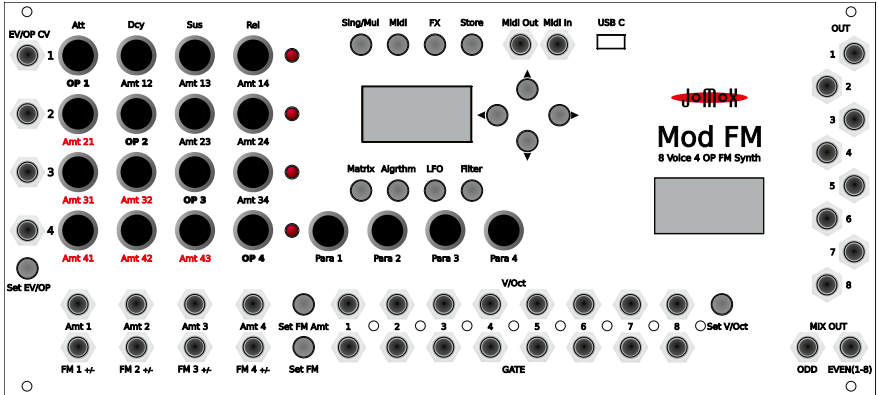




# Mod FM

8 Voice 4 OP FM Synth



## USER MANUAL



**JoMoX Elektronische Musikinstrumente GmbH**  
**Sophie-Charlotte-Str. 15**  
**14059 Berlin**

# CONTENT

<b>INTRO</b>	<b>4</b>
<b>What is Mod FM?</b>	<b>4</b>
<b>Installation / Rack Mounting</b>	<b>5</b>
<b>Operating Panel</b>	<b>7</b>
Control Elements and Displays	7
Editing Parameters	8
Changing Presets	9
Connection Sockets	9
<b>SOUND GENERATION</b>	<b>10</b>
<b>Signal Path Overview</b>	<b>10</b>
FM Engine (Experimental Field and Key to outstanding Timbres)	10
Analogue Processing (Efficient Parameters with real analogue Flavor)	10
Effects Section (Adding sonic Spice)	10
Signal Output (Make it audible)	10
External Control (Link to the Eurorack System)	10
Signal Flow	11
<b>Menu Overview</b>	<b>12</b>
<b>FM Engine</b>	<b>13</b>
Enter the Matrix	13
Operators	14
How to operate the matrix	15
Matrix Menue	15
Algorithm Menue	17
Operator Envelopes	18
LFO Menue	19
<b>Sound Processing</b>	<b>21</b>
Filter / VCA	21
Effects (FX)	23
<b>Randomisation and Reset Functions</b>	<b>25</b>
<b>SINGLE-/MULTIMODE</b>	<b>26</b>
<b>Single Mode</b>	<b>26</b>
<b>Multi Mode</b>	<b>26</b>
<b>STORE PRESETS</b>	<b>28</b>
<b>EXTERNAL CONTROL</b>	<b>29</b>
<b>MIDI</b>	<b>29</b>
<b>External Control via CV/Gate and Control Voltages</b>	<b>32</b>
CV/Gate	32
Modulation with external control voltages	32
<b>ADDENDUM</b>	<b>36</b>
<b>FM Algorithms</b>	<b>36</b>
<b>MIDI Implementation</b>	<b>42</b>
<b>Technical Specification</b>	<b>46</b>
<b>Imprint</b>	<b>47</b>

# INTRO

Welcome and thank you for purchasing your JoMoX Mod FM! We wish you lots of creative fun with your new JoMoX Eurorack synthesizer. Any feedback is very welcome!

Your  
Jürgen Michaelis

## What is Mod FM?

Mod FM is an eight-voice polyphonic FM synthesizer with multimode. It is intended for use in a Eurorack frame and can be controlled via MIDI (TRS or USB-C) and CV/Gate.

### Mod FM provides some interesting features:

- Mod FM is self-contained - in other words, a complete synthesizer in just one single Eurorack module. Apart from a power supply, no other modules are necessary for operation.
- Mod FM has a hybrid sound generation. This means that it works both digitally and real analogue.
- The digital part of the sound generation uses FM synthesis, the analogue part complements classic subtractive synthesis.
- The FM engine has four operators that can be interconnected in any way via a matrix. Fixed FM algorithms, as usually found in classic FM synthesizers, are also available.
- Mod FM makes it easy to create interesting harmonic timbres and tonal sounds. Above that, Mod FM provides a wide range of outstanding and unusual timbres.
- The filter/VCA section makes it easy to add real analogue flavour to the FM timbres.
- Mod FM sports three internal audio effects (reverb, 2 x delay) which add some more spice to every timbre.
- Mod FM has an easy to use 8 channel multi-mode. Even in multi-mode, Mod FM can be controlled with CV/Gate.
- Numerous sound parameters can be controlled via external voltages from an Eurorack system.
- Mod FM stores up to 128 single and 119 multi presets.

### Rtfm...!



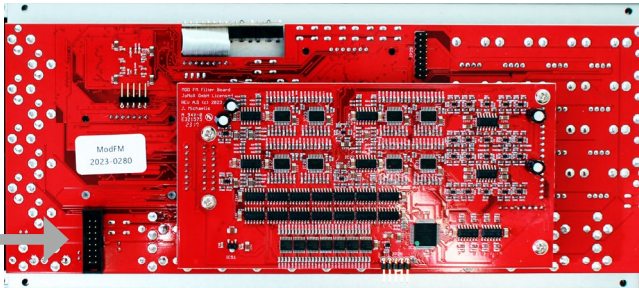
***We pray to you: Please read (and internalise) the f... manual! You will do yourself a big favour, because it will (hopefully) help you to find a quick access to your new Mod FM. And that means: more and faster fun with your new synthesizer. Sounds good, eh...? Thank you so much!***

## Installation / Rack Mounting



**Please power off your Eurorack prior to installation!**

On the backside of the Mod FM module you can find this connector:



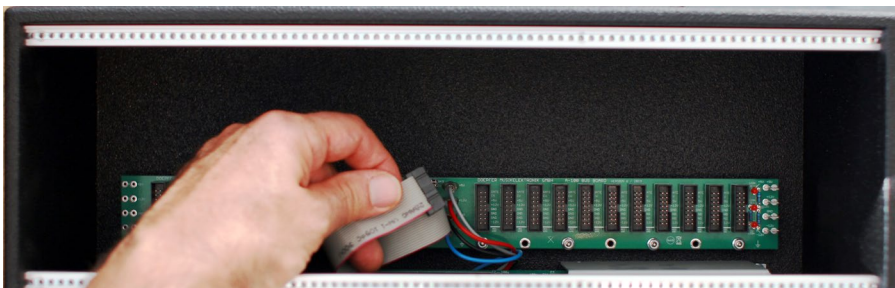
### Rack Mounting

Please connect the included ribbon cable to the Eurorack system bus rails as shown on the pictures. The Mod FM module needs +/-12 Volts at a supply current of maximum 370mA on +12V and about 170mA on -12 Volts. The optional 5 Volts and the CV/Gate on the A-100 Doepfer bus are both not wired inside the Jomox module and not needed.

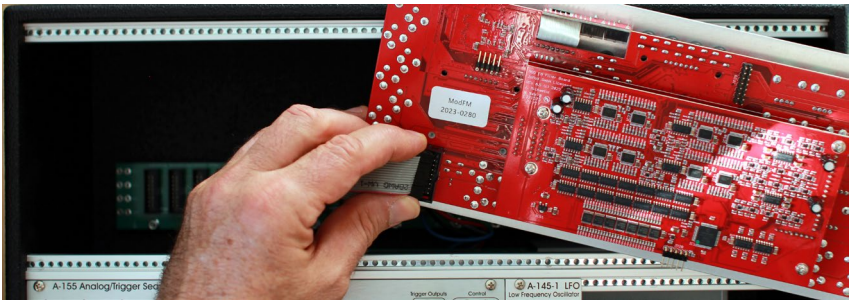
Other 10 pin systems may be used as well if only the lower part of the 16 pin connector is connected. Please pay attention for the position of the voltages and the ground pins! The printed voltage information have to match, please check the wires again and make sure no pin is left or bent.



**There are protection diodes inside the modules but please take extra care to protect the rack and the module!**



The A-100 Doepfer bus. (The Doepfer GmbH enterprise and all of their shown products are registered trademarks. With friendly approval of Doepfer Musikelektronik GmbH)



The JoMoX Mod FM euro rack supply connector. Please connect the power supply of the eurorack system bus here.



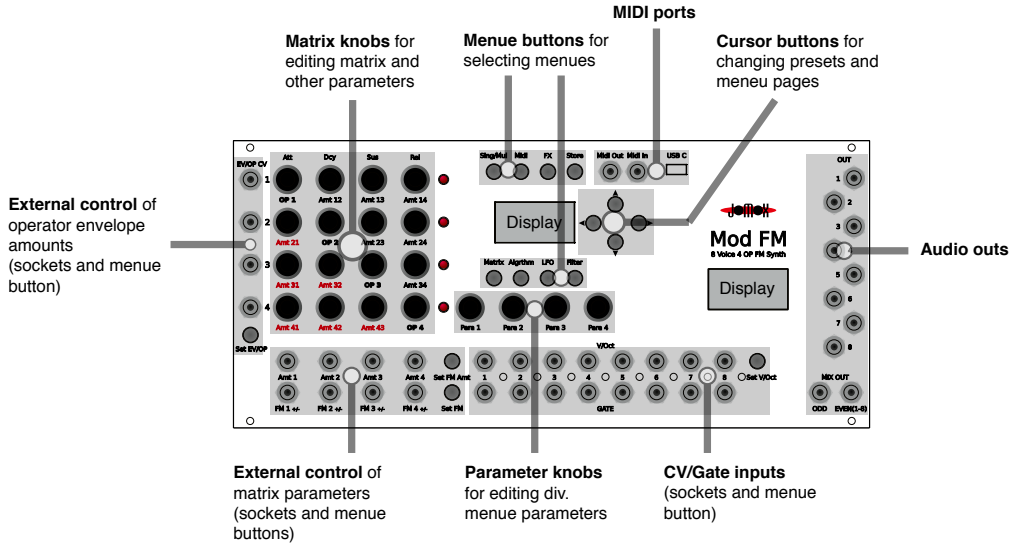
**Attention: DO NOT connect, under any circumstances, the power supply cable to the Jomox Inter-D-module bus!!!  
The rack power supply and the module could get seriously damaged!**

Then please mount the module on the rack rails using the supplied metric M3 screws. The rack mounting is now completed and Mod FM ready to play.



# Operating Panel

## Control Elements and Displays



On the user interface you will find the following control elements:

### Buttons:

- **Menu** buttons:  
They are used to access the various menus.
- **Cursor** buttons:  
The cursor buttons < and > are used to change the display pages within a menu.  
The cursor buttons ^ and v are used to change the current preset.



### Knobs:

The **knobs** set certain parameter values. Depending on the menu, they change their function.

### Displays:

Both displays provide information about operating states and parameter settings. They basically show several pieces of information and parameters at the same time, summarised on menu pages.

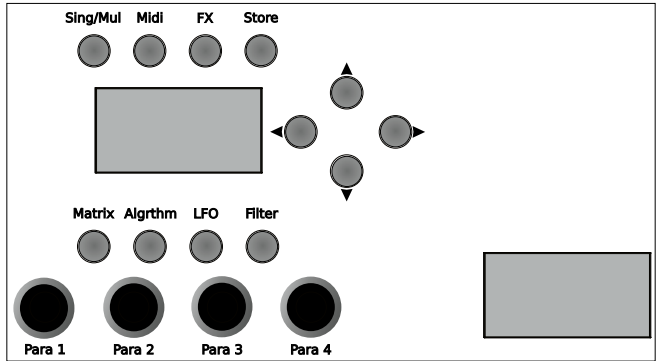
To make it easier to find your way around the display contents, the following display modes apply (please refer to the figure on the next page):

- On all pages of the left display, the top line shows the current preset name and number.
- Names of menu pages are shown inverted and are usually located in the top right-hand corner of the left-hand display.
- An editable parameter is shown with a shortened name (e.g. **FRQ**) and a little knob symbol. 
- The position of the slider mark roughly shows the current parameter value.
- If a parameter controls a signal level, a little vertical bar is displayed instead of the knob symbol. 
- When the corresponding knob is turned, the display briefly shows the parameter value as a number instead of the shortened parameter name.
- Some display pages - such as envelope curves - are animated and change their shape according to the corresponding parameter values.

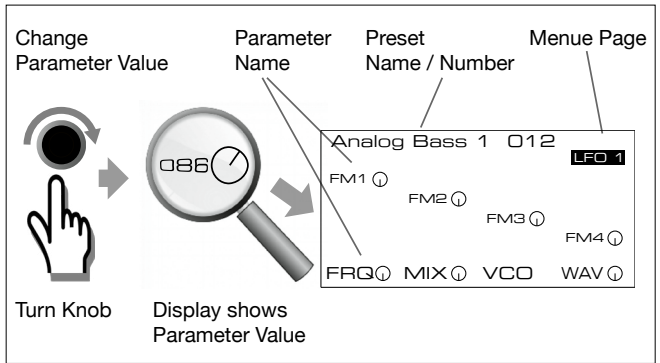
## Editing Parameters

- **Menu buttons** open the menus.
- **Cursor buttons** < / > change menu pages.
- **Cursor buttons** ^ / v change the current preset.
- **Knobs** change parameter settings.

