Sequencer64 User Manual

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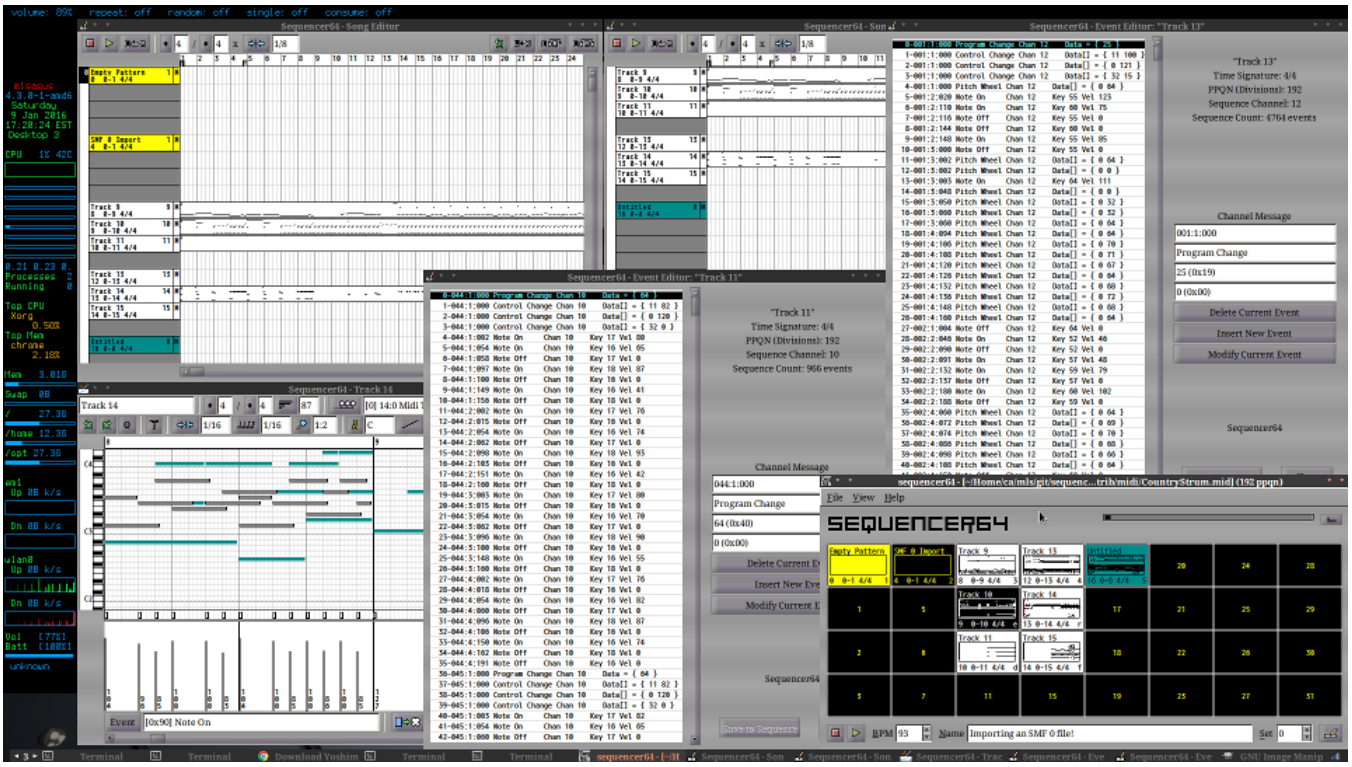
February 7, 2016



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1 Introduction

This document describes how to use *Sequencer64* [11], through version 0.9.9.15, dated approximately through January, 2016. The biggest new work has been getting the JACK support to work properly, in the "fixups" branch, now merged into "master".

We thought we had broken JACK support in our refactoring of the program, but it turns out there was a long-standing bug in *Seq24*, where the JACK position structure was not being initialized. But the position values were good enough on most computers to allow the JACK support to set itself up and run. Anyway, this bug had us hustling for quite a few days.

Also made some fixes to JACK Master mode, replacing the existing timebase callback with code adopted from the SooperLooper project. This code allows the klick metronome application to be driven by *Sequencer64*.

1.1 Sequencer64: What?

Sequencer64 is an continuation of *Sequencer24*, which itself is a continuation of *Seq24*, a live-looping sequencer with an interface more like a hardware sequencer than the typical software MIDI sequencer. *Sequencer64* has many updates and improvements, and a modestly new look, so that a new manual is now a necessity.

Seq24 was, a few years back, a very active project, with a number of contributors, who have created patches, additional functionality, and even ports to Windows. We have been assiduous about searching

for all of these updates, and incorporating them into *Sequencer64* where feasible. There are still some things to be done, including a port to Windows/Portmidi (but that is a low priority).

Sequencer64 is not a synthesizer. It requires a hardware synthesizer, or a software synthesizer such as Timidity [13], FluidSynth [4], ZynAddSubYX [20], Yoshimi [16] [17], AmSynth [2], Bristol [3], and others (see [6] for a fairly comprehensive list of "Linux" synthesizers).

Sequencer64, like *Seq24*, is meant to work a bit like an Alesis SR16 drum machine, which, for some, is a very intuitive and fast way to do MIDI. If one has worked with trackers like *SoundTracker* and *ShakeTracker*, then "you are a tracker guy and it gonna go fast". With *Sequencer64*, one creates several patterns, and then combines them.

There are a number of authors of *Seq24*, and currently only one author of *Sequencer64*, as one can see in figure 17 ("Help Credits") on page 29, and in figure 18 ("Help Documentation") on page 30. All of these authors have contributed to *Sequencer64*, whether they know it or not. The original author is Rob C. Buse; where the word "I" occurs, that is probably him.

Now, unfortunately, *Seq24* is not under active development (2010 seems to be the last update). There are a number of minor forks for it on *GitHub*, and some conversions to code in other languages, and some patches. There is also a fairly extensive port to Windows. So, why would we bother creating yet another fork of *Seq24*?

1.2 Sequencer64: Why?

The first reason is consolidation of all the features and fixes that *Seq24* has accumulated in various forks over the years.

Also, although "feature-complete", *Seq24* could use a few more features, such as "infinite patterns" (i.e. "tracks"), support for more session managers, better annunciation, uniformity, even more use of keystrokes, work-arounds for the need for two mouse buttons, a more up-to-date user-interface framework, a few bug fixes, beefing up the support for the "user" configuration file, and a way to edit parts of the MIDI file textually.

The original author:

> *Seq24* is a real-time MIDI sequencer. It was created to provide a very simple interface for editing and playing MIDI 'loops'. After searching for a software based sequencer that would provide the functionality needed for a live performance, there was little found in the software realm. I set out to create a very minimal sequencer that excludes the bloated features of the large software sequencers, and includes a small subset of features that I have found usable in performing.
>
> Written by Rob C. Buse. I wrote this program to fill a hole. I figure it would be a waste if I was the only one using it. So, I released it under the GPL.

This project deserves to stay alive! (And it is alive! A new version, 0.9.3, has come out from the LaunchPad group! It corrects a problem with MIDI Clock drift). Taking advantage of Rob's generosity, we've created a continuation, a refactoring, and an improvement (we hope) of *Seq24*. It preserves, we hope, the lean nature of *Seq24*, while adding a few features we've found useful, making it the "vi of sequencers".

Always remember that, without *Seq24* and its authors, *Sequencer64* would never have come into being.

1.3 Improvements

The following improvements have been made to *Seq24* for *Sequencer64*:

- A new *event editor* dialog is now supported. It allows for the viewing and editing of MIDI channel events. The user is able to see all types of events in the sequence at once. This editor is still a work-in-progress.
- *Sequencer64* can now read SMF 0 MIDI files. It splits the file into tracks based on channel number. Each track becomes one sequence/pattern in the main window grid.
- One can optionally bring up two song editor windows, to have a view of two different parts of a large sequence while arranging it.
- The Set Tempo and Time Signature events of normal MIDI files are now processed and incorporated into the user-interface.
- It is now possible to save the scale, key, and background sequence settings to the *Sequencer64* MIDI file, either globally or per-sequence.
- Additional mouse and keystroke support in the pattern and song editor windows:
  - Ability to move selected notes or triggers using the arrow keys.
  - Better explanation of existing keystroke support for that window.
  - Additional keystroke support for entering and exiting "paint" mode.
  - Ability to use the Mod4/Super/Windows key to keep editing (painting) mode enabled after releasing the right mouse button, for some of the modern crappy touchpads shipped with "gamer" laptops.
- The "user" configuration is now written to disk, and we will be adding more settings to it as time goes on. It currently offers the long-standing feature of customizable buss, instrument, and controller information, plus some customizations of the user-interface, such as font and display of the main window's pattern grid.
- Support for mapping MIDI events to a single MIDI buss for testing or simple use cases.
- On-going support for handling PPQN values other than the default value of 192. Still not complete.
- Small improvements in appearance:
  - Support for showing empty sequences (i.e. having only meta events) in a highlight color.
  - Modification of the colors of the scale and background sequence in the sequence editor to make it easier to see them all.
  - A new font, enabled at build time, that is bolder and has a more modern, anti-aliased look.
  - Clean, solid lines to replace the dotted lines in the piano-roll grids.
- Consolidated various patches in forks of the *Seq24* project found by searching the web. Fixes to bugs found while refactoring *Seq24* were also made. These fixes are noted in detail in the project's ROADMAP file.
- More musical scales (harmonic minor, melodic minor, and whole tone scales) have been added.
- Internal improvements.
  - Provided a new, more MIDI-compliant output format for the MIDI files. The old format can still be read, and, with a "legacy" option, be written.
  - Changed the type of MIDI event container used, which greatly speeds up the loading of a MIDI file, especially in debug mode. If the new container reduces the maximum output of the sequencer, we will dump the slow container into a vector container for faster playback.
  - The code was reformated using *astyle* and personal preferences. Modules were split into smaller units. Header file "includes" were moved into the "cpp" files to reduce header-file dependencies and build times, and to facilitate modularity and understanding of the code.

  - Much documentation was added to the code as we figured out how it worked. Generation of Doxygen output (including a PDF file) provides a developer's reference manual.
  - Debian packaging was incorporated into the project to make it easier to install without source code. Bootstrapping and packing scripts were added so that other developers can rebuild the project from scratch.
- New minor features.
  - The size of the Patterns Panel (main windows) is now locked (well, partly anyway), since enlarging it offers no benefits.
  - Support for LASH is now a run-time option (as well as a build option).
  - Support for reading and writing configuration files from the user's `$HOME/.config/sequencer64` directory.

In the future, version 1.0 will be even more object-oriented, hopefully faster, and easier to modify. Eventually, we might get it to build for Windows, using MingW, though this is a low priority and a fairly significant task.

1.4 Document Structure

The structure of this document is based on the user-interface of *Sequencer64*. The sections are basically provided in the order their contents appear in the user interface of *Sequencer64*. To help the reader jump around this document, multiple links, references, and index entries are provided.

Usage tips for each of the functions provided in *Sequencer64* are sprinkled throughout this document. Each tip occurs in a section beginning with "**Tip:**". Each tip is provided with an entry in the index, under the main topic "tips".

Bug notes for some of the oddities found in *Sequencer64* are sprinkled throughout this document. Each bug occurs in a sentence beginning with "**Bug:**". Each bug is provided with an entry in the index, under the main topic "bugs". These bugs are items that we will try to fix as time goes on.

"To-do" items are also present, again in the same vein. Each to-do occurs in a sentence beginning with "**TODO:**". This document currently has a lot of them!

"New" items are also present, in the same vein. New features (post version 0.9.2) will be noted with the tag "**New:**".

1.5 Let's Get Started!

Let us run *Sequencer64*, but run it without using *JACK*, which complicates the discussion of *Sequencer64*. The first thing to do is make sure one has no other sound application running (unless one wants to risk blocking *Sequencer64* or hearing two sounds simultaneously, depending on one's sound card and ALSA setup). Then start *Sequencer64* so that it uses ALSA for MIDI. Provide a default MIDI file so that all elements of the user interface can come into play. Also use the "&" character so that we get back to the command-line prompt. Finally, on our system the main synthesizer (*Yoshimi*) comes up on MIDI buss 5, so we add an option to remap all events to that buss:

```
$ sequencer64 --bus 5 b4uacuse-seq24.midi &
```

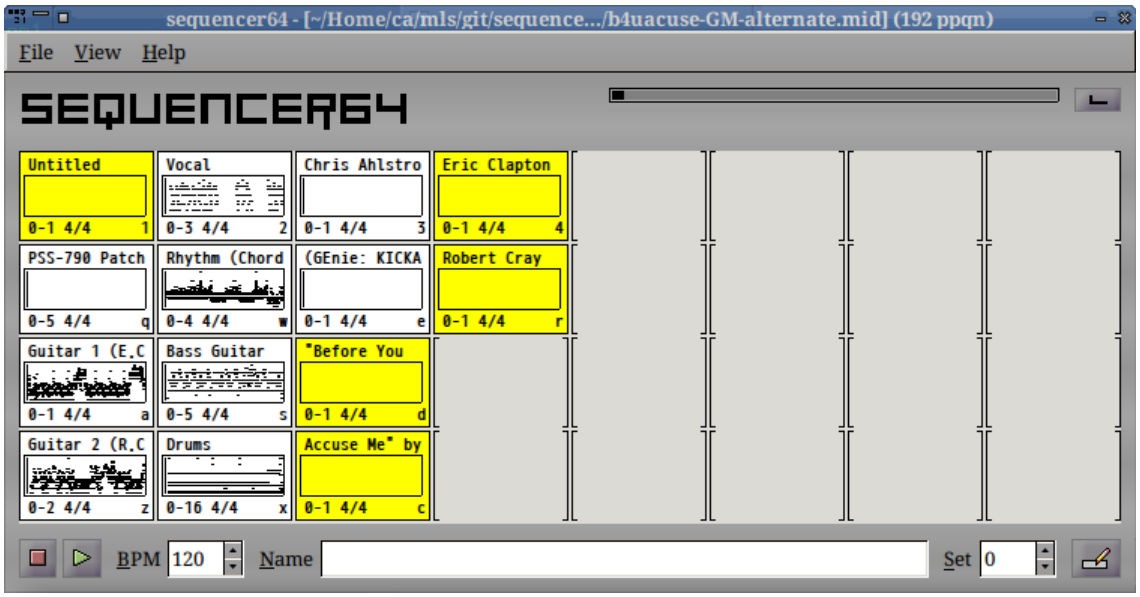

Figure 1: Sequencer64 Main Screen

Then the *Sequencer64* main window appears, as shown in figure 1 ("Sequencer64 Main Screen") on page 10. It has a two minor differences from the *Seq24* main window: the highlighting of empty patterns in yellow; and a different font.

Tip: As with most user-interfaces, holding the mouse over any button for a short period will let one view a short description (tooltip) of what it does.

2 Concepts

The *Sequencer64* program is basically a loop-playing machine with a fairly simple interface. Before we describe this interface, it is useful to present some concepts and definitions of terms as they are used in *Sequencer64*. Various terms have been used over the years to mean the same thing (e.g. "sequence", "pattern", "loop", and "slot"), so it is good to clarify the terminology.

2.1 Concepts / Terms

This section doesn't provide comprehensive coverage of terms. It covers terms that puzzled the author at first or that are necessary to understand the *Sequencer64* program.

2.1.1 Concepts / Terms / armed

An armed sequence is a sequence (see section 2.1.15 ("Concepts / Terms / sequence") on page 13) that will be heard. "Armed" is the opposite of "muted". Performing an *arm* operation in *Sequencer64* means clicking on an "unarmed" sequence in the patterns panel (the main window of *Sequencer64*). An unarmed sequence will not be heard, and it has a white background. When the sequence is *armed*, it will be heard, and it has a black background. A sequence can be armed or unarmed in three ways:

- Clicking on the sequence/pattern box.

- Pressing the hot-key for that sequence/pattern box.
- Opening up the Song Editor and starting playback; the sequences arm/unarm depending on the layout of the sequences and triggers in the piano roll of the Song Editor.

2.1.2 Concepts / Terms / buss (bus)

A *buss* (also spelled "bus" these days; https://en.wikipedia.org/wiki/Busbar) is an entity onto which MIDI events can be placed, in order to be heard or to affect the playback. A *buss* is just another name for port. See section 2.1.10 ("Concepts / Terms / port") on page 12.

2.1.3 Concepts / Terms / group

A *group* in *Sequencer64* is one of up to 32 previously-defined mute/unmute patterns in the active screen set. A group is a set of patterns that can toggle their playing state together. Every group contains all 32 sequences in the active screen set. This concept is similar to mute/unmute groups in hardware sequencers. Also known as a "mute-group".

2.1.4 Concepts / Terms / loop

Loop is a synonym for *pattern* or *sequence*, when used in existing *Seq24* documentation. Each loop is represented by a box (pattern slot) in the Pattern (main) Window.

2.1.5 Concepts / Terms / measures ruler

The *measures ruler* is the bar at the top of the Song Editor arrangement window that shows the numbering of the measures in the song. Left and right markers can be dropped on this ruler to set durations to be played, looped, expanded, or collapsed.

Note: The original *Seq24* documentation calls this item the *bar indicator*.

2.1.6 Concepts / Terms / muted

The opposite of section 2.1.1 ("Concepts / Terms / armed") on page 10.

2.1.7 Concepts / Terms / MIDI clock

MIDI clock is a MIDI timing reference signal used to synchronize pieces of equipment together. MIDI clock runs at a rate of 24 ppqn (pulses per quarter note). This means that the actual speed of the MIDI clock varies with the tempo of the clock generator (as contrasted with time code, which runs at a constant rate).

2.1.8 Concepts / Terms / pattern

A *Sequencer64 pattern* (also called a "sequence" or "loop") is a short unit of melody or rhythm in *Sequencer64*, extending for a small number of measures (in most cases). Each pattern is represented by a box in the Patterns window.

Each pattern is editable on its own. All patterns can be layed out in a particular arrangement to generate a more complex song.

pattern is a synonym for *loop* or *sequence*. It is our preferred term.

2.1.9 Concepts / Terms / performance

In the jargon of *Sequencer64*, a *performance* is an organized collection of patterns. This layout of patterns is created using the Song Editor, sometimes called the "performance editor".

2.1.10 Concepts / Terms / port

A *port* is just another name for buss. See section 2.1.2 ("Concepts / Terms / buss (bus)") on page 11. Each port can support 16 MIDI channels.

2.1.11 Concepts / Terms / pulses per quarter note

The concept of "pulses per quarter note", or PPQN, is very important for MIDI timing. To make it a bit more confusing, sometimes these pulses are referred to as "ticks", "clocks", and "divisions". To make it even more confusing, there are separate timing concepts to understand, such as "tempo", "beats per measure", "beats per minute", "MIDI clocks", and more.

While a full description of all these terms, and how they are calculated, is beyond the scope of this document, we will try to clarify the discussion when such confusion could be an issue.

2.1.12 Concepts / Terms / queue mode

To "queue" a pattern means to ready it for playback on the next repeat of a pattern. A pattern can be armed immediately, or it can be queued to play back the next time the pattern restarts.

A set of queued patterns can be temporarily stored, so that a different set of playbacks can occur, before the original set of playbacks is restored.

The "keep queue" functionality allows the queue to be held without holding down a button the whole time.

2.1.13 Concepts / Terms / replace

Replacement is a form of muting/unmuting. When the "replace" key is pressed while click a sequence, that sequence is unmuted, and all of the other sequences are muted.

2.1.14 Concepts / Terms / screen set

The *screen set* is a set of patterns that fit within the 8x4 grid of loops/patterns in the Patterns panel. *Sequencer64* supports multiple screens sets, up to 32 of them, and a name can be given to each for clarity. Some day *Sequencer64* will support an 8x8 grid and 64 patterns per screen set.

2.1.15 Concepts / Terms / sequence

Sequence is another synonym for *pattern*, used in some of the *Seq24* documentation. *Loop* is another synonym. Each sequence is represented by a box (pattern slot) in the Patterns window.

Note that many, for other sequencer applications) use the term "sequence" to apply to the complete song, and not just to one track or pattern in the entire song.

2.1.16 Concepts / Terms / snapshot

A *Sequencer64 snapshot* is simply a briefly preserved state of the patterns. One can press a snapshot key, change the state of the patterns for live playback, and then release the snapshot key to revert to the state when it was first pressed. (One might call it a "revert" key, instead.)

2.1.17 Concepts / Terms / song

A *song* is a collection of patterns in a specific layout, as assembled via the Song Editor window. Also see 2.1.9

2.2 Concepts / Sound Subsystems

2.2.1 Concepts / Sound Subsystems / ALSA

ALSA is a sound and MIDI system for Linux, with components built into the Linux kernel. It is the main subsystem used by *Sequencer64*. The name of the library used to build *ALSA* projects is `libasound`. See reference [1].

2.2.2 Concepts / Sound Subsystems / PortMIDI

PortMIDI is a cross-platform API (applications programming interface) for MIDI. It seems to be used in the "portmidi" C++ modules included with the base source-code repository of *Seq24* available (for example) from Debian Linux. See reference [9] for the PortMIDI home page. Unfortunately, the code in the Debian package is not quite ready to build on Windows. We might fix that someday, though Windows is not a high priority.

The SubatomicGlue Windows port of *Seq24* (see reference [12]) bundles a version of the PortMIDI project with the source code for the port. It also provides a complete bundle of the other products (e.g. gtkmm 2.4) needed to build and run the project. (By the way, the Windows port is built with MingW, which provides the GNU compilers and tools. This is a good thing, as Visual Studio Community, though "free", is not "Free".)

2.2.3 Concepts / Sound Subsystems / JACK

JACK is a cross-platform (with an emphasis on Linux) API and infrastructure for making it easier to connect and reroute MIDI and audio event between various applications and hardware ports. See reference [5].

3 Menu

The *Sequencer64* menu, as seen at the top of figure 1 ("Sequencer64 Main Screen") on page 10, is fairly simple, but it is important to understand the structure of the menu entries.

3.1 Menu / File

The **File** menu is used to save and load standard MIDI files. *Sequencer64* should be able to handle any Format 1 standard files that any other sequencer is capable of exporting.

The *Sequencer64* menu entry contains the sub-items shown in figure 2 ("Sequencer64 File Menu Items") on page 14. The next few sub-sections discuss the sub-items in the *File* sub-menu.

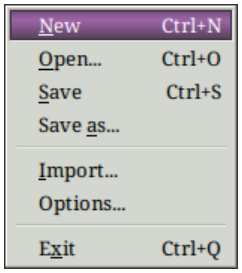

Figure 2: Sequencer64 File Menu Items

1. **New**
2. **Open...**
3. **Save**
4. **Save As...**
5. **Import...**
6. **Options...**
7. **Exit**

3.2 Menu / File / New

The **New** menu entry clears out any current song and patterns, allowing one to create news ones from scratch. If unsaved changes are pending, the user will be prompted to save the changes.

Currently, the detection of situations requiring a save (or not requiring a save) needs a bit of work.

3.2.1 Menu / File / Open

The **Open** menu entry opens a song (MIDI file) that had been saved previously. It opens up a standard GTK+2 file dialog:

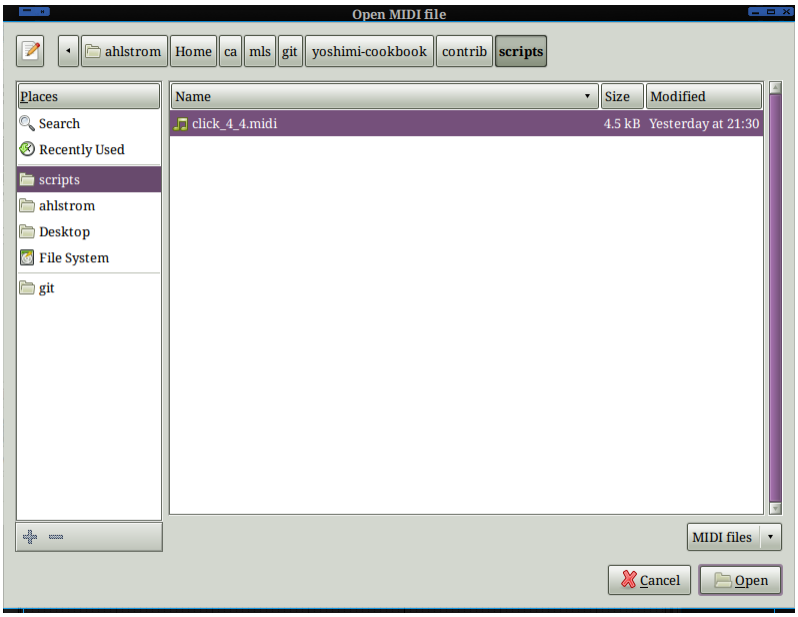

Figure 3: File Open

If unsaved changes are pending, the user will (usually) be prompted to save the changes. When in doubt, save! If still in doubt, keep backups of your tunes!

3.2.2 Menu / File / Save and Save As

The **Save** menu entry saves the song under its current file-name. If there is no current file-name, then it opens up a standard GTK+2 file dialog to name and save the file.

The **Save As** menu entry saves a song under a different name. It opens up the following standard GTK+2 file dialog:

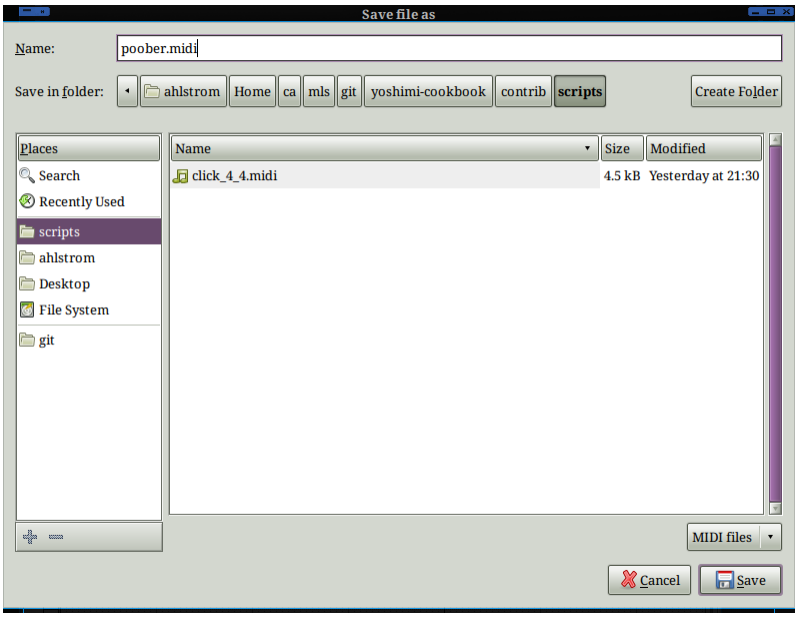

Figure 4: File Save As

To save a new file, or to save the current existing file to a new name, enter the name in the name field, *without an extension*. *Sequencer64* will append a `.midi` extension to the filename. The file will be saved in a format that the Linux *file* command will tag as something like:

```
myfile.midi: Standard MIDI data (format 1) using 16 tracks at 1/192
```

It looks like a simple MIDI file, and yet, if one re-opens it in *Sequencer64*, one sees that all of the labelling, pattern information, and song layout has been preserved in this file. Even the pattern subsections, as discussed in section 6.2.2 ("Song Editor / Arrangement Panel / Piano Roll") on page 59, have been saved. (But the L and R marker positions are not saved.)

Compare the sizes of the original project MIDI file, `contrib/b4uacuse.mid`, and the output MIDI file after *Sequencer64* saved the patterns and the song layout we created, `contrib/b4uacuse-seq24.midi`. The latter is a lot bigger.

The reason is that, after the last track in the file, a number of sequencer-specific (SeqSpec) items are saved, to preserve this extra information. In legacy mode, *Sequencer64* saves this information in the same format as *Seq24*. Unfortunately, this format is not quite standard, and a few MIDI applications may produce error messages (as opposed to just ignoring it) when parsing this section.

New: Therefore, in its normal mode, *Sequencer64* saves this information in a more MIDI-compliant format, marking each SeqSpec section as vendor-specific information, and marking this section as a regular MIDI track. The legacy and new formats of the final "track" are explained in section 12.2 ("Legacy Proprietary Track Format") on page 98.

3.2.3 Menu / File / Import

The **Import** menu entry allows one to import a Format 1 MIDI file into one or more patterns, one pattern per track in the MIDI file. Even long tracks, that aren't short loops, are read in properly.

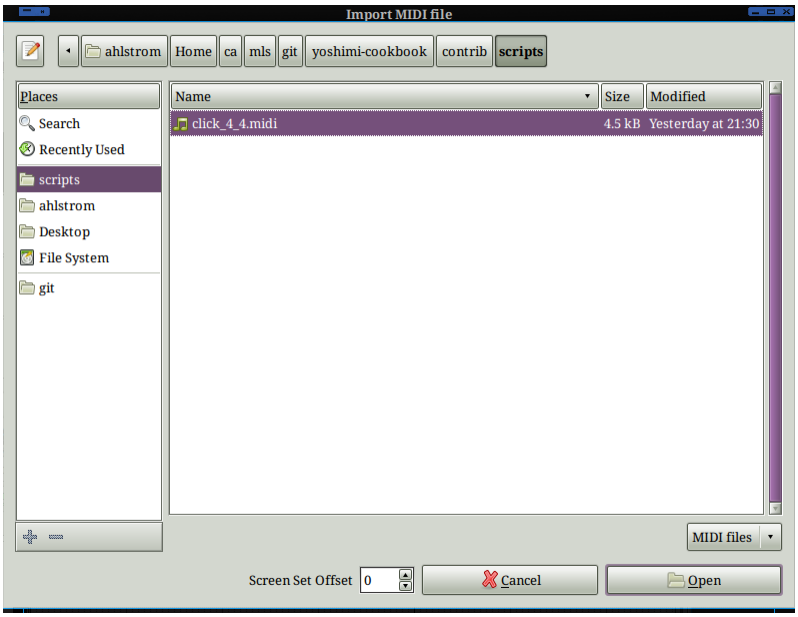

Figure 5: File Import

When imported, each track, whether a music track or an information track, is entered into its own loop/pattern box. The import operation can handle reasonably complex files, as shown in the following diagram, which shows an import of the `contrib/b4uacuse.mid` file, which contains a transcription of an Eric Clapton tune that we'd made over 20 years ago and had uploaded to the *GEnie* network service.

Note the additional file-dialog field, **Select Screen Offset**. This setting lets one place the imported data into a screen-set other than the first screen-set, screen-set 0. This field is not editable. It requires using the scroll button to move the screen set offset up or down in value. The legal values range from -31 to 0 to +31.

When the file is imported, the sequence number for each track read in is adjusted to put the track in the desired screen set. The negative numbers are probably more useful to move sequences around in an already-created *Sequencer64* song file with a lot of screen-sets in it.

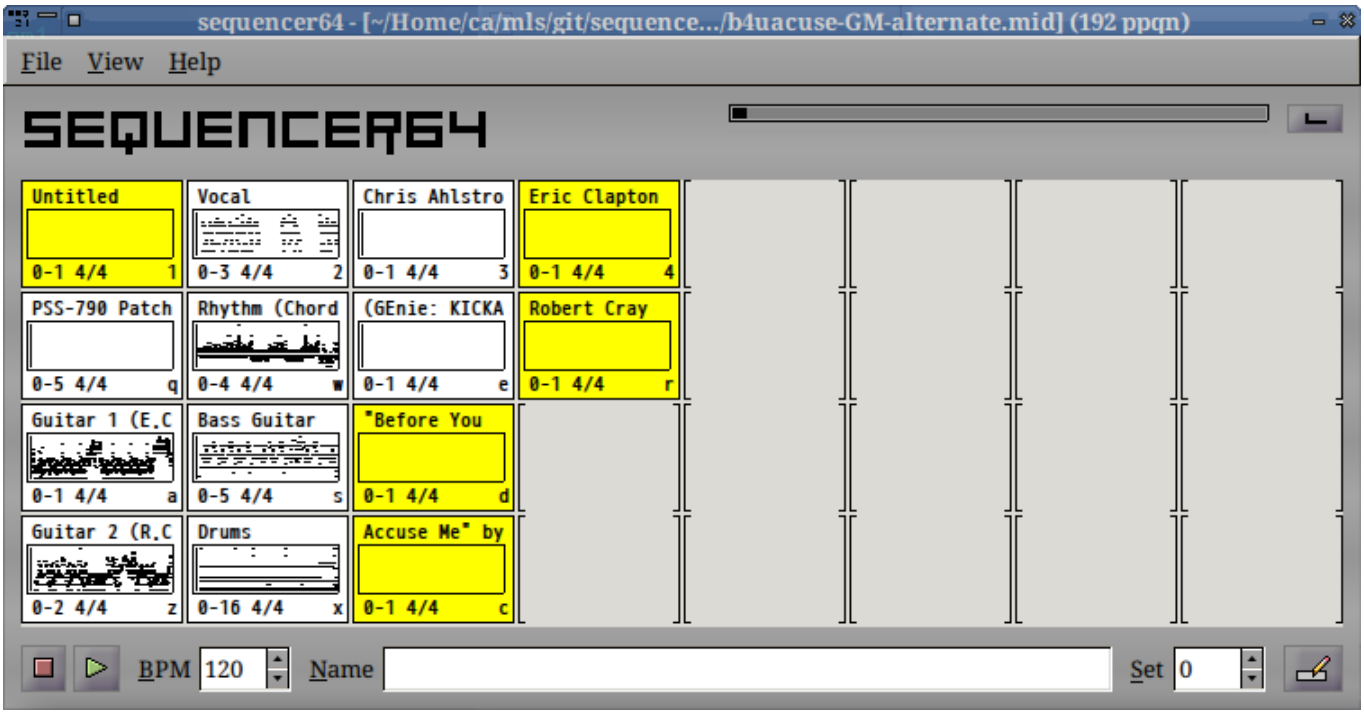

Figure 6: Imported MIDI Song

This song has a number of non-event tracks containing labels. **New:** These tracks are treated as "empty", and show up with a yellow background. They are ignored on playback. Some of the tracks which look empty, but are not yellow, contain program-change events.

