



# USER MANUAL

Updated May 10th 2022

Welcome to Blast Beats!

Please check the website for the latest firmware!

The feature set is also likely to evolve so it is recommended to check the website for updates to this manual.

We always value feedback and ideas, so feel free to reach out.  
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# Features Overview

At the heart of this groove box is a YMF-262 Chip AKA OPL3 FM chip  
-the same chip that was previously found in the Soundblaster16 /  
SoundBlaster PRO2 sound cards found in 90s computers.

Blast Beats has two Stereo YAC512 DACs allowing 4 individually  
assignable outputs to multi-track and route the instruments with  
flexibility.

Blast Beats features 10 voices consisting of:

-6 drum voices: kick/SD/tom/closed hat/open hat and cymbal

-4 synth voices. Each synth voice can be dual or quad operator  
depending on the chosen algorithm.

Other features include:

-8 waveforms per operator

-56 faders with per step automation

-32 illuminated buttons, including: 3 mode buttons (top left), 3 transport  
buttons (bottom left), a top row of 10 voice buttons referred to in this  
manual as "top10" and a bottom row of 16 step buttons referred to as  
"bottom16"

-DIN5 MIDI IN and OUT (each track receives and transmits MIDI)

-USB for firmware updates

-4 Assignable MONO T/S 1/4" outputs

-1 MONO T/S 1/4" MIX output (with all instruments mixed to one output)

-1 DUAL MONO T/S 1/4" headphone output (same as mix on both sides)

-Analog Sync in and out via 1/8" mono TS jack

-MicroSD (included card and USB adaptor) for data storage

# About Drum and Synth Voices

The YMF262 FM chip synthesises drum sounds using several FM operators. Some operators are shared between instruments. As a result some of Blast Beats' faders affect several instruments at once:

- Hats and Tom share the same pitch modulation;
  - The multiplier of the snare will also affect the pitch of the hats & tom.
- This hardware limitation/quirk can however lead to interesting surprises.

There are 4 synth instruments. Synths 1 and 2 are monophonic (one voice) whereas synths 3 and 4 are duo-phonic (2 voices) and differ in the way their 2 voices are triggered:

- Synth 3 has 2 overlapping voices useful for duo-phonic chords. You can record 1 or 2 notes on each step for synth3.
- Synth 4 triggers both voices at once. They can be detuned using the operator3 tune fader allowing fat bass lines or chord stabs.

You can choose between 5 algorithms for each synth instrument with the algo fader. The algorithms will be explained below.

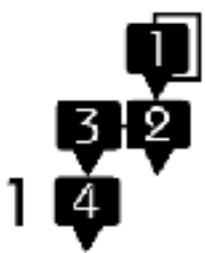
Depending on the algorithm, the second vibrato will either affect the pitch ( as expected from a vibrato) or the multiple (for arpeggiator effects) of the operator.

# Synth Algorithms



Synths voices consist of up to four oscillators called operators. If we observe the algorithm icons, the numbered boxes represent the operators and the arrows represent the modulation signal path.

When an operator receives the signal from a previous operator, its **f**requency is **m**odulated by it (FM). Some operators feed back into themselves as represented by a line joining the top and bottom of the operator.



## Algo1:

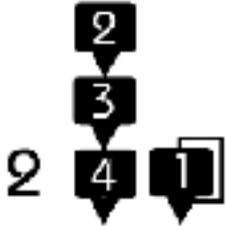
Operator 4 is the carrier. If you mute operators 1 to 3, operator 4 will be a pure waveform. However operator 4 will be modulated by all previous operators in the chain. As a result this first algorithm can yield the most complex sounds.

Operator 1 modulates operator 2

Operator 2 (aka  $op1+op2$ ) modulates operator 3

Operator 3 (aka  $op1+op2+op3$ ) modulates operator 4

The amount of modulation stacks up with each step so operator 4 is likely to distort at the end of the modulation chain!



### Algo2:

Operator 1 is left alone unmodulated, without a care in the world! But it will bend if you apply vibrato with the op2 fader.

