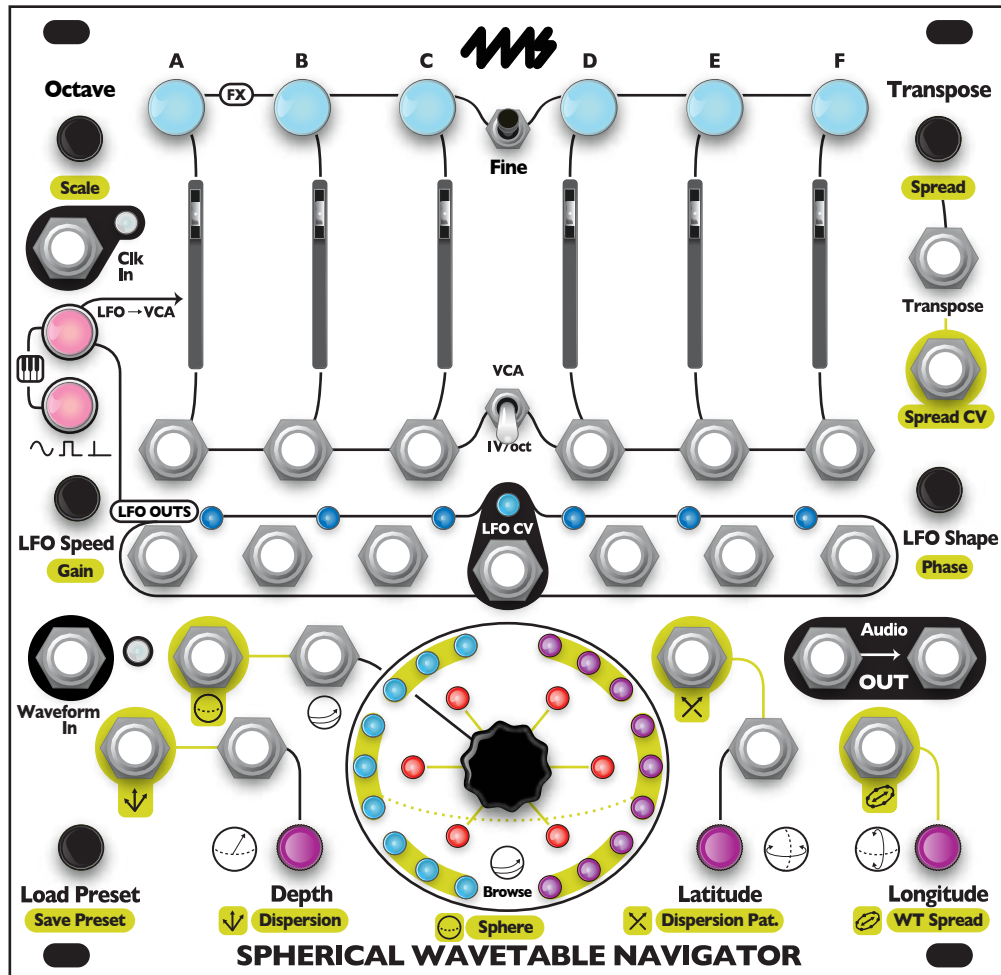# Spherical Wavetable Navigator
4ms Company
User Manual 2.2 for Firmware version 2.2
September 14, 2020

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 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.

Table of Contents

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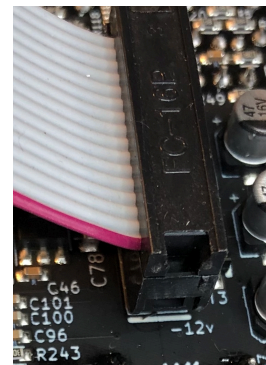
> Note: The **Spherical Wavetable Navigator** is reverse-polarity protected, but incorrectly connecting *any* module can damage *any other* module on the power bus.

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).
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.
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!
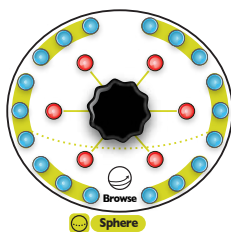
Tutorial 2: Making a Melody

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 at time!

*If you want to learn more about **LFO->VCA**, read the section on LFOs (page 15).*
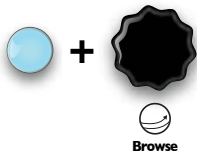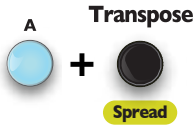
What's an LFO?… and a VCA?
An LFO is an oscillator that goes up and down repeatedly at a relatively slow tempo. You can visualize the LFOs on the **SWN** by watching the row of six lights in the center of the module; they get brighter and dimmer as the LFOs go up and down. Usually an LFO is set up to 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.
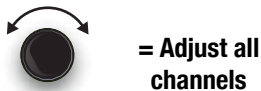
This technique works across almost every feature of the **SWN**. For example, try holding down a **Channel** button while turning the **Octave** knob — just that channel will go up or down by octaves. If you just turn the **Octave** knob by itself, all of the channels will go up or down in octaves.

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.

Transpose ← **Turn knob to Transpose**

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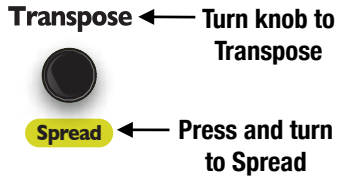
For example, look at the **Transpose** knob. The word "Transpose" is written above the knob, and the word "Spread" is written below the knob on a gold background. If you simply turn the **Transpose** knob, you'll transpose the pitches of the channels. If you push down on the **Transpose** knob while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

Turn knob to Browse

Browse

Press and turn to change Spheres

Sphere

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 <u>Presets Tutorial</u> to learn how to use this knob.

Fine button

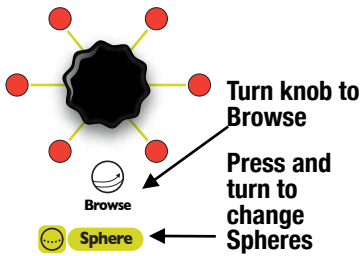You may have noticed the small button at the top-center of the module named **Fine**. When you hold down the **Fine** button you can turn another knob to adjust by small amounts. Most knobs on the **SWN** work with the **Fine** button**.** Here are some examples:
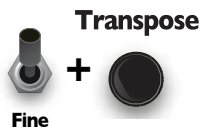
Transpose

Fine +

Fine + Transpose
= Fine-tune pitch by micro-tonal steps
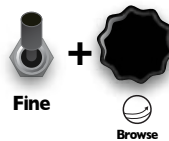
Fine +
Browse

Fine + Browse
= Browse the sphere by small amounts

Fine + **Spread**

Fine + Spread (push+turn)
= Detune **Spread**: all channels detune by different amounts

Fine + LFO Shape **Phase**

Fine + LFO Phase (push+turn)
= Fine-adjust LFO Phase

Fine **LFO Speed** +

Fine + LFO Speed
= Fine-tune LFO Speeds (by non-integer div/mult)

Fine **Latitude** +

Fine + Latitude/Long/Depth
= Navigate the sphere by small amounts

Fine LFO Speed **Gain** +

Fine + LFO Gain (push+turn)
= Fine-adjust LFO amplitude

Fine Depth **Dispersion** +
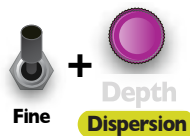
Fine + Dispersion
= Channels disperse (move within sphere in different directions) in tiny steps

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.
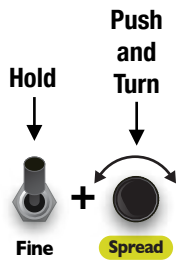
1) Start where you left off at the end of Tutorial 2 (page 4).

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.*

Hold

Push and Turn

Fine   **Spread**

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.
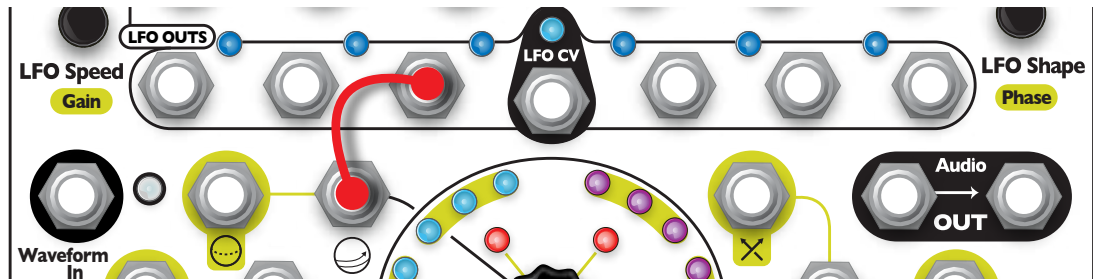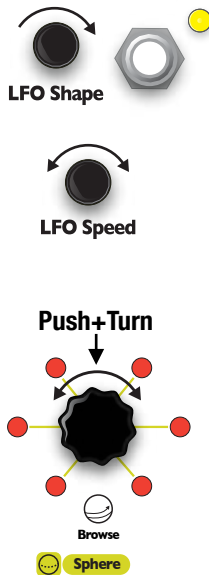

4) Patch channel C's LFO to the **Browse** jack (patch the third **LFO OUT** jack to the jack below it: see above). Depending on how much you played with the **LFO Shape** and **LFO Speed** in the last tutorial, you may be hearing anything from a slow sweeping sound to an occasional blip.

LFO Shape

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.*

LFO Speed

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!

Push+Turn

Browse

Sphere

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:

Turn to choose slot

Press 2 sec.