Unfortunately, this song was created before the days of General MIDI. It was scored for the Yamaha PSS-790 consumer-level synthesizer, definitely not a GM-compliant device. One can use the MIDI-conversion project, *midicvt* (see reference [8]), to convert it to General MIDI format, including General MIDI drums.

3.2.4 Menu / File / Options

The **Options** menu item provides a number of settings in one tabbed dialog, shown in the figures that follow. This dialog allows one to select which sequence gets the MIDI clock, which incoming MIDI events control the sequencer, what keys are mapped to functions, how the mouse works, and some JACK parameters.

3.2.4.1 Menu / File / Options / MIDI Clock

The **MIDI Clock** tab provides a way to send the MIDI clock to one or more of the *Sequencer64* output busses. It is used to configure to what busses the MIDI clock gets dumped. It also shows the devices that one can play music with. The items that appear in this tab depend on three things:

- What MIDI devices are connected to the computer. For example, MIDI controllers, USB MIDI cables, and other devices will add MIDI output devices (ports) to the system.
- What MIDI software devices are running on the computer. For example, running MIDI software synthesizers such as *Timidity* and *Yoshimi* will add extra output devices (playback ports) to a system.

- The setting of the "manual ALSA ports" option, `--manual_alsa_ports` command-line option or the `[manual-alsa-ports]` section of the `sequencer64.rc` configuration file, as described in section 8.7 ("Sequencer64 / Other Sections") on page 74

For the current discussion, a USB MIDI cable was plugged into the system, and the *Timidity* and *Yoshimi* (in ALSA mode) software synthesizers were running. *Sequencer64* was also running, of course. Here are the devices shown by the ALSA MIDI playback command-line application:

```
$ aplaymidi -l
 Port    Client name                      Port name
 14:0    Midi Through                     Midi Through Port-0
 24:0    USB2.0-MIDI                      USB2.0-MIDI MIDI 1
 24:1    USB2.0-MIDI                      USB2.0-MIDI MIDI 2
128:0    TiMidity                         TiMidity port 0
128:1    TiMidity                         TiMidity port 1
128:2    TiMidity                         TiMidity port 2
128:3    TiMidity                         TiMidity port 3
130:16   seq24                            seq24 in
```

(For some reason, the *Yoshimi* input port is not showing up in the output of `aplaymidi`, though, as shown in figure 8 ("MIDI Clock, Manual ALSA Option Off") on page 21, *Sequencer64* sees it on port 7. Perhaps that application is not providing a good ALSA device name.)

Turning to figure 7 ("MIDI Clock, Manual ALSA Option On") on page 20, note the 16 devices provided by *Sequencer64*. Also note that its first value is 1, not 0, due to the MIDI Thru port occupying slot 0. This figure shows the result with the manual ALSA option of *Sequencer64* turned on.

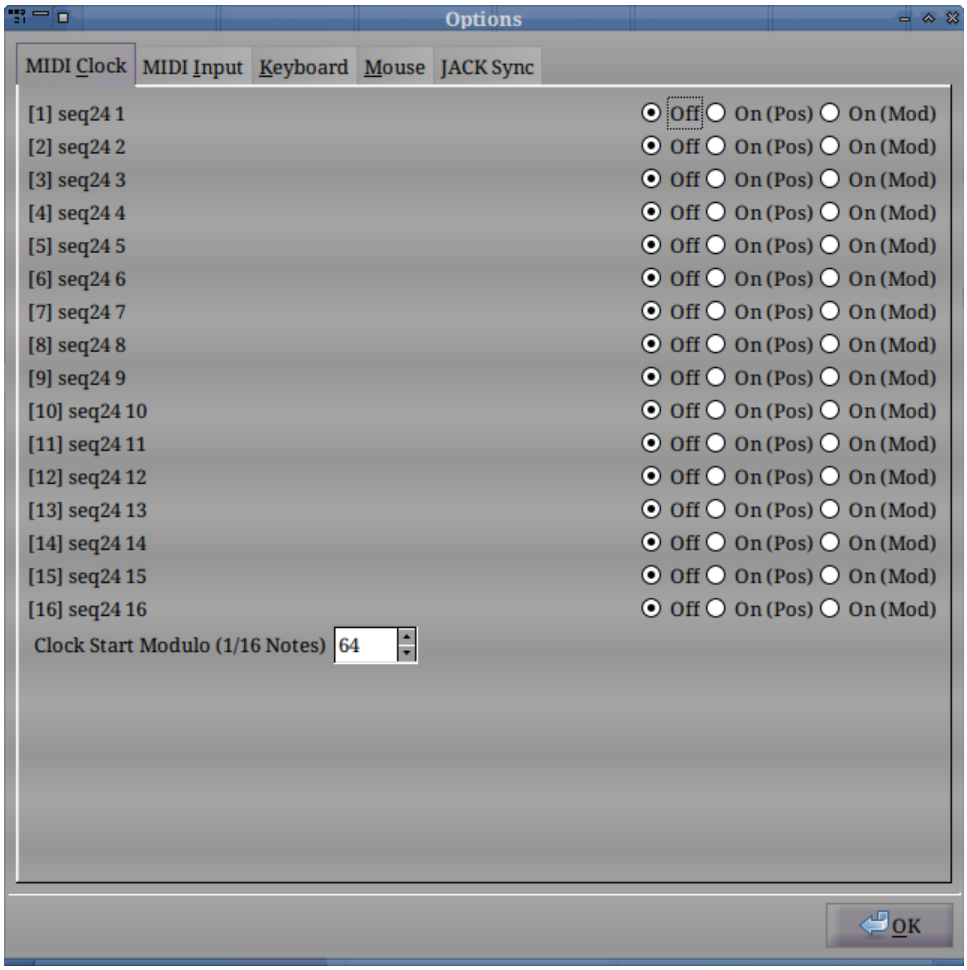

Figure 7: MIDI Clock, Manual ALSA Option On

It basically shows the 16 MIDI output busses that *Sequencer64* can drive. One would have to use an ALSA MIDI connection application to put a device on each of those outputs. The fact that the the buss names can start with different numbers, depending on the system setup, can complicate the playing of MIDI in this manner.

The following elements are present in this dialog:

1. **Buss Name**
2. **Off**
3. **On (Pos)**
4. **On (Mod)**
5. **Clock Start Modulo**

1. Buss Name. These labels indicate the output busses (ports) of *Sequencer64*. They range from **[1] seq24 1** to **[16] seq24 16**.

2. Off. This setting disables the MIDI clock for the given output buss. However, note that MIDI output can still be sent to those ports, and each port that has a device connected to it will play music.

For feeding *Yoshimi* with MIDI data, we found that this setting is the one that must be made in order for *Yoshimi* to produce a sound.

3. On (Pos). The MIDI clock will be sent to this buss. MIDI Song Position and MIDI Continue will be sent if playback is starting at greater than tick 0 in Song mode. Otherwise, MIDI Start will be sent.

4. On (Mod). The MIDI clock will be sent to this buss. MIDI Start will be sent and clocking will begin once the Song Position has reached the start modulo of the specified size (see the next item's description). This setting is used for gear that does not respond to Song Position.

5. Clock Start Modulo. Clock Start Modulo (1/16 Notes). This value starts at 1 and ranges on upward to 16384. It defaults to 64. It is used by the **On (Mod)** setting discussed above. It is the `[midi-clock-mod-ticks]` option in the *Sequencer64* "rc" file as described in section 8.7 ("Sequencer64 / Other Sections") on page 74.

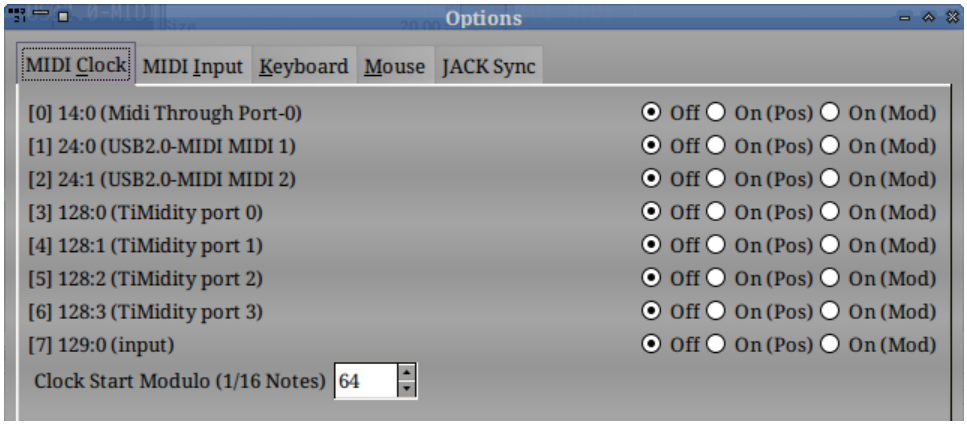

Figure 8: MIDI Clock, Manual ALSA Option Off

As shown by the figure above, with the manual ALSA option turned off, all of the devices that can be driven by MIDI output are shown, including the MIDI Thru port, the two MIDI ports on the USB cable, the four ports provided by *Timidity*, and the unlabelled port provided by *Yoshimi*.

One could theoretically play music through 6 or 7 devices using *Sequencer64* with this setup.

TODO: There is currently no user-interface item corresponding to this command-line and "rc" configuration file option.

3.2.4.2 Menu / File / Options / MIDI Input

To allow *Sequencer64* to record MIDI from MIDI devices such as controllers and keyboards, the output of the ALSA MIDI recording command-line application is relevant:

```
$ arecordmidi -l
 Port    Client name                      Port name
 14:0    Midi Through                     Midi Through Port-0
 24:0    USB2.0-MIDI                      USB2.0-MIDI MIDI 1
130:0    seq24                            [1] seq24 1
130:1    seq24                            [2] seq24 2
130:2    seq24                            [3] seq24 3
 . . .   . . .                              . . .
130:15   seq24                            [16] seq24 16
```

We see that we can record MIDI from the MIDI Thru port, from the USB MIDI cable, and MIDI from any of the 16 output ports provided by the manual ALSA port mode of *Sequencer64*.

If the "manual ALSA ports" option (see below) is turned on, then the only item in the **MIDI Input** tab is the single MIDI input buss provided by *Sequencer64*: **[0] seq24 0**, or, since the MIDI Thru port takes slot 0, **[1] seq24 1**.

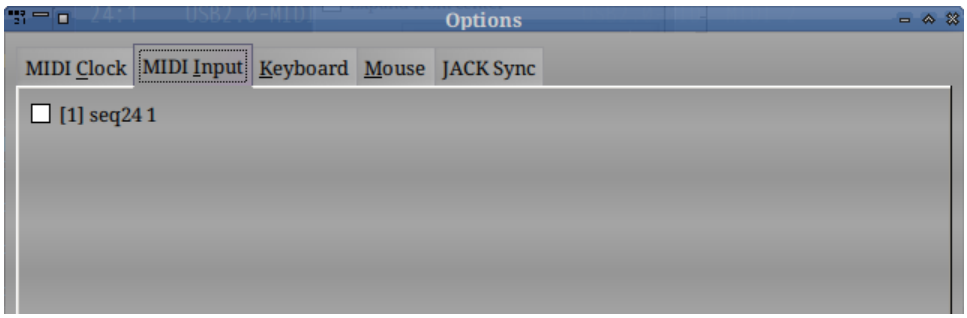

Figure 9: MIDI Input, Manual ALSA Ports On

This item, if checked, allows *Sequencer64* to be used to record MIDI information from another source (which must be connected to this port by another application), or pass it through to the output busses that are configured to allow pass-through (in the Pattern Editor, as discussed in section 5.4 ("Pattern Editor / Bottom Panel") on page 53.)

If the "manual ALSA ports" option is turned off, then the input ports from the system are shown:

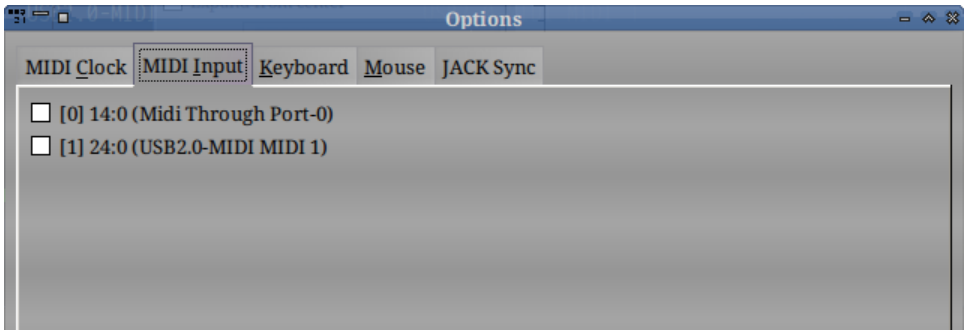

Figure 10: MIDI Input, Manual ALSA Ports Off

For example, one could check input #1 to have *Sequencer64* record MIDI from an old-fashioned MIDI keyboard that is connected to the USB MIDI cable. If the keyboard didn't have a sound generator, one would also want *Sequencer64* to pass this MIDI on to a sound generator, such as a software or hardware synthesizer attached to one of the ports shown in figure 8 ("MIDI Clock, Manual ALSA Option Off") on page 21.

3.2.4.3 Menu / File / Options / Keyboard

Sequencer64, as befits a good application, allows extensive use of keyboard shortcuts to make operations go faster than when using a mouse. The **Keyboard** tab allows for the configuration of these keyboard shortcuts.

Warning: Whenever one of the text fields in this dialog has the focus (and that is usually the case), then any keystroke, including keys like Ctrl, Alt, and Super (Mod4 or Windows key), can alter the value of a field to that of the keystroke. This change is very easy to do accidentally! **Use the mouse** to move this window and to click its **OK** button!

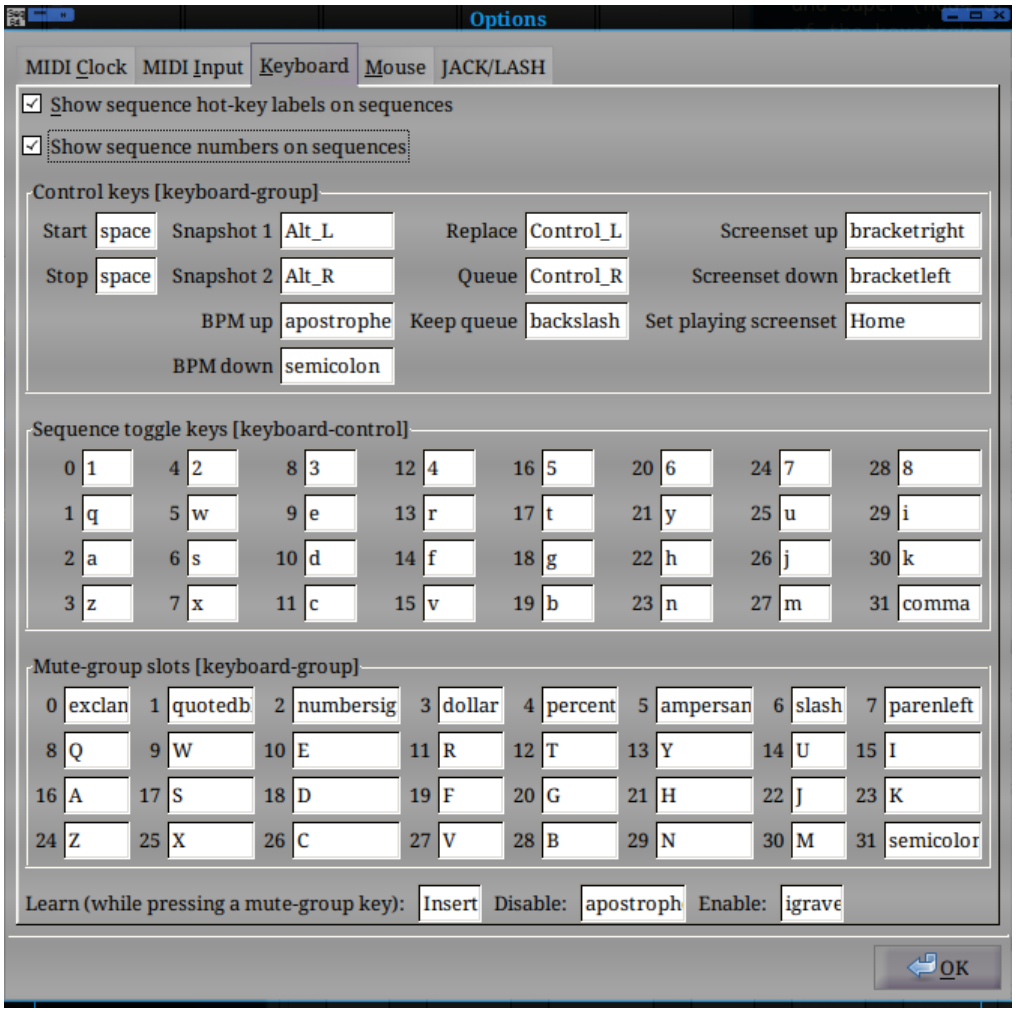

Figure 11: File / Options / Keyboard

We won't attempt to cover every user-interface item in this busy dialog, just the categories. Some items are discussed in other parts of this manual.

1. **Show key labels on sequences**
2. **Show sequence numbers on sequences**
3. **Control keys**
4. **Sequence toggle keys**
5. **Mute-group slots**
6. **Learn**
7. **Disable**
8. **Enable**

1. Show key labels on sequence. This item, if enabled, shows the key labels in the lower-right corner of each loop/pattern in the Patterns window (the main window). This feature is useful for live

playback and control of a song. Note that this option is also available in the "rc" configuration file.

2. Show sequence numbers on sequence. **New:** If this option is turned on, the empty slots in the Patterns window show the prospective sequence number. See the following figure for the look.

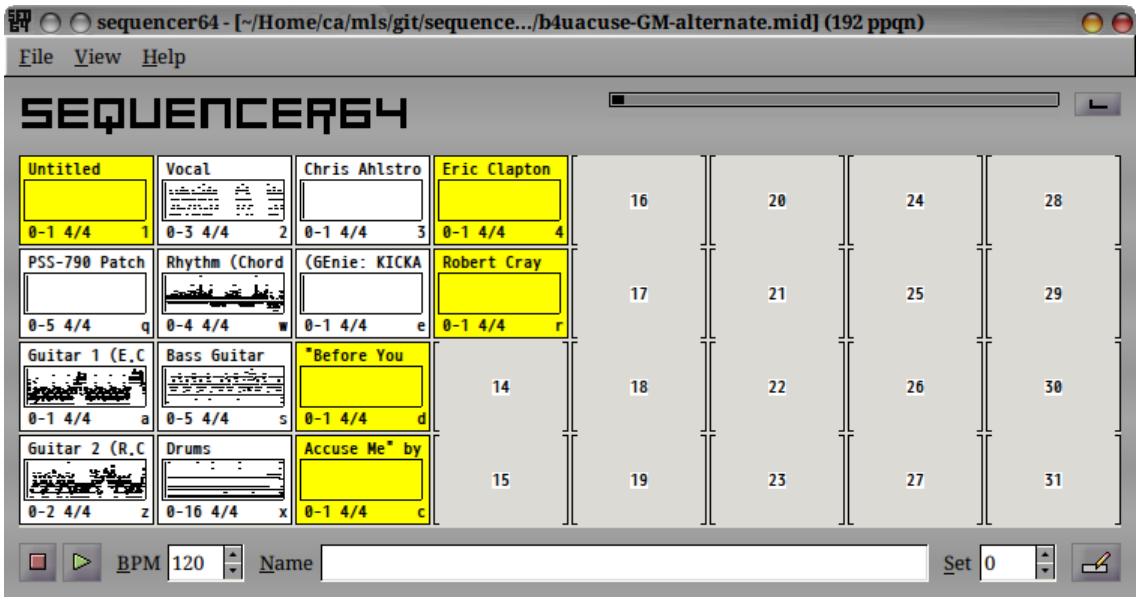

Figure 12: Pattern Window with Numbering

If you don't like it, turn off the option, or try other grid options in the "user" configuration file.

Also note that this option also changes the visibility of sequence numbers in active sequences and in the performance editor's names column.

3. Control keys. This block of fields provides shortcut keys for many operations of *Sequencer64*.

1. **Start**. Key: **space**.
2. **Stop**. Key: **Escape**.
3. **Snapshot 1**. Key: **Alt_L**.
4. **Snapshot 2**. Key: **Alt_R**.
5. **bpm up**. Key: **apostrophe**.
6. **bpm down**. Key: **semicolon**.
7. **Replace**. Key: **Control_L**.
8. **Queue**. Key: **Control_R**.
9. **Keep queue**. Key: **backslash**.
10. **Screenset down**. Key: **bracketleft**.
11. **Screenset up**. Key: **bracketright**.
12. **Set playing screenset**. Key: **Home**.

Note that some of the keys have positional mnemonic value. For example, for BPM control, the semicolon is at the left (down), and the apostrophe is at the right (up).

Also note that the keys definable in this tab are only a subset of the various keys that can be used, especially keys used with the `Ctrl` key or other modifier keys.

A *snapshot* is a briefly preserved state of the patterns. One can press a snapshot key, change the state of the patterns for live playback, and then release the snapshot key to revert to the state when the snapshot key was first pressed.

To "queue" a pattern means to ready it for playback upon the next repeat of a pattern. A pattern can be armed immediately, or it can be queued to play back the next time the pattern starts.

The "keep queue" functionality allows the queue to be held without holding down a button the whole time.

4. Sequence toggle keys. Each of these keys toggles the playing/muting of one of the 32 loop/pattern boxes. These keys are layed out logically on the keyboard, and can also be shown in each loop/pattern box. No need to list them all here!

5. Mute-group slots. Each of these keys operates on the mute-grouping of one of the 32 loop/pattern boxes. These keys are layed out logically on the keyboard, and can also be shown in each loop/pattern box. No need to list them all here!

Apparently groups work with the playing screen set only. Change the screenset and give the command to make it the playing one (e.g. set the HOME key for this purpose.)

6. Learn. Learn (while pressing a mute-group key). This items sets the key used to initiate a learn mode. It is the **Insert** key by default.

7. Disable. **TODO:** What gets disabled? It is the **apostrophe** key by default.

8. Enable. **TODO:** What gets enabled? It is the **igrave** (back-tick) key by default.

There is much to learn about this learn/enable/disable triad!

3.2.4.4 Menu / File / Options / Mouse

This item selects the mouse-interaction method.

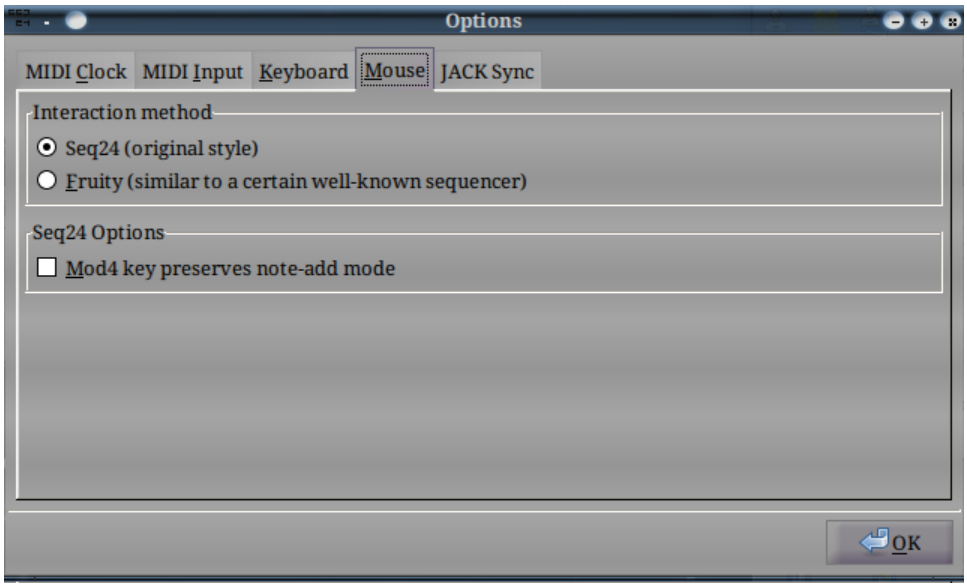

Figure 13: File / Options / Mouse (Condensed View)

The default method is **seq24 (original style)**. The alternate method is **fruity (similar to a certain well known sequencer)**.

The alternate method is presumably that of the *Fruity Loops* (now *FL Studio*) sequencer. The fruity mode seems to involve the following (based on scanning the source code):

- **Left-click left side**. Begin a grow/shrink operation for the left side.
- **Left-click right side**. Begin a grow/shrink operation for the right side.
- **Left-click middle**. Move the object.
- **Left-click**. Add an event if nothing selected.
- **Middle-click**. Split the note?

The *Seq24* "original style" is pretty much as expected for basic actions such as selecting and moving notes using the left mouse button. Drawing a note or event is a bit different, in the one must first *click and hold* the right mouse button, and then *click and drag* the right mouse button to insert notes, Notes are inserted to be at the current length and grid-snap values for the sequence editor for as long as the left button is pressed. Notes are inserted only up to the boundary of the sequence length. And, once notes are inserted, moving the mouse with the left button still held down simply moves the notes to the new note value of the mouse.

If one releases the left button, then presses and holds it again, more notes will be added in the same way. This is strange, but it is a powerful way to layer notes into a short sequence. We call it the "draw mode" or "paint mode".

Note that drawing/painting can also be done while the sequence is playing, and notes will be added to be played the next time the progress bar crosses them.

New: The Mod4 Right-Click Mode. In order to work better with certain trackpads, the "Seq24" mode of mouse interaction can be modified (only in the Pattern Editor at present) so that the Mod4 key (Super or Windows key) can be pressed when releasing the right mouse button. This keeps the mouse in note-add mode. Another right-click, without pressing Mod4, will exit this mode.

The reason for this feature is the crummy FocalTech touchpad on one of the author's laptops. This trackpad seems to have only a single button, which the driver interprets as left or right depending where the finger is when it is clicked. There's no way to click the right and left buttons at the same time. There's no way to make a middle-click action.

Note that this option will not interfere with the Mod4 key being set in the **Keyboard** option tab, since the keys there mainly apply to the Patterns Panel (main window).

New: Another way to turn on the paint mode has been added, based on a feature found in a patch that someone posted about in some mailing list somewhere on the internet. To turn on the paint mode, press the "p" key while in the sequence editor. This is just like pressing the right mouse button, but the draw/paint mode sticks (as if the Mod4 mode were in force). To get out of the paint mode, press the "x" key while in the sequence editor. These keys, however, do not work (currently) while the sequence is playing.

TODO: These convenience options are currently limited to the pattern/sequence editor window and the performance editor window, and may need some heavier testing. But note that some *Sequencer64* windows can use the ctrl-left-click as a middle click.

3.2.4.5 Menu / File / Options / Jack Sync and LASH

This tab sets up options for JACK synchronization, if *Sequencer64* was built with JACK support. (Why wouldn't it be?) This tab also sets up options for using LASH session management, if *Sequencer64* was build with LASH support.

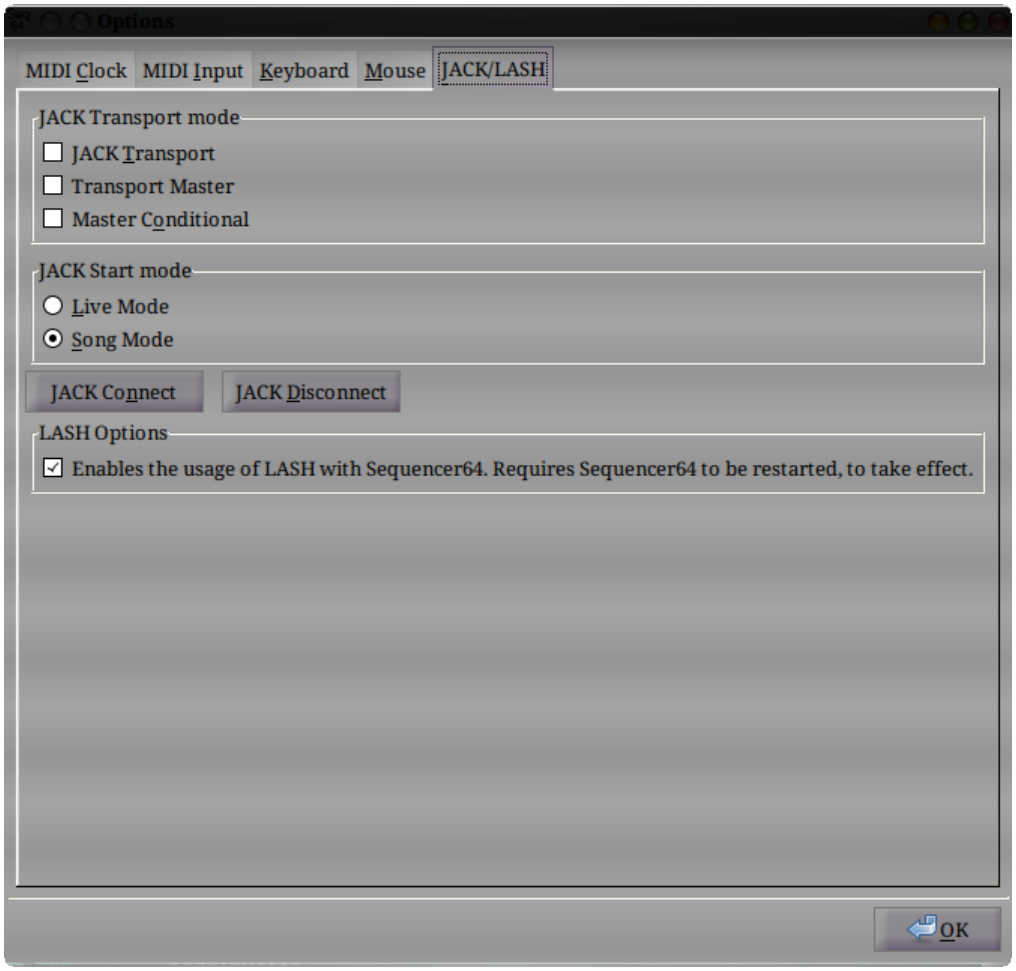

Figure 14: File / Options / JACK Sync or JACK/LASH

1. **Transport**
2. **JACK Start mode**
3. **Connect**
4. **Disconnect**
5. **LASH Options**

1. Transport. These settings are stored in the "rc" file settings group `[jack-transport]`. See section 8.6 ("Sequencer64 / JACK Transport") on page 74, which describes this configuration option. This items collects the following settings:

- **Jack Transport**. Enables slave synchronization with JACK Transport. The command-line option is `--jack_transport`. The behavior of this mode of operation is perhaps not quite correct. Even as a slave, *Sequencer64* can start and stop playback.
- **Transport Master**. *Sequencer64* will attempt to serve as the JACK Master. The command-line option is `--jack_master`.
- **Master Conditional**. *Sequencer64* will fail to serve as the JACK Master if there is already a Master set. The command-line option is `--jack_master_cond`.

Note that there are long-standing issues with the JACK support of *Seq24*, and *Sequencer64* currently

inherits some of them, in spite of some bug fixes. Generally, if one experiences issues in transport control, try making one of the other sequencer applications the JACK Master.

Also be aware that, if one starts *Sequencer64* without JACK running, it will take a little while for *Sequencer64* to start up.

Finally, if one makes a change in the JACK settings, it is best to then press the **Disconnect** button, then the **Connect** button. Another option is to restart *Sequencer64*... the settings are automatically saved when *Sequencer64* exits.

2. JACK Start mode. This item collects the following settings, also stored in the "rc" file settings group `[jack-transport]`.

- **Live Mode**. Playback will be in live mode. Use this option to allow muting and unmuting of patterns. This option might also be called "non-playback mode". The command-line option is `--jack_start_mode 0`.
- **Song Mode**. Playback will use only the Song Editor's data. The command-line option is `--jack_start_mode 1`.

Note that, in ALSA mode (non-JACK mode), *Sequencer64* now *does* select the playback modes according to which window started the playback. We have reverted back to legacy *Seq24* behavior.

The main window, or pattern window, causes playback to be in live mode. The user can arm and mute patterns in that windows, by clicking on sequences, using their hot-keys, and by using the group-mode and learn-mode features (we think). The song editor causes playback to be in performance mode, also known as "playback mode", or "song mode".

Of course, in JACK mode, it selects them according to the chosen live/song mode as discussed above.

