

Arithmophone MPE QuickStart Guide

INTRODUCTION

The Arithmophone keyboard uses 7-limit just intonation tuning. The 'just intonation' part refers to the fact that this tuning is based on perfect harmonic ratios. This sets it apart from instruments like piano and guitar, that use a tempered tuning system (12 tone equal temperament). The '7-limit' part refers to the highest prime factor that occurs in these ratios. In 7-limit tuning, only the first four primes (2, 3, 5 and 7) are used.

7-limit just intonation provides a much wider palette of tones than standard tuning. 12 tone equal temperament cannot really represent any septimal intervals like $7/4$ or $6/7$. Expanding the prime limit from 5 to 7 introduces a whole new class of notes, that are not really a part of the standard story of Western music. However, these intervals do appear frequently in many kinds of music, like Blues and Jazz - where they are played on instruments with flexible tuning like slide guitars or saxophones, as well as sung. These intervals are often referred to as 'blue notes', a fact I have used as inspiration for the colour scheme of the Arithmophone.

You can use the Arithmophone MPE as a Midi controller for hardware and software instruments, provided that your setup allows this: it works using Web Midi, which not all browsers and devices support. You will also need a (software) instrument that supports MPE (Midi Polyphonic Expression) and, to make the most of it, a touchscreen device that is at least tablet sized. I use a Microsoft Surface tablet myself, but you should be able to get it working on other touchscreen devices that run Windows, and potentially on Android, Chrome OS and Linux as well, although I haven't been able to test this. It also works fine on a regular Mac or Windows computer. Without the touch screen you lose much of the immediacy, but it can still be useful for sequencing and for general exploration.

This QuickStart Guide explains how to get the Arithmophone MPE set up on your device and provides a brief description of the layout of the keyboard and its additional functions. This should be all you need to start making some music, but if you would like some instructions on how to play chords and scales, or gain a more in depth understanding of the way the Arithmophone works, there is a lot of additional information on my [website](#). In the meantime, I hope you enjoy playing the Arithmophone and exploring 7-limit just intonation!

Chiel Zwinkels, Amsterdam, April 2025

HOW TO GET THE ARITHMOPHONE MPE UP AND RUNNING

1. Select a suitable device and browser

You will need to use a browser that supports Web Midi. Chrome and Edge are perfect for this, other chromium-based browsers such as Opera should work as well. Firefox also supports Web Midi, though not on Android. Web Midi is not supported in Safari. It is also not supported on iOS/iPad OS (regardless of the browser you use). So unfortunately, Midi control is not available for the Arithmophone on iPhones and iPads at the moment. You can still [play the Arithmophone with Web Audio](#) on these devices though.

2. Select a suitable instrument to control

You will need an instrument that supports MPE (Midi Polyphonic Expression). Many hardware and software synthesizers have this functionality (though many others don't). If you don't have any instruments that support MPE, then [Surge XT](#) is a great place to start. It is a very comprehensive software synthesizer that is completely free. Running Surge XT in standalone mode with the Arithmophone is all you need to turn any old Windows touchscreen device into a powerful self-contained musical instrument. For a very different flavour, a personal favourite of mine that is not free, but highly affordable is the excellent [Chipsynth Porta FM](#) by Plogue. Whatever instrument you use, you should make sure you set it to MPE mode, and for the Arithmophone to work correctly, the pitch bend range must be set to +/- 48 semitones (this is the standard setting for MPE so on most instruments you won't need to adjust it).