Tap to confirm
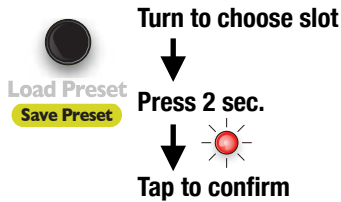
Saving a Preset:
1) Turn the **Load/Save Preset** knob to select a slot. A bright yellow light will move around the outer light ring as you turn the knob. Each light represents a slot where you can save a preset. If the light is off, the slot is empty.
2) Press and hold the knob down until the slot starts 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:

Turn to choose slot

Tap knob

Tap again to confirm

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.
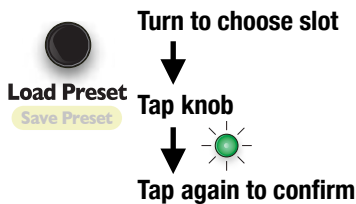3) Tap the knob again (while the green light is still flashing) to confirm the load: you'll see an animation of green lights while it's loading and the sound will change. (If you change your mind and don't want to load the preset, just do nothing and the light will stop flashing after a couple seconds.)

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

Clearing a Preset:

Turn to choose slot

Press 6 sec.

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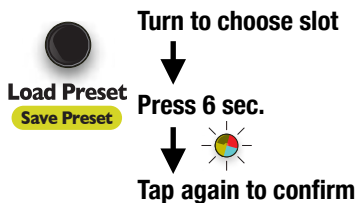
Clearing a Preset:
1) Turn the **Load/Save Preset** knob to select a slot.
2) Press the knob for 6 seconds until the light flashes multi-colored, then let go.
3) Tap the knob again (while the light is still flashing) to confirm the clear. (If you change your mind and don't want to delete the preset,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

Undo/Redo:

Press Fine and Preset

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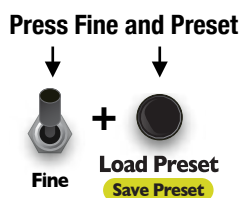
What if you accidentally saved over a preset you wanted to keep? You can undo it! Press the **Fine** button and the **Preset** knob at the same time. When you release, you'll see an animation on the outer light ring. You can undo a save, load, clear, or even an undo (which makes it a "redo").

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?
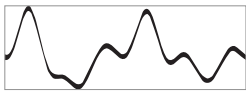
A waveform

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 **Browse**) 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 The Geometry of a "Sphere" on page 11 if you're curious about the true geometry of the **SWN**.)
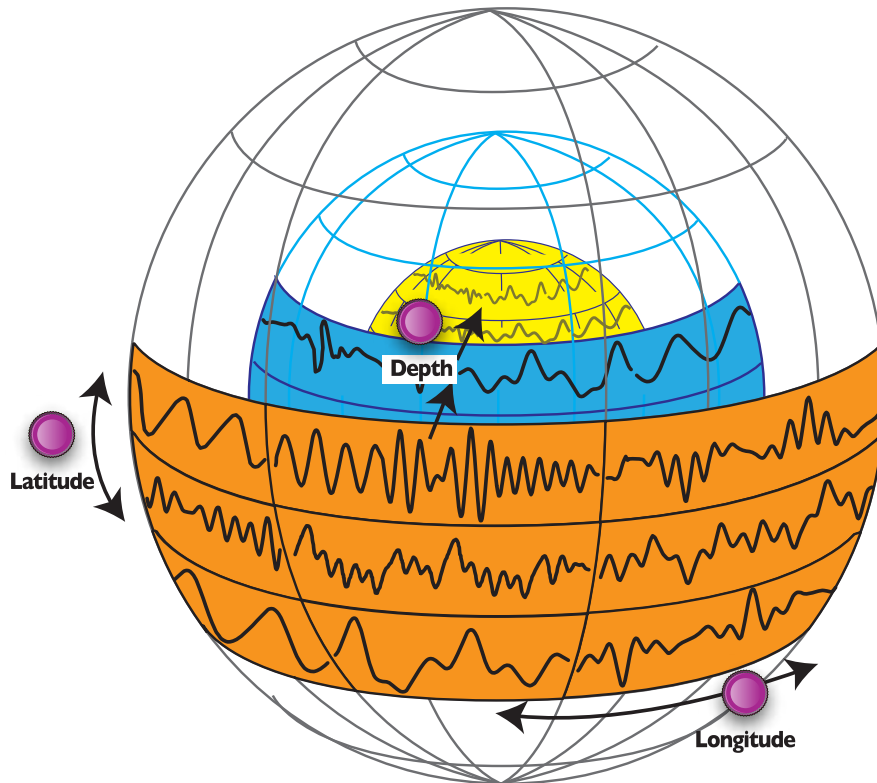
SWN's wavetables visualized as concentric spheres
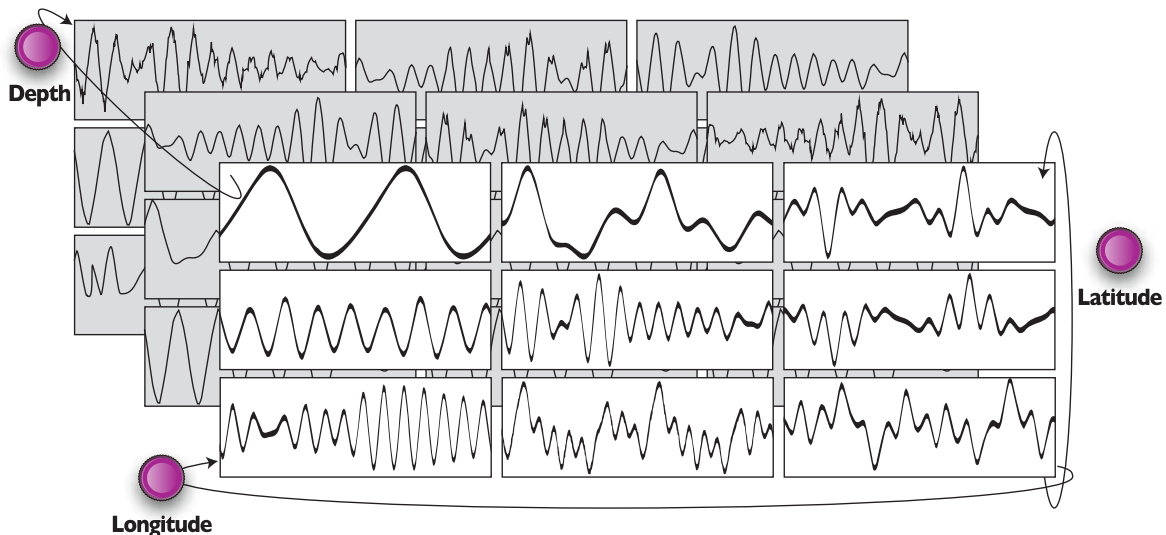
SWN's wavetables visualized as a 3 x 3 x 3 matrix

Tutorial 5: Creating Your Own Spherical Wavetables

Push all three knobs to enter Sphere Recording Mode

Depth   Latitude   Longitude

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.

Audio Source

Waveform In

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**.

Push to Record

LFO→VCA

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.

Color of inner lights show position in Sphere

Browse

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 d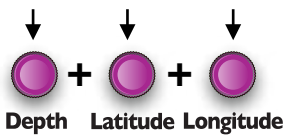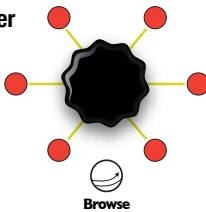istinct waveforms.) If you want to hear morphing, just hold down the **Fine** button while you turn the **Browse** knob. Keep turning **Browse** to hear all the waveforms. *Tip: The inner ring of lights shows your position in the Sphere. You can always find the first waveform because inner ring lights will glow dim gray.*

A

Wavefolding

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.

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.

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

Load Preset
Save Preset

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.

Available Effects:

A	B	C	D	E	F
FX					
Wavefolding	Bit Decimation	Metalizer	Low Pass Filter	Gain/ Normalization	Seam Smoothing

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 29) 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).

