretch, and Shift

Waveform Spread

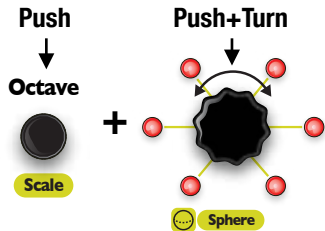


Waveform Spread

Pushing the **Transpose/Spread** knob while pushing and turning the **Browse** knob controls the amount of **Waveform Spread**. This changes the spacing between the 27 waveforms throughout the 2.5 second recording. The spacing between the red, green, and blue lights on the light ring signifies the amount of **Waveform Spread** occurring. Immediately after recording, **Waveform Spread** will be set to its maximum value and the red, green and blue lights on light ring will be spread apart. Turning **Waveform Spread** down will bring the colored lights closer together.

Holding **Fine** while pushing **Transpose/Spread** and pushing and turning **Browse** will spread the waveform by smaller increments.

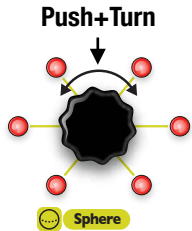
Waveform Stretch



Waveform Stretch

Pushing the **Octave** knob while pushing and turning the **Browse** knob controls the amount of **Waveform Stretch**. The number of samples for each waveform will be increased or decreased and then re-sampled back into 512 samples, which results in the pitch changing. The colored lights on the light ring signify the amount of **Waveform Stretch**. Holding **Fine** while pushing **Octave** and pushing and turning **Browse** will stretch the waveform by smaller increments.

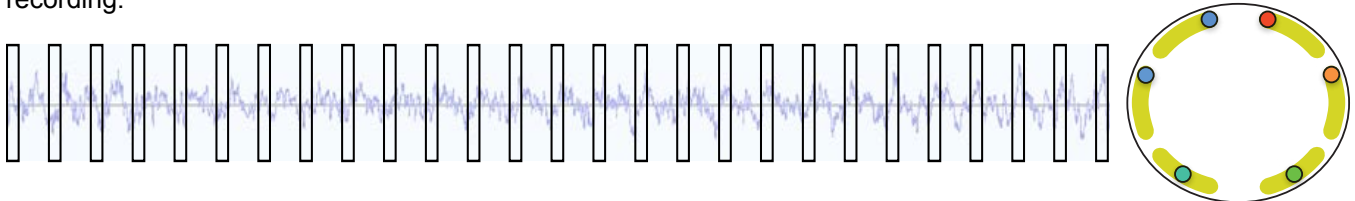
Waveform Shift



Waveform Shift

Pushing and turning the **Browse** knob controls the amount of **Waveform Shift**, which changes the start position of the waveforms. The lights on the light ring will rotate around as this is adjusted. The light to the right of the top center represents the beginning of the recorded audio; the red light starts here immediately after recording. Holding **Fine** while pushing and turning **Browse** will shift the waveform by smaller increments.

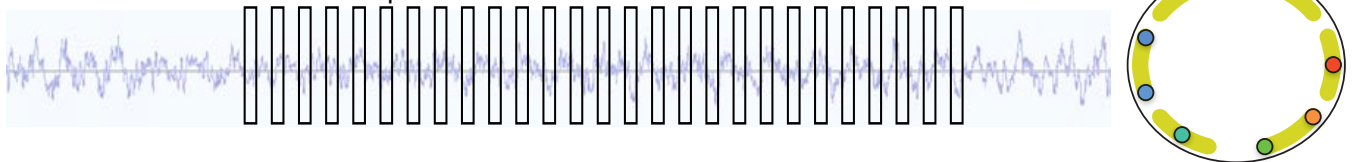
Below is an example of how the recorded audio is split into 27 waveforms as **Waveform Spread, Shift, and Stretch** are adjusted. Initially, the 27 waveforms are evenly spaced throughout the entire 2.5 second audio recording:



