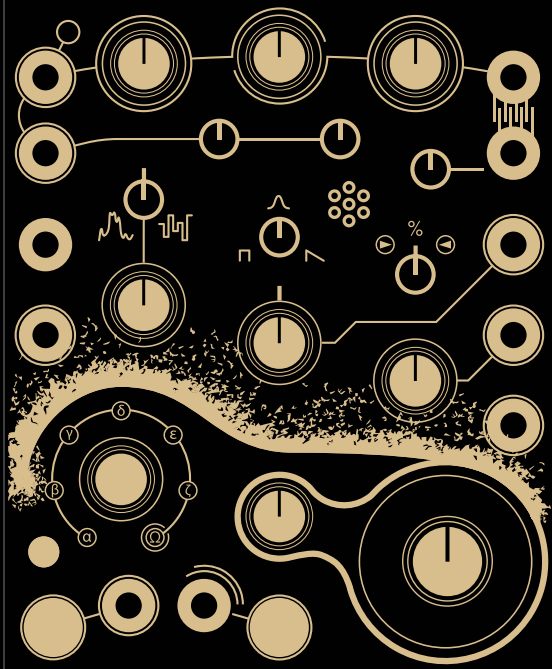
INSTRUO | SPECIALIST SYNTHESIZERS



arbhar

Granular Audio Processor

User Manual

(Firmware 2.0)

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Description

In 2019 the launch of the arbhar heralded a new generation of granular processing in Eurorack. Sampled audio could be chopped into tiny grains, scattered, shaped, re-pitched, reversed, and layered for an endless range of audio manipulation ranging from seamless frozen tones to mutated acousmatic madness. Each grain sounds with its defined specifications. When modulation is used, the "per-grain parameter" definition allows for true polyphonic layering.

With the introduction of firmware version 2 (2023) comes a complete rewrite of the entire codebase to implement both technical and conceptual improvements that will enhance the entire user experience of arbhar. We have ensured that the overall feel of the module has been preserved as much as possible. Advances in efficiency and expanded features will allow arbhar to explore many more sonic and musical spaces.

Meet the **Lexer Method** V2

Features

- Up to 88 sounding polyphonic grains between two granular engines
- Mono and stereo input configurations
- Six 10 second individual audio buffers
- 1 volt per octave pitch tracking
- On-board random pitch deviation and grain direction probability
- Scan Mode, Follow Mode, and Wavetable Mode
- Stereo pan, feedback delay, and reverb configurations
- Built-in condenser microphone
- Analogue input preamplifier and limiter
- USB import and export functionality
- Audio analysis with onset detection for automatic audio capturing
- User-definable configuration file for complete instrument customization
- Includes 2 HP passive CV Expansion module, 2 HP Passive USB Expansion module and 4GB USB flash drive

Installation

1. Confirm that the Eurorack synthesiser system is powered off.
2. Locate 18 HP of space in your Eurorack synthesiser case for the module.
3. Locate an additional, but optional 2 HP of space in your Eurorack synthesiser case for the included CV Expansion module.
4. Locate an additional, but optional 2 HP of space in your Eurorack synthesiser case for the included USB Expansion module.
5. 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 IDC power cable is connected to -12V, indicated with a white stripe on the module.
6. 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.
7. Optional: To install the CV Expansion module, connect the included 12 pin IDC cable to both modules. Ensure that the red strip of the IDC cable matches the white stripe on each module.
8. Optional: To install the USB Expansion module, connect the mini USB cable to the expansion module and the USB socket on the back of arbhar.
9. Mount the Instruō arbhar and the optional expansion modules in your Eurorack synthesiser case.
10. Power your Eurorack synthesiser system on.

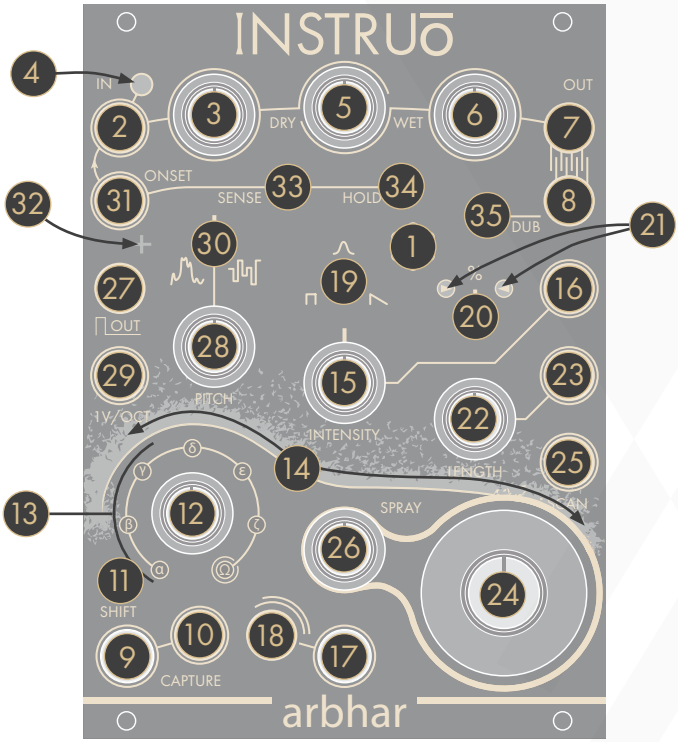
Note:

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

Specifications

- Width: 18 HP Module + 2 HP CV Expansion Module + 2 HP USB Expansion Module
- Depth: 42mm
- +12V: 250mA
- -12V: 30mA
- Sample Rate: 48kHz
- Bit Depth: 32 Bit

arbhar | ˈarˠuːrˠ | **noun** (agricultural) a grain, a very small amount of a particular quantity, natural patterns or lines in the surface of wood or cloth



Key

1. Condenser Microphone
2. Input (In)
3. Input Level Knob
4. Input Indicator
5. Dry/Wet Mix
6. Output Level Knob
7. Outputs 1
8. Output 2
9. Capture Button
10. Capture Pulse Input
11. Shift Button
12. Layer Knob
13. Layer Indicators
14. Granular Stream Display
15. Intensity Knob
16. Intensity CV Input
17. Strike Button
18. Strike Input
19. Grain Window Knob
20. Grain Direction Knob
21. Grain Direction Indicators
22. Length Knob
23. Length CV Input
24. Scan Knob
25. Scan CV Input
26. Spray Knob
27. Pulse Output
28. Pitch Knob
29. 1V/Octave Input
30. Pitch Deviation Knob
31. Onset Input
32. Onset Indicator
33. Sensitivity Knob
34. Hold Knob
35. Dub Knob

CV + USB Expansion Modules

Key

1. Spray CV Input
2. Layer CV Input
3. Grain Direction CV Input
4. Grain Window CV Input
5. Pitch Deviation CV Input
6. Dub CV Input
7. Mod CV Input
8. Dry/Wet Mix CV Input
9. USB Port

Input and Output

Condenser Microphone: The **Condenser Microphone** located on the front panel can be used for capturing audio.

- The **Condenser Microphone** is normalled to the **Onset Input**.
- The **Onset Input** is normalled to the **Input**. When no cables are connected to either input, the **Condenser Microphone** will normal through the **Onset Input** to the **Input**.
- Connecting a cable to the **Input** or **Onset Input** will break the normalisations.

Normalised Signal Path:

Condenser Microphone	ONSET	IN
	Signal to be Analysed	Signal to be Recorded

Input (In): The Input is an AC coupled audio input.

Input Level Knob: The **Input Level Knob** sets the level of the signal present at the Input. This includes the level of the normalled **Condenser Microphone** signal. The input stage incorporates analogue limiting. This allows arbhar to saturate rather than digitally clip when high amplitude signals are used.

- If the knob is at its 10:00 position, the signal present at the **Input** is approximately set to unity gain. If the knob exceeds the 10:00 position, arbhar drives the signal through its preamplifier.

Input Indicator: The **Input Indicator** illuminates amber when a signal is present at the **Input**. The brightness of the LED indicates the amplitude of the input signal.

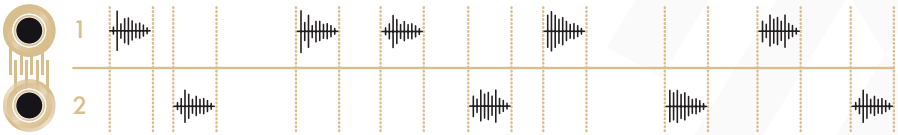
Dry/Wet Knob: The **Dry/Wet Knob** will equal power crossfade between the dry signal and the granular engines.

Output Level Knob: The **Output Level Knob** sets the level of the signal present at the **Outputs**.

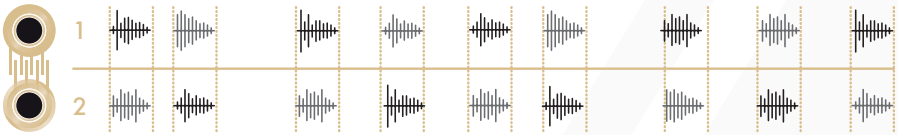
Outputs (Out): The **Outputs** are audio outputs.

- By default, grains are randomly distributed between both **Outputs** using coin toss logic.
- For mono playback, monitor from **Output 1**, as **Output 2** is normalised to **Output 1**.
- Connecting **Output 2** enables stereo imaging and independent effect processing for each output (See the **Mod CV Input Modes** section for more information).
- The phase polarity of **Output 2** can be modified for optimum use cases between mono and stereo patching (See Phase Switching section for more information).

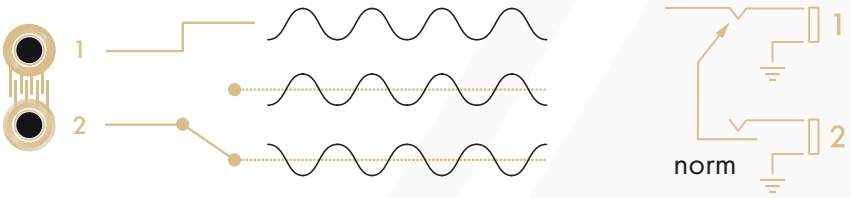
Mono: grains "coin-toss" between **Output 1** and **Output 2**



Stereo: grains coin toss L/R or R/L

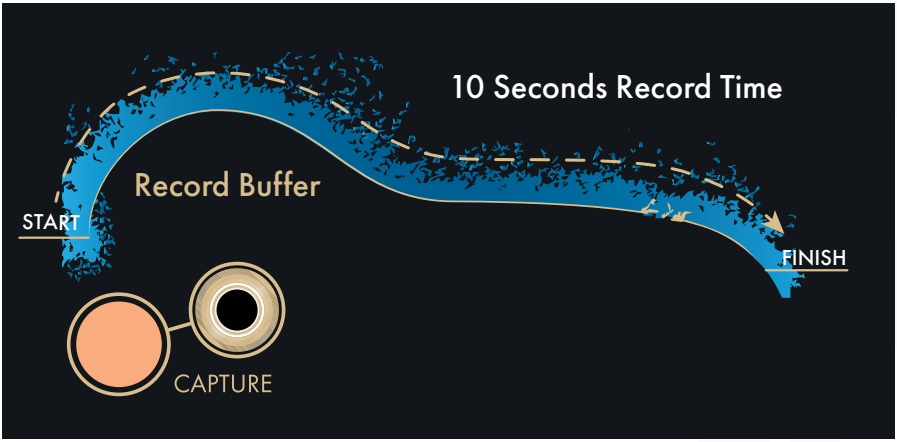


Phase Switch: **Output 2** sums with **Output 1** when unpatched.



Capture

Capture Button: The **Capture Button** activates recording of the signal present at the **Input** (and **Onset Input** when in **Stereo Input Mode**).



- By default, pressing this button will start recording from the start of the layer. This behaviour can be changed in the preset.txt configuration file located on the USB flash drive (See the Capture Button Modes and Accumulative Capture Mode in the Loading Presets section for more information).
- Once the recording has started, the **Capture Button** will illuminate amber and recording will continue until the layer is filled, even if the currently selected layer is being changed.
- The recording will automatically stop once the layer is filled. This is indicated by an unilluminated **Capture Button**.
- Pressing the **Capture Button** while recording is activated will stop recording.
- arbhar automatically saves recordings and will retain recordings between power cycles.

