



User Guide

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Introduction

MC-2oh2 is an upgrade for the Roland MC-202 synthesizer / composer. It replaces the original CPU and keyboard/display PCB of an MC-202 or 'DIN-SYNC RE-202' synthesizer.

MC-2oh2 introduces a completely new control scheme for MC-202 synthesizers.

The sound however stays the same, though some additional sound features are added.

Some features:

- Optimized for live performance, turns your 202 into a 'groove box'.
- Three completely independent synthesizer control channels: the internal synth, the 2nd CV/gate output and a 3rd MIDI out or DRUM channel. Each channel has its own clock divider and MIDI input and output.
- Extended note range
- Versatile sequencer with 32 patterns, chainable in song mode, edit patterns and songs while playing, shortcuts for quick live arrangement. Seven sequencer play directions.
- Sequence editor with copy, paste, insert and delete options, can modify note pitch, length and note-modifiers on the fly
- Arpeggiator with multiple octaves, seven direction modes including 'order of key press'. Can inherit the 'chemistry' of existing sequences, optional euclidian mode and live shortcuts.
- Additional modulations: Filter Accent and additional envelopes for Filter and PW
- Additional noise sound with envelope.
- 8-bit LOFI drum sample output with various sound modifiers, sample packs can be uploaded via MIDI
- Save and recall up to 8 sets containing sequencer and modulation parameters.
- MIDI CC control of all additional parameters, filter cutoff, pulse width, clock dividers and more.
- Midi velocity can be linked to various sound parameters.
- Various CV-input modes including a 'direct' mode.
- Optional HiRes version of MC-2oh2 allows pitch bend control and microtonal tunings.

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About this manual

This is the user manual for the MC-2oh2 mod. If you are new to MC-2oh2 and already have one installed, it is best to read and try the Quick start tutorial first. Then proceed to read the following chapters, especially [2oh2 architecture](#), [Sequencer architecture](#) and [Navigating the 2oh2](#) as these provide insight into the 2oh2 philosophy and general approach.

Chapters [MIDI control](#), [DIN Sync](#) and [External CV / Gate](#) explain various methods of input and output notes and clock.

The [Config menu](#) chapter includes all settings and parameters, many of which were explained in previous chapters.

Finally, [Appendix I - MIDI CC values](#) and [Appendix II - MIDI sysex specifications](#) include additional MIDI specification.

Coming from the MC-202

MC-2oh2 introduces a completely new control scheme. If you are used to the original MC-202 sequencer, it is best to forget everything you know about it.

There are a lot of improvements and a lot more functionality in MC-2oh2. The sequencer however has one vital difference. Here, the step length is fixed and has the same value for all steps. The gate length can still be varied though. In the original MC-202 it is possible to also vary the step length.

This change has been made to simplify (live) programming. The approach is very similar to the sequencer of a SH-101.

You can read more about this in chapter [Sequencer architecture](#).

Quick start

This chapter provides a quick introduction and shows some first steps how to use the MC-2oh2. The following chapters provide a deeper understanding and explain all features in detail.

This quick start tutorial assumes the MC-2oh2 is reset to factory default. If you suspect somebody might have changed some settings already, here is how to reset everything:

Press SHIFT, hold it and then press the ENTER button on the right. You are now in the [Config menu](#). Navigate all the way to the bottom of the menu by pressing the FWD button (upper right corner) multiple times until the cursor selects 'Reset parameters'. Now press ENTER.

To exit the config menu press the ACC button (lower right corner).

Turn it on

After turning on your MC-2oh2 it starts in [Normal mode](#). Here you can just play on the keyboard. Try moving the internal keyboard up and down using the UP and DOWN buttons on the left.

You can press one or more of the four buttons in the lower right corner while playing. These add note modifiers: Accent, filter accent, portamento and noise.

You might also notice that there is portamento when playing legato. You can change this behavior by pressing SHIFT, hold it and press the PORTA button in the lower right corner.

Your first sequence

In order to program a sequence, press and release the EDIT button to open the [Pattern Editor](#). You can now enter a new sequence note by note. You can also add note modifiers by pressing the modifier buttons and then entering a note.

Made a mistake? Use the FWD and BACK buttons on the upper right side to navigate the sequence. Replace a note by another simply by pressing a keyboard key. You can also add or remove note modifiers by pressing their buttons.

There is a lot more you can do here: Copy, paste, delete, insert, change gate lengths, rotate ... All of this is explained in detail in the [Pattern Editor](#) chapter.

Play the sequence

Now press the PLAY button. You can see the display now shows PLAY, but the sequence is in fact not playing. This is because the MC-2oh2 does not receive a clock yet!

Press the START button to start the main clock and the sequence will start and play in a loop.

Now press PLAY again. The sequence stops, you are now back in normal view.

Press PLAY again. Your sequence starts playing again but waits until the start of a bar of the main clock.

What is more?

A lot! Program multiple patterns and chain them to a song. Try the arpeggiator. Try the extra modulations, midi and control multiple synthesizers at once. And much more. Have fun!

2oh2 architecture

MC-2oh2 features a layered architecture with three completely independent synthesizer channels:

1. Channel 1, the internal synthesizer
2. Channel 2, the “external” synthesizer
3. Channel 3, used for drum sounds or for an additional external midi synthesizer

At any moment, you can switch to a different channel shown on the display and tweak settings of that particular channel. The other channels will continue to function – the arpeggiator or sequencer keeps running and it is still possible to play other channels via midi.

User interface

Even though we changed the MC-202 control scheme completely, we tried to implement the user interface so most text on the buttons still make sense. In some rare cases it was unavoidable to assign a completely different functionality. This is marked in red in the images below.

SHIFT

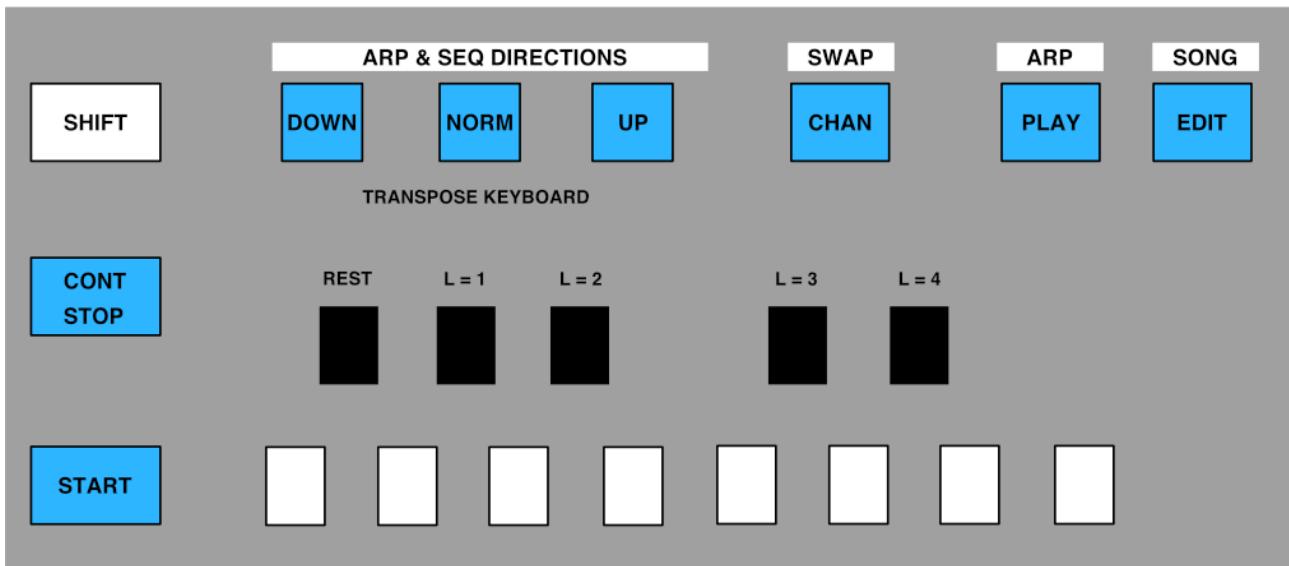
Many buttons have secondary functions. When pressing a button while holding the SHIFT button, these functions are invoked. In the image below, these functions are shown above the button, while the main functions are printed on the button.

Left side

Buttons START and CONT/STOP control the internal main clock. The internal clock is only one of several clock options, see Clocking.

The DOWN, NORM and UP buttons control the transposition of the internal keyboard. When shifted, these buttons control the play direction of sequencer and arpeggiator.

The CHAN button changes the selected channel. When shifted channel 1 and 2 are swapped. PLAY and EDIT access the various modes and views (see Modes and views)



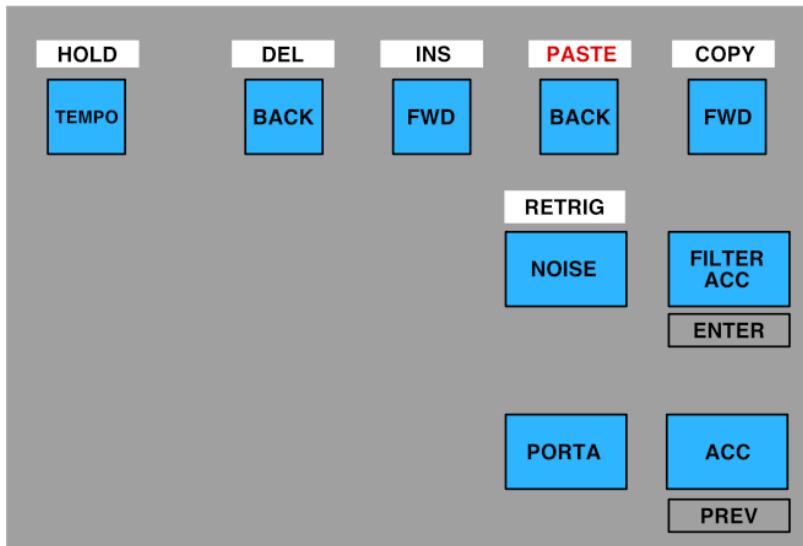
When shifted, the lower black keyboard keys can modify gate lengths or insert a break/rest.

Right side

The TEMPO button shows the current tempo in BPM. When shifted it toggles the HOLD function of the arpeggiator.

The four BACK and FWD buttons are used for menu and editor navigation, copy, paste, insert and delete (See Config menu, Pattern editor and Song editor).

The four buttons in the lower right corner are used to toggle note modifiers (See Notes and note modifiers), Config menu navigation and to toggle some functions in 'normal play' view.



Inputs and Outputs

MC-2oh2 features the following inputs and outputs. Most are identical to the ones of the original MC-202, others are repurposed or extended.

- SYNC-IN serves as SYNC input or MIDI input.
- The first SYNC-OUT serves as MIDI and DIN-sync output, the second SYNC-OUT is DIN-sync output only.
- TAPE-out is an audio output for drum sounds and metronome
- TAPE-in is now a trigger input
- EXT KEYB CV/Gate can now have various functions (see [External CV / Gate](#))
- The CV / GATE outputs remain the outputs for channel 1 and 2



Modes and views

Mc-2oh2's user interface uses the concept of 'modes' and 'views':

Each channel can be in one of the following **modes**:

1. The 'normal' play mode: Here, you can play the synthesizer on the keyboard
2. The 'sequencer' mode: a sequence is playing
3. Arpeggiator mode

Independently from these modes, each channel can show a number of different **views**:

Normal, play, arpeggiator, pattern edit, song edit, quick song, pattern copy/paste and more

Presses on the keyboard or buttons on the MC-2oh2 are handled by the current view.

This means that it is possible to edit patterns or songs while a sequencer or arpeggiator is running.

