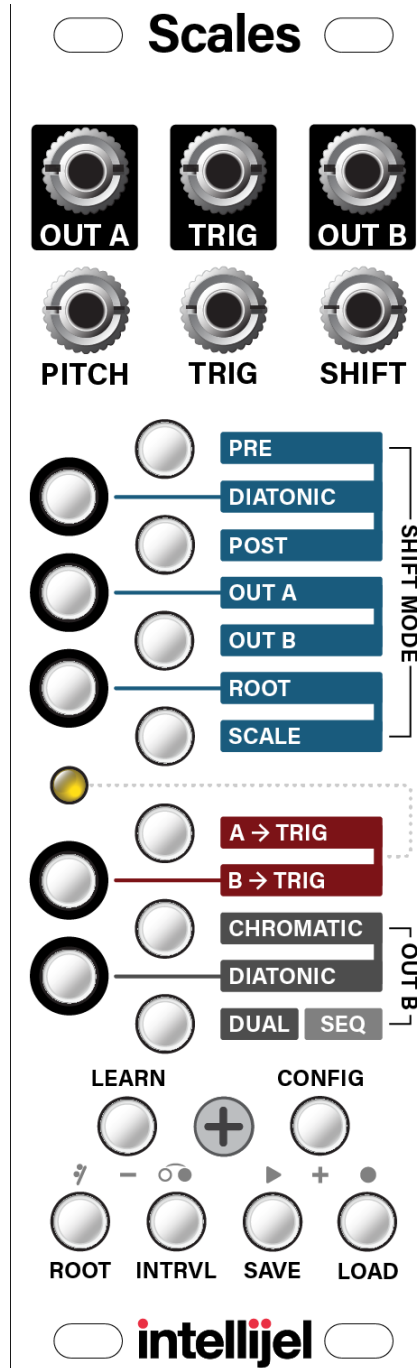


# Scales

Dual Channel Note Quantizer and Step Sequencer



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## Compliance



This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Intellijel Designs, Inc. could void the user's authority to operate the equipment.

Any digital equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.



This device meets the requirements of the following standards and directives:

EMC: 2014/30/EU

EN55032:2015 ; EN55103-2:2009 (EN55024) ; EN61000-3-2 ; EN61000-3-3

Low Voltage: 2014/35/EU

EN 60065:2002+A1:2006+A11:2008+A2:2010+A12:2011

RoHS2: 2011/65/EU

WEEE: 2012/19/EU



## Installation

Intellijel Eurorack modules are designed to be used with a Eurorack-compatible case and power supply. We recommend you use Intellijel cases and power supplies.

Before installing a new module in your case, you must ensure your power supply has a free power header and sufficient available capacity to power the module:

- Sum up the specified +12V current draw for all modules, including the new one. Do the same for the -12 V and +5V current draw. The current draw will be specified in the manufacturer's technical specifications for each module.
- Compare each of the sums to specifications for your case's power supply.
- Only proceed with installation if none of the values exceeds the power supply's specifications. Otherwise you must remove modules to free up capacity or upgrade your power supply.

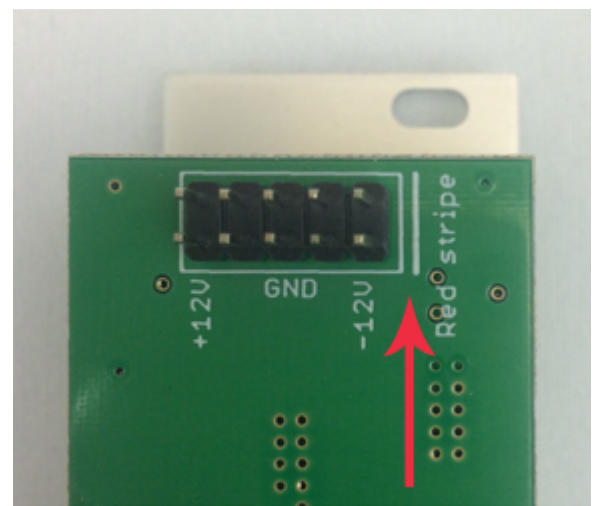
You will also need to ensure your case has enough free space (hp) to fit the new module. To prevent screws or other debris from falling into the case and shorting any electrical contacts, not leave gaps between adjacent modules, and cover all unused areas with blank panels. Similarly, do not use open frames or any other enclosure that exposes the backside of any module or the power distribution board.

You can use a tool like [ModularGrid](#) to assist in your planning. Failure to adequately power your modules may result in damage to your modules or power supply. If you are unsure, please [contact us](#) before proceeding.

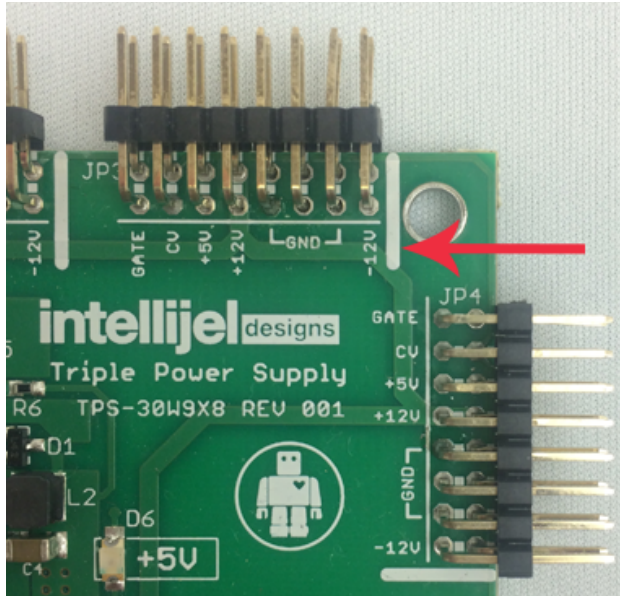
## Installing Your Module

When installing or removing a module from your case always turn off the power to the case and disconnect the power cable. Failure to do so may result in serious injury or equipment damage.

Ensure the 10-pin connector on the power cable is connected correctly to the module before proceeding. The red stripe on the cable must line up with the -12V pins on the module's power connector. The pins are indicated with the label -12V, a white stripe next to the connector, the words "red stripe", or some combination of those indicators.



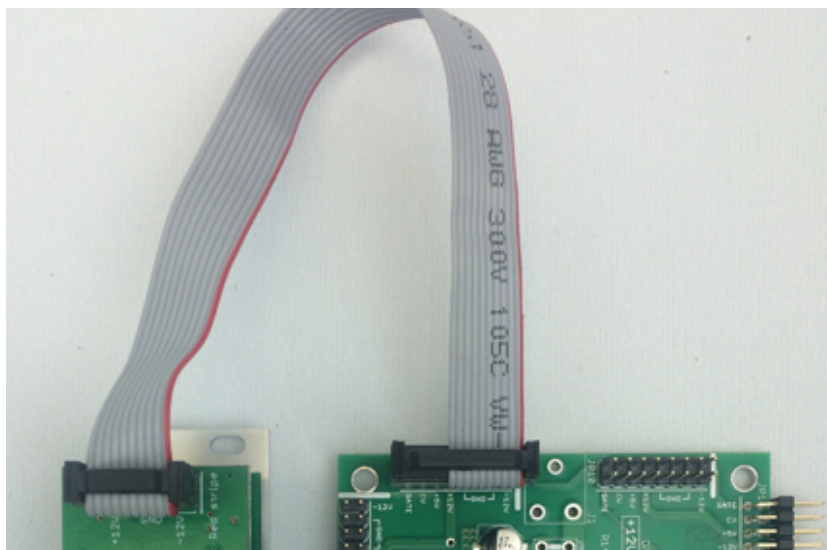
Most modules will come with the cable already connected but it is good to double check the orientation. Be aware that some modules may have headers that serve other purposes so ensure the cable is connected to the right one.



The other end of the cable, with a 16-pin connector, connects to the power bus board of your Eurorack case. Ensure the red stripe on the cable lines up with the -12V pins on the bus board. On Intellijel power supplies the pins are labelled with the label “-12V” and a thick white stripe:

If you are using another manufacturer’s power supply, check their documentation for instructions.

Once connected, the cabling between the module and power supply should resemble the picture below:



Before reconnecting power and turning on your modular system, double check that the ribbon cable is fully seated on both ends and that all the pins are correctly aligned. If the pins are misaligned in any direction or the ribbon is backwards you can cause damage to your module, power supply, or other modules.

After you have confirmed all the connections, you can reconnect the power cable and turn on your modular system. You should immediately check that all your modules have powered on and are functioning correctly. If you notice any anomalies, turn your system off right away and check your cabling again for mistakes.

## Overview

Scales is an 8hp dual-channel note quantizer and step sequencer. Fundamentally, it takes an input voltage, quantizes it to notes in a user-defined scale, and sends that quantized voltage to an output, where you can use it as a melodic pitch source for oscillators or any other module that expects to see discreet note values at its input.

This makes it possible to turn LFO's into arpeggiators; random voltages into harmonic counterpoint; and unquantized external CV sequencers into chromatically tuned note sequencers.

But Scales goes far beyond the fundamental, allowing you unprecedented control of the pitches and intervals hiding inside your control voltages.

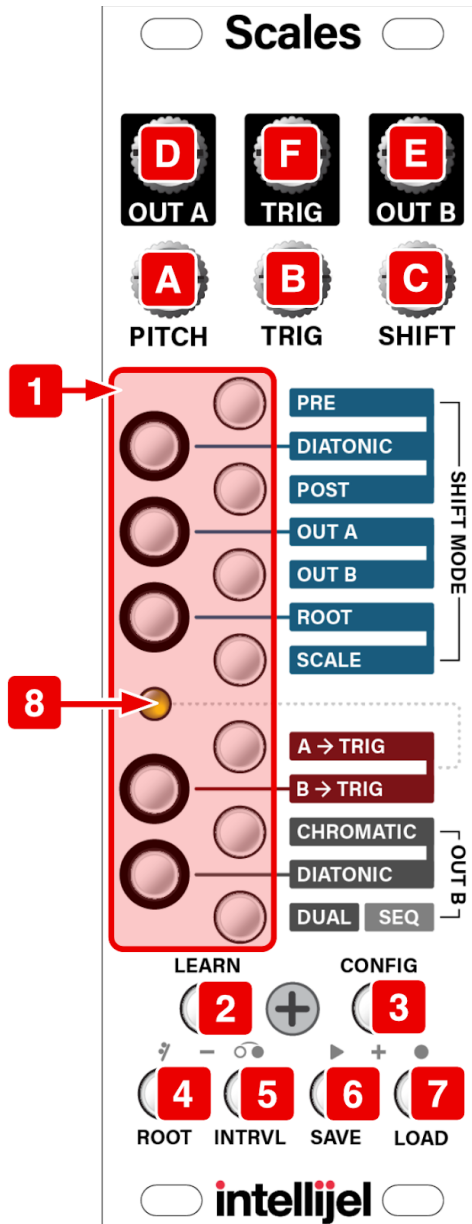
For example, Scales features two independent outputs, enabling you to create shifted harmonic intervals within your chosen scale using only a single pitch input. Scales can even be split into two quantizers — each conforming to a common scale, but fed entirely different voltage sources.

Quantization can be triggered or untriggered. If untriggered, voltages are quantized and output whenever the input voltage changes enough to force a new note. If triggered, new quantization values are output only when an input trigger is received, allowing you to precisely time your quantization to external events. Similarly, there are a number of trigger output options as well, ranging from no triggering (good for pitch shifting drones); through triggers that sync with either of the two outputs (or both); to a trigger or gate transmitted in sync with one sent to the module's trigger input.

And since the module is called “Scales” (plural) and not “Scale” (singular), you can bet it has the ability to save and recall up to 35 different scale patterns, arranged in 5 banks (black keys) of 7 scales each (white keys). An assortment of factory scale patterns is provided with the module, but you can overwrite these with your own scales anytime you wish. You can even use external CV to switch between scales or to change the root of any existing scale pattern.

And if all this weren't enough, Scales even doubles as a 128-step SH-101 style step sequencer (complete with storage for up to 35 fully programmable patterns) — allowing you to feed OUT B with internally created notes and rhythm patterns, while OUT A continues to function as a standard pitch quantizer for external voltages.

## Front Panel



## Inputs & Outputs

- A. PITCH IN - Connect the signal you wish to quantize to this input. Any voltage from -10V to 10V will be quantized and sent to the OUT A and OUT B jacks in accordance with Scales' parameter settings.

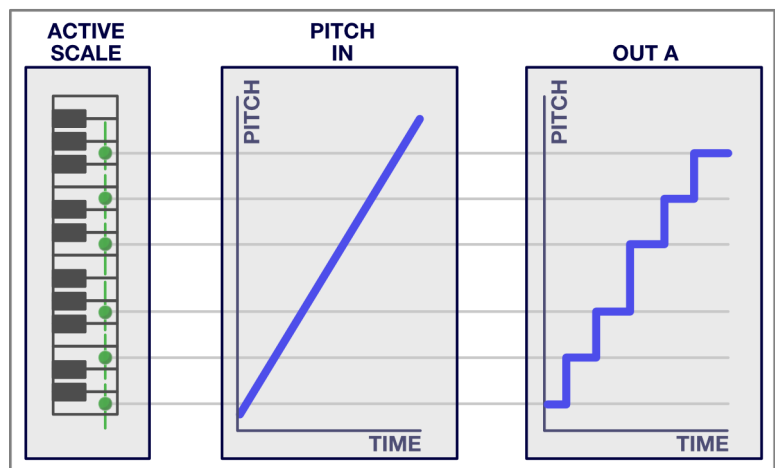
**B. TRIG IN** - With a trigger or gate signal inserted in this jack, Scales will sample the PITCH input every time the trigger goes high, sending the nearest quantized pitch to OUT A and OUT B (in accordance with their output configuration settings).

If nothing is inserted into the TRIG IN jack, Scales will continuously sample the PITCH input and compare it to the active scale. Every time the pitch changes enough to trigger a new quantization value, Scales sends the newly quantized pitch to OUT A and OUT B (in accordance with their output configuration settings).

If Scales is in SEQ Mode, this jack functions as a clock input.

