MOTAS ELECTRONICS

MOTAS-6
SYNTHESIZER

User Guide

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for firmware version 06020106

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Contents

1 Foreword

Thank you for taking the time to read this user guide.

The MOTAS-6 synthesizer is the result of many years of development to create a great-sounding instrument with very comprehensive modulation capabilities and an easy to use and responsive interface.

To get the most out of this powerful synthesizer we recommend studying this guide carefully whilst practising and listening at the same time. You cannot beat hands-on experience!

We hope you will find using MOTAS-6 an enjoyable experience and discover some great new sounds.

For the latest news and updates please visit our website motas-synth.uk.
For technical support, general enquiries or user feedback (gratefully received) please email support@motas-synth.uk

2 Proper use and maintenance

Please read the following instructions carefully and keep them with the apparatus. Do not operate the apparatus until you have read and understood this section.

Proper use

- Only use a correctly specified power supply otherwise damage may occur to the apparatus and/or other connected equipment.
- Place the apparatus on a stable surface.
- Never use the apparatus under damp conditions. Do not expose the apparatus to rain. Use the apparatus in enclosed rooms only.
- Unplug the apparatus during lightning storms or when unused for long periods of time.
- Never operate the apparatus or power supply with wet hands.
- Never place objects containing liquids on or near the apparatus.
- Do not use the apparatus in extremely dusty or dirty environments.
- The rear left of the chassis gets warm in normal use – make sure that adequate ventilation is available. Do not place the apparatus near heat sources such as radiators.
- Make sure no foreign objects find their way into the chassis. If for some reason this should occur, switch the power off, unplug the device and consult qualified service personnel.
- Do not expose the apparatus to direct sunlight as this could damage the display and fade the finish.
- Do not expose the apparatus to extreme vibrations.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged (or potentially has been damaged) in any way such as power connections damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, apparatus does not operate normally or has been dropped.
- This apparatus, used on its own or with amplifiers, speakers or headphones, can generate volume levels that may do irreparable damage to your hearing.

Do not allow the apparatus to get damp or wet, if this happens turn off the unit immediately and seek advice of qualified service personnel.

Do not open the apparatus, there are no user-serviceable parts inside.

Only use a correctly specified power supply otherwise damage may occur to the apparatus and/or other connected equipment. The power supply must be regulated 12 VDC (± 10 %, centre positive) and have a current rating of at least 800 mA.

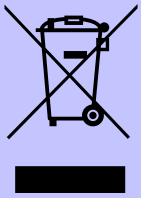
This apparatus is designed exclusively to produce low- frequency audio signals for the purpose of generating sound. Any other use is prohibited. Motas Electronics Limited is not liable for damages due to incorrect use.

Maintenance

- Do not open the apparatus or remove the cover. Refer all service and repair tasks to qualified personnel. The interior of the chassis contains no components that require user maintenance.
- The top and rear panels (if not the painted finish) have been treated with a special surface coat-

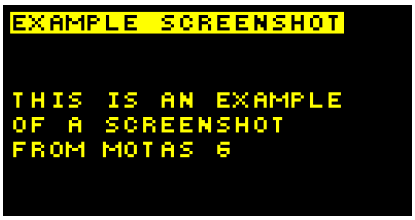
ing to reduce the appearance of finger marks. Use only a dry, soft cloth (e.g. a micro-fibre cloth) or brush to clean the device. Never use alcohol, cleaning solutions or similar chemicals as they will probably damage the surface finish of the chassis and/or the markings.

The symbol below indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste for recycling, please contact your Local Authority, or where you purchased your product.



3 Document conventions

You will find many screenshots taken from MOTAS-6 throughout this guide. An example is show below:



The following document formatting conventions are used:

- Link (blue text) is a weblink or a link to another part of this document.
- ❶ (number) refers to an item on the top panel of the unit.
- Ⓐ (letter) refers to an item on the rear panel of the unit.
- THIS or THIS shows text you may see on the display.
- ♩ shows a symbol you may see on the display.
- TEXT or refers to a push button on the top panel labelled with that text or symbol.
- TEXT or refers to a rotary knob on the top panel labelled with that text or symbol.
- rotary encoder refers to the rotary data-entry wheel on the front panel.

Tip section highlighted with a 'light-bulb' icon.

Information section highlighted with an 'i' icon.

Advanced information section highlighted with a 'gears' icon. It is not necessary to understand these sections to successfully use MOTAS-6.

Warning section highlighted with a 'warning' icon. It is important to ensure that you read and understand these sections.

4 Introduction

MOTAS-6 is a super-flexible monophonic synthesizer with classic analogue subtractive synthesis and powerful digital control - giving huge modulation possibilities.

- Fully analogue audio signal path
- Three analogue oscillators (VCOs) with freely mixable waveforms:
  - triangle (oscillators 1, 2 and 3)
  - sawtooth (oscillators 1, 2 and 3)
  - variable width pulse (oscillators 1 and 3)
  - square and sub-oscillator (oscillator 2)
- Oscillator hard-syncing (multiple options)
- Analogue phase modulation (oscillators 2 and 3)
- Analogue noise souce (white or pink)
- Internal audio feedback or external audio input
- 4 CV/gate inputs for analogue control
- Three independent analogue filters (VCFs) with flexible routing:
  - Low-pass resonant filter (6-pole with selectable outputs and resonance character adjustment)
  - Second low-pass resonant filter (4-pole)
  - High-pass filter (2-pole)
- Multiple output distortion options
- Powerful modulation architecture:
  - 4 global LFOs (Low Frequency Oscillators)
  - 4 global EGs (Envelope Generators)
  - 33 parameter-local LFOs
  - 33 parameter-local EGs
  - Four freely configurable modulation sources from MIDI and CV/gate inputs
- Quick-access buttons to 5 active patches
- Copy/reset/randomise feature
- Full MIDI control and USB MIDI interface
- Oscilloscope and spectrum analyser
- Flexible arpeggiator
- Built-in pattern sequencer
- Non-volatile internal memory for saving 500 patches, 56 patterns, 16 sequences and user settings
- High-resolution OLED graphic display
- Compact high-quality tabletop case

Analogue oscillators

MOTAS-6 has three analogue voltage-controlled oscillators (VCOs) with various hard-sync, pulse-width and phase-modulation options. These are true analogue oscillators and *not* DCOs. The oscillators, analogue noise source (with white/pink output option) and an internal feedback routing or external audio input all feed into a mixer before the filters.

Analogue filters

MOTAS-6 has very powerful filtering capabilities. There is a 6-pole voltage-controlled low-pass filter (VCF) with adjustable resonance to self-oscillation (with selectable 1, 2, 3, 4, 5 and 6-pole outputs), a 2-pole high-pass filter and a second 4-pole low-pass filter with adjustable resonance to self-oscillation (similar in design to the filter from a certain silver box from the 1980s. . .)

The filters can be chained in parallel or in series and the outputs are separately mixable giving huge sound-creation potential. The final audio output has a variety of clipping distortion options.

Modulation

Each analogue-controlled parameter has its own dedicated LFO and EG. In addition each parameter has dedicated modulation amount settings from velocity, pitch, the global modulation sources and the global LFOs and EGs. Secondary 'modulation of the modulators' is also possible, for example, a global modulation source can control the LFO frequency. This allows very flexible and powerful control of the analogue sound.

Up to four global modulation sources can be freely

defined from incoming MIDI controller data and/or analogue signals on the CV/gate inputs.

The internal architecture uses high-resolution digital signals for the modulation allowing a total of 37 simultaneous LFOs and EGs.

User interface

Dedicated analogue rotary potentiometers are used to access the basic analogue parameter pages and to allow fast 'tweaking' in real-time. In addition MOTAS-6 uses a rotary rotary encoder in combination with tactile push buttons for data entry and editing.

Display

MOTAS-6 has an OLED (organic light emitting diode) display with a fast update rate and wide viewing angle. The display intensity can be adjusted.

External connections

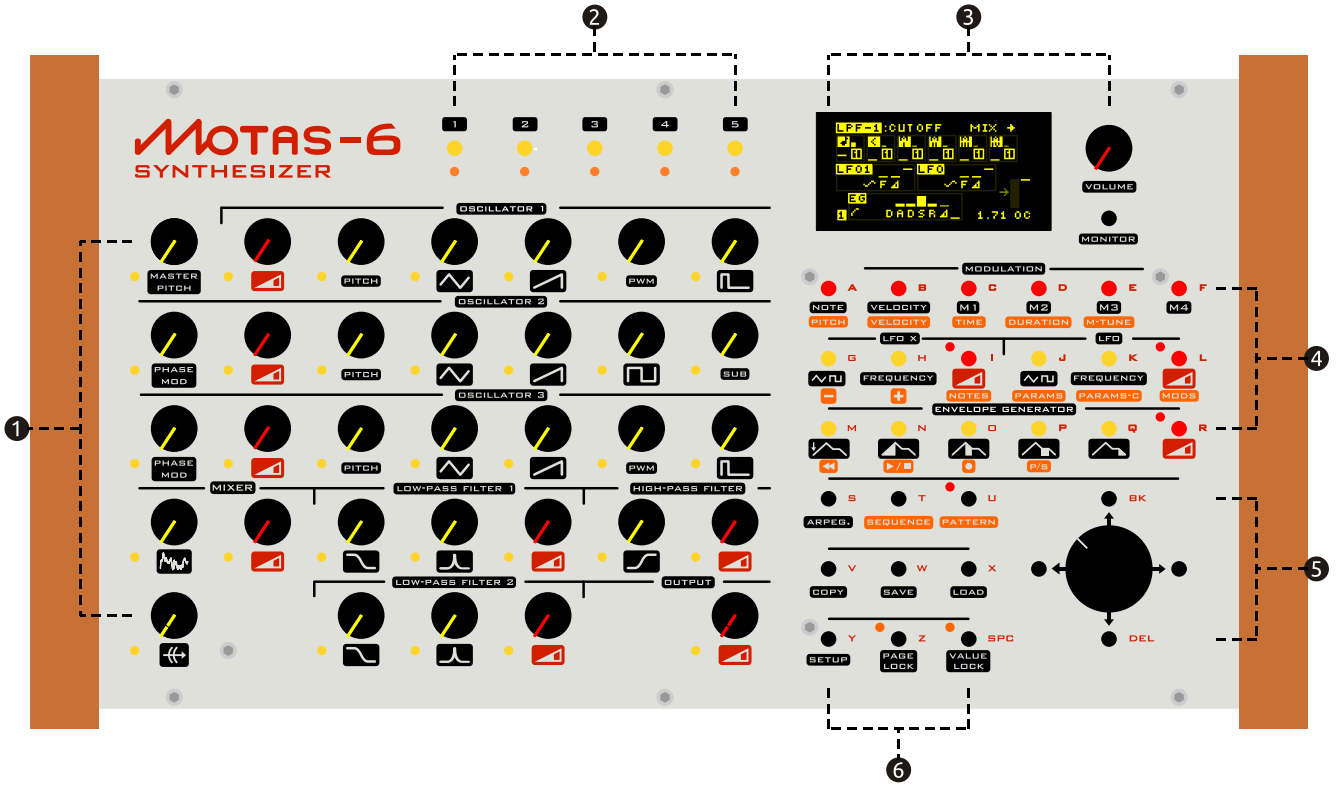
MOTAS-6 has traditional MIDI input and MIDI output connectors in addition to USB MIDI. USB MIDI allows faster data transfer to and from a PC and MOTAS-6 is recognised as a standard MIDI device (no special drivers should be needed). There are four analogue CV/gate inputs to allow playing/modulation from e.g. analogue sequencers and modular synthesizers.

The main audio output is monophonic and in addition there is a mono headphone output (on a stereo connector).

Other features

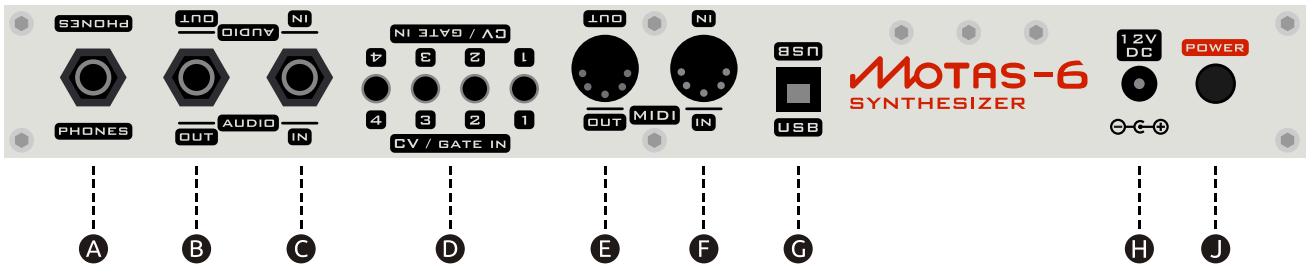
MOTAS-6 has a flexible arpeggiator that can sync to MIDI clock and a pattern sequencer. More than 500 sound patches can be saved to its internal non-volatile memory. There is a useful oscilloscope and spectrum analyser feature that allow the user to study the output signals on the display.

5 Top panel



1. sound editing 'parameter' knobs with LEDs [x 33]
2. quick-access patch-change buttons with LEDs [x 5]
3. OLED display, main volume knob and monitor button
4. modulation settings / sequence control buttons [x 18]
5. rotary encoder and buttons [x 4] for data entry/options
6. buttons to access other features [x 9]

6 Rear panel



The lettering at the top of the rear panel is printed upside down so that the user can read the lettering when peering over from the top of the unit.

- **A** headphones out (2 channel mono)
  [Stereo 6.35mm phone socket]
- **B** main audio out (mono)
  [Mono 6.35mm phone socket]
- **C** external audio input (leave unconnected for internal feedback)
  [Mono 6.35mm phone socket]
- **D** CV/gate inputs [3.5mm sockets x 4]
- **E** MIDI out [5-pin DIN socket]
- **F** MIDI in [5-pin DIN socket]
- **G** USB MIDI socket for connection to PC
  [USB type-B]
- **H** power supply in
  [2.1mm. 12V DC, centre positive]
- **J** power on/off push switch
  [button in = power on]

7 Quick-start

1. Firstly ensure that the power button (J) is off and the main volume control (3) is set to minimum.

2. Plug a MIDI cable from your MIDI keyboard to the MIDI IN connector (F). Turn on your MIDI keyboard and set it up to send MIDI notes as you play.

   Alternatively connect MOTAS-6 to your PC with a USB cable – it should appear as a standard MIDI device (once powered on). Use your sequencer or other software to send note data.

   Ensure the MOTAS-6 receive MIDI channel matches the send channel number – for more info see 18.3.

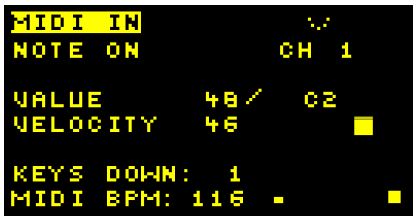
3. Plug a mono audio patch cable from the main audio out (B) to your external amplification system. Set the gain level low initially, to avoid any audio pops when MOTAS-6 is switched on. Alternatively monitor on headphones (A).

4. Plug in the 12V DC power supply into connection (H).

5. Turn on MOTAS-6 using the power button (J). The display will show the start-up image.

6. Press MONITOR (in the 3 group) and then the right arrow button →. The display will change and show MIDI diagnosics monitoring information for the incoming MIDI data if everything is working correctly. If you don't see this check your connections and external settings. For more information on the MIDI monitoring see chapter 14.

7. Press LOAD (button in the 6 group). and then use the rotary encoder to scroll through



the available presets sounds (in bank 0). As each preset is selected the settings are loaded in and you should be able to hear audio as you play. For more information on loading sounds see chapter 13. Adjust the volume level control (3) to a suitable listening level.

8 Control Overview

To access the settings (also known as parameters) that determine the sound you turn a rotary knob ❶ corresponding to the setting that you want to change. Each rotary knob ❶ is associated with it's own 'parameter page'. Normally the display will then change to show the settings for the parameter page associated with that knob.

Turning a rotary knob ❶ normally has the side-effect of also changing the offset value for that parameter page. Use the 'value lock' feature to allow changing of the active parameter page without changing the offset. Press the VALUE LOCK button to toggle 'value-lock' on and off. When 'locked' the LED will flash next to the VALUE LOCK button.

Conversely use the 'page-lock' mode to allow rapid hands-on changes of parameter basic offsets such as sweeping filter cut-off, changing oscillator mix levels etc. without changing the active parameter page. Press the PAGE LOCK button to toggle 'page-lock' on and off. When 'locked' the LED will flash next to the PAGE LOCK button.

For faster data entry when using the rotary encoder, push the rotary encoder wheel down at the same time as turning.

MIDI panic

In the case of any 'stuck' notes e.g. if a MIDI keyboard is unplugged whilst a note is 'on', press and hold the rotary encoder wheel down and then also press ⬇ to turn all notes off.

Master volume

Turn the VOLUME to set the output volume level.

Patch parameter editing

The sound generated by MOTAS-6 is controlled by the settings on 33 parameter 'pages' – each parameter has its own 'page' shown on the display. These are explained in detail in chapter 11. To access a particular parameter page turn the appropriate rotary knob ❶. The active parameter page is shown by the adjacent flashing LED.

Patch changing

MOTAS-6 has 5 patches (sound setups) in memory ready for easy access. To change presets press one of the preset ❷ buttons 1, 2, 3, 4 or 5. The corresponding preset ❷ LED will be lit to show the active patch. See chapter 12 for more details.

Load/save/copy

To load or save patches, patterns or sequences press LOAD or SAVE. To copy patch sounds around or reset parameter page settings press COPY. See chapter 13 for more details.

Monitor

To view signal level, the incoming MIDI signals and output signals and access the oscilloscope and spectrum analyser features use the 'monitor' feature MONITOR. See chapter 14 for more details.