An example: 2oh2 is in sequencer mode, the sequencer is running. In view mode the keyboard selects the currently playing pattern. If you now switch to EDIT mode, the sequencer keeps running, but the keyboard keys edit notes in a pattern.

Global indicators

On the left side of the display are some global indicators visible in all views. These are the internal keyboard transpose indicator and the main clock downbeat and state indicator.

You can also see the current channel and the current view.

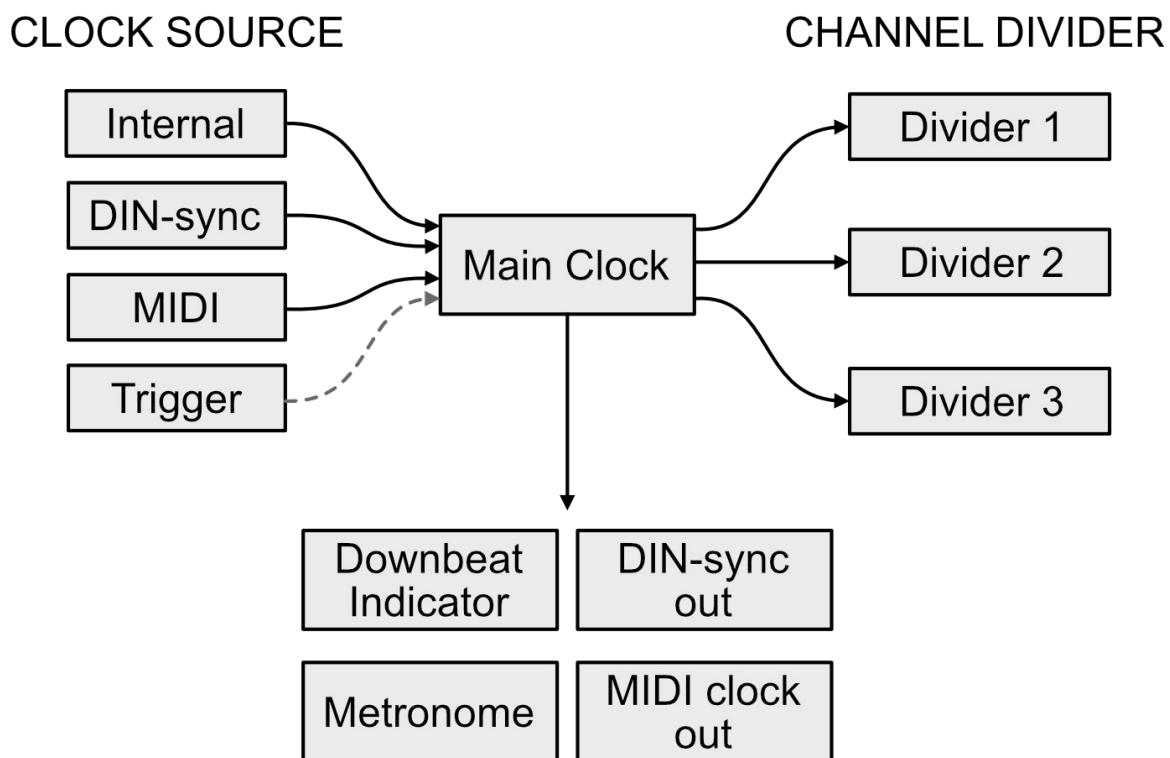


Clocking

MC-2oh2 is clocked by a main clock. Several clock sources can be selected for it: The internal clock generator, external DIN-sync, MIDI clock or a trigger pulse. The main clock is used for the downbeat indicator, metronome and to clock the channel dividers. Each channel has its own clock divider and sequencers can be started/stopped on demand independently from the master clock.

The main clock can also be used to sync external devices via MIDI or DIN-sync.

A special case is the trigger clock source. It will not generate Midi or DIN-sync output and has limited metronome and downbeat capabilities. It also skips the clock dividers and triggers the channels directly.



Clock source and dividers can be set in the Config menu and changed on the fly.

Notes and note modifiers

In MC-2oh2, each note has a pitch, one or more modifiers and in some modes a specific gate length.

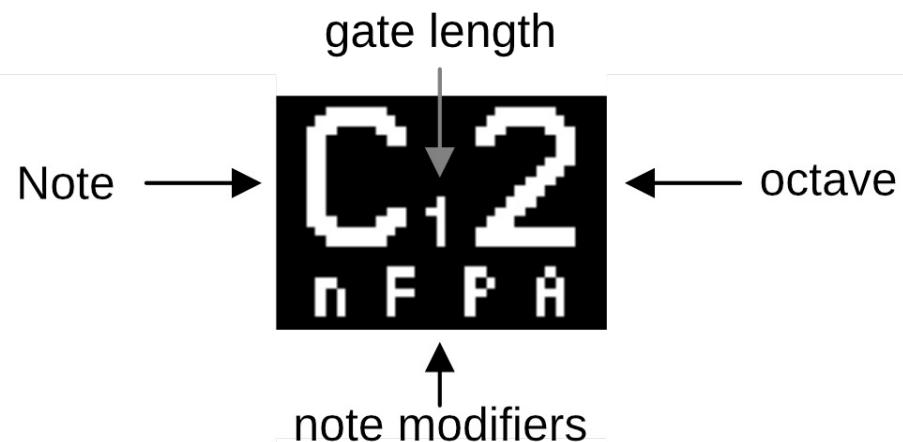
The pitch is given in the notation form N(#/b)O, where N is the note name (C, D, E, F..), followed by # or b if it applies. O is the octave ranging from 0 to 10.

Not all of the 128 possible notes can actually be played by the MC-202, but all can be sent out via midi. (See 'MC-202 pitch range').

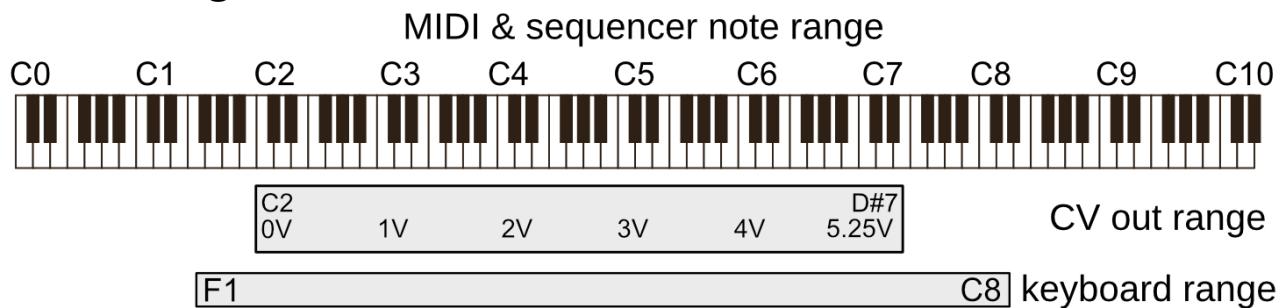
The four note modifiers are

- Accent: A volume accent envelope is triggered, its magnitude is adjustable via the ACCENT knob
- Filter Accent: A filter accent is triggered. If filter accent is combined with a volume accent, its magnitude is controlled via the ACCENT knob. If a filter accent is triggered without a volume accent, the 2oh2-specific filter accent settings apply
(see Config menu → MOD → VCF Accent)
- Noise: The noise waveform's envelope is triggered. Its parameters can be adjusted in the MOD Noise menu.
- Portamento: Setting portamento will create a slide from the previous pitch to the new one. Portamento speed can be set with the portamento speed knob.

In sequencer and arpeggiator modes, notes will also have one of four different gate lengths or act as break. See Steps



Note range



MC-2oh2 can handle a range of 128 notes spanning over 10 octaves. This range is identical to range of MIDI notes.

The lowest note is C0 (midi note 0), the highest note is D#10 (midi note 127).

Note: Some MIDI gear labels notes differently, starting at C-2 instead of C0.

The range of the internal synthesizer however is smaller. The pitch control voltage (CV) generated internally is 0 to 5.25V resulting in a note range of a bit more than 5 octaves at 1V/octave. *

Thus, the internal synthesizer has a range of C2 – D#7.

This range extends the original MC-202 range which is only F2 - C7 (there called F1 - C6).

If notes outside the CV range are played, the notes are wrapped to fit inside the range. For example, playing G1 will result in a pitch of G2. Similarly playing F7 will sound F6. This is not true for the midi output which has the full note range.

Finally, the internal keyboard can be transposed up and down and spans a range from F1 to C8 extending beyond the CV range.

Modulators and sounds

Several additional modulation signals such as LFO or ADSR are available for filter cutoff and pulse width of the internal synthesizer. An additional noise sound with adjustable 'quality' can be mixed with the existing square and sawtooth wave forms.

The parameters for these modulations can be set in the [Config menu](#) or adjusted via midi CC:

Accent

Accents can be triggered via note modifiers and add a little bit of punch to the sound. In the original MC-202 each note can have volume accent or volume + filter accent. Just filter accent is not possible and a hardware limitation prevents us from triggering just the filter accent alone. MC-2oh2 adds an additional filter accent envelope with amount, attack and decay settings.

This additional filter accent is triggered if a note has the filter accent modifier, but not the volume accent modifier.

Adjustments can be made in the Config Menu -> Mod & Sound -> [VCF Accent](#)



ADSR envelopes

MC-2oh2 features two additional ADSR-type envelopes for filter cutoff and pulse width.

Each envelope has amount, delay, attack, decay sustain and release parameters.

The envelopes can also be inverted and looped. Looping will repeat the envelope between attack and decay phases until a note is released. This creates an additional LFO with adjustable rise and fall times.



These envelopes will always trigger when a note on channel 1 is played.

Adjustments can be made in the Config Menu -> Mod & Sound -> [VCF and PW ADSR](#)

LFOs

MC-2oh2 features two additional LFOs (low frequency oscillators) for filter cutoff and pulse width. The LFO frequency has a wide range from a 20 second period all the way up to 1kHz. This allows modulations in the audio range to create interesting filter modulation effects.

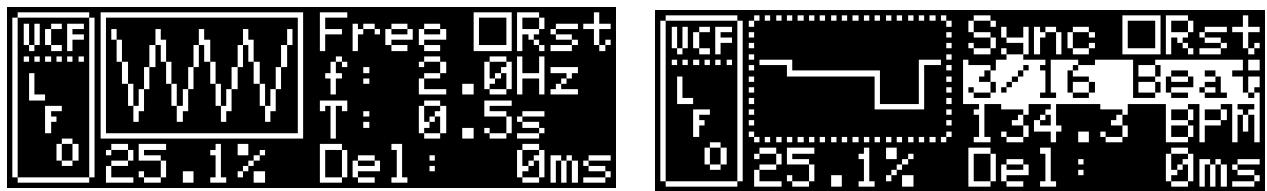
Several LFO wave forms are available: Triangle, sawtooth, reversed sawtooth, square and sample and hold (S/H). The latter creates a new random value each cycle.

The LFOs can run in free mode with adjustable frequency, but can also be synced to the main clock. A clock divider sets the frequency/period of the LFO in this case. Setting the clock divider to 1/16 for example will create an LFO with the period of a 16th note.

The LFO can run continuously, or re-trigger each time a new note is played.

There is also a delay parameter – after a key press the LFO will be inactive at first and then turn on after a certain amount of time.

Adjustments can be made in the Config Menu -> Mod & Sound -> VCF and PW LFO



Noise

An additional noise sound with adjustable quality can be mixed with the existing square and sawtooth wave forms. The noise sound can be triggered for each note using the noise note modifier. The noise sound can be adjusted in quality: White noise at the highest setting all the way down to lo-fi bit-crushing noise.