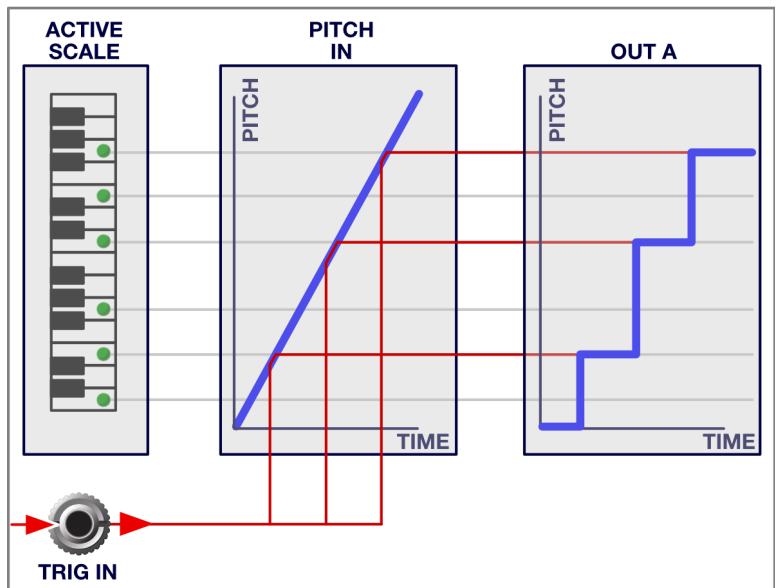
In the example shown top-right, no TRIG input is used. A Steady voltage sweep is sent to the PITCH in, and the active scale is as shown. The quantized output value changes whenever the input voltage crosses another quantization threshold.

**PITCH IN Quantized without a TRIG IN**



In the example shown bottom-right, a TRIG input is used. A steady voltage sweep is sent to the PITCH in, and the active scale is as shown. Scales only outputs a new quantized voltage when it receives a TRIG input.

**PITCH IN Quantized with a TRIG IN**



- 
- C. SHIFT IN** - Connect a modulation source (such as a second sequencer output, LFO, offset generator or keyboard) to this input to shift the range of quantized outputs up/down in accordance with various SHIFT Mode options (accessed via [CONFIG Mode](#)). This input accepts a -10V to 10V signal.

If Scales is in [DUAL mode](#), the SHIFT input functions as a dedicated PITCH input for OUT B.

If Scales is in [SEQ Mode](#), the SHIFT input functions as a reset jack — a trigger received here resets the internal sequencer to the first step.

- D. OUT A** - Outputs a quantized version of the signal appearing at the **PITCH** input jack.

Quantized output voltages fall within a 20 Octave (-10V to 10V) range, tuned to 1V/Oct, and conform to the currently active scale notes and (if applicable) any scale shifts routed to OUT A.

- E. OUT B** - Outputs a quantized version of the signal appearing at the **PITCH** input jack.

Quantized output voltages fall within a 20 Octave (-10V to 10V) range, tuned to 1V/Oct, and conform to the currently active scale notes and (if applicable) any scale shifts routed to OUT B.

If Scales is in [DUAL mode](#), then OUT B quantizes voltages sent into the SHIFT input to the active scale, enabling the unit to quantize two entirely different voltage inputs to a common scale.

If Scales is in [SEQ Mode](#), then OUT B is the output of the step sequencer.

- F. TRIG OUT** - Outputs a trigger or gate setting depending on how Scales is configured. Specifically, if both **A > TRIG** and **B > TRIG** are turned off in CONFIG Mode, then Scales thru's any gate arriving at the TRIG In jack to the TRIG Out jack. If either (or both) **A > TRIG** and **B > TRIG** are turned on in CONFIG Mode, then Scales sends a trigger to the TRIG Out only when OUT A and/or OUT B detects a quantized pitch change.

If Scales is in [SEQ Mode](#), **TRIG > A** and **B > TRIG** are exclusive. If neither are selected, incoming gates on TRIG In will be passed through to TRIG Out and advance the sequence. When **TRIG > A** is selected, the sequencer becomes tied to the quantizer; a quantized pitch change detected on OUT A will advance the sequence and fire a trig on the TRIG Out. When **TRIG > B** is selected, an incoming gate on TRIG In will advance the sequence, but not pass through to TRIG Out unless the sequencer is playing.



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## Controls

1. **MULTIFUNCTION** buttons - These buttons perform different tasks depending on which mode is currently active. In Scales' default mode (none of the bottom buttons [2] - [7] are lit), it's in Scale Display Mode, and the buttons set/display the scale notes. In ROOT Mode, they set the scale's root note; in INTRVL Mode, they set the interval amounts; in SAVE and LOAD Modes, they select the Bank and Preset slot of the scale you wish to save or load; and in CONFIG Mode, they set the options indicated by the labels to the right.
2. **LEARN** button - Press this button to enter Learn Mode and light the button. Use Learn Mode to enter a scale via the PITCH input jack. This is particularly useful if, for example, you want to quantize Scales to match the scale used by another sequencer or pitch source, and don't know exactly what scale that device is using.

*NOTE: A short press of the LEARN button retains the active scale, and any notes you add via Learn Mode will be added to that scale. A long-press (>1 sec) of the LEARN button clears the active scale, so any notes you add via Learn Mode define the scale entirely.*

In [SEQ Mode](#), this button shifts the note scale down one octave when recording a sequence.

3. **CONFIG** button - Press this button to enter CONFIG Mode and light the button. Exit CONFIG Mode by pressing the button again, returning to Scale Display Mode.

CONFIG Mode contains numerous parameters, all of which are indicated by the labels to the right of the MULTIFUNCTION buttons. Use CONFIG mode to configure all the Shift options (as indicated by the labels with the blue background), Trigger options (red background), and OUT B options (grey background). See [CONFIG Mode](#) to learn about all the various configuration options.

In [SEQ Mode](#), this button shifts the note scale up one octave when recording a sequence.

4. **ROOT** button - Press this button to enter ROOT Mode and light the button. Exit ROOT Mode by pressing the button again, returning to Scale Display Mode.

In [ROOT Mode](#), the MULTIFUNCTION buttons display notes, which you use to set the root of the scale. Pushing any of the note buttons transposes the scale pattern so it's rooted at that note. Holding any of the note buttons sets that note as the root without transposing the pattern.

In [SEQ Mode](#), this button inserts a rest into the step sequence when recording a sequence.

5. **INTRVL** button - Press this button to enter INTRVL Mode and light the button. Exit INTRVL Mode by pressing the button again, returning to Scale Display Mode.

INTRVL Mode sets the interval of **OUT B** relative to **OUT A**, and the MULTIFUNCTION buttons are used to display and edit that interval. Specifically, the “C” note is an interval of 0 semitones, C# is one semitone, D is two, etc. Click a note button once to apply a positive interval offset to **OUT B** (indicated by a green note button). Click a note button a second time to turn it red, and apply a negative interval offset to **OUT B**.

In [SEQ Mode](#), pressing this button will tie (or slur) the previously entered note to the next note you enter, when recording a sequence.

6. **SAVE** button - Press this button to enter SAVE Mode and light the button.

This mode saves scales to the EEPROM memory. The black buttons select the scale bank, with bank 1 on C#, bank 2 on D#, etc. The white buttons select the actual “slot” into which you wish to save your scale pattern.

In [SEQ Mode](#), a long-press (>1 sec) of this button enables you to save sequences, rather than scale patterns, while a short-press plays the internal step sequence in time with a clock received at the **TRIG** input jack.

7. **LOAD** button - Press this button to light the LOAD button and enter LOAD Mode.

This mode loads scales from the EEPROM memory. The black buttons select the scale bank, with bank 1 on C#, bank 2 on D#, etc. Clicking a white button loads the current scale pattern from that location within a bank and exits LOAD Mode.

In [SEQ Mode](#), a long-press (>1 sec) of this button enables you to load sequences, rather than scale patterns, while a short-press of this button enables/disables recording. When recording is enabled, the note, rest and tie buttons are used to step-record a sequence.

8. **Trigger LED** - Lights every time Scales sends a trigger (or gate) signal to its **TRIG** out jack.



# MODES

Though it masquerades as a simple and elegant quantizer, below the surface lies a multitude of functions, options, and capabilities that transcend what one might traditionally expect from a quantizer. These features are accessed via the numerous blue buttons at the bottom of the module, which reassign the functionality of the the vertical scale note buttons and the in/out jacks at the top.

The following sections discuss these various modes in detail.

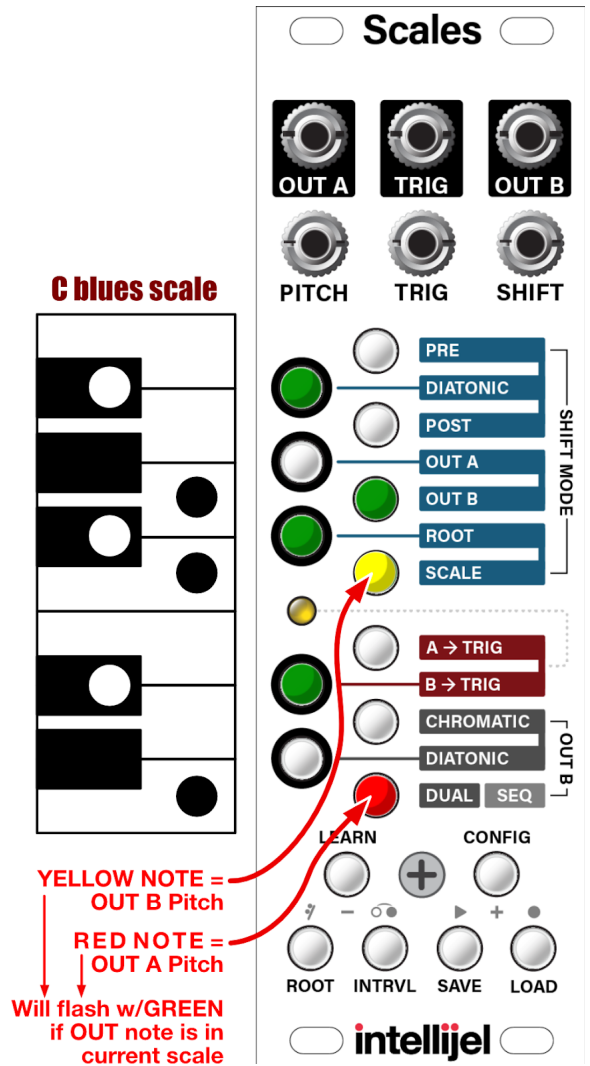
## Scale Display Mode

When none of the lower buttons are lit, Scales is in Scale Display Mode. In this mode, the 12 Multifunction buttons are used to display and define an active scale (the notes to which the incoming PITCH voltage is quantized). The 12 buttons are arranged like a one-octave vertically oriented keyboard, with “C” at the bottom and “B” at the top. The “black keys” are the five buttons in the left column, and the “white keys” are the seven buttons in the right column.

Push a button to toggle the corresponding note assignment on or off. Notes that are “on” and included in the currently active scale glow green. When a note button lights red, it indicates the note value to which Scales is currently quantizing OUT A. Notes being sent to OUT B light yellow. If the notes being sent to both OUT A and OUT B are the same, only the red light is used.

The Scale Display is always active, meaning you can turn notes on/off while Scales continues to quantize incoming voltages.

**IMPORTANT:** The scale you are editing is volatile and will not be recalled unless you [save it to a bank and preset](#).



## LEARN Mode

Press the **LEARN** button to enter Learn Mode. Use Learn Mode to enter a scale via the **PITCH** input jack. This is particularly useful if, for example, you want to quantize Scales to match the scale used by another sequencer or pitch source, and don't know exactly what scale that device is using.

1. Press or long-press the **LEARN** button to enter Learn Mode.

A short press of the **LEARN** button retains the active scale, and any notes you add via Learn Mode will be added to that scale.

A long-press (>1 sec) of the **LEARN** button clears the active scale, so any notes you add via Learn Mode define the scale entirely.

2. Connect a pitch source to **PITCH** In jack, and a gate or trigger source to the **TRIG** In jack.

This could be the pitch & gate outputs of a keyboard, sequencer, tetrapad, or any other such device.

3. Play the desired pitches on the external device.

Scales will add any notes you play on the external device to the active scale, lighting the corresponding note buttons on Scales.

4. When you're done learning the external scale, press the **LEARN** button again to exit Learn Mode, and use Scales as you normally would.

## CONFIG Mode

Press the **CONFIG** button to enter CONFIG mode (indicated by the glowing **blue CONFIG** button). CONFIG mode sets numerous configuration options for the Scales module and, itself, contains several sub modes. Specifically, use CONFIG mode to:

- Specify how the **SHIFT** input is interpreted. For example, it can be summed with the **PITCH** input (either PRE quantizer, POST quantizer, or DIATONICALLY) to provide a shifted output; or it can be used to change the root of the scale, or even the scale itself; and in Sequencer Mode, it functions as a reset trigger.
- Assign the Shifted value to either **OUT A**, **OUT B**, neither, or both
- Configure whether a trigger is sent to the **TRIG** output whenever **OUT A** changes quantization value; **OUT B** changes quantization value; both; or neither.
- Assign a delay to any incoming **TRIG** signal. (Some external sequencers take longer to stabilize their output voltages, so adding some delay to Scales' detection algorithm can prevent false readings from a lethargic device).
- Configure **OUT B** to either chromatically or diatonically offset its pitch, relative to **OUT A**, by a defined INTERVAL amount.
- Configure Scales as a DUAL quantizer. In this mode, the **PITCH** input is quantized to the active scale and sent to **OUT A**, while the **SHIFT** input is quantized to the same active scale, and sent to **OUT B**.
- Configure Scales as a 128-step, 101-style step sequencer, with the output of the sequencer sent to **OUT B**.
- Calibrate Scales' **OUT A**, **OUT B**, **PITCH** in and **SHIFT** in values.

The following sections discuss each of these Config Modes in detail.

## SHIFT MODE: PRE

In CONFIG Mode, press the **PRE** (B) button to set Scales' shifted output to "PRE scale quantizer."

