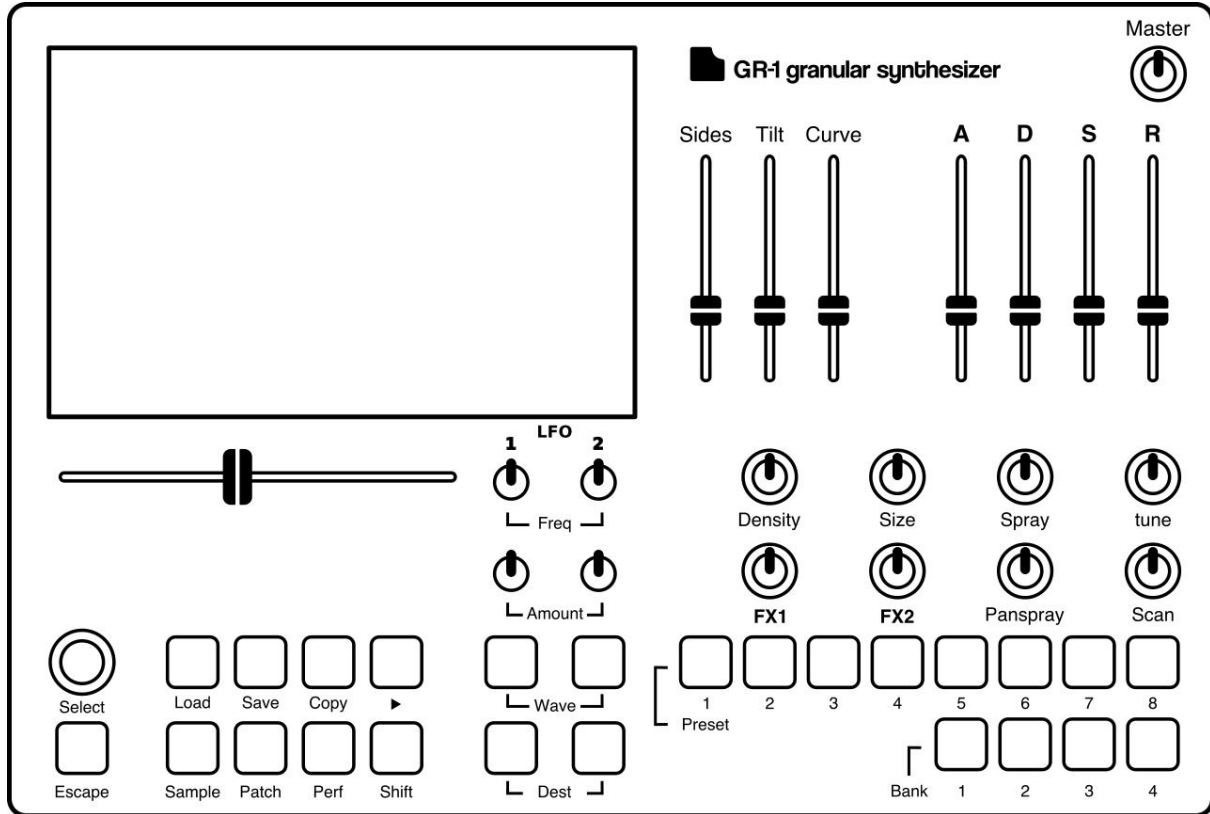# User manual

GR-1 Granular Synthesizer

Written by:

Pieter van der Meer
Jasper Andrea
Koen Pepping

-Tasty Chips Team (2017)

Illustrated by:

Koen Pepping

A little history about the GR-1

The idea of the GR-1 came up 4 years ago, when our friend Erwin Tuijl, from the band "Pocket Knife Army", brought up the idea of a hardware granular synthesizer.

Pieter van der Meer, Koen Pepping and Jasper Andrea representing the Tasty Chips Team (2017), took on the idea and turned it into reality.

After a lot of brainstorm sessions, Hardware revisions, test sessions, hard work and dedication by our team, the GR-1 Granular Synthesizer was born.

We love this thing and we invested a lot into building it. We hope you will enjoy and love the GR-1 as much as we do!

Thank you for buying the GR-1 Granular Synthesizer!

-Tasty Chips Team (2017)

Contents

Important notice!

Power specification

Please do not use an adapter other than included in the GR-1 packet. Using another adapter or power source, may cause damage to your GR-1.

Reading the manual

The GR-1 is designed as an easy-to-use device, but we also wanted to give the user access to more complex functionalities for more options. To take full advantage of all the functionality the GR-1 offers, please read the whole manual. To get the GR-1 up and running in short time, please read the Quick start guide.

GR-1 Specifications

- **128 grains per voice**
- **16 voice** polyphony
- **Standalone** or **MIDI** controllable
- MIDI IN & MIDI THRU connection with **DIN** and **USB MIDI**
- High quality stereo audio: internally: 32 bit float, DAC: 44.1KHz, 106 dB SNR
- High quality headphone amplifier with dedicated volume control
- Quad core ARM Cortex-A running optimized Neon SIMD code
- 800 x 480 pixel, **7" TFT true color display**
- **Firmware updates** via USB
- **Sample file uploads** in multiple formats via USB
- The GR-1 can handle 32 **sample files of 10 MB** (about 2 minutes long)
- Presets and performances can be saved to **internal flash (4GB)** or **external** (USB) **memory**
- 2 **control voltage** assignable inputs 0-5V with voltage protection
- 1 **gate** output
- 12dB/oct digital **lowpass filter** with direct and MIDI controls
- 2 assignable **LFO**'s with waveforms (sine, random, saw, square) and direct controls
- **4 banks of 8 presets** all hands-on accessible and overwritable
- ADSR amplitude envelope and Grain window envelope with direct controls
- Rotary encoder for configuration, file/sample selection. Configuration menus provide **extended possibilities** beyond what the pots and sliders offer**.**
- Access to **configuration** screen providing many more options
- **32 x 21 x 7 cm** aluminum casing
- Full MIDI control: All on-board sliders and knobs, and internal controls are represented as MIDI CC. Full support for program change, pitch bend
- Ability to read and write any USB stick or drive: FAT, ExFat, NTFS (Windows), HFS+ (Mac), Ext4 (Linux).

Quick start guide

To get your GR-1 Granular Synthesizer up and running (stand alone), you can simply connect your headphone and follow the next steps:

1. Connect the adapter that came with your GR-1 to the DC connector at the back of your GR-1 and turn on the on/off switch (see figure below). The display and buttons should now light up.

DC adapter
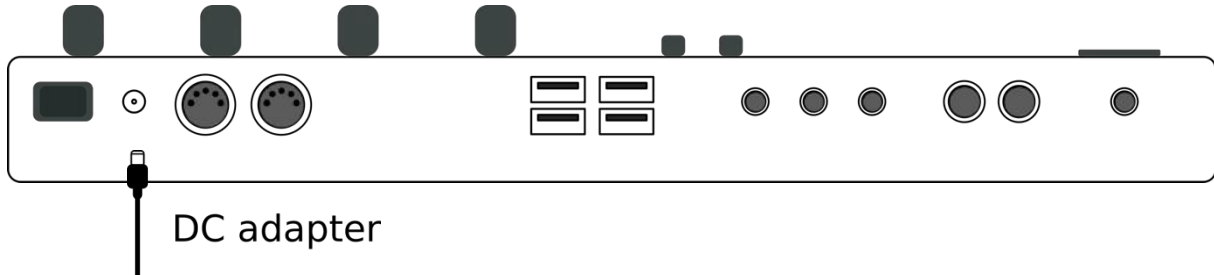
2. Press the "play" button, a single voice will now play constantly and "bank" button 1 will light up, indicating voice 1 of 4 is playing. The other 3 "bank" buttons will trigger voice 3-4 to play. When the **shift button is lit**, the ADSR sliders will now function as