Capture Pulse Input (Capture): Recording and overdubbing is activated when a pulse signal is present at the **Capture Pulse Input**.

The **Capture Pulse Input** can be set to **Momentary Capture Mode**, **Latching Capture Mode**, or **Retrigger Capture Mode**.

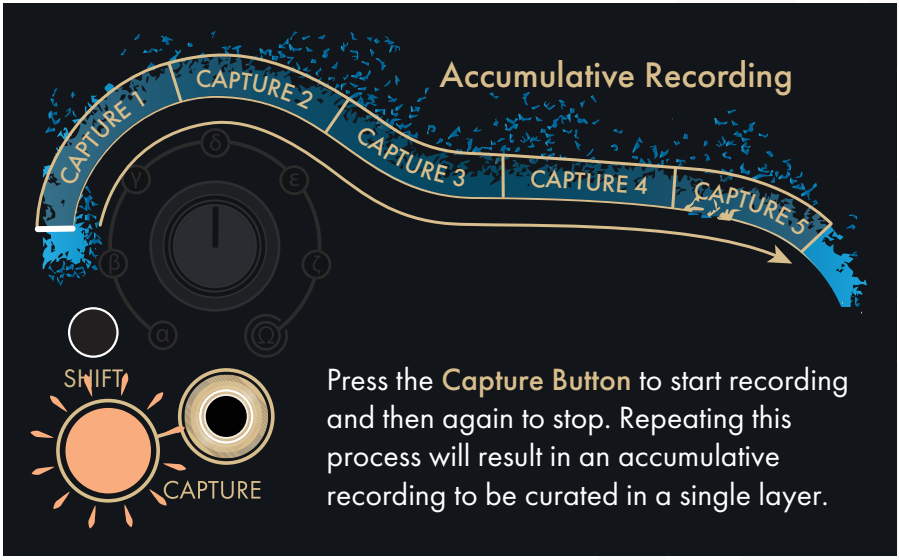
- **Momentary Capture Mode** (Default) will record for as long as the signal present at the **Capture Pulse Input** is held HIGH. This is best used with gate signals.
- **Latching Capture Mode** will start recording when a rising-edge signal is received at the **Capture Pulse Input** and will continue recording until another rising-edge signal is received. This is best used with trigger signals.
- **Retrigger Capture Mode** will restart recording with every raising hard-edge signal received at the **Capture Pulse Input**, but will not interfere with the recording state.
    - A pulse signal present at the **Capture Pulse Input** is indicated by a flashing white **Capture Button**, but will only restart recording if arbhar is manually set to record.
- Press and hold the **Shift** and **Capture Buttons** and then turn the **Dub Knob** from its centre position. Turning the knob fully anticlockwise sets **Momentary Capture Mode**. Turning the knob fully clockwise sets **Latching Capture Mode**.
- **Retrigger Capture Mode** is only accessible via the preset.txt configuration file located on the USB flash drive (See the Loading Presets section for more information).
- **Capture Modes** can be set via the preset.txt configuration file located on the USB flash drive (See the Loading Presets section for more information).

Shift Button: The **Shift Button** is used for secondary features, modes, and controls. If the **Shift Button** is held down, the colour of the **Granular Stream Display** illuminates red with white illumination on each side.

Accumulative Capture Mode

arbhar can be set to **Accumulative Capture Mode**.

- This mode allows for the consecutive collage of different recordings within different locations of a layer. When enabled, pressing the **Capture Button** will pause the record head, rather than reset it to the start of the layer.
- To activate/deactivate **Accumulative Capture Mode**, press and hold the **Capture Button** and then press the **Shift Button**. Recording will begin and continue until paused. While paused, the **Capture Button** will pulse amber to indicate you are in this mode.

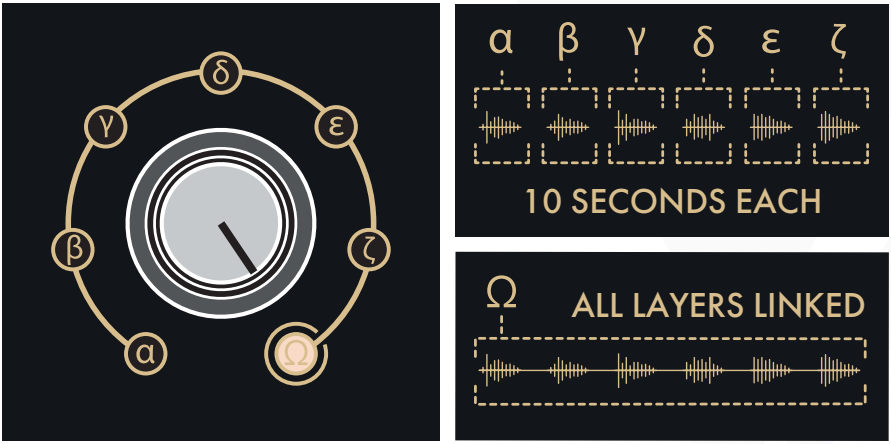


- The recording position will automatically reset to the beginning of the layer if the record head is paused beyond the 10 second mark.
- For a manual reset of the record head, double tap and hold the **Shift Button** to enter **Track and Hold Mode** and then press the **Capture Button**.

- Additionally, it is possible to manually set the record head to a particular position. To do this, set the **Scan Knob** to the desired position, then double tap and hold the **Shift Button** to enter **Track and Hold Mode** and then press the **Strike Button**.
- **Accumulative Capture Mode** can also be enabled or disabled via the preset.txt configuration file located on the USB flash drive (See the Loading Presets section for more information).

Layers

Layer: The **Layer Knob** sets the currently selected layer. There are six layers that can each store up to 10 seconds of recorded or imported audio.

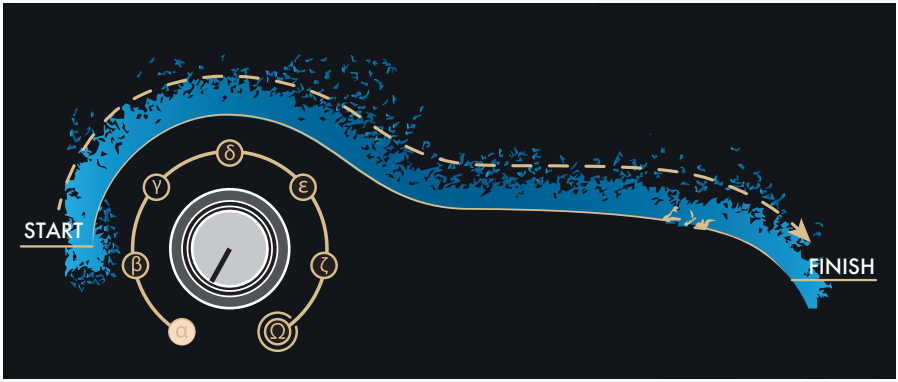


- They are referred to as **alpha**, **beta**, **gamma**, **delta**, **epsilon**, and **zeta**.
- Layer content is set at the beginning of each grain and remains unchanged for the duration of the grain.
- When the **Layer Knob** is fully clockwise and the **omega Layer Indicator** is illuminated, all layers are consecutively available via the **Scan Knob**.
- To ensure the absence of audio drop outs at extreme **Scan Knob** positions and long grain sizes, arbhar records for an additional 3 seconds at the end of each layer.

Layer Indicators: The **Layer Indicators** will illuminate around the **Layer Knob** to indicate the currently selected layer.

- When the knob is fully clockwise and the **omega Layer Indicator** is illuminated, the currently selected layer is determined by the position of the **Scan Knob** and indicated by the corresponding **Layer Indicator**.

Granular Stream Display: The **Granular Stream Display** indicates various information relevant to the granular engines. It changes colour to indicate the currently selected layer, it illuminates from left to right to indicate individual grain amplitudes, it indicates the **Scan Knob** position, it indicates the grain length, it indicates the offset deviation displaced by the **Spray Knob**, and it indicates the position and direction of the record and playheads in **Scan** and **Follow Mode**.



- The **alpha** layer is indicated by the colour blue.
- The **beta** layer is indicated by the colour magenta.
- The **gamma** layer is indicated by the colour amber.
- The **delta** layer is indicated by the colour yellow.
- The **epsilon** layer is indicated by the colour turquoise.
- The **zeta** layer is indicated by the colour violet.
- The **omega** layer is a combination of all layers, therefore it is indicated by a combination of all colours based on the current **Scan Knob** position.

Granular Synthesis

arbhar has two separate granular synthesis engines:

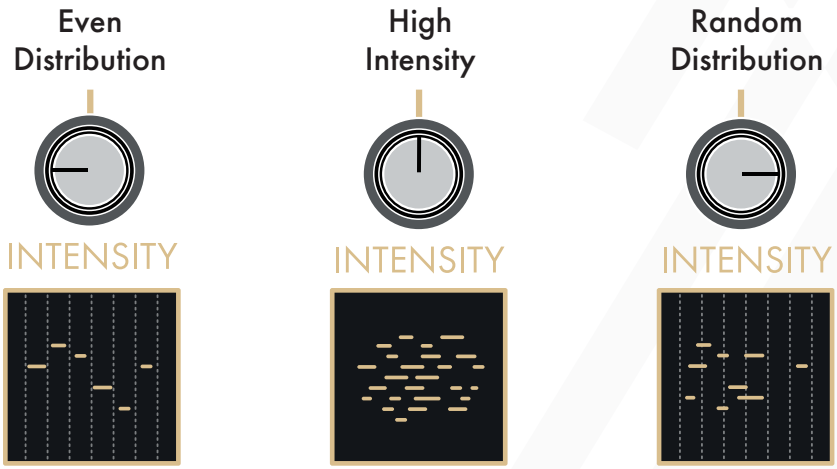
1. In the **Continuous Granular Engine**, the grains are clocked at the speed set by the **Length Knob** and the number of simultaneous sounding grains is controlled by the **Intensity Knob**.
2. The **Strike Granular Engine** is controlled by the **Strike Input**.

A total of 88 grains can be polyphonically generated between both granular engines.

Continuous Granular Engine

By default, 44 grains can be generated polyphonically.

Intensity Knob: The **Intensity Knob** sets the amount and rate of generated grains from the **Continuous Granular Engine**.



- The maximum number of grains are generated when the knob is in its centre position.
- Turning the knob anticlockwise from its centre position will decrease the number of grains.

    - By default, any anticlockwise knob setting will generate grains at the same amplitude and set a synchronous grain generation pattern.
- Turning the knob clockwise from its centre position will decrease the number of grains.
    - Any clockwise knob setting will generate grains at random amplitudes and set asynchronous grain generation (default).
    - Random amplitude and asynchronous grain generation settings can be adjusted in the preset.txt configuration file located on the USB flash drive.
      (See the Loading Presets section for more information).
- The amplitude of grain playback adheres to a specially curated summing algorithm that aims to be consistent in overall perception while giving additional saturation at higher **Intensity Knob** settings.
- Turning the knob to either of its extreme settings will disable the **Continuous Granular Engine**.
    - In these settings, the **Strike Button** and **Strike Input** can be used for time-synchronised grain generation via the **Strike Granular Engine**.
- When changing the **Intensity Knob**, all currently generated grains will remain uninterrupted. It is therefore possible that the change of the **Intensity Knob** may not have an immediate audible effect in relation to the value set by the **Length Knob**.
- The rate of grain generation from the **Continuous Granular Engine** is set by both the **Intensity** and **Length Knobs**.

Intensity CV Input: The **Intensity CV Input** is a bipolar control voltage input for the **Intensity** parameter.

- Control voltage is summed with the knob position.
- Input range: 10Vpp.

Strike Granular Engine

By default, this engine 44 grains can be generated polyphonically.

Strike Button: The **Strike Button** will generate a single grain at the **Outputs** when pressed.

- The grains generated by the **Strike Granular Engine** are 15% louder than those of the **Continuous Granular Engine**. This allows the grains generated by the **Strike Granular Engine** to act as accents within dense granular textures.
- All other parameters are set identical to those of the **Continuous Granular Engine**.
- If only **Strike Granular Engine** grains are desired, set the **Intensity Knob** to either of its extreme positions to disable the **Continuous Granular Engine** and use the **Strike Input** or **Strike Button** to access the **Strike Granular Engine**.

Strike Input: The **Strike Input** is a pulse input that generates a single grain when it receives a trigger or gate signal.