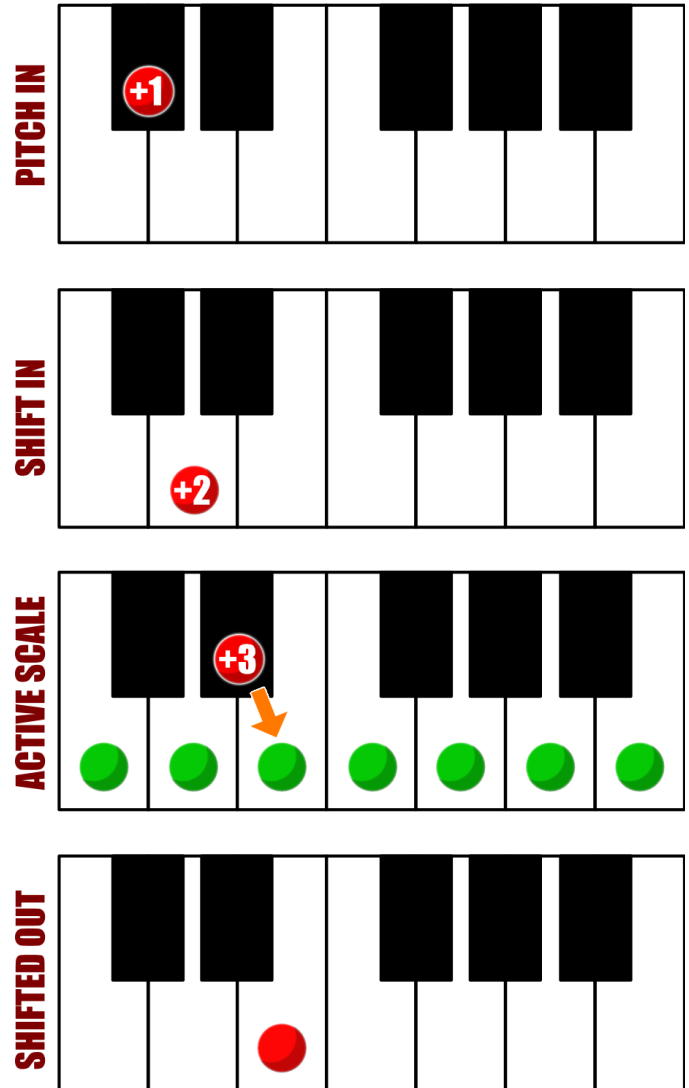
The value of the **PITCH** input is quantized to its nearest chromatic value. The actual value of the **SHIFT** input is then added to the **PITCH** input and the resulting sum is quantized to the active scale.

Look at the example to the right. Assume Scales is set to a C Major scale. If the **PITCH** input is C# (1 semitone above C) and the **SHIFT** input is D (2 semitones above C), then the sum is 3 semitones, or D#. But since the active scale is a C Major scale, and D# is not in that scale, the actual value of the shifted note is raised to E.

Any output assigned to a Shift Mode of PRE will always output a shifted note that conforms to the selected scale.

**NOTE:** The **PRE** button/option is unavailable if **OUT B** is set to **DUAL** mode (**C** button) since, in that mode, the **SHIFT** input acts as a dedicated **PITCH** input for **OUT B**.

## SHIFT MODE = PRE



## SHIFT MODE: DIATONIC

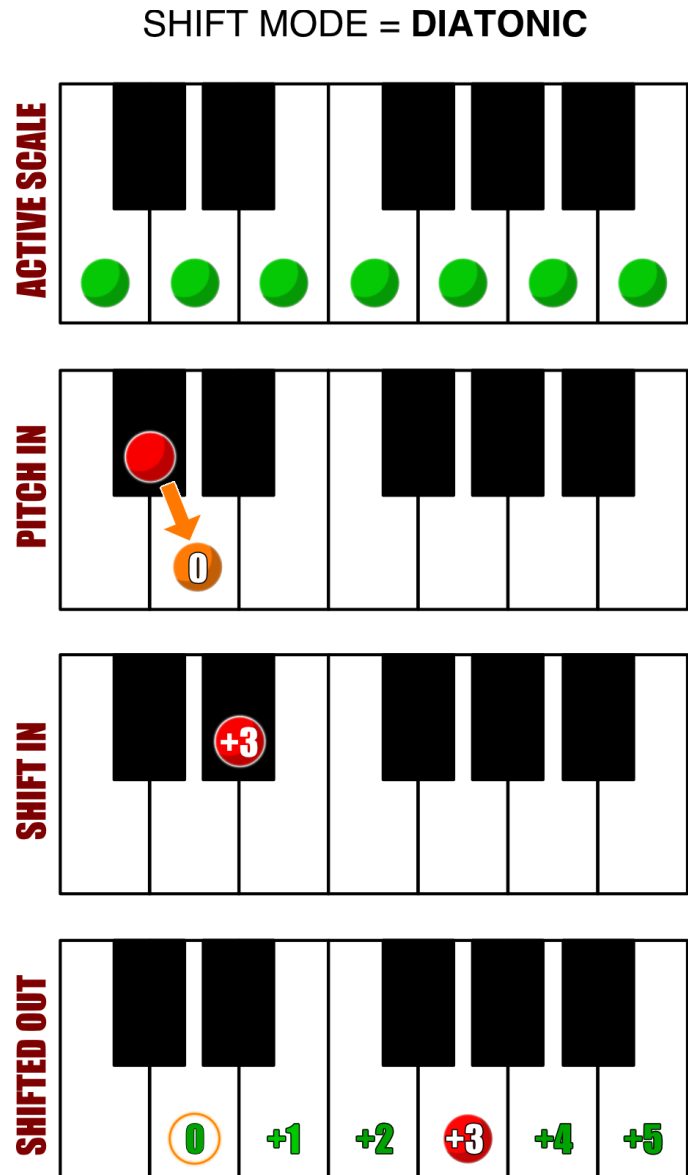
In CONFIG Mode, press the **DIATONIC** (A#) button to set Scales' shifted output to "Diatonic."

The value of the **PITCH** input is quantized to its nearest Active Scale value, and used to define the zero point of the diatonic transposition. The value of the **SHIFT** input (in semitones) is then used to define the number of scale degrees by which the shifted output is changed.

Look at the example to the right. Assume Scales is set to a C Major scale. If the **PITCH** input is C# (1 semitone above C) then it is shifted to D by the C Major scale. If the **SHIFT** input is D# (+3 semitones), then Diatonic Mode uses this value to set the number of *scale degrees* (not semitones) by which the quantized **PITCH** input is shifted. So 3 scale degrees above the D note (in the active C Maj scale) is a G.

Any output assigned to a Shift Mode of DIATONIC will always output a shifted note that conforms to the selected scale.

**NOTE:** The **DIATONIC** button/option is unavailable if **OUT B** is set to **DUAL** mode (C button) since, in that mode, the **SHIFT** input acts as a dedicated **PITCH** input for **OUT B**.



## SHIFT MODE: POST

In CONFIG Mode, press the **POST** (A) button to set Scales' shifted output to "Post scale quantizer."

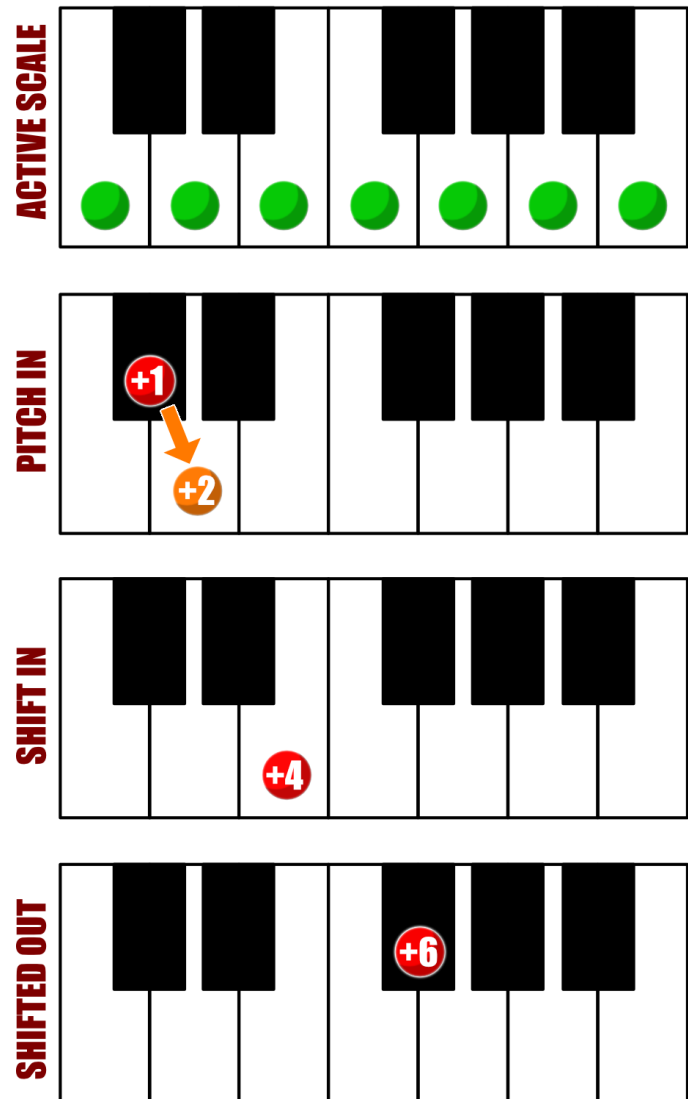
The value of the **PITCH** input is quantized to its nearest Active Scale value. The actual value of the **SHIFT** input is then added to the quantized **PITCH** input and the resulting sum is sent to the shifted output.

Look at the example to the right. Assume Scales is set to a C Major scale. If the **PITCH** input is C# (1 semitone above C), then it is shifted to D by the C Major scale (2 semitones above C). If the **SHIFT** input is E (4 semitones above C), then the sum is 6 semitones, or F#, and this is the note sent to the shifted output.

Outputs assigned to a Shift Mode of POST are not constrained by the active scale, meaning the shifted output may be any note in the chromatic scale.

**NOTE:** The **POST** button/option is unavailable if **OUT B** is set to **DUAL** mode (**C** button) since, in that mode, the **SHIFT** input acts as a dedicated **PITCH** input for **OUT B**.

## SHIFT MODE = POST



## SHIFT MODE: OUT A

In CONFIG Mode, press the **OUT A** (G#) button to enable or disable Shift Mode for **OUT A**.

- If Shift Mode is OFF for OUT A, then the button is unlit, and OUT A contains scale-quantized values of the **PITCH** input.
- If Shift Mode is ON for OUT A, then the button is lit, and OUT A contains quantized values that result from a combination of the **PITCH** and **SHIFT** inputs, the active scale, and the Shift Mode setting (PRE, DIATONIC or POST).

**OUT A** can be independently enabled or disabled from **OUT B**, meaning it's possible for both outputs to be shifted; either to be shifted; or neither.

## SHIFT MODE: OUT B

In CONFIG Mode, press the **OUT B** (G) button to enable or disable Shift Mode for **OUT B**.

- If Shift Mode is OFF for OUT B, then the button is unlit, and OUT B contains scale-quantized values of the **PITCH** input.
- If Shift Mode is ON for OUT B, then the button is lit, and OUT B contains quantized values that result from a combination of the **PITCH** and **SHIFT** inputs, the active scale, and the Shift Mode setting (PRE, DIATONIC or POST).

**OUT B** can be independently enabled or disabled from **OUT A**, meaning it's possible for both outputs to be shifted; either to be shifted; or neither.

**NOTE:** *When in Scale Display Mode, quantized note values being sent to OUT A light red, while notes being sent to OUT B light yellow. If the notes being sent to both OUT A and OUT B are the same, only the red light is used.*

## SHIFT MODE: ROOT

In CONFIG Mode, press the **ROOT** (F#) button to use the **SHIFT** input (1V/Oct) to select the root note of the current scale pattern.

For example, assume your current scale is Cmaj (C D E F G A B); If you send a D note into the SHIFT input, then the active scale shifts to Dmaj (D E F# G A B C#) and any voltages arriving at the pitch input get quantized to the Dmaj scale, rather than the Cmaj scale.

## SHIFT MODE: SCALE

In CONFIG Mode, press the **SCALE** (F) button to use the **SHIFT** input ( $\pm 0-5$  V) to select a scale from the most recently loaded or saved bank. There are 7 scale patterns in a bank, so every 0.7V (approximately) will load a new scale, with 0V selecting the first scale in the bank (the one assigned to the C-note slot).

**NOTE:** *If Scales is in SCALE Shift Mode, then front panel scale editing is not possible (since scale selection is under voltage control). If you want to manually enter scale patterns, you cannot be in SCALE Shift Mode.*

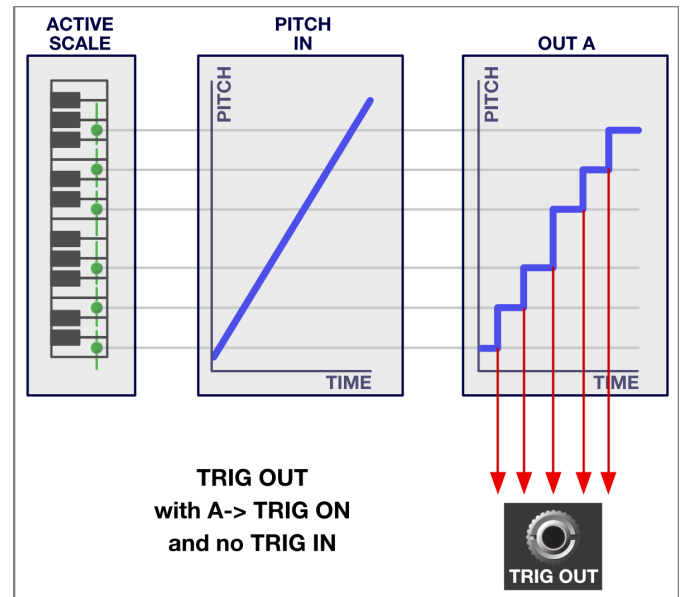


## A -> TRIG

Press this button to toggle on/off the **A > TRIG** feature. When **A > TRIG** is on, the button is lit and Scales sends a trigger signal to the **TRIG** output whenever **OUT A** changes in pitch.

