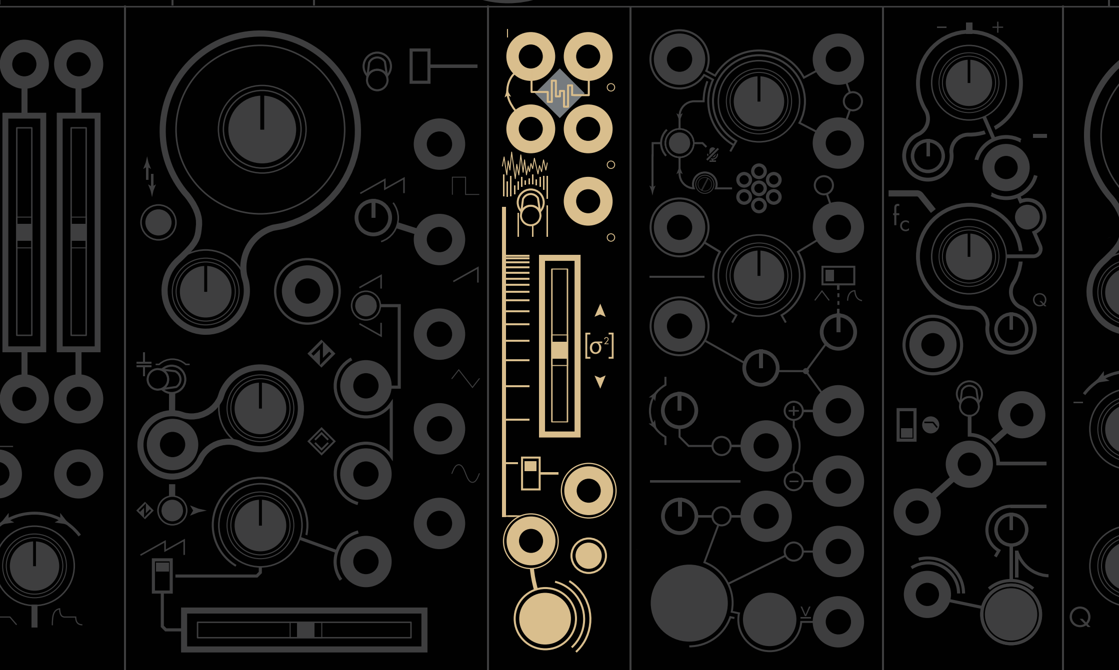
INSTRUŌ | SPECIALIST SYNTHESIZERS



tágh

Hybrid Random Voltage Generator

User Manual

Contents

Description

The Instruō tágh is a “Swiss Army Knife” modulation source. It features an analogue sample and hold, white noise generator, digital random voltage generator, morphing LFO, and probabilistic trigger generator, all with a unique phase-adaptive tap tempo functionality.

After many iterations of random voltage generation experiments, tágh’s 6 algorithms were meticulously curated to meet the needs of the designer. Once realised, it was quick to see its importance in small and big systems alike. These 6 random algorithms include Classic Stepped Random, Repeatable Stepped Random, Chaos, LFO, Probability-Synced LFO, and Downsampled LFO.

At only 4 HP, tágh is a true modulation workhorse.

Features

- Analogue sample and hold
- Analogue white noise generator
- Six digital random voltage algorithms
- Built-in bias and attenuation controls
- Smart tap tempo follower with manual button
- Steady and rhythmically-relevant clock generator
- Internal or external clock options of analogue sample and hold

Installation

1. Confirm that the Eurorack synthesiser system is powered off.
2. Locate 4 HP of space in your Eurorack synthesiser case.
3. Connect the 10 pin side of the IDC power cable to the 2x5 pin header on the back of the module, confirming that the red stripe on the power cable is connected to -12V.
4. Connect the 16 pin side of the IDC power cable to the 2x8 pin header on your Eurorack power supply, confirming that the red stripe on the power cable is connected to -12V.
5. Mount the Instruō tágh in your Eurorack synthesiser case.
6. Power your Eurorack synthesiser system on.

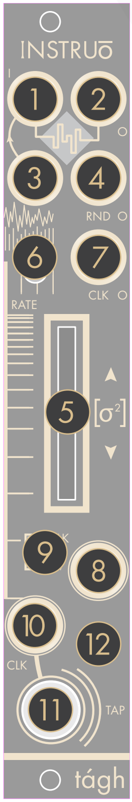
Note:

This module has reverse polarity protection.
Inverted installation of the power cable will not damage the module.

Specifications

- Width: 4 HP
- Depth: 27mm
- +12V: 40mA
- -12V: 15mA

tàgh | tʰˠɤ | verb (sampling) to choose, select or sample: to choose a small number of things by making careful decisions



Key

1. Sample & Hold Input
2. Sample & Hold Output
3. White Noise Output
4. Random Algorithm Output (Rnd O)
5. Random Slider
6. Random Toggle
7. Clock Output (Clk O)
8. Clock/CV Input
9. Clock/CV Switch (Clk/CV)
10. Clock Input (Clk)
11. Tap Tempo Button
12. Shift Button

Analogue Random

Sample and Hold Input: The **Sample and Hold Input** is a full scale analogue input to the sample and hold.

