

ENDORPHINES[®]

GROUND CONTROL

FIRMWARE V.2.10

WARRANTY

1-year warranty is guaranteed from the product's purchase date in case of any manufacturing errors or other functional deficiencies during runtime.

The warranty does not apply in case of:

- damage caused by misuse
- mechanical damage arising from careless treatment (dropping, vigorous shaking, mishandling, etc.)
- damage caused by liquids or powders penetrating the device
- heat damage caused by overexposure to sunlight or heating
- electric damage caused by improper connecting

The warranty covers replacement or repair, as decided by us. Please contact us via email for a return authorization before sending anything. Shipping costs of sending a module back for servicing is paid by the customer. Device complies with all EU regulations concerning RoHS lead-free manufacturing and WEEE disposal.

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For dealer / marketing inquiries: info@endorphin.es

FURTH BARCELONA, S. L. (EU VAT ID: ES B66836487)

GROUND CONTROL

- 42hp eurorack modular polymetric and polyrhythmic performance
CV/MIDI/USB-MIDI sequencer / workstation for drums and melodies
- 4 tracks: drum track with 8 triggers and modulation and 3 melodic
CV/Gate tracks. Velocity and CC is recorded from external MIDI
- 2 octave keyboard (no velocity or pressure action), play sequences
and grooves on the fly or use external USB/MIDI gear or DAW
integration or control external MIDI gear
- arbitrary, up to 64 steps per pattern, 24 patterns per track, 24
projects
- various record modes: 101-style step input with step editing, live
recording and step editor with x0x-style drum editing
- dedicated mute/solo bus with momentary mute or quantized to
pattern length action
- works also as a power supply for your modular system (same as
Shuttle Control) or can be powered by a buss board like any other
module
- arpeggiator, roller, patterns queue, slides, ties/rests, ratchets,
transpose
- music scales easily editable via highlighted keys: chromatic, minor,
major, pentatonic etc.
- external CV modulation matrix: control various sequencer
parameters under CV: pattern shift, semitone and octaves offset,
shuffle, ratchets, slide, gate length, CV to CC values or pattern
change

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INTRO

Ground Control is a powerful performance sequencer for CV/Gate signals, drum triggers as well as MIDI and USB-MIDI devices.

It features X0X, 101, step editing and live play approaches for sequencing and recording. That empowers you to create grooves on the fly with fast polymetric input so you can concentrate on the score without menu diving.

- Quick start guide: <https://youtu.be/t00jK-sw3zl>
- Loopop's full tutorial: <https://youtu.be/XhriE0MKjp0>
- Turbo start: <https://youtu.be/UwHBbIPGvRA>
- Essential guide: <https://youtu.be/gUsYx2ekUPg>

CONNECTING THE POWER

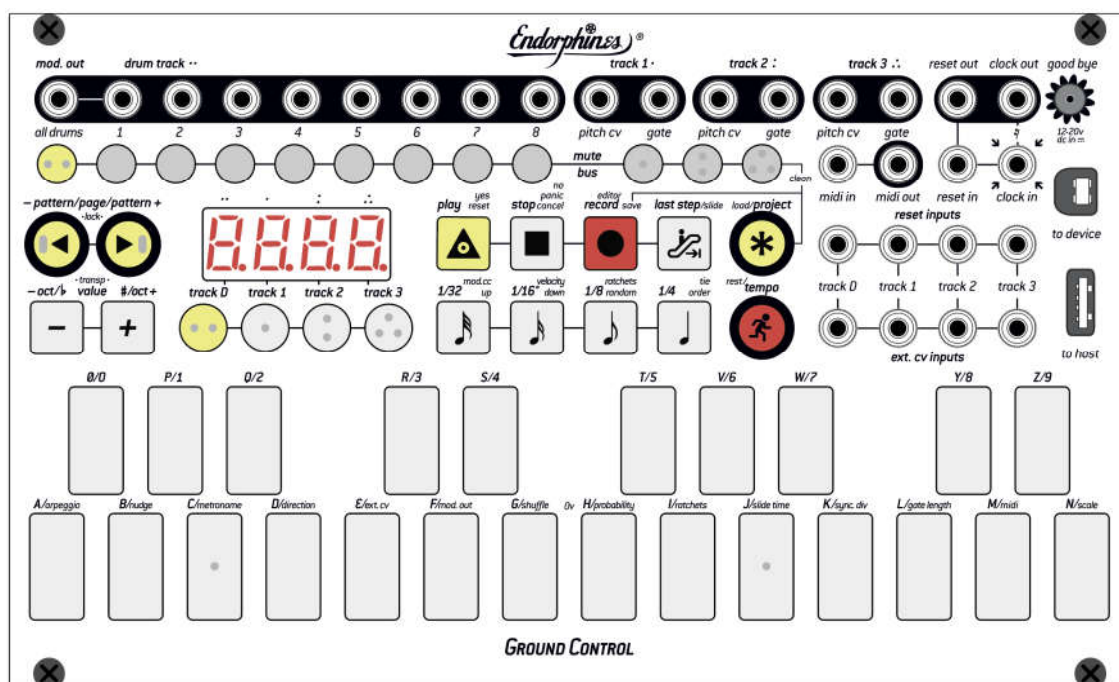
Ground Control module can be powered in two different ways. It is very important to use only one of the powering options:

1) Connect the module ***directly into the power buss board with supplied 16-16*** ribbon cable like any other eurorack module

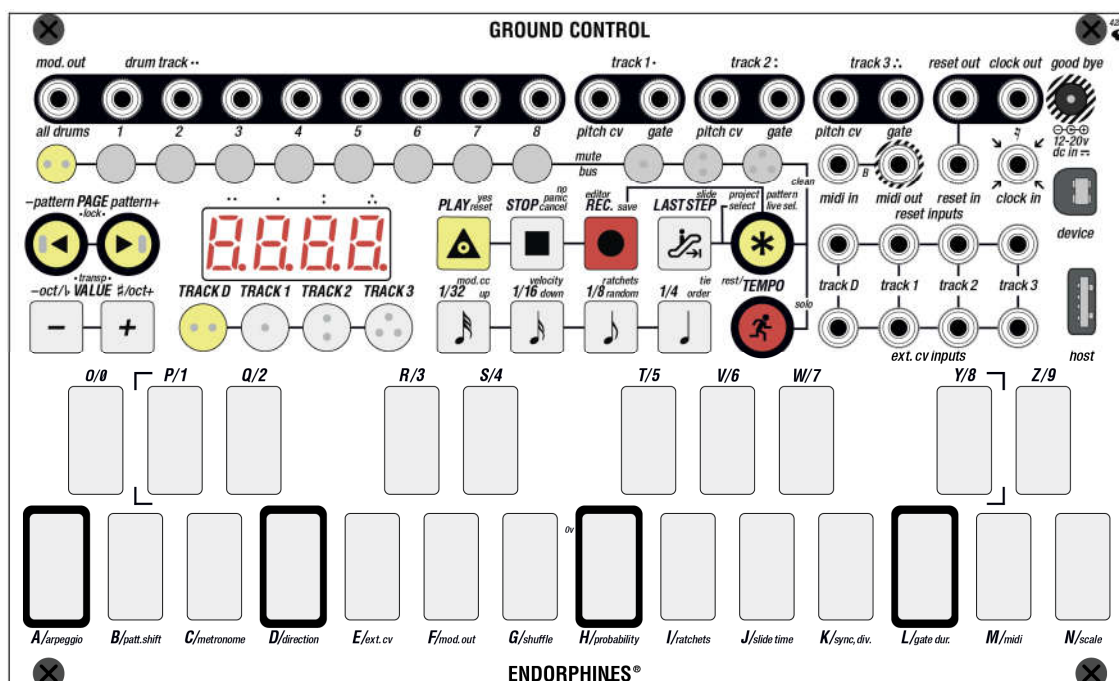
2) Power the module ***from the faceplate with 12-20V DC power adapter***. In that case the ribbon cable connector will act as a power supply. For single sequencer connection you would need 500mA adapter. For using the sequencer as a power supply - the higher the amperage of the DC adapter the better, minimum recommended rated as 3A or more. The DC jack accepts universal 2.1 or 2.5mm / 5.5mm barrel. In that case the 16 pin cable can act as a power source for your buss board – that can be any passive or flying buss-board. It will deliver identical current – up to 1A per +12V rail and up to 700mA per -12V rail. Small +5V jumper (off by default) on the left side will enable +5V source into the buss-board.

→ *Hint: power consumption will increase, if devices are powered from USB HOST*

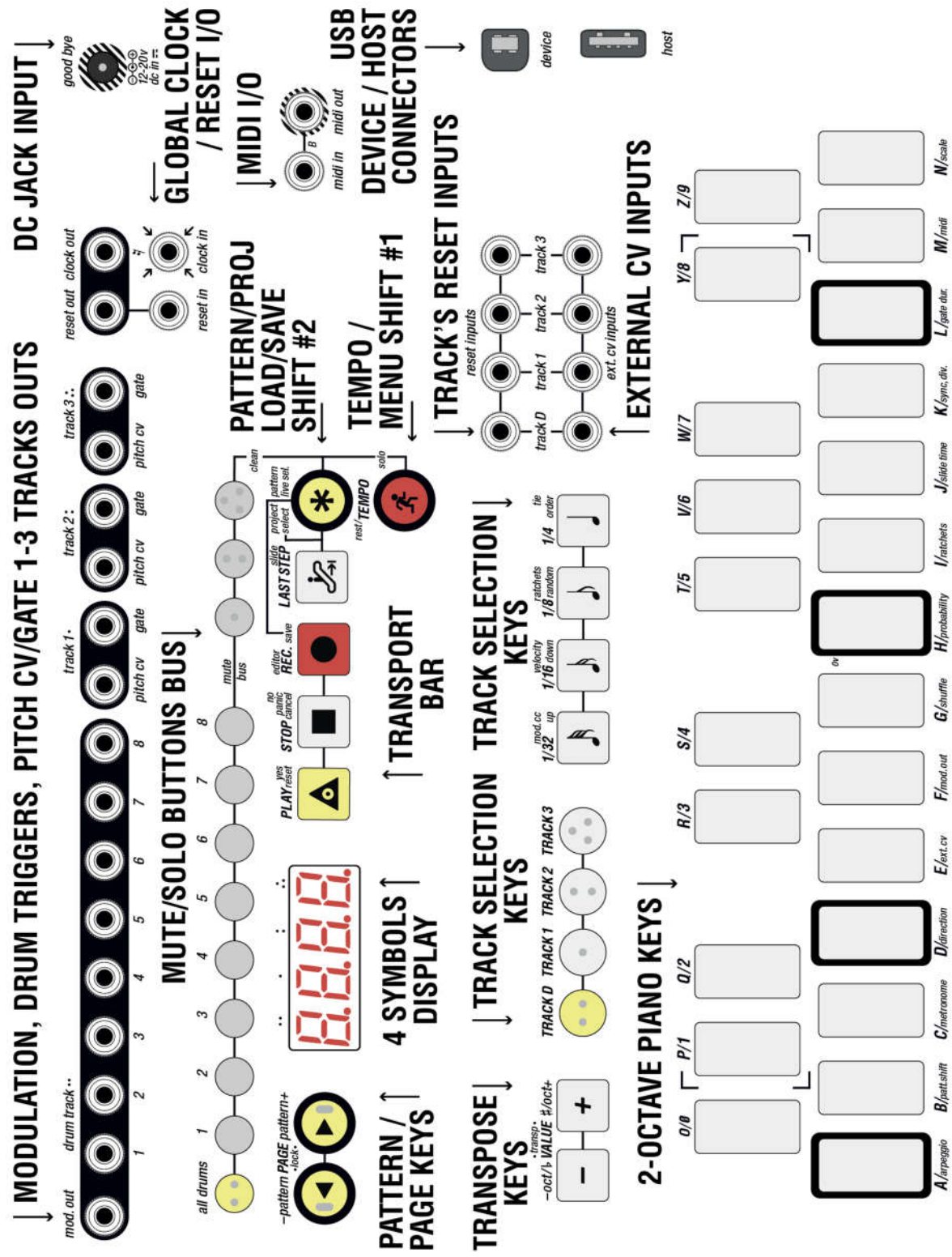
INITIAL PANEL DESIGN



NEW PANEL DESIGN



INTERFACE



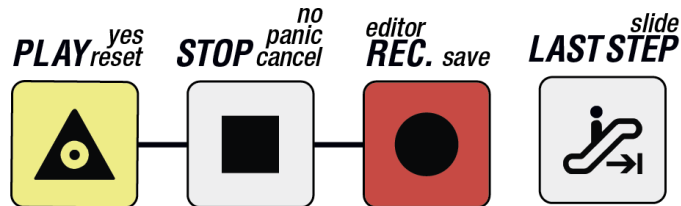
TRIGGERS / CV / GATE / OUTPUTS

Ground Control has the following tracks:

- **DRUM TRACK** that consists of 8x drum triggers. Each drum trigger also sends individual velocity value via MIDI or USB-MIDI, with velocity editing via the step editor. By default, the drum track is assigned to Rt/Tx MIDI channel 10 (see **MENU** → **M/MIDI** settings). Trigger outputs are v-trigger outputs with increased 0...10V output range to drive low pass gates more efficiently
- **3X MONOPHONIC MELODIC TRACKS** with physical 1v/oct pitch CV and gate outputs. Pitch CV outputs cover 10 octaves -5v to +5v (similar as the Shuttle Control outputs. Gate outputs are 0 to 10V
- **MODULATION TRACK** with physical CV output. Can be assigned to drum or melodic tracks with MIDI CC#01. Alternatively can be assigned to any track's note velocity.