3. Connect. Connect to JACK Sync.

4. Disconnect. Disconnect from JACK Sync.

5. LASH Options. Currently contains only one item, which enables the usage of LASH session management. Currently, *Sequencer64* needs to be restarted to complete the enabling or disabling of LASH support. Like the rest of the options, this one is written to the "rc" configuration file.

3.3 Menu / View

If the "allow two perfedits" option is turned off in the "user" configuration file, this menu item has only one entry, **Song Editor**, which is already covered by a button at the bottom of the Patterns window. Selecting this item bring up the Song Editor window. See figure 45 ("Song Editor Window") on page 55

The Song Editor window can also be brought up via the Ctrl-E key.

If the "allow two perfedits" option is turned on in the "user" configuration file, this menu item has two entries, as shown in the following figure:

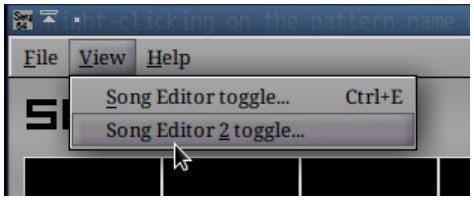

Figure 15: Dual Song Editor Entries in View Menu

Note that only the first Song Editor has a user-interface button and a hot-key. Also note that there can be issues bringing up the second song-editor with the hot-key. The menu entry will always work.

If two song editors are up, they each track any changes made in the other song editor. But the main purpose of two song editors is to arrange two different parts of the performance at the same time.

3.4 Menu / Help About...

This menu entry shows the "About" dialog.

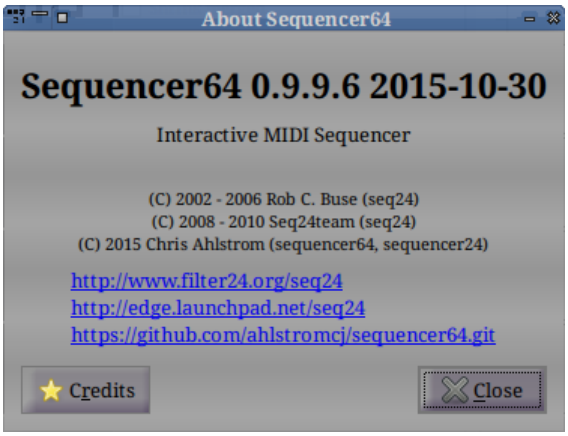

Figure 16: Help About

That dialog provides access to the credits for the program, including the authors and the project documentors.

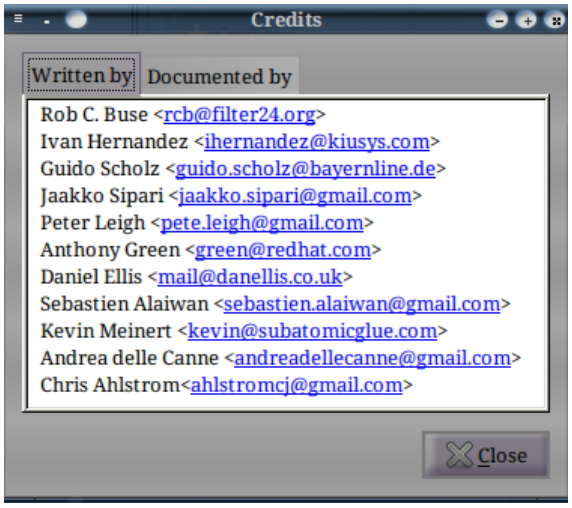

Figure 17: Help Credits

Shows who has worked on the program, with the original author at the top of the list.

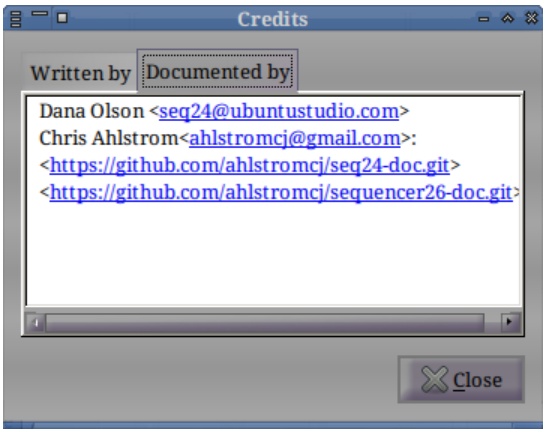

Figure 18: Help Documentation

Shows who has documented this project.

4 Patterns Panel

Sequencer64 works with the idea of patterns (loops) that are repeated all along a song. One composes and edits small patterns, and combines them to create a full song. This is a powerful way to work, and makes one productive within an hour.

The *Sequencer64 Patterns Panel* is the main window of *Sequencer64*. See figure 1 ("Sequencer64 Main Screen") on page 10. It is also called the "main window" or the "patterns window". It is here one manages a set of patterns (see section 2.1.14 ("Concepts / Terms / screen set") on page 13), manages the configuration, and opens the pattern or song editors.

Obsolete behavior: When the Patterns Panel has the application focus, it puts *Sequencer64* in "live mode". The musician can control the playback and muting/unmuting of the song, while it is playing, from within this window.

Instead of the behavior described above, live versus song mode is controlled by the JACK start mode option. Do we want to make the old behavior a new option?

For exposition, we break the Patterns Panel into a menu bar, a top panel, a pattern panel, and a bottom panel. Note that the *Sequencer64* menu bar was already discussed in section 3 ("Menu") on page 14.

4.1 Patterns / Top Panel

The top panel of the Pattern window is simple, consisting of the name of the program and a couple of controls.

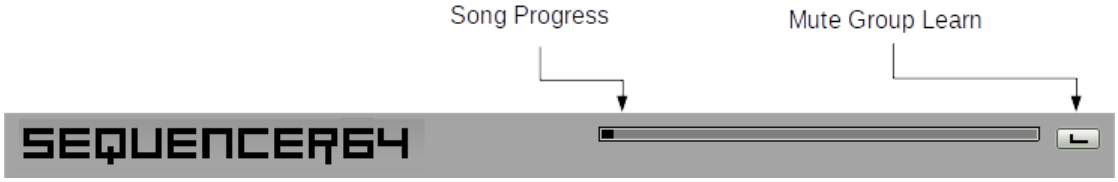

Figure 19: Patterns Panel, Top Panel Items

1. **Song Progress**
2. **Mute Group Learn**

1. Song Progress. The **Song Progress** bar is also known as the "main time" bar. This bar shows a number of small black cursors ("pills") that show the progress of the song through the various patterns. For short patterns, the progress is fast. For patterns that last longer, the progress is slow. The whole field flashes in time with the beat. This field shows that something is going on. It can also indicate the relative lengths of the various patterns.

Note that the individual pattern boxes in the main panel, for patterns that are not empty, have their own moving progress cursor, a tall thin line in each box.

2. Mute Group Learn. This button is also known as the "L" button. Click this button, and then press a mute-group key to store the mute-state of the patterns with in that key.

See the **File / Options / Keyboard** menu entry to bring up the dialog showing the available mute-group keys and the corresponding hot-key for the "L" button.

Group-learn is a modifier key to be pressed *together* with the toggle key, and the group on/off keys are there to enable/disable the whole feature, *not* to toggle group states.

To set up the mute groups, press the 'L' button, and then press a key on the keyboard to 'learn' or 'save' the preset. Looking at the list of keys assigned for these mute groups (in **File / Options / Keyboard**), the first bank of keys are "!", "", "?", etc., and the second bank are "Q", "W" "E", etc. When you ask the program to 'learn' the key, one can't use the Shift key, so (on Windows at least) one cannot use the "!" or other symbol keys. Similarly, make sure Caps Lock is off before starting the 'learn' process (as it won't recognise "q", only "Q").

Once that works, one can configure the MIDI settings in similar ways by assigning MIDI commands to toggle loops, using the 'on' option in the "rc" file. See section 8.1 ("Sequencer64 / MIDI Control Section") on page 66.

One can toggle the playing status of up to 32 previously defined mute/unmute patterns (groups) in the active screen set, similar to hardware sequencers. One can mute-unmute (according to the group definition) all loops in the playing screen set, which is the only one that can have sequences playing (like a live sequencer).

This toggling is done either by one of the *group toggle* keys or by a MIDI controller, both assigned in the `/.config/sequencer64/sequencer64.rc` or `/.seq24rc` files.

A mute/unmute pattern (group) is stored by holding a *group learn* key (`Insert` by default) while pressing the corresponding *group toggle* key. There are also keys assigned to turn on/off the group functionality.

Remember that groups work with the playing screen set only. One must change the screenset and give it the command to make it the playing one (some set the Home key for this purpose). Everything is configurable in the "rc" file.

4.2 Patterns / Main Panel

The main panel of the Patterns window provides a grid of empty boxes, each box delimited by brace-like lines at left and right. Each filled box represents a loop or pattern. One sees only 32 loops at a time in the main panel (but many more than 32 loops can be supported by *Sequencer64*). This group of 32 loops is called a "screen set", as discussed in section 2.1.14 ("Concepts / Terms / screen set") on page 13. One can switch between sets by using the `[` and `]` keys on the keyboard, or by using the spin-widget-driven, labelled **Set** interface item, or by hitting the (default) Home key to make it the playing screenset. There

are a total of 32 sets, for a total of 1024 loops/patterns. Only one screen set can be playing at a time, according to other notes we have found.

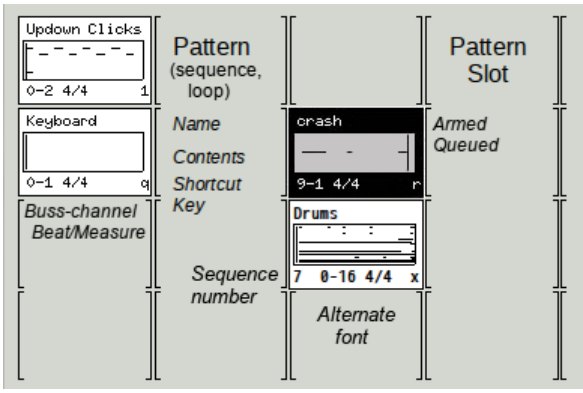

Figure 20: Patterns Panel, Main Panel Items

The individual items annoted in this figure are described in section 4.2.2 ("Pattern") on page 33, in more detail.

1. **Pattern Slot**
2. **Pattern**

4.2.1 Pattern Slot

An empty box is a slot for a pattern. By right-clicking on an empty box one brings up a menu to create a new loop, as well as some other operations:

Figure 21: Empty Pattern, Right-Click Menu

1. **New**
2. **Paste**
3. **Song / Mute All Tracks**

1. New. Creates a new loop or pattern. Clicking this menu entry fills in the empty box with an untitled pattern, and brings up the Pattern Editor so that one can fill in the new pattern.

New: In addition to right-clicking and selecting **New**, the user can Ctrl-left-click on the empty slot, or double-click on the empty slot, to bring up a new instance of the sequence editor. For the double-click, the effect can be a bit confusing at first, because it currently also toggles the arming/mute status of the slot twice (leaving it as it was), as well. For now, get used to it.

2. Paste. Pastes a loop or pattern that was previously copied.

3. Song / Mute All Tracks. This item is the one item in the **Song** context menu; it mutes all tracks (or loops/patterns). It works when one has opened the Song Editor window and started playing in playback mode by starting play using that window.

So, let us assume the song is running in playback mode. The patterns that are active (unmuted) in by that playback window are shown with a black background in the main patterns window. If one right clicks on a pattern cell and selects **Song / Mute All Tracks**, all those patterns will become white and be silenced. Eventually, the Song Editor window catches up and shows the "M" activated for all tracks.

4.2.2 Pattern

A filled pattern slot is referred to informally as a pattern. A pattern is shown in the Pattern windows as a filled box with the following items of information in it. Examine figure 20 ("Patterns Panel, Main Panel Items") on page 32; it shows these items annotated for clarity.

- **Name**. This line contains the name or title of the pattern, to help reference it when juggling a number of patters.
- **Contents**. The contents of the pattern provide a fairly detailed and distinguishable representation of the notes or events in the pattern. Also, when the song is playing, a vertical bar cursor tracks the position of the playback of the pattern or loop; it returns to the beginning of the box every time that pattern starts over again. **New:** With *Sequencer64*, an imported empty pattern will no longer needlessly scroll. However, if a pattern has even a single event (say, a program change), it will scroll. **TODO:** It might be good to have some patterns marked as one-shot patterns. They play once at the start of playback, and that is it. They could be marked with a cyan background.
- **Bus-Channel**. This pair of numbers shows the the MIDI buss number, a dash, and the MIDI channel number. For example, "0-2" means MIDI buss 0, channel 2.
- **Beat**. This pair of numbers is the standard time-signature of the pattern, such as "4/4" or "3/4". The first number is the beats-per-measure, and the second is the size of the beat, here, a quarter note.
- **Shortcut Key**. If the display of shortcut keys is enabled (see section 3.2.4.3 ("Menu / File / Options / Keyboard") on page 22), then the key noted in the lower-right corner of the pattern can be pressed to toggle the mute/unmute status of that pattern. This action is an alternative to left-clicking on the pattern.
- **Progress Cursor**. At the left of each box is a vertical line, waiting for playback to start so that it can move through the pattern, again and again.
- **Armed**. See figure 20 ("Patterns Panel, Main Panel Items") on page 32; it shows a black and grey pattern. The black color indicates that the pattern is armed (unmuted), and will play if playback is initiated in the pattern window in live mode.
- **Queued**. That same pattern also shows that it is queued, which means that it will start playing when the pattern next begins again.
- **Alternate font**. Later builds of *Sequencer64* are now built with a new font. See figure 20 ("Patterns Panel, Main Panel Items") on page 32. It shows the new font. The old font can be selected in the "user" configuration file, and is also selected automatically if *Sequencer64* is run in the *legacy* mode.
- **Sequence number**. Later builds of *Sequencer64* are now built with the option to also show the sequence number in the pattern box, if the "show sequence numbers" option is on. This option can be set in the "user" configuration file. See figure 20 ("Patterns Panel, Main Panel Items") on page 32. It shows an example of the sequence number, using the new font.

Left-clicking on an filled pattern box will toggle the status of the pattern between muted (white background) and unmuted (black background). If the song is playing via the main window, toggling this status

makes the pattern stop playing or start playing. Note that the armed status can also be toggled using hot-keys.

Also note that, if the Song Editor is the active window and was used to start the playback, the pattern boxes will toggle between the muted/unmuted states as the music plays, and the pattern is active or inactive at the point of playback. (The Song Editor acts as a list of triggers).

By right-clicking on an already-filled box, one brings up a menu to allow one to edit a existing one, or perform a few other actions specified in the context menu. Here is that menu:

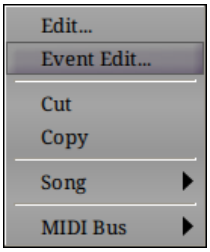

Figure 22: Existing Pattern, Right-Click Menu

Here one can choose to edit the pattern, cut and copy the pattern, set the MIDI bus/channel, and more. One can also clear all performance data for the pattern.

1. **Edit...**
2. **Event Edit...**
3. **Cut**
4. **Copy**
5. **Song/**
6. **MIDI Bus/**

1. Edit.... Edits an existing loop or pattern. Clicking this menu entry brings up the **Pattern Editor** so that one can modify the existing pattern by click-dragging new notes in a piano roll user-interface. See figure 29 ("Pattern Edit Window") on page 40. Also known as the "sequence editor".

New: In addition to right-clicking and selecting **Edit...**, the user can Ctrl-left-click on the empty slot, or double-click on the empty slot, to bring up the sequence editor. For the double-click, the effect can be a bit confusing at first, because it currently also toggles the arming/mute status of the slot twice (leaving it as it was), as well. For now, one must get used to it.

2. Event Edit.... **New:** Edits an existing loop or pattern, but using a detailed event editor that shows events as text and numbers, and allows editing them as text and numbers. Clicking this menu entry brings up the **Event Editor** so that one can view and modify the events in the existing pattern. See figure 29 ("Pattern Edit Window") on page 40.

There are two things to note about this editor. First, this editor is not the same as the event editor pane in the pattern editor – it shows all events at once, and shows them only in text format. Second, this editor is still a work in progress. See section 7 ("Event Editor") on page 60for more information.

Now, in order to simplify the application, and avoid editing a pattern in two different dialogs, if either the pattern editor or the event editor is active for a given seqeuence, the right-click sequence-slot menu leaves out the **Edit...** and **Event Edit...** menu entries. This trimmed menu looks like this:

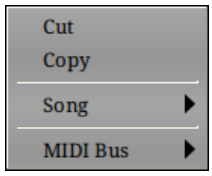

Figure 23: Existing Pattern, Right-Click Menu Without Edit Entries

The old functionality was to have the **Edit...** menu entry simply raise the existing pattern editor to the top of the windows.

3. Cut. Deletes and copies an existing loop or pattern. Note than one can also drag-and-drop a pattern into another cell. **Bug:** Allow this operation works, it does not cause the user to be prompted if the application is exited.

4. Copy. Copies an existing loop or pattern. The pattern can then be pasted elsewhere in the Patterns panel. See section 4.2.1 ("Pattern Slot") on page 32.

5. Song. Clicking this menu entry brings up a small popup menu:

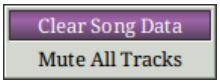

Figure 24: Existing Pattern, Right-Click Menu, Song

1. **Clear Song Data**
2. **Mute All Tracks**

1. Clear Song Data. Selecting this filled-box right-click menu item causes that box's loop/pattern to be removed from the song. This means that it disappears from the Song Editor window, and so will not be played when the song plays.

2. Mute All Tracks. Selecting this filled-box right-click menu item causes the tracks in the Song Editor to be muted. Sometime it takes a few seconds for the user-interfaces to show this big change.

3. Midi Bus. Selecting this filled-box right-click menu item brings up a list of the 16 MIDI output busses that *Sequencer64* supports:

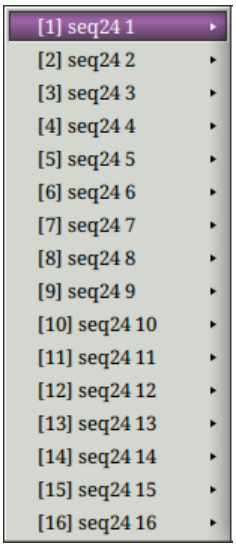

Figure 25: Existing Pattern, Right-Click Menu, MIDI Output Busses

New: Note that another way of specifying the busses is to supply the new `--buss n` option. This option is currently available only from the command line. It causes *every* pattern in the MIDI file to be allocated to that buss number when loaded. This option is meant for convenience or testing. If you save the file, it will now have that buss number as part of each track's data.

For each of these buss items, another pop-up menu allows one to specify the MIDI output channel for that buss:

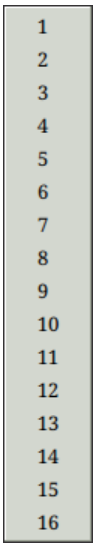

Figure 26: Existing Pattern, Right-Click Menu, MIDI Bus Ports

4.2.3 Pattern Keys and Click

This section recapitulates all the clicks and keys that perform actions in the Pattern windows. Some additional clicks and keys are noted here as well.

4.2.3.1 Pattern Keys

Each pattern in the patterns panel can have a hot-key associated with it.

For each pattern, hitting its assigned keyboard key will also toggle its status between muted/unmuted (armed/unarmed). Below is the default grid that is mapped to the loops/patterns on the screen set. This grid can be changed in the Keyboard options tab, and is saved in the *keyboard-control* section of the "rc" file.

```
[ 1   ][ 2   ][ 3   ][ 4   ][ 5   ][ 6   ][ 7   ][ 8   ]
[ q   ][ w   ][ e   ][ r   ][ t   ][ y   ][ u   ][ i   ]
[ a   ][ s   ][ d   ][ f   ][ g   ][ h   ][ j   ][ k   ]
[ z   ][ x   ][ c   ][ v   ][ b   ][ n   ][ m   ][ ,   ]
```

These characters are shown in the lower right corner of each pattern, as an aid to memory.

These hot-keys can be modified

The `[` and `]` keys on the keyboard switch between sets, either decrementing or incrementing the set number.

The left and right Alt keys are, by default, set up in the **File / Options / Keyboard / Snapshot 1** and **Snapshot 2** fields to be used as "snapshot" keys.

When one of these snapshot keys is pressed, the state of the patterns (which ones are armed versus unarmed) is instantly saved. While the snapshot key is pressed, on can then change the state of the patterns to change how the song plays back. When the snapshot key is released, the original saved state of the patterns is restored.

Holding `Alt` will save the state of playing patterns and restore them when `Alt` is lifted.

The handling of `Alt` is generally taken over by the window manager, so there could be a need to change these items to some other keys.

Holding `Right Ctrl` will queue a on/off toggle for a sequence when the loop ends. This is the "queue" functionality. This means that the change in state of the pattern will not take hold immediately, but will kick in when the pattern restarts.

This pending state is indicated by coloring the central box of the pattern grey, as shown in the following figure.

Queue also works for mute/unmute patterns (groups). In this case every sequence will toggle its status after its individual loop end.

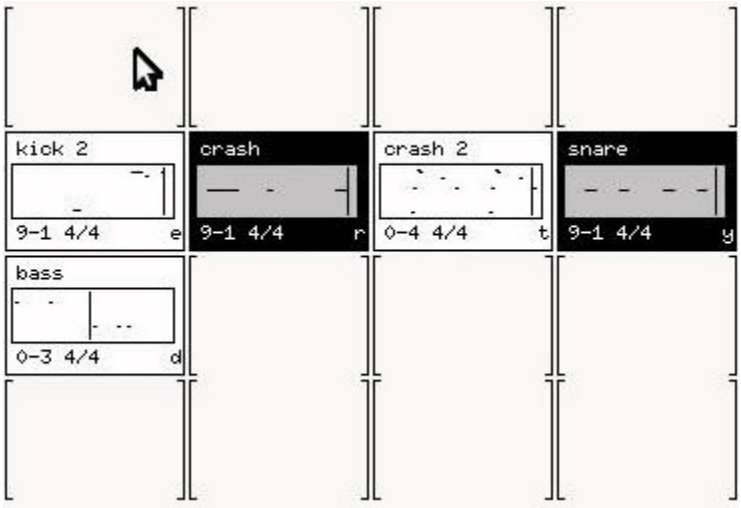

Figure 27: Pattern Coloration when Queued

Queue also works for mute/unmute patterns (groups); in this case every sequence will toggle its status after its individual loop end.

Of course, the Ctrl key is used to manage the GUI (e.g. Ctrl-q will unceremoniously quit the application), so one will usually want to change this key to something else in the **File / Options / Keyboard / Queue** field. The Super key (i.e. the Mod4 or Windows key) is a good candidate to replace the right Ctrl key, unless one has (like the author) configured the window manager to use the Super key modifier to manipulate windows and applications *(laughter ensues)*.

Note that there is also a "replace" key, which is the left Ctrl key by default. Replacement is a form of muting/unmuting. When the "replace" key is pressed while click a sequence, that sequence is unmuted, and all of the other sequences are muted.

Pressing the "keep queue" key (by default, the backslash key) assigned in the "rc" file. activates permanent queue mode until you use the temporary queue function again pressing `Right Ctrl`.

This key can be changed in the **File / Options / Keyboard / Keep queue** field.

There are more keys defined in the **Keyboard** dialog, and it is worth figuring out what they do, if not documented here. For a couple of short, but good, tutorials about using arming, queueing, and snapshots, see references [14] and [15].

4.2.3.2 Pattern Clicks

Left-clicking on a pattern-filled box will change its state from muted (white background) to playing (black background) when the sequencer is running.

Holding down `Left Ctrl` while selecting a pattern with a left click will mute all other patterns and turn on the selected pattern.

By clicking and holding the left mouse button on a pattern, one can drag it to a new location on the grid. The box will disappear while dragged, and reappear in the new location when dropped. However, note that a pattern cannot be dragged if its Pattern Editor window is open.

Right-clicking a pattern will bring up the appropriate context menus, as discussed earlier, depending on whether the pattern box is empty or filled.

Middle-click does nothing when the mouse rests inside a pattern box.

4.3 Patterns / Bottom Panel

The bottom panel of the Patterns window provides way to control the overall playback of the song.

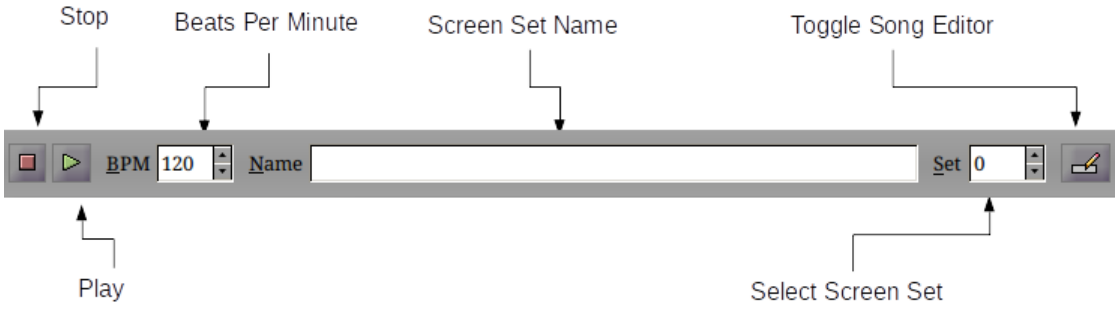

Figure 28: Patterns Panel, Bottom Panel Items

1. **Stop**
2. **Play**
3. **bpm**
4. **Name**
5. **Set**
6. **Toggle Song Editor**

1. Stop. The red squarebutton stops the playback of the song and all its patterns. It is not clear if it also sends MIDI Off messages on all notes. The keystroke for stopping playback is the `Escape` character. It can be changed to `Space`, so that the space-bar then becomes a playback toggle key.

2. Play. The green triangular button starts the playback of the whole song. The keystroke for starting playback is the `Space` character.

3. bpm. The spin widget adjusts the "Beats Per Minute" or BPM value. The range of this field is from 20 bpm to 500 bpm, with a default value of 120 bpm. Although this field looks editable, it is not. Most keystrokes that are entered actually toggle one of the pattern boxes. However, the following keys can also modify the BPM in small increments: The `semicolon` reduces the BPM; The `apostrophe` increases the BPM.

4. Name. Each of the 32 available screen sets can be given a name by entering it into this field.

Bug: While one is typing in the name of the set in this field, the keystrokes will affect the panel window, causing playback to start and pattern boxes to be toggled!

5. Set. This spin widget selects the current screen set. The values in this field range from 0 to 31, and default to 0. Although this field looks editable, it is not.

Bug: While one is typing in the number of the set in this field, the keystrokes will affect the panel window as well.

6. Toggle Song Editor. Pressing this button toggles the presence on-screen of the Song Editor.

5 Pattern Editor

The *Sequencer64 Pattern Editor* is used to edit and preview a pattern, as well as to configure its buss and channel settings. In programmer's jargon, this window is represented by the seqroll class (and other "seq" classes.

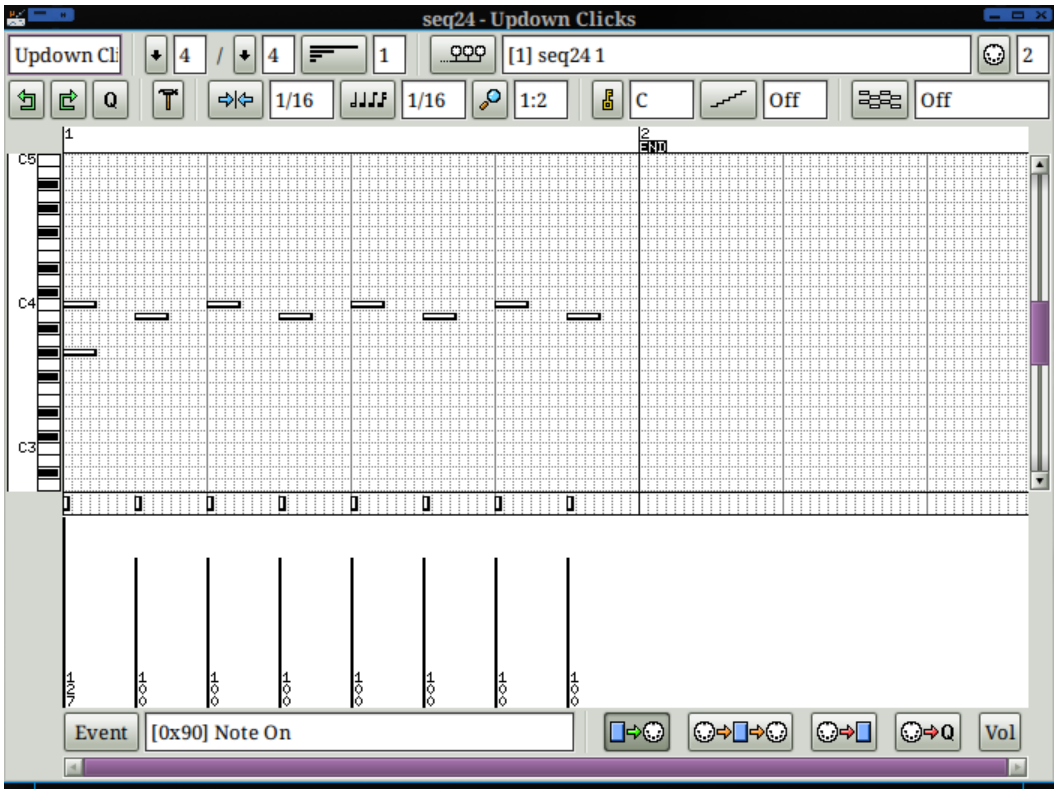

Figure 29: Pattern Edit Window

This dialog is quite complex. For exposition, we break it into a first panel, a second panel, a bottom panel, and a piano-roll/events section.

1. **First Panel**
2. **Second Panel**
3. **Piano-Roll/Events Panel**
4. **Bottom Panel**

5.1 Pattern Editor / First Panel

The top bar (horizontal panel) of the Pattern (sequence) Editor lets one change the name of the pattern, the time signature of the piece, how long the loop is, and some other configuration items.

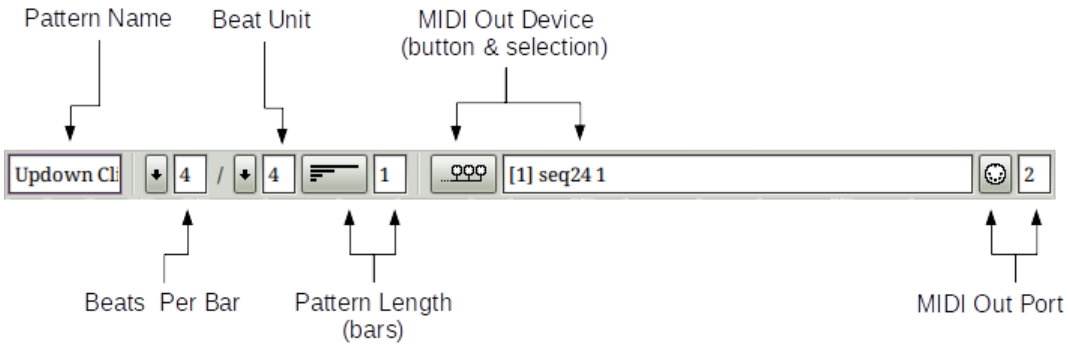

Figure 30: Pattern Editor, First Panel Items

1. **Pattern Name**
2. **Beats Per Bar**
3. **Beat Unit**
4. **Pattern Length**
5. **MIDI Out Device**
6. **MIDI Out Port**

1. Pattern Name. Provides the name of the pattern. This name should be short and memorable. It is displayed in the Patterns window, on the top line of its pattern box/slot.

2. Beats Per Bar. Part of the time signature, and specifies the number of beat units per bar. The possible values range from 1 to 16.

3. Beat Unit. Part of the time signature, and specifies the size of the beat unit: 1 for whole notes; 2 for half notes; 4 for quarter notes; 8 for eight notes; and 16 for sixteenth notes. The whole time signature is display at the bottom center of a pattern box/slot.

4. Pattern Length. Sets the length of the current pattern, in measures. The possible values range from 1 to 16, then 32, and 64.

(It would sure be nice to have a value that represents "indefinite", so that the loop or pattern would be more like a track, and not be repeatable. Or perhaps add lengths of 128 and 200. The length of the longest track in our sample is 101. Also nice would be a "one-shot" pattern, useful for live intro patterns, for example.)

5. MIDI Out Device (Buss). This setting specifies one of the 16 MIDI output busses provided by *Sequencer64*. The settings look a lot like figure 25 ("Existing Pattern, Right-Click Menu, MIDI Output Busses") on page 36.

6. MIDI Out Port (Channel). This settings select the MIDI output channel, or port. The possible values range from 1 to 16. If instruments are defined in the "user" configuration file to that device and channel.

5.2 Pattern Editor / Second Panel

The second horizontal panel of the Pattern Editor provides a number of additional settings.

