CYCLE INSTRUMENTS

TETRACHORDS

USER GUIDE

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Controls - Index

TODO

Important!

The Tetrachords is not a stand-alone instrument.

It plays very well with other instruments and can function as studio's connective hub. However, it has certain requirements without which it cannot function.

It requires a standard Eurorack power supply and takes 36hp of rack space.

It requires an external source of MIDI notes or CV triggers. The Tetrachords on its own does not generate rhythms.

It requires instruments to connect to. The Tetrachords outputs MIDI notes and 4 channels of CV but on its own does not generate sounds.

Reading this guide

Each section in this guide begins with an overview, illustrating and briefly describing the relevant controls, followed by a more detailed description.

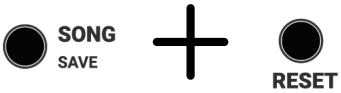
The hope is that the overview sections will be sufficient for players who prefer to learn with minimal guidance whilst extra detail is available for those who want it.

Installation

TODO

Initialise patch

Pressing and holding the SONG button and then pressing the RESET button initialises the Tetrachords.

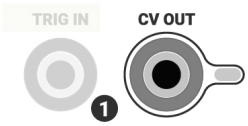


What initialising the Tetrachords means is detailed in the Structure section of this guide.

(cont.)

First patch

❶ Connect the CV OUT 1 output of the Tetrachords to a v/octave input of a VCO.

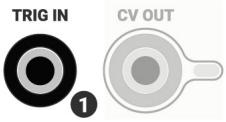


OR

Connect to a MIDI instrument via either the MIDI OUT jack or the USB C connector.

The MIDI instrument should be set to respond to notes on MIDI channel 1.

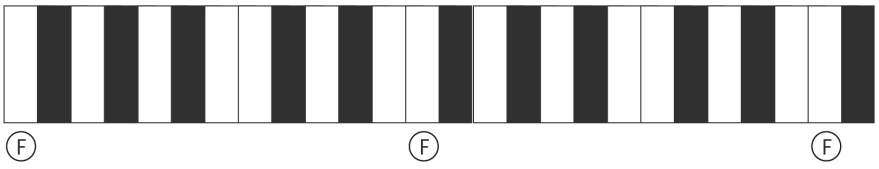
❷ Connect a gate signal to the Tetrachords TRIG IN jack.



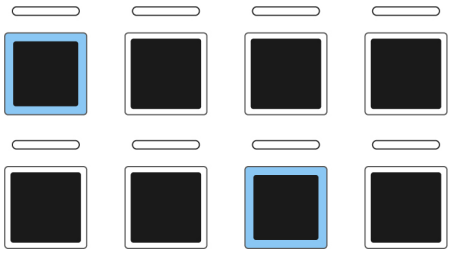
OR

Connect a MIDI sequencer via either the MIDI IN jack or the USB C connector.

The Tetrachords will respond to any F notes received on MIDI channel 5.



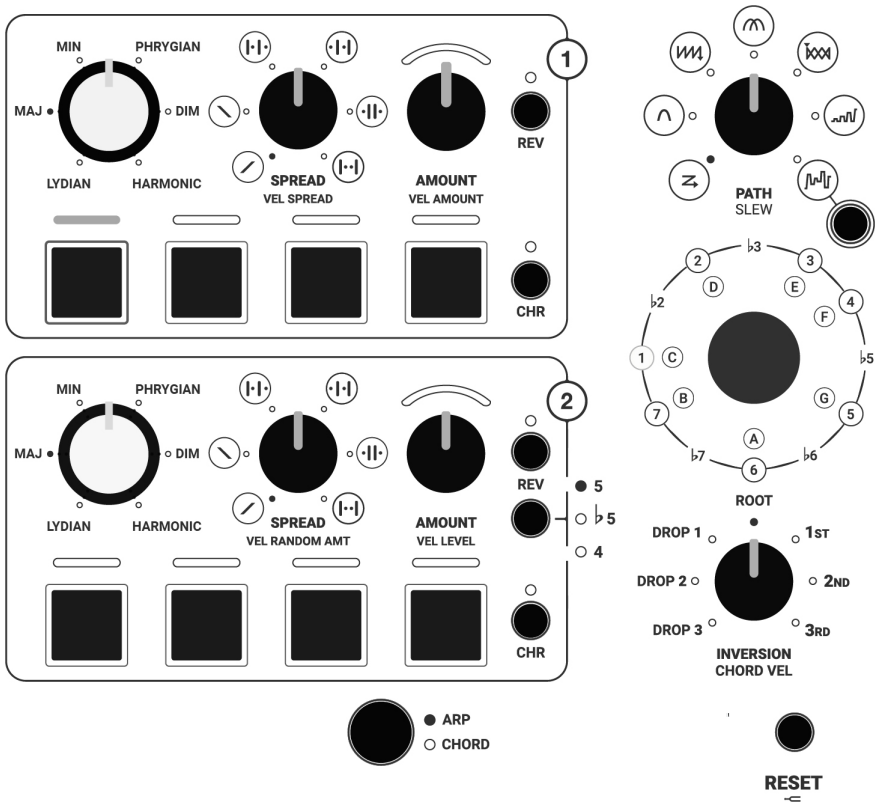
❸ Activate notes by pressing any of the 8 RGB NOTE BUTTONS.



When a GATE or MIDI signal is received, the Tetrachords will output CV or MIDI notes corresponding to the active notes.

(cont.)

❹ Experiment!



The controls above all affect this first patch in some way.

NOTE

- *It can be easier to get a sense of what the controls are doing when many notes are active i.e. most of the RGB buttons are blue.*
- *The ARP/CHORD button has a dramatic effect when connected to MIDI OUT but doesn't do anything interesting (in this patch) when the Tetrachords is connected to CV OUT only.*
- *The SPREAD knob doesn't do anything when the AMOUNT knob is at 12 o'clock.*

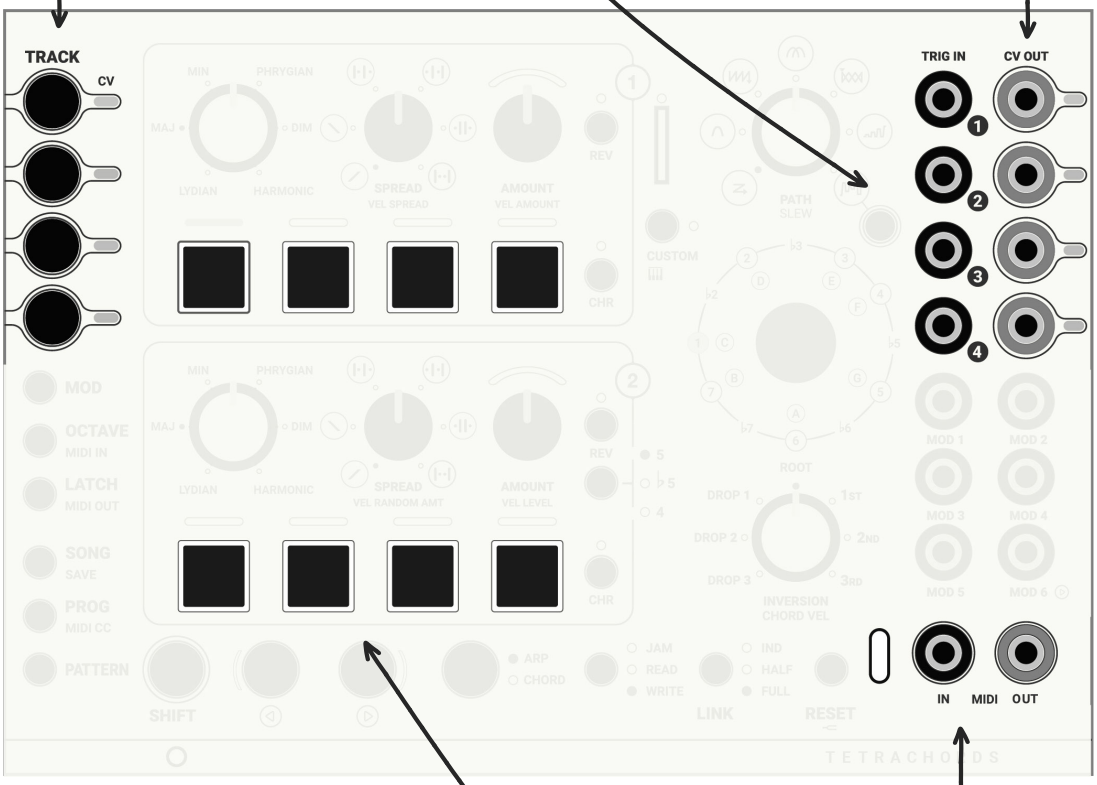
Tracks - Overview

The Tetrachords features 4 polyphonic tracks with fixed CV inputs, assignable MIDI inputs and assignable CV and MIDI outputs.

TRIG INS
Assigned to tracks 1-4 respectively.

TRACK BUTTONS
Select the active track.

CV OUTS
Assigned by default to tracks 1-4 respectively



RGB NOTE BUTTONS
Press to activate notes.

Active notes assume the colour of the current track.

MIDI INPUTS & OUTPUTS

Tracks - Inputs

An external CV or MIDI connection is required to trigger notes.

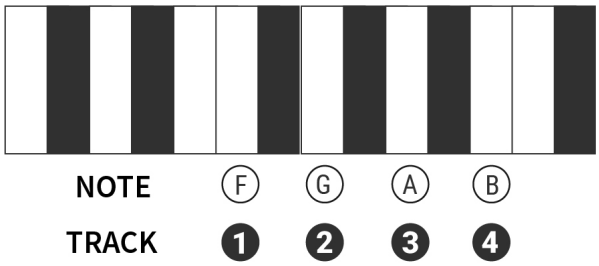
MIDI input connections are made by USB or by the MIDI IN jack.

The MIDI IN jack works with both Type A (Korg) and Type B (Arturia) MIDI jack connectors.

Trig In connections 1 - 4 are used to trigger tracks 1 - 4 respectively.

By default, MIDI channel 5 is used for triggering tracks.

MIDI notes F, G, A & B, played in any octave, trigger tracks 1 - 4 respectively.

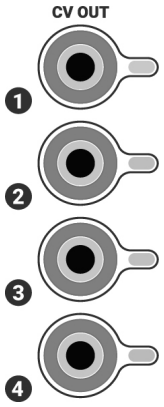


See the MIDI IN section of this guide for a comprehensive run down of how the Tetrachords handles incoming MIDI.

Tracks - Outputs

The Tetrachords sends note information via its CV or MIDI outputs.

By default, tracks 1 - 4 send one-volt per octave CV signals to CV OUTs 1 - 4 respectively.



MIDI output connections are made by USB or by the MIDI OUT jack.

The MIDI OUT jack works with Type A (Korg) by MIDI jack connectors by default.

TODO - when the new board is built add illustrations showing how to switch to Type B.

By default, tracks 1 - 4 send MIDI note messages on channels 1 - 4 respectively.

The Tetrachords MIDI functionality is highly configurable. See the MIDI OUT section of this guide for a comprehensive run down of how the Tetrachords handles outgoing MIDI.

Tracks - Input response

TODO does this belong here? Somehow indicate when a section is more informative than practical.

When the Tetrachords receives a MIDI NOTE ON message or detects the rising edge of a CV GATE, up to three things happen.

1. 1 or more MIDI NOTE ON messages are transmitted via any active MIDI OUTPUTS.

2. A CV voltage/note signal is sent via any of the CV OUTS that have been set up to transmit pitch signals.

3. A CV voltage/velocity signal is sent via any of the CV OUTs that have been set up to transmit velocity/ gate signals.

When the Tetrachords receives a MIDI NOTE OFF message or detects the falling edge of a CV GATE, up to two things happen.

1. 1 or more MIDI NOTE OFF messages are transmitted via any active MIDI OUTPUTS.

2. Any of the CV OUTS that have been set up to transmit velocity/ gate signals output zero volts.

The graphs on the following pages illustrate these responses.

To learn how to configure the CV and MIDI output settings will be detailed later, in the CV and MIDI sections of this guide.

TODO add links once the CV and MIDI sections are finished.

(cont.)

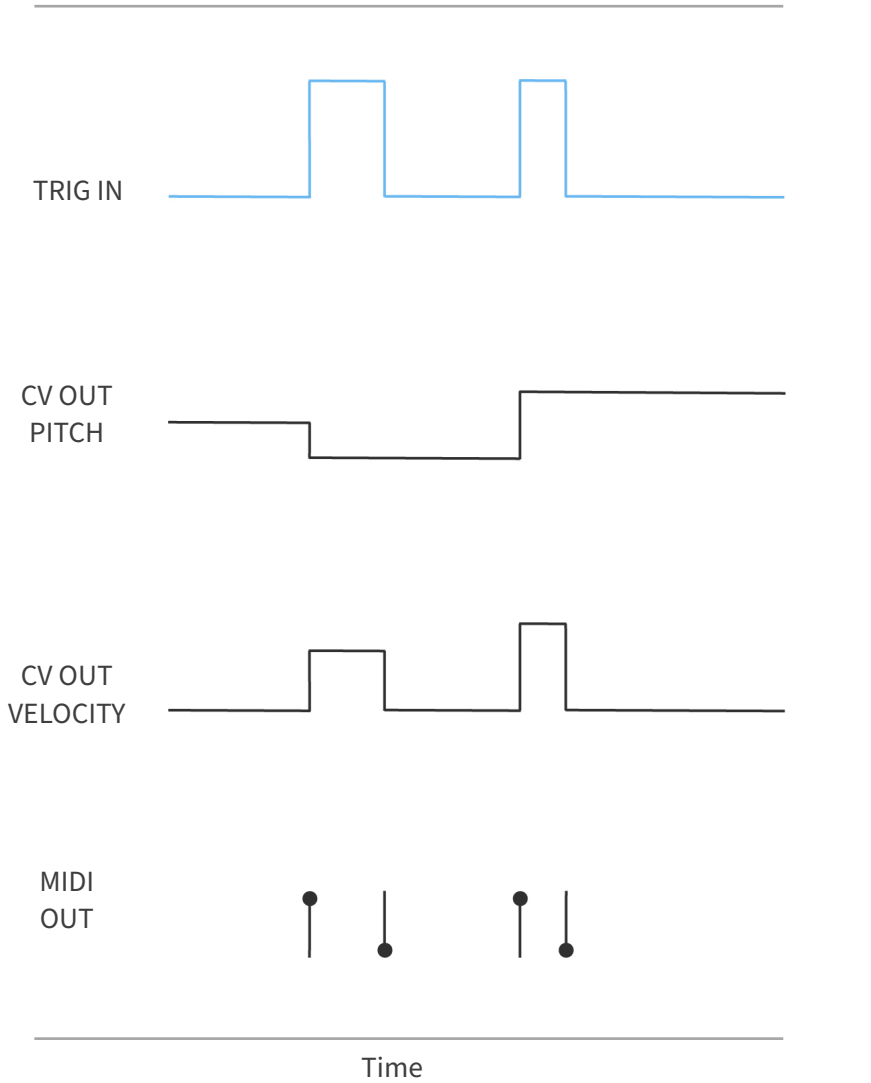
This symbol represents a MIDI note on message

This symbol represents a MIDI note off message.

Inputs are blue

Outputs are black

TRIG IN RESPONSE



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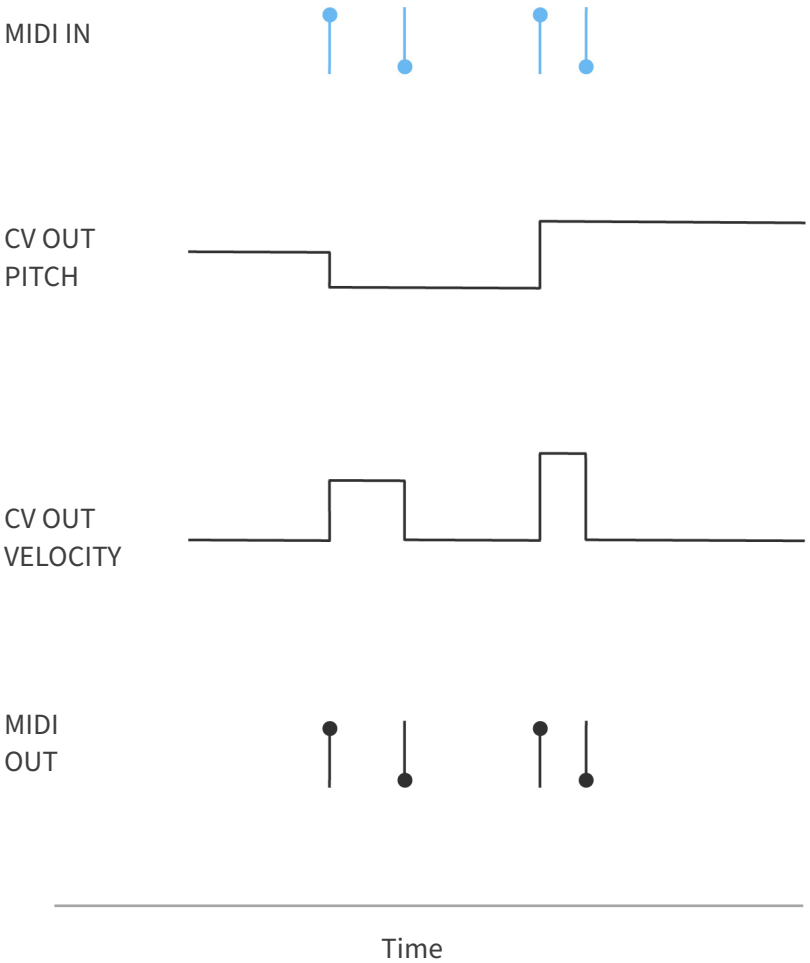
MIDI IN RESPONSE



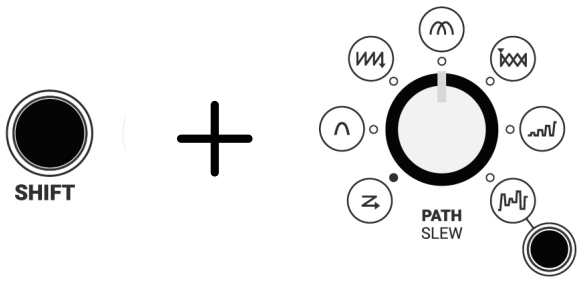
Note that the CV OUT pitch does not respond to a MIDI note off message or to the falling edge of a CV TRIG IN signal.

Shift Button

Many of the Tetrachords controls have primary and secondary functions.

Secondary functions are accessed using the SHIFT button.

For example, pressing and holding the SHIFT button, then turning the PATH knob sets the amount of slew applied to the CV output.

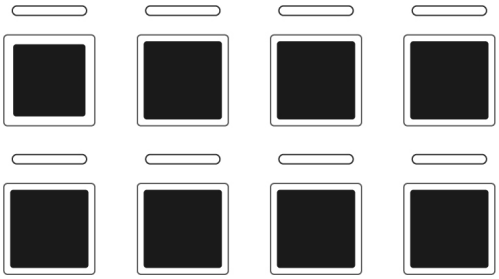


Note that the primary function PATH is labelled more prominently than the secondary SLEW.

Where any control has two labels. The less prominent label describes the SHIFT function.

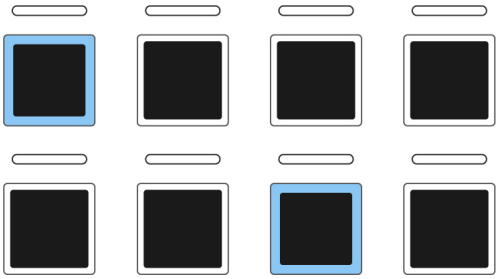
RGB Buttons

Pressing an RGB note button, results in a note being added to, or removed from, the current pattern.



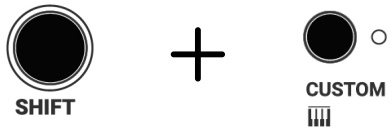
RGB note buttons are white when inactive.

When active, they assume the colour associated with the current track.



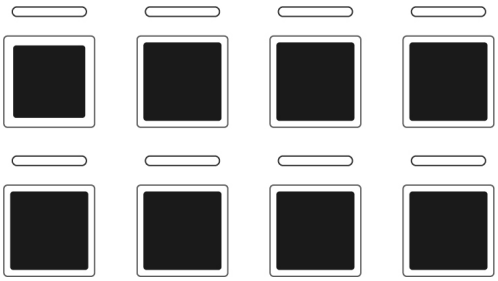
RGB Buttons - Keyboard Mode

Pressing and holding shift, then pressing the custom button places the RGB buttons into *Keyboard Mode*.

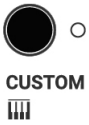


The CUSTOM button LED will flash, indicating that *Keyboard Mode* has been engaged.

In *Keyboard Mode*, the RGB buttons can be triggered manually by pressing them.

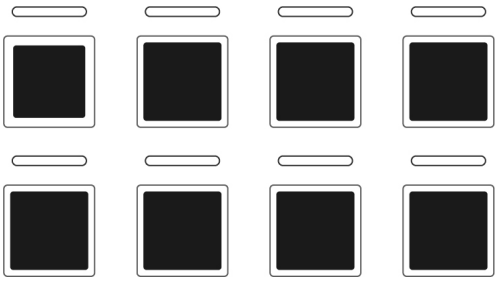


To exit *Keyboard Mode*, press the CUSTOM button again (with or without the SHIFT button).

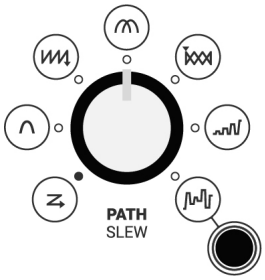


Path Knob - Overview

Pressing an RGB note button, results in a note being added to, or removed from, the current pattern.

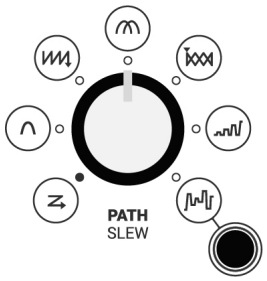


The order in which a pattern's notes play is determined by the position of the PATH knob.