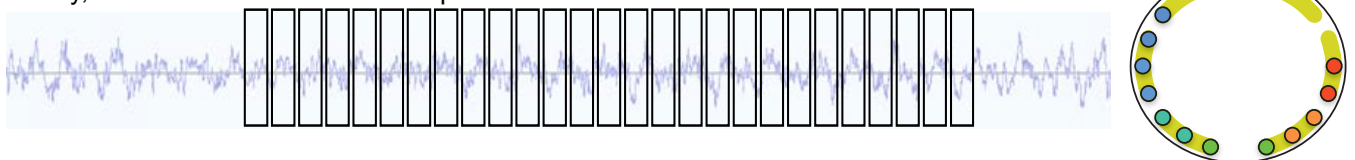
First, **Waveform Spread** is turned down:



Then **Waveform Shift** is turned up:

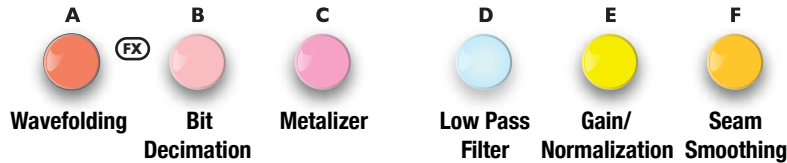


Finally, **Waveform Stretch** is turned up:



Waveform Effects

You can apply effects to waveforms in the current Sphere. There are four traditional effects (Wavefolding, Bit Decimation, Metalizer, and Low Pass Filter) and two utility effects (Gain/Normalization and Seam Smoothing). Each of the top row of buttons is assigned to an effect:



Wavefolding

The waveform is distorted and folded back on itself, creating harmonics of the fundamental waveform.

Bit Decimation

The allowable sample values are quantized, creating the same effect as if the recording was made at a low bit-rate (e.g. 12-bit, 8-bit, 6-bit, 4-bit, etc). The effect amount controls the simulated bit rate.

Metalizer

Feedback through a high-pass filter is simulated, creating harsh, higher harmonics.

Low Pass Filter

A non-resonant brick-wall low pass filter is applied to the signal, filtering out any higher harmonics. The effect amount controls the cut-off frequency.

Gain/Normalization

From 0% to 50%, this effect controls the attenuation of the waveform. At 0%, the waveform is silence; at 50%, no change will be made to the amplitude. From 50% to 100% normalization will be applied. This means the gain will be increased as much as possible without clipping. If the waveform is already at its maximum amplitude, then increasing this effect from 50% to 100% will have no effect. **Gain/Normalization** is set to 50% when you first enter Sphere Recording Mode (meaning that the amplitude of all waveforms is unaltered). When a recording is finished, the effect is automatically set to 100% (meaning all waveforms are brought to their maximum amplitude).

Seam Smoothing

When splitting up a live audio recording into waveforms, the last sample value of the waveform might not always line up with the first sample value. This creates a harsh sound when played, even if the waveform itself is something simple and pure (like a sine wave). **Seam Smoothing** takes the audio data that follows the recorded waveform and cross-fades it back into the original waveform, creating a seamless loop. Since waveforms are almost always repeated in live audio, taking some data from the next waveform usually introduces no extra sounds that what was originally recorded.

You can apply an effect to waveform(s) in several ways:

Applying an Effect to a Single Waveform

If you hold down one of the effect buttons and turn the **Browse** knob, the effect is applied to the current waveform. The light ring will display a number of lights to indicate how much effect is currently being applied to the waveform.

Applying an Effect to a Dimension of Waveforms

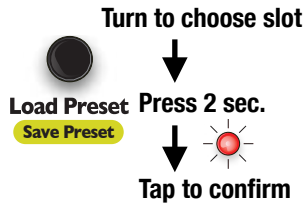
Holding down an effect button while turning **Depth**, **Latitude**, or **Longitude** will apply the effect to the three waveforms located in the chosen dimension of the current waveform. For instance, if you browse to the first waveform and then hold an effect button while turning **Longitude**, the effect will be applied to all three waveforms that have the same **Depth** and **Latitude** as the first waveform, but vary in **Longitude**. If the effect has already been applied to any individual waveform in the dimension, the effect level will be offset by the new amount.

Applying an Effect to All Waveforms

To apply an effect to all 27 waveforms, hold down the effect button as you push and turn the **Browse** knob. If the effect has already been applied to any individual waveform, the effect level will be offset by the new amount. You can clear the effect amount on all waveforms by first increasing the effect level on all waveforms to maximum, and then reducing it to minimum.