Arpeggiator

MOTAS-6 has a powerful arpeggiator feature – press ARPEG.. See chapter 15 for more details.

Pattern sequence

MOTAS-6 has a pattern sequencer. Press PATTERN to access the patterns and SEQUENCE to access the sequencer. See chapter 16 for more details.

Vector morphing

MOTAS-6 has a vector morphing feature to allow smooth transition from the sound parameters of one patch to another using an external controller. To access the vector morphing feature press ➡ whilst a preset page is displayed. See chapter 17 for more details.

Setup

To access various global settings and parameters (such as MIDI receive channel, calibration and modulation sources) press  SETUP . See chapter 18 for more details.

Live sound changes

MOTAS-6 can send and receive MIDI NRPN messages to allow external recording and control of patch settings. See chapter 19 for more details.

9 Parameter pages

The sound generated by MOTAS-6 is controlled by the settings on 33 parameter 'pages' – each parameter has its own 'page' shown on the display. These are listed below and explained in detail in chapter 11. To access a particular parameter page turn the appropriate rotary knob ① 1. The active parameter page is shown by the adjacent flashing LED indicator.

Use the 'value lock' feature to allow changing of the active parameter page without changing the sound parameters. Press the VALUE LOCK button to toggle 'value-lock' on and off. When 'locked' the LED will flash next to the VALUE LOCK button.

The listing below is a summary of each parameter page starting from the top left of the front panel moving from left-to-right and then down in rows.

Parameter page summary

- **Master pitch page:**
  - MASTER PITCH — pitch control of all 3 oscillators
- **Oscillator 1 pages:**
  - overall volume level
  - PITCH — pitch control and hard sync. options
  - triangle waveform volume level
  - sawtooth waveform volume level
  - PWM — pulse-width control
  - pulse waveform volume level
- **Oscillator 2 pages:**
  - PHASE MOD — phase modulation control
  - overall volume level
  - PITCH — pitch control and hard sync. options
  - triangle waveform volume level
  - sawtooth waveform volume level
  - square waveform volume level
  - SUB — sub-oscillator waveform volume level
- **Oscillator 3 pages:**
  - PHASE MOD — phase modulation control
  - overall volume level
  - PITCH — pitch control
  - triangle waveform volume level
  - sawtooth waveform volume level
  - PWM — pulse-width control
  - pulse waveform volume level
- **Mixer pages:**
  - noise source volume level and white/pink option
  - overall volume level from mixer and boost option
  - feedback/external audio input volume level

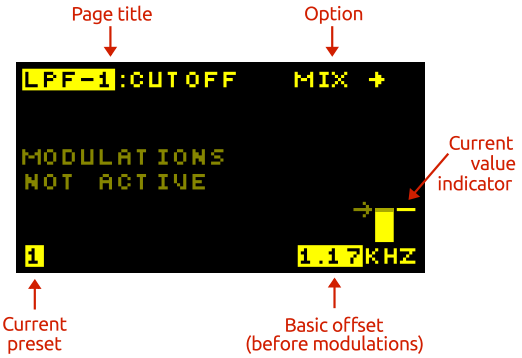
- **Low-pass filter 1 pages:**
  - cut-off frequency and input routing options
  - resonance amount and character option
  - output volume level and routing options
- **High-pass filter pages:**
  - cut-off frequency and input routing options
  - output volume level and routing options
- **Low-pass filter 2 pages:**
  - cut-off frequency and input routing options
  - resonance amount
  - output volume level and routing options
- **Output stage page:**
  - output volume level and clipping options

Use the 'page-lock' mode to allow rapid hands-on changes of parameter basic offsets such as sweeping filter cut-off, changing oscillator mix levels etc. without changing the active parameter page. Press the PAGE LOCK button to toggle 'page-lock' on and off. When 'locked' the LED will flash next to the PAGE LOCK button.

9.1 Parameter page display overview

Although controlling the sound in MOTAS-6 may appear to be rather daunting at first given the number of parameter pages and the large number options on each page, once you have mastered operation of one of the parameter pages you will understand most of all the others as the basic operation is common to all pages.

So let's start by explaining operation of one of the parameter pages. Start by reseting the current patch by pressing COPY and selecting 'reset patch'. Then turn the low-pass filter 1 cut-off control to access that parameter page. You should now see something similar on the display to that shown in the figure below.



Page title

Each page has a 'destination' i.e. what aspect of the synthesizer it controls, and this is labelled at the top left of the display. In this case it is LPF-1:CUTOFF - the cut-off frequency of low-pass filter 1.

Basic offset

Each parameter page has a basic offset level that can be adjusted using the rotary knobs ❶ or rotary encoder and up and down buttons ❺. All of the modulation sources (see chapter 10) add (or subtract) from this offset to generate the final level. The rotary encoder, and adjust the basic offset for the active page only when the basic offset is the active editable item (shown as flashing), otherwise they will control other parameters. However, the rotary knobs ❶ always control the basic offset for their parameter page (except when 'value-lock' is enabled).

Use the rotary knobs ❶ for smooth fine control of the parameter page offset. Use the ↑ and ↓ buttons to jump set amounts in offset.

Push the rotary encoder and turn at the same time to change values in larger steps for rapid sound adjustments.

Page options

Some parameter pages have additional options. For pages with a single option ← and → cycle back and forth through the single option settings. For pages with two options the ← button cycles through option 1 whilst the → button cycles through option 2.

In the example shown the single option is for the source of the audio input to the filter, in this case set to the main mix. You can only change the page option when the active editing item is the basic offet (shown by flashing value at the bottom right-hand of the display) otherwise ← → control other parameters (more on this later!).

Current values

At the far right of the screen a horizontal bar shows the current level of the destination signal in real time. The current value is the sum of the basic offset for the page with all the modulation signals (see chapter 10 for explanation of the modulation options).

If the controlling signal rises above the maximum of the destination then an 'up' arrow + is shown instead of the bar, and if the controlling signal falls below the minimum a 'down' arrow + is shown instead of the bar.

The horizontal arrow next to the solid vertical bar shows the current position of the rotary knob ❶.

When the parameter page displays MODULATIONS NOT ACTIVE the current value will follow the basic offset, since all the modulations amounts are set to zero.

The current value bar tries to follow the parameter page value in real-time. However, if the modulation is very fast this display will not be able to 'keep-up' and so you will only see a snapshot of the value at that point in time.

Current preset

MOTAS-6 has 5 preset patches. The current active patch is shown as a number in the bottom left corner (patch 1 in this case). In addition a corresponding preset ❷ LED will be lit. To change presets press one of the preset ❷ buttons.

10 Modulation

Modulation means changing parameter values from a modulation source. This could be a freely-changing modulation with time, such as from a low-frequency oscillator (LFO) that is not synchronised or modulation that is synchronised to the start of a key press, such as from an envelope generator (EG) triggered by a note-on event.

Conventional analogue synthesizers typically have a small number of LFOs (from 1 to 3 or so) and EGs (usually 1 or 2) that are used for modulation. In some cases the modulation sources have fixed destinations (such as a dedicated EG for output level) or can be set to only a limited number of destinations (such as filter cut-off frequency or pitch).

MOTAS-6 is different – *every* parameter has its own dedicated LFO and dedicated EG in addition to dedicated modulation amount settings from velocity, pitch, 4 global LFOs, 4 global EGs and 4 external modulation sources (MIDI or CV input)! This powerful architecture allows complete freedom to modulate and control almost every aspect of the sound generation. You can freely set the modulation for every parameter separately if desired or have coupled modulation between parameters using the global modulation sources, if you wish.

Each parameter page allows you to set the levels and routings of the various parameters that determine the sound, but things get a lot more interesting once some modulation is used. Modulation allows creation of interesting sounds that change in character over time.

Perhaps the most common 'modulation' used in synthesizing sounds (and often not really considered as modulation) is simply applying an envelope modulation to the output signal level. With this 'modulation' the volume increases once a key is pressed and decays away once the key is released. Without this modulation a constant sound volume would be heard whether or not a key was pressed.

Each and every parameter page has dedicated modulation control amounts from 9 sources:

♩	MIDI/CV note-on value
<	MIDI note velocity
M1	MIDI/CV global modulation M1
M2	MIDI/CV global modulation M2
M3	MIDI/CV global modulation M3
M4	MIDI/CV global modulation M4
LFOx	choice of global LFO x = 1–4
LFO	dedicated LFO for each parameter page
EGx	choice of global EG x = 1 – 4, or dedicated EG

The modulation amount can be zero (for no modulation), positive or negative. The actual modulation signal applied to the parameter page value is the product (i.e. multiplication) of the modulation amount and the modulation source signal at that point in time. All of the modulation signals are added together with the parameter page basic offset value to give the resulting value for the parameter page value.

The modulation signals are 'bipolar' – this means that when the source is at its middle value the modulation effect will be zero. For a positive modulation amount when the source is at its positive peak the modulation will increase the parameter page value and when the source is at its negative peak the modulation will decrease the parameter page value.

The modulation amount displayed shows the modulation peak-to-peak maximum change. For example, if the modulation amount for LFO on the oscillator 1 pitch parameter page is set to 12.00 s then the modulation of the pitch will vary over 12 semitones (1 octave) as the LFO waveform cycles from it's minimum to maximum values.

10.1 MIDI / CV Modulations

There are 6 possible MIDI / CV modulation sources: MIDI note-on value (or CV pitch), MIDI velocity (or CV velocity) and 4 globally assigned MIDI or CV modulation sources.

The interface for all these modulations is the same. Each source has it's own icon on the display running along the second row.

Each modulation source has two amount settings. The first (primary) sets the amount of the modulation signal to add or subtract to the parameter page basic offset e.g if set on the parameter page LPF-1 :CUTOFF it would directly increase or decrease the cut-off frequency of low-pass filter 1 as the modulation signal increases or decreases.

It is also possible to modulate the modulations! This is where the secondary destination and secondary amount is used.

From a patch parameter page press the modulation button desired once (i.e. KEY, VELOCITY, M1, M2, M3 or M4). The modulation icon flashes to show it is in primary edit mode (i.e. one of , , , , or flashes). Now turn the rotary encoder 5 or push the up or down buttons - the amount of this modulation source applied to the parameter page (the primary destination) is shown as a small vertical bar on the left-hand side above the modulation icon. Set positive values to increase the parameter page basic offset with increasing modulation signal or set negative values to decrease the parameter page basic offset with increasing modulation signal.

Positive modulation amounts are shown by a solid bar whilst negative amounts are shown with a hollow bar.

Now press the modulation button a second time (i.e. press the KEY, VELOCITY, M1, M2, M3 or M4 again). The modulation icon flashes together with the secondary destination icon. Now turn the rotary encoder 5 or push the up or down buttons - this sets the amount this modulation source has on the secondary destination. The amount is shown as a small vertical bar on the right-hand side above the modulation icon. Set positive values to increase the destination level with increasing modulation signal or set negative values to decrease the destination level with increasing modulation signal.

Now press the modulation button a third time (i.e. press the KEY, VELOCITY, M1, M2, M3 or M4 again). Only the secondary destination icon flashes. Now the rotary encoder controls the secondary destination from one of the following nine options:

- selected global LFO 1–4 amount
  LFOX AMOUNT
- dedicated LFO frequency
  LFO FREQ
- dedicated LFO amount
  LFO AMOUNT
- dedicated EG rate
  EG RATE
- dedicated EG attack
  EG ATTACK
- dedicated EG decay
  EG DECAY
- dedicated EG sustain
  EG SUSTAIN
- dedicated EG release
  EG RELEASE
- dedicated EG amount
  EG AMOUNT

Pressing the modulation button a fourth time returns editing to the parameter page basic offset.

Details of each modulation source is given in the subsections below.

On the **MASTER PITCH** parameter page set a secondary destination of LFO amount (and set an appropriate secondary level amount) for a global modulation source which is assigned to the MIDI modulation wheel. Now the MIDI modulation wheel will control the depth of vibrato effect of the LFO.

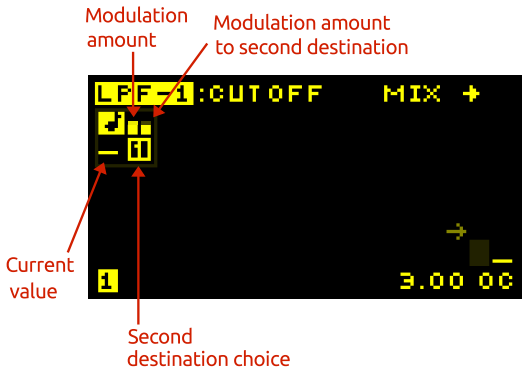
On the **OUTPUT** parameter page set a secondary destination of EG rate (and an appropriate secondary level amount) for the MIDI note modulation source. Set the output page to use the unique EG. Now higher pitch notes will have an EG envelope which processes faster such as is common for real-world stringed instruments.

Note pitch modulation

On row 2 of the display, starting at the left-hand side is shown the note modulation setting, indicated by the ♩ symbol. This controls how much the MIDI note-on signals or CV pitch voltage affect the page's destination (which in the example shown below is the LPF-1 cut-off frequency) or how note-on signals affect other modulations for this page (if the secondary destination is used).

The higher the incoming MIDI note-on pitch or CV pitch voltage the higher the modulation signal.

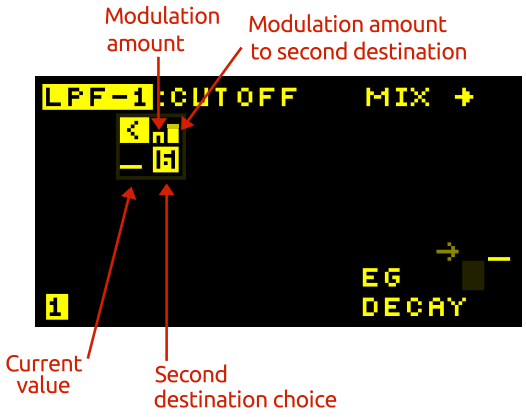
The note pitch modulation signal is derived from the 'latest' (i.e. most recent) note currently being played, including the effects of portamento, but excluding pitch-bend signals.



Velocity modulation

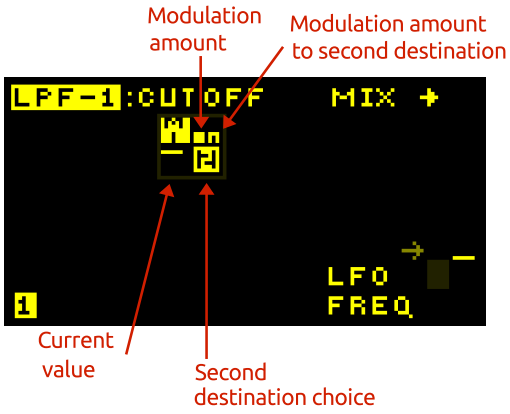
To the right of the note modulation setting is shown the velocity modulation setting indicated by the < symbol. This section controls how MIDI note velocity signals affect the page's destination and levels or setttings of other modulators for this page, in exactly the same way as for the note-on modulation.

The note-on MIDI velocity is the source of this modulation signal. The harder the key is struck (on a touch sensitive MIDI keyboard) the higher this signal.



Modulation sources M1, M2, M3 and M4

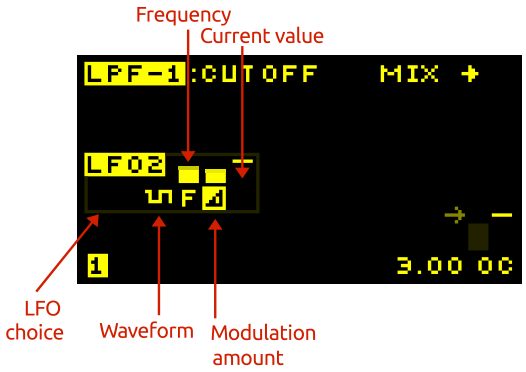
Each of these separate modulation sources can be assigned to any MIDI controller code e.g. modulation wheel, breath control, volume. . . or even pitch bend. Alternatively the modulation signals can come from the analogue CV/gate signal inputs. The source is stored with the patch but can be overridden by a global modulation source setting. See section 18.4 for how to setup these global modulation sources.



10.2 Global low-frequency oscillators (LFOx)

The LFOx modulation source for each parameter page is one from a choice of four LFOs which are globally available to the current patch. This allows exactly the same LFO modulation frequency and waveform to be applied to several parameter page destinations. This is in contrast to the unique LFO for each parameter page. Although the LFO waveform and frequency is global the level of modulation *is* unique to each page.

On the fourth row down on the display, on the left hand side the settings for LFOx are shown.



The global LFOs are useful when the same LFO modulation signal is desired applied to more than one destination, e.g. a tremolo modulation (volume modulation) at the same frequency as vibrato (pitch modulation). Note that although the LFOx are global, the level applied to each destination is independent.