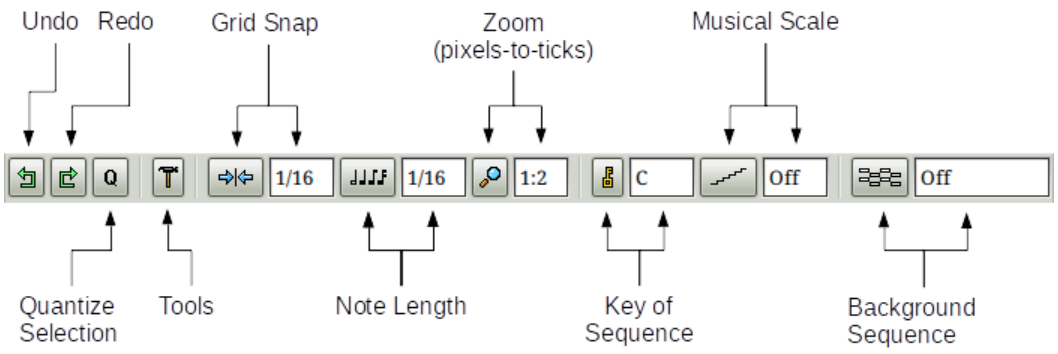

Figure 31: Pattern Editor, Second Panel Items

1. **Undo**
2. **Redo**
3. **Quantize Selection**
4. **Tools**
5. **Grid Snap**
6. **Note Length**
7. **Zoom**
8. **Key of Sequence**
9. **Musical Scale**
10. **Background Sequence**

1. Undo. The Undo button will roll back any changes to the pattern from this session. It will roll back one change each time it is pressed. It is not certain what the undo limit is, however. Pressing `Ctrl-Z` is the same as using the **Undo** button.

2. Redo. The Redo button will restore any undone changes to the pattern from this session. It will restore one change each time it is pressed. It is not certain what the redo limit is, however. There doesn't seem to be a "Redo" key.

3. Quantize Selection. Pressing this button will quantize the selected events, presumably as per the **Grid Snap** setting.

4. Tools. This button brings up a nested menu of tools for modifying selected events and notes.

Figure 32: Tools, Context Menu

1. **Select**
2. **Modify Time**
3. **Modify Pitch**

• **Select** provides two sets of selections for notes:

- **All Notes**, which selects all notes in the pattern; Note that `Ctrl-A` will also select all of the events in the pattern editor.
- **Inverse Notes**, which inverts the selection of notes.

Other event-selection actions are provided:

- **Left Click**. Pressing the left button on a note or a event deselects all other notes or events, and selects the item clicked on.
- **Ctrl Left Click**. Pressing the `Ctrl` key and the left button on a note or an unselected event *adds* that event to the selection.
- **Left Click Drag**. Pressing the left mouse button and dragging also lets one select multiple events and notes.
- **Ctrl Left Click Drag**.
  - Pressing the `Ctrl` while left-click-dragging *on unselected events* lets one make additional selections of multiple events and notes.
  - Pressing the `Ctrl` while left-click-dragging *on an already-selected event* lets one stretch or compress the lengths of multiple notes in the selection.

• **Modify Time** offers two ways to tweak the timing of the selected note: **Quantize Selected Notes**, which quantizes the selected notes, presumably the same way as the **Quantize** ("**Q**") button; **Tighten Selected Notes**, which presumably is a less strict form of quantization. **TODO:** Need more information about the meaning of "tightening a note".

• **Modify Pitch** has only one entry by default, **Transpose Selected** (not shown). Selecting the **Transpose Selected** entry brings up the following sub-menu:

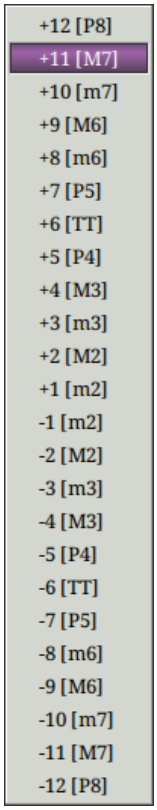

Figure 33: Tools, Transpose Selected Values

• If the user has selected a **Musical Scale** setting other than **Off**, then **Modify Pitch** has two entries:

Transpose Selected, discussed above, plus another sub-menu, **Harmonic Transpose Selected**, which makes sure that all transpositions stay on the selected scale.

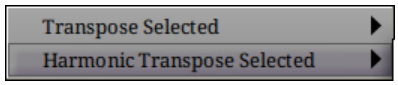

Figure 34: Tools, Two "Transpose" Menus

Remember that only the **Transpose Selected** entry is shown if the **Musical Scale** setting is **Off**.

Selecting the **Harmonic Transpose Selected** entry brings up the following sub-menu:

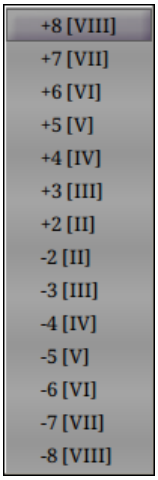

Figure 35: Tools, Harmonic Transpose Selected Values

Again, the harmonic-transpose option will not be available unless a scale has been selected.

5. Grid Snap. Grid snap selects where the notes will be drawn. The following values are supported: 1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, and 1/128. Additional values are also supported: 1/3, 1/6, 1/12/, 1/24, 1/48, 1/96, and 1/192.

6. Note Length. Note Length determines what size they will be. Like the **Grid Snap** values, the following values are supported: 1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, and 1/128. Additional values are also supported: 1/3, 1/6, 1/12/, 1/24, 1/48, 1/96, and 1/192.

7. Zoom. Zoom is the relation between MIDI pixels and ticks, written as "pixels:ticks", where "ticks" is really the "pulses" in "PPQN". For example, 1:4 = 4 ticks per pixel. Supported values are 1:1, 1:2, 1:4, 1:8, 1:16, and 1:32. This is the zoom of the Pattern Editor. As the right number goes higher, the effect is to zoom out, and show more of the pattern at once. In fact, it is probably better to list them as ticks (pulses) per pixel:

- 1 pulse per pixel
- 2 pulses per pixel (default value)
- 4 pulses per pixel
- 8 pulses per pixel
- 16 pulses per pixel
- 32 pulses per pixel (same as Song Editor)

Note that the Song Editor, which has no zoom functionality, has a resolution of 32 pulses per pixel, so, by default, it has 16 times the resolution of the Pattern Editor.

8. Key of Sequence. Selects the desired key for the pattern. The following scales are supported: C, C#, D, D#, E, F, F#, G, G#, A, A#, and B. Note that changing the **Key** will also shift the marked notes for the **Musical Scale** setting.

New: With *Sequencer64 v. 0.9.9.8*, the key that a sequence is set to is now saved in the MIDI file along with the rest of the data for the sequence. **However**, it turns out that a change made to the key, scale, or background sequence in the sequence editor is saved in that editor, so that opening another sequence will apply the same settings to that sequence. This is a feature, now more rigorously supported, as noted below.

If the global-sequence-feature is enabled, and the user selects a different key, scale, or background sequence in the sequence editor, then all sequences will share the selected key, scale, or background sequence. Furthermore, these settings are saved in the "proprietary" section of the MIDI file, where they are available for all sequences.

If the global-sequence-feature is not enabled, and the user selects a different key, scale, or background sequence in the sequence editor, then only that sequence will use the selected key, scale, or background. The key, scale, or background sequence change will be saved in the MIDI file only for that sequence, as a SeqSpec meta event.

The global-sequence-feature setting can be made in the "user" configuration file.

9. Musical Scale. Selects the desired scale for the pattern. When a scale is selected, the following features are supported:

- The notes that are not in the scale are shown as grey in the piano roll, to make it easier to key all notes in-scale.
- When harmonic transposition is performed, the notes are shifted so that they remain in scale.
- The exact notes that are considered "in-scale" depend also on the exact value of the **Key of Sequence** setting.

Originally, only the following scales were supported: Off, Major, and Minor.

New: With *Sequencer64 v. 0.9.3*, the following scales are supported:

- **Off (chromatic)**
- **Major**
- **Minor**
- **Harmonic Minor**
- **Melodic Minor**
- **Whole Tone**

The new scales added in *Sequencer64* are **Harmonic Minor**, **Melodic Minor**, and **Whole Tone**. Please let us know of any mistakes found in the new scales.

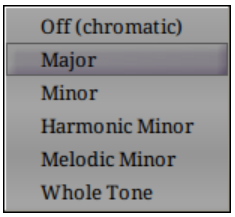

Figure 36: Available Scales

One can select which **Musical Scale** and **Key** the piece is in, and *Sequencer64* will grey those keys on the piano-roll that are *not* in the selected scale for the selected key. This is purely a visual thing; a user can still add off-key notes. This effect is shown for the C Major scale in the following figure:

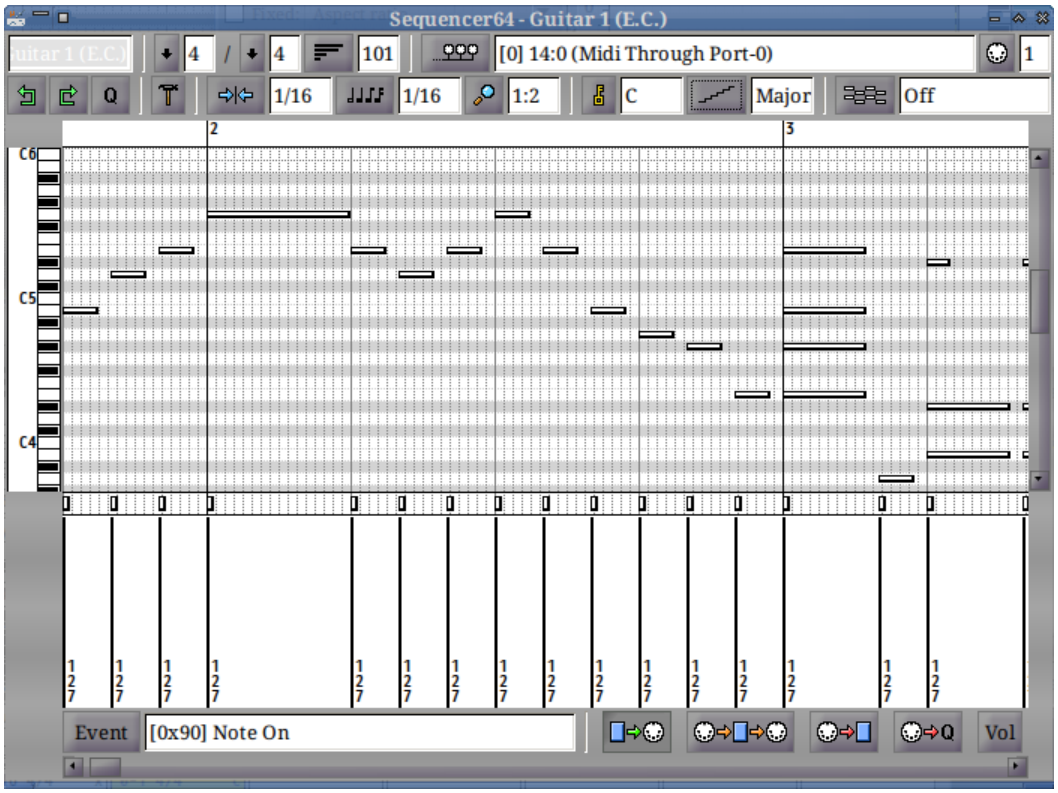

Figure 37: C Major Scale Masking

This feature makes it a bit easier to stay in key while playing and recording. Note that the scale will shift when a different **Key** is selected.

New: With *Sequencer64 v. 0.9.9.7*, the scale that a sequence is set to is now saved in the MIDI file along with the rest of the data for the sequence. **However**, it turns out that a change made to the key, scale, or background sequence in the sequence editor is saved in the editor, so that opening another sequence will apply the same settings to that sequence. This is a feature. The feature had some quirks, which are fixed, and it is now an optional feature. Also, the user has the option of applying the key/scale/background-sequence either globally (all sequences) or locally, per-sequence, with each sequence holding its key, scale, and background-sequence settings in SeqSpec meta events.

10. Background Sequence. One can select another pattern to draw on the background to help with

writing corresponding parts. The button brings up a small menu with values of **Off** and [**0**]. Presumably, the 0 is a set number. Under the **0** entry, a menu like the following appears:

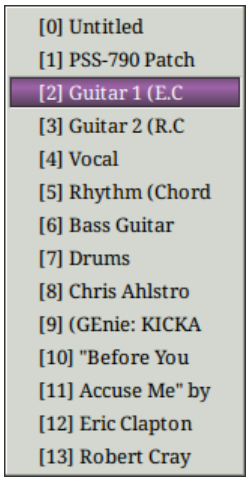

Figure 38: Sample Background Sequence Values

Once the desired pattern is selected from that list, it appears as dark cyan note bars, along with the notes that are part of the pattern. (Also note the orange selected notes and events in the following figure.)

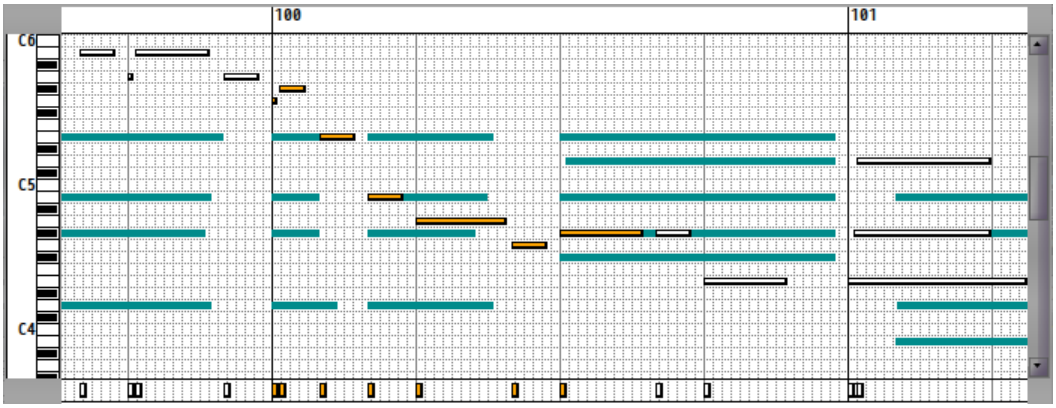

Figure 39: Background Sequence Notes

The dark cyan notes shown represent a rhythm pattern.

New: With *Sequencer64 v. 0.9.9.7*, the background seqeuence that a sequence shows is now saved in the MIDI file along with the rest of the data for the sequence. **However**, it turns out that a change made to the key, scale, or background sequence in the sequence editor is saved in the editor, so that opening another sequence will apply the same settings to that sequence. This is a feature, now more rigorously supported, as noted earlier.

5.3 Pattern Editor / Piano Roll

The piano roll is the center of the pattern editor. It is accompanied by a thin "event" bar just below it, and a taller "data" bar just below that.

The piano roll is the heart of the pattern (loop, sequence) editor. While it is very similar to note editors in other sequencers, it is a bit different in feel. A good mouse with 3 or more buttons is practically a necessity for editing (though we have added some features to make it usable with some pretty crummy trackpads). We tend to like the Logitech Marble Mouse, an ambidextrous USB trackball. It has four bottons, and we use the `contrib/scripts/marblemouse` script to set up the left small button as a middle button. The script merely makes the following call:

```
xmodmap -e "pointer = 1 8 3 4 9 6 7 2 5 10 11"
```

Editing is much easier after making that setting. Of course, keystrokes and additional mouse configuration have been added to make editing easier even without a good mouse.

5.3.1 Pattern Editor / Piano Roll Items

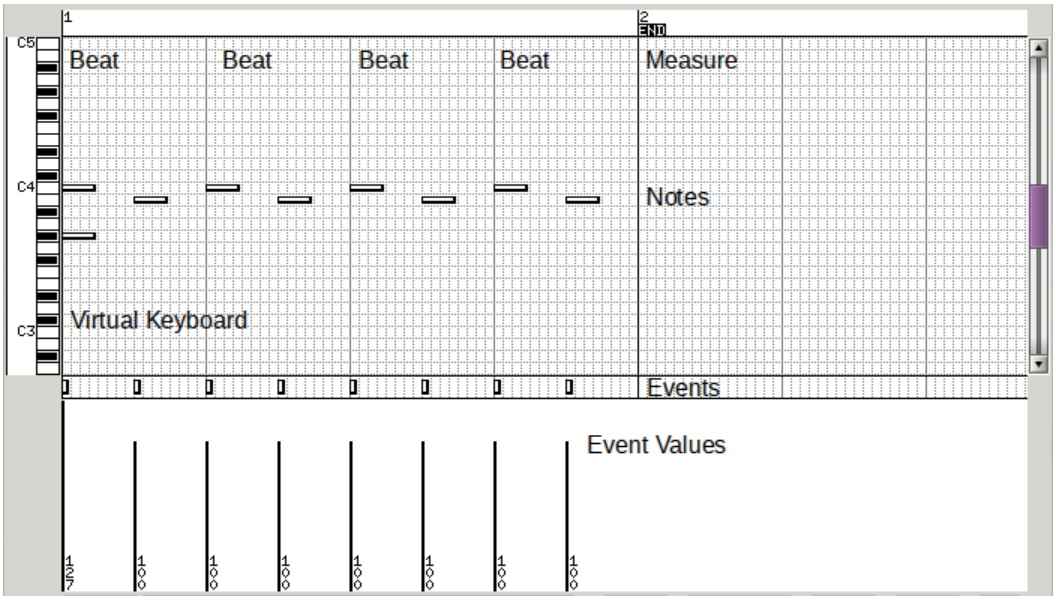

Figure 40: Pattern Editor, Piano Roll Items

1. **Beat**
2. **Measure**
3. **Virtual Keyboard**
4. **Notes**
5. **Events**
6. **Event Values**

1. Beat. The light vertical lines represent the beats defined by the configuration for the pattern.

2. Measure. The heavy vertical lines represent the measures defined by the configuration for the pattern. Also note that the end of the pattern occurs at a measure, and is marked by a blocky **END** marker.

3. Virtual Keyboard. The virtual keyboard is a fairly powerful interface. It shows, by shadowing, which note on the keyboard one will be drawing. It can be played with a mouse, to preview a short motif. It can show marks to indicate off-scale notes, to make them easy to avoid.

4. Notes. Musical notes are indicated by thick horizontal bars with white centers. Each bar provides a visual representation of the pitch of a note and the length of a note.

5. Events. The small (just a few pixels high) events strip shows discrete events, such as Note On and Note Off and their velocities, or various Controller items and their values. We recommend not trying to edit or select events in that pane, in general, but it is a good way to add events. Either left-click (to add one event), or left-click-drag horizontally (to add a series of events at the current note resolution.) One can also click in that section, then hit the "p" key to go into "paint" mode, and hit the "x" key to escape that mode.

6. Event Values. The events values for the currently selected category of events are shown in this window as vertical lines of a height proportional to the value. These values can be easily modified by left-clicking and dragging the mouse past each line, to chop it off at the given value. Easier to try it than explain it. Right-click-drag also works the same.

5.3.2 Pattern Editor / Event Editing

When we say "editing" in the context of the piano roll, in part we mean that we will "draw" or "paint" notes. Drawing, modifying, copying, and deleting notes is actually very elegant in *Seqeuencer64* (and in *Seq24*).

Note editing is a bit different with *Sequencer64*, since it requires two mouse buttons in many cases. There are some new laptop touchpads from FocalTech that have only one mouse button, and use positioning to determine if the click is a left-click or a right-click. The Linux drivers for this touchpad aren't sophisticated enough (as far as we know) to handle converting a two-fingered press properly. We've found that a good solution is to use a four-button USB trackball configued with an easy middle-button setup. It's easier than a touchpad, anyway.

Note that, if only a middle-button is needed, ctrl-left-button will simulate that button. Also note the "Mod4 mode" for the right-click action, and the "p" and "x" keys for getting in and out of "paint mode", discussed elsewhere.

New: There is a feature to allow the Mod4 (the Super or Windows) key to keep the right-click in force even after it is released. See 3.2.4.4. Basically, pressing Mod4 before releasing the right-click that allows note-adding, keeps note-adding in force after the right-click is released. Now notes can be added at will with the left mouse button. Right-click again to leave the note-adding mode.

New: Another way to turn on the paint mode has been added. To turn on the paint mode, first make sure that the piano roll has the keyboard focus by left-clicking in it, then press the "p" key while in the sequence editor. This is just like pressing the right mouse button, but the draw/paint mode sticks (as if the Mod4 mode were in force). To get out of the paint mode, press the "x" key while in the sequence editor, to "x-scape" (get it? get it?) from the paint mode. These keys, however, do not work (currently) while the sequence is playing.

The "p" and "x" key also works in the small event-data editing bar just above the white data area. However, the Mod4-right-click feature does not yet work in that aread of the user interface.

5.3.2.1 Editing Note Events

The Piano Roll pane provides for a quite sophisticated set of note-editing actions. Not only is there a native mouse-interaction mode, but there is a "fruity" mouse-interaction mode that works more like the applications "Fruity Loops", it's follow-on "FL Studio', and its imitator "LMMS".

1. Fruity Mode. **TODO:** At some point, we will add a section detailing the usage of the "fruity" mode of mouse-interaction.

Please study the following paragraphs carefully, ideally while trying them out in *Sequencer64*.

2. Enter Draw Mode. In the note (grid/roll) panel, **holding** down the **right** mouse button will change the cursor to a pencil and put the editor into "draw" mode, also known as "note-adding" or "paint" mode. To exit the draw mode, release the right mouse button, and the cursor will turn back into an arrow.

Another way to enter paint mode is to make sure the piano roll has focus (left click in it), and then press the "p" key. To exit the draw mode, press the "Shift-p" key.

3. Add Notes. Then, while still **holding** the **right** mouse button, click the **left** mouse button to **insert** new notes. Many people find this combination strange at first, but once one gets used to it, it becomes a very fast method of note manipulation. An new option is to hold the Mod4 key while releasing the right button, which keeps the mouse in draw mode. Another new option is to press the "p" to enter draw mode, and stay in it until "Shift-p" is pressed.

Note that this click will add a single note, and the length of the note will be that specified in the note-length setting (e.g. "1/16").

To increase the number of notes, keep dragging the mouse (with both buttons held). It can be dragged rightward, leftward, upward, and downward. Dragging left or right adds new notes, while dragging upward or downward moves the current note to a different pitch. We call this the "auto-note" feature.

The draw mode has the following features:

- Notes are continually added as the mouse is dragged ("auto-notes").
- Notes cannot be added past the "END" marker of the pattern, which marks the **Sequence Length in bars** setting.
- As the mouse is dragged while the left button is held in draw mode, notes are either added, or, if already present at that note-on time, are moved up and down.
- If the draw mode is exited, and entered again, then the original notes will not be altered. Instead, new ones will be added.
- Notes can be added while the pattern is playing, and will be heard the next time the progress bar passes over them.

Thus, one can, with some care, draw a nice chorded sequence. Adjustments to it can be made afterward.

4. Select Notes. Adjustments can be made to one or more notes by selecting one or more notes, and then applying one or more special "selection actions" to the selection.

To select a single note, simply **left click** on it. The selected note will turn orange.

To select multiple notes, perform a **left click drag** to form a selection box that intersects (even partly) the desired notes. Once the mouse is released, all of the desired notes should be orange.

To add more notes to a selection of notes, move to an unselected note and perform a **ctrl left click drag** to form a selection box that intersects (even partly) the desired notes. Once the mouse is released, all of the desired notes should be orange. Be careful! If you ctrl-left-click-drag on an already-selected note, the drag will change the length of all of the notes in the selection.

Pressing the `Ctrl-A` key will select all of the events in the pattern editor.

The **Tools** button described in section 5.2 ("Pattern Editor / Second Panel") on page 41can also be used to modify selections.

Once one or more notes are selected, they can be modified in time, pitch, or length.

5. Deselect Notes. To deselect the notes, click somewhere else in the piano roll, and the notes should change back to white.

There is no way to deselect a single note, with, say a shift-click or ctrl-click action.

6. Move Notes in Pitch. To move notes in pitch, once selected, grab one of the notes in the selection and drag it upward or downward. **New:** Also, since a selection is in force, the Up and Down arrow keys can also be used to change the pitch of every note in the selection. The smallest unit of pitch change is one MIDI note value.

Warning: If one moves the selection too low or too high in pitch, whether with the mouse or the arrow keys, any notes that go below the lowest MIDI pitch or above the highest MIDI pitch **will be lost!** If done using the mouse, the undo feature (Ctrl-z) will work. If done using the arrow keys, the undo feature does not work! Be careful, especially if you have a fast keyboard repeat rate!

7. Move Notes in Time. To move notes in time, once selected, grab one of the notes in the selection and drag it leftward or rightward. **New:** Also, since a selection is in force, the Left and Right arrow keys can also be used to change the time of every note in the selection. The smallest unit of time change is the **Grid snap** value, which might be a 16th note, for example.

Note that there is no possibility of note loss with a change in time. When a note disappears at one end of the pattern boundary, it wraps around to the other end. Cool.

(There is another feature of the arrow keys when no selection is made, that supposedly moves an "origin" for playback, but we haven't been able to figure out exactly if it does anything.)

8. Change Note Length. Pressing the **middle** mouse button ***or*** pressing the **ctrl left** mouse button in tandem, while the pointer is hovered over a selected note, will let one change the length of a selected note. If more than one note is selected, then the length of all selected notes is changed.

Once a selection of notes is made, one can use the shift-middle-click-drag (true?) or ctrl-left-click-drag sequence over the selected notes to draw a box beyond the extent of the notes. When the mouse is released, each of the events is moved and lengthed to be proportionally longer to fit exactly within the box one drew. This feature is called *event stretch*.

If the box that was drawn was shorter than the original extent of the notes, then the notes move and shrink proportionally to occupy the smaller box. This feature is called *event compression*.

Warning: If one reduces or increases the length of a note selection by too much, the note or notes will "wrap-around" to the end of the sequence boundary and grow more from the beginning of the sequence. It is not clear if this new note has an ending time that is less than its beginning time. If it happens, you probably want to undo it.

Note that notes can be shortened below the default note length by event compression. Note that there is currently no way to change the length of the note using a keystroke.

9. Copy/Paste. cut (`Ctrl-X`), copied (`Ctrl-C`), or pasted (`Ctrl-V`). When the notes are selected, one can delete them with the `Delete` or `Backspace` key.

For the appearance of selected events (orange), see figure 41 ("Piano Roll, Selected Notes and Events") on page 52.

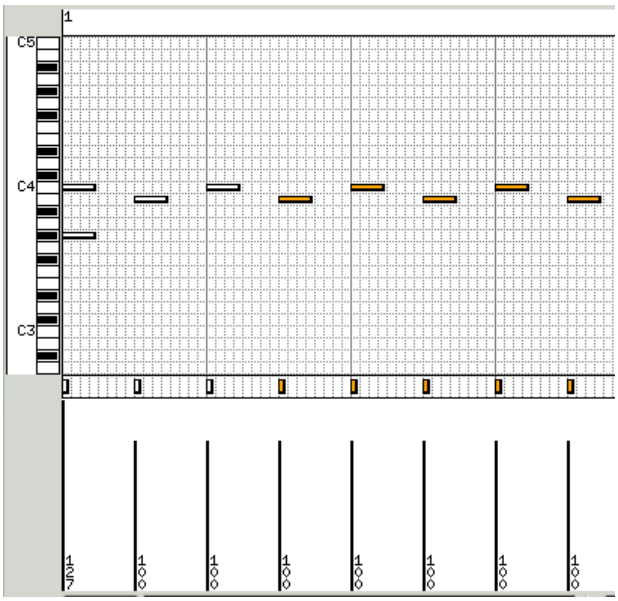

Figure 41: Piano Roll, Selected Notes and Events

5.3.2.2 Editing Other Events

Note On and Note Off events (and other events) can appear as small squares in the event strip, along with a black vertical bar with a height proportional to the velocity of the note event, plus a numeric representation of that value. Note events do not need to be inserted in the event strip. (*Note events can be inserted there, but they end up as short events of the lowest possible note, 0 or C1, and they don't have a Note Off event. So don't do that!*)

Other event types can be inserted via the event strip. To do that, first select the kind of event to insert using the **Event** button in the bottom panel. The place the mouse cursor in the event strip. Right-click to make the drawing pencil appear at the exact spot where the event must go. While holding the right button, click the left button. A small square for the event should appear.

Should one want more of the same event, continue to hold both buttons and drag the mouse. One event should appear at each beat position (e.g. at each 16th note position) that is crossed.

To move the event(s) to a different spot, select it or them via the left button. Then drag it or them to where one wants them. it is currently not possible to move them to positions smaller than the beat size. The work-around is to temporarily reduce the beat size, but this requires caution.

Once the event positions are set, the next step is to modify the data values of the events.

The event value (data) editor (directly under the event strip) is used to change note velocities, channel pressure, control codes, patch select, etc. Just left-click+drag the mouse across the window to draw a line. The values will match that line. middle-click+drag and right-click+drag also draw the value line.

Bug: Sometimes the editing of event values in the event data section will not work. The workaround is to do a `Ctrl-A`, and the click in the roll to deselect the selection; that makes the event value editing work again.

Any events that are selected in the piano roll or event strip can have their values modified with the mouse wheel.

5.3.2.3 Editing Note Events the "Fruity Way"

This mode is a lot different, and we have yet to do the exhaustive testing needed to understand how this mode works. Input from actual users of this mode would be welcome.

5.4 Pattern Editor / Bottom Panel

The bottom horizontal panel of the Pattern Editor provides for selecting events for viewing and edition, and the MIDI playback, pass-through, and recording options of *Sequencer64*.

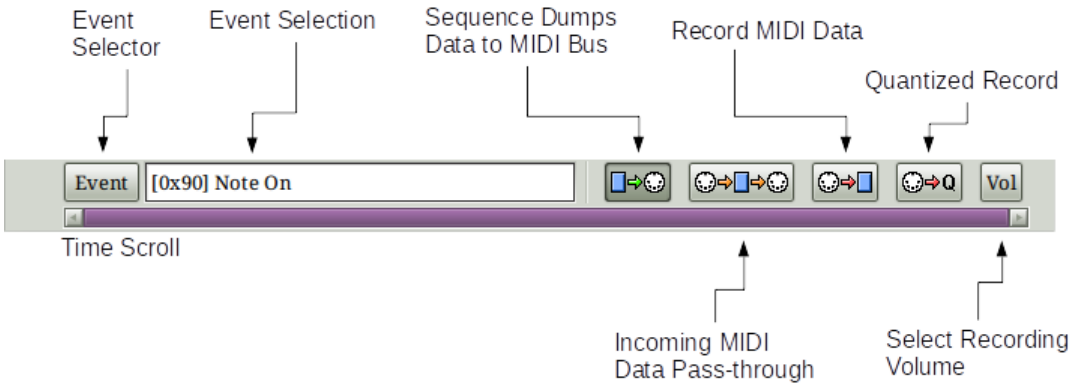

Figure 42: Pattern Editor, Bottom Panel Items

1. **Event Selector**
2. **Event Selection**
3. **Time Scroll**
4. **Data To MIDI Buss**
5. **MIDI Data Pass-Through**
6. **Record MIDI Data**
7. **Quantized Record**
8. **Select Recording Volume**

1. Event Selector. This button brings up the following context menu, so that the user can select the category of events to view and edit.

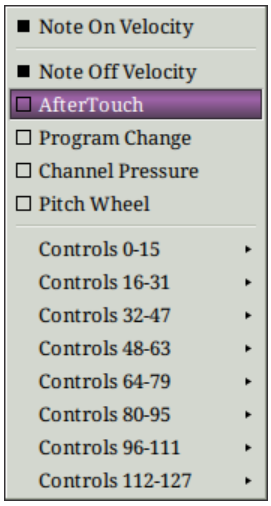

Figure 43: Pattern Editor, Event Button Context Menu

The sub-menus of this context menu show 128 controller messages, so we won't try to show all of them here.

These sub-menus can be modified, as far as we know, by editing the file `$HOME/.config/sequencer64/sequencer64.r` (legacy mode: `$HOME/.seq24usr`), to make it match one's instrument. See section 9 ("Sequencer64 User Configuration File") on page 76.

2. Event Selection. Shows the selection event, with its number shown in hexadecimal notation, and the name of the event shown.

3. Time Scroll. Allows one to pan through the whole pattern, if it is too long to fit in the window.

4. Data To MIDI Buss. Activating this button will cause the pattern to be output to the MIDI output buss, which will normally be connected to a software or hardware synthesizer, to be heard.

5. MIDI Data Pass-Through. Activating this button will route incoming MIDI data through *Sequencer64*, which will then write it to the MIDI output buss.

6. Record MIDI Data. Activating this button will route incoming MIDI data into *Sequencer64*, which will then save the data to its buffer, and also display the new information (notes) in the piano roll view.

7. Quantized Record. Activating this button will also cause MIDI data to be recorded, but it will be quantized on the fly before saving it.

8. Vol. This button allows controlling the volume of the recording.

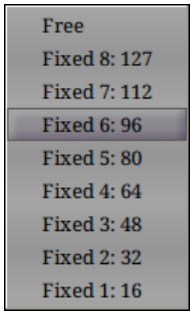

Figure 44: Pattern Recording Volume Menu

The values provided are: Free (record incoming volumes), Fixed 8, Fixed 7, Fixed 6, Fixed 5, Fixed 4, Fixed 3, Fixed 2, and Fixed 1. These values correspond to MIDI volume levels from 127 down to 16, as shown in the figure.

6 Song Editor

The *Sequencer64 Song Editor* is used to combine all of the patterns into a complete tune. It works by showing one row per pattern/loop/sequence in numbered columns, and the placement of each pattern at various musical bars in the song.

New: As an option in the `[user-interface]` section of the "user" configuration file, two song editor windows can be brought onscreen, as a convenience for arrange projects with a large number of sequences.

