

# Spectral Multiband Resonator

## Firmware version 5 New Features Summary

December 5, 2016: Firmware version 5 is announced for the Spectral Multiband Resonator. Many new features and improvements have been included, and all users are encouraged to update their SMR for free!

### To download the new firmware

Go to <http://4mscompany.com/smr.php>

Click on "Manuals/Firmware"

Download/Save the .wav file for firmware version 5 (we do not recommend playing it from your browser)

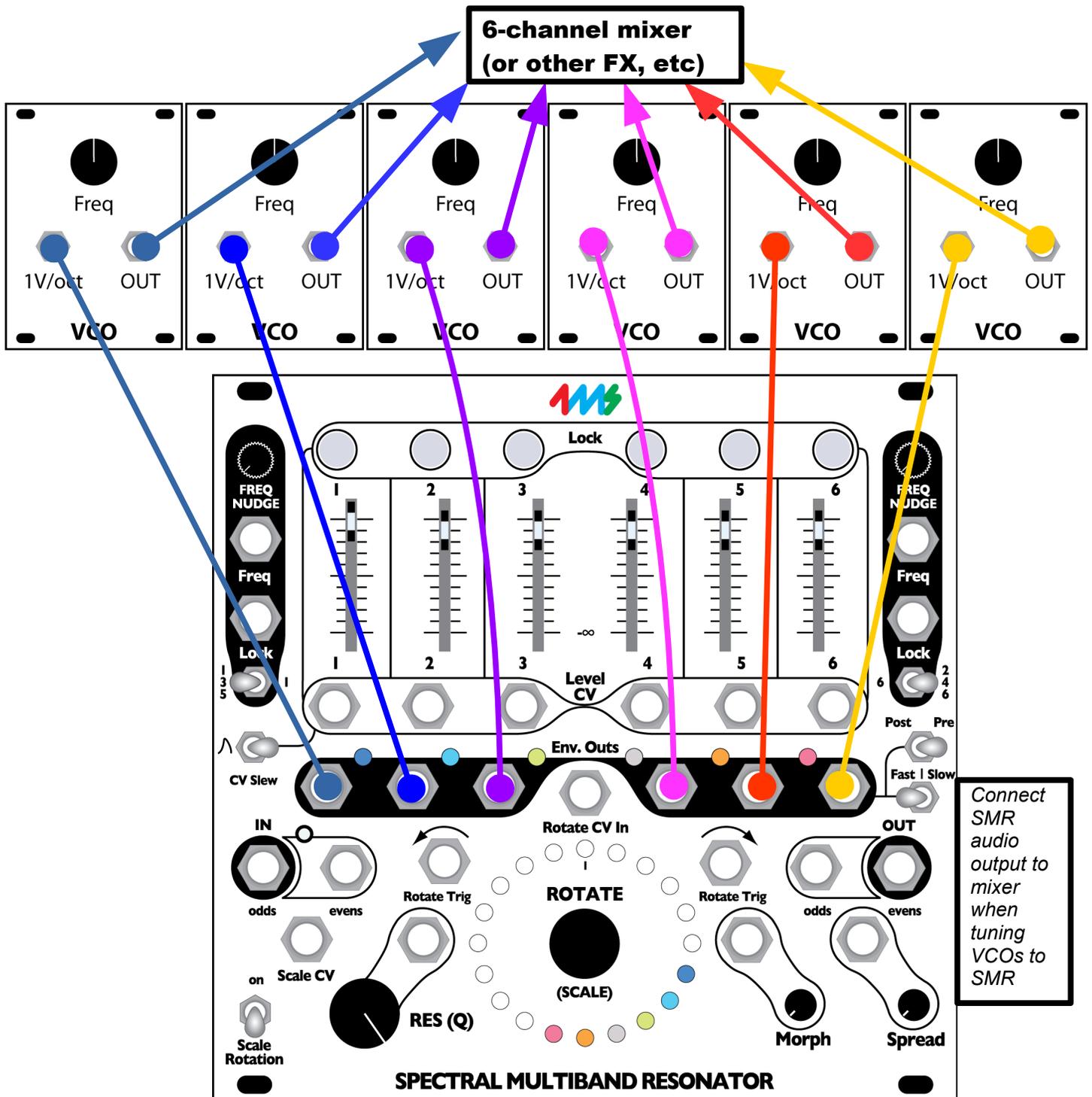
### To load the firmware into your SMR

Follow the instructions at the end of this document

- **New Features in version 5:**
  - **1V/Octave outputs:** Control up to 6 external VCOs with 1V/oct CV, for sequences, chords, and melodies
    - Holding down ROTATE while flipping to "Fast" enables 1V/octave outputs on Env Out jacks
    - Glissando (glide) can be enabled with the Pre/Post switch
    - In System Mode, adjust the 1V/oct tracking for 1V/oct outputs, in order to compensate for external VCOs that may track slightly more or less than 1.00V/octave
    - *User Manual pages 18 and 20*
  - **Transposition and fine tuning** allows the SMR to be quickly tuned to external equipment
    - Each channel can be transposed from -6 to +6 semitones
    - Each channel can be fine-tuned up to 120 cents (a little over a half-step)
    - New light display features show the transposition and fine tuning
    - *User Manual page 12*
  - **Forbidden Notes** - select notes that will be skipped when rotating or spreading
    - Forbidden Notes can be saved into Settings Slots for use after power-down
    - *User Manual page 16*
  - **Two-pass resonant filter** - lusher tones and tighter filtering of the input signal
    - New algorithm filters out all background bleed-through by acting like two SMRs in series
    - RES (Q) knob fades in the second resonator for a much wider range of resonance values
    - Two-pass resonance has a slower attack and decay when "struck" with a trigger, so backwards strike effects can be obtained
    - Original one-pass resonant filter available by turning Q knob down, or by selecting it System Mode
    - *User Manual page 13 and 21*
  - **New major and minor scale banks**
    - Major and Minor scales
    - Major chords: Pentatonic, Major 6<sup>th</sup> and 7<sup>th</sup> chords, Augmented and Diminished 7<sup>th</sup>
    - Minor chords: Blues Scales, Minor Pentatonic, Minor 6<sup>th</sup>/7<sup>th</sup> chords, Half Dim 7<sup>th</sup>
    - All scales and chords can be transposed to any key
    - *User Manual, back page*
  - **New intuitive organization and display of scales and banks**
    - Banks are now arranged into Color Groups (blue, pink orange, green, white)
    - Each Color Group has a theme: for example Blue is Equal Temperament and Green is Modern
    - The six Env Out lights show the Color Group, and the current bank selection within the group
  - Env Out Trigger threshold level can be saved independently of channel audio level
    - Flip switch to "Pre" to cache the threshold levels set by the sliders. Then you can adjust the audio mix with the sliders without changing the trigger thresholds
    - *User Manual page 18, and "Beat-syncing: Advanced Re-mixing" example patch, page 7*
  - To adjust 1V/oct input (Freq jack) tracking, press Lock button 5 in Custom Scale mode
  - To adjust 1V/oct output (Env Out jack) tracking, press Lock button 6 in Custom Scale mode
  - Reduced noise in controls, cleaned up some scales

The following pages are excerpts from the User Manual. Read the full manual here: <http://4mscompany.com/SMR/manual/SMR-manual-1.1.pdf>

# Six voice sequencer, chord machine and hexaphonic VCO controller



The SMR's Env Out jacks have a special feature where they can output 1V/octave CV to control external VCOs. Since the SMR has many different chords and scales amongst which you can rotate, spread, lock, etc, the SMR can be a powerful sequencer, arpeggiator, or chord generator.

