

Comparative Temperaments for Autoharp

The purpose of this document is to provide a reference for classic tuning alternatives for the autoharp, whether chromatic or diatonic configuration. Why one would need to tune an autoharp in any manner except standard Equal Temperament is outside the scope of this document. Suffice it to say that many are interested in the idea of exploring ways of getting a better sound from an autoharp by way of tuning.

The reader should note that the autoharp is one of the very best candidates among all common instruments to use tempered tunings. Two main reasons include the autoharp's unique ability to play chords across multiple octaves and its natural space limitation in supporting no more keys than the 6 major key constraint imposed by the stronger meantone variants. That is, the autoharp cannot well represent more than about 6 keys, and enharmonics occur beyond 6 keys in a meantone tuning.

All charts that follow list notes across the page in fifth interval order, the sequence by which temperaments are derived.

The following chart lists all the most important alternatives currently in use to the author's knowledge. These include only those with some academic basis or which are known to be commonly used by more than one person (not a personal, subjective preference). The settings are theoretical, mostly mathematically derived. Actual tuner readings from an application may vary due to inharmonicity, octave stretching, or accommodating an instrument's unique acoustics by ear, what some may refer to as tweaking. However, any significant amount of "tweaking" by ear after using these tuner settings results in an entirely different temperament. One should always set their middle octave as "bearings" using exactly the settings shown. Any displeasure with the sound should result in selection of a different temperament, not significant tweaking by ear.

Comparing the numbers

Values in cents indicated on an electronic tuner

Name	Ab	Eb	Bb	F	C	G	D	A	E	B	F#	C#	G#	D#	A#
(ET) Equal Temperament	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/6 comma	10.5	9	7.5	6	4.5	3	1.5	0	-1.5	-3	-4.5	-6	-7.5	-9	-10.5
Silbermann	14	12	10	8	6	4	2	0	-2	-4	-6	-8	-10	-12	-14
1/5 comma	17.5	15	12.5	10	7.5	5	2.5	0	-2.5	-5	-7.5	-10	-12.5	-15	-17.5
2/9 comma	21	18	15	12	9	6	3	0	-3	-6	-9	-12	-15	-18	-21
1/4 comma	24.5	21	17.5	14	10.5	7	3.5	0	-3.5	-7	-10.5	-14	-17.5	-21	-24.5
Whitmer Sweet GDA-based Chromatic	-18 (G#)	+7	+6	+4	+4	+4	+2	0	-2	-6	-13	-13	-18	+7 (Eb)	+6 (Bb)

Fig. 1 - Comparative tunings for autoharp (diatonic or chromatic, doesn't matter)

About the Whitmer tuning

The above chart is composed of all *regular* fifth interval temperaments except the last one. Whitmer has "*irregular*" fifth intervals, although fifths generally more pure than in the others. Examples of other "*irregular*" temperaments include Young, Werckmeister, Vallotti and Young. It is only the irregular temperaments that have any differences in *character* among keys, because some keys are more in tune than others.

Note that irregular temperaments attempt to be "*circular*", i.e. to close the circle of fifths, allowing full modulation or nearly so. Whitmer doesn't do that. It is irregular and *noncircular*, a hybrid that simply allows the autoharp to sound good in important keys while "playable" with other instruments. The "playable" will have to remain debatable, but Charles provides a very credible opinion. It is his *opinion*, not a *fact*. Some of the settings are certainly far enough off equal temperament (+/-0) to be noticeable in a contrasting situation. The trick is to avoid that "situation". For example, expect that the key of D will be a bit edgy among other instruments, and one should avoid sustained notes like an ending note.

The fact is that Charles' tuning was developed for GDA and then transplanted to a chromatic, which wouldn't necessarily be centered on GDA. He also has a version that favors F and C. Despite indications to the contrary in the Autoharp Owner's Manual, the Whitmer chromatic tuning settings are supporting BbFCGDA, not CGDAE. We know that by the setting indicated for D#, which is fine for an Eb chord but far from what would be needed for a B7.

When Charles tuning is applied to a standard 21 chord chromatic (EbBbFCGDA), the problem arises of how to have both a B7 and an Eb chord. The two tunings of D# strings are far apart. His +10 setting for D# would create a dreadful B triad, but some may consider it usable. Actually even 1/6 comma meantone isn't a lot better at 18 cents apart. It helps to keep in mind that full 1/4 comma meantone would have those notes at 42 cents apart. At some point the variance is at least "usable", or so the logic goes and the motivation for using smaller comma fractions and their wider fifths. Only "*circular* temperaments" resolve this problem, although with great compromises in the process, not really sounding that good except in the favored keys.