The Geometry of a "Sphere"
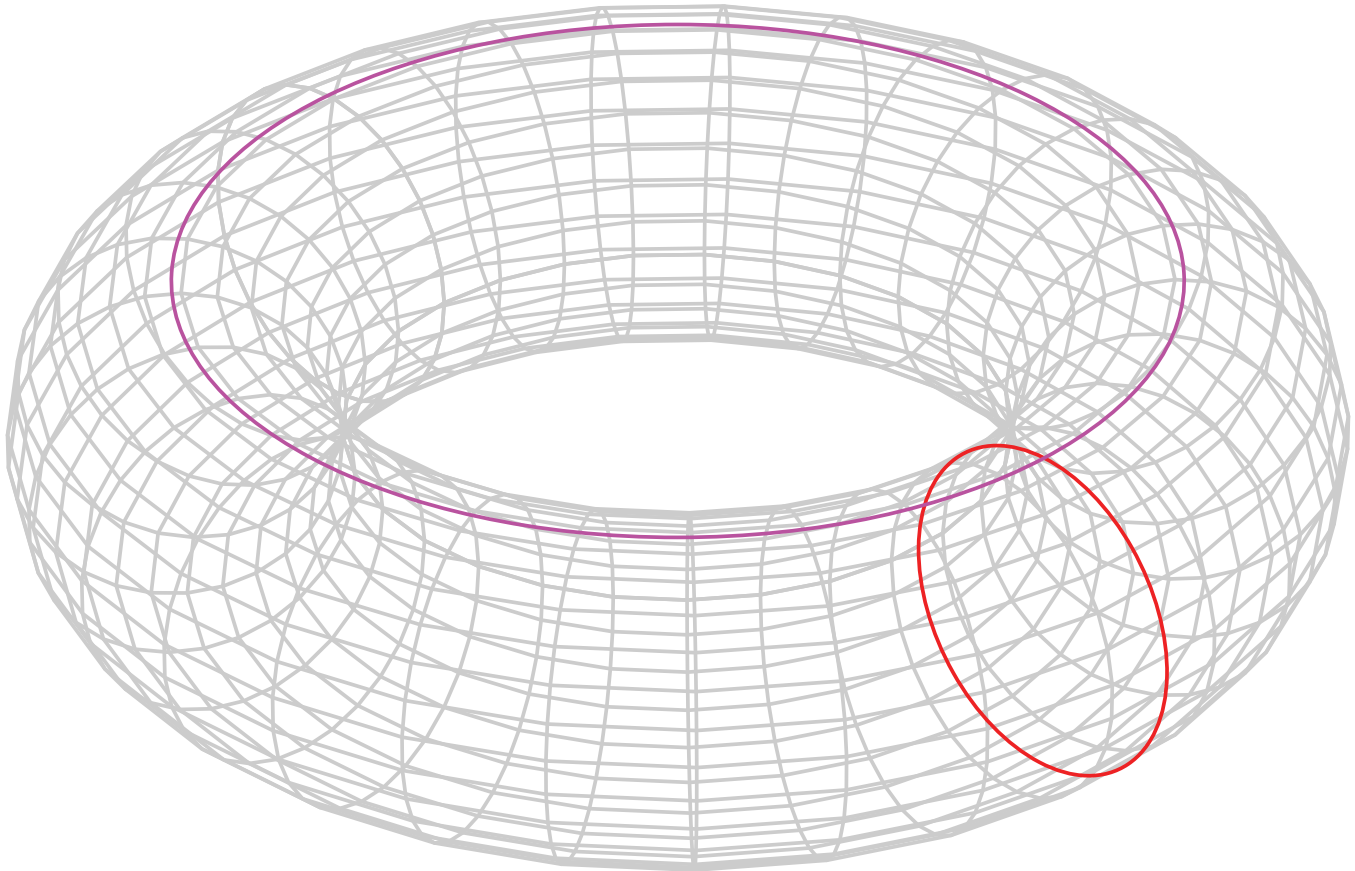
A torus

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

Outer ring color = Position within Sphere

Channel C
Channel D
Channel B
Channel E
Channel A
Channel F
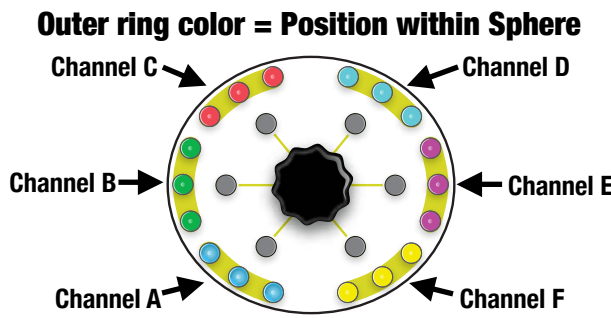
A Sphere is a collection of 27 waveforms arranged in a 3x3x3 shape. A Sphere can be navigated in three directions: Depth, Latitude, and Longitude. Navigating in a direction "wraps" around to the beginning when it reaches the end. Each direction has three waveforms, and navigating in any direction morphs 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 indicates that Channels A and E were playing similar waveforms.
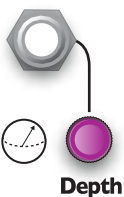
Depth (knob and CV jack)

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).
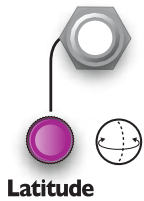
Latitude (knob and CV jack)

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).
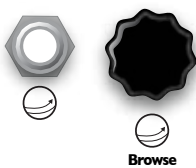
Browse (knob and CV jack)

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).
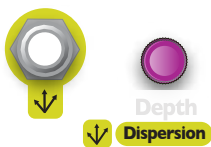
Dispersion (knob and CV jack)

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.
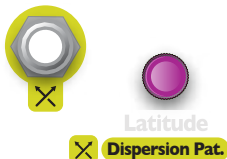
Dispersion Pattern (knob and CV jack)

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

Example Sphere Selection

A　　B　　C　　D　　E　　F

Channel B on 8th Sphere (ruby)

Channels C, D on 12th Sphere (purple)

Channels A, E, F on first Sphere (red)

Spheres (built-in)
- Harmonics
- Sine Distortions
- Formants 1
- Formants 2
- Morphing Cello
- Talkative FM
- Distorted FM
- 909 Hits
- Wavefolded Rings
- Smooth Troughs
- Alias Maximizer
- Sine Sequences

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

The **SWN** allows you to select different Spheres for each channel to navigate. There are twelve built-in Spheres, and you can create and import up to 108 custom Spheres of your own. 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. Whenever you turn the **Sphere** or **WT Spread** knobs, the top row of buttons glow the color of the currently selected Sphere for each channel, and the lights on the outer ring display the selected Spheres clockwise in order from the first to the last available Sphere (*Note: there are only 18 outer ring lights and 120 Spheres, so if two channels end up on the same light but have different Spheres, the light will alternate between the two Spheres' colors*). To view the Sphere Selection without changing the current Sphere, tap the **Sphere** knob without turning it.

Even when you're not adjusting the Sphere or WT Spread, the **SWN** will usually display the current Sphere selection for each channel on the inner ring (the exceptions are when you're adjusting another parameter such as Octave or Transposition).

Push+Turn

Sphere

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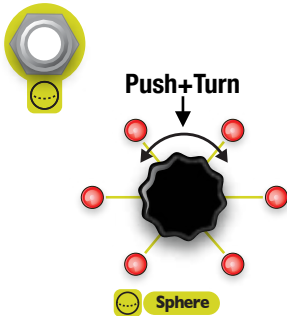
When selecting a Sphere, the **SWN** will scroll through the twelve built-in Spheres and then any User Spheres which are saved. User Sphere slots that are empty and any Sphere that's disabled will be skipped. After reaching the last User Sphere, the selection will wrap around to the first enabled built-in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

Longitude

WT Spread

WT Spread (knob and CV jack)
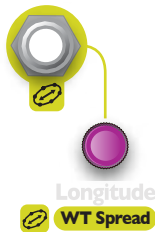
WT Spread (**Wavetable Spread**) selects a different Sphere for each channel. Increasing the **Wavetable Spread** adds space between each channel by pushing the lower three channels downwards in the list of Spheres and the upper three channels upwards. The outer channels (A/F) move more than the inner channels (C/D). Applying CV from 0V to +5V will offset the position selected by using the knob. If **WT Spread** is used with manual **Sphere** selection or CV, the two offsets will be added to each other to determine the final Sphere selection.

Resetting Navigation and Sphere Selection

Reset Navigation

Press Preset+Depth

Load Preset **+** **Depth**

Reset Sphere Selection

Press Preset+Latitude

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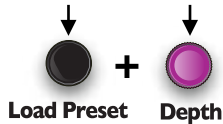
The navigation position for all unlocked channels can be reset by pressing the **Preset** and **Depth** knobs at the same time. The **Depth**, **Latitude**, and **Longitude** positions will be reset to the starting position within the Sphere, and **Dispersion** and **Dispersion Pattern** will be cleared.
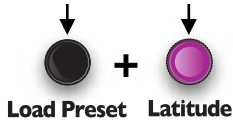
The selected Sphere for all unlocked channels can be reset by pressing the **Preset** and **Latitude** knobs at the same time. The first built-in Sphere will be selected, and **Wavetable Spread** will be cleared.

Both these features can be used at the same time by pressing **Preset + Depth + Latitude** at the same time to clear the navigation position and sphere selection. No other setting (**Octave**, **Transpose**, **LFO Speed**, etc) will be affected, and locked channels will not be reset.

Presets

Saving a Preset:

Load Preset
Save Preset
Turn to choose slot
Press 2 sec.
Tap to confirm

Loading a Preset:

Load Preset
Save Preset
Turn to choose slot
Tap knob
Tap again to confirm

Clearing a Preset:

Load Preset
Save Preset
Turn to choose slot
Press 6 sec.
Tap again to confirm

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 t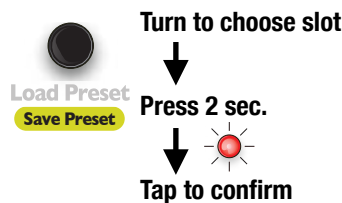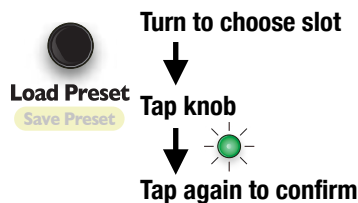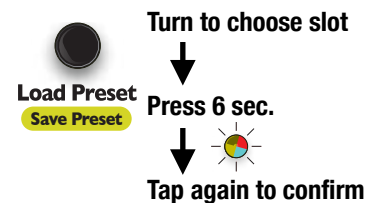urning the **Preset** knob to select a preset slot. Next, tap the **Preset** knob quickly (to load), or hold it down for two seconds (to save), or hold it down for six seconds (to clear/delete). When you release the **Preset** knob, the slot light will flash. While the light is still flashing, tap the **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

↓   ↓

Fine   **+**   **Load Preset**
                Save Preset
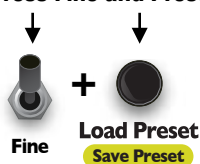
Undo a Save/Load/Clear

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.

