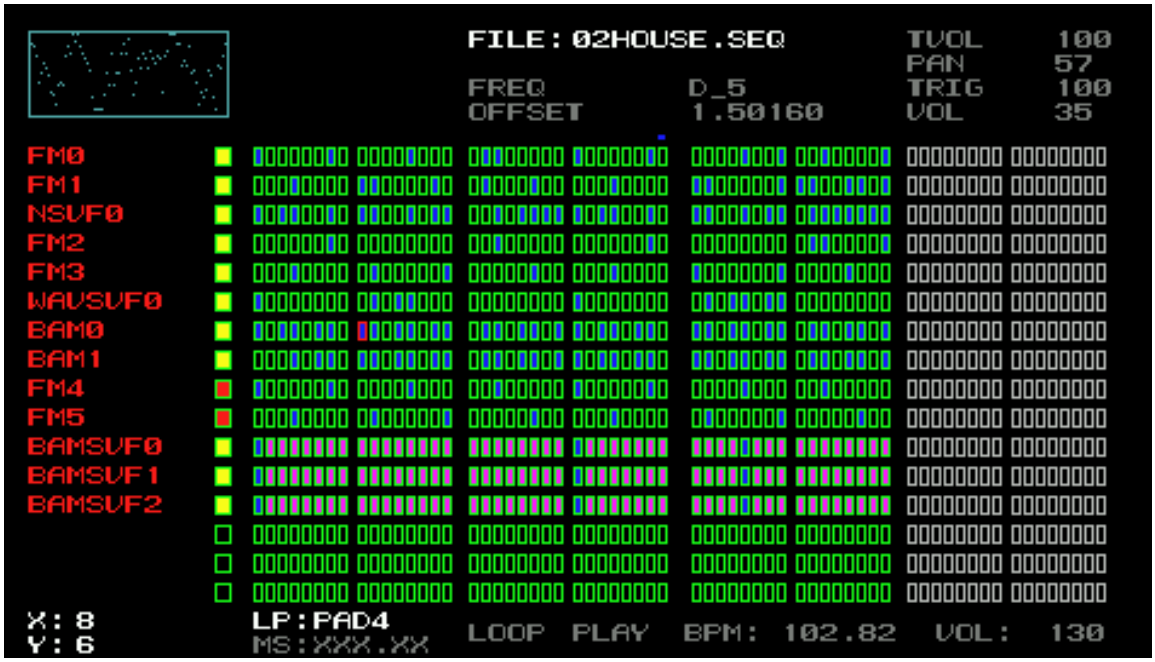

PSPSeq 3.00 User's Manual
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Introduction

PSPSeq is a full music synthesizer and sequencer running on the Sony PSP. This document covers the functionality of release 3.00 of PSPSeq. Some of the features of this release include:

- up to 16 independent fully synthesized audio tracks
- 1-64 step sequencer with pan, mute, and probabilistic sequencing
- multiloop sequencing with loop repeat capability
- multiple synthesis and FX modules with full parameter configurability at each step
- preset save/load, with multiple preset banks for each track
- track/loop copy, paste and delete
- absolute or standard 12-tone frequency configurability
- file save/load, WAV file output rendering

If you have questions on PSPSeq after reading this document, features requests, use PSPSeq for composing some music, etc, please join the PSPSeq user's community at http://groups.google.com/group/pspseq. Also, I can be reached at pspseq@dspmusic.org. Thanks!

Installation/Directory Structure

PSPSeq is delivered as a .zip file with a number of directories underneath it. The basic structure is as follows:

```
1.0
  PSPSEQ300
    SEQ
      *.SEQ
    WAV
      *.WAV
    PRESETS
      *.PSP
      custom.psi
      colors.pci
    EBOOT.PBP
1.5
  PSPSEQ300
    SEQ
      *.SEQ
    WAV
      *.WAV
    PRESETS
      *.PSP
      custom.psi
      colors.pci
    EBOOT.PBP
  PSPSEQ300%
    EBOOT.PBP
PSPSeq.pdf
PSPSeq Quick Reference.pdf
readme.txt
```

PSPSeq is homebrew software; because of this to run this program you must follow very specific steps which change depending on the firmware revision on your PSP. To find your firmware revision, go the Cross

Media Bar (XMB) and select System Settings->System Information. The System Software version is the firmware revision.

There are a number of online guides which generally detail the steps required to run homebrew. Because firmware compatibility is always changing, it is recommended using one tied to a popular online forum is used as a reference. Below are a couple good references on custom firmware for the PSP:

http://forums.qj.net/f-psp-homebrew-and-hacks-help-21/t-ultimate-homebrew-guide-faq-v214-updated-jan-30-07-76940.html

http://alek.dark-alex.org/pspwiki/index.php/Main_Page

Generally speaking, there are two different versions of the PSP; the first revision (PSP fat/phat) and the second revision (PSP slim). The best way to run PSPSeq on a PSP fat is to either run Sony official firmware 1.0/1.5 or install the latest M33 custom firmware. To run PSPSeq on a 1.0 or 1.5 firmware system, copy the appropriate subdirectories to the Memory Stick (generally speaking this directory is ms0:\PSP\GAME\PSPSEQ300). These are the only official Sony firmware revisions that allow for directly executing homebrew software. PSPSeq also runs without problems on the latest M33 custom firmware (3.90 M33-3) but only if it has the 1.50 firmware add-on installed. To run PSPSeq in this configuration, copy the contents of the 1.5 folder from the PSPSeq zip to the ms0:/PSP/GAME150 folder on the memory stick. PSPSeq should also run on other M33 firmware variants as long as the 1.50 kernel is installed.

As for PSP slim, the best way to run PSPSeq is to use the eLoader. You can find more information on this tool here:

http://www.noobz.eu/joomla/news/eloader-v1.000.html

As of the date of the release of PSPSeq 3.00, slim PSPs cannot run the 1.50 kernel. Therefore this is the only option for running PSPSeq on PSP slim. I have not personally tested this method, however, other PSPSeq users report it works.

In general, the best way to install 3.90 M33-3 (or any custom firmware) is to use Pandora's Battery in combination with a Memory Stick which has the appropriate custom firmware copied on it (known as a "magic memory stick". Pandora's Battery is a specially programmed battery which gains control of the PSP before any firmware is loaded. The magic memory stick contains files for installing the latest firmware along with additional programs such as the 1.50 add-on. The steps required to create Pandora's Battery and the magic memory stick are more complicated than I can reasonably get into here (plus this will undoubtedly be out of date as soon as it is released). The easiest way to learn how to install custom firmware is either by asking on a major PSP forum like qj.net, dcemu.co.uk, or forums.afterdawn.com, or by googling Pandora's Battery and Magic Memory Stick. You will find a number of people willing to sell these things to you, or you can simply follow the necessary instructions and do everything yourself.

The firmware update and compatibility landscape is constantly changing. In general PSPSeq is a well-behaved program; therefore it should be

compatible with new methods developed to run unsigned code as long as it allows for kernel-mode access (which is enabled via the eLoader or the 1.50 add-on). If you are having trouble getting PSPSeq to run on your firmware revision, visit the PSPSeq forums at http://groups.google.com/group/pspseq or contact me at pspseq@dspmusic.org and I will do what I can to help.

PSPSeq saves all sequence files (.SEQ) in the SEQ subdirectory. By default all rendered output WAV files are placed in the WAV subdirectory (it is also possible to configure PSPSeq to place rendered WAV files in the ms0:/PSP/MUSIC directory for direct playback on PSPs with firmware above 2.00). If the ./SEQ and ./WAV directories are not available when running PSPSeq, it will not be possible to save/load sequences or access WAV files. The custom PSPSeq synthesis initialization file (custom.psi) must be in the same directory as the EBOOT.PBP executable.