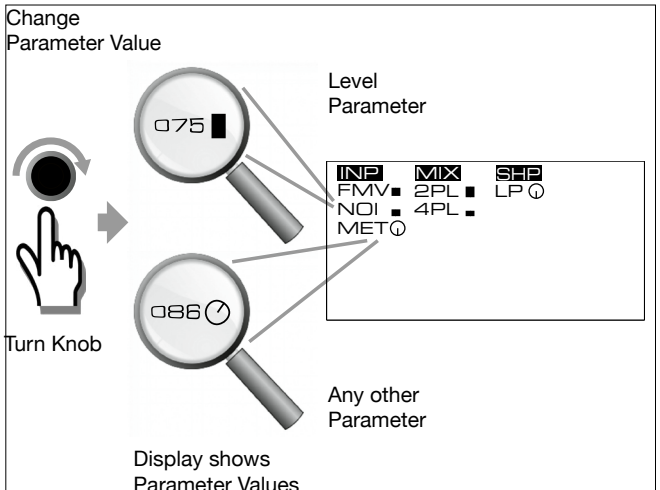
(Sometimes both "Para"- and "Matrix" knobs are used to access parameters shown in the two displays)



Example for the left handed display:



Example for the right handed display:



To optimise the live span of the displays, a screen saver switches on after three minutes without an input. Touching any control element calls up the normal display again.



## Changing Presets

After switching Mod FM on, the preset that was last active before powering down is always active. It can be changed at any time. This works in single and multi mode.

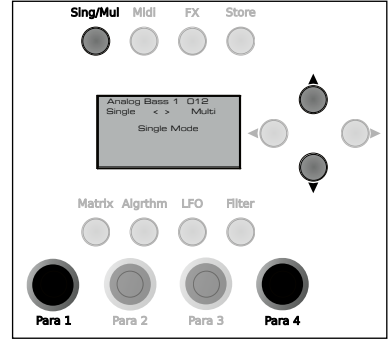
- Change the current preset at any time with the  $\wedge$  /  $\vee$  **Cursor** buttons.

To scroll through the presets much faster,

- hit **Sing/Mul** knob to select the Preset menue.
- Scroll through the presets with **Para 1** or **Para 2** knobs.



**Please note that unsaved changes will be irretrievably lost when changing presets. So please save your edited presets first! (Please refer to page 28).**



## Connection Sockets

### • Audio

On the right are the audio output sockets (individual outputs for all eight voices, stereo mix output. They provide a signal level of 10Vpp (Eurorack standard).

### • MIDI

At the top are the MIDI connections (mini-TRS, USB-C). Please do not use MIDI-TRS and USB at the same time!

### • Control Voltages

On the far left and bottom left are CV inputs for external control of sound engine parameters. They handle control voltages from 0V to +5V.

### • CV/Gate

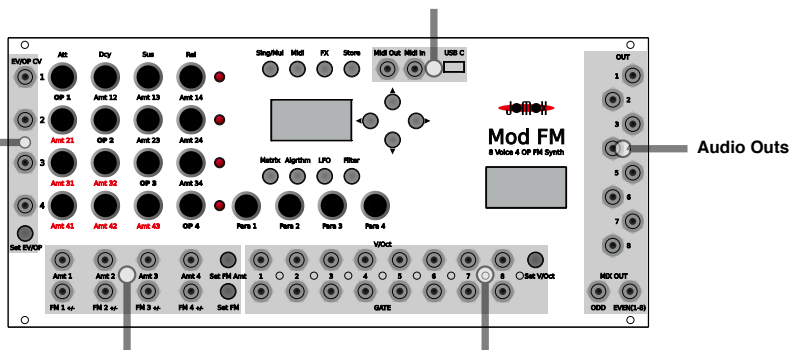
At the bottom are CV/gate inputs for pitch and trigger of all eight voices. Mod FM handles gate signals of 3V to 15V, according to the Eurorack standard.



**The control voltage inputs and the CV/Gate inputs of the Mod FM are compatible with the Eurorack standard and should only be operated with signals from suitable Eurorack modules!**

### MIDI Ports

External Control of operator envelope amounts (sockets and corresponding menue button)



External Control of matrix parameters (sockets and corresponding menue buttons)

CV/Gate inputs (sockets and corresponding menue button)

# SOUND GENERATION

## Signal Path Overview

### FM Engine (Experimental Field and Key to outstanding Timbres)

The sound generation of Mod FM is both digital and real analogue: An **FM engine** serves as the main signal source. It consists of **four operators** (sine oscillators). They are interconnected in the form of a **matrix**, so that each operator can frequency-modulate every other operator with individual intensity. At the same time, each operator can itself be modulated by all other operators.

Each of these four operators sports an **ADSR envelope generator**. It controls the volume curve as well as the pitch curve of its operator.

**26 preset FM-algorithms** offer sensible and easy-to-use interconnections of the matrix.

A so-called **overtone function** scales the operators to harmonic overtones and thus simplifies the programming of tonally playable sounds.

### Analogue Processing (Efficient Parameters with real analogue Flavor)

The signal of the FM engine is fed into a **post-processing section** with a true analogue signal path. It consists of a multimode **filter**, a **VCA** as well as two **envelope generators** and **LFOs** each for modulating the filter and VCA.

The LFOs can be switched into a VCO mode. Then they work in the audio range and can be used as additional audio oscillators together with the FM engine or alternatively.

In this section you will also find a **noise generator** as a further signal source.

### Effects Section (Adding sonic Spice)

The analogue post processing section is followed by an **effects section** sporting three effects: reverb, delay 1 and delay 2.

### Signal Output (Make it audible)

The **output** signal is available either via the Main Out, with voices 1, 3, 5, 7 at the left output channel, and 2, 4, 6, 8 at the right output channel. Next to this, individual outputs for each voice can be found.

### External Control (Link to the Eurorack System)

Several parameters of the FM matrix can be controlled by **external voltages**.

These are:

- pitch and volume envelope amount of each operator (**EV/OP CV** sockets)
- modulation amounts between each operator (**Amt 1 – 4** sockets)
- pitch of each operator (**FM1 – 4 +/-** sockets)

The figure on the following page shows a simplified representation of Mod FM's entire sound generation.

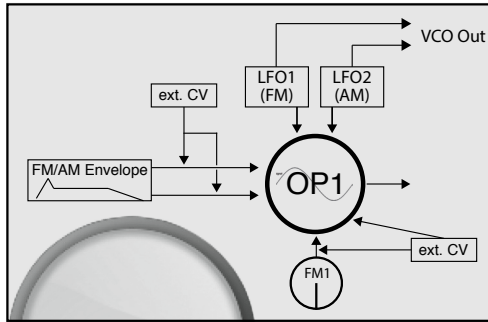


**Lots of information about FM sound synthesis can be found on the internet.**

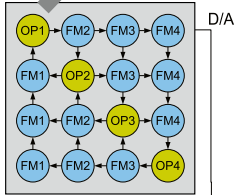
# Signal Flow

(simplified)

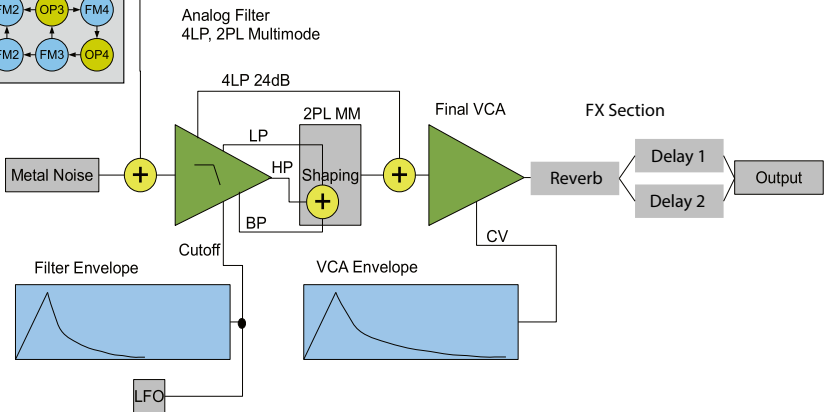
Operator 1 and peripherals in detail



## FM Engine



## Analogue Section



# Menu Overview

The following figure shows all menus with their corresponding display pages. You can use this as a quickstart guide and /or as a navigation aid when operating Mod FM. All menus and their functions will be described later in detail.

Sing/Mul	<table border="1"> <tr> <td>Analog Bass 1 D12 Single &lt; &gt; Multi Single Mode</td> <td>kick&amp;synth 000 Single &lt; &gt; Multi Multi Mode 000   016   008   003   004   005   007   003  </td> </tr> </table>	Analog Bass 1 D12 Single < > Multi Single Mode	kick&synth 000 Single < > Multi Multi Mode 000   016   008   003   004   005   007   003																			
Analog Bass 1 D12 Single < > Multi Single Mode	kick&synth 000 Single < > Multi Multi Mode 000   016   008   003   004   005   007   003																					
Midi	<table border="1"> <tr> <td>Analog Bass 1 D12 Midi Setup 1</td> <td>RxCh TxCh CkSy PBRg 01 01 OFF 00</td> </tr> </table>	Analog Bass 1 D12 Midi Setup 1	RxCh TxCh CkSy PBRg 01 01 OFF 00	<table border="1"> <tr> <td>Analog Bass 1 D12 Midi Setup 2</td> <td>SplT TxTr TxCC RxTr 0 OFF OFF ON</td> </tr> </table>	Analog Bass 1 D12 Midi Setup 2	SplT TxTr TxCC RxTr 0 OFF OFF ON	<table border="1"> <tr> <td>Analog Bass 1 D12 Midi Setup 3</td> <td>System Transmit 1Prs 1Mul BkP BkM OFF OFF OFF OFF</td> </tr> </table>	Analog Bass 1 D12 Midi Setup 3	System Transmit 1Prs 1Mul BkP BkM OFF OFF OFF OFF	<table border="1"> <tr> <td>Analog Bass 1 D12 Midi Setup 4</td> <td>SyErr MUltH MUB OFF OFF ON OFF</td> </tr> </table>	Analog Bass 1 D12 Midi Setup 4	SyErr MUltH MUB OFF OFF ON OFF										
Analog Bass 1 D12 Midi Setup 1	RxCh TxCh CkSy PBRg 01 01 OFF 00																					
Analog Bass 1 D12 Midi Setup 2	SplT TxTr TxCC RxTr 0 OFF OFF ON																					
Analog Bass 1 D12 Midi Setup 3	System Transmit 1Prs 1Mul BkP BkM OFF OFF OFF OFF																					
Analog Bass 1 D12 Midi Setup 4	SyErr MUltH MUB OFF OFF ON OFF																					
FX	<table border="1"> <tr> <td>Analog Bass 1 D12 REVERB</td> <td>LEV 0 Slz 0 LP 0 HP 0</td> </tr> </table>	Analog Bass 1 D12 REVERB	LEV 0 Slz 0 LP 0 HP 0	<table border="1"> <tr> <td>Analog Bass 1 D12 DELAY 1</td> <td>BPM120.0 LEV 0 1/2 SYN FBK 0</td> </tr> </table>	Analog Bass 1 D12 DELAY 1	BPM120.0 LEV 0 1/2 SYN FBK 0	<table border="1"> <tr> <td>Analog Bass 1 D12 DELAY 2</td> <td>BPM120.0 LEV 0 1/2 SYN FBK 0</td> </tr> </table>	Analog Bass 1 D12 DELAY 2	BPM120.0 LEV 0 1/2 SYN FBK 0													
Analog Bass 1 D12 REVERB	LEV 0 Slz 0 LP 0 HP 0																					
Analog Bass 1 D12 DELAY 1	BPM120.0 LEV 0 1/2 SYN FBK 0																					
Analog Bass 1 D12 DELAY 2	BPM120.0 LEV 0 1/2 SYN FBK 0																					
Store	<table border="1"> <tr> <td>Store to location Name edit: right &gt; To cancel: left &lt;</td> <td></td> </tr> </table>	Store to location Name edit: right > To cancel: left <		<table border="1"> <tr> <td>Analog Bass 1 D12 Edit Name Analog Bass 1</td> <td></td> </tr> </table>	Analog Bass 1 D12 Edit Name Analog Bass 1																	
Store to location Name edit: right > To cancel: left <																						
Analog Bass 1 D12 Edit Name Analog Bass 1																						
Set EV/OP	<table border="1"> <tr> <td>OP ENV / PRT CV IN</td> <td>ENVAM PITCH</td> </tr> <tr> <td>OP1 OP2 OP3 OP4</td> <td>0 0 0 0</td> </tr> </table>	OP ENV / PRT CV IN	ENVAM PITCH	OP1 OP2 OP3 OP4	0 0 0 0	<table border="1"> <tr> <td>V/OCT CV SCALE</td> <td></td> </tr> <tr> <td>MTARGET OFF SCALE</td> <td>0 13 0 27</td> </tr> </table>	V/OCT CV SCALE		MTARGET OFF SCALE	0 13 0 27	Set V/Oct											
OP ENV / PRT CV IN	ENVAM PITCH																					
OP1 OP2 OP3 OP4	0 0 0 0																					
V/OCT CV SCALE																						
MTARGET OFF SCALE	0 13 0 27																					
Set FM Amt	<table border="1"> <tr> <td>EXT OPMOD AMT CV</td> <td></td> </tr> <tr> <td>OP1 OP2 OP3 OP4</td> <td>0 0 0 0</td> </tr> </table>	EXT OPMOD AMT CV		OP1 OP2 OP3 OP4	0 0 0 0	Matrix	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Matrix</td> </tr> <tr> <td>TUN CVTD ALDO VOL</td> <td></td> </tr> </table>	Analog Bass 1 D12	Matrix	TUN CVTD ALDO VOL		<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Matrix</td> </tr> <tr> <td>TUN CVTD ALDO VOL</td> <td></td> </tr> </table>	Analog Bass 1 D12	Matrix	TUN CVTD ALDO VOL		<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Matrix</td> </tr> <tr> <td>TUN CVTD ALDO VOL</td> <td></td> </tr> </table>	Analog Bass 1 D12	Matrix	TUN CVTD ALDO VOL		left-hand display
EXT OPMOD AMT CV																						
OP1 OP2 OP3 OP4	0 0 0 0																					
Analog Bass 1 D12	Matrix																					
TUN CVTD ALDO VOL																						
Analog Bass 1 D12	Matrix																					
TUN CVTD ALDO VOL																						
Analog Bass 1 D12	Matrix																					
TUN CVTD ALDO VOL																						
Set FM	<table border="1"> <tr> <td>EXT OP FM CV INP</td> <td></td> </tr> <tr> <td>OP1 OP2 OP3 OP4</td> <td>0 0 0 0</td> </tr> </table>	EXT OP FM CV INP		OP1 OP2 OP3 OP4	0 0 0 0	<table border="1"> <tr> <td>input calibration remove FM cables press SET FM</td> <td></td> </tr> </table>	input calibration remove FM cables press SET FM		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		right-hand display				
EXT OP FM CV INP																						
OP1 OP2 OP3 OP4	0 0 0 0																					
input calibration remove FM cables press SET FM																						
right-hand display																						
right-hand display																						
right-hand display																						
Algorithm	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Algorithm</td> </tr> <tr> <td>TUN CVTD ALDO VOL</td> <td></td> </tr> </table>	Analog Bass 1 D12	Algorithm	TUN CVTD ALDO VOL		<table border="1"> <tr> <td>NO ALGORITHM FREE MATRIX</td> <td></td> </tr> </table>	NO ALGORITHM FREE MATRIX		<table border="1"> <tr> <td>OPERAT TUNE MODE</td> <td></td> </tr> <tr> <td>OP1 OP2 OP3 OP4</td> <td></td> </tr> </table>	OPERAT TUNE MODE		OP1 OP2 OP3 OP4		<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td></td> </tr> </table>	Analog Bass 1 D12		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display		
Analog Bass 1 D12	Algorithm																					
TUN CVTD ALDO VOL																						
NO ALGORITHM FREE MATRIX																						
OPERAT TUNE MODE																						
OP1 OP2 OP3 OP4																						
Analog Bass 1 D12																						
right-hand display																						
LFO	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>LFO</td> </tr> <tr> <td>FRG MIX 0 LFO WAV 0</td> <td></td> </tr> </table>	Analog Bass 1 D12	LFO	FRG MIX 0 LFO WAV 0		<table border="1"> <tr> <td>LFO1 FM FRG0</td> <td></td> </tr> </table>	LFO1 FM FRG0		<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>LFO</td> </tr> <tr> <td>FRG0 MIX 0 LFO WAV 0</td> <td></td> </tr> </table>	Analog Bass 1 D12	LFO	FRG0 MIX 0 LFO WAV 0		<table border="1"> <tr> <td>LFO2 AM FRG0</td> <td></td> </tr> </table>	LFO2 AM FRG0		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display		
Analog Bass 1 D12	LFO																					
FRG MIX 0 LFO WAV 0																						
LFO1 FM FRG0																						
Analog Bass 1 D12	LFO																					
FRG0 MIX 0 LFO WAV 0																						
LFO2 AM FRG0																						
right-hand display																						
Filter	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Filter</td> </tr> <tr> <td>CV FIS AMT TR</td> <td></td> </tr> </table>	Analog Bass 1 D12	Filter	CV FIS AMT TR		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display				
Analog Bass 1 D12	Filter																					
CV FIS AMT TR																						
right-hand display																						
right-hand display																						
right-hand display																						
right-hand display																						
Filter	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Filter</td> </tr> <tr> <td>FRM SFL LP</td> <td></td> </tr> </table>	Analog Bass 1 D12	Filter	FRM SFL LP		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display				
Analog Bass 1 D12	Filter																					
FRM SFL LP																						
right-hand display																						
right-hand display																						
right-hand display																						
right-hand display																						
Filter	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Filter</td> </tr> <tr> <td>FRM SFL LP</td> <td></td> </tr> </table>	Analog Bass 1 D12	Filter	FRM SFL LP		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display				
Analog Bass 1 D12	Filter																					
FRM SFL LP																						
right-hand display																						
right-hand display																						
right-hand display																						
right-hand display																						
Filter	<table border="1"> <tr> <td>Analog Bass 1 D12</td> <td>Filter</td> </tr> <tr> <td>FRM SFL LP</td> <td></td> </tr> </table>	Analog Bass 1 D12	Filter	FRM SFL LP		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		<table border="1"> <tr> <td>right-hand display</td> <td></td> </tr> </table>	right-hand display		left-hand display				
Analog Bass 1 D12	Filter																					
FRM SFL LP																						
right-hand display																						
right-hand display																						
right-hand display																						
right-hand display																						