Path Knob - Description

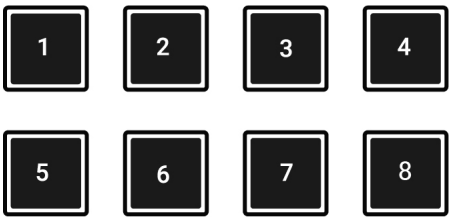
The order in which a pattern's notes play is determined by the position of the PATH knob.



There various path settings are described on the following pages.

In the descriptions, note order refers to order in which the RGB note buttons are triggered.

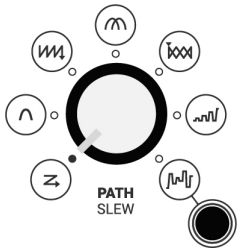
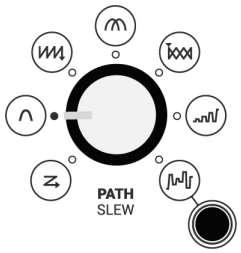
The buttons are referred to by number as illustrated below.



(cont.)

	NOTE ORDER	PATH KNOB
SETTING 1	1 - 2 - 3 - 4 5 - 6 - 7 - 8	
SETTING 2	1 - 2 - 3 - 4 5 - 6 - 7 - 8 8 - 7 - 6 - 5 4 - 3 - 2 - 1	
SETTING 3	1 - 5 - 2 - 6 3 - 7 - 4 - 8	
SETTING 4	1 - 3 - 2 - 4 5 - 7 - 6 - 8	
SETTING 5	1 - 5 - 2 - 7 4 - 8 - 3 - 6	

(cont.)

	NOTE ORDER	PATH KNOB
SETTING 6	**1** **1 - 2** **1 - 3** **1 - 4** **1 - 5** **1 - 6** **1 - 7** **1 - 8** This pattern adapts dynamically in response to which notes are active.	
SETTING 7	**RANDOM** A random combination of all active notes. Press the random button to shuffle the pattern.	

Scales - Overview

These five controls affect the current musical scale settings.

ROTARY ENCODER (TURN)

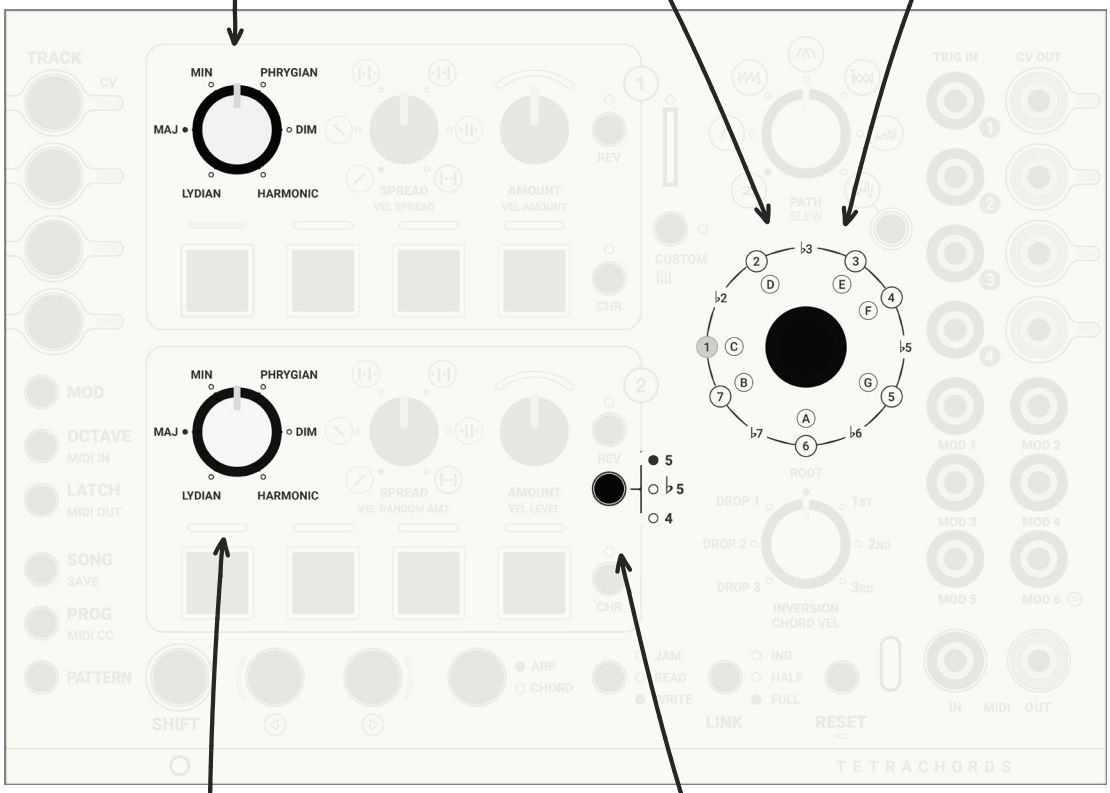
Sets the *mode* of the scale.

ROTARY ENCODER (PRESS &TURN)

Sets the *root note* of the scale.

TETRACHORD 1 KNOB

Sets the pattern for scale notes 1 to 4



TETRACHORD 2 KNOB

Sets the pattern for scale notes 5 to 8

5 ♭5 4 BUTTON

Sets the interval between Tetrachord 1 & Tetrachord 2

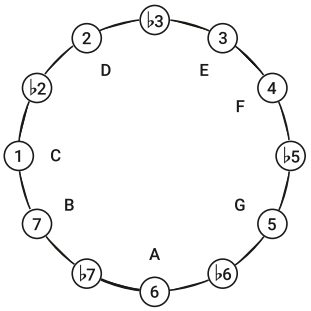
Scales 1 - Display

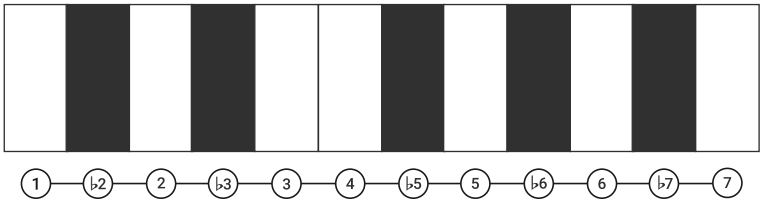
LED RING

In standard operation, the LED ring displays the scale setting for the current track.

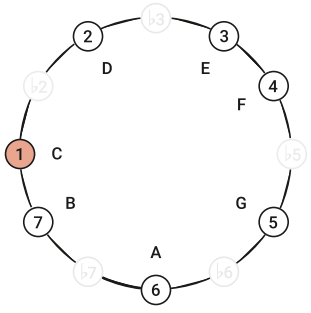
The LED ring consists of 12 LEDs, each representing a note in the Western chromatic scale.

By default, LED 1 represents the note C.





Notes active in the current scale are illuminated and notes outside the current scale are not.



Here the LED ring displays a major scale, with notes 1, 2, 3, 4, 5, 6 & 7 active.

Scales 2 - Root Note

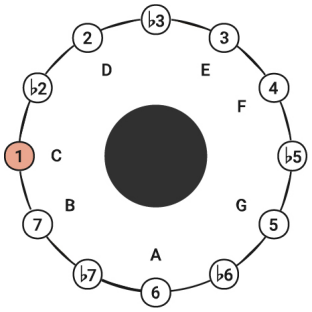
Musical scales have a first name and a second name e.g. *C major* has first name *C* and second name *major*, *B minor* has first name *B* and second name *minor*.

The technical term for a scale's first name is *root note*.

To adjust the root note on the Tetrachords, press and, whilst still pressing, turn the ROTARY ENCODER.

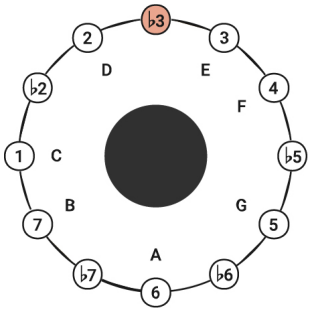
There are 12 root note options, visually represented by the 12 LEDs surrounding the ROTARY ENCODER. Each LED represents one of the 12 notes of the Western chromatic scale.

When the encoder is pressed, the current root note is indicated by a red LED. See the example below, which shows the default setting, root note C.



To change the root note, press and turn the ROTARY ENCODER.

LEDs that don't have a note name label represent accidentals i.e. the black notes on a piano. See the example below, which shows the root note set to D♯/E♭.

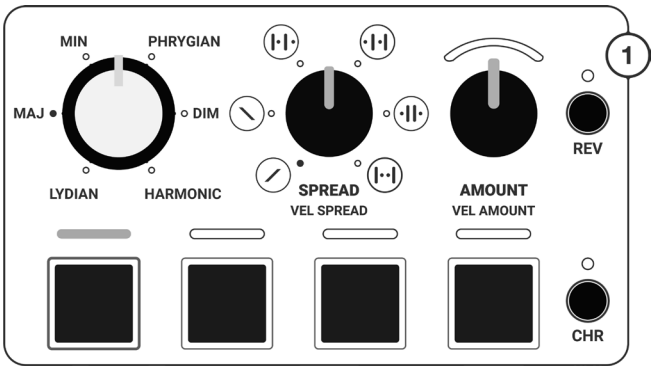


Scales 3 - Tetrachords

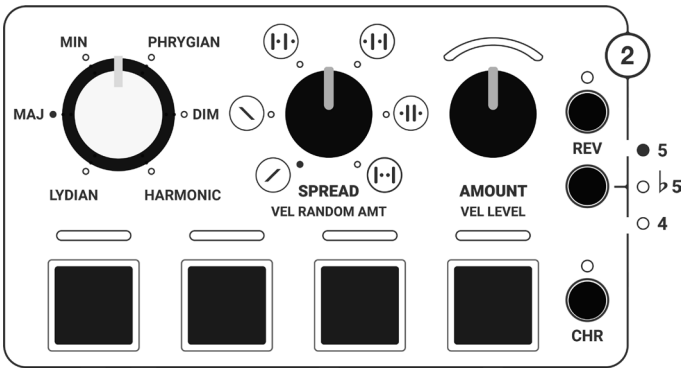
A musical scale can be divided into two, four note halves, called *tetrachords*.

This idea inspired the layout of the Tetrachords with the centre of the module being divided into two sections.

The **TETRACHORD 1** section, for controlling scale notes 1 - 4...



... and the **TETRACHORD 2** section, for controlling scale notes 5 - 8.



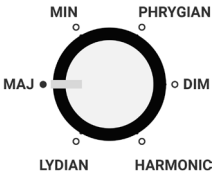
Scales 4 - Note Patterns

As mentioned previously, musical scales have a first name and a second name, with their first name being the root note.

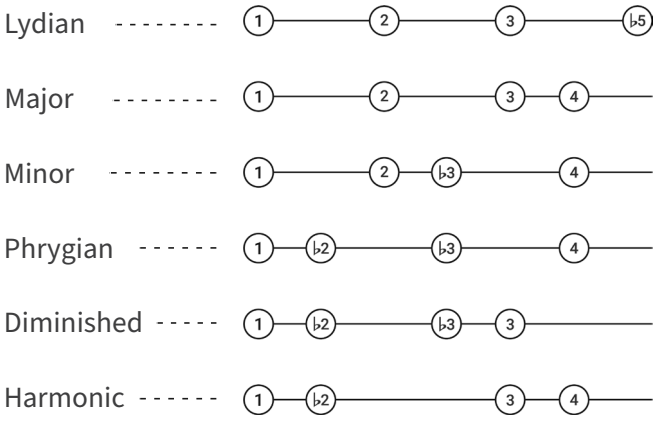
Their second name is derived from the characteristic pattern of *intervals*, aka musical distances, between each note.

Three of the panel controls on the Tetrachords module define the pattern of intervals for a scale.

The first half of the scale is set by the **TETRACHORD 1 KNOB.**



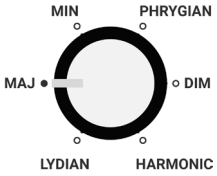
This knob sets the first four scale notes to one of 6 possible *tetrachord* patterns.

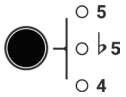


Note: the first note of tetrachord 1 ***is always note 1.***

(cont.)

The second half of the scale is set by the **TETRACHORD 2 KNOB** and the **5 ♭5 4 BUTTON**.

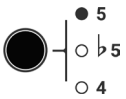




Similar to the **TETRACHORD 1 KNOB**, The **TETRACHORD 2 KNOB** sets scale notes 5 - 8 to one of 6 possible *tetrachord* patterns.

The **5 ♭5 4 BUTTON** sets the interval between *Tetrachord 1* & *Tetrachord 2* i.e. the first note of *Tetrachord 2*

By combining these two controls, the second half of the scale can be set 17 ways. Illustrated below:



Major ------- (5) (6) (7) (1)

Minor ------- (5) (6) (♭7) (1)

Phrygian ----- (5) (♭6) (♭7) (1)

Diminished ---- (5) (♭6) (♭7) (7)

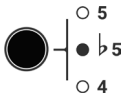
Harmonic ----- (5) (♭6) (7) (1)

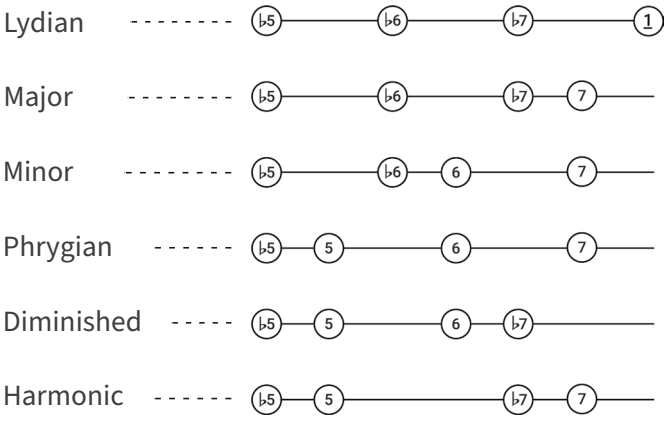
An underscore indicates a note which is an octave higher, i.e. (1) is an octave above (1).

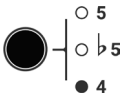
Observe that in some of the above examples, note 1 follows note 7.

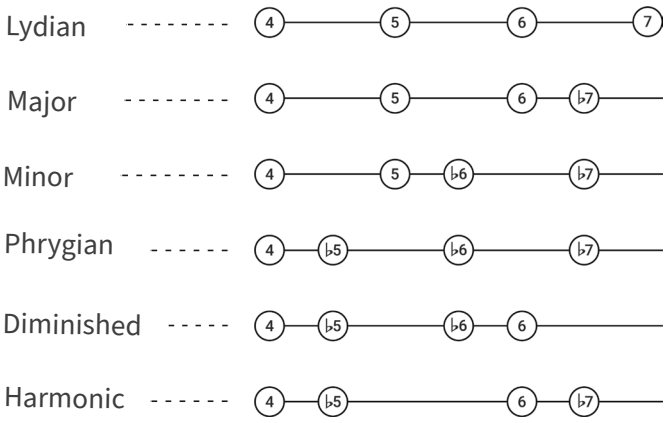
This is a feature of musical scales, after their final note, they begin again on their first note (though one octave higher).

(cont.)









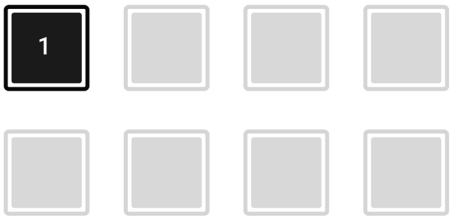
Note: The Tetrachord 1 Lydian setting has no effect when **5 ♭5 4** *is set to* **4**.

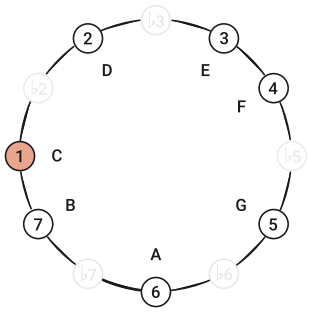
The Tetrachord 2 Lydian setting has no effect when **5 ♭5 4** *is set to* **5**.

Scales 5 - Rotary Encoder aka Mode

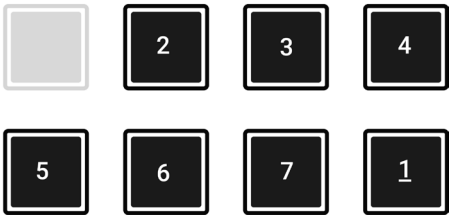
On initialisation, note 1 of the LED ring is red.

This indicates that RGB button 1 corresponds to scale note 1.

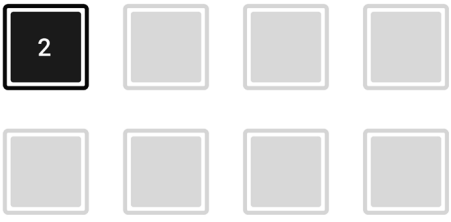


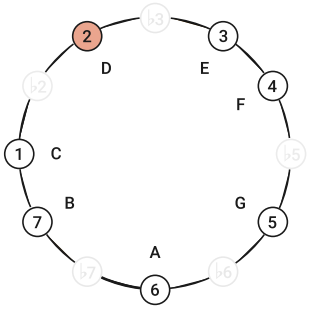


Subsequent RGB buttons correspond to subsequent scale notes.

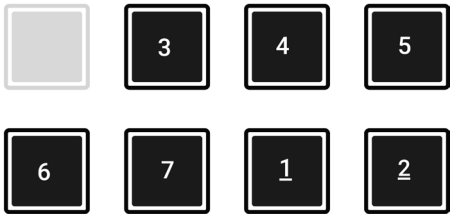


If the Rotary Encoder is turned one step clock-wise, note 2 of the LED ring turns red, indicating that RGB button 1 now corresponds to scale note 2.





Again, subsequent RGB buttons correspond to subsequent scale notes.



(cont.)

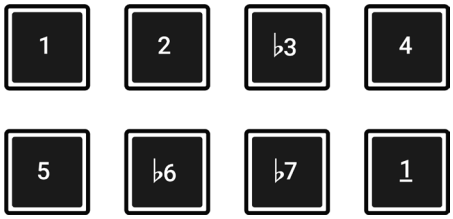
Turning the encoder has the effect of shifting any active notes ones step up or down the scale.

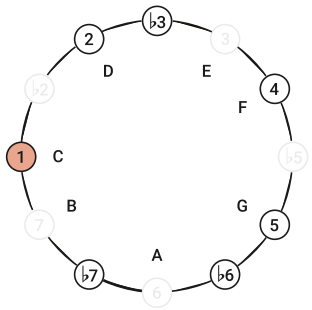
Note that turning the encoder does not change what notes make up the scale.

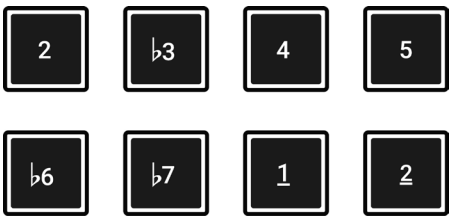
There are as many encoder settings as there are notes in any given scale.

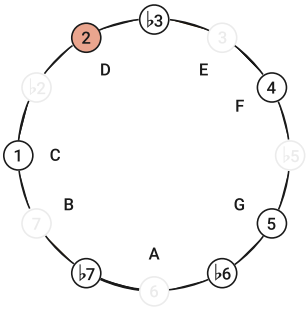
As an example, the seven possible encoder settings for the natural minor scale are illustrated below.

(Theoretical note: these settings correspond to what are known as the 7 modes of the natural minor scale.)

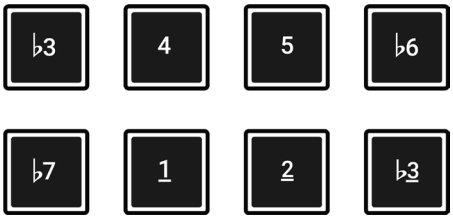


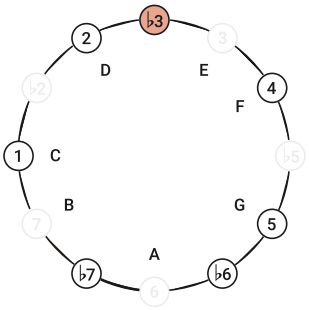


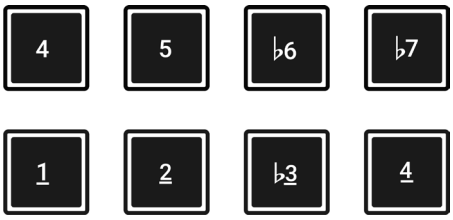


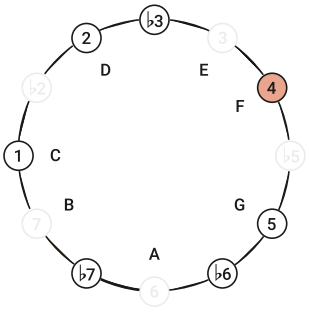


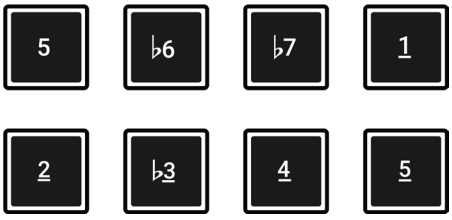
(cont.)

