

Tuning Chart, Diatonic Scale, Equally Tempered. Numeric values for pitch are approximate, given the linear scale of the oscillators. The scale is based on standard tuning of 440Hz, and derives the 12 tone scale from the 12th root of 2, 1.0594630943592952645618252949463

Note	Freq (Hz)	Value	Osc Freq	Note	Freq(Hz)	Value	Osc Freq
C	32.703	18801	32Hz70	C	261.625	25347	261Hz6
C#	34.648	18983	34Hz65	C#	277.183	25530	277Hz2
D	36.708	19165	36Hz71	D	293.665	25712	293Hz7
D#	38.891	19346	38Hz89	D#	311.127	25893	311Hz1
E	41.203	19528	41Hz21	E	329.628	26075	329Hz6
F	43.654	19709	43Hz65	F	349.228	26257	349Hz2
F#	46.249	19891	46Hz25	F#	369.994	26439	369Hz9
G	48.999	20073	49Hz00	G	391.995	26621	391Hz9
G#	51.913	20254	51Hz91	G#	415.305	26804	415Hz4
A	55.000	20436	55Hz00	A	440.000	26986	440Hz1
A#	58.270	20618	58Hz27	A#	466.163	27167	466Hz1
B	61.735	20800	61Hz74	B	493.883	27350	494Hz0
C	65.406	20981	65Hz40	C	523.251	27531	523Hz2
C#	69.296	21163	69Hz29	C#	554.365	27713	554Hz3
D	73.416	21345	73Hz41	D	587.330	27895	587Hz3
D#	77.781	21527	77Hz78	D#	622.254	28077	622Hz2
E	82.407	21709	82Hz41	E	659.255	28259	659Hz2
F	87.307	21890	87Hz29	F	698.456	28441	698Hz4
F#	92.499	22072	92Hz49	F#	739.989	28623	739Hz9
G	97.999	22254	97Hz99	G	783.991	28805	783Hz9
G#	103.826	22437	103Hz8	G#	830.609	28988	830Hz8
A	110.000	22618	110Hz0	A	880.000	29169	879Hz9
A#	116.541	22800	116Hz5	A#	932.328	29351	932Hz2
B	123.471	22982	123Hz4	B	987.767	29533	987Hz6
C	130.813	23165	130Hz8	C	1046.50	29716	1046Hz
C#	138.591	23346	138Hz6	C#	1108.73	29898	1108Hz
D	146.832	23527	146Hz8	D	1174.66	30080	1174Hz
D#	155.563	23710	155Hz5	D#	1244.51	30262	1244Hz
E	164.814	23892	164Hz8	E	1318.51	30444	1318Hz
F	174.614	24074	174Hz6	F	1396.91	30626	1397Hz
F#	184.997	24256	185Hz0	F#	1479.98	30808	1480Hz
G	195.998	24438	196Hz0	G	1567.98	30990	1568Hz
G#	207.652	24620	207Hz7	G#	1661.22	31172	1661Hz
A	220.000	24802	220Hz0	A	1760.00	31354	1760Hz
A#	233.081	24984	233Hz1	A#	1864.66	31536	1864Hz
B	246.942	25165	246Hz9	B	1975.53	31718	1975Hz
C	261.625	25347	261Hz6	C	2093.00	31900	2093Hz

To a maximum frequency of about 76 cents short of F#. The oscillator response is exponential, like the Minimog and Arp Odyssey. Thus, a linear input results in exponential output. In the case of SynFactory oscillators, frequency doubles everytime you add 2183 to the frequency (FM) input.

The neat thing here is that offsets are a breeze with linear input. There is no need to constantly recalculate from octave to octave. The following is a chart of offsets. Given the inherent minor inaccuracies, the offsets are based on averages, but I have had good luck using them. Again, this is Analog we are talking about.

Interval	Offset
One-half step	182
Whole step	364
m3	544

Note: The numbers don't always add up, so if you are going to add more than one offset, you might want to compensate a little here or there.

M3	727
4	909
Aug4 (tritone)	1092
5	1273
m6	1456
M6	1638
m7	1820
M7	2002
Octave	2183

### Cents Tuning

The method for tuning calculations is the use of cents. One half step equals 100 cents, one octave equals 1200 cents. Again, this is a linear scale, and so easily used with SynFactory oscillators. A cent is worth about 1.82 on the frequency scale, or 182 (one half step) /100 or 2183/1200. If you want to create an offset of one Pythagorean half step, 90.225 cents, use INT(90.225\*1.82). This would be an offset of 164.

### Pythagorean Scale

The following is a Pythagorean chromatic scale covering one octave from C 32.703Hz. What is interesting about this scale is that the 5ths and 4ths are "perfect". They are about 2 cents off from their equally tempered equivalents. You will note that there are two tritones, A4 and d5, creating 13 tones in an octave. This scale is created using ratios instead of an exponent. Since this scale is not equally tempered, it does not lend itself to key changes.

Note	Freq~(Hz)	Interval	Value	Ratio	Cents	Offset(SynFactoryOsc)
C	32.703	Unison	18801	1:1	0	0
C#	34.453	m2	19008	256:243	114	207
D	36.791	M2	19172	9:8	204	371
D#	38.759	m3	19335	32:27	294	535
E	41.390	M3	19542	81:64	408	743
F	43.593	4th	19707	4:3	498	906
F#	46.563	A4	19912	729:512	588	1114
Gb	46.937	d5	19940	1024:729	626	1139
(Note, this is only about 14 cents off, though still a discernable distinction)						
G	49.055	5th	20079	3:2	702	1278
G#	51.679	m6	20242	128:81	792	1441
A	55.186	M6	20450	27:16	906	1649
A#	58.139	m7	20614	16:9	996	1813
B	62.085	M7	20821	243:128	1110	2020
C	65.406	Oct	20984	2:1	1200	2183

Note that the cents tunings are segments of 90, 114, and 204 cents between intervals. These are SynFactory relative offsets of 164, 207, and 371 for doing sequencer work.

This scale is the basis for the "Church Modes" in medieval music: Lydian, Phrygian, Dorian, etc. scales.

Other scales can be found listed on the web. Many of these scales are microtonal, having many more than 12 tones per octave. Harry Partch, who wrote "Genesis of a Music" created a Just intonation scale with 81 notes per octave. See <http://home.earthlink.net/~kgann/tuning.html> and <http://home.earthlink.net/~kgann/Octave.html>. Also see <http://www.medieval.org/emfaq/harmony/pyth.html> for more on Pythagorean tuning. <http://www.microtonalsynthesis.com/> has quite a few microtonal scales. Some of these are based on ratios, other equally tempered based on other roots of 2. There are 17, 19, and 23 tone scales out there that are equally tempered.