Usage - Stepedit Mode

When PSPSeq is first started it is in Stepedit Mode. The sequencer is represented as a 64 by 16 grid of rectangles. The digital pad (D-pad) is used to step one location to the left or right and to move from track to track. The analog pad (A-pad) is used to jump 8 steps left or right by tapping the A-pad in the appropriate direction. Holding the A-pad left or right causes PSPSeq to jump 8 steps in a rapid fashion. Holding the A-pad either up or down causes the sequencer to jump from instrument to instrument in a rapid fashion. The A-pad can also be configured to operate differently for jumping in the step sequencer. The method to change this behaviour is covered under the *SYSTEM MENU Options* portion of this document.

The current active location is indicated by a red box and other steps in the sequence are a green box. The current step location is also indicated by the X & Y values at the lower left hand side of the screen. A moving blue dot at the top of the sequencer indicates the step that is currently being triggered. If the blue dot is not moving, this means that the sequencer is halted, muting the audio output (this can also be confirmed by looking at the transport at the bottom of the screen; if the blue dot is halted the word STOP will be visible at the bottom of the screen). Some features of PSPSeq cause the sequencer to stop automatically. It is possible to manually start/stop the sequencer via the audio transport at the bottom of the screen (for information on this functionality, read *Usage - Transport Mode*).

PSPSeq allows for 100 independent loops to enable writing entire songs. To access different loops press the left or right trigger (L-trigger, R-trigger) to jump from loop to loop. The loop chosen depends on the mode the sequencer is running in. If it is in LOOP mode the L-trigger and R-trigger navigate to the previous and next loops (i.e. if the current loop is 14 pressing the R-trigger set the current loop to 15). If the sequencer is in SONG mode, pressing the L-trigger and R-trigger navigate to the previous and next loops that are a part of the song (as set by the SONG->SEQUENCE menu). Setting LOOP and SONG modes is explained in the *Usage - Transport Mode* section of the document and sequence programming is explained under the *SEQUENCE* section of this document. The current loop is displayed next to the LP label at the

bottom of the screen; at startup this value ranges from 00-99. It is also possible to change these names through the LOOP->RENAME LOOP menu option.

Hits in PSPSeq are handled slightly differently than in typical sequencing programs. Rather than have each hit always retrigger, PSPSeq allows for each hit to have a trigger probability. A hit that never retriggers has a probability of 0, a hit with a 50% chance of retriggering has a probability of 50, and a hit that always retriggers has a trigger probability of 100. The current trigger probability for the active step is seen next to TRIG in the upper right hand side of the screen. When PSPSeq is first launched, all hits have a probability of 0. The first time the X button is pressed in a track it causes the trigger probability to be 100 and the volume to be 50. Subsequent hits triggered in a track take their trigger probability and volume from the last hit in a track. For example, if step 10 has TRIG and VOL values of 75 and 40, pressing X on step 11 would cause its TRIG and VOL to also be equal to 75 and 40. Also note that all synthesizer parameter values are also copied from the previous hit though these may be changed independently afterwards.

By holding X and pressing either the L-trigger or R-trigger, it is possible to quickly remove or add hits. By pressing X and the L-trigger, the current hit is immediately erased and by pressing X and the R-trigger, a hit with TRIG of 100 and VOL of 50 is added, overriding the TRIG and VOL copy done when only pressing X. Even though TRIG and VOL are overridden, all other parameter values are copied from the previous hit.

To modify the probability that a hit occurs, hold down the X button and move the A-pad either up or down. To modify the volume on a particular hit, press the A-pad either left or right. Fine tuning of volume is handled via the left and right buttons on the D-pad. It is not possible to fine tune the trigger probability via the D-pad.

If the instrument was already playing a note and the sequencer reaches a step where it decides to not retrigger (no matter what the trigger probability was set to), the previous note continues to play.

It is also possible to force a track to retrigger without resetting the audio output envelope. This is done by holding the X button while moving the D-pad up or down. If the fill color in a particular step is blue, the audio envelope resets if the note is retriggered. If the fill color is orange the audio envelope will not retrigger but all synthesis parameters along with the VOL parameter are updated for that particular step. This functionality is useful for creating legato notes, sounds with evolving parameters (for example a pad with a filter whose frequency rises and falls), and generally for modifying synthesis parameters without forcing the audio envelope to start again.

The square button mutes and unmutes tracks. A track is on if the larger box after the track name is yellow and it is off if the box is red. The mute values for each loop are independent from each other. Muting a track in a loop does not affect the mute values in other loops. The mute state is saved and loaded when songs are saved and loaded in PSPSeq. Because muting is handled on a loop by loop basis, this makes it possible to use muting of tracks in loops as a means to

compose songs simply by having a single sequence copied among multiple loops and muting different tracks in each loop.

PSPSeq also has quick solo and unmute all track capability built into the step sequencer. By pressing square and the L-trigger all tracks except the currently selected track are muted in the current loop. Pressing square and the R-trigger unmutes all tracks in the loop.

The O button controls the global track volume and stereo pan. To modify the global track volume, press the O button and move either the A-pad or D-pad up or down. Panning is set on a per-step basis but controls exist within PSPSeq to sync pan values for all steps in a loop (but not for all loops in a song). Pan for a particular step is set by holding the O button while moving either the A-pad or D-pad to the left or right. To synchronize the pan value for all steps in a loop, press O and R-trigger at the same time while pressing the A-pad or D-pad to the left or right.

The O button is also used for copying synthesizer data between steps. To select a step to copy, press O+L-trigger. Once the red box is moved off the selected step, it is drawn in brown rather than green. To deselect the step, press O+L-trigger again on the selected step. A different step can be directly chosen by pressing O+L-trigger on the desired step. To copy synthesizer parameters, press O+R-trigger. This copies all synthesis data along with the TRIG or VOL data. Note that it is not possible to copy synthesizer data across loops; all copies must be done within a single loop. Step copy does allow for copying data across tracks as long as the two tracks are of the exact same name/type and their frequency data (if applicable) is of the same type. For information on frequency mode settings, see the *FREQMODE* section of this document under the CONFIG menu description.

Note that O+R-trigger serves two purposes; it can sync all pan values in a loop or be used to paste synthesizer parameters between steps. Because of this, no steps can be selected for copying when trying to sync all pan values in a loop.

The triangle button is mapped to two unique synthesis parameters for each track. There are additional parameters which further modify the sound of each track; however only two of the more commonly used ones are available in Stepedit Mode. All other parameters on the track are accessed through the menu system. To modify the directly accessible parameters, hold the triangle button and move the A-pad in either the up or down direction (to modify the top parameter) or the left or right direction (to modify the bottom parameter). The rate of parameter modification is changed by holding the L-trigger and R-trigger buttons. To use the D-pad to modify synthesis parameters, either the L-trigger or R-trigger *must* be held. By holding the L-trigger while also holding the triangle button, parameter modifications happen at 1/10th the rate versus the rate when L-trigger is not held. Also, by holding the R-trigger parameter modifications happen at 10x the rate versus when R-trigger is not held. This same concept of allowing slow or fast parameter modifications is also used when modifying synthesis parameters from the menu system. Usage of the L-trigger is especially important when setting frequency values as controlling frequency values directly with the A-pad is generally too fast to set specific values.

Lastly, the triangle button can also be used to provide quick access to all synthesis parameters for the selected track. By pressing triangle + L-trigger and R-trigger the GEN/FX/ENV menu for the current track pops onto the screen. For more information on how to access and modify synthesizer parameters, refer to the **Edit Synth** section of this document.