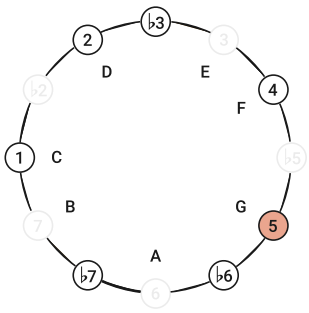

♭3
4
5
♭6
♭7
1
2
♭3

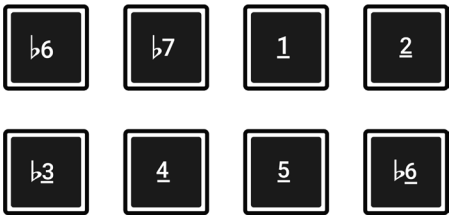

♭3
2
D
E
3
♭2
4
F
1
C
♭5
B
G
7
5
A
♭7
♭6
6

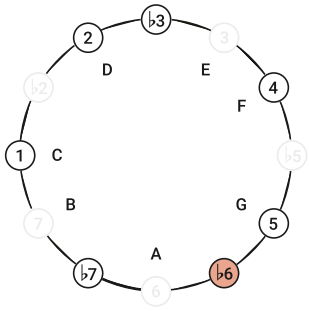

4
5
♭6
♭7
1
2
♭3
4


♭3
2
D
E
3
♭2
4
F
1
C
♭5
B
G
7
5
A
♭7
♭6
6

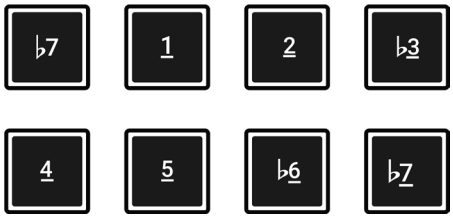

5
♭6
♭7
1
2
♭3
4
5

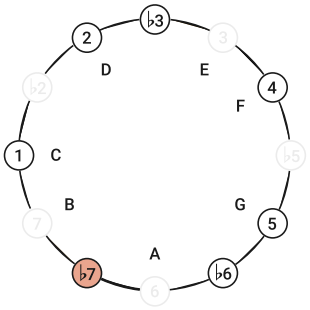

♭3
2
D
E
3
♭2
4
F
1
C
♭5
B
G
7
5
A
♭7
♭6
6


♭6
♭7
1
2
♭3
4
5
♭6

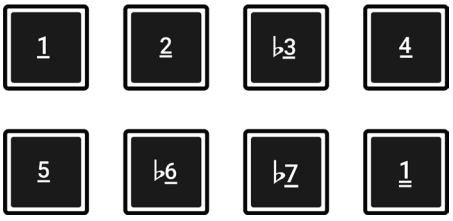

♭3
2
D
E
3
♭2
4
F
1
C
♭5
B
G
7
5
A
♭7
♭6
6

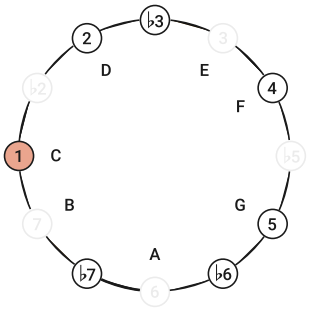
(cont.)



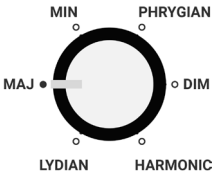
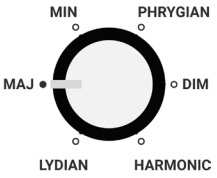
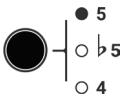
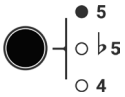
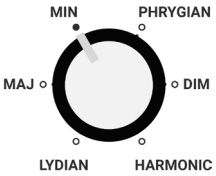
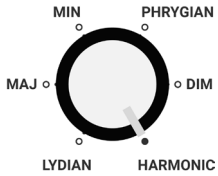
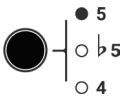
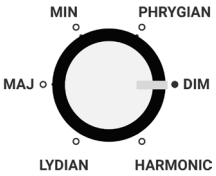
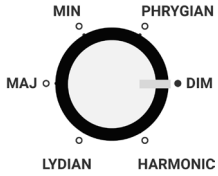
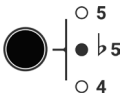
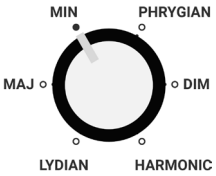
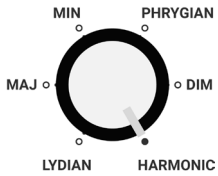
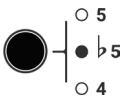
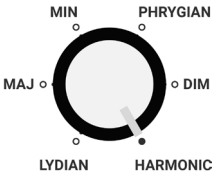
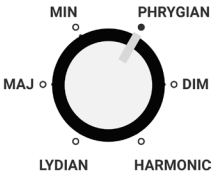
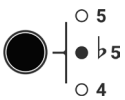


Turning the encoder clock-wise after the 7th setting results in a return to the original setting, though with all notes shifted 1 octave higher.

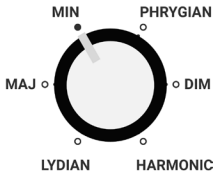
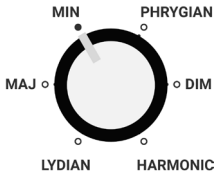
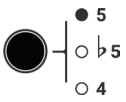
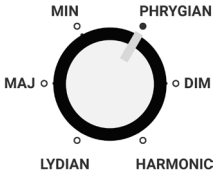
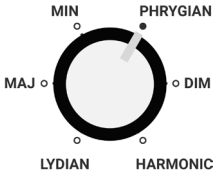
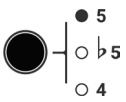
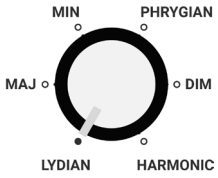
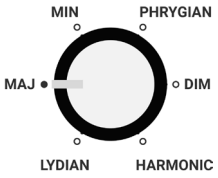
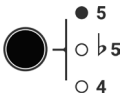
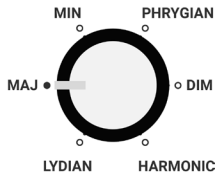
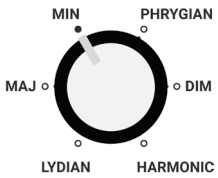
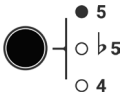
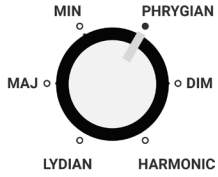
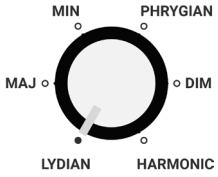
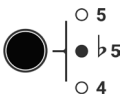
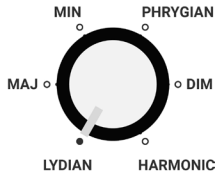
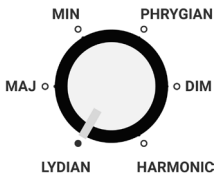
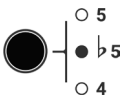




Scales 6 - Scale recipes

SCALE	TETRACHORD 1	TETRACHORD 2	5 ♭5 4
Major			
Natural Minor			
Harmonic Minor			
Half-Whole Diminished			
Blues (ish)			
Phrygian Dominant			

(cont.)

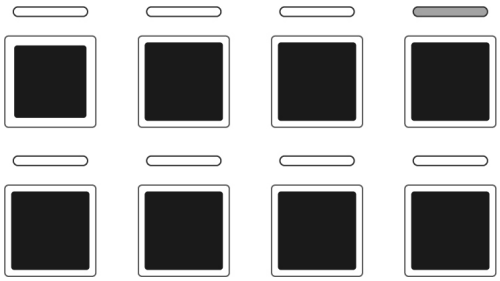
SCALE	TETRACHORD 1	TETRACHORD 2	5 ♭5 4
Dorian Mode			
Phrygian mode			
Lydian Mode			
Myxolydian Mode			
Locrian Mode			
Whole Tone			

Octaves

The octave setting affects all notes played by the track.

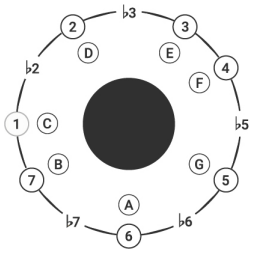
When the Octave button is pressed, the LEDs above the RGB note buttons display the current track's octave setting.

The default setting is octave 4, as illustrated below.



Pressing an RGB note button, whilst the octave button is pressed, changes the octave setting for the current track.

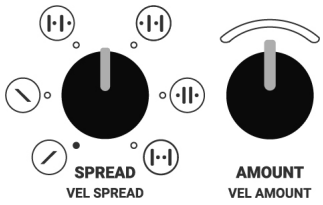
Turning the rotary encoder, whilst the octave button is pressed, also changes the track octave setting.



A clockwise turn increments the octave setting, an anti-clockwise setting decrements it.

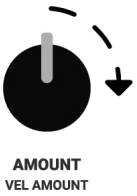
Spread - Overview

Each tetrachord section has two spread controls, SPREAD and AMOUNT.

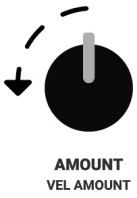


The SPREAD knob selects which notes will be shifted up or down by the AMOUNT KNOB.

The AMOUNT knob has no effect at the 12 o'clock position.



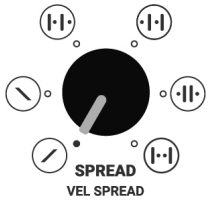
When turned clockwise, the AMOUNT knob shifts selected notes up by 1 to 3 octaves.



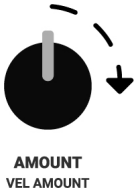
When turned counter-clockwise, the AMOUNT knob shifts selected notes down by 1 to 3 octaves.

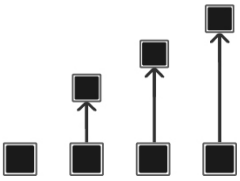
Spread - Detail

SETTING 1

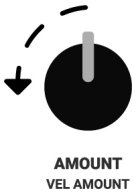


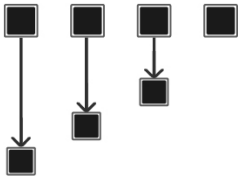
In this setting, notes at the beginning of the tetrachord will always be lower than those at the end.





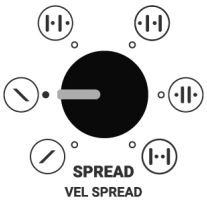
Turning the AMOUNT knob clockwise raises notes by 1 to 3 octaves.



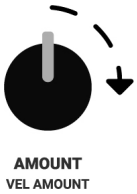


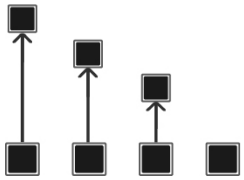
Turning the AMOUNT knob counter-clockwise lowers notes by 1 to 3 octaves.

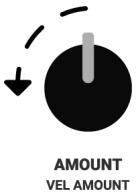
SETTING 2

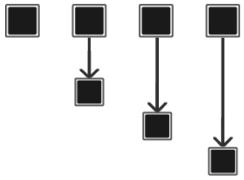


In this setting, notes at the beginning of the tetrachord will always be higher than those at the end.



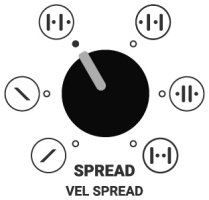




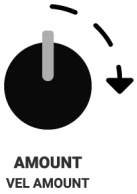


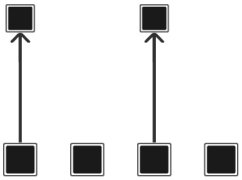
(cont.)

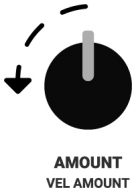
SETTING 3

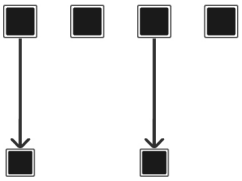


In this setting, the amount knob affects only the 1st and 3rd notes of the tetrachord.

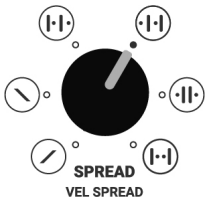




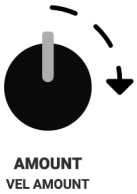


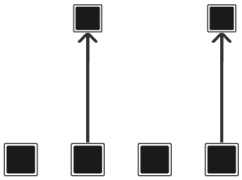


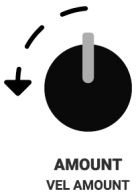
SETTING 4

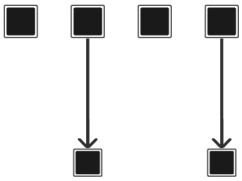


In this setting, the amount knob affects only the 2nd and 4th notes of the tetrachord.









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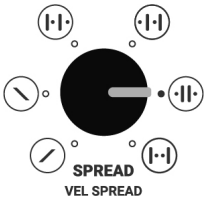
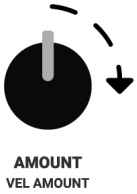
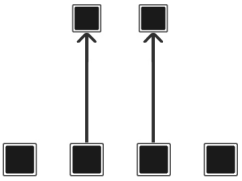
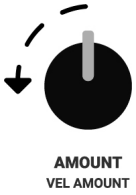
SETTING 5

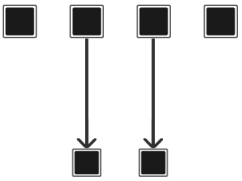


In this setting, the amount knob affects only the middle notes of the tetrachord.

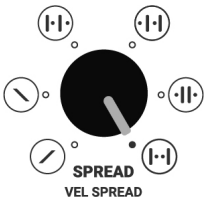




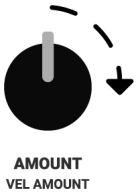


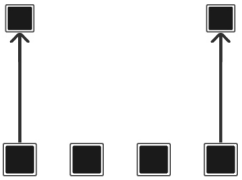


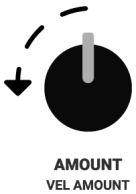
SETTING 6

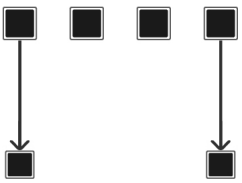


In this section, the amount knob affects only the outer notes of the tetrachord.



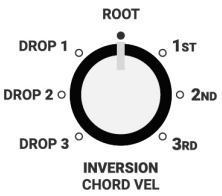






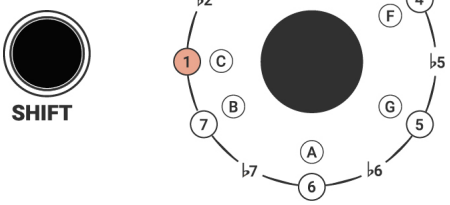
Inversions - Overview

The inversion knob selectively shifts notes in the scale up or down by 1 octave.



Pressing and holding the shift button and then turning the rotary encoder clockwise causes the lowest active notes to be raised by one octave.

Continuously turning the encoder clockwise results in notes cascading upwards until they reach their upper limit.



Similarly, pressing shift and turning the encoder counter-clockwise causes the highest active notes to be lowered one octave.

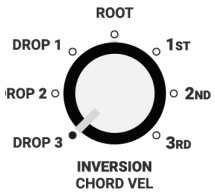
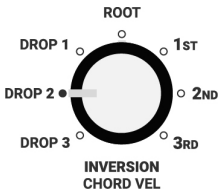
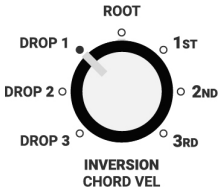
Continuously turning the encoder counter-clockwise results in notes cascading downwards until they reach their lower limit

Inversion knob

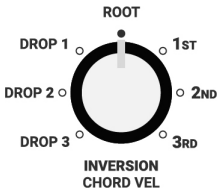
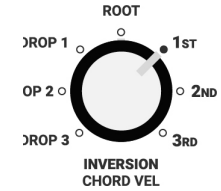
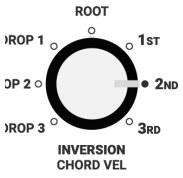
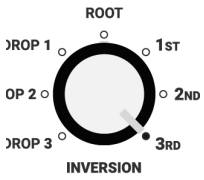
The inversion knob selectively shifts notes up or down by 1 octave.

Unlike the SPREAD and AMOUNT control sections, which affect only one tetrachord, the INVERSION knob affects the entire scale.

A detailed description of each inversion setting is given below.

SETTING		TETRACHORD 1	TETRACHORD 2
DROP 3		Notes 3 and 4 are lowered by 1 octave.	
DROP 2		Notes 5 and 6 are lowered by 1 octave.	
DROP 1		Notes 7 and 8 are lowered by 1 octave.	

(cont.)

SETTING		TETRACHORD 1	TETRACHORD 2
ROOT		The neutral setting. No notes are affected.	
1st		Notes 1 and 2 are raised by 1 octave.	
2nd		Notes 1, 2, 3 and 4 are raised by 1 octave.	
3rd		Notes 1, 2, 3, 4, 5 and 6 are raised by 1 octave.	

THEORETICAL DISCLAIMER

(safe to ignore for everyone - possibly interesting to those familiar with inversions and associated terminology)

The Tetrachords implementation of inversions does not align 100% with established practice.

This is for pragmatic reasons, to make the INVERSION knob more useful and fun.

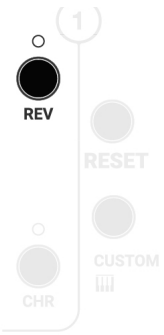
The way it works is the INVERSION knob handles notes in pairs. any octave shift performed on the 1st of the scale gets performed on the 2nd also. Similarly shifting the 3rd shifts the 4th, shifting the 5th shifts the 6th and shifting the 7th shifts the 8th.

The result of this is that when playing 3 or 4 note chords based on 3rds, inversions work as anyone who is familiar with standard terminology would expect.

When playing with 9ths, 11ths 13th etc. inversions are handled in a non-standard manner idiosyncratic to the Tetrachords.

Reverse Button

Each tetrachord section features a reverse button, labelled REV.

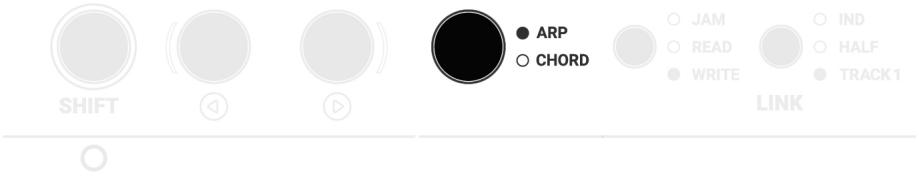


The reverse button reverses the order in which any active notes in the corresponding tetrachord are played.

The blue LED above the button illuminates when reverse is engaged.

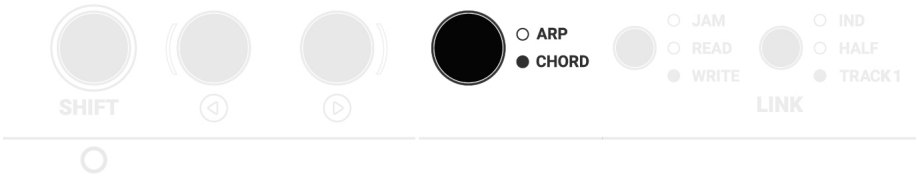
Arp / Chord Button

When the Arp / Chord button is set to ARP, notes in the current pattern are played one at a time.



The order of the notes is determined by the PATH knob.

When the Arp / Chord button is set to CHORD, all notes in the current pattern are played simultaneously.



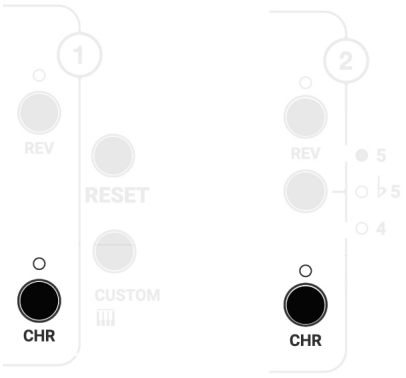
Note that, depending on how many notes are active and how the chromatic buttons are set, a pattern can contain as many as 13 notes.

The Tetrachords module can easily transmit 13 note chords via MIDI, however it is limited to a maximum of 4 simultaneous notes via CV.

For more details, see the CV section of this guide.

Chromatic Button - Overview

Each tetrachord section features a chromatic button, labelled CHR



The chromatic button adds non-scale notes to the current pattern.

The white LED above the button illuminates when the chromatic button is engaged.

The chromatic button affects a pattern differently depending on the how many notes are active in the corresponding tetrachord.

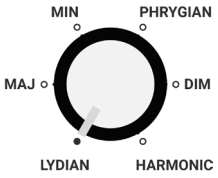
The way this works is detailed on the following pages.

Chromatic Button

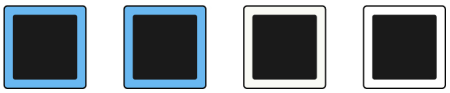
When two notes are active, and the chromatic button is engaged, any notes in between the two active notes will play.

For example:

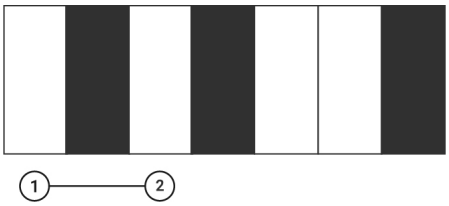
1. Set Tetrachord 1 to Lydian



2. Activate notes 1 & 2

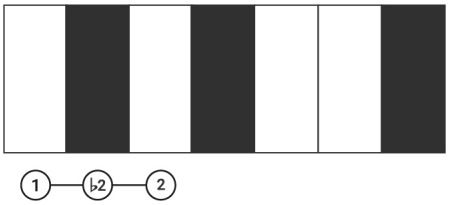


Scale notes 1 & 2 are now part of the current sequence.



3. Press the chromatic button

The ♭2 note i.e. the note between scale notes 1 & 2, is now part of the sequence also.



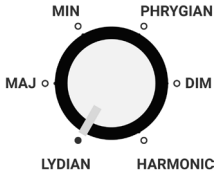
(cont.)

When three notes are active the chromatic button causes, any two notes in between the first two active notes to play.

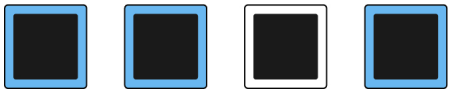
The chromatic button has no effect on the third active note.

For example:

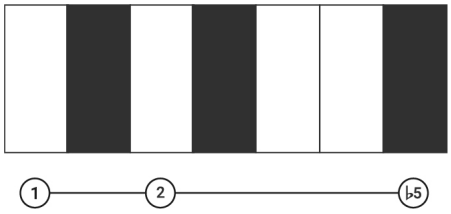
1. Set Tetrachord 1 to Lydian



2. Activate notes 1, 2 & 4

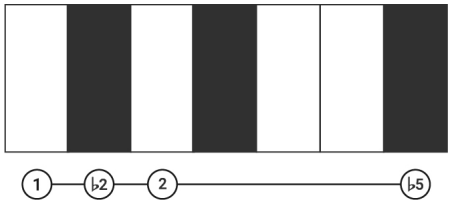


Scale notes 1, 2 & ♭5 are now part of the current sequence.