voice
1-4
pitch

Play
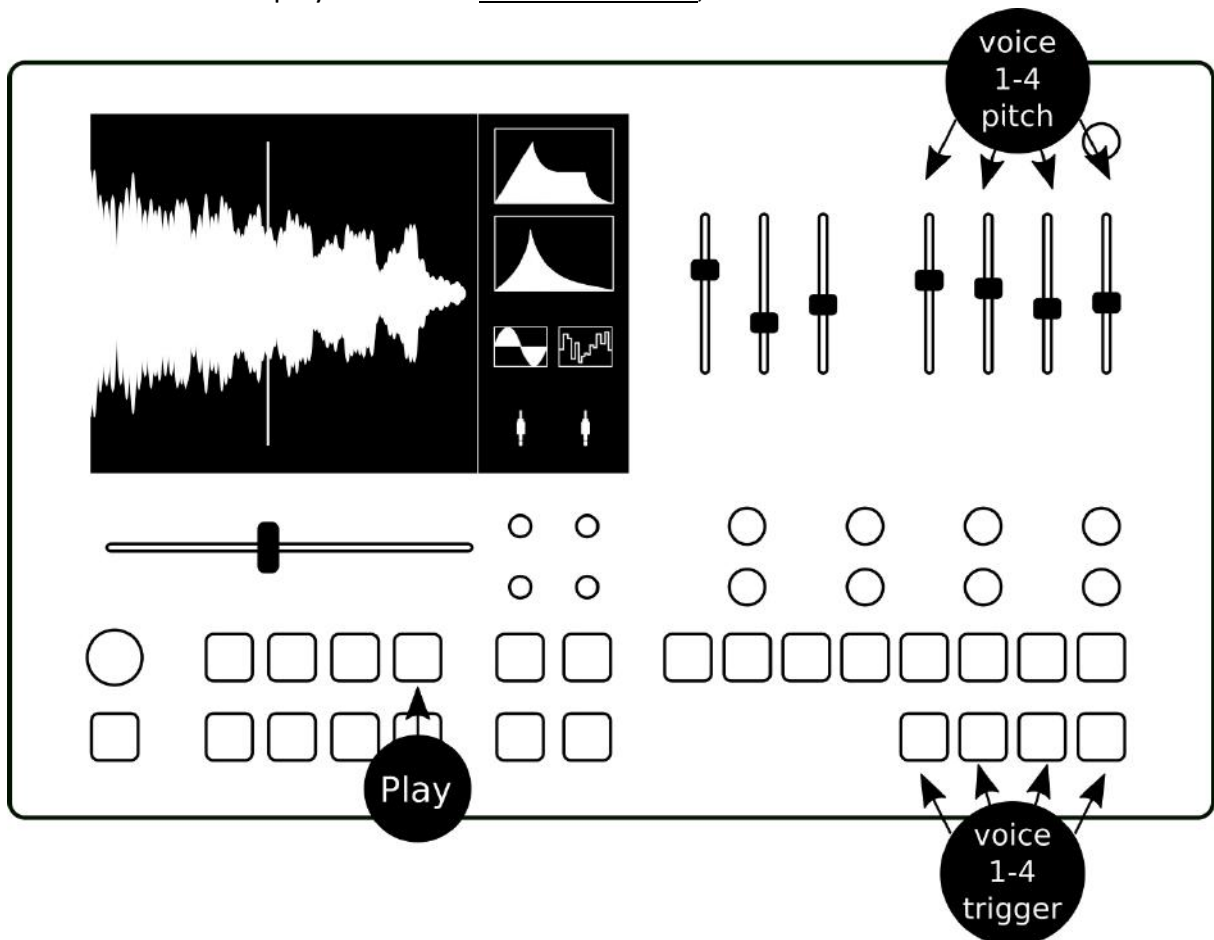
voice
1-4
trigger

pitch controls for the 4 voices, making it possible to play chords and drones. See figure below.

7
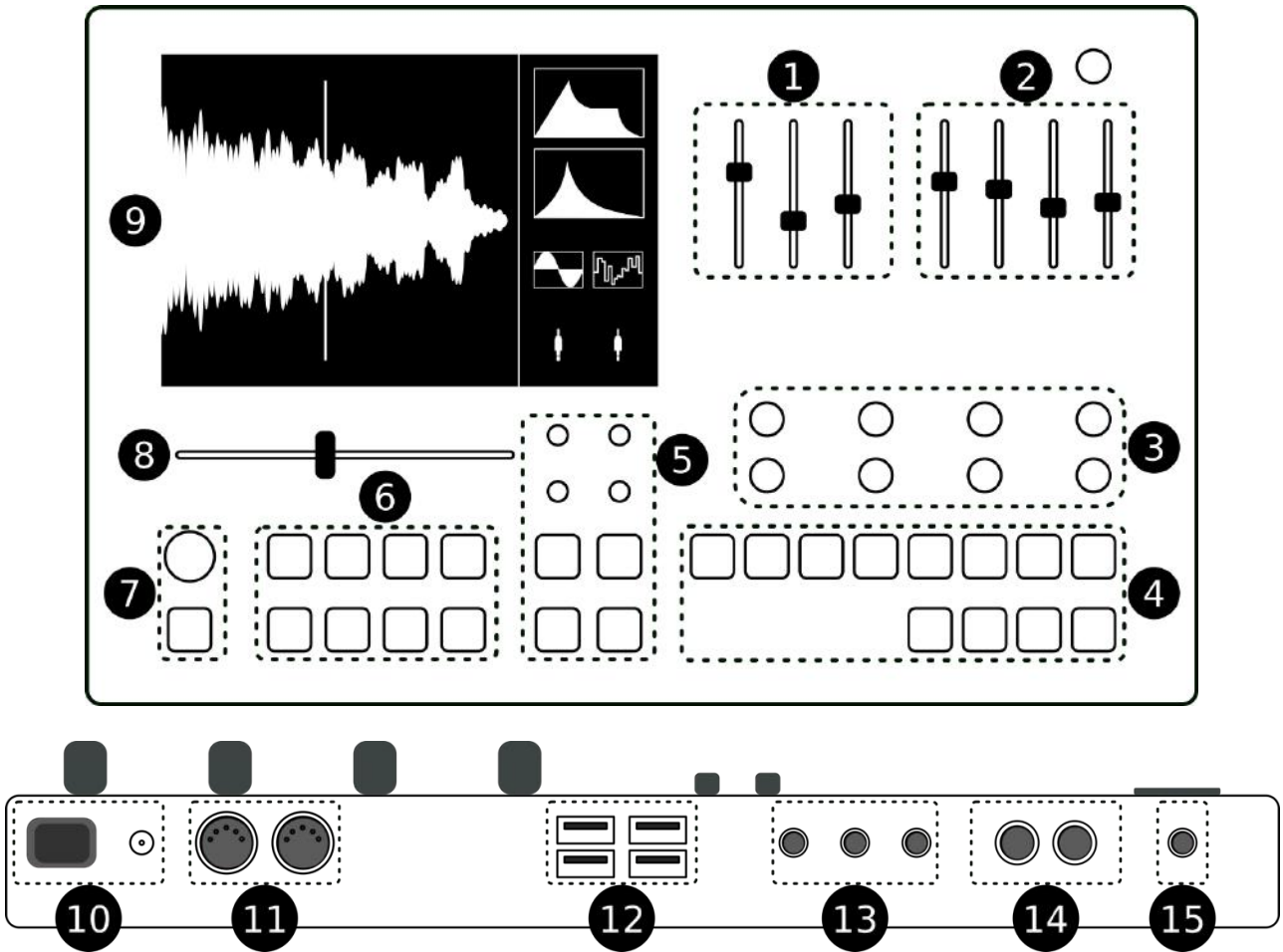
Global overview

Figure 1: Global overview

1.	Grain window section (Sides, tilt, curve)	9.	Display
2.	Envelope section (ADSR)	10.	On/off switch & DC adapter
3.	Knob section	11.	MIDI in & thru
4.	Presets	12.	USB connection
5.	LFO section	13.	CV & Gates
6.	Modes & more	14.	Audio output
7.	Select knob & Escape button	15.	Headphone connection
8.	Position slider		

1. Grain window

The grain window is an amplitude envelope for each grain. The parameters of the grain envelope are (see figure 2):

- Sides
- Tilt
- Curve

The lengths of the window-slopes is relative to the grainSize that was set. In other words: A window is exactly as long as the grainSize.

