

**How to create  
and use the  
432 HZ  
PRECISE  
TEMPERAMENT  
scale files**

Calculated by  
**Robert E. Grant**  
and implemented  
by **Toni Mazzotti**

# INTRODUCING PRECISE TEMPERAMENT

*"The problem with "Just" Scale Tuning is that while the mathematical intervals are considered "perfect", due to the "Major 3rd Problem" (explained in [slides](#)), the octaves never quite double through Major 3rds. The mathematical ratio of the Major 3rd is  $5/4$  (1.25x). Well,  $1(1.25^3) = 1.953$  and  $\neq 2.00$ . Whereas  $1(1.26^3) = 2.00$ . This one ratio throws the entire Pythagorean Just Tuning out of whack despite its clear mathematical correspondences for all other notes. Equal Temperament is also problematic because it simply cuts the octave range of frequency into 12 equal parts (based on  $2^{.5}$ ), when there is slight variation between tonal transitions exhibiting yet again wave behavior. Also, equal temperament loses a lot of the benefit of the Base 9 mathematical system and depending on your sound system/software, the numbers may no longer sum to 9 in modular arithmetic.*

*How to solve this conundrum? A potential solution: **Precise Temperament Tuning**. By simply replacing Major 3rd's 1.25 with 1.26 (derived as  $2^{1/3}$  instead of  $5/4$ ), this brings the entire scale into very close equivalence with Equal Temperament tuning. Additionally, there is another consequence of this 1.26x usage seen on the very last slide: All of the notes create a decimal extension with "Just" undertone dominant chords represented in the decimal extension (for example Note D5: 576.108288hz, whereas 576 = D in Just Tuning); 108hz is an A3 in Just tuning and 288 is a D4 in Just tuning. This "BLOCKCHAIN-style" chordal representation appearing in the decimal extensions is one of the natural consequences of the 1.26x replacement for the Major 3rd when used with Pythagorean "Just" values (abandoning 1.25x).*

*But how does it sound? Based on the ratios and the very close equivalence to Equal Temperament values in 432hz, I am quite sure it will sound great. Another plus is that all the new "Precise" frequencies Sum to 9 naturally just like the sum of angles of ALL regular polygons/polyhedra/polytopes!" - [Robert's announcement at 20 July 2020 on Facebook](#).*

# WELCOME

Hi my name is [Toni](#), this is my guide to help you to create and use the musical scales based on [Precise Temperament](#) calculated by [Robert E. Grant](#) specifically for 432 Hz tuning and released in July 2020.

I used the web application [ScaleWorkShop](#) for create 3 of the main scale formats which I provide on a zip file on the website [ToniMazzotti.com](#), on all root musical notes for you to use in **Virtual Instruments, DAWs and Hardware Synthesizers**. But if you want to better understand by doing the scales yourself or converting to other formats, follow the steps at the end of this guide.

## USING THE SCALE FILES

The **3 most common formats** of musical scale files are: [AnaMark v2 \(.TUN\)](#), [Scale Scale \(.SCL\)](#) and [Kontakt Tuning Scrips \(.TXT\)](#). But not all music software and hardware has this feature. Among those that have this functionality some allow us to enter the Equal Temperament deviation values directly into the interface, while others require only this method and are not able to load musical scale files.

**Ableton Live, Cubase, FL Studio, Logic Pro, Pro Tools, Reaper and Studio One** are DAWs (Digital Audio Workstations) with microtonal features. See the [Xenharmonic Wiki](#) website for a complete list of microtonal softwares. The update MIDI 2.0 of 2020 expanded the microtonal capabilities for music softwares and hardwares, see more at [MIDI.org](#).

**Next I show 3 examples** of use of each musical scale format provided, and also **1 more example** of direct input of values by the user.

# LOGIC PRO

**Logic Pro** from Apple need us to put the files **Scale Scale (.SCL)** into the **Tuning Tables** folder within the application.

1. Right-click the **Logic Pro** application, choose **Show Package Content** and put the files in **Content/Resources/Tuning Tables**.
2. Open the menu **File/Project Settings/Tuning** and type **-31,8** in the **Software Instrument Pitch**, to get 432 Hz.
3. In the **Software Instrument Scale**, select **Fixed** and look for the **Precise Temperament** of any note, because Logic Pro ignores the Root Note present in the SCL file, replacing it with the selection field below called **Root Note**; To see the values changing in the graphic musical notes, press **Copy to User**, but this is not necessary for Precise Temperament to be enabled.

## IMPORTANT

- A. Logic Pro Settings **only affect internal plug-ins** and have no effect on third-party virtual instruments.
- B. Logic Pro also allows you to enter the Equal Temperament deviation values **directly into the interface**.
- C. The list of temperament names shown in the menu **Type** on the window **Tuning** is not based on the file name, but on the name written internally, which can be edited with any text editor app. Once edited, you must reopen the **Tuning** window for the changes to be displayed.
- D. When updating Logic Pro application you will need to put the scale files inside the new application. **This is necessary with each update**.