3. Press the chromatic button

The ♭2 note i.e. the note between scale notes 1 & 2, is now part of the sequence also.



(cont.)

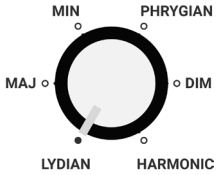
When four notes are active and the chromatic button is engaged:

Any notes between the first two active notes become part of the sequence.

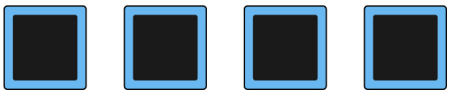
Any notes between the last two active notes become part of the sequence.

For example:

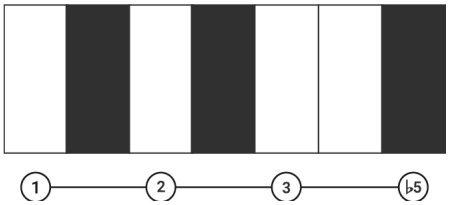
1. Set Tetrachord 1 to Lydian



2. Activate notes 1, 2, 3 & 4



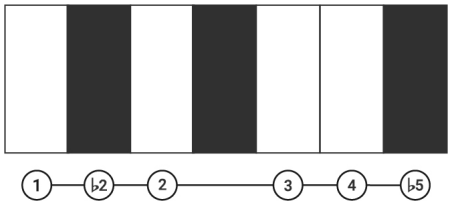
Scale notes 1, 2, 3 & ♭5 are now part of the current sequence.



3. Press the chromatic button

The ♭2 note i.e. the note between scale notes 1 & 2, is now part of the sequence.

The 4 note i.e. the note between scale notes 3 & ♭5, is now part of the sequence.



Custom Path - Overview

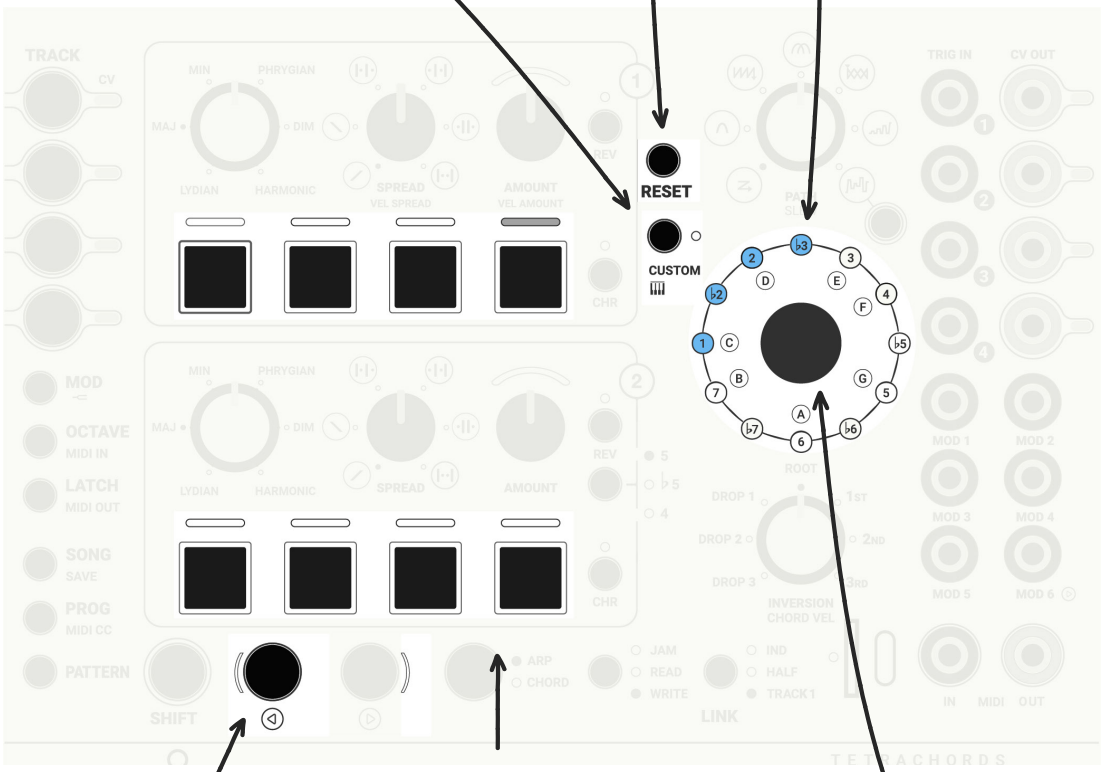
The custom path is a user programmable sequence of up to 32 notes.

RESET BUTTON
Clears all notes from the custom path when the custom button is held.

CUSTOM BUTTON (PRESS)
Toggles between the custom path and regular playback as described in the PATH KNOB section of this guide.

LED RING
Indicates notes active in the custom path.

CUSTOM BUTTON (PRESS & HOLD)
Press and hold the custom button to edit the custom note path.



Left Button
Deletes notes from the custom pattern when the custom button is held.

RGB Buttons
Add notes to the custom pattern when the custom path is active.

ROTARY ENCODER
When the custom button is held, the encoder shifts the point at which notes will be added to or removed from the custom path.

Custom Path - Description

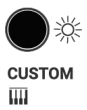
The custom path is a user programmable sequence of up to 32 notes.

In regular operation, the order of notes is determined by the PATH knob, which selects one of the 6 pre-defined note patterns, or a randomised pattern.

When the custom path is enabled, the order of notes and the length of the pattern is determined by the user.

TOGGLE CUSTOM PATH

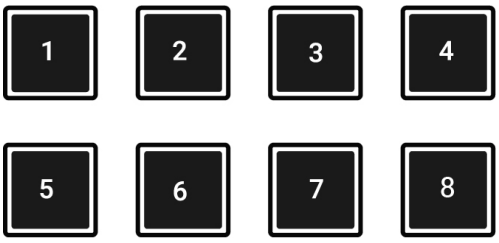
Press the CUSTOM button to toggle between the custom path and the regular, PATH knob controlled path.



The white LED beside the CUSTOM button is illuminated when the custom path is active.

ADD NOTES TO THE CUSTOM PATH

The RGB buttons add notes to the custom path, when it is active.



The order of the notes is determined by the order in which the buttons are pressed.

For example, pressing buttons 1, 1, 4, 3, 4, 1 generates the corresponding note order.

1 - 1 - 4 - 3 - 4 - 1

(cont.)

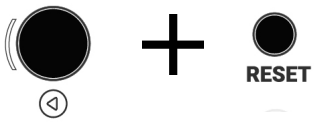
Custom Path

CLEAR ALL NOTES FROM THE CUSTOM PATH

Press and hold the CUSTOM button then press the RESET button to clear all notes from the custom path.

CLEAR ONE NOTE FROM THE CUSTOM PATH

Press and hold the CUSTOM button then press the BACK button to clear a single note from the custom path.



LED DISPLAY - CUSTOM PATH LENGTH

When the custom button is pressed, the RGB LED ring and the FORWARD and BACK button LEDs indicate the length of the custom path sequence.

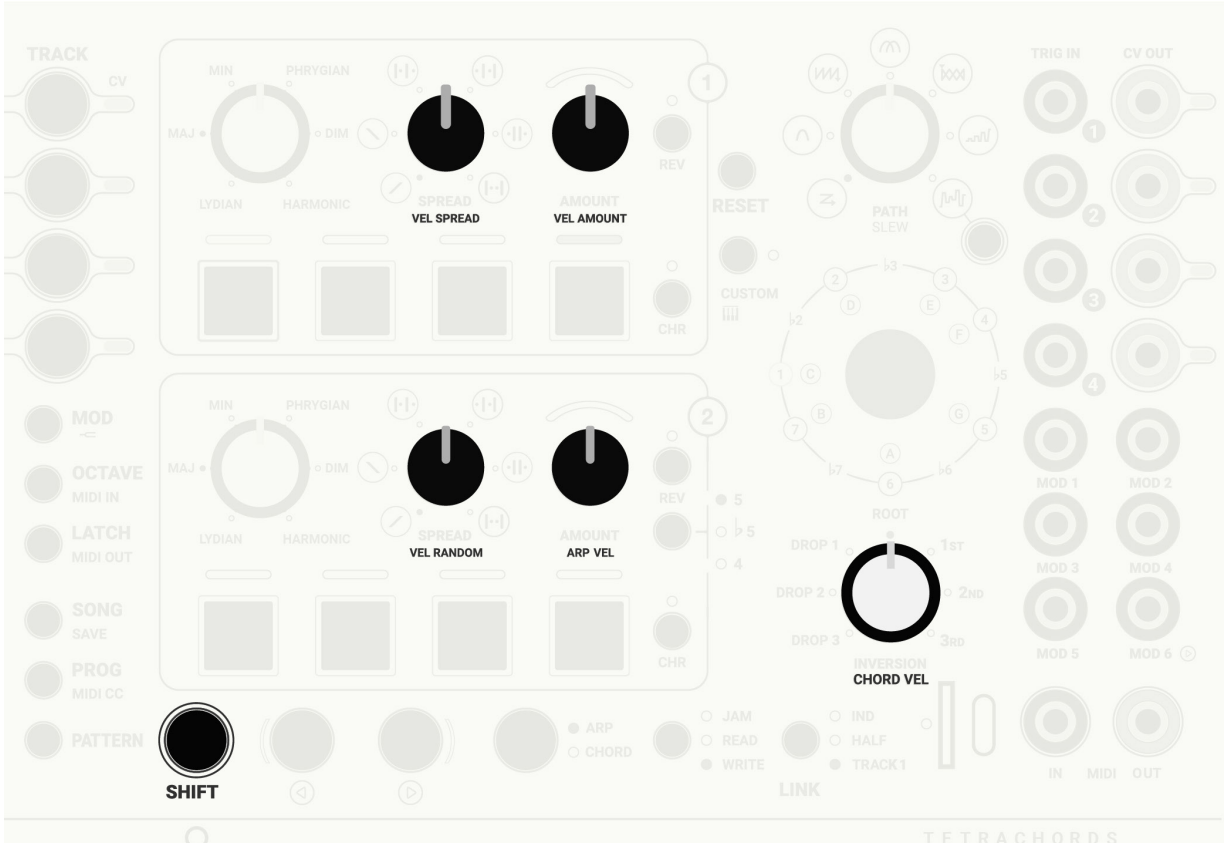
(cont.)

Custom Path

(cont.)

MIDI Velocity - Overview

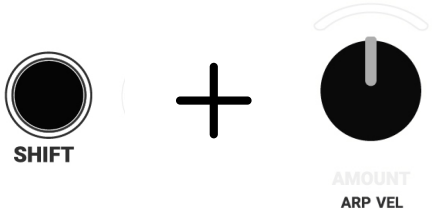
The five knobs below, combined with the SHIFT button, manipulate the MIDI velocity values of sequenced notes.



MIDI Velocity

ARP VEL

Press SHIFT and turn the Tetrachord 2 AMOUNT / ARP VEL knob.



This is labeled VEL LEVEL on the prototype .

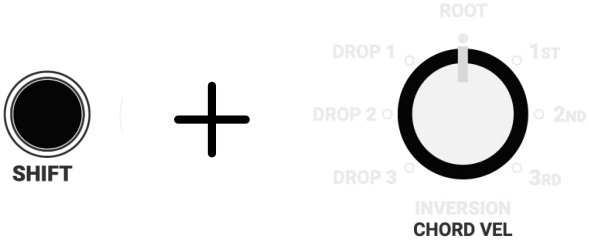
This sets the MIDI velocity for notes played when the ARP CHORD button is set to ARP.

The maximum MIDI velocity value is 127.

ARP VEL is set to 90 by default.

CHORD VEL

Press SHIFT and turn the INVERSION / CHORD VEL knob.



This sets the MIDI velocity for notes played when the ARP CHORD button is set to CHORD.

CHORD VEL is set to 75 by default.

(cont.)

VEL RANDOM

VEL RANDOM, short for velocity random, is the secondary function of the Tetrachord 1 AMOUNT knob.

This is labeled VEL RANDOM AMT on the prototype.

This adds a random component to the MIDI velocity of notes in the current pattern.

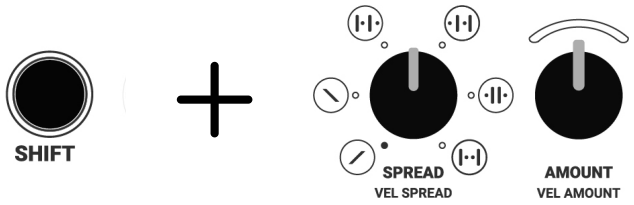
The VEL RANDOM setting effects all notes, regardless of the ARP CHORD button setting.

VEL RANDOM is set to 15% by default.

(cont.)

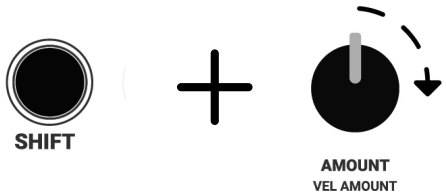
MIDI Velocity Spread

There are two velocity spread controls, VEL SPREAD and VEL AMOUNT, accessed by pressing shift and turning the Tetrachord 1 SPREAD and AMOUNT knobs respectively.

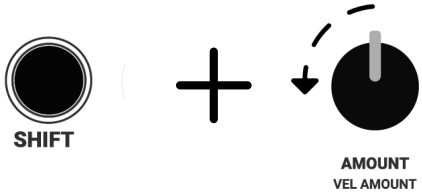


The VEL SPREAD knob selects which notes will have their velocity increased or decreased by the VEL AMOUNT setting.

The VEL AMOUNT knob has no effect at the 12 o'clock position.



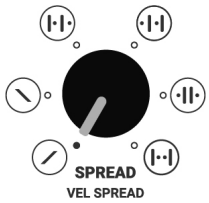
When turned clockwise, the VEL AMOUNT knob increases the velocity of selected notes.



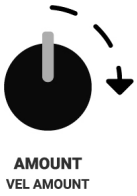
When turned counter-clockwise, the VEL AMOUNT knob decreases the velocity of selected notes.

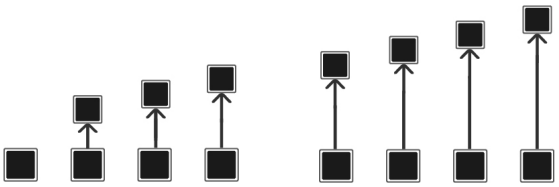
(cont.)

SETTING 1

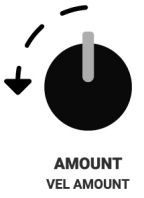


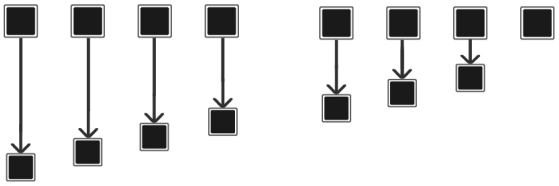
In this setting, notes at the beginning of the pattern will always be softer than those at the end.



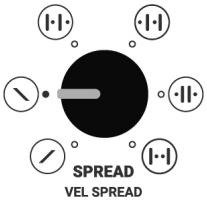


(Buttons 1 - 4) *(Buttons 5 - 8)*

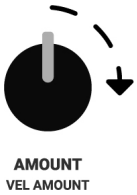


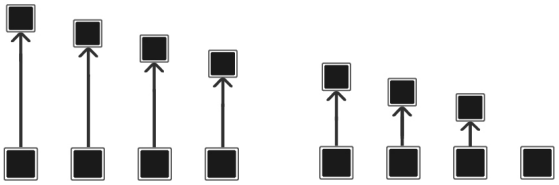


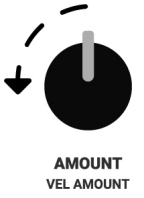
SETTING 2

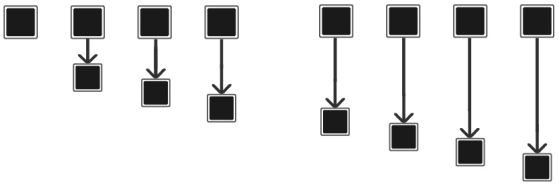


In this setting, notes at the beginning of the pattern will always be louder than those at the end.



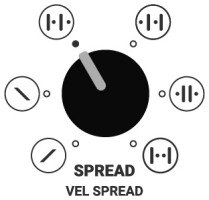




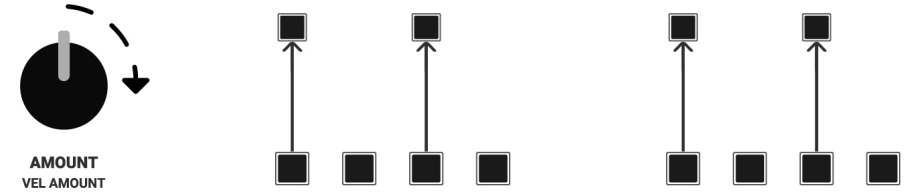


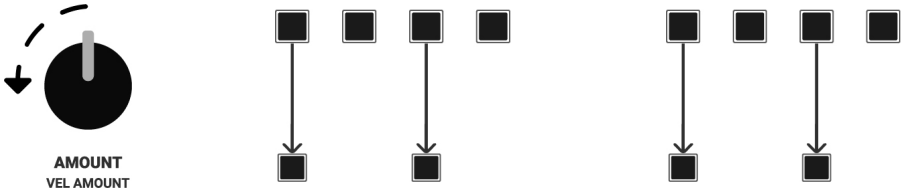
(cont.)

SETTING 3

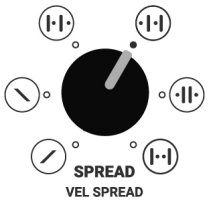


In this setting, the amount knob affects only the odd notes of the pattern.

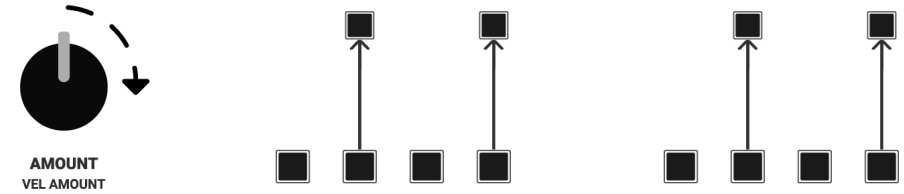


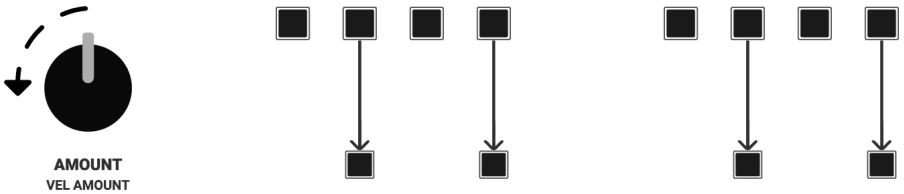


SETTING 4



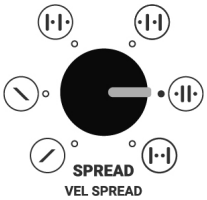
In this setting, the amount knob affects only the even notes of the pattern.



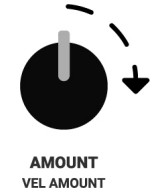


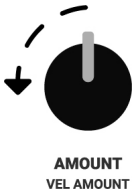
(cont.)

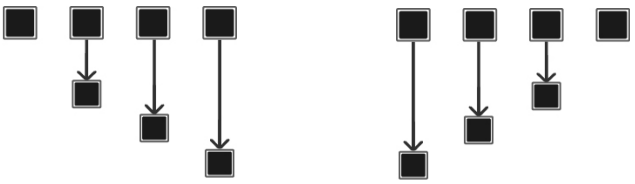
SETTING 5



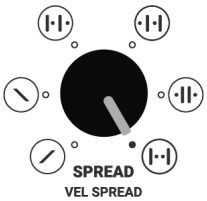
In this setting, the amount knob affects only the middle notes of the pattern.



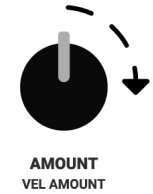


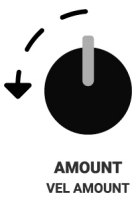


SETTING 6



In this section, the amount knob affects only the outer notes of the pattern.





CV Out - Track settings

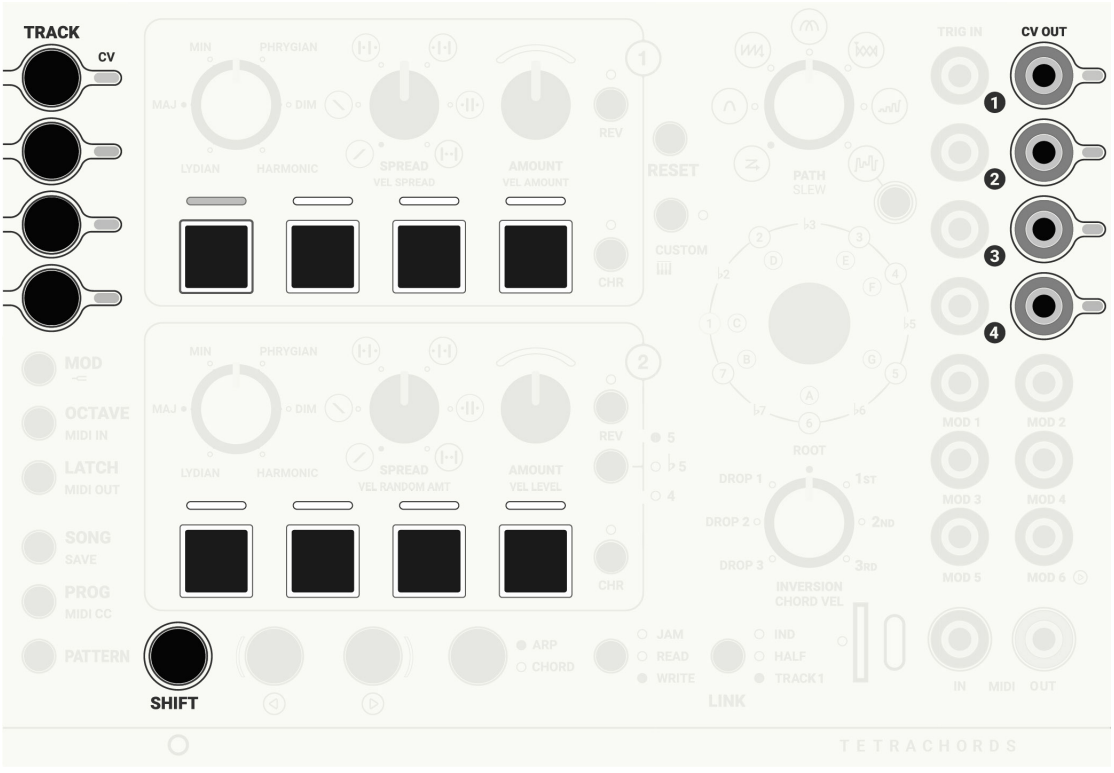
Adjusting a track's CV OUT settings is a two step process.