The settings Charles uses for the sharps indicate that he is favoring a standard chromatic. That would mean the instrument plays in Bb rather than B, a flat rather than a sharp. The setting for the D# strings support an Eb note as a fourth above Bb. The tuning for D# as a major third above B, as in a B7 chord, is not supported. The key of Eb is eliminated, because the tuning of the G# strings is too far off to support a reasonable Ab Maj chord, the IV of Eb, but able to do a very nice E or E7 chord (EG#B (D)), the V7 of the key of A. As would be true of other noncircular temperaments, i.e. unable to close the circle of fifths and then allow free modulation among keys, the Whitmer tuning *supports up to 6 major keys* before *enharmonic* tones occur, requiring two tunings for some of the same strings.

The Whitmer chromatic tuning then supports the 6 major keys of BbFCGDA. If there are enough chord bars for other keys on the instrument, they would need to be ignored or reassigned by refelting. A 15 chord instrument does not have enough bars to encounter the limitation, but a 21 chord has more bars than really needed.

On the 21 chord instrument, this is all resolved in symbiotic fashion by adding three *diminished 7th* chords and limiting the instrument to 6 major keys rather than 7. That would remove any key of Eb major, including chord bars for Ab Maj and Bb7, among the ones supplied on a standard autoharp. One other would need to be selected but not due to abandonment of its tuning. I believe Cm is the common choice of bars to sacrifice for a dim7.

In Whitmer, the tuning of the dim7 chords will be rough, so they should be used judiciously, more as single note palettes than fully strummed chords. When including dim 7th chords, I believe the diminished triads are best in tune using 1/6 comma meantone.

The Whitmer tuning shown above in Figure 1 has been modified by -3 cents on all settings to make it comparable to the others at A440. The actual temperament would use settings 3 cents greater all across the series, i.e. Charles indicates the A set at +3, all others raised by the same amount. Charles' actual specifications are as follows:

Name	(Ab)	(Eb)	(Bb)	F	C	G	D	A	E	B	F#	C#	G#	D#	A#
Whitmer	-18 See G#	10 See D#	9 See A#	7	7	7	5	3	1	-3	-10	-10	-15 (*)	+10 No B7 See Eb Maj	+9 Bb Maj only

Fig. 2 - Whitmer Chromatic (BbFCGDA)

(*) Charles later modified the settings of G# to -13, improving the E-G# *major third interval*. In any case, it is shown that way in The Autoharp Owner's Manual, subject to typographical errors, of which it is known to have some in that same article. I think it is correct as shown, because it makes sense. Any following reference to Whitmer will use the [G# = -13] reference.

Whitmer adapted to Orthey FCGDAE chromatic

With A# set to a Bb tuning, any F# (F#A#C#) chord or key of B will be out of tune. With D# set to an Eb tuning, any B7 chord and key of E will be out of tune. If one wanted to set up an instrument for FCGDAE, the tuning (still centered on E = +1) would look like the following:

Name	(Ab)	(Eb)	(Bb)	F	C	G	D	A	E	B	F#	C#	G#	D#	A#
Lewis/ Whitmer FCGDAE E center	Not used See G#	Not used See D#	See A#	7	7	7	5	3	1	-3	-10	-10	-13	-10	+9 tuned as Bb

Fig. 3 - Lewis modified Whitmer for use on Orthey FCGDAE with dim7 chords - E center (+1)

This is merely a shift in the tuning of D# strings, favoring use in E instead of Bb. Since the tuning is limited to 6 major keys, chords that use Ab and Eb tunings would be removed to make room for the three dim 7 chords. There would also have been some chords removed in favor of the key of E and additional minor chords. Those chords abandoned from a factory 21 bar set selection would include AbMaj, EbMaj, Bb7, F7, Cm, Gm. Chords added would include Bm, F#m, E, 3-dim7. One with no interest in dim7 chords would simply opt for an 18 bar chord set, if available as a custom option. The resulting FCGDAE instrument would use the settings shown in Figure 3.