Select Bus – Preset Load/Save
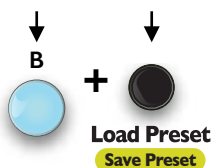
Enable/Disable Select Bus:

Hold "B" and Preset…

↓   ↓

B   **+**   **Load Preset**
                Save Preset

… and use LFO buttons to enable/disable:

LFO→VCA

Load En/Disabled

∿ ⊓ ⊥

Save En/Disabled
(hold 2 sec. to enable)

dim = disabled
bright = enabled

This feature is present in firmware v2.2 and later.

The **SWN** can load and save presets via the Select Bus. The Select Bus is a protocol used by several Eurorack manufacturers that sends messages between modules connected to the same power bus board. To use Select Bus, the **SWN** must be connected to the same power bus that a Select Bus compatible "Leader", "Master", or "Transmitter". Such modules are listed at the end of the manual.

The **SWN** can only receive messages on the Select Bus, it can't transmit. There are two messages to which the **SWN** will respond: Load Preset, and Save Preset. Each of these can be enabled or disabled. By default, both are disabled.

Load Preset

A Load Preset command, also known as "Recall Preset" or "State Select", sends a preset number to the SWN and asks that it be loaded. If enabled, the **SWN** will load the preset exactly as if you had used the **Load Preset** knob. If the preset slot is blank, then a blank preset will be loaded.

Save Preset

A Save Preset command, also known as "Save Preset" or "State Save", sends a preset number to the **SWN** and asks that the current state be saved into that slot. If enabled, the **SWN** will save the state exactly as if you have used the **Save Preset** knob. If a preset already exists in the preset slot, it will be over-written.

Note that the **SWN** has 108 presets, but not all Select Bus modules can handle that many (some are limited to 64, some are limited to 100), so higher numbered presets may not be accessible via Select Bus.

Enabling Select Bus

1. Hold down the **Load Preset** knob and the **Channel Button B** at the same time. Keep holding them down and notice that the **LFO->VCA** button turns green and the **LFO Type** button turns red.
2. *Enable/disable Loading:* Tap the **LFO -> VCA** button to enable or disable the **SWN** from loading presets when the appropriate message is received over the Select Bus. When preset loading is enabled, the button will show bright green. When disabled, the button will show dim green.
   Enable/disable Saving: Holding the **LFO Type** button for 2 seconds will allow the **SWN** to save presets when receiving the appropriate message over the Select Bus. Tap the button to disable this function, the button will then show dim red. When the function is enabled, the button will show bright red.
3. Release the **Load Preset** knob and **Channel Button B** button. A short beep will be heard to confirm your Select Bus settings have been saved to memory and will persist after the power is turned off.

Select Bus Troubleshooting

The CV pins on the bus-board are used for Select Bus, so in the rare case that you are using these pins for other purposes, Select Bus will not work.

Select Bus is designed to have exactly one module sending messages per power bus. All other modules on the power bus must either be ignoring or receiving messages. Multiple "masters" or transmitters are not permitted. You must consult the user manual for the device you intend to use as the transmitter (leader/master) in order to configure it.

A list of devices that have been tested with the **SWN** is in the appendix

Startup Preset

The **SWN** will startup with the last preset that was loaded or saved. *This feature is present in firmware version 2.2 and later.*

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 ∿⊓⊔ 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 **Clk In** jack will sync the base clock to the external clock.
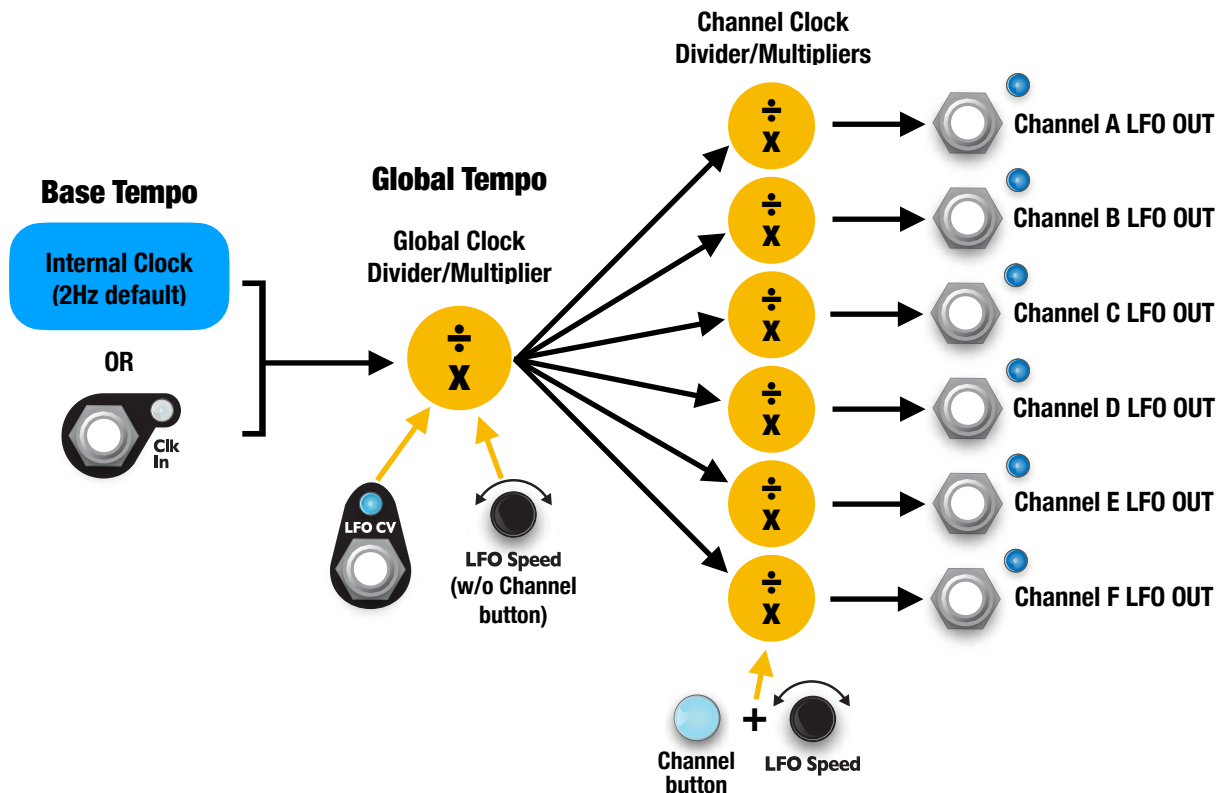
LFO Speed

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:

÷64 ÷48 ÷32 ÷24 ÷16 ÷8 ÷7 ÷6 ÷5 ÷4 ÷3 ÷2 = x2 x3 x4 x5 x6 x7 x8 x12 x16 x24 x32

The sequence is infinite in both directions: when slowing the tempo down past ÷64 the tempo divides by a factor of eight more than the previous factor (÷72, ÷80, ÷88, etc..). When speeding the tempo up past x32 the tempo multiplies by a factor of two more than the previous factor (x34, x36, x38, etc…) Holding down **Fine** while turning **LFO Speed** adjusts by non-integer amounts.

When a channel is locked, the current global **LFO Speed** is stored and used for that locked channel only when calculating the speed of the channel's LFO. When the channel is unlocked, the cached value is continued to be used until the global **LFO Speed** is changed. Changing the global **LFO Speed** will set the speed of the LFOs for all unlocked channels.

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 adjust both the global and channel **LFO Speed**.

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)	Ramp-up	Utility	Complex Shapes	
Saw 100%	Ramp-up 100%	Sine	Shape 1	Shape 7
Saw 75%	Ramp-up 75%	Triangle	Shape 2	Shape 8
Saw 50%	Ramp-up 50%	Steady DC	Shape 3	Shape 9
Saw 25%	Ramp-up 25%		Shape 4	Shape 10
Saw 12%	Ramp-up 12%		Shape 5	Shape 11
			Shape 6	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.

Each click of the **LFO Phase** knob adjusts the phase by 1/24th of a measure or beat. Holding down the **Fine** button adjusts it by 1/12th as much, or 1/288th of a measure.

Toggle Phase Pattern
Press LFO Speed + Shape

LFO Speed
Gain

+
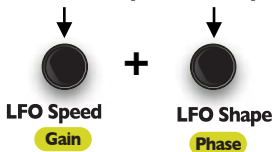
LFO Shape
Phase

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 22).

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.

The maximum clock in speed that can be read is about 20Hz, or 1200 pulses per minute. If each clock pulse represents a quarter note, this is 300 BPM. If each clock pulse represents one of the six channels on the **SWN** firing a note, this is about 200 BPM.

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, Keyboard Mode, CV/Gate Mode, and CV/Gate/Sustain Mode

Press both buttons to toggle modes

Pressing both the **LFO->VCA** and **LFO Type (∿ ⎍ ⎍)** buttons at the same time toggles between five modes in this order: Mute Mode, Note Mode, Keyboard Mode, CV/Gate Mode, and CV/Gate/Sustain Mode. If you hold down a **Channel** button while pressing the **LFO->VCA** and **LFO Type** buttons together, only that channel will change modes. Otherwise, all channels will change modes.

The **Channel** button colors tell you which mode each channel is in:

White = Mute, Pink = Note, Purple = Keyboard, Red = CV/Gate, Yellow = CV/Gate/Sustain.

Mute Mode

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.

Note Mode

A

Note Mode

Note Mode is useful when using the **1V/oct**, **Transpose** or **Spread CV** jacks with continuous CV sources such as LFOs or anything besides a sequencer or keyboard. In Note Mode, the LFOs don't run continuously and instead become envelopes which fire whenever the channel's note changes.