Shared parameters for both grain engines:

Grain Window Knob: The **Grain Window Knob** sets the amplitude envelope of the grains.

- If the knob is in the centre position, the grain window is set to a Gaussian shape.
    - The Gaussian shape is suitable for smooth drones and textures.
- Turning the knob anticlockwise from the centre position smoothly morphs the grain window to a square shape.
    - The square shape is suitable for sharper textures and can be used for loop effects with low **Intensity** parameter settings.
- Turning the knob clockwise from the centre position smoothly morphs the grain window to a descending sawtooth shape.
    - The sawtooth shape is suitable for percussive textures.

Grain Direction Knob: The **Grain Direction Knob** sets the probability percentage of grain playback direction.

- If the knob is in its centre position, grain direction probability is set to 50% forward playback and 50% reverse playback.
- If the knob is fully anticlockwise, grain direction probability is set to 100% forward playback.
- If the knob is fully clockwise, grain direction probability is set to 100% reverse playback.
- **Grain Direction** values are applied at the beginning of each grain and remain unchanged for the duration of that grain. It is therefore possible that the change of the **Grain Direction Knob** may not have an immediate audible effect in relation to the value set by the **Intensity** and **Length Knobs**.

Grain Direction Indicators: The **Grain Direction Indicators** illuminate to indicate the playback direction of each generated grain.

- If the left **Grain Direction Indicator** is illuminated, forward playback direction is set for at least one current grain.
- If the right **Grain Direction Indicator** is illuminated, reverse playback direction is set for at least one current grain.
- Grains from the **Continuous Granular Engine** are indicated by white LED illumination.
- Grains from the **Strike Granular Engine** are indicated by amber LED illumination.
- Both **Grain Direction Indicators** will continuously illuminate amber when arbhar is set to **Wavetable Mode** (See the Wavetable Mode section for more information).

Length Knob: The **Length Knob** sets the duration of each grain ranging from ~4ms - 3s.

- Length values are applied at the beginning of each grain and remain unchanged for the duration of the grain.
- The time set by the **Length Knob** follows an exponential distribution, at the centre position the grain duration is 750 milliseconds.

Length CV Input: The **Length CV Input** is a bipolar control voltage input for the **Length** parameter.

- Control voltage is summed with the knob position.
- If the Length Knob is at its centre position, the accepted input range is -/+5V.

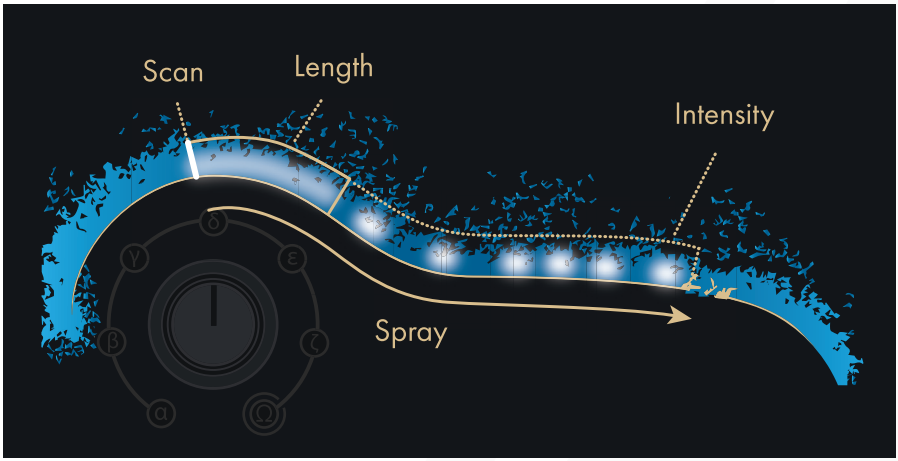
Scan Knob: The **Scan Knob** sets the position of grain generation within the layer.

- The offset position is set at the start of each grain and remains unchanged for the duration of the grain.
- The behaviour of this knob changes when **Follow Mode** is enabled (See the Scan and Follow Modes section for more information).

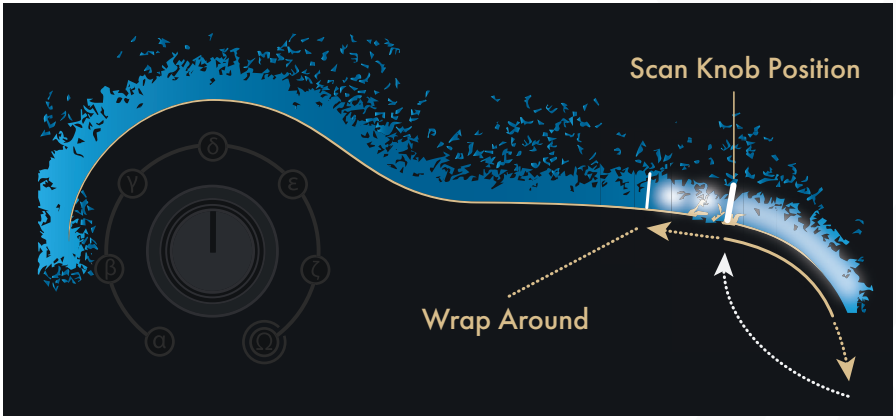
Scan CV Input: The **Scan CV Input** is a bipolar control voltage input for the **Scan** parameter.

- Input range: -/+5V.
- Setting the **Scan Knob** to centre position will enable full CV control over the entire layer.

Spray Knob: The **Spray Knob** controls a random deviation of the grain offset position.



- Grain generation will deviate from the current **Scan Knob** position to the right of the layer. The **Spray** parameter is biased towards the current **Scan Knob** position in order to create a sense of moving through the recording if the **Scan** position is changed.
- The random grain offset position is set at the start of each grain and remains unchanged for the duration of the grain.
- If the random value set by the **Spray Knob** is greater than the duration available from the **Scan Knob** position to the end of the layer, the grain start position will wrap around to include the time in front of the current **Scan Knob** position.



- If the **Spray Knob** is set to its maximum value, the offset position for the grains will be completely random throughout the entire layer.

Pulse Output: The **Pulse Output** generates trigger or gate signals depending on the selected **Onset Control Mode**.

- Whether or not signals are generated at the **Pulse Output** is dependent on the selected **Onset Control Mode**.
  (See the Onset Control Modes section for more information).
- Output range: +5V.
- Duty cycle: Trigger signals at 10ms or gate signals depending on the selected **Onset Control Mode**.

Pitch

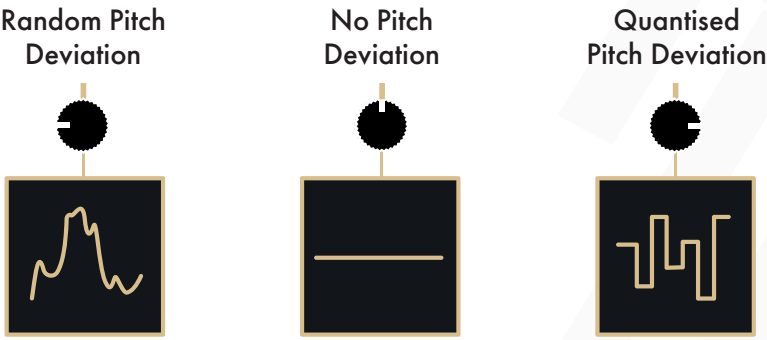
Pitch Knob: The **Pitch Knob** will change the pitch of the grains.

- **Pitch Knob** values are applied at the beginning of each grain and remain unchanged for the duration of the grain. It is therefore possible that by modulating the **Pitch Knob**, arbhar can generate polyphonic overlapped grains. Decreased **Length Knob** settings will result in more immediate **Pitch Knob** changes.

1V/Octave Input (1V/Oct): The **1V/Octave Input** is a bipolar control voltage input for the **Pitch** parameter.

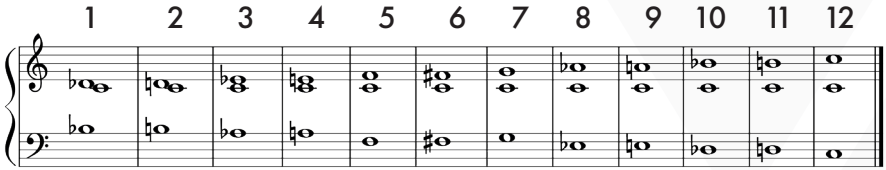
- Control voltage is summed with the **Pitch Knob** position.
- Input range: -/+5V.

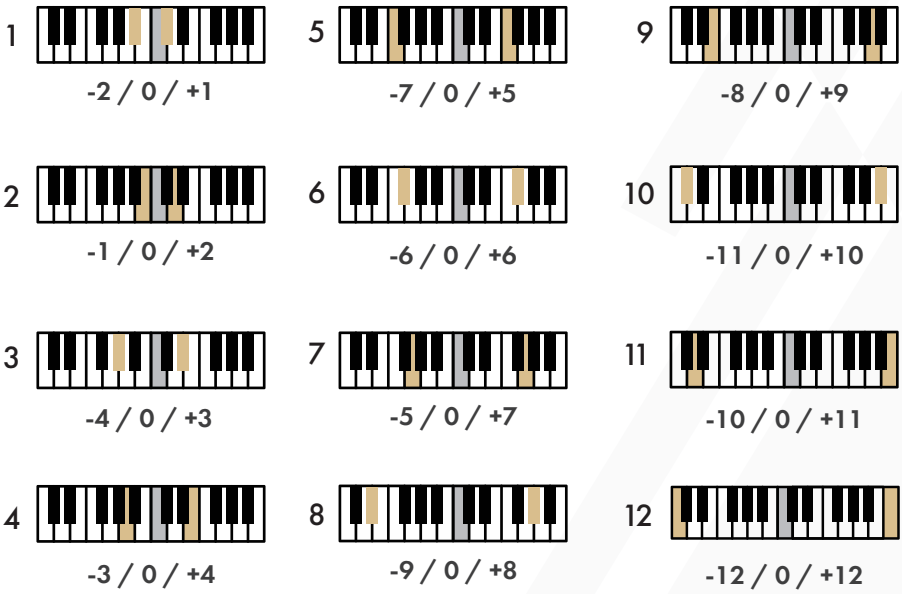
Pitch Deviation Knob: The **Pitch Deviation Knob** applies an intervallic voltage offset to the pitch of each grain.



- If the knob is at the centre position, no pitch deviation is applied.
- Turning the knob anticlockwise from its centre position applies bipolar unquantized random pitch deviation.
- Turning the knob clockwise from its centre position applies bipolar quantized random pitch deviation of increasing intervals for each grain. The intervallic voltage offset increases as the knob is moved clockwise.

- **Pitch Deviation Knob** values are applied at the beginning of each grain and remain unchanged for the duration of the grain. It is therefore possible that by modulating the **Pitch Deviation Knob**, arbhar can generate polyphonic overlapped grains. Decreased **Intensity** and **Length Knob** will result in more immediate **Pitch Deviation Knob** changes.
- Measured in semitones, the following default intervallic pitch deviations are available.



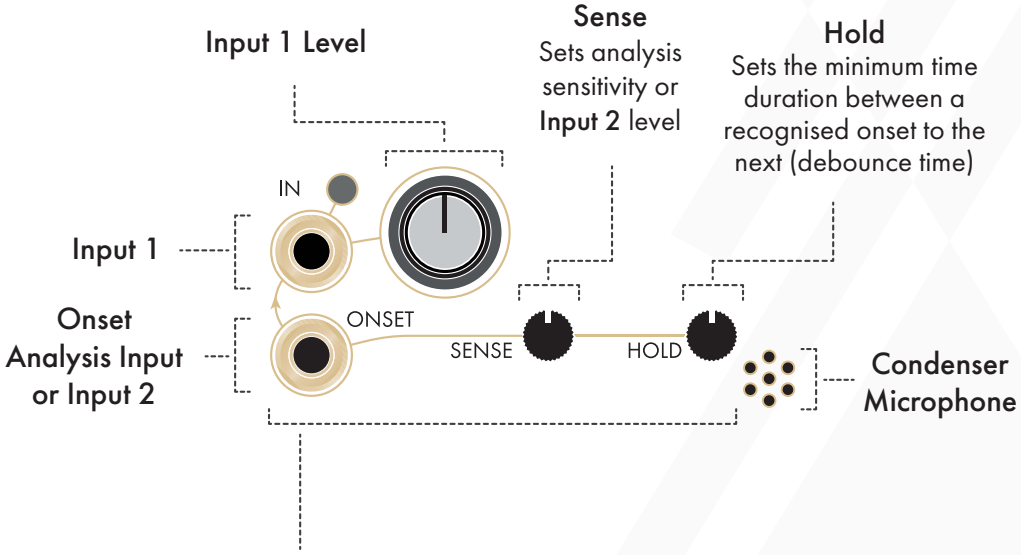


Intervallic voltage offsets can be set in the preset.txt configuration file located on the USB flash drive (See the Loading Presets section for more information). A selection of the factory scenes/presets offer some alternative settings.