1. Press SHIFT + any of the TRACK/CV buttons (SHIFT can be released at this point).

2. Use the RGB buttons to assign CV outputs to the selected track.

CV PITCH OUT
Buttons 1 to 4 assign CV OUT 1 to 4 to the selected track. The assigned outputs send a 1V/octave pitch signal.

CV OUT LEDS
The CV OUT LED colour indicates which track is assigned to which CV OUT.



CV GATE/VELOCITY OUT
Buttons 5 to 8 assign CV OUT 1 to 4 to the selected track. The assigned outputs send a gate signal, scaled according to the MIDI velocity value of the current note.

CV Out - Polyphonic example

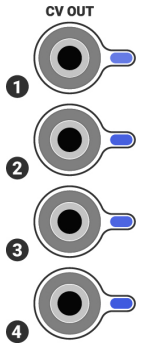
❶ Press SHIFT + TRACK/CV button 1.

SHIFT can be released at this point.

❷ Press RGB buttons 1, 2, 3 & 4.

CV OUTS 1 to 4 are now assigned to TRACK 1. They will transmit note/voltage signals.

This is indicated by CV OUT LEDS 1 to 4 which are now blue, the colour of TRACK 1



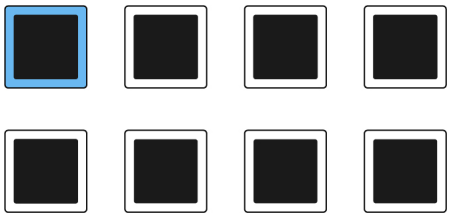
When TRACK 1 is playing and the ARP CHORD button is set to ARP, all 4 CV OUTS transmit the same note/voltage.

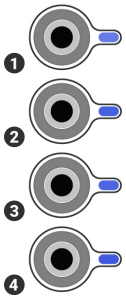
When TRACK 1 is playing and the ARP CHORD button is set to CHORD, the 4 CV OUTS can transmit up to 4 different notes/voltages.

The way it works depends on how many notes are active.

(cont.)

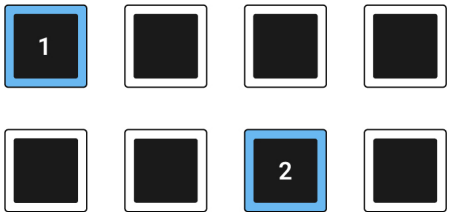
When 1 note is active, all 4 CV OUTS transmit the same note/ voltage.

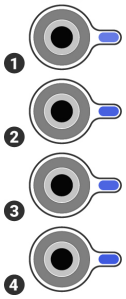




RGB Button 1 note
RGB Button 1 note
RGB Button 1 note
RGB Button 1 note

When 2 notes are active, CV OUTS 1 & 3 transmit the 1st note/voltage and CV OUTS 2 & 4 transmit the 2nd.

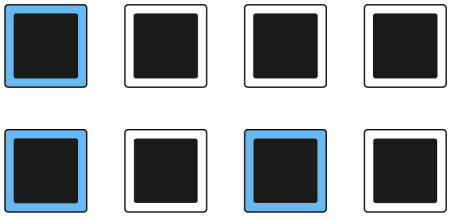


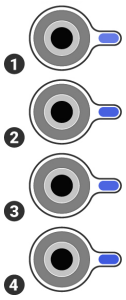


RGB Button 1 note
RGB Button 7 note
RGB Button 1 note
RGB Button 7 note

When 3 notes are active, CV OUTS 1, 2 & 3 transmit the active notes/ voltages.

CV OUT 4 duplicates note 1.

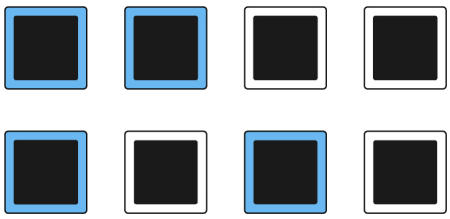


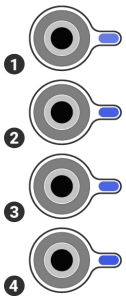


RGB Button 1 note
RGB Button 5 note
RGB Button 7 note
RGB Button 1 note

(cont.)

When 4 note are active the 4 CV OUTS
each transmit one of the active notes





RGB Button 1 note

RGB Button 2 note

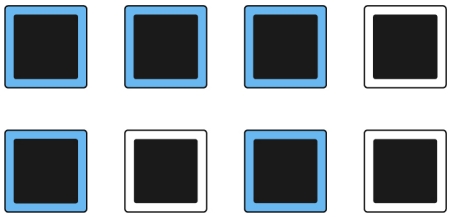
RGB Button 5 note

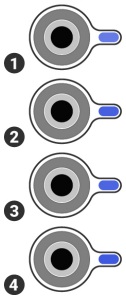
RGB Button 7 note

When more than 4 notes are active, the
first 4 active notes (in button order), are
transmitted on CV outs 1 to 4 respectively.

Extra notes are omitted.

E.g. when 5 notes are active, the
5th note is omitted.





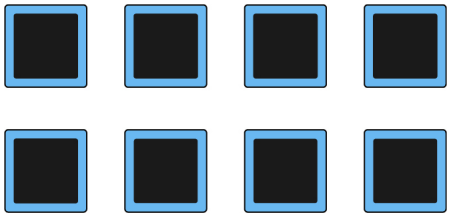
RGB Button 1 note

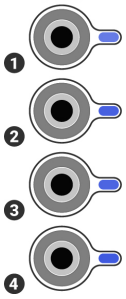
RGB Button 2 note

RGB Button 3 note

RGB Button 5 note

E.g. when all notes are active,
notes 5, 6, 7 & 8 are omitted.





RGB Button 1 note

RGB Button 2 note

RGB Button 3 note

RGB Button 4 note

CV Out - Gate out Example

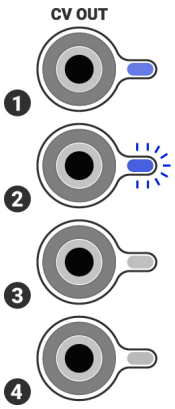
❶ Press SHIFT + TRACK/CV button 1.

SHIFT can be released at this point.

❷ Press RGB buttons 1 & 6

CV OUTS 1 is now assigned to TRACK 1. It will transmit note/voltage signals.

This is indicated by CV OUT LED 1, which shines blue, the colour of track 1.



CV OUT 2 is also assigned to TRACK 1. It will transmit gate signals when notes are triggered.

CV OUT LED 2 flashes blue, the colour of track 1. The flashing indicates that CV OUT 2 is transmitting gate signals.

The generated gate signal will be in the range 0 to 8 volts. 0v- 6.2v on the prototype

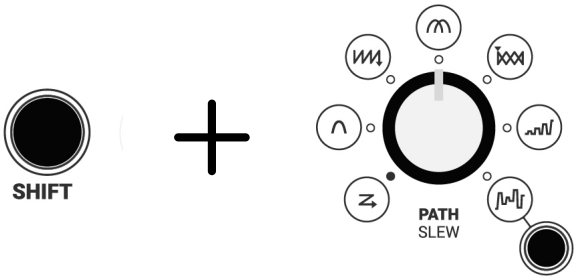
The amplitude of is proportional to the MIDI velocity of the note that is triggered i.e. maximum velocity corresponds to 8 volts, minimum to 0 volts.

For details of how to manipulate note velocity, refer to the MIDI Velocity section of this guide.

For details of how the gate output responds to the CV input, refer to the Trig Input Response section of this guide.

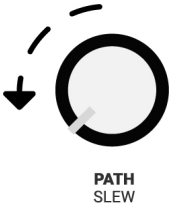
CV Out - Slew

Pressing and holding the shift button, then turning the PATH knob sets the amount of SLEW applied to the CV output.



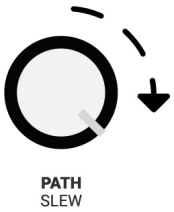
With SLEW turned fully anti-clockwise, the transition between CV notes is as fast as possible, less than 1 millisecond.

This is the default setting.



Turning SLEW clockwise increases the transition time between CV notes.

When turned fully clockwise, the transition between CV notes is as slow as possible, approximately 5.5 seconds.

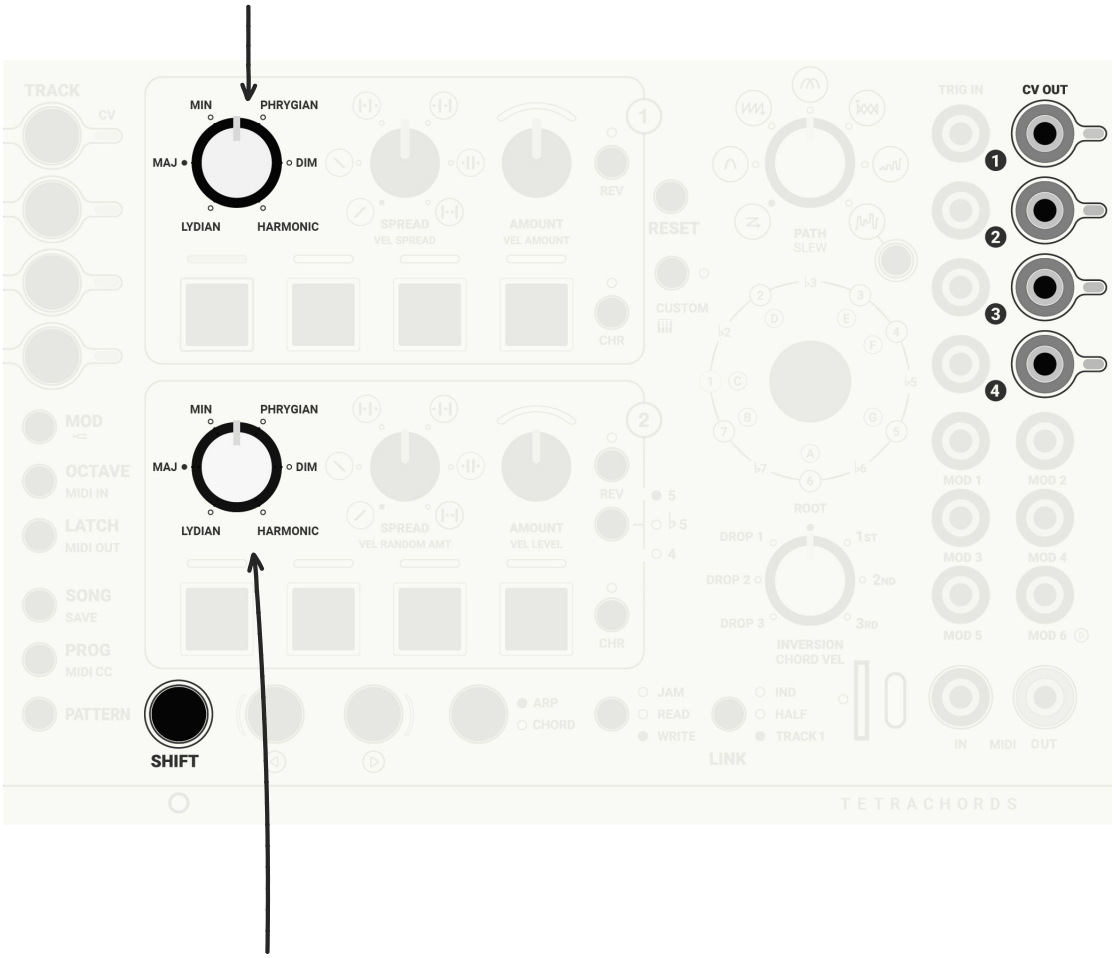


Note that the transition time is independent of the distance between sequenced notes.

CV Out LFO

CURRENT TRACK LFO

SHIFT + TETRACHORD 1 KNOB
Sets the LFO rate for all CV OUTS assigned to the current track.



SHIFT + TETRACHORD 2 KNOB
Sets the LFO depth for all CV OUTS assigned to the current track.

Note: the controls described above can be used to synchronize the LFOS of all CV outputs assigned to a track.

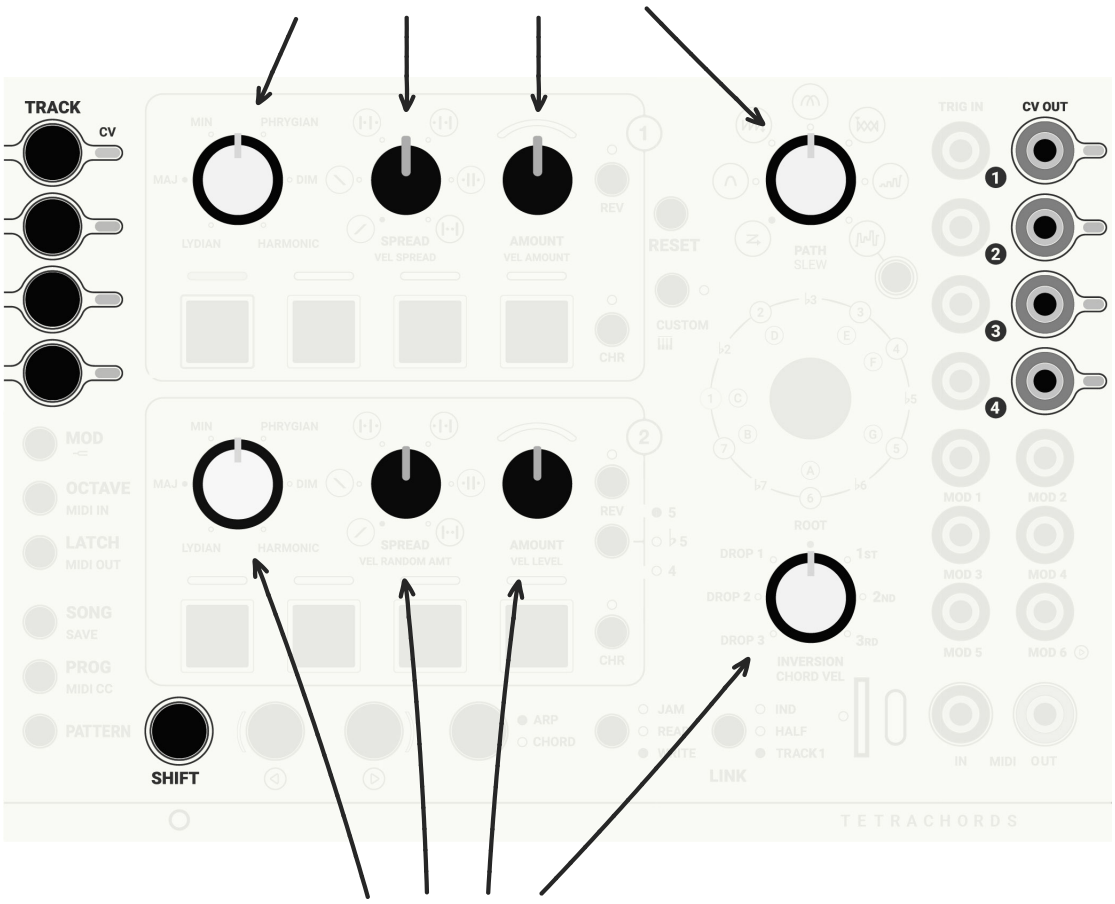
Edit all CV LFOs

1. Press SHIFT + any of the TRACK/CV buttons.

   SHIFT can be released at this point.

2. Use the knobs to adjust LFO settings for all CV OUTS.

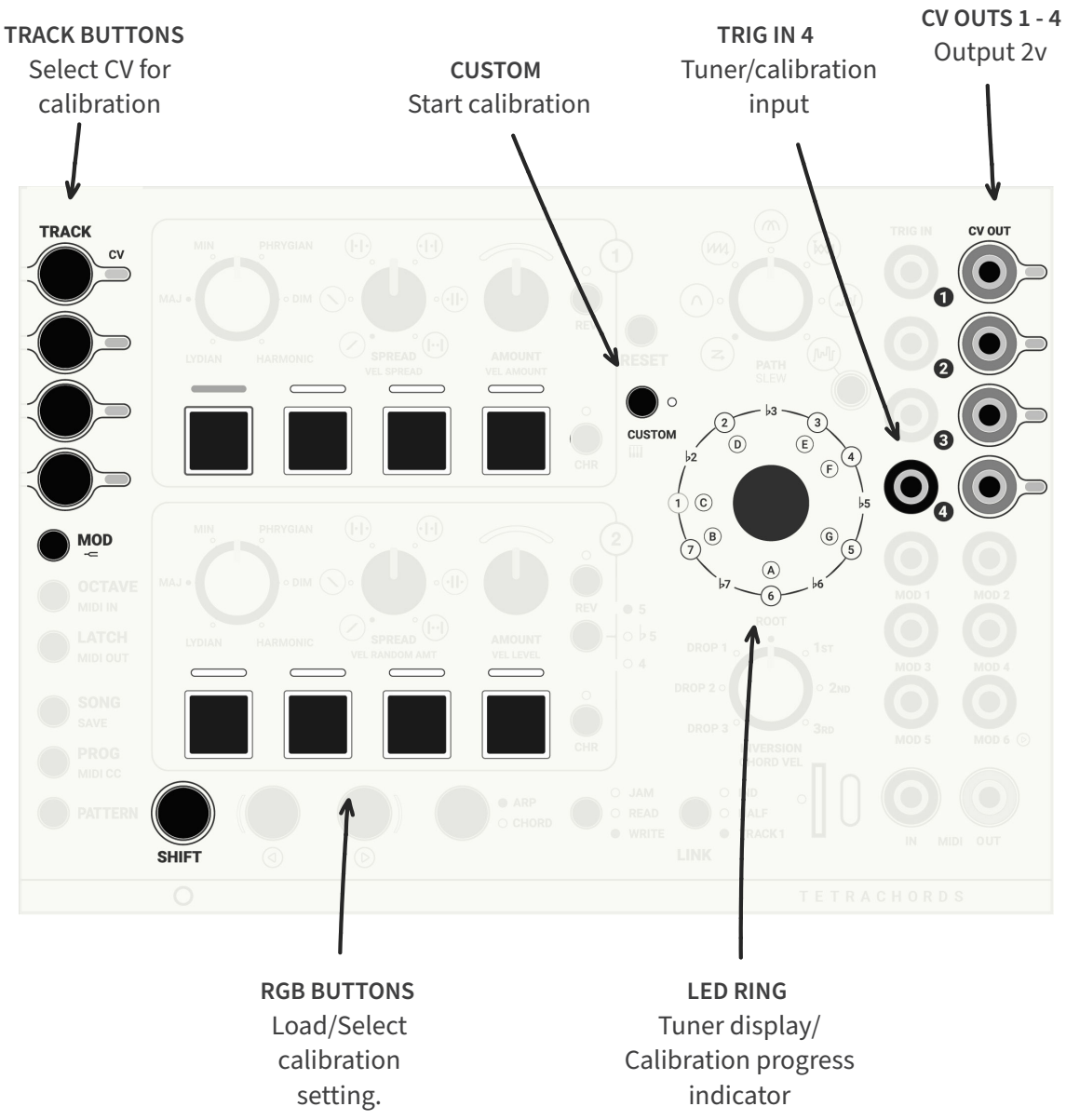
KNOBS 1 to 4
Set the LFO rate for CV OUTS 1 to 4 respectively.



KNOBS 5 to 8
Set the LFO amount for CV OUTS 1 to 4 respectively.

The controls described above can be used to independently set the LFOS of all CV outputs assigned to a track.

Tuning Mode

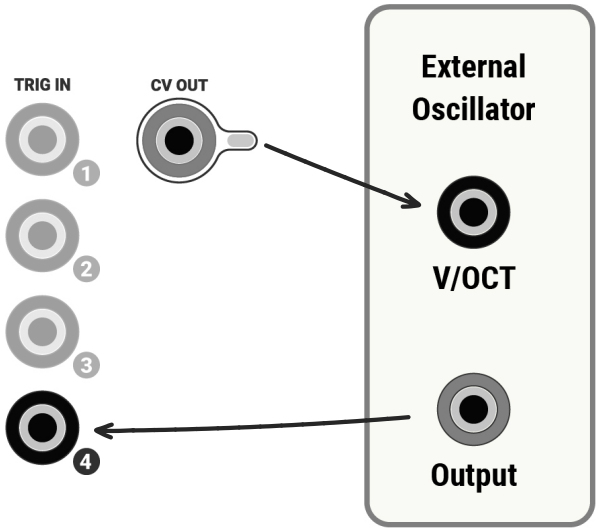


Pressing SHIFT + MOD / ⊂ places the Tetrachords in TUNING MODE.

Tuning

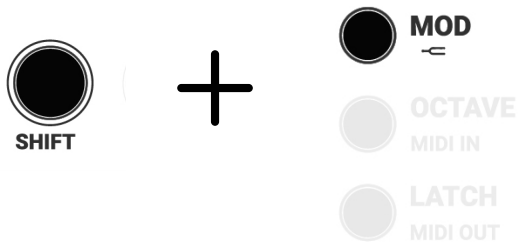
The Tetrachords features a basic tuner, designed to help keep CV controlled oscillators in tune with MIDI instruments and with each other.

To use the tuner, first connect any of the Tetrachords CV OUTS to an oscillator's v/octave input.