You can adjust the noise volume and there is an envelope with attack and decay parameters for the noise sound. This allows you to create novel sounds never heard from an MC-202.



Adjustments can be made in the Config Menu -> Mod & Sound -> Noise

Metronome

The MC-2oh2 built in metronome outputs metronome audio samples via the internal speaker or the tape-output. It is clocked by the main clock and uses two of the drum samples. One is played at the start of a bar, the other is played every quarter note.

The metronome can be turned on or off and the drum samples used can be selected in the Config Menu -> Inputs and Outputs -> Metronome.

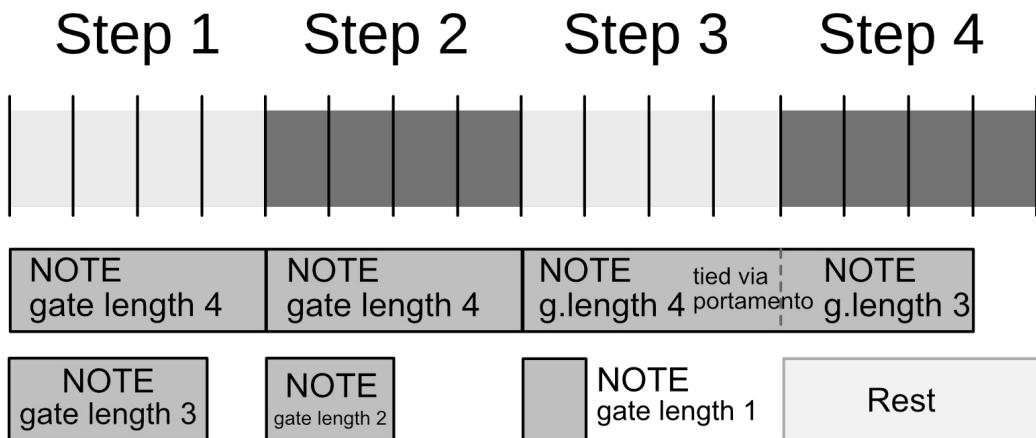
If samples are playing on the 3rd channel in sequencer or arpeggiator modes, the metronome is automatically muted. If the 3rd channel is not used for drums, the metronome is not muted.

Sequencer architecture

Steps

The 2oh2 sequencer is **step** based. This means each note is aligned to a fixed grid set by the clock divider setting. Notes will always start at the beginning of the grid, but can have four different gate lengths. By using the portamento note modifier it is also possible to tie notes next to each other to create longer notes. A rest means no note will sound at that step.

Note: Even though it says "4 TIE" on the MC-202, a note with gate length 4 does **not** tie to the next note. If you want to tie two notes, set the portamento modifier for the second note. This change allows us to have more different gate lengths.



Patterns

A pattern is a sequence of notes. Each pattern has a maximum length of 64 steps.

In the MC-2oh2 you can program up to 32 different patterns. The different patterns can be accessed via the keyboard – one pattern for each key. Pattern names are derived from the keyboard notes preceded by a lowercase p: The first pattern is pF1, the second pG#1, .. all the way up to pC4.

Song

Patterns can be chained into a Song. A song a sequence of patterns with a maximum length of 64. A song can contain a single pattern multiple times.

For example, a song containing four patterns might play patterns in the following order: pF1, pG#2, pF1, pF#1

Sets

A set includes all patterns and song data. It also includes modulation parameters and settings as well as the clock dividers for each channel. Up to 8 sets can be saved or recalled and are stored in MC-2oh2 memory after power down (See Config Menu, [Set](#)).

Sets can be transferred to other MC-2oh2 synths or to a computer via MIDI sysex. (See [Sending and receiving Set data](#))

Navigating the 2oh2

The PLAY and EDIT buttons, in combination with the SHIFT button are used to switch between the modes and views.

Pressing PLAY will switch to sequencer view. If the sequencer was not previously running, this will also switch the mode to sequencer mode and start the sequencer at the beginning of the next bar. When in sequencer view, pressing PLAY will stop the sequencer and return to 'normal' mode.

Pressing SHIFT + PLAY will switch to arpeggiator view. If the arpeggiator was not previously running, it will start the moment you press keyboard keys.

Pressing SHIFT + PLAY again stops the arpeggiator and returns to the previous view.

Pressing EDIT will open the pattern edit view. The mode does not change, sequencer or arpeggiator will keep running while you can edit a pattern.

Pressing EDIT again will return to the previous view.

Pressing SHIFT + EDIT will open song edit view. The mode does not change, sequencer or arpeggiator will keep running while you can edit a pattern.

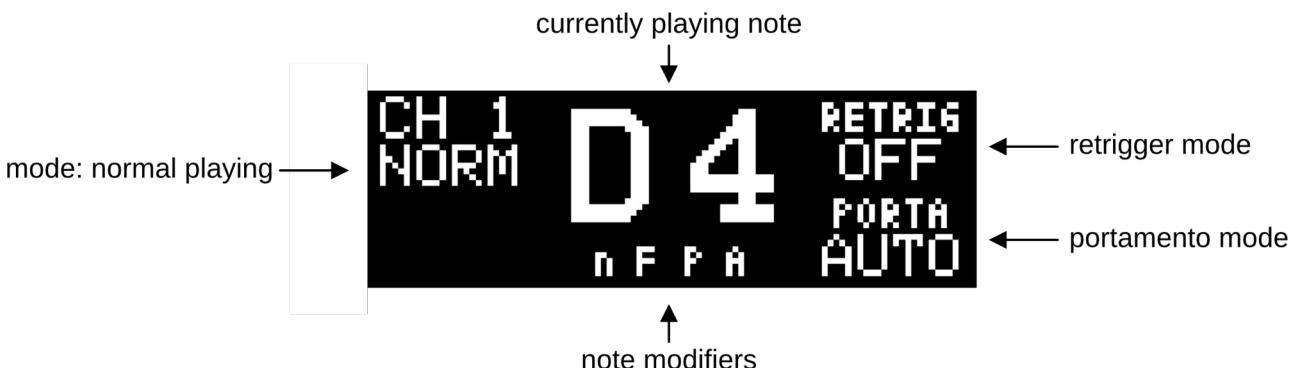
Pressing SHIFT + EDIT again will return to the previous view.

Normal mode

In normal mode you can play the 202 normally with the keyboard, MIDI or CV/gate. MC-2oh2 remembers the order in which keys are pressed and features a 'last' style key priority scheme. Several options concerning monophonic playing are given:

- **Retrigger:** Determines if the envelopes re-triggers when playing legato or not.
Toggle by pressing SHIFT + BAR
- **Portamento mode:** Is portamento always off, on, or turned on when playing legato (AUTO). Cycle by pressing SHIFT + PORTA

It is also possible to use the four modifier keys to add Accent, Filter Accent, Noise or Portamento to the next playing note.



A few shortcuts are available int Normal mode:

Pressing SHIFT + SAVE will save the current set

Pressing SHIFT + VERIFY will open the set menu

Pressing SHIFT + #/b will toggle the notation display

Pattern Editor

The pattern editor can be used to edit notes of a pattern. You can add, delete, copy paste and insert notes. You can also modify existing notes in pitch, edit note modifiers or the gate length.

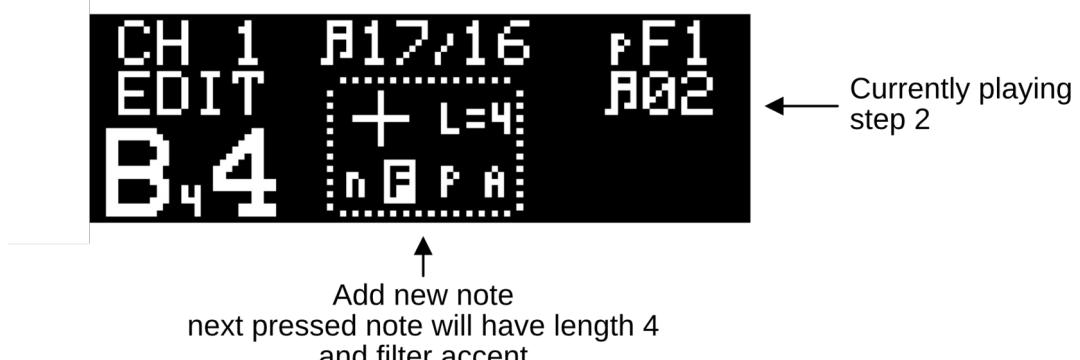
Select pattern to edit

Press and hold EDIT. The screen will display which pattern is currently playing in the sequencer (or if stopped the first pattern in a song). You can now use the keyboard keys to select the pattern you want to edit, or just release the EDIT button if the desired pattern is already selected.



EDIT View

You will now see the pattern editor.



You can add notes to the pattern by pressing keys on the keyboard. Each key press will add a new note.

The "Ghost Note" shows the properties of the next entered note. You can see the gate length and note modifiers. By pressing note modifier buttons or length buttons, you can change those properties. When then entering a note via the keyboard, the new note will have this gate length and modifiers.

A break/rest can be inserted by pressing SHIFT + REST (black F#) key. Gate lengths 1-4 can be entered or modified via SHIFT + black A#, G#, C# and D# keys as printed on the panel.

Use the FWD and BACK (MEAS) buttons to navigate the pattern, press a keyboard key to change the pitch of the currently selected note. Press modifier buttons to toggle its modifiers or use the gate length buttons to change lengths.

Press SHIFT + REST replace the current note with a REST, press SHIFT + REST again to get back to the original note.

With the FWD and BACK (STEP) buttons you can rotate a pattern left or right. When shifting right, all notes are moved one step to the right and the last step is moved into the first step. When shifting left this is reversed. All notes are moved to the left, the first note is placed into the last note.

When adding or changing notes, a preview is played depending on the [Editor preview modes](#). The preview includes pitch and note modifiers. Gate length of notes is previewed only when the main clock is running.

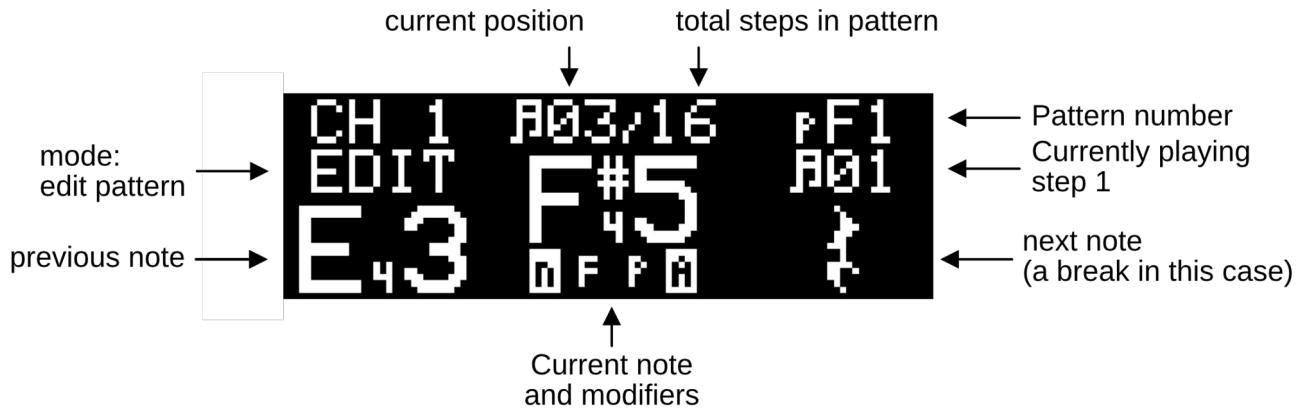
Further editing tools are provided:

SHIFT + COPY copies the current note.