LFO waveform

There is a choice of 50 waveforms for each of the 4 global LFOs. The first 33 waveforms are:

- sine SIN
- sine phase-shifted by 90 degrees SIN-90
- triangle TRI
- triangle phase-shifted by 90 degrees TRI-90
- square SQUARE
- pulse short PULSE1
- pulse medium PULSE2
- pulse long PULSE3
- ramp wave RAMP
- ramp phase-shifted by 90 degrees RAMP90
- ramp-hold RMPHLD
- 3-step 3-STEP
- 4-step 4-STEP
- sample-and-hold S+H
- sampled noise NOISE
- random triangle RANTRI
- pulse short reverse PLSE1R
- pulse medium reverse PLSE2R
- pulse long reverse PLSE3R
- ramp-hold reverse RMPH-R
- pulsed wave speeding up BOUNCE
- pulsed wave speeding up variant BOING
- pulsed wave slowing down RETARD
- damped sine SINDEC
- damped sine reversed SININV
- very fast burst BURST
- fast burst BURST2
- sine + sine at twice frequency SIN+2
- sine + sine at three-times frequency SIN+3
- half sin and half triangle combo SINTRI
- half triangle, half constant combo TRI/2
- modulated sine BEAT
- modulated sine variation BEAT2

The remaining 17 waveforms are primarily aimed at pitch modulation of the oscillators to play tuned notes (but of course you don't have to do that!). They give the intended pitch with an LFO amount set to 12.00s

- chromatic increasing CHROM
- major chord triad MAJOR
- minor chord triad MINOR
- augmented chord triad AUG
- diminished chord triad DIM
- diminished 7th chord DIM7
- half-diminished seventh 7th chord 2DIM7
- minor seventh 7th chord MIN7
- minor major 7th chord MINMAJ
- dominant 7th chord DOM7
- major seventh 7th chord MAJ7
- augmented seventh 7th chord AUG7
- augmented major seventh 7th chord AMAJ7
- mini sequence 1 SEQ1
- mini sequence 2 SEQ2
- mini sequence 3 SEQ3
- mini sequence 4 SEQ4

To change the LFO waveform press  for LFO X then use the rotary encoder to change the waveform, the current setting will be shown on the display. For example when the waveform is a sine wave the symbol will be shown.

> If you change the parameters for the global LFO on a parameter page (except for the level amount) you will change the parameters of that LFO for all the parameter pages that use that LFO – because it is global. If you want to have a unique LFO for parameter page then either use an unused global LFO or use the dedicated LFO.

LFO single-shot

When waveform  is the active option pressing  and  toggles between single-shot mode. In this mode S is shown on the display and the LFO will only do one cycle of oscillation (however this only is active when the LFO is also set to trigger mode, see below).

LFO frequency

Here the frequency of LFO X can be modified. To change the frequency press FREQUENCY for LFO X and then use rotary encoder or or . The frequency can be set from 0.001Hz – 452Hz (time period from 1000s to 2.2 ms).

Values below 0.001 Hz are synchronised to the clock source (note that you must use the rotary encoder to go below 0.001 Hz – the only allows setting down to 0.001 Hz). See section 18.2 for details on the clock source. When set to synchronise to the clock the display will show a metronome indicator and the LFO period value (down to as fast as 32 triplet).

LFO trigger options

When frequency FREQUENCY is the active option pressing the and selects from the LFO X trigger mode options. The selected mode is shown as a small icon on the screen to the left of the waveform icon, from the following 3 options:

- the LFO is not synchronised to note-on or gate signals.
- the LFO resets on the *first* note-on or gate signal.
- the LFO resets on *all* note-on or gate signals.

Modulation amount and choosing LFO 1 – 4

Finally, to control the strength of LFOx on the parameter page destination press for LFO X .

There are 4 global LFOs. When the modulation amount of LFOx is the active item choose the active one by pressing and to scroll through the selection.

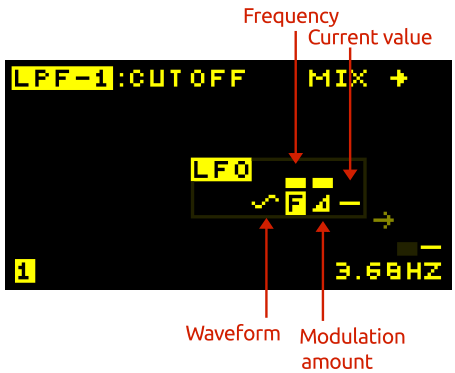
Use a negative modulation amount to have an inverted modulation waveform.

Try applying the or stepped waves to modulate the oscillator pitch and the oscillator will play an arpeggio where the notes heard depend on the level control. Try levels of 5, 7 or 9 semitones. Use a positive level to play 'up' and negative level to play 'down'.

When the LFO is synced to note-on or arpeggiator then you can choose the standard or phase-shifted waves depending whether you want to the wave to start from the peak or mid-range value at the sync event.

10.3 Dedicated low-frequency oscillator (LFO)

This LFO is unique to each parameter page. In other words, *every* parameter page has it's own unique LFO. This allows highly complex LFO modulations to each characteristic of the patch.



LFO waveform

There is a choice of 50 waveforms for each dedicated LFO. The first 33 waveforms are:

- sine SIN
- sine phase-shifted by 90 degrees SIN-90
- triangle TRI
- triangle phase-shifted by 90 degrees TRI-90
- square SQUARE
- pulse short PULSE1
- pulse medium PULSE2
- pulse long PULSE3
- ramp wave RAMP
- ramp phase-shifted by 90 degrees RAMP90
- ramp-hold RMPHLD
- 3-step 3-STEP
- 4-step 4-STEP
- sample-and-hold S+H
- sampled noise NOISE
- random triangle RANTRI
- pulse short reverse PLSE1R
- pulse medium reverse PLSE2R
- pulse long reverse PLSE3R
- ramp-hold reverse RMPH-R
- pulsed wave speeding up BOUNCE
- pulsed wave speeding up variant BOING
- pulsed wave slowing down RETARD
- damped sine SINDEC
- damped sine reversed SININV
- very fast burst BURST
- fast burst BURST2
- sine + sine at twice frequency SIN+2
- sine + sine at three-times frequency SIN+3
- half sin and half triangle combo SINTRI
- half triangle, half constant combo TRI/2
- modulated sine BEAT
- modulated sine variation BEAT2

The remaining 17 waveforms are primarily aimed at pitch modulation of the oscillators to play tuned notes (but of course you don't have to do that!). They give the intended pitch with an LFO amount set to 12.00s

- chromatic increasing CHROM
- major chord triad MAJOR
- minor chord triad MINOR
- augmented chord triad AUG
- diminished chord triad DIM
- diminished 7th chord DIM7
- half-diminished seventh 7th chord 2DIM7
- minor seventh 7th chord MIN7
- minor major 7th chord MINMAJ
- dominant 7th chord DOM7
- major seventh 7th chord MAJ7
- augmented seventh 7th chord AUG7
- augmented major seventh 7th chord AMAJ7
- mini sequence 1 SEQ1
- mini sequence 2 SEQ2
- mini sequence 3 SEQ3
- mini sequence 4 SEQ4

To change the LFO waveform press the  for LFO then use the rotary encoder to change the waveform, the current setting will be shown on the display.

LFO single-shot

When waveform  is the active option pressing  and  toggles between single-shot mode. In this mode S is shown on the display and the LFO will only do one cycle of oscillation (however this only is active when the LFO is also set to trigger mode, see below).

LFO frequency

Here the frequency of the dedicated LFO can be modified. To change the frequency press  for LFO and then use rotary encoder or  or  . The frequency can be set from 0.001Hz – 452Hz (period 1000s to 2.2 ms).

The dedicated LFOs cannot be synchronised to the arpeggiator clock.

LFO trigger options

When frequency FREQUENCY is the active option pressing ← and → buttons selects from the LFO trigger mode options. The selected mode is shown as a small icon on the screen to the left of the waveform icon, from the following 3 options:

- the LFO is not synchronised to note-on or gate signals.
- the LFO resets on the *first* note-on or gate signal.
- the LFO resets on *all* note-on or gate signals.

LFO modulation amount

To control the strength of the dedicated LFO on the parameter page destination press .

LFO modulation options

When level is the active option pressing ← and → selects from the LFO modulation options. The selected mode is shown as a small icon on the screen to the far left of the dedicated LFO display, from the following 3 options:

- LFO amount is not modulated.
- LFO amount is modulated by the active EG.
- LFO amount is modulated by the active LFOx.

Modulate the MASTER PITCH with the dedicated LFO and use the modulation option to create a vibrato effect that is delayed and builds in amplitude as a key is pressed, according to the EG setting for that parameter page.

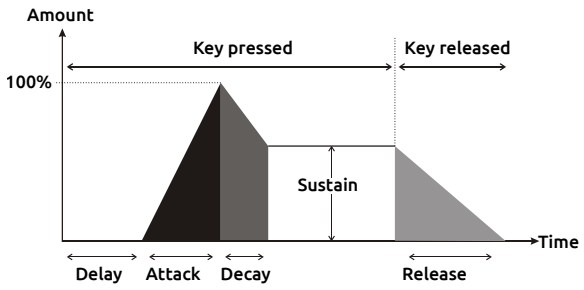
10.4 Envelope Generator (EG)

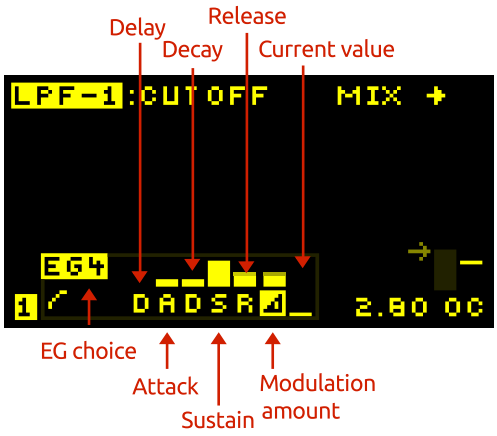
Each parameter page can be assigned either a unique EG (labelled on the screen as EG) or one of four global EGs (labelled on the screen as EG1, EG2, EG3 and EG4).

The envelope generator creates a signal that varies over time. It consists of 5 phases. The first phase 'delay' is started by a MIDI note-on or gate trigger event. The final release phase starts by a MIDI note-off or gate off event.

- D delay – sets the delay in time before the attack phase starts, from 0 to 2.43 seconds.
- A attack – sets the rate at which the envelope rises after the delay phase, from 1 ms to 34.6 seconds (from zero to peak).
- D decay – sets the rate at which the envelope falls after reaching the maximum level in the attack phase, from 1 ms to 34.6 seconds (from peak to zero).
- S sustain – sets the level to which the envelope falls at the end of the decay phase.
- R release – sets the rate that the envelope falls from the sustain level, from 1 ms to 34.6 seconds (from peak to zero).

The following figures show how the EG signal varies over time and how the settings typically look on the display





EG trigger mode options

When delay time is the active option pressing ← and → selects from the EG trigger mode options. The selected mode is shown as a small icon on the screen to the left of the delay **D** icon, from the following 8 options:

- ■ EG triggers on *first* note-on event, release phase starts when all notes have been released.
- **1** EG triggers on *1st* note-on event, release phase starts when that note is released.
- **2** EG triggers on *2nd* note-on event (when multiple keys held down), release phase starts when that note is released.
- **3** EG triggers on *3rd* note-on event (when multiple keys held down), release phase starts when that note is released.
- **E** EG triggers on *every* note-on event, release phase starts when all notes have been released.
- **H** EG triggers on *highest* note-on event, release phase starts when all notes have been released.
- **M** EG triggers on *middle* note-on event, release phase starts when all notes have been released.
- **L** EG triggers on *lowest* note-on event, release phase starts when all notes have been released.

Additionally, the behaviour of EG re-triggering on note-off events is determined by a global patch setting for all EGs (see section 18.1). All EGs can be set to never re-trigger on note-off events, or can re-trigger under certain conditions.

EG trigger mode **H** means that whenever there is a new 'highest' note played the EG will trigger. This means that the EG will trigger when a first note is played (as this is a new 'highest' note). The EG will then re-trigger if a second note is played whilst the first is held down, as long as the second note is higher. If a third note is played but lower in pitch, then the EG will not react. If the patch setting **TRACK NOTE-OFF** is set to **P+EG** then if the second note is released the EG will re-trigger as there is now another 'new' highest note (either the first or the third, depending which notes were played!). EG trigger modes **M** and **L** work in similar ways to **H**.

EG response curve options

When attack or release is the active option pressing ← and → selects from the EG response curve options. The selected response curve option is shown as a small icon on the screen to the far left of the **EG** area from the following 3 options:

- faster initial rise with slower settling to maximum value.
- linear response curve.
- slower initial rise with faster settling to maximum value.

EG repeat option

When decay is the active option pressing ← and → selects the EG repeat option on or off.

Normally the EG will progress from the delay phase

to the attack phase to the decay phase and then hold at the sustain level whilst a note is held. When the EG repeat option is set shown by the symbol (to the right of the displayed EG choice) the EG will move to the delay phase after the decay phase, repeatedly.

Use the EG repeat feature to use the EG as a sort of LFO where the rise and fall time of the waveform is set by the attack and decay times.

EG reset option

When sustain is the active option pressing and selects the EG reset option on or off.

Normally when re-triggered by a note-on or gate event the EG will start the delay phase from the level the EG was at before the event. When EG restart option is set shown by a symbol the EG output will instead reset to zero on re-trigger.

Use the EG reset feature on percussion sounds where you want the EG cycle to always restart from zero.

Modulation amount and EG choice

To control the strength of the active EG on the parameter page destination press and use the rotary encoder or and .

Choose the active EG by pressing and to scroll through the selection when the modulation amount is the active item. Choose either the unique EG (labelled on the screen simply as EG) or one of four global EGs (labelled on the screen as EG1, EG2, EG3 and EG4).

11 Parameter pages - in depth

This chapter describes each parameter page in detail. The settings on each parameter page control the sound MOTAS-6 makes. To access a particular parameter page turn the appropriate rotary knob 1. The active parameter page is shown by the adjacent flashing LED.

Use the 'value lock' feature to allow changing of the active parameter page without changing the sound parameters. Press VALUE LOCK to toggle 'value-lock' on and off. When 'locked' the LED will flash next to the VALUE LOCK button.

11.1 Master Pitch

MASTER PITCH

MASTER PITCH

This parameter page controls the pitch of the three oscillators. Although each oscillator has it's own pitch control parameter page you can easily apply offset and modulation to all the oscillators together using this parameter page.

Set up a vibrato effect by applying a fast sine wave from an LFO to this page. This will pitch shift all three of the oscillators at the same time.

Pitch-shift all 3 oscillators up an octave by applying an offset of +12 semi-tones to this page.

Internally the analogue pitch control signals for each oscillator are generated from the output of this parameter page added to the dedicated pitch parameter page outputs for each oscillator.

11.2 Oscillator 1

Oscillator 1 has triangle, sawtooth and variable pulse-width waveforms available. It can be hard-synced to oscillators 2 and 3.

OSC-1 LEVEL

This parameter page sets the overall volume level of the waveforms from oscillator 1 into the mixer.

Although each waveform from oscillator 1 has it's own level parameter page you can easily apply offset and modulation to the overall volume level of oscillator 1 from this parameter page.

If the overall level is zero from the oscillator level page then no output from that oscillator will be input to the mixer, even if the individual wave outputs (e.g. triangle, sawtooth) are set to non-zero.

High level settings can cause the internal analogue circuitry to distort and clip the waveforms - use this feature to add further sonic interest to the sound. For a cleaner sound use low to moderate levels. You can use the oscilloscope feature to monitor the waveforms to see if they are clipping.

OSC-1 PITCH

This parameter page sets the pitch (frequency) of oscillator 1. The basic offset settings displayed here are relative offsets. An offset of zero means that the oscillator will play in-tune with the incoming MIDI note or CV signal (for calibrated CV signals). For small offsets the display shows pitch in cents C which is 1/100 of a semi-tone. Above 99 cents the display shows the pitch in semi-tones S.

When multiple notes are held down at the same time the pitch of oscillator 1 can be set in a number of different ways. Choose the mode desired by pressing the ← button and cycling through the following 7 options:

LST	pitch set to the *last* note on.
1	pitch set to the *1st* or earliest note on.
2	pitch set to the *2nd* note on
3	pitch set to the *3rd* note on.
HI	pitch set to the *highest* note on.
MED	pitch set to the *middle* note on. (If fewer than 3 notes are on then pitch is set to the highest note on).
LOW	pitch set to the *lowest* note on.

Additionally, the behaviour of the pitch tracking on note-off events is determined by a global patch setting TRACK NOTE-OFF for all oscillators. See section 18.1 for more details. In some modes, with this feature turned on, the pitch will change to track the remaining notes pressed as others are released.

Oscillator 1 has 4 hard-sync options. Cycle through the options with the → button – the display will show:

S:OFF	sync is off
S:2	hard-sync to oscillator 2
S:3	hard-sync to oscillator 3
S:2+3	hard-sync to oscillator 2 and 3

Hard-sync means that the oscillator core resets whenever the oscillator it is synced to resets – this causes the oscillator to track in pitch although because the reset could happen part-way along the waveform interesting timbral effects can be obtained.

MOTAS-6 can play paraphonically – you can play up to 3-note chords where each note of the chord is generated by each oscillator. The oscillators of course still share the same filter and output settings so this is paraphonic not polyphonic operation. Setup 1ST for OSC-1:PITCH, 2ND for OSC-2:PITCH and 3RD for OSC-3:PITCH. Also, setup OSC-1:LEVEL to have an envelope that is triggered only by the 1st note, OSC-2:LEVEL with an envelope triggered by the 2nd note and OSC-3:LEVEL with an envelope triggered by the 3rd note.
As a variation, use the HI, MED and LOW tracking modes for each of the oscillators so that when only one note is played all 3 oscillators play in unison but as multiple notes are held each oscillator will play a different pitch forming a chord! With this setup you can use a standard envelope that responds to all notes.

For a more interesting audible effect set the oscillator with hard-sync to a higher pitch than the oscillator it is synced to.

Hard-sync oscillator 1 to oscillator 2 and use phase-modulation on oscillator 2. Then, vary oscillator 1 pitch with modulation. The effect will be that the oscillator 2 triangle and sawtooth waveforms distort strongly but in a (possibly musical. . .) pitch-controlled way.

OSC-1 :TRIANGLE

This parameter page sets the volume level of the triangle wave output of oscillator 1.

The triangle wave has a linear rising and falling shape and has a low level of harmonics (principally odd harmonics) so is closest to a pure tone and so is useful for generating flute-like tones, pure bass notes and for adding into the mix to add stronger fundamental tones.

OSC-1 :SAWTOOTH

This parameter page sets the volume level of the sawtooth wave output of oscillator 1.