Operators 2-4 are set up similarly to algo1. Operator 4 is the carrier and is modulated by operator 3 which in turn is modulated by operator 2.

### Algo3:

Here we split the chain into a pair of 2op synths that can be detuned using the tune fader.



Op4 is a carrier modulated by op3  
Op2 is a carrier modulated by op1.



### Algo4:

Here operators 1 and 4 re carriers with no operators modulating them.  
And op3 is a carrier modulated by op2.

### Algo5:

In this final setup all the operators are carriers, singing along together as individuals.



# Step Edit Mode

Press step to enter this mode. Here we can edit steps of the pattern to create beats.

## Selecting a page

If the pattern is more than 1 page long (more than 16 steps) press step to flick through the pages. The top 10 row of LEDs will briefly indicate the current page. A pattern can be up to 4 pages (or 64 steps) long.

Please refer to the [length mode](#) section of this manual to learn how to add pages.

## Selecting an instrument

Blast Beats has 10 voices consisting of 6 drum voices and 4 synth voices. Select the voice you wish to edit by pressing any of **the top 10** voice buttons. If the sequencer is stopped the selected voice will trigger, allowing you to preview its sound.

## Cloning a synth

You copy the sound of a synth over to another. To do so hold the top button of the source synth and press the top button of the destination. For example: hold **top button #7** and **press top button #9** to copy synth 1 over synth 3.

## X0X style step input

When **REC** is off, you can toggle steps on or off simply by pressing the **bottom 16** buttons. If the sequencer is stopped synths 1 to 4 will play the step that you press. This helps identify the note of a step that you are enabling or disabling.

## Real time drum input

With **REC** armed and Blast Beats running press **top10** buttons 1 to 6 to punch in a drum beat.

## Real time synth input

When **REC** is armed and Blast Beats is running the **16 bottom buttons** can be used to punch notes into the sequencer in real time. The bottom LEDs represent the keys of a piano - the lit LEDs are white keys.

## Synth monitor mode

If you'd like to practise playing a synth with the **16 bottom buttons** before recording it (without arming **REC**) you can activate synth monitor mode. Double-tap any of the **4 last top buttons** to toggle synth monitor mode on or off. When synth monitor mode is on, the bottom LEDs represent the keys of a piano - the lit LEDs are white keys.

Double-tap any of the **4 last top buttons** again to resume normal operation.

## Changing the synth input octave

Hold **REC** and press the **kit/patt**, **step** or **function** buttons to choose **low**, **normal** or **high** octaves respectively

## Changing the playback octave (applies to synths & drum)

You can transpose the octave of any voice by holding its **top10** button and pressing the following menu buttons:

- the **kit/patt** button transposes the playback down an octave
- the **step** button plays back with octave unchanged
- the **function** button transposes the playback up an octave

Double-tapping any of the 3 above buttons transposes all voices at once

## Step by step synth input

To activate or deactivate step by step synth mode, hold **REC** and press **run**. In step by step mode, when **REC** is armed and Blast Beats is stopped, you can input a melody step by step by tapping the **bottom16** buttons. A bottom16 LED will blink to indicate the step you are currently editing.

The LEDs will chase from left to right when step by step mode is activated.

If you reach the end of your sequence (16 steps if the song is only 1 page) it will loop back to step1 and overwrite endlessly

You can input a rest by pressing the **step** button.

You can also input notes via MIDI using the channels 1-4 (or other depending on the [MIDI channel routing](#))

If you wish to start over at any time toggle **REC** off then on again to reset the step recorder to the first step.

## MIDI real-time punching

When Blast Beats is running and **REC** is armed, it will pick up MIDI notes sent to the corresponding MIDI channel depending on the settings (see [MIDI channel routing](#) for details).

Send the following notes on CH10 (by default) to input drum notes

MIDI note 36 = kick

MIDI note 38 = snare

MIDI note 41 = tom

MIDI note 42 = closed hat

MIDI note 46 = open hat

MIDI note 49 = cymbal

CH1-4: MIDI notes 36 to 100 synth1-4 respectively

## Undo/redo

Whenever you press **REC** before recording some changes, Blast Beats creates a snapshot of the current pattern and its parameters. You can undo (and redo) the changes by holding **function** and pressing **REC** in step mode.