1) Find up to 6 VCOs in your system and patch an audio output like sine or triangle from each one to a mixer. You should be able to listen to all six at the same time, and control each VCO's level. Later you may wish to

run some VCOs through VCAs or effects or other processing (or even use one VCO to FM the next) – but if you want to keep things simple, just run the VCOs directly to a mixer. Also run the SMR to the mixer so you can monitor it. It's OK to use fewer than 6 VCOs, even a single VCO will produce fun results.

- 2) Enter 1V/oct mode on the SMR by holding down the ROTATE button while flipping the Fast|Slow switch to “Fast”, as described on page 18 (1V/oct outputs).
- 3) Patch each of the six Env Out jacks on the SMR to the 1V/oct input on each of the six VCOs.
- 4) Turn down all the SMR sliders except one channel, and turn down all the VCOs in the mixer except the one associated with that SMR channel. Use the VCO's frequency knob to tune it to the SMR's pitch. Repeat this step for all six channels/VCOs. (Of course, this is purely optional since you are welcome to tune or de-tune to suit your tastes and the requirements of the patch)
- 5) When you are satisfied with the tuning, go ahead and play! Spin the ROTATE knob and listen to the VCOs track with the scale. If you have Morph turned up and Post/Pre flipped to Pre, then you'll hear a glissando effect. Flip to Post to disable to effect, or just turn down Morph. The Morph time and the glide time are equal if glissando is enabled.
- 6) Mixing in both the SMR and the VCOs at the same time can be interesting, especially if the SMR is morphing and the VCOs are gliding (glissando).
- 7) Try FM'ing the SMR using the Freq jacks. The FM gets passed to the VCOs. You can even use one SMR to sequence a second SMR which is controlling VCOs.
- 8) Try transposing some channels on the SMR (see Transposition section later in this manual). Hold down an odd channel lock button and turn the left side Freq Nudge knob (or hold down an even channel and turn the right side knob).
- 9) For an arpeggiation patch, run triggers into the Rotate → and Rotate ← jacks. And/or run CV into the Spread CV jack.

## **New in v5 : Fine Tuning with the Freq Nudge knobs**

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There are two Freq Nudge knobs, one for the odd channels, and one for the even channels. The Odds Freq Nudge knob is the one on the left (next to channel 1), and the Evens Freq Nudge knob is the one on the right (next to channel 6).

A switch labelled “135 | 1” or “6 | 246” selects whether the Freq Nudge knob controls all the odd or even channels or just channel 1 or 6. So if the switch on the left is flipped to “135” then the Freq Nudge knob (as well as the Freq jack and Lock jack below the Nudge knob) will control channels 1, 3, and 5. On the other hand if the switch was flipped to “1”, then Freq Nudge (and the two jacks below it) will control just channel 1. The same is true for the 246 | 6 switch on the evens side.

*Note: The word “Lock” is written above the 135 | 1 switch, and it's a common beginner mistake to call this switch the “Lock” switch. However the word “Lock” refers to the jack above the switch, not the switch. The switch selects whether the Lock jack, Freq jack, and Freq Nudge knob control channels 1,3, and 5 or just channel 1. Likewise, the same is true on the right side for the 6 | 246 switch.*

Freq Nudge's default position is at 0%, this means the frequency is not nudged and the notes in the current scale will be unaffected. Thus if you wish to keep the channels in tune with the scale as it was programmed, keep the Freq Nudge knobs all the way down. As you turn Freq Nudge up, the frequency will bend upwards. At 100%, the frequency will be shifted up by a little more than a half-step (about 120 cents, just over a semitone).