The sawtooth wave has a rising and then abruptly falling shape giving a tone very rich in harmonics (odd and even). Use for many sounds including strings, with appropriate filtering.

OSC-1 :PULSE MOD.

This parameter page sets the pulse-width (or duty cycle) of the pulse wave of oscillator 1.

With very short or very long widths the tone is very raspy with many harmonics but low overall signal strength. At a mid setting the tone is that of a square wave (odd harmonics only) with the maximum signal strength.

To create a classic PWM (pulse width modulation) phasing effect apply a slow sine-wave LFO (< 1 Hz) to modulate the output of this page.

OSC-1 :PULSE LEVEL

This page sets the volume level of the pulse wave for oscillator 1. This wave is a rectangular wave with a pulse width (or duty cycle) determined from the **OSC-1 :PULSE MOD.** page.

11.3 Oscillator 2

Oscillator 2 has triangle, sawtooth, square and sub-square waveforms available. It can be hard-synced to oscillators 1 and 3. It's triangle and sawtooth waveforms can be phase-modulation from oscillator 1.

OSC-2 :PHASE MOD

This parameter page sets the phase modulation depth for oscillator 2. The triangle and sawtooth waveforms from oscillator 2 are phase-modulated from the internal triangle waveform of oscillator 1.

Phase-modulation is a form of waveform distortion where the phase of the waveform is changed over time. It is very similar to frequency modulation but does not have the problems of pitch stability that can occur with frequency modulation.

OSC-2 LEVEL

This parameter page sets the overall volume level of the waveforms from oscillator 2 into the mixer.

Although each waveform from oscillator 2 has it's

own level parameter page you can easily apply offset and modulation to the overall volume level of oscillator 2 from this parameter page.

Setup a global modulation source such as the MIDI modulation wheel on this parameter page with a positive modulation amount. When that controller value increases the volume level of oscillator 2 going to the mixer will then increase. Set the controller value to minimum and then adjust the parameter page basic offset (with the rotary knobs ❶ or rotary encoder and ⬆ up and ⬇ down buttons ❺) to set the level desired.

OSC-2:PITCH

PITCH

This parameter page sets the pitch (frequency) of oscillator 2. The basic offset settings displayed here are relative offsets. An offset of zero means that the oscillator will play in-tune with the incoming MIDI note or CV signal (for calibrated CV signals). For small offsets the display shows pitch in cents C which is 1/100 of a semi-tone. Above 99 cents the display shows the pitch in semi-tones S.

When multiple notes are held down at the same time the pitch of oscillator 2 can be set in a number of different ways. Choose the mode desired by pressing the ⬅ button and cycling through the following 7 options:

LST	pitch set to the *last* note on.
1	pitch set to the *1st* or earliest note on.
2	pitch set to the *2nd* note on
3	pitch set to the *3rd* note on.
HI	pitch set to the *highest* note on.
MED	pitch set to the *middle* note on. (If fewer than 3 notes are on then pitch is set to the highest note on).
LOW	pitch set to the *lowest* note on.

Additionally, the behaviour of the pitch tracking on note-off events is determined by a global patch setting TRACK NOTE-OFF for all oscillators. See section 18.1 for more details. In some modes, with this feature turned on, the pitch will change to track the remaining notes pressed as others are released.

To play guitar-style lead solo sounds try using pitch tracking option HI for OSC-1,2,3:PITCH and set the patch global setup TRACK NOTE-OFF to PITCH or P+EG so that the pitch will track note-off events (so that as a higher key is released the pitch jumps to the new 'highest' pitch of the lower note still pressed). Hold a low note down and tap higher notes on and off to play the riff.

Oscillator 2 has 4 hard-sync options. Cycle through the options with the ➡ button – the display will show:

S:OFF	sync is off
S:1	hard-sync to oscillator 1
S:3	hard-sync to oscillator 3
S:1+3	hard-sync to oscillator 1 and 3

To make an oscillator have a fixed pitch regardless of the incoming MIDI note value set a note modulation amount of -12 semi-tones.

OSC-2:TRIANGLE

This parameter page sets the volume level of the triangle wave output of oscillator 2.

This waveform can be phase-modulated to distort the waveform from a pure triangle.

OSC-2 : SAWTOOTH

This parameter page sets the volume level of the sawtooth wave output of oscillator 2.

This waveform can be phase-modulated to distort the waveform from a pure sawtooth.

OSC-2 : SQUARE

This parameter page sets the level of the square wave going to oscillator 2 mix.

The square wave has a hollow tone and has strong odd harmonics. Use for organ sounds and for strong bass notes.

OSC-2 : SUB-OSC

This parameter page sets the level of the sub-oscillator wave going to oscillator 2 mix.

The sub-wave is a square wave at half the frequency of the other oscillator 2 waveforms (one octave lower). Adding this wave to the mix adds a deep sub-octave sound, especially useful for bass tones.

adding some sub-wave to the mix is a quick way to strengthen the bass-end of the sound.

11.4 Oscillator 3

Oscillator 3 has triangle, sawtooth and variable-width pulse waveforms available. It's triangle, sawtooth and pulse waveforms can be phase-modulation from oscillator 1 or 2.

OSC-3 : PHASE MOD

This parameter page sets the phase modulation depth for oscillator 3.

The triangle, sawtooth and pulse waveforms from oscillator 3 can be phase-modulated from the internal triangle wave of oscillator 1 or 2.

Press the  button to set the phase-modulation from oscillator 1 and press the  button to set the phase-modulation from oscillator 2.

Use phase-modulation to create FM-style sounds. Use an EG to modulate the phase-modulation amount to create sharp attack sounds that decay to softer undistorted sounds.

OSC-3 LEVEL

This parameter page sets the overall volume level of the waveforms from oscillator 3 into the mixer.

Although each waveform from oscillator 3 has it's own level parameter page you can easily apply offset and modulation to the overall volume level of oscillator 3 from this parameter page.

OSC-3 : PITCH

This parameter page sets the pitch (frequency) of oscillator 3. The basic offset settings displayed here are relative offsets. An offset of zero means that the oscillator will play in-tune with the incoming MIDI note or CV signal (for calibrated CV signals). For small offsets the display shows pitch in cents C which is 1/100 of a semi-tone. Above 99 cents the display shows the pitch in semi-tones S.

When multiple notes are held down at the same time the pitch of oscillator 3 can be set in a num-

ber of different ways. Choose the mode desired by pressing the ← button and cycling through the following 7 options:

LST	pitch set to the *last* note on.
1	pitch set to the *1st* or earliest note on.
2	pitch set to the *2nd* note on
3	pitch set to the *3rd* note on.
HI	pitch set to the *highest* note on.
MED	pitch set to the *middle* note on. (If fewer than 3 notes are on then pitch is set to the highest note on).
LOW	pitch set to the *lowest* note on.

Additionally, the behaviour of the pitch tracking on note-off events is determined by a global patch setting TRACK NOTE-OFF for all oscillators. See section 18.1 for more details. In some modes, with this feature turned on, the pitch will change to track the remaining notes pressed as others are released.

Set each of the three oscillators in a patch to slightly different pitches to create a thick, very rich analogue sound.

Since MOTAS-6 has real analogue oscillators even at a setting of zero pitch offset the oscillators will still drift in tune slightly producing a naturally rich sound. To truely lock the oscillator pitches use the hard-sync feature.

OSC-3 : TRIANGLE

This parameter page sets the volume level of the triangle wave output of oscillator 3.

This waveform can be phase-modulated to distort the waveform from a pure triangle.

OSC-3 : SAWTOOTH

This parameter page sets the volume level of the sawtooth wave output of oscillator 3.

This waveform can be phase-modulated to distort the waveform from a pure sawtooth.

OSC-3 : PULSE MOD.

PWM

This parameter page sets the pulse-width (or duty cycle) of the pulse wave of oscillator 3.

OSC-3 : PULSE LEVEL

This page sets the volume level of the pulse wave for oscillator 3. This wave is a rectangular wave with a pulse width (or duty cycle) determined from the OSC-3 : PULSE MOD. page.

This waveform can be phase-modulated to distort the waveform so that the pulse-width varies with the phase-modulation (i.e. at audio frequencies).

11.5 Mixer

The mixer combines the audio signals from the 3 oscillators together with the noise source and feedback/external input signals.

MIXER : NOISE

The noise generator can be set to pink or white noise main output. This parameter page sets the output level to the main mix.

Press ← to choose white noise or press → to choose pink noise.

Use an EG to modulate the noise level to give a short burst of noise at the start of each note press to simulate percussive sounds.

white noise has a uniform energy density with frequency. To the ear this sounds very 'hissy' because for each rising octave of pitch there is a doubling of frequency, so most of the energy is present at the higher octaves. Pink noise has a frequency spectrum such that the energy density is inversely proportional to the frequency. To the ear this sounds more uniform since although for each octave of pitch there is a doubling of frequency the density of the pink noise is reduced to compensate.

MIXER : FB/EXTERNAL

When no audio connector is plugged into C then an internal audio connection is made from the audio output (after the 'output' stage but before the final volume control stage) to the mixer. This parameter page sets the level of that signal into the mixer. This internal 'feedback' feature allows additional feedback effects to be generated.

To process an external mono audio signal (instead of the internal feedback) plug your external audio source into the rear of the unit on the 'external in' socket C. This parameter page sets the level of that signal into the mixer. This allows you to process external audio through the filters, alongside the internal audio sources.

When the feedback connection is active the feedback effect will vary with the output level, and will change according to the clipping options in the output stage.

Using the internal feedback feature setup a fast attack and decay EG with low sustain level to modulate the level of this parameter page. This might give an initially heavily distorted sound that decays to something cleaner. With very high levels (around the loop from the mixer, through the filters and to the output) self-oscillation can occur - so be careful of your speakers/-hearing!

The phase of the internal feedback signal is in-phase with the oscillator outputs. This means that you can increase the bass-end of the signal using the feedback feature even when the low pass filters are set at high resonance (which would normally attentuate the bass-end).

MIXER

This parameter page sets the total level of the outputs of oscillators 1, 2 and 3 together with the noise and external input signals.

Press ← to choose normal gain setting or press → to set gain boost - this adds gain to this stage before the audio signal reaches the filter stages. This can be useful to overdrive the filters to create a harsher sound.

11.6 Low-pass filter 1

A key part in subtractive synthesis is the use of filters to shape the harmonic content to give a rich variety of sounds. This filter is a very powerful low-pass filter with up to 6-pole roll-off (-36 dB per octave). It has adjustable resonance (or feedback) amount, with three options for the source of the feedback. The output can be tapped off from any of the poles (from zero to the 6th pole).

LPF-1 : CUTOFF

The cut-off frequency is controlled with this parameter page. The lower the setting the more filtering will be applied to the input signal. At higher settings more of the input harmonics are pased through with corresponding brighter sound.

This parameter page also allows control of which audio signal is input to the filter. Press ← and → to select the input signal from the following options:

MIX	the main mix (normal setting).
LPF2	low-pass filter 2.
HPF	the high-pass filter.
NOISE	the noise source.
PULS1	pulse waveform of oscillator 1.
SAW2	sawtooth waveform of oscillator 2.
TRI3	triangle waveform of oscillator 3.
SUB2	sub-square waveform of oscillator 2.

LPF-1 : RESONANCE

Resonance amount is controlled from this parameter page. A portion of the output of the filter is fed-back to the input causing a resonance peak in the output at high levels, changing the characteristic of the sound passing through the filter. At very high settings the filter may self-oscillate and make noise even without any input signal - watch your speakers!

The signal from where the feedback signal is derived can be chosen using ← and → to select from the following options:

POLE-4	pole-4 output (-24 dB roll-off per octave).
POLE-6	pole-6 output (-36 dB roll-off per octave).
HPF	high-pass filter output.

Each of these sound different - the 4-pole output gives a higher resonant frequency (for the same filter cut-off frequency) and tends to attenuate the signals below the resonance frequency more than the 6-pole setting.

> The filter will self-oscillate at offset values around 70 (assuming no modulations are present)

LPF-1 : OUTPUT

This parameter page sets the level of the audio signal passing into the final mixer stage. Note that when chaining the output of this filter to the input of another filter this setting is not relevant - it only sets the level to the output stage.

Low-pass filter 1 has separate filtering stages and the one selected for the final output can be selected using ← and → from the following options:

BYPASS	output directly from the input
POLE-1	pole-1 (-6 dB per octave).
POLE-2	pole-2 (-12 dB per octave).
POLE-3	pole-3 (-18 dB per octave).
POLE-4	pole-4 (-24 dB per octave).
POLE-5	pole-5 (-30 dB per octave).
POLE-6	pole-6 (-36 dB per octave).

At the pole-6 (-36dB roll-off per octave) setting the roll-off of the filter is at it's most steep and so the harmonics of the sound above the cut-off frequency are most strongly attenuated. Most traditional analogue synthesizers only have a maximum roll-off of -24dB (i.e. 4 poles).

Use the -36dB setting for the darkest, most filtered bass sounds. Use other settings for brighter sounds.

11.7 High-pass filter

The high-pass filter is a 2-pole design (-12dB/octave). The sound is left brighter, lacking in bass as the cut-off frequency is increased.

HPF : CUTOFF

This parameter page sets the cut-off frequency. The higher the setting the more of the input signal at low frequencies is attenuated.

This parameter page also allows control of which audio signal is input to the filter. Press ← and → to select the input signal from the following options:

MIX	output of the main mix (normal setting).
POLE-1	low-pass filter 1 pole 1.
POLE-2	low-pass filter 1 pole 2.
POLE-4	low-pass filter 1 pole 4.
POLE-5	low-pass filter 1 pole 5.
POLE-6	low-pass filter 1 pole 6.
NOISE	the noise source.
LPF2	low-pass filter 2.

Use this filter in series with the low-pass filters to produce a band-pass filter effect. For example, set the output levels of the low-pass filters to zero, and set the input of this filter to LPF2. Now the sound from the mixer will pass first through LPF2 and then into this high-pass filter, creating the band-pass effect.

HPF : OUTPUT

This parameter page sets the level of the audio signal passing into the final mixer stage. Note that when chaining the output of this filter to the input of another filter this setting is not relevant - it only sets the level to the final mixer.

11.8 Low-pass filter 2

This filter is similar in design to that from a certain famous metallic grey bassline synthesizer from the early 80s . . . It has a characteristic sound all of it's own.

LPF-2 : CUTOFF

The cut-off frequency is controlled with this parameter page. The lower the setting the more filtering will be applied to the input signal. At higher settings more of the input harmonics are pased through with corresponding brighter sound.

This parameter page also allows control of which audio signal is input to the filter. Press ← and → to select the input signal from the following options:

MIX	output of the main mix (normal setting).
POLE-1	low-pass filter 1 pole 1.
POLE-2	low-pass filter 1 pole 2.
POLE-4	low-pass filter 1 pole 4.
POLE-5	low-pass filter 1 pole 5.
POLE-6	low-pass filter 1 pole 6.
NOISE	the noise source.
HPF	the high-pass filter.

LPF-2 : RESONANCE

Resonance amount is controlled from this parameter page. A portion of the output of the filter is fed-back to the input causing a resonance peak

in the output at high levels, changing the characteristic of the sound passing through the filter. At very high settings the filter may self-oscillate and make noise even without any input signal - watch your speakers!


Try high resonance settings with EG modulation of the resonance and filter cut-off frequency to get a classic 'acidic' sound ...

LPF-2 : OUTPUT

This parameter page sets the level of the audio signal passing into the final mixer stage. Note that when chaining the output of this filter to the input of another filter this setting is not relevant - it only sets the level to the final mixer.

11.9 Output stage

OUTPUT

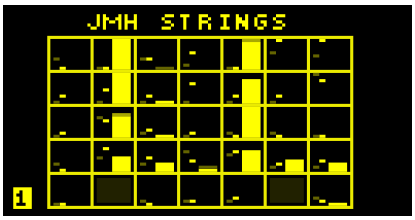
The final parameter page is the main output stage. This is where the level of the outputs of the filters are mixed and sent out of the MOTAS-6 audio out connectors (mono signal B and headphones A). Usually an EG controls this level to allow the sound to be off when no keys are pressed. However, of course, this does not have to be so: by setting EG modulation to zero and increasing this parameter page offset it is possible to have a free-running output sound.

The output can be optionally passed though a selection of clipping circuits. Press ← and → to choose from the options. The options are 'dry' (no clipping), soft clip and hard clip, plus combinations. Press ← button to reduce the extent of clipping ('dry' at the extreme) and → to increase the extent of clipping. Typically increased clipping produces a louder, harsher sound.


Use the oscilloscope feature to study the effect of the clipping options on the output waveform.

12 Patch summary

When not called upon for other functions, pressing 1, 2, 3, 4 or 5 changes the active patch (from 1 – 5) and shows a summary page of the patch settings similar to that shown in the screenshot below. The patch selected is shown in the bottom left-hand corner of the display.



The title on the top row shows the name of the patch.

Each of the boxes contains summary information corresponding to each of the 33 parameter pages. In feint on the far left of each box is shown a small horizontal bar that shows the rotary knob 1 position which was saved with the patch. Next to this a similar but brighter bar shows the current rotary knob 1 position. The larger bar on the right of each box shows the current value for that parameter page.

Use 'page lock' and study this page for a patch. Turn each rotary knob 1 and watch the values change. Also, when you turn each rotary knob 1 the title changes to show the name of the parameter page you are changing.

On the far right outside of the boxes is shown the output audio level as a vertical bar.

You can press the COPY button and then press another preset button (1, 2, 3, 4 or 5) to copy over a patch to another preset.

When a lot of modulation is being used it sometimes be difficult to work out what is going on! Use the patch summary page to help see an overview of the patch settings.