In *Sequencer64* parlance, the Song Editor creates a *performance*.

Obsolete behavior: It also provides the "song mode" of *Sequencert64*, as opposed to the "live mode" provided by the Patterns Panel.

Currently, the live versus song mode is controlled by the JACK start-mode flag. Do we want to revert to the old behavior, or offer it as another option?

Obsolete behavior: When the Song Editor has the focus of the application, it takes over control from the Patterns Panel. The Song Editor controls now control playback. Once playback is started in the Song Editor, some actions in the Patterns Panel no longer have effect, effectively disabling live mode. The Song Editor takes over the arming/unarming (unmuting/muting) shown in the Patterns Panel. The highlighting of armed/unarmed patterns changes according to whether the pattern is playing in the Song Editor, or not. If one tries to change the muting using a hot-key (or even a click) in the Patterns Panel, the Song Editor immediately returns the pattern to the state it has in the Song Editor. The only way to manually change the muting then is to click the pattern's label in the Song Editor.

Both the Song Editor and the Patterns Panel both reflect the change in muting in the user interface.

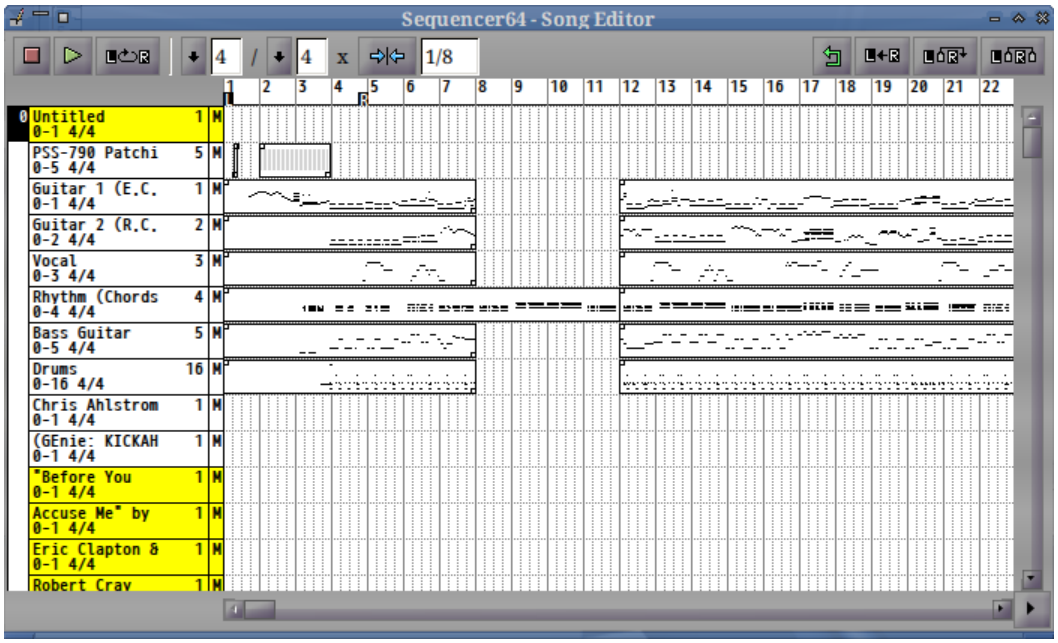

Figure 45: Song Editor Window

New: This dialog (in *Sequencer64*) shows any empty patterns highlighted in yellow. An empty pattern is one that exists, but contains only meta information, and contains no MIDI events that can be played. For example, some tracks just serve as name tracks or information tracks.

The Song Editor is not too complex, but for exposition, we break it into the top panel and the rest of the window.

6.1 Song Editor / Top Panel

The top panel provides quick access to song-playback actions and configuration.

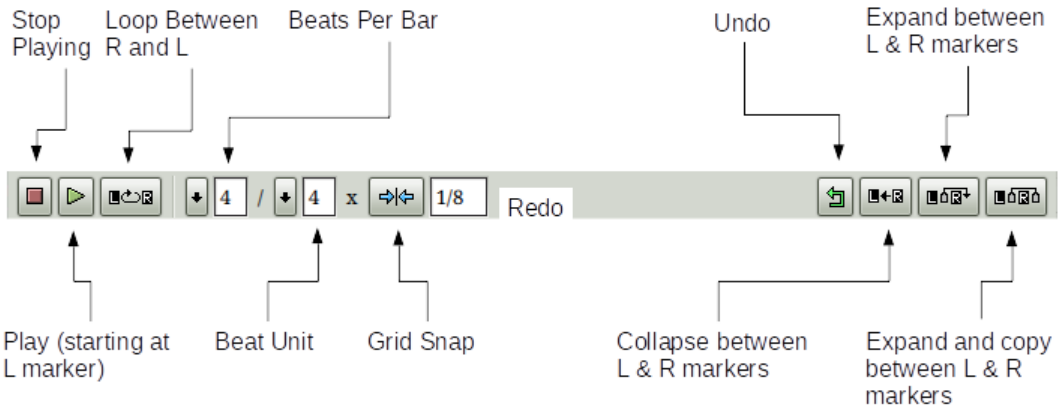

Figure 46: Song Editor / Top Panel Items

1. **Stop**
2. **Play**
3. **Play Loop**
4. **Beats Per Bar**
5. **Beat Unit**
6. **Grid Snap**
7. **Undo**
8. **Collapse**
9. **Expand**
10. **Expand and copy**

1. Stop. Stops the playback of the song. The keystroke for stopping playback is the 'Escape' character. It can be configured to be another character (such as 'Space', which would make the space-bar toggle the playback status).

2. Play. Starts the playback of the song, starting at the **L marker**. The **L marker** serves as the start position for playback in the Song Editor. One can change the start position only when the performance is not playing. The keystroke for starting playback is the 'Space' character.

3. Play Loop. Activate loop mode. When Play is activated, play the song and loop between the **L marker** and the **R marker**. This button is a state button, and its appearance indicates when it is depressed, and thus active. If this button is deactivated during playback, then playback will continue past the **R marker**.

4. Beats Per Bar. Part of the time signature, and specifies the number of beat units per bar. The possible values range from 1 to 16.

5. Beat Unit. Part of the time signature, and specifies the size of the beat unit: 1 for whole notes; 2 for half notes; 4 for quarter notes; 8 for eight notes; and 16 for sixteenth notes.

6. Grid Snap. Grid snap selects where the patterns will be drawn. Unlike the **Grid Snap** of the Pattern Editor, the units of the Song Editor snap value are in fractions of a measure length. The following values are supported: 1/1, 1/2, 1/4, 1/8, 1/16, and 1/32.

7. Undo. The Undo button will roll back the last change in the layout of a pattern. Each time it is clicked, the most recent change will be undone. It will roll back one change each time it is pressed. It is not certain what the undo limit is, however. There is no Redo button in the Song Editor.

8. Collapse. This button collapses the song between the **L marker** and the **R marker**. What this means is that, if there is song material (patterns) before the **L marker** and after the **R marker**, and the **Collapse** button is pressed, any song material between the L and R markers is wiped out, and the song material after the **R marker** is moved leftward to the **L marker**.

Collapsing occurs in all tracks present in the Song Editor.

9. Expand. This button expands the song between the **L marker** and the **R marker**. It inserts blank space between these markers, moving the song material that is after the **R marker** to the right by the duration of the blank space.

Expansion occurs in all tracks present in the Song Editor.

10. Expand and copy. This button expands the song between the **L marker** and the **R marker** much like the **Expand** button. However, it also copies the original data that is present after the **R marker**, and pastes it into the newly-available space between the L and R markers.

6.2 Song Editor / Arrangement Panel

The arrangement panel is the middle section shown in figure 45 ("Song Editor Window") on page 55. It is also known as the "piano roll" of the song editor. Here, we zero in on its many features.

The following figure is taken from a conventional MIDI file, imported, with a few long tracks, rather than a large number of smaller patterns. In other words, the patterns used here are very long, and used only once in the song.

We might need to provide an example that shows off *Sequencer64*'s pattern features better, at some point.

Please note that, if playback is started with the Song Editor as the active window, then the pattern boxes in the patterns panel will show as armed/unarmed (unmuted/muted) depending upon whether or not the pattern is shown as playing (or not) at the current playback position in the Song Editor piano roll.

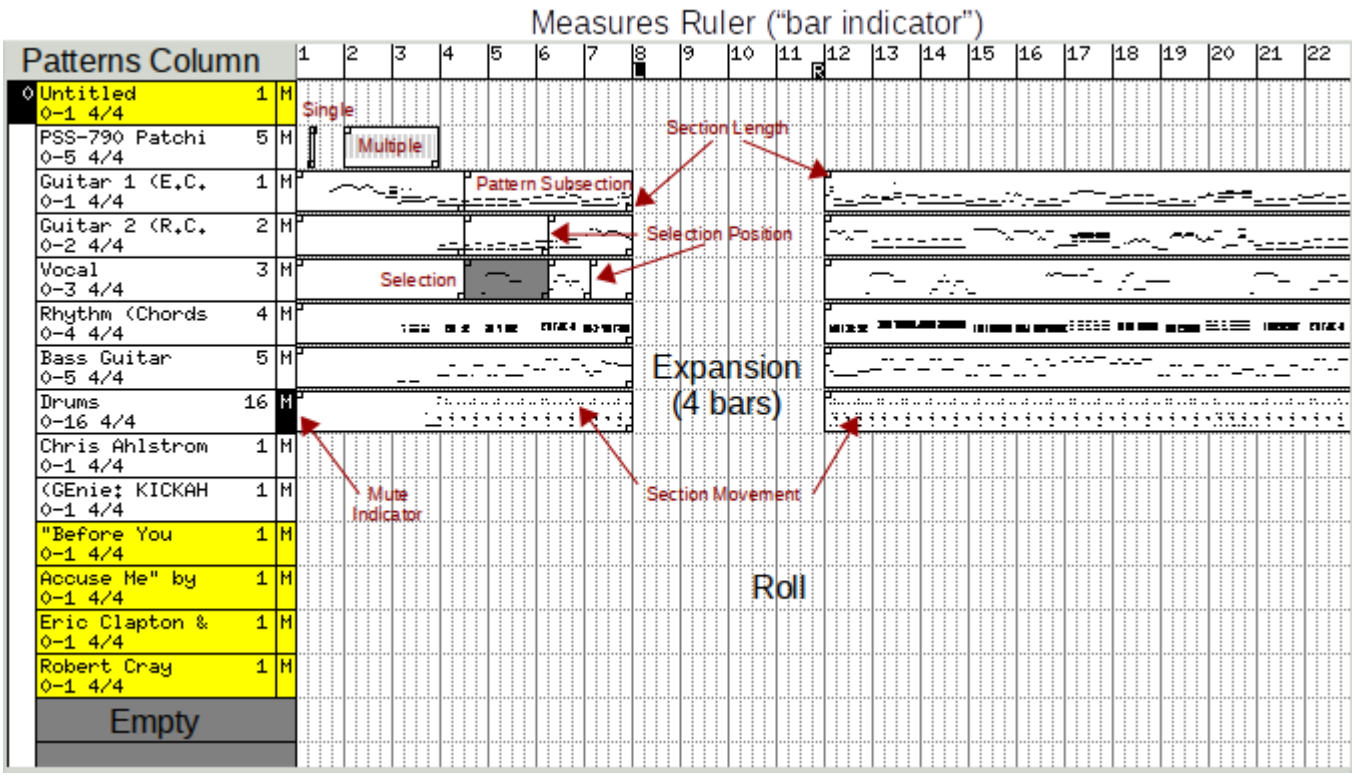

Figure 47: Song Editor Arrangement Panel, Annotated

It consists of a *measures ruler* (bar indicator) at the top, a numbered patterns column at the left with a muting indicator, and the grid or roll section. There are a lot of hidden details in the arrangement panel, as the figure shows. Here are the main sections we will deal with:

1. **Patterns Column**
2. **Piano Roll**
3. **Measures Ruler**

These items are discussed in the following sections.

6.2.1 Song Editor / Arrangement Panel / Patterns Column

Here are the items to note in the patterns column:

1. **Number**. Not yet sure what the number on the left means. The number of the screen set?
2. **Title**. The title is the name of the pattern, for easy reference.
3. **Channel**. The channel number appears (redundantly) at the right of the title.
4. **Buss-Channel**. This pair of numbers shows the MIDI buss number used in the pattern and the channel used for the pattern.
5. **Beat/Measure**. This pair of numbers is the standard time-signature of the pattern.
6. **Mute Indicator**. The letter M is in a black box if the track/pattern is muted, and a white box if it is unmuted.
7. **Empty Track**. Completely empty tracks (no track events or meta events) are indicated by a dark-gray filling in the pattern column. Tracks that have only meta information, but no playable event, are indicated by a yellow filling in the pattern column.

The patterns column shows a list of all of the patterns that have been created in the current song. Each pattern in this list has a track of pattern layouts associated with it in the piano roll section.

Left-clicking on the pattern name or the "M" button toggles the muting (arming) status of the track.

Right-clicking on the pattern name or the "M" button brings up the same pattern editing menu as discussed in section 4.2.2 ("Pattern") on page 33. Recall that this context menu has the following entries: **Edit...**, **Cut**, **Copy**, **Song**, and **Midi Bus**.

6.2.2 Song Editor / Arrangement Panel / Piano Roll

The "Piano Roll" section of the arrangement panel is where patterns or subsections are inserted, deleted, shrunk, lengthened, or moved. Here are the items to note in the annotated Piano Roll area shown in figure 47 ("Song Editor Arrangement Panel, Annotated") on page 58:

1. **Single**. In the diagram, under the word "Single", is a very small pattern. It is small because it consists only of some MIDI Program Change messages meant to set the programs on a Yamaha PSS-790 keyboard.
2. **Multiple**. This item is the same pattern as in "Single", but dragged out for multiple repetitions, simply to show how even the shortest patterns can be replicated easily.
3. **Pattern Subsection**. Middle-clicking inside a pattern inserts a selection position marker in it, breaking the pattern into two equal pieces. We call each piece a *pattern subsection*. This division can be done over and over. (Note that, in the Song Editor, a middle-click *cannot* be simulated by ctrl-left-click.)
4. **Selection Position**. A selection position is a marker that divides a pattern into two pieces, called *pattern subsections*. This makes it easy to select smaller portions of a pattern for editing or deleting. It is especially useful for making holes in a pattern. There may be other uses of a selection position that we have not yet discovered.
5. **Selection**. By clicking inside a pattern or a pattern subsection, it darkens (gray) to denote that it is selected. A pattern subsection can be deleted by the Delete key, copied by the `Ctrl-C` key, and then inserted (one or more times) by the `Ctrl-V` key. When inserted, each insert goes immediately after the current item or the previous insertion. The same can be done for whole patterns.
6. **Section Length**. Looking closely at the diagram where the arrows point, small squares in the corner of the patterns can be seen. By grabbing that square with a left-click, the square can be moved horizontally to either lengthen or shorted the pattern or pattern subsection, if there is room to move in the desired direction. It doesn't matter if the item is selected or not.
7. **Section Movement**. If, instead of grabbing the section length handle, one grabs inside the pattern or pattern subsection, that item can be moved horizontally, as long as their is room. Or course, left-clicking inside the item will also cause it to show as selected.
8. **Expansion**. If, instead of grabbing the section length handle, one grabs inside Originally, all the long patterns of this sample song were continuous. But, by setting the L and R markers, and using the **Expand** button, we opened up some silent space in the song, just to be able to show it off.

The *Seq24* help files refer to work in the Song Editor as the "Performance Editor" or "Performance Mode". Adding a pattern in this window is a bit like adding a note in the Pattern Editor. One clicks, holds, and drags the mouse to insert a copy of the pattern associated with the row in which one is dragging. The longer one drags, the more copies of the pattern that are inserted.

Right-click on the arrangement panel (roll) to enter draw mode, and hold the button. **New:** Just like the Patterns Panel, there is a feature to allow the Mod4 (the Super or Windows) key to keep the right-click in force even after it is released. See 3.2.4.4. Basically, pressing Mod4 before releasing the right-click that

allows pattern-adding, keeps pattern-adding in force after the right-click is released. Now pattern can be entered at will with the left mouse button. Right-click again to leave the pattern-adding mode.

New: Another way to turn on the paint mode has been added. To turn on the paint mode, first make sure that the piano roll has the keyboard focus by left-clicking in it, then press the "p" key while in the performance editor. This is just like pressing the right mouse button, but the draw/paint mode sticks (as if the Mod4 mode were in force). To get out of the paint mode, press the "x" key while in the sequence editor, to "x-scape" (get it? get it?) from the paint mode. These keys, however, do not work (currently) while the sequence is playing.

Then simultaneously left-click the mouse to insert one copy of the pattern. The inserted pattern will show up as a box with a tiny representation of the notes visible inside. (Some patterns, however, can be less than a measure in length, resulting in a tiny box.)

To keep adding more copies of the pattern, continue to hold both buttons and drag the mouse rightward.

Middle-click on a pattern to drop a new selection position into the pattern, which breaks the pattern into two equal *pattern subsections*. Each middle-click on the pattern adds a new selection position, halving the size of the subsections as more pattern subsections are added.

When a pattern or a pattern subsection is left-clicked in the piano roll, it is marked with a dark gray filling. When a right-left-hold-drag action is done in this gray area, the result is to *delete* that pattern section or subsection. One can also hit the Delete key to *delete* that pattern section or subsection.

6.2.3 Song Editor / Arrangement Panel / Measures Ruler

The *measures ruler* is the ruled and numbered section at the top of the arrangement panel. It provides a place to put the left and right markers. In the *Seq24* documentation, it is called the "bar indicator".

Left-click in the measures ruler to move and drop an **L marker** (**L anchor**) on the measures ruler. Right-click in the measures ruler to drop an **L marker** (**R anchor**) on the measures ruler.

Once these anchors are in place, then use the *Collapse* and *Expand* buttons to modify the placement of the pattern events.

Note that the **L marker** serves as the start position for playback in the Song Editor. One can change the start position only when the performance is not playing.

New: Another way to move the L and R markers, a so-called "movement mode" has been added. To turn on the movement mode, first make sure that the piano roll (not the bar indicator!) has the keyboard focus by left-clicking in it at a blank spot, then press the "l" key or "r" key or while in the sequence editor. *There is no visual feedback that one is in the movement mode.* Then press the left or right arrow key to move the "L" or "R" (depending whether "l" or "r" was used to enter the movement mode) markers by one snap value at a time.

To get out of the movement mode, press the "x" key while in the performance editor, to "x-scape" from the movement mode.

We're still working on refining that feature.

7 Event Editor

The *Sequencer64 Event Editor* is used to view and edit, in detail, the events present in a sequence/pattern/track.

Warning: This dialog is a new feature of *Sequencer64*, and is still a work-in-progress. Basic viewing and scrolling generally work well, and editing, deleting, and inserting events does work. But there are many possible interactions between event links (Note Off events linked to Note On events), performance triggers, and the pattern, performance, and event editor dialogs. Surely some bugs still lurk. If anything bad happens, do *not* press the **Save to Sequence** button! If the application aborts, let the programmer know!

Also note that this editor is not very sophisticated:

1. It requires the user to know the details about MIDI events and data values.
2. It does not present handy dropdown lists for various items.
3. It does not detect any changes made to the sequence in the pattern editor.
4. It does not have any undo function.
5. It cannot mark more than one event for deletion or modification.
6. There is no support for dragging and dropping of events.

If, some day, we find ourselves needing that kind of functionality, then we can add it. There may also be issues with interactions between the event editor and things like the performance editor and triggers. For now, the event editor is a good way to see the events in a sequence, and to delete or modify problematic events. Unlike the event pane in the pattern editor, this dialog shows all types of events at once.

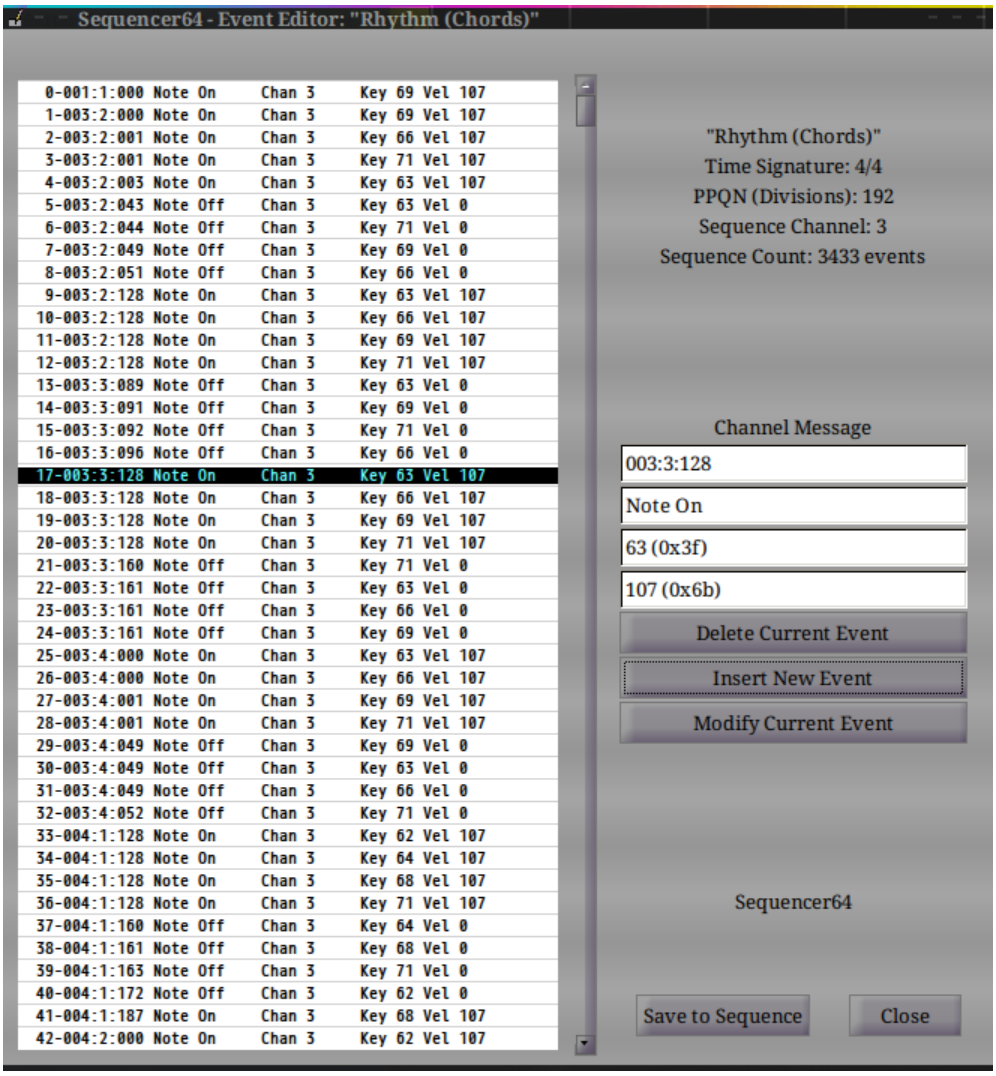

Figure 48: Event Editor Window

The event-editor dialog is fairly complex. For exposition, we break it down into a few sections:

1. **Event Frame**
2. **Info Panel**
3. **Edit Fields**
4. **Bottom Buttons**

The event frame consists of a list of events, which can be viewed, traversed, and edited. The info fields in the info panel show the name of the sequence containing the events, and some other information about the sequence. The edit fields provide four text fields for viewing and entering information about the current event, and buttons to delete, insert, and modify events. The bottom buttons allow changes to be saved and the editor to be closed.

The following sections described these items in detail.

7.1 Event Editor / Event Frame

The event frame is the event-list shown on the left side of the event editor. It is accompanied by a vertical scroll-bar, for moving one line or one page at a time.

7.1.1 Event Frame / Data Items

The event frame shows a list of numbered events, one per line. The currently-selected event is highlighted in cyan text on a black background. Here is an example of the data line for a MIDI event:

```
17-003:3:128 Note On   Chan 3    Key 66 Vel 107
```

This line consists of the following parts:

1. **Index Number**
2. **Time Stamp**
3. **Event Name**
4. **Channel Number**
5. **Data Bytes**

1. Index Number. Displays the index number of the event. This number is purely for the reference of the user, and is not part of the event. Events in the pattern are numbered from 0 to the number of events in the pattern. They serve as a way to better know where one is in the sequence.

2. Time Stamp. Displays the time stamp of the event. This value indicates the cumulative time of the event in the pattern. It is displayed in the format of "measure:beat:divisions". The measure values start from 1, and range up to the number of measures in the pattern. The beat values start from 1, and range up to the number of beats in the measure. The division values range from 0 up to one less than the PPQN (pulses per quarter note) value for the whole song.

3. Event Name. Displays the name of the event. The event name indicates what kind of MIDI event it is. The following event names are supported:

1. **Note Off**
2. **Note On**
3. **Aftertouch**
4. **Control Change**
5. **Program Change**
6. **Channel Pressure**
7. **Pitch Wheel**

Note that these are all MIDI *channel events*. Support for MIDI *system events* is in place, but is not ready for exposure to the user.

4. Channel Number. Shows the channel number (for channel-events only). Be sure to note that, for the user, MIDI channels always range from 1 to 16. (Internally, they range from 0 to 15).

5. Data Bytes. Shows the one or two data bytes for the event.

Note Off, Note On, and Aftertouch events requires a byte for the key (0 to 127) and a byte for the velocity (also 0 to 127). Control Change events require a control code and a value for that control code. Pitch wheel events require two bytes to encode the full range of pitch changes.

Program change events require only a byte value to pick the patch or program (instrument) to be used for the sequence. The Channel Pressure event requires only a one-byte value.

7.1.2 Event Frame / Navigation

Moving about in the event frame is fairly straightforward, but has some wrinkles to note. (It was more difficult to get working than expected!)

Navigation with the mouse is done by moving to the desired event and clicking on it. The event becomes highlighted, and its data items are shown in the "info panel" (discussed in the next section). There is currently no support for dragging and dropping events in the event frame.

The scrollbar can be used to move within the frame, either by one line at a time, or by a page at a time. A page is defined as one frame's worth of lines, minus 5 lines, for some overlap in paging.

Navigation with keystrokes is also supported, for the Up and Down arrows and the Page-Up and Page-Down keys. Note that using the Up and Down arrows by holding them down for awhile causes autorepeat to kick in, and the updates become very erratic and annoying. Use the scrollbar or page keys to move through multiple pages. Home and End also work.

7.2 Event Editor / Info Panel

The "info panel" is simply a read-only list of properties on the top right of the event editor. It serves to remind the used of the sequence being edited and some characteristics of the sequence and the whole song. Currently, five items are shown:

1. **Sequence Name**. This item is redundant, as the window caption for the event editor also shows the sequence name. It can be set in the pattern editor.
2. **Time Signature**. This item is a sequence property. It can be set in the pattern editor.
3. **PPQN** This item shows the "parts per quarter note", or resolution of the whole song. The default PPQN of *Sequencer64* is 192.
4. **Sequence Channel** In *Sequencer64*, the channel number is a property of the sequence. All channel events in the sequence get routed to the same channel, even if somehow the event itself specifies a different channel.
5. **Sequence Count** Displays the current number of events in the sequence. This number changes as events are inserted or deleted.

7.3 Event Editor / Edit Fields

The edit fields show the values of the currently-selected event. They allow changing an event, adding a new event, or deleting the currently-selected event.

1. **Event Category** (read-only)
2. **Event Timestamp**
3. **Event Name**
4. **Data Byte 1**
5. **Data Byte 2**
6. **Delete Current Event**
7. **Insert New Event**
8. **Modify Current Event**

It is important to note that changes made in the event editor are *not* written to the sequence until the **Save to Sequence** button is clicked. If one messes up an edit field, just click on the event again; all the

fields will be filled in again. That's as much "undo" as the event-editor offers at this time, other than closing without saving.

1. Event Category. Displays the event category of the event. Currently, only channel events can be handled, but someday we hope to handle the wide array of system events, and perhap even system-exclusive events.

2. Event Timestamp. Displays the timestamp of the event. Currently only the "measure:beat:division" format is fully supported. We allow editing (but not display) of the timestamp in pulse (divisions) format and "hour:minute:second.fraction" format, but there are bugs to work out.

If one wants to delete or modify an event, this field does not need to be modified. If this field is modified, and the **Modify Current Event** button is pressed, then the event will be moved. This field can locate a new event at a specific time. If the time is not in the current frame, the frame will move to the location of the new event and make it the current event.

3. Event Name. Displays the name of the event, and allows entry of an event name. The event name indicates what kind of MIDI event it is. The following event names are supported:

1. **Note Off**
2. **Note On**
3. **Aftertouch**
4. **Control Change**
5. **Program Change**
6. **Channel Pressure**
7. **Pitch Wheel**

Typing in one of these names should change the kind of event if the event is modified. Abbreviations and case-insensitivity can be used to reduce the effort of typing.

Bug: Currently, the handling of the editing of the event name is a bit clumsy. Also, it would be better to provide a drop-down list for more painless selection of events.

4. Data Byte 1. Allows the modification of the first data byte of the event. One must know what one is doing. The scanning of the digits is very simple: start with the first digit, and convert until a non-digit is encountered. The data-byte value can be entered in decimal notation, or, if prepended with "0x", in hexadecimal notation.

5. Data Byte 2. Allows the modification of the second data byte of the event (if applicable to the event). One must know what one is doing. The scanning of the digits is very simple: start with the first digit, and convert until a non-digit is encountered. The data-byte value can be entered in decimal notation, or, if prepended with "0x", in hexadecimal notation.

6. Delete Current Event. Causes the currently-selected event to be deleted. The frame display is updated to move following events upward.

Sequencer64 would support using the Delete and Insert keys to supplement the buttons, but the Delete key is needed for editing the event data fields. The current structure of the dialog prevents using it for both the frame and the edit fields. Therefore, *Sequencer64* allows the usage of the asterisk keys (both regular and keypad) for deletion.

7. Insert New Event. Inserts a new event, described by the **Event Timestamp**, **Event Name**, **Data Byte 1**, and **Data Byte 2** fields. The new event is placed in the appropriate location for the given timestamp. If the timestamp is at a time that is not visible in the frame, the frame moves to show the new event, so be careful.

8. Modify Current Event. Deletes the current event, and inserts a new event. The modified event is placed in the appropriate location for the given timestamp.

7.4 Event Editor / Bottom Buttons

The buttons at the bottom of the event editor round out the functionality of this dialog.

1. **Save to Sequence**
2. **Close**

1. Save to sequence. Saves the current state of the event container back to the sequence from whence the events came. This button does not close the dialog; further editing can be performed. The Save button is enabled only if some unsaved changes to the events still exist.

Note that there may still be some subtle bugs in the dialog editor, so be careful about pressing this button.

Also note that any sequence/pattern editor that is open should be reflected in the pattern editor once this button is pressed. However, at present, simultaneous use of the pattern editor and event editor has been disabled.

If both the event editor and the pattern editor are open for a sequence (currently disabled), and some events are deleted in the event editor, and the **Save to Sequence** button is pressed, the pattern editor would crash and takes down *Sequencer64* with it. Therefore, when either editor is open for a given sequence, the right-click menu entries that bring them up are hidden.

2. Close. Closes the event editor. Any unsaved event changes are discarded. There is a "modification indicator" to show that the events have been modified.

Again, good luck with the dialog. Bug reports are appreciated.

8 Sequencer64 Configuration File

The *Sequencer64* configuration file originally was `.seq24rc`, and it was stored in the user's `$HOME` directory. This is the same name used by *Seq24*, so we created an new file to take its place, with a fall-back to the original file-name if the new file does not exist, or if *Sequencer64* is running in legacy mode.

After you run *Sequencer64* for the first time (in non-legacy mode), it will generate a `sequencer64.rc` file in your home directory:

```
/home/ahlstrom/.config/sequencer64/sequencer64.rc
```

It contains the the data for remote MIDI control, keyboard control, and MIDI clock.

Sequencer64 will overwrite the `sequencer6.4rc` file upon quitting. One should therefore quit *Sequencer64* before doing manual modifications to the `sequencer64.rc` file.

8.1 Sequencer64 / MIDI Control Section

For each pattern, we can set up MIDI events to turn a pattern on, off, or to toggle it. This setup is in the MIDI Control section of `sequencer64.rc`, and begins with an "INI" group marker `[midi-control]`.

THe MIDI Control section is implicitly broken into subsections, though those subsections are marked with comment-lines for better comprehensibility. The subsections of the MIDI Control section are:

1. **pattern group**. Consists of 32 lines, one for each pattern box shown in the Pattern window.
2. **mute in group**. Consists of 32 lines, one for each pattern box shown in the Pattern window.
3. **automation group**. Each item in this group consists of one line.
    1. **bpm up**. Consists of one line.
    2. **bpm down**. Consists of one line.
    3. **screen-set up**. Consists of one line.
    4. **screen-set down**. Consists of one line.
    5. **mod replace**. Consists of one line.
    6. **mod snapshot**. Consists of one line.
    7. **mod queue**. Consists of one line.
    8. **mod gmute**. Consists of one line.
    9. **mod glearn**. Consists of one line.
    10. **screen-set play**. Consists of one line.