See figure 3 below, for a visual representation of what the controls do.
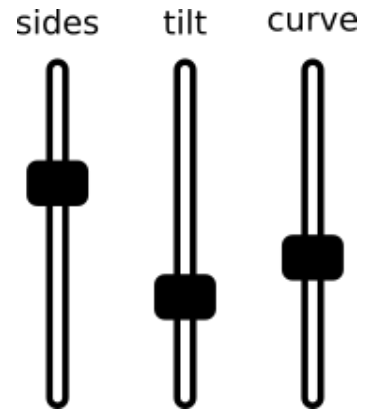
Figure 2
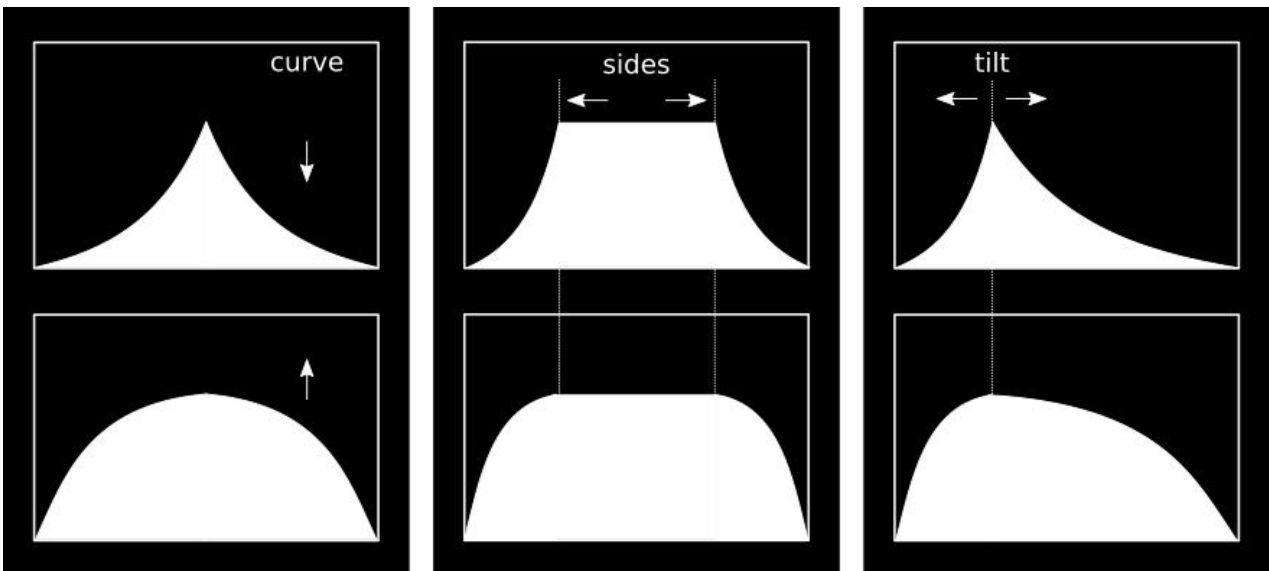
Figure 3

The window envelope is displayed on de display on the GR-1 (middle right).

2. Envelope section

The amplitude envelope, is triggered when a key/voice is active. The envelope is a standard Attack, Decay, Sustain, Release envelope. The Attack, decay and Release times can be set between 0-12 seconds. The Attack slope is linear, the Decay and Release slopes are exponential.

A = Attack   D = Decay   S = Sustain   R = Release
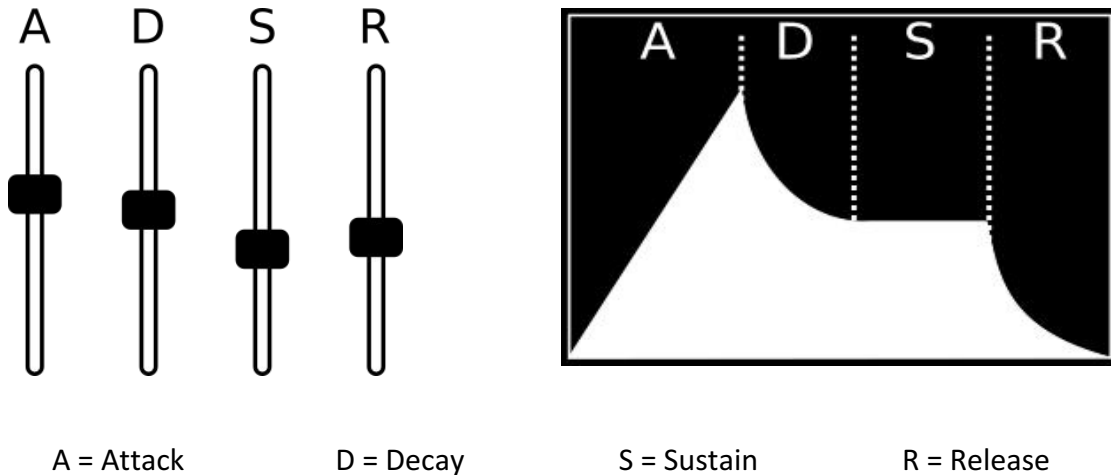
The envelope is displayed on the display on the GR-1 (upper right).

3. Knob section

The knob section, is a section of 8 single turn potentiometers/knobs. All knobs have their own functionality:

density   grainsize   spray   tune

cutoff   resonance   pan spray   scan
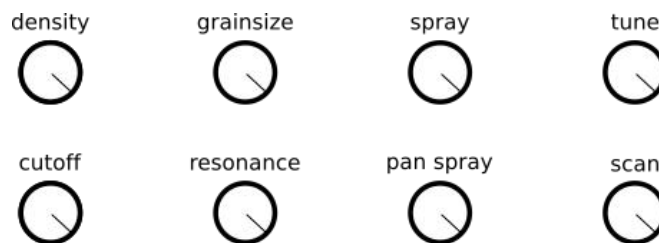
4. Presets

The GR-1 is able to store 4 banks of 8 direct accessible pre-set patches. You can save and load between these presets.

1   2   3   4   5   6   7   8

presets

banks

1   2   3   4
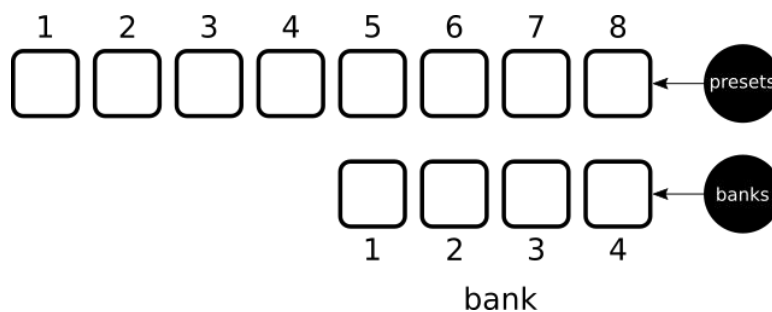
bank

In the figure above, you see that the 8 buttons on top are the presets, the 4 buttons below are the banks. The button of the selected bank/preset will light up. Read more in chapter "Patch mode" on page 12 about saving, loading and copying presets.

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5. LFO section

The GR-1 has 2 assignable Low Frequency Oscillators (LFO's). The LFO's can produce 2 different waveforms as modulating signal for different parameters. The controls of the LFO's from top to bottom:

- Frequency: controls the speed of the modulating signal
- Amount: controls the amount of modulation
- Wave: selects the waveform of the modulation signal
- Dest: selects the destination parameter to modulate

Read more about the LFO controls and options in chapter "LFO's" on page 24.

6. Modes & more

There are 3 modes on the GR-1:

- Sample
- Patch
- Performance

These modes can be selected with the buttons "Sample", "Patch" and "Perf". Read more about these modes in the corresponding chapters.

Play

The GR-1 has a "play" button. The play button triggers 1 single voice and makes it possible to use the GR-1 standalone. Read more about the play function in the Quick start guide.

Load, save and copy

The GR-1 is able to load, save and copy patches and performances. The load, save and copy functions are explained in different sections of this manual. Please read this manual.

Shift

When active, the shift button, allows buttons and knobs to have different functions. The shift button gives access to parameters that don't have to be direct accessible.

7. Select knob & Escape button

The "select" knob can be used to scroll and select through menu's. Scrolling is done by rotating/turning the knob. Selecting is done by pressing the knob. To leave menu's and go back to the previous step press "Escape".