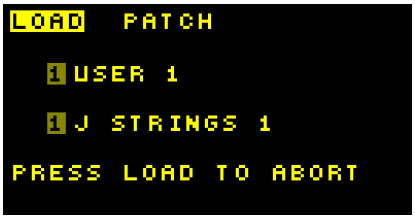
13 Load, save and copy patch

MOTAS-6 allows up to 500 individual patches to be saved and loaded (in addition to the patches saved with sequences) and these are arranged into 10 'folders' or 'banks'.

The first 'bank' of 50 patches cannot be edited or erased from the MOTAS-6 interface (but they can using external software).

13.1 Load patch

To load a new patch press LOAD and the new patch is immediately recalled – you can immediately hear the newly loaded patch. The 'folder' name and patch name is shown on the display. The patch will be loaded into the current active preset (1 – 5).



Turn the rotary encoder 5 or push ↑ or ↓ to select the patches stored in non-volatile memory – they are loaded automatically as you select them. Use ← and → to change 'folder'. To abort and return to the previous patch you were working with press LOAD again at any time.

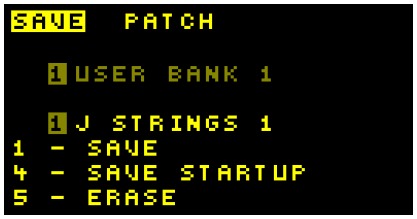
Empty unused patch locations are named EMPTY (in reverse colour), in this case no patch is loaded when they are selected (since they are empty).

When a new patch is loaded 'value lock' is automatically enabled to prevent any changes in the patch parameters from any rotary knob 1 changes. To immediately edit the loaded patch press VALUE LOCK and the parameter page you were previously on is shown. To explore the loaded patch without immediate editing press one of the buttons 3 or the current preset 2 button, to leave the 'load' page.

> The load/save page remembers which patch you last accessed so when you load or save again you will return to the same patch location.

13.2 Save and erase patches

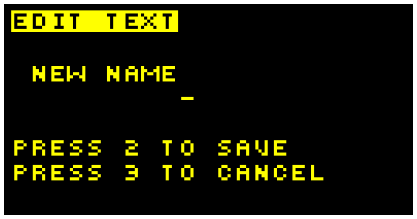
To save or erase the patch settings press SAVE.



Save patch

Turn the rotary encoder 5 or push ↑ or ↓ to select the patch you want to save over. Use ← and → to change 'folder'. To abort and return press SAVE again at any time. Empty unused patch locations are named EMPTY.

Press 1 to save over the selected patch with the current active patch. You will then be prompted to enter a save name for the patch – use the tactile buttons 4, 5 and 6 to enter letters directly or use the rotary encoder. Then press 2 to confirm the save operation or 3 to cancel.



Save quick presets

To save the current 5 quick-access preset patches so that they are automatically loaded next time MOTAS-6 is powered on press 4 (in this

case the selected save slot is irrelevant as the quick-access patches are stored in their own dedicated area).

Erase patch

Turn the rotary encoder 5 or push ↑ or ↓ to select the patch you want to erase. Use ← and → to change 'folder'.

Press 5 to erase the selected patch (you will be asked to confirm by pressing 1).

13.3 Copy/Reset/Randomise patch

Copy

The copy feature allows fast copying of settings. This means the setting for one parameter page can be applied to another page.

Reset

Press ← to reset (i.e. set to simple default values) the parameter settings on the current parameter page or press ↑ to reset the parameter settings on *every* parameter page.

Randomise

Press → to randomise the parameter settings on the current parameter page or press ↓ to randomise the parameter settings on *every* parameter page.

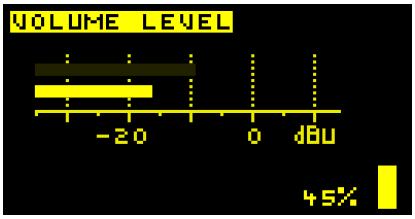
14 Monitor

Press MONITOR to enter monitor mode. There are 4 types of monitor mode: Volume level, MIDI, Oscilloscope and Spectrum Analyser.

To leave monitor mode press another control button or turn a parameter control (when 'page-lock' is not enabled). When monitor mode is enabled again the last selected mode is recalled.

Press ← and → to navigate the different modes. A detailed description of each mode is given in the sections below.

14.1 Volume level monitor



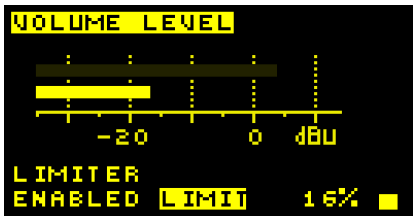
This mode shows the current master volume level as a percentage and a vertical bar at the right of the display adjusted by the volume knob 3. This is the level controlling the output on the main out B and headphones output A .

At the top of the display, a dimmed horizontal signal level monitor bar shows the average audio level in approximate dBu (0 dBu is 0.775 V or 1 mW into a 600 Ω load) which would be output on the main audio out B when the volume is set to maximum (100%). Underneath the top bar, the approximate dBu actually present on the main audio out B is shown.

The signal level monitor has similar response time to a traditional analogue VU meter

Limiter

Press ↑ and ↓ to toggle the audio limiter function. When enabled the output levels will be attenuated automatically to not exceed approximately 0 dBU on the main audio out B. When the limiting is activated LIMIT will appear on the display.



MOTAS-6 can generated very strong audio signals, use the limit feature to prevent excessive output levels, or use for creative effects!

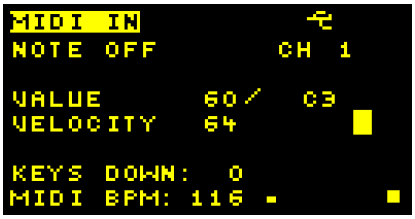
Turn the volume fully down when connecting audio amplification to avoid damaging external equipment from loud pops.

Be careful not to listen at too high a volume level especially when using headphones attached to A, to avoid damaging your hearing.

14.2 MIDI in monitor

This mode show incoming MIDI data on either the MIDI in connector F (shown by the symbol) or the USB MIDI interface G (shown by the symbol).

Depending of the data coming in the display will change. In the example screenshot above the last data received was a note-off event over the USB interface on channel 1 with note value 60 (C3).

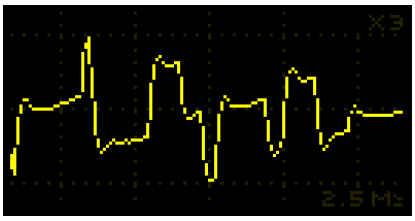


MIDI events coming in on the MIDI in port F can be set to automatically sent out again on the MIDI out port E without any processing (MIDI thru feature). See section 18.9.

If you don't seem to be getting MOTAS-6 to play properly then use this MIDI diagnostics page to check that indeed the correct MIDI events are being received. If not then a common problem could be that you have not set up your external MIDI device correctly, or a cable is not connected, or MOTAS-6 is set to the wrong MIDI receive channel.

If there is incoming MIDI clock data then the beats per minutes (BPM) of the clock is displayed at the bottom left of the screen.

14.3 Oscilloscope



The oscilloscope mode allows you to 'see' the output audio waveform on the display. Time increases from left-to-right horizontally. Using the rotary encoder the display time can be zoomed in or out. The horizontal scale is divided into divisions with feint vertical dashed lines. The current time scale is shown in the bottom right-hand side of the display. For example, in the figure the setting is 2.5 ms (i.e. $2\frac{1}{2}$ thousandths of a second) per division.

Press 2 to pause/unpause the display (pause shown by P on the screen). Press 1 to autoscale the vertical display (shown by an R on the screen). Note that the rescaling is limited and so for weak signals rescaling may not cause the waveform to fully fit the display. Press ↑ and ↓ to manually set the vertical display scale (from x1 to x16 zoom).

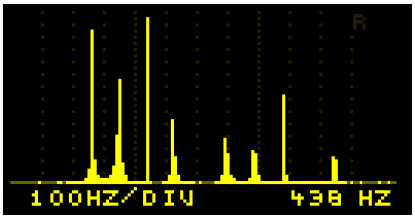
The signals are measured on the audio output directly before the main volume control, so waveforms can still be seen even if the volume level is at the minimum setting.

Use the oscilloscope feature with 'page-lock' enabled whilst adjusting parameter controllers for e.g. filter cut-off or resonance to see the effect on the waveform!

Internally the oscilloscope feature works by digital sampling of the audio signal. The timebase is synchronised to the waveform as far as possible in order to prevent a 'rolling' display, however, depending on the waveform good synchronisation may not be possible.

14.4 Spectrum analyser

In spectrum analyser mode the amplitude (or volume level) of the audio signal versus frequency (or pitch) is shown. The horizontal scale is divided into divisions with feint vertical dashed lines. The current frequency scale is shown in the bottom left-hand



side of the display. For example, in the figure the setting is 100 Hz per division.

Using the rotary encoder the range of frequency displayed can be zoomed in or out.

Press 2 to pause/unpause the display (pause shown by P on the screen). Press 1 to auto-scale the vertical display (shown by an A on the screen). Note that the rescaling is limited and so for weak signals rescaling may not cause the waveform to fully fit the display. Press ↑ and ↓ to manually set the vertical display scale (from x1 to x16 zoom).

As in oscilloscope mode the signals are measured on the audio output directly before the main volume control, so the spectrum analysis can still be seen even if the volume level is at the minimum setting.

An automatic peak detector shows the frequency of the strongest peak at the bottom right-hand side of the display. For example, in the figure there are many signal peaks with the strongest one at 438 Hz.

Use the spectrum analyzer feature with 'page-lock' enabled whilst adjusting parameter controllers for e.g. filter cut-off or resonance to see the effect on the waveform!

Use the spectrum analyser mode to look at the harmonics of a waveform. With a sawtooth wave there are harmonics at 1f, 2f, 3f, 4f, 5f... all at decreasing strength. With a pure square wave there are harmonics at 1f, 3f, 5f, 7f... that is the main reason for the different sound to the ear. On the other hand, a pure sine wave tone has only the 1f component. Look at the spectrum analyser signals and listen to the differences!

Look at the spectrum analyser display with high filter resonance, and sweep the cut-off frequency around. You should see a moving strong signal peak at the resonance frequency.

Use the spectrum analyser to measure the frequency of a continuous bass note. Change the oscillator pitch and test out the response of your sound system or room resonances!

Internally the spectrum analyser feature works by digital sampling of the audio signal over a fixed time period. Then an FFT (Fast Fourier Transform) calculation is performed on the samples to determine the strength of the audio signal over a range of frequencies.

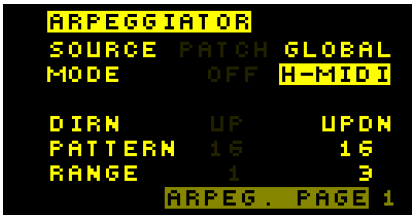
15 Arpeggiator

The arpeggiator feature allows MOTAS-6 to automatically play notes from a chord in succession with adjustable direction, number of octaves, pattern etc. The tempo is determined from the current active clock setting see section 18.1

Press the ARPEG. button to enter the arpeggiator settings.

Press ← and → to navigate the pages. On each page press ↑ and ↓ to move between the options and use the rotary encoder to change the values. For fast value changing push the rotary encoder and turn at the same time.

15.1 Main arpeggiator settings



SOURCE sets the active arpeggiator settings in use. This can be set to either those stored with the current patch shown as PATCH or from global settings shown as GLOBAL. The global settings are stored to internal non-volatile memory when you exit the ARPEG. settings.

MODE sets the arpeggiator mode:

- OFF – apeggiator off,
- MIDI – use incoming MIDI notes,
- H-MIDI use incoming MIDI notes holding after all keys released,
- INT – use internal preset chord (see section 15.3 below)
- H-INT – use internal preset with hold after all keys released (see section 15.3 below)

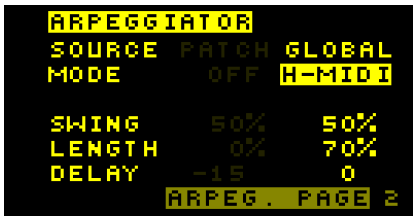
DIRN sets the direction (or order) of the notes played. Choose from:

- UP plays notes in ascending order of pitch
- DOWN plays notes in descending order of pitch
- UPDN plays in ascending and then descending order of pitch
- UP2 plays in the order of the keys as played within each octave, but ascending octaves (when the RANGE is greater than 1)
- DOWN2 plays in the order of the keys as played within each octave, but descending octaves (when the RANGE is greater than 1)
- U/D2 plays in the order of the keys as played within each octave, but ascending and then descending octaves (when the RANGE is greater than 1)
- RAND plays the notes in random order.

PATTERN sets the timing pattern of the arpeggiator. From very fast 32T (48 per bar) to a very slow 1 (1 note per bar), with triplet, standard and dotted values. Values greater than 1 are a selection of preset patterns instead of regular timing intervals labelled from A to P.

RANGE sets the arpeggiator octave range from 1 to 10 to set the number of octaves to play the arpeggios over.

15.2 More arpeggiator settings



Page 2 has further arpeggiator settings.

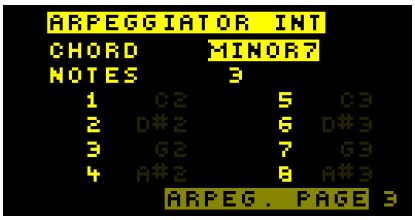
SWING sets the 'swing' of the timing. At 50% the timing is as per the PATTERN settings otherwise alternate notes have increased and decreased timings.

LENGTH sets the 'length' of each played note from 0% to 99% . This changes how long the notes are 'held' down as they are played by the arpeg-

giator.

DELAY sets a delay from -15 to +16 (normal setting would be 0) to allow correction of any synchronisation issues with external equipment (when using an external clock source).

15.3 Internal arpeggiator settings



Page 3 has the settings for the arpeggiator relevant in **INT** or **H-INT** modes only.

CHORD sets the type of chord used (i.e. which notes are used for the arpeggiator sequence). **CUSTOM** uses up to 8 notes as defined lower down on this page. Otherwise choose from notes played from following chords:

- **MAJOR** major triad chord (C, CM)
- **MINOR** minor triad chord (Cm, Cmin)
- **AUG** augmented triad chord (Caug, C^{+})
- **DIM** diminished triad chord (Cdim, C^{o})
- **DIM7** diminished 7th chord (C^{o7},$Cdim^{7}$)
- **M7B5** half diminished 7th chord ($C^{ø7}$,$Cm^{7\flat5}$)
- **MINOR7** minor 7th chord (Cm^{7},$Cmin^{7}$)
- **MMAJ7** minor major 7th chord (Cm^{M7},Cm^{maj7})
- **DOM7** dominant 7th chord (C^{7},$Cdom^{7}$)
- **MAJOR7** major 7th chord (CM^{7},C^{M7})
- **AUG7** augmented 7th chord ($C+^{7}$,$Caug^{7}$)
- **M7+5** augmented major 7th chord ($C+^{M7}$,C^{M7+5})

NOTES sets the number of notes to be played from the chosen chord from 1 to 8.

When the **CHORD** is set to **CUSTOM** then the 8 chord note values can be edited. Set the base note value from C1 to C5 (from 2 octaves below middle C to 2 octaves above). When the **CHORD** is NOT set to **CUSTOM** then the note values are greyed out but change to show the notes corresponding to the chosen chord.

If MIDI note data is received then the chord will be transposed to start from the first note held down.

Use the internal hold arpeggiator mode to play the arpeggiator when you don't have a MIDI controller keyboard around, to hear MOTAS-6 play on its own.

16 Pattern sequencer

MOTAS-6 allows 1 bar patterns to be created. Each pattern can contain a series of notes, parameter changes and controller events. The start-time, pitch, velocity, duration and micro-tune of each note can be adjusted. In pattern mode each 1-bar pattern plays in a loop. In pattern record mode the note data can be recorded into the active pattern using incoming MIDI data.

In sequence mode a series of patterns can be played, one after the other in a track. Each pattern can be repeated, transposed and time-offset adjusted.

There are 15 patterns in memory at any time. Individual patterns can be named and saved. In sequence mode any of the patterns in memory can be played. When a sequence is saved all the patterns, patches in memory and sequence data is saved together.

The tempo of the playback is synchronised to the current clock (see section 18.2).

16.1 Control overview

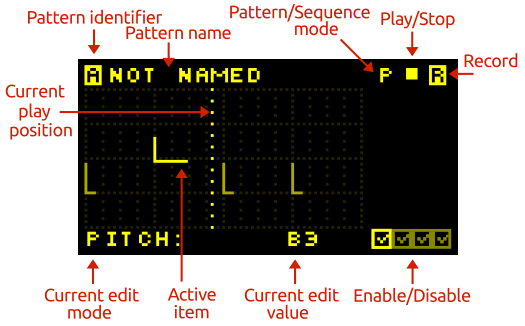
Press ▶/■ to play/stop the pattern/sequence, ◀◀ to rewind the position to the start and ● to enter record mode.

When in record mode the recording LED indicator flashes (situated next to the PATTERN button) and the symbol R flashes on the display. MIDI input to MOTAS-6 as well as live patch changes (from rotary knobs ❶, rotary encoder ○ etc.) are recorded (and can later be edited).

Press P/S to toggle between pattern mode (shown by P on the top row of the display) and sequence mode (shown by S on the top row of the display). In pattern mode only the current active pattern is played (in a loop). In sequence mode the patterns in the sequence are played as determined by the sequence settings.

16.2 Pattern edit mode

To enter pattern edit mode press the PATTERN button.



The active pattern can be selected using the + and − buttons. There are 15 to choose from A, B . . . O. Each can be re-named when they are saved.

Within each pattern there is 1 bar of events. There are 4 pages of event types. The active page is shown by the highlighted enable/disable icon in the lower right corner.