# Kit / Pattern Mode

In this mode you can change and chain patterns, and assign different kits to each pattern. Press **kit/pat** to enter this mode.

## Changing Kit

Press a **top10** button at any time to change the kit assigned to the current pattern.

Each of the 16 patterns can have any of the 10 kits assigned to it.

You can automate kit changes per step: simply change the kit with **REC** lit!

## Cloning Kit

It's quick and simple to clone kits. This is useful if you wish to create variations of the same kit. Hold the kit you wish to clone ( any **top10** button), and press the destination kit ( any other **top10** button) to paste it. You can make multiple clones at once.

## Changing pattern

Press any **bottom16** button to change patterns.

If the sequencer is stopped, Blast Beats will immediately change to the new pattern. If the sequencer is running, Blast Beats will cue the next pattern and make the change when it reaches the last step of the current pattern. In this case the cued pattern will be indicated by a blinking **bottom16** LED.

## Cloning pattern

Same process as cloning kits. Hold the pattern you wish to clone (**bottom16** button), and press any other **bottom16** button to paste it.

Note: When changing pattern, the assigned kit will automatically be loaded.

## Chaining patterns

You can chain up to 256 patterns in a row to form a song.

Press **REC** to arm the sequencer (**REC** LED should blink)

When ready press the first pattern of your song to start recording a chain. This will also delete the previously recorded chain.

Blast Beats will record up to 256 pattern changes in a row. You can loop the same pattern several times.

The current pattern will blink during the chain recording phase to indicate that it's armed.

When you have reached the end of the chain, Press **REC** again. The current pattern will no longer blink and Blast Beats will return to the first pattern in the chain and loop the chain endlessly.

Stopping the sequencer resets to the first pattern of the chain.

## Clear the chain

Suppose we want to play only pattern 1

- press **REC** to arm Blast Beats,
- press **bottom16** button1,
- press **REC** again to un-arm Blast Beats (before pattern 1 reaches the end of its cycle if the sequencer is running).

## Add or replace patterns in the chain

Start the song by pressing run. Now you can arm the **REC** button at any point and press **bottom16** buttons to swap patterns in the chain. If the end of the chain is reached with **REC** still armed, you will extend the chain until you disarm **REC** or stop the sequencer.

## Freeze the chain

To temporarily disable the chain (and repeat any pattern) without clearing it you can freeze it. hold **REC** and press **freeze** to freeze and unfreeze the chain.

## Song Mode

Press **kit/patt** and **function** at the same time to enter song mode. Both **kit/patt** and **function** LEDS will light at the same time.

The 160 available songs are arranged in 10 folders/banks of 16 songs

To load a new song tap a **top10** button to select a folder, Then tap a **bottom16** button to load a song.

1 song consists of:

16 patterns (up to 64 steps per pattern (arranged in 4 pages of 16 steps))

A chain of up to 256 pattern changes can be recorded per song.

Kits and songs are saved separately. The songs share the same kits.

## Function Mode

Press **function** to enter this mode to edit the following functions:

### Save Song (Patterns only!)

updates the SD card. You can save the current song to any location (1 to 16) within any folder (1 to 10). Blast Beats will select the current folder and location by default, press any **top10** button to select a destination folder 1 to 0 (10), then press any **bottom 16** to confirm location. Blast Beats only writes to SD when the synth is stopped. If it is running, it will wait for the next time you stop it (by pressing run) and save then.

Note: The song saving system is optimised to only update the files that have changed resulting in **variable save times** ranging from instant (when updating some steps) to 6 seconds ( when saving an entire song to a new slot).

## Save Kit

Kits are saved by pressing the flashing **kit/patt** button when you are in save mode.

## Clear

-fader automation: Hold **clear** and move a fader to erase its automation.

