

Arithmophone 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.

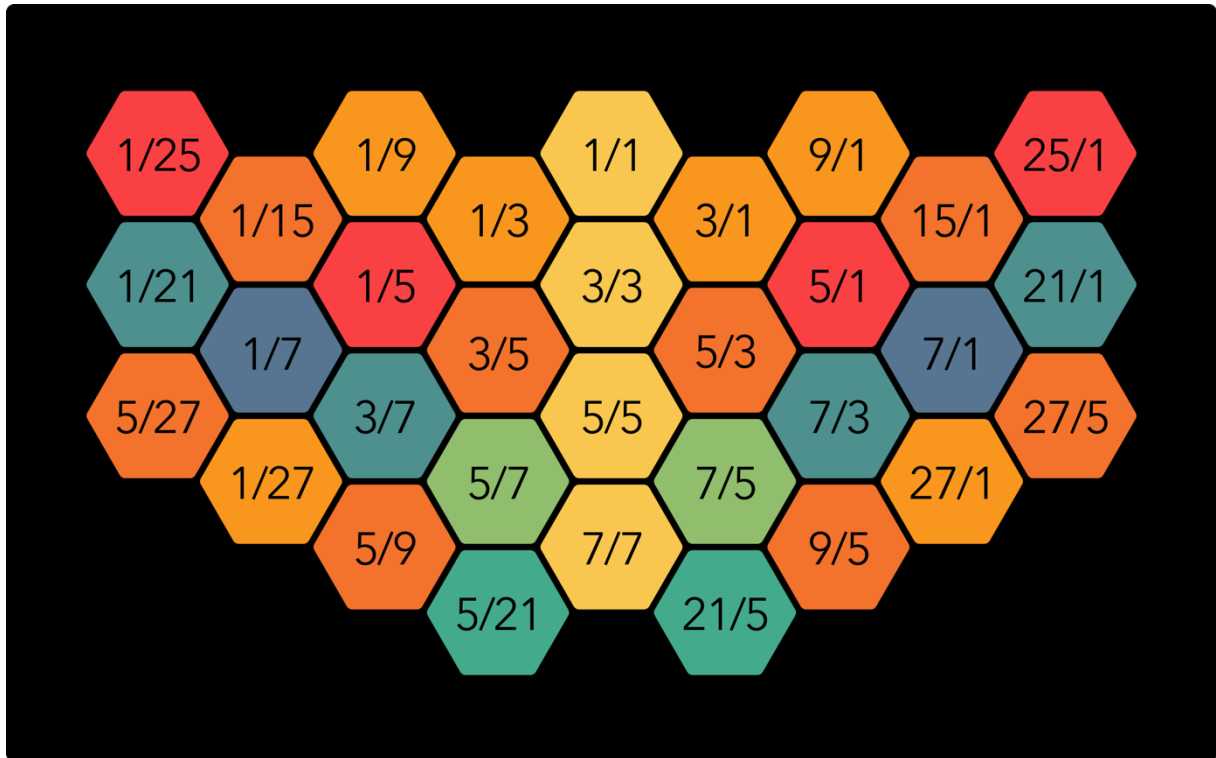
You can play the Arithmophone from any phone, tablet or computer (it works best on tablets, in landscape orientation). The Arithmophone is web based, so you can play it straight from your browser: simply go to chielzwinkels.net/arithmophone, click on the 'play the Arithmophone' button and start playing. You can also install it as a standalone app, so you can have a nice full screen experience and also play it when you're not online. For this, you will need to use a suitable browser: this works with Safari on iOS or iPad OS, and with Chrome on Android. In Safari, click the share button and choose 'add to home screen'. In Chrome, click the three dots in the top right and choose 'install app'. You can also install the Arithmophone app on Mac and Windows desktop computers: If you use Chrome or Edge as your browser an icon for this option will appear in the address bar when you open the website. After you have installed the Arithmophone, it will appear alongside the other apps on your device, and you can open it to start playing.

This QuickStart Guide explains how to get the Arithmophone 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

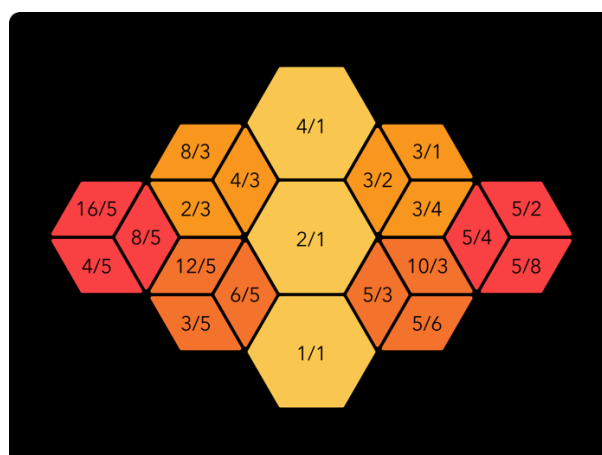
THE KEYBOARD

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 relationship 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.