To change the active page press one of the following four buttons:

NOTES	note page
PARAMS	discrete parameters page
PARAMS-C	continuous parameters page
MODS	modulation controllers page

Repeated pressing of the same button toggles whether the data in that page is active or ignored (shown by a cross or a tick in the bottom right hand side of the display).

The active item is shown flashing. To move to the next item press →, to move the previous item press ←. To delete the current item press ↓ and to insert a new item press ↑.

To change the value of the active item turn the rotary encoder ○.

Note edit page

Press NOTES to create, edit and delete notes in the active pattern.

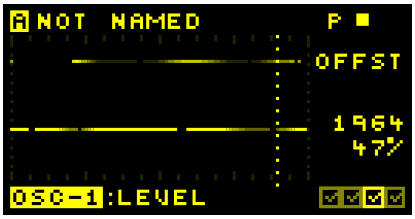
Press PITCH to change to pitch edit mode. Then each note can be selected and the pitch changed. Similarly press VELOCITY to edit each each note's velocity, TIME to edit the position in time of the note, DURATION to edit the note's duration and MICRO-TUNE to edit the microtune (from 0 – +98 cents).

Parameter edit page

Here discrete patch parameters can be edited and deleted (only created by recording panel changes).

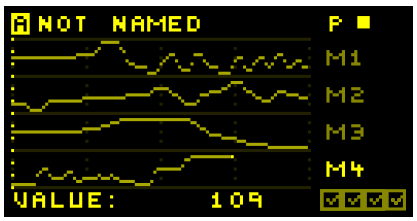
Continuous parameter edit page

Here continuous patch parameters can be edited and deleted (only created by recording panel changes).



Modulations edit page

Here events for modulations M1, M2, M3 and M4 can be created, edited and deleted. Press and hold ↓ to create a series of new values and then use the ← and → buttons to select the events and the rotary encoder to change the values.



Note that the number of parameter change and controller events that can be stored is limited, due to memory limitations.

16.3 Load/save/copy patterns

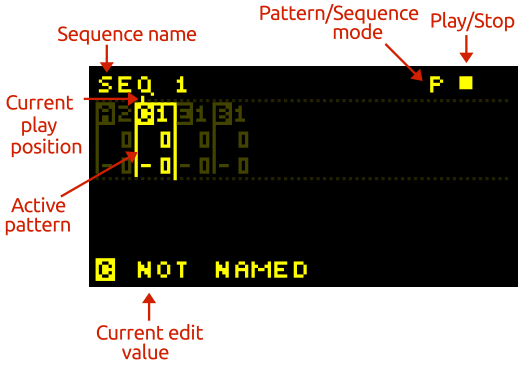
Patterns can be loaded and saved in much the same way as for patches (see section 13). There are 7 banks of patterns each containing 8 patterns. Press the LOAD or SAVE buttons when in pattern edit mode to access loading and saving.

Patterns can be copied (from one pattern to another in memory) – press the COPY button when in pattern edit mode.

16.4 Sequence edit mode

To enter sequence mode press the SEQUENCE button.

Here the patterns in memory can be played in any order as a sequence, with up to 2 parallel 'tracks'.



Press + to insert a pattern at the current point

or press  to remove a pattern from the sequence. Use the  and  to move between the patterns in the sequence. A pattern in the sequence is active when brighter than the other patterns.

Use the  and  buttons to navigate the options for the active pattern:

X PATTERN NAME	choice of which pattern to play at that point
REPEATS	number of times to repeat the pattern
TRANSPOSE	transpose note value from -24 to +24 semitones
PRESET	which preset to change to (1–5) to play the pattern
TIME-OFFSET	shift the timing of the pattern in clock ticks (0 – 8)

16.5 Load/save sequences

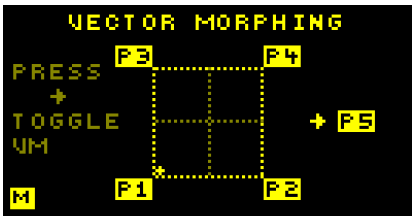
Sequences can be loaded and saved in much the same way as for patches (see section 13). There are 2 banks of sequences each containing 8 sequences. Press the  or  buttons when in sequence edit mode to access loading and saving.

When a sequence is saved the sequence data, all of the patterns *and* all 5 patch presets are saved together. This means that every detail of the sequence is recorded. When a sequence is loaded you have the choice to load in either all of this data or any of the separate parts.

 Load in only the sequence and pattern data (not the patch data) to try a sequence playing with new sounds that were not used when the sequence was created.

 Use the sequence saving to allow saving of a further 80 patches in addition to the regular patch saving area (5 x 2 x 8 = 80)!

17 Vector morphing



MOTAS-6 has a 'vector morphing' feature. This allows blending of the parameters for the active patch from the presets 1–4, in a 2-D space, using the morph-x and morph-y modulators (set these in section 18.5).

To enter vector morphing mode press ➡ whilst a preset page is displayed. The display will change to that shown above. In this mode 'value lock' will be switched on automatically and cannot be turned off until vector morphing mode is disabled. The symbol M is shown in the bottom left of the display in vector morphing mode.

As the morph-x control is varied the patch parameters blend from left to right (P1 / P3 to P2 / P4). Similarly as the morph-y control is varied the patch parameters blend from bottom to top (P1 / P2 to P3 / P4). A small cross-hair on the display shows the current blend position. Also, the preset LEDs ❷ will flash with a brightness reflecting the current blend amount from that preset.

To exit the vector morphing mode press ➡ again. The blend at that point is automatically stored into preset 5. The name of preset 5 will be changed to VM XX-XX-XX-XX where the xx values are the blend amounts in percent from the presets 1–4.

ⓘ Some of the patch parameters cannot be blended smoothly. For example the mixer gain has a normal or boost setting. If you blend from a patch with normal mixer gain to one with boost then a sudden switch over occurs at the midway point (shown by the dotted line on the vector morphing display).

Set 4 preset patches on preset buttons 1–4 with similar sounds and then use vector morphing mode to blend between them in real-time. You could use the copy function to initially setup 4 identical patches and then edit each patch to provide the differences.

18 Setup

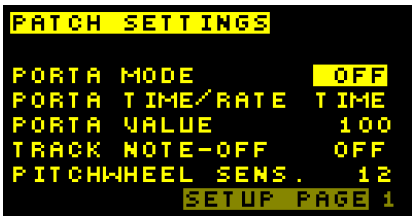
The setup pages allow setting of a variety of operating settings arranged over 16 pages. Press the SETUP button to enter the setup pages.

Press ← and → to navigate the pages. On each page press ↑ and ↓ to move between the options and use the rotary encoder to change the values. For fast value changing push the rotary encoder and turn at the same time.

When you leave the setup pages the settings are saved to internal non-volatile memory (and so will be remembered when you power the unit off and on again) – except for patch-specific parameters as detailed below.

The current setup page is shown in the bottom right of the display.

18.1 Patch settings



Here settings for the current patch can be set. Settings for the current patch are not saved automatically (but of course will be saved when the patch itself is saved).

PORTA MODE sets the portamento (glide) mode of the current patch. **OFF** turns off portamento, **LEGAGO** gives portamento when notes are held and **ALWAYS** always gives a portamento effect. **PORTA TIME/RATE** sets the portamento mode to constant time or constant rate.

PORTA VALUE sets the portamento time/rate from 0 (no effect – instant pitch change) to a maximum of 2000.

TRACK NOTE-OFF sets whether the pitch of the oscillators can update and the envelope generators can re-trigger after note-off events. There are 3 options: **OFF**, **PITCH** and **P+EG**. With settings **PITCH** and **P+EG** the pitch of the oscillators can update on note-off events. With setting **P+EG** re-triggering of the EGs is enabled on note-off events.

> if oscillator pitch is set to track 'highest' note then setting **OFF** the pitch will not change when the highest note is released. However, with setting **P** or **P+EG** the pitch may change to track the new 'highest' note still being played when the note is released. Similarly if EG trigger is set to track 'highest' note then with the setting **OFF** or **P** the EG will not re-trigger when the highest note is released. However, with this setting **P+EG** the EG will re-trigger if there is a new 'highest' note still being played when the note is released.

PITCHWHEEL sets the pitch sensitivity of the current patch in semitones to incoming MIDI pitchbend. Set from 0 (no effect) to 24 (for 2 octaves shift at maximum pitchbend signal).

18.2 Tempo settings

Here the global tempo settings can be set.

At the top right is shown a pulsing square in time with the current clock source (if present).

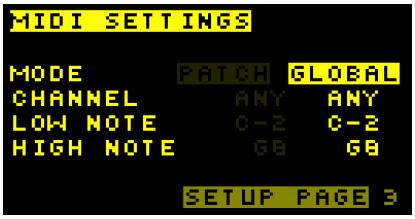
CLK SOURCE sets the active clock source for any synced LFOs, the arpegiator and the pattern/

sequencer. Choose **EXT MIDI** for external MIDI (incoming on USB or MIDI in), **EXT CLK** for gate pulses on the CV/Gate inputs or **INTERNAL** for internal clock source.

The internal clock tempo **INT TEMPO** can be set from 30 to 300 beats per minute (bpm).

CLK OUT sets the options for output clock (only when in internal clock mode). Choose **OFF** to not send MIDI clock, **MIDI** to send MIDI clock on the MIDI out port, **USB** to send MIDI clock on the USB port and **MIDI+USB** to send MIDI clock on both the MIDI out port and USB.

18.3 MIDI channels



The response to incoming MIDI data can be defined for each patch (which is saved with the patch) and in addition as a global setting. **MODE** sets whether MOTAS-6 responds to MIDI data according to the current patch setting or according to the global setting. When **PATCH** is set the editing is for the current patch and when **GLOBAL** is set the editing is for the global setting.

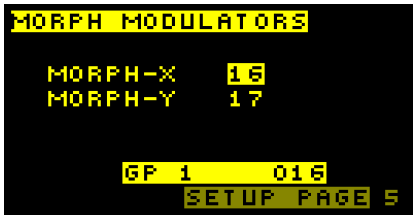
CHANNEL sets the MIDI channel to receive from. **ANY** means data on any MIDI channel will be accepted otherwise set from 1 to 16 to only respond to MIDI data on that channel. **LOW NOTE** sets the lowest MIDI note to process (lower ones are ignored). **HIGH NOTE** sets the highest MIDI note to process (higher ones are ignored). The range is from C-2 (MIDI note 0) to G8 (MIDI note 127), middle C (MIDI note number 60) is C3.

18.4 Modulators

MODE sets whether the 4 patch modulation sources **M1**, **M2**, **M3** and **M4** are set to the current patch settings or to the global setting. When **PATCH** is set the editing is for the current patch and when **GLOBAL** is set the editing is for the global setting.

MOD 1 sets the assignment of the incoming controller to **M1**. The choice is from the standard MIDI controllers plus channel aftertouch, pitchbend and CV/gate channels 1 to 4. At the bottom of the displaya longer name for the chosen source is displayed (channel aftertouch in the screenshot shown above). The same options are available to set the **M2**, **M3** and **M4** modulation sources under **MOD 2**, **MOD 3** and **MOD 4**.

18.5 Morph modulators

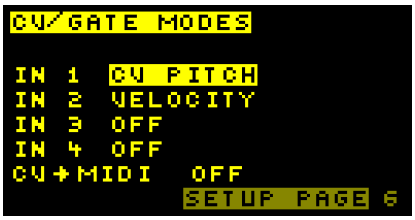


MORPH-X sets the modulation source to control the patch morphing in the x-direction. The choice is from the standard MIDI controllers plus channel aftertouch, pitchbend and CV/gate channels 1 to 4. At the bottom of the display a longer name for the chosen source is displayed.

MORPH-Y sets the modulation source to control the morphing in the y-direction (in exactly the same way as for the **MORPH-X**).

If your MIDI keyboard has a joystick then that is a perfect controller for the morphing x and y.

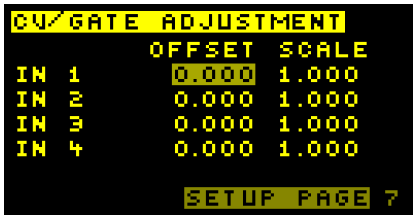
18.6 CV/Gate inputs



MOTAS-6 has 4 analogue CV/gate inputs (D). Each input can be configured independently.

Each input can be set to one of the following 11 options:

OFF	off (ignored)
CV MOD	signal routed to modulation (M1 – M4)
CV PITCH	signal routed to control master pitch
VELOCITY	signal routed to control note velocity
GATE+	signal triggers note on (on positive edges)
GATE-	signal triggers note on (on negative edges)
CLOCK+	signal triggers clock s (on positive edges)
CLOCK-	signal triggers clock (on negative edges)
CV OSC1	signal routed to control pitch of oscillator 1
CV OSC2	signal routed to control pitch of oscillator 2
CV OSC3	signal routed to control pitch of oscillator 3



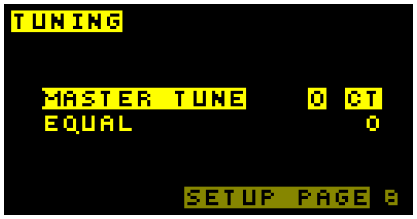
CV/gate offset and scaling

Here the offset and scaling of the input signals on the CV/gate inputs (D) can be indepedently set.

OFFSET sets the offset voltage (zero point) for the input from -9.999 to 9.999. SCALE sets the input scaling from 0.100 to 2.400.

Use the offset and scale values to match your external analogue CV/-gate generating equipment to that of MOTAS-6

18.7 Tuning



MASTER TUNE sets the master tuning of MOTAS-6 from -100 to +100 cents (-1 semitone to +1 semitone).

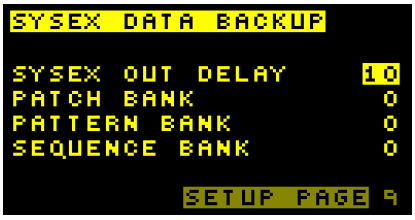
The master tuning system can be set chosen from EQUAL, PYTHAGOREAN, WERKMEISTER, KIRNBERGER, VALLOTTI, MEANTONE C and PURE A MINOR.

The tuning adjustments in cents from EQUAL for each note in the octave are:

PYTHAGOREAN	14, 4, -6, 8, -2, 12, 2, 16, 6, -4, -1
WERKMEISTER	-10, -8, -6, -10, -2, -12, -4, -8, -12, -4, -8
KIRNBERGER	-10, -7, -6, -14, -2, -10, -3, -8, -10, -4, -12
VALLOTTI	-6, -4, -2, -8, 2, -8, -2, -4, -6, 0, -10
MEANTONE C	-24, -7, 10, -14, 3, -21, -3, -17, -10, 7, -17
PURE A MINOR	-29, -18, 16, -16, 2, -31, 2, -17, -16, 18, -12

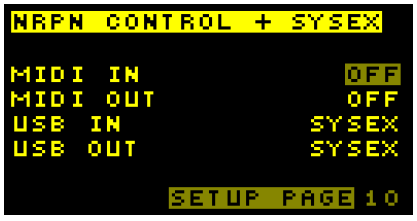
EQUAL tuning is the most common tuning system used in Western music and is the usual tuning for synthesizers that do not have a tuning option.

18.8 SysEx data backup



SYSEX OUT DELAY sets a delay in sending each packet of sysex data (such as patch settings) when using MOTAS-6 with external software over USB/MIDI. Sometimes too small a setting here will cause loss of packets by the receiving device so increase as required (a value of 10 is normally ok). The only downside to a larger number here is slower data transfer.

With PATCH BANK, PATTERN BANK and SEQUENCE BANK the chosen bank (using the rotary encoder) can be sent over USB/MIDI when 1 is pressed to allow data backup.



18.9 NRPN control + SysEx

Here the response to NRPN (Non-Registered Parameter Number) MIDI data and SysEx (System Exclusive) MIDI data is configured. NRPNs are used by MOTAS-6 to send and receive parameter changes in real-time.

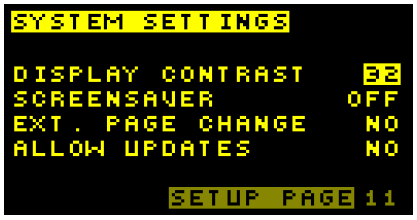
MIDI IN sets which data is processed on the MIDI in connector F. OFF ignores NRPN and SysEx data, NRPN processes NRPN data only, SYSEX processes SysEx data only, NRPN+SYSEX processes both NRPN and SysEx data.

MIDI OUT sets which data is sent on the MIDI out connector with the same options as for the MIDI IN with the addition of THRU which relays incoming MIDI data on the MIDI in port to the MIDI out port E.

USB IN sets which incoming data is processed on the USB connector G with the same options as for MIDI IN .

USB OUT sets which data is sent out on the USB connector G with the same options as for MIDI IN .

18.10 System settings



DISPLAY CONTRAST sets the display con-

trast from 0 to 127.

SCREENSAVER – when set to **ON** the display dims (to contrast level 0) after a certain period of inactivity.

EXT.PAGE CHANGE – when set to **ON** means that the displayed page may change to match that corresponding to the incoming external MIDI controller NRPN data.

ALLOW UPDATES – when set to **ON** allows system firmware updates to be received over MIDI/USB (note that also the **MIDI IN** or **USB IN** must be set to receive sysex to allow upates).

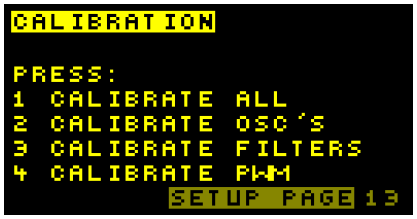
18.11 Custom settings

This page allows a start-up message to be displayed, press 1 to enter your custom message. To enter the message the rotary encoder selects characters or press the labelled letter keys A , B ... Z The ← and → buttons move left and right in the message area. Press ↑ for 'backspace', ↓ for 'delete'. Press 2 to cancel or 3 to save the changes.