Saving a User Sphere

Saving a Sphere: (in WT Rec mode)



Spheres (user)

- User Spheres 1-18
- User Spheres 19-36
- User Spheres 37-54
- User Spheres 55-72
- User Spheres 73-90
- User Spheres 91-108

When you are satisfied with your new Sphere (or changes to an existing Sphere), you can save your work. Turn the **Load/Save Preset** knob and a display similar to the normal Preset display will appear on the light ring. However, the colors will be different and each slot will represent a User Sphere slot you can save into. Like presets, there are 108 User Spheres, organized into six pages of 18 slots per page.

To save, turn the **Preset** knob to select a slot. Each page has a unique color scheme, and the color of each slot is unique (although often very similar to its neighbors). Pick a color you want to associate with this Sphere. If a slot already contains a Sphere, it will be lit up. Saving over an existing Sphere deletes the older Sphere permanently.

Next, press and hold the **Preset** knob for about two seconds until the light starts flashing red. Release the knob and tap it to confirm the save. The **SWN** will immediately exit Sphere Recording Mode and load the new Sphere you just saved.

When pushing and turning the **Browse** knob to select a Sphere, the User Spheres are located after the twelve factory Spheres.

As new Spheres are created, the Spheres selected by **WT Spread** will change. Keep this in mind if you have presets that use **WT Spread**.

SphereEdit software (Mac/Windows/Linux)

SphereEdit is free, open source software compatible with Mac, Windows, and Linux. SphereEdit allows you to create, edit, import and export waveforms and Spheres and then load them into the **SWN** using an audio cable. You can download SphereEdit from the 4ms Company website: <https://4mscompany.com/SWN>.

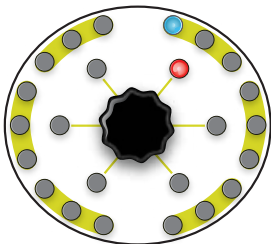
SphereEdit is a slight modification of [Synthesis Technology's](http://www.synthtech.com/) WaveEdit open-source software written by Andrew Belt. More information about WaveEdit can be found here: <http://synthtech.com/waveedit/>. Synthesis Technology's website is here: <http://www.synthtech.com/>.

A complete User Manual is available for SphereEdit and should be read if you intend to use the software. The PDF manual is included when you download SphereEdit. The source code for SphereEdit is here: <https://github.com/danngreen/SphereEdit.git>.

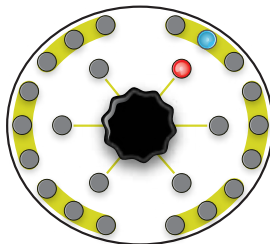
Read the [Creating Spheres with SphereEdit](#) section (page 10 of this manual) or the beginning of the [SphereEdit User Manual](#) for a quick-start guide.

Checking the Firmware Version

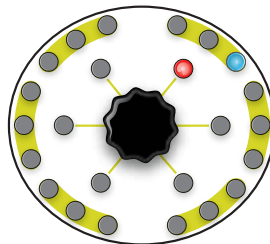
When you power the **SWN** on, a red and a blue light on the light ring will turn on for half a second. These two lights indicate the currently installed firmware version. The red light is on the inner ring and shows the major version number. The first inner light (upper right) indicates version 1.x. Going clockwise, the second inner light (middle right) indicates version 2.x, and the third inner light (lower right) indicates version 3.x, etc. The blue light is on the outer ring and indicates the minor version number. The first outer light (12:30) indicates version x.0, the next outer light going clockwise indicates version x.1, and the next indicates version x.2, etc. Various examples are shown below:



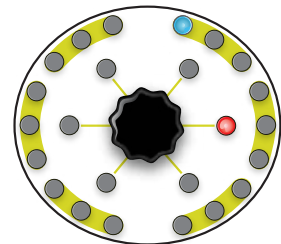
Firmware Version 1.0
(current version)



Firmware Version 1.1



Firmware Version 1.2



Firmware Version 2.0

Factory Reset

A factory reset will erase all user data including presets and User Spheres. There is no recovery or “undo” from a factory reset. If you simply want to remove your presets, you can clear presets manually without doing a factory reset. See the [Presets](#) section (page 7) for details.