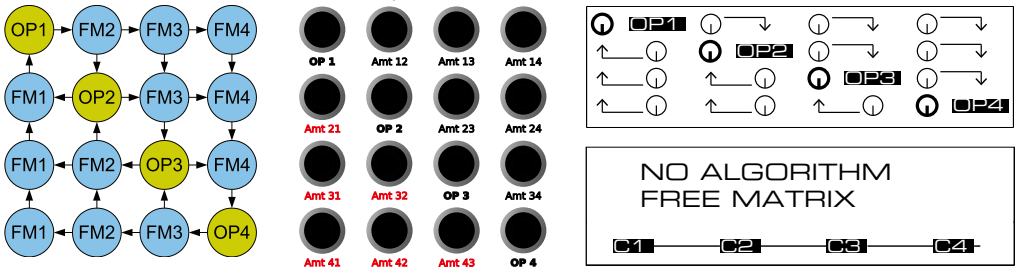
# FM Engine

## Enter the Matrix

The main signal source of the Mod FM is its FM engine. It consists of four operators (sine oscillators). They are all interconnected in the form of a matrix, so that each operator can frequency-modulate every other operator with individual intensities. At the same time, each operator can itself be modulated by all other operators.

Operators that modulate others are usually called "modulators" (sounds kind of sensible...). Operators that are modulated by others are called "carriers". A carrier - or "base operator" - provides the fundamental and thus determines the pitch of the entire sound. The modulators - or "overtone operators" - produce, you guessed it, overtones and thus determine the sonic character.

The following figure shows the FM matrix with all its modulation interconnections, the corresponding matrix knobs and the representation of the matrix in the left display, as well as the currently selected algorithm in the right display.

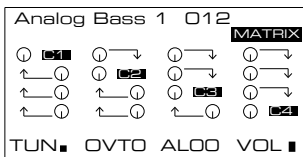


The four diagonally positioned **matrix knobs "OP1" to "OP4"** control the frequencies (itches) of the four corresponding operators. Operator pitches are generally tuned in semitones by default. In the so-called overtone mode, the operators are tuned according to the overtone series (see below).

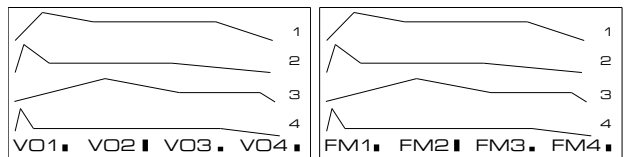
The remaining 12 **matrix knobs ("Amt XY")** control the intensity of all modulation paths between the operators ("FM1" to "FM4"). The numbers correspond to the modulation paths, i.e. "Amt31" determines the modulation intensity from operator 3 to operator 1, "Amt24" that from operator 2 to operator 4, etc.

In matrix mode, the **left display** visualises the matrix, depending of the currently selected algorithm. Together with the matrix knobs, it is used for programming the modulation paths within the matrix.

Depending on the selected display page, the **right display** shows a schematic representation of the operator envelopes and their amounts for operator volume or pitch.



Matrix Mode  
left Display



Matrix Mode  
right Display

# Operators:

We have just dealt with the basic functioning of the FM matrix. Now let's take a closer look at a single operator.

As we already know, an operator is a sine wave oscillator. It can modulate the pitch of other operators and/or can be modulated in turn. There are several ways to do this:

## Modulation of the **operator pitch** by

- other operators (= > resulting in steady timbres) - editing with Matrix knobs ("AmtXY")
- FM envelope (= > resulting in dynamic timbres) - editing with Matrix menu / FM envelope page
- LFO1 (= > resulting in periodical sound changes) - editing with LFO menu / LFO1 page

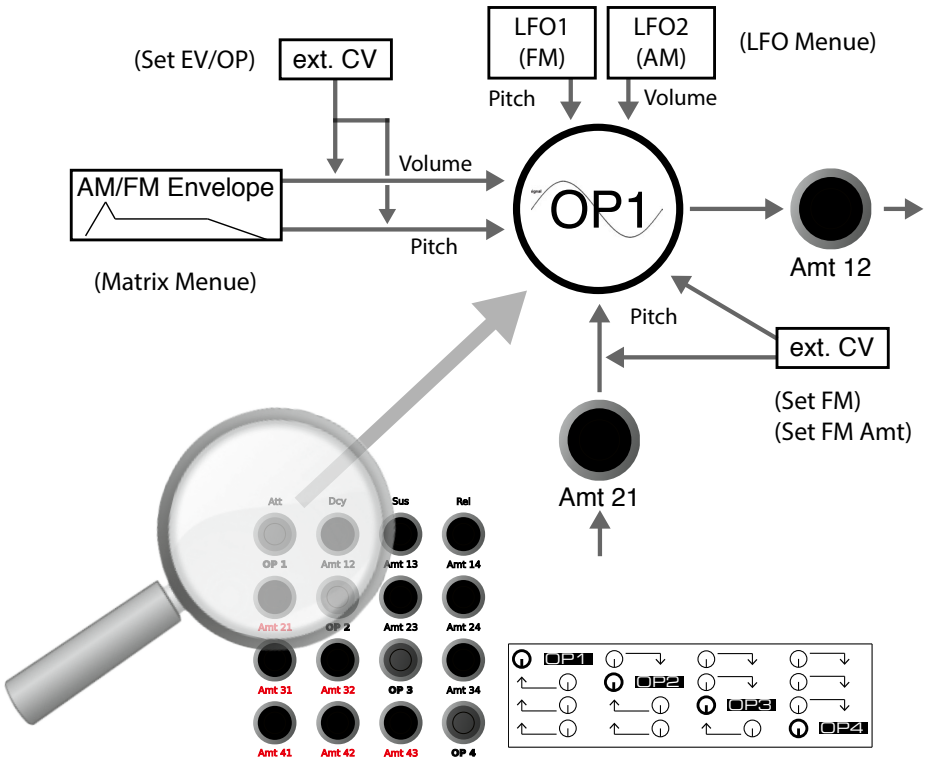
## Modulation of the **operator volume** by

- AM envelope (= > resulting in volume progression) - editing with Matrix menu / AM envelope page
- LFO2 (= > resulting in periodical volume change) - editing with LFO menu / LFO2 page

Above that, the operator pitches and both the modulation depths between the operators and those of envelopes can be controlled with the help of external voltages.

The interaction of the various modulation sources allows highly complex and dynamic timbres to be created.

The following figure shows the various interconnections and modulation sources to control pitch and volume of each operator:



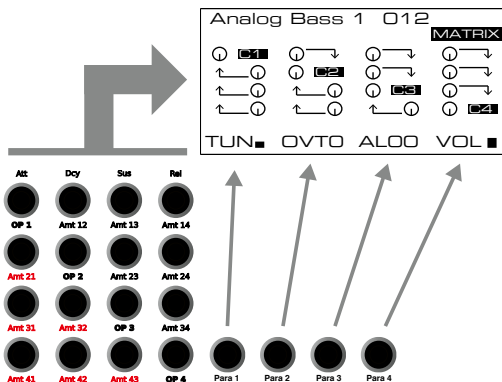
## How to operate the matrix:

### Matrix Menue:

The **Matrix** button opens the **matrix menu**.

If no preset algorithm is called up, the left display shows the complete FM matrix with all operators and modulation paths active.

The following parameters are available:



Display Content	Value	Knob / Button	Function
C1/M1 to C4/M4	000 - 127	OP1 / OP 2 / OP 3 / OP4	Operator Pitch
⊖	000 - 127	Amt XY (12x)	Operator Mod Depth
TUN	000 - 127	Para 1	Tuning entire FM Engine
OVT	0 - 6	Para 2	Overtone Mode
AL	00 - 26	Para 3	Algorithm
VOL	000 - 127	Para 4	Volume entire FM Engine

- **C1/M1 to C4/M4:** Pitch of the operators 1 to 4 – Depending on the selected algorithm, the individual operators work either as carriers (C) or as modulators (M).
- **AmtXY:** Amount XY (shown in the display as a knob symbol) – Modulation intensities between the operators.
- **TUN:** Tuning – Base pitch of the entire FM engine.
- **OVT:** Overtone – Selects the overtone mode 0 – 6 of the operators (overtone function).

This **overtone function** scales the operators to harmonic overtones and thus simplifies the programming of tonally playable sounds. To understand exactly how it works, we have to dive a bit deeper (To use the overtone function, you do not have to fully understand it – but knowledge doesn't hurt...) So please feel free to continue reading:

In the "usual case" (i.e. OVT 0), all four operators receive the same basic pitch information via MIDI or CV. In addition, they can be detuned independently of each other in semitones over a wide range with the help of the matrix knobs OP1 to OP4. However, harmonics are hit only "occasionally" (i.e. wholenumber frequency ratios between the operators) - and only *then*, harmonic and tonally playable sounds are produced.

To simplify the creation of harmonic sounds, Mod FM has its overtone mode in which the operators provide exclusively harmonic overtones. To achieve that, the "overtone operators" (OT) are locked (resp. set into mathematical relation) to the "base tone operator(s)" (BT) instead. When turning the matrix knobs OP1 to OP4 the operators now deliver exclusively harmonic overtones. All intermediate, inharmonic frequencies are omitted.

The overtone mode offers six different settings resp. interconnections of fundamental- and overtone operators (settings OVT 1 to OVT 6). Each of these six settings provides a different harmonic selection, resulting in different timbres. This works with the free matrix as well as with all FM algorithms.

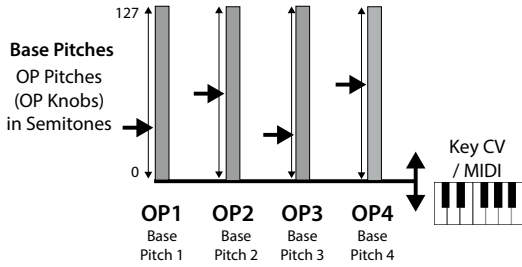
The following figure illustrates the overtone mode's theory of operation. The upper half shows overtone mode 0, the lower half corresponds to overtone mode 1 as an example.