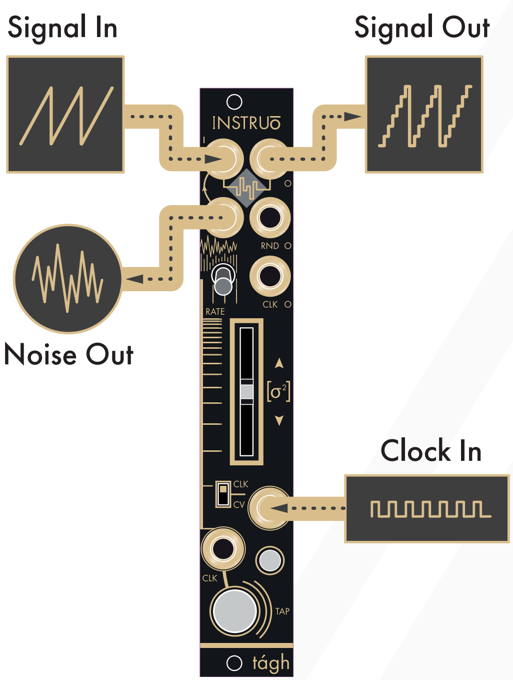
- Connecting a signal to the **Sample and Hold Input** will break the normal of the internal white noise generator.

Sample and Hold Output: The **Sample and Hold Output** is a full scale analogue output from the sample and hold.

- Range: 10Vpp

White Noise Output: The **White Noise Output** is a white noise generator output.

- The **White Noise Output** is normalled to the **Sample and Hold Input**.



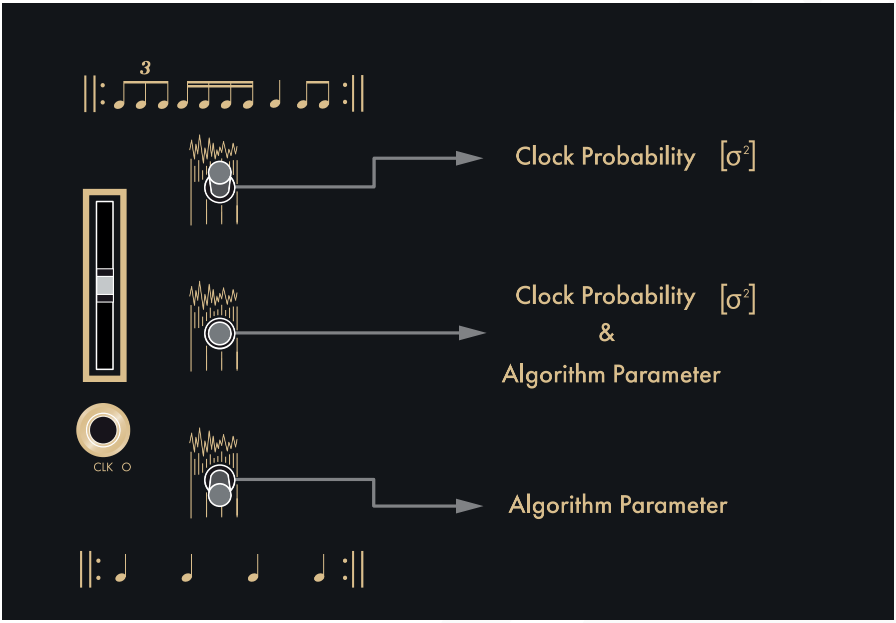
Digital Random

Random Algorithm Output (Rnd O): The **Random Algorithm Output** is a full scale random voltage output.

- Six different digitally-generated random algorithms are available (See the Random Algorithms section for more information).
- Range: 10Vpp.

Random Slider: The **Random Slider** changes a specific parameter of the selected random algorithm and/or the probabilistic selection of the random trigger signals present at the **Clock Output** (See the Clock and Random Algorithms sections for more information).

Random Toggle: The **Random Toggle** determines the behaviour of the **Clock Output** and the effect of the **Random Slider**. (See the Clock and Random Algorithms sections for more information).



- If the toggle is in its downward position, the **Random Slider** will affect a specific parameter of the selected random algorithm. The selected random algorithm is clocked by the tap tempo or an external clock signal. The **Clock Output** will follow the precise tempo of the defined clock signal.
- If the toggle is in its upward position, the **Random Slider** defines the probabilistic selection of randomised rhythmically-relevant subdivisions that are produced at the **Clock Output**. As the **Random Slider** is increased, the range of available subdivisions widens, increasing the chance of a new selection on the next beat. The selected random algorithm is clocked by the tempo or random trigger signals.
- If the toggle is in its centre position, the **Random Slider** affects both the specific parameter of the selected random algorithm and the probabilistic selection of the random trigger signals present at the **Clock Output**. The selected random algorithm is clocked by the tempo or random trigger signals.

Clock

Clock Output (Clk O): The **Clock Output** is an output that generates either steady trigger signals or rhythmically-relevant random trigger signals based on the position of the **Random Toggle** and **Random Slider** (See the Digital Random and Random Algorithms sections for more information).

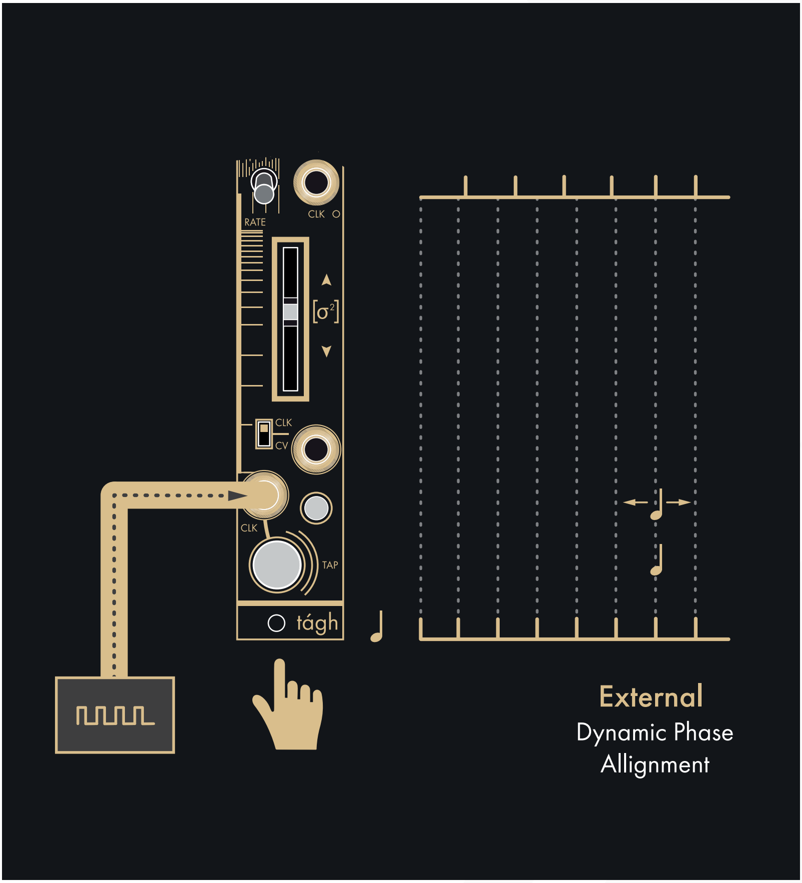
Clock/CV Input: The **Clock/CV Input** is either an external clock input for the sample and hold or a control voltage input for the selected random algorithm, based on the position of the **Clock/CV Switch** (See the Analogue Random section for more information).