The lowest recognizable MIDI note is C of -2nd octave (MIDI note number 0) — its output voltage corresponds to exact -5V. The highest note is C of 8th octave (MIDI note number 120) with the corresponding output voltage of +5V. C3 is the central note that returns exactly 0 volts. It is important to notice that the range of output voltages for any CV output is limited to -5V ... +5V.

TRANSPORT BAR



→ **PLAY**: playback start button:

- Single press starts the playback when the sequencer is stopped
- Once pressed during the playback, it resets all the tracks to their first steps
- Combination of **TRACK D/1/2/3 + PLAY** during the playback resets pressed track to the first step

- In some actions **PLAY** button acts as Yes/confirmation of the call to action (e.g. overwriting not empty project).

→ **STOP**: playback stop button:

- Once we are in the menus, single press acts as an exit from the menu or cancel of call to action without stopping the playback
- Also acts as a **PANIC BUTTON** when pressed and held a few times in case some MIDI devices have hanged notes

→ **RECORD**: that button enables record or edits the notes in different combinations:

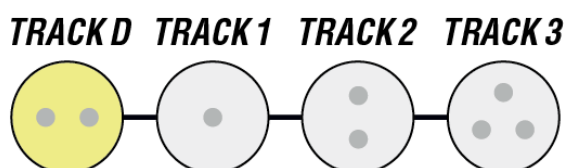
- When sequencer is not running, short **RECORD** button press starts the step record input on the selected track (see **TRACK D/1/2/3** buttons)
- Long press enters the editor (**XOX** for drums or step editor for melodic tracks)
- When sequencer is running, then short press enables live recording and long hold enters the live editor, so you can preview all the changes on the fly
- Combination * → **RECORD** enters the save Pattern/Project menu
- Combination * → **RECORD** → **RECORD** saves all the current project settings as well as all unsaved tracks
- Combination TEMPO+RECORD starts RECORD WAIT mode.

→ **LAST STEP**: sets the amount of steps per track but in other menus acts as alternative key (e.g. alternating project / pattern) etc.:

- Combination **LAST STEP + MUTE BUS** → **VALUE-/+** (or **PAGE** or numeric keys **P/0...Z/9**) sets the amount of steps per separate drum or melodic tracks. After choosing the track with **TRACK D/1/2/3** buttons, we adjust its pattern length
- In melodic tracks editor that button acts as a flag for enabled slide on the active step
- In the * menu acts as alternative selection of project or pattern load/save

- **TEMPO + LAST STEP** locks the BPM value on the screen
- When arpeggiator enabled with **1/32...1/4** buttons, short press latches the arpeggiator, and long hold enables arpeggiator's super-latch mode
- In **F/MOD.OUT** settings, pressing that buttons enables smooth CV values vs stepped modulation values.

TRACKS D/1/2/3



Ground Control features **1 DRUM TRACK** (consisting of **8 TRIGGERS**), **3 MONOPHONIC MELODIC TRACKS** and **1 MODULATION TRACK** assignable to any of those tracks. Once we are going to record, play, or edit one of the tracks, we activate it with appropriate **TRACK D/1/2/3** buttons.

Each track has a special dot symbol, which is written in same combination on the track names as well as also duplicated with physical bumps on the rubber keys to help navigate those main tracks with the fingers when you are on the stage:

drum track ∙∙ **track 1** ∙ **track 2** ∶ **track 3** ∶ ∶

You can only select one of the four tracks at a time and depending on which track is active you can configure different MENU settings.

- In the menu settings of a specific track, **TRACK D/1/2/3** buttons enter that track's settings
- Combination of **TRACK 1/2/3 + TRANSPOSE +/-** buttons will shift currently selected pattern by 1 octave up or down on each combo press
- Combination of **TRACK D/1/2/3 + 1/32...1/4** buttons sets the time division of the track. Same combination with the long hold sets the same division but in triplets
- Combination of **TRACK D/1/2/3 + PLAY** during the playback resets pressed track to the first step.


DISPLAY



4-symbol display shows various information:

- By default or on time-out it always shows currently selected preset on each of the tracks: each of the 4 letters of alphabet shows one of the 24 (**A to Z**) patterns on each of the **TRACKS D/1/2/3**. The dots pattern above the screen corresponds to same bumps on the rubber buttons of the tracks
- In the menus display shows numeric values, parameters of selected menu items, hints etc.



 - small dot near each track letter appears if that pattern is altered and is currently *unsaved*. That dot disappears if we switch to another not altered pattern. After returning back to the unsaved pattern the dot will appear again. Once we save the pattern (or **SAVE EVERYTHING** by *^(PROJ) → **RECORD** → **RECORD**), the dot disappears.

- Once we turn off the module's power, all unsaved patterns will be lost.

THE ALPHABET / DISPLAY TYPE-FACE FAMILY

88888888888888888888888888888888

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

000000000000000.

0 1 2 3 4 5 6 7 8 9 # / - * > ? + .

PATTERNS

Each of 24 A to Z projects of Ground Control has **4 TRACKS: D, 1, 2, 3**.

Each of those four tracks consist of **24 PATTERNS**.

Each of 24 patterns correspond to twisted 24 Latin alphabet letters from **A** to **Z** (with the same pattern sharing V/U letter and missing X letter).

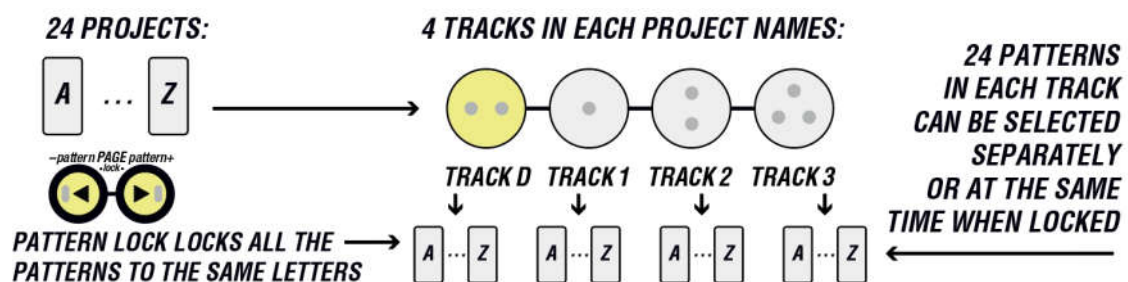
Each pattern consist of maximum **64 STEPS**.

Combination of **LAST STEP + ◀PATTERN/PATTERN▶** or **TRANSCOPE+/-** sets amount of steps on each of those tracks.

Drum track consists of **8 DRUM TRIGGERS TRACKS**.

Each of those 8 drum tracks can be of any length and up to **64 STEPS LONG** – i.e. fully polymeric.

Combination **LAST STEP + MUTE BUS buttons** → **TRANSCOPE +/-** sets the length of each drum track. After choosing the track, we adjust its amount of steps



→ *Note: there are no patterns with the letters U and X.*

Each track can have any of 24 available patterns, or you can lock them (with **◀PATTERN/PATTERN▶** buttons, so switching the patterns on one track will switch the same pattern's names on other tracks.

→ *Once the patterns are locked, both **◀PATTERN/PATTERN▶** buttons are lit and the patterns on all 4 tracks are switched **ONCE THE LONGEST PATTERN ON EITHER OF THOSE TRACKS HAS FINISHED**.*

Selecting the patterns can be done in the various ways:

→ Selecting active track with TRACK D/1/2/3 buttons and then switching the pattern on that track by incrementing up or down with **◀PATTERN/PATTERN▶** buttons

- We can change to exact pattern on the any track by pressing **TRACK D/1/2/3 + A...Z** piano keys buttons
- Pressing * → **A...Z** piano keys buttons in the live pattern mode.

POLYMETRICS

Ground Control's power is in its freedom of workflow and pattern flexibility, where each track can run at its own speed and have independent pattern length - polymeric sequencing.

A *polymer* is best described as the superimposition of one meter on top of another. It could also be described as the simultaneous performance of two or more independent meters.

For example: by using the **LAST STEP** button we can set **TRACK 1** to have pattern length of 16 steps and **TRACK 2** to have pattern length of 12 steps. This will create an interesting Polymetric relationship between tracks 1 and 2 as they will no longer loop at the same points in time, creating a phasing and hypnotic feel that always evolves in time. Each of 8 drum triggers can also have independent amount of their steps. This can be extremely useful when creating more complex rhythmic relationships between tracks.

You can use additional reset inputs to control and reset the tracks in case you don't want to hear constant sequence phasing with polymeric configuration.

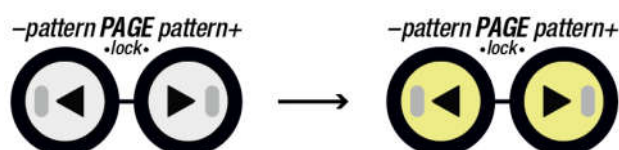
PATTERN CHAIN

By holding **TRACK D/1/2/3** buttons + entering a sequence of the letters **A...Z** (even repeating the same letters) will add the patterns to the **PATTERN CHAIN** – i.e. they will be played sequentially and in order once the chain is entered. After we choose another pattern or its chains, we lose the previous chain. Maximum amount of patterns in the chain is 24. There is no specified song mode in the Ground Control however you can chain the patterns to switch one by one in the chain imitating that mode.

Once recorded, pattern chains can also be saved with **SAVE ALL** combination:
*** → RECORD → RECORD** and restored on the next project or module's power up.

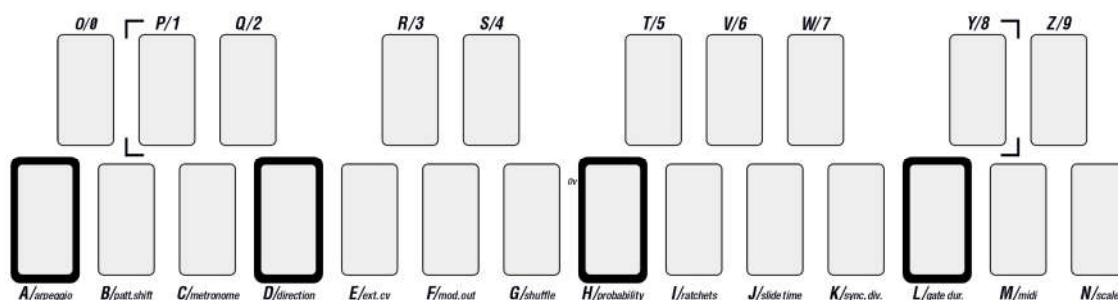
PATTERNS LOCK

By pressing both ◀ **PATTERN + PATTERN** ▶ buttons, we lock the patterns which means changing one pattern on one track will change to the same pattern name on the other tracks:



Patterns are not changed instantly to the next one, but after the current one is finished. The next step after current pattern has finished will be the first step of the new selected pattern.