3. Connect to Midi

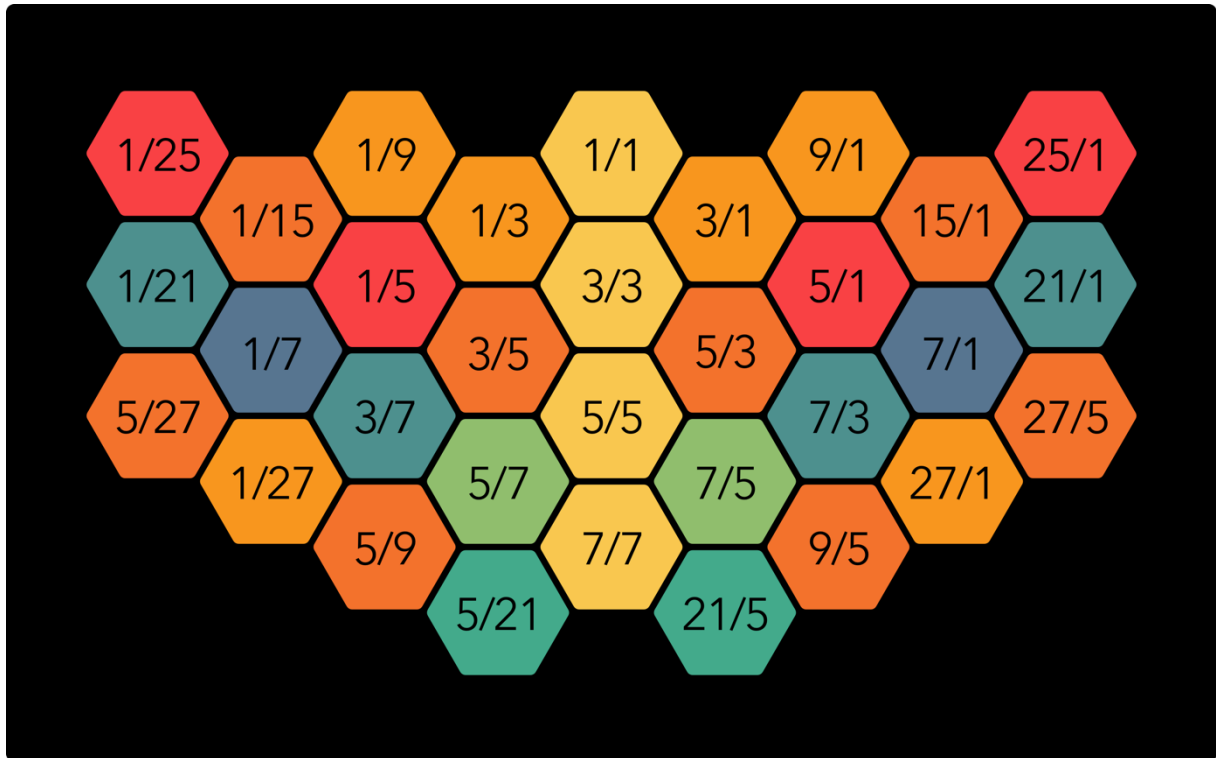
Your browser will need to 'see' at least one Midi output. If you have more than one Midi connection, you can select which one you want to use from the settings within the Arithmophone (see below). If you have connected a hardware synthesizer (or any hardware Midi interface) to your computer, it should show up automatically. If you want to send Midi from the Arithmophone to a DAW or standalone software synthesizer, you may need to create a virtual Midi port first. On Mac OS, this is done by opening the audio midi setup, opening a midi studio window and activating IAC Driver. On Windows, you can achieve this by installing an app like [Loop Midi](#).

4. Open the Arithmophone Midi keyboard app

The Arithmophone Midi keyboard app is web based, so you can play it straight from your browser, but you can also install it as a standalone app. To play from your browser, simply go to chielzwinkels.net/arithmophone/ and click on the MPE app link. To install the keyboard as a standalone app, you will need to use a suitable browser: if you use Chrome or Edge as your browser an icon for this option will appear in the address bar when you open the keyboard. After you have installed the Arithmophone, it will appear alongside the other apps on your device, and you can open it from there to start playing. In this way, the Arithmophone app will stay available even when you are not online.

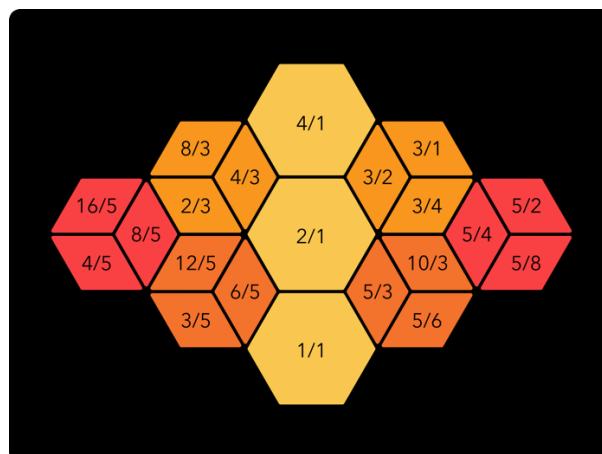
THE KEYBOARD

The Arithmophone keyboard offers a selection of 29 'pure' harmonic intervals, that can be used to play many familiar and unfamiliar sounding melodies and harmonies. The notes are arranged like this:



Please note that the ratios in the center column all simplify to 1/1; I have only written them in this way to highlight their relationships to the surrounding notes.

In the illustration above, all ratios are shown in their simplest form, without octave reduction. In actuality, each key (except for those in the central 1/1 column) is split into three separate octaves, so that the keyboard has a full 3 octave range. How this works is shown for the central region of the keyboard in the illustration below.