# UPDATE FOR LOGIC PRO USERS - October 2023

**When changing the fundamental note in Logic Pro tuning**, you will need to readjust the Tune slider. For each selected note the slider will take on a slightly **different value**. This happens to rearrange the different proportions between the notes, while keeping the note **A at 432.81 Hz**. To confirm the frequencies in Logic Pro, use the internal plugin called Test Oscillator. Both in the Tuning window and in the Test Oscillator plugin the accuracy is **2 decimal digits**.

The **SCL tuning file**, which is the one used by Logic Pro, does not contain the Standard Pitch information internally. It is the simplest type of tuning file and has only the number of notes, in this case 12, and their relative proportions. There is a file that can accompany the SCL called **KBM**, it contains this additional information. But Logic Pro is designed to, instead of loading this secondary file, adjust this **Standard Pitch and Root Note information in its own interface**. Use the values below for each root note. **Attention:** Logic Pro Tuning only has an effect on your internal instruments and plugins.

<b>A</b>	<b>-31.44</b>
<b>A#</b>	<b>-35,52</b>
<b>B</b>	<b>-35,57</b>
<b>C</b>	<b>-29,29</b>
<b>C#</b>	<b>-31,67</b>
<b>D</b>	<b>-33,73</b>
<b>D#</b>	<b>-31,13</b>
<b>E</b>	<b>-29,50</b>
<b>F</b>	<b>-31,55</b>
<b>F#</b>	<b>-33,60</b>
<b>G</b>	<b>-35,35</b>
<b>G#</b>	<b>-29,38</b>

Thanks to Devin McLellan-Kavanagh on Instagram and @kingluui3613 on YouTube, for helping me update this information.

# SPECTRASONICS

The instruments **Omnisphere**, **Keyscape** and **Trilian** by [Spectrasonics](#) works with files **AnaMark v2 (.TUN)** pasted into the **Tuning Files** folder.

1. Put the scale files in **User/Library/Application Support/Spectrasonics/STEAM/Omnisphere(or Keyscape, or Trilian)/Settings Library/Presets/Tuning Files**. You can put it in any folder or create a new one.
2. On the **System** subpage select **432 Hz** in the **Master Tune** field. In the **Scala** field choose **Precise Temperament** in the desired musical root note.

## IMPORTANT

- A. Inside the zip file are **TUN files modified** specifically for use on Spectrasonics instruments. To understand how to create and use them see the end of this guide.
- B. These melodic instruments by Spectrasonics have the function **Global Pitch Options** . This feature allows you to change all instances of each instrument at once, plug-ins and standalone.

# KONTAKT

**Kontakt** by **Native Instruments** works with the content of the **Kontakt Tuning Scripts (.TXT)** pasted into the subpage **Script Editor**.

1. Type **-0.32** in the **Tune** parameter of the instrument header or set the **Master Tune** on the main panel to **432.08**.
2. So enter on **Edit Mode** by clicking the gray button with a drawn tool, click on **Script Editor**, choose an empty script tab and click on **Edit**.
3. Open the **TXT** music scale of the desired root note with any text editor application and copy all its contents. After, paste it into the script box and press **Apply**.

## IMPORTANT

- A.** The Tune setting present in the instrument header and the script filled in **are saved together when you save the instrument**.
- B.** You can save each of the 12 musical scales provided as a **Tuning Preset** for later use.

# SWAM

**Brass, Woodwinds** and **Strings** instruments from [SWAM – Audio Modeling](#), work by typing the values directly into the interface.

1. On the **Pitch** subpage, select the **Master Tuning** tab and scroll the **Master Tune** slider at **-32 cents** to get **432 Hz**.
2. On the **Micro Tuning** tab, enter these values below in the graphic musical notes. Make sure that each note is activated by **clicking on them to make it white**. These are roundings of deviations from Equal Temperament in cents.

I	0
II <sub>m</sub>	-2
II	4
III <sub>m</sub>	2
III	0
IV	-2
V <sub>m</sub>	0
V	2
VI <sub>m</sub>	0
VI	-2
VII <sub>m</sub>	4
VII	2

3. Now when you change the key musical note on the slider **Root**, observe the notes by changing their proportions in relation to the intervals.

## IMPORTANT

**A.** In order for each root note change made with the slider **Root** take effect, click on **Clear** and re-enter the values. To avoid this rework, you can begin by click and hold one of the **Favorites** to save these values. After that, you can change the slider **Root**, so click on **Clear** and recover the saved values on the **Favorite** chosen.



# CREATING THE SCALE FILES

The [ScaleWorkshop](#) web application by microtonal artist **Sevish**, offers **3 format options for importing** and **14 format options for exporting** the music scale files. There is information about each of them in your online manual.

**1.** On the ScaleWorkshop website, create a new **Equal Temperament** scale, then selected **12** notes in the **Number of Divisions** field and wrote **2/1** in the **Interval To Divide** field. This create the standard musical scale of Western music, with 12 equally distributed notes and with the octaves mathematically treated like doubles and halves. Slightly tightening the fifths to treat them like a closed circle. This simplification in Western musical tuning created the need to distribute the resulting errors. It is the process of distributing this resulting errors that we call Temperament. **Robert E. Grant** calculated the **Precise Temperament** starting from the central musical note A at **432.081216 Hz**, distributing the notes in a more harmonious way than the Equal Temperament.