-All automation: Hold **clear** and press **REC** to clear all automation.

-pattern clear (single voice): Hold **clear** and press a **top10** button to erase the enabled steps.

-pattern initialise: Hold **clear** and press **kit/patt** to erase the current pattern resulting in a blank 16-step pattern.

-wiggle automation: hold **clear** and press **wiggle** to reset the wiggle depth automation.

-vibrato rate automation: hold **clear** and press **vibrato** to reset the vibrato rate automation.

-tremolo rate automation: hold **clear** and press **tremolo** to reset the tremolo rate automation.

-swing automation: hold **clear** and press the **swing** button to clear the swing automation.

-Clear Kit (set all faders to zero): double tap the clear button when in clear mode.

## Wiggle

This function adds randomness to any fader. To assign the wiggler to a fader, hold **wiggle** and move a fader. Set the depth of the wiggler: press any of the **top10** buttons once to apply the wiggle depth to the current pattern. Double click any **top10** buttons to apply the depth to all patterns of the song at once. You can also automate the wiggle depth. Simply light the **REC** button and wiggle depth changes will be recorded and played back.

To clear all faders assigned to the wiggler: hold **wiggle** and press **clear**.

Shuffle kit: Hold **wiggle** and press **kit/patt** to randomise the kit (automatically move some random faders)

Shuffle pattern: Hold **wiggle** and press **step** to randomise the pattern (automatically enable or disable steps)

## Swing

Use the **top10** buttons to set the amount of swing. Each pattern of a song has its own swing setting.

You can also automate the swing setting. Simply light the **REC** button and swing setting changes will be recorded and played back.

## Mute

In this mode use the **top10** buttons to mute/unmute a channel

## Solo

in this mode use the **top10** buttons to solo a channel

## Prob

In this mode set the trigger probability of a channel.

Select a channel: hold **prob** and use a **top10** button

Now release **prob** and set the level of probability (chances out of 10 of triggering) with the **top10** buttons.

## Stutter

This is a performance function, enabling you to re-trigger the same instrument rapidly (like a Blast Beat). Hold the **top10** buttons to repeat the current step at various rates. The rates are divisions of the current tempo.

Tip: try holding **wiggle** during a stutter :)

## **Bend** (spindown effect)

Hold **bend** to bend the global tuning of the FM chip downwards. Use the **top10** buttons to set the bend strength.

## **Freeze**

When **freeze** is held, the communication between Blast Beats and the FM chips is suspended leading to sustained notes and glitches (can be combined with bend and stutter)

## **Vibrato / Tremolo waveform**

By default vibrato and tremolo oscillate up and down (sine waveform). There are 9 other waveforms to choose from to modulate volume and pitch of your operators. In function mode hold **trem** or **vibr** and press the top10 buttons to change the waveform. The first 8 buttons represent the 8 waveforms printed on the top of the device. 9th and 10th waveforms are random waveforms.

Note: waveform changes can be automated per step! Just change the waveform with **REC** lit.

## **Tremolo**

Use the **top10** buttons to set the tremolo rate (each pattern has its own tremolo rate).

This function will continuously modulate the volume of the operator.

A different tremolo rate can be assigned to each pattern.

You can also automate the tremolo rate on each step. Simply light the **REC** button and tremolo rate changes will be recorded and played back.

## **Vibrato**

Use the **top10** buttons to set the vibrato speed (each pattern has its own vibrato rate).

This function will modulate the pitch of the operator. A different vibrato rate can be assigned to each pattern.

You can also automate the vibrato rate. Simply light the **REC** button and vibrato rate changes will be recorded and played back.

## Phones

Use the **top10** buttons to set the phones level (recalled at startup).  
You can automate this parameter per step, just change it with **REC** lit.

## Mix

Use the **top10** buttons to set the mix level (recalled at startup).  
You can automate this parameter per step, just change it with **REC** lit.