SHIFT + PASTE (MEAS-DEL) pastes a previously copied note

SHIFT + INSERT inserts a new note at the current position in the pattern

SHIFT + DEL deletes the current note in the pattern



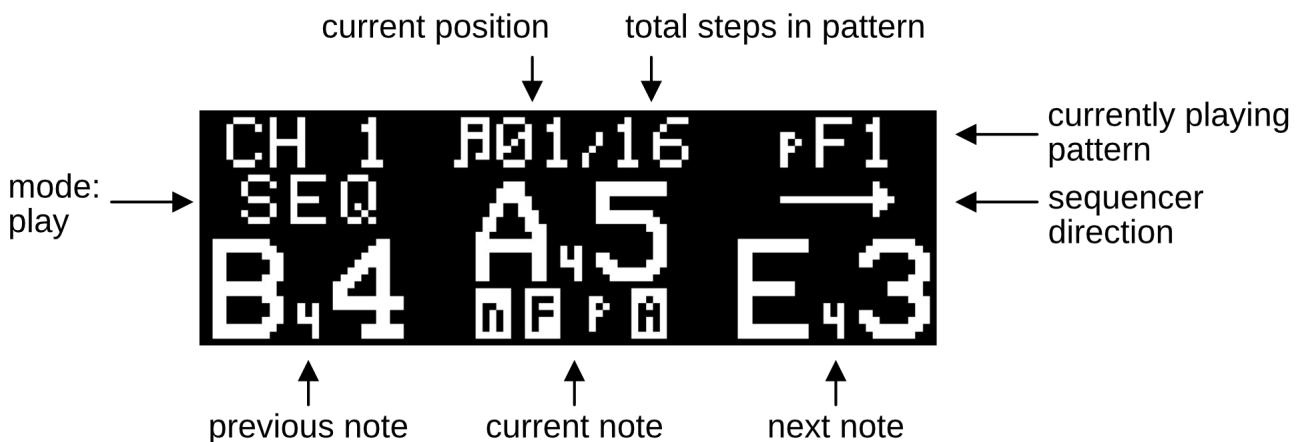
Editor preview modes

Various editor preview modes are available. The preview mode decides in which cases a preview is played or not. In some cases you might want to hear the preview whenever possible. For example when programming sequences in the studio. In other instances note preview is inconvenient, for example when playing live. The following modes are available and can be set in the config menu: MISC -> Behavior:

- OFF: Preview is always off. No preview will sound
- NORMAL: A preview is played when editing in NORMAL mode, but not when in PLAY or ARP mode.
- STOPPED: A preview is played when the main clock is stopped, no matter which mode. When 'trigger' is selected as main clock, preview will always sound.
- STOPPED or NORMAL: A preview is played when the main clock is stopped. When the main clock is started, preview is only played in NORMAL mode.

Sequencer

Play view



Starting and stopping

When the sequencer is stopped, press PLAY to start it, you may select one or more patterns to play while holding PLAY (see [Quick song recording](#)).

The sequencer will start playing in sync with the start of the next bar. If the main clock is stopped, the sequencer will start with the start of the main clock.

The sequencer can be stopped by pressing PLAY again, provided you are in PLAY view. When in other views, you may need to press PLAY in order to get into play view, then press PLAY again to stop the sequencer.

Changing the current pattern

When in play view, you can use the keyboard keys to change the currently playing pattern. Pressing a key will change the pattern immediately while staying in sync.

Another way is to use [Quick song recording](#). Changing the pattern this way will not change it immediately, but with the start of the next bar. To do this, press and hold PLAY and then select one (or more) patterns.

Play Directions

The sequencer features seven play directions. These can be selected using SHIFT combined with the DOWN, NORM and UP keys:

- SHIFT + UP: Forward. Plays the sequencer in a normal forward direction
- SHIFT + NORM: UP/DOWN: Plays the sequence forward, the next sequence backwards and so on: In this mode, the first and last notes of a sequence are repeated to make sure the total step length is twice that of the pattern.
- SHIFT + DOWN: backwards
- SHIFT + UP + DOWN: Ping-Pong: Similar to UP/DOWN, but here the first and last notes are not repeated.

- SHIFT + DOWN + NORM + UP: Random: notes of the sequence are playing in a random fashion
- SHIFT+ NORM + UP: Random Offset: The Random play mode does not play the steps in completely random order, but rather jump in the pattern based on an algorithm that is optimized to produce interesting rhythmic and melodic results.
- SHIFT + NORM + DOWN: Random Offset Reverse: The same as Random Offset, but backwards

Transpose sequence

To transpose a sequence press SHIFT + a keyboard key. The middle C defines the point where transpose is off, moving away from the middle C will transpose a number of semitones up or down.

Song

Patterns can be chained into a Song. A song is a sequence of patterns with a maximum length of 64. A song can contain a single pattern multiple times.

For example, a song containing four patterns might play patterns in the following order: pF1, pG#2, pF1, pF#1

When a pattern in a song is finished playing, the sequencer will switch to the next pattern in the song. If the last pattern in a song is finished, the sequencer will continue with the first pattern.

If a patterns has N steps, the pattern switch will occur after N steps even when Ping-Pong or Updown directions are used. This is to make sure a song always has the same length, no matter which direction mode is selected.

For example a song with 2 patterns pF1 and pF#1 in Updown direction mode will play:
pF1 forward, pF#1 backward, pF1 forward,

A song will repeat until the sequencer is stopped.

Quick song recording

To quickly record a new song, press and hold the PLAY button. While pressed, enter the patterns of the new song with the keyboard. You can use patterns multiple times.

When finished, release the PLAY button. If the sequencer was running, the currently playing pattern will finish and the new song will start. If the sequencer was stopped, the new song will start with the start of the next bar.



Song Editor

The song editor works similarly to the pattern editor. Here the current song can be edited.

The display shows the current pattern in the middle, the previous pattern on the left and the next pattern in the song on the right. For the current pattern, the length in steps is shown as well. On the top, you can see the current position in the song and the total number of patterns in the song.

If the sequencer is running, the currently playing pattern is highlighted.

Use the FWD and BACK buttons to navigate in the song. If you want to add a new pattern to the song, go all the way forward until a + is visible. Pressing keyboard keys adds new pattern to the song.

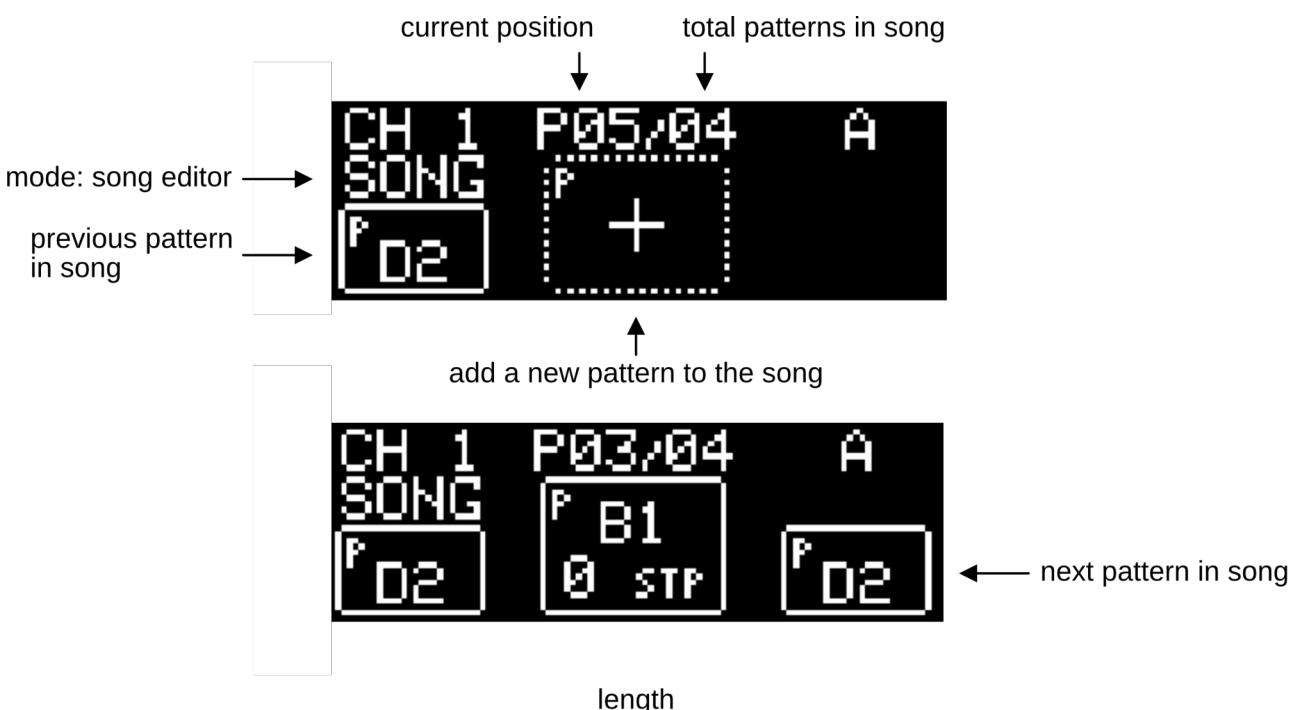
Existing patterns can be replaced simply by pressing the key of another pattern.

SHIFT + COPY opens the pattern copy menu (see [Copy patterns](#))

SHIFT + PASTE (MEAS-DEL) Opens the pattern paste menu (see [Paste patterns](#))

SHIFT + INSERT inserts a new pattern at the current position in the song

SHIFT + DEL: Deletes the current pattern from the song (but not the pattern itself)



Copy patterns

Press SHIFT + COPY in any view except the pattern editor to open Pattern copy view.



Here, pressing any keyboard key will copy the contents of that pattern. The display shows the currently copied pattern.

Press FWD, BACK, EDIT or PLAY to exit pattern copy view.

Paste patterns

Press SHIFT + PASTE in any view except the pattern editor to open Pattern paste view.



Here you can see the previously copied pattern in the middle. Pressing any of the keyboard keys will paste the copied pattern into the pattern of the pressed key. The most recently pasted pattern will be shown on the right. Copied and pasted patterns do not need to be of the same channel. It is possible to copy a pattern from one channel to another.

Press FWD, BACK, EDIT or PLAY to exit pattern paste view.

Arpeggiator

The arpeggiator mode can be accessed by pressing SHIFT + PLAY.



In the arpeggiator view, the display shows the following:

- The keyboard on the bottom shows the pressed or held notes
- On the left you can see the indicator for the arpeggiator directions
- In the upper right corner is the Hold indicator. Currently Hold is off.
- Below it you can see the arpeggiator range in octaves
- And finally next to the little chemistry flask: The current chemistry pattern

Hold

When arpeggiator Hold is off, only keys that are held down will be arpeggiated. When Hold is on, you can press a number of keys and those will arpeggiated even when you release them. Only when you have released all keys and then press keys again, the previously held notes are released.

You can toggle Hold by pressing SHIFT + TEMPO

Arpeggiator Directions

Seven different arpeggiator directions are available. These can be selected using SHIFT combined with the DOWN, NORM and UP keys:

- SHIFT + UP: **Upwards** . The arpeggiator moves in an upwards direction from lowest to highest note.
- SHIFT + NORM: **UP/DOWN**: The arpeggiator moves in an upwards direction followed by a downwards movement. The first and last notes are repeated.
- SHIFT + DOWN: **Downwards**: The arpeggiator moves in a downwards direction from highest note to lowest.
- SHIFT + UP + DOWN: **Ping-Pong**: Similar to UP/DOWN, but here the first and last notes are not repeated.
- SHIFT + DOWN + NORM + UP: **Random**: notes are playing in a random fashion
- SHIFT+ NORM + UP: **Order**: Notes are playing in the order they were pressed. If Hold is active, it is possible to press notes multiple times – as long as at least one key is held down, up to 32 notes can be added. This allows you to program little sequences on the fly very intuitively.
- SHIFT + NORM + DOWN: **Redro**: The same as **Order**, but backwards

Octaves

The arpeggiator octave range can be set between 1 and 5. Arpeggiated sequences will repeat in higher octaves for settings higher than 1. Use the (MEAS) FWD and BACK buttons to change the octave range.