Audio Analysis and Onset Detection

Onset Input: The **Onset Input** is an AC coupled audio input for the audio analysis section of **arbhar**.

- The **Onset Input** is normalled to the **Input**.
- The **Onset Input** can be configured as a stereo input in **Stereo Input Mode** (See the Mono and Stereo Input Modes section for more information).
- Depending on the currently selected **Onset Control Mode** and **Input Mode**, signals present at the **Onset Input** will activate recording and/or generate a trigger or gate signal at the Pulse Output (See the Onset Control Modes section for more information).



Onset Analysis Section: Takes an audio signal input and looks for 'attacks' defined by sharp spectral changes of the incoming sound. These 'attacks' are used to trigger **Capture**.

Note: When in **Stereo Mode**, **Input 1** and **Input 2** pots are matched tin volume at the 12 o'clock positions.

Onset Indicator: The **Onset Indicator** shows the current state of the onset detection. If the indicator is illuminated, onset detection is armed. If the indicator is not illuminated, an onset was detected and will remain unarmed for the duration of time set by the **Hold** parameter.

The **Onset Indicator** relates to the **Onset Control Modes** and is dependent on the **Sensitivity** and **Hold** parameters.

In the **alpha** and **beta Onset Control Modes**, the **Onset Indicator** illuminates amber to show that a detected onset will activate recording.

In the **gamma**, **delta**, **epsilon**, and **zeta Onset Control Modes**, the **Onset Indicator** illuminates white to show that the detected onset will not activate recording.

- In **Stereo Input Mode**, the **Onset Indicator** for **alpha** and **beta Onset Control Modes** will also be illuminated white to show that the detected onset will not activate recording.

Once an onset is detected, the **Onset Indicator** will be unilluminated for the duration of time set by the **Hold Knob**.

- When the **Onset Indicator** illuminates again, arbhar is waiting for another onset to detect.
- In the **gamma Onset Control Mode**, onset-derived pulse signals are mixed with the pulse signals generated by the **Continuous Granular Engine**.
- In the **delta Onset Control Mode**, the onset-derived pulse signals are solely dependent on the detected onset.
- It can be useful to connect the **Pulse Output** to the **Capture Pulse Input**, and set the **Hold Knob** to have a time duration as long as the record duration.

Sensitivity Knob (Sense): The **Sensitivity Knob** sets the responsiveness of the **Onset Input** or the **Input 2** level in Stereo configurations

- Turning the knob anticlockwise decreases the responsiveness of the **Onset Input**; or in stereo configurations, decreases the **Input 2** level.

- Turning the knob clockwise increases the responsiveness of the **Onset Input**; or in stereo configurations, increases the **Input 2** level.

Hold Knob: The **Hold Knob** changes functionality depending on the selected **Onset Control Mode**.

- If recording is triggered by onset detection, the **Hold Knob** sets the minimum record time when recording is activated.
- If trigger or gate signals are generated at the **Pulse Output** upon onset detection, the **Hold Knob** sets the minimum time between signals.
- The **Hold Knob** offers a range from 5ms - 10 seconds.
- The time set by the **Hold Knob** follows an exponential distribution, at the centre position the hold time is ~2.5 seconds.
- See the Onset Control Modes section for more information.

Dub Knob: The **Dub Knob** is used for audio replacement and sound-on-sound recording. It sets the attenuation of the existing audio level within the layer that is mixed with the audio of the new recording.

New audio capture destructively replaces previous audio.

Previous audio will be attenuated by 50% and summed with new audio.

New audio will sum with previous audio at full amplitude.

- If the knob is fully anticlockwise, the new recording will replace the current recording in the currently selected layer at full amplitude.
- If the knob is in the centre position, the existing layer content at half amplitude is mixed with the new recording at full amplitude.
- If the knob is fully clockwise, the existing layer content at full amplitude is mixed with the new recording at full amplitude. This setting can be used for accumulating audio layers.

Onset Control Modes

arbhar features 6 Onset Control Modes that analyse the incoming audio for significant spectral changes in order to estimate the start of new sonic events and/or observe other playback specific features.

With the **Shift Button** and **Capture Button** held down, turn the **Layer Knob** to set the **Onset Control Mode**:

alpha: Onset detection of an audio signal triggers recording. With every generated grain, a trigger signal is generated at the **Pulse Output**.

beta: Onset detection of an audio signal triggers recording. A gate signal is generated at the **Pulse Output** and is held HIGH for a duration set by the **Hold Knob**.

gamma: With every generated grain, a trigger signal is generated at the **Pulse Output**. An additional trigger signal is generated upon Onset analysis.

delta: A gate signal is generated at the **Pulse Output** and is held HIGH for a duration set by the **Hold Knob**.
It can be useful to connect the **Pulse Output** to the **Capture Pulse Input**, and set the **Hold Knob** to have a time duration as long as the record duration.

epsilon: Pressing the **Strike Button** will generate a trigger signal at the **Pulse Output**.

zeta: With playback in **Follow Mode**, an End of Cycle (EOC) trigger signal will generate at the **Pulse Output** at the end of the set loop time (**Hold Knob**).

It is important to note that in **Stereo Capture Mode**, the link between the onset detection and the capture triggering is disabled (i.e. **alpha** and **beta** become **gamma** and **delta**, but do not change visually).

CV Expansion

Spray CV Input: The **Spray CV Input** is a bipolar control voltage input for the **Spray Knob**.

- Control voltage is summed with the knob position.
- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Spray Knob** is at its centre position, the accepted input range is -/+5V.

Layer CV Input: The **Layer CV Input** is a bipolar control voltage input for the **Layer Knob**.

- More than 360 degrees of movement is accessible via positive and negative control voltage.
- Input range: -/+5V.
- Changing the **Layer** parameter between 0V and 5V will enable two clockwise cycles through all six layers from the currently selected layer.
- Changing the **Layer** parameter between 0V and -5V will enable two anticlockwise cycles through all six layers from the currently selected layer.

Grain Direction CV Input: The **Grain Direction CV Input** is a bipolar control voltage input for the **Grain Direction Knob**.

- Control voltage is summed with the knob position.
- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Grain Direction Knob** is at its centre position, the accepted input range is -/+5V.

Grain Window CV Input: The **Grain Window CV Input** is a bipolar control voltage input for the **Grain Window Knob**.

- Control voltage is summed with the knob position.

- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Grain Window Knob** is at its centre position, the accepted input range is -/+5V.

Pitch Deviation CV Input: The **Pitch Deviation CV Input** is a bipolar control voltage input for the **Pitch Deviation Knob**.

- Control voltage is summed with the knob position.
- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Pitch Deviation Knob** is at its centre position, the accepted input range is -/+5V.

Dub CV Input: The **Dub CV Input** is a bipolar control voltage input for the **Dub Knob**.

- Control voltage is summed with the knob position.
- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Dub Knob** is at its centre position, the accepted input range is -/+5V.

Mod CV Input: The **Mod CV Input** is a bipolar control voltage input for the parameter defined and set in the preset.txt configuration file.

- Grain panning algorithm
- Voltage control over **Hold** duration. This parameter is also the loop time in **Follow Mode** with **Follow Loop** enabled.
- Reverb
  - Unipolar positive control voltage = dry signal with reverb up to infinite decay
  - Unipolar negative control voltage = wet signal of reverb only up to infinite decay
- Feedback/Delay

- Positive voltage controls delay times between 80ms - 1000ms with a fixed feedback level of 67% for a more standard echo effect.
- Negative voltage controls delay times between 25ms - 1ms with a fixed feedback level of 99% for some shimmering Karplus-Strong effects.

Dry/Wet CV Input: The **Dry/Wet CV Input** is a bipolar control voltage input for the **Dry/Wet Knob**.

- Control voltage is summed with the knob position.
- Input range: 10V. e.g. a voltage difference of 10V is needed to control from the minimum to maximum knob position. If the **Dry/Wet Knob** is at its centre position, the accepted input range is -/+5V.

Track and Hold Mode

Track and Hold Mode allows for parameter changes to only engage on the release of the **Shift Button**.

Double press and hold the **Shift Button** to activate **Track and Hold Mode**.

- When **Track and Hold Mode** is activated, the **Granular Stream Display** illuminates green.

The parameters that get held are:

- Grain Window
- **Pitch** – Turning the **Pitch Knob** in **Track and Hold Mode** gives quantised pitch selection and uses the **Layer Indicators** to give visual feedback on the pitches in semitones.

Following display system is used:

omega - original pitch or octaves lower or higher

+1 (-11) Semitone: White **alpha**
+2 (-10) Semitones: White **beta**
+3 (-9) Semitones: White **gamma**
+4 (-8) Semitones: White **delta**
+5 (-7) Semitones: White **epsilon**
+6 (-6) Semitones: White **zeta**
-5 (+7) Semitones: Amber **beta**
-4 (+8) Semitones: Amber **gamma**
-3 (+9) Semitones: Amber **delta**
-2 (+10) Semitones: Amber **epsilon**
-1 (+11) Semitone: amber **zeta**

- Pitch Deviation
- Intensity

Erase and Undo

Once audio has been recorded into arbhar, both **Erase** and **Undo** functions are available.

Undo: If audio replacement or a sound-on-sound overdub has been recorded into an existing layer, one **Undo** function is accessible. After recording has been stopped into the currently selected layer, the **Strike Button** will flash amber when the **Shift Button** is held down, In this case, press and hold the **Shift Button** and then press the **Strike Button** to perform the **Undo** function. The **Undo** function will always return back to the last manually recorded or loaded layer.

Erase: After recording into an empty layer or once the **Undo** function has been performed, the **Strike Button** will flash white when holding the **Shift Button**, indicating that there is still audio stored in the currently selected layer that can be **Erased**. Press and hold the **Shift Button** and then press the **Strike Button** to perform the **Erase** function.

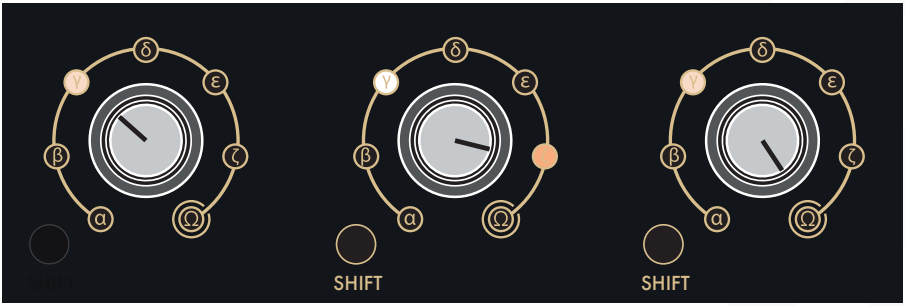
When pulsing orange the action will undo. To undo an overdub hold 1, press 2.

When pulsing white the action will erase. To erase the buffer, hold 1, press 2.

Layer Record Destination Lock

Audio can be recorded into a layer while a different layer is being monitored. This can be done by decoupling the recording destination from the playback **Layer** parameter.

- To set a **Layer Record Destination Lock**, press and hold the **Shift Button** and then turn the **Layer Knob**. The **Layer Record Destination Lock** is indicated by an amber **Layer Indicator**. The monitored layer is indicated by a white **Layer Indicator**.
- To recouple the recording destination and the **Layer** parameter, press and hold the **Shift Button** and then set the **Layer Knob** to the **omega** layer.



Move layer knob to desired location to select record and playback layer (illuminated off white).

Holding shift and moving the layer knob will decouple record layer (illuminated amber) from playback layer (illuminated white).

Holding shift and moving layer knob to 'omega' will recouple the layers.