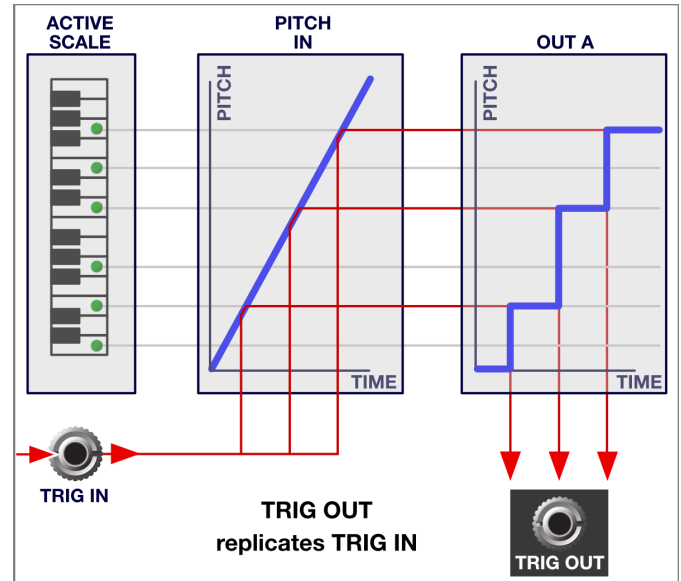
In the example shown top-right, **A > TRIG** is turned on and the **TRIG** input jack is not used. A steady voltage sweep is sent to the **PITCH** in, and the active scale is as shown. The quantized output value changes whenever the input voltage crosses another quantization threshold, sending a trigger signal to the **TRIG** Output jack.

Both the **A > TRIG** and the **B > TRIG** buttons can be turned on simultaneously, resulting in a trigger signal being output whenever either **OUT A** or **OUT B** change in pitch.



If neither the **A > TRIG** nor the **B > TRIG** buttons are turned on, then Scales sends any gate or trigger signal present at the **TRIG** input directly to the **TRIG** output.

In the example shown bottom-right, both **A > TRIG** and **B > TRIG** are turned off and the **TRIG** input is used. A steady voltage sweep is sent to the **PITCH** in, and the active scale is as shown. Scales only outputs a new quantized voltage when it receives a **TRIG** input, and this input (Gate or Trig) is thru'd to the **TRIG** output.



### Trigger Delay Feature:

Different pitch sources (sequencers, keyboards, etc) require varying amounts of time for their pitch outputs to stabilize when generating new voltages. Because of this, there is a possibility that Scales might sample its **PITCH** input before the source module has stabilized, resulting in a false reading or some pitch 'chattering'. To compensate for any lethargic input devices, Scales has a built-in, programmable incoming trigger delay option, which is accessed via a long-press (>1 sec) of the **A > TRIG** button. In this

mode the note LEDs indicate the amount of input trigger delay, with a C-note being the least amount of delay, and a B-note being the most. Press **CONFIG** or any other of the bottom buttons to get out of this screen.

## B -> TRIG

Press this button to toggle on/off the **B -> TRIG** feature. When **B > TRIG** is on, the button is lit and Scales sends a trigger signal to the **TRIG** output whenever **OUT B** changes in pitch.

The **B > TRIG** function works the same as the **A > TRIG** function, described earlier — so see that section for more information.

Both the **A > TRIG** and the **B > TRIG** buttons can be turned on simultaneously, resulting in a trigger signal being output whenever either **OUT A** or **OUT B** change in pitch.

If neither the **A > TRIG** nor the **B > TRIG** buttons are turned on, then Scales sends any gate signal present at the **TRIG** input directly to the **TRIG** output.

## OUT B: CHROM

In CONFIG Mode, press the **CHROM.** (D) button to light it **red**, and to chromatically offset the pitch of **OUT B** (relative to **OUT A**) by the selected INTERVAL amount.

The INTERVAL amount is set by pressing the **INTRVL** button, then pressing one of the note value buttons to define the chromatic shift.

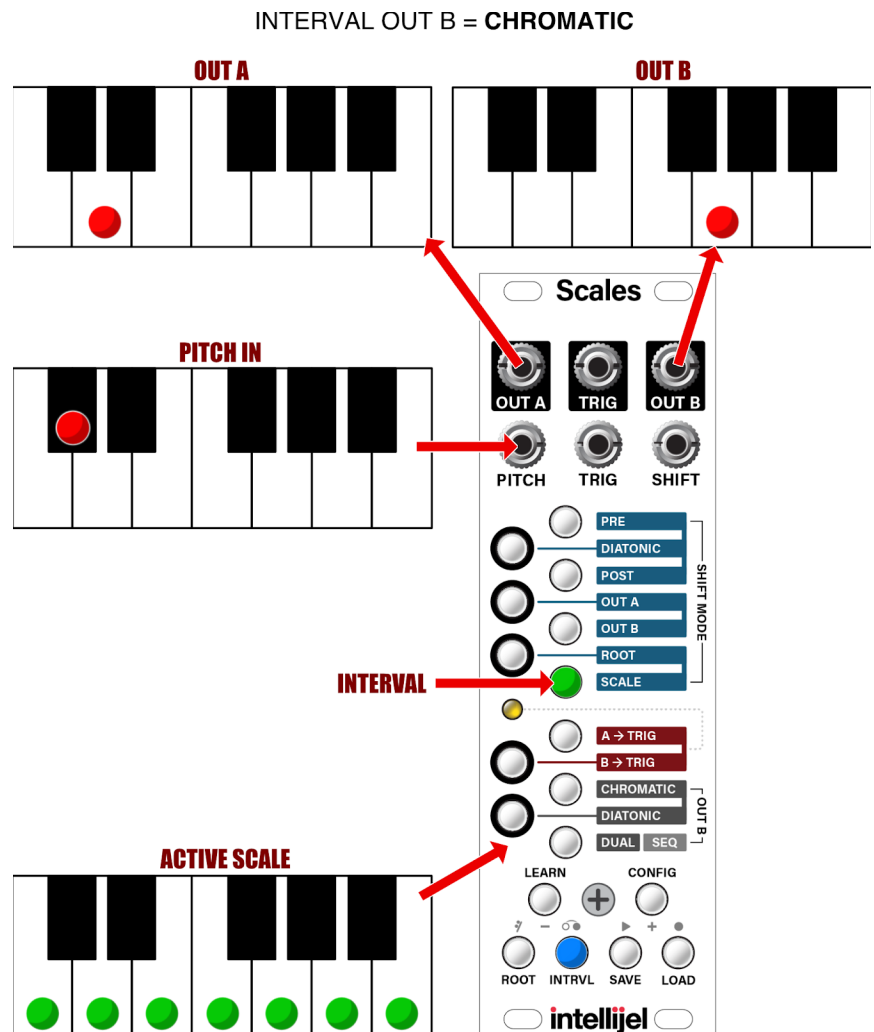
Pressing a note button once turns it **green**, resulting in a positive offset interval from **OUT B**. Pressing the note button a second time turns it **red**, resulting in a negative offset interval from **OUT B**.

The interval value of **OUT B** is summed with any additional Shift values assigned to OUT B using the SHIFT MODE functions described previously.

In the example shown here, Scales is set to C Maj, and Shift Mode is turned off for both **OUT A** and **OUT B**.

If a C# is sent to the **PITCH** input, it gets quantized to the active scale (C Maj), meaning a D note is sent to **OUT A**.

If the **INTRVL** has been set to a **green** F-note (5 semitones up), then **OUT B** will contain the Chromatically shifted value 5-semitones above **OUT A** (G).



## OUT B: DIATONIC

In CONFIG Mode, press the bottom **DIATONIC** (C#) button to light it **red**, and to diatonically offset the pitch of **OUT B** (relative to **OUT A**) by the selected **INTERVAL** amount.

The **INTERVAL** amount is set by pressing the **INTRVL** button, then pressing one of the note value buttons to define the diatonic shift.

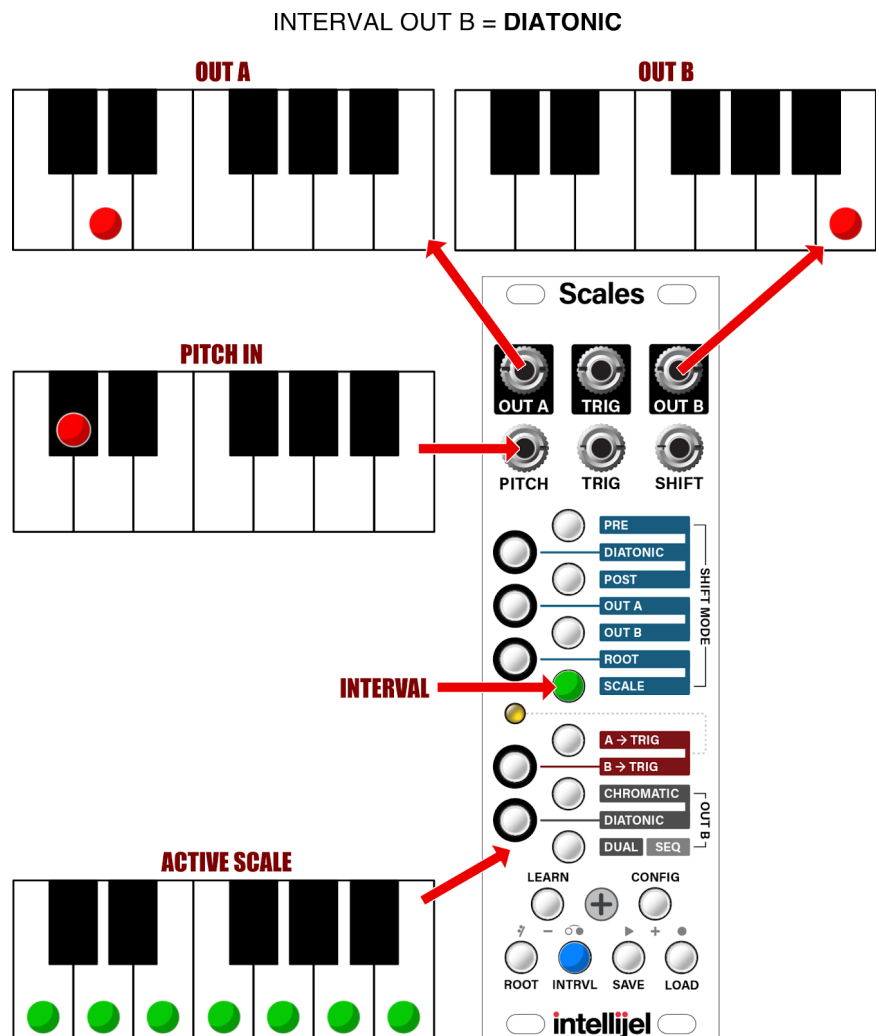
Pressing a note button once turns it **green**, resulting in a positive offset interval from **OUT B**. Pressing the note button a second time turns it **red**, resulting in a negative offset interval from **OUT B**.

The interval value of **OUT B** is summed with any additional Shift values assigned to **OUT B** using the **SHIFT MODE** functions described previously.

In the example shown here, Scales is set to C Maj, and Shift Mode is turned off for both **OUT A** and **OUT B**.

If a C# is sent to the **PITCH** input, it gets quantized to the active scale (C Maj), meaning a D note is sent to **OUT A**.

If the **INTRVL** has been set to a **green** F-note (5 semitones up), then **OUT B** will be shifted 5 *scale tones* above **OUT A** (B).



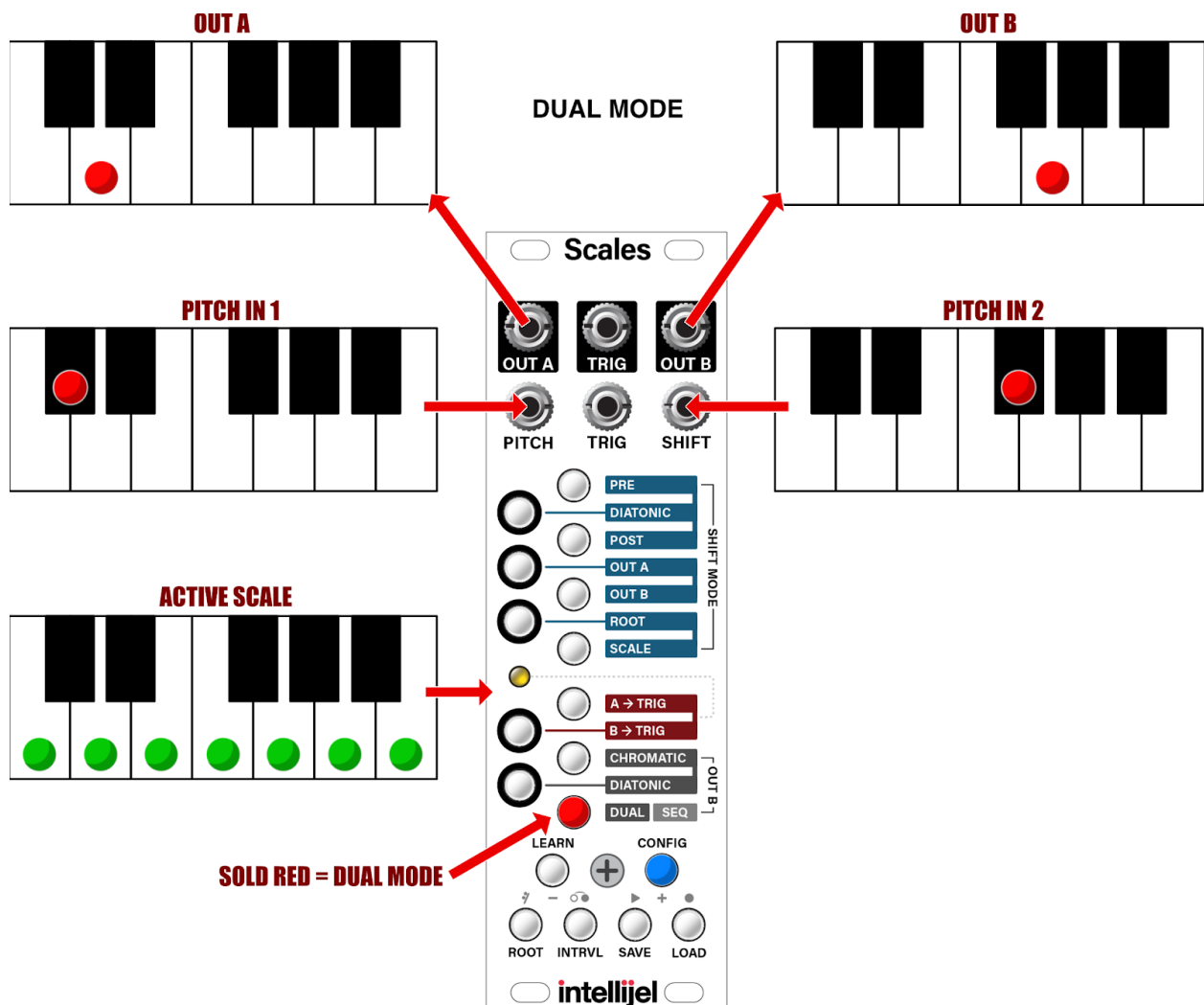
## OUT B: DUAL

In CONFIG Mode, press the bottom **DUAL | SEQ ( C )** button once to light it solid **red**, and to configure Scales as a dual quantizer.