Clock/CV Switch (Clk/CV): The **Clock/CV Switch** changes the behaviour of the **Clock/CV Input**.

- If the switch is in its downward position, tagh's internal clock source clocks the sample and hold. Additionally, the **Clock/CV Input** becomes a bipolar or unipolar positive/negative control voltage input for the selected random algorithm. Control voltage present at the **Clock/CV Input** will either sum with the position of the **Random Slider** or affect a parallel parameter depending on the selected random algorithm.
  - It's important to note that in this setting, the sample and hold will always be clocked by the precise tempo, not the rhythmically-relevant random clock signals.
- If the switch is in its upward position, tágh no longer clocks the sample and hold and the **Clock/CV Input** becomes a dedicated external clock input for the sample and hold (See the Analogue Random section for more information).

Clock Input (Clk): The **Clock Input** is a gate/trigger input for the precise tempo of tágh.

- If the time between successive clock signals is variable, tágh will smoothly increase or decrease to new values, providing musical transitions between tempos.



Tempo

Tap Tempo Button: The **Tap Tempo Button** is a manual control for the precise tempo of tágh.

- Pressing the button two times will calculate a new tempo.
- The **Tap Tempo Button** blinks white at steady tempos, amber while transitioning between tempos, and off-white when an external clock signal or dummy cable is present.
- Pressing the button when externally clocked will toggle lock/unlock of the voltage present at the **Random Algorithm Output**. Disconnecting the cable connected to the **Clock Input** will automatically unlock the voltage present at the **Random Algorithm Output**.
- Pressing and holding the button will stall tágh's internal clock.
    - If this is done with an LFO-based algorithm selected, the rate of the LFO remains steady, but the internal clock of tágh stalls.
    - External control voltage present at the **Clock/CV Input** will change the waveform of the LFO (if the **Clock/CV Switch** is in its downward position), but the **Random Slider** will be inactive.
- If tágh's internal clock is stalled and a dummy cable is present at the **Clock Input**, pressing the **Tap Tempo Button** will act as a manual clock, instead of following new tempos.
    - Gate signals are produced from the **Clock Output**, instead of trigger signals, and the voltage will be held HIGH for as long as the button is held down.
    - If this is done with a random-based algorithm selected, the button will seed new random values to the **Random Algorithm Output**. If this is done with an LFO-based algorithm selected, the button will continue to act as a tap tempo control, but without smooth transitions between tempos.

- If the clock is stalled and no dummy cable is present at the **Clock Input**, the **Random Toggle** will change the behaviour of the **Random Slider**.
  - Moving the **Random Toggle** to its upward position will enable the internal clock, and the **Random Slider** will control the rate of the internal clock at a medium-high range.
  - Moving the **Random Toggle** to its centre position will allow the **Random Slider** to control the random algorithm.
  - Moving the **Random Toggle** to its downward position will enable the internal clock, and the **Random Slider** will control the rate of the internal clock at a slow-medium range.

Random Algorithms

Shift Button: The **Shift Button** is used for various edit features.

- Press and hold the **Shift Button** and then press the **Tap Tempo Button** to switch between random algorithms.
- Press and hold the **Shift Button** to display the currently selected random algorithm.

    - Algorithm 1 – Classic Stepped Random is indicated by an upward-pulsing amber animation through the **Tap Tempo Button**, **Shift Button** and **Random Slider**.
    - Algorithm 2 – Repeatable Stepped Random is indicated by an upward-pulsing white animation through the **Tap Tempo Button**, **Shift Button** and **Random Slider**.
    - Algorithm 3 – Chaos is indicated by an upward-pulsing off-white animation through the **Tap Tempo Button**, **Shift Button** and **Random Slider**.
    - Algorithm 4 – LFO is indicated by a downward-pulsing amber animation through the **Random Slider**, **Shift Button** and **Tap Tempo Button**.
    - Algorithm 5 – Probability-Synced LFO is indicated by a downward-pulsing white animation through the **Random Slider**, **Shift Button** and **Tap Tempo Button**.
    - Algorithm 6 – Downsampled LFO is indicated by a downward-pulsing off-white animation through the **Random Slider**, **Shift Button** and **Tap Tempo Button**.