Scroll   Select

8. Position slider

The position slider is the control for the sample play position. The slider will correspond to the position of the vertical blue line in the sample display:
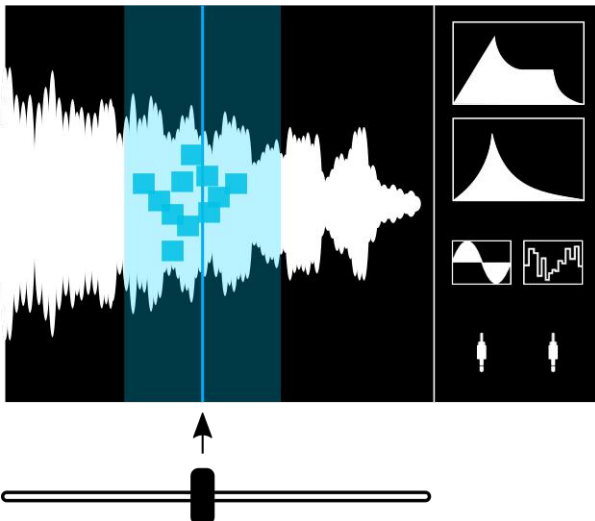
9. Display

The display visualizes everything that is happening in your GR-1. Most icons and interface details are already explained in the previous paragraphs (ADSR, window, LFO waves etc.), but here are some icons that are not explained yet:

The icons display (from left to right):
- MIDI events via DIN inputs
- MIDI events via USB
- Knob/slider event
- A knob/slider has a (in a patch) saved setpoint and has to be turned in the direction of that setpoint before the new value takes over (see patch configuration on page 18)

10. On/off switch & DC adapter

The DC adapter can be connected to the DC jack input. The on/off switch turns the whole GR-1 on or off.

WARNING: Do not use an adapter other than the one that comes with the GR-1.

11. MIDI in & thru

Connect MIDI devices to these DIN connectors. See page 14 for more info about MIDI connectivity and page 27 for the MIDI cc table.

12. USB connection

The 4 USB ports offer various options:

- Connect the MIDI output of one or more MIDI devices to one or more of the 4 USB ports to control the GR-1 with MIDI
- Load samples from one or more USB disks/sticks
- Load (copy) and save, presets and performances on one or more USB disks
- Perform firmware updates from a USB disk
- Connect USB audio interfaces (class compliant) to record audio on the GR-1.

13. CV & Gates

There are 2 CV inputs on the GR-1 which can be routed to different destinations. The gate output provides a gate signal (5V) when the GR-1 receives one or more note-on messages.

14. Audio output

The GR-1 outputs high quality, low noise, stereo audio on 2 channels, left (L) and right (R).

15. Headphone connection

There is a high quality headphone amplifier on the GR-1. The amplifier has 2 selectable output settings: Loud and normal, which can be selected with the small switch on the back of the GR-1:

Loud/normal
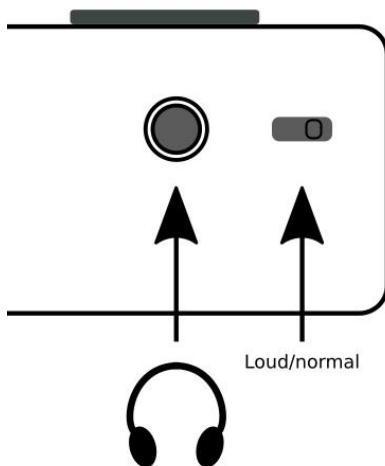
MIDI options

The GR-1 offers a lot of MIDI-options. There are 2 MIDI connectors on the GR-1, "MIDI in" and "MIDI thru".

MIDI in

To control the GR-1 with MIDI, connect the output of the MIDI device to the MIDI or USB input of the GR-1:
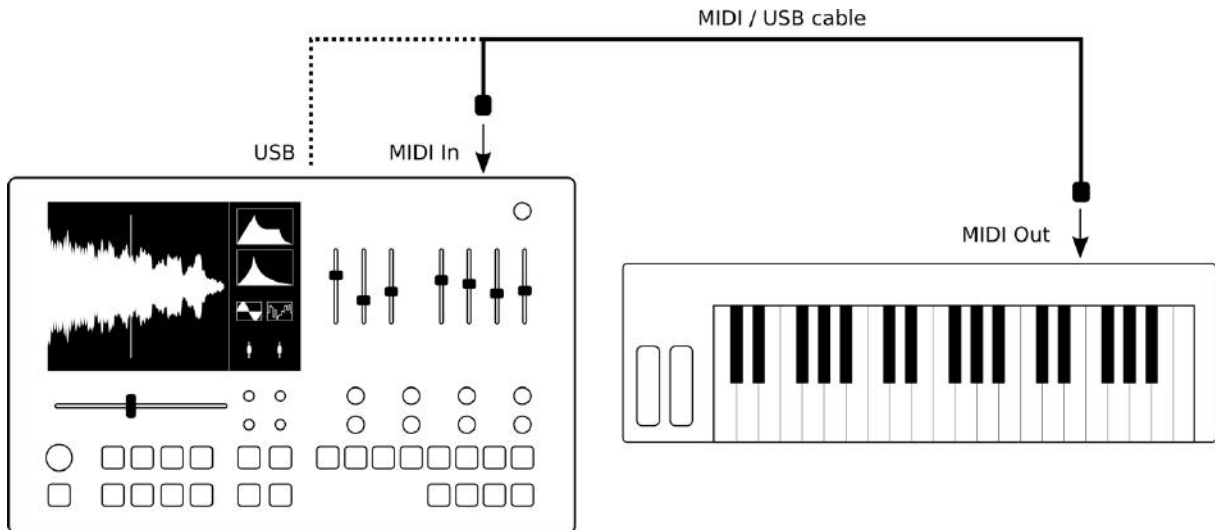
The GR-1 is now controlled by your MIDI device of choice. MIDI in offers the following MIDI features:

- Note (16 voice polyphonic, velocity sensitive)
- Pitchbend (bends all played notes in tune)
- Controls (cutoff, ADSR times, LFO speed, etc. can be controlled with MIDI controls)

MIDI thru

The GR-1 can be chained with other MIDI controlled devices, by simply connecting a MIDI cable from the MIDI thru connector on the GR-1 to the MIDI in of any other synthesizer:

GR-1 or any other synth with MIDI in
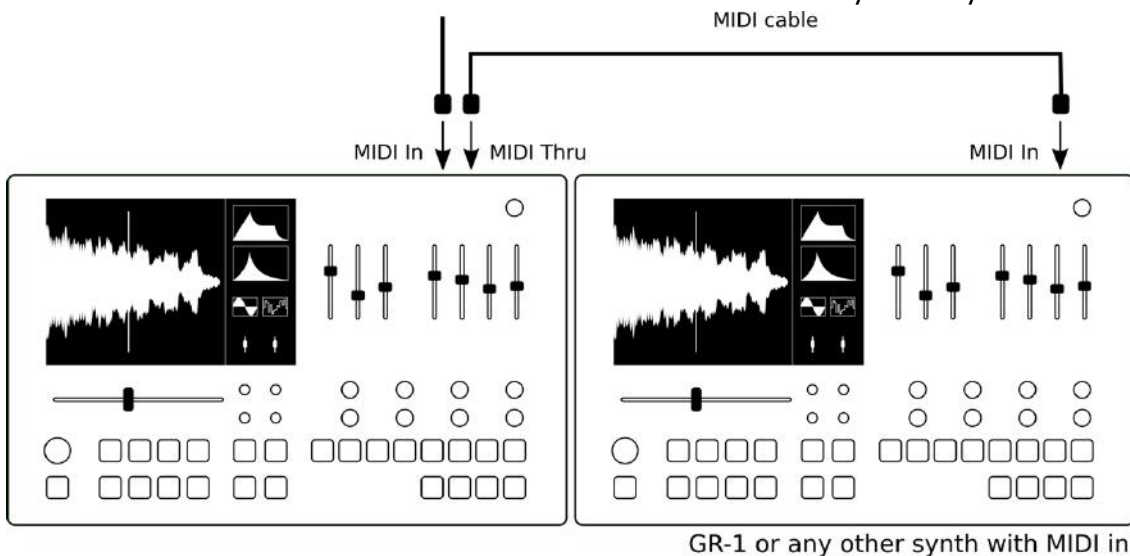
Set MIDI channel

To set the change the MIDI-channel the GR-1 listens to, you will need to enter the configuration screen to do this. The configuration screen can be entered by following these 4 steps:

1. Press the "shift" + "perf" to enter configuration screen
2. Select "MIDI-channel" parameter with the "select" knob (turn & press)
3. Select the desired channel with the "select" knob (turn & press)
4. Press "Escape" button to exit the configuration screen

Find a table of MIDI controls on page 28.