Then connect an oscillator output to TRIG IN 4.

Press and hold SHIFT and then press MOD / ⊂ button.



LINK/TUNE button on the prototype

SHIFT can be released at this point.

(cont.)

Whilst the MOD / button is held, two things happen.

❶ All four of the CV OUTS output 2 volts.

Note: the Tetrachords associates 2 volts with middle C *aka* 261.6Hz *aka* MIDI note 60.

TODO - update the voltage value when the production version is built.

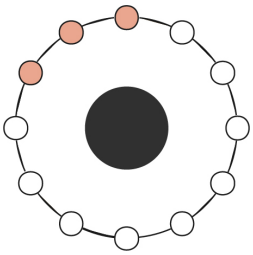
❷ The LED ring indicates the tuning of the oscillator connected to TRIG IN 4.

The LED ring tuning display mimics common instrument tuners. See details on the following page.

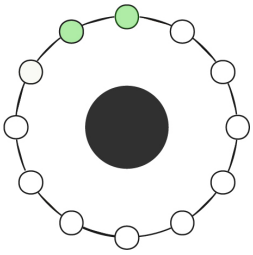
(cont.)

LED RING TUNER DISPLAY

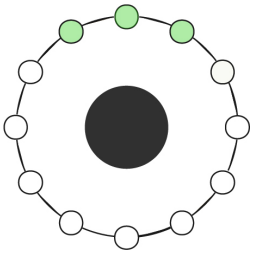
Low
(less than
261.6Hz)



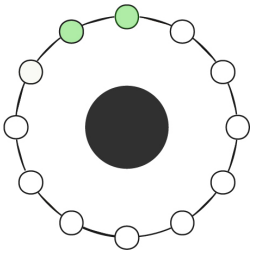
Slightly low
(slightly less
than 261.6Hz)



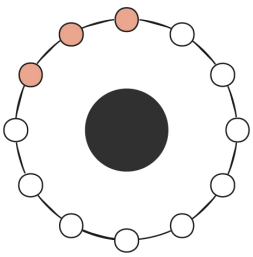
'In Tune'
261.6Hz



Slightly low
(slightly greater
than 261.6Hz)



High
(greater than
261.6Hz)



(cont.)

Troubleshooting tuning

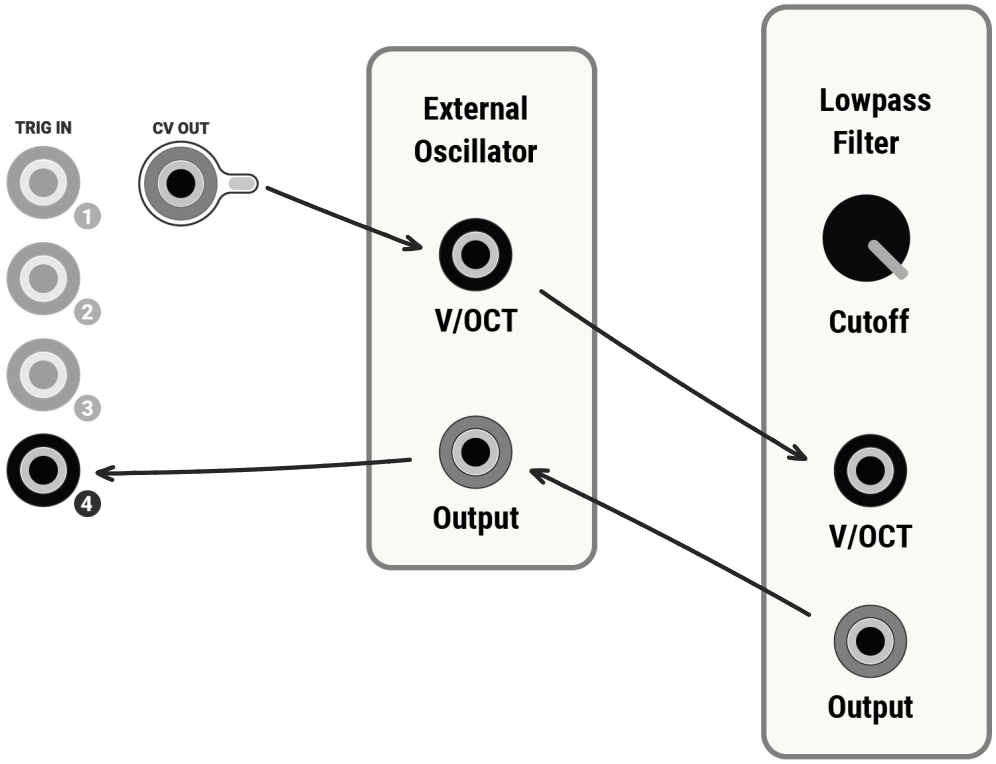
❶ The Tetrachords tuner works best with simple waveforms. Where possible use a square wave.

Otherwise basic waveforms such as saw, triangle and sine waves can work well.

The tuner may not work with more complex waveforms, though by all means try.

❷ Some oscillators generate ultrasonic noise which, though inaudible to humans, may confuse the Tetrachords tuner.

If the tuner appears not to work with an oscillator, try inserting a fully open low pass filter between the oscillator output and TRIG IN 4 of the Tetrachords.



Calibration

The Tetrachords is capable of calibrating its CV OUTS to individual oscillators.

This can significantly improve how in-tune oscillators will play when sequenced by the Tetrachords, especially for sequences with a wide pitch range.

The calibration process currently takes between 3 to 5 minutes.

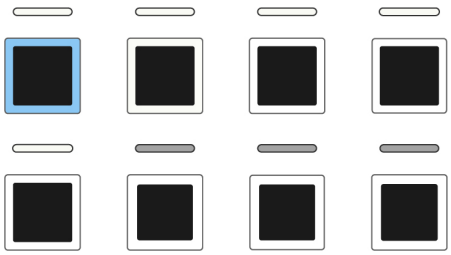
Once calibration is complete, the calibration data is stored on the SD card and can be recalled instantly or even loaded by default if specified in the *CONFIG.TXT* file.

ACTIVE CALIBRATION

One of the track buttons will be illuminated with the current track colour, indicating which calibration setting is active for the current CV OUT.

There are 8 possible calibration settings, corresponding to the 8 RGB buttons.

Here RGB button 1 is illuminated, indicating that calibration setting 1 is active.

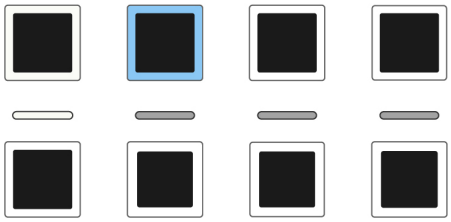


Note that calibration setting 1 is the factory default, 1 volt per octave setting.

(cont.)

RGB buttons 2 - 8 represent the 7 possible custom user calibrations.

Here button 2 is illuminated, indicating that the first custom user calibration is active.

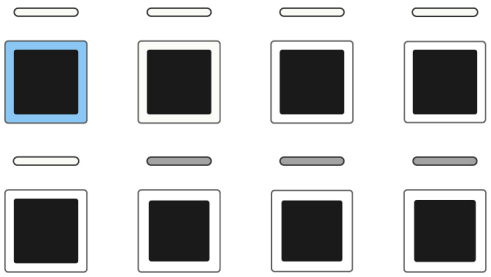


LOADING CALIBRATIONS

The RGB buttons can be used to load saved calibrations from a compatible micro SD card.

The white LED pills indicate where calibrations have been saved.

Here LED pills 1 - 5 are illuminated, indicating that calibrations have been saved in slots 1 - 5.



Pressing buttons 1 - 5 will load the corresponding saved calibration setting.

Beta testers note - button presses aren't detected very well in TUNING MODE.

Just keep pressing. The module should register a press after a few goes.

This will be fixed but probably not until we get the next version of the hardware up and running.

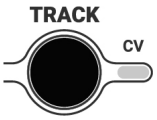
(cont.)

SAVING CALIBRATIONS

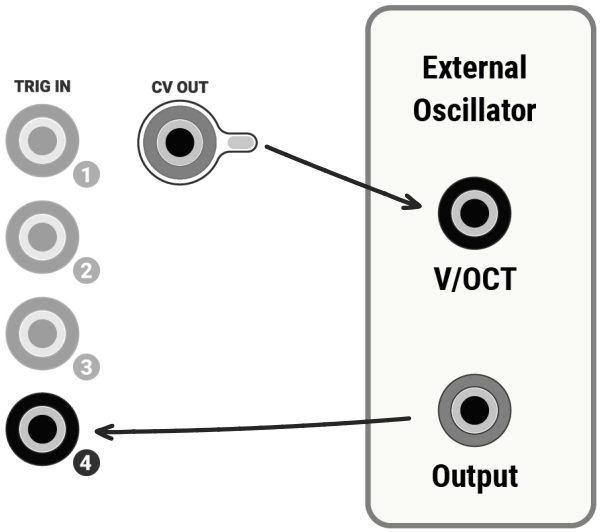
Save a calibration via the following steps.

Note: saving a calibration requires that a compatible micro SD card be inserted in the module.

1. Press the track button corresponding to the CV OUT you wish to use for the calibration e.g. press TRACK 1 if calibrating CV OUT 1



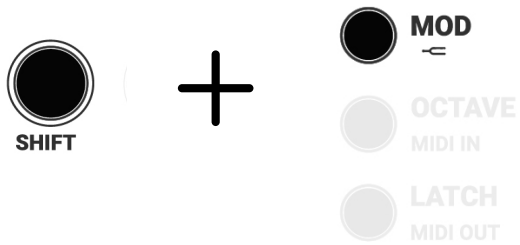
2. Connect the selected CV OUT to an oscillator's v/octave input.



3. Connect the oscillator's output to TRIG IN 4.

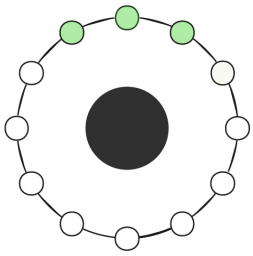
(cont.)

4. Press and hold SHIFT and then press MOD / ⊂ . LINK/TUNE button on the prototype

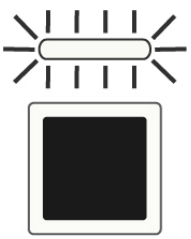


SHIFT can be released at this point.

5. Tune the oscillator to middle C. The LED ring indicates when the oscillator is in tune.



6. Press one of RGB buttons 2 - 8 to select where the calibration is to be saved.

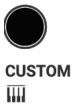


The LED pill above the button will flash, indicating the slot where the calibration is to be saved.

(cont.)

Note that it is not possible to save a calibration slot 1, the factory setting.

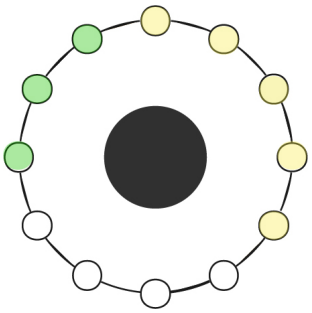
7 Press the custom button to start the calibration routine and save the calibration data to the selected slot.



The MOD / button can be released at this time.

Calibration takes 3 to 5 minutes.

The LED RING displays the progress of the calibration process.



calibration complete

calibration in progress

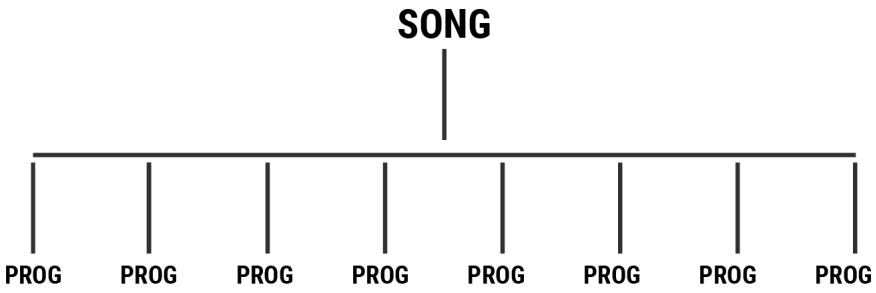
Beta testers note: an 'abort calibration' button will be implemented sometime but at the moment powering off then on is the only way to abort calibration.

8 When calibration is complete, the Tetrachords exits TUNING MODE and can be operated as normal.

Musical Structures - Concept

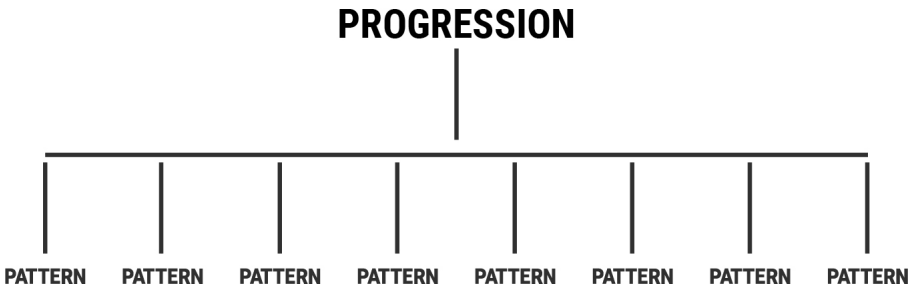
A SONG is the highest-level Tetrachords structure.

A SONG consists of 8 PROGRESSIONS, labelled PROG on the faceplate.



Each PROGRESSION can contain up to 8 PATTERNS

PATTERNS are called CHORDS in the prototype.



Songs

NOTE The song saving feature is not fully implemented:

It should work - please let meknow if you use it and find any bugs.

BUT - songs saved are not likely to be compatible with future firmware versions.

LOADING A SAVED SONG

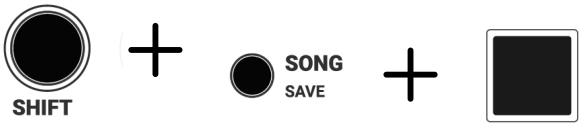
Press and hold SONG then press one of the RGB buttons to load the corresponding song from the SD card.

WARNING - loading a new song causes any unsaved work to be lost from the current song.

SAVING A SONG

There are two ways to save a SONG

1. Press SHIFT then press and hold SONG/SAVE then press one of the RGB buttons to save the current SONG to the corresponding slot.



2. Double click SONG/SAVE to save the current SONG to the current SONG slot.

NOTE - to see which SONG slot is currently selected, press and hold SONG/SAVE. The white LED pills will indicate the current SONG slot.

INITIALISING A SONG

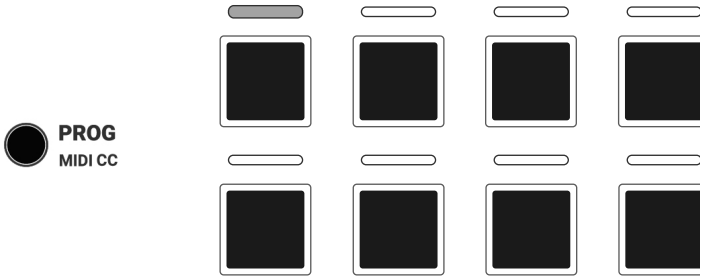
Hold SONG then press the RESET to clear/initialise the current SONG and all PROGRESSIONS within it.

Progressions

A SONG consists of 8 PROGRESSIONS.

DISPLAY

When the PROG button is pressed the bright LED pill indicates the currently active PROGRESSION.



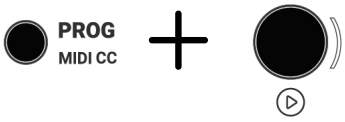
PROGRESSION 1 is active by default.

SWITCHING PROGRESSIONS

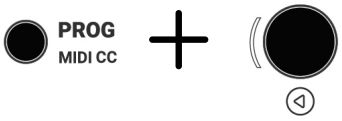
Hold PROGRESSION then press one of the 8 RGB buttons to navigate to the corresponding PROGRESSION

COPYING PROGRESSIONS

Hold PROGRESSION then press the RIGHT button to copy the current PROGRESSION to the next PROGRESSION slot.



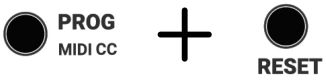
Hold PROGRESSION then press the LEFT button to copy the current PROGRESSION to the previous PROGRESSION slot.



(cont.)

INITIALISING PROGRESSIONS

Hold PROGRESSION then press the RESET to initialise the current PROGRESSION and all PATTERNS within it.



Patterns - Overview

A PROGRESSION is made up of up to 8 PATTERNS.

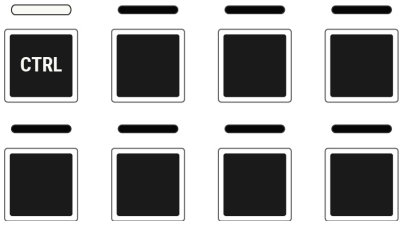
During normal operation, the white LED pills display the state of all the PATTERNS in the current PROGRESSION.

A bright white pill indicates the *control* PATTERN

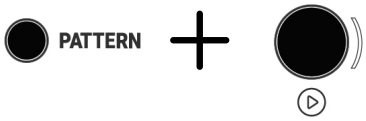
A dim white pill indicates an *active* PATTERN.

A dark pill indicates an *inactive* PATTERN.

By default, PATTERN 1 is the *control* and is the only *active* PATTERN.



Hold PATTERN then press the RIGHT button to copy the current PATTERN to the next PATTERN slot.



The LEFT and RIGHT buttons to navigate between *active* patterns.

Sending a trigger to MOD 6 switches to the next active PATTERN. This is equivalent to pressing the RIGHT button.

Patterns - Display

A PROGRESSION is made up of up to 8 PATTERNS.

During normal operation, the white LED pills display the state of these PATTERNS

A bright white pill indicates the *control* PATTERN i.e. the PATTERN linked to the controls on the Tetrachords faceplate.

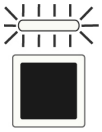
Bright red on the prototype.

Note: the CTRL text has been added to this guide for clarity. It does not appear on the faceplate.

A dim white pill indicates an *active* PATTERN.

Dim red on the prototype.

A dark pill indicates an *inactive* PATTERN.

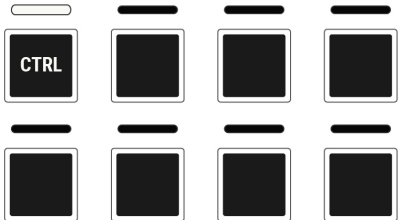


A blinking white pill indicates a pattern that is playing but is not the *control* pattern.

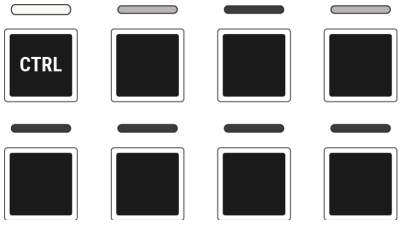
This is explained in full in the LINK section of this guide. Usually, the pattern that is playing is also the PATTERN linked to the controls on the faceplate.

TODO - add a hyperlink to the LINK section when it is written.

By default, PATTERN 1 is the *control* PATTERN and the only *active* PATTERN.



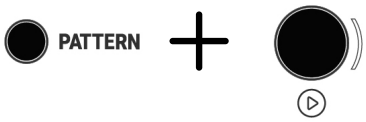
In the example below, PATTERN 1 is the *control* PATTERN and PATTERNS 2 & 4 are *active*.



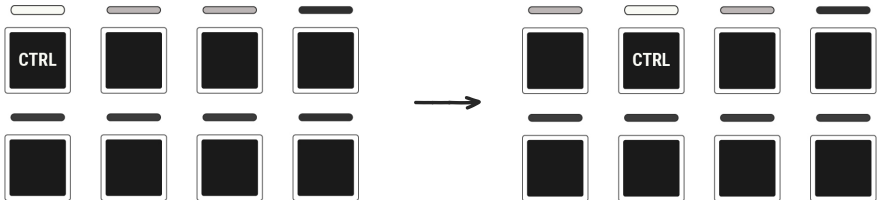
Patterns - Copying

There are 3 ways to copy a PATTERN.

1. Press and hold the PATTERN button and then press the RIGHT ARROW button to copy the *control* PATTERN to the next PATTERN.

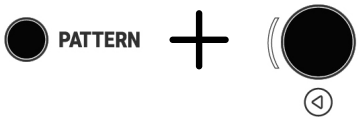


For example, if the *control* PATTERN is PATTERN 1, the PATTERN and RIGHT ARROW button combination will copy PATTERN 1 to PATTERN 2.



Note that PATTERN 2 is now the *control* PATTERN.

2. Press and hold the PATTERN button and then press the LEFT ARROW button to copy the *control* PATTERN to the previous active PATTERN.



3. Press and hold the PATTERN button and then press an RGB button corresponding to an inactive PATTERN.

This copies the current *control* PATTERN to the PATTERN corresponding to the RGB button and makes it the new *control*.

Note that the PATTERN being copied to must be inactive, otherwise this process simply switches the *control* PATTERN without copying.

Patterns - Control Pattern Switching

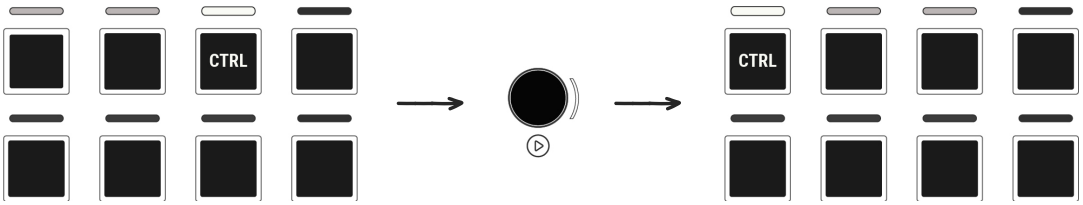
PATTERN SWITCHING METHOD 1 - ARROW BUTTONS

The LEFT or RIGHT ARROW buttons switch the *control* PATTERN.

Pressing the RIGHT ARROW makes the next *active* PATTERN the *control* PATTERN.