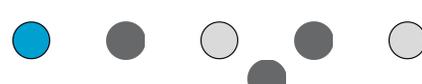
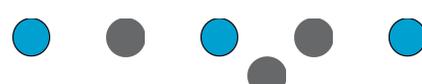
In firmware v4 and earlier, the Freq Nudge knobs blended linearly between adjacent notes in the scale. In firmware v5, the knobs work exponentially, setting a precise number of cents (1/1200th of an octave). This is useful for tuning to external instruments since you can tune using one note only and all other notes will track.

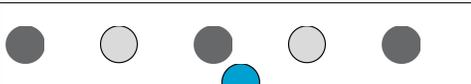
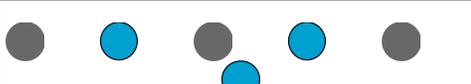
Locking a channel also locks the Freq Nudge setting. So you can nudge a channel up to an exact frequency and then lock it, continuing to use Freq Nudge to nudge other channels without effecting the locked channel.

## Light display of Freq Nudge

*New in v5:* When you turn either Freq Nudge knob, the channels that are effected will change color on their Env Outs lights to indicate how much “Nudge” is assigned to that channel. After a second, the lights will go back to their original function to indicate the signal on the Env Out jacks. Let’s take an example: if have the 6 | 246 switch flipped to 246 and you turn the Evens Freq Nudge knob, then the Env Out lights next to channels 2, 4, and 6 will change from white (no Nudge) to blue (a little over a semitone of Nudge upwards). At the same time, the odd channel lights will turn off to show that you are using the Evens Nudge knob. Locking a channel with the buttons also disables Nudging: in the previous example if channel 4 happened to be Locked with its lock button, then only channels 2 and 6 will show white/blue, and channel 4 will be dim.

If you flip the 135 | 1 or 6 | 246 switches, the channels that were effected will blink twice to attract your attention before changing to dim or bright to indicate they are enabled or disabled by the switch. For example if you flip from 135 to 1, then channels 3 and 5 will blink twice and go dim to indicate that the Freq Nudge knob (and the jacks below it) are no longer effecting channels 3 and 5. If you flip back to 135, channels 3 and 5 will blink twice and go bright to indicate they can be controlled now. A similar thing happens if you press a channel’s Lock button: it will blink twice and then go dim or bright to indicate it’s able to be controlled by the Freq Nudge pot.

135   1 Switch	Env Out light display	When turning Odds Freq Nudge knob...
		Channel 1 is being Nudged (light is changing color) <i>Channels 2, 3, 4, 5, 6 are not effected (lights dim or off)</i>
		Channels 1, 3, 5 are being Nudged (lights changing color) <i>Channels 2, 4, 6 are not effected (lights off)</i>

Env Out light display	6   246 Switch	When turning Evens Freq Nudge knob...
		Channel 6 is being Nudged (light is changing color). <i>Channels 1, 2, 3, 4, 5 are not effected (lights dim or off)</i>
		Channels 2, 4, 6 are being Nudged (lights changing color) <i>Channels 1, 3, 5 are not effected (lights off)</i>

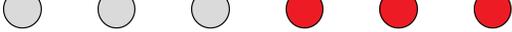
Experiment a bit with listening to which channels change pitch as you turn the Freq Nudge knobs. Watch the lights change from white to blue to indicate how much each channel has been Nudged. Then flip the 135|1 and/or 246|6 switches, watch the Env Out lights, and listen again to see which channels are effected. The light display is only there to help you know which channels are being changed when you adjust a control, and it does not change the signal on the Env Out jacks.

Since multiple channels share a single Freq Nudge knob and the knob can also be used for Transposition, the setting is only updated when the knob cross the actual Freq Nudge setting. Therefore if you want to quickly clear the Freq Nudge setting, flip the switches to 246 and 135, and turn both Freq Nudge knobs fully up and then full down. This will set all unlocked channels back to zero Nudge. To verify, check that the Env Out lights turned white.

## New in v5: Transposition (changing keys)

*New in v5:* Besides being able to fine-tune each channel using the Freq Nudge knob (see above), you also can transpose each channel by an integer number of semitones, a maximum of 6 half-steps up or down. Each channel can be transposed on the fly, while playing live, independently of other channels. This allows for real-time chord modulations, key changes, etc.

**Lock**   To transpose a channel, hold down its Lock button and turn its Freq Nudge knob (left Freq Nudge for odd channels, right Freq Nudge for even channels). The Env Out lights will immediately change color to red and/or blue to show you how many steps the channel is transposed. Red lights indicate downward transposition, and blue lights indicate upwards transposition. So if you see 4 red lights, the channel is transposed down 4 semitones (2 whole steps). When the channel is not transposed (0), the display shows three red lights and three blue lights. See the following chart:

Env. Out light display:	# Semitones Transposed	Key of C becomes...
	+6	F#
	+5	F
	+4	E
	+3	D#
	+2	D
	+1	C#
 = No Transposition	(none)	C
	-1	B
	-2	A#
	-3	A
	-4	G#
	-5	G
	-6	F#

The Transposition of a channel does not start changing until you turn the Freq Nudge knob past the point at which the channel's transposition was last set. If no transposition has been set yet, then you must turn the Freq Nudge knob to center (0) before any transposition will happen. This is useful if you want to check a channel's transposition, just hold down its lock button and slightly wiggle its Freq Nudge knob. The Env Out lights will show the current transposition without changing it.

Transposition is very useful with the Major and Minor scales in the Western Bank, which are tuned to C-major and C-minor. With transposition you can set them to any key. For instance, if you want to play minor chords in the key of E, you would go to the C-Minor scale bank (Blue group, Bank 2, Scale 1) and then transpose all six channels up 4 semitones (4 blue lights). If you are tuning to another instrument or to something like A=432Hz, you could use the Freq Nudge knobs to make fine-tuning adjustments.