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

Scale quantization in Note Mode

The **Scale** selection on the **SWN** is important in Note Mode. The notes in the currently selected scale for each channel define the voltages at which the envelope will fire. Selecting the No Quantization scale (light blue) will disable the automatic envelope firing and the channels will only play by using the buttons.

Patching with Note Mode

An example patch would be to patch up to six LFOs 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 each LFO varies enough to transpose the channel to a new note in the current scale. 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 CV you patch in, and the envelope and audio waveshape and timbre controlled by the **SWN**.

For example, if you patch a slow ramp-up sawtooth wave into Channel A's **1V/oct** jack and select the Major scale, then Channel A will play the major scale upwards. If you patched in a triangle wave instead, then the channel will play the scale up and then down.

If you were to slow down the incoming LFO, you'll hear more time between the notes. If you were to speed up the incoming LFO, the notes will compress together — but if the incoming LFO is changing faster than the **SWN's** envelopes (LFOs) can finish, then some notes in the scale be skipped. If you were to speed up the channel's envelopes by turning up **LFO Speed**, then the full scale will play again. This simple example shows how the rate of change of the incoming CV and the timing of the **SWN's** envelopes (LFOs) are linked. Because of that, it can be useful to have a common clock driving the external LFO or CV source and also the **SWN's Clk In** jack.

Buttons in Note Mode

Notes can also 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 the button.

Automatic Settings for LFO Shape, Speed, and Scale

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 (Quantization) section, page 26). When switching back to Mute Mode, the previous LFO speeds and shapes are restored.

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 pitches by patching an LFO or sequence into the **1V/oct** jack and pressing the buttons in the rhythm you want.

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

The envelopes are AD (attack-decay) in Keyboard Mode, so unlike Note Mode, the notes don't sustain when you hold the buttons down. This is the only difference between a channel in Keyboard Mode versus one in Note Mode with the No Quantization scale selected.
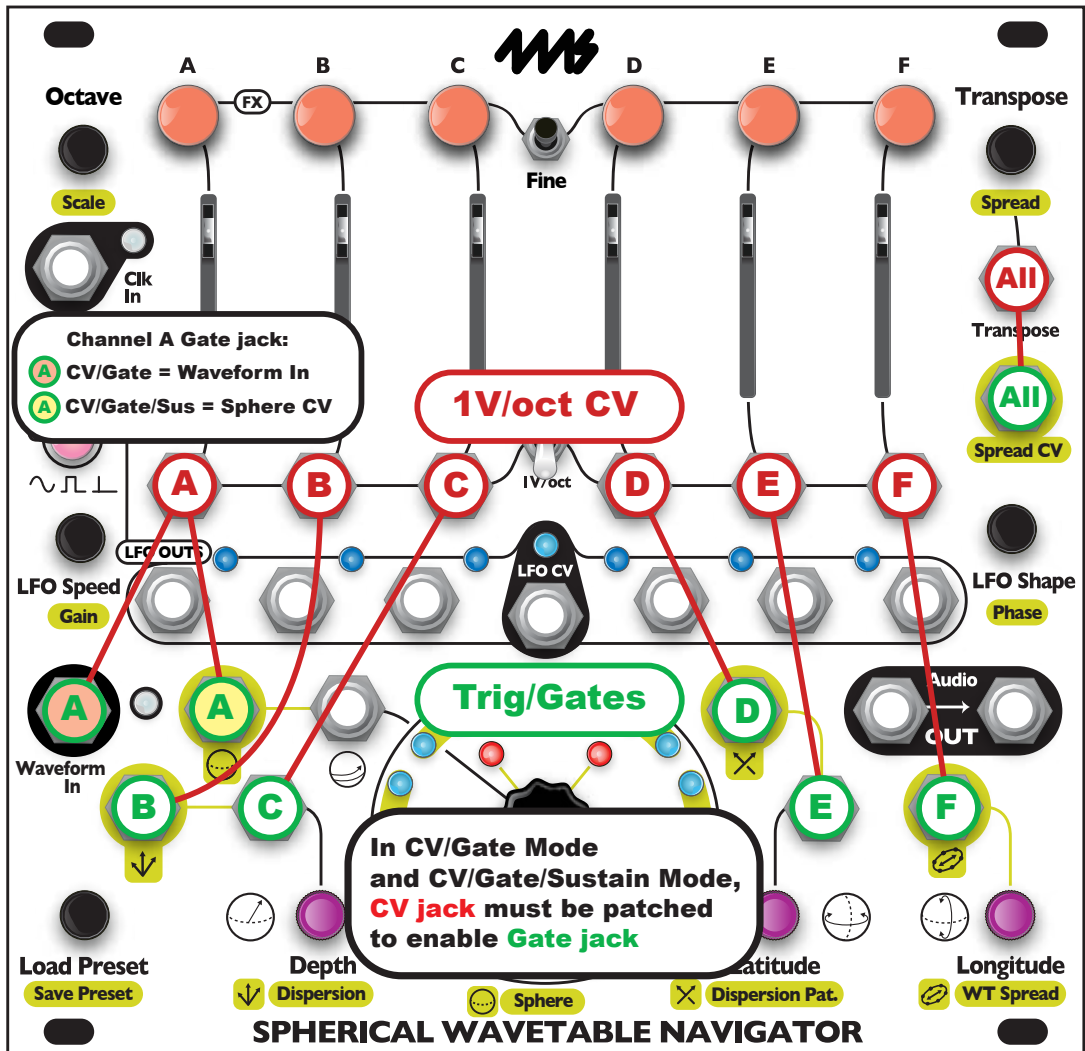
CV/Gate and CV/Gate/Sustain Modes

CV/Gate Mode is present in firmware v2.1 and later. CV/Gate/Sustain mode is present in firmware v2.2 and later.

CV/Gate and CVGate/Sustain Modes let you use up to seven CV and seven gate signals to control the **SWN's** voices. These modes work well with keyboards and sequencers that have a CV output and a gate or trigger output. CV/Gate and CV/Gate/Sustain modes are identical with two exceptions: 1) the pulse width of the incoming gate is ignored in CV/Gate Mode and controls the sustain of the envelope in CV/Gate/Sustain Mode; and 2) **Channel A**'s Gate jack is **Waveform In** in CV/Gate Mode and **Sphere CV** in CV/Gate/Sustain Mode.

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

In CV/Gate mode, the **Channel** buttons are dim red. In CV/Gate/Sustain Mode, the **Channel** buttons are dim yellow.

Gate Jacks in CV/Gate and CV/Gate/Sustain Modes

Each channel is assigned a gate jack. The diagram above illustrates the gate jack for each channel. In CV/Gate Mode, Channel A uses the **Waveform In** jack for its gate jack, Channel B uses the **Dispersion CV** jack, and Channel C uses the **Depth CV** jack, etc. In CV/Gate/ Sustain mode, the jacks are the same except that Channel A uses the **Sphere CV** jack.

Once you are in CV/Gate or CV/Gate/Sustain mode, patch the 1V/oct (CV) and gate/trigger output of a keyboard or sequencer into any channel's 1V/oct jack and gate jack. You can patch any number of channels. You can also control all six channels together with a single CV/gate source using the global CV and gate jacks (**Transpose** and **Spread CV**). Any channel with nothing patched into its gate jack can be played with the global gate jack. The 1V/oct jack will be active for these channels, but they won't play unless you press the **Channel** button or fire a trigger into the global gate jack.

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

At least one channel has to be in CV/Gate mode to use **Spread CV** as a global trigger (and **Transpose** has to be patched).

No quantization (light blue)

Recommended: No Quantization in CV/Gate and CV/Gate/Sustain Modes

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

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

**Transpose
Global 1V/oct**

**Spread CV
Global Gate/Trig**

Global CV and Gate/Trig

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

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

LFO Shape

Envelopes in CV/Gate and CV/Gate/Sustain Modes

The envelope for each channel can be controlled using the **LFO Speed** and **LFO Shape** knobs. This works in the same way that it does in every other mode: turning the **LFO Speed** or **Shape** knob by itself will adjust all six channels, and holding down a **Channel Button** while turning a knob will adjust just that channel. If you're using a sequencer, you might want to patch its clock out into the **SWN**'s **Clk In** jack so the envelope timings will be synced.

LFO Speed

Envelope Attack/Sustain/Decay

The rising edge of the incoming gate will trigger the channel's envelope. In CV/Gate Mode, the entire LFO shape (envelope) plays once and then stops. In CV/Gate/Sustain Mode, each LFO shape (envelope) is split into an attack segment and a decay segment. If the attack segment ends and the gate is still high, the envelope will hold, or sustain, at that position until the gate falls. At this point, the envelope's decay segment will play.

When a gate is received on the global gate jack (**Spread CV**), any channel in CV/Gate/ Sustain mode will sustain as long as the global gate is high.

Multiple triggers before the envelope finishes will re-trigger the envelope.

Buttons in CV/Gate and CV/Gate/Sustain Modes

The **Channel Buttons** at the top can be used to manually fire a channel. This works similarly to Note and Keyboard Modes, but with a slight difference: pressing the buttons will play the entire envelope even if you let go of the button before the envelope finishes.