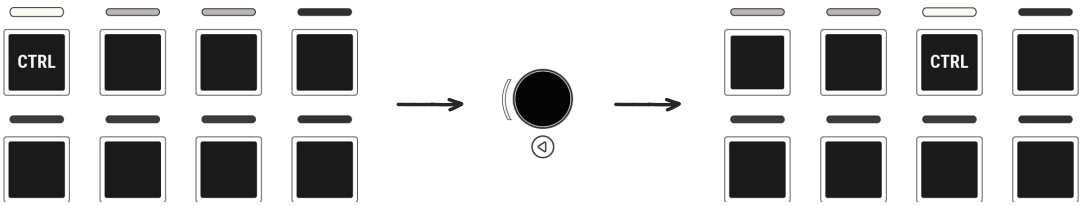
Pressing the LEFT ARROW makes the previous *active* PATTERN the *control* PATTERN.

PATTERN switching is cyclical, if the last *active* PATTERN is the *control* PATTERN and the RIGHT ARROW button is pressed...



... the first *active* PATTERN becomes the new *control* PATTERN.

Conversely, if the first *active* PATTERN is the *control* PATTERN and the LEFT ARROW button is pressed...



... the last *active* PATTERN becomes the new *control* PATTERN.

(cont.)

PATTERN SWITCHING METHOD 2 - RGB BUTTONS

Whilst the PATTERN button is pressed, the RGB buttons switch the *control* PATTERN.

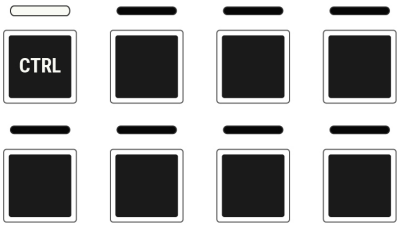
If the target PATTERN, i.e. the PATTERN being switched to, is inactive, the RGB button switching method:

1. makes the target PATTERN *active*.
2. copies the control PATTERN to the target PATTERN.
3. makes the target PATTERN the *control* PATTERN.

If the target PATTERN is active, the RGB button switching method simply makes the target pattern the *control* PATTERN.

For example:

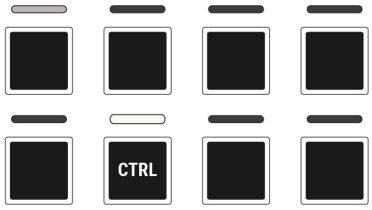
1. Start with the default case, where PATTERN 1 is both the *control* PATTERN and the only *active* PATTERN.



2. Press and hold the PATTERN button, then press RGB button 6

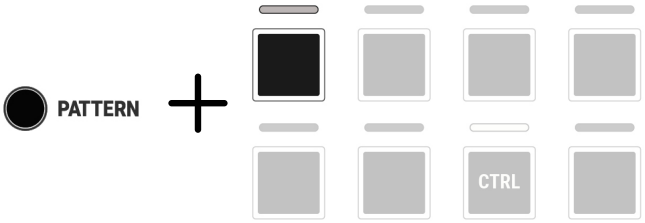
(cont.)

PATTERN 6 is now *active* and has become the *control* PATTERN.

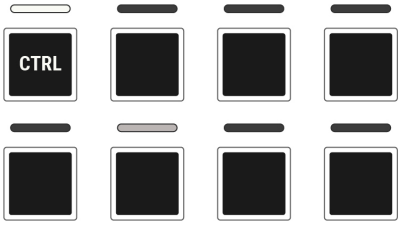


Because PATTERN 6 was previously inactive, PATTERN 1 has been copied to PATTERN 6.

3. Press and hold the PATTERN button, then press RGB button 1



PATTERN 1 is now *active* and has become the *control* PATTERN.



Because PATTERN 1 was previously active, this has been a simple switch. No copying has taken place.

PATTERN SWITCHING METHOD 3 - CV

By default, sending a trigger to MOD 6 makes the next *active* PATTERN the *control* PATTERN.

This is equivalent to pressing the RIGHT ARROW button.

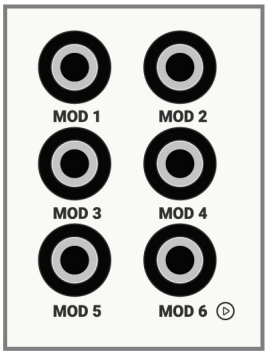
The following settings are stored within each PATTERN

Path settings
Scale settings
Octave settings
Spread settings
Inversion settings
Arp/Chord settings
Chromatic settings
Reverse settings
Active note settings i.e. which notes play
Custom pattern settings
MIDI CC settings
MIDI velocity settings
LFO settings

(cont.)

CV Modulation

The 6 MOD inputs can be used to control any (almost) of the Tetrachords' settings via CV.

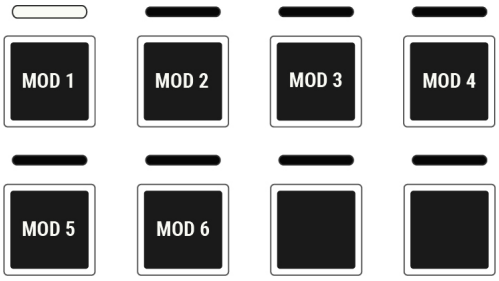


Modulations are set up via a four step process.

1. Press and hold the MOD button.

2. Choose and configure the modulation source.

   Press RGB buttons 1-6 to choose MOD 1 - 6 respectively as the modulation source.

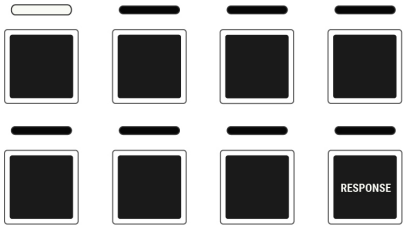


   A bright white LED indicates the chosen modulation source (MOD 1 is chosen by default.

   Multiple modulations can be assigned to the same source.

(cont.)

Press RGB button 8 to specify how the selected MOD responds.



MODs can be configured to respond in 3 ways.

BIPOLAR (-5v to 5v)

The AMOUNT 2 LED oscillates to indicate the bipolar setting.

UNIPOLAR (0v to 5v)

The AMOUNT 2 LED pulses right to indicate the unipolar setting.

TRIGGER

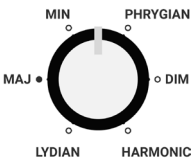
The AMOUNT 2 LED blinks to indicate the trigger setting.

When the TRIGGER response is selected, a CV trigger input causes the modulation target value to cycle through its range of possible settings.

3 Choose what will be modulated.

Select the mod target by using the control associated with that target.

For example, whilst still pressing MOD, turn the Tetrachord 1 knob to select Tetrachord 1 as the mod target.

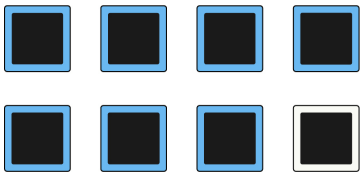


(cont.)

4 Fine tune the mod response.

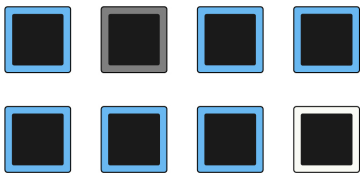
Once the mod target has been selected, RGB buttons 1 - 8 may be used to fine tune the mod response.

For example, if TETRACHORD 1 is selected as the mod target...



... RGB buttons 1 to 7 will illuminate, indicating that the incoming CV modulation may set the TETRACHORD 1 control to any of its 7 possible values.

Pressing RGB button 2 at this point has the result that incoming CV can no longer set the TETRACHORD 1 value to it's 2nd setting, MAJ.



RGB button 2 goes dark to indicate this.

Incoming CV can now set the TETRACHORD 1 value to LYDIAN, MIN, PHRYGIAN, DIM or HARMONIC but not MAJ.

Note that pressing the RESET button at this point will disable the MOD.

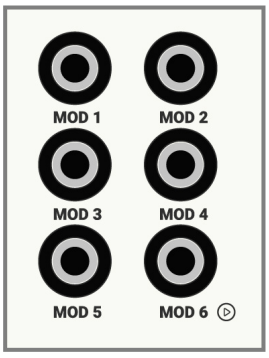
Disabling Mods

There are three ways to disable CV Mods

1. Press SHIFT then MOD/UNMOD

Then manipulate the control for which you wish to disable modulation e.g. turn the PATH knob to disable PATH modulation.

2. Remove the cable from the physical MOD input.



Removing the cable temporarily disables any modulations associated with that MOD input.

The MOD settings aren't deleted when the cable is removed. Modulation resumes if the cable is plugged back in.

CV Modulation Example 1

Target: *Musical Mode*

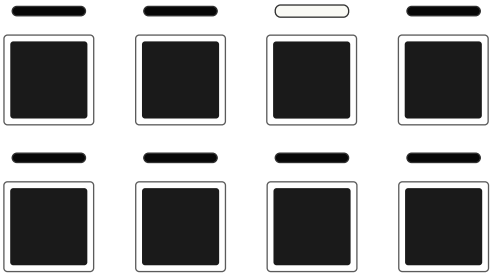
Physical input: *Mod 3*

Type of input: *0 to 5v*

Targeted Settings: *Mode 1* | *Mode 2* | *Mode 4* | *Mode 6*

1. Press and hold the MOD button.

2. Press RGB BUTTON 3 to select MOD 3 as the physical input



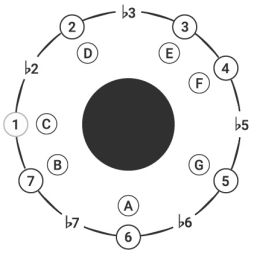
3. Use RGB BUTTON 8 to select unipolar (0 to 5v) input.

UNIPOLAR (0v to 5v)

The AMOUNT 2 LED pulses right to indicate the unipolar setting.

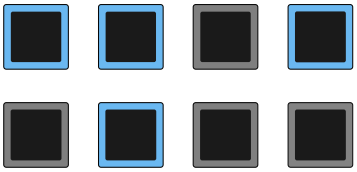
(cont.)

4 Turn the rotary encoder to set *Musical Mode* as the mod target.



5 At this point, RGB buttons 1 to 8 will illuminate, indicating that the incoming CV modulation may set the MUSICAL MODE control to any of its 8 possible values.

Press RGB buttons 3, 5, 7 & 8 to exclude the corresponding values from CV control.



Incoming CV can now set the MUSICAL MODE value to modes 1, 2, 4 or 6.

Note that the buttons act as a toggle.

For example, pressing RGB BUTTON 5 again will make mode 5 accessible to CV modulation.

6 Release the MOD button.

CV Modulation Example 2

Target: *MIDI Out*

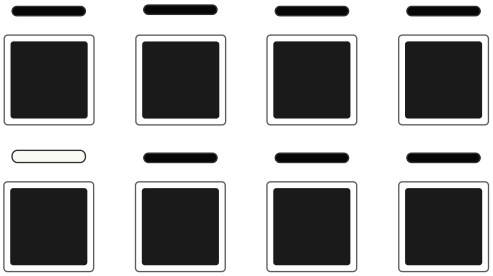
Physical input: *Mod 5*

Type of input: *Trigger*

Targeted Settings: *Channel 1* | *Channel 2* | *Channel 3*

1. Press and hold the MOD button.

2. Press RGB BUTTON 5 to select MOD 5 as the physical input



3. Use RGB BUTTON 8 to select trigger input.

TRIGGER

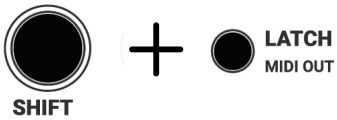
The AMOUNT 2 LED blinks to indicate the trigger setting.

(cont.)

STEP 4 - CURRENT PROTOTYPE
Release MOD then double tap and hold MOD

There is currently a bug where modulating the midi out from multiple tracks is messed up somehow. It should work fine for 1 track.

4 Press and hold SHIFT then press LATCH/ MIDI OUT



5

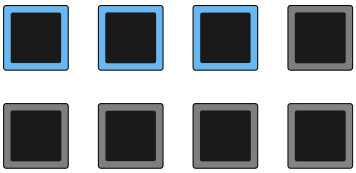
NOTE

This step is slightly different for MIDI IN and MIDI OUT than for other modulations setups.

First, by default, no modulation is activated and the player activates channels as part of the setup process.

Second, navigating the setup is different because the are 16 possible values i.e. there are more values than RGB buttons.

The RGB



Incoming CV triggers will now CYCLE the MIDI OUT channel setting

6. Release the MOD button.

CV Modulation Example 3

Target: *Rev 1*

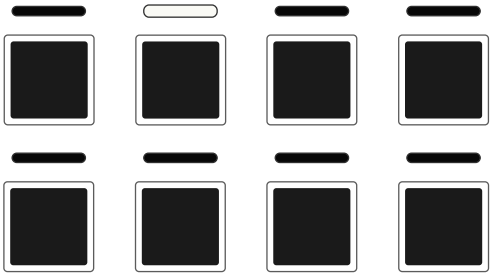
Physical input: *Mod 2*

Type of input: *0 to 5v*

Targeted Settings: *Rev 1 on/off*

1. Press and hold the MOD button.

2. Press RGB BUTTON 2 to select MOD 2 as the physical input



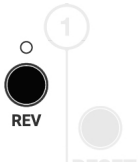
3. Use RGB BUTTON 8 to select unipolar (0 to 5v) input.

UNIPOLAR (0v to 5v)

The AMOUNT 2 LED pulses right to indicate the unipolar setting.

(cont.)

4. Press the REV 1 BUTTON



5. At this point, RGB button 1 illuminates, indicating the incoming CV can set REV 1 on or off.

6. Release the MOD button.

CV Modulation Example 4

Target: *Vel Level*

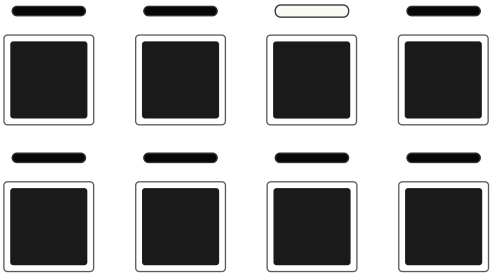
Physical input: *Mod 3*

Type of input: *-5 to 5v*

Targeted Settings: *MIDI velocity 50% to 87.5%*

1. Press and hold the MOD button.

2. Press RGB BUTTON 3 to select MOD 3 as the physical input

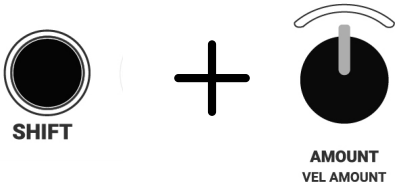


3. Use RGB BUTTON 8 to select bipolar (-5v to 5v) input.

BIPOLAR (-5v to 5v)

The AMOUNT 2 LED oscillates to indicate the bipolar setting.

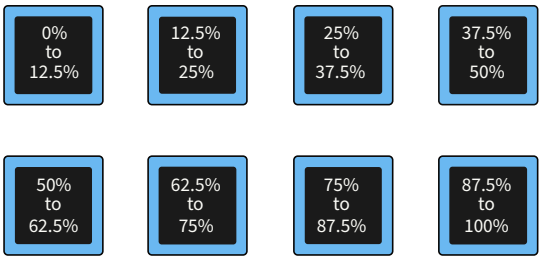
4. Press and hold SHIFT then turn the AMOUNT/VEL AMOUNT knob



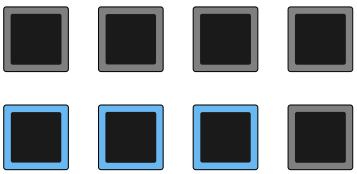
(cont.)

5 At this point, RGB buttons 1 to 8 will illuminate, indicating that the incoming CV modulation may set the MIDI VELOCITY over its entire range, from 0 to 127.

Each RGB button represents 12.5% of the overall range.



Press RGB buttons 1, 2, 3, 4 & 8 to exclude the lowest 50% and highest 12.5% of values from CV control.



Incoming CV can now set the MIDI velocity level to between 50% and 87.5% of the MIDI velocity range.

6 Release the MOD button.

CV Modulation Example 5

Target: *Next Pattern*

Physical input: *Mod 6*

Type of input: *Trigger*

Targeted Settings: *Next Pattern*

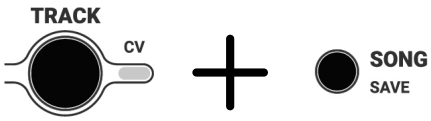
1. Next PATTERN modulation is enabled by default.

   When a CV trigger is received on MOD 6, the next PATTERN, if there is one, will play.

(cont.)

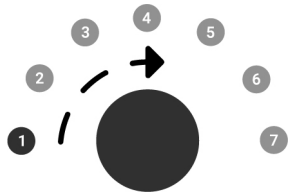
LED display settings

To change display presets or edit the LED display, press and hold the TRACK 1 button then press and hold the SONG/SAVE button.



TRACK 1 can be released at this stage.

With SONG/SAVE still pressed, turn the ROTARY ENCODER to select an LED display preset for loading and/or editing.



At this point, there are two options:

1. Pressing the ROTARY ENCODER button, loads the selected preset and returns the TETRACHORDS to normal operation.

2. Releasing SONG/SAVE button, loads the selected preset and puts the TETRACHORDS module in LED DISPLAY EDITOR MODE.

To exit LED DISPLAY EDITOR MODE without making any changes, press the PATTERN button. This can be done at any time.

To exit LED DISPLAY EDITOR mode and set the LED display to factory settings, press the the RESET button.

(cont.)

LED DISPLAY EDITOR

Once in LED DISPLAY EDITOR mode, customising the LED display is a four-step process:

1. Use ROTARY ENCODER to load or select a display preset for editing (details to follow).

2. Adjust the LEDs (details to follow).

3. Press the SONG/SAVE button to save the new LED settings.

   If an SD card is present, the new settings will be saved and will load when the Tetrachords powers on.

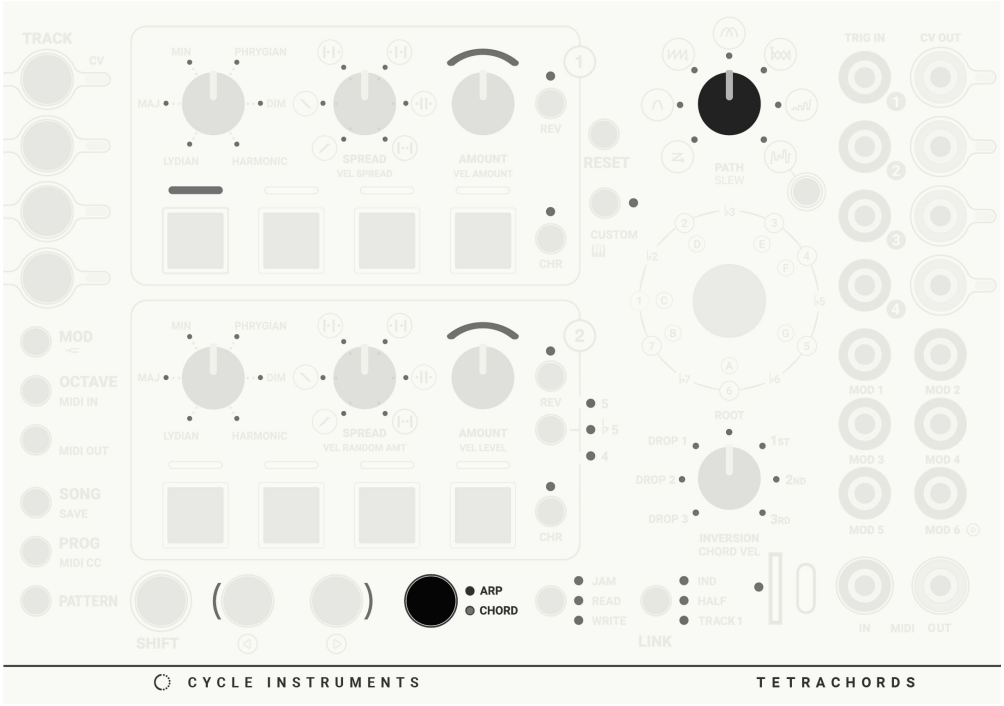
4. Double tap the the SONG/SAVE button to save the new LED settings and return to regular Tetrachords with the new LED settings loaded.

   REMEMBER: press the PATTERN button at any time to return to regular Tetrachords functionality without changing LED settings.

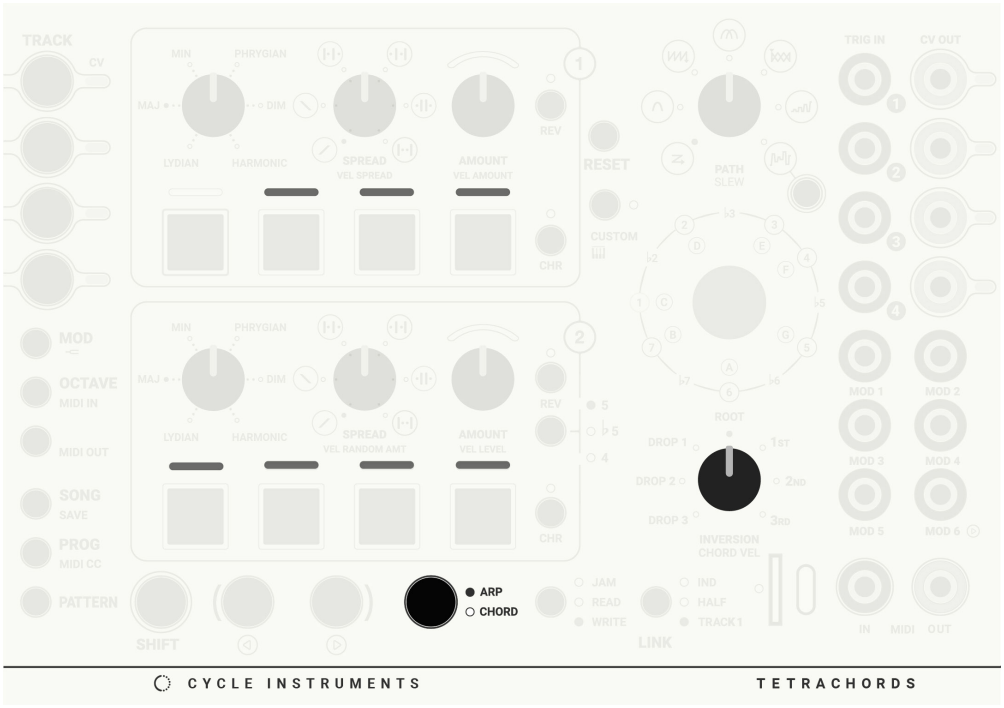
(cont.)