- If the **Clock/CV Switch** is in its bottom position, the **Shift Button** will indicate the polarity and amplitude of the signal present at the **Clock/CV Input.**

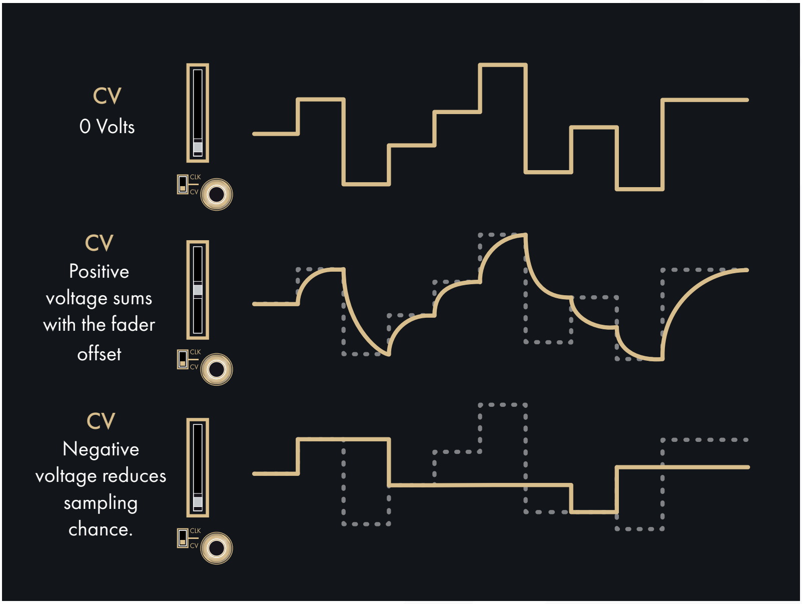
    - White illumination indicates positive polarity.
    - Amber illumination indicates negative polarity.

Algorithm 1 – Classic Stepped Random: Digitally-generated random steps derived from pseudo-random number generation.

This is the most "traditional" random algorithm.

Dynamic parameters:

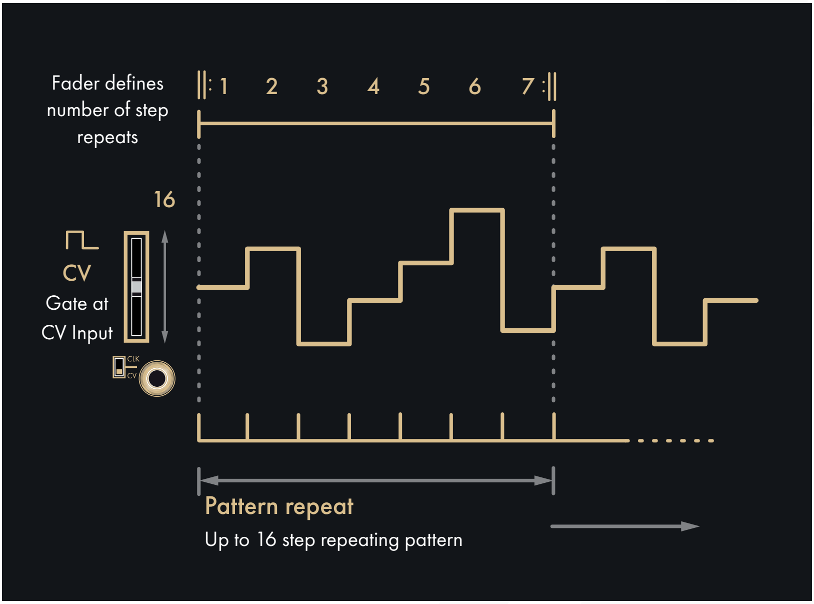
- The **Random Slider** controls the slew amount between random steps.
- Positive voltage present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) controls the amount of slew between random steps.
- Negative voltage present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) defines the probabilistic chance of new random steps.
    - 0V = 100% chance
    - -5V = 0% chance



Algorithm 2 – Repeatable Stepped Random: Digitally-generated random steps derived from pseudo-random number generation.

Dynamic parameters:

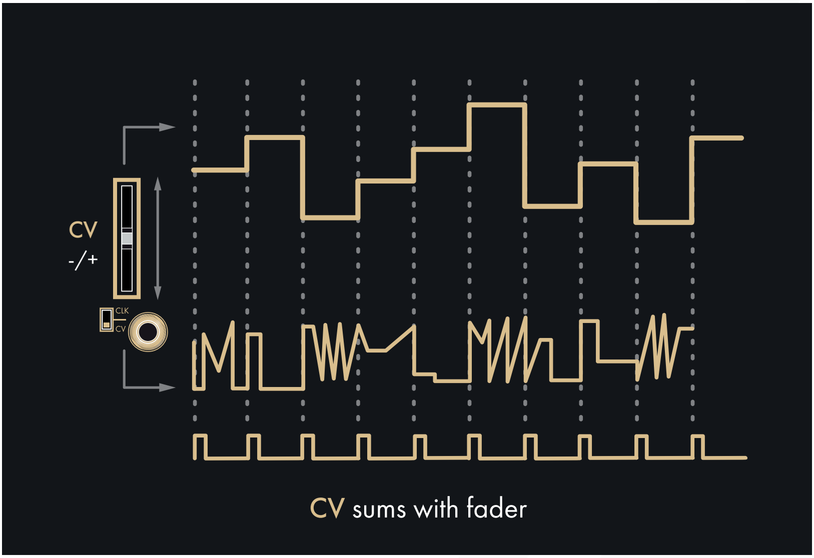
- The **Random Slider** defines the number of steps in the loop.
- The length of the repeated pattern can be set between 1 and 16 steps.
- If a gate is held HIGH at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position), the random steps will lock into a repeating ring buffer.
- Threshold voltage: 4.71V



Algorithm 3 – Chaos: On each clock cycle, the algorithm might flutter, cycle, wobble, produce a random control voltage, or drift. This algorithm is best suited for slower tempo clocking.