Usage - Transport Mode

The SELECT button activates the transport functionality at the bottom of the screen. The active function is shown in white while all other functions are shown in grey. Press the D-pad left or right to access each transport function. While in transport mode it is possible to perform the following operations:

1. Set the sequencer to run in LOOP or SONG mode. To modify this value move the D-pad either up or down. In LOOP mode PSPSeq only plays the current loop. In SONG mode, PSPSeq plays the full loop listing found in the SONG->SEQUENCE menu option. When SONG mode is activated, the measure (MS) and loop (LP) values are displayed on the screen. MS indicates the current measure (with the iteration count on that particular measure listed after the period) while LP indicates which loop is being played. Additional information on this functionality is given in the *SONG Menu Options* section of this document.

One very important thing to note is that the menu system is deactivated while in SONG mode unless the sequencer is also halted. If START is pressed while in SONG mode and the song is playing, PSPSeq jumps to its visualizer functionality rather than opening the menu system.

2. Stop or restart the sequencer. To modify this value move the D-pad either up or down. When the transport says PLAY it continues to play the current loop (in LOOP mode) or play the current song (in SONG mode). If the transport says STOP, the sequencer stops moving. To force the sequencer to start at the beginning of the current loop (in LOOP mode) or the first measure of the current song (in SONG mode) press X while this option is highlighted in the transport. The best way to start a song from the beginning is as follows:

b. set PSPSeq to STOP in the transport
a. set PSPSeq to SONG mode in the transport
c. press X while selecting STOP to reset the sequencer
d. set PSPSeq to PLAY

Note that any sounds previously playing will continue to play when the sequencer is started again. Because of this, if a completely clean rendition of a song is necessary the sequencer should be set to a loop which has no triggers in it. This ensures that there aren't spurious notes playing at the beginning of the song.

3. Set the current BPM. This value is set via the A-pad and D-pad. To increase the speed of the song move the A-pad or D-pad in the upward direction and to decrease the speed of the song move the A-pad or D-pad in the downward direction. The A-pad changes the BPM quickly while the D-pad provides fine grained tuning of this value.

4. Set the global volume. This value is set via the A-pad and D-pad. To increase the volume of the song move the A-pad or D-pad in the upward direction and to decrease the volume of the song move the A-pad or D-pad in the downward direction. The A-pad changes the volume quickly while the D-pad provides fine grained tuning of this value.

Pressing the SELECT button while in transport mode brings PSPSeq back into Stepedit Mode.

Usage - Menus

To open the menu system, press the START button. Note that the menu system is only available when running in LOOP mode or if the sequencer is halted. If PSPSeq is playing a song pressing START brings up the visualizer. This limitation exists because the additional processing load of handling menus can cause audio to glitch when changing loops.

PSPSeq has an extensive menu system for performing many different operations. An overview of the menu system is listed below.

```
SYSTEM
  NEW
  LOAD
  SAVE
  SAVE AS
  RECORD
  VISUALIZE
  DISPLAY
    LOAD COLORS
    SAVE COLORS
    SET COLORS
    DEFAULT COLORS
    GRID STEPS
  CONTROL
    APAD SCALAR
    APAD NAV
  ABOUT
  HELP
  EXIT
TEMPO
  BPM
  TAP TEMPO
  SWING
  SWING STEPS
  SEQLEN
TRACK
  COPY TRIG
  COPY TRACK
  COPY GEN
  COPY FX
  COPY ENV
  COPY FREQ
  CLEAR TRACK
  SHIFT TRACK
  FILL TRACK
LOOP
  COPY TRACK TO LOOP
  COPY LOOP
  COPY TRACK TO ALL LOOPS
  CLEAR LOOP
  RENAME LOOP
SONG
  SEQUENCE
CONFIG
  FREQMODE
  STEREOIZE
  HUMANIZE
  LOOP JUMP
  RECORD LOCATION
SYNTH
  EDIT SYNTH
    INSTRUMENT0
      GEN
      FX
      ENV
    INSTRUMENT1
      GEN
      FX
      ENV
    ...
    ...
    ...
    INSTRUMENTn
      GEN
      FX
      ENV
  ADD SYNTH
  DEL SYNTH
  MAKE PRESET FILE
  LOAD PRESET
  SAVE PRESET
```

Navigating PSPSeq Menus

After pressing the START button, PSPSeq moves from Stepedit Mode to Menu Mode. In Menu Mode, the input buttons serve a different purpose. Pressing the D-pad up or down moves from one menu item to another (active menu items are highlighted in white while the unselected options are in grey). All menus wrap top/bottom and bottom/top. Pressing the D-pad to the left goes back one level in the menu system (along with returning to Stepedit Mode if at the Main Menu) and pressing the D-pad to the right selects a menu option. Also note that the X and O buttons are used to select menu options and go back one level in the menu system. In the case that the D-pad or X/O buttons are needed for a menu option (for example, pressing the D-pad left/right selects characters in SAVE/SAVE AS mode) then the other buttons must be used to select options and go back a level in the menu. Pressing START immediately returns back to Stepedit Mode.

Each option in the menu system is explained in details below.

SYSTEM Menu Options

The SYSTEM menu handles creation of new songs, file I/O, visualization, general configuration, and exiting PSPSeq.

NEW

The NEW option picks a new instrument group and starts a new song. After selecting NEW a list of possible instrument groups is presented. This list includes both the PSPSeq preset lists along with a customizable lists of instruments. The customizable lists are loaded from the PSPSeq Synthesis Initialization (custom.psi) file and can be configured from within PSPSeq. For more information on this process, refer to the *Creating Custom Synthesis Initializations* section of this document.

PSPSeq contains the following default instrument groupings:

Group Name	Type
808ISH	some instruments modeled on TR-808 + some general synths
MELODEE	many melodic instruments
NOFI	instruments with interesting FX
OLDSKOOL	some 808 instruments + other oldskool sounds
WISPY	lots of resonant filtered noise + a bit of rhythm
CUSTOM0	custom preset 0
CUSTOM1	custom preset 1
CUSTOM2	custom preset 2
CUSTOM3	custom preset 3

Table 1. PSPSeq Instrument Groupings.

LOAD

Selecting LOAD brings up a list of .SEQ files that can be loaded into PSPSeq. The LOAD window only shows a maximum of 8 files at a time; by pressing the D-pad either up or down the window contents scroll in that direction. To skip 8 items at a time within the LOAD window press triangle and up/down on the D-pad. Select a file to load by pressing either X or the D-pad to the right. Depending on the complexity of the file, it can take a long time (30+ seconds) to load some songs.

The only .SEQ files visible to PSPSeq are those placed in ./SEQ subdirectory.

PSPSeq comes with a number of example .SEQ files which demonstrate various features and synthesis capabilities of the software. Some are loops while others are full songs Attributions for each SEQ are given at the end of this document under *Acknowledgements*.

SAVE

Selecting SAVE either brings up an empty box where the name of the file is created or a dialog box asking if the current filename should be overwritten, depending on whether or not a filename has already been tied to this particular sequence (the current filename is listed after "FILE: " in the main sequencer screen). Press up and down on the A-pad or D-pad to move through all of the letters and numbers. To add another character to the filename, press the D-pad to the right; to edit a previous character move the D-pad to the left. Pressing O deletes the currently selected character. Press X to save the file with the created filename. The .SEQ extension is automatically added to the filename. If a file with that name does not exist, it is saved to the ./SEQ subdirectory. If a file of the same name already exists, a prompt appears asking if the file should be overwritten. Select either 'Y' or 'N' with the up and down D-pad buttons and press X to select. Depending on the complexity of the file, it can take a long time (30+ seconds) to save some songs.

SAVE AS

Selecting SAVE AS allows a new filename to be tied to the current PSPSeq sequence. The filename is input the same was as if SAVE was selected. If a pre-existing filename is created with SAVE AS, PSPSeq prompts whether or not the old file should be overwritten.