Mono and Stereo Input Modes

arbhar can function in both **Mono** or **Stereo Input Modes**. In **Stereo Input Mode**, the **Input** becomes the left input and the **Onset Input** becomes the right input. The **Sensitivity Knob** functions as a level control for the **Onset Input**.

- Press and hold the **Shift** and **Capture Buttons** and then turn the **Grain Window Knob** from its centre position.
- Turning the knob fully anticlockwise sets **Mono Input Mode** (Default).
- This is indicated by amber illumination of the **Onset Indicator**.
- Turning the knob fully clockwise sets **Stereo Input Mode**.
- If arbhar is in **Onset Mode alpha** or **beta**, this is indicated by white illumination of the **Onset Indicator** as the control of capture is being disabled.
- **Mono** and **Stereo Input Modes** can be set in the preset.txt configuration file located on the USB flash drive.
  (See the Loading Presets section for more information).

Mono Input Mode

To set mono input mode.
Press and Hold 1 and 2,
turn 3 fully anticlockwise.

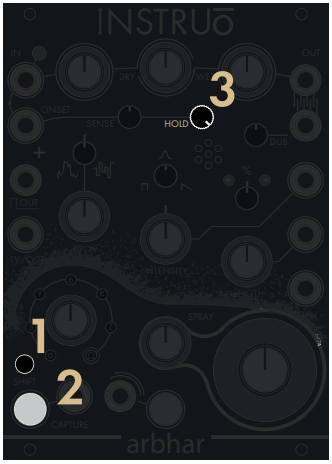
Stereo Input Mode

To set stereo input mode.
Press and Hold 1 and 2,
turn 3 fully clockwise.

Phase Switching

By default, arbhar's **Output 2** is phase-inverted from **Output 1**. Dependent on the way the user patches and uses the outputs, arbhar's **Output 2** can be set to either phase-inverted or phase-corrected audio.

Phase-corrected



Phase-inverted

To activate the **Phase Switch** to phase-corrected setting, press and hold the **Shift Button (1)** and **Capture Button (2)** and then turn the **Hold Knob (3)** fully clockwise. To deactivate the **Phase Switch** to phase-inverted setting, press and hold the **Shift Button (1)** and **Capture Button (2)** and then turn the **Hold Knob (3)** fully anticlockwise. This is the default state.

- If mono input/mono output patching is desired, set the **Phase Switch** to phase-inverted.
- If mono input/stereo output patching is desired, set the **Phase Switch** to phase-corrected.
- If stereo input/stereo output patching is desired, set the **Phase Switch** to phase-corrected.

- The **Phase Switch** can be set in the preset.txt configuration file located on the USB flash drive.
  (See the Loading Presets section for more information).

Scan and Follow Modes

arbhar can be set to either **Scan Mode** or **Follow Mode**.

In **Scan Mode**, the **Scan Knob** will move through the layer, setting the playback position at any point to freeze audio playback. **Scan Mode** is the factory default mode.

In **Follow Mode**, audio playback is triggered and directed internally and the **Scan Knob** becomes a speed control for the grains to progress through the recorded material. This mode allows for changing playback speed of layers independent of pitch control. The **Scan Knob** controls from 20x speed (fully anticlockwise) to a 1/20th in speed (fully clockwise).

To change between **Scan Mode** and **Follow Mode**, press and hold the **Shift Button** and **Capture Button** and then turn the **Scan Knob** from its centre position.

- Turning the knob fully anticlockwise enters **Follow Mode**. This is indicated by white illumination of the **Strike Button**
- Turning the knob fully clockwise sets **Scan Mode**. This is indicated by an unilluminated **Strike Button**.

1) Shift Button
2) Capture Button
3) Scan Knob
4) Strike Button

In **Follow Mode**, the playback is still a composite of the number of grains selected (**Intensity Knob**), grain length (**Length Knob**) and random deviation of the position (**Spray Knob**). However, the **Spray Knob** randomises the start position of the grain with the audio prior to the current playhead position. Therefore, in the instance of a new playback or recording, the position of the **Spray Knob** will increase from 0 to the set **Spray Knob** value as the playhead or record head progresses.

- Pressing the **Capture Button** or sending a gate or trigger signal to the **Capture Pulse Input** will start recording and simultaneously trigger the playback from the start of the layer at the speed and direction set by the **Scan Knob**.
- Pressing the **Strike Button** or sending a gate or trigger signal to the **Strike Input** will start playback from the start of the layer.

If the **Onset Control Mode** is set to **alpha** or **beta**, onset detection will record audio and trigger playback simultaneously. If the **Onset Control Mode** is set to **gamma** or **delta**, the onset detection will only restart playback. In this case, the **Capture Button** and **Capture Pulse Input** are used to record audio into the layer.

Many **Scan** and **Follow Mode** settings can be set in the preset.txt configuration file located on the USB flash drive.
(See the Preset section of the manual for more information).

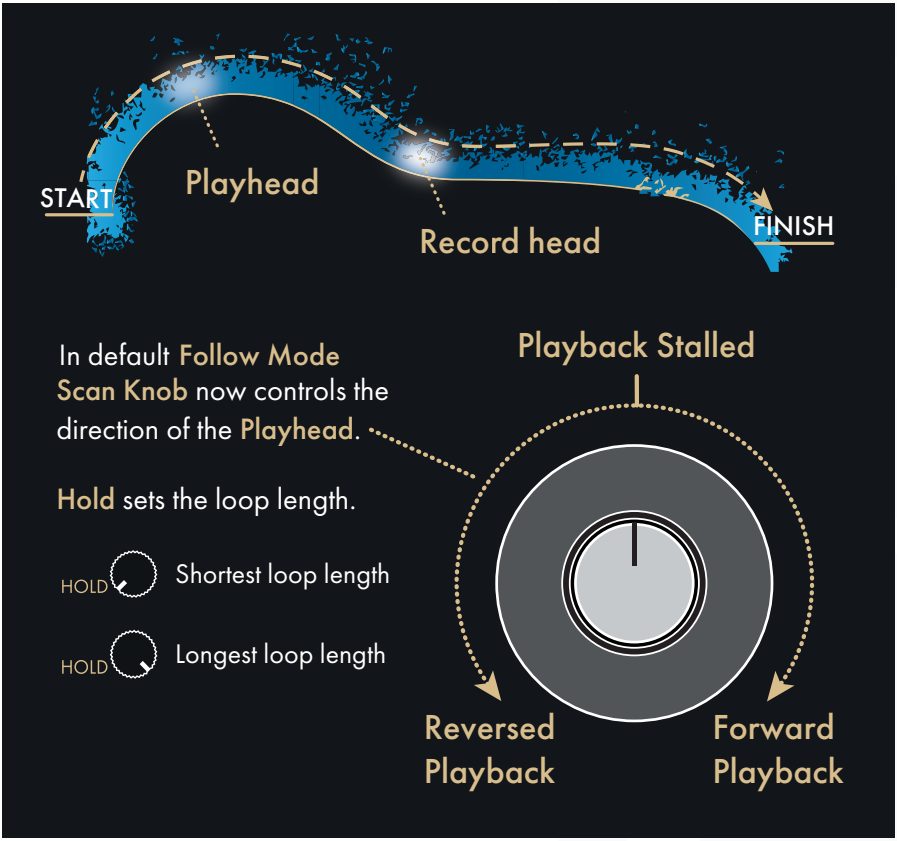
Customisation of the **Follow Mode Speed Control** (**Scan Knob**) is available to choose between bipolar and unipolar speed controls.

Follow Mode Scan Offset (**Scan CV Input**) can be used to control an offset/bias of the start position for **Follow Mode** playback and recording head.

Follow Mode Looping is enabled in the preset file by default, this parameter can only be set in the preset file, and can be switched off to allow one-shot playback with independent pitch and speed control.

Please note: Disabled **Follow Mode Looping** also disables the bipolar **Follow Mode Speed Control**.

The **Follow Mode Loop Length** (turn the **Hold Knob** or use the **Mod CV Input** set to **Hold Mode**) can be controlled. By default this parameter is enabled in preset file.



Wavetable Mode

Turning the **Length Knob** fully anticlockwise crossfades into **Wavetable Mode**. The generated wavetable is derived from a single-cycle loop of the recorded content within the layer.

Both **Grain Direction Indicators** are illuminated amber when this mode is active.

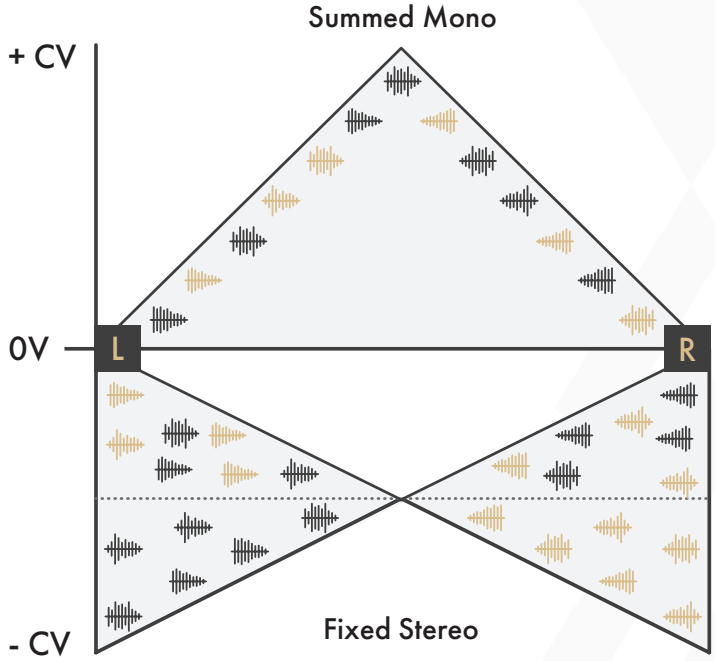
- The pitch of the **Wavetable Synthesis Engine** is calibrated to produce a C note when the **Pitch Knob** is set to its centre position.
- The **Pitch Deviation Knob** functions in its normal manner.
- The **Scan** and **Spray Knobs** will change the position in the layer from which the wavetable is derived.
- Turning the **Intensity Knob** to either of its extreme positions will disable its continuous oscillation.
    - In either of these extreme positions, the **Strike Button** and **Strike Input** can be used to trigger a short note.
    - These notes are 15% louder than the continuous oscillation and can be used to accentuate continuous oscillation.
- Turning the **Grain Direction Knob** will influence the interpolation speed between the wavetables derived from the recorded content within the layer.
- By default, the centre frequency of the wavetable is C2 (C below middle C) at 130.813Hz.
    - The **Centre Frequency of Wavetable Oscillator** can be set in the preset.txt configuration file located on the USB flash drive (See the Loading Presets section for more information).

Mod CV Input Modes

The **Mod CV Input** can be configured to control 1 of 4 different parameters. This configuration is defined in the preset.txt configuration file located on the USB flash drive.

Stereo Panning Configuration:

The **Mod CV Input** on the **CV Expansion Module** sets the amount of stereo panning.



- At 0V, arbhar distributes the grains in the default coin toss method.
- With inceasing the positive voltage, in addition to the coin toss method, the stereo spread is reduced gradulally, until the stereo spread is reduced to a full mono mix.
- With increasing negative voltage, the panning algorithm offers following stages:

- In addition to the coin-toss distribution an increasingly random deviation from the left and right extremes is introduced until a fully random equal power stereo distribution has been reached.
- From there the coin-toss distribution is switched off and a gradually reduced random deviation leads eventually in a fixed stereo distribution preserving the stereo placement of stereo samples loaded into the arbhar or what has been captured using the **Input** and **Onset** inputs.

Hold CV Configuration:

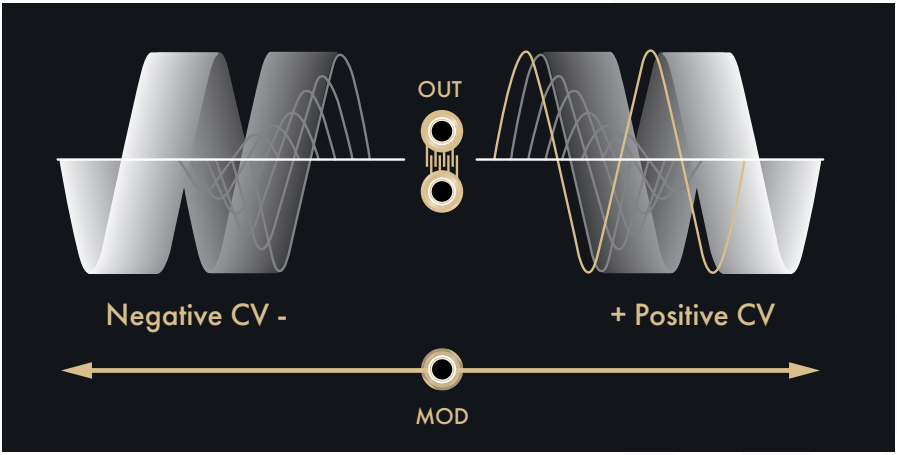
The **Mod CV Input** on the **CV Expansion Module** modulates the **Hold** parameter.