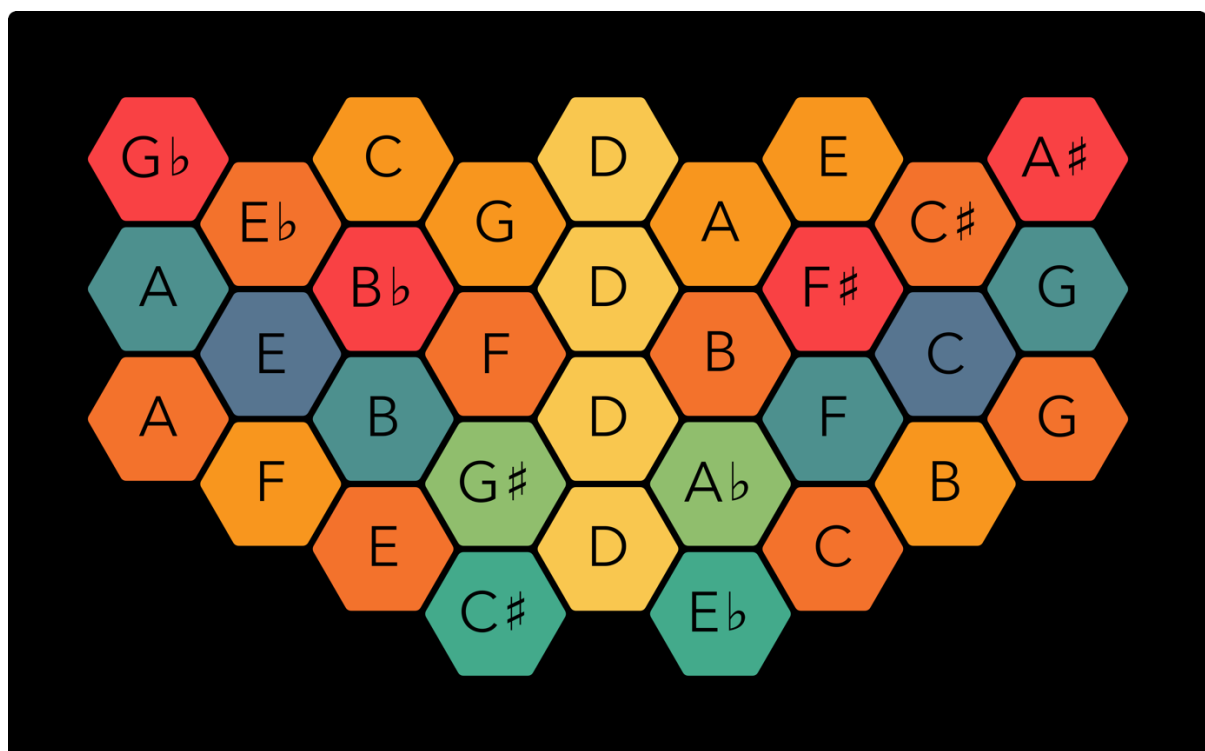


On the Arithmophone keyboard, the colours of the keys reflect the nature of the interval they form with the root note. The colour scheme works as follows:



Factors of 2 have no influence on the colour, so different octaves of the same note always have the same colour. The other primes (3, 5 and 7) each get their own colour, and in-between colours are used for ratios that contain multiple primes, such as 5/7. This colour scheme does not just serve an aesthetic purpose, it also provides a strong visual aid for navigating the keyboard and understanding the relationships between different notes.

When actually playing the Arithmophone, it may be more useful to think of the notes by name instead of by ratio. Without transposition or modulation, the root note (1/1 ratio) of the Arithmophone is tuned to D, which makes the note map look like this:



CONTROLS & OPTIONS

When you open the Arithmophone MPE, you will see the keyboard and some additional controls. The controls below the keyboard are function keys, the controls above the keyboard are modulators.

Modulators

The modulator keys are not part of the Arithmophone keyboard per se, but they are an important extra feature. In just intonation, the number of possible ratios is essentially infinite, so even though the Arithmophone features 29 different notes, there are still many potentially useful intervals that are not available directly from the keyboard. The modulator keys transpose the entire keyboard by a set ratio. This has the same effect as shifting a capo on a guitar neck: you can play the same shapes and patterns, but they will sound in a different key.