Dynamic parameters:

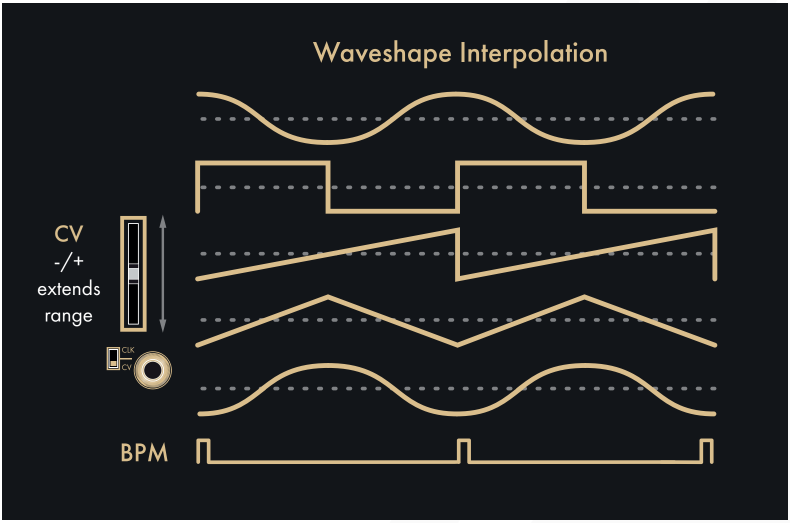
- If the **Random Slider** is in its fully up position, more basic random stepped voltage is generated.
- If the **Random Slider** is in its fully down position, full chaos is generated.
- The **Random Slider** vaguely crossfades between these extremes.
- Bipolar voltage with a range of -/+5V present at the **Clock/CV Input** (when the Clock/CV Switch is in its downward position) sums with the position of the **Random Slider**.



Algorithm 4 – LFO: Digitally-generated interpolating LFO waveforms. The LFO rate matches the tempo, but is not phase-aligned. The tempo/frequency changes are fully interpolated and completely smooth.

Dynamic parameters:

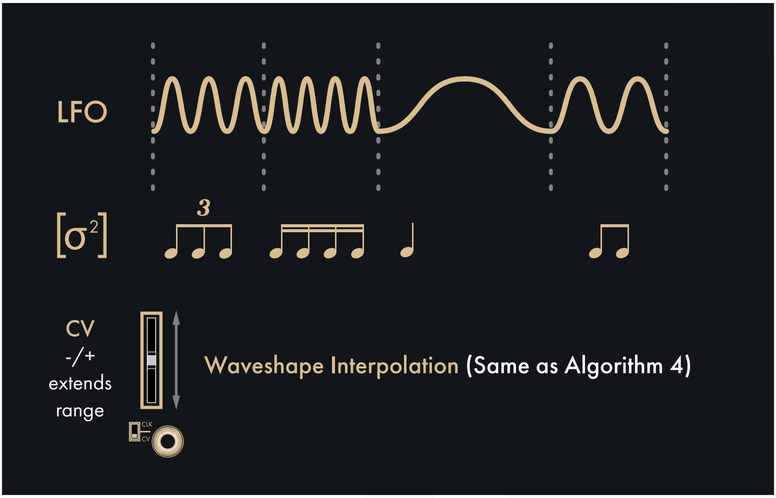
- Moving the **Random Slider** from its fully down to fully up position interpolates between the following waveforms:
    - Sine
    - Triangle
    - Ascending Sawtooth (Ramp)
    - Square
    - Inverted Sine
- Bipolar voltage with a range of -/+5V present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) extends the waveform options
    - Descending Sawtooth and other inverted polarities are available.



Algorithm 5 – Probability-Synced LFO: Digitally-generated interpolating LFO waveforms. The LFO rate matches the rhythmically-relevant subdivisions if the clock probability engine is enabled. Tempo/frequency changes are fully interpolated and completely smooth. Functionally, this algorithm is the same as Algorithm 4, but the LFO frequency will adapt and follow the rhythmically-related subdivisions.

Dynamic parameters:

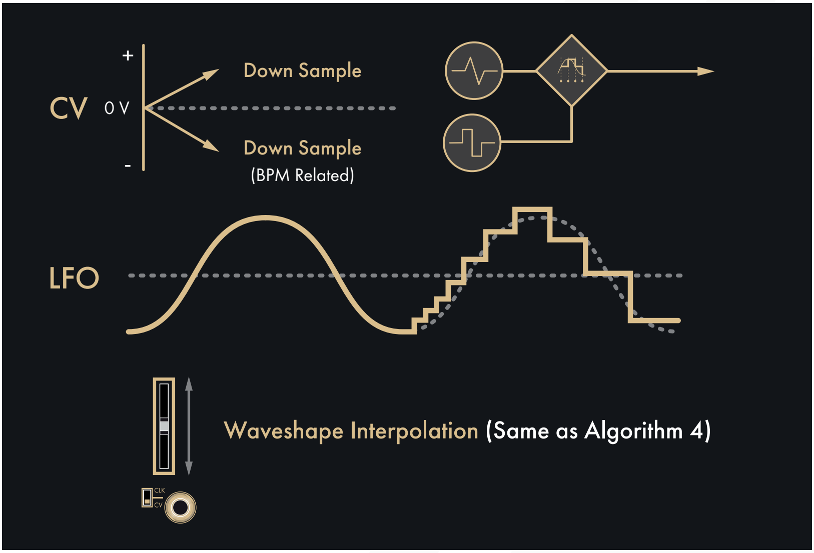
- Moving the **Random Slider** from its fully down to fully up position interpolates between the following waveforms:
  - Sine
  - Triangle
  - Ascending Sawtooth (Ramp)
  - Square
  - Inverted Sine
- Bipolar voltage with a range of -/+5V present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) extends the waveform options
  - Descending Sawtooth and other inverted polarities are available.



