

Quantum Soundtracker

OWNER'S MANUAL

INTRODUCTION

Unlock the power of **quantum computation** with **Quantum Soundtracker**! This groundbreaking player routine brings the mysteries of quantum mechanics to your Commodore 64, harnessing concepts like **superposition**, **interference**, and **quantum entanglement** to create sound that defies the conventional limits of the platform.



Imagine this: three audio channels, mixed together and not mixed together—**simultaneously**. Thanks to the magic of **undocumented 6502 opcodes** like **LAX**, Quantum Soundtracker performs **two operations at once**, bringing bytes onto the data bus from **two unexpected sources** and letting the **electrons themselves** naturally perform the logical **AND** function on them. By integrating principles from the renowned **Mahoney/Tufvesson 8-bit DAC routine**, we've achieved **unprecedented sound quality**. It's as if the very **electrons** are **entangled** in delivering crystal-clear audio.

You almost believed it, right? **Gotcha!** That was, of course, just a **fabricated backstory** behind the Quantum Soundtracker name. In reality, it's simply a **superbly optimized digital mixer**, crafted to squeeze every last drop of performance from your Commodore 64.

Quantum Soundtracker is a **3-channel sample-based tracker** with **16 kHz mixing rate** and **internal 8-bit resolution**. The editor loads signed 8-bit mono raw samples, but scales them down to 6 bits upon loading. Output resolution is ~6.5 bits on a stock machine.

The exact sample rate is **16151,61 Hz (PAL)** or **16765,37 Hz (NTSC)**, should you need that for resampling your sounds. See the Frequency Table for details.

Due to different CPU clocking, Quantum Soundtracker plays 3.8% faster in tempo (as well as 3.8% higher in pitch) on NTSC machines. Not fully tested on NTSC, so some random hiccups may happen.

SID TYPES

Quantum Soundtracker works on both old 6581 and new 8580 SID's, and the SID type is detected automatically when starting the editor or an exported executable. Generally, **8580 sounds slightly better**, because the DAC output values possible are more evenly distributed.

In emulators, choose the mode ReSID 8580 or ReSID 6581. If it doesn't sound quite right, try resetting the emulator settings or try another emulator. VICE is great!

Note that a SID 8580 with digiboost modification does not work with Quantum Soundtracker!

THREE CHANNELS & LIMITATIONS

There's indeed 3 channels, but it comes with a little catch: Channel 3 can only play sounds at the highest note. This is why you usually want to reserve channel 3 for drum sounds and loops.

Up to 31 samples can be loaded in, as long as they fit into the 48K reserved for sample data. We've got another little catch there: The latter 16 samples can be only played on channel 3. Therefore, you should load drums and percussion samples in the last 16 sample slots—unless you also plan to play them at different pitches on the channels, for example to play tom fills.

Sounds	Description
01-0F	15 sample slots for “tuned” instruments, playable on all three channels
10-1F	Additional 16 “drum” sample slots, for playing on channel 3 only

The note range on channels 1 and 2 is from **C-1** (7139 Hz) through **D-2** (16152 Hz). Channel 3 can only play **D-2** (16152 Hz). **Note: Sample rate is halved (and every other sample skipped) when entering notes in the editor and the screen is on. Full sample rate is reached only in block and song playback!**

Sample data is aligned at memory pages when loaded, and padded up to the next 256-byte page boundary. Similarly, sample loop length can be only defined in steps of 256 samples. Trim the sample end (**c+=M**) by a few pages to cut the padding before seeking for a loop position.

Tip: For seamless sample loops, use audio editing software that displays editing position at single sample accuracy, and create crossfaded loops that are an exact multiple of 256, while also keeping the sample length an exact multiple of 256. If you plan to use upsampling (**c+=U**) in Quantum Soundtracker, you should use multiples of 512 or 1024 samples, so that you can upsample it by an octave or two without breaking the loops.

MAKING AN EXECUTABLE

A song file saved from Quantum Soundtracker is actually a valid C-64 program, located at \$0801-\$FFBF. Editor code at \$D000-\$DCFF and some tables are omitted.

At the size of 250 disk blocks the file is too big for being loaded using KERNAL LOAD or the LOAD command at BASIC prompt. What you need to do is simply use Pucrunch or Exomizer (or a compressor of your choice) to crunch the program to a smaller size.

