

Appendix E - Music Note and Frequency Tables

Each audio engine programs pitch through either a direct Hertz value, a period/divisor, or a chip-specific frequency register. This appendix gives the formula for each engine and a 12-note octave-4 table.

The reference frequencies are:

- **SoundChip / SFX / WAV / MOD / Amiga Paula DMA:** programmed in Hertz directly (the mixer runs at the system output sample rate). No divisor formula applies.
- **PSG / AY-3-8910:** master clock 2,000,000 Hz, period $\text{clock} / (16 * f)$.
- **SN76489:** master clock 3,579,545 Hz (NTSC), period $\text{clock} / (32 * f)$.
- **SID:** master clock 985,248 Hz (PAL), period $f * 16777216 / \text{clock}$.
- **TED audio:** PAL master clock 886,724 Hz, sound clock 110,840 Hz, register $1024 - \text{sound_clock} / f$.
- **POKEY:** master clock 1,789,773 Hz (NTSC) divided by 28, divisor $\text{clock} / 28 / f - 1$.
- **MIDI/MUS:** use MIDI note numbers. The player converts note 69 to A4 = 440 Hz and applies pitch bend internally.

E.1 Octave 4 (middle C through B), equal temperament A4 = 440 Hz

Note	f (Hz)	PSG period	SN76489 period	SID period	TED register	POKEY divisor
C	261.63	478	427	4455	600	243
C#	277.18	451	403	4720	624	229
D	293.66	426	381	5001	647	216
D#	311.13	402	359	5298	668	204
E	329.63	379	339	5612	688	192
F	349.23	358	320	5947	707	182
F#	369.99	338	302	6300	724	171
G	392.00	319	285	6675	741	162
G#	415.30	301	269	7073	757	153
A	440.00	284	254	7493	772	144
A#	466.16	268	240	7939	786	136
B	493.88	253	226	8410	800	128

E.2 Extending the table

To move up one octave (double the frequency): halve the PSG and SN76489 periods, double the SID period, halve the POKEY divisor, and for TED halve the internal divisor:

$$\text{newTED} = 1024 - \text{INT}((1024 - \text{oldTED}) / 2)$$

To move down one octave (halve the frequency): double the PSG and SN76489 periods, halve the SID period, double the POKEY divisor, and for TED double the internal divisor:

$$\text{newTED} = 1024 - 2 * (1024 - \text{oldTED})$$

The relation is exact to within rounding error. Octave shifts of more than four become noticeably flat or sharp on the small-divisor chips (SN76489, POKEY, and high TED values) and need a tempered correction table for accurate music.

E.3 SoundChip, MIDI/MUS, and modern engines

The SoundChip channels and the sample-based engines (WAV, MOD, SFX, Amiga Paula DMA) take frequency in Hertz directly through the `FREQ` register or period model owned by that engine. A program writes `int(round(f))` into a SoundChip `FREQ` register and the channel plays at that frequency. No table is needed: middle C is 262, A4 is 440.

MIDI/MUS does not expose note pitch as a divider register. The file stores note numbers, programme changes, volume/expression controllers, tempo, and pitch bend. The RawlandMini synth converts those note numbers to frequency internally, with note 60 as middle C and note 69 as A4.

E.4 RawlandMini programme numbers

RawlandMini accepts 128 melodic programme numbers. They follow the GM-style numbering and family order, but they select RawlandMini's built-in IE-native patches. They are not a promise that sampled General MIDI instruments are present.

No.	Selection	No.	Selection
0	Acoustic grand piano	64	Soprano sax
1	Bright acoustic piano	65	Alto sax
2	Electric grand piano	66	Tenor sax
3	Honky-tonk piano	67	Baritone sax
4	Electric piano 1	68	Oboe
5	Electric piano 2	69	English horn
6	Harpsichord	70	Bassoon
7	Clavinet	71	Clarinet
8	Celesta	72	Piccolo
9	Glockenspiel	73	Flute
10	Music box	74	Recorder
11	Vibraphone	75	Pan flute
12	Marimba	76	Blown bottle
13	Xylophone	77	Shakuhachi
14	Tubular bells	78	Whistle
15	Dulcimer	79	Ocarina
16	Drawbar organ	80	Lead 1 square