Editing Blue/White single colour LEDs

The PATH knob adjusts the brightness of the BLUE/WHITE LEDs including the brighter setting of the BLUE/WHITE LED pills.



The INVERSION knob adjusts the dimmer setting of the BLUE/WHITE LED pills



(cont.)

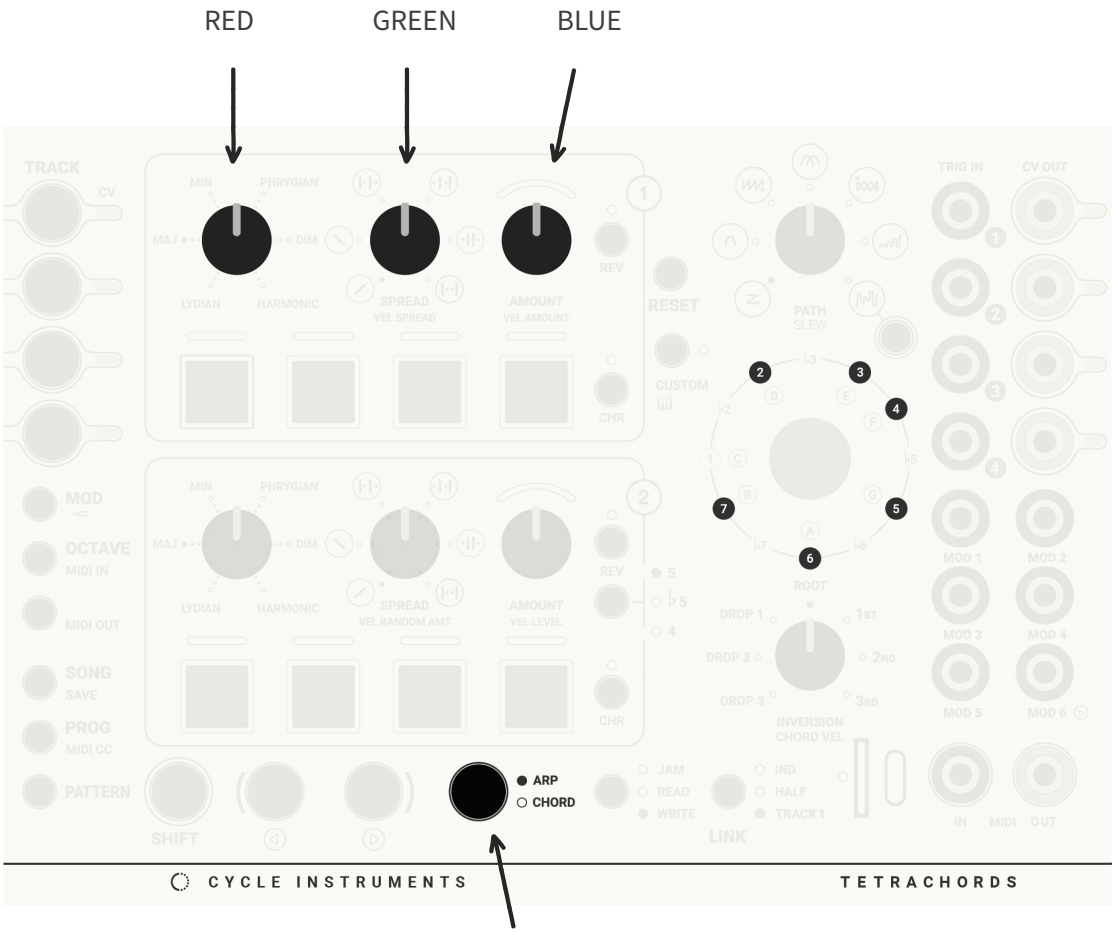
Editing Generic Colour LEDs

The Tetrachords module has two generic colour settings.

To adjust these settings, first press the ARP/CHORD button, then edit them as follows...

1. The colour of scale notes that are not the root note on the LED RING. By default, this is set to white.

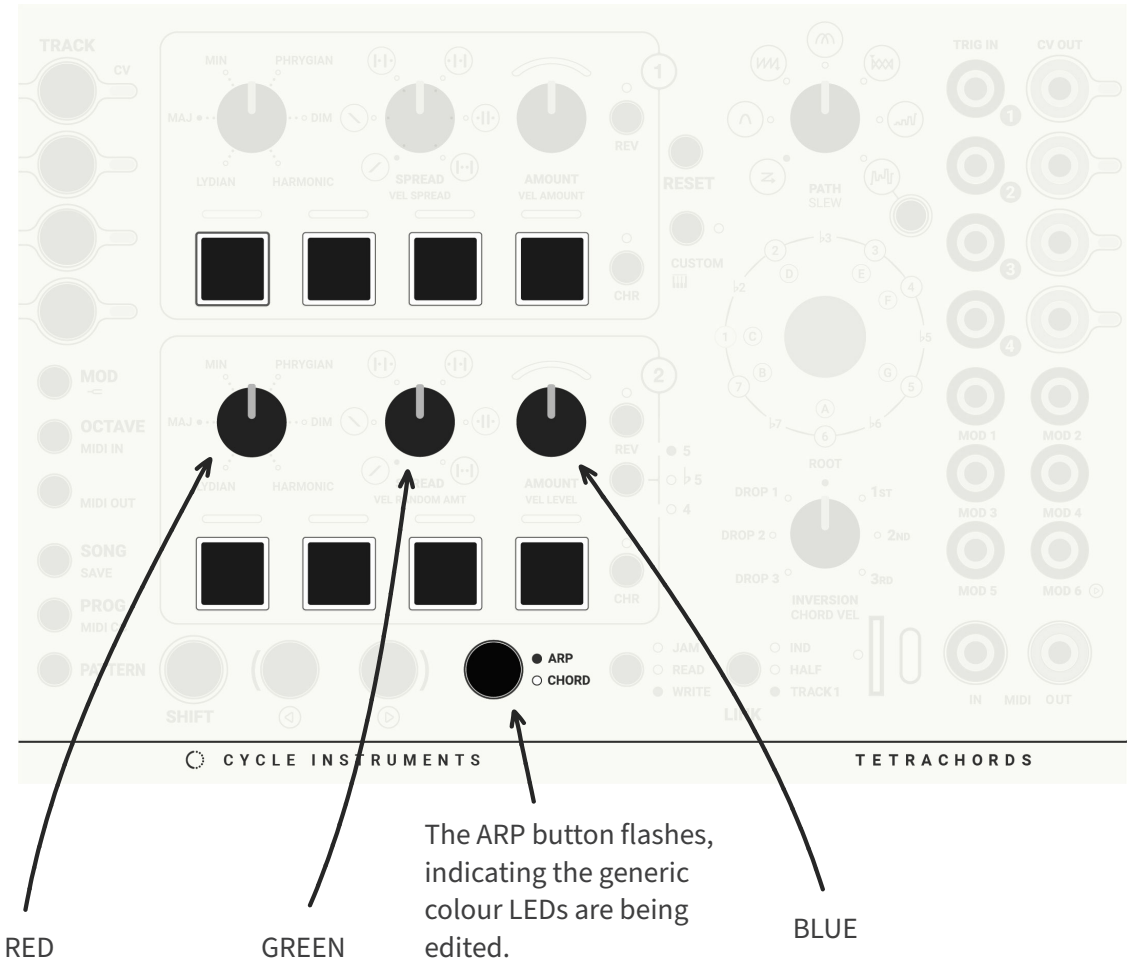
   The three tetrachord 1 knobs adjust the red, green and blue values of the scale note LEDs, as indicated.



The ARP button flashes, indicating the generic colour LEDs are being edited.

(cont.)

2 The colour of the RGB buttons when not selected or playing. By default, the RGB buttons are off when not selected.



(cont.)

Editing TRACK Colour LEDs

The Tetrachords module has four colour settings associated with each track.

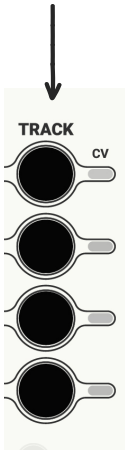
1. The colour of the TRACK button, CV OUT and scale root note LEDs.

2. The secondary version of the scale root note LEDs, seen when editing the CUSTOM NOTE QUEUE.

3. The colour of the RGB buttons when a note is activated.

4. The highlighted version of the RGB button colour, seen as a flash when a note is playing.

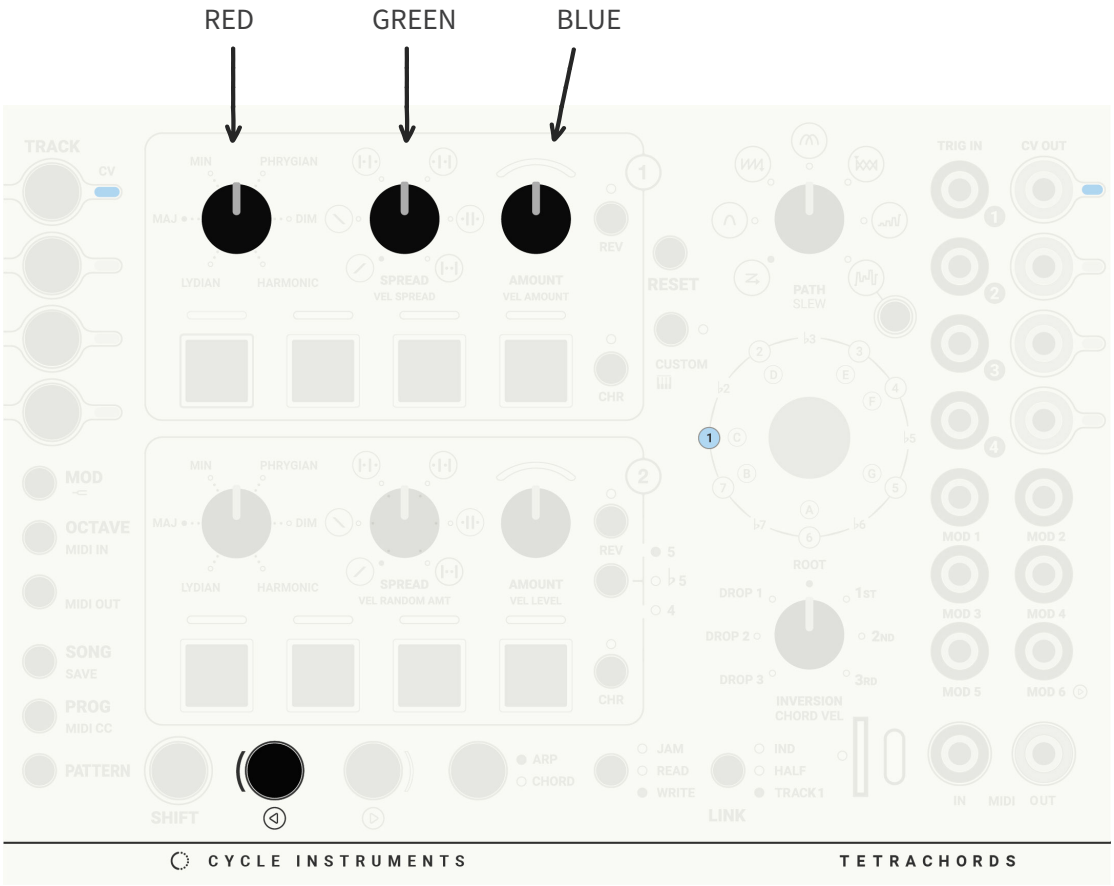
Use the TRACK buttons to select a track for editing.



Then edit as follows...

(cont.)

1. Press the LEFT button, then use the Tetrachord 1 knobs to adjust the colour of the TRACK button, CV OUT and scale root note LEDs.

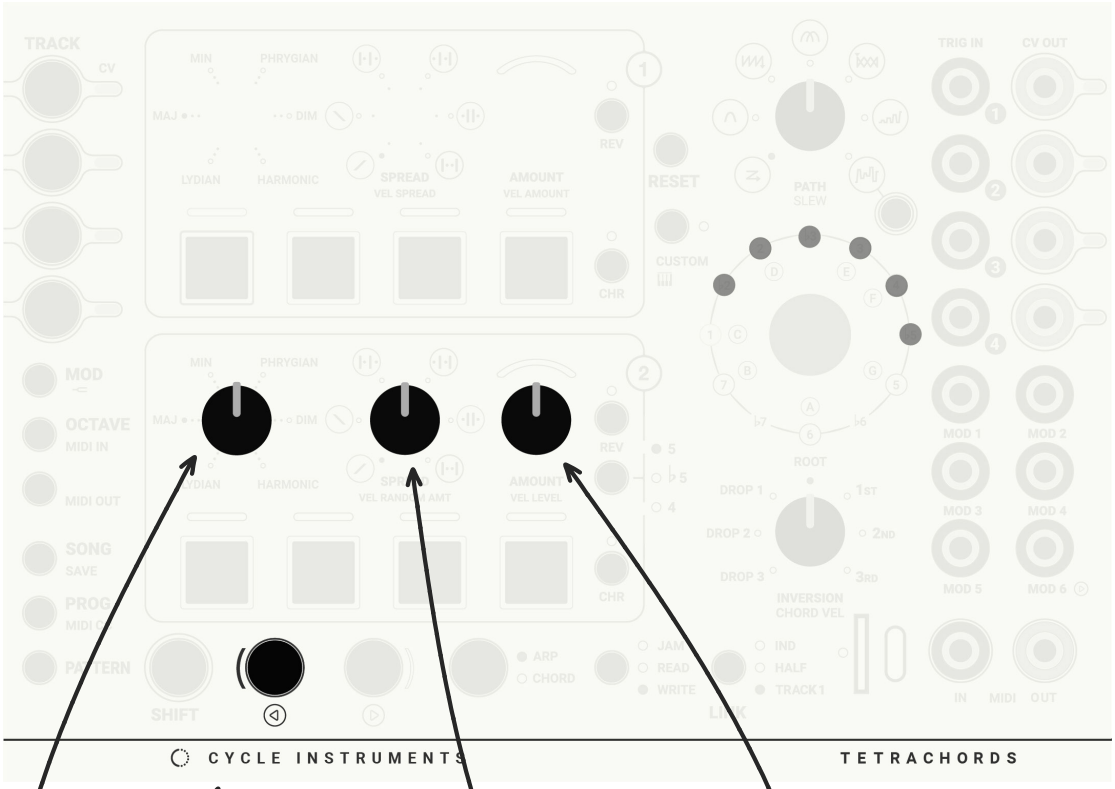


The LEFT button LED flashes, indicating the TRACK button, CV OUT, and LED RING LEDs are being edited.

(cont.)

2 The secondary version of the scale root note LEDs, seen when editing the CUSTOM NOTE QUEUE.

By default, this is a dimmer version of the primary ROOT NOTE colour.



RED

The LEFT button LED flashes, indicating the TRACK button, CV OUT, and LED RING LEDs are being edited.

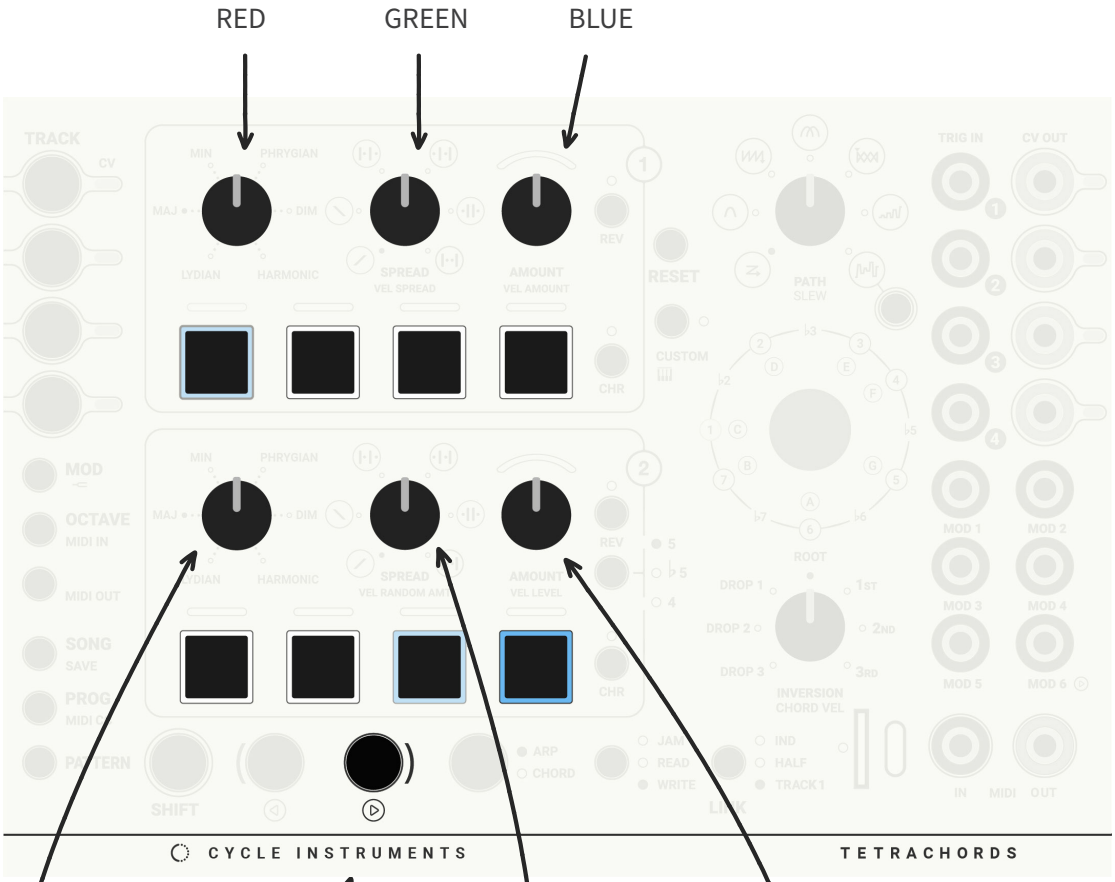
GREEN

BLUE

(cont.)

Press the RIGHT button, to adjust the RGB Button colours for the selected TRACK

The Tetrachord 1 knobs edit the colour of the RGB buttons when a note is activated.



RED

The RIGHT button LED flashes, indicating the RGB button colours are being edited.

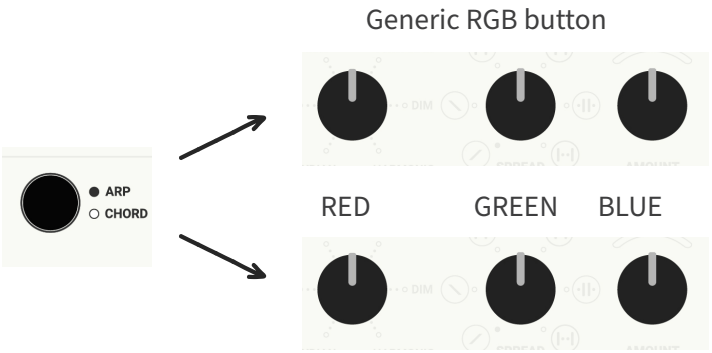
GREEN

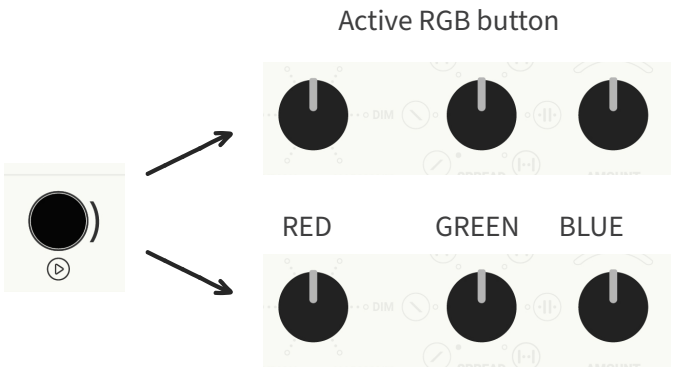
BLUE

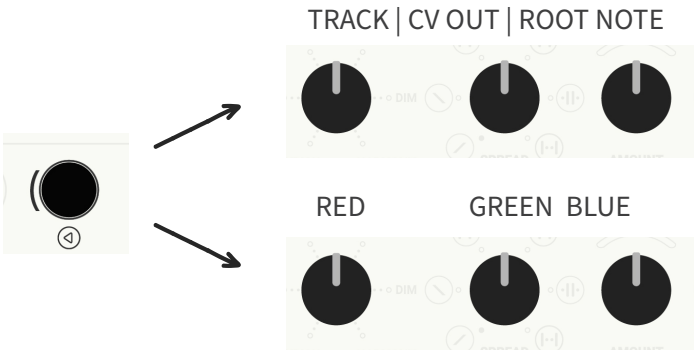
The Tetrachord 2 knobs edit the highlighted RGB button colours.

(cont.)

RGB editing quick quide







Appendix 1 - CONFIG.TXT

Acknowledgements

(cont.)

LINK

A bright blue pill indicates the *control* PATTERN i.e. the PATTERN linked to the controls on the Tetrachords faceplate.

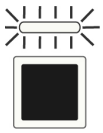
Bright red on the prototype.

Note: the CTRL text has been added to this guide for clarity. It does not appear on the faceplate.

A dim blue pill indicates an *active* PATTERN.

Dim red on the prototype.

A dark pill indicates an *inactive* PATTERN.

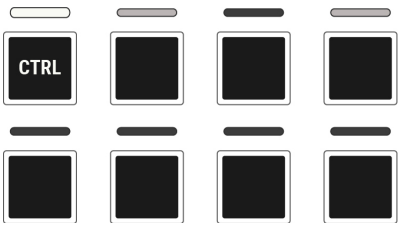


A blinking blue pill indicates a pattern that is playing but is not the *control* pattern.

This is explained in full in the LINK section of this guide. Usually, the pattern that is playing is also the PATTERN linked to the controls on the faceplate.

TODO - add a hyperlink to the LINK section when it is written.

In the example below, PATTERN 1 is the *control* PATTERN and PATTERNS 2 & 4 are *active*.



(cont.)

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