We see the following lines in the MIDI Control section, which is broken into groups or subsections marked by comments:

```
[midi-control]
74      # MIDI controls count

# pattern group
 0  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
 1  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
 2  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
...     ...             ...             ...
31  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]

# mute in group section:
32  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
33  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
...     ...             ...             ...
63  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]

# bpm up:
64  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# bpm down:
65  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# screen set up:
66  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# screen set down:
67  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# mod replace:
68  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# mod snapshot:
69  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# mod queue:
70  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# mod gmute:
71  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
```

```
# mod glearn:
72  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
# screen set play:
73  [0 0 0 0 0 0]   [0 0 0 0 0 0]   [0 0 0 0 0 0]
```

The number (74) is the number of lines in the MIDI Control section.

The first number is the pattern/sequence number in the main window, which ranges from 0 to 31. Each set of brackets corresponds to a MIDI filter. The MIDI filter in the leftmost brackets is the *toggle* filter. The MIDI filter in the middles brackets is the *on* filter. The MIDI filter in the rightmost brackets is the *off* filter. If the incoming MIDI event matches the filter, it will either [toggle], [on], or [off] the pattern/sequence, respectively.

The layout of each filter inside the brackets is as follows:

[OPR INV STAT D1 D2min D2max]

where

- **OPR = on/off**
- **INV = inverse**
- **STAT = MIDI status byte** (channel ignored)
- **D1 = data1**
- **D2min = data2 min**
- **D2max = data2 max**

If **on/off** is set to 1, it will match the incoming MIDI against the **MIDI status byte** pattern and perform the action (on/off/toggle) if the data falls in the range specified. All values are in decimal.

The **inverse** field will make the pattern perform the opposite action (*off* for *on*, *on* for *off*) if the data falls outside the specified range. This is cool because one can map several sequences to a knob or fader.

The last three fields describe the range of data that will match.

8.1.1 Sequencer64 / MIDI Control Pattern Group

Complex? Here is an example for the some of the first 32 lines, which comprise the *pattern group*. The following is an example of responding to Note On events for note 0, with any velocity, to turn the pattern on, and Note off events for note 0, and any velocity, to turn the pattern off.

```
   Toggle                 On                      Off
1 [0 0 0 0 0 0]      [1 0  144 0 0 127]       [1 0 128 0 0 127]
```

The **toggle** field is off (inactive).

The **on** field is on (active). Inverse is inactive. The **MIDI status byte**, 144, is 0x90 (hex), which is a Note On event on channel 0. However, the channel is ignored. **data1** is 0, and **(**data2) can range from 0 to 127.

The **off** field is on (active). The **MIDI status byte**, 128, is 0x80 (hex), which is a Note Off event on channel 0. Again, the channel is ignored. **data1** is 0, and **data2** can range from 0 to 127.

So, basically, pattern 1 starts when any Note On is received, and it stops when any Note Off is received.

The following example would map a row of sequences to one knob sending out changes for Control Code 1:

```
  Toggle                 On                        Off
0 [0 0 0 0 0 0]      [1 1 176 1   0   15]      [0 0 0 0 0 0]
1 [0 0 0 0 0 0]      [1 1 176 1  16   31]      [0 0 0 0 0 0]
2 [0 0 0 0 0 0]      [1 1 176 1  32   47]      [0 0 0 0 0 0]
3 [0 0 0 0 0 0]      [1 1 176 1  48   63]      [0 0 0 0 0 0]
4 [0 0 0 0 0 0]      [1 1 176 1  64   79]      [0 0 0 0 0 0]
5 [0 0 0 0 0 0]      [1 1 176 1  80   95]      [0 0 0 0 0 0]
6 [0 0 0 0 0 0]      [1 1 176 1  96  111]      [0 0 0 0 0 0]
7 [0 0 0 0 0 0]      [1 1 176 1 112  127]      [0 0 0 0 0 0]
```

The **on** field is on (active). Inverse is active. The **MIDI status byte**, 176, is 0xB0 (hex), which is a Control Change event (channel ignored). **data1** is 1, which is the controller number for a Modulation Wheel. The **data2** ranges are set so that, as the controller data increases (as the modulation-wheel knob is turned, so to speak), patterns 0 through 7 come on one at a time until all are running.

8.1.2 Sequencer64 / MIDI Control Mute In Group

This section controls 32 groups of mutes in the same way as defined for `[midi-control]`, and is in fact placed in the `[midi-control]` section.

A group is a set of patterns that can toggle their playing state together. Every group contains all 32 sequences in the active screen set (see after).

So, this part of the MIDI Control section is used for muting and unmuting (and toggling) a group of patterns.

8.1.3 Sequencer64 MIDI Control Automation Group

1. bpm up. Increases the BPM (speed) of the sequencer based on MIDI input.

2. bpm down. Decreases the BPM (speed) of the sequencer based on MIDI input.

3. screen-set up. Increases the active screen-set of the sequencer based on MIDI input.

4. screen-set down. Decreases the active screen-set of the sequencer based on MIDI input.

5. mod replace. This item provides a way to automate replacement. TODO. Explain the concept of replacement.

6. mod snapshot. This item provides a way to automate snapshots. TODO. Explain the concept of snapshots.

7. mod queue. This item provides a way to automate queueing. TODO. Explain the concept of queue.

8. mod gmute. This item provides a way to automate group-muting. Explain the concept of snapshots.

9. mod glearn. This item provides a way to automate group-learning. TODO. Explain the concept of group-learning.

10. screen-set play. This item provides a way to automate screen set play. TODO. Explain the concept of screen set play.

8.2 Sequencer64 / Mute-Group Section

This section is delimited by the `[mute-group]` construct. It controls 32 groups of mutes in the same way as defined for `[midi-control]`. A group is set of sequences that can toggle their playing state together. Every group contains all 32 sequences in the active screen set.

```
[mute-group]
1024    # group mute value count
0 [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0]
1 [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0]
2 [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0]
...      ...                ...                ...                ...
31 [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0] [0 0 0 0 0 0 0 0]
```

The initial number, 1024 is probably the total count of 32 x 32 sequences.

In this group are the definitions of the state of the 32 sequences in the playing screen set when a group is selected. Each set of brackets defines a group:

```
[state of the first 8 sequences] [second 8] [third 8] [fourth 8]
```

After the list of sequences and their MIDI events, one can set *Sequencer64* to handle MIDI events and change some more settings in `sequencer64.rc`.

8.3 Sequencer64 / MIDI-Clock Section

The MIDI Clock fields will contain the clocking state from the last time *Sequencer64* was run. Turn off the clock with a 0, or on with a 1. This section has 16 entries, one for each MIDI output buss that *Sequencer64* supports.

This configuration item is the same as the **MIDI Clock** tab described in paragraph 3.2.4.1 ("Menu / File / Options / MIDI Clock") on page 18

Here is the format:

```
[midi-clock]
16
 0 0  #  [1] seq24 1
 1 0  #  [2] seq24 2
 2 0  #  [3] seq24 3
 3 0  #  [4] seq24 4
```

```
 4 0  #  [5] seq24 5
 5 0  #  [6] seq24 6
 6 0  #  [7] seq24 7
 7 0  #  [8] seq24 8
 8 0  #  [9] seq24 9
 9 0  # [10] seq24 10
10 0  # [11] seq24 11
11 0  # [12] seq24 12
12 0  # [13] seq24 13
13 0  # [14] seq24 14
14 0  # [15] seq24 15
15 0  # [16] seq24 16
```

That sample would be written one had started up *Sequencer64* in manual-alsa-mode. On our system, where we have Timidity running, and erroneously, have also specified 3 MIDI busses that we do not have, in the `sequencer64.usr` file:

```
[midi-clock]
5    # number of MIDI clocks/busses
# Output buss name: [0] 14:0 2x2 A (SuperNova,Q,TX81Z,DrumStation)
0 0  # buss number, clock status
# Output buss name: [1] 128:0 2x2 B (WaveStation,ESI-2000,MV4,ES-1,ER-1)
1 0  # buss number, clock status
# Output buss name: [2] 128:1 PCR-30 (303)
2 0  # buss number, clock status
# Output buss name: [3] 128:2 TiMidity port 2
3 0  # buss number, clock status
# Output buss name: [4] 128:3 TiMidity port 3
4 0  # buss number, clock status
```

8.4 Sequencer64 / Keyboard Control Section

The keyboard control is a dump of the keys that *Sequencer64* recognises, and each key's corresponding sequence number. Note that the first number corresponds to the number of sequences in the active screen set.

```
[keyboard-control]
32     # number of keys
# Key #  Sequence #   Key name
44  31        # comma
49  0         # 1
50  4         # 2
51  8         # 3
52  12        # 4
53  16        # 5
```

```
54  20          # 6
55  24          # 7
56  28          # 8
97  2           # a
98  19          # b
99  11          # c
100  10         # d
101  9          # e
102  14         # f
103  18         # g
104  22         # h
105  29         # i
106  26         # j
107  30         # k
109  27         # m
110  23         # n
113  1          # q
114  13         # r
115  6          # s
116  17         # t
117  25         # u
118  15         # v
119  5          # w
120  7          # x
121  21         # y
122  3          # z
```

8.5 Sequencer64 / Keyboard Group Section

This section is the same as [**keyboard-control**], but to control groups. The keyboard group specifies more automation for the application. The first number specifies the Key number, and the second number specifies the Group number.

Additional control:

1. **# bpm up and down**. Keys to control BPM (beats per minute).
2. **# screen set up and down**. Keys for changing the active screenset.
3. **# group functionality on, off, learn**. Note that the group learn key is a modifier key to be held while pressing a group toggle key.
4. **#replace, queue, snapshot_1, snapshot_2, keep queue**. These are the other modifier keys explained in section 3a.

To see the required key codes when pressed, run `seq24` with the `--show_keys`.

Some keys should not be assigned to control sequences in *Sequencer64* as they are already assigned in the *Sequencer64* menu (with `Ctrl`).

This configuration item is the same as the **Keyboard** tab described in section 3.2.4.3 ("Menu / File / Options / Keyboard") on page 22.

```
[keyboard-group]
# Key #, group #
32
33  0          # exclam
34  1          # quotedbl
35  2          # numbersign
36  3          # dollar
37  4          # percent
38  5          # ampersand
40  7          # parenleft
47  6          # slash
59  31         # semicolon
65  16         # A
66  28         # B
67  26         # C
68  18         # D
69  10         # E
70  19         # F
71  20         # G
72  21         # H
73  15         # I
74  22         # J
75  23         # K
77  30         # M
78  29         # N
81  8          # Q
82  11         # R
83  17         # S
84  12         # T
85  14         # U
86  27         # V
87  9          # W
88  25         # X
89  13         # Y
90  24         # Z
39 59          # bpm up, down: apostrophe semicolon
93 91 65360    # screen set up, down, play: bracketright bracketleft Home
236 39 65379   # group on, off, learn: igrave apostrophe Insert
# replace, queue, snapshot_1, snapshot 2, keep queue:
65507 65508 65513 65514 92  # Control_L Control_R Alt_L Alt_R backslash
1              # show_ui_sequence_key (1=true/0=false)
32             # space start sequencer
65307          # Escape stop sequencer
0 #  show sequence numbers (1 = true / 0 = false);  ignored in legacy mode
```

8.6 Sequencer64 / JACK Transport

The JACK Transport options are also command-line options, as indicated in the comments below.

This configuration item is the same as the **Jack Sync** tab described in section 3.2.4.5 ("Menu / File / Options / Jack Sync and LASH") on page 26.

```
[jack-transport]

# jack_transport - Enable slave sync with JACK Transport.
0

# jack_master - Sequencer64 attempts to serve as JACK Master.
0

# jack_master_cond - Sequencer64 is master if no other master exists.
0

# jack_start_mode
# 0 = Playback in live mode. Allows muting and unmuting of loops.
# 1 = Playback uses the song editor's data.
1
```

Please note that only *one* of jack_transport, jack_master, and jack_master_cond should be selected (set to 1) at a time.

8.7 Sequencer64 / Other Sections

This configuration item is the same as the **Clock Start Modulo** option described in paragraph 3.2.4.1 ("Menu / File / Options / MIDI Clock") on page 18.

```
[midi-clock-mod-ticks]
64
```

This configuration item is the same as the **MIDI Input** tab described in paragraph 3.2.4.2 ("Menu / File / Options / MIDI Input") on page 21. The "1" is undoubtedly a record count, and would equal the number of supported input ports. This "rc" entry here has two variables; the first is the record number or port number, and the second number indicates whether it is disabled (0), or enabled (1).

```
[midi-input]
1   # number of MIDI busses
# [0] 14:0 2x2 A (SuperNova,Q,TX81Z,DrumStation)
0 0
```

There is no user-interface item for the following value, but it does correspond to the `--manual_alsa_ports` command-line option.

```
# set to 1 if you want seq24 to create its own alsa ports and
# not connect to other clients

[manual-alsa-ports]
1
```

Turning on the manual-alsa-ports option is necessary if one wants to use *Sequencer64* with JACK.

This configuration item is the same as the **Mouse** tab described in paragraph 3.2.4.4 ("Menu / File / Options / Mouse") on page 25.

```
# 0 - 'seq24' (original seq24 method)
# 1 - 'fruity' (similar to a certain fruity sequencer we like)

[interaction-method]
0

# Set to 1 to allow seq24 to stay in note-adding mode when
# the right-click is released while holding the Mod4 (Super or
# Windows) key.
0
```

New: There is now an option to use the Mod4 (Super, or Windows) key in the Pattern Editor to lock the editing of a note. When this mode is enabled, and Mod4 is pressed while the mouse right-button is released, the editing pencil icon remains, and notes can be added. This feature is useful for crippled trackpads and trackpad drivers that cannot provide two simultaneous button presses.

This configuration item is the same as the `--lash` or `--no-lash` options described in section 10 ("Sequencer64 Man Page") on page 87. If set to 0, LASH session support is disabled. If set to 1, LASH session support is enabled. However, if LASH support is not built into the application, neither option has any effect – there is no LASH support. To determine if LASH support is built in, run sequencer64 from the command line with the `--help` option, and see if LASH is mentioned.

```
[lash-session]
# Set the following value to 0 to disable LASH session management.
# Set the following value to 1 to enable LASH session management.
# This value will have no effect is LASH support is not built into
# the application.  Use the --help option to see if LASH is part of
# the options list.
1     # LASH session management support flag
```

This new item determines if the "rc" configuration file is saved upon exit of *Sequencer64*. The legacy behavior is to save it, which can sometimes be inconvenient when one is just trying out some command-line options.

```
[auto-option-save]
# Set the following value to 0 to disable the automatic saving of the
# current configuration to the 'rc' file.  Set it to 1 to
# follow legacy seq24 behavior of saving the configuration at exit.
# Note that, if auto-save is set, many of the command-line settings,
# such as the JACK/ALSA settings, are then saved to the configuration,
# which can confuse one at first.  Also note that one currently needs
# this option set to 1 to save the configuration, as there is not a
# user-interface control for it at present.
0     # auto-save-options-on-exit support flag
```

The following item refers to the last directory in which one opened or saved a MIDI file.

```
[last-used-dir]

# Last used directory.

/home/ahlstrom/Home/ca/mls/git/sequencer64/contrib/midi/
```

9 Sequencer64 User Configuration File

The *Sequencer64* configuration file provides a way to give more informative names to the MIDI busses, MIDI channels, and MIDI controllers of a given system setup. This configuration will override the default values of some drop-down lists and menu items, and make them reflect your names for them.

By default, the list of MIDI items that *Sequencer64* shows depends on one's system setup and whether the manual-alsa-port options is specified or not. Here's our system, which has Timidity installed and running as a service, and the manual-alsa-port option turned off, shown in a composite view with all menus one can look at for MIDI settings:

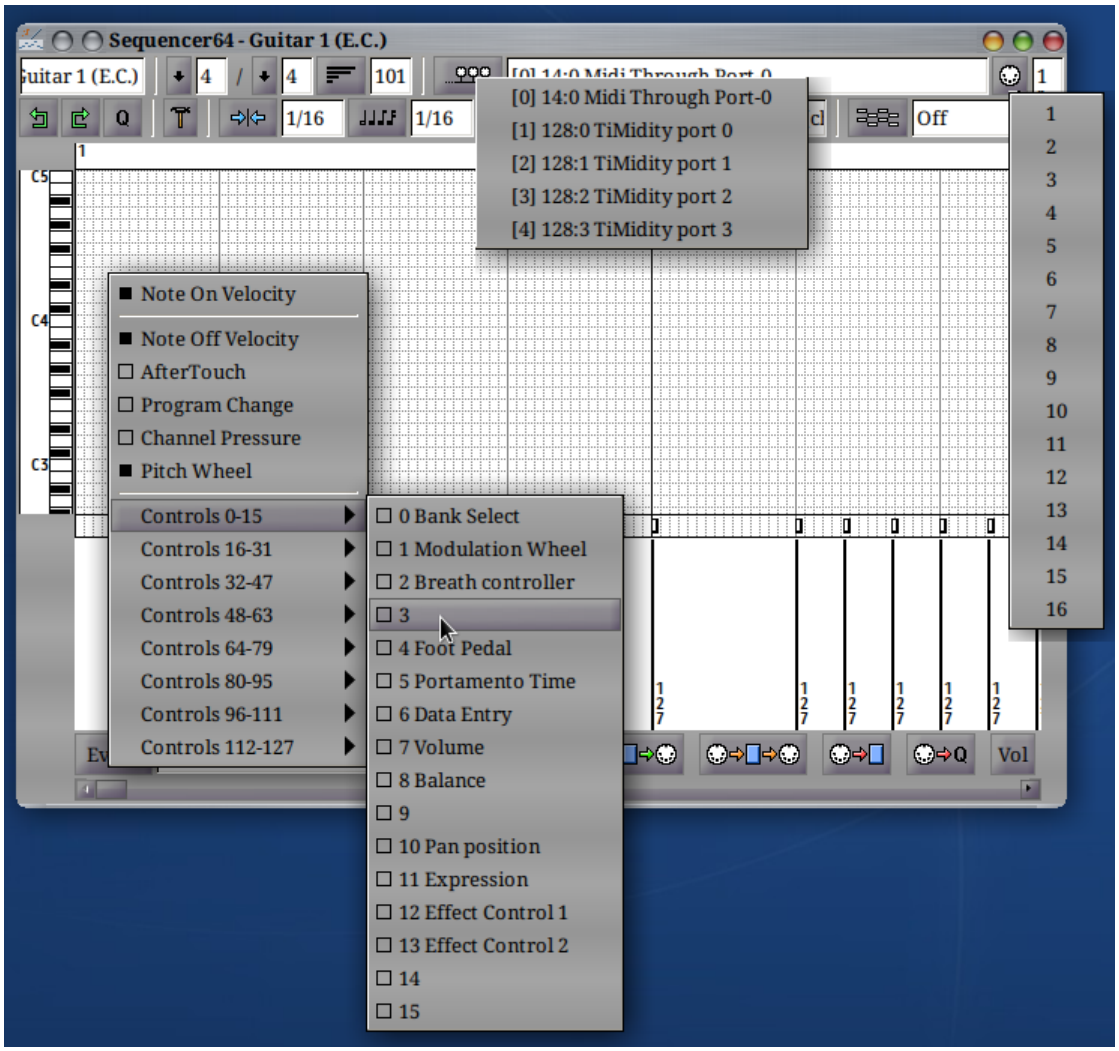

Figure 49: Sequencer64 Composite View of Native Devices

At the top center, the dropdown menu contains the 5 MIDI busses (also known as "MIDI ports") supported by our system. At right, the MIDI channel shows the channels numbers that can be picked for buss 0. At bottom left, we see the default controller values that *Sequencer64* includes. We have no idea if these correspond to any controllers that the selected MIDI buss supports. We *can* use this dropdown to see if any such controller events are in the loaded MIDI file, of course.

Now let's assume we have 3 MIDI "buss" devices hooked to our system: two Model "2x2" MIDI port devices, and an old PCR-30 MIDI controller keyboard. Let's number them:

1. Model 2x2 A
2. Model 2x2 B
3. PCR-30

Then assume that we have nine different MIDI instruments in our kit. Let's number them, too:

1. Waldorf Micro Q

2. SuperNova
3. DrumStation
4. TX81Z
5. WaveStation
6. ESI-2000
7. ES-1
8. ER-1
9. TB-303

The Waldorf Micro Q, the SuperNova, and the DrumStation all have a large number of special MIDI controller values for affecting the sound they produce. The DrumStation accepts MIDI controllers that change various features of the sound of each type of drum it supports.

The buss devices can be configured (apparently) to route certain MIDI channels to certain MIDI devices. Let's assume we have them set up this way:

1. Model 2x2 A
    - SuperNova: channels 1 to 8
    - TX81Z: channels 9 to 11
    - Waldorf Micro Q: channels 12 to 15
    - DrumStation: channel 16
2. Model 2x2 B
    - WaveStation: channels 1 to 4
    - ESI-2000: channels 5 to 14
    - ES-1: channel 15
    - ER-1: channel 16
3. PCR-30
    - TB-303: channel 1

How can we get *Sequencer64* to show these items with the proper names associated with each device, channel, and controller value? We use the oddly-named **"user" configuration file**.

The *Seq24* configuration file was called `.seq24usr`, and it was stored in the user's `$HOME` directory. For *Sequencer64*, we created an new file-name to take its place, with a fall-back to the original file-name if the new file does not exist, or if *Sequencer64* is running in legacy mode.

After you run *Sequencer64* for the first time, it will generate a `sequencer64.usr` file in your home directory:

```
/home/ahlstrom/.config/sequencer64/sequencer64.usr
```

It allows you to give an alias to each MIDI bus, MIDI channel, and MIDI control codes, per channel. The name is a bit misleading... do not confuse this file with the `sequencer64.rc` file.

The process for setting up the user file is to:

1. Define one or more MIDI busses, the name of each, and what instruments are on which channels. Each buss is configured in a section of the form "[**user-midi-bus-X**]", where "X" ranges from 0 on up.

2. Define all of the instruments and their control-code names if they have them. Each instrument is configured in a section of the form "**[user-instrument-X]**", where "X" ranges from 0 on up.

So, taking our list of devices and channels we created above, deducting 1 from each device number and channel number (so that numbering starts from 0), and consulting the device manuals to determine the controller values it supports, we can assemble a "user" configuration file that makes the setup visible in *Sequencer64*.

Peruse the next couple of sections to understand a bit about the format of this file. Look at the example file in the `contrib` directory as well, to see the whole thing put together. Once you're satisfied, go to section 9.5 ("Sequencer64 User / Results") on page 85, and see what it all looks like.

9.1 Sequencer64 User / MIDI Bus Definitions

This section begins with an "INI" group marker `[user-midi-bus-definitions]`. It defines the number of user busses that will be configured in this file.

```
[user-midi-bus-definitions]
3     # number of user-defined MIDI busses
```

This means that the `sequencer64.usr` file will have three MIDI buss sections: [user-midi-bus-0], [user-midi-bus-1], and [user-midi-bus-2]. Here's is an annoted example of one such section:

```
[user-midi-bus-0]
2x2 A (SuperNova,Q,TX81Z,DrumStation)     # name of the device
16                                        # number of channels

# NOTE: Channels are 0-15, not 1-16.  Instruments set to -1 = GM

0 1                                       # channel and instrument
1 1
2 1
3 1
4 1
5 1
6 1
7 1
8 3
9 3
10 3
11 0
12 0
13 0
14 0
15 2
```

Here's an example of one that needs only one override:

```
[user-midi-bus-2]
PCR-30 (303)
1                                       # number of channels
0 8                                     # channel and instrument
# The rest default to -1 - General MIDI
```

9.2 Sequencer64 User / MIDI Instrument Definitions

This section begins with an "INI" group marker `[user-instrument-definitions]`. It defines the number of user instruments that will be configured in this file.

```
[user-instrument-definitions]
9     # number of user instrument
```

So this "usr" file will define 9 instruments. We will provide one section as a sample.

```
[user-instrument-0]
Waldorf Micro Q                     # name of instrument
128                                 # number of MIDI controllers
0                                   # first controller value, unnamed
1 Modulation Wheel
2 Breath Control
3
4 Foot Control
5 Glide Rate
6
7 Channel Volume
8
9
10 Pan
11
12 Arp Range (0-9) (1-10 octaves)
13 Arp Length (0-15) (1-16 steps)
14 Arp Active (0-3) (Off,On,One Shot,Hold)
15 LFO 1 Shape (0-5) (Sine,Tri,Square,Saw,Rand,S&H)
   . . .
119
120 All Sound Off (0)
121 Reset All Controllers (0)
122 Local Control (0-127) (Off,On)
123 All Notes Off (0)
124
125
126
127
```

We assume that an unnamed control number is an unsupported control number.

Here is an instrument where its synthesis parameters can be controlled:

```
[user-instrument-1]
SuperNova
128
0 Bank Select MSB
1 Modulation Wheel
2 Breath Controller
3 Arp Pattern Select
4 Ring Modulator 2 * 3 Mix Level
5 Portamento Time
6 Data Entry
7 Part / Program Volume
8 Effects Confg Morph Amount
9 Arp Speed (Internal Clock Rate) [*]
10 Pan
11 Osc 1 Fine Tune
12 Osc 3 Fine Tune
13 Osc 1 Soften
14 Osc 2 Soften
15 Osc 3 Soften
16 LFO 1 Speed
17 LFO 1 Delay
   . . .
119 Delay Mod Wheel Depth
120 All Sound Off
121 Reset Controllers
122 Local Control [*]
123 All Notes Off
124 All Notes Off
125 All Notes Off
126 All Notes Off
127 All Notes Off
```

Here is an instrument that perhaps has no controllers, or maybe is simply not configured yet.

```
[user-instrument-4]
WaveStation
0
```

The sample file `contrib/scripts/dot-seq24usr` contains examples of some other kinds of instruments, such as drum machines.

9.3 Sequencer64 User / User Interface Settings

This section begins with an "INI" group marker `[user-interface-settings]`.

It provides for a feature we will hopefully be able to complete some day: the better specificiation of the appearance of the user interface. Currently, these settings are not yet in force... we still have to figure out a fair number of user interface items.

But, for now, this section shows some of the current values.

```
#   ======== Sequencer64-Specific Variables Section ========

[user-interface-settings]

# These settings specify the soon-to-be-modifiable sizes of
# the Sequencer64 user-interface elements.

# Specifies the style of the main-window grid of patterns.
# 0 = normal style, matches the GTK theme, has brackets.
# 1 = white grid boxes that have brackets.
# 2 = black grid boxes.
2       # grid_style

# Specifies box style box around a main-window grid of patterns.
# 0  = Draw a whole box around the pattern slot.
# 1  = Draw brackets on the sides of the pattern slot.
# 2 and up = make the brackets thicker and thicker.
# -1 = same as 0, draw a box one-pixel thick.
# -2 and lower = draw a box, thicker and thicker.
2       # grid_brackets

# Specifies the number of rows in the main window.
# At present, only a value of 4 is supportable.
# In the future, we hope to support an alternate value of 8.
4       # mainwnd_rows

# Specifies the number of columns in the main window.
# At present, only a value of 8 is supportable.
8       # mainwnd_cols

# Specifies the maximum number of sets, which defaults to 1024.
# It is currently never necessary to change this value.
32      # max_sets

# Specifies the border width in the main window.
0      # mainwid_border

# Specifies the border spacing in the main window.
```

```
2      # mainwid_spacing

# Specifies some quantity, it is not known what it means.
0      # control_height

# Specifies the initial zoom for the piano rolls.  Ranges from 1.
# to 32, and defaults to 2 unless changed here.

2      # zoom

# Specifies if the key, scale, and background sequence are to be
# applied to all sequences, or to individual sequences.  The
# behavior of Seq24 was to apply them to all sequences.  But
# Sequencer64 takes it further by applying it immediately, and
# by saving to the end of the MIDI file.  Note that these three
# values are stored in the MIDI file, not this configuration file.
# Also note that reading MIDI files not created with this feature
# will pick up this feature if active, and the file gets saved.
# It is contagious.
#
# 0 = Allow each sequence to have its own key/scale/background.
#     Settings are saved with each sequence.
# 1 = Apply these settings globally (similar to seq24).
#     Settings are saved in the global final section of the file.

1      # global_seq_feature

# Specifies if the old, console-style font, or the new anti-
# aliased font, is to be used as the font throughout the GUI.
# In legacy mode, the old font is the default.
#
# 0 = Use the old-style font.
# 1 = Use the new-style font.

1      # use_new_font

# Specifies if the user-interface will support two song editor
# windows being shown at the same time.  This makes it easier to
# edit songs with a large number of sequences.
#
# 0 = Allow only one song editor (performance editor).
# 1 = Allow two song editors.

1      # allow_two_perfedits

# Specifies the number of 4-measure blocks for horizontal page
# scrolling in the song editor.  The old default, 1, is a bit
# small.  The new default is 4.  The legal range is 1 to 6, where
```

```
# 6 is the width of the whole performance piano roll view.

4      # perf_h_page_increment

# Specifies the number of 1-track blocks for vertical page
# scrolling in the song editor.  The old default, 1, is a bit
# small.  The new default is 8.  The legal range is 1 to 18, where
# 18 is about the height of the whole performance piano roll view.

8      # perf_v_page_increment
```

9.4 Sequencer64 User / User MIDI Settings

This section begins with an "INI" group marker `[user-midi-settings]`.

It provides for a feature we will hopefully be able to complete some day: Being able to support files with different PPQN properly, and to specify the global defaults for tempo, beats per measure, and so on.

```
[user-instrument-4]
[user-midi-settings]

# These settings specify MIDI-specific value that might be
# better off as variables, rather than constants.
# Specifies parts-per-quarter note to use, if the MIDI file.
# does not override it.  Default is 192, but we'd like to go
# higher than that.  BEWARE:  STILL GETTING IT TO WORK!
192       # midi_ppqn

# Specifies the default beats per measure, or beats per bar.
# The default value is 4.
4       # midi_beats_per_measure/bar

# Specifies the default beats per minute.  The default value
# is 120, and the legal range is 20 to 500.
120       # midi_beats_per_minute

# Specifies the default beat width. The default value is 4.
4       # midi_beat_width

# Specifies the buss-number override. The default value is -1,
# which means that there is no buss override.  If a value
# from 0 to 31 is given, then that buss value overrides all
# buss values specified in all sequences/patterns.
# Change this value from -1 only if you want to use a single
# output buss, either for testing or convenience.  And don't
# save the MIDI afterwards, unless you really want to change
# all of its buss values.
```

```
-1      # midi_buss_override
```

9.5 Sequencer64 User / Results

Okay, now we have this file copied to our home directory:

```
/home/ahlstrom/.config/sequencer64/sequencer64.usr
```

If we'd already run *Sequencer64* at least once, we'd have overwritten the skeleton sample file that *Sequencer64* writes by default. We now have a full-fledged "user" file.

However, because we don't actually have all that equipment (we got the example from the Web, for cryin' out loud), let's see what we end up with when we run *Sequencer64* this time.

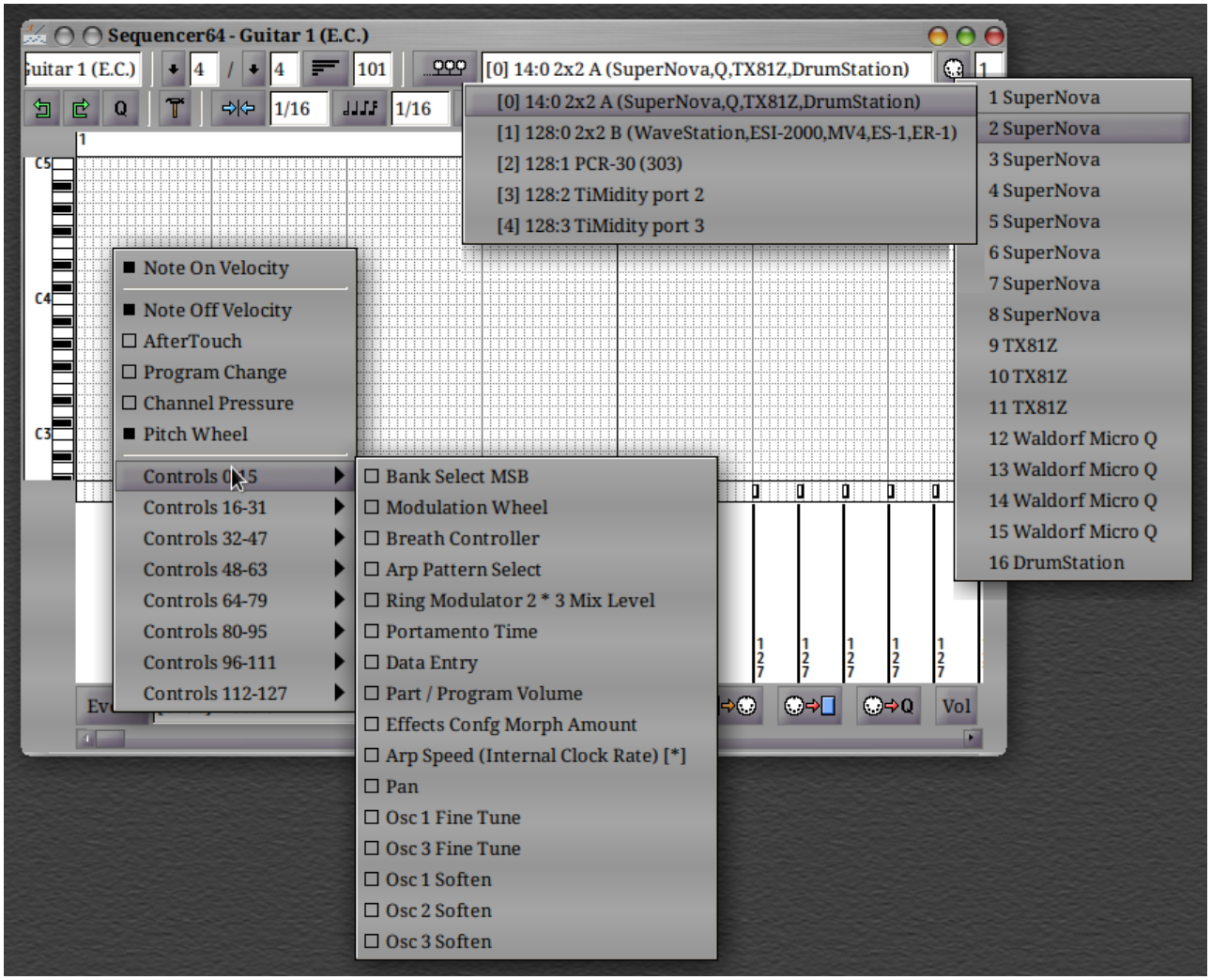

Figure 50: Sequencer64 Composite View of Non-Native Devices

Compare that diagram to figure 49 ("Sequencer64 Composite View of Native Devices") on page 77. If the original figure, we saw the 5 native busses (ports) on our system, their bare-bones channel numbers, and the default controller values. In this new figure, we see the three buss devices (ports), plus the two Timidity ports. If we stopped the Timidity service, these would go away.