2 OCTAVE / 24 PIANO KEYS



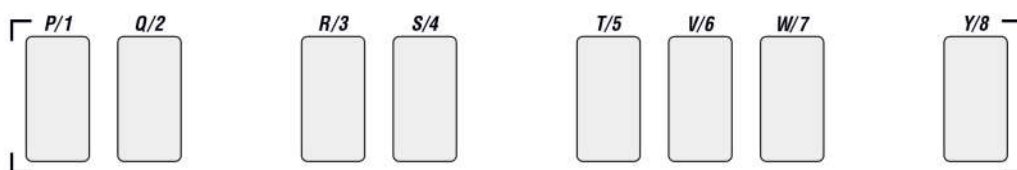
Sequencer has 2 octaves or 24 piano keys buttons – they are momentary, silicone rubber keys for entering melodies, drums, steps, selecting the patterns, accessing the menus, entering alphabetical and numerical values etc.

→ *Piano keys are not velocity or pressure sensitive*

PIANO KEYS USE

→ Play/preview melodies or trigger the drums when we are in a normal, non-recording mode:

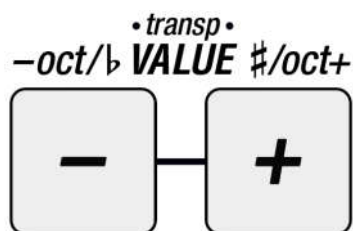
- Once we activate one of the melody **TRACKS 1/2/3**, pressing those keys will generate the pitch CV and gate information on appropriate 3,5 mm TRACK 1/2/3 **OUTPUT JACKS** as well as generate MIDI notes information on MIDI and USB-MIDI outputs on the channels set in the **MENU TEMPO** → **M/MIDI**. Keys cover range of two octaves F to E and we can shift (transpose) the keyboard up or down to play the keys in higher or lower octaves. When no octaves are shifter (TRANSPPOSE+/- buttons not lit), C-note **E/EXT.CV** corresponds to **C3** note or 0v on pitch CV outputs.
- Once we activate the drum track with **TRACK D** button, we can preview/play/record drum triggers with the top row of keys marked as **P/1...Y/8**. Each of those keys has a number, digits **1 to 8** corresponds to appropriate 1 to 8 trigger outputs marked with []:



- Once we activate the arpeggiator/roller with **1/32...1/4** buttons, piano keys buttons activate the notes sequences once pressed in a chord or activate the drum rolls once we press the drum triggers
- Select the next pattern on active track in the combination of buttons: *** → A...Z** buttons. Once the new pattern is selected, it will be launched once the current one has finished playing its last step (or its full cycle in case of pendulum or random directions)
- Enter the menu items using the lower row of keys A to N and combination of **TEMPO + A...N** or **TEMPO → A...N**. Small hints are written near each of A...N letters and correspond to various menu item group settings, which are described in the MENU section below
- Numerical input **0...9** with the upper row of **0/0...Z/9** buttons to enter the exact parameter value along with the **VALUE-/+** incremental buttons

- Save current pattern to another pattern (via combo ***** → **RECORD** → **A...Z**) and also to load (open) or save one of 24 projects (via combo ***** → **LAST STEP** → **A...Z** to load another project and ***** → **RECORD** → **LAST STEP** → **A...Z** to save current project into another project name cell).

TRANPOSE / VALUE CHANGE BUTTONS



Initially **-OCT / OCT+** buttons are used to transpose the keyboard playing or recording melodic **TRACKS 1/2/3**. Ground Control range is **10 OCTAVES** per each melodic track so there are 4 octave shifts down to the lower range with **-OCT** button and 4 octaves shifts up to the higher range with **OCT+** button.

Combination with **TRACK 1/2/3 + TRANSPOSE +/-** buttons will shift currently selected pattern by one octave up or down on each combo press.

VALUE +/- buttons are also used to set values in various menu items (incrementing up or down), for example changing the track's step number via combo **LAST STEP + MUTE BUS** buttons and adjusting selected track length with **VALUE +/-** buttons. In contrary to **VALUE +/-** buttons, which adjust incremental values by ± 1 , **◀ PATTERN/PAGE/PATTERN ▶** buttons increment values usually by ± 10 or ± 16 depending on the context to speed up the values adjustment.

- *Transpose buttons don't work on the drum track.*

SEMITONE TRANPOSE (MELODIC TRACKS)



By pressing both **-OCT + OCT+** buttons together once, we activate the semitone transpose mode. In that mode both **-OCT/OCT+** buttons will be fully lit and you will see **'SEMI'** message on the display. That means after pressing **A...Z** buttons

we can shift the notes on the track by the amount of semitones up or down from the root C note (marked with **E/EXT.CV**). In that mode you can press single **-OCT + OCT+** buttons to shift the keyboard to transpose to higher octave intervals up or down on the currently selected active **TRACKS 1/2/3**.

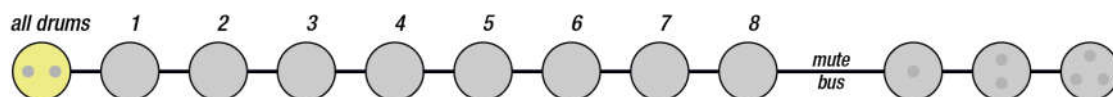
LOCK SEMITONE TRANSPOSE



In semitone transpose that mode, short press the **LAST STEP** activates the **LOCK SEMITONE TRANSPOSE** mode: you will see '**LOCK**' message on the display. That means that semitone transpose on current track, will be applied to all three melodic **TRACKS 1/2/3** at once.

You can exit transpose mode again by both **-OCT + OCT+** buttons press or single **STOP** button press without stopping the sequencer. Remember to save your edited patterns after you shifted them by semitones up or down. Otherwise, you will lose those changes on the next module's power up.

MUTE/SOLO BUS



Mute bus is a row of buttons, whose main function is to mute a certain track. In addition, each of those buttons blink each time the note happens on that track which is useful to monitor activity on the tracks. **ALL DRUMS** button isn't blinking as we already have every drum trigger blinking with its own drum trigger.

By default, the mutes have **NON-QUANTIZED** action – i.e. they mute/unmute instantly. However if we hold the MUTE button for 1 second, it changes its mute action to **QUANTIZED**: i.e. that track will stop or start its new cycle quantized to the track's pattern length. Use it on your musical choice – sometimes it is important to enable some tracks instantly, however sometimes is good to queue the mute for one or multiple tracks so it will be enabled or disabled at a certain time.

ALL DRUMS button will mute/unmute immediately all the 8 drum triggers. After ALL DRUMS unmute, manually muted before tracks will be remembered. You can press any MUTE buttons at a time to mute certain channels at once. Muted tracks are remembered once you save the project (*** → RECORD → RECORD**).

SOLO

TEMPO+MUTE BUS buttons acts as a momentary **SOLO** for the tracks. This action works opposite to the mutes i.e. rest tracks will be muted and only selected tracks will be enabled.

CLEARING THE PATTERN

Combination of single **PROJECT + ANY MUTE BUS** buttons press will **CLEAR** the notes/triggers on the selected track but will leave the pattern length unchanged. Second **PROJECT + SAME MUTE BUS** press will clear the steps number of that track to default 16 steps.

Single **PROJECT + ALL DRUMS** press will clear all 8 drum triggers at once. Second press will reset all 8 drum trigger tracks to 16 steps.

→ *Maximum number of steps per track is 64*

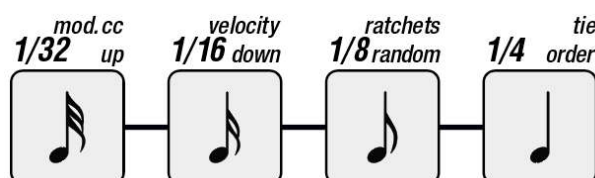
PATTERN / PAGE BUTTONS



The main functions of these buttons is to switch the patterns on the active track, incrementing up or down with **◀ PATTERN/PATTERN ▶** buttons.

These buttons have additional labels as ◀ **PAGE** ▶, i.e. in certain menus they increment values by numbers of 10 or 16 depending on the context to speed up the values adjustment in the menus.

TIME DIVISION / ARPEGGIATOR / 1/32...1/4



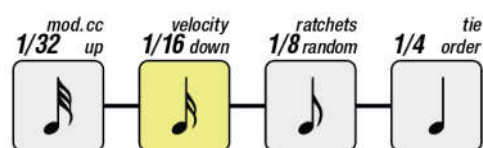
Combination with **TRACK D/1/2/3 + 1/32...1/4** buttons sets the **TIME DIVISION** of the track. Same combination with the long hold (1.5 seconds) sets the same track's division but in **TRIPLETS**.

1/16 is always default and most used time division for any new projects therefore is marked with ° symbol at 1/16° in the old design.

ARPEGGIATOR / ROLLER

Another function for those buttons is to enable/disable **ARPEGGIATOR** on melodic TRACKS 1/2/3 and the **ROLLER** for the drum track.

Pressing **1/32...1/4** buttons enables one of the **4 ARPEGGIATOR MODES** available: **UP / DOWN / RANDOM / ORDER** (the button selected will start to blink):



Pressing **1/32...1/4** buttons on the drum TRACK D will enable the drum **ROLLER**: each drum trigger note **P/1...Y/8** pressed will repeat itself following the selected time division **1/32...1/4**. To disable the roller press **1/32...1/4** button again.

The roller on the drum track follows the pressed 1/32...1/4 time division – however only the time division initially selected for the track will be recorded if recording the roller in real-time (see section below).

When we are on the active melodic TRACKS 1/2/3, combination **1/32...1/4 + TRANSPOSE-/+** set the arpeggiator's **OCTAVES RANGE** (**0** by default, possible options: **-2, -1, 0, 1, 2**) – that means how many octaves the arpeggio pattern will sweep through.

- *Once the arpeggiator is running the notes, you can change the modes on the fly. You can play and latch all arpeggiators and a roller on all available tracks simultaneously*
- *Arpeggiator and rolls can be recorded in the live recording mode, however remember the rolls will always be recorded taking into the account the current track's time division settings*

LATCH / SUPERLATCH / TRANSPOSE

Pressing LAST STEP enables **ARPEGGIATOR'S LATCH**: it enables the arpeggiator to remember the last set of notes played on the keyboard. When Latch is activated, the Arpeggiator sequence will continue to play even after notes have been released. Arpeggiator's notes are cleared when playing the next chord.

To disable the arpeggiator, press **1/32...1/4 or LAST STEP** again. The arpeggiator will always have the track's time division it is played on and is set by **TRACK D/1/2/3 + 1/32...1/4**.

Holding LAST STEP for longer than 1.5 seconds enables **ARPEGGIATOR SUPER-LATCH**:

- Pressing keys, will add them to the arpeggiating cycles
- Pressing keys that are already part of the arpeggio playing, will remove them from the current arpeggio
- Short press on **STEP** while super-latch is active, deactivates super-latch without clearing the note buffer to allow seamless integration of modes
- Maximum notes amount in arpeggiator is 24.

- One can also lock the mode to transpose all tracks
- Pressing **STOP** button exits the transpose mode (or lock status)

project pattern
select live sel.