Each modulator consists of 3 keys. The yellow modulator keys use the 2-ratio: in the center position, the keyboard is not transposed, in the left position every ratio is divided by 2 and in the right position every ratio is multiplied by 2. This makes it work exactly like the octave down/up keys that can be found on most electronic keyboard instruments. The orange modulator uses the 3-ratio, octave reduced to $2/3$ and $3/2$. This results in a shift of a musical fifth, up or down. The red modulator uses the 5-ratio as $4/5$ and $5/4$, which is a musical major third, and the blue modulator uses the 7-ratio as $4/7$ and $7/4$, resulting in a shift of a septimal flat seventh. Modulator keys can be combined, so for example by putting the orange modulator in the right position and the red modulator in the left position, the keyboard is transposed by $3/2 * 4/5$, which is $6/5$, a musical minor third.

Function keys

The two inner function keys are used to sustain and release notes: while the red key is held, any note that is played will be sustained even after its key is no longer directly held down.



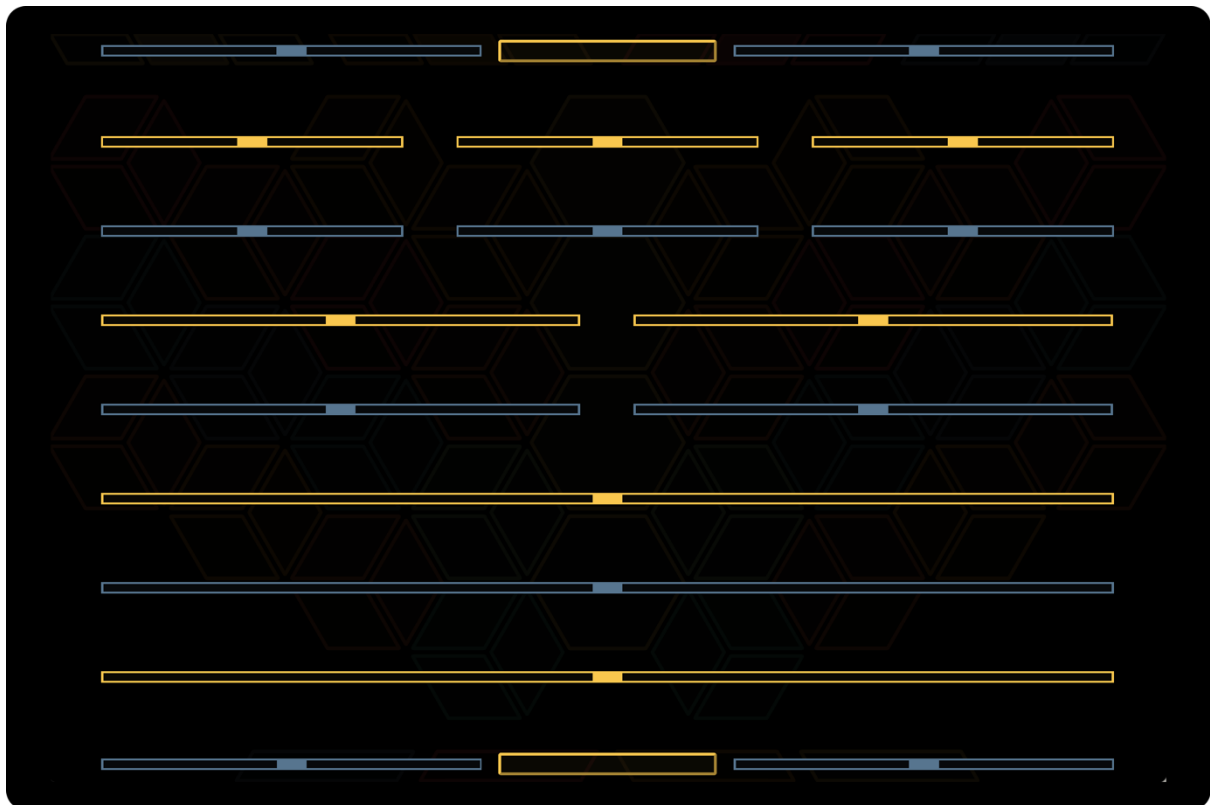
Sustained notes will remain lit up on the keyboard to indicate their status. Individual notes can be released by tapping them once more when the red key is not held down. The orange key will release all sustained notes at once.

The blue function key on the left functions as a full screen button, making it easy to switch between the full screen mode that is best for playing the keyboard and a smaller windowed mode that is useful for configuring DAW settings et cetera.

The yellow key on the right opens the controller screen, providing a set of sliders that output Midi CC messages. It has a secondary 'secret' function as well: if you press it while holding down the red 'sustain' key, this will alternately hide and show the modulator keys.

Midi CC Sliders

The three large sliders that cover the full width of the screen have fixed functions: the top one (yellow) adjusts the velocity value with which notes are triggered, the second one (blue) controls the 'mod wheel' position (Midi CC1) and the third one (yellow again) is a global transpose that can change the pitch of the entire keyboard by +/- 7 semitones. You can use this to tune the Arithmophone to any other instrument or track you'd like to play along with.