18.12 Calibration

MOTAS-6 will have been factory calibrated, but sometimes re-calibration of the internal analogue circuitry may be necessary because it is a real analogue synthesiser (not a digital synth) and the properties of the analogue components can vary with time and temperature.

One of the most important calibrations is the pitch of the oscillators. Some vintage analogue synths have a poor reputation for pitch stability but with MOTAS-6, thanks to advanced design and digital control, the stability is very good.



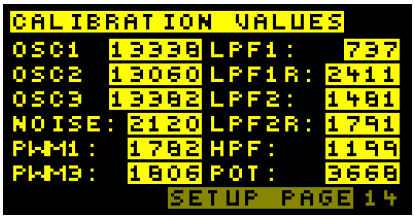
Press 1 to calibrate all parts of the analogue circuitry, 2 to calibrate the pitch of the oscillators and analogue noise level, 3 to calibrate the filter cut-off frequency and resonance levels or 4 to calibrate the PWM offsets (so that 50% is a perfect square wave). Whilst the calibration is running the audio output is disabled and the progress is displayed on the display. To abort any stage of the calibration process press ↓ (and then any other button). The full calibration process will usually take at least 40 seconds to complete.

Occasionally, due to the sensitive nature of some of the measurements the calibration may fail. Don't worry, just try calibrating again later (possibly with a power-cycle).

The calibration of the oscillators internally sets the analogue oscillators at certain pitches and calibrates them against an accurate crystal frequency source, the calibration results are stored in internal non-volatile memory.

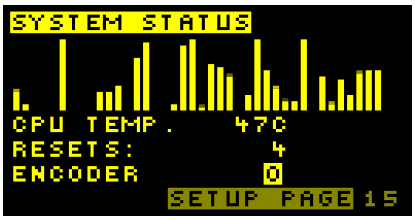
Since MOTAS-6 has real analogue oscillators and filters these will drift a small amount in frequency over time and temperature (helping to give the rich sound quality). Occasionally you may wish to run the calibration particularly if the unit is moved from one extreme of temperature to another or after a long time (say several months).

18.13 Calibration values



This diagnostic page displays the current calibration values (determined from the calibration process), for reference only.

18.14 System status



This diagnostic page shows a series of bar charts representing the current settings of the 33 potentiometers, the approximate CPU temperature, the number of power cycles of the unit and the rotary encoder signal.

18.15 Version info

This page shows (at the top left) a set of 3 unique serial numbers for your MOTAS-6 product as well as the firmware version and the firmware build date.

Pressing 1 on this page allows all of the user settings to be initialised to default values.

Initialising the settings means that all the stored calibration values will be lost as well as modulation assignments, MIDI settings, tuning, cv/gate settings etc. Basically all the settings under the SETUP pages will be initialised to default values.

19 Real-time patch change recording

MOTAS-6 can send and receive MIDI NRPN messages to allow external recording and control of patch settings – see 18.9.

When a patch parameter is changed using the rotary knobs ❶, rotary encoder or buttons ❸ a series of 4 MIDI controller messages are sent:

- NRPN MSB #99 (0x63 in hex)
- NRPN LSB #98 (0x62)
- data entry MSB #6 (0x06)
- data entry LSB #38 (0x26)

The same format of messages, if received via USB or MIDI, cause the current patch to change accordingly.

The NRPN messages indicate exactly which parameter is being changed whilst the data entry messages contain the new parameter value. The first message (controller 99) is sent with the data value from the following table, denoting the parameter page being changed. If the data is for a global source (such as a shared EG or LFO) then the data value is zero.

Parameter Page	NRPN MSB data
N/A (global parameter)	0
Master pitch	1
Oscillator 1 Level	2
Oscillator 1 Pitch	3
Oscillator 1 Triangle Level	4
Oscillator 1 Sawtooth Level	5
Oscillator 1 PWM	6
Oscillator 1 PWM Level	7
Oscillator 2 Phase Mod.	8
Oscillator 2 Level	9
Oscillator 2 Pitch	10
Oscillator 2 Triangle Level	11
Oscillator 2 Sawtooth Level	12
Oscillator 2 Square	13
Oscillator 2 Sub Level	14
Oscillator 3 Phase Mod.	15
Oscillator 3 Level	16
Oscillator 3 Pitch	17
Oscillator 3 Triangle Level	18
Oscillator 3 Sawtooth Level	19
Oscillator 3 PWM	20
Oscillator 3 PWM Level	21
Noise Level	22
Mix Level	23
Low-pass Filter 1 cut-off	24
Low-pass Filter 1 resonance	25
Low-pass Filter 1 level	26
High-pass Filter cut-off	27
High-pass Filter level	28
Feedback/Ext in Level	29
Low-pass Filter 2 cut-off	31
Low-pass Filter 2 resonance	32
Low-pass Filter 2 Level	33
Output Level	35

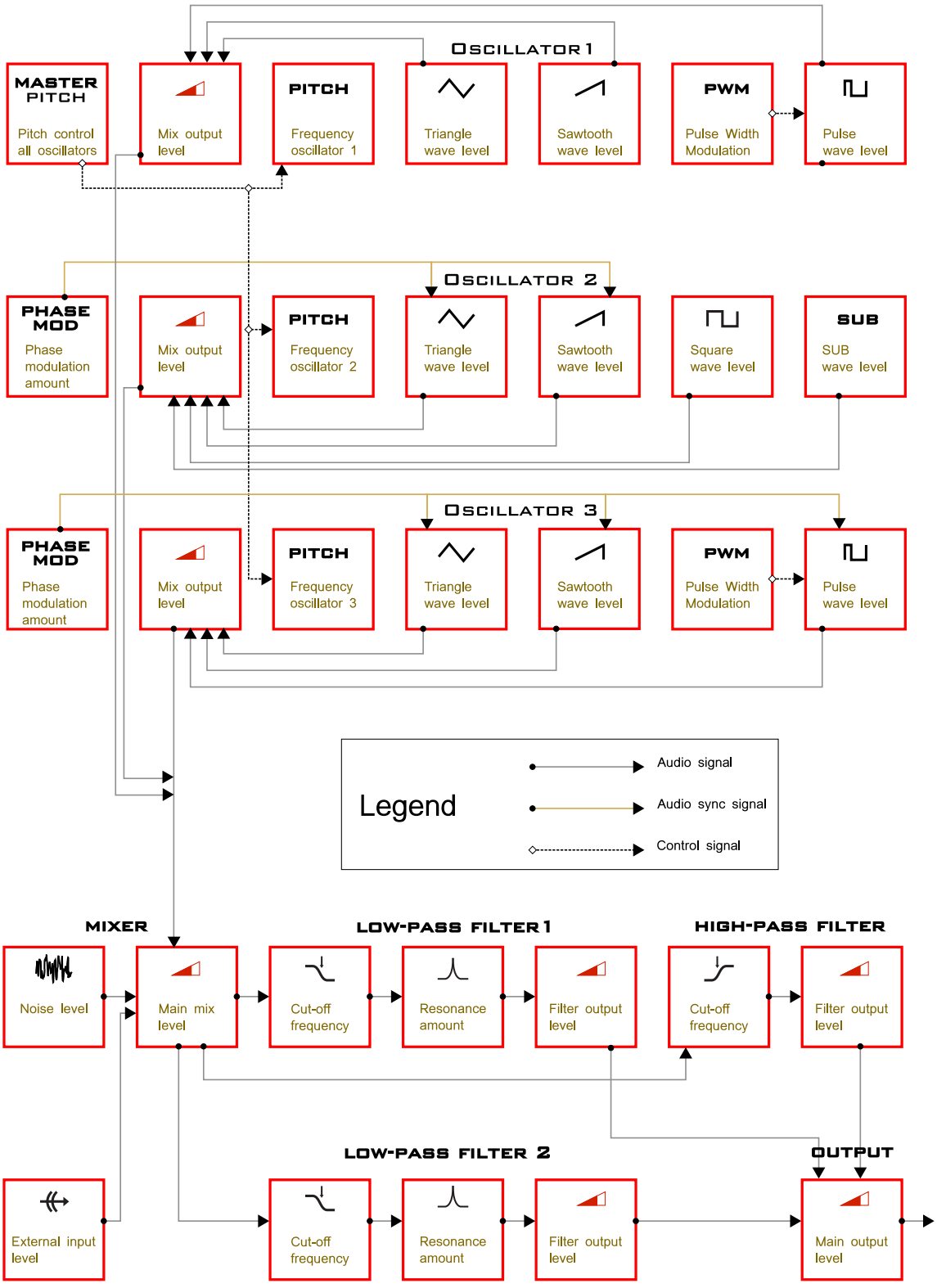
In the case of a page-related parameter changing (i.e. NRPN MSB value not zero) then the second message sent (controller 98) has the data value from the following table, denoting the parameter from that page being changed.

Page data	NRPN LSB data
Offset	1
EG mod depth	5
EG delay	10
EG attack	11
EG decay	12
EG sustain	13
EG release	14
LFOx mod depth	20
LFO frequency	25
LFO mod depth	26
M1 level	30
M1 alternate dest. level	31
M2 level	35
M2 alternate dest. level	36
M3 level	40
M3 alternate dest. level	41
M4 level	45
M4 alternate dest. level	46
Velocity level	50
Velocity alternate dest. level	51
Note level	55
Note alternate dest. level	56
Page option 1	64
Page option 2	65
EG source	70
EG retrig	71
EG restart	72
EG shape	75
LFO source	80
LFO waveform	85
LFO trigger	86
LFO single shot	87
LFO output mode	88
M1 destination	90
M2 destination	95
M3 destination	100
M4 destination	105
velocity destination	110
note destination	115

In the case of a global parameter changing (i.e. NRPN MSB value was zero) then the second message sent (controller 98) has the data value from the following table, denoting the global parameter.

Global data	NRPN LSB data
LFOx 1 frequency	4
LFOx 2 frequency	5
LFOx 3 frequency	6
LFOx 4 frequency	7
EGx 1 delay	12
EGx 2 delay	13
EGx 3 delay	14
EGx 4 delay	15
EGx 1 attack	20
EGx 2 attack	21
EGx 3 attack	22
EGx 4 attack	23
EGx 1 decay	28
EGx 2 decay	29
EGx 3 decay	30
EGx 4 decay	31
EGx 1 sustain	36
EGx 2 sustain	37
EGx 3 sustain	38
EGx 4 sustain	39
EGx 1 release	44
EGx 2 release	45
EGx 3 release	46
EGx 4 release	47
portmento mode	52
portmento time	53
portmento time/rate	54
M1 source	64
M2 source	65
M3 source	66
M4 source	67
LFOx 1 trigger	72
LFOx 2 trigger	73
LFOx 3 trigger	74
LFOx 4 trigger	75
LFOx 1 single-shot	76
LFOx 2 single-shot	77
LFOx 3 single-shot	78
LFOx 4 single-shot	79
LFOx 1 waveform	80
LFOx 2 waveform	81
LFOx 3 waveform	82
LFOx 4 waveform	83
EGx 1 trigger	88
EGx 2 trigger	89
EGx 3 trigger	90
EGx 4 trigger	91
EGx 1 restart	96
EGx 2 restart	97
EGx 3 restart	98
EGx 4 restart	99
EGx 1 shape	104
EGx 2 shape	105
EGx 3 shape	106
EGx 4 shape	107

I Signal path diagram (simplified)



II Glossary

Here are some terms used in sound synthesis relevant to MOTAS-6.

ADSR – Abbreviation for Attack, Decay, Sustain and Release, the four stages of an envelope control commonly present on classic analogue synthesizers. MOTAS-6 has a D-ASDR structure for it's envelopes. That is Delay, Attack, Sustain, Decay, Release expanding on the usual ADSR envelope generator structure.

Amplitude – The strength of a sound's vibration. Amplitude corresponds to the musical term loudness.

Continuous Controller (CC) – A type of MIDI message used to transmit control commands. These commands are digital control signals for parameters such as volume, vibrato and panning. With MOTAS-6 any of these controller codes can be mapped to each of the 4 modulation sources.

Envelope – An envelope describes the contour that affect the characteristics of a sound (pitch, tone and volume) over time. For example, when a string is plucked, its amplitude or volume begins strongly and decays gradually over time. To synthesize this effect an envelope can be applied to the level of the sound i.e. using a parameter page with the  symbol.

The initial part of the plucked sound is very bright, but then the brightness fades away. This describes a tonal envelope. To synthesize this effect an envelope can be applied to the cut-off frequency of one of the MOTAS-6 low-pass filters i.e. using the parameter pages  .

We may also hear the frequency of the sound go slightly higher when the string is plucked, and then drop slightly as the note fades. This is the pitch envelope contour. To synthesize this effect an envelope can be applied to the frequency of the MOTAS-6 oscillators i.e. pages  .

Envelope Generator – In MOTAS-6 this is a modulation signal that has 5 stages in time: Delay, Attack, Decay, Sustain and Release (D-ADSR). This signal can be applied to the parameters of the patch to cause the sound to vary over time.

The Delay, Attack, Decay and Release segments are specified in units of time, while the Sustain segment is a simply a level setting.

The envelope is triggered by MIDI key presses.

Delay specifies the delay after the envelope is triggered until the envelope starts the Attack portion. Attack specifies the time taken for the envelope signal to rise to it's maximum value. Decay specifies how quickly the onset of the envelope fades into the sustained portion. Sustain is the level at which the envelope sustains after the delay, attack and decay portions. Finally, Release determines how long the envelope takes to fade away when the envelope trigger is removed. Depending on the trigger mode the release phase starts when a key, or all keys are released.

Filter – A circuit that attenuates (reduces the strength of) some frequencies allowing other frequencies to pass through essentially unchanged. A filter has a cutoff frequency that determines the point at which frequencies begin to be attenuated. A low-pass filter is one in which frequencies above the cutoff frequency are attenuated and all frequencies below the cutoff are passed through.

A high-pass filter is one in which frequencies below the cutoff frequency are attenuated and frequencies above the cutoff are passed through. A band-pass filter has two cutoff frequencies that define a frequency band, outside of which the frequencies are attenuated.

MOTAS-6 has 2 independent low-pass filters and one high-pass filter.

Frequency – The rate of vibration in Hertz (Hz or cycles per second). The average hearing range of the human ear is from 20 to 20,000 Hz. Frequency corresponds to the musical term 'pitch', but the

two terms are not always interchangeable. Frequency is an objective measurement of a sound, while pitch is the perception of a sound, low, high, or mid-ranged. A low frequency corresponds to a low-pitched sound such as a bass; a high frequency sound corresponds to a high-pitched sound such as a piccolo. In music, a change in pitch of one octave higher equals a doubling of the frequency.

Harmonic – A sound is made up of simple vibrations at many different frequencies (called harmonics) that give a sound its particular character. This corresponds to the musical term timbre or tone color. A harmonic sound, such as a vibrating string, is one in which the harmonics are mathematically related by what is called the harmonic series. These sounds are typically pleasing to the ear and generally the consecutive vibrations have the same characteristic shape or waveform. An inharmonic sound, such as a crash cymbal, is one in which the harmonics are not mathematically related. Their waveforms look chaotic. White noise is an inharmonic sound that contains equal signal levels at all frequencies. A sine wave is a 'pure' tone that has no harmonics.

Low Frequency Oscillator – Also called an LFO, this is a special type of oscillator that generates signals primarily below the range of human hearing (generally below 20 Hz but up to more than 400 Hz on MOTAS-6). LFOs are typically used as a source of modulation. For instance, an LFO with a triangle waveform, set to about 6 Hz and modulating the pitch of a VCO results in vibrato. Changing the LFO waveform to a square wave will result in a trill. An LFO modulating a VCA with a triangle wave creates tremolo.

Mixer – A circuit for combining multiple sound sources.

Modulation – Modulation is the use of a control signal to shape a sound parameter. Modulation has a source, a destination, and an amount. This could be as simple as the filter cutoff of a filter (a modulation destination) being changed by the rotary knob 1. Modulation is used in synthesis to create complex sounds and add interesting variation.

Morphing – a feature on MOTAS-6 where you can smoothly change the sound settings from one patch to another using a MIDI controller.

Noise – A random audio signal having no fundamental, and where all the harmonics have equal strength with frequency (white noise) or decaying level at higher frequencies at a certain rate (pink noise). Noise can be used as either an audio or modulation source. When used as an audio source, noise can be used by itself to synthesize explosions or wind noises, or can be mixed with other waveforms to create noise artifacts, such as breath sounds.

Oscillator – A circuit that electronically 'vibrates'. When used as a sound source, an oscillator is the electronic equivalent of a vibrating reed, or string. An oscillator produces a pitched sound whose frequency is determined by one or more control voltages. Changes to these voltages correspond to changes in pitch. An oscillator's vibration can have different shapes or waveforms, such as a triangle, sawtooth, or square wave.
MOTAS-6 has three oscillators for generating sounds.

Phase modulation – Also known as PM, Phase Modulation describes the technique of using one oscillator to modulate the phase of another. In PM, the modulating oscillator is called the 'modulator', while the other oscillator is known as the 'carrier'. The carrier oscillator is the one you hear. When the modulator frequency is very low (about 6Hz), the effect is described as vibrato. As the modulator frequency is raised into the audio range, new modulation frequency components are created, and the effect is perceived as adding new overtones to the carrier signal. Phase Modulation is related (and is similar) to Frequency Modulation (FM) but the pitch stability is better. In fact, the classic 'FM synthesizers' from the 80s actually employed Phase Modulation. . .

Pitch – The subjective perception of sound. A bass

guitar generates low pitches (low frequencies), while a flute generates high pitches (high frequencies).

Pole (or poles) – A term referring to the design of a filter circuit. In a low-pass filter each filter pole adds 6 dB/octave of attenuation to the filter response, so while a single pole filter has a 6dB/Octave response, a 4-pole filter has a 24dB/Octave response. MOTAS-6 has 3 separate analogue filters. One is a low-pass up to 36-pole design with adjustable resonance, the second is a 4-pole low-pass filter with resonance and the third is a 2-pole high pass filter. The more poles the steeper the roll-off and the stronger the filtering effect.