Transpose

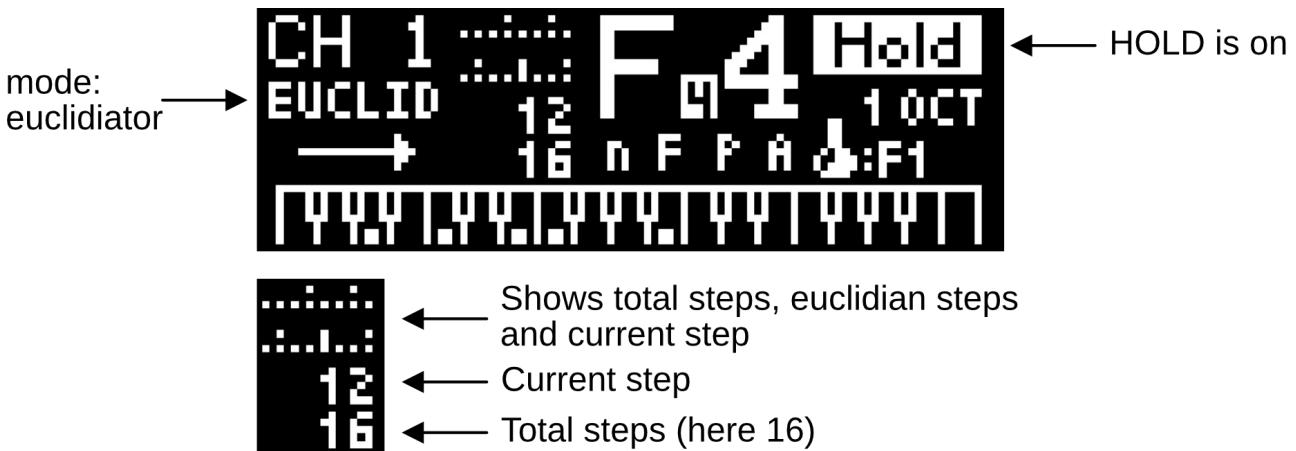
To transpose an arpeggio press SHIFT + a keyboard key. The middle C defines the point where transpose is off, moving away from the middle C will transpose a number of semitones up or down.

Chemistry patterns

It is possible for the arpeggiator to inherit the 'chemistry' of patterns. Note modifiers (Accent, Filter Accent, Portamento and Noise), gate lengths and rests are taken from an existing pattern and transferred to the arpeggiator sequence. This makes it possible to create rhythmic or polyrhythmic arpeggiator structures.

To select a pattern as chemistry pattern, press INS + a keyboard key. To select no pattern as chemistry pattern (turn off the chemistry feature) press INS and release it without selecting a pattern via the keyboard.

Euclidian mode (Euclidiator)



The arpeggiator has an euclidian clocking mode called Euclidiator. Here, the arpeggiator is not clocked at every step. Instead, the pressed (or latched) notes are distributed evenly across a fixed number of steps. The distribution is calculated using an euclidian algorithm.

In euclidiator view, you can see the total number of steps as little dots (up to 32) and the distributed notes as little dots above these. A small line indicates the current position. If space allows it, the current step and total number of steps are also shown as numbers below that.

The total number of steps are taken from the selected chemistry pattern. If no chemistry pattern is selected, the number of steps defaults to 16.

To switch between the normal arpeggiator and the Euclidiator, press DEL.

Press SHIFT + FWD/BACK (STEP) to shift the euclidian steps left or right.

The Drum channel

The 3rd channel can be used to program drums, specifically the Lo-FI drum samples with audio output via the Tape-OUT output or the internal speaker. The drum samples can be uploaded via MIDI sysex (See Sample Upload).

Please note that the sample feature is fun, but very limited. Only one sample can be played at a time, samples are of low quality and there is only a limited number of ways to modify the samples. Use this feature or don't, just don't expect a full high quality sampling engine ;-)

The 3rd channel can also be used for normal notes output via midi. This behavior can be changed in the config menu.

When configured as drum channel, the 3rd channel behaves and looks slightly different to the other channels:

There are up to 12 samples, one for each note in the octave. It does not matter on which octave you play the samples.

Instead of note names, sample names are displayed. For example BD for Bass Drum. The note modifiers are also changed, the following modifiers are now available:

- A: Attack, play the sample louder
- F: Fast: Play the sample at double speed
- S: Slow: Play the sample at half speed
- R: Reverse: Play the sample in reverse.
If used with a REST: Continue playing previous sample

The modifiers can be combined. You can for example play a sample at half speed reversed. When combining Slow and Fast, interesting effects can be heard for samples containing high frequency content (for example hihats).



In normal view and PLAY view, you can see a list of samples – only the first 11 of the 12 samples are shown, not enough space on the display. The list shows which drums are muted in the sequencer. See below.



In PLAY view there is a drum muting display on the bottom. In the picture above, SD and CB are currently muted and will not play.

You can mute or unmute samples by pressing SHIFT + the keyboard key of the sample

MIDI control

MC-2oh2 has a MIDI input which is shared with the DIN-input. Likewise the MIDI output is shared with DIN-sync output 1.

Playing the 2oh2 via midi

The MC-2oh2 has four separate midi input channels: One for each synthesizer channel (CH1, CH2 and CH3 or DRUM) and one 'keyboard channel'. In the Config Menu the mid channels can be set or turned off completely.

Keyboard input midi channel

The keyboard input channel acts similar to the built in keyboard. Here, the currently visible channel will receive the midi notes. Depending on the current view, you can play normally, use the arpeggiator or use the keyboard to enter a new pattern.

There are however limitations built in on purpose: Unlike the built-in keyboard, the keyboard midi input will not react to pressing SHIFT (e.g. changing a note's gate length) and is not affected by internal keyboard transpose.

Playing individual channels

For each synthesizer-channel a different midi-channel can be selected. This allows you to play the three channels independently.

In normal mode, the MC-2oh2 will play the received midi notes normally, in arpeggiator mode, the received notes will be arpeggiated. When a channel is in sequencer play mode, the received midi is ignored.

Velocity mapping

Midi note velocity can be linked to various sound parameters. This allows dynamic playing via midi:

- Filter cutoff
- Filter Accent amount
- Filter ADSR attack, decay, sustain or release
- Pulse Width ADSR attack, decay, sustain or release
- Noise accent amount
- Note modifiers: Here, depending on the velocity, one or multiple of the note modifiers are triggered. This mapping is more suited for controlling MC-2oh2 from a DAW rather than playing by hand.

Pitch bend (HiRes version only)

The optional HiRes version of MC-2oh2 can also receive midi pitch bend commands. Since the midi standard is not quite clear about the midi pitch bend range, the range can be adjusted in the config menu. Pitch bend works on synthesizer-channels 1 and 2, a voltage is added or subtracted from the pitch CV. It is not possible to bend the pitch below the lowest note or above the highest note because of the limited CV range.

Receiving tunings (HiRes version only)

The HiRes version can receive microtonal tunings via midi. Several tunings can be stored and recalled.

See [Micotonal Tunings](#)

2oh2 midi output

MC-2oh2 has four midi output channels. The keyboard channel sends what is played on the internal keyboard. Additionally, each synthesizer channel has its own midi output channel sending whatever is playing on that channel.

Midi output can also be turned off channel-wise.

Velocity values for outgoing MIDI notes can be adjusted for non-accented and accented notes in the config menu, Inputs and Outputs, MIDI, [MIDI output](#).

When portamento is active, MC-2oh2 sends the note on of the next note first, then the note off. This legato-style playing is interpreted as triggering glide, bend or similar behaviors in many synthesizers (including MC-2oh2).

MIDI clock input

MC-2oh2 can be clocked via MIDI clock if the main clock source is set to 'MIDI'.

MIDI clock output

If desired, MC-2oh2 can output midi clock as well. Depending on the selected clock source for the main clock, MC-2oh2 will forward the incoming midi clock, or convert the internal or DIN clock to midi clock. When 'trigger' is selected as main clock, there is no midi clock output.

MIDI CC control

Some of the analogue MC-202 synthesizer parameters and many of the additional sound parameters can be controlled with midi controller messages (MIDI CC).

This includes filter cutoff, additional ADSRs and Accent envelopes, clock dividers and more. A complete list can be found in [Appendix I - MIDI CC values](#).

The setting "Overlay timeout" (Config menu -> [Display](#)) can be set to show the corresponding menu page when sending midi CC values. When activated, changing ADSR attack for example, will shortly display the filter ADSR menu and show the changes in real time. This is only useful when changing one parameter at a time - when using automation or changing several parameters simultaneously, the overlay can be very distracting, so it is normally turned off.

Sending and receiving Set data

Patterns, Songs, Modulation parameters and complete sets can be sent and received via midi Sysex.

This can be used to manage Sets from a computer using software such as MIDIox or SysexLibrarian. A more advanced software that can also edit Set data and drum samples is [MC-2oh2-Hack by Defective Records](#)

You can send Sets by pressing "Send as Sysex" in the SET menu. When receiving Set data via sysex, MC-2oh2 will overwrite the existing set. This way you can also send Set data from one MC-2oh2 to another.

The MIDI sysex specification for the set data can be found in [Appendix II - MIDI sysex specifications](#)

Receiving sample data

MC-2oh2 can receive drum sample data via MIDI sysex. Upon receiving sample data, the current samples are replaced with the new ones.

The MIDI sysex specification for the sample data can be found in Appendix [Appendix II - MIDI sysex specifications](#)

External CV / Gate

The external CV and gate input can be used for several purposes.

In keyboard mode you can use them to connect an external CV keyboard or other CV/Gate source to program the 2oh2. Here, the CV/Gate input acts like the internal or a MIDI keyboard. You can enter sequences in the editor, change playing sequences or use the arpeggiator - though only monophonically.

Quantized mode, allows you to play the synthesizer directly, but the CV voltage is quantized by the CPU. Quantization is typically in semi-notes, but can differ when other tunings are loaded (HiRes version only). Quantization is much faster compared to the original MC-202 as we do not use the original slow ADC to read the CV voltage.

If this mode is active, 2oh2 arp, sequencer etc can not play the internal synthesizer. However, CH1 can be used to control other synthesizers via midi out.

In direct mode where the incoming CV and gate signals are directly sent to the internal synthesizer bypassing the CPU completely.

If this mode is active, 2oh2 arp, sequencer etc can not play the internal synthesizer. However, CH1 can be used to control other synthesizers via midi out.

Finally there is "Reset/CV" mode. Here the gate input can be used to reset the main clock when "trigger" is used as clock source. The CV input is currently unused in this mode, but will be able to control various parameters in future firmwares.

DIN Sync

MC-2oh2 has one DIN-Sync input and two DIN-Sync outputs. The DIN-sync input is shared with the MIDI input, while DIN-sync out 1 is share with the MIDI-output. The shared output has a minor drawback: As pins 4 and 5 are used for midi, DIN-sync gear that uses these pins might behave incorrectly. More about this, see DIN-sync continue.

The two DIN-sync outputs send clock and start/stop signals when the main clock is running. An exception: If trigger is selected as clock source, the DIN-sync outputs will not output clock signals, but will output the start/stop signal.