**2.** Type the values below in the **Scale Data** for enter the deviations from Equal Temperament. These values were calculated from the proportions provided by Robert E. Grant and confirmed as generators for the exact frequencies also provided by him. Note that now the graphical representation of the distances between musical intervals is no longer distributed equally, as in Equal Temperament.



	<b>DEVIATION FROM EQUAL TEMPERAMENT</b>	
<b>97.933</b>		<b>0.000</b>
<b>203.910</b>		<b>-2,063</b>
<b>302.170</b>		<b>3.910</b>
<b>400.107</b>		<b>2.170</b>
<b>498.044</b>		<b>0.107</b>
<b>599.675</b>		<b>-1,956</b>
<b>702.279</b>	For create the	For type directly on
<b>800.217</b>	Precise	the interface of
<b>897.829</b>	Temperament	virtual instruments
<b>1004.126</b>	musical scale on	and DAWs like Logic
<b>1102.062</b>	the ScaleWorkshop	Pro and SWAM
<b>1200.000</b>	web application.	Instruments. <b>2.062</b>

# CREATING THE SCALE FILES

**3.** Enter the value **432.081216** in the **Base Frequency** field. Now you will see the number of notes on the graphic piano, their frequencies, their deviations from Equal Temperament and their proportions in the division of the octave. The **Precise Temperament** on the **A** key is ready and can now be **named** and **downloaded** from the menu **Export**.

**4.** To make the other 11 keys, change the **Base Note** to the desired key and change the **Base Frequency** until note **A5** is exactly at **432.081**, because on the **ScaleWorkShop** website it is only possible to view 3 decimal digits after the decimal point on the graphic piano. On each of these 11 scales, the other musical notes excluding **A5** at **432.081** Hz, will slightly change their frequencies to accommodate the new positions of the proportions between intervals. The frequencies at which I arrived to keep the **A5** at **432.081** Hz are listed below. Repeat the process for each key, **name her** and **export** in the desired formats.



60	C	257.239
61	C#	272.160
62	D	288.000
63	D#	305.585
64	E	324.061
65	F	342.922
66	F#	362.880
67	G	384.072
68	G#	408.317
69	A	432.081
70	A#	457.229
71	B	483.840

## IMPORTANT

**A.** The exported files are simple blocks of text **and can be edited easily**.

**B.** All exported files are **importable and convertible** using the ScaleWorkshop online application.

# ONLY FOR SPECTRASONICS

Each music applications developer implements musical tuning settings in a different way. Spectrasonics instruments use the exact frequencies written internally in the **AnaMark v2 (.TUN)** files. However, this causes the adjustment of the **Master Tune** parameter of the **System** subpage to duplicate this parameter value. And to get around this problem there are **2 options**:

**Option 1.** You can use the AnaMark v2 file (. TUN) without modifications and keep the **Master Tune** parameter of the **System** page at **440 Hz**, because the frequencies from the Precise Temperament and Tuning are already being read internally. But this option will hinder a little the comparative tests between temperaments.

**Option 2.** Or you can save all 12 keys with the **A5 note exactly 8 Hz above** that indicated on the Precise Temperament, that is, at **440.081 Hz**. This way when the **Master Tune** parameter of the **System** subpage is set to **432 Hz**, all notes will assume the frequencies indicated by the Precise Temperament in the Tuning of 432 Hz.

If you chose the **Option 2**, below are listed the frequencies for creating the scale in each root note. The use of each of these frequencies as the root note should always result in the **A5 note exactly at 440,081 Hz**.



60	C	262.002
61	C#	277.199
62	D	293.3325
63	D#	311.243
64	E	330.061
65	F	349.271
66	F#	369.599
67	G	391.183
68	G#	415.877
69	A	440,081
70	A#	465.695
71	B	492.798

## IMPORTANT:

**A.** The exported TUN file **needs to be edited** for reference key to sound correctly on Spectrasonics Instruments. To do this, a semicolon must be inserted before quoting the note, number and frequency on the last line of the file. Or putting this quote at the end of the previous line, which already has a semicolon. This causes this line to be ignored.

THE GLOBAL MUSIC COMMUNITY THANKS THESE GENIUS  
MINDS FOR SHARING THEIR KNOWLEDGE FOR FREE

## ROBERT E. GRANT

<https://www.RobertEdwardGrant.com>

<https://www.Instagram.com/robertedwardgrant>

<https://www.robertedwardgrant.com/precise-temperament-tuning>

## SEVISH

<https://sevish.com/scaleworkshop>

<https://www.youtube.com/c/Sevish>

**Help me** make more educational content about 432 Hz  
with some financial support. Thank you! 😊

<https://www.ToniMazzotti.com>

<https://www.YouTube.com/ToniMazzotti>

<https://www.Instagram.com/ToniMazzotti>

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