## Route

With this function you can assign the instruments to any of the 4 outputs. Note some instruments are locked together (snare+hats , tom+cymbal). This is a hardware limitation due to the way the voices are created by the YMF262. Hold route and press a top10 button select a target instrument. Release route and now press the first 4 top10 buttons to attach/detach the target voice to outputs 1-4 (you can route a voice to multiple outputs to make it louder in the main mix).  
You can also automate this parameter per step, just change it with **REC** lit.

# Syncing

## Master Mode

Blast Beats will automatically start up in master clock mode.

## Clock Out

Blast Beats will send a 5V pulse every 2 steps (2PPQ) at all times.

## Analog Slave Mode

Plug a 1/8" mono TS cable into the sync input to activate Analog Slave mode. In this mode Blast Beats will advance 2 steps on every received pulse (2PPQ). MIDI clock is ignored in analog Slave mode.

Blast Beats will automatically reset to step 1 if no pulses have been received for several seconds. Pressing run in this mode will reset the sequencer to step 1.

## MIDI Slave Mode

Blast Beats will automatically sync to incoming MIDI clock. MIDI slave mode is activated when Blast Beats receives a MIDI Start command. Pressing run in this mode will reset the sequencer to step 1. Blast Beats will go back to Master mode after receiving a MIDI Stop command.

## Setting The Tempo (Master Mode)

### Tap tempo

Press a **tempo** button at least 3 times to tap the tempo. If Blast Beats isn't running it will start on the third tap.

### Manual a.k.a BPM tempo

Press and hold the **tempo** button then press the **top10** buttons to input the tempo in beats per minute. You can input either 2 or 3 digit BPM values.

Example 1: Set Blast Beats to 123 BPM

-Hold **tempo** and tap first, second then third **top10** button

Example2: Set Blast Beats to 51 BPM

-Hold **tempo** and tap fifth then first **top10** button

-Release **tempo** button to set to 51.

## Fader Automation

When in step mode you can record and automate the faders.

### Recording a fader

To record a fader simply press the **REC** button in step mode (the **REC** LED will flash). Now the sequencer will record and repeat the fader movements. Press **REC** again to no longer record the faders.

### Deleting automation for a single fader

To delete the automation of a single fader press **function** to enter function mode. Now hold clear and move the fader for which you wish to delete the automation.

## Step lock automation (A.K.A parameter locks)

You can record a fader position in non-real-time to any step.  
hold a bottom button to define the step and move the fader.

Note **REC** must be off

## Deleting all fader automation

To delete all the fader automation of the current pattern press **function** to enter function mode. Now hold clear and press **REC**.

## Trick Automation and step edit

In function mode you can record and play back the 3 available trick functions that are stutter, bend and freeze

### Recording a trick

To record a trick simply press the **REC** button in function mode (the **REC** LED will flash). Now the bends, freezes, and stutters that you activate will be recorded and played back.

### Deleting trick automation

To delete trick automation press **function** to enter function mode. Now hold **clear** and press **stutter**, **freeze** or **bend** to the delete the respective automation

### Step Editing trick automation

You can edit the automation using the 16 step buttons just like you would edit the steps of a regular beat.

To access the trick step edit page hold **step** and press **stutter**, **bend** or **freeze** to access the respective editors. Now you can flick through the

pages of the pattern by pressing **step** and the bottom 16 LEDs will light up when automation of the trick is present on a step.

To exit trick step editor press **function**, **kit/patt** or **step** + any top10 button

## Bend and Freeze step edit

Bend and freeze trick automation are edited the same way in that a single press of the bottom 16 buttons will turn the trick on or off for any step.

## Stutter step edit

Stutter trick step edit allows you to activate and deactivate the stutter on any step, but it also allows you to choose the stutter rate per step. Press a bottom 16 button to select a step. If no stutter automation is present on the step the LED will light and stutter will be added. Next press any of the top10 buttons to select the rate of the stutter for the selected step. To clear a stutter on a step, press any LIT bottom 16 button twice

## Special Startup Settings

There are special settings that can be changed by holding a specific button at startup:

### Safe envelope ranges

Hold **length** button at startup to toggle safe envelope ranges on or off. The **length** LED will blink once or twice to indicate the new setting. 1 blink = on. 2 blinks = off. When Safe mode is on, the **att(ack)** and **dec(ay)** faders keep the envelope speeds within pre set ranges judged useful for drum machines.