**Overtone Mode 0:**

- all Operators provide Base Pitch
- all Operator Pitches in Semitone Steps



mostly inharmonic Sounds

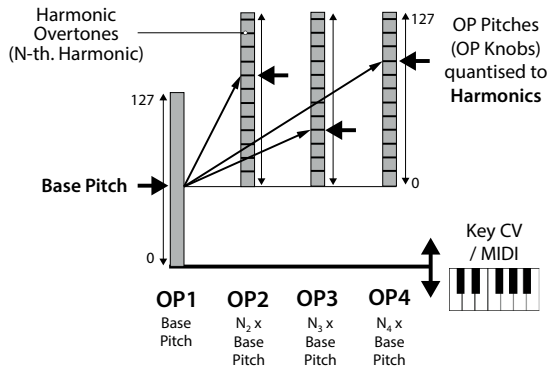


**Overtone Mode 1:**

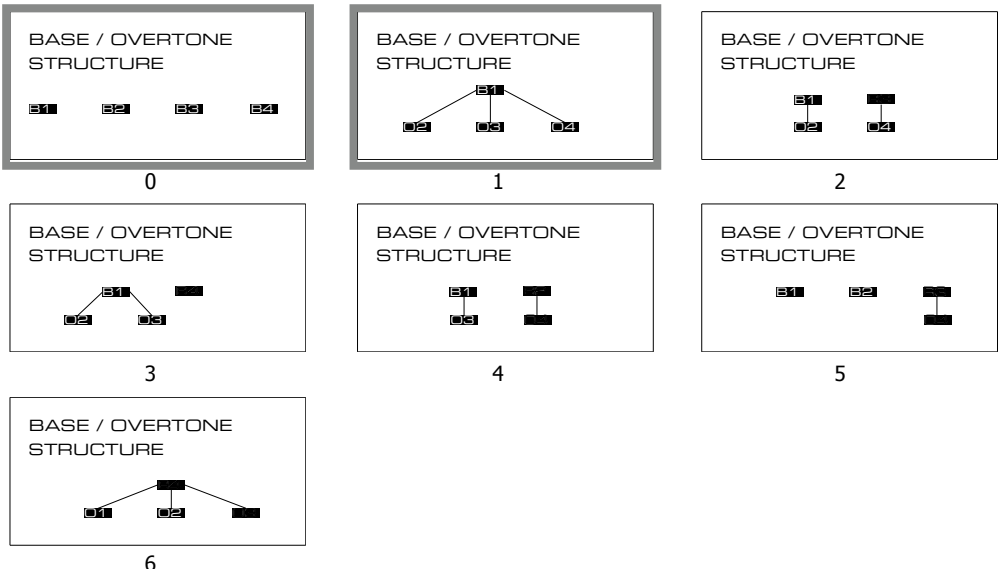
- only Operator 1 provides Base Pitch
- Operators 2, 3, 4 locked to Operator 1, providing N-th. Harmonic x Base Pitch (harmonic Overtones)



harmonic Sounds



The following figure shows the synchronisation between the basetone- and overtone operators in the different overtone modes 0 to 6. In mode "0" is no sync between the operators (see above).

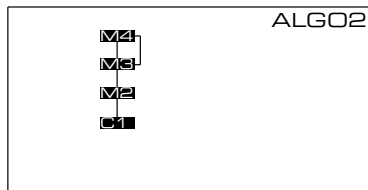
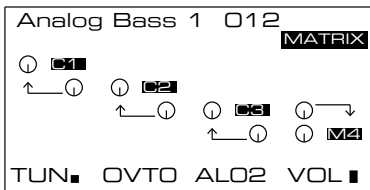




- **AL:** Algorithm – Turning the **Para 3** knob selects one of 26 preset algorithms. Each algorithm offers a different wiring of operators and provides different timbres. Value "00" provides the free matrix with no preset algorithm selected. A list with the available algorithms can be found in the addendum on page 36. Overtone mode (see above) works with all algorithms.
- **VOL:** Volume – sets the level at which the output signal of the FM engine is fed into the subsequent analogue post-processing section. High values can produce deliberate saturations or distortions in the sound. In Algorithm menu (see below) values of "001" and "002" provide a steady "drone" tone of the FM engine making it easier to program specific sound colours.

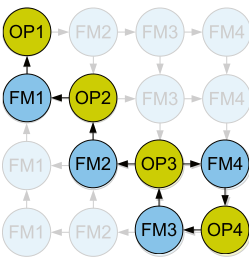
### Algorithm Menu:

When pressing the **Algrhm** button, the Algorithm menu opens up. The left display still shows the active matrix knobs for editing operator tuning and modulation amounts. The right display shows a schematic representation of the currently selected algorithm. As an example, the following figures show algorithm 2.

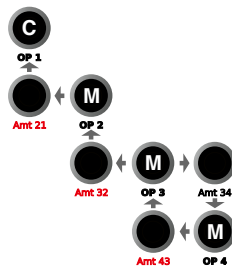


Depending on which operator modulation paths are used by the particular algorithm, only some specific of the 12 **Amt XY** knobs are active.

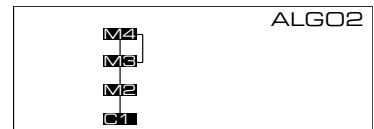
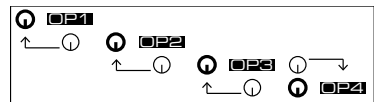
#### Algorithm 2:



Matrix Scene



active Matrix Knobs



left / right Display

Hit the **Cursor >** button to select Algorithm mode page 2 "**Operator Tune Mode**". The left display shows:

- **Para 1 to Para 4** knobs now allow toggling between two different tuning modes per operator:
- **TUN:** Operator is tuned in semitones. This is the usual operation mode as we know (and love) it.
- **FRQ:** Operator is tuned to a fixed frequency (in Hertz) that is selected with the corresponding matrix knob (**OP1** to **OP4**).

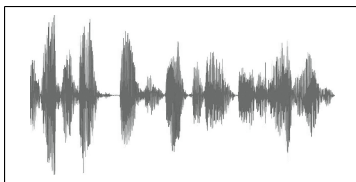
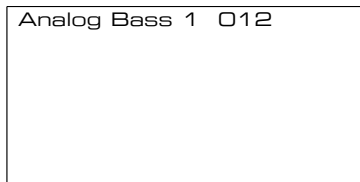
Now the operator is unable to work in any overtone modes (because its frequency is fixed). It neither reacts to incoming note information.

This mode is especially useful for inharmonic and noisy sounds.



Hit the **Cursor >** button again to select Algorithm mode page 3. The left display just shows name and number of the current preset.

The right display shows an animated waveform of the currently generated sound.



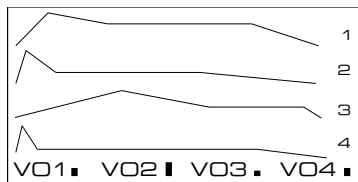
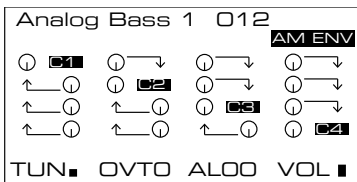
### Operator Envelopes

Each of the four operators provides an ADSR envelope generator. It controls both the volume- and the pitch curve of its operator but with independently adjustable amounts. With the help of this envelope, very dynamic and percussive sounds can be created. It requires a little practice and experimentation to find the most suitable and sonically productive settings.

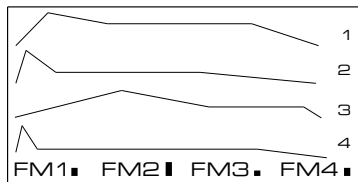
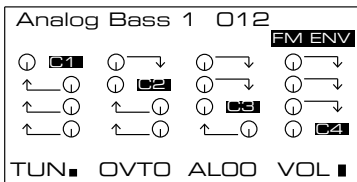
After opening the Matrix menu (**Matrix** button) – actually a submenu of the Matrix menu – the right display shows the envelopes of the four operators as a graphic. The corresponding modulation amounts for volume and pitch can be seen in the bottom line.

The **> Cursor** button switches to the FM (pitch) modulation amounts page.

Operator Envelopes with Volume Amounts

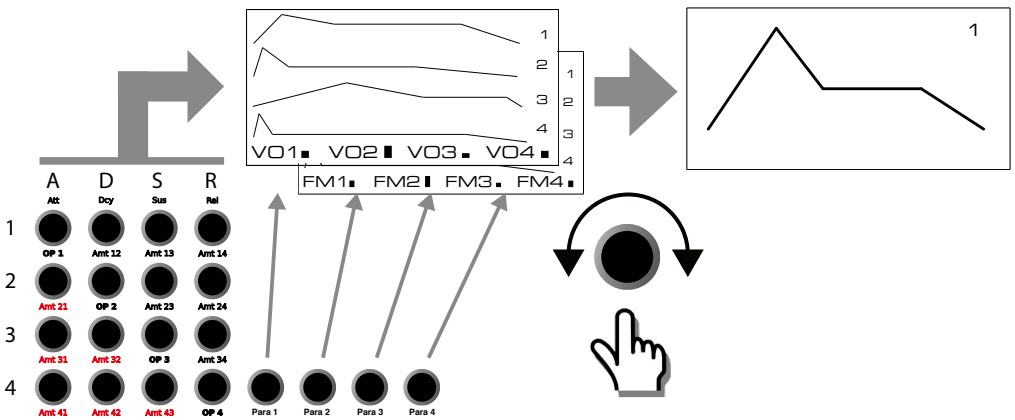


Operator Envelopes with Pitch Amounts



The editing process is exactly the same for both Volume- and FM envelope. The example uses the Volume envelope.

Display Content	Value	Knob / Button	Function
OP 1 Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 1	OP 1 Envelope Shape (ADSR)
OP 2 Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 2	OP 2 Envelope Shape (ADSR)
OP 3 Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 3	OP 3 Envelope Shape (ADSR)
OP 4 Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 4	OP 4 Envelope Shape (ADSR)
VO 1 / FM 1	000 - 127	Para 1	OP 1 Envelope Mod-Amount
VO 2 / FM 2	000 - 127	Para 2	OP 2 Envelope Mod-Amount
VO 3 / FM 3	000 - 127	Para 3	OP 3 Envelope Mod-Amount
VO 4 / FM 4	000 - 127	Para 4	OP 4 Envelope Mod-Amount



- **Envelope shape:** The 16 **Matrix knobs** control the shape of the four operator envelopes. Each row controls the ADSR- parameter of its corresponding envelope. When turning a Matrix Knob, the right display briefly shows an animated graphic of the corresponding envelope shape.
- **VO1 – VO4 (AM ENV): Para 1 – 4** knobs set the volume modulation amounts of the four operator envelopes. It also can be used to adjust the volume of each operator independently.
- **FM1 – FM4 (FM ENV): Para 1 – 4** knobs set the pitch modulation amounts of the four operator envelopes.

### LFO Menu

The LFO menu provides two more oscillators with both two different operation modes. These two oscillators can either work as LFOs and then modulate the frequency/pitch (LFO 1) or volume (LFO 2) of the four operators.

Alternatively, they can work in the audio range and then serve as additional signal sources with 64 waveforms each. They can be used together with the FM engine or independently.

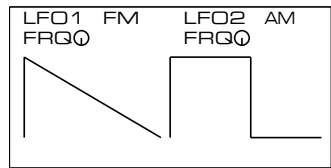
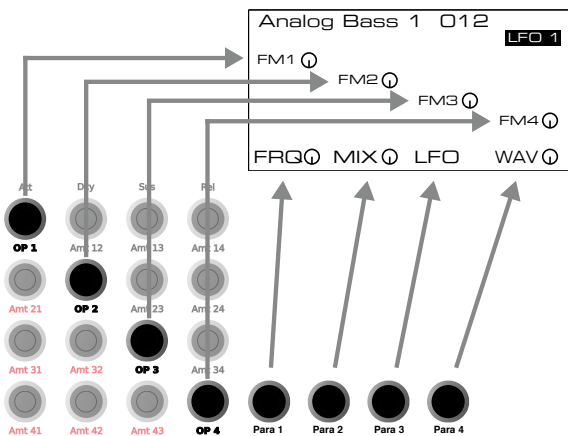
The **LFO** button opens the LFO menu.

The **< / > Cursor** buttons switch between LFO 1 and LFO 2. The left display shows the parameters for LFO 1 and LFO 2 individually.

The right display shows parameter values and waveforms of both LFOs/VCOs simultaneously.

The following functions are available:

Display Content	Value	Knob / Button	Function
FM/AM 1 / 2 / 3 / 4	000 - 127	Matrix Knobs OP 1 - 4	Mod-Amount OP 1– 4
FRQ / DET	000 - 127	Para 1	LFO Frequency (LFO Mode) VCO Detune (VCO Mode)
MIX	000 - 127	Para 2	VCO Audio Level in Signalpath
LFO / VCO	LFO / VCO	Para 3	LFO / VCO Mode
WAV	00 - 63	Para 4	Waveshape
OCT (right Display)	0 - 6	Matrix Knobs 2, 3, Row 1	Octave Pitch (VCO Mode only)

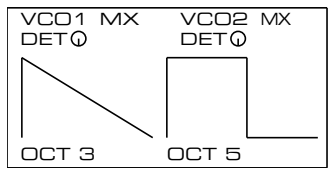
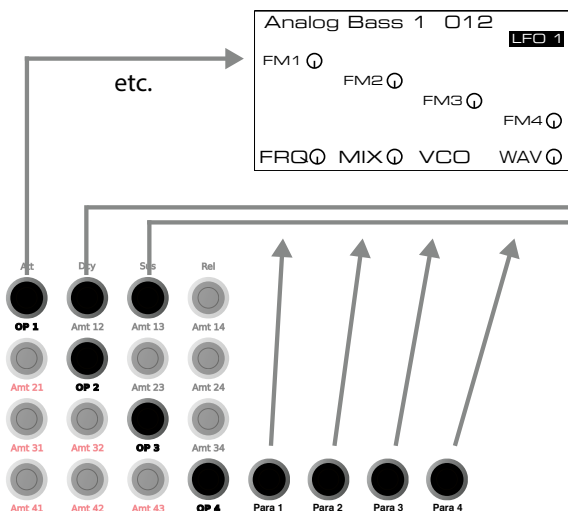


Both LFO 1 and LFO 2 in LFO Mode

- **FM1 - FM4 (LFO1):** Modulation depth for the frequency of the operators OP1 to OP4. It is set with the four corresponding **matrix** knobs **OP1** to **OP4**.
- **AM1 - AM4 (LFO2):** Modulation depth for the volume of the operators OP1 to OP4. It is set with the four corresponding **matrix** knobs **OP1** to **OP4**.
- **FRQ / DET:** - LFO frequency (in LFO mode).  
- Detune of the VCOs to each other and to the FM engine (in VCO mode).
- **MIX:** Mixes the signal of the LFOs or VCOs into the signal path. (This also works in LFO mode and can be sonically interesting).
- **LFO / VCO:** Operating mode - toggles between LFO and VCO mode.  
When set to VCO, the corresponding oscillator works in the audio range and can be used as an additional sound source, together or alternatively to the FM engine.
- **WAV:** Waveform – there are 64 different waveforms to choose from in both modes.