## Resetting and Re-syncing LFOs

Reset LFO Speeds
Press Preset + LFO Speed

Load Preset
Save Preset
LFO Speed
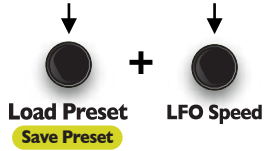
Press **Preset + LFO Speed** to reset the LFO Speeds. All channel clock divider/multipliers and the global clock divider/multiplier will be reset to x1. If you're using an external clock or if you had been using an external clock and stopped or unpatched it, the base tempo from that clock will not be 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

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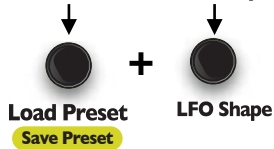
Press **LFO Speed + LFO Shape** to reset all channel phase offsets. This toggles between resetting the channels to all be in phase (firing at the same time), versus being 60 degrees out of phase (firing in sequence). The first time you press this button combination, the LFOs will reset to being in-phase.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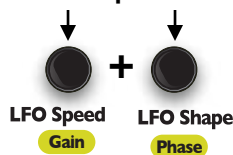**Tap Preset knob**

LFO Shape
Phase

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

LFO Speed
Gain
LFO Shape
Phase

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

Load Preset
Save Preset
LFO Speed
Gain
LFO Shape
Phase

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 <u>Fine Tuning</u> section on page 25.

Display
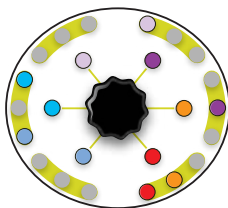
The light ring displays the transposition amount of each channel. Each channel is assigned a color, which is shown on the **Channel** buttons. The lights on the outer ring each represent a semitone. As you transpose a channel up or down, a light with the channel's color will move up or down to indicate 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 of 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 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.

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. If you patch a keyboard or sequencer into the **Spread CV** jack, you can pick any of the 26 chords by using the "black keys" from C#0 to C#5. The **Spread CV** jack also can be used to cycle through chords with an LFO or other CV source.

	Channel:	A	B	C	D	E	F
1	-	C4	C4	C4	C4	C4	C4
2		C4	C4	G4	G4	C4	C4
3	Fifths	C4	C4	G4	G4	G3	G3
4		C4	C5	G4	G5	C3	G3
5		C4	C4	E4	E4	G4	G4
6	Major Thirds	E3	G3	C4	E4	G4	G4
7		C3	G3	C4	E4	G4	C4
8		C4	C4	Eb4	Eb4	G4	G4
9	Minor Thirds	Eb3	G3	C4	Eb4	G4	G4
10		C3	G3	C4	Eb4	G4	C4
11		C4	C4	E4	E4	G4	A4
12	Major Sixths	C3	C4	E4	G4	A4	A4
13		C3	A3	C4	E4	E4	A4

|	Channel:	A	B	C	D	E	F
14		C4	C4	E4	E4	G4	B4
15	Major Sevenths	C3	C4	E4	G4	B4	B4
16		C3	B3	C4	E4	G4	B4
17	Major 9th	C4	C4	E4	G4	B4	D5
18	Major 11th	C4	E4	G4	B4	D5	F#5
19		C4	C4	Eb4	Eb4	G4	A4
20	Minor Sixths	C3	C4	Eb4	G4	A4	A4
21		C3	A3	C4	Eb4	Eb4	A4
22		C4	C4	Eb4	Eb4	G4	Bb4
23	Minor Sevenths	C3	C4	Eb4	G4	Bb4	Bb4
24		C3	Bb3	C4	Eb4	G4	Bb4
25	Minor 9th	C4	C4	Eb4	G4	Bb4	D5
26	Minor 11th	C4	Eb4	G4	Bb4	D5	F5

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 an 18-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. The **SWN's** lowest octave is three octaves below C0, and the highest octave is four octaves above C10. These extremes causes the Spheres to sound drastically different than when played at normal audio frequencies, which is useful for creating new timbres and textures.
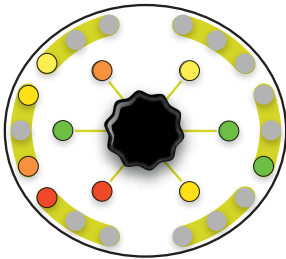
Octave Display

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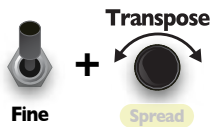
Holding down the **Fine** button while turning the **Transpose** knob will adjust the frequency by micro-tonal amounts, detuning the channel(s). Some common uses for detuning are: to tune the SWN to another instrument, to create beat frequencies and phasing effects, to utilize microtonal scales, or to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

The amount of detuning is 1/100th of a semitone (one cent) per click. If a channel is detuned and then fine-tuned in the opposite direction so that it returns to its original tuning, its phase will be reset in order to not cancel out other channels with the same frequency. This phase jump may be heard as a slight 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.

Channel C (flat) **Channel D (sharp)**

Channel B (flat)

Channel E (not detuned)

Channel A (sharp)

Channel F (not detuned)
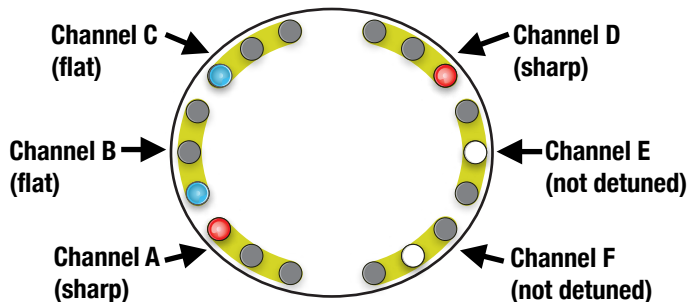
Detuning Display

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
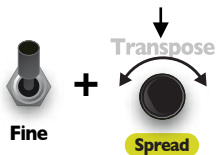
Holding down the **Fine** button while pushing and turning the **Transpose/Spread** knob will detune all six channels by a different amount for each channel. With every click of the knob, the outer channels (A and F) will detune by three cents, the middle channels (B and E) will detune by two cents, 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.
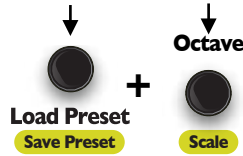
Resetting Pitch

Reset Transpose/Spread

Load Preset / Save Preset **+** **Transpose** / Spread
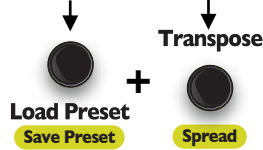
Resetting Transposition and Spread
Press the **Preset** and **Transpose/Spread** knobs at the same time to set the transposition of all channels to the default pitch. All **Spread** offsets will also be cleared.
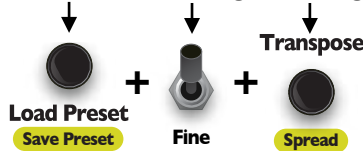
Reset Octave

Load Preset / Save Preset **+** **Octave** / Scale

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

Load Preset / Save Preset **+** **Fine** **+** **Transpose** / Spread

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 (Quantization)

Octave / 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:

A — **No quantization** (light blue)
A — **Major scale** (pink)
A — **Harmonic minor** (orange)
A — **Semitones** (dark blue)

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). When you flip the switch all unlocked channels will change modes. Any locked channel will remain in the mode it was in when locked. Locking one or more channels and then flipping the switch is the only way to have some channels in VCA mode and some in 1V/oct mode.

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, Keyboard Mode, and CV/Gate Mode section, page 19), 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.

Channel Panning
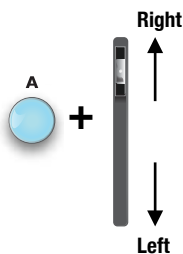
This feature is present in firmware v2.2 and later. In earlier firmware versions, panning is set to the defaults and cannot be adjusted.

When using the **SWN** in stereo (by patching both **Audio Out** jacks) each channel can be positioned in the stereo field. By default, channels A, C, and E are panned to the right **Audio Out** jack, and channels B, D, and F are panned to the left **Audio Out** jack.

Hold down a **Channel** button while moving the channel's slider to adjust the panning. When the slider is all the way down, the channel will be panned fully to the left **Audio Out** jack. When the slider is all the way up, it will be panned fully to the right **Audio Out** jack. The channel can be panned to any other position in the stereo field by setting the slider in between these extremes.

After panning, the slider will often be in a new position that no longer represents the level of the channel. For example, if you pan a channel fully left, the slider will be all the way down, but the level will not necessarily be zero. In order to remind you that the slider's position doesn't represent the level, the slider light will flicker once per second after you pan a channel. Adjusting the slider will have no effect on the volume until you bring the slider back to its original position before the panning was adjusted. At this point, the slider will stop flickering.

When you save or load a preset, the panning of each channel is saved or loaded along with the channel's pitch, sphere navigation, and other parameters.

Calibrating 1V/oct and Transpose Jacks

Calibrate 1V/oct

Press Octave + Transpose

Octave   Transpose

Scale   **+**   Spread
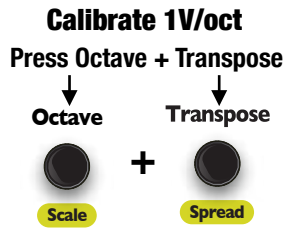
The **1V/oct** and **Transpose** jacks are calibrated at the factory to change the pitch by one octave for every 1.000V received. However, due to issues with impedance between equipment, offset and gain errors from using buffered multiples, mis-calibrated or inaccurate outputs from sequencers and keyboards, 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.

**Save Calibration**

Push 2 sec.
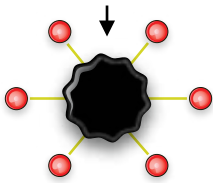
You also can calibrate each jack separately. This is not usually necessary, but could be useful if you want to use multiple tuning systems for each channel. To calibrate each jack individually:

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:

Push all three knobs

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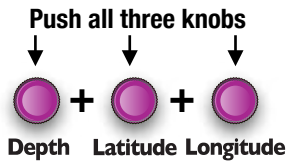
Sphere Recording Mode lets you create new Spheres by recording audio from any modular or line-level signal. You can also edit and apply effects to new or existing Spheres. Only one Sphere can be edited or created at a time.