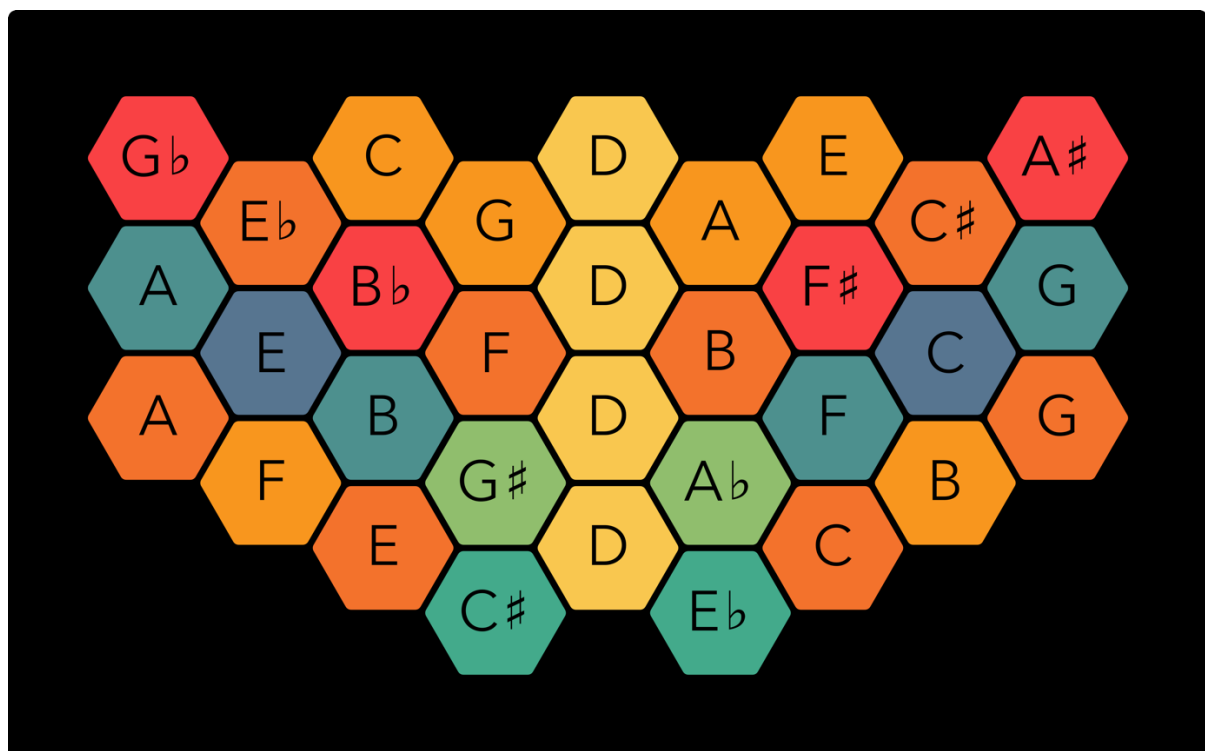


On the Arithmophone keyboard, the colours of the keys reflect the nature of the interval they form with the root note. The colour scheme works as follows:



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 note names instead of ratios. By default, 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, you will see the keyboard and two additional controls: the blue and a yellow function keys. Pressing the blue function key will display two more function keys below the keyboard, as well as a set of extra controls at the top. These are the modulator keys. Pressing the blue function key once more will hide these extra elements again, providing more room for the keyboard itself on oblong displays like phone screens.

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 still 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 inner function keys can be used as shortcut keys for two important sound parameters, that can also be adjusted from the options screen (see below): the red key will cycle between the three available waveforms sine, triangle and square, while the orange key will cycle between the monophonic and polyphonic keyboard modes.



The blue key hides and displays these additional keys, as described above, while pressing the yellow function key brings up the options screen, where you can adjust different sound parameters.

Options screen

The **high/low** button changes the register of the Arithmophone, transposing the entire keyboard up or down by a full octave.

The three buttons in the middle let you switch between different waveforms:

- = Sine wave (dark, round sound)
- △ = Triangle wave (warm, mellow sound)
- = Square wave (bright, sparkly sound)

The **mono/poly** button switches between polyphonic and monophonic mode. In poly mode, the Arithmophone can sound up to four notes at a time, so you can play chords as well as melodies. In monophonic mode, the Arithmophone will sound only one note at a time. This gives a different kind of sound, less like a piano or a guitar and more like a saxophone or an old school synthesizer.

Seven sliders allow for further adjustments of the sound, as detailed on the following page.

Sliders

Slider 1: Delay mix

There is a stereo delay on the Arithmophone, that produces echoes to make the sound wider and more spacious. This slider determines the amount of delay that is mixed in with the original sound. Low values (slider to the left) give you less delay, high values (slider to the right) give you more delay. When the slider is completely to the left, there is no delay at all mixed in.

Slider 2: Delay feedback

This slider determines how many echoes are produced by the delay. Low values give only a few echoes, while at high values the echoes have many repeats.

Slider 3: Delay time

This slider determines the time between echoes. At low values, the echoes follow each other very quickly, like in a small room. At high values, there is a lot of time between echoes, like in a large cave or a canyon.

Slider 4: Vibrato

This slider determines the vibrato added to the notes. Vibrato is a slight 'wobble' in pitch that can make notes sound livelier and more expressive. At the lowest value there is no effect at all, at the highest value there is a very fast and pronounced effect.

Slider 5: Attack

This slider determines how quickly the notes rise to full volume. Low values give a snappy sound (like a piano or a guitar), high values produce a softer start of the sound (like a violin or a cello).

Slider 6: Decay

This slider determines how long the notes ring out. Low values make for short notes, high values make for longer notes.

Slider 7: Transpose

By default, the Arithmophone is tuned to D. With the red slider, you can adjust the pitch up or down in semitone steps, from G (7 semitones below D) up to A (7 semitones above D).