**NOTE:** This button has two states: solid red (indicating DUAL mode) and flashing red (indicating SEQ mode). If the button is currently flashing, Scales is in SEQ mode, so press the button once to switch into DUAL mode.

When in dual quantizer mode, Scales' **SHIFT** input functions as a second pitch input and the resulting quantized value is output at **OUT B**. The other shift settings have no effect.

In the example shown here, Scales is in DUAL mode, and set to quantize inputs to C Maj. So if C# is sent to the **PITCH** input, Scales quantizes it up to a D, and sends it to **OUT A**. Similarly, if an F# is sent to the **SHIFT** input, Scales quantizes it up to a G and sends it to **OUT B**.



## OUT B: SEQ

In CONFIG Mode, press the bottom **DUAL | SEQ ( C )** button *twice* to make it flash **red**, and to configure Scales as a 101-style sequencer.

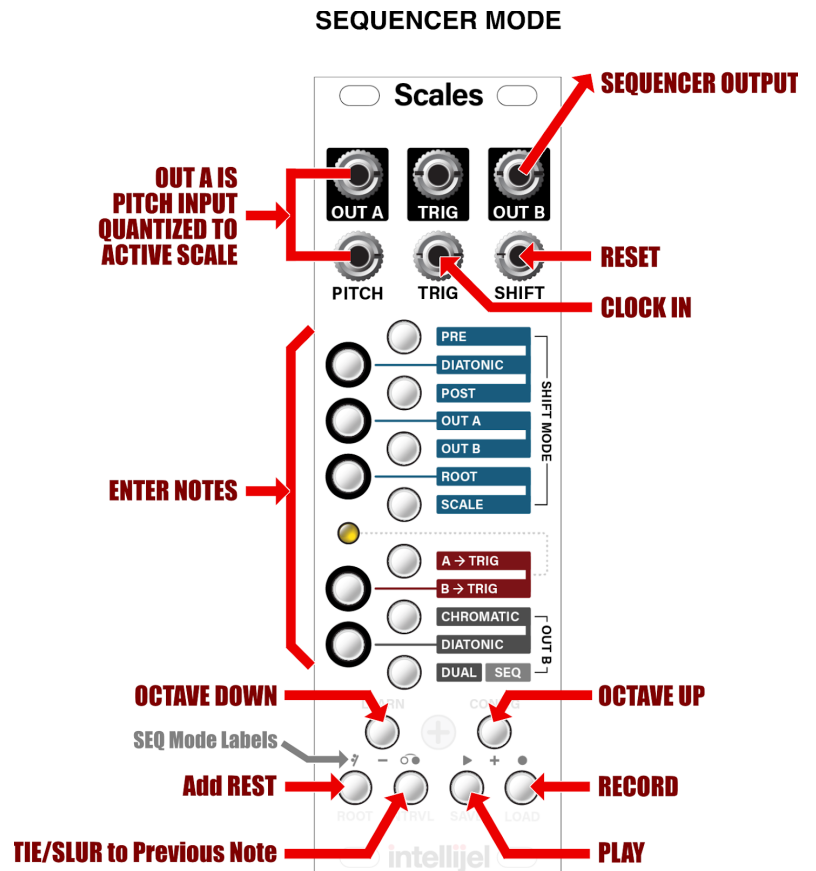
*NOTE: This button has two states: solid red (indicating DUAL mode) and flashing red (indicating SEQ mode). If the button is red, but not flashing, Scales is in DUAL mode, so press the button once more to switch into SEQ mode.*

Sequences can be a maximum of 256 steps, with a step being either a note, rest or tie, depending on which you entered.

*NOTE: You can save up to 35 custom sequences in 5 banks (black keys) of 7 slots each (white keys) as described in [Save and Load Sequences](#), later in this manual.*

When in SEQ Mode, the jacks and buttons take on alternate functionality as shown in the diagram to the right.

For a complete description of how to use SEQ Mode, see [Appendix A: Using SEQ Mode](#).



## ROOT Mode

This mode sets the root of the active scale pattern. Pushing any of the note buttons transposes the scale pattern so it's rooted at that note. Holding any of the note buttons sets that note as the root without transposing the pattern.

To change the root of a scale, and transpose the pattern accordingly:

1. Press **ROOT** to enter Root Mode (and turn on the blue **ROOT** button).
2. Press a note button to transpose the scale to that note.

In the example shown to the right, pressing D has transposed the scale pattern to D MAJOR.

3. Press **ROOT** to exit Root Mode (and turn off the blue **ROOT** button).

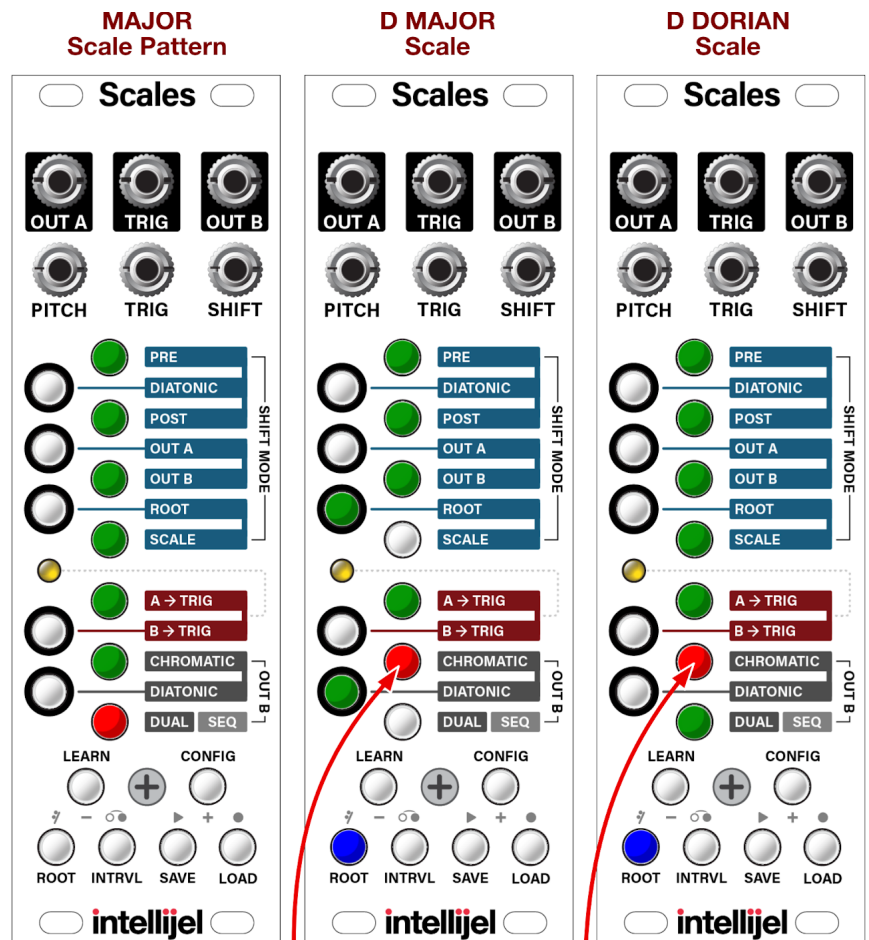
To change the root of a scale without transposing the pattern:

1. Press **ROOT** to enter Root Mode (and turn on the blue **ROOT** button).
2. Long-press a note button (>1 sec) to make it the root without transposing the scale.

In the example shown here, long-pressing D has changed the Root note of the scale pattern to D without transposing the scale, resulting in a D DORIAN scale.

3. Press **ROOT** to exit Root Mode (and turn off the blue **ROOT** button).

**NOTE:** If a sequence is playing (as discussed in [Appendix A: Using SEQ Mode](#)) then any root change will also transpose the sequence playback as described above.



## INTRVL Mode

This mode sets the interval of **OUT B** relative to **OUT A**. The actual interval played depends on whether you select [OUT B: CHROM](#) or [OUT B: DIATONIC](#) in Config Mode.

To use Interval Mode:

1. Decide if you want **OUT B** to be chromatically or diatonically transposed from **OUT A**.
  - If you want a chromatic interval, press the **CONFIG** button to enter Config Mode, then press the [OUT B: CHROM](#) (D) button, then press **CONFIG** again to exit.
  - If you want a diatonic interval, press the **CONFIG** button to enter Config Mode, then press the [OUT B: DIATONIC](#) (C#) button, then press **CONFIG** again to exit.

2. Press the **INTRVL** button to enter Interval Mode. Interval mode forces **OUT B** to play notes that are some predefined interval distance from **OUT A**.

*NOTE: The **INTRVL** value will be added on top of any shift amount that's also applied to **OUT B**.*

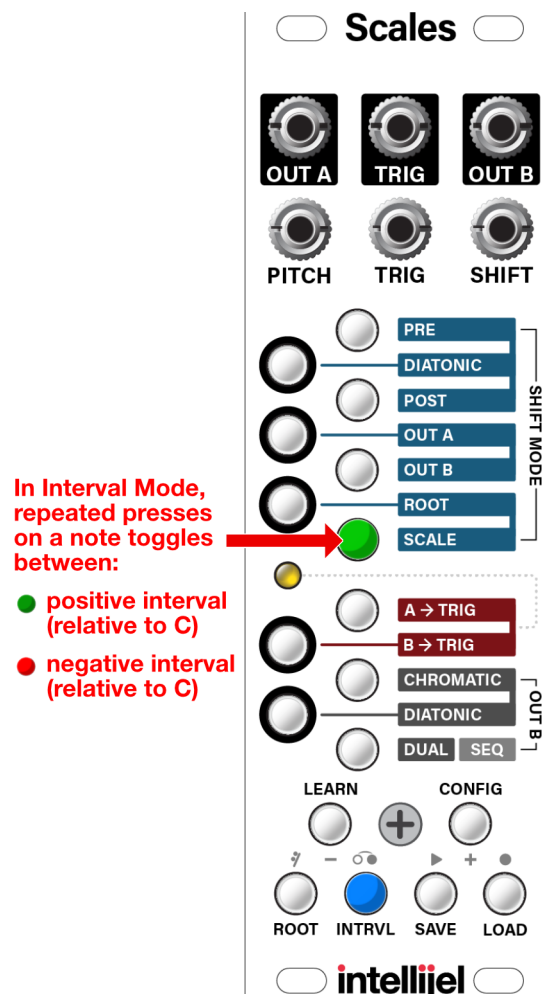
3. Press the Multifunction button corresponding to the desired interval of **OUT B** relative to **OUT A**.

Press once to set a positive interval (turning the button **green**). Press a second time to set a negative interval (turning the button **red**).

The note you select for **OUT B** is relative to "C." So if you press "F" (turning it **green**), then **OUT B** will play 5 interval steps *above* **OUT A** (with an interval step defined by whether **OUT B: CHROM** or **OUT B: DIATONIC** is active). Similarly, if you press "F" again (turning it **red**), then **OUT B** will play five interval steps *below* **OUT A**.

4. Press the **INTRVL** button again to exit Interval Mode.
5. Send voltages into the **PITCH** input.

Notice that **OUT A** is quantized to the active scale (with its pitch indicated by the red note in Scale Display Mode), while **OUT B** is quantized to a different note value (indicated by the yellow note in Scale Display Mode), which is determined by the interval value you just set (plus any shift value applied to **OUT B**).





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## Tuning Mode

Scales contains a special Tuning Mode, which is accessed by long-pressing the **INTRVL** button. Specifically:

1. Long-press (>1 sec) the **INTRVL** button to enter Tuning Mode.

The **INTRVL** button will flash **blue** and the note buttons will all extinguish.

In Tuning Mode, Scales sends 0V to both **OUT A** and **OUT B**, plus a high gate signal to the **TRIG** out jack. This gives you a quick and easy tuning source for your oscillators.

2. When you are done tuning your oscillators, press the **INTRVL** button to exit Tuning Mode.

## SAVE Mode

This mode saves either scale patterns or sequences to the EEPROM memory. The module can store up to 35 custom scale patterns and 35 custom sequences, using five banks of seven “slots.” Specifically, “black key” buttons select the bank into which you wish to save the scale/sequence, and “white key” buttons select the scale/sequence “slot.”

### To save a custom scale pattern:

1. In Scale Display mode (all bottom **blue** buttons turned OFF), use the note buttons to define which notes you want in your custom scale pattern.
2. Press **SAVE** to enter Save Mode for scale patterns.  
Multipurpose buttons for the current bank & slot will light **red**, indicating you’re saving a scale pattern.
3. Press the “Black Key” button (C#, D#, F#, G#, A#) to select the bank in which you want your pattern saved.
4. Press the “White Key” button (C, D, E, F, G, A, B) corresponding to the “slot” in which you want your pattern saved.
5. Press **SAVE** to save your scale and exit Save Mode.

The custom scale pattern will be saved to EEPROM (overwriting any scale previously stored in the slot), extinguishing the SAVE button and exiting Save Mode.

**NOTE:** Long-press the **SAVE** button (>1 sec) to save sequences (instead of scale patterns), as discussed in [Save and Load Sequences](#), later in the manual. If Sequence saving is activated, the multipurpose buttons glow **yellow**.

**To reset Scales and restore the Factory Scales:**

1. Turn off the power to Scales.
2. Hold the **SAVE** button while powering Scales back on.

This erases any custom scale patterns you previously saved, and reverts Scales to its factory default settings and banks of scale patterns (as detailed in Appendix B: Factory Scales).

**NOTE:** *This will not erase any stored sequences. If you wish to do that, hold the **INTRVL** button on power up.*

## LOAD Mode

This mode loads either scale patterns or sequences from the EEPROM memory. The module can store up to 35 custom scale patterns and 35 custom sequences, using five banks of seven “slots.” Specifically, “black key” buttons select the bank containing the scale/sequence you wish to load, and “white key” buttons select the scale/sequence “slot.”