When safe is off, the faders reach the full range of the chip allowing very long to infinite attack and release times (drones).

## Faster pitch fall (default=off)

Hold **bend** button at startup to toggle this on setting or off.  
the LED of the button will blink once or twice to indicate the setting.  
Once=on twice=off.

When faster pitch fall is on the fall faders will pull the tune of the instrument up or down 4x faster.

Useful for fast paced music.

## MIDI channel routing

Hold **route** at startup to enter MIDI channel routing.

Blast Beats listens and transmits to 5 MIDI channels of your choice:

Drums (default CH10)

SYNTH 1 (default CH1)

SYNTH 2 (default CH2)

SYNTH 3 (default CH3)

SYNTH 4 (default CH4)

To change the channel select a target by pressing the following top buttons:

Top button 1-6 selects the drum voice

Top button 7-10 selects SYNTH1 to SYNTH4 respectively

Now press any bottom button (1-16) to choose the channel.

Power-cycle Blast Beats to resume normal operation.

## Factory reset

Hold clear at startup to reset the settings to factory default. This can be useful if Blast Beats isn't behaving as expected after an accidental setting change.

These are the default settings:

Fall rate=normal

Current song=1

Current folder=1

Swing=off

Phones and Mix volume=6

All voices routed to all outputs

Safe envelope ranges = on

MIDI Channel routing:

Drums=CH10

Synth1=CH1

Synth2=CH2

Synth3=CH3

Synth4=CH4

Factory resetting won't affect the SD card data

# File Structure (SD Card)

## IMPORTANT:

The included micro SD card contains all your song and pattern data. The card is required for Blast Beats to operate. At start-up if the card is not detected all the LEDs will blink twice every second until the card is inserted.

From a single SD card Blast Beats can load up to 160 songs (10 folders X 16 songs).

There are 2 main folders on your card labelled KITS and SONGS. Each have 10 sub-folders labeled BANK1 to BANK10

Each main folder contains 16 song folders labelled 1 to 16

Each song folder contains the following files:

AUTO.BB (automation)

BANKS.BB (kit bank assignments)

CHAIN.BB (pattern chain)

10x DRUMX.BB (drum kits/presets where X= 1-10)

PAT-D1.BB to PAT-D16.BB (drum patterns)

PAT-S1.BB to PAT-S16.BB (synth/melodic patterns)

10x SYNTAX.BB (synth kits/presets where X=1-10)

Each kit folder contains the following files:

DRUM1.BB to DRUM10.BB (drum fader positions)

SYNT.BB to SYNT10.BB (synth fader positions)

You can safely mix and match these files between folders.

# Firmware Updates



To perform a firmware update connect Blast Beats to your computer with a standard USB type A to type B cable (the kind typically used by a printer).

- Hold the **run** button and power on Blast Beats.
- Keep the **run** button held until your computer sees a hard drive labelled "UPLOAD\_DISK"
- Now simply delete the file located on the disk and replace with the new firmware file.
- The disk will automatically eject from your computer and Blast Beats will reboot with the new firmware installed.

# MIDI Implementation

Blast Beats responds to the following Note On messages. The drum voices will transmit MIDI notes out of the MIDI port when triggered by the internal sequencer allowing you to use Blast Beats as a MIDI drum sequencer!

Parameter	MIDI Note number
<b>DRUMS (channel 10 by default)</b>	
<b>Bass drum</b>	20
<b>Snare</b>	21
<b>Closed Hat</b>	22
<b>Open Hat</b>	23
<b>Tom</b>	24
<b>Cymbal</b>	25
<b>SYNTHS (channels 1 to 4 by default)</b>	

Blast Beats responds to the following MIDI Control Change (CC) messages. When moved all faders will send their respective MIDI CC out of the MIDI output port allowing you to use Blast Beats as a MIDI controller.