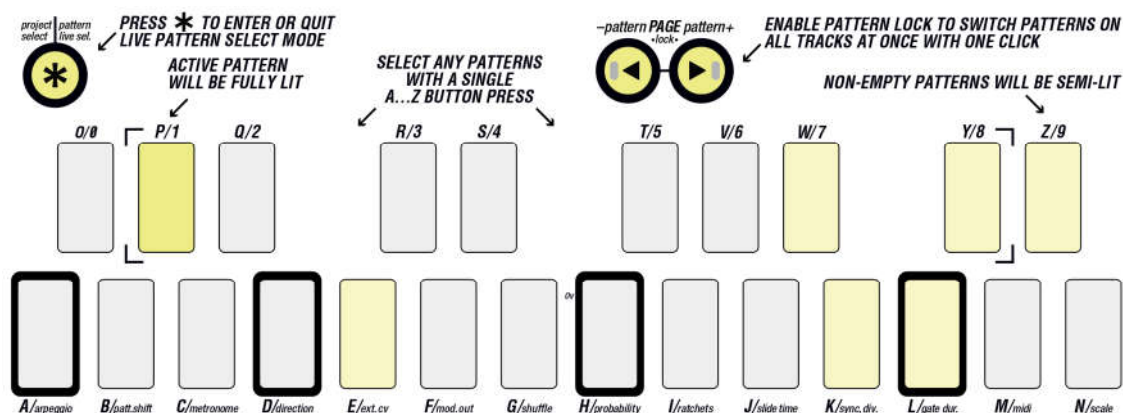
*** (PROJ, asterisk symbol)** button combinations are related to the pattern/project saving/loading/clearing functions, which usually are associated on the same level or upper the ***** button.

[illegible]

Single press of the *^(PROJ) button will enter the **LIVE PATTERN MODE**. In that mode you can change patterns with appropriate 24 piano keys. That is essential live performance tool when you can choose the patterns only with a single button

press. When you enable **PATTERN LOCK**, then you can select the same patterns on all 4 tracks at the same time with a single key press.

Pressing ***^(PROJ)** button during live pattern mode will exit that mode.



Pressing **LAST STEP** button in live pattern mode will enter the **PROJECT LOAD** menu and you can load any other project with **A...Z** buttons without stopping the sequencer. Loading a new project can be done smoothly on the fly when the current project is still running without losing the sync. Once you press a new project load, after the longest pattern of current project will be finished, all new patterns from the new project will be played on the next step.

→ Pressing **TEMPO** button during live pattern mode will act exactly the same as **LAST STEP** button (i.e. selecting new project), however after the new project will be loaded, the live pattern mode will be enabled automatically.

SAVING THE PATTERNS AND PROJECTS

Pressing ***^(PROJ)** → **RECORD** or ***^(PROJ)** + **RECORD** buttons will enter the pattern save function.

Once you pressed ***^(PROJ)** → **RECORD**, you can further:

→ press **RECORD** one more time to **SAVE ALL** settings – means all unsaved patterns on all the tracks will be saved. That also will save all the settings you've made in the menus – e.g. MIDI channels, slide amount, pattern direction, BPM etc. That is the fastest combination to save anything you have just recorded or changed

- press any of **24 A...Z** piano keys to save current pattern to another pattern letter
- press **TRACK 1/2/3** → **A...Z** to save currently selected pattern on currently active track into ANOTHER track's pattern letter
- press **LAST STEP** → **A...Z** to save current project in one of 24 project letters A...Z. Unused (clean) project will show as unlit buttons and used projects will show as semi-lit ones. The project you are currently are in will blink. To confirm the saving you will see **SAVE** question on the screen and you can confirm overwrite ('**OUR?**' message) with either pressing **RECORD** or **PLAY** buttons if another project destination letter you are trying to save is not empty. To cancel the procedure and exit press **STOP** once.

After you save any pattern on a certain track (or save all fast via ***^(PROJ)** → **RECORD** → **RECORD**), those chosen patterns are restored on next modules power up. Last used project is also loaded on the next modules power up.

- *Remember the logic: you can always only save current pattern/project to itself or other destination.*

TEMPO BUTTON

*rest/***TEMPO**



TEMPO and ***^(PROJ)** buttons mainly work as **SHIFT** buttons.

TEMPO button functions are mostly related to the various **MENU** settings in combination with the lower row of **A...N** piano keys (**TEMPO + A...N** or **TEMPO** → **A...N**).

One particular feature of the **TEMPO** button is setting the tempo value in beats-per-minute (**BMP**):

- when pressing **TEMPO** button 3 or more times, it will act as a **TAP TEMPO** button (for security reasons to not accidentally change - it can be disabled via **SETTINGS** menu: **TEMPO** → **M/MIDI** → **C**)
- when pressing **TEMPO** button once you will see current project tempo or tempo of external clock if the sequencer engaged to external MIDI/USB or jack clock. Default project's BPM value is 120. Once you see that value on the display, you can adjust it:
 - with **VALUE** **-/+** buttons incrementing by 1 value at a press or long press to speed up the values changing
 - with **◀PAGE▶** buttons incrementing tempo values by values of 10 per single press
 - entering new BPM value with numeric **0/0...Z/9** piano keys
 - **TEMPO + LAST STEP** combo **LATCHES THE BPM** value appearance on the display – that is useful if you need to monitor the tempo

RECORDING



There are a few ways to record the notes on the tracks:

- **STEP RECORDING**: sequencing 101-style
- **XOX-STYLE EDITOR** for DRUMS: editing triggers with 16 steps per page
- using **LIVE RECORDING** using internal 24-piano keys or external MIDI controllers
- manually entering/altering the notes/velocities/modulation in the **EDITOR**

STEP RECORDING

STEP RECORDING is a method of entering notes step-by-step (starting from first step) with entering **ACTIVE NOTES** and **RESTS** (pauses) into existing time-division grid. It was introduced old ago in synthesizers such as Roland® SH-101 but also in *Endorphin.es – Running Order*.

Once the sequencer stopped, the **RECORD** button is pressed once. The existing sequence/pattern on the current track is cleared and overwritten by a newly entered sequence of notes/pauses (**rests**). Exit that mode by pressing **RECORD** or **STOP** without anything to record and the previous sequence will not be cleared. This mode currently only works when the sequencer is not running. To store the sequence of notes/rests, just press **PLAY**. The newly entered sequence will run through the CV/gate jacks or via MIDI.

In that record mode, **TEMPO** button acts as a **REST** - i.e. inputting an empty step and engaging to the next one. Overlapping the keys (i.e. holding one of **A...Z** buttons and pressing another **A...Z** button) will put a **SLIDE** on that steps transition.

Pressing **1/4** (**TIE**) or **TEMPO** buttons in record mode in conjunction with one of the **A...Z** keys will create a **TIE** - i.e. creating a note that occupies more than one step in the pattern and has a longer duration. Thus using TIEs creates longer notes. After years of trial and error, we found that this method is one of the most effective for entering patterns and grooves fast, which are melodic, occasionally unpredictable and can have a various metric (steps length) which is useful in various electronic music styles

EXAMPLE #1 OF STEP RECORD

Press **STOP** and switch to melodic **TRACK 1**. Select new pattern **B** by switching **PATTERN►** button. Press **RECORD** button and press a notes sequence with **A...Z** keys pairing with **TEMPO** button acting as a **REST**. Press **PLAY** to start the currently entered sequence. Alternatively, you can press another **TRACK D/1/2/3** to instantly continue entering steps on another track. That is useful to quickly fill the patterns on all the tracks.

EXAMPLE #2 OF STEP RECORD

Press **STOP** and switch to drum **TRACK D**. Select the pattern you wish to record and then press a few times one of the **1...8** piano keys. In that case, you will know exactly which drum trigger you are going to record and you can switch to different drum triggers to preview the drums. After you decided which drum you are going to record in step mode – just press **RECORD** and enter that drum sequence of triggers pressing the same **1...8** drum trigger keys and **REST** button. After you have a sequence ready, you can either: press play to start that sequence playing or press another **1...8** button to immediately start to record another drum trigger sequence. Once you press that buttons, the amount of steps and all the triggers/rests on the previously recorded track will be saved.

→ *Selecting other **1...8** drum triggers on drum track or choosing other **TRACKS D/1/2/3**, will switch the step input or live recording on next track while keeping the recording enabled. In such way you can speed up the step input or live record of tracks one by one.*

LIVE RECORDING

Live recording is another way to record the notes into the tracks.

First of all you have to press **PLAY** so the sequencer is running. Then press **RECORD** button and enter the notes with the keyboard or attached MIDI or USB-MIDI keyboard controller. The notes will be recorded quantized to the currently selected grid.

If you don't like what you recorded you can quickly **CLEAN** that track by pressing ***^(PROJ) + MUTE BUS** button once. That will clean only the notes on that track but will keep it's length. Second ***^(PROJ) + MUTE BUS** button press will also clean the step number of that track to default 16 steps.

There is no way to adjust the amount of steps of the pattern during the live recording mode. You can do that only via the step record mode, or manually set the amount of steps via LAST STEP+MUTE BUS button that corresponds to that track + adjust the value with **VALUE-/+** or **◀PAGE▶** buttons or using numerical **0/0...Z/9** keys.

Remember to always save the pattern once you have entered the notes and you like it. The easiest way to do that is ***^(PROJ)** → **RECORD** → **RECORD** from anytime the sequencer is running or stopped. Last saved project or selected patterns saved are restored on the next module's power up.

WAIT FOR RECORDING



Is a special live record mode in which sequencer is stopped and waits for the first note to be entered with the piano keys or via MIDI to immediately start playback with the live recording enabled. That feature is enabled by **TEMPO + RECORD** once the sequencer is stopped. Once pressed you will see **WAIT...REC** on the screen meaning you have to enter the notes or triggers for the live record to begin. That's a nice feature if you want to record some melody or arpeggiator faster, but don't want to wait for the next pattern cycle to properly start first notes.

EDITOR

Once you want to edit already recorded notes, you can do that via the editor.

Press and hold **RECORD** button for more than 1 second to enter the currently selected track editor. In the editor you can change the tracks without quitting the editor by pressing **TRACK D/1/2/3** buttons.

In the editor, you can navigate thru the steps via **◀PAGE▶** buttons and current step will be shown on the display. Once there is an active note on that track you will see that key light up on the piano keys. Be aware that piano keys show only current middle view of the keyboard so if you are sure the note is present on the current step but you don't see it, then you should navigate with the **TRANSPOSE-/+** buttons to find that note appeared on another octaves. Once you will reach the last step on the current track, it will be marked with two dots, i.e. if you are on the pattern A with length of 16 steps, then reaching the 16th step you will see: A_.16. Pressing ***^(PROJ)** button anywhere in the editor will add one extra step in the end of

the currently edited pattern. Pressing **REST/TEMPO** anywhere in the editor will clear current step from any notes and associated flags.

Once you navigating thru the steps, you can edit the notes and their features – so called **FLAGS**. Flag is a binary additional feature (0 or 1) which that step can have. You can turn the notes on or off in the editor and then add or disable their flags. To clean the note you can either press it again – i.e. press on the light up piano key or press the **REST** button. Each note can have following flags: **RATCHETS**, **TIE** or **SLIDE** or **REST** (empty step). Those are ON/OFF features, meaning they are either present or not.

- **TIE** ($1/4$ button) merges current note with the next one creating a twice longer one. If that next note will also be tied with the third one, then the overall note's duration will be triple longer than selected track's time division etc.
- **REST** (**TEMPO** button light up red) always cleans the current note and any modulations/velocities that are on that current step.
- **RATCHET** ($1/8$ button) flag means the ratchet is enabled on the current step. The amount of ratchets can be set via the MENU: TEMPO → I/ratchets per track.
- **SLIDE** (**LAST STEP** button) flag means that the note will slide to another one on the last step before the destination note. Slide time can be set via **MENU: TEMPO** → **J**.

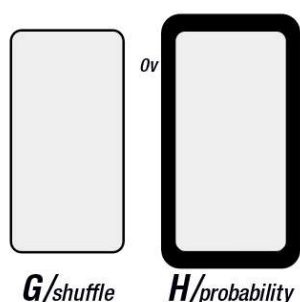
There are other additional features of the notes: **MODULATION** and **VELOCITY**.

While there is only one modulation track, which can be connected, to any of 8 drum or 3 melodic tracks, each note or drum has a velocity. Both can be recorded via MIDI or USB-MIDI controller, however also manually entered or adjusted per-step in the editor.

MODULATION EDITOR

To access the **MODULATION EDITOR**, switch to the track it is assigned to and long press **RECORD**. Press **MOD.CC** ($1/32$) button and you will get into the modulation step editor for the current pattern with the display showing **C__1**: meaning you are editing CC modulation #01 (always **CC#01**) on the drum track (default Rx/Tx MIDI channel 10).