When syncing the MC-2oh2 via midi, the midi clock will be converted to DIN-sync clock and sent to the outputs as well.

It is possible to deactivate sending the DIN-sync clock in the config menu -> Inputs and outputs -> [DIN Sync](#). The start / stop signal however will always be sent due to hardware limitations of the MC-202.

DIN-sync continue

Continue indicates that a previously stopped sequence continues from the point it was stopped, rather than starting from the beginning. Such a continue condition occurs when pressing the CONT button on the MC-2oh2, receiving a continue message via midi or getting a continue signal via DIN-sync.

DIN-sync start/stop and clock signals typically work well between different gear as there is a pseudo-standard. The continue signal however is not standardized even between different kind of gear of the same vendor. This makes continue problematic. We implemented different continue modes to interface with various gear, but recommend to not use continue at all when clocking gear via DIN-sync. Instead use start and stop only.

No Continue output

If continue output is disabled, connected gear will start and stop in sync, but will be out of sync to the MC-2oh2 when a continue condition occurs.

The DIN-sync continue signal

Some gear uses pin 5 on the DIN-sync connector to implement continue. When the signal at this pin is high the moment a start condition is received, continue is activated. Not all DIN-sync gear implements this and some gear uses the pin for different functions.

MC-2oh2 implements this continue mode, but only for DIN-sync output 2 (!). DIN-sync output number one on the other hand will send a high signal *all the time*. This is due to it being a shared DIN-sync/MIDI connection. Gear that uses DIN-sync pin 5 might behave incorrectly when connected to DIN-sync output 1.

Pin 5 continue mode can be activated in the config menu -> Inputs and outputs -> [DIN-Sync](#)

Stopping the clocking

Another way to implement DIN-sync continue is to leave the start signal active when stopped, but stop the clock instead. When continuing, the clock simply continues.

However, when starting, the start/stop signal needs to be stopped for a short duration and then started again - otherwise connected gear would not reset correctly. This can be problematic as some gear does not behave as expected in this situation.

Another disadvantage of this method: In the MC-202 the red start/stop LED is directly connected to the DIN-sync start stop signal. Therefore, when the 'clock stopping' continue method is active, the LED will always be on.

Clock stopping continue mode can be activated in the config menu -> Inputs and outputs -> DIN-Sync

Using MIDI and DIN-sync simultaneously

It is possible to use DIN-sync and MIDI simultaneously. You can receive MIDI messages via the MIDI input, output MIDI to out 1 and output a DIN-sync clock on DIN-out 2.

Similarly it is possible to sync the MC-2oh2 via external DIN-sync, but send the generated notes and clock to external MIDI gear.

It is even possible to use the input for both, MIDI and DIN-sync simultaneously. This requires a special adapter that splits the 5 DIN pins as following: Pins 4 and 5 to a midi socket and Pins 1,2,3 to a DIN-sync socket. With this adapter you could sync the MC-2oh2 from a DIN-sync source, but play notes or control additional parameters via MIDI.

Such an adapter could also be used to get one MIDI and two DIN-sync outputs by plugging it into DIN-out 1.

Some gear shares one DIN-sync socket for both MIDI and DIN input. (Such as the MC-2oh2). In this case, even when not sending a midi clock, that gear might still be clocked via DIN-sync. If that is not desired, turn off DIN-sync via the config menu.

Micotonal Tunings

The HiRes version of MC-2oh2 can manage microtonal tunings, send and receive them via MIDI.

Several tunings can be stored and recalled using the tuning Manager in the config menu.

Both, channel 1 and 2 have a tuning resolution of 0.37 cents.

Tuning Manager

The tuning manager has 9 tuning slots. If available, the name of the tuning is shown, otherwise only the slot number. The first slot (Slot 'C') always shows the currently active tuning. Slot 1 is always 12 TET, the default tuning. Tuning slots 2-8 can be stored and loaded from memory.

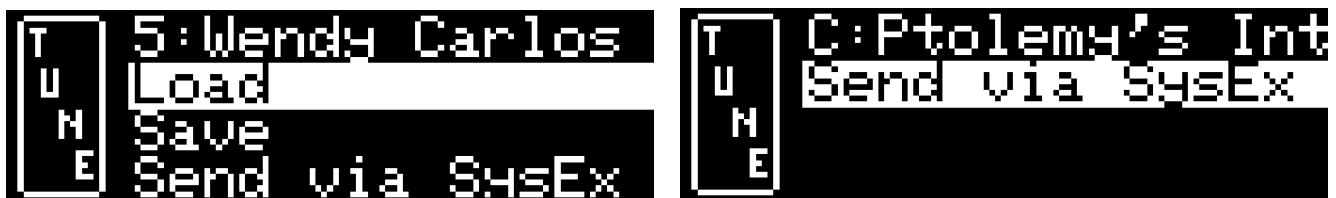
Select a tuning by pressing enter on the first line and using the FWD and BACK buttons to navigate. Press enter again.

To load the selected tuning, select Load and press enter. The current tuning will be overwritten by the loaded tuning. You can navigate to the 'C' slot and now see the loaded tuning here as well.

To save the current tuning to a new slot, navigate to the slot and press Save. This way you can also move or copy tunings from one slot to another.

The Current tuning can be sent as MIDI Sysex 'tuning bulk dump'. To do so, press "Send as Sysex" on the current tuning slot (C).

Note: If the tuning manager is not visible in the config menu, navigate to MISC->Calibration->Cal out and turn the HiRes mode on. This only makes sense if you do have the HiRes version of Mc-2oh2 and should have been done at installation.



Receive Tunings

Note: When receiving tunings via sysex, the current tuning will be overwritten!

There are various hardware and software options for sending tunings to MC-2oh2.

This includes the Tubbutec µTune module and the software Scala by Manuel Op de Coul.

MC-2oh2 supports both 'bulk tuning dump' and realtime tuning sysex messages, the 'Device ID' and 'MTS present' are ignored, the received tuning is always stored in the Current Tuning (C) slot.

When receiving a new tuning MC-2oh2 will show the message "Received tuning" on the display and overwrite the current tuning with the received one.

Config menu

Many settings can be changed in the MC-2oh2 configuration menu (config menu). This includes settings for clock, modulation, MIDI and more. The config menu also includes functions for managing sets.

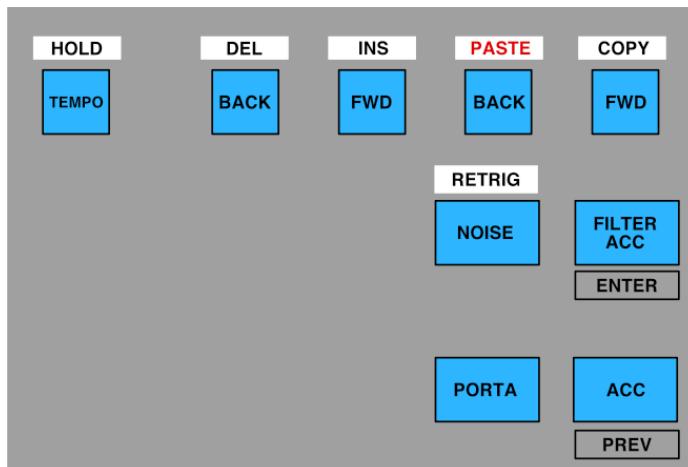
All settings except those that are part of a set (Modulations and clock dividers) are saved when exiting the config menu.

Navigating the config menu

To access the config menu press SHIFT + ENTER.

Once in the config menu use ENTER to select a menu item or enter a sub-menu. The PREV button (ACCENT button) goes back the previous menu page or exits the config menu from the main page.

Use FWD and BACK to move to the next or previous menu item.



Main Page

The main menu page is the first menu page you see after entering the config menu. Pressing PREV here, exits the config menu. There are various sub-menus here, you can enter them by navigating using FWD/BACK and pressing ENTER.



Clock

The clock settings page contains the main clock source and channel clock dividers. (see [Clocking](#))

Src: Main clock source

- Internal: The internal clock is used as main clock
- Din-Sync: An external DIN-Sync clock is used
- Midi: Midi clock is used as main clock
- Trigger: Trigger input via Tape-in is used as clock.

CH1,2,Drum dividers: Channel clock dividers. Here you can set different clock dividers for each channel.



Mod & Sound

The Mod & Sound menu is home to settings for additional modulations like Accent, ADSR or LFOs as well as the additional noise sound source. (See Modulators and sounds)



VCF Accent

Here parameters for the additional filter accent can be set.

Amount: Sets the filter accent amount between 0% and 100%

Attack: Sets the accent attack between 0ms and 10s

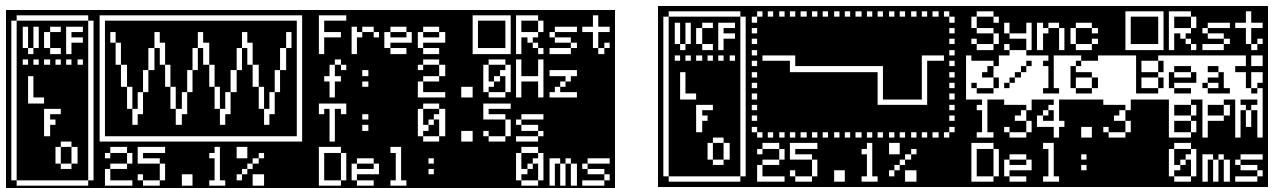
Decay: Sets the accent decay between 0ms and 10s



VCF and PW LFO

In these menus parameters for the VCF (Filter) LFO or the PW (pulse width) LFO can be set.

- The number with % sets the LFO amount between 0% and 100%
- Selecting the **waveform** preview lets you change the waveform. Triangle, Sawtooth, Sawtooth inverted, rectangular and an S/H random LFO can be selected.
- **Free** or **Sync**: Toggle between free running and synced LFO mode.
- **Rst**: Defines if the LFO should reset on each new note.
- **f / T**: In free running mode, you can define the LFO frequency or period. Both values are displayed simultaneously. The frequency can be adjusted between 50mHz (a 20s period) and 1kHz.
- In synced mode the LFO frequency and period is defined by the clock speed. Here you can set a clock divider between 4 bars and 32nd notes. The currently measured clock frequency is shown in BPM for your convenience.
- The Delay (Del) parameter: LFO Delay can be adjusted between 0 and 10s.

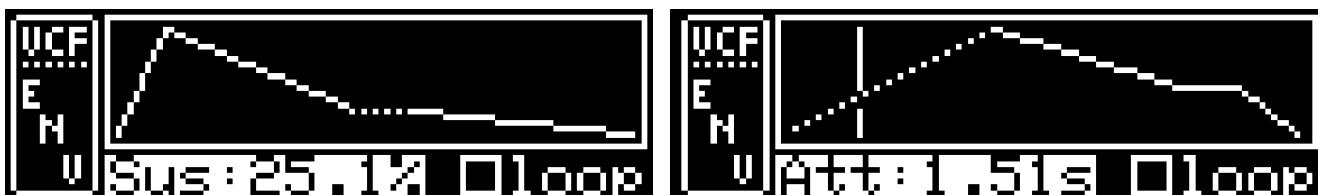


VCF and PW ADSR

In these menus parameters for the VCF (Filter) ADSR envelope or the PW (pulse width) ADSR envelope can be set.

The display shows a preview of the envelope a pointer marks the current position when a note is played. If looping is activated, the start and end of the loop are shown as well.

The envelope display is not to scale on the time axis.