- Positive voltage increases the set **Hold** time.
- Negative voltage decreases the set **Hold** time.
- Voltage is added to the knob position.
- If arbhar is set to **Follow Mode**, this will also affect the **Loop Length** of the **Follow Mode Playback**.

Stereo Reverb Configuration:

The **Mod CV Input** on the **CV Expansion Module** controls curated parameters of the stereo reverb.

- Positive voltage controls reverb parameters mixed with the dry signal. The reverb freezes at +5V.
- Negative voltage omits the dry signal and only allows the wet signal to pass. The reverb has additional shimmering modulation.

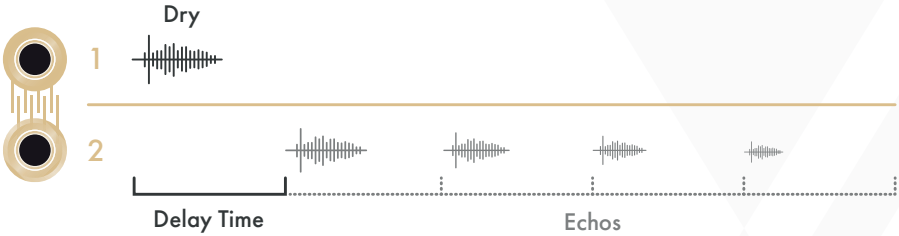


Feedback/Delay Configurations:

The **Mod CV Input** on the **CV Expansion Module** controls curated parameters of the feedback/delay.

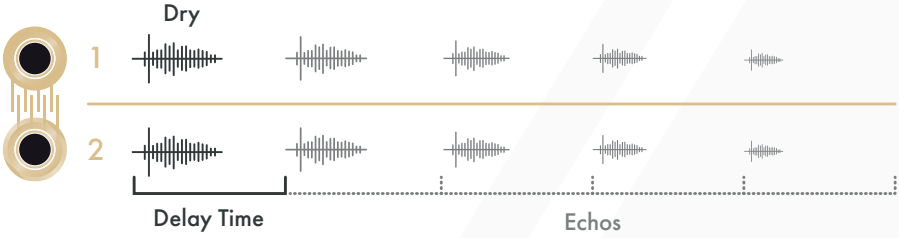
In Mono Input mode:

- **Output 1** generates the dry signal when both outputs are connected.
- **Output 2** generates the wet signal only.



In Stereo Input mode:

- **Output 1 and 2** generate a fixed mix of the stereo dry signal and the wet signal of a stereo delay.
- Positive voltage controls delay times between 80ms - 1000ms with a fixed feedback level of 67% for a more standard echo effect.
- Negative voltage controls delay times between 25ms - 1ms with a fixed feedback level of 99% for some shimmering Karplus-Strong effects.



USB Flash Drive

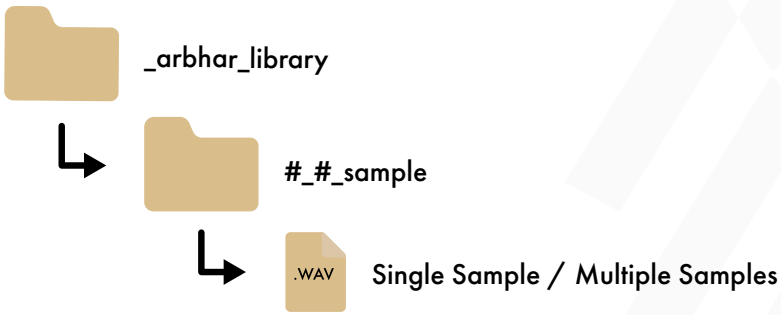
arbhar includes a 4GB USB flash drive. Upon first boot up of the arbhar V2 firmware, 3 folders and up to 2 files are automatically loaded to the root directory of the USB flash drive.

The 3 folders are:

_arbhar_library

This folder contains 36 subfolders with a #_#_sample naming convention that are used for storing audio files that can be loaded to arbhar's 6 layers.

- The first number represents the bank and the second number represents the layer.

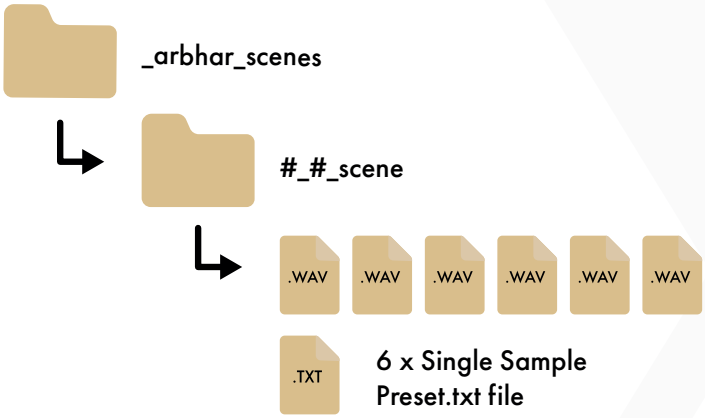


- When loading is activated, the arbhar will load the first 13 seconds of the first audio file found in the selected folder. In the case of more than one shorter audio files being present, arbhar will continue to load these samples until the total length of the loaded audio has exceeded 10 seconds.

_arbhar_scenes

This folder contains 36 subfolders with a #_#_scene naming convention that are used for storing up to 6 audio files and a preset.txt configuration file.

- The first number represents the bank and the second number represents the scene.

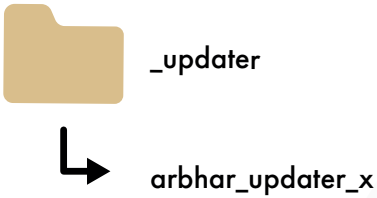


- When loading is activated, the arbhar will load the first 6 audio files present in the folder.

_updater

This folder is used for updating the firmware with a .gz updater file.

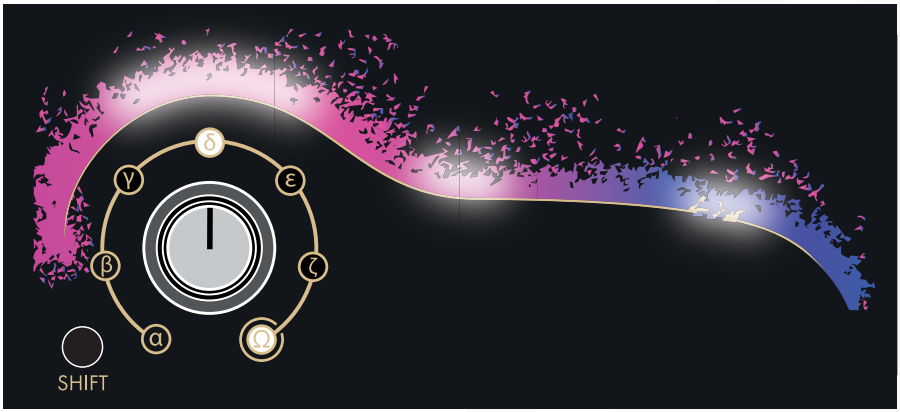
- Once the arbhar V2 microSD card image has been flashed to arbhar's microSD card, subsequent .gz files may be made available for additional firmware updates. That is the only case in which this folder is used.



Clone Layers

Recordings can be cloned from one layer to another.

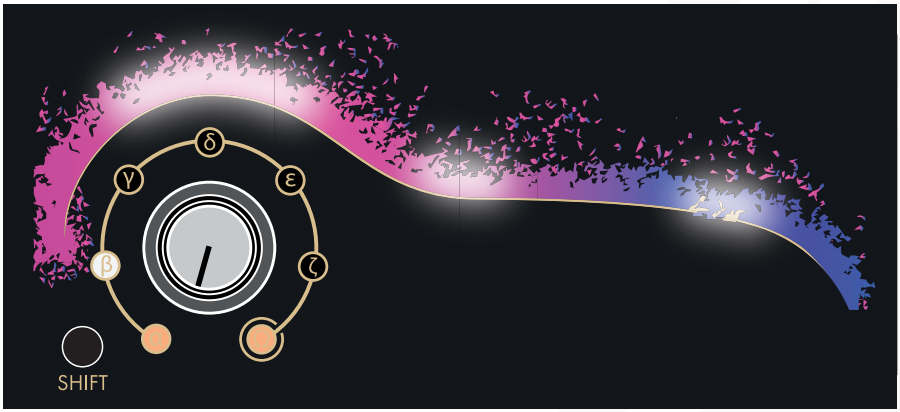
- Set the **Layer Knob** to the layer that will be cloned.
- Press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to enter the **Load/Save Menu**.
- Ensure that the **Granular Stream Display** is illuminated magenta and violet and that the **omega Layer Indicator** is illuminated white.
- If other colours are displayed, use the **Capture** and **Strike Buttons** to navigate to the correct page of the **Load/Save Menu**.
- Adjust the **Layer Knob** to set the destination of the cloned layer.
- Double tap the **Shift Button** to clone the layer.
    - This action does not exit the **Load/Save Menu** so that multiple clones can be made.
    - Visual feedback is given by a quick movement of the white LEDs from left to right in the **Granular Stream Display**.
- Press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to exit the **Load/Save Menu**.



Load Layers

Audio files can be loaded into a layer from the **_arbhar_library** directory on the USB flash drive.

- Set the **Layer Knob** to the desired layer.
- Press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to enter the **Load/Save Menu**.
- Ensure that the **Granular Stream Display** is illuminated magenta and violet.
    - If other colours are displayed, use the **Capture** and **Strike Buttons** to navigate to the first page of the **Load/Save Menu**.
    - This is also indicated by a left sided pulsing white LED animation on the **Granular Stream Display**.
- Move the **Layer Knob** past the 6 clone layer indicators so that the **omega Layer Indicator** is illuminated amber to access 6 available banks containing 6 audio file locations (36 audio files in total).



- Each bank is indicated by amber-illuminated **Layer Indicators** and is accessible by adjusting the **Layer Knob**.
- Bank 1 is indicated by amber-illuminated **alpha** and **omega Layer Indicators**, Bank 2 is indicated by amber-illuminated **alpha**, **beta**, and **omega Layer Indicators**, etc.
- The selected **Sample** slot is illuminated white.

    - Banks and locations are only accessible when a valid USB flash drive is installed.
- Adjust the **Layer Knob** to the desired bank and location.
- Press and hold the **Shift Button** to preview the audio file.
- Double tap the Shift Button to load the layer.
    - An LED animation indicates the disk activity of the loading procedure until completed.
    - This action will exit the **Load/Save Menu** so that immediate interaction with the new audio files can be made.
- If no layer is selected and loaded, press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to exit the **Load/Save Menu**.

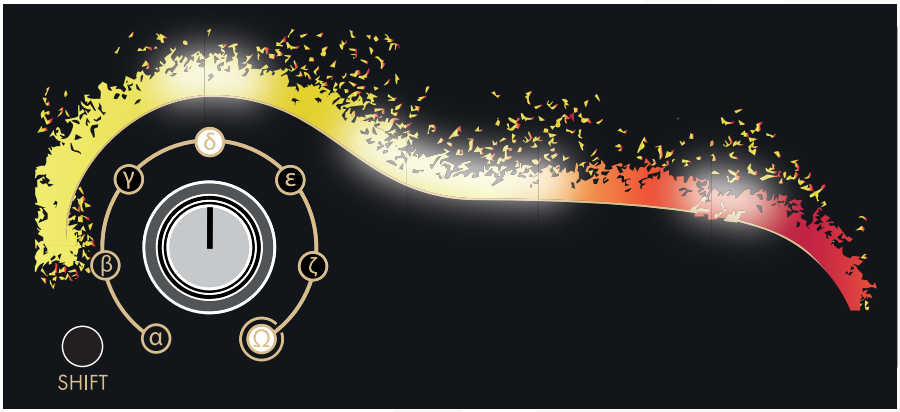
Load Scenes

Scenes, which are combinations of preset.txt configuration files and up to 6 audio files, can be loaded from the USB flash drive. With a valid USB flash drive installed, there are 42 different scenes that can be accessed and loaded to arbhar. Without a valid USB flash drive installed, there are 6 local scenes that can be accessed and loaded to arbhar.