No.	Selection	No.	Selection
17	Percussive organ	81	Lead 2 sawtooth
18	Rock organ	82	Lead 3 calliope
19	Church organ	83	Lead 4 chiff
20	Reed organ	84	Lead 5 charang
21	Accordion	85	Lead 6 voice
22	Harmonica	86	Lead 7 fifths
23	Tango accordion	87	Lead 8 bass and lead
24	Nylon guitar	88	Pad 1 new age
25	Steel guitar	89	Pad 2 warm
26	Jazz guitar	90	Pad 3 polysynth
27	Clean guitar	91	Pad 4 choir
28	Muted guitar	92	Pad 5 bowed
29	Overdriven guitar	93	Pad 6 metallic
30	Distortion guitar	94	Pad 7 halo
31	Guitar harmonics	95	Pad 8 sweep
32	Acoustic bass	96	FX 1 rain
33	Fingered bass	97	FX 2 soundtrack
34	Picked bass	98	FX 3 crystal
35	Fretless bass	99	FX 4 atmosphere
36	Slap bass 1	100	FX 5 brightness
37	Slap bass 2	101	FX 6 sound effect
38	Synth bass 1	102	FX 7 echoes
39	Synth bass 2	103	FX 8 sci-fi
40	Violin	104	Sitar
41	Viola	105	Banjo
42	Cello	106	Shamisen
43	Contrabass	107	Koto
44	Tremolo strings	108	Kalimba
45	Pizzicato strings	109	Bag pipe
46	Orchestral harp	110	Fiddle
47	Timpani	111	Shanai
48	String ensemble 1	112	Tinkle bell
49	String ensemble 2	113	Agogo
50	Synth strings 1	114	Steel drums

No.	Selection	No.	Selection
51	Synth strings 2	115	Woodblock
52	Choir aahs	116	Taiko drum
53	Voice ooohs	117	Melodic tom
54	Synth voice	118	Synth drum
55	Orchestra hit	119	Reverse cymbal
56	Trumpet	120	Guitar fret noise
57	Trombone	121	Breath noise
58	Tuba	122	Seashore
59	Muted trumpet	123	Bird tweet
60	French horn	124	Telephone ring
61	Brass section	125	Helicopter
62	Synth brass 1	126	Applause
63	Synth brass 2	127	Gunshot

E.5 RawlandMini drum notes

On MIDI channel 9, note numbers select the RawlandMini drum table. Notes 35 through 81 have distinct GM-style drum selections. Other drum-channel notes use a default noise hit.

Note	Drum selection	Note	Drum selection
35	Acoustic bass drum	59	Ride cymbal 2
36	Bass drum 1	60	High bongo
37	Side stick	61	Low bongo
38	Acoustic snare	62	Mute high conga
39	Hand clap	63	Open high conga
40	Electric snare	64	Low conga
41	Low floor tom	65	High timbale
42	Closed hi-hat	66	Low timbale
43	High floor tom	67	High agogo
44	Pedal hi-hat	68	Low agogo
45	Low tom	69	Cabasa
46	Open hi-hat	70	Maracas
47	Low-mid tom	71	Short whistle
48	High-mid tom	72	Long whistle
49	Crash cymbal 1	73	Short guiro

Note	Drum selection	Note	Drum selection
50	High tom	74	Long guiro
51	Ride cymbal 1	75	Claves
52	Chinese cymbal	76	High woodblock
53	Ride bell	77	Low woodblock
54	Tambourine	78	Mute cuica
55	Splash cymbal	79	Open cuica
56	Cowbell	80	Mute triangle
57	Crash cymbal 2	81	Open triangle
58	Vibraslap		

E.6 Tuning notes

The numbers in section E.1 are calculated, not measured. The real-silicon SID, PSG, and POKEY chips drift with temperature and with the precise master-clock crystal; an Intuition Engine program that needs the same pitch on every machine should derive its own period from the engine clock at startup rather than hard-coding the values above.

The reference table assumes equal temperament. A program that wants just intonation, meantone, or other historical tunings generates the period table from the desired ratios using the same divisor formula. The engines have no awareness of a "scale": each channel plays whatever pitch its period register encodes.