Sample mode

The GR-1 can load samples in different formats from the internal or external (USB) memory.

Sample Formats

The GR-1 can handle different audio formats and quality, with a maximum of 10 MB (about 2 minutes long). The samples will internally be converted to 44.1KHz 16 bit bitdepth. The following formats are accepted:

- .wav
- .ogg
- .flac
- .aiff
- .avr
- .XI

Loading samples

To load a sample, follow the next steps:

1. Press the "sample" button to enter sample mode, this button will now light up
2. Press the "load" button, you will now enter a menu that looks like figure 4
3. Select the desired sample directory with the "select" knob (turn and press the knob)
4. Select the desired sample with the "select" knob (turn and press the knob)

To **cancel** sample loading and exit the menu press the "Escape" button.

LOAD SAMPLE
Path: /media/.../...

Name
sample1.wav
sample2.ogg
sample3.flac
sample4.aiff
sample5.avr
sample6.XI

Figure 4

Copy samples

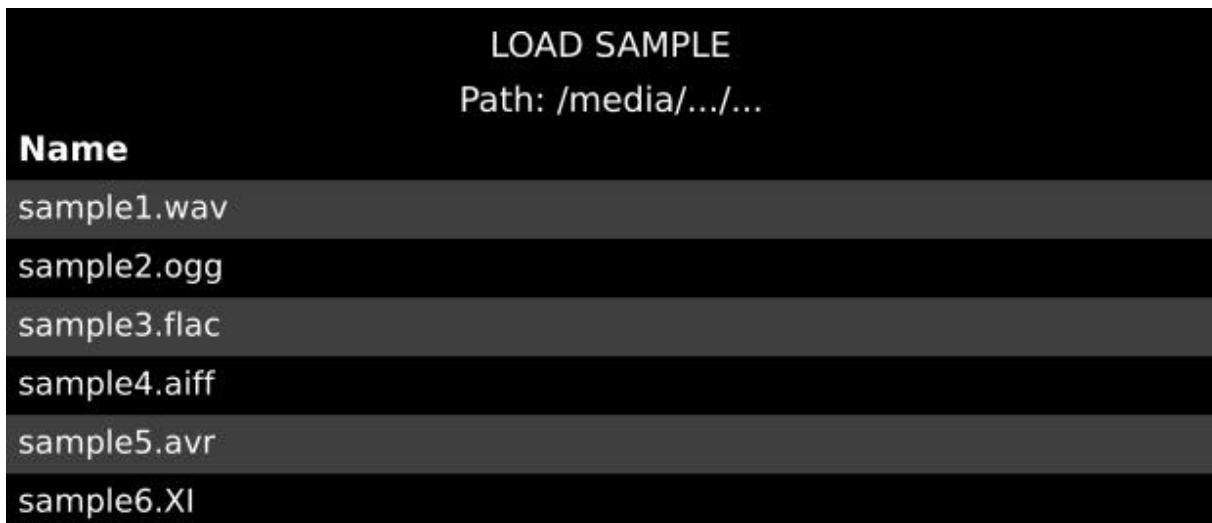To copy sample to another preset, follow the next steps:

1. Press the "sample" button to enter sample mode, this button will now light up
2. Press the "copy" button, the copy button will now blink
3. Press the desired "preset" (with bank and or preset buttons)
4. Press the "copy" button again, the copy button will now stop blinking

To **cancel** after step 2, simply press the "Escape" button.

Patch mode

When you are tweaking knobs and pressing buttons you are making a "patch". You can save, load and copy a patch. There are 4 banks of 8 overwritable presets that are direct accessible within a performance.

Saving a patch

To save your patch as a preset, follow the next steps:
1. Press the "patch" button to enter "patch mode", this button will now light up
2. Press the "save" button, you will now enter the save screen
3. Select the desired directory with the "select" knob, (turn the knob)
4. The patch will be named automatically to the corresponding patch and bank, for example patch 1 bank 2: P1B2. You can change the name with the select knob, by selecting a character, press the select knob and rotate. Then press the select knob again
5. Press the "save" button to save

To **cancel** anytime after step 2, simply press the "Escape" button.

Loading a patch

To load a patch, follow the next steps:
1. Select the preset to load the desired patch on, using the bank and preset buttons
2. Press the "patch" button to enter "patch mode", this button will now light up
3. Press the "load" button, you will now enter the load screen
4. Select the desired directory and patch with the "select" knob, (turn and press the knob)

To **cancel** after step 2, simply press the "Escape" button.

Copy a patch

To copy the current patch to another preset, follow the next steps:
1. Press the "patch" button to enter "patch mode", this button will now light up
2. Press the "copy" button, the copy button will now blink
3. Select the preset to copy the desired patch to, using the bank and preset buttons
4. Press the "copy" button, the copy button will now blink

To **cancel** after step 2, simply press the "Escape" button.

Patch volume

The patch volume is very handy when it comes to matching volumes of different patches for a (live) performance. The patch volume can be controlled with the "tune" knob when the shift button is lit, see figure 5:
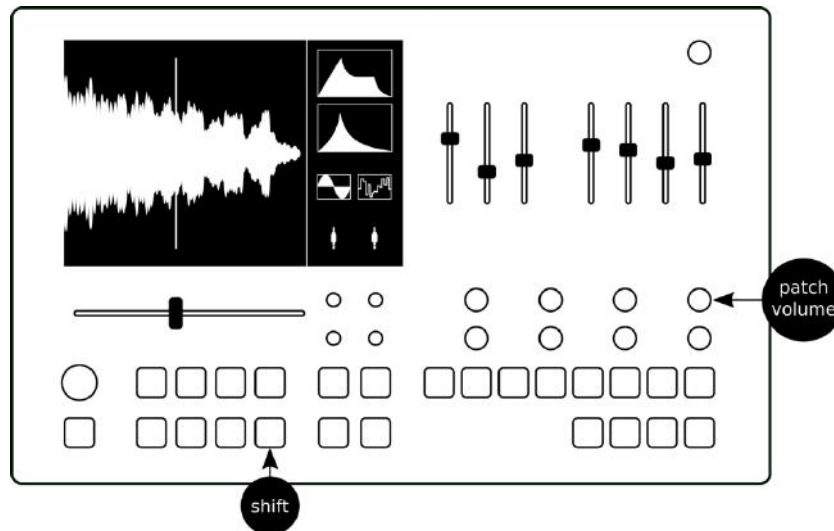

Figure 5

Patch configuration

Press "shift" and then "patch" to enter the "patch configuration" screen. You will now be able to set:

- Scan Key Sync
- LFO1 KEY Sync
- LFO2 KEY Sync
- Resample anti-aliasing
- LFO1 Sync
- LFO2 Sync
- Grain Scheduler Sync
- Voice stealing algorithm

Scan Key Sync

The scanning (scan) through the sample can be synced to a voice trigger/note-on event. When "Scan Key Sync" is "ON", the scan position will reset to the "Play position" on every voice trigger/note-on event.

LFO 1 or 2 Key Sync

Each LFO can individually be synced to a voice trigger/note-on event. When this feature is "ON", the LFO wave will reset to the beginning of the waveform on every voice trigger/note-on event.

Resample anti-aliasing

When this setting is "ON" an anti-aliasing filter will be turned on. This will reduce the amount of voices/polyphony, but increase the audio quality.

LFO 1 or 2 Sync

When this setting is "ON" the LFO will be synced to the MIDI beat clock, with the selected time division. This setting can be turned on for each individual LFO.

Grain Scheduler Sync

Normally the grains that are playing will play until the end of the set "grain size" at the same note pitch of the note that was played when the grain started playing. When the Grain Scheduler Sync setting is "ON" the grains will be tuned to the notes that are played at that very moment.

In other words: If you want the grains to follow the played pitch immediately turn this setting "ON".