In VCO mode, there is one more function available in the right display:

- **OCT:** Octave – selects the octave position of the VCO in a range of seven octaves (0 - 6)



Both LFO 1 and LFO 2 in VCO Mode

# Sound Processing

## Filter / VCA

Mod FM has a real analogue sound post-processing. It provides clearly audible sound changes with a few simple steps. It also combines the typical FM sound characteristics with that of a real-analogue synthesiser. The analogue part of the Mod FM consists of a mixer that combines Mod FM's different signal sources followed by a multimode filter with subsequent VCA.

The modulation is done with one ADSR envelope each for timbre (Filter) and volume (VCA) progressions as well as with one more LFO that modulates the filter cutoff.

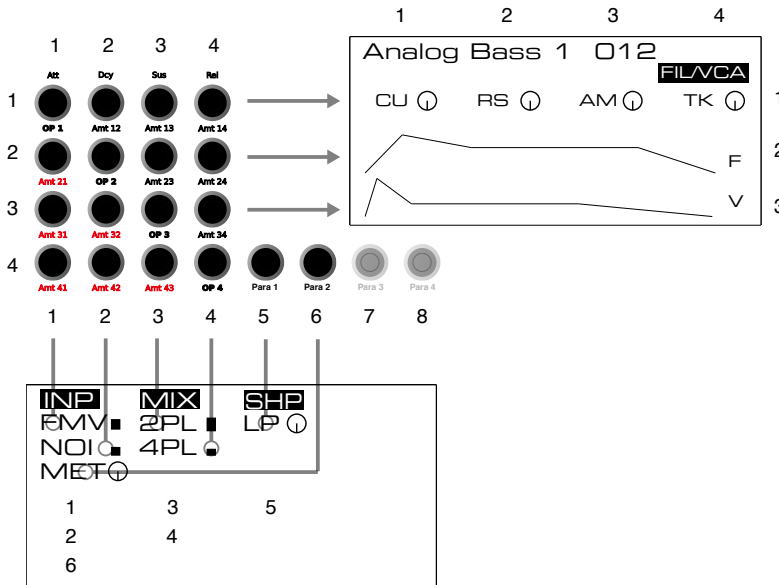
There is also a noise generator with selectable sound characteristics as a further signal source.

FM engine, VCOs and noise generator can be mixed in any ratio. These signal levels (INP / Input) can overdrive the filter input stage, if desired. This creates saturation effects or distortion that can be used to shape the sound.

The filter is a resonant multimode filter. Its characteristics (SHP / Shape) can be blended continuously between low-pass (LP), band-pass (BP) and high-pass (HP). It also works as a 2-pole and as a 4-pole filter. The two corresponding outputs can be mixed continuously (MIX).

The **Filter** button opens the Filter/VCA menu.

The parameters are distributed over both displays. They are each arranged in three lines with up to four parameters. The following figure shows the assignment of knobs and functions:



Display Content	Value	Knob / Button	Function
CU	000 - 127	Matrix Knob 1 / Row 1	Cutoff Frequency
RS	000 - 127	Matrix Knob 2 / Row 1	Resonance
AM	000 - 127	Matrix Knob 3 / Row 1	Envelope Amount
TK	000 - 127	Matrix Knob 4 / Row 1	Keyboard Tracking
Filter Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 2	Filter Envelope Shape (ADSR)
Volume Envelope Graphic	Graphic	Matrix Knobs 1 - 4 / Row 3	Volume Envelope Shape (ADSR)
FMV	000 - 127	Matrix Knob 1 / Row 4	FM Volume
NOI	000 - 127	Matrix Knob 2 / Row 4	Noise Volume
2PL	000 - 127	Matrix Knob 3 / Row 4	Signal Level 2-Pole Filter
4PL	000 - 127	Matrix Knob 4 / Row 4	Signal Level 4-Pole Filter
SHP	000 - 127	Para 1	Filter Characteristics (LP/BP/HP)
MET	000 - 127	Para 2	Noise Sound

The following parameters are available in the left-hand display:

### Filter Parameter

- **CU:** Cutoff - sets the cutoff frequency of the filter.
- **RS:** Resonance - sets the resonance frequency of the filter.
- **AM:** Amount - sets the modulation depth of the filter envelope.
- **TK:** (Keyboard) Tracking - varies the modulation depth depending on the played keyboard pitch.
- **ADSR F(ilter):** The second row of matrix knobs controls the parameters A, D, S and R of the filter envelope.
- **ADSR V(CA):** The third row of matrix knobs controls the parameters A, D, S and R of the volume envelope.

The following parameters are available in the right-hand display:

### INP

**Input** - Sets the level ratio of the signals at the filter input stage:

- **FMV:** FM Volume - level of the FM engine
- **NOI:** Noise - level of the noise signal
- **MET:** Metallic - sound character of the noise signal

### MIX

**Mixer** - Sets the level ratio of the filter's output signals:

- **2PL:** 2-pole - output level of the 2-pole filter
- **4PL:** 4-pole - output level of the 4-pole filter

### SHP

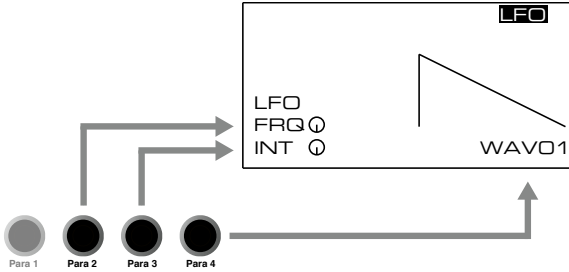
**Shape** - sets the characteristics of the filter:

- **LP / BP / HP:** The filter blends continuously between low-pass (LP), band-pass (BP) and high-pass (HP).  
When the **Para 1** knob is turned, the display briefly shows a value, then returns to the selected characteristics (LP, BP or HP).

## LFO

The **> Cursor** button opens a second page of the Filter/VCA menu. The right-hand display provides access to the third LFO. It is used exclusively to modulate the filter cutoff.

- **FRQ**: Frequency - LFO speed
- **INT**: Intensity - modulation depth
- **WAV 01**: LFO waveform - 64 different waveforms are available for selection.



Display Content	Value	Knob / Button	Function
FRQ	000 - 127	Para 2	LFO Frequency
INT	000 - 127	Para 3	Modulation Intensity
WAV	00 - 63	Para 4	Waveshape

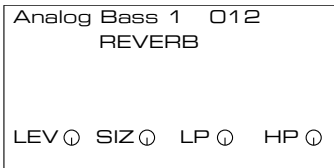
## Effects (FX)

Mod FM sports three on-board effects that are connected to the sound generation. These are a reverb effect and two identically designed delays.

The **FX** button calls up the effect menu in the left-hand display. Use the **< / > Cursor** buttons to switch between the three effects.

Each effect provides four parameters that are controlled with the **Para 1 - 4** knobs. The following parameters are available:

### Reverb:



Display Content	Value	Knob / Button	Function
LEV	000 - 127	Para 1	Level Reverb Signal
SIZ	000 - 127	Para 2	Reverb Decay Time
LP	000 - 127	Para 3	Hi Cut
HP	000 - 127	Para 4	Lo Cut

- **LEV:** Level - sets the level of the reverb signal.
- **SIZ:** Size - sets the reverberation time.
- **LP:** Lowpass - cuts the high frequencies of the reverb signal. The reverb sound becomes duller.
- **HP:** Highpass - cuts the low frequencies of the reverb signal. The reverb sound becomes brighter.

### Delay 1 / Delay 2:

Both delay effects provide identical parameters.

```

Analog Bass 1 012
      DELAY 1

BPM120.0
LEV 1/2 SYN FBK
  
```

```

Analog Bass 1 012
      DELAY 2

BPM120.0
LEV 1/2T SYN FBK
  
```

Display Content	Value	Knob / Button	Function
LEV	000 - 127	Para 1	Level Delay Signal
DLY / 128 / 1/2	000 - 127 / 1/2 - 1/64T	Para 2	Delay Time
SLO / SYN	SLO / MED / FAST / SYN	Para 3	Delay Time Range / MIDI Sync
FBK	000 - 127	Para 4	Delay Feedback

- **BPM:** Beats per Minute – shows delay time in beats per minute (BPM) when Mod FM ist synced to an external MIDI clock signal (no editable value).
- **LEV:** Level - sets the level of the delay signal.
- **DLY:** Delay – selects the delay time, i.e. the time interval between the throws back. The Para 2 knob first sweeps a range of values from 000 to 127, after which note values (1/2 to 1/64 triplet) appear. If Mod FM receives an external MIDI clock, both delays automatically synchronise to it. Then these note values determine the desired clock divider.
- **Para 3:** If **DLY** (Para 2) shows a numerical value (000 - 127), the three delay time ranges SLOW, MED(ium) and FAST can be selected here. If **DLY** shows a note value, (clock divider) e.g. 1/16, the delay time is synchronised to an external MIDI clock and the display shows SYN here. The display also shows the MIDI clock tempo in BPM.
- **FBK:** Feedback - sets the feedback level, resp. the number of audible reflexions (echo).



## Randomisation and Reset Functions

Even if you have become an expert in programming your Mod FM, you might like its randomisation- and initialisation functions. They can speed up your sound programming work a lot and provide interesting results.

### Randomise FM Matrix

- Enter the Matrix menu (**Matrix** button).
- Press and hold the **< Cursor** button for at least 3 seconds. The current settings of the FM matrix are randomised. The other settings (filter, VCA, FX etc.) are not randomised. The display shows:



Matrix randomizd

### Initialise FM Matrix

- Enter the Matrix menu (**Matrix** button).
- Press and hold the **Matrix** button for at least 3 seconds. The current settings of the FM matrix are initialised, i.e. reset to their basic settings (basic tone, modulation amounts off, etc.).



Matrix initialzd

### Randomise Filter

- Enter the Filter menu (**Filter** button).
- Press and hold the **< Cursor** button for at least 3 seconds. The current settings of the filter are randomised. The other settings (FM engine, FX etc.) are not randomised. The display shows:



Filter randomizd

### Initialise Single Preset

- Press and hold the **Sing/Mul** button for at least 3 seconds. The current Single preset is entirely initialised, i.e. all its sound engine parameters are reset to their basic settings.



Preset initialzd

# SINGLE-/MULTIMODE

## Single Mode

In single mode, Mod FM provides one single sound (resp. a preset), playable with eight voices. It can be addressed via Midi or - for each voice individually - via CV/Gate sockets. The current (single) preset can be changed at any time with the  $\wedge$  /  $\vee$  **Cursor** buttons. All sound parameters are available for editing. Modified single presets can be saved. Please refer to page 28. Mod FM stores up to 128 single presets.

The sum signal of all voices is output via the Mix Out. Voices 1, 3, 5, 7 are at the left output. Voices 2, 4, 6, 8 are at the right output. To put out all voices on one output (mono), please use the right socket ("EVEN (1-8)"). Voices 1 - 8 are also output via the corresponding single outs.

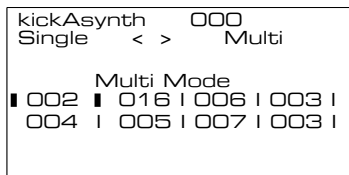
The **Sing/Mul** button opens the Single/Multi menu, starting with the Single menu. The left display shows:



To change the current Single preset, please use the  $\wedge$  /  $\vee$  **Cursor** buttons or **Para 1** and **Para 4** knobs. The right-hand display shows the matrix menu of the current single preset. Except changing Single presets, there is nothing to edit here.

## Multi Mode

Hit the **Sing/Mul** button and change to the Multi Mode page by hitting the **> Cursor** button. The left display shows:



In multi-mode, each voice of the Mod FM can be assigned its own single preset. The combination of up to eight single presets forms a multi-preset. Multi presets can be stored. Mod FM stores up to 128 multi presets.

Each voice is controlled via its own pair of CV/gate sockets (as in single mode).

When controlled by MIDI, two different note assignment modes are available. They can be accessed in the **MIDI** menu, page 2, function Split 0/1 ("Split"). Please refer to page 30.

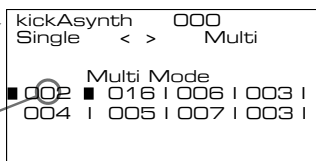
The voices 1 - 8 (resp. their assigned single presets) are output via the corresponding single outs. The sum signal of all voices is additionally output via the Mix Out. Voices 1, 3, 5, 7 are at the left output. Voices 2, 4, 6, 8 are at the right output.

The current multi preset can be changed with the  $\wedge$  /  $\vee$  **Cursor** buttons and **Para 1** and **Para 4** knobs.

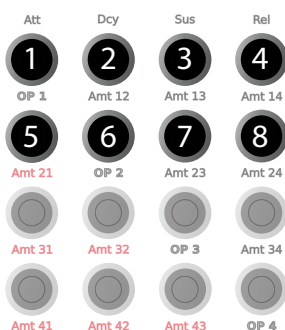
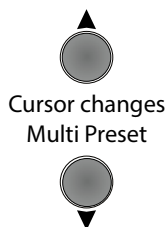
## Editing Multi Presets:

The eight voices are now assigned to the upper eight matrix knobs. Turning one of the upper eight **Matrix knobs** changes the single preset of the corresponding voice. The last changed single preset is shown with two bars around it. It is the current preset and can be edited via the control panel.