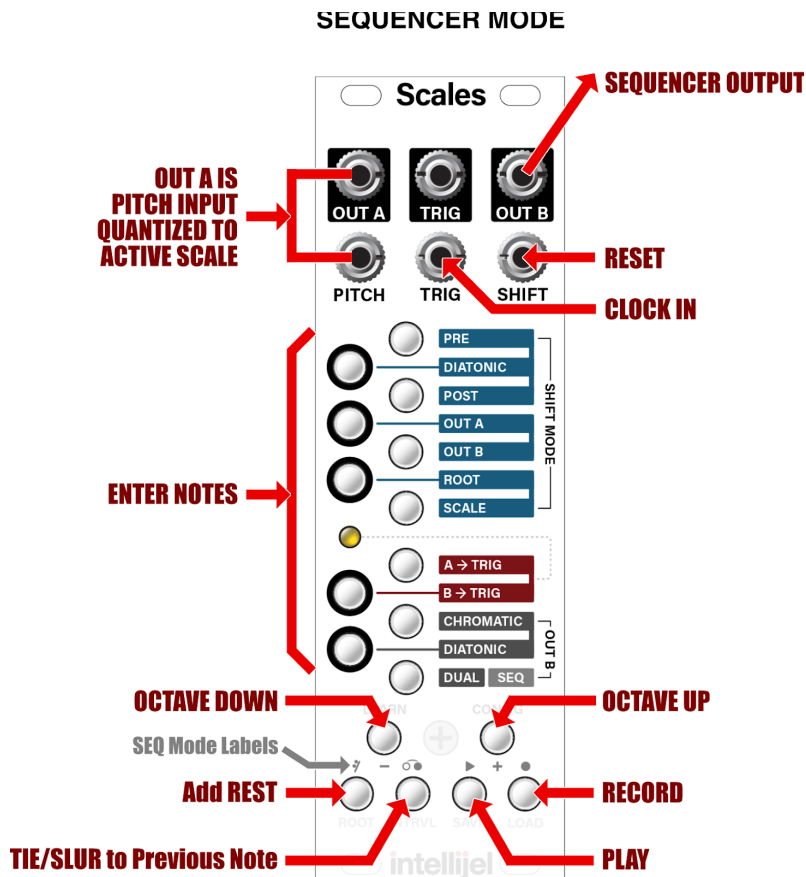
**To load a scale pattern:**

1. Press **LOAD** to enter Load Mode for scale patterns.  
Multipurpose buttons for the current bank & slot will light **red**, indicating you’re loading a scale pattern.
2. Press the “Black Key” button (C#, D#, F#, G#, A#) to select the bank that contains the scale pattern you wish to load.
3. Press the “White Key” button (C, D, E, F, G, A, B) associated with the “slot” that stores the scale pattern you want loaded.
4. Press **LOAD** to read the scale pattern from EEPROM (overwriting the currently active scale), extinguishing the **LOAD** button and returning Scales to Scale Display mode.

**NOTE:** *Long-press the **LOAD** button (>1 sec) to load sequences (instead of scale patterns), as discussed in [Save and Load Sequences](#), later in the manual. If Sequence loading is activated, the multipurpose buttons glow **yellow**.*

## Appendix A: Using SEQ Mode

SEQ Mode is an alternate Scales function that allows you to program sequences up to 128 steps in length using a Roland SH-101 type of step-entry technique. When recording/loading a sequence in SEQ Mode, use the note buttons to enter notes. The other buttons are re-assigned to sequencing functions (as indicated by the alternate labels in the middle), enabling you to shift octaves, insert rests or ties; and record or playback the sequence. In addition, jacks take on new functionality, with the **TRIG IN** functioning as a clock input; the **SHIFT** input functioning as a RESET input; and **OUT B** carrying the pitch sequence.



### Enter SEQ Mode

1. Press the **CONFIG** button to enter Config Mode.
2. If the **DUAL | SEQ ( C )** button is unlit, press it *twice* to enter SEQ Mode (causing the button to flash red).

If the **DUAL | SEQ ( C )** button is already lit when you enter Config Mode, press it *once* to switch into SEQ Mode. Similarly, if the button is already flashing when you enter Config Mode, then you're already in SEQ Mode. A steadily lit red button indicates DUAL Mode, and a flashing red button indicates SEQ Mode — pressing the **DUAL | SEQ** button toggles between them.

3. Once in SEQ Mode, press the **CONFIG** button again to exit Config Mode.

Scales remains in SEQ Mode as indicated by the blue **SAVE** and **LOAD** buttons, which now function as **PLAY** and **REC** buttons.

In SEQ Mode, all the buttons and jacks are reconfigured to perform the functions illustrated above.

## Record a Sequence

1. Connect an external clock to Scales' **TRIG IN** jack to drive the sequencer.

There are actually several ways to drive the sequencer, including using the quantizer itself to determine when to advance to the next step. To learn more about these various clocking options, see [Clocking the Sequencer](#), later in this manual.

2. Connect **OUT B** to the oscillator or synth voice you plan to sequence, and the **TRIG OUT** to your synth voice's trigger input, or to a function generator connected to the VCA through which you run your oscillator

*NOTE: This lets you hear the notes and trigger a new envelope as you enter steps into the sequence.*

3. Press the **RECORD** button.

It will flash to indicate that Scales' step-recording feature is now enabled, and any note buttons contained within the currently active scale will glow **yellow**.

4. Press one of the note buttons on Scales to record that note into the step sequence and advance the sequence one step.
  - If you want to enter a note in a higher octave, press the Octave Up (+) button.
  - If you want to enter a note in a lower octave, press the Octave Down (-) button.
  - If you want to enter a rest, press the **ADD REST** button.
  - If you want to enter a note that ties (or slurs) to the previous note, press the **TIE** button (bottom row, immediately to the right of the **ADD REST** button) before pressing the next note button.

*NOTE: Although notes in the currently active scale are displayed in **yellow** as a guide, you're free to enter any note — regardless of whether or not it's in the scale.*

5. When you're done recording your step sequence, press the **RECORD** button to finish, or press the **PLAY** button to finish and play it back immediately.

*IMPORTANT: Recorded sequences remain in temporary memory and are volatile unless you save them to one of the 35 available sequence storage 'slots,' as described in [Save and Load Sequences](#), later in this manual.*

## Playback a Sequence

1. Connect an external clock to Scales' **TRIG IN** jack to drive the sequencer.
2. Connect **OUT B** to the oscillator or synth voice you wish to play.
3. Connect the **TRIG OUT** jack to your synth voice's trigger input, or to an envelope connected to the VCA through which you run your oscillator.
4. Press the **PLAY** button to start playback.

Your step sequence begins to play back in a continuous loop, and the **PLAY** button flashes to indicate that Scales' step-sequencer is now playing back. If the **REC** button flashes, it indicates that nothing has been recorded or loaded into the sequencer yet.

5. Press the **PLAY** button again to stop playback.

## Transpose a Sequence

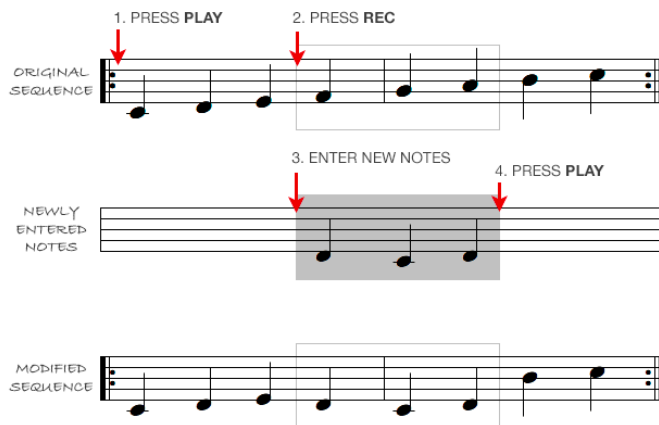
You can transpose a sequence while it plays back by using the **ROOT** button as described in earlier in [ROOT Mode](#). Specifically:

1. With SEQ Mode active, press **PLAY** to start sequence playback.  
The **PLAY** button flashes to indicate that Scales is now playing back a sequence.
2. Press the **CONFIG** button.  
The **CONFIG** button turns **blue**, indicating you can now set Configuration options.
3. Next, press the **ROOT** button.  
The **ROOT** button turns **blue**, indicating Scales is now in Root Mode.
4. Press a Note button to transpose playback by the indicated amount (relative to C).

## Replace Notes In a Sequence

1. Connect a clock to the **TRIG IN** jack, and press the **PLAY** button to begin playing back a sequence.
2. At any point during playback, press the **REC** button again to freeze the playhead at the current location in the sequence.
3. Enter any number of steps, rests or ties you desire, then press **PLAY**. Your new sequence plays back with your newly entered steps replacing the previously entered steps.

If you entered fewer notes than the original sequence contained, the new section merely replaces the subsection of notes within your original sequence:



If you enter more notes than the original sequence contained, the new sequence is extended by however many extra steps you entered:



## Overwrite An Existing Sequence

1. Connect a clock to the **TRIG IN** jack, and press the **PLAY** button to begin playing back a sequence.
2. At any point during playback, press the **PLAY** button again to stop the sequence.

Unlike pressing the **REC** button to stop the sequence, pressing the **PLAY** button to stop it causes any subsequently recorded notes to completely overwrite the existing sequence.

3. Press the **REC** button.
4. Enter your new notes, rests or steps.

The new sequence completely replaces the previous sequence.

The diagram illustrates the process of overwriting an existing sequence in three stages:

- 1. PRESS PLAY**: A musical staff labeled "ORIGINAL SEQUENCE" shows a sequence of seven notes. A red arrow points to the start of the sequence.
- 2. PRESS PLAY AGAIN TO STOP SEQ, THEN PRESS REC**: A musical staff labeled "NEWLY ENTERED NOTES" shows a sequence of four notes. A red arrow points to the start of the sequence, and another red arrow points to the end of the sequence.
- 4. PRESS PLAY**: A musical staff labeled "MODIFIED SEQUENCE" shows the original sequence of seven notes, but the last three notes are replaced by the newly entered notes from the previous stage.

## Clear a Sequence

1. Make sure the sequence is stopped.  
If it's currently playing, press the **PLAY** button to stop it from playing.
2. Press the **REC** button to clear the sequence completely.

---

## Save and Load Sequences

Scales can store up to 35 custom sequences, arranged in five banks of seven “slots.” Specifically, “black key” buttons select the bank into which you wish to save the sequence, and “white key” buttons select the sequence “slot.”

### To save a sequence:

1. Record a sequence as discussed above.
2. Long-press **SAVE** (>1 sec) to enter Save Mode for sequences.  
Multipurpose buttons for the current bank & slot will light **yellow**, indicating you’re saving a sequence.
3. Press the “Black Key” button (C#, D#, F#, G#, A#) to select the bank in which you want your sequence saved.
4. Press the “White Key” button (C, D, E, F, G, A, B) corresponding to the “slot” in which you want your sequence saved.

Note that any slots currently containing saved sequences will be lit in **yellow**, and the most recently loaded sequence slot flashes yellow. Empty slots are not lit.

5. Press **SAVE** to save your sequence and exit Save Mode.

The custom sequence will be saved to EEPROM (overwriting any sequence previously stored in the slot), extinguishing the SAVE button and exiting Save Mode.

**NOTE:** To erase every sequence in every bank, turn off the power to Scales, then hold down the **INTRVL** button while powering it back on.

### To load a sequence:

1. Long-press **LOAD** (>1 sec) enter Load Mode for sequences.  
Multipurpose buttons for the current bank & slot will light **yellow**, indicating you’re loading a sequence.
2. Press the “Black Key” button (C#, D#, F#, G#, A#) to select the bank that contains the sequence you wish to load.
3. Press the “White Key” button (C, D, E, F, G, A, B) associated with the “slot” that stores the sequence you want loaded.

Note that any slots currently containing saved sequences will be lit in **yellow**, and the most recently loaded sequence slot flashes yellow. Empty slots are not lit.

4. Press **LOAD** to read the sequence from EEPROM (overwriting the currently active sequence), extinguishing the **LOAD** button and exiting Load Mode.



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## Clocking the Sequencer

As discussed previously, under normal usage, any time Scales detects a trigger at its **TRIG** input jack, the sequence advances one step. Using this knowledge, you can connect a master clock to the **TRIG** in jack, or you could feed it varying rhythms (such as the output of a Steppy module), or even advance the sequence through more esoteric means, like using an EOC output from a Quadra Expander or the GATE out from a Planar<sup>2</sup> to drive the sequence.

But there are other ways to advance through your sequenced steps:

- If you disconnect the **TRIG** input and enable the **A > TRIG** button in CONFIG Mode (discussed earlier in the [A-> TRIG](#) section) and send a signal to the **PITCH** input, then the sequencer will advance in sync with your quantizer. Specifically, the sequencer will advance and a trigger will be sent to the **TRIG** out jack *only* when **OUT A** sees a change in pitch.
- If you keep the **A > TRIG** button on and connect a **TRIG** input, then with each trigger input, Scales looks to see if **OUT A** is a different quantized pitch than it was the last time it got a trigger input. If it is, then the sequence advances and a trigger is sent to the **TRIG** output.
- If you enable the **B > TRIG** button in CONFIG Mode, and send a clock to the **TRIG** input, then Scales sends a trigger to the **TRIG** output *ONLY* if the sequence is playing. If you want the sequence clocked by an external dedicated clock, and you want the sequence to start and stop in sync with the **PLAY** button (and without continuing to emit triggers when stopped), then this is the configuration to use.
- If you disable both the **A > TRIG** and **B > TRIG** buttons in CONFIG Mode, then the **TRIG** input is thru'd to the **TRIG** output regardless of whether the sequencer is playing.

*NOTE: In SEQ Mode, **A > TRIG** and **B > TRIG** are mutually exclusive, and can not be simultaneously enabled.*

## Resetting the Sequencer

In SEQ mode, a trigger sent to the **SHIFT** input will reset the sequencer to step 1.