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 New Sphere

LFO→VCA

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.

Record One Waveform

Press Fine and Record

Fine   +   LFO→VCA
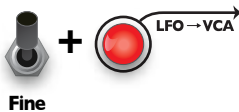
Record Single Waveform

New feature in firmware v2.0 and later.

Instead of recording all 27 waveforms at once, you can record each waveform one at a time. First, use the **Browse/Latitude/Longitude/Depth** knobs to navigate to the waveform you want to replace. Hold down **Fine** button while pressing the **Record** button to record just one waveform. The **SWN** will wait until it detects a signal on the **Waveform In** jack, and then will replace the current waveform with a waveform from the audio input. Recording a single waveform allows you to prepare or change your sound sources for each 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

Fine   +

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.
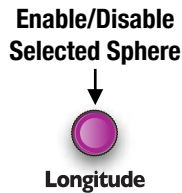
Enable/Disable Sphere (Longitude press)

Pressing the Longitude button while selecting a Sphere with the **Preset** knob will toggle the enable/disable state of that Sphere. See the Enable/Disable Spheres section for details.

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 loading and saving a Sphere.

Light Ring Display
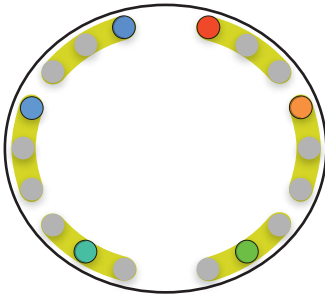
The outer light ring displays a rainbow of lights to help visualize where the recorded audio buffer is being split to create the 27 waveforms. The entire outer light ring represents the 2.5 seconds of recorded audio, starting at the top right and moving clockwise around the circle, ending at the top 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 visual 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.

Technical Details of Recording

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 32) 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.
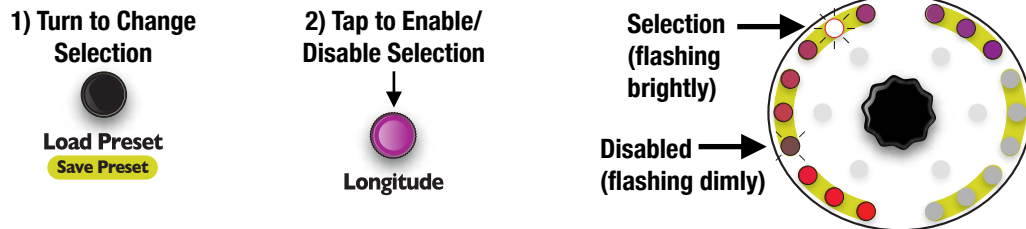
Duration of Single Waveform Recording

When recording a single waveform, the **SWN** records as much audio data as it can without overwriting the next waveform in the audio buffer. This duration depends on the amount of **Waveform Spread**. See the Waveform Spread, Stretch, and Shift section for a series of illustrations. By default, the waveforms are spread a distance of eight waveforms apart, so the **SWN** will record 4096 samples, or about 93ms. Since a waveform on the **SWN** is only 512 samples long, this extra data allows you to use the Seam Smoothing effect and small amounts of the **Waveform Shift** feature while still keeping the waveforms distinct.

Enable/Disable Spheres

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

1) Turn to Change Selection

Load Preset
Save Preset

2) Tap to Enable/ Disable Selection

Longitude

Selection (flashing brightly)

Disabled (flashing dimly)

Enable/Disable a Sphere

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

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

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

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

Navigating with Enabled Spheres

Once you've picked a group of Spheres to be enabled, when you exit Sphere Recording Mode you'll be limited to just those enabled Spheres. Using the **Sphere** knob and CV, and the **WT Spread** knob and CV will act like those Spheres don't exist. Even if you locked a channel onto a Sphere and then disabled the Sphere, the locked channel will be re-assigned to a nearby enabled Sphere.

Saving a Group of Enabled/Disabled Spheres

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

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

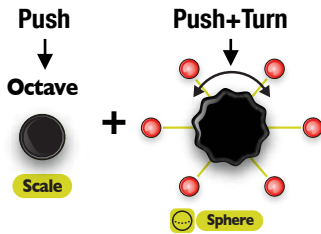# Waveform Spread, Stretch, and Shift
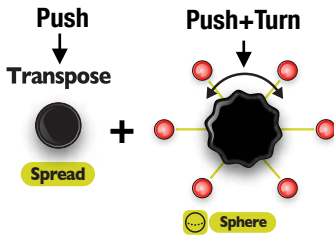
Waveform Spread

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

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.
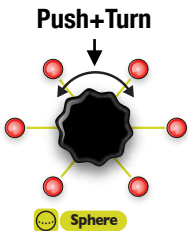
Waveform Shift

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:
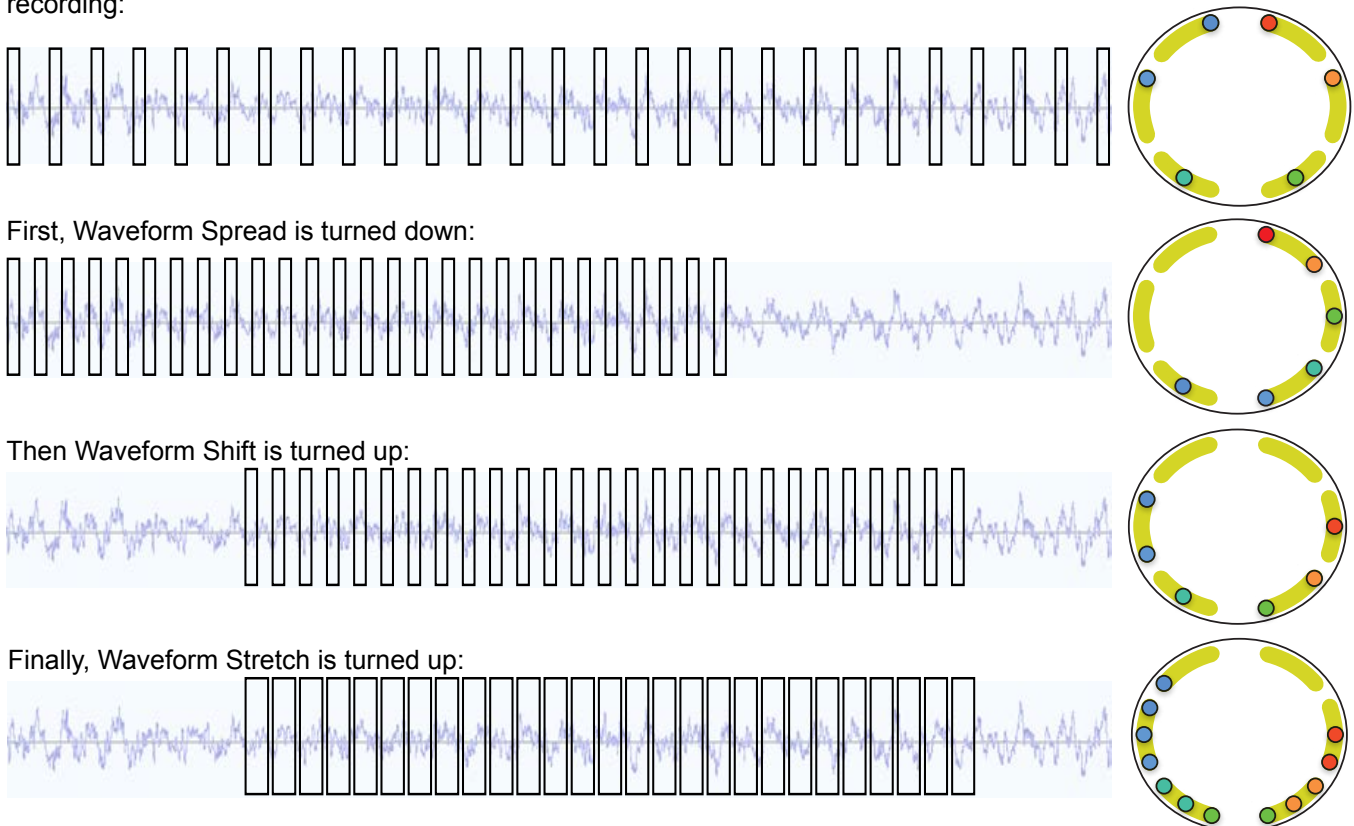
Waveform Effects

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:

A	B	C	D	E	F
Wavefolding	Bit Decimation	Metalizer	Low Pass Filter	Gain/ Normalization	Seam Smoothing
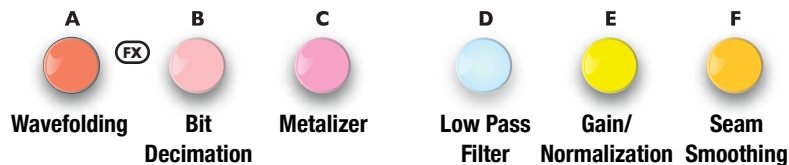
Wavefolding
The waveform is distorted and folded back on itself, creating harmonics of the fundamental waveform.

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.

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 timbal 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.