Parameter	MIDI CC	Range
<b>DRUMS (channel 10 by default)</b>		
<b>Bass drum carrier volume</b>	20	0-127
<b>Bass drum carrier waveform</b>	21	0-127
<b>Bass drum carrier feedback</b>	22	0-127
<b>Bass drum carrier multiplier</b>	23	0-127
<b>Bass drum carrier tune</b>	24	0-127
<b>Bass drum carrier tune fall</b>	25	0-127
<b>Bass drum carrier attack</b>	26	0-127

<b>Parameter</b>	<b>MIDI CC</b>	<b>Range</b>
<b>Bass drum carrier decay</b>	27	0-127
<b>Bass drum modulator volume</b>	28	0-127
<b>Bass drum modulator waveform</b>	29	0-127
<b>Bass drum modulator multiplier</b>	30	0-127
<b>Bass drum modulator multiplier fall</b>	31	0-127
<b>Bass drum modulator attack</b>	32	0-127
<b>Bass drum modulator decay</b>	33	0-127
<b>Snare volume</b>	34	0-127
<b>Snare waveform</b>	35	0-127
<b>Snare multiplier</b>	36	0-127
<b>Snare tune</b>	37	0-127
<b>Snare tune fall</b>	38	0-127
<b>Snare attack</b>	39	0-127
<b>Snare decay</b>	40	0-127
<b>Hats Volume</b>	43	0-127
<b>Hats waveform</b>	45	0-127
<b>Hats multiplier</b>	55	0-127
<b>Hats tune</b>	56	0-127
<b>Hats tune fall</b>	57	0-127
<b>Hats attack</b>	51	0-127
<b>Hats decay</b>	54	0-127
<b>Tom Volume</b>	42	0-127
<b>Tom waveform</b>	44	0-127
<b>Tom multiplier</b>	48	0-127
<b>Tom/Cymbal tune</b>	46	0-127
<b>Tom/Cymbal tune fall</b>	44	0-127
<b>Tom attack</b>	50	0-127
<b>Tom decay</b>	53	0-127
<b>Cymbal Volume</b>	41	0-127
<b>Cymbal waveform</b>	45	0-127
<b>Cymbal multiplier</b>	48	0-127

<b>Parameter</b>	<b>MIDI CC</b>	<b>Range</b>
<b>Cymbal attack</b>	49	0-127
<b>Cymbal decay</b>	52	0-127
<b>Synth (channels 1 to 4 by default)</b>		
<b>Operator 1 volume</b>	20	0-127
<b>Operator 1 waveform</b>	21	0-127
<b>Operator 1 feedback</b>	22	0-127
<b>Algorithm</b>	23	0-127
<b>Operator 1 multiplier</b>	24	0-127
<b>Operator 1 attack</b>	25	0-127
<b>Operator 1 decay</b>	26	0-127
<b>Operator 2 volume</b>	27	0-127
<b>Operator 2 waveform</b>	28	0-127
<b>Operator 2 multiplier</b>	29	0-127
<b>Operator 2 tremolo depth</b>	30	0-127
<b>Operator 2 vibrato depth</b>	31	0-127
<b>Operator 2 attack</b>	32	0-127
<b>Operator 2 decay</b>	33	0-127
<b>Operator 3 volume</b>	34	0-127
<b>Operator 3 waveform</b>	35	0-127
<b>Operator 3 feedback</b>	36	0-127
<b>Operator 3 tune</b>	37	0-127
<b>Operator 3 multiplier</b>	38	0-127
<b>Operator 3 attack</b>	39	0-127
<b>Operator 3 decay</b>	40	0-127
<b>Operator 4 volume</b>	41	0-127
<b>Operator 4 waveform</b>	42	0-127
<b>Operator 4 multiplier</b>	43	0-127
<b>Operator 4 tremolo depth</b>	44	0-127
<b>Operator 4 vibrato depth</b>	45	0-127
<b>Operator 4 attack</b>	46	0-127
<b>Operator 4 decay</b>	47	0-127