



MEEBLEEPS MACHINES

FREQ FM

8-BIT GENERATIVE DIGITAL FM SYNTHESIZER

OPERATION MANUAL

HARDWARE REVISION	1.30
FIRMWARE REVISION	1.10
DOCUMENT REVISION	1.30

CONTENTS

Introduction	3
Voices	3
Sequencer	3
Hardware	3
Operations Manual	4
Display	4
Sound Synthesis	4
Sequencer	5
Button Controls	6
Rotary Controls	7
Specifications	8
Voice Architecture	8
Sequencer Architecture	8
Technical Specifications	9

INTRODUCTION

The Freq FM is an 8-bit digital synthesizer for your desktop featuring dual FM voices paired with a 2-track generative sequencer.

From soul-soothing sine waves to multiverse-shredding modulated distortion, slapping bass lines to soaring arp leads, the Freq FM is a powerhouse of sound design packaged with a melodic and intuitive generative sequencer inspired by the likes of Elektron, Intellijel & Music Thing.

With 2 channels of liquid FM sounds, it plays great by itself or synced with your favourite external gear.

VOICES

- 2 independent FM voices
- 2-operator FM (for old-school Prince of Persia vibes!)
- Multi-mode FM ratios – quantised, free-multiple, independent
- Multiple operator waveforms for carrier & modulator – Sine, Saw, Reverse Saw, Square, Noise, Off
- Attack/Decay modulation envelope per voice
- LFO per voice with multiple waveforms and selectable destination: envelope attack, decay & depth, FM ratio, note length or modulation level

SEQUENCER

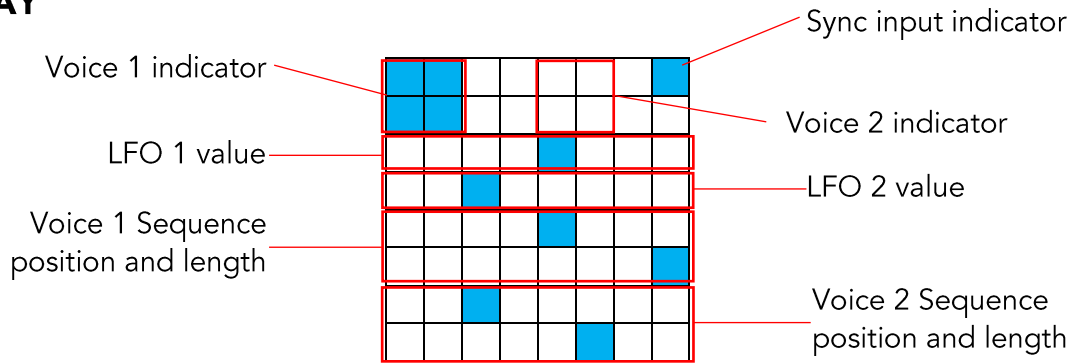
- 2/1.5 track polymeric sequencer with up to 16 steps per track (Both tracks use same note sequence but can have different step-counts for poly-metric rhythms)
- Multiple generative algorithms – (semi)random notes, (semi)random runs, arpeggio, drone
- Sequence mutates/evolves at user-defined rate & note-density
- Selectable tonic, octave & scale – Ionian (Major), Minor (Dorian), Pentatonic, Phrygian (GOA!), Octaves, Fifths
- Tap-tempo control
- Sync input & output (Korg Volca compatible)
- 16-step parameter-lock recording of synth parameters (**track 1 only**)

HARDWARE

- Audio output (16KHz 14-bit DAC)
- Sync input / output (0-5V rising-edge)
- Powered by an Arduino Nano V3
- 112mm (w) x 100mm (d) x 40mm (h)
- 7-12V DC or micro USB powered.
- Current draw 300mA @ 12VDC

OPERATIONS MANUAL

DISPLAY



SOUND SYNTHESIS

VOICE SELECTION

- Press [VOICE] to toggle between the two voices
- Press [FUNC]+[VOICE] to toggle Control-All mode to control both voices at once