You can transpose up to three odd channels or three even channels at the same time by holding down all their Lock buttons while adjusting the odd or even Freq Nudge knob. You can transpose Locked channels, as well.

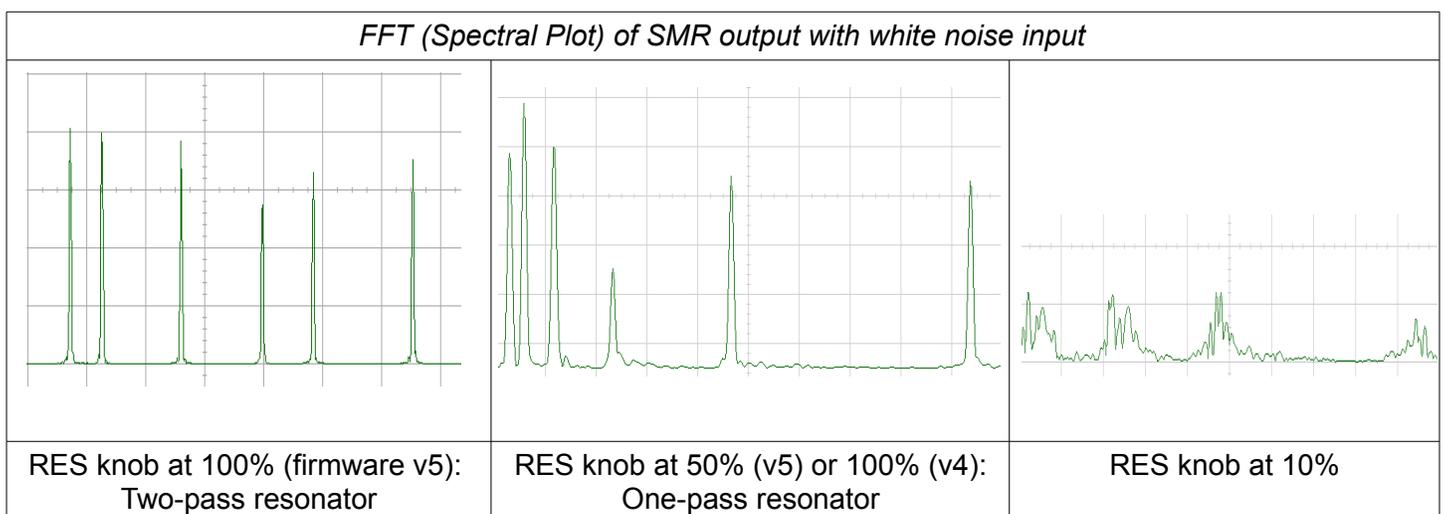
To clear transposition, you can either transpose the channel back to 0, or you can clear all transpositions by holding down all six Lock buttons for two seconds. Any channel that's transposed will start flashing on its Lock button. When you release the button, the transposition will be cleared back to 0. You can use this to "play" transpositions live, by timing when you release each button. Also, if you transpose a channel a locked channel and then clear all transpositions, its transposition will not be cleared until you unlock it. This is another way to facilitate live performance.

## Two Pass filtering: Resonance (Q)

*New in v5:* As you turn up the RES (Q) knob or apply CV, the channels move from low resonance to high resonance at about 12:00. After this point, as you continue turning up RES (Q), a second resonator is cross-faded in, which is essentially like running two SMR modules in series. This second resonator greatly increases the total resonance and helps filter out virtually all background sounds, only allowing the pure tones of the resonant frequencies to pass. This is called a Two-pass resonator and only exists in version 5 and later. In firmware v4 and earlier, the RES knob's range from 0 to 100% is the same as firmware v5's range from 0 to 50% (there is no second resonator in v4 and earlier).

When used with triggers into the audio inputs, Two-Pass resonance with a high Q (80%-100%) slows down the attack and decay. You can use this to get different reverse/backwards effects and play with the envelope timings by adjusting Q.

*Note: If you want to emulate a particular sound found in the one-pass resonator of v4 firmware, you can do so by halving the RES(Q) knob setting. So if in v4 the knob was at 80%, turn it to about 40% with v5's Two-Pass resonator. If you prefer to use the classic SMR sound only, you can switch to the One-Pass filter mode in System Settings (see page 21).*



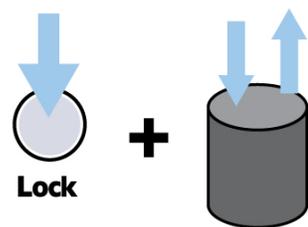
## Banks and Scales display and organization

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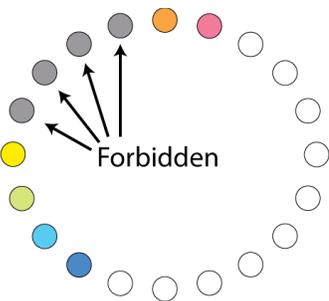
*New in v5:* As you turn the ROTATE knob while holding it down, you will notice the six Env Outs lights change color. The dominant color of the lights tell you what bank Group you are in. There are five groups: blue, pink, orange, green, and white. Each group has a theme, for instance, the Blue Group is all Equal Temperament scales. See the back page of the manual for all scales/banks/groups. One of the lights will be flashing to indicate which Bank you've selected within the Group. So if all the lights are Orange-ish and the fourth light is flashing, then you are in Orange Group, Bank 4 (and looking at the back page of the manual, that's Gamelan Pelog). To get a feel for the organization, just try it: hold down the ROTATE button while turning it, and watch the Env Out lights. Notice that each Group has a dominant color, but the colors within the group have slight variations. This helps distinguish the banks within a group.