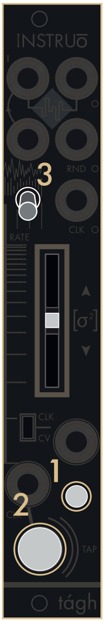
Algorithm 6 – Downsampled LFO: Digitally-generated interpolating LFO waveforms with downsample control. The LFO rate matches the tempo, but is not phase-aligned. Tempo/frequency changes are fully interpolated and completely smooth. Functionally, this algorithm is the same as Algorithm 4, but the LFO waveform has the ability to be downsampled.

Dynamic parameters:

- Moving the **Random Slider** from its fully down to fully up position interpolates between the following waveforms:
  - Sine
  - Triangle
  - Ascending Sawtooth (Ramp)
  - Square
  - Inverted Sine
- Positive voltage present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) reduces the sample rate of the LFO waveform.
  - +5V will stall the held amplitude.
- Negative voltage present at the **Clock/CV Input** (when the **Clock/CV Switch** is in its downward position) reduces the sample rate of the LFO waveform.
  - The sample rate reduction is directly proportional to the tempo of the LFO.



Offset & Attenuation



The order of process is offset and then attenuation. Full attenuation will always result in 0V.

Attenuation: Press the **Shift Button (1)** 3 times and hold it on the third press. The **Tap Tempo Button (2)** and the **Shift Button** will begin to pulse white. With the **Shift Button (1)** still pressed, moving the **Random Slider** will define the amplitude of the signal present at the **Random Algorithm Output**.

Offset: With the **Shift Button (1)** still pressed, press the **Tap Tempo Button (2)** and it will pulse amber. With the **Shift Button (1)** still pressed, moving the **Random Slider** will offset the signal present at the **Random Algorithm Output**. Centering the **Random Slider** will produce a bipolar signal at the **Random Algorithm Output** centred around 0V. The **Tap Tempo Button (2)** will display pulsing off-white when centred.

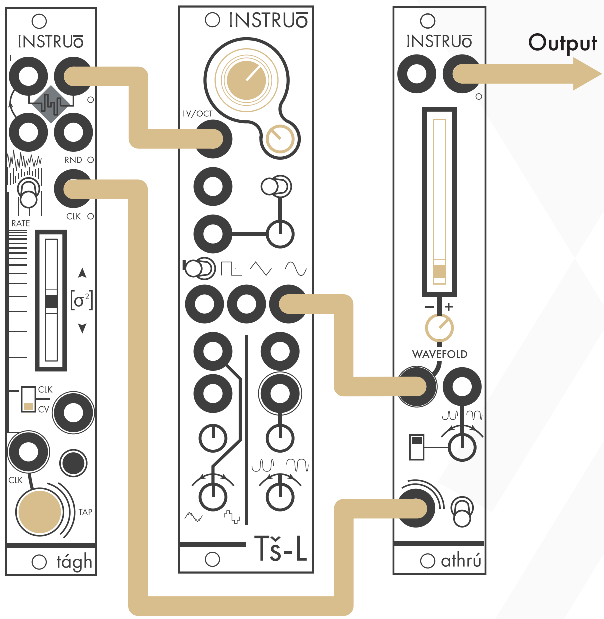
Factory Reset

Press and hold both the **Shift Button (1)** and the **Tap Tempo Button (2)** and switch the **Random Toggle (3)** up and down 3 times.

Patch Examples

West Coast Synth Voice:

Summary: tágh samples the internal white noise and sends random voltage to the pitch input of an oscillator. tágh is internally clocked and strikes a wavefolder.



Audio Path:

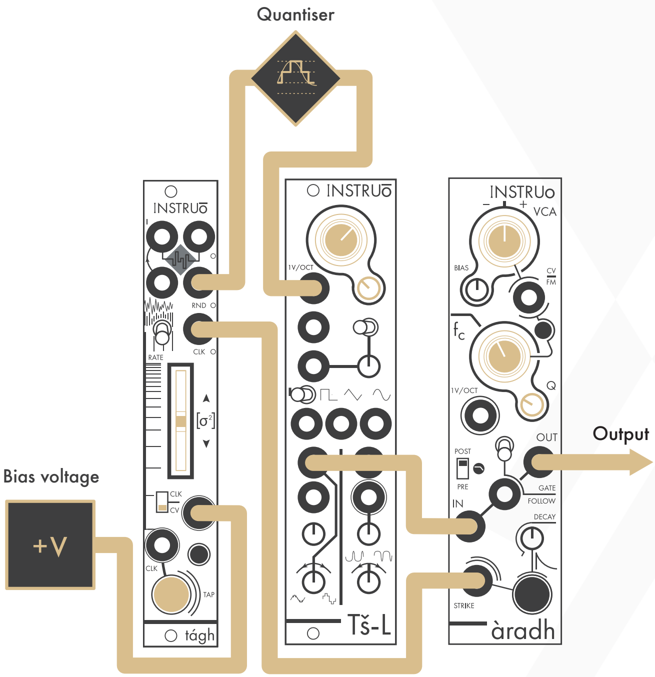
- Connect the output of the oscillator to the audio input of a wavefolder.
- Monitor the audio output of the wavefolder.
- Set the fundamental frequency of the oscillator to a desired position.
- Set the wavefolder amount to its minimum position.

Control Path:

- Set the tap tempo of tágh via the **Tap Tempo Button**.
- Set the **Clock/CV Switch** to its downward position, so that the sample and hold is clocked by tágh's tap tempo.
- Connect the **Sample and Hold Output** of tágh to the 1V/Oct Input of the oscillator.
- Connect the **Clock Output** of tágh to the strike input of the wavefolder.

Diatonic Locked Random:

Summary: A manually set bias signal locks the random voltage algorithm to create repeating patterns. These repeating patterns are then quantised and sent to the pitch input of an oscillator. Additionally, tágh triggers the strike input of a low pass filter/VCA.