OCTAVE

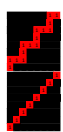
- Hold [FUNC] and turn [AMP DECAY] to set the octave for the current voice

MODULATION ENVELOPE

- Use the [ATTACK], [DECAY] and [DEPTH] controls to set the shape and intensity of the modulation envelope

FREQUENCY MODULATION RATIO

- Turn [FM RATIO] to control the ratio between the carrier and modulator
- Hold [FUNC] and turn [MODE] to access different multiplier modes for the ratio



Quantised multiple



Un-quantised multiple (low range)

Un-quantised multiple (high range)

Unrelated

- Hold [FUNC] and turn [ATTACK/CARRIER] or [DECAY/MOD] to control the waveform of the carrier or the modulator

LFO

- Turn [LFO DEPTH] to control the intensity of the LFO
- Hold [FUNC] and turn [LFO RATE] to control the speed of the LFO
- Hold [FUNC] and turn [DEPTH/LFO] to change the waveform for the LFO
- Press [FUNC]+[LFO ->] to control what parameter is affected by the LFO



attack



envelope depth



amp decay



decay



ratio



overall modulation amount

OPERATIONS MANUAL (CONTINUED...)

SEQUENCER

- Press [START] to start the sequencer running
- Hold [FUNC] while tapping [START] to set the tempo. The Freq FM will average 4 consecutive taps

SYNC WITH OTHER GEAR

- The Freq FM responds to a rising-edge 5V trigger signal received on the SYNC IN jack.
- To control how many steps the sequencer advances, hold [FUNC] and turn [SEQ LEN]. The default value is 2 (Volca compatible).

MUTATION - HOW FAST THE SEQUENCE CHANGES

- More often: turn [MUTATION] clockwise
- Less often: turn [MUTATION] anticlockwise
- Never: turn [MUTATION] fully anti-clockwise

DENSITY - HOW MANY STEPS HAVE NOTES

- More steps have notes: hold [FUNC] and turn [DENSITY] clockwise
- Less steps have notes: hold [FUNC] and turn [DENSITY] fully clockwise

LENGTH - HOW MANY STEPS IN THE SEQUENCE (SETTING IS PER VOICE)

- More steps (up to 16), turn [SEQ LEN] clockwise
- Less steps (down to 1), turn [SQL LEN] anticlockwise

MUSICAL TONIC & SCALE

- To change the scale, press [SCALE]
- To change the tonic, press [FUNC]+[SCALE]

ALGORITHM – HOW THE NOTES ARE GENERATED

- To change the generative algorithm, press [ALGO]

PARAMETER LOCKING

- Hold [REC] while moving a control to record that movement into the sequence



is displayed when recording mode is activated

- Hold [FUNC]+[REC] while moving a control to delete all recorded parameter locks for that control



is displayed when recording-delete mode is activated

OPERATIONS MANUAL (CONTINUED...)

BUTTON CONTROLS

Button	Primary Function	Alternative Function (hold [FUNC])
[START]	Start or stop the sequencer	Tap tempo
[SCALE]	Select current musical scale <ul style="list-style-type: none">• Ionian• Dorian• Minor Pentatonic• Phrygian• Octave• Octave + 5ths	Select tonic through natural notes A - G
[LFO]	Select the destination for the current voice LFO <ul style="list-style-type: none">• Mod Envelope Attack• Mod Envelope Decay• Mod Envelope Depth• Modulation amount• FM Ratio• Note length	Select the generative algorithm used to control the sequencer <ul style="list-style-type: none">• Standard mode. Creates single notes with a bias to the tonic note• Arp-run mode. Creates short runs of multiple notes in the scale will be inserted• Drone. Disables the sequencer and puts the modulation envelope into looping mode• Scale. Sequence loops through all scale notes with no generative algorithm
[VOICE]	Switch between voice 1 and voice 2	Toggles all-voice control. When active, changes to control values affect both voice 1 and voice 2
[REC]	Hold [REC] while moving a control to record those parameter changes to the sequence	Hold [FUNC]+[REC] while moving a control to delete any recorded parameter changes from the sequence
[FUNC]	Access control's alternative function	n/a

OPERATIONS MANUAL (CONTINUED...)