Voice stealing algorithm

There are different implementations of polyphony on the GR-1. This setting allows the user to choose between 3 algorithms:

1. Chord+solo
2. Round robin
3. Steal oldest

Chord+solo

The voice playing, most nearby to the new note will be overwritten, which allows you to play a melody over a chord.

Round robin

A new note event will overwrite the next voice, stepping through voices 1-12. When the last voice, voice 12 is reached the next note event will trigger voice 1 and the cycle will start over again.

Steal oldest

The oldest voice playing will be overwritten on a new note event.

Performance mode

A set of 32 (max) patches/presets, is what we call a performance. MIDI channel and hardware settings etc. can be configured for an individual performance. You can load and save performances.

Configuration

To enter the performance configuration press "shift" and then "perf". The configuration parameters can be set with the select knob. Leave this configurations screen with "Escape".
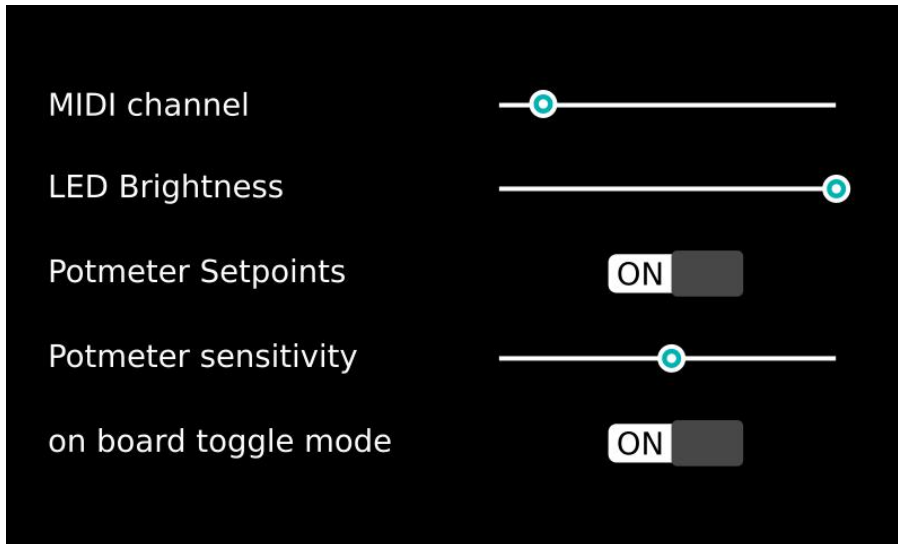
MIDI channel

Sets the MIDI channel your GR-1 will listen to.

LED Brightness

Controls the brightness of the LED buttons.

Potmeter Setpoints

When "ON" the potmeters/knobs of a saved patch are locked, until you turn/slide past the saved set point.

Potmeter Sensitivity

Sets the readout time of the potentiometers/knobs/sliders. Left is slow, right is fast response.

On board toggle mode

Normally the play mode toggles voices on/off with the bank 1-4 buttons. Turn this off and the voices will only play when the buttons are pressed.

Saving a Performance

To save your performance, follow the next steps:

1. Press the "performance" button to enter "performance mode", this button will now light up
2. Press the "save" button, you will now enter the save screen
3. Select the desired directory with the "select" knob, (turn the knob)
4. The performance will be named automatically to the corresponding patch and bank, for example patch 1 bank 2: P1B2. You can change the name with the select knob, by selecting a character, press the select knob and rotate. Then press the select knob again
5. Press the "save" button to save

To **cancel** anytime after step 2, simply press the "Escape" button.

Loading a performance

To load a performance, follow the next steps:

1. Press the "performance" button to enter "performance mode", this button will now light up
2. Press the "load" button, you will now enter the load screen
3. Select the desired directory and performance with the "select" knob, (turn and press the knob)
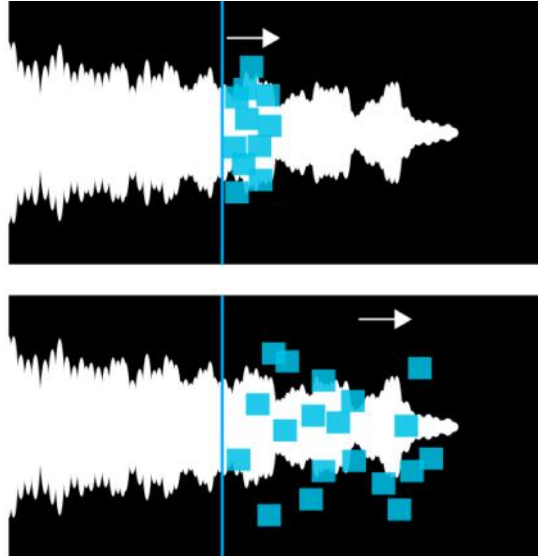
Granular controls explained

Density

The density parameter controls the amount of grains per second. The amount can be set between 0.1-1000 grains per second, with a maximum of 128 grains per voice playing at the same time.
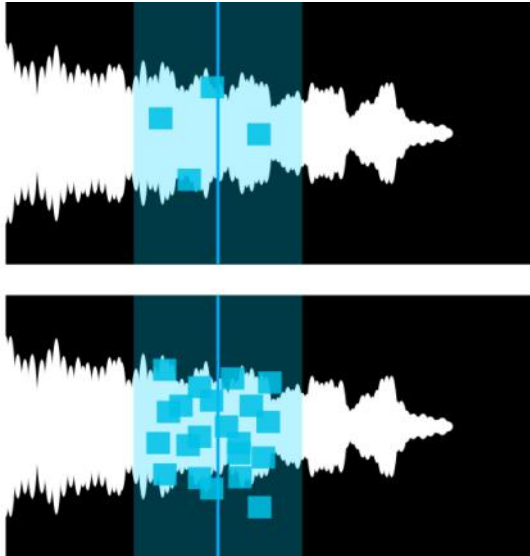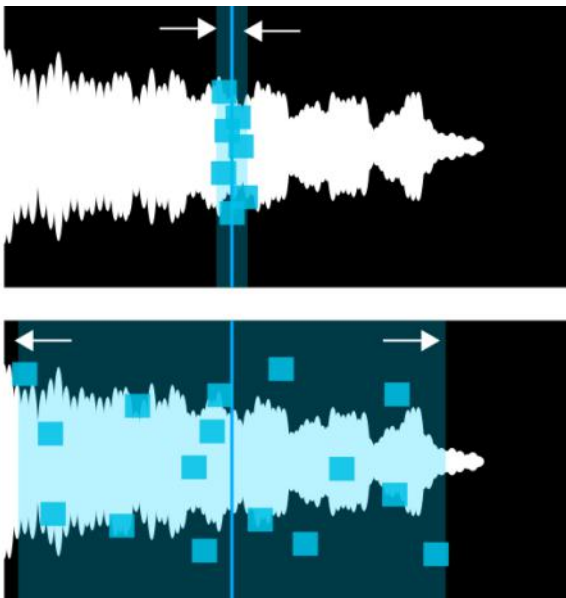

Grain size

The grain size parameter controls the playing length of a grain. The length can be set between 5-1000 milliseconds.
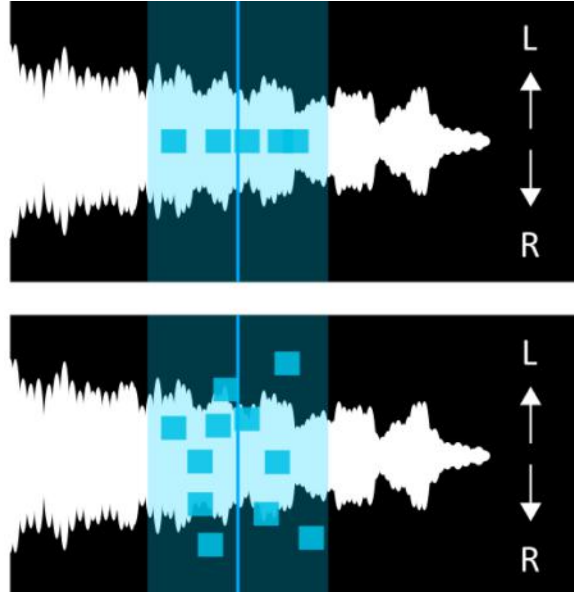