## Forbidden Notes

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In firmware version 5 and later, you can tell the SMR to completely avoid certain notes on the scale by “forbidding” the note. This is an advanced feature that lets you control which notes will and will not be used when rotating and spreading. No matter what you do, none of the six channels will go to a Forbidden note. One common use of this feature might be to avoid playing high frequencies: just Forbid all the high notes and the SMR will only rotate around the low and mid notes. This also is useful for arpeggiations and sequences (either using the SMR's resonators or controlling external VCOs), you can tell the SMR which notes in the sequence/arpeggiation to play or not play.



To Forbid a note, rotate/spread one of the channels to the note you want to be avoided. Then hold down that channel's Lock button while you press the ROTATE knob button. You can release both buttons at this point. The note that the channel was on will be Forbidden, and the light on the light ring will turn gray. To confirm this Forbid action, rotate or spread to another note. On the other hand, if you made a mistake, you can immediately undo the Forbid action by repeating the Lock/ROTATE button press. Once you've rotated or spread after forbidding a note, you cannot

undo or clear just that one particular Forbidden note. You can only clear all the Forbidden notes at once. To clear all Forbidden notes, hold down all six Lock buttons and tap the ROTATE knob button.

Keep in mind that the Forbidden notes refer to positions on the ring of 20 lights. Changing the scale or bank will not change the Forbidden notes. One interesting phenomenon arises due to the algorithms that force the channels to maintain different frequencies: forbidding multiple notes and rotating and spreading around them repeatedly can mix up the order of the channels.

*Tip:* you can set multiple Forbidden notes at once by holding down multiple lock buttons as you tap the ROTATE button. However, you can only hold down a maximum of 5 Lock buttons at a time, since holding down 6 buttons and tapping ROTATE tells the SMR to clear all Forbidden notes.

When you save the current state in a Settings Slot (see later in this manual), the current set of Forbidden Notes will be saved and will appear the next time you power on the SMR. Otherwise, if you do not explicitly save your settings, the Forbidden notes will be cleared when you power down.

## Env Out jacks: Trigger mode

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When the switch is in the center position, the Env Out jacks are in Trigger mode. Trigger mode also tracks the frequency content of the audio input signal, but it outputs triggers instead of CV. Whenever the amount of frequency present exceeds a certain threshold, the jack will send a trigger. The jack will remain high as long as

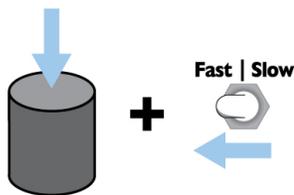
the frequency content stays above the threshold. This is very useful for beat-syncing or triggering external modules that track percussive content of an audio signal (see example patch). It's also useful for patching the SMR to itself (Env Out → Rotate Trigger jacks and Lock jacks)

### Pre | Post (trigger mode)

The threshold is set by the channel's slider (and the Level CV jack). The Pre/Post switch must be set to Post to adjust the threshold. You typically need to adjust the threshold manually to get a good trigger pattern.

**New in v5:** Once you've set the thresholds, flip the switch to Pre and the threshold levels will be saved. At this point you can freely adjust the audio mix using the sliders without changing the thresholds. This is crucial for advanced beat-syncing (see example patch), since you can get all the triggers dial-in and then mix the audio live. *Note: if you flip back to Pre, the saved threshold levels will be erased. Threshold levels are never saved after power-down.*

## Env Out Jacks: 1V/Octave outputs



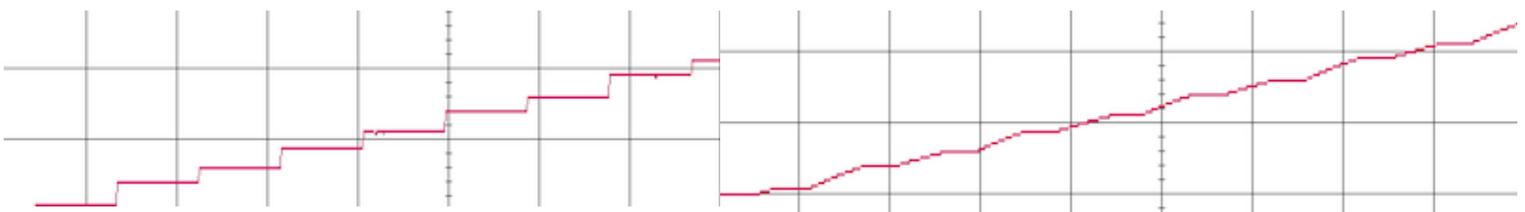
Hold down ROTATE while flipping to Fast

In firmware version 5 and later, holding down the ROTATE button while flipping the Fast | Slow switch to “Fast” will make the Env Out jacks output 1V/Octave CV for each channel. This is a powerful feature that allows you to control up to 6 external VCOs or voice modules, creating sequences, arpeggiations, chords, etc. You can even tune the VCOs to the SMR to create controllable twelve-voice harmonies. You also can use the SMR's Transposition and Freq Nudge features (see page 11) to transpose and fine-tune or de-tune the external VCOs.

The 1V/oct outputs track across 8 octaves (C1 – C9). The Env Out lights will be brighter to indicate higher pitches, and dimmer for lower pitches. To turn off 1V/octave output mode, flip the Fast | Slow switch to any other setting.