ROTARY CONTROLS

Rotary Control	Primary Function	Alternative Function (hold [FUNC])
[MUTATION]	Control the likelihood that the sequence will change over time	Control the density of the sequence, i.e. how likely is a step to play a note
[SEQ LEN]	Control the length of the sequence for the currently selected voice	Control the number of steps the sequencer will advance per sync pulse (1 – 4)
[AMP DECAY]	Control the length of each note. In drone mode , this controls the carrier frequency of the voice	Controls the base octave of the currently selected voice
[LFO DEPTH]	Control the depth of the LFO for the currently selected voice	Control the rate of the LFO for the currently selected voice
[FM RATIO]	Control the FM ratio (ratio of modulator frequency to carrier frequency) for the currently selected voice	Control the FM ratio mode for the currently selected voice. <ul style="list-style-type: none">• Quantised multiple• Unquantised multiple (high range)• Unquantised multiple (low range)• Free (modulator unrelated to carrier)
[ATTACK]	Control the modulation envelope attack time for the currently selected voice	Select the carrier waveform for the current voice
[DECAY]	Control the modulation envelope decay time for the currently selected voice	Select the modulation waveform for the current voice
[DEPTH]	Control the modulation envelope depth for the currently selected voice	Select the LFO waveform for the current voice

SPECIFICATIONS

VOICE ARCHITECTURE

Voice 1		Voice 2	
Carrier	8-bit digital oscillator	Carrier	8-bit digital oscillator
Octave	0 - 6	Octave	0 - 6
Waveform	Sine, saw, reverse saw, square, noise, off	Waveform	Sine, saw, reverse saw, square, noise, off
Amp Decay	Note length ~20ms – ~16s	Amp Decay	Note length ~20ms – ~16s
Modulator	8-bit digital oscillator	Modulator	8-bit digital oscillator
FM Ratio		FM Ratio	
FM Mode	quantised, high multiple, low multiple, fixed	FM Mode	quantised, high multiple, low multiple, fixed
Waveform	Sine, triangle, distorted-tri, square, reverse saw, off	Waveform	Sine, triangle, distorted-tri, square, reverse saw, off
Mod Envelope		Mod Envelope	
Depth		Depth	
Attack time		Attack time	
Decay time		Decay time	
LFO		LFO	
Depth		Depth	
Rate		Rate	
Waveform	Sine, triangle, distorted-tri, square, reverse saw, off	Waveform	Sine, triangle, distorted-tri, square, reverse saw, off
Parameter locks		-	
Per step* parameter locks			
Note length			
LFO depth			
FM ratio			
Mod envelope attack, decay and depth			
* controls voice 1 but step based on track with longest sequence length			

SEQUENCER ARCHITECTURE

Track 1	Track 2
Sequence length	Sequence length
Current step	Current step
Note length	Note length
Sequence notes	
Sequence mutation rate	
Sequence note density	
Steps per sync pulse	

SPECIFICATIONS (CONTINUED...)

TECHNICAL SPECIFICATIONS

SPECIFICATIONS	
Synthesis	2-operator FM 8-bit digital oscillators
Polyphony	2 bi-timbral voices
Sequencer	16 step polymetric sequencer
Modulation	Attack/decay envelope per channel Multi-waveform LFO per channel Parameter locking per step (voice 1 only)
I/O	Audio out Sync in / out Power 9-12v USB (power and firmware update) Eurorack power (with modification)
External sync	Sync in & out 0-5v sync pulse 1 or 2 steps per pulse
Signal output	14-bit 16384Hz DAC Mono output
Microprocessor	Arduino Nano V3 (ATMEGA328P)
Power supply	Micro USB 9-12VDC 2.1mm Positive tip Can be adapted for +12V eurorack power
Display	8 x 8 LED matrix
Power consumption	310mA @ 12VDC
Dimensions	111mm (w) (~22HP) x 100mm (d) x 40mm (h)