Navigating thru the steps with the ◀ **PAGE** ▶ buttons you select the step on which you wish to adjust the modulation value and then either with **VALUE-/+** buttons or lower row of **A...N** buttons set the value from 0 to 127. Those 128 values correspond to 7-bit CC#01 message sent thru the MIDI and USB-MIDI outputs as well as converted into physical CV from 0 to +5V or -5 to +5v range at the MOD. OUT jack output. In the bipolar output mode to select exact 0v output, just press both **G** and **H** keys together that will correspond to CC or velocity value to 64:



MODULATION OUT JACK ^{FW V.2}

It is possible to assign modulation or velocity of a certain track to modulation output jack. If it is assigned to modulation of a certain track or drum track, it automatically obtains the length of the steps on that or other drum track.

Modulation output jack settings are accessible in the menu via **TEMPO** → **F/MOD.OUT** combination: see the **MENU** section below for all the settings.

VELOCITY EDITOR

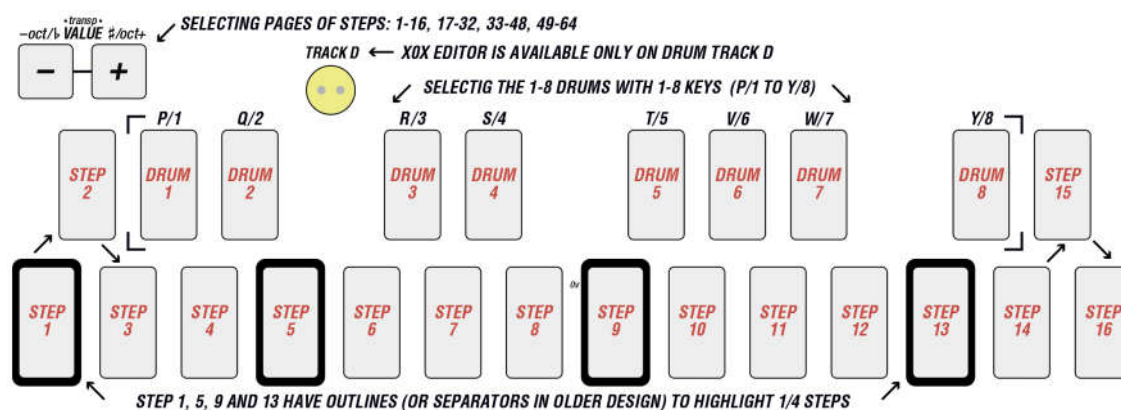
To access the **VELOCITY EDITOR**, switch to any of the **TRACK D/1/2/3** and long press **RECORD**. Press **VELOCITY** ^(1/16) button and you will get into the velocity step editor for the current pattern with the display showing **V__1:** meaning you are editing velocity value on the selected track or selected drum trigger with 1...8 buttons. Navigating thru the steps with the ◀ **PAGE** ▶ buttons you select the step, the note's velocity on which you wish to adjust and then either with **VALUE-/+** buttons or lower row of **A...N** buttons you set the value from 0 to 127. Those 128 values correspond to 7-bit note's velocity message sent thru the MIDI and USB-MIDI outputs on certain note appearance.

→ Velocity value 0 means the note isn't fired

XOX-STYLE EDITOR (FOR DRUM TRACKS)

For editing the drums patterns, is easier to use **XOX-STYLE** editing inspired by Roland® TR-606/808/909 etc. machines. That XOX editor is a part of standard editor and exists only for the drum track.

To enter the editor long press **RECORD** and then select **TRACK D**. In that mode lower row of 14-piano keys together with **O/O** and **Z/9** side keys creates 16-step grid. Press **P/1...Y/8** buttons to select the drum trigger – that selection activates its steps on imaginary 16-step grid:



In that drum mode we see only 16 steps at once: from step 1 to 16 (page 1 is shown as **P_1**). Press **VALUE-/+** buttons to navigate to **NEXT PAGES**: page 2: **17-32** steps, page 3: **33-48**, page 4: **49-64** steps. You can access pages 2 to 4 only if a certain selected drum has more than 16 steps (selected via **LAST STEP + MUTE BUS DRUM + VALUE-/+** or **◀ PAGE ▶**).

In the XOX editor you can switch between the drum notes to see each drums' grid by single press of those drums. Second press of the same drum will preview it on the drums triggers and MIDI or USB-MIDI outputs.

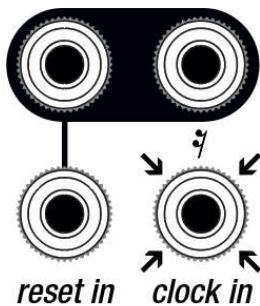
→ You can access the editor when the sequencer is stopped or when it is running

LIVE EDITOR

It is possible to adjust notes and drums step-by-step on the go – i.e. when the sequencer is running. Once the playback is running, long press the **RECORD** button will enter into the live editor mode. On the drum track you will be shown the XOX editor where you can see steps running in real-time and navigate thru the pages with **VALUE-/+** buttons. On melodic **TRACKS 1/2/3** you will see the step editor and the notes will blink if they run on the current selected step.

CLOCK I/O / RESET I/O

reset out clock out

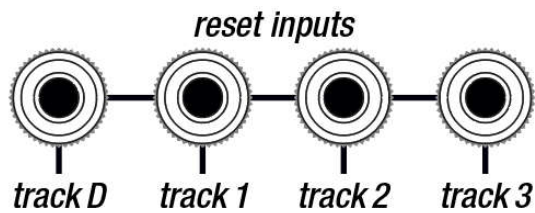


Clock and reset are analog logic **INPUT** and **OUTPUT** signals made to synchronize Ground Control together with other Eurorack gear (typical 1/16th notes clock and reset). The trigger outputs are 0...+10V range 10 mSec length to be able to clock various gear. Trigger inputs are typically 0...+5V expected with the threshold of 0.65V.

Ground Control sends one short trigger from its **RESET OUT** jack on playback start when you press the **PLAY** button.

Applying a trigger into the **RESET IN** jack (or manually pressing PLAY while the sequencer is running) will reset all the sequences on all 4 **TRACKS D/1/2/3** to the first step.

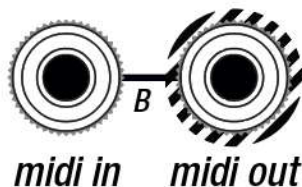
There is a row of separate track's reset inputs, meaning you can apply a trigger on a certain track to reset it independently from others to the first step. You can also manually reset certain tracks to the first step by **TRACK D/1/2/3 + PLAY** combo. Each separate track's reset is synchronized to the grid of each track's selected time division (**1/16** by default):



CLOCK OUT – is a master clock output sent by default in sixteenth notes (corresponds to PPQN/6 or 1/16th notes), therefore is marked with $\frac{1}{16}$ symbol. Refer to **K / SYNCHRONIZATION / DIVIDERS** below of the **MENU** section on how to set the **MASTER CLOCK** and its **OUTPUT DIVIDRS**.

CLOCK IN – is external clock input from another master sequencer or clock generator (e.g. Running Order). By default the standard is typical in eurorack in sixteenth notes (PPQN/6 or 1/16th) by default.

MIDI I/O



Those are 3,5 mm TRS type B MIDI jacks.

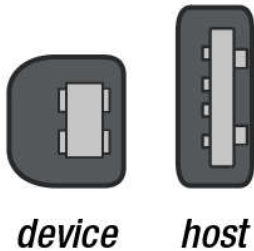
MIDI pinout – **TYPE B**: standard of Arturia® Beatstep Pro, 1010Music, ALM, Erica Synths, Polyend, VPME etc. (see more at <https://minimidi.world>):

- **PIN 5 – RING** (current sink)
- **PIN 4 – TIP** (current source)
- **PIN 2 – SLEEVE** (shield)

One adapter is included with the module and you can use any third party ones just ensure it is B-standard.

All the MIDI related settings can be accessed via the **MENU: TEMPO → M/MIDI** (see MIDI settings below).

USB-MIDI HOST-DEVICE I/O



Those are similar as **CLASS COMPLIANT** USB-MIDI **TYPE A** and **TYPE B** sockets.

If you familiar with *ENDORPHIN.ES - SHUTTLE CONTROL*, they are similar in the Ground Control. Moreover, Shuttle Control may and will work as a perfect MIDI expander module for the sequencer where you can assign all the velocities, internal generators etc.

You can plug any USB class-compliant USB-MIDI devices:

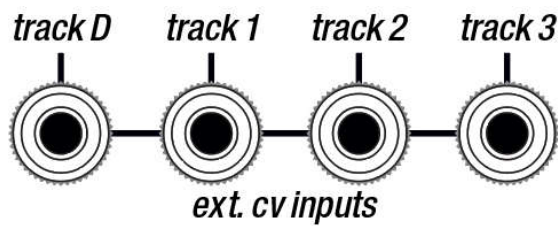
- Usually **DEVICE** is connected to the computer or tablet. In that case Ground Control works as a USB-MIDI to CV converter or you can use Ground Control as MASTER clock for your DAW since USB-MIDI is bidirectional.
- usually **HOST** is connected to various MIDI controllers: from USB-MIDI keyboards, faderbanks etc.

By default, any MIDI input events are appearing into any MIDI outputs. However with the USB-MIDI sockets we can decide if we wish to pass the MIDI flow from host to device or from device to host or have a host loopback (a.k.a. **MIDI THRU**) in the **MIDI MENU** settings via **TEMPO** → **M/MIDI**.

Note for using the Ground Control with Arturia® Beastep Pro/Keystep Pro devices via USB. Those devices mirror any MIDI notes that enter that via USB-MIDI connection. That may cause issues and double notes press or unwanted loops using the arpeggiator. For best work set TX channels on BSP/KSP devices to unused MIDI channels (i.e. 4 or other).

EXT. CV INPUTS ^{FW V.2}

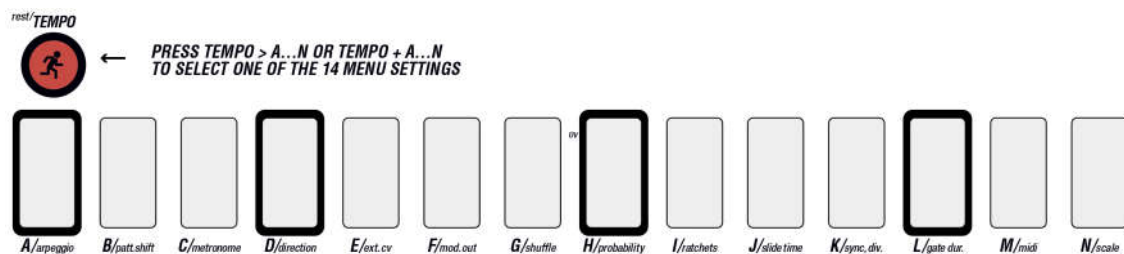
There are four, assignable, un-attenuated **CV INPUTS: D, 1, 2, 3**. CV input range is -5v...+5v or 0...+5V depending on the destination it is assigned.



Modulation matrix is accessed via **MENU: TEMPO** → **E/EXT. CV** and is available from firmware version 2 of higher.

In the CV modulation matrix, you can assign each of the 4 CV inputs (D, 1, 2, 3) to various parameters from the list: see **E/EXT.CV** menu list below.

MENU



There is no obvious menu diving in the module except **TEMPO** → **A...N** or **TEMPO + A...N** lower row of 14 piano buttons. With those keys combinations we instantly access to various sequencer settings, which are organized into 14 PAGES over **A...N** buttons. Some of the menu items are picked with similar letters to remember their access but all other coincidences are for technical purpose only. You can change those settings whenever when sequencer is stopped or is running.

A / POLYRHYTHMICAL TIME-BASE ^{FW V.2}

Polyrhythms allow you to stretch and squeeze a given number of steps within a defined pattern length, in other words as "stretching a pulse train".