RECORD

Selecting RECORD allows for recording of the current loop or song. If the sequencer is in LOOP mode, the current loop is saved to the created filename, and if SONG mode is chosen, the current song (all measures in the current sequence) are rendered and written to the WAV file. *Note that because the menu system is disabled when playing audio in SONG mode, it is necessary to first stop the sequencer by going to the transport (by pressing SELECT) and setting the play mode to STOP to record an entire song.*

Writing WAV files is a slow process; depending on the number and type of instruments, it can take longer to write a WAV file than it takes to

play the audio (i.e. it is rendered slower than real-time). While in SONG mode each measure is drawn to the screen as it is recorded (and the LP/MEAS parameters are also updated). If there is not enough room on the Memory Stick to save the loop or song, PSPSeq reports an error before attempting to save.

By default PSPSeq records all WAV files to the WAV subdirectory. It is also possible to record to the ms0:/PSP/MUSIC directory by modifying the RECORD LOCATION menu setting in the CONFIG menu. By doing this, it is possible to listen to rendered PSPSeq output without running PSPSeq. Note that only firmware revisions 2.00 and above are capable of natively playing WAV files (though other homebrew applications may enable playback of WAV files on older firmware versions).

VISUALIZE

Selecting VISUALIZE redraws the current screen and draws images on the screen which are influenced by the music. The controls of the VISUALIZE mode are as follows:

Button	Action
X	start/stop sequencer
square	refresh screen
triangle	reset loop/song
L/R-trigger	increment/decrement current loop or song measure
D-pad L/R	switch to previous/next visualization mode
O/START	exit visualizer

Table 2. Visualizer Controls.

Also note that two of the visualization modes have addition controls built into them. The visualizer which draws random 4 mirrored random lines can be influenced with the A-pad. By pressing the A-pad left/right or up/down it is possible to change the probability that the line will step in either direction. The visualizer which draws circles based on signal power is modified by pressing up/down on the D-pad. Each time the D-pad is pressed the visualizer switches between drawing just a single circle and keeping all previous circles on the screen in a persistent fashion.

DISPLAY

Selecting DISPLAY brings up a menu for configuring the colors and appearance of PSPSeq. Every color used in PSPSeq can be modified, saved, and loaded. The colors values are stored in a file called colors.pci which must be located in the same place as EBOOT.PBP.

PSPSeq supports 8 color configurations. To load a configuration select LOAD COLORS and then the appropriate color preset. Saving a color preset is handled similarly with SAVE COLORS. To set different colors select SET COLORS. This brings up a list of every parameter and object which can be configured, along with the current color for each item. The meaning of each parameter is listed below:

Parameter	Purpose
BACKGROUND	background color on main screen
TRACKNAME	color of text on far left hand side
MUTE ON	color indicating track is muted
MUTE OFF	color indicating track is active
ACTIVE TEXT	color of highlighted text on main screen
INACTIVE TEXT	color of non-highlighted text on main screen
SEQUENCER BOX	color of steps in sequencer
SEQUENCER BOX OFFSET	color of offset steps (see *GRID COLORS*)
ACTIVE STEP	color of step selected in step sequencer
TRIGGERED STEP	fill color of triggered step in sequencer
CONTROL STEP	fill color of control-only step in sequencer
INACTIVE TRIG STEP	fill color of inactive triggered step
INACTIVE SEQ BOX	color of inactive box
SEQUENCER TIC	color of dot indicating current step
MENU BACKGROUND	color of background in menu system
ACTIVE MENU TEXT	color of selected text in menu system
INACTIVE MENU TEXT	color of non-selected text in menu system
INTERPOLATE TEXT	color of special selected items in SYNTH menus
OSCILLISCOPE	color of oscilloscope box and waveform
SEQUENCER COPY	color of selected step for copy in sequencer

Table 3. Parameters in SET COLORS menu.

After selecting a parameter, the red, green, and blue parameters can be modified independent of each other. To modify the red component, hold square while pressing the A-pad up/down. To modify the green component, hold X while pressing the A-pad up/down. To modify the green component, hold O while pressing the A-pad up/down. It is also possible to copy and paste colors between parameters with the L-trigger (copy) and R-trigger (paste). Once the proper colors are set, press triangle and confirm the desired change. At this point the colors set in this mode are displayed on-screen. Note that PSPSeq does not perform any special checks to make sure that the color choices don't make it difficult to navigate the program (ex: setting the menu background and all menu text to the same color). If this accidentally happens, the button combination necessary to restore default colors is as follows: START, D-pad right, 6 D-pad down, D-pad right, 3 D-pad down, D-pad right.

The file that stores color data is a simple ACII file with each parameter stored on a separate line. If you want to share color presets with another user it should be possible to manually edit the colors.pci file in a text editor. However, PSPSeq does not perform much error checking when loading a color preset therefore it is recommended that the original colors.pci file be backed up and the modified colors.pci file be loaded before any unsaved music data exists in the step sequencer.

The last configuration option in the DISPLAY menu is GRID STEPS. PSPSeq can be configured to display two difference colors in the sequencer grid, and the number of steps between the two different colors can also be configured. By default the two colors are configured to be the same meaning that all steps in the sequencer look the same. However, if the colors for SEQUENCER BOX and SEQUNECER BOX

OFFSET are set differently then there will be two different colors displayed within the sequencer. These two colors help break up the 64 steps in the sequencer into smaller chunks and can highlight important steps within a measure. At startup GRID STEPS is set to 4. What this means is that the color for SEQUENCER BOX is displayed for the first 4 steps, then the next 4 steps get the color for SEQUENCER BOX OFFSET, and then the next 4 steps get SEQUENCER BOX again, repeating until all active steps are set to the appropriate color. GRID STEPS changes the number of steps between the two color types and can be set to anything between 1-64 steps.

ABOUT

Selecting ABOUT brings up some basic information on PSPSeq. Specifically the following is displayed:

1. PSPSeq version.
2. PSPSeq release data.
3. PSPSeq website.
4. PSPSeq contact email address.
5. Current time.
6. Battery remaining.
7. Flash memory remaining.
8. Current processor loading from selected synthesizers.
9. RAM available for loading samples.

The processor loading and RAM available for samples is an estimate and is not guaranteed to be accurate.

HELP

Selecting HELP brings up a list of options that cover the most basic functionality and button mapping of functions in PSPSeq. This is only provided as a quick reference in case the full documentation (this file plus "PSPSeq Quick Reference.pdf" and the readme) are not available.

EXIT

Selecting EXIT gives the option to quit PSPSeq.

TEMPO Menu Options

The TEMPO menu handles BPM, swing, and sequence length configuration.

BPM (Beats Per Minute)

Selecting BPM brings up a box where the tempo of the loop is set. Press either up on the D-pad or A-pad to increase the tempo and down on the D-pad or A-pad to decrease the tempo. The maximum BPM is 999.0 and the minimum BPM is 1.0. Note that BPM changes do not take effect until the next step is reached. This means that if the BPM is set very low it can take a long time for any rate adjustments to take effect (because the time to reach the next step is very long). Also keep in mind that a single measure of music is assumed to happen over 32 steps;

therefore if the BPM is set to 120 BPM it takes 4 seconds to travel all 64 steps before restarting the loop.

TAP TEMPO

Selecting TAP TEMPO allows for manually creating a tempo by tapping on the X button. Eight taps are necessary as input to create the target tempo. Note that due to limitations of the PSP input functions, TAP TEMPO has a rather limited accuracy. TAP TEMPO is best used to get an approximate target tempo and then use the BPM settings to further tweak this tempo such that the exact target is reached.