Look at the selected buss, "[0]". It's 16 channels are now associated with the devices to which the channels have been assigned.

Thus, when we have a new pattern we've created in *Sequencer64*, can assign it to exactly the buss and device we want.

If we don't have port-mappers installed, and thus have only one playback device plugged into the buss, we can still create a setup that shows the device and a specific program setup. Doing so would be tedious, but perhaps there's some automated way to do it?

Lastly, note the following figure.

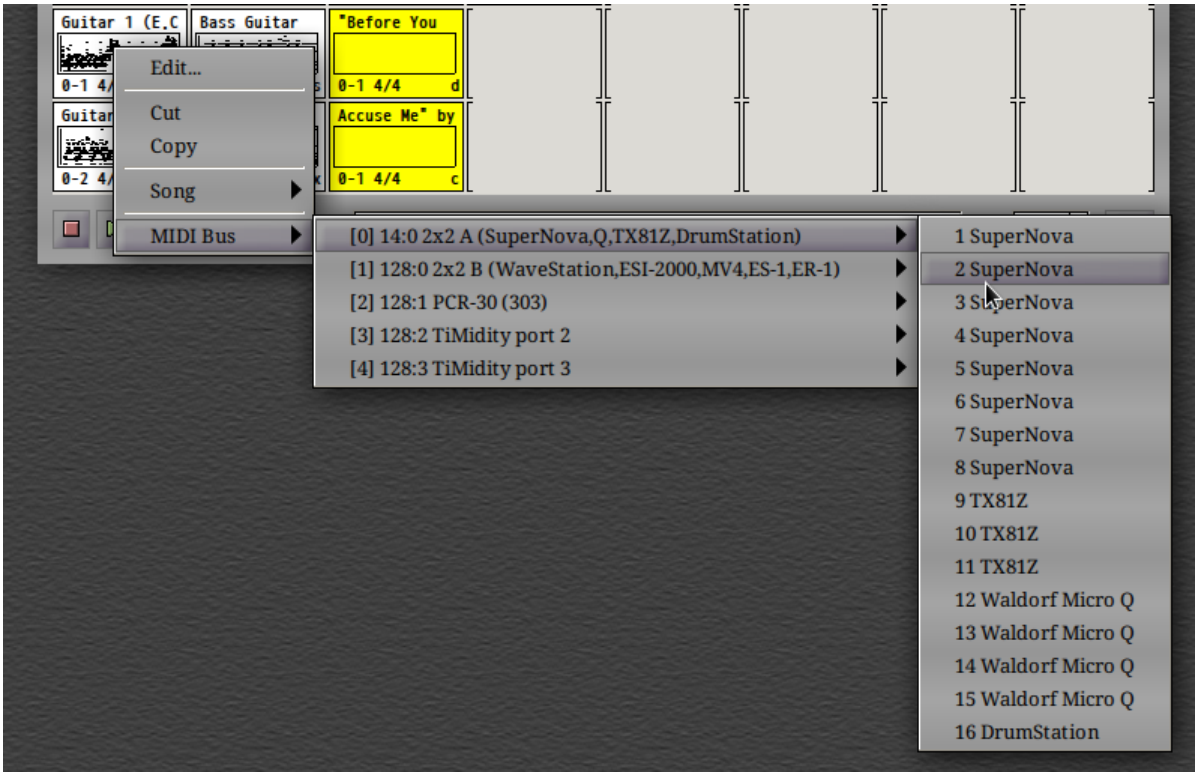

Figure 51: The MIDI Bus Menu for a Specific Pattern

This figure shows that we can also select the desired port and channel directly from the main window.

There's a lot more to the "user" configuration file than we've exposed here, but finding more information about this file has proven a bit tricky.

Sometime we would like to create a "user" that sets up the *Yoshimi* 1.3.5+ software synthesizer as a device and instrument.

10 Sequencer64 Man Page

This section presents the contents of the *Sequencer64* man page, but not exactly in *man* format. Also, an item or two are shown that somehow didn't make it into the man page, and minor corrections and formatting tweaks were made. For example, we replaced the underscore with the hyphen in the names of some options. The legacy Seq24 options, which use underscores or are missing the option hyphen, are still unofficially supported.

`$HOME/.config/sequencer64/sequencer64.rc` holds the "rc" settings for *Sequencer64*. `$HOME/.config/sequencer6` holds the "user" settings for *Sequencer64*. But the old style names are used for the "legacy" mode. See the `--legacy` option below.

Sequencer64 is a real-time MIDI sequencer. It was created to provide a very simple interface for editing and playing MIDI 'loops'.

```
sequencer64 [OPTIONS] [FILENAME]
```

Sequencer64 accepts the following options, plus an optional name of a MIDI file.

`-h --help`
Display a list of all command-line options.

`-v --version`
Display the program version.

`-l --legacy`
New: Save the MIDI file in the old Seq24 format, as unspecified binary data, instead of as a legal MIDI track with meta events. Also read the configuration, if provided, from the `/.seq24rc` and `/.seq24usr` files, instead of the new `/.config/sequencer64/sequencer64.rc` and `/.config/sequencer64/sequencer64.usr` files. The user-interface will indicate this mode with a small text note. This mode is also used if *Sequencer64* is invoked as the `seq24` command (one can create a soft link to the sequencer64 executable to make that happen).

`-b --bus`
New: Supports modifying the buss number on all tracks when a MIDI file is read. All tracks are loaded with this buss-number override. This feature is useful for testing, making it easy to map the MIDI file onto the system's current hardware/software synthesizer setup.

`-q --ppqn`
New: Supports modifying the PPQN value of Sequencer64, which is currently hardwired to a value of 192. This setting should allow MIDI files to play back at the proper speed, and be written with the new PPQN value. This feature is **STILL IN PROGRESS**. It seems to work – one can load MIDI files of arbitrary PPQN, and they play normally and look normal in the editor windows. They can also be saved, and load with the new PPQN value. But use the feature carefully for now, and save your work. We'll have more to say on this topic in the future.

`-L --lash`
New: If LASH support is compiled into the program, this option enables it. If LASH support is not compiled into the program, this option will not be shown in the output of the –help option.

`-n --no-lash`
New: If LASH support is compiled into the program, this option disables it, even if the default or

configuration file set it. If LASH support is not compiled into the program, this option will not be shown in the output of the –help option.

`N/A --file [filename]`
Load a MIDI file on startup. **Bug:** This option does not exist. Instead, specify the file itself as the last command-line argument.

`-m --manual-alsa-ports`
Sequencer64 won't attach ALSA ports. Instead, it will create is own set of input and output busses/ports.

`-a --auto-alsa-ports`
Sequencer64 will attach ALSA ports. This variant is useful for overriding the rc configuration file.

`-A --alsa`
Sequencer64 will not run the JACK support, even if specified in the configuration file. The configuration options are sticky (they are saved), and sometimes they aren't what you want to run.

`-s --show-midi`
Dumps incoming MIDI to the screen.

`-p --priority`
Runs at higher priority with a FIFO scheduler.

`N/A --pass-sysex`
Passes any incoming SYSEX messages to all outputs.

`-i --ignore [number]`
Ignore ALSA device [number].

`-k --show-keys`
Prints pressed key value.

`-x --interaction-method [number]`
Select the mouse interaction method. 0 = seq24 (the default); and 1 = fruity loops method. The latter does not completely support all actions supported by the Seq24 interaction method, at this time.

The following options will not be shown by –help if the application is not compiled for JACK support.

`-j --jack-transport`
Sequencer64 will sync to JACK transport.

`-J --jack-master`
Sequencer64 will try to be JACK master.

`-C --jack-master-cond`
JACK master will fail if there is already a master.

`-M --jack-start-mode [x]`
When *Sequencer64* is synced to JACK, the following play modes are available: 0 = live mode; and 1 = song mode, the default.

`-S --stats`
Print statistics on the command-line while running.

`-U --jack-session-uuid [uuid]`
Set the UUID for the JACK session.

`-u --user-save`
Save the "user" configuration file when exiting Sequencer64. Normally, it is saved only if not present in the configuration directory, so as not to get stuck with temporary settings such as the –bus option. Note

that the "rc" configuration option are generally also saved. But see the "auto-option-save" directive in the "rc" file. It is new with version 0.9.9.15.

The current Sequencer64 project homepage is a simple git repository at the https://github.com/ahlstromcj/sequencer64 URL. Up-to-date instructions can be found in the project at the https://github.com/ahlstromcj/sequencer64-doc.git URL.

The old Seq24 project homepage is at http://www.filter24.org/seq24/ the new one is at https://edge.launchpad.net/seq24/. It is released under the GNU GPL license.

Sequencer64 is also released under the GNU GPL license.

Sequencer64 was written by Chris Ahlstrom ¡ahlstromcj@gmail.com¿. *Seq24* was written by Rob C. Buse mailto:seq24@filter24.org and the *Sequencer64* team.

This manual page was written by Dana Olson mailto:seq24@ubuntustudio.com with additions from Guido Scholz mailto:guido.scholz@bayernline.de and Chris Ahlstrom mailto:ahlstromcj@gmail.com.

Version 0.9.9.6 November 4 2015 sequencer64(1)

11 Building Sequencer64 From Source Code

The current packaging for Sequencer64 is primarily aimed at developers. This section presents a bit of a how-to on building *Sequencer64* from source code.

11.1 INSTALL

There are many build options. Some of modifiable via the normal GNU `configure` script method. Many more are modifiable by editing the source code to **define** and **undefine** certain macros. If you don't care about options, start here. If you want to see what options are available, skip to section 11.2.1 ("Using More "configure" Options") on page 90, which has many details one can adjust.

There is currently no `configure` script... it must be created by using the `bootstrap` script, as the following instructions make clear.

Steps:

1. Preload any DEPENDENCIES, as listed in the last section of this document. However, if some are missing, the configure script will tell you, or, at worst, a build error will tell you.
2. Check-out the branch you want; normally you will be happy to get "master". Make a branch if you want to make changes.
3. From the top project directory, run the commands:

```
$ ./bootstrap
$ ./configure
```

4. For debugging without libtool getting in the way, just run one of the following commands, which will run the `configure` script, adding the `--enable-debug` and `--disable-shared` options to it.

```
$ ./bootstrap --enable-debug
$ ./bootstrap -ed
```

5. Run the make command:

```
$ make
```

   If you do not care about the documentation and debian packaging, change to the various sub-project directories before running make.
6. To install *Sequencer64*, become root and run:

```
# make install
```

Please note that there are other things you can do to speed up the build process. Already noted above is the `--enable-debug` option. The following command will bootstrap the code and then configure for release mode, and greatly reduce the amount of compiler output:

```
$ ./bootstrap --enable-release
$ ./bootstrap -er
```

This option will run the following command for you:

```
$ ./configure --enable-silent-rules
```

This anti-verbosity option can be overridden at "make" time:

```
$ make V=1
```

(Using `V=0` is another way to quiet down the build.)

Also note that the build can be sped up by telling make to use more cores. For example, if you have an 8-core system:

```
$ make -j 9
```

Of course, you can use fewer than the number of cores, if desired.

11.2 Options for Sequencer64 Features

Sequencer64 comes with options for the `configure` command and options represented by definable macros in the source code.

11.2.1 Using More "configure" Options

The following `configure` options can be specified on the command line:

1. `--disable-highlight`**.** This option undefines the `SEQ64_HIGHLIGHT_EMPTY_SEQS` macro, which is otherwise defined by default. If defined, the application will highlight empty sequences/patterns by coloring them yellow. If not defined, empty sequences/patterns are shown in the normal black-on-white coloring. In either case, empty patterns will not be played.

2. `--disable-lash`**.** This option undefines the `SEQ64_LASH_SUPPORT` macro, which is otherwise defined by default. Even if this option is left defined, however, *Sequencer64* will still not use LASH support unless

you specify `--lash` on the `sequencer64` command-line or turn on the new `[lash-session]` option in the "rc" configuration file, `/.config/sequencer64/sequencer64.rc`.

3. `--disable-jack`**.** This option undefines the `SEQ64_JACK_SUPPORT` macro, which is otherwise defined by default. Even if this option is left defined, however, *Sequencer64* will still not use JACK support unless you specify the various JACK options on the `sequencer64` command-line or turn them on in the "rc" configuration file, `/.config/sequencer64/sequencer64.rc`.

4. `--disable-jack-session`**.** This option undefines the `SEQ64_JACK_SESSION` macro, which is defined if JACK support is defined, and the jack/session.h file is found. Again, this option, if left defined, can be affected by command-line options and options in the "rc" configuration file.

To summarize, these options undefine the following build macros:

- `SEQ64_HIGHLIGHT_EMPTY_SEQS`
- `SEQ64_LASH_SUPPORT`
- `SEQ64_JACK_SUPPORT`
- `SEQ64_JACK_SESSION`

11.2.2 Manually-defined Macros in the Code

As we have explored what *Seq24* does while we add improvements to *Sequencer64*, we've found a lot of things that might change the code for the worse in some people's minds. So we've been careful to mark those changes with macros. And sometimes we tried a change, but left it disabled.

You are free to look at those macros, modify them, and build the source code to your preferences.

The following items are not yet part of the configure script, but can be edited manually to achieve the desired settings:

1. `SEQ64_USE_NEW_FONT`**.** Already defined in the `font` module. If defined, a new, anti-aliased, bold font is used in the user-interface. This new font is implemented in new XPM files in `resources/pixmaps` directory: `wen*.xpm`. The font is slightly larger, but changes the user-interface sizes only to an infinitesmal degree. Using this new font is the default.

Obsolete: This option is no longer a compile-time option, but a run-time option. It is now the default, but the usage of the old versus new font can be set in the "user" configuration file. Also, if the legacy mode is specified, the old font becomes the default.

2. `SEQ64_USE_EVENT_MAP`**.** Already defined in the `event_list` module. It enables the usage of an `std::multimap`, instead of an `std::list`, to store MIDI events. Because the code does a lot of sorting of events, using the `std::multimap` is actually a lot faster (especially under debug mode, where it takes many seconds for a medium-size MIDI file to load using the `std::list` implementation.

There is still a chance that the `std::multimap` might prove the limiting factor during playback. If that is the case, then we would probably implement dumping the multimap to a vector before playback. We shall see!

3. `SEQ64_USE_MIDI_VECTOR`**.** Already defined in the `midifile` module. It enables the usage of an `std::vector`, instead of an `std::list`, to store MIDI data bytes. It provides the preferred alternative to the list for storing and counting the bytes of MIDI data. It is an attempt to stop reversing certain events due to the peculiarities of using `std::list` to store MIDI bytes from a sequence. This new implementation uses `std::vector` and does not use `pop_back()` to retrieve the bytes for writing to a file.

Obsolete: Still need to replicate the descriptions that follow in the proper sections.

4. `SEQ64_USE_GREY_GRID`. **This item is no longer defined**. Instead, the option is now part of the "rc" configuration file. This description will be moved to the correct section eventually.

This configuration item causes the pattern slots/boxes to be colored grey (actually, they will be colored normally as per the current GTK them). Otherwise, they are colored black. By default, this value is defined (in the `mainwid` module).

5. `SEQ64_USE_WHITE_GRID`. **This item is no longer defined**. Instead, the option is now part of the "rc" configuration file. This description will be moved to the correct section eventually.

This configuration item causes the pattern slots/boxes to be colored white. Also definable(in the `mainwid` module).

6. `SEQ64_USE_BRACKET_GRID`. **This item is no longer defined**. Instead, the option is now part of the "rc" configuration file. This description will be moved to the correct section eventually.

This configuration box that outlines the pattern slots/boxes is painted over to convert the box to look like a pair of brackets. By default, this value is defined (in the `mainwid` module).

Defining both of the macros (`USE_GREY_GRID` and `USE_BRACKET_GRID`) gives the normal Seq24 look for the Pattern Window. Eventually we might move these definitions into the configure script, for easier modification.

7. `SEQ64_SEQNUMBER_ON_GRID`. **This item is no longer defined**. Instead, the option is now part of the "rc" configuration file. This description will be moved to the correct section eventually.

If the "show sequence numbers" option is on, then each of the blank pattern slots in the main window show the would-be sequence number for that slot. The background color of the numbers will not match the background color of the grid (which matches the chosen GTK theme). But, no matter what the GTK background color, they will at least be visible. There is a little image of this style inside the screenshot shown on the first page of this manual.

If `SEQ64_USE_WHITE_GRID` are defined, so that the grid cells are white, then the sequence numbering looks a little nicer, as can be seen in the following figure:

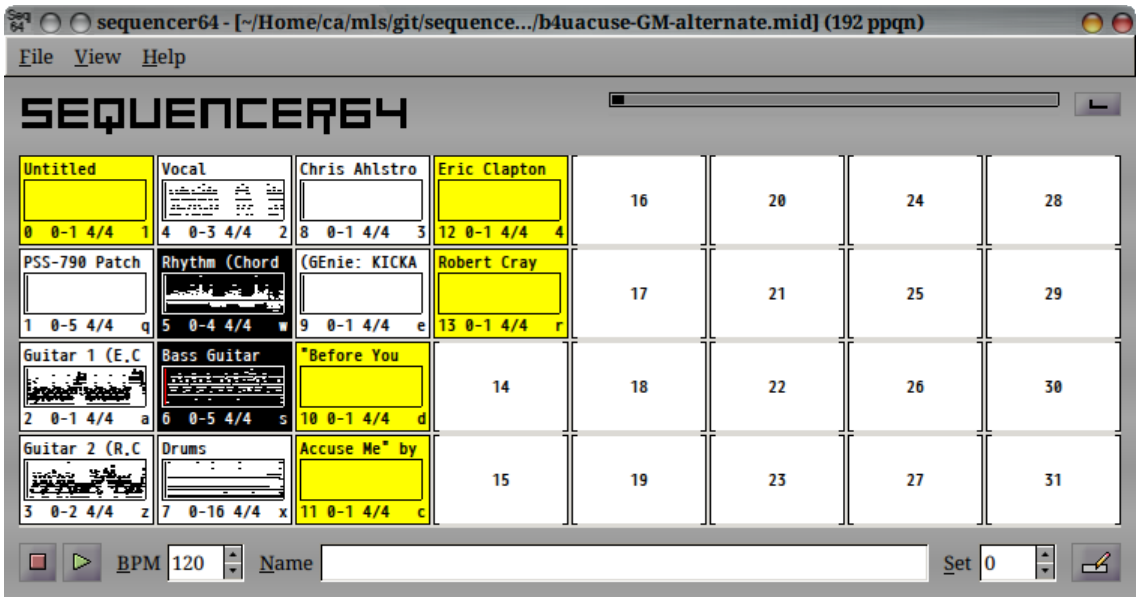

Figure 52: Pattern Window Built for White Grid with Numbering

There is a little image of this style inside the screenshot shown on the first page of this manual, as well.

If neither `SEQ64_USE_GREY_GRID` nor `SEQ64_USE_WHITE_GRID` are defined, so that the grid slots are black, then the numbering will be yellow on a black background, and match perfectly. This style is shown in the following figure:

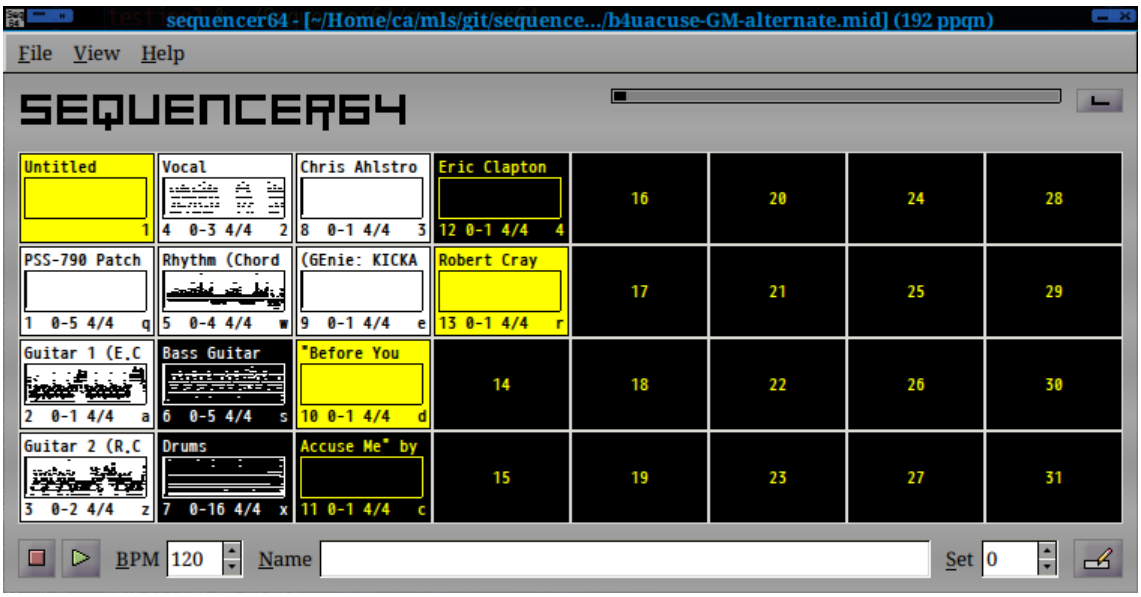

Figure 53: Pattern Window Built for Black Grid with Numbering

There is a little image of this style inside the screenshot shown on the first page of this manual, as well.

Take your pick, modify the code accordingly before you build it. Perhaps these can eventually be options for the `configure` script, or even run-time options! Let us know!

8. `SEQ64_SOLID_PIANOROLL_GRID`**.** Enabling this macro makes the grid lines for the piano rolls more solid, with about the same perception of lightness. It also calls in some other tweaks, such as the positioning of markers. We currently like this look a little better, and so it is the default. See the `app_limits.h` header file for the definition of this variable.

Here is the pattern editor (sequence editor) with this alternate look.

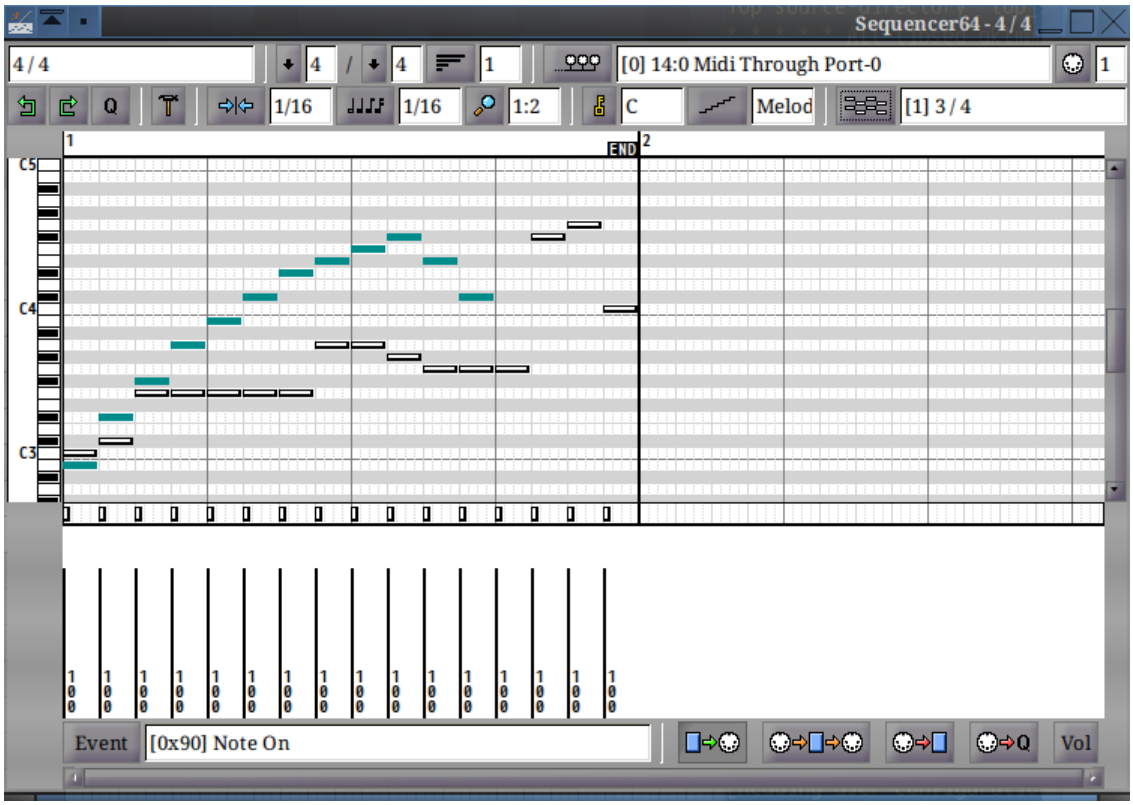

Figure 54: Sequence Pattern Editor Alternate Look

Note the smmoothness of the grid lines, the extra emphasis of the C notes at each octave, the emphasis of the note-drawing snap lines that mark the default length of a click-to-add note, the emphasis of the beat and bars, and, finally, the new location of the **END** marker. Also note the dark-cyan background pattern, discussed elsewhere in this document.

Here is the grid-styling for an 8/4 time signature in the song editor:

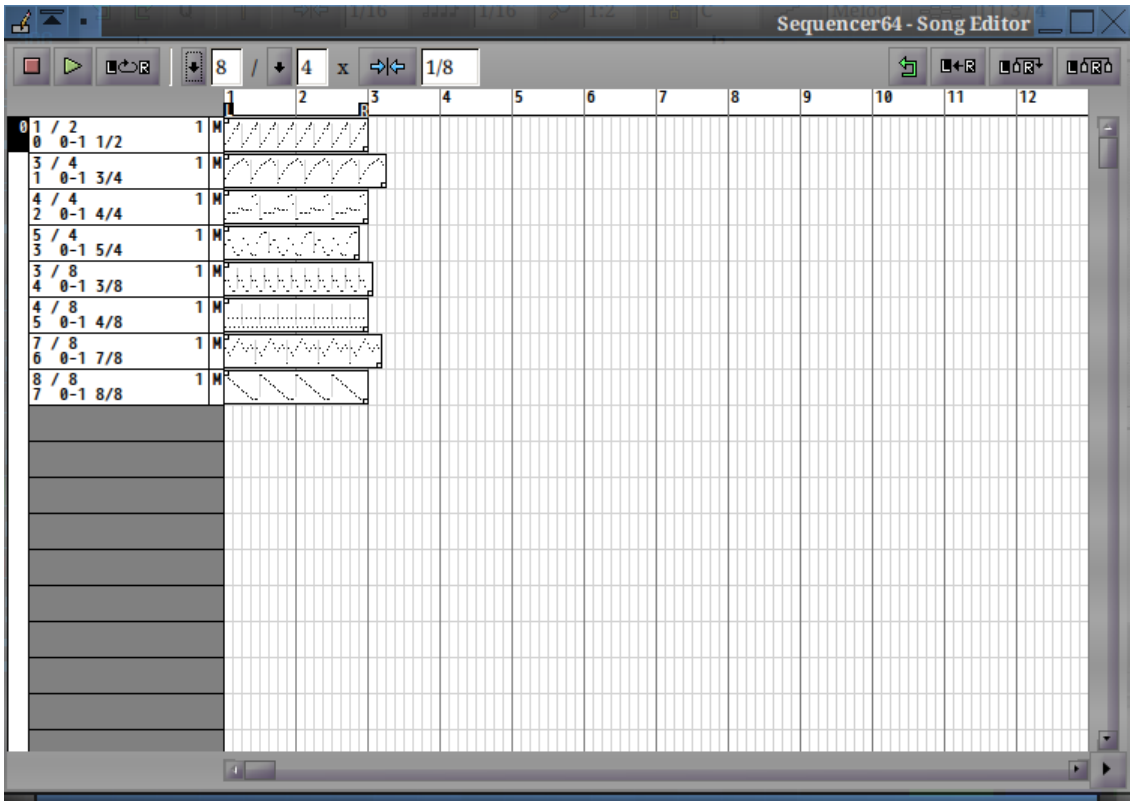

Figure 55: Song Editor Alternate Look

Also note the sequence numbers shown in the bottom left of each pattern name box. This is a new feature, and, as noted elsewhere, is a new option in the *File / Options / Keyboard* tab and in the "rc" configuration file.

9. `SEQ64_USE_VI_SEQROLL_MODE`**.** Definable in the seqroll module, this macro allows the vi hjkl keys to be used as arrow keys for moving notes. Not yet tested. We will not make this a default, because it could drive non-vi users nuts.

10. `SEQ64_USE_DEBUG_OUTPUT`**.** Enable this macro in the globals.h header file, to see extra console output if the application is compiled for debugging. This macro can be activated only if `PLATFORM_DEBUG` is defined, which is taken care of by the build process. If set, this macro turns on extra console output for the following modules:

- `globals`
- `jack_assistant`
- `optionsfile`
- `user_settings`

11. `USE_SEQ42_PATCHES`**.** This macro, in `globals.h`, currently merely marks a couple places where we found potentially useful code in the seq42 fork of seq24.

11.3 Sequencer64 Build Dependencies

With luck, the following dependencies will bring in their own dependencies when installed.

Code:

- libgtkmm-2.4-dev (dev is the header-file package)
- libsigc++-2.0-dev
- libjack-jackd2-dev
- liblash-compat-dev (optional)

Runtime:

- libatk-adaptor (and its dependencies)
- libgail-common (and its dependencies)
- valgrind (optional, very useful for debugging)
- gdb (optional, very useful for debugging)
- gprof and gcov (optional, very useful for debugging)

Build tools:

- automake and autoconf
- autoconf-archive
- g++
- make
- libtool
- More?

Documentation:

- doxygen and doxygen-latex
- graphviz
- texlive
- More?

Debian packaging:

- debhelper
- fakeroot
- More?

12 MIDI Format and Other MIDI Notes

12.1 Standard MIDI Format 0

New: *Sequencer64* can now read and import SMF 0 MIDI files, and performs channel splitting automatically.

When an SMF 0 format is detected, *Sequencer64* reads the file as if were an SMF 1 file, but puts all of the events into the same sequence/pattern. While the file is being processed, a list of the channels present in the track is maintained.

Tempo and Time Signature events are also read, if present in the file. (This new feature also holds for SMF 1 songs. In addition, when saving a *Sequencer64* MIDI file, in non-legacy mode, the Tempo and Time Signature events are also saved as MIDI events. This allows other sequencers to more thoroughly read a *Sequencer64* MIDI file.)

Once the end-of-track is encountered for that sequence, one new empty sequence is created for each channel found in the original (main) sequence. The events in the main sequence are scanned, one by one, and added at the end of the appropriate sequence. If the event is a channel event, then the event is inserted into the sequence that was created for that channel. If the event is a non-channel event, then each sequence gets a copy of that event.

After processing, the MIDI buss information, track name, and other pieces of information are attached to each sequence. The following figure shows in imported SMF 0 tune, split into tracks.