### Pre | Post (1V/oct mode)

You also can add glissando (glide) to the 1V/oct CV outputs by flipping the Pre/Post switch to “Pre”. The glissando/glide time is set by the Morph knob/jack. As the SMR morphs from one note to another, the 1V/oct output will pitch bend from the first note to the second. To turn glissando off, flip the switch to “Post”. At this setting, the 1V/oct output will stay at the first note and then sharply jump to the second note until the morph is complete. See the scope shots below:



1V/oct output on Env Out jack  
Switch flipped to **Post** = no glissando

1V/oct output on Env Out jack  
Switch flipped to **Pre** = glissando

Any changes to the resonant frequency of the channel (Transposition, Freq Nudge, Freq jacks, Scale/Bank, Rotation and Spreading) will be reflected by the 1V/oct output. Except when bending between two notes with glissando, each channel's 1V/oct output always reflects the resonant frequency of that channel. Thus your VCOs and the SMR can be tracked together no matter how you patch the SMR.

## Adjust 1V/oct output tracking (Env Out jacks in 1V/oct mode)

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The 1V/octave tracking of the Env Out jacks when in 1V/oct mode can be fine tuned. This allows you to compensate for external VCOs that do not have tracking adjustments of their own. The exponential tracking can be adjusted by about +/-10%.

To change the 1V/oct output tracking:

- 1) Enter 1V/oct mode by holding down ROTATE while flipping the Fast|Slow switch to Fast (see page 18).
- 2) Enter Custom Scales mode by tapping the ROTATE button 10 times rapidly.
- 3) Use the ROTATE knob and button to select a note and scale that you want to use as a test. You may find it useful to program a few octaves into adjacent notes in a custom scale, since octaves are a nice way to tune. This is fast and easy to do since slider #1 is an octave control. See Custom Scales section on previous page.
- 4) Patch the channel 1 Env Out jack into an external VCO's 1V/oct jack.
- 5) Tune the VCO using its frequency or pitch knob to the frequency you hear on the SMR's output.
- 6) Rotate the SMR up and down the scale and see if the VCO and SMR stay in tune.
- 7) If the VCO and SMR go too far out of tune for your taste (and you can't fix it by simply tuning the VCO's frequency knob), then adjust the SMR's 1V/oct output tracking as follows:
  - 7a) Tap the Channel 6 Lock button so that it turns off
  - 7b) Set sliders 5 and 6 to center position
  - 7c) Rotate between two notes on the SMR that are at least one octave apart, while listening to the difference in pitch of the SMR and the VCO
  - 7d) Adjust slider 5 (coarse amount) and slider 6 (fine amount), as well as periodically re-tuning the VCO's frequency knob, until you can rotate back and forth between notes while keeping both devices in tune
  - 7e) If you want to switch to editing a Custom Scale instead, tap the channel 6 Lock button to stop editing the tracking, and then tap the Channel 1 Lock button to start editing the Custom Scales (as described in Custom Scales section above)

Setting slider 5 and 6 higher means the VCO will be more sharp when going from a low to high octave; setting the sliders lower means the VCO will be more flat when going from a low to high octave.

At all times, make sure the SMR's Fast/Slow switch stays at Fast, and the Freq Nudge knobs are all the way down, and nothing else is plugged into the SMR besides the Env Out (1V/oct) output and the audio output cables.

When finished, hold ROTATE for five seconds. The tracking information will be saved into memory. If you want to restore the factory default setting, put both sliders 5 and 6 in the center and then save it. Note that even though the tracking adjustments are made in Custom Scale mode, they apply globally to all scales and banks, not just the Custom Bank.

## Filter Type/mode

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There are three filter modes available in the SMR: One-Pass, Two-Pass, and BpRe.

Firmware v4 and earlier had only One-Pass (default) and BpRe.

In Firmware v5, Two-Pass is added and made the default.

**One-Pass** mode is the classic SMR sound, it's a simple resonator based on an algorithm from Max Matthews and Julius O. Smith III.

**Two-Pass** is essentially the same as running two SMR One-Pass resonators in series. In Two-Pass mode, turning the RES (Q) knob down to a position between 0% and 50% makes the SMR behave as if it were in One-Pass mode: that is to say, One-Pass's range from 0% to 100% has been squeezed into Two-Pass's range from 0% to 50%. Turning the RES (Q) knob up past 50% fades in the second resonator. After about 90% almost all of the background sound is filtered out, leaving just the resonant frequencies. At high Q settings, Two-Pass responds to triggers on the audio input almost with a very slow attack, giving you an almost backwards struck effect.

**BpRe** is an experimental filter mode. The timbre is subtly different, and the decay when struck with a trigger is

more exponential. However, the BPre filter type cannot be tracked 1V/octave. Thus the Freq jacks and Freq Nudge knobs do a linear frequency shift (will not track to external gear if tuned with the jack or knob).

To change filter types, enter System Mode and turn the Odds Freq Nudge knob all the way down. Then rapidly turn it all the way up and then all the way down. This will toggle between Two-Pass and One-Pass mode. When in One-Pass mode, you can rapidly turn the Evens Freq Nudge knob in the same way to toggle between One-Pass and BpRe mode. When the mode is changed you will hear the audio output change, so listen carefully. There is no visual indication of what mode you're in, but you can easily tell with two quick tests:

1) Unplug the IN jacks and turn Q slowly from 0% to 100%, if you hear the white noise in the background disappear around 90-100% then you are in Two-Pass Mode; if it never goes away completely, you are in One-Pass mode.

2) Input a 0-5V triangle wave into one of the Freq jacks: if you hear the pitch of one or more channels go up 5 octaves then you are in Two-Pass or One-Pass; if you hear the pitch bend by less than an octave then you are in BpRe.