Centering the tuning

In the process of putting my own mark on Charles work, in the context of FCGDAE, I would *center* the tuning on D rather than E. To do that, I need to subtract 5 cents from all settings, making D=+0. That looks like the following:

Name	(Ab)	(Eb)	(Bb)	F	C	G	D	A	E	B	F#	C#	G#	D#	A#
Lewis/ Whitmer FCGDAE D center	Not used See G#	Not used See D#	4	2	2	2	0	-2	-4	-8	-15	-15	-18	-15	Not used See Bb

Fig. 4 - Lewis modified Whitmer for use on Orthey FCGDAE with dim7 chords - D = +0

It should be apparent that this would likely do a better job of being compatible with the customary ET tuning of other instruments.

In perspective

Placing my "D centered Whitmer" in a context to allow direct comparison with other tunings brings us back to the original table with all temperaments centered on D instead of A as follows:

Values in cents indicated on an electronic tuner

Name	Ab	Eb	Bb	F	C	G	D	A	E	B	F#	C#	G#	D#	A#
(ET) Equal Temperament	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/6 comma	9	7.5	6	4.5	3	1.5	0	-1.5	-3	-4.5	-6	-7.5	-9	-10.5	-12
Silbermann	12	10	8	6	4	2	0	-2	-4	-6	-8	-10	-12	-14	-16
1/5 comma	15	12.5	10	7.5	5	2.5	0	-2.5	-5	-7.5	-10	-12.5	-15	-17.5	-20
2/9 comma	18	15	12	9	6	3	0	-3	-6	-9	-12	-15	-18	-21	-24
1/4 comma	21	17.5	14	10.5	7	3.5	0	-3.5	-7	-10.5	-14	-17.5	-21	-24.5	-28
Whitmer FCGDAE Chromatic D center	No Ab Maj See G#	No Eb Maj See D#	4	2	2	2	0	-2	-4	-8	-15	-15	-18	-15	No F#7 See Bb
Whitmer BbFCGDA Chromatic D center	No Ab Maj See G#	5	4	2	2	2	0	-2	-4	-8	-15	-15	-18	No B7 See Eb Maj	No F#7 See Bb

Fig. 5 - Comparative tunings for autoharp D=+0 (diatonic or chromatic, doesn't matter)

Short of showing it plotted on a graph here, which he actually did, Steve Young pointed out that Charles' tuning corresponds to Silbermann quite closely, yet always tending to have a little more pure fifth intervals. Silbermann as a regular temperament simply doesn't favor any key. All are equally "smooth sounding" relative to ET or equally lacking in consonant fifths.

String schedule

Changing the keys supported by the chord set warrants revisiting how the bass section of the instrument is tuned. The octaves are not complete in that area, and the reasons why that is true need to be reconsidered.

To avoid being misled, the reader should understand that an Orthey configured (by George) with an FCGDAE chord set also has an adjustment in the pitch of the strings in the bass section. It is tuned FGACDEFF#GABC instead of the Oscar Schmidt Model 73 standard of FCGDEFF#GAA#BC. There is a low A to support D, A, and E at the expense of a lower Bb. In other words, as the key of Bb is dropped from one end of the chord set, string tuning is adjusted to favor the key added on the other end, in this case the key of E. A change in the chord set always calls for a review of how (and if) the strings are employed in the octaves that are incomplete, which would be the bass section.

Drew Smith proposes something similar for FCGDAE. He suggests tuning the bass as GCDEFF#GG#AA#BC. Drew preserves the integrity of the key of F by maintaining support for a Bb Maj chord. He also greatly improves the E/E7 chord by adding G#. The Orthey method goes for a stronger A chord, more central to the prime keys of D and A.

Personally, I like the hybrid between the two approaches, keeping George's low A, Drew's insertion of G#, GACDEFF#GG#ABC. This results in a quite lame key of F, giving it a weak Bb chord, but a strong D, A, and E.

The real question in all three approaches to retuning the bass for support of FCGDAE is whether proper string sizes are available to support the note array. The last, my hybrid is the one best suited to using a standard string set of most any vintage. George's, the first, also works well with his standard string set. Drew's approach becomes very questionable unless using a string set with diameters exactly like George's older spec. Newer strings such as Fladmark and Vinci could present too much tension to some instruments, some of the string diameters too large for the notes desired. Usually the strings cannot be moved to another position because they wouldn't *fit*.