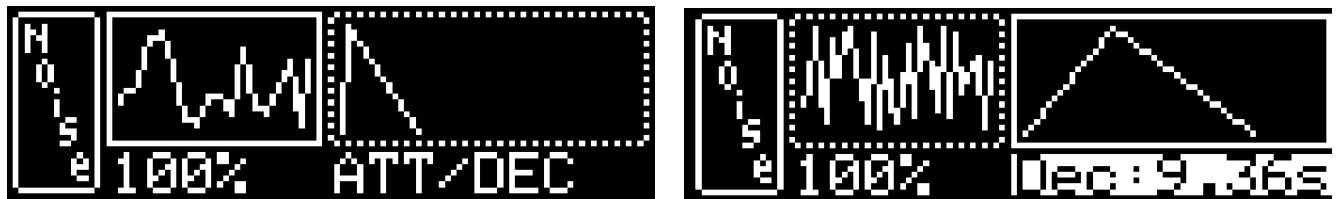
Parameters are:

- Amount: Set the envelope amount between 0% and 100%
- Delay: Set the envelope delay time between 0ms and 10s
- Attack: Set the envelope attack time between 0ms and 10s
- Decay: Set the envelope decay time between 0ms and 10s
- Sustain: Set the envelope sustain parameter between 0% and 100%
- Release: Set the envelope release time between 0ms and 10s
- Loop: Turns envelope looping on and off
- Invert: Inverts the envelope if activated

Noise

The Noise menu shows the parameters for the additional noise sound. On the left is a preview of the noise waveform. Below that the setting for noise volume and to the right attack and decay settings. (Also see [Noise](#))

- Amount: Adjust the noise volume between 0% and 100%
- Noise Quality: selecting the waveform preview lets you change the noise quality
- Attack: Sets the attack of the noise envelope
- Decay: Sets the decay of the noise envelope



Reset parameters

Selecting this menu entry and pressing ENTER will reset all modulation parameters to their default values.

Input and Output

MIDI

In the MIDI menu all MIDI related settings can be made. (Also see [MIDI control](#))

MIDI input

For a detailed explanation of these parameters see [MIDI Control](#)

- Set MIDI channels for the keyboard input and channel 1-3 inputs. Set to OFF to turn these inputs off.
- Velocity mapping: set the various velocity mapping modes.
- MIDI CC-in: Defines if the 2oh2 can be controlled via MIDI CC
- Pitch bend range: Set the pitch bend range in semitones (HiRes version only)

MIDI output

- Set midi output channels of channel 1-3 and the keyboard
- Send clock: If turned on, 2oh2 will send a midi clock generated from the main clock.

DIN-Sync

(Also see [DIN Sync](#))

- Cont-IN: Select the MC-2oh2 DIN-sync input continue behavior:
 - OFF: Ignore continue Signal on PIN 5
 - PIN 5: Use continue signal on pin 5
- Cont-OUT: Selects the MC-2oh2 DIN-sync output continue behavior:
 - OFF: Do not create a special continue signal
 - PIN 5: output a continue signal on Pin 5
 - Clock Stop: Clock stopping scheme to implement continue (warning the red LED will be always on).

Metronome

(Also see [Metronome](#))

- Metronome: Turn the metronome ON/OFF.
- Bar Sound: Select the metronome sample sounding at the first beat of a bar
- Beat Sound: Select the metronome sample sounding at each quarter note

Speaker: Turn the internal speaker on or off. The speaker plays samples or the metronome.

CV-In Mode

(Also see [CV-In Mode](#))

- OFF: CV and gate input are not used
- Keyboard: CV and gate inputs are used as keyboard
- Quantize: CV in and gate control the internal synthesizer directly. MC-2oh2 is disconnected from the internal synthesizer as has no control over it. The incoming CV however is quantized. Quantization is typically to seminotes, but with the Hires version it is possible to use other scales.
- Direct: CV in and gate control the internal synthesizer directly. MC-2oh2 is disconnected from the internal synthesizer as has no control over it. The incoming CV is not quantized.
- Reset/CV: The gate input is used as 'Reset' for the trigger clock. The CV input is currently unused in this mode, but will be able to control various parameters in future firmwares.

Set

In the set menu you can manage sets. (Also see [Sets](#))

- Slot: Select a slot between 1 and 8 for storing / loading sets.
- Load: load the set stored in the selected slot
- Save: Save the current set into the selected slot.
- Clear set: Clears and resets all data of the current set. This requires confirmation by pressing ENTER a second time. Press PREV to cancel
- Autosave: Set a time interval to save the current set automatically. If turned off, the current set needs to be saved manually. 5min, 10min, 15min and 30min time intervals are available.
- Send via SysEx: Sends all set data via MIDI sysex to be captured by another 2oh2 or sysex capture tool

Tuning Manager

The [Tuning Manager](#) can save, load, reset and send tunings (HiRes version only).

- Select the tuning slot. Slot numbers and name of the tuning (if available) are shown.
- Load: Load tuning from currently selected slot
- Save: Save current tuning to selected slot
- Reset: Resets the current slot to 12 TET / 12 EDO
- Send via Sysex: Sends tuning via sysex

Misc

Display

Various settings dealing with display and display content

- b notation: switch between sharp notation (#) and flat notation (b)
- Overl. Timeout: Time in seconds the parameter is overlayed when receiving MIDI CC (See MIDI CC control)
- Brightness: Adjust the display brightness

Behavior

- DRUM chan: Defines if the 3rd channel is used for DRUMs or is a normal note channel
- Def gate len: Default gate length for new notes in the editor
- Editor Preview mode: OFF, NORM, STOPPED, NRM+STPD (see [Editor preview modes](#))

About

Shows infos about the 2oh2 version and collaborators

Calibration:

Calibration for inputs and outputs. Not for the user. Don't change anything here unless you know what you are doing !

Cal OLED

- OLED Border: Draw a border around the display for better alignment
- OLED Offset: Move display content left / right

Cal in

Calibrate CV-in

- 0V -> all: Apply 0V to CV-in, press here
- 5V -> pitch: Apply 5V to CV-in, press here

Cal out

Output calibration for HiRes DAC

- HiRes DAC: Turn using HiRes DAC on or off
- Chan: 0 : select channel to calibrate (0 = internal, 1 = external)
- 1V: Adjust until CV-out is 1V
- 5V: Adjust until CV-out is 5V

Cal aux

Offset values for internally used CVs

- Filter: Default: 128
- PW/VOL: Default: 128
- Noise: Default: 128
- Aux: Default: 512

Tubbutec MC-2oh2 User Guide

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The most recent version of this manual can be found at tubbutec.de/6equencer/

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Appendix I - MIDI CC values

Parameter	MIDI CC	Range	Parameter	MIDI CC	Range
Filter LFO amount	14	0 – 127	PW ADSR decay	43	0 – 127
Filter LFO frequency	15	0 – 127	PW ADSR sustain	44	0 – 127
Filter LFO shape	16	see table	PW ADSR release	45	0 – 127
Filter LFO synced	17	≥ 64 → ON	PW ADSR loop	46	≥ 64 → ON
Filter LFO delay	18	0 – 127	PW ADSR invert	47	≥ 64 → ON
Filter LFO divider	19	see table	Modifier Accent	48	≥ 64 → ON
Filter LFO resetting	20	≥ 64 → ON	Modifier Filter Accent	49	≥ 64 → ON
Filter ADSR amount	21	0 – 127	Modifier Portamento	50	≥ 64 → ON
Filter ADSR delay	22	0 – 127	Modifier Noise	51	≥ 64 → ON
Filter ADSR attack	23	0 – 127	Noise amount	52	0 – 127
Filter ADSR decay	24	0 – 127	Noise attack	53	0 – 127
Filter ADSR sustain	25	0 – 127	Noise decay	54	0 – 127
Filter ADSR release	26	0 – 127	Noise quality	55	0 – 127
Filter ADSR loop	27	≥ 64 → ON	reserved	56	
Filter ADSR invert	28	≥ 64 → ON	reserved	57	
Filter Accent amount	29	0 – 127	reserved	58	
Filter Accent attack	30	0 – 127	Velocity Link	60	see table
Filter Accent decay	31	0 – 127	PW amount	70	0 – 127
Filter LFO amount	33	0 – 127	Filter amount	74	0 – 127
Filter LFO frequency	34	0 – 127	Clock source	102	see table
Filter LFO shape	35	see table	Clock divider CH1	103	see table
Filter LFO synced	36	≥ 64 → ON	Clock divider CH2	104	see table
Filter LFO divider	37	see table	Clock divider CH3	105	see table
Filter LFO delay	38	0 – 127	reserved	106	
Filter LFO resetting	39	≥ 64 → ON	Clock divider all chans	107	see table
PW ADSR amount	40	0 – 127	reserved	108	
PW ADSR delay	41	0 – 127	Speaker on/off	109	≥ 64 → ON
PW ADSR attack	42	0 – 127	reserved	110	

Midi CC values for velocity link

0-9	10-19	20-29	30-39	40-49
Off	Filter Cutoff	Filter Accent Amt	Filter env attack	Filter env decay
50-59	60-69	70-79	80-89	90-99
Filter env sustain	Filter env release	PW env attack	PW env decay	PW env sustain
100 - 109	110-129	120 - 127		
PW env release	Noise accent amt	Modifier switch		

Midi CC values for the clock source

0 - 31	32- 63	64 – 95	96 - 127
Internal	DIN-sync	MIDI	Trigger

LFO midi mapping

Midi CC values for the various LFO shapes

0 - 25	26 - 51	52 – 77	78 - 103	104 - 127
Triangule	Saw	Inverted Saw	Square	Random

Midi CC values for the LFO clock divider in synced mode

0 – 6	7 – 13	14 – 20	21 – 27	28 – 34	35 - 41	42 - 48	49 - 55	56 - 62
4 Bars	3 Bars	2.5 Bars	2 Bars	1.5 Bars	1 Bar	3 / 4	1 T	1 / 2
63 – 69	70 – 76	77 – 83	84 – 90	91 – 97	98 – 104	105 – 111	112 – 118	119 – 125
3 / 8	1 / 2 T	1 / 4	3 / 16	1 / 4 T	1 / 8	3 / 32	1 / 8 T	1 / 16
126-127								
1/32								

LFO midi value vs Period / frequency in free running mode

VAL	Period	VAL	f[Hz]											
0	20 s	16	0.25	32	4.25	48	8.25	64	32.5	80	72.5	96	225	
1	19 s	17	0.33	33	4.5	49	8.5	65	35	81	75	97	250	
2	18 s	18	0.5	34	4.75	50	8.75	66	37.5	82	77.5	98	275	
3	17 s	19	1	35	5	51	9	67	40	83	80	99	300	
4	16 s	20	1.25	36	5.25	52	9.25	68	42.5	84	82.5	100	325	
5	15 s	21	1.5	37	5.5	53	9.5	69	45	85	85	101	350	
6	14 s	22	1.75	38	5.75	54	9.75	70	47.5	86	87.5	102	375	
7	13 s	23	2	39	6	55	10	71	50	87	90	103	400	
8	12 s	24	2.25	40	6.25	56	12.5	72	52.5	88	92.5	104	425	
9	11 s	25	2.5	41	6.5	57	15	73	55	89	95	105	450	
10	10 s	26	2.75	42	6.75	58	17.5	74	57.5	90	97.5	106	475	
11	9 s	27	3	43	7	59	20	75	60	91	100	107	500	
12	8 s	28	3.25	44	7.25	60	22.5	76	62.5	92	125	108	525	
13	7 s	29	3.5	45	7.5	61	25	77	65	93	150	109	550	
14	6 s	30	3.75	46	7.75	62	27.5	78	67.5	94	175	110	575	
15	5 s	31	4	47	8	63	30	79	70	95	200	111	600	
													127	1000