Portamento – Also called glide, is the slowing down of pitch changes as you play different notes on the keyboard. Certain acoustic instruments, like the trombone or the violin, create this effect when the performer adjusts the tubing or string length. The rate of change of pitch can be set in constant time or constant rate mode.

Sample and Hold (S&H) – A circuit that generates a control voltage corresponding to the input signal at the time a trigger or gate signal is received. Sample and hold circuits usually employ white noise as a signal source, taking samples of this signal and holding that sample until the next sample is taken. The LFOs on MOTAS-6 have a S&H waveform option.

Sound – Audible vibrations of air pressure. For electronic sounds such as those produced by a synthesizer, loudspeakers or headphones are used to translate the electrical vibrations into the changes in air pressure which we perceive as sound.

Subtractive synthesis – A method of creating tones using harmonically rich (bright) source material, and then removing (or in some cases emphasizing) various frequency components to create the desired sound. MOTAS-6 employs subtractive synthesis in common with most other analgue synthesizers.

Synthesis – The generation of sound by electronic means, where programmer/performer has the ability to change the pitch, volume, timbre and articulation.

Timbre – Refers to the quality of a sound by its overtones. An unprocessed sawtooth wave has a bright timbre, while a triangle wave has a mellow timbre.

Tremolo – Low frequency amplitude modulation of the volume level. In synthesizers, tremolo is produced when a 5–7Hz LFO triangle or sine wave signal is applied to the volume level.

Waveform – The shape of an oscillator's vibration. This determines its timbre. Commonly used waveforms in subtractive synthesis are sawtooth, triangle, square, or rectangular. Different waveforms have different timbres. A sawtooth has the even and odd harmonics, and sounds bright and buzzy. A square wave has only odd harmonics, and sounds bright, but hollow, like a clarinet. A rectangular wave can vary in shape, but typically has a bright but thin sound. A triangle wave has the same odd harmonics as the square wave but the amplitudes lower in amplitude so that it sounds muted and flutelike.

Vibrato – a low frequency modulation of the pitch - giving a smooth warble sound. In synthesizers, vibrato is produced when a 5–7Hz LFO triangle or sine wave signal is applied to oscillator pitch, causing the pitch to deviate slightly above and below the base frequency.

III MIDI Implementation Chart

MIDI Implementation Chart v. 2.0 (Page 1 of 3) Manufacturer: Motas Electronics Limited. Model: Motas 6. Version: r2. Date: September 2017.			
	Transmit/Export	**Recognise/Import**	**Remarks**
1. Basic Information			
MIDI channels	1 – 16	1– 16	see 18.3
Note numbers	No	0 – 127	see 18.3
Program change	No	0 – 4	changes active preset
Bank Select response? (Yes/No) If yes, list banks utilized in remarks column		No	
Modes supported : Mode 1: Omni-On, Poly (Yes/No) Mode 2: Omni-On, Mono (Yes/No) Mode 3: Omni-Off, Poly (Yes/No) Mode 4: Omni-Off, Mono (Yes/No) Multi Mode (Yes/No)		No No No No No	Can be set to receive on any channel see 18.3
Note-On Velocity (Yes/No)		Yes	
Note-Off Velocity (Yes/No)	No	No	
Channel Aftertouch (Yes/No)		Yes	see 18.4
Poly (Key) Aftertouch (Yes/No)		No	
Pitch Bend (Yes/No)		Yes	see 18.1
Active Sensing (Yes/No)		Yes	
System Reset (Yes/No)	No	No	
Tune Request (Yes/No)	No	No	
Universal System Exclusive: Sample Dump Standard (Yes/No) Device Inquiry (Yes/No) File Dump (Yes/No) MIDI Tuning (Yes/No) Master Volume (Yes/No) Master Balance (Yes/No) Notation Information (Yes/No) Turn GM1 System On (Yes/No) Turn GM2 System On (Yes/No) Turn GM System Off (Yes/No) DLS-1 (Yes/No) File Reference (Yes/No) Controller Destination (Yes/No) Key-based Instrument Ctrl (Yes/No) Master Fine/Coarse Tune (Yes/No) Other Universal System Exclusive	No No No No No No No No No No No No No No No No	No No No No No No No No No No No No No No No No	
Manufacturer or Non-Commercial System Exclusive	Yes	Yes	Motas Electronics Ltd ID# : 00H 21H 2FH
NRPNs (Yes/No)	Yes	Yes	see 19
RPN 00 (Pitch Bend Sensitivity) (Yes/No) RPN 01 (Channel Fine Tune) (Yes/No) RPN 02 (Channel Coarse Tune) (Yes/No) RPN 03 (Tuning Program Select) (Yes/No) RPN 04 (Tuning Bank Select) (Yes/No) RPN 05 (Modulation Depth Range) (Yes/No)	No No No No No No	No No No No No No	
2. MIDI Timing and Synchronization			
MIDI Clock (Yes/No)	Yes	Yes	see 18.2
Song Position Pointer (Yes/No)	No	No	
Song Select (Yes/No)	No	No	
Start (Yes/No) Continue (Yes/No) Stop (Yes/No)	No No No	Yes Yes Yes	
MIDI Time Code (Yes/No)	No	No	
MIDI Machine Control (Yes/No)	No	No	
MIDI Show Control (Yes/No) If yes, MSC Level supported	No No	No No	
3. Extensions Compatibility			
General MIDI compatible? (Level(s)/No) Is GM default power-up mode? (Level/No)	No	No	
DLS compatible? (Levels(s)/No) (DLS File Type(s)/No)	No No	No No	
Standard MIDI Files (Type(s)/No)	No	No	
XMF Files (Type(s)/No)	No	No	
SP-MIDI compatible? (Yes/No)	No	No	

MIDI Implementation Chart v. 2.0 (Page 2 of 3)

Manufacturer: Motas Electronics Limited. Model: Motas 6. Version: r2. Date: September 2017.

Control #	Function	Transmitted (Y/N)	Recognised (Y/N)	Remarks
0	MIDI Bank Select (MSB)	Y	Y	18.4
1	Modulation Wheel (MSB)	Y	Y	See 18.4
2	Breath Controller (MSB)	Y	Y	see 18.4
3		Y	Y	see 18.4
4	Foot Controller (MSB)	Y	Y	see 18.4
5	Portamento Time (MSB)	Y	Y	see 18.4
6	Data Entry (MSB)	Y	Y	see 18.4 and 19
7	Channel Volume (MSB)	Y	Y	See 18.4
8	Balance (MSB)	Y	Y	see 18.4
9		Y	Y	see 18.4
10	Pan (MSB)	Y	Y	see 18.4
11	Expression (MSB)	Y	Y	see 18.4
12	Effect Control 1 (MSB)	Y	Y	see 18.4
13	Effect Control 2 (MSB)	Y	Y	see 18.4
14		Y	Y	see 18.4
15		Y	Y	see 18.4
16	General Purpose Controller 1 (MSB)	Y	Y	see 18.4
17	General Purpose Controller 2 (MSB)	Y	Y	see 18.4
18	General Purpose Controller 3 (MSB)	Y	Y	see 18.4
19	General Purpose Controller 4 (MSB)	Y	Y	see 18.4
20		Y	Y	see 18.4
21		Y	Y	see 18.4
22		Y	Y	see 18.4
23		Y	Y	see 18.4
24		Y	Y	see 18.4
25		Y	Y	see 18.4
26		Y	Y	see 18.4
27		Y	Y	see 18.4
28		Y	Y	see 18.4
29		Y	Y	see 18.4
30		Y	Y	see 18.4
31		Y	Y	see 18.4
32	Bank Select (LSB	N	N	
33	Modulation Wheel (LSB)	N	N	
34	Breath Controller (LSB)	N	N	
35		N	N	
36	Foot Controller (LSB)	N	N	
37	Portamento Time (LSB)	N	N	
38	Data Entry (LSB)	Y	Y	see 19
39	Channel Volume (LSB)	N	N	
40	Balance (LSB)	N	N	
41		N	N	
42	Pan (LSB)	N	N	
43	Expression (LSB)	N	N	
44	Effect Control 1 (LSB)	N	N	
45	Effect Control 2 (LSB)	N	N	
46		N	N	
47		N	N	
48	General Purpose Controller 1 (LSB)	N	N	
49	General Purpose Controller 2 (LSB)	N	N	
50	General Purpose Controller 3 (LSB)	N	N	
51	General Purpose Controller 4 (LSB)	N	N	
52		N	N	
53		N	N	
54		N	N	
55		N	N	
56		N	N	
57		N	N	
58		N	N	
59		N	N	
60		N	N	
61		N	N	
62		N	N	
63		N	N	

MIDI Implementation Chart v. 2.0 (Page 3 of 3)

Manufacturer: Motas Electronics Limited. Model: Motas 6. Version: r2. Date: September 2017.

Control #	Function	Transmitted (Y/N)	Recognised (Y/N)	Remarks
64	Sustain Pedal	Y	Y	see 18.4
65	Portamento On/Off	Y	Y	see 18.4
66	Sostenuto	Y	Y	see 18.4
67	Soft Pedal	Y	Y	see 18.4
68	Legato Footswitch	Y	Y	see 18.4
69	Hold 2	Y	Y	see 18.4
70	Sound Controller 1 (default: Sound Variation)	Y	Y	see 18.4
71	Sound Controller 2 (default: Timbre / Harmonic Quality)	Y	Y	see 18.4
72	Sound Controller 3 (default: Release Time)	Y	Y	see 18.4
73	Sound Controller 4 (default: Attack Time)	Y	Y	see 18.4
74	Sound Controller 5 (default: Brightness)	Y	Y	see 18.4
75	Sound Controller 6 (GM2 default: Decay Time)	Y	Y	see 18.4
76	Sound Controller 7 (GM2 default: Vibrato Rate)	Y	Y	see 18.4
77	Sound Controller 8 (GM2 default: Vibrato Depth)	Y	Y	see 18.4
78	Sound Controller 9 (GM2 default: Vibrato Delay)	Y	Y	see 18.4
79	Sound Controller 10 (GM2 default: Undefined)	Y	Y	see 18.4
80	General Purpose Controller 5	Y	Y	see 18.4
81	General Purpose Controller 6	Y	Y	see 18.4
82	General Purpose Controller 7	Y	Y	see 18.4
83	General Purpose Controller 8	Y	Y	see 18.4
84	Portamento Control	Y	Y	see 18.4
85		Y	Y	see 18.4
86		Y	Y	see 18.4
87		Y	Y	see 18.4
88		Y	Y	see 18.4
89		Y	Y	see 18.4
90		Y	Y	see 18.4
91	Effects 1 Depth (default: Reverb Send)	Y	Y	see 18.4
92	Effects 2 Depth (default: Tremolo Depth)	Y	Y	see 18.4
93	Effects 3 Depth (default: Chorus Send)	Y	Y	see 18.4
94	Effects 4 Depth (default: Celeste (Detune) Depth)	Y	Y	see 18.4
95	Effects 5 Depth (default: Phaser Depth)	Y	Y	see 18.4
96	Data Increment	Y	Y	see 18.4
97	Data Decrement	Y	Y	see 18.4
98	Non-Registered Parameter Number (LSB)	Y	Y	see 19
99	Non-Registered Parameter Number(MSB)	Y	Y	See 19
100	Registered Parameter Number (LSB)	Y	Y	see 19
101	Registered Parameter Number(MSB)	Y	Y	see 19
102		Y	Y	see 18.4
103		Y	Y	see 18.4
104		Y	Y	see 18.4
105		Y	Y	see 18.4
106		Y	Y	see 18.4
107		Y	Y	see 18.4
108		Y	Y	see 18.4
109		Y	Y	see 18.4
110		Y	Y	see 18.4
111		Y	Y	see 18.4
112		Y	Y	see 18.4
113		Y	Y	see 18.4
114		Y	Y	see 18.4
115		Y	Y	see 18.4
116		Y	Y	see 18.4
117		Y	Y	see 18.4
118		Y	Y	see 18.4
119		Y	Y	see 18.4
120	All Sound Off	N	Y	
121	Reset All Controllers	N	Y	
122	Local Control On/Off	N	N	
123	All Notes Off	N	Y	
124	Omni Mode Off	N	N	
125	Omni Mode On	N	N	
126	Poly Mode Off	N	N	
127	Poly Mode On	N	N	

IV MIDI SysEx messages

This appendix is for reference purposes mainly for those wishing to develop software to communicate with MOTAS-6. MIDI system exclusive (SysEx) messages allow transfer of bulk data such as patch data, screenshot images and firmware updates. Further details are available on request.

The following table shows the message format that can be used by a connected MIDI device to request data from MOTAS-6

MIDI SysEx request message format	
SysEx byte	**Description**
0xF0	start
0x00	Motas Electronics identifier
0x21	Motas Electronics identifier
0x2F	Motas Electronics identifier
0x06	product id (6 = motas-6)
X	MIDI channel byte 'X'
0x00	reserved
CB	SysEx command byte 'CB'
P	SysEx parameter byte'P'
0xF7	end

The following table shows the message format for bulk data messages that can be sent or received. In the case of larger data transfers they are split up and sent in multiple smaller packets using the start/continue/end byte indicator.

MIDI SysEx bulk data transfer message format	
SysEx byte	**Description**
0xF0	start
0x00	Motas Electronics identifier
0x21	Motas Electronics identifier
0x2F	Motas Electronics identifier
0x06	product id (6 = motas-6)
X	MIDI channel 'X'
0x00	reserved
CB	SysEx command byte 'CB'
SCE	SysEx start/continue/end byte 'SCE' 0x71 = start, 0x72 = continue, 0x73 = end
A	SysEx parameter 'A'
B	SysEx parameter 'B'
C	SysEx parameter 'C'
DD . . .*	multiple data bytes 'DD' encoded from original data bytes 'XX' to limit each byte value <= 0x7F required by MIDI protocol
CRC †	only present if this is an 'end' packet – 4-byte CRC of the original data bytes 'XX'
0xF7	end

MIDI SysEx Command Listing		
Command description	**SysEx command 'CB'**	**SysEx parameter(s)**
Request commands		
Request screenshot bitmap	0x0A	–
Request oscilloscope trace	0x0B	–
Request bulk data	0x0C	–
Request info	0x0E	–
Request global data	0x0F	–
Request status	0x11	P = 0x01 : auto page change on
Request patch	0x14	–
Request patch bank	0x15	P = bank number
Request pattern	0x19	–
Request pattern bank	0x1A	P = bank number
Request sequence	0x1E	–
Request sequence bank	0x1F	P = bank number
Request abort process	0x4B	–
Data transfer		
Screenshot	0x28	–
Oscilloscope data	0x29	–
Info	0x2A	–
Screenshot compressed‡	0x2B	–
Global data	0x2D	–
Patch	0x32	A = 0x73 B = current preset#
Patch bank	0x33	A = bank# B = index#
Pattern	0x37	A = 0x73 B = current pattern#
Pattern bank	0x38	A = bank# B = index#
Send sequence	0x3C	A = 0x73 B = 0
Send sequence bank	0x3D	A = bank# B = index#
Send status	0x3E	–
Send bulk data	0x0C	–
Receive-only commands		
Receive bulk data	0x0D	
Receive firmware	0x46	

* To decode the bytes values to the original data a sequence of 8 bytes is processed using the following c-code algorithm:

```
for (i = 0; i < 8; i++) {
  if (i == 0) {
      msbByte = byte(i);
      msbCount = 1;
    } else {
      decodedByte =  byte(i) | ((msbByte << msbCount
    ) & 0x80);
      msbCount++;
    }
}
```

† The CRC algorithm is 32 bit, uses the initial value 0xFFFFFFFF, polynomial value 0x04C11DB7 and final XOR value of 0x00000000

‡ Compression algorithm details available on request.

V Specifications

Input power connection	12 V DC (± 10 %) on 2.1 mm socket (positive centre pin)
Power/current consumption	< 10 W / < 800 mA
Dimensions (w x d x h)	408 mm x 218 mm x 58 mm
Weight	approx. 3 kg
Operating temperature	15 – 30 °C
Storage temperature	5 – 40 °C
Sound generation	analogue with digital control
Construction	stainless steel and aluminium panels (top/rear panels painted or with clear anti-fingerprint coating), stainless steel fixings and solid wood end-cheeks
Display	128 x 64 pixel OLED graphic display
User interaction	34 rotary potentiometers, 33 tactile buttons and rotary encoder
Audio input	mono input on 6.35 mm ($\frac{1}{4}''$) phone socket
CV/Gate inputs	4 CV/Gate analogue inputs on 3.5 mm mono sockets. Input impedance 22 kΩ. Voltage range 0 . . . 12V max.
Audio outputs	mono master out and headphones out on 6.35 mm ($\frac{1}{4}''$) phone sockets
MIDI connections	MIDI in and MIDI out on 5-pin DIN sockets
USB	USB MIDI device on type-B connector

VI EU Declaration of Conformity

Type of Equipment

Electronic music synthesizer audio equipment.

Object of the Declaration:

Named product: Motas-6 Synthesizer

Manufacturer:

Motas Electronics Limited, Windsor House, Station Court, Station Road, Great Shelford, Cambridge, CB22 5NE, United Kingdom. email: info@motas-synth.uk web: www.motas-synth.uk

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

DIRECTIVE 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.

DIRECTIVE 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Standards to Which Conformity Is Declared:

(for DIRECTIVE 2014/30/EU) EN 55032:2012 and EN 55103-2:2009

Signed for and on behalf of Motas Electronics Limited:

Place of issue:

Cambridge, United Kingdom.

Date of issue:

25th September 2017

Name and position:

Dr J M Hayes, director.

CE