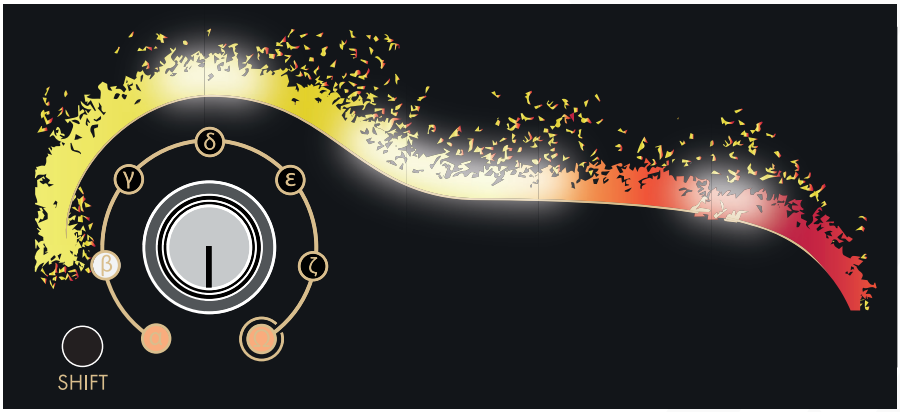
The preset.txt configuration file contains the **Load Configuration** parameter that specifies whether the scene, the preset, or the audio file group is loaded.

The local factory default scenes are set with preset.txt configuration '**Load Preset**' that will only load the preset configuration and preserve any existing audio files in the layers.

- Press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to enter the **Load/Save Menu**.
- Ensure that the **Granular Stream Display** is illuminated yellow and red.
    - If other colours are displayed, use the **Capture** and
    - **Strike Buttons** to navigate to the second page of the
    - **Load/Save Menu**.
    - This is also indicated by a centre pulsing white LED animation on the **Granular Stream Display**.



- When the **omega Layer Indicator** is illuminated white, access to the first local 6 scene locations is available by turning the **Layer Knob** to a desired layer.
- Move the **Layer Knob** past the 6 local scenes indicators so that the **omega Layer Indicator** is illuminated amber to access 6 additional banks containing 6 scene locations (36 extra scene locations in total).



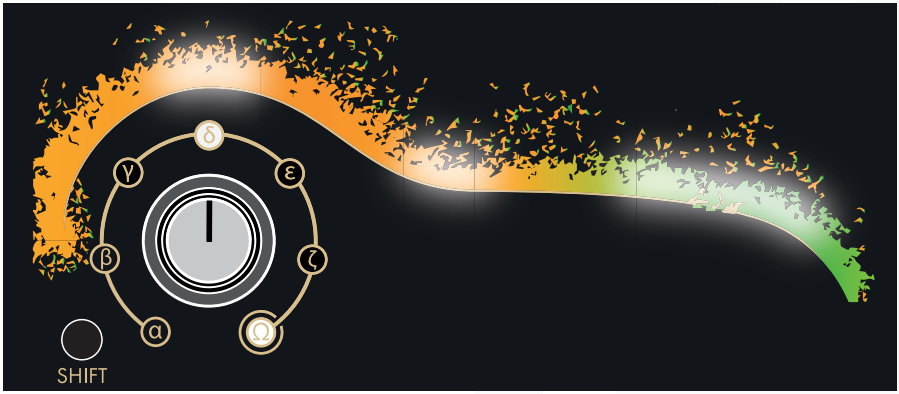
  - Each bank is indicated by amber-illuminated **Layer Indicators** and is accessible by adjusting the **Layer Knob**.
  - Bank 1 is indicated by amber-illuminated **alpha** and **omega Layer Indicators**, Bank 2 is indicated by amber-illuminated **alpha**, **beta**, and **omega Layer Indicators**, etc.
  - Banks and locations are only accessible when a valid USB flash drive is installed.
  - The selected **Scene** slot is illuminated white.
- Adjust the **Layer Knob** to the desired bank and location.
- Double tap the **Shift Button** to load the scene.
- An LED animation indicates the disk activity of the loading procedure until completed.
- This action will exit the **Load/Save Menu** so that immediate interaction with the new audio files and configuration can be made.
- If nothing is loaded, press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to exit the **Load/Save Menu**.

Saving Scenes

Scenes, which are combinations of preset.txt configuration files and up to 6 audio files, can be saved to the USB flash drive. With a valid USB flash drive installed, there are 42 different scenes that can be saved to arbhar. Without a valid USB flash drive installed, there are 6 local factory default scenes that can be saved to arbhar.

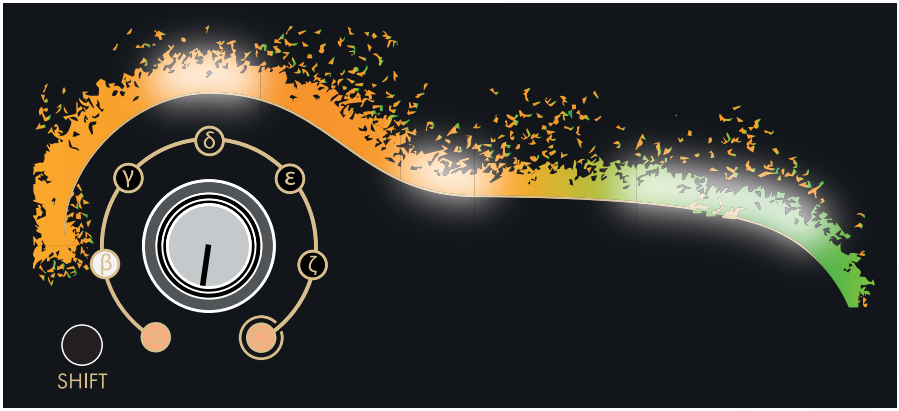
Any of the local factory default scenes can be overwritten with a customised scene. The arbhar will save all scenes with the configuration parameter set to '**Load Scene**' to ensure that the scene mirrors the current state of arbhar.
Note: arbhar will not delete any existing files but rename these files so that the saved files will appear alphabetically above.

- Press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to enter the **Load/Save Menu**.
- Ensure that the **Granular Stream Display** is illuminated orange and green.
    - If other colours are displayed, use the **Capture** and **Strike Buttons** to navigate to the third page of the **Load/Save Menu**.
    - This is also indicated by a right sided pulsing white LED animation on the **Granular Stream Display**.



- When the **omega Layer Indicator** is illuminated white, access to the first six local scene locations is available by turning the **Layer Knob** to a desired layer.

- Move the **Layer Knob** past the 6 local factory default scenes indicators, so that the **omega Layer Indicator** is illuminated amber to access 6 additional banks containing 6 scene locations (36 extra scene locations in total).



  - Each bank is indicated by amber-illuminated **Layer Indicators** and is accessible by adjusting the **Layer Knob**.
  - Bank 1 is indicated by amber-illuminated **alpha** and **omega Layer Indicators**, Bank 2 is indicated by amber-illuminated **alpha**, **beta**, and **omega Layer Indicators**, etc.
  - The selected **Scene** slot is illuminated white.
  - Banks and locations are only accessible when a valid USB flash drive is installed and audio files are in the corresponding **_arbhar_scenes** folders.
- Adjust the **Layer Knob** to the desired bank and location.
- Double tap the **Shift Button** to save the scene.
  - An LED animation indicates the disk activity of the saving procedure until completed.
  - This action will exit the **Load/Save Menu** automatically at the end of the saving procedure.
  - Saving scenes is non-destructive.
- If nothing is saved, press and hold the **Shift**, **Capture**, and **Strike Buttons** in that order to exit the **Load/Save Menu**.

Loading Presets

arbhar's user interface has been developed with live performance in mind, giving direct and immediate control over all parameters of the granular playback engine. However, there are various audio-processing parameters, as well as control approaches, that might not need immediate influence. Nevertheless, these parameters allow for changes to arbhar's configuration that will enable particular workflow and performance approaches.

To load a preset.txt configuration file without it being part of a scene, place the preset.txt configuration file in the root directory of the USB flash drive. Upon successful loading, the preset.txt configuration file will be renamed to preset_was_loaded.txt.

These are the settings that can be changed in the preset.txt configuration file:

Load Configuration: Presets, Layers, and Scenes:

- arbhar can load Presets, Layers, and Scenes.
- 'Load Preset' will load all parameters defined in the configuration file and ignore any audio files that are present in the **_arbhar_scene** directory. The parameters will set arbhar to the defined configuration and may change the control behaviour of arbhar drastically, but all content in the layers will be preserved. This option is equal to only having a configuration file in the directory. All factory presets available in the local factory default scenes are set to this configuration.
- 'Load Layers' will load the first 6 audio files present in the **_arbhar_scene** directory, and ignore all the parameters defined in the configuration file. The control behaviour of the arbhar will remain the same, but the audio files in the layers will be replaced. This option is equal to having audio files in the directory, but no configuration file.
- 'Load Scene' will load all parameters defined in this configuration file and the first 6 audio files present in the _arbhar_scene directory.

Mono and Stereo Input Modes:

- arbhar can function in both **Mono** or **Stereo Input Modes**. In **Stereo Input Mode**, the Input becomes the left input and the **Onset Input** becomes the right input. The **Sensitivity Knob** functions as a level control for the **Onset Input**.

Analogue Emulation Mode:

- arbhar allows for analogue emulation for the **Onset Input**.
- Because arbhar's top input incorporates analogue limiting and its **Onset Input** does not, **Analogue Emulation Mode** can be enabled for the **Onset Input**, so that both inputs affect the input signal similarly in **Stereo Input Mode**.
- If the user has a lárachd module, the Enhance I/O can be used instead of arbhar's analogue emulation.

Phase Switch:

- arbhar can set the phase relationship of the audio outputs.
- By default, arbhar's **Output 2** is phase-inverted from **Output 1**.
- If mono input/mono output patching is desired, set the **Phase Switch** to phase-inverted. If mono input/stereo output patching is desired, set the **Phase Switch** to phase-corrected. If stereo input/stereo output patching is desired, set the **Phase Switch** to phase-corrected.

Capture Modes: Momentary, Latching, and Retrigger:

- arbhar can set 1 of 3 captures modes: **Momentary Capture Mode**, **Latching Capture Mode**, and **Retrigger Capture Mode**.
- **Momentary Capture Mode** will record for as long as the signal present at the **Capture Pulse Input** is held **HIGH**. This is best used with gate signals.
- **Latching Capture Mode** will start recording when a rising-edge signal is received at the **Capture Pulse Input** and will continue recording until another hard-edge signal is received. This is best used with trigger signals.

- Retrigger **Capture Mode** will restart recording with every rising-edge signal received at the **Capture Pulse Input**, but will not interfere with the capture state.

Capture Button Modes: Latching or Momentary:

- arbhar's **Capture Button** can be set to **Latching** or **Momentary Modes**.
- **Latching Mode** will activate recording when the **Capture Button** is pressed and deactivate recording when the **Capture Button** is pressed again.
- **Momentary Mode** will activate recording as long as the **Capture Button** is pressed and will deactivate recording when the **Capture Button** is released. This behaviour might be more appropriate for certain use cases, including capturing shorter samples when using the **Accumulative Capture Mode**.

Activate Capture On Button Up:

- arbhar can be set to record on a button down action or a button up action.
- By default recording is activated upon pressing the **Capture Button** down. This parameter can be changed so that recording is activated upon the release of the **Capture Button**. This behaviour might be more appropriate for certain use cases, including working with the **Accumulative Capture Mode** or when working with the built-in **Condenser Microphone** minimising the recording of button noises.

Accumulative Capture Mode:

- arbhar can be set to **Accumulative Capture Mode**.
- This mode allows for the consecutive collage of different recordings within different locations of a layer. When enabled, pressing the **Capture Button** will pause the record head, rather than reset it to the start of the layer.