The more technical definition of polyrhythms is as follows: polyrhythm is the simultaneous use of two or more rhythms that are not readily perceived as deriving from one another, or as simple manifestations of the same meter. The rhythmic layers may be the basis of an entire piece of music (cross-rhythm), or a momentary section.

Some examples of the polyrhythmic patterns:

17:16 - this means that the pattern length is 16 steps, but instead of having 16 16th notes within this pattern, we have 17 notes, which are slightly shorter. This way we are squeezing 17 steps into 16, without changing the pattern length.

27:32 - this means that our pattern length is 32 steps, but instead of having 32 16th notes we only have 27, that still fill up all 32 steps with extended note duration. In this case we are stretching 27 steps to fit the 32 steps.

As you can see, polyrhythms allow you to play around with the length of steps in the pattern, creating more complex rhythmic structures and relationships both between steps in the sequence and between tracks. Ground Control allows you to have polyrhythmic patterns up to 32:32, which is not possible on any other sequencer currently available in either eurorack or outboard hardware formats.

First we need to select a track, any of the 4 tracks can have polyrhythmic behaviour.

Once the track is selected, we can access the polyrhythmic setup using a combination of **TEMPO + A** buttons. The 2 numbers light up on the screen, by default it is set to 4:4, which is the most basic time signature. The first number sets the imaginary number of steps in a sequence and the second number sets over how many steps the previously selected number of steps are stretched / squeezed.

Note: 4:4 / 8:8 / 16:16 / 32:32 will all give you the same time signature as in the end the ratio is always 1:1 and no steps are being stretched or squeezed.

Once the numbers appear on the screen you can start changing them, the first nominator number can be incremented by +/-1 using the **PAGE** buttons and the second denominator number is changed using the **VALUE** buttons.

Let's set the first number to be 5 and the second to be 4, resulting in a 5:4 time signature. This means that now we can fit 5 steps into an imaginary pattern of 4 steps long, which will shrink the duration of each note in the sequence to accommodate one extra step.

The time signature numbers do not change the pattern length, as they only set the timing of steps in the sequence, so for example you can still have a 16 step

sequence, but the time signature will now be 5:4 instead of 4:4. It is best to play around with this to get a better feel and understand how the time is affected. Try setting the same time signature for all tracks, create a beat on the Drum Track and a melody on the TRACK 1/2/3 and you will hear the subtle differences that polyrhythms introduce. Another interesting time signature to try out is 17:16, which almost sounds like 4:4, but has a slight shift in the step duration.

→ *If you want to experiment even more, we recommend trying to combine Polymetric and Polyrhythmic sequences, where both the time signature and pattern length are changed.*

B / PATTERN SHIFT (NUDGE) EXT. CV



Pattern shift, nudge or pattern's rotation is the same name for **SHIFTING THE TRACK** notes on their pattern's grids forward and backward.

On entering that menu, we select the track we want to shift with **TRACK D/1/2/3** buttons. On drum **TRACK D** we can select any of the 8 drum tracks which we want to shift with **MUTE BUS** buttons. After selecting the track we want to shift we press **TRANSPOSE+/-** buttons to adjust the shift in steps (up to +/-64 steps range however limited to the patterns' length).

→ *Note: that parameter can be modulated under external CV*

C / METRONOME



Ground Control has a small piezo buzzer. When enabled it acts as a physical metronome so you can start recording grooves without necessity to patch something and hear the clock first.

Metronome settings are accessible with combination **TEMPO** → **C**. With the **VALUE** **-/+** buttons we choose the following options: **CLC** (**CLC** means **CLICK**):

- **CLC.—** (none),
- **CLC.D** (drum track),
- **CLC.1/2/3** (certain melodic tracks).

When you choose any value other than '—', the metronome is enabled and follows selected track's time division. If you choose '—', then metronome click sound is off.

- *Metronome is a small physical buzzer located on the rear side of the module and its volume can be perceived differently depending how close or open your case is*

D / DIRECTION OF THE PATTERN

This menu item sets the direction of the currently active selected track. With the **VALUE** **-/+** buttons we choose the following options:



- **FRWD**: means **FORWARD** – typical direction from first step 1 to the last step and then again returning to the first and so on.
- **REWD**: means **REWIND** – direction from the last step to the first step 1 and then again returning to the last and so on.
- **PEND**: means **PENDULUM** – is a combination of first forward and then backward movement.
- **RAND**: means **RANDOM** – each next step the sequencer is selected is random of track's set steps.
- **RSTP**: means **RANDOM STEP** – on each step sequencer decides if it goes forward or backwards.

Whatever direction you choose, keep in mind that once you choose another pattern, it will be switched once the current pattern will finish its full cycle. In **FORWARD** mode that means once the pattern will reach its last step, the next

step will be the first step from new pattern. In **BACKWARD** mode the pattern should reach its first step and then will be switched to the new pattern. In **PENDULUM** mode the pattern should go forward and then backward and only then will be switched to the next pattern – i.e. will pass twice more steps before the switch. In **RANDOM** and **RANDOM STEP** modes the logic is simple – the switch to the new pattern will occur after initiated and once the pattern will pass the full number of its set steps (by default 16).

E / EXT. CV ^{FW V.2}

In that menu with the buttons **TRACK D/1/2/3** we select the CV jack source.

Then with **◀PAGE▶** buttons you select the following **MODULATION DESTINATIONS** with additional parameters like tracks selected via **TRANSPOSE+/-** buttons.

MODULATION DESTINATION SELECTED WITH PAGE▶	EXTRA SETTINGS WITH TRANSP+/-	SHOWN ON DISPLA y	MODULATIO N RANGE	EXPECTED CV RANGE
PATTERN SHIFT	D.1...8, T.1...3	SHFT	+/-64 steps	increasing voltage on 1v, shifts on 12 steps, or 0.833V per step
SEMITONE OFFSET	T 1...3	SEMI	+/-5 octaves	voltage added from the jack quantized to semitones and adds to pitch CV outputs. Also those influences on the MIDI notes outputs
OCTAVES OFFSET	T 1...3	OCTS	+/-5 octaves	same as above, just the CV inputs applied to octaves: i.e. when CV from 0 to +1V then no change, when CV from +1 to +2v, then shifts 1 octave up etc up to 5 octaves and similar in negative range
SHUFFLE AMOUNT	D.1...8, T.1...3	SHFL	-50...+50	CV values -5 to +5v correspond to -50 to +50 shuffle values
PROBABILITY	D.1...8, T.1...3	PROB	0...100	Accepts only positive CV values: 0 to +5V which correspond to 0 (none) to 100% (max.) tracks probability / notes skipped
RATCHETS	D.1...8, T.1...3	RATC	0...4	5 values: 0 to 4 scaled to 0 to 5v sectors (0-1, 1-2, 2-3, 3-4, 4-5). Value of 0 ratchets doesn't output the note at all, value of 4 repeats the note on its step 4 times)
SLIDE	D all / T1...3	SLDE	0...100	Accepts only positive CV values: 0 to +5V which correspond to 0 (none) to 100% (max.) longest portamento slide time

GATE LENGTH	D.1...8, T.1...3	GATE	0...100	Defines the gate/trigger length of a certain drum trigger or melodic track. Accepts only positive values 0 to +5V which correspond from 0 to 100% (max)
CC VALUE UNIPOLAR	CC#1...127	CC.UN	0...127	Basically works as CV to MIDI CC# converter. Unipolar means that CV accepts only 0 to +5V range which converts from 0 to 127 defined CC# value. CV=0v corresponds to CC value 0
CC VALUE BIPOLAR	CC#1...127	CC.BI	0...127	Same as above, just CV accepts bipolar values -5...+5v converted to 0...127 CC# values, CV=0v corresponds to CC value 63. MIDI channel corresponds to the track's name which that track is assigned to. E.g. if CC assigned to CV 1, then it follows Track 1 MIDI channel: 1 by default

- *Once we have assigned something to one CV input – same setting for exactly same trigger is excluded with the list in other CV sources. I.e. once we assigned CV1 to Shuffle of Track1, we cannot assign CV2 to the Shuffle of the same Track1, but Track D, 2 and 3 only*
- *Once we have assigned something to some CV input – same setting for manual change in the MENU will be ignored*
- *External CV inputs work from the Firmware version 2 and above*

F / MODULATION OUTPUT JACK ^{FW V.2}

This menu item contains settings for what is assigned to the **MODULATION OUTPUT CV JACK**.



It is possible to assign modulation output to the modulation or velocity of a certain track. If it is assigned to modulation of a certain track or drum track, it automatically obtains the length of the steps that track or certain drum track has.

Modulation output jack settings are accessible in the menu via **TEMPO** → **F/MOD.OUT** combination.

In that menu:

ALL DRUMS button defines whether the **MOD. OUT** jack outputs CC#01 modulation or velocity by altering **D.1.V** and **D.1.M** letters. **V** means velocity and **M** means modulation.

D.1.V → **D.1.M**

◀ **PAGE** ▶ buttons will change the polarity or the velocity or modulation output: unipolar 0 to +5V (default) or bipolar -5v...+5v with **D.1.V_b** letter:

D.1.V → **D.1.V_b**

Finally, pressing one of the **MUTE BUS** buttons will assign that modulation output to a certain track or drum tracks.

Pressing the **LAST STEP** in that menu settings will enable **SLEW** on the modulation output meaning all the modulation output will not be stepped but interpolated and can be used as an envelope or LFO if programmed properly.

By default the **MODULATION OUTPUT JACK** is assigned to a special modulation track which together with 8 trigger outputs is a part of the drum track. Default modulation output range is 0...+5V and with the further firmware updates will be possible to reassign that modulation output jack to other generators or CV destinations.

→ *Assignable Modulation output jack works fully from the Firmware version 2 and above*

G / SHUFFLE ^{EXT. CV}

SF.50

SHUFFLE, groove or swing (shown at display as **SF.50** by default) – is settings per one of the **TRACKS D/1/2/3** inspired directly from famous AKAI® MPC vintage machines by Roger Linn. It is set in values 0-50-100, which is a ratio of time duration between the first and second 16th notes within each 8th note. At value 50% there is no swing. There is a perfect triplet swing at value 66%. Most used

(and secret) value in electronic music producers used: 53-54%, which gives a light yet very musical feeling.

→ *Note: that parameter can be modulated under external CV*

H / PROBABILITY ^{EXT. CV}



PROBABILITY or humanization means some of the notes on the track can be accidentally skipped, imitating imperfection of the human nature. It is shown at display from **PR_0** to **PR99**.

Zero setting corresponds to zero imperfections (default values on all the tracks). The higher the values increase from 0 to 99, the more notes or triggers will be skipped.

→ *Note: that parameter can be modulated under external CV*

I / RATCHETS ^{EXT. CV}



Ratchet means that trigger fires per **ITS OWN STEP** not once, but up to 3 times more (4 in total with the original trigger).

Ratchets amounts are assigned per track (or a certain drum track) and then in the patterns can either be enabled or disabled or modulated via external CV.

Value **1** means no ratchets (only original trigger), while the value of **4** gives us 4 times note repeat on the step where RATCHET FLAG was enabled.

With **0** value of ratchet the whole note will not be fired.

Additional possible settings are:

- **FWRD** means **FORWARD**: ratchets amount increases by 1 on every pattern cycle
- **RAND** means **RANDOM**: random ratchets amount is set every time the note will ratchet on a certain track.

It is very interesting to modulate the amount of ratchets per track using external CV via **MODULATION MATRIX**.

You can assign only one global ratchet per track (or certain drum track)

- *With 0 value ratchets you can mute notes with CV*
- *Note: that parameter can be modulated under external CV*

J / SLIDE TIME ^{EXT. CV}



SLIDE occurs when we record two consequent notes on melodic tracks overlapped – means the initial note key is still held while the new one is already pressed. Slide range per melodic track is 0 to 99 and its default value is 50 – which corresponds to approximately 100 mSec of slide from one note to the other. In case of having the long notes merged with the TIEs which occupy a few steps, the slide occurs on the last step of that TIE'd long note – before the upcoming note where the pitch slides to. That type of slide is inspired by Roland® TB-303 type of sliding with fixed default slide time.