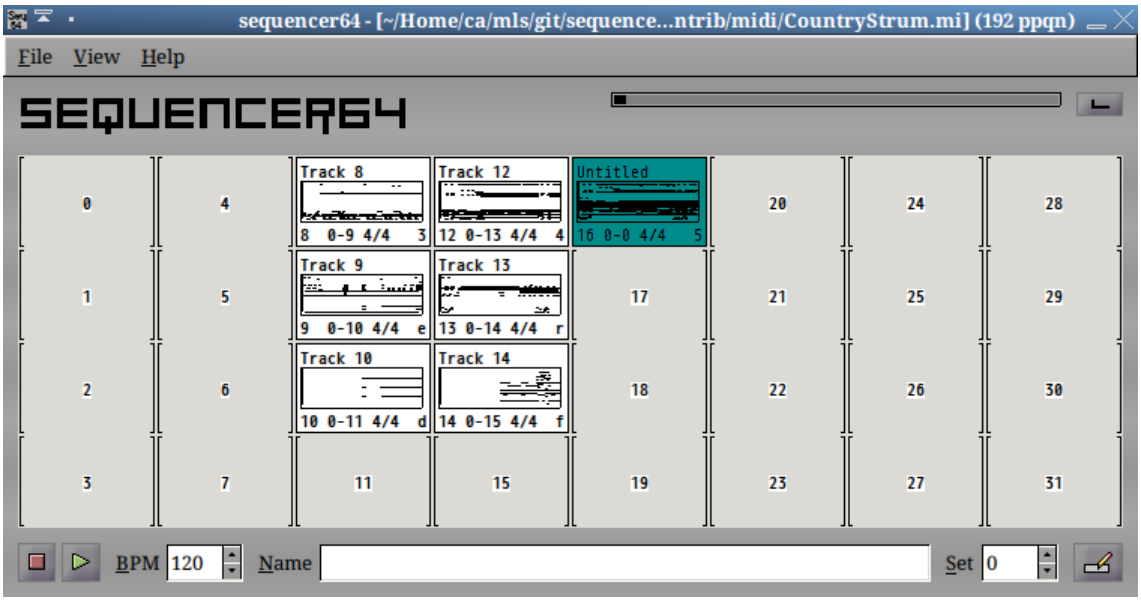

Figure 56: Imported SMF 0 MIDI Song

The original imported SMF 0 track is preserved, intact, in main window pattern slot #16. It is highlighted in a dark cyan color to remind the user that it is not a normal, playable *Sequencer64* sequence. It has no channel number. It is assigned the non-existent MIDI channel of 0. If the original track had no title, this track is named "Untitled". Normally, one will either delete this track before saving the file, or at least keep it muted.

Each new, single-channel track is given a title of either the form "N: Track-name" or, if the song was untitled, "Track N". The sequence number of each new track is the internal channel number (which is always the actual MIDI channel number minus one).

The time-signature of each track is currently set to defaults, unless a time-signature event is encountered in the imported file.

New: *Sequencer64* adds support for obtaining some of the other information a MIDI SMF 0 track might have, such as the Tempo and the Time Signature. It also now will save this information in the first track of the MIDI file.

The original SMF 0 track is also shown in the song editor, as shown in the following figure.

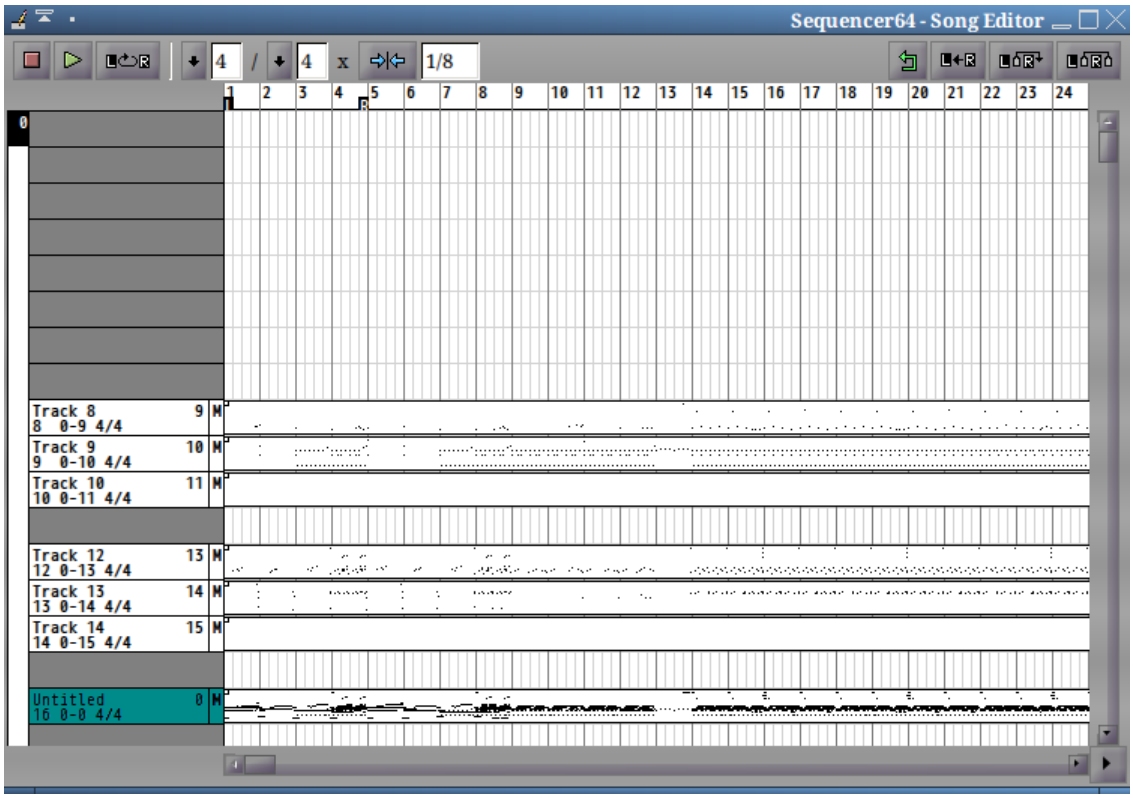

Figure 57: SMF 0 MIDI Song in the Song Editor

One is free to edit the imported tune to heart's content. Here, we added one instance of each track, including the SMF 0 track, to show what the imported song looks like.

12.2 Legacy Proprietary Track Format

The authors of *Seq24* took the trouble to make sure that the format of the MIDI files it write are compatible with other MIDI applications. *Seq24* also stores its own information (triggers, MIDI control information, etc) in the file, but marked so that other sequencers can read the file and ignore the *Seq24*-specific information.

Sequencer64 continues that MIDI-compliant behavior, but has improved the compliance just a little bit. We call that last chunk of sequencer-specific information the "proprietary track". Before we discuss that last, proprietary track, note that the normal MIDI tracks that precede it include the SeqSpec ("sequencer-specific", sort of) control tags shown in table 1 ("SeqSpec Items in Normal Tracks") on page 99. These control tags are global constants in the *Seq24* source code, ranging from 0x24240001 to 0x24240013.

The `c_triggers` tag is obsolete.

New: The `c_musickey`, `c_musicscale`, and `c_backsequence` control tags are new with *Sequencer64* version 0.9.9.7 and above. They are now saved as additional information in each sequence in which they have been specified in the sequence editor. However, for backward compatibility (and because it is probably the more common use case), these items can also be saved globally for the whole MIDI song, as an option.

Table 1: SeqSpec Items in Normal Tracks

c_midibus	24 24 00 01 00 00 00 00
c_midich	24 24 00 02 00 00 00 00
c_triggers	24 24 00 04 00 00 00 00
c_timesig	24 24 00 06 00 00 00 00
c_triggers_new	24 24 00 08 00 00 00 00
c_musickey	24 24 00 11 00
c_musicscale	24 24 00 12 00
c_backsequence	24 24 00 13 00 00 00 00

Note that these tags (created by the application, but not present in the proprietary track, and perhaps also created by other MIDI applications) are preceded by the standard MIDI "FF 7F length" meta-event sequence.

The following discussion applies to the final "proprietary" track as saved in the legacy *Seq24* format.

After all the counted MIDI tracks are read, *Seq24* checks for extra data. If there is extra data, *Seq24* reads a long value. The first one encountered is a MIDI "sequencer-specific" (*SeqSpec*) section. It starts with

```
0x24240010 == a Seq24 c_midictrl proprietary value
```

Getting this value first is simplified MIDI in two ways. First, the second does not begin with any kind of track marker. MIDI requires an "MTrk" marker to start a track, though it also requires unknown markers to be supported. Some applications, like *timidity*, handle this situation. Others, like *midicvt*, complain about an unexpected header marker. Second, normally, MIDI wants to see the triad of

```
status = FF, type= 7F (proprietary), length = whatever
```

to precede proprietary data. Now, as shown by table 5 ("Application Support for MIDI Files") on page 103, most applications accept the shortcut legacy format, but *midicvt* does not.

So, as a "bug" fix, we now write and read this information properly in *Sequencer64*; it is now preceded by the `0xFF 0x7F` marker.. We also need to be able to read legacy Seq24 MIDI files, so that ability has been preserved in *Sequencer64*..

Anyway, at this point, we have the **c_midictrl** information now. Next, we read a long value, seqs. It is 0.

```
24 24 00 10 00 00 00 00
```

Read the next long value, 0x24240003. This is **c_midiclocks**. We get a value of 0 for "TrackLength" (now a local variable called "busscount"):

```
24 24 00 03 00 00 00 00
```

If the buss-count was greater than 0, then for each value, we would read a byte value represent the bus a clock was on, and setting the clock value of the master MIDI buss. Another check for more data is made.

```
24 24 00 05 00 20 00 00
```

0x24240005 is **c_notes**. The value screen_sets is read (two bytes) and here is 0x20 = 32. For each screen-set:

```
len = read\_short()
```

If non-zero, each of the `len` bytes is appended as a string. Here, len is 0 for all 32 screensets, so the screen-set notepad is set to an empty string. Another check for more data is made.

```
24 24 00 07 00 00 00 78
```

0x24240007 is **c_bpmtag**. The long value is read and sets the perform object's bpm value. Here, it is 120 bpm. Another check for more data is made.

```
24 24 00 09 00 00 04 00
```

0x24240009 is **c_mutegroups**. The long value obtained here is 1024. If this value is not equal to the constant **c_gmute_tracks** (1024), a warning is emitted to the console, but processing continues anyway, 32 x 32 long values are read to select the given group-mute, and then set each of its 32 group-mute-states.

In our sample file, 32 groups are specified, but all 32 group-mute-state values for each are 0.

So, to summarize the legacy proprietary track's data, ignoring the data itself, which is mostly 0 values, as shown in table 2 ("SeqSpec Items in Legacy Proprietary Track") on page 100

Table 2: SeqSpec Items in Legacy Proprietary Track

`c_midictrl`	`24 24 00 10 00 00 00 00`	
`c_midiclocks`	`24 24 00 03 00 00 00 00`	(buss count = 0)
`c_notes`	`24 24 00 05 00 20 00 00`	(screen sets = 32)
`c_bpmtag`	`24 24 00 07 00 00 00 78`	(bpm = 120)
`c_mutegroups`	`24 24 00 09 00 00 04 00`	(mg = 1024)

The new format (again, ignoring the data) takes up a few more bytes. It starts with the normal track marker and size data, followed by a made-up track name ("Sequencer64-S"), as shown in table 3 ("SeqSpec Items in New Proprietary Track") on page 101.

For the new format, the components of the final proprietary track size are as shown here:

1. **Delta time**. 1 byte, always 0x00.
2. **Sequence number**. 5 bytes. OPTIONAL.
3. **Track name**. 3 + 10 or 3 + 15

Table 3: SeqSpec Items in New Proprietary Track

"MTrk" etc.	4d 54 72 6b 00 00 11 0d 00 ...
Track name	53 65 71 75 65 6e 63 65 72 32 34 2d 53
c_midictrl	ff 7f 04 24 24 00 10 00 (???)
c_midiclocks	ff 7f 04 24 24 00 03 00 (buss count = 0)
c_notes	ff 7f 46 24 24 00 05 00 20 00... (screen sets = 32)
c_bpmtag	ff 7f 08 24 24 00 07 00 00 00 78 (bpm = 120)
c_mutegroups	ff 7f a1 08 24 24 00 09 00 00 04 00... (mg = 1024)

4. **Series of proprietary specs**:
   - **Prop header**:
     - If legacy format, 4 bytes.
     - Otherwise, 2 bytes + varinum_size(length) + 4 bytes.
     - Length of the prop data.
5. **Track End**. 3 bytes.

12.3 MIDI Information

This section provides some useful, basic information about MIDI data.

12.3.1 MIDI Variable-Length Value

A variable-length value (VLV) is a quantity that uses additional bytes and continuation bits to encode large numbers without confusing a MIDI interpreter. See https://en.wikipedia.org/wiki/Variable-length_quantity.

The length of a variable length value obviously depends on the value it represents. Here is a simple list of the numbers that can be represented by a VLV:

```
1 byte:  0x00 to 0x7F
2 bytes: 0x80 to 0x3FFF
3 bytes: 0x4000 to 0x001FFFFF
4 bytes: 0x200000 to 0x0FFFFFFF
```

12.3.2 MIDI Track Chunk

```
Track chunk == MTrk + length + track_event [+ track_event ...]
```

- *MTrk* is 4 bytes representing the literal string "MTrk". This marks the beginning of a track.
- *length* is 4 bytes the number of bytes in the track chunk following this number. That is, the marker and length are not counted in the length value.
- *track_event* denotes a sequenced track event; usually there are many track events in a track. However, some of the events may simply be informational, and not modify the audio output.

Table 4: MIDI Meta Event Types

Type	Event
0x00	Sequence number
0x01	Text event
0x02	Copyright notice
0x03	Sequence or track name
0x04	Instrument name
0x05	Lyric text
0x06	Marker text
0x07	Cue point
0x20	MIDI channel prefix assignment
0x2F	End of track
0x51	Tempo setting
0x54	SMPTE offset
0x58	Time Signature
0x59	Key Signature
0x7F	Sequencer-Specific event

A track event consists of a delta-time since the last event, and one of three types of events.

```
track_event = v_time + midi_event | meta_event | sysex_event
```

- *v_time* is the variable length value for elapsed time (delta time) from the previous event to this event.
- *midi_event* is any MIDI channel message such as note-on or note-off.
- *meta_event* is an SMF meta event.
- *sysex_event* is an SMF system exclusive event.

12.3.3 MIDI Meta Events

Meta events are non-MIDI data of various sorts consisting of a fixed prefix, type indicator, a length field, and actual event data..

```
meta_event = 0xFF + meta_type + v_length + event_data_bytes
```

- *meta_type* is 1 byte, expressing one of the meta event types shown in the table that follows this list.
- *v_length* is length of meta event data, a variable length value.
- *event_data_bytes* is the actual event data.

Timidity reads the legacy and new formats and plays the tune. *Sequencer64* saves the "b4uacuse" tune out, in both formats, with a "MIDI divisions" value of 192, versus its original value of 120. The song plays a little bit faster after this conversion.

The *midicvt* application does not read the legacy *Seq24* file format. It expects to see the MTrk marker. Even if the *midicvt* `--ignore` option is provided, *midicvt* does not like the legacy *Seq24* format, and ends with an error message. However, as shown by table 5 ("Application Support for MIDI Files") on page 103, most applications are more forgiving, and can read (or ignore) the legacy format. The *gsequencer* application has some major issues in our installation, but it is probably our setup. (No JACK running?)

Table 5: Application Support for MIDI Files

Application	**Legacy**	**New**	**Original File**
ardour	TBD	TBD	TBD
composite	TBD	TBD	TBD
gsequencer	No	No	No
lmms	Yes	Yes	Yes
midi2ly	Yes	Yes	TBD
midicvt	No	Yes	Yes
midish	TBD	TBD	TBD
muse	TBD	TBD	TBD
playmidi	TBD	TBD	TBD
pmidi	TBD	TBD	TBD
qtractor	Yes	Yes	Yes
rosegarden	Yes	Yes	Yes
superlooper	TBD	TBD	TBD
timidity	Yes	Yes	Yes

12.4 More MIDI Information

This section goes into even more detail about the MIDI format, especially as it applies to the processing done by *Sequencer64*. The following sub-sections describe how *Sequencer64* parses a MIDI file.

12.4.1 MIDI File Header, MThd

The first thing in a MIDI file is The data of the header:

```
Header ID:     "MThd"         4 bytes
MThd length:     6            4 bytes
Format:        0, 1, 2        2 bytes
No. of track:  1 or more      2 bytes
PPQN:           192           2 bytes
```

The header ID and it's length are always the same values. The formats that Sequencer64 supports are 0 or 1. SMF 0 has only one track, while SMF 1 can support an arbitary number of tracks. The last value in the header is the PPQN value, which specifies the "pulses per quarter note", which is the basic time-resolution of events in the MIDI file. Common values are 96 or 192, but higher values are also common. Sequencer64 and its precursor, Seq24, default to 192.

12.4.2 MIDI Track, MTrk

The next part of the MIDI file consists of the tracks specified in the file. In SMF 1 format, each track is assumed to cover a different MIDI channel, but always the same MIDI buss. (The MIDI buss is not a data item in standard MIDI files, but it is a special data item in the sequencer-specific section of *Seq24/Sequencer64* MIDI files.) Each track is tagged by a standard chunk marker, "MTrk". Other markers are possible, and are to be ignored, if nothing else. Here are the values read at the beginning of a track:

```
Track ID:      "MTrk"         4 bytes
Track length:  varies         4 bytes
```

The track length is the number of bytes that need to be read in order to get all of the data in the track.

Delta time. The amount time that passes from one event to the next is the *delta time*. For some events, the time doesn't matter, and is set to 0. This values is a *variable length value*, also known as a "VLV" or a "varinum". It provides a way of encoding arbitrarily large values, a byte at a time.

```
Delta time:    varies         1 or more bytes
```

The running-time accumulator is incremented by the delta-time. The current time is adjusted as per the PPQN ratio, if needed, and passed along.

12.4.3 Channel Events

Status. The byte after the delta time is examined by masking it against 0x80 to check the high bit. If not set, it is a "running status", it is replaced with the "last status", which is 0 at first.

```
Status byte:   varies         1 byte
```

If the high bit is set, it is a status byte. What does the status mean? To find out, the channel part of the status is masked out using the 0xF0 mask. If it is a 2-data-byte event (note on, note off, aftertouch, control-change, or pitch-wheel), then the two data bytes are read:

```
Data byte 0:   varies         1 byte
Data byte 1:   varies         1 byte
```

If the status is a Note On event, with velocity = data[1] = 0, then it is converted to a Note Off event, a fix for the output quirks of some MIDI devices. If it is a 1-data-btye event (Program Change or Channel Pressure), then only data byte 0 is read. The one or two data bytes are added to the event, the event is added to the current sequence, and the MIDI channel of the sequence is set.

12.4.4 Meta Events Revisited

If the event status masks off to 0xF0 (0xF0 to 0xFF), then it is a Meta event. If the Meta event byte is 0xFF, it is called a "Sequencer-specific", or "SeqSpec" event. For this kind of event, then a type byte and the length of the event are read.

```
Meta type:     varies         1 byte
Meta length:   varies         1 or more bytes
```

If the type of the SeqSpec (0xFF) meta event is 0x7F, parsing checks to see if it is one of the Seq24 "proprietary" events. These events are tagged with various values that mask off to 0x24240000. The parser reads the tag:

```
Prop tag:     0x242400nn      4 bytes
```

These tags provide a way to save and recover Seq24/Sequencer64 properties from the MIDI file: MIDI buss, MIDI channel, time signature, sequence triggers, and (new), the key, scale, and background sequence to use with the track/sequence. Any leftover data for the tagged event is let go. Unknown tags ate skipped.

If the type of the SeqSpec (0xFF) meta event is 0x2F, then it is the End-of-Track marker. The current time marks the length (in MIDI pulses) of the sequence. Parsing is done for that track.

If the type of the SeqSpec (0xFF) meta event is 0x03, then it is the sequence name. The "length" number of bytes are read, and loaded as the sequence name.

If the type of the SeqSpec (0xFF) meta event is 0x00, then it is the sequence number, which is read:

```
Seq number:    varies         2 bytes
```

Note that the sequence number might be modified latter to account for the current *Seq24* screenset in force for a file import operation.

Anything other SeqSpec type is simply skipped by reading the "length" number of bytes.

The remaining sections simply describe MIDI meta events in more detail, for reference.

12.5 Meta Events

Here, we summarize the MIDI meta events.

1. `FF 00 02 ssss`: Sequence Number.
2. `FF 01 len text`: Text Event.
3. `FF 02 len text`: Copyright Notice.
4. `FF 03 len text`: Sequence/Track Name.
5. `FF 04 len text`: Instrument Name.
6. `FF 05 len text`: Lyric.
7. `FF 06 len text`: Marker.
8. `FF 07 len text`: Cue Point.
9. `FF 08 through 0F len text`: Other kinds of text events.
10. `FF 2F 00`: End of Track.
11. `FF 51 03 tttttt`: Set Tempo, us/qn.
12. `FF 54 05 hr mn se fr ff`: SMPTE Offset.
13. `FF 58 04 nn dd cc bb`: Time Signature.
14. `FF 59 02 sf mi`: Key Signature.
15. `FF 7F len data`: Sequencer-Specific.
16. `FF F0 len data F7`: System-Exclusive

The next sections describe the events that *Sequencer* tries to handle. These are:

- Sequence Number (0x00)
- Track Name (0x03)
- End-of-Track (0x2F)
- Set Tempo (0x51) (Sequencer64 only)
- Time Signature (0x58) (Sequencer64 only)
- Sequencer-Specific (0x7F) (Handled differently in Sequencer64)
- System Exclusive (0xF0) Sort of handled, functionality incomplete.

12.5.1 Sequence Number (0x00)

```
FF 00 02 ss ss
```

This optional event must occur at the beginning of a track, before any non-zero delta-times, and before any transmittable MIDI events. It specifies the number of a sequence.

12.5.2 Track/Sequence Name (0x03)

```
FF 03 len text
```

If in a format 0 track, or the first track in a format 1 file, the name of the sequence. Otherwise, the name of the track.

12.5.3 End of Track (0x2F)

```
FF 2F 00
```

This event is not optional. It is included so that an exact ending point may be specified for the track, so that it has an exact length, which is necessary for tracks which are looped or concatenated.

12.5.4 Set Tempo Event (0x51)

The MIDI Set Tempo meta event sets the tempo of a MIDI sequence in terms of the microseconds per quarter note. This is a meta message, so this event is never sent over MIDI ports to a MIDI device. After the delta time, this event consists of six bytes of data:

```
FF 51 03 tt tt tt
```

Example:

```
FF 51 03 07 A1 20
```

1. 0xFF is the status byte that indicates this is a Meta event.
2. 0x51 the meta event type that signifies this is a Set Tempo event.
3. 0x03 is the length of the event, always 3 bytes.
4. The remaining three bytes carry the number of microseconds per quarter note. For example, the three bytes above form the hexadecimal value 0x07A120 (500000 decimal), which means that there are 500,000 microseconds per quarter note.

Since there are 60,000,000 microseconds per minute, the event above translates to: set the tempo to 60,000,000 / 500,000 = 120 quarter notes per minute (120 beats per minute).

This event normally appears in the first track. If not, the default tempo is 120 beats per minute. This event is important if the MIDI time division is specified in "pulses per quarter note", which does not itself define the length of the quarter note. The length of the quarter note is then determined by the Set Tempo meta event.

Representing tempos as time per beat instead of beat per time allows absolutely exact DWORD-term synchronization with a time-based sync protocol such as SMPTE time code or MIDI time code. This amount of accuracy in the tempo resolution allows a four-minute piece at 120 beats per minute to be accurate within 500 usec at the end of the piece.

12.5.5 Time Signature Event (0x58)

After the delta time, this event consists of seven bytes of data:

```
FF 58 04 nn dd cc bb
```

The time signature is expressed as four numbers. `nn` and `dd` represent the numerator and denominator of the time signature as it would be notated. The denominator is a negative power of two: 2 represents a quarter-note, 3 represents an eighth-note, etc. The `cc` parameter expresses the number of MIDI clocks in a metronome click. The `bb` parameter expresses the number of notated 32nd-notes in a MIDI quarter-note (24 MIDI Clocks).

Example:

```
FF 58 04 04 02 18 08
```

1. 0xFF is the status byte that indicates this is a Meta event.
2. 0x58 the meta event type that signifies this is a Time Signature event.
3. 0x04 is the length of the event, always 4 bytes.
4. 0x04 is the numerator of the time signature, and ranges from 0x00 to 0xFF.
5. 0x02 is the log base 2 of the denominator, and is the power to which 2 must be raised to get the denominator. Here, the denominator is 2 to 0x02, or 4, so the time signature is 4/4.
6. 0x18 is the metronome pulse in terms of the number of MIDI clock ticks per click. Assuming 24 MIDI clocks per quarter note, the value here (0x18 = 24) indidicates that the metronome will tick every 24/24 quarter note. If the value of the sixth byte were 0x30 = 48, the metronome clicks every two quarter notes, i.e. every half-note.
7. 0x08 defines the number of 32nd notes per beat. This byte is usually 8 as there is usually one quarter note per beat, and one quarter note contains eight 32nd notes.

If a time signature event is not present in a MIDI sequence, a 4/4 signature is assumed.

In *Sequencer64*, the `c_timesig` SeqSpec event is given priority. The conventional time signature is used only if the `c_timesig` SeqSpec is not present in the file.

12.5.6 SysEx Event (0xF0)

If the meta event status value is 0xF0, it is called a "System-exclusive", or "SysEx" event.

Sequencer64 has some code in place to store these messages, but the data is currently not actually stored or used. Although there is some infrastructure to support storing the SysEx event within a sequence, the SysEx information is simply skipped. *Sequencer64* warns if the terminating 0xF7 SysEx terminator is not found at the expected length. Also, some malformed SysEx events have been encountered, and those are detected and skipped as well.

12.5.7 Sequencer Specific (0x7F)

This data, also known as SeqSpec data, provides a way to encode information that a specific sequencer application needs, while marking it so that other sequences can safely ignore the information.

```
FF 7F len data
```

In *Seq24¡/i¿ and ¡i¿Sequencer64*, the data portion starts with four bytes that indicate the kind of data for a particular SeqSpec event:

```
c_midibus        ^  0x24240001  Track buss number
c_midich         ^  0x24240002  Track channel number
c_midiclocks     *  0x24240003  Track clocking
c_triggers       ^  0x24240004  See c_triggers_new
c_notes          *  0x24240005  Song data, notes
c_timesig        ^  0x24240006  Track time signature
c_bpmtag         *  0x24240007  Song beats/minute
c_triggers_new   ^  0x24240008  Track trigger data
c_mutegroups     *  0x24240009  Song mute group data
c_midictrl       *  0x24240010  Song MIDI control
c_musickey       +  0x24240011  Track key (Sequencer64 only)
c_musicscale     +  0x24240012  Track scale (Sequencer64 only)
c_backsequence   +  0x24240013  Track background sequence (Sequencer64 only)

* = global only; ^ = track only; + = both
```

In *Seq24*, these events are placed at the end of the song, but are not marked as SeqSpec data. Most MIDI applications handle this situation fine, but some (e.g. midicvt) do not. Therefore, *Sequencer64* makes sure to wrap each data item in the 0xFF 0x7F wrapper.

Also, the last three items above (key, scale, and background sequence) can also be stored (by *Sequencer64*) with a particular sequence/track, as well as at the end of the song. Not sure if this bit of extra flexibility is useful, but it is there.

12.5.8 Non-Specific End of Sequence

Any other statuses are deemed unsupportable in *Sequencer64*, and abort parsing with an error.

If the –bus option is in force, it overrides the buss number (if any) stored with the sequence. This option is useful for testing a setup.

At the end, *Sequencer64* adds the sequence to the encoded tune.

13 Sequencer64 JACK Support

This section describes some details concerning the JACK support of *Sequencer64*.

This section is just underway. Here are some of the topics to be discussed:

1. What JACK functions are supported.
2. Exposing the ALSA MIDI ports to JACK.
3. Fixes to JACK Master mode.
4. Interactions with the Klick and Hydrogen applications.
5. Patches from the new (!) version of Seq24, 0.9.3, to correct for MIDI Clock drift. It seems to have some issues, so that support is currently commented out.

First, if *Sequencer64* is run in JACK mode without JACK running on the system, it will take awhile to come up (in ALSA mode). If run from the console, one will see:

```
Cannot connect to server socket err = No such file or directory
Cannot connect to server request channel
jackdmp 1.9.11
Copyright 2001-2005 Paul Davis and others.
Copyright 2004-2014 Grame.
jackdmp comes with ABSOLUTELY NO WARRANTY
This is free software, and you are welcome to redistribute it
under certain conditions; see the file COPYING for details
JACK server starting in realtime mode with priority 10
self-connect-mode is "Don't restrict self connect requests"
audio_reservation_init
Acquire audio card Audio1
creating alsa driver ... hw:PCH|hw:PCH|1024|3|48000|0|0|nomon|swmeter|-|32bit
ATTENTION: The playback device "hw:PCH" is already in use. Please stop the
application using it and run JACK again
JackTemporaryException : now quits...
Cannot initialize driver
JackServer::Open failed with -1
Failed to open server
Cannot connect to server socket err = No such file or directory
Cannot connect to server request channel
 . . .
jack server is not running or cannot be started
JackShmReadWritePtr::~JackShmReadWritePtr - Init not done for 4294967295,
```

```
skipping unlock
JackShmReadWritePtr::~JackShmReadWritePtr - Init not done for 4294967295,
skipping unlock
[JACK server not running, JACK sync disabled]
```

14 Sequencer64 Metrics Issues

This section goes into the details of MIDI metrics and user-interface metrics. *Seqeuencer64* is full of hardwired constants that affect both the playback of MIDI data the display of MIDI data. If we're going to be able to support variation in things like playback time and parts-per-quarter-notes per song, then we have to understand these constants perfectly and pin down all of the effects of modifying them.

STILL INCOMPLETE AND IN PROGRESS.

14.1 MIDI Metrics

TODO.

14.1.1 MIDI Metrics, PPQN

TODO.

14.2 User-Interface Metrics

TODO.

14.2.1 User-Interface Metrics, Sequence Editor

The sequence or pattern editor (module `seqedit`) allows for the creations of a sequence with a particular time signature. Each sequence can have its own time signature.

TODO.

14.2.2 User-Interface Metrics, Song Editor

The song or performance editor (module `perfedit`) allows for the layout of a number of sequences, each of which can have its own particular time signature. Furthermore, the song editor has a piano roll grid that has its own, single time signature, which can be set to a number of different time signature values. What are the visible effects of time signature on the appearance and layout of the sequences? What internal *Sequencer64* variables control the appearance and layout?

TODO.

WE NEED TO MAKE A TABLE, KEEP THIS SAMPLE FOR NOW.

Table 6: BOGUS

Application	Legacy	New	Original File
ardour	TBD	TBD	TBD
composite	TBD	TBD	TBD

15 Summary

In summary, we can say that you will find *Sequencer64* intriguing.

Contact: If you have ideas about *Sequencer64* or a bug report, please email us (at mailto:ahlstromcj@gmail.com). If it's a bug report, please add **[BUG]** to the Subject.

16 References

The *Yoshimi* seq24 reference list.

References

[1] ALSA team *Advanced Linux Sound Architecture (ALSA) project homepage* http://www.alsa-project.org/ ALSA tools through version 1.0.29. 2015

[2] amSynth team, Nick Dowell *amSynth and Demos with Calf Effects.* http://amsynth.com/amsynth.html Includes links to demos and the source code. 2015.

[3] Bristol team Nick Copeland *Bristol: A Vintage Synthesizer Emulator* http://www.linuxsynths.com/BristolPatchesDemos/bristol.html 2014.

[4] FluidSynth team *FluidSynth: A SoundFont Synthesizer* http://www.fluidsynth.org/ 2014.

[5] JACK team *JACK Audio Connection Kit* http://jackaudio.org/ 2015.

[6] LinuxSynths team, briandc@linuxsynths.com *A Sonic Palette on the Linux Platform.* http://www.linuxsynths.com/ 2015.

[7] Dave Phillips *At the Sounding Edge: Introducing seq24.* http://www.linuxjournal.com/article/8304 Linux Journal, May 12, 2005.

[8] Chris Ahlstrom *Extension of midicomp/midi2text to convert between MIDI and ASCII text format.* https://github.com/ahlstromcj/midicvt 2015.

[9] PortMedia team *Platform Independent Library for MIDI I/O* http://portmedia.sourceforge.net/portmidi/ 2010.

[10] Seq24 Team. *The home site for the Sequencer64 looping sequencer.* http://www.filter24.org/seq24/download.html 2010.

[11] Chris Ahlstrom. *A continuation of the Sequencer64 project as "Sequencer64".* https://github.com/ahlstromcj/sequencer64/ 2015.

[12] Kevin at subatomicglue.com *Subatomic Mods for Seq24 Win32* http://www.subatomicglue.com/seq24/ 2010.

[13] Timidity++ Team. *Download site for Timidity++ source code.* http://sourceforge.net/projects/timidity/ 2015.

[14] Author's name. *Sequencer64 Tutorial Video, Part 1.* http://wootangent.net/2010/10/linux-music-tutorial-seq24-part-1/ 2010.

[15] Author's name. *Sequencer64 Tutorial Video, Part 2.* http://wootangent.net/2010/10/linux-music-tutorial-seq24-part-2/ 2010.

[16] Yoshimi team abrolag@users.sourceforge.net *The download site for the Yoshimi software synthesizer.* http://yoshimi.sourceforge.net/ 2015.

[17] Yoshimi team *The alternate location for the Yoshimi source-code.* https://github.com/abrolag/yoshimi/ 2015.

[18] Chris Ahlstrom *A Yoshimi User Manual.* https://github.com/ahlstromcj/yoshimi-doc/ 2015.

[19] Chris Ahlstrom *A Yoshimi Cookbook.* https://github.com/ahlstromcj/yoshimi-cookbook/ 2015.

[20] Mark McCurry, Paul Nasca (ZynAddSubFX team) *The download site for the ZynAddSubFX software synthesizer.* http://zynaddsubfx.sourceforge.net/ 2015.

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