Saving, Loading, and Deleting User Spheres

Saving a Sphere:
(in Sphere Rec mode)
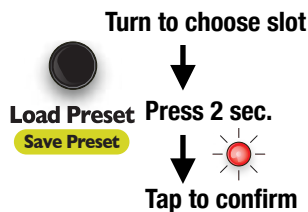
Turn to choose slot
↓
Load Preset **Press 2 sec.**
Save Preset
↓
Tap to confirm

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. There are 12 Factory Spheres on the first page, followed by 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). The first page is Factory Spheres and can't be saved onto. You can tell you are on the factory Page because 1) All six inner lights are white, and 2) Exactly 12 lights on the outer ring are on, ranging from red to purple. Keep turning the Preset knob until you are off the Factory Page. 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.
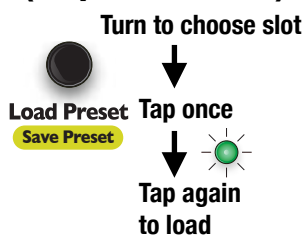
When pushing and turning the **Browse** knob to select a Sphere, the User Spheres are located after the twelve factory Spheres. As new Spheres are created, the Spheres selected by **WT Spread** will change. Keep this in mind if you have presets that use **WT Spread.** If you need to preserve exact functionality of **WT Spread** in a preset created before you added one or more User Spheres, disable the new Spheres and re-save the Preset.

Load a Sphere:
(in Sphere Rec mode)

Turn to choose slot
↓
Load Preset **Tap once**
Save Preset
↓
Tap again
to load

Loading a Sphere

When you enter Sphere Recording Mode, whatever Sphere assigned to channel 1 will be loaded for editing. If you want to load a different Sphere, you can use the **Preset** knob. The functionality is identical to the way you load Presets outside of Sphere Recording Mode. Simply turn the **Preset** knob to select the Sphere you want to load or delete, then tap the knob twice to load.

Delete a Sphere:
(in Sphere Rec mode)

Turn to choose slot
↓
Load Preset **Press 6 sec.**
Save Preset
↓
Tap again
to delete

Deleting a Sphere

Deleting a Sphere is also similar to deleting a Preset. Turn the knob to select the Sphere you want to delete, and then press and hold the knob for 6 seconds until the light flashes multi-color rapidly. Release the knob and then tap it to delete.

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

Exporting a Sphere

Tap to Monitor…

…then tap to Export

Browse

In order to backup, share, and use SphereEdit with your Spheres, you can export Spheres from your SWN as audio files.

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

Backing up a Sphere

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

Sharing Spheres

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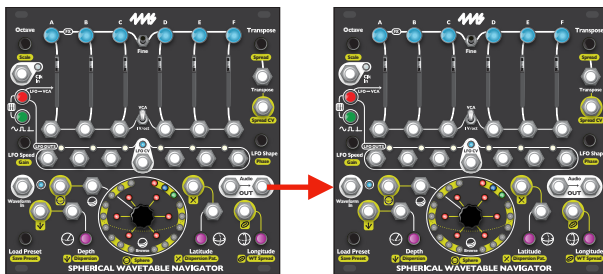
Sharing Spheres SWN to SWN

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

Editing Exported Spheres in SphereEdit

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

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

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 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.

Locking Channels

Lock/Unlock Channel

Fine + Channel Button

Fine

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

Locking and Unlocking

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

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

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

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

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

1V/oct | VCA switch

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

Light Brightness

Light Brightness

Push
↓
Load Preset

+

Turn

Sphere
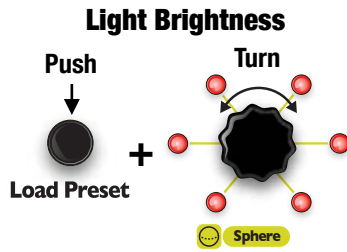
The brightness of all the lights on the **SWN** can be adjusted. This is especially useful when filming the **SWN,** or when using the **SWN** outdoors or in a dark room.

To adjust the brightness, push the **Load Preset** knob and turn the **Browse** knob. The brightness of the lights will immediately change. When you release the **Load Preset** knob, you'll hear a short beep as the setting is stored in system memory and automatically applied when the module powers up. Note that the setting is very subtle, so you may have to turn the **Browse** knob many times to see a change.

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. You also can delete User Spheres, see the Save, Loading, and Deleting User Spheres (page 34).

To perform a Factory Reset, hold down five knobs at the same time for 4 seconds: **Transpose, Octave, Preset, Longitude and Browse.** The SWN will make some high pitched sounds and you may release the knobs. Power the **SWN** off and back on. Verify all presets and User Spheres are gone.

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.
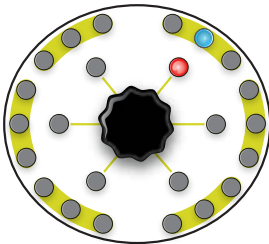
| Firmware Version 1.1 | Firmware Version 2.0 | Firmware Version 2.1 | Firmware Version 2.2 |
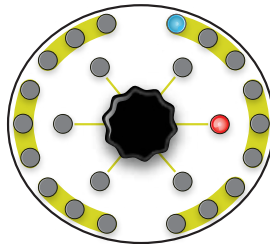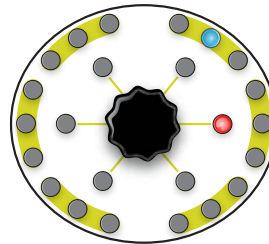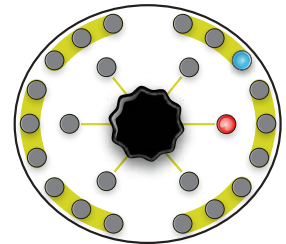
Updating Firmware (bootloader)

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 j**ack.
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).
- Try adjusting the volume on your device: usually 100% volume is best, but sometimes reducing it will output a more clean signal.

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

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

- **Select Bus**
  - The following modules are known to send Select Bus messages and be compatible with the **SWN**:
    - MakeNoise Rene mk2 (Store All and Mesh/Paste commands are ignored)
    - Malekko Varigate 4+ (Save and Recall)
    - Malekko Varigate 8+ (Save and Recall)
    - Expert Sleepers Select Bus Breakout Kit may be compatible if used with a MIDI device that can send the appropriate PC/Select Bus messages.
  - Two styles of Save and Recall Preset are accepted by the **SWN**:

Recall Preset (brief style)	Program Change + Preset#	`(0xC0 0x##)`
Recall Preset (brief style)	Command 0xF4 + Preset#	`(0xF4 0x##)`
Recall Preset (verbose style)	Control Change 16 + 64 + Program Change + Preset#	`(0xB0 0x10 0x40 0xC0 0x##)`
Save Preset (verbose style)	Control Change 16 + 127 + Program Change + Preset#	`(0xB0 0x10 0x7F 0xC0 0x##)`

My Presets:

My Spheres:

Sphere Recording Mode

Enter Sphere Recording Mode:
Push all three knobs

Depth   Latitude   Longitude

Record Entire Sphere:
Press Record,
Audio->Waveform In

Record One Waveform:
Press Fine+Record

Fine

Export Sphere:
Tap Monitor…
…then tap Browse

Monitor Input

Play Test Tone for tuning

Fine

Save/Load Sphere:
Turn to choose slot

Load Preset
Save Preset

Press 2 sec to SAVE or tap to LOAD

Tap to confirm

En/Disable Sphere
While Selecting w/ Preset knob:
Tap

Longitude

Sphere Recording Mode Effects:

A	B	C	D	E	F
FX					
Wavefolding	Bit Decimate	Metalizer	Low Pass Filter	Gain/ Normalize	Seam Smoothing

Turn = one waveform
Push+Turn = all waveforms

Waveform Spread
Push
Transpose

Spread

Push+Turn

Sphere

Waveform Stretch
Push
Octave

Scale

Push+Turn

Sphere

Waveform Shift
Push+Turn

Sphere

Transpose ← Turn for main feature
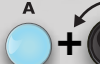
Spread ← Push while turning for gold feature

= Adjust all channels

A + = Adjust one channel

Fine + Knob = Adjust by small amounts

Fine

Lock/Unlock Channel
Fine + Channel Button

Fine

Reset LFO Speeds
Press Preset + LFO Speed

Load Preset
Save Preset
+ LFO Speed

Reset LFO Shapes
Press Preset + LFO Shape

Load Preset
Save Preset
+ LFO Shape

Adjust Panning

Right

A +

Left

Toggle Phase Pattern
Press LFO Speed + Shape

LFO Speed
Gain
+ LFO Shape
Phase

Re-phase LFOs
Tap LFO Phase knob

LFO Shape
Phase

Full Reset of LFOs
Press and hold for one second:

Load Preset
Save Preset
+ LFO Speed
Gain
+ LFO Shape
Phase

Reset Navigation/Sphere
Press Preset+Depth+Latitude

Load Preset + Depth + Latitude

Reset Transpose/Spread
Press Preset + Transpose

Transpose

Load Preset
Save Preset
+ Spread

Reset Octave
Press Preset + Octave

Octave

Load Preset
Save Preset
+ Scale

Reset Fine Tuning
Press Preset + Fine + Transpose

Transpose

Load Preset
Save Preset
+ Fine + Spread

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
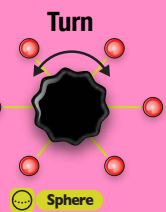
Fine + Load Preset
Save Preset

Light Brightness

Push
Load Preset
+ Turn

Sphere

Select Bus

Hold "B" and Preset…

B + Load Preset
Save Preset

… press either LFO->VCA, or LFO Type

+ LFO→VCA
Enable/Disable Load
(tap to toggle)

+ Enable/Disable Save
(hold 2 sec. to enable, tap to disable)