### Summary of Advanced control settings

	<p><b>Transpose channel -6 to +6 semitones</b>          Channel Lock + Evens/Odds Freq Nudge          (red/blue lights show amount of transposition)  <i>Hold all six Locks for 2 seconds to clear Transposition</i></p>
	<p><b>Forbid Note (that the channel is currently assigned to)</b>          Channel Lock + tap ROTATE knob          (note on the light ring goes dim)  <i>Press all six Locks + ROTATE to clear Forbidden notes</i></p>
	<p><b>Q-Lock (locks the channel's Q value)</b>          Channel Lock + turn RES (Q)          (Lock button blinks)</p>
	<p><b>1V/Octave output mode</b>          Hold down ROTATE while flipping switch to Fast          (Env Outs jacks output 1V/oct CV)  <i>Pre/Post selects Glissando On/Off</i></p>
	<p><b>Change scale banks</b>          Hold down ROTATE while turning          (lights show color of current bank, see back page)</p>

## Updating firmware with the Audio Bootloader

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The SMR contains a bootloader that is used to update the firmware by playing an audio file into odds IN jack. Firmware audio files can be downloaded at <http://4mscompany.com/smr.php>

1. To enter bootloader mode, power off the SMR and connect a computer or smart phone audio output to the odds IN jack. Either a stereo or mono cable is fine. Plug the evens OUT jack to an amp/speakers so you can listen.  
**Remove your phone case, it may be preventing the cable from fully plugging in.**
2. **Set the computer/phone's volume is at 100%** and the audio player software is also at 100% volume. Turn off all audio and vibrate notifications (use Airplane mode).
3. Hold the ROTATE button down while powering the SMR on. Keep holding it down, and release the button when you see just a single light on, slowly changing color. The SMR is ready to receive firmware.
4. Begin playing the file. Immediately you should see the slider LEDs do a sequential animation, and the light ring slowly filling up with lights, and then clearing, then filling up again. Do not interrupt the process! You can monitor the audio by listening to the evens Lock jack or the audio OUT jacks.
5. If at any time two of the Lock lights turn on (channels 2 and 3, or channels 2 and 4) and the other lights stop animating, then an error has occurred. Verify the cable is not loose, all sounds/vibrate/notifications are off, and that you have downloaded the audio file completely (avoid streaming or playing from the browser). Check the volume is at 100%. Remove the protection case from your smart phone. Stop the audio file, reset it back to the start, and tap the ROTATE button to reset. The single flashing light should come on and the Lock lights should turn off. Play the file from the beginning again.

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

The audio files are not at this location, they are available from <http://4mscompany.com/smr.php>

## Firmware Version

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To view the firmware version, tap the ROTATE button 10 times rapidly to enter “Custom Scales” mode. Starting with Firmware version 2, the Blue/Green/Red elements of the Env. Outs LEDs read as a binary code of the firmware version number, with Channel 1 Red being the least significant bit, and Channel 6 Blue being the most significant bit.

*Firmware version 1: All Env Out LEDs normal colors*

*Firmware version 2: Channel 1 Green*

*Firmware version 3: Channel 1 Yellow*

*Firmware version 4: Channel 1 Blue (early 2016)*

*Firmware version 5: Channel 1 Pink (Dec. 2016)*

## System Mode

4 sec.



**ROTATE**

Hold down ROTATE for 4 seconds to enter System Mode

Factory Reset:  
Hold down all six Lock buttons and ROTATE button for 4 seconds

Turn up and down 2x rapidly to toggle One-Pass and Two-Pass filter modes

Tap a Lock button to load a Settings Slot (exits without saving)

Hold a Lock button for 4 seconds to save current settings into a Slot and exit

Turn up and down 2x to toggle One-Pass and BpRe filter modes (disabled if Two-Pass is enabled)

Slide up and down 5 times to toggle clipping indication

Turn to change Color Schemes

Tap quickly to exit without saving

Hold again for 4 seconds to Save and exit

Hold for 4 seconds to create Custom Color Scheme

## Custom Scale and Tracking

Tap 10 times



**ROTATE**

Tap ROTATE rapidly 10 times to enter Custom Scale/Tracking Mode

Tap Lock 1 to edit Custom Scale

Tap Lock 5 to edit Freq Jack Tracking (1V/oct input)

Tap Lock 6 to edit 1V/oct output tracking (Env Outs)

Octave

Note

Micro-tone

Nano-tone

Input Tracking V/oct

Offset

Output Tracking (coarse)

Output Tracking (fine)