Audio Path:

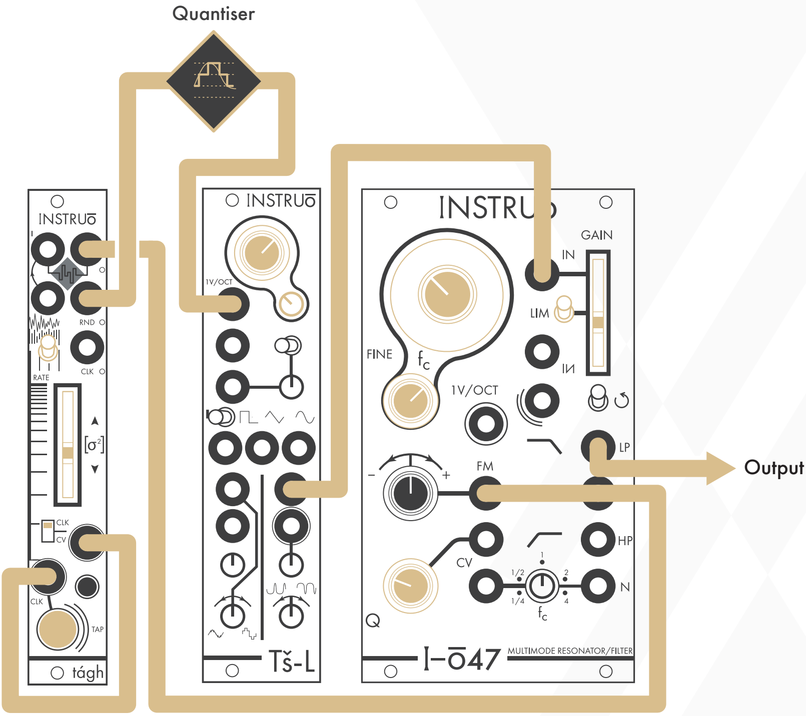
- Connect the output of an oscillator to the audio input of a low pass filter/VCA.
- Monitor the audio output of the low pass filter/VCA.
- Set the fundamental frequency of the oscillator to a desired position.
- Set the cutoff frequency of the low pass filter to a desired position.
- Set the resonance of the low pass filter to a desired position.
- Set the level of the VCA to its minimum position.

Control Path:

- Set tágh to **Algorithm 2 – Repeatable Stepped Random**.
- Set the tap tempo of tágh via the **Tap Tempo Button**.
- Set the **Clock/CV Switch** to its downward position, so that the **Clock/CV Input** acts as an external control voltage input.
- Connect the **Random Algorithm Output** to the input of a quantiser and set the quantiser's control voltage input to a desired position.
- Connect the output of the quantiser to the 1V/Oct input of the oscillator.
- Connect the **Clock Output** to the strike input of the low pass filter/VCA.
- Set the **Random Slider** to select a desired amount of locked random steps.
- Connect an adjustable bias signal that has a maximum voltage of at least +5V to the **Clock/CV Input**. Everytime the bias signal reaches +5V, the random voltages will lock into a repeating ring buffer.

Synchronous Dual Random for Pitch and Timbre:

Summary: A digitally-generated random algorithm modulates the pitch of an oscillator while the analogue sample and hold modulates the cutoff frequency of a low pass filter.



Audio Path:

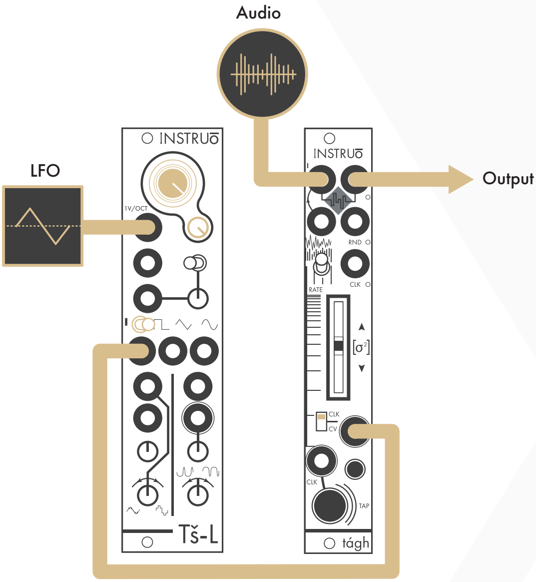
- Connect the output of an oscillator to a low pass filter.
- Monitor the output of the low pass filter.

Control Path:

- Set tágh to **Algorithm 1 – Classic Stepped Random**.
- Set the tap tempo of tágh via the **Tap Tempo Button**.
- Set the **Clock/CV Switch** to its upward position, so that tágh's sample and hold can be externally clocked.
- Connect the **Random Algorithm Output** to the input of a quantiser
- Connect the output of the quantiser to the 1V/Oct input of the oscillator.
- Connect the **Sample and Hold Output** to the control voltage input of the low pass filter and set the corresponding control voltage attenuator to its desired position.
- Connect the **Clock Output** to the **Clock/CV Input**.
- Set the **Random Toggle** to its upward position, so that the random algorithm is clocked by the tempo or random trigger.
- Set the **Random Slider** to a position that achieves the desired probability of random trigger signals.

Audio Rate Downsampling:

Summary: tágh acts as an analog audio degrader by sampling audio signals at audio rate.