## Appendix B: Factory Scales

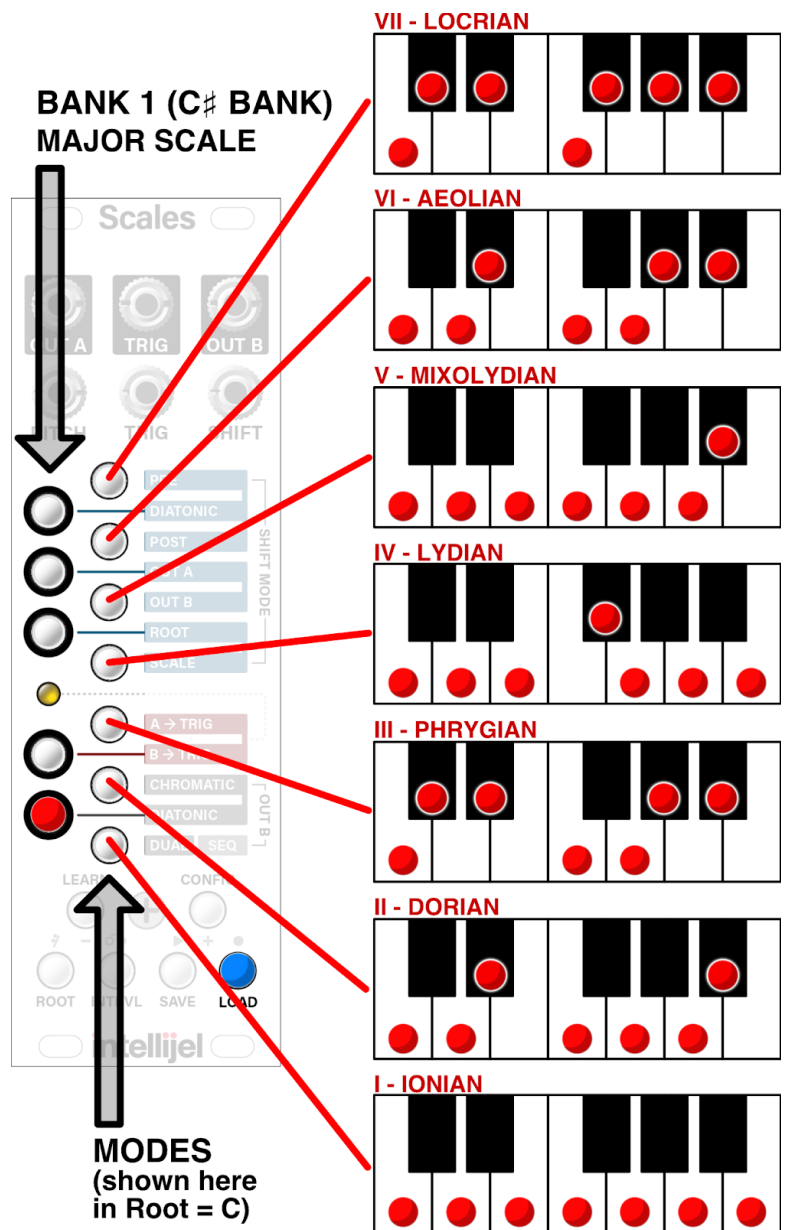
Scales ships from the factory with 5 banks of scales. You're free to erase, modify and program your own scales/banks instead. These can serve as a starting point or provide inspiration on how to set up you own banks.

*NOTE: You can reset Scales to these default factory settings by holding the SAVE button while powering it on.*

### Bank 1: Major Scale & Modes

Bank 1 (assigned to the C# button) contains all seven modes of a major scale, the root of which is set via the ROOT button.

The seven modes are assigned to the seven "white key" buttons, with the first mode assigned to the bottom button ( C ) and the seventh mode assigned to the top button ( B ).



## Bank 2: Melodic Minor Scale & Modes

Bank 2 (assigned to the D# button) contains all seven modes of a melodic minor scale, the root of which is set via the ROOT button.

The seven modes are assigned to the seven "white key" buttons, with the first mode assigned to the bottom button ( C ) and the seventh mode assigned to the top button ( B ).

**BANK 2 (D# BANK)  
MELODIC MINOR**

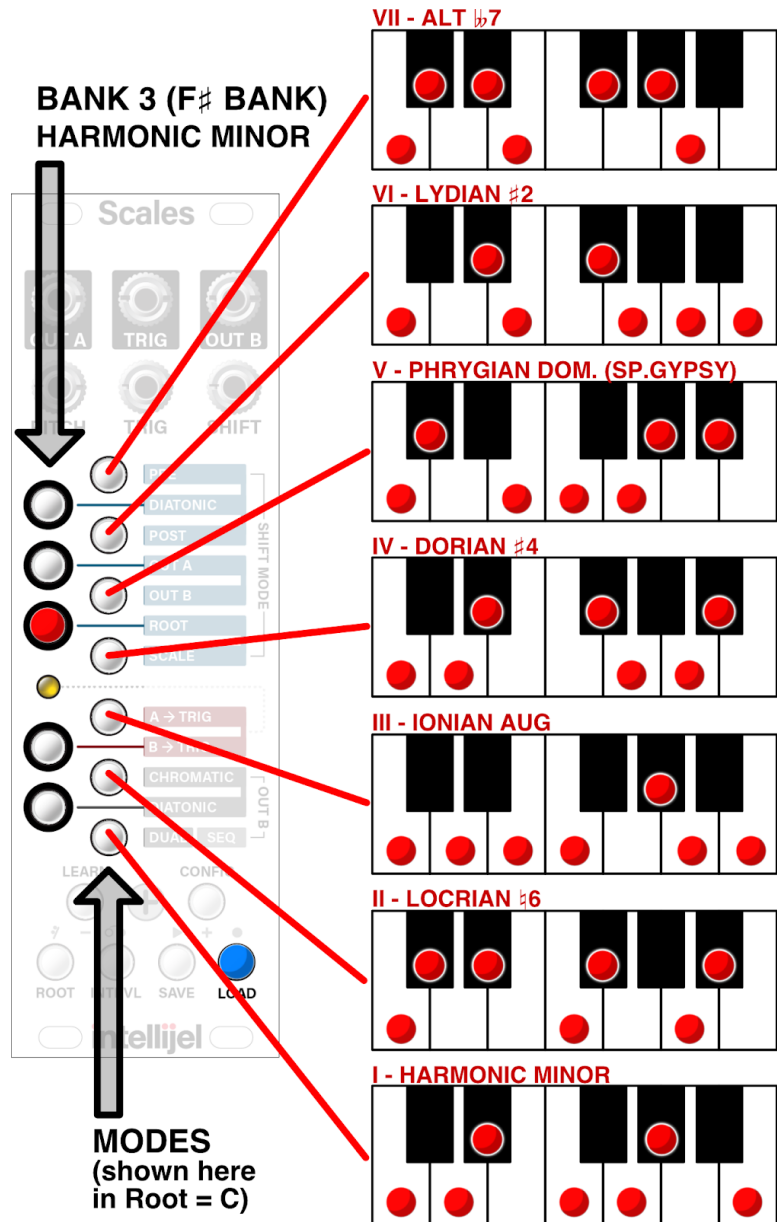
**MODES**  
(shown here in Root = C)

- VII - SUPER LOCRIAN**
- VI - LOCRIAN  $\flat 2$**
- V - HINDU**
- IV - LYDIAN DOMINANT**
- III - LYDIAN AUGMENTED**
- II - DORIAN  $\flat 2$**
- I - MELODIC MINOR**

### Bank 3: Harmonic Minor Scale & Modes

Bank 3 (assigned to the F# button) contains all seven modes of a harmonic minor scale, the root of which is set via the ROOT button.

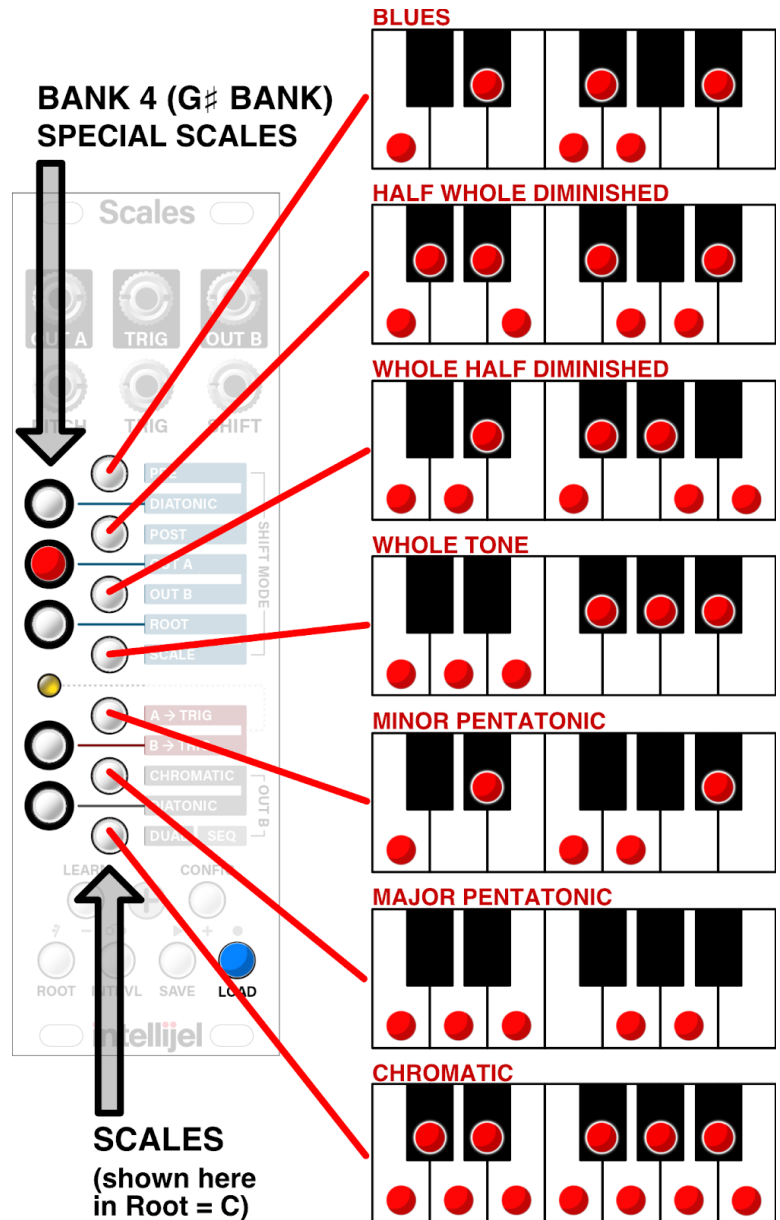
The seven modes are assigned to the seven "white key" buttons, with the first mode assigned to the bottom button ( C ) and the seventh mode assigned to the top button ( B ).



### Bank 4: Special Scales

Bank 4 (assigned to the G# button) contains seven special scales of various type — the root of which is set via the ROOT button.

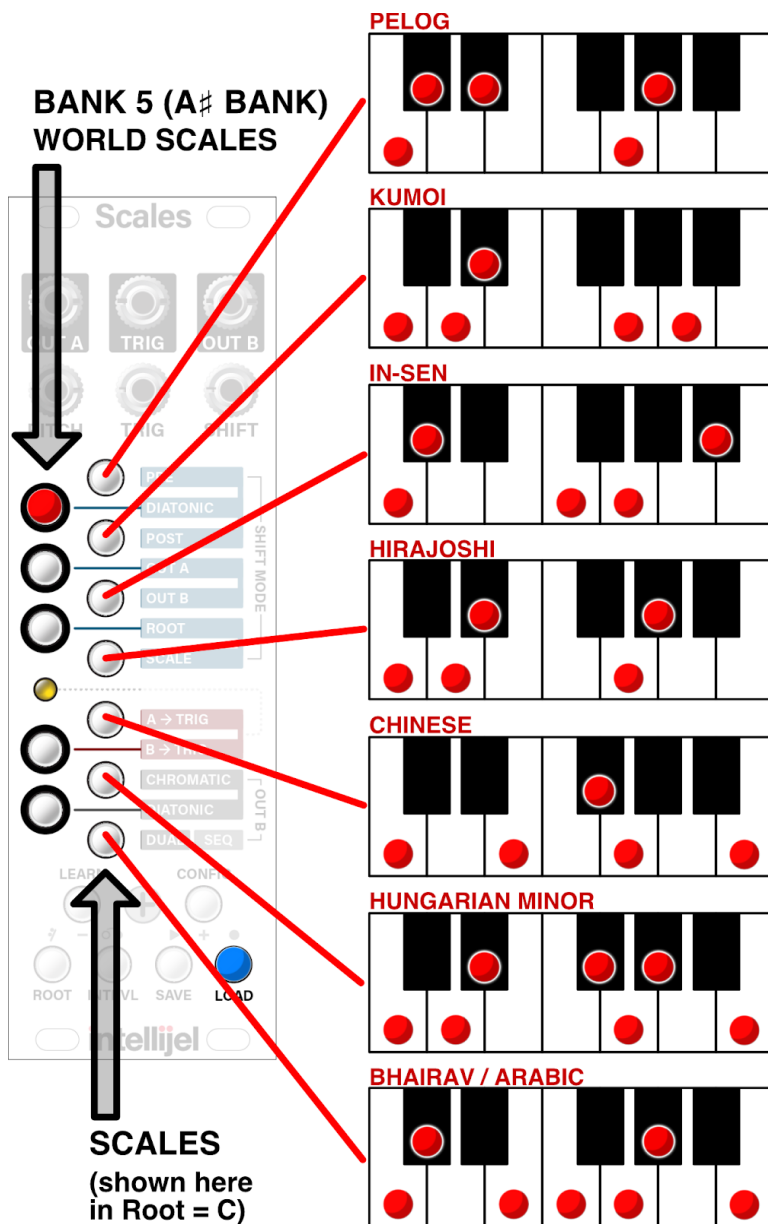
The seven scales are assigned to the seven “white key” buttons, with the first (chromatic) assigned to the bottom button ( C ) and the seventh (blues) assigned to the top button ( B ).



## Bank 5: World Scales

Bank 5 (assigned to the A# button) contains seven varieties of world music scales — the root of which is set via the ROOT button.

The seven scales are assigned to the seven “white key” buttons, with the first (arabic) assigned to the bottom button ( C ) and the seventh (pelog) assigned to the top button ( B ).



## Appendix C: Calibration

Scales comes calibrated from the factory, and the following processes might never be required. However, should you need to calibrate your unit for some reason, you can do so by entering a special Calibration Mode from within CONFIG Mode.

To enter Calibration Mode:

1. Enter CONFIG Mode by pressing the **CONFIG** button (lighting it).
2. Once in CONFIG Mode, long-press (>1 sec) the **CONFIG** button to enter Calibration Mode, causing the **CONFIG** button to flash.
3. The **SAVE** button will also light, indicating that your Calibration can be saved to EEPROM. All the other mode select buttons are disabled in Calibration Mode.
4. Should you wish to exit CALIBRATION mode (without saving your changes), simple press and hold the **CONFIG** button to return to CONFIG Mode.