SWING

Selecting SWING brings up a box where the swing amount is set. SWING causes an increase in tempo for the first N steps and decreases the tempo for the next N steps (where 'N' is equal to the value set in SWING STEPS). The SWING value is a percentage time spent playing the first N steps, and an inverse percentage of the time spent playing the next N steps. In the simplest case, SWING is set to 50.0 and the first N steps and next N steps take an equal amount of time to play. If SWING is set above 50.0, the first N steps take longer to play than the next N steps. For example if SWING is set to 70.0, the first N steps take 70% of the time to play and the next N steps take 30% of the time to play.

Press the square button to reset swing to 50.0%.

SWING STEPS

Selecting SWING STEPS brings up a box where the number of steps for the increased/decreased tempo due to swing is set. The SWING STEPS value is set by pressing up or down on the A-pad and D-pad. This value can range from anywhere between 1-64. The overall swing period is 2x the SWING STEPS value; it takes twice the number of steps to resync with the current BPM. The appropriate number to set for SWING STEPS depends on the time signature, BPM, and desired overall feel for the music. In general for music composed in 4/4 time, SWING STEPS is set to a power of 2. However, experimentation is important and recommended.

The SWING STEPS value isn't written to the sequencer until the X button is pressed. When X is pressed, the sequencer is reset back to the first step. This is necessary to ensure that the swing steps are consistently synced with the sequence.

SEQLEN

Selecting SEQLEN sets the number of steps per loop. This value ranges from 1-64. SEQLEN is a global parameter and affects each loop in the song. All sequencer steps which are not used are set to the color from the INACTIVE SEQ BOX parameter in the SET COLORS menu option (default is grey). By setting SEQLEN to a different value, various time signatures and unique timing constraints can be placed on sequencer steps. For example, to easily compose in 5/4 time, set SEQLEN to 40 (allowing for 8 steps between each beat). Also, if you want to compose

in 4/4 time and allow for triplets, set SEQLEN to 48 and assume each quarter note beat occurs on steps 0, 12, 24, and 36.

TRACK Menu Options

The TRACK menu handles data copying, creation, and deletion within a single track.

COPY TRIG

Selecting COPY TRIG allows for the TRIG and VOL, parameters to be copied between any two tracks in a single loop. This function does not copy any synthesis parameters between tracks.

Selecting COPY TRIG brings up a list of all tracks in the song. After selecting one of the tracks to copy from another list of tracks in the song is displayed, giving the choice of where to copy to. Once the two tracks are selected a prompt appears that confirms the 'copy from' and 'copy to' choices. Change Y or N by pressing up or down on the D-pad and the X button to select.

COPY TRACK

Selecting COPY TRACK allows for all parameters to be copied between two tracks in a loop. Note that COPY TRACK can only be used between two tracks of the same type; PSPSeq cannot copy parameters between tracks if either the generator or FX module is different.

If there are any duplicate tracks in the current song, selecting COPY TRACK brings up a list of all tracks, otherwise PSPSeq returns to Stepedit Mode. Select one of the tracks to copy from; only tracks which have more than one copy are selectable. After picking the copy from track, another list of tracks in the song is brought up again. However, this time the only selectable tracks are those that are of the same type as the one first selected. Therefore, if there are two BAMSVF tracks in a song and one of them is selected as the 'copy from' track, the track highlighted in the 'copy to' menu would be stuck on the other BAMSVF. Once the two tracks are selected a prompt appears that confirms the 'copy from' and 'copy to' choices. Change Y or N by pressing up or down on the D-pad and the X button to select. All parameters on the destination track are copied over with those of the source track.

COPY GEN

Selecting COPY GEN allows for copying just the GEN (generator) parameters between tracks. This is useful for sharing parameters when the FX attached to two tracks are different.

Selecting COPY GEN brings up a list of all tracks in the song. The only selectable tracks are those that have more than one of the same GEN in the song. For example, if there is only one noise generator in the list of all tracks, it is not possible to select that track as one to copy from. After picking the track to copy from, another list of

tracks is brought up again. However, this time only those tracks which share the same generator as the track selected previously are selectable. After selecting the track to copy to, a confirmation window is presented. Change Y or N by pressing up or down on the D-pad and X to select. If Y is chosen, all generator parameters from the source track are copied to the destination track.

If there are no duplicate generators in all of the tracks (meaning no valid COPY GEN options exist), selecting COPY GEN causes PSPSeq to return to Stepedit Mode.

COPY FX

Selecting COPY FX allows for copying just the FX (effects) parameters between tracks. This is useful for sharing parameters when the generator attached to two tracks is different.

Selecting COPY FX brings up a list of all tracks in the song. The only selectable tracks are those that have more than one of the same FX in the song. For example, if there is only one State Variable Filter (SVF) in the list of all tracks, it is not possible to select that track as one to copy from. After picking the track to copy from, another list of tracks is brought up again. However, this time only those tracks which share the same FX as the track selected previously are selectable. After selecting the track to copy to, a confirmation window is presented. Change Y or N by pressing up or down on the D-pad and X to select. If Y is chosen, all FX parameters from the source track are copied to the destination track.

If there are no duplicate FX or no FX at all in all of the tracks (meaning no valid COPY FX options exist), selecting COPY FX causes PSPSeq to return to Stepedit Mode.

COPY ENV

Selecting COPY ENV allows for copying just the ENV (output envelope) parameters between tracks.

Selecting COPY ENV brings up a list of all tracks in the song. After picking the track to copy from, another list of tracks is brought up again. After selecting the track to copy to, a confirmation window is presented. Change Y or N by pressing up or down on the D-pad and X to select. If Y is chosen, all envelope parameters from the source track are copied to the destination track.

Note that because all tracks share the same output envelope function type, it is possible to copy ENV parameters between any two tracks. Also note that if two tracks are configured for different envelope types (exponential and DADSR) the target track will be converted to the envelope type of the source track.

COPY FREQ

Selecting COPY FREQ allows for copying frequency data between two tracks, even if they are not the same generator type. Note that there are two restrictions on copying frequency data between tracks:

1. Only those tracks which have a frequency component can be selected (the noise generator and WAV playback cannot be selected).
2. Because of the nature of the instrument, the Karplus-Strong (KS) plucked string generator cannot generate any arbitrary frequency. Therefore, when copying frequency parameters between a non KS and a KS track, the exact frequency values may not match.

Selecting COPY FREQ brings up a list of all tracks in the song. The only selectable tracks are those which match the criteria above. After selecting the track to copy from, another list of tracks is given where the only selectable tracks are those that match the criteria above. After selecting the track to copy to, a confirmation window is presented. Change Y or N by pressing up or down on the D-pad and X to select. If Y is chosen, the frequency values are copied between the tracks.

Note that if one track was set for absolute frequencies and the other was set for MIDI frequencies, an additional warning pops up on the screen. By switching frequency types, all other frequency data will be lost on the target track. Therefore, care must be taken when copying between tracks with different frequency types as potentially valid data may be removed.

CLEAR TRACK

CLEAR TRACK resets all data on a particular track to its default value. This includes the trigger, volume, track volume, pan, and all instrument parameters.

Selecting CLEAR TRACK brings up a list of all tracks in the song. After selecting one of the tracks to clear, a prompt appears to confirm the choice. Press the D-pad up or down to toggle between Y and N, and the X button to select.

SHIFT TRACK

SHIFT TRACK allows for hits and synthesis parameters to be time-shifted in a track. This is useful for a lot of things, such as creating echo-based effects for rhythms and arpeggios. The starting shift point is dependent the location of the selected step in Stepedit Mode before selecting SHIFT TRACK.

The shift amount can be either a positive or negative number. A positive shift means that all hits to the right of active step are shifted right by the shift amount. A negative shift means that all hits to the left of active step are shifted left by the shift amount.