Spray

The spray parameter controls, how much a start position of a grain can differ from the Sampleposition. The play position of each Individual grain is random.
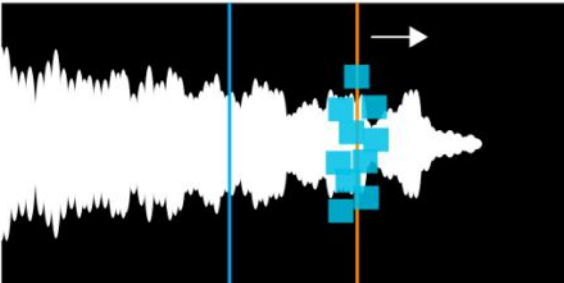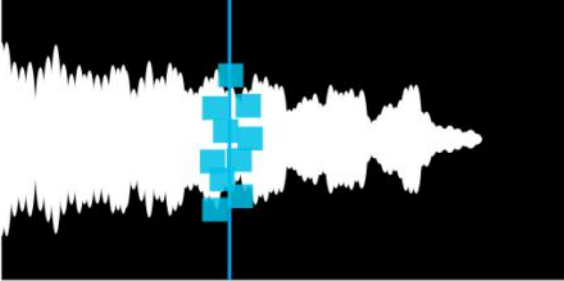

Pan spray

The pan spray parameter controls, how much the position of a grain within the stereo image, can differ from the center position. The placing of each individual grain is random.

Scan

The scan parameter makes the play position slider play the sample, while the granular engine is still doing its thing. It can play the sample in normal and reversed direction.

LFO's

Controls

The GR-1 has 2 assignable Low Frequency Oscillators (LFO's). The LFO's can produce 2 different waveforms.

Sine wave   Random wave   Saw wave   Square wave

LFO

Freq
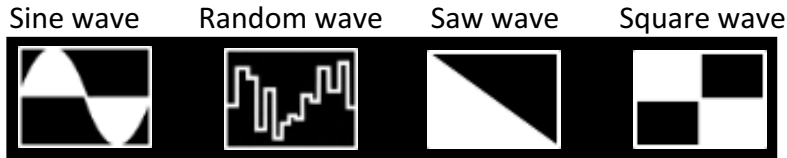
Amount

Wave

Dest

The waveforms can be selected with the "Wave" button. The frequency can be controlled with the "Freq" knob and the amount of modulation can be controlled with the "Amount" knob. The destination to be modulated can be selected with the "Dest" button. Both LFO's are identical.

See "patch configuration" on page 18 for extended LFO options: key sync and clock sync.
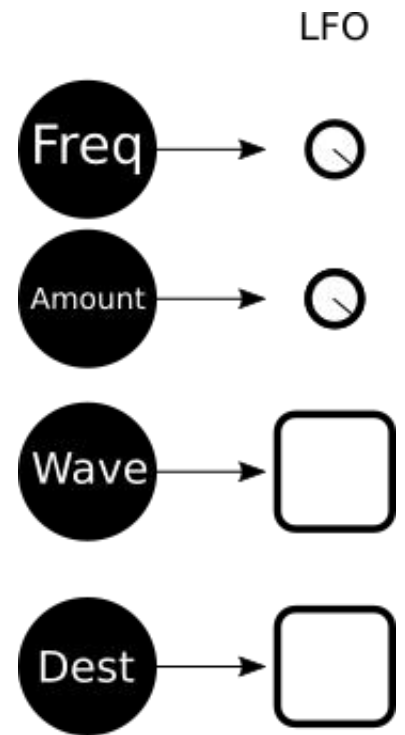
CV section

The CV section makes it possible to combine the GR-1 with a modular system (Eurorack for example). The CV section contains 2 control voltage inputs and 1 gate output.

gate   CV 2   CV 1

CV inputs:

CV1 and CV2 accept voltages within the range of 0-5V. The CV inputs are protected for voltages outside of the 0-5V range, but we would still recommend to use them with care. The CV inputs are assignable to different parameters.

The CV is displayed with a mini jack cable icon. On top the CV number is displayed and below the mini jack icon the destination is displayed.
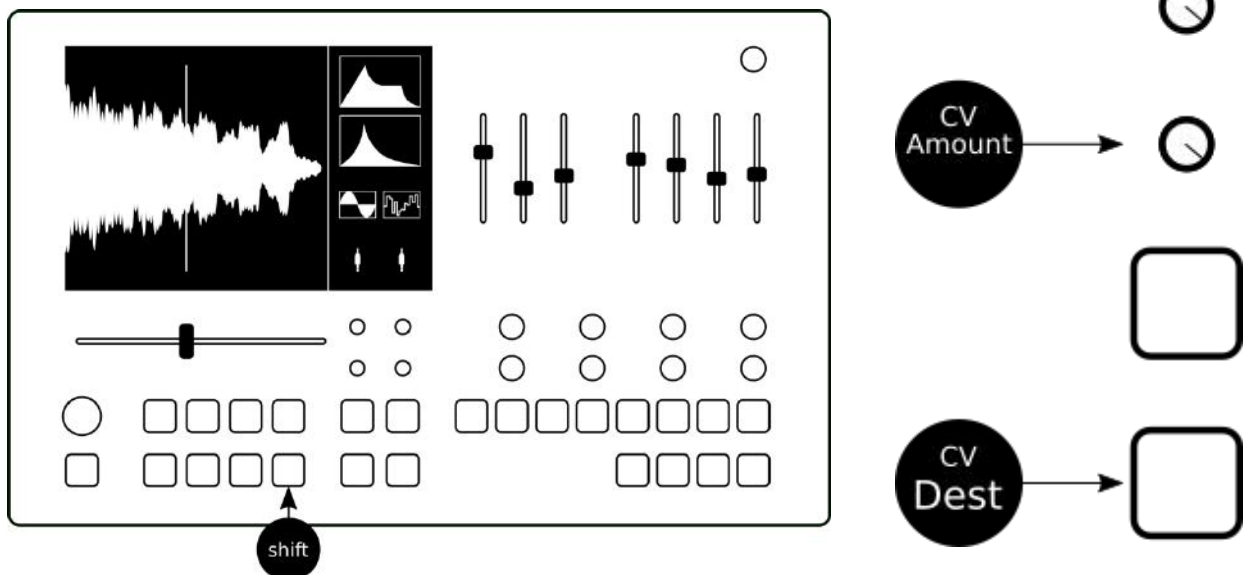

CV Amount & Destination

To control the CV options, Press the "shift" button, to change the LFO controls to CV controls:

1. LFO amount will now function as CV amount
2. LFO destination will now function as CV destination

See figure .. , LFO 1 corresponds to CV 1 and LFO 2 to CV 2.

Note:
CV inputs have a 0-5V range, voltages outside of that range will be clipped.

Gate output:

The gate output responds to incoming midi notes. When one ore more notes are play the gate output signal will be "High", 5V, and when notes are released/off the gate output signal will be "Low", 0V. **Warning: Do not use the gate output as an input!**
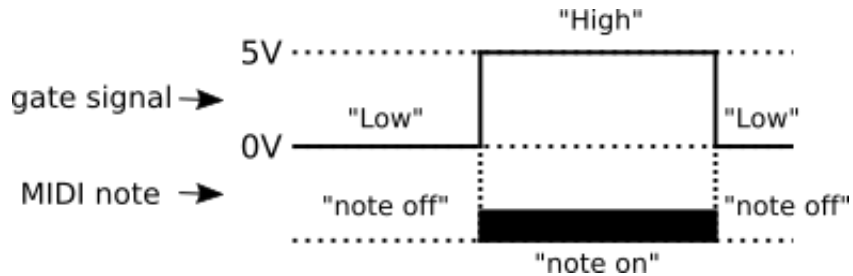
Example patch:

You can run the GR-1 audio through an external (analog) VCF. Then control the cutoff with an external ADSR, triggered by the gate out of the GR-1.