Linking Accumulative Capture Mode and Capture Button Mode:

- arbhar can be set to link **Accumulative Capture Mode** and **Capture Button Mode**.
- This allows for linking the **Capture Button Mode** to be activated when the **Accumulative Capture Mode** is enabled.

Onset Control Modes:

- arbhar features 6 **Onset Control Modes** that analyse the incoming audio for significant spectral changes in order to estimate the start of new sonic events.
- These modes are **alpha**, beta, **gamma**, **delta**, **epsilon**, and **zeta**.

Strike Button to Trigger Signal:

- arbhar can set the **Strike Button** to generate a trigger signal at the **Pulse Output** when pressed.
- If this feature is disabled, pressing the **Strike Button** will not generate a trigger signal at the **Pulse Output**. If this feature is enabled, pressing the **Strike Button** will generate a trigger signal at the **Pulse Output**.

Trigger Delay On Strike Input:

- arbhar can be set to apply a trigger delay to the **Strike Input**.
- This defines the time added to the **Strike Input** latency. Adjusting this delay can improve the response to devices that produce both a trigger signal and a control voltage signal, especially if the trigger signal occurs before the control voltage signal has been set.

Scan and Follow Modes:

- arbhar can be set to either **Scan Mode** or **Follow Mode**.
- In **Scan Mode**, the **Scan Knob** will move through the layer, setting the playback position at any point to freeze audio playback.
- In **Follow Mode**, audio playback is triggered and directed internally and the **Scan Knob** becomes a speed control for the grains to progress through the recorded material. This mode allows for changing playback speed of layers independent of pitch control. The **Scan Knob** controls from 20x speed (fully anticlockwise) to a 1/20th in speed (fully clockwise).

Follow Mode Speed Control:

- arbhar can set the behaviour of the playback speed control (**Scan Knob**) in **Follow Mode**.
- **Unidirectional** sets the playback position to move forward only. If the **Scan Knob** is set to its fully anticlockwise position, the playback speed will be at its slowest rate. If the **Scan Knob** is set to its fully clockwise position, the playback speed will be at its fastest rate.
- Bidirectional sets the playback position to move forward or reverse. If the **Scan Knob** is set to its centre position, playback speed will be at its slowest rate. If the **Scan Knob** is set to its fully clockwise position, playback speed will be at its fastest rate in the forward direction. If the **Scan Knob** is set to its fully anticlockwise position, playback speed will be at its fastest rate in the reverse direction.
- **Inverted Unidirectional** sets the playback position to move forward only. If the **Scan Knob** is set to its fully anticlockwise position, the playback speed will be at its fastest rate. If the **Scan Knob** is set to its fully clockwise position, the playback speed will be at its slowest rate. This is identical to Unidirectional, but the behaviour of the **Scan Knob** is inverted.

Follow Mode Scan Offset:

- arbhar can set a **Scan** offset in **Follow Mode** if **Follow Mode**'s playback speed is set to be controlled by the **Scan Knob** and **Scan CV Input**.

Follow Mode Scan Offset and Speed Control:

- arbhar can set the behaviour of the **Scan Knob** and **Scan CV Input** while in **Follow Mode**.
- The **Scan Knob** and **Scan CV Input** can be set to control playback speed, **Scan** offset, or both.

Follow Mode Looping:

- arbhar can enable or disable looped playback of the playheads in **Follow Mode**.
- An end-of-layer (EOL) trigger signal can be internally routed to retrigger playback from the start of the layer or the defined offset value. This is the same EOL trigger signal that is available in the **zeta Onset Control Mode**.
- Please note that if the **Follow Mode Looping** parameter is set disabled, the bidirectional option of the **Follow Mode Speed Control** will also be omitted and be automatically set to unidirectional.

Follow Mode Loop Length:

- arbhar can set the Hold duration as the length of the looped playback in **Follow Mode**.
- The end-of-layer (EOL) trigger signal can be triggered at the **Follow Mode Scan Offset** and looped for the **Hold** duration. This is the same EOL trigger signal that is available in the **zeta Onset Control Mode**.

Random Timing of Grains:

- arbhar can set the random timing of grains.
- Randomised timing of internally triggered grains can be applied by turning the **Intensity Knob** from its centre position to its fully clockwise position.

Random Amplitude of Grains:

- arbhar can set the random amplitude of grains.
- Randomised amplitude of internally triggered grains can be applied by turning the **Intensity Knob** from its centre position to its fully clockwise position.

Mod CV Input Configuration:

- arbhar can set the target of the **Mod CV Input** and replaces the hardware configuration set by the physical switches on the module.
- If an arbhar older than or matching hardware revision no 1.7 is used, the V2 firmware disables the functionality of the **Hardware Configuration Switches** entirely. For this reason, newer hardware revisions do not have the **Hardware Configuration Switches** installed.

Centre frequency of Wavetable Oscillator:

- arbhar can set the centre frequency in Hz of the **Wavetable Mode**.

Quantised Random Pitch Deviation Table:

- arbhar can set customised pitch deviation offsets available by clockwise **Pitch Deviation Knob** settings.
- At each stage of the clockwise **Pitch Deviation Knob** setting, a pair of the numbers in the list, as well as the 'original' pitch (set by the **Pitch Knob**) will be used by the **Pitch Deviation** parameter.

Default Presets

The arbhar comes preloaded with 6 default presets. They are as follows:

Preset 1: arbhar Classic

arbhar Factory Presets	Preset 1
PRESET_NAME:	arbhar Classic
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Mono
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Inverted
PARAMETER: CaptureCVMode:	Momentary
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Disable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	alpha
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Scan Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Reverb
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Chromatic

Preset 2: arbhar Delay

arbhar Factory Presets	Preset 2
PRESET_NAME:	arbhar Delay
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Mono
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Inverted
PARAMETER: CaptureCVMode:	Momentary
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Disable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	alpha
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Scan Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Delay
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Octaves

Preset 3: arbhar Stereo

arbhar Factory Presets	Preset 3
PRESET_NAME:	arbhar Stereo
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Stereo
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Corrected
PARAMETER: CaptureCVMode:	Momentary
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Disable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	deltIa
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Scan Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Reverb
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Chromatic

Preset 4: arbhar Follow Mode

arbhar Factory Presets	Preset 4
PRESET_NAME:	arbhar Follow Mode
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Mono
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Inverted
PARAMETER: CaptureCVMode:	Retrigger
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Disable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	zeta
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Follow Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Hold
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Octaves

Preset 5: arbhar Panning

arbhar Factory Presets	Preset 5
PRESET_NAME:	arbhar Panning
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Mono
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Inverted
PARAMETER: CaptureCVMode:	Momentary
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Disable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	gamma
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Scan Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Panning
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Octaves

Preset 6: arbhar Accumulative Record

arbhar Factory Presets	Preset 6
PRESET_NAME:	arbhar Accumulative Record
PARAMETER: LoadConfiguration:	Load Preset
PARAMETER: InputMode:	Mono
PARAMETER: AnalogEmulation:	Enable
PARAMETER: PhaseSwitch:	Phase-Corrected
PARAMETER: CaptureCVMode:	Momentary
PARAMETER: CaptureButtonMode:	Latching
PARAMETER: ActivateCaptureOnButtonUp:	Disable
PARAMETER: AccumulativeCaptureMode:	Enable
PARAMETER: LinkAccumulativeRecordingCaptureAsGate:	Disable
PARAMETER: OnsetMode:	delta
PARAMETER: StrikeButtonToTrigger:	Disable
PARAMETER: StrikeCVDelay:	10ms
PARAMETER: FollowMode:	Scan Mode
PARAMETER: FollowSpeedDirection:	Bidirectional
PARAMETER: FollowScanOffset:	0ms
PARAMETER: FollowPositionOffsetWithScanCV:	Scan Knob controls the playback speed and the Scan CV Input controls an offset between the record and playheads
PARAMETER: FollowLoop:	Enable
PARAMETER: FollowSetLoopLengthWithHold:	Enable
PARAMETER: RandomTimingWithRandomIntensity:	Enable
PARAMETER: RandomAmpWithRandomIntensity:	Disable
PARAMETER: ModCV:	Reverb
PARAMETER: WavetableCentreFrequency:	C2
PARAMETER: QuantiseTable:	Chromatic

Factory Reset

Press and hold the **Shift** and **Capture Buttons** and then press the **Strike Button** seven times in fast succession to perform a factory reset.

- A factory reset will clear all layers, reset all modes, and reinitialize the configuration of the first 6 scene locations.
- After the factory reset has completed, arbhar will automatically reboot.

Update Firmware

For information and assets pertaining to arbhar firmware updates, visit https://www.instruomodular.com/support/.

History of the Lexer Method

Granulation is a central part of the piano+ performance system, originally developed in Max/MSP between 2000 – 2012 to augment an acoustic grand piano with electroacoustic processes and extensively used in my musical work over the past 20 years. Granular processes enable working within the ambiguities of acoustic and electronically modified sound. I always found it fascinating for electronically sustained drones to emerge from a sound produced on an acoustic instrument. I wanted a system that allowed me to play with aspects of the processing taking control data from the acoustic playing, rather than playing along with the electronics. It all seemed possible when first encountering Nobuyasu Sakonda's Granular 2.5 Max patch – the first time I experienced independent playback speed and pitch controls – and Miller Puckette's FFT based audio analysis tools.

So rather than following the approach thought of and pioneered by Xenakis and Curtis Roads, to see granulation as a synthesis tool to create new sonic textures from the tiny fragments of recorded sound, I was inspired to extend the sonic parameters of acoustic instruments as a starting point for my artistic practice.

The fundamental approach for the arbhar utilises granulation techniques on audio captured in real-time in response to the sounds produced by the acoustic instrument or sound source. Playing back multiple instances of grains which are out of phase with one another to create the illusion that the sound is continuous. As few as eight grains of 80 ms length are sufficient to create convincing results retaining an acoustic resemblance to the original. As the sample position and pitch of the playback can be independently controlled, the user has the possibility of 'tuning' into selected fragments using any controller, random or sequenced source, considered appropriate. Aspects of random deviation of parameters – a feature that has proven far more important than grain count to achieve convincing organic sounding granular textures – allow further adaptation to create organic sounding drones and textures, but most interestingly of all, it can be the basis to zoom in and out of the recognised source and its endless sonic modulations.

For example, setting the playback position of a captured piano note shortly after the attack phase, with a grain length of ca 300ms with a gauss shaped texture and a slight spray will produce a very convincing piano drone, especially when using a more modest grain count, as the spray will ensure that not one grain is exactly like another. In contrast, reducing density to a single grain, changing the texture to saw or pulse and reducing the spray will be like a stutter or beat repeat effect where the length will decide on the speed.

After years of excitement and frustrations working with the software based piano+ system, I am now delighted to see these processes available in a Eurorack module. With Jason's technical expertise and interface design, informed by his musicality and instrumental talent, the arbhar became so much more than I had initially imagined.

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[1] http://research.gold.ac.uk/8005/

[2] http://formantbros.jp/sako/download.html

[3] v

[4] Xenakis, Iannis, Formalized Music, 1992.

[5] Roads, Curtis, Microsound, 2001

Thoughts on the development of Firmware Version 2 (2023)

The initial release of the arbhar at the close of 2019 has been an immensely gratifying moment for me, seeing the ideas around granular processes–that I had been developing in musical terms as well as the incarnations of realisations and theoretical framework–develop their own mutations and variations in the hands of the users. Getting some insights in what people do with the arbhar has been consolidating the overall success we had in the symbiosis of the User Interface design and the underlying sound engines.

But like with everything oneself feels a passion about, any realisation in terms of the instrument, brings further ideas and generates a wish to push the capabilities in order to allow even more sonic modulations that increase the musical potential of the arbhar. I feel privileged that overall success in design and sales have enabled a full rework of the codebase to maximise and expand the feature set while maintaining the existing user base to upgrade their arbhar to this overall improved device.

The arbhar has grown beyond what I was able to imagine it to be when this journey began. In my eyes it is an instrument that allows for even more elaborate concepts and accommodate various approaches to music performance, composition and music production.

Manual Authors: Collin Russell & Sebastian Lexer
Manual Design: Dominic D'Sylva

CE This device meets the requirements of the following standards: EN55032, EN55103-2, EN61000-3-2, EN61000-3-3, EN62311.