If any hits are shifted beyond the end of the loop, they are removed from the loop entirely. There is no "wraparound" of hits within a loop. For example, if a track had triggers at step 0 and 48 and the selected step was step 0, shifting the track by 32 moves step 0 to step 32 and step 48 disappears entirely.

SHIFT TRACK also allows for keeping the original hits in place when shifting data. This makes it even easier to create echo effects in a single track. Note that if this feature is used and the selected shift amount causes some hits to overlap, the old parameters are overwritten by the shifted parameters. For examples, if there are two hits on a track at steps 0 and 8 with frequency values of 300 and 400 Hz and step 0 is shifted on top of step 8, the frequency at step 8 will be 300 Hz even if the original hits are selected to stay in place. The shifted data takes precedence over the original data.

FILL TRACK

FILL TRACK fills every N steps in a track with the current TRIG, VOL, and synthesis parameter of the step highlighted before selecting FILL TRACK. If a step is chosen whose TRIG value is 0 this is seen as an error and the menu system is closed with control returning back to Stepedit Mode. If the TRIG value is non-zero, a box appears to select the step between retrigger points. Note that FILL TRACK starts retriggering from the selected step in the step sequencer, not from the first step in the track. Also note that FILL TRACK does not wrap around to the beginning of the track; once the last step is reached FILL TRACK quits and PSPSeq returns to Stepedit Mode. All steps filled with FILL TRACK have their synthesis parameters set to the current highlighted step. As an example, if the current highlighted step is step 10, FILL STEP is set to 9, and SEQLEN is 64, steps 10, 19, 28, 37, 46, and 55, are all filled with the TRIG, VOL and synthesis data from step 10. Steps 0-9 are not affected by this operation.

LOOP Menu Options

The LOOP menu handles copying and deleting data at the loop level, as well as renaming loops.

COPY TRACK TO LOOP

COPY TRACK TO LOOP copies a single track from one loop to another loop. The first menu gives the option of picking a specific track and the second box allows for picking the target loop. By default the next loop is given as the target for the track copy, but by pressing up or down on the D-pad or A-pad any loop can be chosen as the target.

COPY LOOP

COPY LOOP copies all parameters (trigger and synthesis) from one loop to another loop. The first two dialog boxes select the source and target loops (the loop name is changed in both boxes by pressing either the A-pad or D-pad up or down and selected via the X button or pressing right on the D-pad). The final dialog box confirms the source and target loops.

COPY TRACK TO ALL LOOPS

COPY TRACK TO ALL LOOPS works like COPY TRACK TO LOOP, except, as the name suggests, this copy is extended to all loops in a song. Because of this (and the fact that no undo function exists in PSPSeq), extreme care should be taken when selecting this option.

CLEAR LOOP

CLEAR LOOP clears all parameters (trigger and synthesis) from the current loop. A dialog box confirms this action.

RENAME LOOP

RENAME LOOP changes the name of the loop in the lower left hand side of the screen next to "LP:" as well as the name in the song sequencer screen. At startup the 100 loops are given names 00-99. However, by selecting RENAME LOOP these names can be changed. After selecting this option and the loop name to change and box appears on screen where the name can be edited. The editing features are the same as for SEQ and WAV saving; the D-pad left/right moves the cursor in the dialog box, D-pad and A-pad up/down change the character at the cursor location, O deletes the selected character, and X saves the name. Press START to cancel the operation completely.

SONG Menu Options

The SONG menu handles sequencing of loops to make a song.

SEQUENCE

The SEQUENCE option is used to create complete songs by sequencing loops together. PSPSeq supports 100 unique loops and 1000 measures per song, with each measure repeating up to 100 times. The loops and repetitions per measure are all configured via the SEQUENCE menu. The SEQUENCE menu displays a 16 measure window into the composition, with measure 000 initially appearing in the middle of the window. A typical line of the SEQUENCE menu looks like this:

```
004:  LOOP 03      REPS 01
```

The first number refers to the measure. These numbers range from 000 to 999. When a song is restarted, it begins with measure 000. After LOOP is the name of the loop to be played at that point in the sequence. If the names of the loops are kept at their default values this value ranges from 00-99; however if the names of the loops are changed via LOOP->RENAME LOOP the name here reflects the name created in that context. There are a maximum of 100 different loops per song in PSPSeq. Different loops are selected in the SEQUENCE menu via holding the L-trigger button and pressing the A-pad or D-pad up or down. The last number indicates the number of repetitions of this specific loop before moving to the next measure. In this case, the number of repetitions is 1. It can be set from 1 to 99 repetitions for each loop. Setting the number of repetitions is done via holding the R-trigger and pressing the A-pad or D-pad up or down.

Different measures are selected by moving the D-pad either up or down. To jump 10 measures at a time, hold down the square button while moving the D-pad up or down. The current selected measure is always displayed in the middle of the menu.

To insert and delete measure into the song sequence, press the triangle button and up or down on the D-pad. Pressing down inserts a measure into the sequence and pressing up deletes a measure from the sequence. Both the insertion and deletion occur at the currently selected measure. PSPSeq inserts measures into a sequence as long as measure 999 is the default value (LOOP 00 REPS 01). If it is any other value it is not possible to insert measures, as this could delete valid sequencer data.

Pressing X in SEQUENCE mode causes the sequencer to jump to that loop in the current selected measure. This makes it easy to audition loops to add to the sequence without returning to Stepedit Mode.

There are two additional special measure settings; RESTART and HALT. These are accessed by pressing the L-trigger while moving either the A-pad or D-pad down when the loop is set to 00. If RESTART is set for a measure, the song automatically restarts at measure 000 when that measure is hit. If HALT is set in a measure, the song halts (the sequencer is set to STOP) when that measure is hit. Note that neither of these values are available for the first measure in the song.

Config Menu Options

The CONFIG menu configures audio output for PSPSeq tracks, behaviour of Stepedit buttons, the output location of rendered WAV files, and other miscellaneous features of PSPSeq.

FREQMODE

FREQMODE configures how frequencies are set for pitched instruments in PSPSeq. For those instruments that are FREQMODE configurable, they can be set with either an absolute frequency or a standard 12-tone value. All instruments except for the white noise generator (which is by definition unpitched) and WAV file player can be set to operate in either frequency mode.

Selecting FREQMODE brings up a list of all tracks in the song. Only those tracks which can have a FREQMODE set to them are selectable from this list. Once a track is selected a prompt appears giving the choice for either ABS (absolute direct frequency input) or MIDI (standard 12-tone MIDI frequencies).

IMPORTANT: Changing the FREQMODE from one type to another erases all previous frequency data in that track for the entire song. Be very careful when using this feature!

Once a mode is selected the display changes both when setting frequency in Stepedit Mode and when accessing the frequency in the SYNTH menu. If the frequency is absolute a number representing the actual frequency

in Hz is visible. If the frequency is taken from a MIDI table it is written in this format:

NOTE_OCTAVE

For example, an A above middle C (440Hz) is written as A_5, and the next higher note (A#/Bb) is written as AS_5.

STEREOIZE

STEREOIZE applies a simple stereo effect to the output of the selected track. All PSPSeq tracks are mono; however by inverting the phase of one channel the output gains a pseudo-stereo effect. The quality of this effect depends on the instrument it is being applied to; it sounds better on instruments with complex harmonic content (such as noise-generated hihats) rather than instruments with simple harmonic content (such as sine wave-generated kick drums). Also note that the quality of the effect depends on whether speakers or headphones are used to listen to the output, the positioning of speakers in a room, and the number of other tracks playing at the same time as the stereoized track. The stereoize effect is toggled on or off by pressing the D-pad up or down on the selected track.