Name / Number  
Multi Preset



Copy of active  
Single Preset



**Unlike some other multi mode capable synthesizers, the multi mode memory of Mod FM contains copies of the respective single presets. That means that editing individual sounds in multi mode has no effect on the corresponding single presets.**

**Conversly, editing single presets does not change the settings of the respective multi mode parts.**

The multi-mode of Mod FM is deliberately kept simple. Volume ratios, panning positions, etc. of the individual sounds can be controlled with the help of external Eurorack modules.

Interesting applications of Mod FM's multi-mode can be the simultaneous use of up to eight percussion-like sounds. Mod FM thus becomes a drum/percussion synth with extraordinary sounds. It is also interesting to stack several presets that are only minimally modified and/or detuned against each other.

# STORE PRESETS

The Store menu saves the settings of the Mod FM. Up to 128 single and multi presets can be stored. The storing process is identical for single and multi presets.

## Storing the current preset in the same memory location:

- Pressing the **Store** button calls up the Store function. Regardless in which mode Mod FM is in, the left display shows the entry:

```
Store to location
Name edit: right >
To cancel: left <
```

- Pressing **Store** a second time saves all changes to the current preset. The preset remains in the previous memory location and retains its previous name.

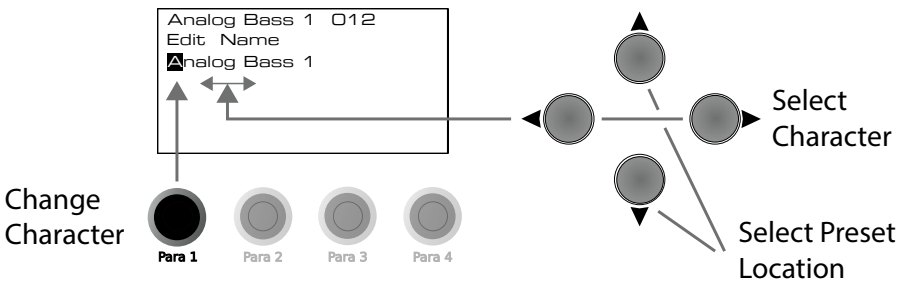


**Attention please - there is NO UNDO! Sounds that have been overwritten are irretrievably lost! No exceptions...**

- If the **< Cursor** button is pressed instead, the save function is cancelled.

## To save the current preset to a new memory location / edit preset name:

- Press **Store** to enable the Store function.
- Select a memory location with **^ / v Cursor** buttons.
- Press **Store** again to save the preset permanently on the selected memory location.
- Then press **> Cursor** to open the name entry page.
- The character to be edited is selected with the **< / > Cursor** buttons.
- The desired character is selected with the **Para 1** knob.
- Press **Store** again for two times to save the edited preset name.



**According to the section above, save the edited preset first. Then – in a second step – change the edited preset name. Once again: Attention please - there is NO UNDO! Sounds that have been overwritten are irretrievably lost! No exceptions...**

- Pressing the **< Cursor** button cancels the storing process.

# EXTERNAL CONTROL

Mod FM can be controlled via MIDI Data and/or CV/gate signals. You should choose between MIDI note information **or** triggering via CV/gate signals – both at the same time might lead to unpredictable results. However it is possible to receive analogue gate signals at the Gate In sockets and translate them into MIDI Note On data which is sent out via MIDI and USB.

When MIDI data is received by the Mod FM, the upper LED flashes. The eight white LEDs indicate the active voice(s) at any given time.

## MIDI

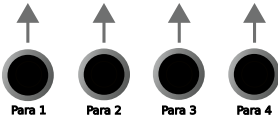
The **Midi menu** contains all functions to control Mod FM via midi.

- Connect the USB port of the Mod FM to a computer or a suitable MIDI device. Use a USB-C cable for this purpose.
- Connect the Midi In socket of the Mod FM to a suitable MIDI interface or other suitable MIDI device. Use Midi-TRS cables for this purpose.

The **Midi** button opens the Midi setup menu. The **< / > Cursor** buttons switch between four pages. The Midi menu is shown exclusively on the left display. The right display shows the matrix menu of the current preset. All parameters/functions are controlled with the **Para 1 - 4** knobs.

### MIDI Setup 1:

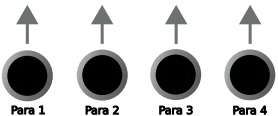
Analog Bass 1 012			
Midi Setup 1			
RxCh	TxCh	CkSy	PBRg
01	01	OFF	00



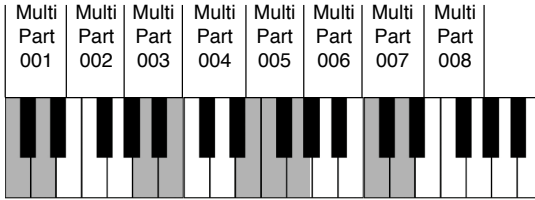
- **RxCh**: Receive Channel - Selects the midi receive channel between 01 and 16
- **TxCh**: Transmit Channel - Selects the Midi transmit channel between 01 and 16
- **CkSy**: Clock Sync - Receive Midi clock data on/off
- **PBRg**: Pitchbend-Range - Determines the range of received pitchbend data in semitone steps: **0** = no pitchbend to **24** = +/- 1 octave

### MIDI Setup 2:

Analog Bass 1 012			
Midi Setup 2			
SpIt	TxTr	TxCC	RxTr
0	OFF	OFF	ON



- **Split:** Split 0/1 - Sets the voice allocation in multi mode. Toggles between:
  - 0:** Voices (resp. sounds) are mapped to the keyboard. Each voice uses four semitones. This mode is especially useful when the multi mode is used to e.g. generate several drum/percussion sounds that should be mapped side by side on the keyboard.

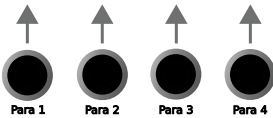
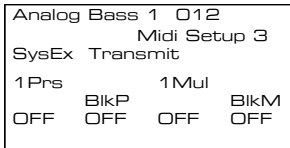


**1:** Voices (resp. sounds) are mapped to the different MIDI channels: Voice 1 uses MIDI channel 1, Voice 2 uses MIDI channel 2, etc... This mode is useful for e.g. multi-track recording and/or playing tonal sounds in multi mode.

- **TxTr:** Transmit Trigger on/off - If enabled, analogue trigger signals received via GATE sockets are transmitted as MIDI note on data.
- **TxCC:** Transmit Midi-Controller (CC) - Sending Midi-Controller data on/off
- **RxCC:** Receive Midi-Controller (CC) - Receive Midi-Controller data on/off

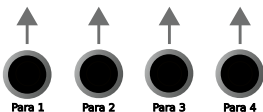
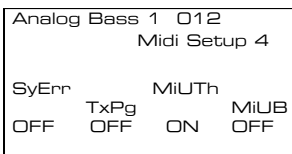
### MIDI Setup 3:

MIDI Setup 3 is used for SysEx data transmission of the the Mod FM presets. Turning a **Para 1 - 4 knob** starts the corresponding data transmission. While sending, the display shows "BUSY". When the transmission is completed, it shows briefly "DONE". Then the display returns to its standard setting "OFF".



- **1Prs:** SysEx dump of the current single preset.
- **BlkP:** SysEx dump of all single presets
- **1Mul:** SysEx dump of the current Multi-Preset
- **BlkM:** SysEx dump of all multi-presets

### MIDI Setup 4:



- **SyErr:** SysEx Error – If a an error occurs during transmission and the dump “hangs”, turn the **Para 1** knob to cancel and re-enable the dump function. Check your MIDI setup and start the dump function again.
- **TxPg:** Transmit Program Change - Enables/disables the transmission of Program Change data.
- **MiTH:** MIDI Through - Enables/disables the MIDI Through function of USB-MIDI and the MIDI In/Out sockets in order to avoid MIDI loops in your setup.
- **MiUB:** MIDI-USB Through - If enabled, incoming MIDI data at the MIDI In socket are transmitted to the MIDI In of the USB port. All MIDI data at the MIDI Out of the USB port are transmitted to the MIDI Out socket. In other words: This function provides a simple USB-to-MIDI interface.



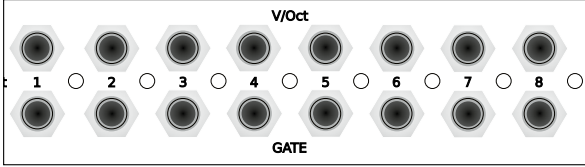
***If MiUB is in use, please make sure not to overload the MIDI data traffic resp. do not use it when transmitting CC data. Note information and MIDI clock should work fine.***

# External Control via CV/Gate and Control Voltages

## CV/Gate

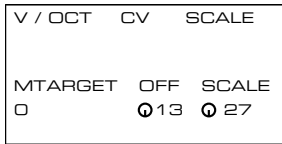
Mod FM can be controlled via external CV/gate signals. Each of the eight voices has a pair of CV/gate sockets for this purpose. Mod FM processes control voltages of 0 volts to +5 volts and gate signals of 3 volts to 15 volts in accordance with the Eurorack standard. The eight white LEDs indicate the active voice(s) at any given time.

Incoming gate signals are translated into MIDI Note On data and transmitted via MIDI Out / USB port (please refer to MIDI Setup 2, "TxTr", page 29/30).



The voltages applied to the V/Oct sockets are used in Mod FM exclusively to control the playing pitch. To be able to play Mod FM exactly tonally, all eight voices can be tuned separately according to the volt/octave standard.

Please note, that MIDI notes and pitch CV do *not* work in parallel – please use MIDI *or* pitch CV!



The **Set V/Oct** button opens the CV Tuning / Scaling menu:

The **Para 1**, **Para 3** and **Para 4** knobs are used here to enter values for:

- **MTARGET:** Modulation Target - Selects voice number 0 to 7 to be tuned.
- **OFF:** Offset - Adjusts the pitch in cents.
- **SCL:** Scale - Adjusts the octave spread (Scaling).

## Modulation with external control voltages

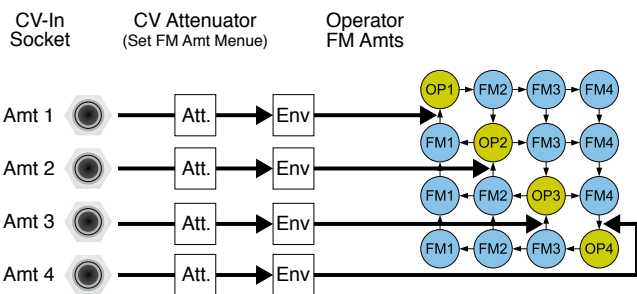
The FM modulation amounts of the envelopes, affecting the four operators as well as the operator pitches can be controlled with the help of external control voltages. According to the Eurorack standard, voltages in the range of 0 volts to +5 volts are processed.

### External control of envelope FM amounts

The FM modulation amounts, provided by the operator envelopes, can be controlled individually by an external voltage. In other words: The amount settings in Matrix page 3 (FM1 - FM4) are controlled externally. For this purpose, an external control voltage (positive) can be added per operator (**sockets Amt 1 - 4**).

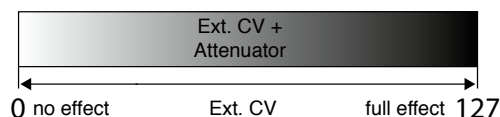




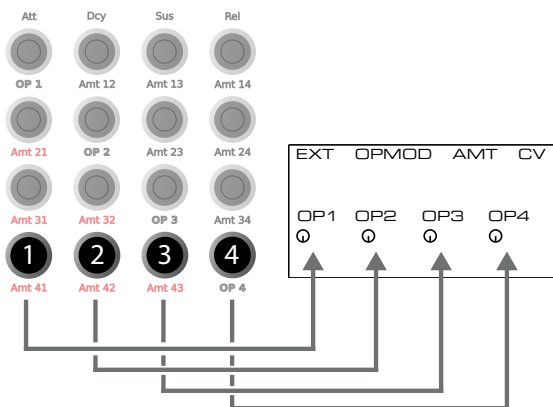


Its effect can be determined in the **Set FM Amt** menu for each operator.

The parameter adjusts the proportion between the external control voltage and the modulation amount, set in the Matrix menu, page 3 (FM ENV). A value of "0" means no effect of the external CV, "127" means full effect.



The **Set FM Amt** button opens the corresponding menu. The left display shows:

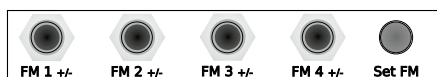


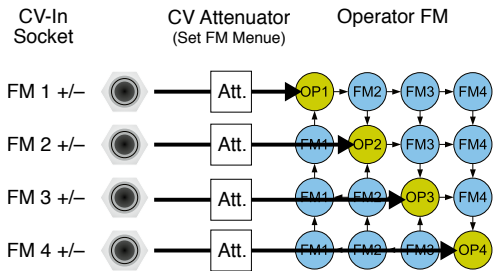
The **lower four Matrix knobs** now set:

- **OP1:** Operator 1 - Effect of the external control voltage at socket Amt 1 on Operator 1.
- **OP2:** Operator 2 - Effect of the external control voltage at socket Amt 2 on Operator 2.
- **OP3:** Operator 3 - Effect of the external control voltage at socket Amt 3 on Operator 3.
- **OP4:** Operator 4 - Effect of the external control voltage at socket Amt 4 on Operator 4.