Updating Firmware (bootloader)

You can update the **SWN** firmware by playing a special audio file into the **Waveform In** jack. When new firmware versions are released, the firmware audio files can be downloaded at <https://4mscompany.com/SWN>. Check/Follow/Like the 4ms Twitter, Facebook, or Instagram social media feeds to be notified of firmware upgrades, or email us through our website if you'd like to be notified.

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 will 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).

The open-source licensed source files (in C, for compiling with gcc) can be found at <https://www.github.com/4ms/SWN.git>

Electrical and Mechanical Specifications

- 26HP Eurorack format module
- 0.98" (25mm) maximum depth (including power cable)
- 16-pin to 16-pin Eurorack power header

- **Power consumption**
 - +12V: 185mA with LED PWR jumper set to 12V; 107mA with LED PWR jumper set to 5V
 - -12V: -30mA
 - +5V: not used with LED PWR jumper set to 12V; 60mA with LED PWR jumper set to 5V

- **Audio outputs**
 - Frequency range: 0Hz (DC) - 22kHz
 - Maximum Amplitude: 19Vpp

- **LFO outputs**
 - Frequency range: 0Hz (DC) - 3kHz
 - Minimum Period: 24 hours
 - Maximum Amplitude: 8Vpp

- **1V/oct inputs (channel CV inputs and Transpose CV)**
 - Voltage range: 0V to +10V (10 octave range)

- **CV inputs (other than 1V/oct and Transpose CV)**
 - Voltage range: 0V to +5V

- **Clock input**
 - Trigger threshold: 1.5V
 - Pulse width must be greater than 1ms

- **User memory (non-volatile)**
 - Preset slots: 108
 - Custom Spherical Wavetables: 108

- **Wavetable**
 - 512 samples per waveform
 - 16 bits per sample
 - 44.1kHz sampling rate
 - 27 waveforms per Spherical Wavetable, arranged in a 3x3x3 3-torus
 - 12 Factory Spherical Wavetables + 108 Custom Spherical Wavetables = 120 maximum

Transpose ← Turn for main feature

Spread ← Push while turning for gold feature

↻ = Adjust all channels

A + ↻ = Adjust one channel

Fine + Knob
= Adjust by small amounts

Fine

Reset Navigation/Sphere
Press Preset+Depth+Latitude

Load Preset + Depth + Latitude

Toggle Phase Pattern
Press LFO Speed + Shape

LFO Speed + LFO Shape

Gain Phase

Reset Transpose/Spread
Press Preset + Transpose

Load Preset + Transpose

Save Preset Spread

Reset Octave
Press Preset + Octave

Load Preset + Octave

Save Preset Scale

Reset Fine Tuning
Press Preset + Fine + Transpose

Load Preset + Fine + Transpose

Save Preset Fine Spread

Reset LFO Speeds
Press Preset + LFO Speed

Load Preset + LFO Speed

Save Preset

Reset LFO Shapes
Press Preset + LFO Shape

Load Preset + LFO Shape

Save Preset

Full Reset of LFOs
Press and hold for one second:

Load Preset + LFO Speed + LFO Shape

Save Preset Gain Phase

Re-phase LFOs
Tap LFO Phase knob

LFO Shape Phase

Saving a Preset:
Turn to choose slot

Load Preset Save Preset

Press 2 sec.

Tap to confirm

Loading a Preset:
Turn to choose slot

Load Preset Save Preset

Tap knob

Tap again to confirm

Clearing a Preset:
Turn to choose slot

Load Preset Save Preset

Press 6 sec.

Tap to confirm

Undo/Redo Preset:
Press Fine and Preset

Fine Load Preset Save Preset

Sphere Recording Mode:

Enter Sphere Recording Mode:

Depth + Latitude + Longitude

Waveform Spread
Push Transpose

Spread

Push+Turn

Sphere

Waveform Stretch
Push Octave

Scale

Push+Turn

Sphere

Waveform Shift
Push+Turn

Sphere

Saving a Sphere:
Turn to choose slot

Load Preset Save Preset

Press 2 sec.

Tap to confirm

Sphere Recording Mode Effects:

A B C D E F

Wavefolding Bit Decimation Metalizer Low Pass Filter Gain/Normalization Seam Smoothing

+ Turn = one waveform Push+Turn = all waveforms