The note buttons are used to perform the calibration procedure. Top buttons (F and above) select the calibration target:

- **OUT A** (G#) - Selects **OUT A** as the calibration target
- **OUT B** (G) - Selects **OUT B** as the calibration target
- **ROOT** (F#) - Selects **PITCH** as the calibration target
- **SCALE** (F) - Selects **SHIFT** as the calibration target
- **DIATONIC** (G#) - Toggles between the different voltages to be calibrated.
- **PRE** (B) - Enter **TEST** mode.

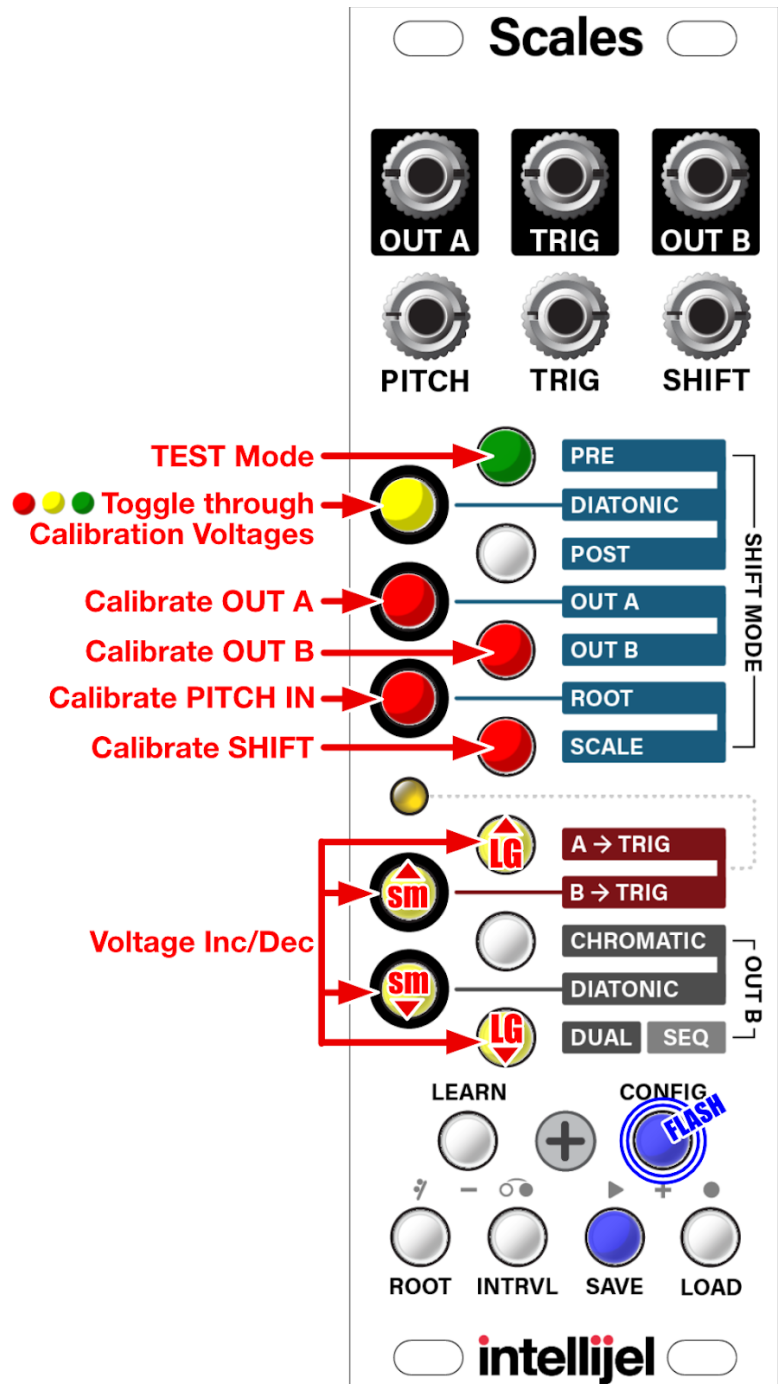
When calibrating **OUT A** or **OUT B**, the bottom note buttons E and below) adjust the calibration value:

- **A->TRIG** (E) - Adjusts the calibration upward by a large amount.
- **B->TRIG** (D#) - Adjusts the calibration upward by a small amount.
- **DIATONIC** (C#) - Adjusts the calibration downward by a small amount
- **DUAL** (C) - Adjusts the calibration downward by a large amount

When calibrating **PITCH** or **SHIFT**, **OUT A**

must be calibrated first. Connect a cable from **OUT A** to the **PITCH** or **SHIFT** input, then press **DUAL** to perform the calibration.

In **TEST** mode, the LG Inc/Dec buttons shift by octave; the SM Inc/Dec buttons shift by semitone.





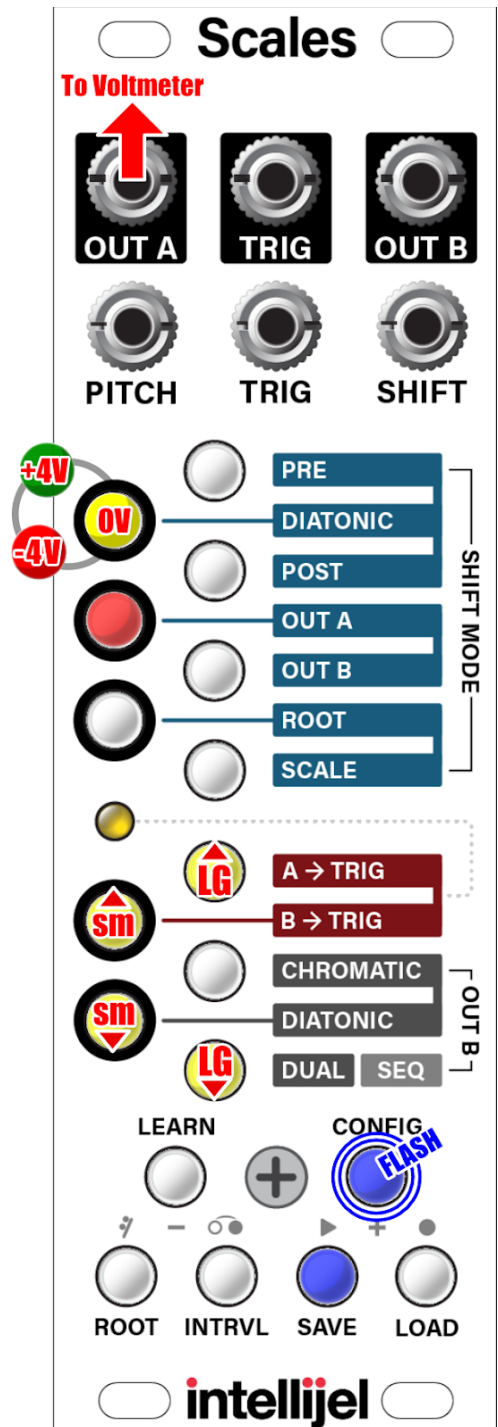
## OUT A Calibration

To calibrate OUT A:

1. Enter Calibration mode as previously described. (i.e. press the **CONFIG** button to enter Config Mode, then press & hold the **CONFIG** button to enter Calibration mode).
2. Patch OUT A into a voltmeter with .001V accuracy.
3. Press the **OUT A** (G#) button to select OUT A for calibration.
4. Press the **DIATONIC** (A#) button.
 

This sends a voltage to OUT A. Calibration involves tuning three separate voltages: -4V; 0V; +4V. Pressing the **DIATONIC** button rotates through the three voltages. A **red** DIATONIC button sends **-4V** to OUT A; a **green** DIATONIC button sends **+4V** to OUT A; and a **yellow** DIATONIC button sends **0V** to OUT A.
5. Monitor the voltage from OUT A using a voltmeter, and use the two increment and two decrement buttons to adjust Scales' output to match the intended target (-4V; +4v; 0V).
 

That is, use the **E** button to increase the voltage output in coarse increments. Use the **D#** button to increase the voltage output in fine increments. Use the **C** button to decrease the voltage output in coarse increments. Use the **C#** button to decrease the voltage in fine increments.
6. When you're finished calibrating the first of the three voltage levels, press the **DIATONIC** (A#) button, and repeat the calibration process for the second voltage target.
7. Press the **DIATONIC** (A#) button one final time, and calibrate the third voltage level.
8. Long-press (>1 sec) the **SAVE** button to write the calibration to EEPROM memory.



## OUT B Calibration

Calibrating OUT B is similar to OUT A, except you press the **OUT B (G)** button to enter OUT B calibration mode; and you patch OUT B into the voltmeter. Specifically:

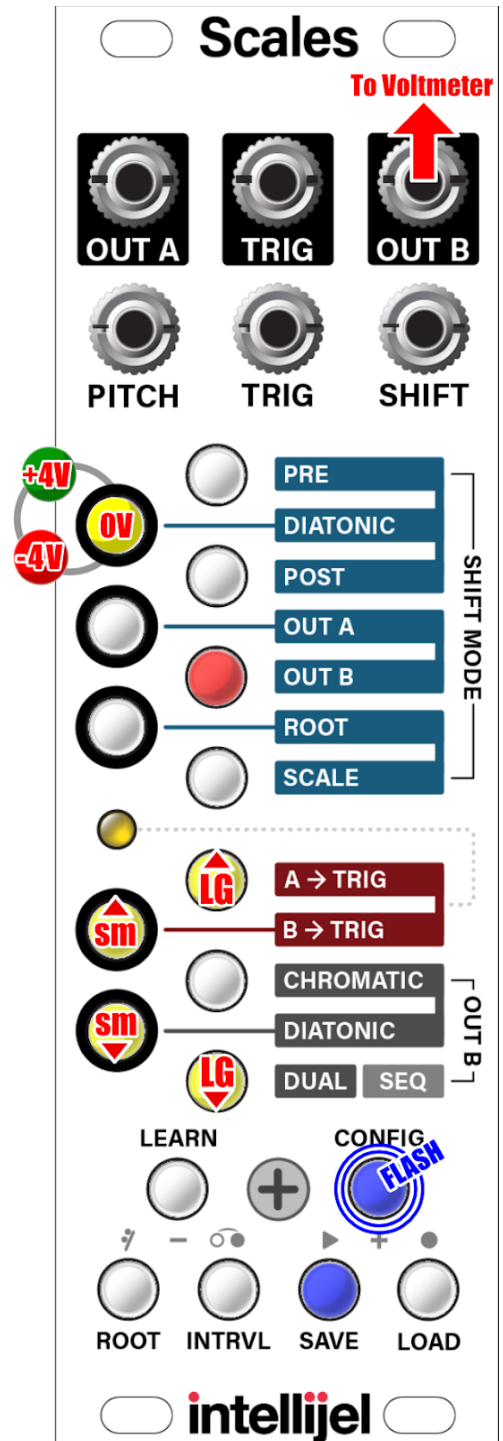
1. Enter Calibration mode as previously described. (i.e. press the **CONFIG** button to enter Config Mode, then press & hold the **CONFIG** button to enter Calibration mode).
2. Patch OUT B into a voltmeter with .001V accuracy.
3. Press the **OUT B (G)** button to select OUT B for calibration.
4. Press the **DIATONIC (A#)** button.

This sends a voltage to OUT B. Calibration involves tuning three separate voltages: -4V; 0V; +4V. Pressing the **DIATONIC** button rotates through the three voltages. A **red** DIATONIC button sends **-4V** to OUT B; a **green** DIATONIC button sends **+4V** to OUT B; and a **yellow** DIATONIC button sends **0V** to OUT B.

5. Monitor the voltage from OUT B using a voltmeter, and use the two increment and two decrement buttons to adjust Scales' output to match the intended target (-4V; +4v; 0V).

That is, use the **E** button to increase the voltage output in coarse increments. Use the **D#** button to increase the voltage output in fine increments. Use the **C** button to decrease the voltage output in coarse increments. Use the **C#** button to decrease the voltage in fine increments.

6. When you're finished calibrating the first of the three voltage levels, press the **DIATONIC (A#)** button, and repeat the calibration process for the second voltage target.
7. Press the **DIATONIC (A#)** button one final time, and calibrate the third voltage level.
8. Long-press (>1 sec) the **SAVE** button to write the calibration to EEPROM memory.



## PITCH Calibration

**IMPORTANT:** In order to calibrate the *PITCH* input, you must first calibrate Calibrate *OUT A* and *OUT B* as described previously. After doing so:

1. Enter Calibration mode as previously described. (i.e. press the **CONFIG** button to enter Config Mode, then press & hold the **CONFIG** button to enter Calibration mode).
2. Calibrate *OUT A* and *OUT B* (as described in the previous sections) if you haven't already done so.
3. Patch *OUT A* (or *OUT B*) into the *PITCH* input.
4. Press the **F#** (ROOT) button to select *PITCH* input for calibration.
5. Press the **C** (DUAL) button.

Scales automatically configures its *PITCH* input using the previously calibrated output values.

6. Press and hold the **SAVE** button to write the calibration to EEPROM memory.

## SHIFT Calibration

**IMPORTANT:** In order to calibrate the *SHIFT* input, you must first calibrate Calibrate *OUT A* and *OUT B* as described previously. After doing so:

1. Enter Calibration mode as previously described. (i.e. press the **CONFIG** button to enter Config Mode, then press & hold the **CONFIG** button to enter Calibration mode).
2. Calibrate *OUT A* and *OUT B* (as described in the previous sections) if you haven't already done so.
3. Patch *OUT A* (or *OUT B*) into the *SHIFT* input.
4. Press the **F** (SCALE) button to select the *SHIFT* input for calibration.
5. Press the **C** (Dual) button.

Scales automatically configures its *SHIFT* input using the previously calibrated output values.

6. Press and hold the **SAVE** button to write the calibration to EEPROM memory.

# Appendix D: Firmware

## Version 1.0 (Jan 2019)

- Initial release

### Firmware Version Display

Scales displays the current version number during start up, in an X.YZ format.

The bottom six buttons (LEARN, CONFIG, ROOT, etc) display the X value of the firmware version. The left column of Multifunction buttons (the “black” keys) displays the Y value of the firmware, and the right column of Multifunction buttons (the “white” keys) displays the Z value.

For example, if Scales was running firmware version 2.13, then it would light the buttons as shown in the illustration to the right.

### Technical Specifications

Width	8 hp
Maximum Depth	39 mm
Current Draw	35 mA @ +12V   5 mA @ -12V