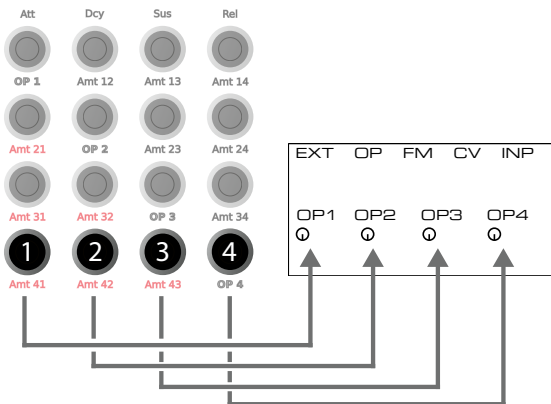
### External control of operator pitches

The pitches of the four operators can be controlled by external control voltages (-5V to +5V). The sockets FM 1 +/- to FM 4 +/- are used for this purpose.





The external control voltages are added to the operator pitches set with knobs **OP 1 - 4**.



The **Set FM** button opens the corresponding menu. The left display shows:

The **lower four matrix knobs** now set:

- **OP1**: Operator 1 - Effect of the external control voltage at socket FM 1 +/- on Operator 1.
- **OP2**: Operator 2 - Effect of the external control voltage at socket FM 2 +/- on Operator 2.
- **OP3**: Operator 3 - Effect of the external control voltage at socket FM 3 +/- on Operator 3.
- **OP4**: Operator 4 - Effect of the external control voltage at socket FM 4 +/- on Operator 4.

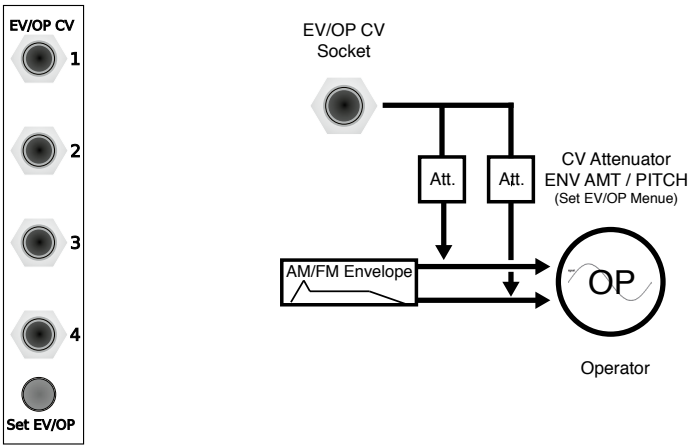


**Please note that these inputs do not accept static voltages because of technical reasons. The connected control voltages have to "sweep", at least very slowly.**

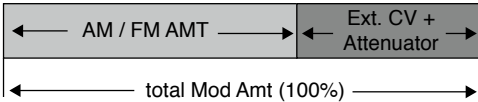
### External control of the operator envelopes

The modulation amounts of the four operator envelopes (in the matrix menu, display pages 2/3) can be controlled with external control voltages (positive values) – independantly for operator volumes and pitches. The four ENV/OP CV sockets are used for this purpose.

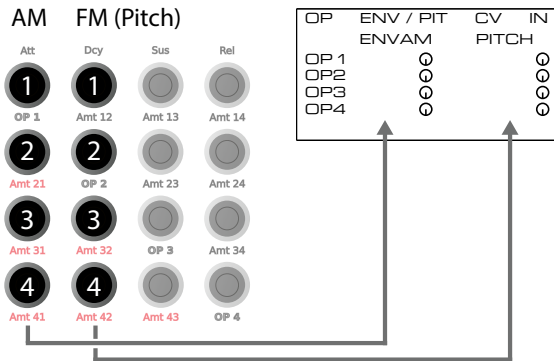
The connected control voltages are first attenuated and then applied to the modulation depths set with the Para 1 - 4 knobs (matrix menu, display page 2, 3). The desired attenuation is done with the help of the settings in the Set EV/OP menu.



Since the maximum modulation depth cannot be exceeded, the effect of the external control voltage depends on the Amount settings made in the Matrix menu.



The **Set EV/OP** button opens the menu for attenuating the external control voltages. The left display shows:



The **left two columns of the matrix matrix knobs** now determine the attenuation of the external control voltage for the AM/volume- and FM/pitch envelope amounts of the four operators.

- **OP1:** Operator 1 - Effect of the external control voltage at socket EV/OP CV 1 on AM/FM envelope amount of Operator 1.
- **OP2:** Operator 2 - Effect of the external control voltage at socket EV/OP CV 2 on AM/FM envelope amount of Operator 2.
- **OP3:** Operator 3 - Effect of the external control voltage at socket EV/OP CV 3 on AM/FM envelope amount of Operator 3.
- **OP4:** Operator 4 - Effect of the external control voltage at socket EV/OP CV 4 on AM/FM envelope amount of Operator 4.

# ADDENDUM

## FM Algorithms

Display View (Matrix Menue)

Left Display

Analog Bass 1 012 **MATRIX**

TUN. OVTO ALOO VOL ■

Right Display

ALG 00

NO ALGORITHM  
FREE MATRIX

Analog Bass 1 012 **MATRIX**

TUN. OVTO ALO1 VOL ■

ALGO1

Analog Bass 1 012 **MATRIX**

TUN. OVTO ALO2 VOL ■

ALGO2

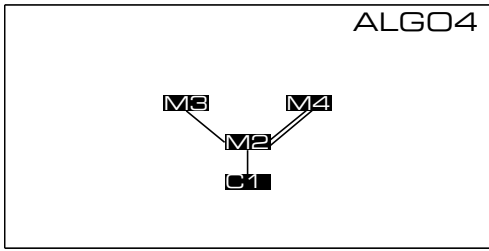
Analog Bass 1 012 **MATRIX**

TUN. OVTO ALO3 VOL ■

ALGO3

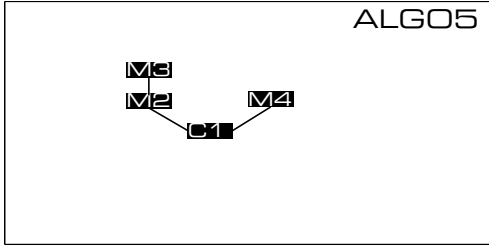
Analog Bass 1 012 **MATRIX**

TUN ■ OVTO AL04 VOL ■



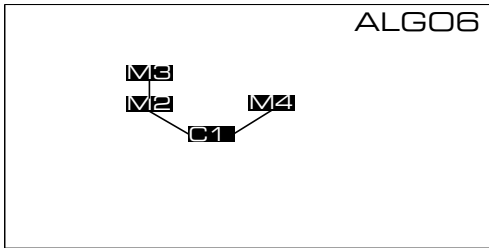
Analog Bass 1 012 **MATRIX**

TUN ■ OVTO AL05 VOL ■



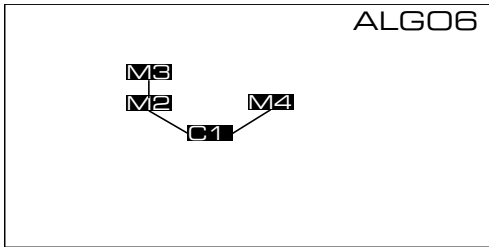
Analog Bass 1 012 **MATRIX**

TUN ■ OVTO AL06 VOL ■



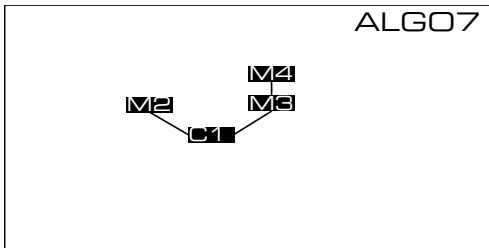
Analog Bass 1 012 **MATRIX**

TUN ■ OVTO AL06 VOL ■



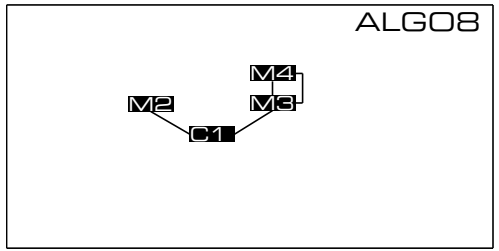
Analog Bass 1 012 **MATRIX**

TUN ■ OVTO AL07 VOL ■



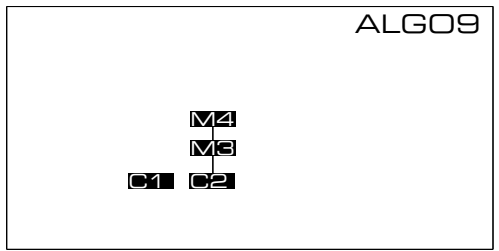
Analog Bass 1 012 **MATRIX**

TUN. OVTO AL08 VOL



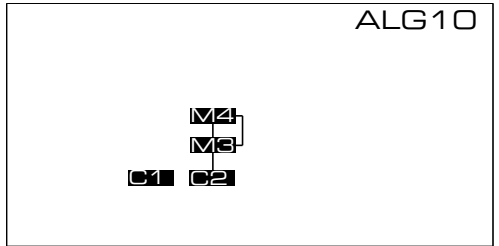
Analog Bass 1 012 **MATRIX**

TUN. OVTO AL09 VOL



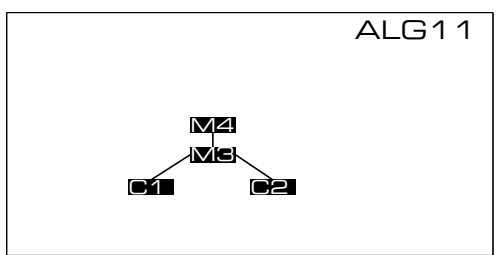
Analog Bass 1 012 **MATRIX**

TUN. OVTO AL10 VOL



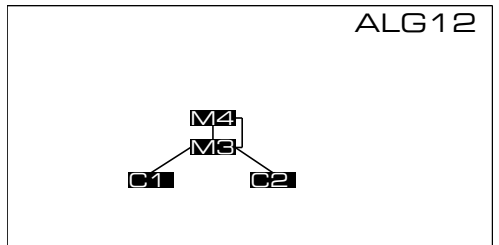
Analog Bass 1 012 **MATRIX**

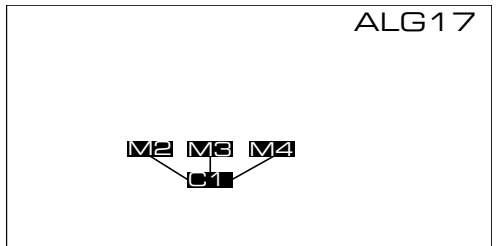
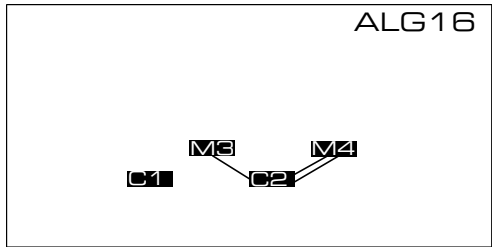
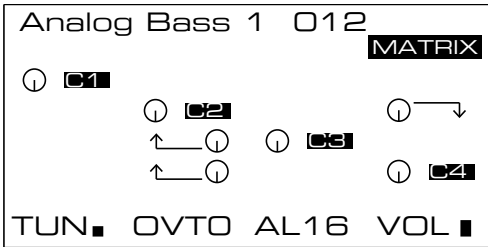
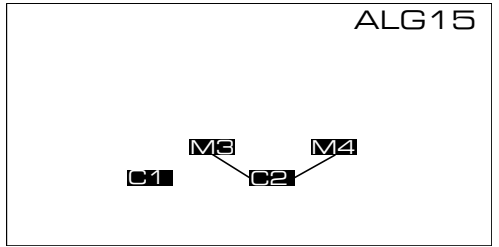
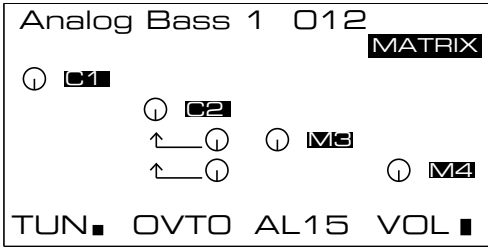
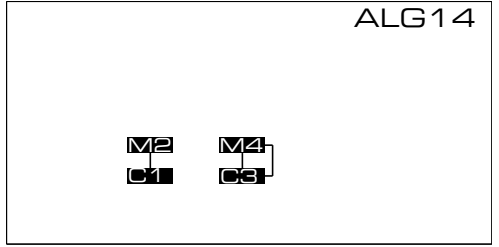
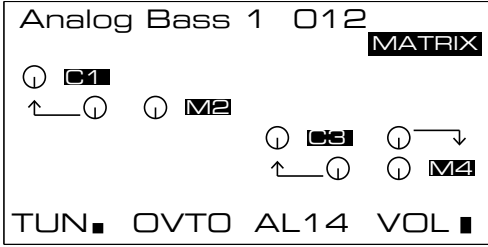
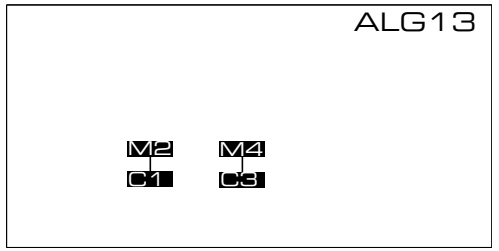
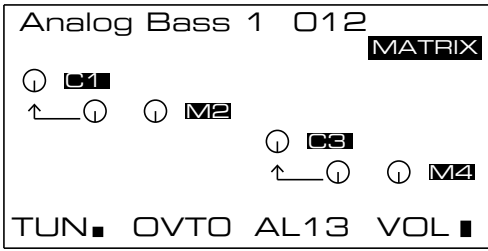
TUN. OVTO AL11 VOL