MIDI Control table

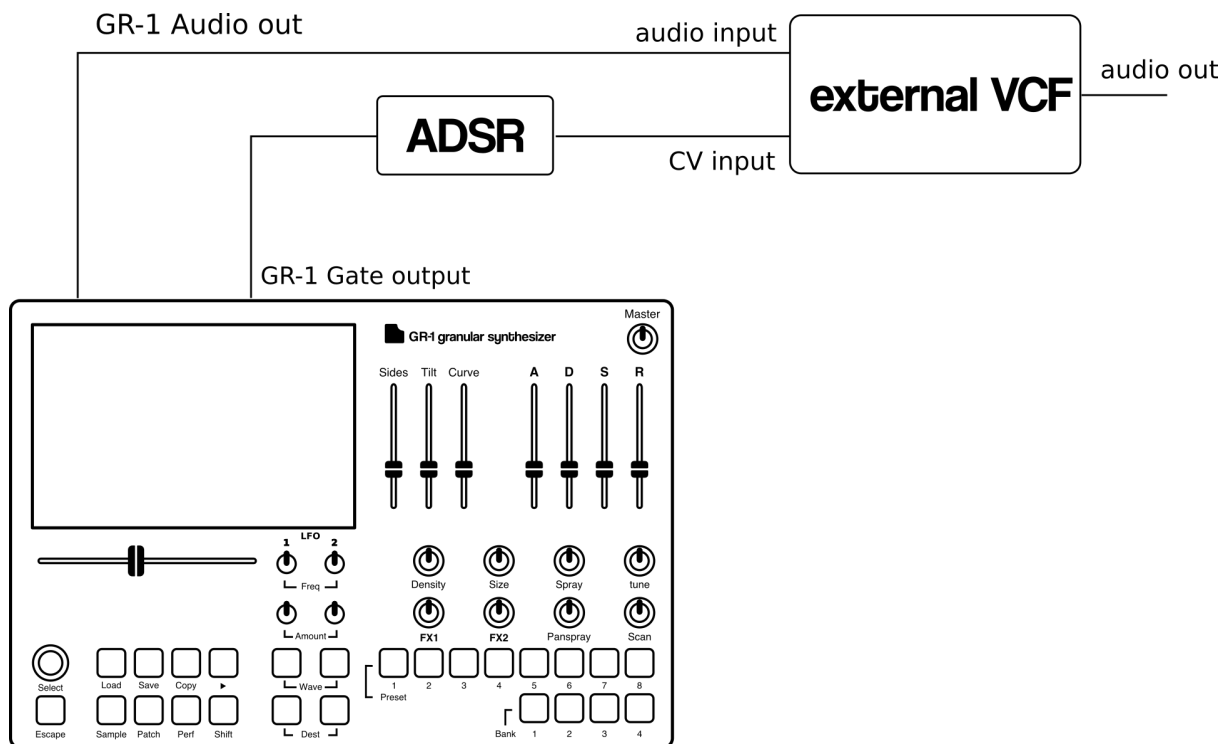| MIDI message	GR-1 parameter	Command / CC	Value	Range	Control curve
Pitch bend	Pitch bend	-	0 – 16383	see CC 60 (pitchbend range)	2^n
Program change		-	0 – 31		
CC	MOD wheel	1	0 - 127	TBD	TBD
CC	position	2	0 – 127	Start .. end of sample	linear
CC	density	3	0 - 127	0.1 .. 1000 grains/s	cubic
CC	grain size	4	0 - 127	5 ms .. 1000 ms	cubic
CC	spray	5	0 - 127	0..3 s max distance	linear
CC	NRPN value MSB	6	0 – 127		
CC	tune	7	0 - 127	-1 .. +1 octave	2^n
CC	cutoff	8	0 - 127	0 Hz .. 20 kHz	cubic
CC	resonance	9	0 - 127		linear
CC	panspray	10	0 - 127	mono..total stereo	linear
CC	scan	11	0 - 127	-2x .. +2x replay speed	linear
CC	Window – Sides	12	0 - 127	0..1 (no sides .. no center)	linear
CC	Window - tilt	13	0 - 127	-1..+1 (left .. right)	linear
CC	Window – curve	14	0 - 127	-1..+1 (hollow..fat)	linear
CC	LFO 1 waveform	15	0 – 3	0:SINE, 1:RAND, 2:SAW, 3:SQR	
CC	LFO 2 waveform	16	0 – 3	0:SINE, 1:RAND, 2:SAW, 3:SQR	
CC	LFO 1 frequency	17	0 - 127	50 mHz .. 50 Hz	cubic
CC	LFO 1 amount	18	0 - 127		linear
CC	LFO 2 frequency	19	0 - 127	50 mHz .. 50 Hz	cubic
CC	LFO 2 amount	20	0 - 127		linear
CC	CV1 amount	21	0 - 127		linear

CC	CV2 amount	22	0 - 127		linear
CC	Attack time	23	0 - 127	0 ms .. 12 s (linear)	cubic (special)
CC	Decay time	24	0 - 127	0 ms .. 16 s (exp)	cubic (special)
CC	Sustain amplitude	25	0 - 127		linear
CC	Release time	26	0 - 127	0 ms .. 16 s (exp)	cubic (special)
CC	LFO1 destination	27	0-5	0:TUNE, 1:POS, 2:SPRAY, 3:SIZE, 4:DENS, 5:CUTOFF	
CC	LFO2 destination	28	0-5	0:TUNE, 1:POS, 2:SPRAY, 3:SIZE, 4:DENS, 5:CUTOFF	
CC	CV1 destination	29	0-5	0:TUNE, 1:POS, 2:SPRAY, 3:SIZE, 4:DENS, 5:CUTOFF	
CC	CV2 destination	30	0-5	0:TUNE, 1:POS, 2:SPRAY, 3:SIZE, 4:DENS, 5:CUTOFF	
CC	LFO1 key sync	31	0-1		
CC	LFO2 key sync	32	0-1		
CC	Scan key sync	33	0-1		
CC	Patch volume	36	0 - 127	[0.10 .. 10.0]	10^n
CC	Resample anti-alias on/off	37	0-1		
CC	Master volume	39	0 – 127	0.003 .. 1.00	10^n
CC	Pitchbend range	60	0 – 127	0 -> -1 octave, 64 -> original pitch, 127 -> +1 octave	2^n

Firmware updates

The GR-1 firmware can be updated via USB. To perform a firmware update, download the newest version on tastychips.nl and follow the next steps:
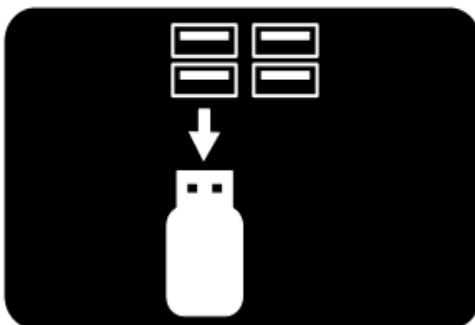
- Place the zip file in the "root directory" on a USB drive
- Place the USB in one of the 4 USB ports on your GR-1
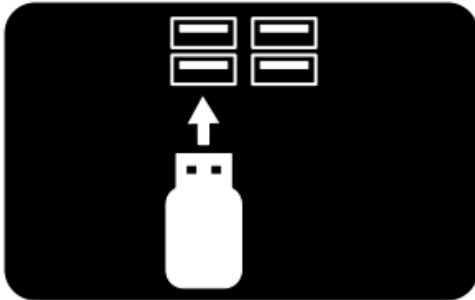
- Turn on/restart your GR-1, you will now see a window popping up
- Press "select" within 5 seconds to perform the firmware update

- The firmware update will now start and takes less than a 30 seconds
- Remove the USB disk and restart the GR-1

Keep in mind that when there is a firmware update in the root-directory of a connected USB drive, the GR-1 will always boot with the "press "Select" to update" window. You might want to remove the firmware update from the USB drive when the update is done.

Credits

Tasty Chips Team:

- Pieter van der Meer   (Founder of Tasty Chips Electronics)
- Jasper Andrea   (Andrea Audio Productions)
- Koen Pepping   (Vannes Engineering)

Hired:

- Niels Johannes de Wit   (Software engineering)
- Bas van Geuns   (Intro Animation video)
- Marco Galtarossa   (3D renders)

Hardware Granular Idea:

- Erwin Tuijl   (Pocket Knife Army)

Special thanks to

Brainstorm sessions:

- Erwin Tuijl   (Pocket Knife Army)
- Jasper Schutz
- Job de Klein
- Leon Stok
- Peter Johan Nyland
- Igor zinken

Feedback, tips and others:

- Ad Nieuwenhuizen
- Nico Sijm

Contact

Tasty Chips Electronics

tastychipselectronics@gmail.com

tastychips.nl