HUMANIZE

HUMANIZE applies a random delay to the delay portion of the audio output envelope. The HUMANIZE parameter is cumulative with any delay that is configured in the audio envelope. If HUMANIZE is set to a large value and there are multiple hits occurring very close to each other, it is possible that one of the hits may not occur at all due to the fact that a latter hit caused the instrument to retrigger before the earlier one could exit the delay stage of the output envelope.

LOOP JUMP

LOOP JUMP configures the behaviour of the L and R-trigger buttons in Stepedit Mode. Normally pressing these triggers causes PSPSeq to immediately jump to the next loop or measure (depending if the sequencer is in LOOP or SONG mode). However, under certain circumstances (such as using PSPSeq in a live setting) it might be advantageous to have PSPSeq not immediately jump to a new loop when pressing the trigger buttons. By setting the instant loop switch to OFF, PSPSeq waits until the current loop finishes before jumping to the next loop. It is important to note that if instant loop jumping is enabled in SONG mode, the L and R triggers are disabled. *Disabling instant loop jump is only valid while in LOOP mode.*

PSPSeq accumulates presses of the L and R triggers when instant loop jump is off. As an example, if PSPSeq is in loop 00 and L-trigger is pressed 5 times and R-trigger is pressed 2 times, the next loop played after loop 00 finishes is loop 03. The next loop that will be played is displayed in grey next to LP: at the bottom left hand side of the screen.

RECORD LOCATION

RECORD LOCATION configures the place where PSPSeq saves WAV file output when the RECORD function is used. At startup, the record location is automatically set to the ./WAV subdirectory for PSPSeq. This allows for resampling of WAV files within PSPSeq songs via the WAV generator, as this is the only place PSPSeq looks for WAV for usage as input samples. The other possible output location is ms0:/PSP/MUSIC, which is the location the PSP music player searches when playing back files. Note that only firmware revisions 2.00 and above have native WAV file playback. If the PSP is running an older firmware, it will be necessary to use a 3rd party application to play back any WAV files in this directory. The advantage of placing WAV files in ms0:/PSP/MUSIC is that the WAV file player consumes less processing power (and hence battery power) than PSPSeq.

SYNTH Menu Options

The SYNTH menu is used to add, delete, and modify instruments and presets in PSPSeq.

EDIT SYNTH

Selecting EDIT SYNTH brings up a list of all tracks in the loop. After selecting a track, an additional menu appears with either 2 or 3 options; GEN and ENV or GEN, FX, and ENV. If the selected instrument does not have any FX attached to it the FX option is not available. Selecting GEN brings up a list of all parameters for the signal generator/oscillator for the particular track. Selecting FX brings up a list of all FX parameters for the particular track. Selecting ENV brings up a list of all output envelope parameters for the particular track.

Parameter modification from the menu is similar to parameter modification from Stepedit Mode. To select a parameter use the D-pad to move up or down the parameter list. Once the desired parameter is selected, both the A-pad and the D-pad can modify the data. To modify data directly with the A-pad, press it either up or down. To change the rate of parameter modifications, hold either the L-trigger or R-trigger while moving the A-pad. By holding the L-trigger, parameters are modified at 1/10th the rate of when the trigger is not held, and by holding the R-trigger, parameters are modified at 10x the rate of when the trigger is not held. Modifying parameters with the D-pad is only possible when also holding the L-trigger or R-trigger.

By default data modification is only made on the specific hit that was last selected in Stepedit Mode. It is possible to jump from hit to hit by pressing the A-pad left or right. Note that this only jumps to steps in the sequencer where there is a TRIG value greater than zero. The current active step is determined by looking at the 'X:' parameter at the lower left hand corner of the screen (the red box which indicates the current step in Stepedit Mode is not updated when in the SYNTH menu). Also note that it is not possible to switch tracks at this level of the menu system; to do that go back to the instrument selection menu (by pressing left on the D-pad).

It is also possible to modify either a single parameter for a subset of steps or all steps of a track at the same time. The simplest case is for modifying all steps at the same time. There are two modes for this type of operation. In one mode all parameters are locked to the same value. ***If other hits in the track have different values they are reset to be the same as the current active value and it is not possible to undo this (or any) operation within PSPSeq.*** This mode is entered by pressing the triangle button while performing parameter modifications as explained above. The other mode of parameter modification keeps the absolute difference between all steps equal. One case where this is useful is in the rapid creation of chords through copying all parameters on a track and shifting the frequency of the new track. Note that if one of the parameters is already set to a minimum or maximum value that it is not possible to modify the track any further in that direction. The absolute distance between parameters is always guaranteed. This mode is entered by pressing the O button while performing parameter modifications as explained above.

To modify a subset of steps they must be explicitly latched. This is done by pressing the D-pad to the right on each step to be latched. After pressing the D-pad right the latched parameter is shown in blue. Pressing the D-pad right again on a latched step unlatches that step. Subsequent steps can be chosen by pressing the A-pad left of right. After all desired steps are latched, the triangle and O buttons are used to modify only the latched parameters in the current track. The parameter latches remain set when switching from parameter to parameter, when switching between GEN/FX/ENV menus, and even when switching between different tracks. However, once control either returns to the SYNTH menu or Stepedit Mode all latches are cleared.

To restore the default value of a particular parameter, press the square button while the parameter is selected. This only restores the default value for that particular step rather than for all hits in the loop current loop. To reset that parameter for all steps in the current loop, follow these steps:

1. Reset the current step by pressing square.
2. Select all steps in the current loop by holding triangle.
3. Hold L-trigger and press the D-pad up and down once to force a modification of all steps.

The easiest way to reset all parameters for a track is to use the CLEAR TRACK functionality described in the *TRACK Menu Options* section of this document. Note that this will also clear all TRIG, VOL, and PAN data as well.

PSPSeq has a method of interpolating parameters between steps in a track. What this means is that, if you have two triggered steps which have different synthesis parameters attached to them, it is possible generate a linear ramp of values between those steps to apply to all other steps between them. As an example, consider a PSPSeq generator with a FREQ parameter for setting the frequency of the output. Let's assume that there are 4 hits in a track; on steps 0, 16, 32, and 40. Also, let's assume that the FREQ value at step 0 is 100.0 and at step 40 it is 500.0. If this is the case and the interpolator in PSPSeq is used to generate new frequencies between steps 0 and 40, the FREQ value

in step 16 would be 260.0 and step 32 would be 420.0. Note that this interpolation is only applied to triggered and control-only steps. If the next operation was to place a new hit at step 8, the FREQ for that hit would be 100.0 (not 180.0) because PSPSeq copies all parameters from the last triggered step.

Interpolation points are set with the SELECT button. When the first interpolation point is set the selected parameter appears blue in the menu rather than white. Note this is only true when the parameter is selected; if it is not selected it appears grey. Once the first interpolation point is set, press the A-pad either left or right to get to other hits triggered on a track. The current hit can be determined by looking at the X parameter in the lower left hand side of the screen; it updates every time the A-pad is tapped left or right. Once the desired end interpolation point is reached, press SELECT again and all steps between the start and end points will have the chosen parameter interpolated. If an improper interpolation point is chosen (not the same parameter or the start and end points are the same), the starting interpolation point is reset and the process of setting a start and end interpolation point must be begun again. Also note that interpolation can only occur within a single loop; it is not possible to interpolate across loops or measures. One last thing to remember is that these interpolation points are discrete for each step. PSPSeq does not do a smooth interpolation of parameters between steps with this feature.

Interpolation is commonly used with non-triggered steps in the sequencer to give the impression of a continuously changing parameter. Non-triggered load synthesis parameters but do not reset the envelope for a hit. Therefore, they can be used in conjunction with interpolation to create complex sounds which smoothly change over time.