When slide value is set to 0, the slide time is instant. With maximum value of 99 the slide time is approximately 1 second.

- *Note: that parameter can be modulated under external CV*

K / SYNCHRONIZATION / DIVIDERS

That menu sets the **MASTER CLOCK** synchronization source (JACK (INTERNAL/EXTERNAL), MIDI, USB HOST, USB DEVICE) and their **INPUT / OUTPUT DIVIDERS**.

→ MASTER CLOCK SOURCE

Selecting the master clock is made via **MENU: TEMPO** → **K** → **VALUE +/-**. The possible options are:



- **INT** – means internal Ground Control clock generator when no cable is inserted into **CLOCK IN** jack.
- **JACK** – When the cable is inserted into **CLOCK IN**, the sequencer automatically detects that and switches to external clock no matter which master clock we have chosen. Depending on if the external clock jack is engaged, you can select either **INT** or **JACK** from those two options.
- **USB.H** – means Ground Control becomes a slave to the clock that comes from the device connected into **USB HOST** socket
- **USB.D** – means Ground Control becomes a slave to the clock that comes from the device connected into **USB DEVICE** socket
- **MIDI** – means Ground Control becomes a slave to the clock that comes from **MIDI IN 3,5 MM JACK** (MIDI type B standard via adapter).
- *Please note: if you selected some master clock source, which is actually not connected, the sequencer will not start with manually pressing PLAY button, as it will expect to receive a START command from external clock source*

→ OUTPUT CLOCK DIVIDER

Output clock divisions are selected via **MENU: TEMPO** → **K** → **◀ PAGE ▶**. Possible options are:

- **o. 1** – original 24 PPQN output clock (typically used for DIN sync)
- **o. 2** – 24PPQN/2 twice slower than original clock output
- **o. 4** – output clock in 24PPQN/4

- ***o. /32*** – output clock in 32nd notes (corresponds to 24PPQN/3)
- ***o. /16*** – output clock in 16th notes (corresponds to 24PPQN/6) - ***DEFAULT CLOCK OUTPUT SET FROM CLOCK OUT JACK***
- ***o. /8*** – output clock in 8th notes (corresponds to 24PPQN/12)
- ***o. /4*** – output clock in 4th notes (corresponds to 24PPQN/24)
- ***o. /2*** – output clock in 8th notes (corresponds to 24PPQN/48)
- ***o. 1br*** – output clock in 1/1 notes (corresponds to 1 tick per 1 bar, 24PPQN/96)
- ***o. 2br*** – output clock in 2/1 notes (corresponds to 2 bars, 24PPQN/192)
- ***o. 4br*** – output clock in 4/1 notes (corresponds to 4 bars, 24PPQN/384)
- ***o. -2*** – twice faster than original output clock (corresponds to 24PPQN*2 = 48PPQN a.k.a. Korg® standard)
- *Hint: o. symbol in the beginning means we adjust output clock division*

→ INPUT CLOCK DIVIDER

It is possible to adjust **INPUT CLOCK DIVIDER** to make sequencer playing slower or faster than incoming clock. It is done **only when the sequencer is in the slave mode** (i.e. USB D/H or MIDI chosen as master clock or there is a cable inserted into CLOCK IN jack) via following combination: **TEMPO** → **VALUE-/+**. The following options are:

- **PQ.24** – corresponds to original **24 PPQN** typical MIDI clock standard. This is default sync option when MIDI or USB-MIDI master clock option selected. Choose this option when you synchronize (slave) Ground Control to other master MIDI device with exact 1:1 tempo.
- **PQ.48** – corresponds to **PPQN48** alternative a.k.a. Korg® MIDI clock standard. Choose this option when you synchronize Ground Control to other master MIDI device with twice-faster 48PPQN clock.
- **PQ.12** – corresponds to **PPQN12**. Choose this option when you synchronize Ground Control to other master MIDI device with twice-slower 12PPQN clock.

With PQ.28 and PQ.12 options you can adjust your Ground Control to essentially be twice faster or twice slower from your typical MIDI clock.

- *i. /32* – input clock in 32nd notes (corresponds to 24PPQN/3).
- *i. /16* – input clock in 16th notes (corresponds to 24PPQN/6) – **default value if JACK is chosen (external CLOCK IN jack) which is eurorack clock 'standard'. Use this option for example if your input clock arrived into CLOCK IN jack is in 16th notes.**
- *i. /8* – input clock in 8th notes (corresponds to 24PPQN/12).
- *i. /4* – input clock in 4th notes (corresponds to 24PPQN/24).

→ *Hint: i. symbol in the beginning means we adjust input clock division*

L / GATE LENGTH EXT. CV

Currently all the sequencer's notes are hard tied to the grid. The track's grid is set by time division buttons via **TRACK D/1/2/3 + 1/32...1/4** buttons combo (and long hold to obtain triplets values of those divisions). **1/16** is always default and most used time division for any new projects therefore is marked with ° symbol at 1/16°.

Each note on a certain melodic **TRACKS 1/2/3** has strict fixed gates duration (the gates we receive from melodic **TRACK 1/2/3 GATE OUT JACKS**). Those values are variable from 1 to 99, measured in % of the step length. There is no 100% gate length otherwise that would mean that current note will be TIEd with the upcoming one. Default gate length is 50% and is the always constant for all the notes in the same track.

→ *Note: that parameter can be modulated under external CV*

M / MIDI

That menu covers all the **MIDI** and some other device specific or global settings. New settings might be added with the further firmware updates – please ensure you are running the latest firmware. Once we press **TEMPO** → **M/MIDI**

combination, we enter the **SETTINGS** menu and see the lower row of certain keys light up. Each of those lit up keys defines the menu item we can select or adjust. By pressing on each of those keys we see corresponding menu hint on the display and the values which we can adjust with **VALUE-/+** buttons. Since some of the settings are per-track settings, we can select those with **TRACK D/1/2/3** buttons.

The settings items are the following:

- **A: CH.RX** – means **CHANNEL RECEIVE** – is a MIDI channel from which selected track will RECEIVE its information. It can be 1 to 16. By default TRACKS D/1/2/3 are set to Ch.Rx. corresponding MIDI channels: 10/1/2/3
- **B: CH.TX** – means **CHANNEL SENT** - is a MIDI channel on which the track will SEND its information. **CP.RX** means '**COPY**' - it is set to the same MIDI channel as CH.RX. In current firmware all TRACKS D/1/2/3 can only be sent on the same TX channel as RX
- **C: TAP.T** – means enable or disable TEMPO button acting as a TAP tempo button (setting the tempo after 3 or more taps). That settings is found to be useful to set to OFF so you can't accidentally change the BPM during performance
- **D: HS I- D** – means **USB HOST to DEVICE** data transfer. Available options are: ON/OFF. With that feature enabled all the USB-MIDI data (notes/CC from all 16 channels and MIDI clock) that appear from USB HOST will be routed to USB DEVICE. Use this feature if for example you use Beatstep Pro as a Master Clock source connected to the USB HOST and you wish that clock appear to USB DEVICE which connected to the computer DAW. Default value is ON
- **E: DE I- H** – means **USB DEVICE to HOST** data transfer. Available options are: ON/OFF. With that feature enabled all the USB-MIDI data (notes/CC from all 16 channels and MIDI clock) that appear from USB DEVICE will be routed to USB HOST. Use this feature if for example you want to send the master clock and all the notes from your computer DAW connected to DEVICE to be send also to Beatstep Pro as a slave source connected to the USB HOST. Default value is ON
- **F: H.LPB** – means **USB HOST LOOPBACK or MIDI THRU**. Everything that is routed into USB MIDI HOST IN will be duplicated and routed thru same USB

MIDI HOST OUT. That is useful to use any USB-MIDI adapter's MIDI OUT plug as a MIDI THRU one. Default value is OFF

- **G: R.CLK** – means **RUNNING CLOCK**. Once the sequencer is running, it sends the MIDI clock and once it is stopped, the MIDI clock also stops. Available options are: ON/OFF and default value is OFF
- **J: T.OUT** – means **MENU TIMEOUT** in seconds. Available options are: 5, 10, 15, 30 sec and NEVR (never or 24 hours). Sets the time after which the menu returns back to patterns view screen, default value is 15 seconds.
- **K: KLED** – means **KEYS LEDS**. Available options are: ON/OFF. By default is enabled and if enabled – you will see blinking PIANO KEYS on active track once active notes appear that correspond to that keys. Note that if the notes are located in higher or lower octaves they will not blink on the keys unless you switch the octaves with **-OCT/OCT+** transpose buttons
- **M: SCAL** – means what happens with the notes when they appear out of our music scale:
 - **SC.UP** – means the out-of-scale note will be 'routed' to the nearest upper note
 - **SC.DN** – means the out-of-scale note will be 'routed' to the nearest lower note
 - **SC.IG** – means the out-of-scale note will be ignored
- **N: VERS** – shows current firmware version number on the display

N / SCALES / DRUM MAPPING ^{FW V.2}

Music scale is any set of musical notes ordered by a fundamental or root note.

NOTE SCALES work like filter on melodic **TRACKS 1/2/3**: allowing which notes can be played and those notes that doesn't fit the scale are either ignored or tuned to the nearest ones.

Ground Control offers a set of a few predefined music scales, any of which can be edited into the custom scale. There is only one custom scale per each musical track and tracks 2 and 3 can follow the same music scale as track 1:

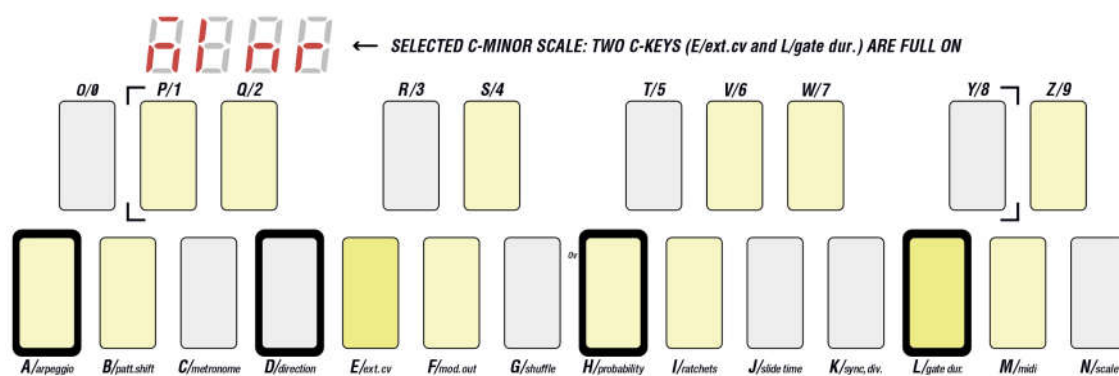
- **CHRM** – means chromatic music scale where all the 12 keys are active

- **MAJR** – major
- **MINR** – minor
- **MMIN** – melodic minor
- **LYDN** – Lydian
- **MAJP** – pentatonic major scale.
- **CUST** – any manually edited scale above becomes custom scale

Scale menu is accessed via **TEMPO** → **N**. It shows the current scale as keyboard LEDs: all 24 keys are either semi-lit or off: duplicating in 2 octaves. The keys which are semi lit show which keys are in the scale. The keys which are full on show the root key of the scale.

◀ **PAGE** ▶ buttons selects predefined scales from the list above.

TRANPOSE +/- buttons select the **ROOT** note, which is always **FULLY ON**.



Default scale on all melodic tracks 1/2/3 is **CHROMATIC**. When we change any of selected pre-defined scales in the list it automatically becomes **CUSTOM**.

Scales work only on melodic Tracks 1, 2 and 3. Once in scales menu we switch to the drum **TRACK D**, then we enter the **DRUM MAPPING** menu: meaning we can set the custom MIDI notes mapping for each of 8 drum trigger notes.

Default **DRUM MAPPING** is the following:

P/1 – TRIGGER 1: **C1**

Q/2 – TRIGGER 2: **C1#**

R/3 – TRIGGER 3: **D1**

S/4 – TRIGGER 4: D1#

T/5 – TRIGGER 5: E1

V/6 – TRIGGER 6: F1

W/7 – TRIGGER 7: F1#

Y/8 – TRIGGER 8: G1

With drum buttons **P/1...Y/8** we select the certain drum trigger we want to change and with **◀PAGE▶** buttons we select its assigned MIDI drum note.