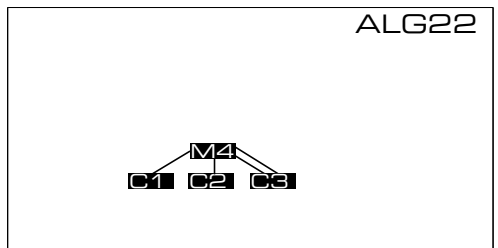
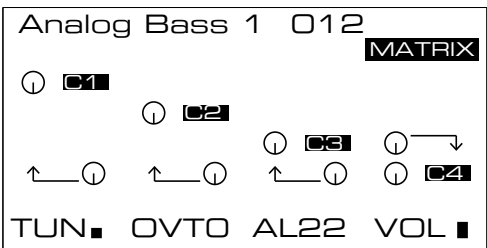
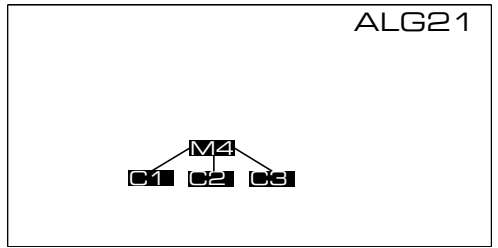
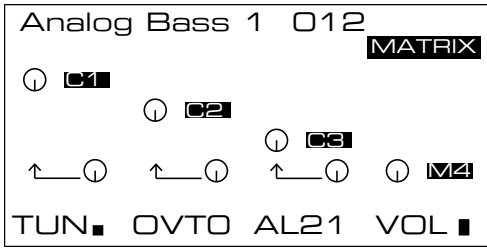
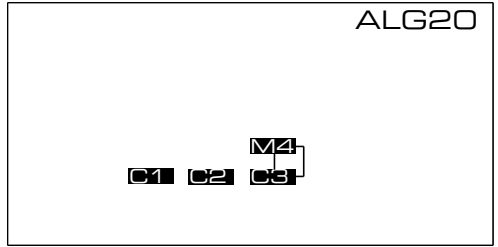
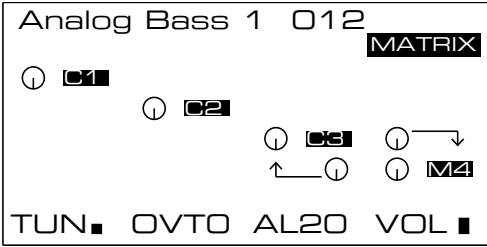
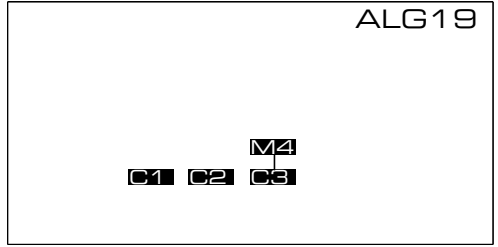
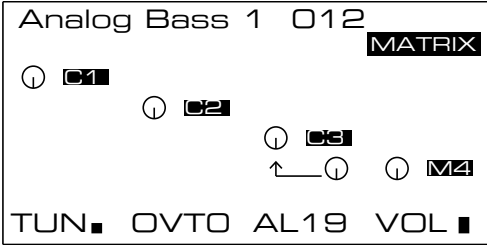
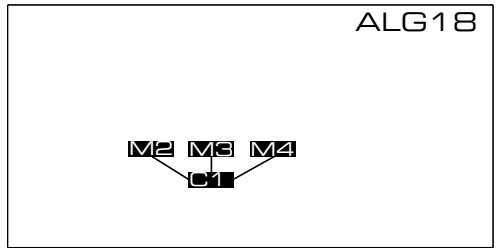
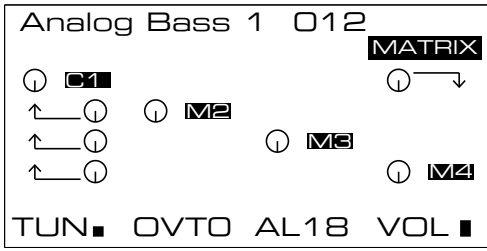


Analog Bass 1 012 **MATRIX**

TUN. OVTO AL12 VOL









Analog Bass 1 012 **MATRIX**

TUN. OVTO AL23 VOL

ALG23

Analog Bass 1 012 **MATRIX**

TUN. OVTO AL24 VOL

ALG24

Analog Bass 1 012 **MATRIX**

TUN. OVTO AL25 VOL

ALG24

Analog Bass 1 012 **MATRIX**

TUN. OVTO AL25 VOL

ALG24

Analog Bass 1 012 **MATRIX**

TUN. OVTO AL26 VOL

ALG26

# MIDI Implementation

## 1. Midi Note Commands

### 1.1. Single Mode

The note number is added to the pitch of the voice. The basic internal tuning is on note C1 (36) and is added from there on to the internal pitch.

Instrument	Note Number	Note	Channel
FM Synth (max. 8 voices polyph.)	36-97	C1-C6	1..16

### 1.2. Multi Mode

In Split Mode 0, ModFM offers a key mapping for all Multi instruments. Each Multi maps four notes on the keyboard. The four notes play the octaves of C1.

Instrument	Note Number	Key note	Play note	Channel
Multi 1	36-39	C1-D#1	C1, C2, C3, C3	1..16
Multi 2	40-43	E1-G1	C1, C2, C3, C3	1..16
Multi 3	44-47	G#1-B1	C1, C2, C3, C3	1..16
Multi 4	48-51	C2-D#2	C1, C2, C3, C3	1..16
Multi 5	52-55	E2-G2	C1, C2, C3, C3	1..16
Multi 6	56-59	G#2-B2	C1, C2, C3, C3	1..16
Multi 7	60-63	C3-D#3	C1, C2, C3, C3	1..16
Multi 8	64-67	E3-G3	C1, C2, C3, C3	1..16
Multi 1	68-71	G#3-B3	C1, C2, C3, C3	1..16
Multi 2	72-75	C4-D#4	C1, C2, C3, C3	1..16
Multi 3	76-79	E4-G4	C1, C2, C3, C3	1..16
Multi 4	80-83	G#4-B4	C1, C2, C3, C3	1..16
Multi 5	84-87	C5-D#5	C1, C2, C3, C3	1..16
Multi 6	88-91	E5-G5	C1, C2, C3, C3	1..16
Multi 7	92-95	G#5-B5	C1, C2, C3, C3	1..16
Multi 8	96-101	C6-D#6	C1, C2, C3, C3	1..16

In Split Mode 1, each Multi voice plays on an own channel.

Instrument	Note Number	Note	Channel
Multi voice 1-8	36-97	C1-C6	1..8 = Multi voice

## 2. Program Change

Function	Value	Channel
Single Preset recall	0-127	1..16
Multi Set recall	0-118	1..16

### 3. Sound Parameter (Continuous Controllers)

<b>FM Synth Engine</b>	<b>Controller No.</b>	<b>Value range</b>
OP Cents	96	0-100
OP1 Tune	100	0-127
OP2 Tune	101	0-127
OP3 Tune	102	0-127
OP4 Tune	103	0-127
FM Amount 1→2	104	0-127
FM Amount 1→3	105	0-127
FM Amount 1→4	106	0-127
FM Amount 2→1	107	0-127
FM Amount 2→3	108	0-127
FM Amount 2→4	109	0-127
FM Amount 3→1	110	0-127
FM Amount 3→2	111	0-127
FM Amount 3→4	112	0-127
FM Amount 4→1	113	0-127
FM Amount 4→2	114	0-127
FM Amount 4→3	115	0-127
OP1 Env Attack	14	0-127
OP2 Env Attack	15	0-127
OP3 Env Attack	16	0-127
OP4 Env Attack	17	0-127
OP1 Env Decay	18	0-127
OP2 Env Decay	19	0-127
OP3 Env Decay	20	0-127
OP4 Env Decay	21	0-127
OP1 Env Sustain	34	0-127
OP2 Env Sustain	35	0-127
OP3 Env Sustain	36	0-127
OP4 Env Sustain	37	0-127
OP1 Env Release	38	0-127
OP2 Env Release	39	0-127
OP3 Env Release	40	0-127
OP4 Env Release	41	0-127
OP1 EG→VCA Amount	22	0-127
OP2 EG→VCA Amount	23	0-127
OP3 EG→VCA Amount	24	0-127
OP4 EG→VCA Amount	25	0-127
OP1 EG→FM Amount	26	0-127
OP2 EG→FM Amount	27	0-127
OP3 EG→FM Amount	28	0-127
OP4 EG→FM Amount	29	0-127
OP1 LFO1→FM Amount	70	0-127
OP2 LFO1→FM Amount	71	0-127
OP3 LFO1→FM Amount	72	0-127
OP4 LFO1→FM Amount	73	0-127
OP1 LFO2→AM Amount	74	0-127
OP2 LFO2→AM Amount	75	0-127
OP3 LFO2→AM Amount	76	0-127
OP4 LFO2→AM Amount	77	0-127
LFO1→MIX Volume	78	0-127
LFO2→MIX Volume	79	0-127
LFO1 Rate	80	0-127
LFO2 Rate	81	0-127
LFO1 Waveform	82	0-63
LFO2 Waveform	83	0-63
LFO1 VCO Oct	84	0-6
LFO2 VCO Oct	85	0-6
LFO1 VCO Mode	86	0:LFO, 1:VCO
LFO1 VCO Mode	87	0:LFO, 1:VCO

MULTI Target	33	0-7
ALGORITHM select	42	0-26
OVERTONE Mode	67	0-5
STORE Preset	62	64
Volume	7	0-127

Filter Engine	Controller No.	Value range
FIL Cutoff	43	0-127
FIL Resonance	44	0-127
FIL Shape LP/BP/HP	45	0-127
FIL Env Amt	46	0-127
FIL Env Attack	47	0-127
FIL Env Decay	48	0-127
FIL Env Sustain	49	0-127
FIL Env Release	50	0-127
FIL LFO Rate	69	0-127
FIL LFO Waveform	52	0-127
FIL LFO Intensity	53	0-127
FIL TP24 Mix Vol	66	0-127
FIL MM12 Mix Vol	57	0-127
FIL Key Track	55	0-127
FIL Noise Mix Vol	56	0-127
FIL Noise Metal	58	0-127 0:Off, 1:White

#### 4. Global Controllers on Channel 16

FX Reverb	Controller No.	Value range
Room Size	100	0-127
Low Pass Reflections	101	0-127
Hi Pass Reflections	102	0-127
Reverb Level	103	0-127

FX Delay	Controller No.	Value range
Delay1 Time	14	0-127
Delay1 Feedback	15	0-127
Delay1 Slow/Medi/Fast	17	0-2
Delay1 Level	18	0-127
Delay2 Time	19	0-127
Delay2 Feedback	20	0-127
Delay2 Slow/Medi/Fast	21	0-2
Delay2 Level	22	0-127

## 5. Sysex Commands

### Single Preset bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$3F(Command Sys Ex dump), \$68(Product code), \$01(Single Preset),\$55, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

### All Preset bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$3F(Command Sys Ex dump), \$68(Product code), \$02(All Presets),\$55, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

### Single Multi bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$3F(Command Sys Ex dump), \$68(Product code), \$03(Single Multi),\$55, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

### All Multi bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$3F(Command Sys Ex dump), \$68(Product code), \$04(All Multis),\$55, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

### OS bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$7F(Command Sys Ex dump), \$68(Product code), \$10(CodeUpdate),\$55, \$00(14 Bit Block ID HB), \$00(14 Bit Block ID LB), \$77, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

### OS Filter Engine bulk dump

\$F0(SysEx begin), \$31(JoMoX-manufact. code), \$7F(Command Sys Ex dump), \$68(Product code), \$11(SlaveUpdate),\$55, \$00(14 Bit Block ID HB), \$00(14 Bit Block ID LB), \$77, XX(Data0),XX(Data1),..., \$F7(End of SysEx)

## Technical Specification

- 8 voices fully multi timbral FM synth
- 4 operators per voice
- Full modulation matrix / 26 algorithms
- 2 LFO/VCOs per voice
- CV/Gate per voice
- CV modulation inputs per operator
- Outputs for each voice plus mix out
- True audio FM modulation inputs
- True analog filters per voice
- 24db low pass
- 12dB multimode LP/BP/HP cont. shape
- True analog VCAs per voice
- Midi TRS type A
- USB C device
- Digital reverb, 2x stereo delay
- Full storeability, also CV amounts
- 128 presets, 118 multi sets
- 2x 128x64px OLED displays

### Power Consumption:

+12V: 370mA max.

-12V: 170mA max.

Total power: 6,5W

### Dimension:

Size: 56 HP = 284mm

Height: 3 RU = 129mm

Depth: 40mm

### Service, updates, tips and tricks

are available at:

JoMoX GmbH  
Sophie-Charlotte-Str. 15  
Hauptgebäude EG  
D-14059 Berlin  
Germany

Email: [support@jomox.de](mailto:support@jomox.de)

Web: [www.jomox.de](http://www.jomox.de)

# Imprint

## Terms of Warranty

Please find all service- and warranty-informationen on our website:

[www.jomox.de](http://www.jomox.de)

## CE Norm & FCC Information

Important notice: do not modify this unit! This product, when installed as indicated in the instructions contained in this manual, is compatible with the Ce norm & FCC requirements 2. Important! When connecting this product to accessories and/or another product, use only high quality .shielded cables. Cables supplied with this product must be used. Follow all installation instructions. Failure to follow instructions could void your FCC authorisation to use this product in the usa.

Note: this product has been tested and found to comply with the requirements listed in FCC regulations, Part 15 for Class B digital devices & in The european standard en 50081-1 on electromagnetic Compatibility - Generic emission standard on residential, commercial and light industry. Compliance with these requirements provides a reasonable level of assurance that the use of this product in a residential environment will not result in harmful interference with other electronic devices.

## Disposal

This device complies to the eu guidelines and is manufactured roHs conform without the use of led, mercury, cadmium and chrome. still, this device is special waste and disposal in household waste is not permitted. For disposal, please contact your dealer or:

## Copyright

Copying, distribution or any commercial use in any way is prohibited and needs the written permission by the manufacturer.

Specifications subject to change without notice.

Although the content of this owners manual has been thoroughly checked for errors, JoMoX GmbH cannot guarantee that it is error-free throughout. JoMoX GmbH cannot be held liable for any misleading or incorrect information within this guide.

All rights reserved ©2023 JoMoX GmbH



**JoMoX Elektronische Musikinstrumente GmbH**

**Sophie-Charlotte-Str. 15**

**14059 Berlin**

Jomox

**Mod FM**

8 Voice 4 OP FM Synth