ADSR times midi mapping

Envelope times: Midi values vs. time

VAL	Time	VAL	Time	VAL	Time	VAL	Time	VAL	Time	VAL	Time	VAL	Time
0	0ms	16	17ms	32	34ms	48	50ms	64	0.32s	80	0.64s	96	0.96s
1	2ms	17	18ms	33	35ms	49	60ms	65	0.34s	81	0.66s	97	1.0s
2	3ms	18	19ms	34	36ms	50	70ms	66	0.36s	82	0.68s	98	1.1s
3	4ms	19	20ms	35	37ms	51	80ms	67	0.38s	83	0.7s	99	1.2s
4	5ms	20	21ms	36	38ms	52	90ms	68	0.4s	84	0.72s	100	1.3s
5	6ms	21	22ms	37	39ms	53	100ms	69	0.42s	85	0.74s	101	1.4s
6	7ms	22	23ms	38	40ms	54	120ms	70	0.44s	86	0.76s	102	1.5s
7	8ms	23	24ms	39	41ms	55	140ms	71	0.46s	87	0.78s	103	1.6s
8	9ms	24	26ms	40	42ms	56	160ms	72	0.48s	88	0.8s	104	1.7s
9	10ms	25	27ms	41	43ms	57	180ms	73	0.5s	89	0.82s	105	1.8s
10	11ms	26	28ms	42	44ms	58	0.20s	74	0.52s	90	0.84s	106	1.9s
11	12ms	27	29ms	43	45ms	59	0.22s	75	0.54s	91	0.86s	107	2s
12	13ms	28	30ms	44	46ms	60	0.24s	76	0.56s	92	0.88s	108	2.1s
13	14ms	29	31ms	45	47ms	61	0.26s	77	0.58s	93	0.9s	109	2.2s
14	15ms	30	32ms	46	48ms	62	0.28s	78	0.6s	94	0.92s	110	2.3s
15	16ms	31	33ms	47	49ms	63	0.3s	79	0.62s	95	0.94s	111	2.4s

Appendix II - MIDI sysex specifications

All messages are encapsulated with a sysex start byte (0xF0) and a sysex stop byte (0xF7). Furthermore all messages begin with the Tubbutec vendor string 0x00, 0x74,0x74 . The vendor string is followed by the product type byte 0x01 and the 'message type' byte MT.

For simplicity sysex start/stop, vendor and product bytes are omitted below. A typical sysex message looks like this:

0xF0 0x00 0x74 074 0x01 **MT** [multiple data bytes] 0xF7

In order to receive data, a host would typically request the set data using a REQUEST command.

Song data, pattern data for each pattern and global set data containing additional parameters can be requested. It is also possible to request a full set containing all patterns, song and set data. This can result in a large amount of sysex traffic and should be used with caution.

Note that some midi interfaces split a sysex message into multiple sysex messages. This is not midi standard conform, but has been seen in the wild. A 65 byte long message might be split into two messages, one 64 byte long, the other one byte long. The second message will of course not contain any header (vendor string etc..). In such a case MC-2oh2 will not receive the message correctly.

Requests

The host can request data from the 2oh2, via sysex request messages:

version_request, returns version number

MT = 0x00

Requests the current firmware version

set_data_request, returns set_data

MT = 0x01

Requests the current set Data

song_request(channel, song number), returns song_data

MT = 0x02, CH, SN

Requests the current song. Only one song per channel is supported currently, but for upwards compatibility a song number can be provided. If not supported, 2oh2 will ignore the song number. Channel number and song number are encoded into the 2 bytes CH and SN.

pattern_request(channel, patternNumber), returns pattern_data

MT = 0x03, CH, PN

Requests the data of a single pattern in a single channel. Channel number and pattern numbers are encoded into two separate bytes CH and PN.

Full set request

MT = 0x04

Request a full set including all songs, pattern data of all channels and set data

fw_update_request

MT = 0x0F

Firmware update request. If 2oh2 receives this, it will enter bootloader mode.

An explanation of the firmware update procedure can be found below.

Data

These are the replies sent by MC-2oh2

version_number:

MT = 0x70, N1, N2

N1 and N2 are DCB encoded numbers (0 – 99), encoding the full version number as:

N1.N2

Example: N1 = 1, N2 = 64 → Firmware version 1.64

set_data: numberChannels, ClockDivider[]

MT = 0x71, NC, CL[4], LFO[20], ADSR[20], ACC[3], NOISE[4], ...

Contains all data related to a set.

NC is the number of channels (typically 3)

CL[4] one byte for each channel encoding the clock dividers. A table of clock dividers can be found in appendix I. The 4th byte is reserved

LFO[2*10] contains LFO parameters, 2 * 10 bytes, see appendix I. First all data of the filter LFO, followed by the PW LFO

ADSR[2*10] contains ADSR parameters, 2 * 10 bytes, see appendix I. First all data of the filter ADSR, followed by the PW ADSR

ACC[3] 3 bytes containing Filter accent amount, attack and decay

NOISE[4] contains 4 bytes of noise parameters: Amount, attack, decay and quality. Each of these is encoded as a 7 bit value.

song_data: song number, len, patterns[]

MT = 0x72, CH, SN, LN, PT[]

Contains song data for the requested channel. SN is the song number (typically 0). LN is the length of the song. The maximum number of patterns in a song is 64. For each pattern in the song, a 1-byte pattern number PT is added.

pattern_data: pattern number, len, note[]

MT = 0x73, CH, PT, LN, NN[]

Contains pattern data for a requested channel and pattern. CH is the sequencer channel, PT is the pattern number, LN is the length of the pattern. The maximum length of a pattern is 64. For each note in the pattern a 2-byte note_data NN is added.

note_data NN:

Note data is 2 bytes with the following bit layout:

Byte 1	Byte 2
Oppppppp	Oafnpllo

where

ppppppp = 7-bit pitch data

Same as in the midi 'note on' message.

MC-2oh2 can not play the whole 127 note pitch range, but can save and recall them for midi use.

afnpllo = 7 bit additional note data

a = volume accent on

f = filter accent on

n = noise accent on

p = portamento on

If the previous note was different, this will result in a glide from the previous note.

If the previous note was the same, this will result in a longer note

Multiple notes can be tied together.

ll = gate length. These 2 bits encode the length of each note.

00 = STAC, 01 = NON STAC, 10 = LEGATO, 11 = TIE

TIE is equal to a full step

o = on/off

normally a note is on (bit is set), if off it is treated as a REST while maintaining all other data.

Samples and sample data

Samples are saved in 8-bit signed Mu-law encoded format. The format is described in appendix III.

Dictionary entries contain 2-character sample names, start offset and lengths. There are a total of 12 samples, one for each semitone.

The space allocated for samples and the sample dictionary is 64kB, the first 256 Bytes are reserved for the dictionary leaving 65280 Bytes for the samples. At 24kHz sampling rate, this results in 2.72s seconds of total length.

Sample data is transferred to the 2oh2 in blocks of 64 bytes. Due to the way the flash memory is organized however, each write will first delete a complete row (4 blocks = 256 byte) of data. It is therefore best practice to write the data with a granularity of 4 blocks or 256 Bytes.

It is possible to use less than 12 samples and allow longer individual samples instead. Just copy dictionary entries to fill the remaining notes. e.g. use the closed hihat multiple times.

It is also possible to use parts of one sample to create a second sound. For example: Use part of an open hihat to create a closed hihat. Or create one voice sample “Acid Techno”, one “Acid” and one “Techno”. This can be accomplished by specifying start and length data accordingly.

Sample dictionary

MT = 0x74, START[3*12], LEN[3*12], NAMES[2*12], VOL_NORMAL[12],
VOL_ACCENT[12]

Start and length encoding:

Start and length of samples are 16bit values encoded as 3*7bit MSB. The first byte contains bits 15,14. The second byte bits 13-7, and the 3rd byte bits 6-0.

START: Three byte indicating the start of a sample in the 64KB-256B space.
This is repeated for each sample, a total of 36 bytes

LEN: Three bytes indicating the length of a sample in bytes
This is repeated for each sample, a total of 36 bytes

NAMES: Ascii encoded name with 2 characters/sample

VOL_NORMAL: Volume for normal playing. 0..127, 127 being the maximum volume. If 0 or not specified, 64 is used. Currently not yet implemented in the 2oh2

VOL_ACCENTED: Volume used for accent sounds. 0..127, 127 being the maximum volume. If 0 or not specified, 127 is used. Currently not yet implemented in the 2oh2

Sample block

MT = 0x75, NUM[2], DATA[128]

NUM = Number of block to write between 0 – 1023. Encoded as 2 bytes. The first byte contains bits 9..7, the second byte bits 6..0.

One block of 64-bit sample DATA encoded as 64*2 7-bit bytes / sample. The First byte contains the upper nibble, the second the lower nibble.

Sysex set data format

ADSR data format:

ADSR parameters are encoded as 7 bytes:

- 1: amount
- 2: delay
- 3: attack
- 4: decay
- 5: sustain
- 6: release
- 7: flags: bit0 - invert, bit1 - loop on/off
- 8: reserved
- 9: reserved
- 10: reserved

A table converting the 7 bit values to time in seconds can be found in appendix 2

LFO data format

parameters are encoded as N bytes:

- 1: amount
- 2: waveform (see below)
- 3: speed (in free running mode)
- 4: syncDivider (for synced mode)
- 5: delay
- 6: flags: bit0 = 1: Synced mode, bit1 = 1: resettable
- 7: reserved
- 8: reserved
- 9: reserved
- 10: reserved

Waveform values are as follows:

- 0: Triangular
- 1: Saw
- 2: Inverted Saw
- 3: Square
- 4: Random (S/H style)

A table converting the 7 bit speed values to frequency/period can be found in appendix 2
A table containing the clock dividers as well

Clock divider

0	1	2	3	4	5	6	7	8
4 Bars	3 Bars	2.5 Bars	2 Bars	1.5 Bars	1 Bar	3 / 4	1 T	1 / 2
9	10	11	12	13	14	15	16	17
3 / 8	1 / 2 T	1 / 4	3 / 16	1 / 4 T	1 / 8	3 / 32	1 / 8 T	1 / 16
18								
1/32								

Channel numbers

The internal representation of the pattern numbers is an integer starting from 0.

In the 2oh2, there are 3 channels names as such:

Internal value	Name
0	“Channel 1”
1	“Channel 2”
2	“Channel 3” or “Drum channel”

Pattern numbers

The internal representation of the pattern numbers is an integer ranging from 0 to 31.

Patterns are named after they keyboard key they are accessed from in the 2oh2.

(In some modes you can select a pattern by pressing keys on the internal keyboard)

The naming scheme is a lower case ‘p’ followed by the name of the keyboard note:

Pattern value	Name	Pattern value	name
0	pF1	16	pA2
1	pF#1	17	pA#2
2	pG1	18	pB2
3	pG#1	19	pC3
4	pA1	20	pC#3
5	pA#1	21	pD3
6	pB1	22	pD#3
7	pC2	23	pE3
8	pC#2	24	pF3
9	pD2	25	pF#3
10	pD#2	26	pG3
11	pE2	27	pG#3
12	pF2	28	pA3
13	pF#2	29	pA#3
14	pG2	30	pB3
15	pG#2	31	pC4

Sample data format

2oh2 sample format:

Samples are encoded as 8-bit @ 24KHz, with the following mu-law encoding scheme:

1. Resample to 24KHz, convert to mono
2. Normalize to +-1.0 (float)
3. apply the following mu-law conversion formula:

```
muval = 11.8  
mu_enc = sign(input) * log(1+muval * abs(input)) / log(muval+1)
```

4. Convert to integer in the range of 1 ... 255:
 $\text{mu8bit} = \text{round}(\text{mu_enc} * 127) + 128$