Audio Path:

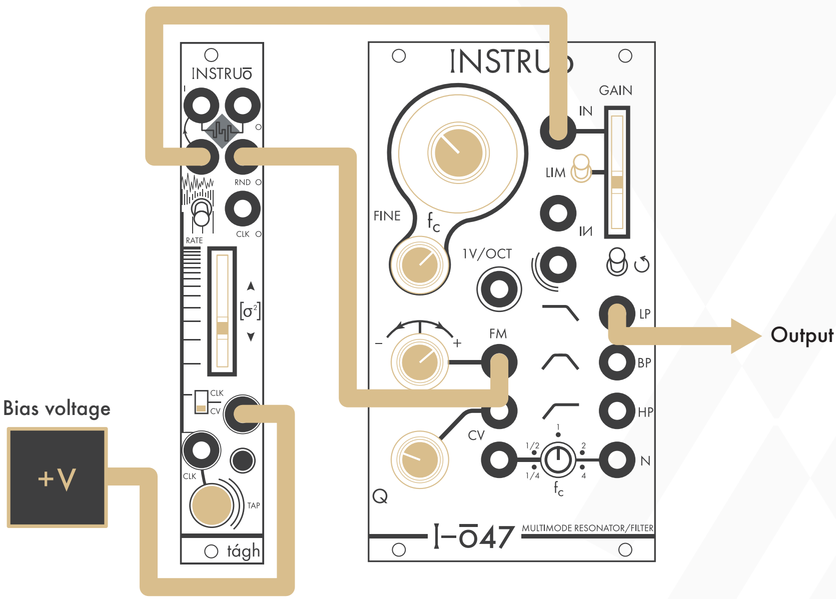
- Connect the final output of a synth voice patch to the **Sample and Hold Input** of tágh. Virtually any audio signal can be used here – audio sample, droning oscillator, synth voice, etc.
- Monitor the output of tágh.
- Set the **Clock/CV Switch** to its upward position so that tágh's sample and hold can be externally clocked.
- Connect an audio rate square waveform from an oscillator to the **Clock/CV Input** of tágh and set the oscillator's fundamental frequency to its highest knob position. The frequency of this oscillator acts as the sampling rate. At this point, there shouldn't be much change in the sound.
- Slowly decrease the fundamental frequency of the sampling rate oscillator to downsample the synth voice patch.

Control Path:

- For extra modulation, connect an attenuated bipolar LFO to the FM input or 1V/Octave input of the sampling rate oscillator.

Step-Filtered White Noise:

Summary: A stepped triangle waveform LFO modulates the cutoff frequency of a low pass filter, which controls the timbre of a white noise signal.



Audio Path:

- Connect the **White Noise Output** of tágh to the input of a low pass filter.
- Monitor the output of the low pass filter.
- Set the cutoff frequency of the low pass filter to a desired position.
- Set the resonance of the low pass filter to a desired position.

Control Path:

- Set tágh to **Algorithm 6 – Downsampled LFO**.
- Set the tap tempo of tágh via the **Tap Tempo Button**.
- Set the **Clock/CV Switch** to its downward position, so that the **Clock/CV Input** acts as an external control voltage input.
- Connect the **Random Algorithm Output** to the control voltage input of the low pass filter and set the corresponding control voltage attenuator to a desired position.
- Set the **Random Slider** to the position associated with a triangle waveform LFO.
- Connect an adjustable bias signal to the **Clock/CV Input**. Set the bias signal to a level that achieves the desired amount of steps per LFO cycle.

History of tàgh

The tágh is an amalgamation of clocking and modulation techniques, signal processes, and weird patches that I have worked with for many years now. It is a true hybrid between analogue random voltage generation and software algorithms that I have developed for, and used in, a wide array of musical contexts for as long as I've been working with modular synthesisers.

Many Instruō users may be familiar with the name tágh. A limited run of a 14 HP module sporting the name was produced in early 2019 and again in December 2021. This module was originally designed as a personal project using aesthetics and iconography from the 2017 hit video game "The Legend of Zelda: Breath of the Wild". I was experimenting with various circuits centred around high precision sample and hold implementations. Designing a prototype around the fictional "Sheikah" technology of ancient Hyrule seemed like a good idea at the time. And I think it looks pretty cool!

The limited production batch of tágh LTD modules featured a more formal faceplate sporting the Instruō hourglass icon in place of the Nintendo graphics. At 14 HP, it is a slightly larger module than I think was really necessary for its feature set. The interface layout was, after all, based around the back lit graphic – not design efficiency.

I do, however, find it to be a very playable module which inadvertently ended up being much more useful in practice than I anticipated it would be. Details such as the switchable full wave rectifier, the input attenuation pre-Sample and Hold, and the built-in slew limiter make for a powerful utility with comfortable control spacing.

The name "tágh" which translates to "select, choose, pick, sample" was ultimately borrowed for the previous limited edition 14HP module. The design I had in mind for the tágh is what has now come to fruition in this 4HP form factor.

There are three parallel components to the module:

1. Analogue – white noise generator and internal/external clocked sample and hold
2. Algorithms – digitally-generated random voltages and modulation signals, each with some form of variable parameter(s). There are six algorithms in total.
3. Clock – the subdivision probability engine which produces rhythmically-relevant subdivisions, and the phase-adaptive clock input/tap tempo.

I am a big advocate for 1V/Oct signal generation derived through sample and hold patching techniques into quantisers, as opposed to manually programmed sequences. I curated the tágh's features from some of my go-to patching techniques. Several of the random voltage algorithms are optimised for efficient control over these methods of random voltage control. Combined with a quantiser, the result can be extremely musical melodically.

The tap tempo engine is a tempo-following algorithm I've played with for many years now. Simplicity in interface was my intent. Either tap a fixed tempo, or send a master clock to the input jack. But where the tágh's clock engine shines is with more naturally variable clock sources that might deviate from a rigid BPM. The tempo follower is always adapting via hysteresis filtering and phase analysis.

I like to describe it as technically loose, but musically tight!

Manual Author: Collin Russell
Manual Design: Dominic D'Sylva