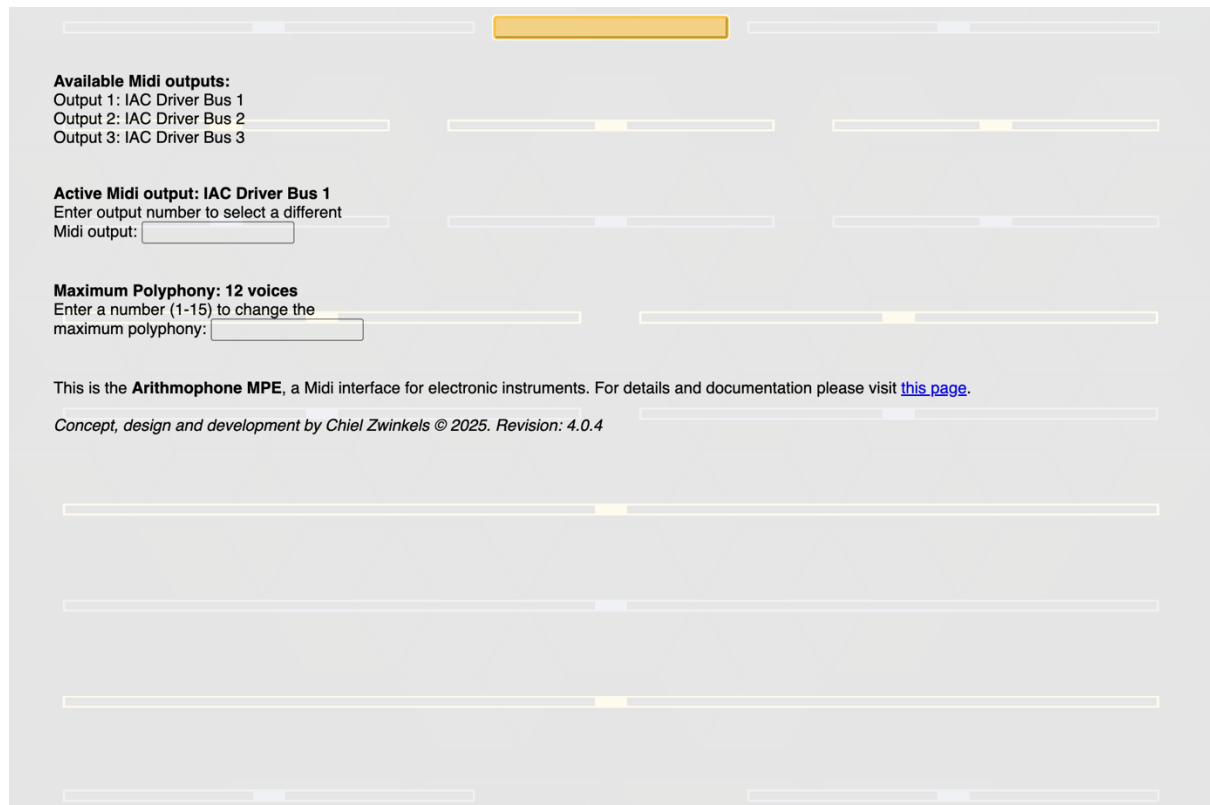


The other sliders send out Midi CC 102 to 115, from top left to bottom right. These CC numbers are generally unused so you can route these to any instrument or DAW parameter you'd like to control from within the Arithmophone MPE app.

The yellow button on the bottom of the screen takes you back to the keyboard, while the yellow button at the top opens the MIDI settings screen.

Midi settings

Here you can select which MIDI output you want to use (if you have connected more than one) and what the maximum polyphony of the keyboard is. MPE Midi works by using midi channel 1 as a control channel while assigning each note its own channel from 2 up to 16. You can limit the number of channels the Arithmophone MPE uses by adjusting the maximum polyphony, all the way down to one for monophonic operation (only channel 2 will be used to send notes).



When using MPE, some functions on some instruments may behave differently from what you are used to. If you are experiencing unexpected behaviour, here are some things to check:

- Set any 'transpose' value within your instrument to zero
- Set the pitch bend range of the instrument to +/- 48 semitones
- When using an arpeggiator, limit the range to 1 octave

Depending on the way MPE is implemented in the plugin/instrument you are using, you may or may not be able to use transpose functions and multi-octave arpeggiators with the Arithmophone, but with the above settings, you should be fine in most cases.

The Midi settings screen can be closed again by pressing the yellow button at the top which brings you back to the control slider screen.