Pucrunch command line:

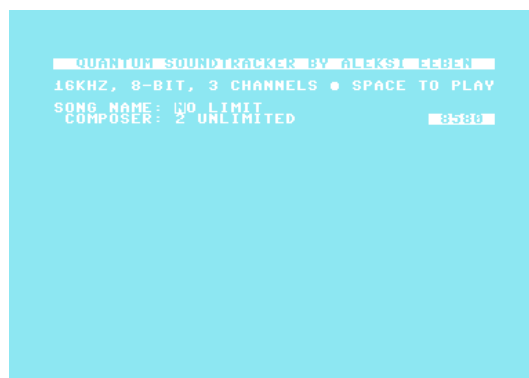
```
pucrunch "save file" "executable.prg"
```

Exomizer command line:

```
exomizer sfx sys "save file" -o"executable.prg"
```

Tip: Freezer cartridges may be able to load and run uncrunched Quantum Soundtracker files directly

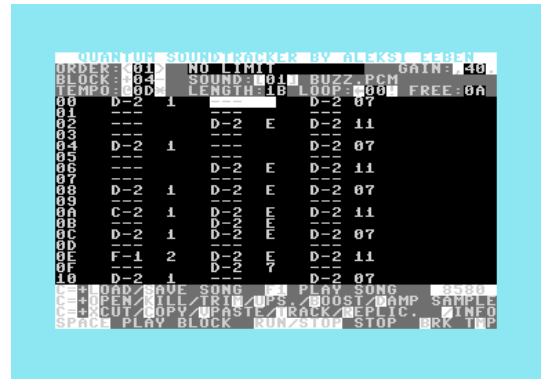
Tip: Hold & release **SPACE** to synchronize playback on two C-64's to create 6-channel songs :)



KEYBOARD COMMANDS

Most of the commands are shown on the screen and many of them are self-descriptive.

Musical Keyboard from **C-1** to **D-2**:



SHIFT + key enters a tied note that does not retrigger the sample from start (on channels 1-2 only)

ORDER	< ... >	Select step in block sequencer. The block at this step is shown below
BLOCK	+ ... -	Change the block at current sequencer step and under editing (00 = song end)
TEMPO	@ ... *	Tempo at song start (01-3F)
GAIN	+ ... -	Adjust master volume (10-80)
SOUND	[...]	Select Sound for editing (see Limitations above)
LOOP	← ... !	Adjust loop length (00 = no loop)

FREE shows the amount of sample memory available (C0 = 192 pages = 48K)

Tip: Go to Block 00 (song end mark) to play notes on the keyboard without editing note data

Tip: Lowering Gain reduces distortion, but increases quantization noise. Find the sweet spot!

Tip: Use Sound number 10 to enter multiple tied notes on channels 1-2

F1	Play song
RUN/STOP	Stop playing
c+=L, S	Load or Save song
SPACE	Play the current block

c+=X, C, V	Cut, Copy, Paste block
c+=T	Paste only the current track (depending on cursor column) from buffer
c+=R	Replicate contents of the block above cursor to fill up the block

RETURN	Play the note under cursor, pick the sound as current sound
=	Set the current sound to a note under cursor
HOME	Go to top left corner of Block

/	View or edit song info. This 6-line text is shown in the executable player as well
BRK, TMP	Enter Block Break or Tempo command on channel 3; M / SHIFT+M to adjust tempo

c+=O, K	Open or Kill the sample at the current sample slot
c+=M	Trim (shorten) the current sample by 256 bytes at the end
c+=U	Upsample the current sample by an octave, also halving the size
c+=B, D	Boost (+1.0 dB) or Dampen (-1.25 dB) the volume of the current sample

CONVERTING AND LOADING SAMPLES - STEP BY STEP

Melodic instruments

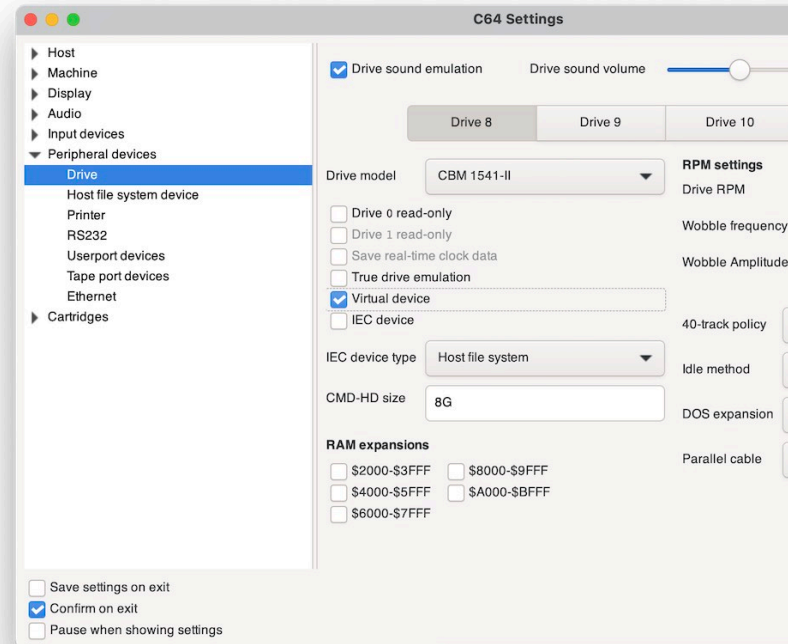
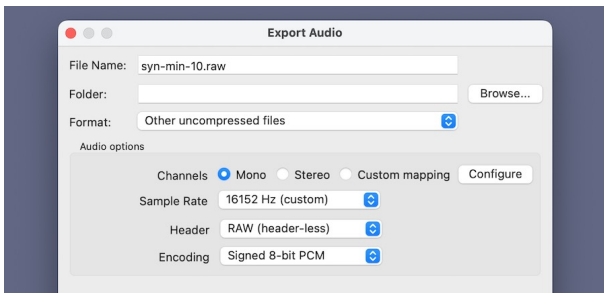
- Record the note D or tune your sound to D on any octave
- Resample to 8076 Hz (**D-1**) to get a range of 1 octave up (to **D-2**) and 2 semitones down (to **C-1**)
- Or resample to 16152 Hz (**D-2**) to get a range of 1 octave + 2 semitones down (to **C-1**)
- Or record and resample to any other note if desired (see Frequency Table on the next page)
- To extend the note range in the editor, load the sample twice and upsample the other instance
- On channel 3 you can only play the note **D-2**