→ *Note: you can't assign the same MIDI note for two different drum triggers. For example if you assigned Trigger 1 to C1, then you can't assign Trigger 2 to C1 anymore etc*

→ *Remember to save any changes of scale with *** (PROJ) → RECORD → RECORD** combination. Once you save the settings, then selected music scales for Tracks 1/2/3 and drum mapping for Track D will be saved and restored on the next modules' power up. If you will not save any of the settings by *** → RECORD → RECORD**, they will be lost on the next power up*

SD CARD / SETTINGS

Everything: from track's notes and modulations to all the settings and calibration data are saved on the SD card. That means if you have a few Ground Control sequencers – you can simply duplicate or swap SD card between them and you will get access to all the same projects and already set settings, scales, MIDI channels etc. All the settings and recorded scores are NOT erased during firmware updates.

Most of the settings from the **TEMPO → A...N** keys are global settings and are applied to all projects at once. Other settings are related to the project only and certain channel.

Each of 24 PROJECTS are stored the SD card into separate folders, which correspond to that project's name: **'A'** to **'Z'**.

The global settings are set for all the 24 projects in **GlobalSettings.txt** file (USB routing, last loaded project, buzzer, master clock source).

Additionally, extra 4x CV output calibration settings are stored in **Calibration.txt** file if the calibration was made and saved with the editor.

Each project parameters are stored in **ProjectSettings.txt** file (BPM, MIDI channels, slide, shuffle, probability, gate length).

PITCH / MOD. CV CALIBRATION

Sometimes pitch CV voltages may deviate a few cents from their proper values.

We recommend doing that when you change the power supply. By default Ground Control is not calibrated. For correcting the calibration values, we use the same Shuttle Control calibrator to enable Ground Control's 4x DAC correction (modulation output and pitch CV on tracks 1/2/3).

CALIBRATION PROCEDURE explained in the following video:

<https://www.youtube.com/watch?v=CHWN2ur-OGk&t=714s>

You will need a voltmeter to read the values from all SHUTTLE CONTROL's jacks in case you feel its output pitch CV isn't precise enough (all C notes should correspond to all whole integer voltage amount: e.g., -3V, +4V, 0V etc).

Almost any consumer voltmeter that can measure two decimals (i.e. 3.00V when putting the voltmeter in the 20V DC range) does the job.

The calibrator is accessible thru the **CARGO 4** web editor:

<https://cargo4.endorphin.es/calibration.php>

A set of buttons is used to read, set, write and test every 4 CV outputs.

READ: When you are using the calibration for the first time, there are no certain values to be read (literally default ones: -3000, 0000, +3000). If you calibrate GC after you already calibrated it in the past, press '**READ**' and all adjusted CV values are shown in the tables below the button.

Now press '**SET ALL TO -3V/0V/+3V**' one by one, and each time measure the CV outputs value with the voltmeter and enter it into the table (each of melodic tracks into CV 1/2/3 and modulation in the drum track on CV 10, a total of 3 x 4 measurements).

All values should be entered in millivolts (three decimals after integer but without decimal point).

- at -3V if multi-meter reads -2.99V, then enter '-2990'.
- at 0V if multi-meter reads -0.01V, then enter '-0010' or if it shows 0.02V, then enter '0020'
- at +3V if multi-meter reads 3.01V, then enter '3010',

Afterwards press the '**WRITE**' button to record the adjusted values and all the calibrated values will be saved.

Afterwards you may press the '**TEST CALIBRATED -3V, 0V, +3V**' buttons to see if the calibrated values show exactly what you expect (-3V, 0V, +3V) by checking them with the voltmeter.

If the desired values deviate only a bit from what you expect (e.g., +2.99V and not +3.00V), then you write a smaller value (decrease for '0001') in the specific cell of the calibrator table, press 'Write' again, and then press '**TEXT CALIBRATED +3V**' again.

Measure it again, and it should be your exact value. When every '**TEST CALIBRATED -3V, 0V, +3V**' values match your measurements exactly, you can close the calibrator. Once the calibration is saved into the device, it is stored on the SD card **Calibration.txt** file located in the root directory. If the file is erased, then default calibration values are applied. Calibration or any other settings are NOT erased during firmware updates.

FIRMWARE UPDATE

Firmware updates are essential for any digital modules. They bring new features or bug fixes.

Feel free to write any bugs, features ideas or improvements to beta@endorphin.es

To update the firmware of your Ground Control sequencer first download the latest firmware file once available on Endorphin.es website. Take the sequencer out of your rack and eject micro SD from it. Insert that card into your computer using SD adapter or card reader (sold separately).

Unzip ***GC-FIRMWARE_XXX.HEX*** file from downloaded archive and place it into the ROOT directory of your SD card. Eject the micro SD card from the computer and insert it back into the Ground Control. Turn on the power of the Ground Control: you will see '***BURN***' message on the screen meaning the firmware is flashed and you will see the process of lower row of A...N keys light up showing the upload process. After approximately 15-25 seconds the module will reboot with the new firmware and new features installed.

Note: the firmware updates doesn't alter any of your recorded patterns information. However we strongly advice to occasionally back up your micro SD card. Different memory cards have different amount of read/write cycles. Don't worry, even using your sequencer every day, your SD card will serve you for years. However SD cards they are considered as consumables and sometimes are good to backup.

CREDITS

ENDORPHIN.ES® – GROUND CONTROL

FIRMWARE VERSION 2.10

COLLECTION SPRING/SUMMER 2022

Module idea, hardware design, direction and manual by Andreas Zhukovsky

Core engine programming by BSVi

UI programming by Xavier Galai / Kouik03

SD card updater by Vitaly (a.k.a. embedder)

Rubber keys 3D design by Simone Fabbri

3D printed light frames for the rubber keys by Leonardo Cardinale

Video review and valuable feedback by Ziv Eliraz (Loopop)

Manual proofreading and demo videos by Wisdom Water

Endorphin.es are made in Barcelona, Spain

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GROUND CONTROL SHORTCUTS CHEAT SHEET (05-MAY-22)

- **PLAY**: starts the playback on all patterns from their first steps. Acts also as confirmation yes in call to actions. During sequencer is running, pressing **PLAY** resets current patterns on all TRACKS D/1/2/3 to first step
- **STOP**: stops the playback. When in menu, single press exits the menu keeping the playback running. Next **STOP** press stops the sequencer.
- **STOP**: when sequencer stopped acts as a panic action in case of hanging MIDI notes. Second **STOP** press sends **ALL NOTES OFF** on all MIDI channels in case of hanging the MIDI notes on external MIDI devices
- **TRACK D/1/2/3**: selecting the active track
- **TRACK D/1/2/3 + 1/32...1/4** sets the time division of the track
- **TRACK D/1/2/3 + PLAY** during the playback resets certain track to the first step (quantized to each track's time division)
- **TRACK D/1/2/3 + ◀ PATTERN/PATTERN ▶**, **TRACK D/1/2/3 + A...Z** piano keys, *** → A...Z**: selecting the pattern on active track
- **TRACK D/1/2/3 + A...Z** sequence of letters: entering the patterns chain
- **TRACK 1/2/3 + TRANSPOSE +/-**: shift currently selected pattern by 1 octave up or down
- **RECORD** on sequencer stop: starts step record mode
- **RECORD** on sequencer start: starts live recording mode
- **RECORD** long hold: enters the editor (XOX on drum track or step editor on melodic tracks 1/2/3)
- **TEMPO + RECORD** starts RECORD WAIT mode
- **TEMPO + LAST STEP** locks the BPM value on the screen
- **LAST STEP + MUTE BUS + VALUE +/-** (or **◀ PAGE ▶** or **0/0...Z/9**) setting the amount of steps per track
- **LAST STEP** in arpeggiator/roller mode acts as arpeggiator's latch (long hold acts as super-latch)
- **LAST STEP** in the F/MOD menu enables smoothing modulation track values instead of stepped values
- **-TRANSPOSE + TRANSPOSE+** both buttons press → A...Z buttons: semitone transpose current pattern from root C key
- **BOTH TRANSPOSE +/- → LAST STEP** activates transpose lock and semitone shifts apply to all TRACKS 1/2/3 at once

- ◀ **PATTERN + PATTERN** ▶ both press: activates the patterns **LOCK**
- **A...Z**: playing / entering the notes/drum triggers on active track
- **1/32...1/4**: activating the arpeggiator/roller on the active track
- **1/32...1/4 + TRANSPOSE** +/- in the arpeggiator mode sets the arpeggiator octave swing
- **MUTE BUS** long press: selecting quantized (one blink) or momentary (default, double blink) mute buttons action
- * (**PROJ**): **'SHIFT'** function button related primarily to saving patterns/projects
- * single press enters or quits live pattern select mode
- * + **MUTE BUS**: 1) first press clears the notes/triggers on the selected track but leaves the same number of steps. 2) second press clears the steps number of that track to default 16 steps
- * → **RECORD** or * + **RECORD** buttons will enter the pattern save function
- * → **RECORD** → **RECORD** saves all project's settings and all unsaved patterns
- * → **RECORD** → **A...Z**: saves current pattern on any of 24 patterns cells in the current track
- * → **RECORD** → **TRACK 1/2/3** → **A...Z**: saves current pattern on any of 24 patterns cells in the other selected TRACK 1/2/3.
- * → **RECORD** → **LAST STEP** → **A...Z**: saves current project into any of 24 project cells. Keys with already non-empty projects will lit.
- ◀ **PAGE** ▶ in the editor navigates thru the steps on the active track/pattern
- * (**PROJ**) in the editor adds extra step in the end of the pattern
- **TEMPO** /rest in the editor cleans current step
- **TIE** ^(1/4) in the editor TRACKS 1/2/3 merges note on current step (ties it) to the next one.
- **RATCHET** ^(1/8) in the editor enables ratchet flag on current step
- **SLIDE** ^(LAST STEP) in the editor on TRACKS 1/2/3 enables slide flag on the current step so it slides to the next note
- **MOD.CC** ^(1/32) in the editor on TRACK D enters the modulation CV output step editor
- **VELOCITY** ^(1/16) in the editor on TRACKS D/1/2/3 enters the notes velocity step editor
- **TEMPO**: **'SHIFT'** button function button related primarily to entering the menu settings via **TEMPO** → **A...N** buttons
- **TEMPO + A...N or TEMPO** → **A...N**: selecting the menu settings items

- **TEMPO** 3x or more times press acts as a tap tempo action when the sequencer acts as a master clock (if enabled via MENU → M → C)
- **TEMPO** → **VALUE-/+** or **◀PAGE▶** or **P/0...Z/9** – setting the tempo manually incrementing in values by 1 or by 10
- **TEMPO + MUTE BUS** does the solo action for the pressed track
- **TEMPO** → **A** → **◀PAGE▶**, **VALUE-/+** active track polyrhythmic time-base (time signature) settings
- **TEMPO** → **B** pattern shift (nudge) setting nudge/pattern rotation settings
- **TEMPO** → **C** enabling the metronome click
- **TEMPO** → **D** setting the tracks direction on current pattern
- **TEMPO** → **E** settings for 4 external CV inputs (modulation matrix)
- **TEMPO** → **F** settings for the modulation CV output jack settings
- **TEMPO** → **G** setting the shuffle value on the current track
- **TEMPO** → **H** setting the notes probability on the current track
- **TEMPO** → **I** setting the ratchets amount on the current track
- **TEMPO** → **J** setting the slide time on the TRACKS 1/2/3
- **TEMPO** → **K** → **◀PAGE▶** sets the divider for CLOCK OUT output clock jack
- **TEMPO** → **K** → **VALUE-/+** sets the input divider for external master clock input
- **TEMPO** → **L** setting the gate length for the melodic TRACKS 1/2/3
- **TEMPO** → **M** entering the MIDI / global settings menu
- **TEMPO** → **N** notes scales / drum mapping settings