Firmware Version  
Pink=v5  
Blue=v4  
Yellow=v4  
Green=v2

Hold for 4 seconds to Save and Exit

## Blue Group = Equal Temperament

Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6
Major scale/chords (key of C-maj unless transposed)	Minor scale/chords (key of C-min unless transposed)	Single Western Intervals (key of A unless transposed)	Western Triads (key of G unless transposed)	Chromatic Scale (Half-steps)	Diatonic Scales (Equal Temperament)
Scale 1: Major chords Scale 2: Major 6 <sup>th</sup> chds Scale 3: Major 7 <sup>th</sup> chds Scale 4: Aug. chords Scale 5: Aug. 7 <sup>th</sup> chords Scale 6: Dom 7 <sup>th</sup> chords Scale 7: Pentaton. (1/2) Scale 8: Pentaton. (2/2) Scale 9: Major Scale C1- Scale 10: Maj. Scale B3- Scale 11: Maj. Scale A6-	Scale 1: Minor chords Scale 2: Minor 6 <sup>th</sup> chds Scale 3: Minor 7 <sup>th</sup> chds Scale 4: Half Dim7 chds Scale 5: Harm.Min C1- Scale 6: Minor Pent C5- Scale 7: Blues C1- Scale 8: Blues F4- Scale 9: Harm.Min C1- Scale 10: Harm.Min. B3- Scale 11: Harm.Min. A6-	Scale 1: Octaves + m2 Scale 2: Octaves + M2 Scale 3: Octaves + m3 Scale 4: Octaves + M3 Scale 5: Octaves + P4 Scale 6: Octaves + d5 Scale 7: Octaves + P5 Scale 8: Octaves + m6 Scale 9: Octaves + M6 Scale 10: Octaves + m7 Scale 11: Octaves + M7	Scale 1: Major 2+minor 2 Scale 2: Major 3+dim. 5 Scale 3: minor 3+5ths Scale 4: Major 3+5ths Scale 5: 4ths + 5ths Scale 6: Major 3+Major 6 Scale 7: minor 3+minor 6 Scale 8: minor 3+Major 6 Scale 9: minor 3+minor 7 Scale 10: 5ths+minor 7 Scale 11: 5ths+Major 7	Scale 1: E2 - C4 Scale 2: A#2 - F#4 Scale 3: E3 - C5 Scale 4: A#3 - F#5 Scale 5: E4 - C6 Scale 6: A#4 - F#6 Scale 7: E5 - C7 Scale 8: A#5 - F#7 Scale 9: E6 - C8 Scale 10: A#6 - F#8 Scale 11: E7 - C9	Scale 1: A2 - B5 Scale 2: A5 - B8 Scale 3: B2 - C#5 Scale 4: B5 - C#8 Scale 5: C2 - D5 Scale 6: C5 - D8 Scale 7: D2 - E5 Scale 8: D5 - E8 Scale 9: E2 - F#5 Scale 10: E5 - F#8 Scale 11: F4 - G7

## Pink Group = Just Intonation

Bank 1	Bank 2	Bank 3
Single Intervals (key of A, Just Int.)	Western Triads (key of G, Just Int.)	Diatonic Scales (Just Intonation)
Scale 1: Octaves + m2 Scale 2: Octaves + M2 Scale 3: Octaves + m3 Scale 4: Octaves + M3 Scale 5: Octaves + P4 Scale 6: Octaves + d5 Scale 7: Octaves + P5 Scale 8: Octaves + m6 Scale 9: Octaves + M6 Scale 10: Octaves + m7 Scale 11: Octaves + M7	Scale 1: Major 2+minor 2 Scale 2: Major 3+dim. 5 Scale 3: minor 3+5ths Scale 4: Major 3+5ths Scale 5: 4ths + 5ths Scale 6: Major 3+Major 6 Scale 7: minor 3+minor 6 Scale 8: minor 3+Major 6 Scale 9: minor 3+minor 7 Scale 10: 5ths+minor 7 Scale 11: 5ths+Major 7	Scale 1: A2 - B5 Scale 2: A5 - B8 Scale 3: B2 - C#5 Scale 4: B5 - C#8 Scale 5: C2 - D5 Scale 6: C5 - D8 Scale 7: D2 - E5 Scale 8: D5 - E8 Scale 9: E2 - F#5 Scale 10: E5 - F#8 Scale 11: F4 - G7

## Orange Group = Non-Western Tunings

Bank 1	Bank 2	Bank 3	Bank 4
Indian Pentatonic	Indian Shrutis	Mesopotamian	Gamelan Pelog
Scale 1: E0 to ~C#3 Scale 2: E1 to ~C#4 Scale 3: E2 to ~C#5 Scale 4: E3 to ~C#6 Scale 5: E4 to ~C#7 Scale 6: E5 to ~C#8 Scale 7: E6 to ~C#9 Scale 8: Spread1, 120Hz- Scale 9: Spread2, 120Hz- Scale 10: Spread1, 20Hz- Scale 11: Spread2, 20Hz-	Scale 1: 16.35 – 31.04Hz Scale 2: 32.7 – 62.1Hz Scale 3: 65.4 – 124Hz Scale 4: 131 - 248Hz Scale 5: 262 - 497Hz Scale 6: 523 - 993Hz Scale 7: 1046 - 1987Hz Scale 8: 2093 - 3973Hz Scale 9: 4186 - 7947Hz Scale 10: 8.3k – 15.9k Scale 11: 16.7k - 20k	Scale 1: ISHARTUM A1 Scale 2: ISHARTUM A4 Scale 3: EMBULUM A1 Scale 4: EMBULUM A4 Scale 5: NIDMURUB A1 Scale 6: NIDMURUB A4 Scale 7: QUABLITUM A1 Scale 8: QUABLITUM A4 Scale 9: KITMUN A1 Scale 10: KITMUN A4 Scale 11: MITUM A1	Scale 1: Java (5 notes) low Scale 2: Bali (7 notes) low Scale 3: Pelog, var1, low Scale 4: Pelog, var2, low Scale 5: Pelog, var3, low Scale 6: Java (5 note) mid Scale 7: Bali (7 note) mid Scale 8: Bali (7 note) high Scale 9: Pelog, var1, high Scale 10: Pelog, var2, hi Scale 11: Pelog, var3, hi

## Green Group = Modern Tunings

Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6
Wendy Carlos's Alpha scale (selected notes)	Wendy Carlos's Alpha scale (more selected notes)	Wendy Carlos's Gamma scale (selected notes)	17-notes/octave Scales are arranged consecutively from 13.75Hz to 20kHz	Bohlen-Pierce Tritave Every 13 notes the frequency triples. Consecutive scales	"296" EQ Frequencies Each scale is shifted up 50 cents from previous

## White Group = Custom Scales (user-programmable)

Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6