Drum sounds and any other sounds to be played on channel 3

- Resample to 16152 Hz (**D-2**)
- On channel 3 you can only play the note **D-2**
- You can use the same sound on channels 1-2 if it's loaded to one of the first 15 sound slots **01-0F**
- Load short drum sounds to the last 16 sound slots **10-1F**; these can be only played on channel 3

Export format and VICE virtual device setup

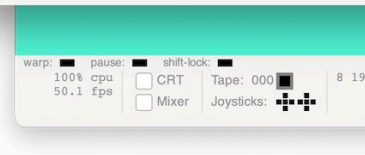
- Find the easiest way to export **signed 8-bit mono raw** samples from your favorite audio editor
- I'm editing sounds in TwistedWave, saving to 8-bit mono wav and batch converting to raw using XLD
- In Audacity, choose Other uncompressed formats, RAW (header-less) and signed 8-bit PCM



For convenience, you may want to configure **VICE Emulator** to use the host file system. Then you can just copy your samples to the working folder where you started Quantum Soundtracker from. Run the editor from the single files folder, not from the D64 image.

To use the host file system first turn off **True drive emulation** and enable **Virtual device**. Select **Host file system** in IEC device type dropdown. Uncheck all P00 file options in the next tab **Host file system device**.

Once you have all the samples edited and loaded in, save your song, transfer it over to the yellowed C128D in your study, make a cup of coffee and continue composing on the real hardware for maximum authenticity!



FREQUENCY TABLE

Pitch accuracy of Quantum Soundtracker is approximately half that of Amiga's Paula chip at its highest octave. Remember noticing that some notes weren't quite in tune on the Amiga? We'll have some of that exotic fun here as well!

Worry not, most likely you wouldn't have even noticed it until reading this, but it's good to know the exact sample rates if you wish to sample also to other notes than **D-2** or **D-1**.

Note	6510 CPU cycles (timer value +1)	Actual Sample Frequency in Quantum Soundtracker	Mathematical / Equal Temperament	Deviation (in cents)
C-1	138	7139,47 Hz	7194.73 Hz	-13
C#1	130	7578,83 Hz	7622.54 Hz	-10
D-1	122	8075,80 Hz	8075.80 Hz	0
D#1	115	8567,37 Hz	8556.02 Hz	+2
E-1	109	9038,97 Hz	9064.78 Hz	-5
F-1	103	9565,51 Hz	9603.80 Hz	-6
F#1	97	10157,20 Hz	10174.87 Hz	-3
G-1	91	10826,90 Hz	10779.90 Hz	+8
G#1	86	11456,37 Hz	11420.91 Hz	+5
A-1	81	12163,56 Hz	12100.03 Hz	+5
A#1	77	12795,43 Hz	12819.54 Hz	-4
B-1	73	13496,55 Hz	13581.83 Hz	-11
C-2	69	14278,96 Hz	14389.45 Hz	-13
C#2	65	15157,66 Hz	15245.09 Hz	-10
D-2	61	16151,61 Hz	16151.61 Hz	0

Sample rates this high are not feasible on C-64 while the screen is enabled, because VIC-II video chip halts the CPU every 8th rasterline for 40 cycles while rendering the text display area.

When playing notes while editing note data, the sample rate is halved (and every other sample skipped) for notes **D#1...D-2**. It's the most noticeable with drum samples, which do sound terribly bad in the editor. In block play and song play modes the screen is turned off to facilitate 16 kHz output.

HAPPY COMPOSING!

Random future updates may or may not appear in Aleksí's Eight Bit Shed:

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