PSPSeq also has the ability to randomize values for a parameter across a user-defined range. This feature works the same as interpolation in that you set start and end points and PSPSeq fills in the data between those points. To set these points use the X button. The range of random values is determined by the values at the start and end points. The start and end points also have random values written to them in this operation; they are not stuck with the chosen minimum and maximum values.

PSPSeq has a shortcut from Stepedit Mode that allows instant access to the GEN/FX/ENV menu for the selected track in the sequencer. By pressing Triangle+L-trig+R-trig a menu is opened allowing for quick access to all synthesizer parameters for the selected track.

Additional information on all of the generators, effects, and envelopes is given in the *GEN/FX/ENV Types* section of this document.

ADD SYNTH

ADD SYNTH is used to access new synthesizers to use in the current song. PSPSeq supports up to 16 instruments in a song; if there are already 16 instruments listed in the sequencer PSPSeq returns an error message stating that the requested operation is not possible. In that

case it is necessary to delete synthesizers (via the DEL SYNTH menu option) before adding any new synthesizers.

Afar selecting ADD SYNTH, a new dialog box is presented where the synthesizer type is chosen. Press either the A-pad or D-pad up or down to scroll through all synthesizer options. Descriptions of all synthesizers are given in the *GEN/FX/ENV Types* section of this document. Once the desired synthesizer is selected, press X to add it to the sequencer. All synthesizers added to PSPSeq are placed at the end of the sequencer list.

Before adding the synthesizer to the sequencer, PSPSeq performs a rough check to determine whether or not adding this new synthesizer will overload the processing capabilities of the PSP. Each generator and effects module requires a different amount of processing power to generate its output. If PSPSeq determines that adding this new synthesizer will overload the PSP, PSPSeq returns an execution time overload error and the synthesizer is not added. In order to add that synthesizer to the sequencer, it is then necessary to delete one or more existing synthesizers to free up the necessary processing resources. A real-time estimate of PSPSeq processor loading is available in the SYSTEM->ABOUT menu option.

DEL SYNTH

DEL SYNTH is used to delete a synthesizer from the sequencer. After selecting this option a list of all synthesizers is presented on the screen. After selecting the appropriate synthesizer a final dialog box appears confirming the choice. Once deleted, all synthesis data for that track is removed and all synthesizers below the deleted track are shifted up in the sequencer.

The sequencer needs at least one instrument; if an attempt is made to delete the last instrument in the sequencer PSPSeq returns with an error message.

MAKE PRESET FILE

MAKE PRESET FILE is used to create a new PSPSeq synthesizer preset file. PSPSeq has the ability to save synthesizer presets which can then be loaded into a new song and shared with other users. Presets are stored in the ./presets subdirectory. Each combination of generator and effect gets its own preset file. The general form of preset file names is:

GENFX.*presetname*.preset.psp

GENFX refers to the generator and FX for the track. *presetname* is the name of the preset file from within PSPSeq. When installed, each GEN/FX combination has a preset file called SEQDEF associated with it which stores example presets and can also be used to store your own presets. Each preset file can store a maximum of 64 presets and can only store presets for one specific GEN/FM combination.

If you want to create your own preset file, select MAKE PRESET FILE. This will bring up a box which allows you to create a preset filename

similar to how SEQ, WAV, and loop names are created. The preset file contains a simple initialization for all presets and each preset is named PRESET*xx* where *xx* ranges from 00-63 for the 64 unique presets.

LOAD PRESET

LOAD PRESET loads a preset into a track of the current song. After selecting the track PSPSeq asks which preset file to load. There must be at least one preset file for each GEN/FX combination. When PSPSeq is installed every GEN/FX combo gets a preset file called SEQDEF. It is possible to make new preset files either by copying/pasting the contents of a preset file into a new file or using the MAKE PRESET FILE option from the SYNTH menu.

After selecting the preset file PSPSeq asks which specific preset you want to load. Presets can be scrolled through by pressing the A-pad or D-pad up or down. They can also be previewed with either the L or R-trigger. If L-trigger is pressed, the frequency data from the existing track is retained while all other synthesizer data is overwritten for preview purposes. If R-trigger is pressed all data, including frequency data, is overwritten for previewing the preset. While a preset is being previewed the text in the preset select box is blue. To stop previewing a preset, press either L-trigger or R-trigger. This must also be done to enable selecting a new preset.

Once the right preset is found, press X to select it. PSPSeq asks if frequency data should be overwritten. All pitched presets contain frequency data in the preset file. Depending on the nature of the sound, it may or may not be desirable to load the frequency data from the preset file. For example, if the preset is a kick drum then the frequency data is most likely critical to get the precise desired sound. However, if the preset is a lead synth tone and it is being loading over an existing melody, it is probably a good idea to retain the frequency data from the track.

Lastly, PSPSeq asks if the preset should be loaded to the current step, the current loop, or all loops in a song. As with other operations which can overwrite lots of data, make sure you choose the proper option as there is no undo feature in PSPSeq.

If the instrument is pitched (not WAV or N) and preset data is of a different type than the data in the track (i.e. the preset was saved with absolute frequencies but the current track is set for MIDI frequencies), PSPSeq may convert the preset to the frequency type of the existing track or convert the track to the frequency type of the preset. The decision is based on if the preset is designated to load to the current step, current loop, or entire song. If the preset is for the current step or loop the frequency type of the track is preserved while if it is for the whole song the frequency type of the preset is used. This is done to ensure that no valid data from other loops is destroyed unless all frequency data is to be overwritten. If the frequency types don't match PSPSeq will come up with the closest match to the target frequency from the preset.

SAVE PRESET

SAVE PRESET saves the preset data from the current step into a preset file. When selected you are prompted to choose the target preset file. Pressing the D-pad up or down scrolls through all the preset files. After selecting the preset file a list of all presets from that file are presented which can also be scrolled through to pick the appropriate preset to overwrite. After the slot is chosen PSPSeq provides a dialog box to create a new name for the preset. This follows the same controls of the other text creation boxes for saving SEQs and WAVs, naming loops, and creating preset files. After a final confirmation screen the preset is saved to the selected preset file.

GEN/FX/ENV Types

PSPSeq contains 8 generators, 7 effects, and 2 output envelopes. Each instrument consists of a single generator, either zero or a single effect, and an output envelope. PSPSeq provides every combination of generators and effects, for 64 base instruments (8*7 + 8 additional instruments for the case when an effect is not a part of the instrument). The reason this isn't doubled for the two output envelope types is because a single envelope function multiplexes both envelope types; either one is selectable for any instrument (and at any step within a track).

PSPSeq creates instrument names by concatenating the generator and effect names together, along with a number indicating how many instruments of the same type preceded it. For example, the first instrument with a Karplus-Strong generator and a decimation effect is called KSDEC0; if another instrument of the same type exists it is called KSDEC1. If KSDEC0 is deleted via the DEL SYNTH command, KSDEC1 is renamed as KSDEC0 but retains all of the parameters from when it was called KSDEC1.

Each generator (except for the noise generator) has two frequency warping parameters attached to it. This is essentially an LFO attached to the frequency of the output. The LFO waveform is selectable and can be chosen from one of the following waveform types:

Waveform	Description
SINE	sine wave
SINE2	$(SINE)^2$
SINE3	$(SINE)^3$
SINE4	$(SINE)^4$
SINER2	$(SINE)^{0.5}$
SINER3	$(SINE)^{0.33}$
SINER4	$(SINE)^{0.25}$
ISINE	inverse sine (sin^{-1})
ISINE2	inverse sine squared ($sin^{-2)}$
ISINE3	inverse sine cubed ($sine^{-3}$)
ISINER2	$(ISINE)^{0.5}$
ISINER3	$(ISINE)^{0.33}$
ISINER4	$(ISINE)^{0.25}$
TRI	triangle wave
TRI2	$(TRI)^2$
TRI3	$(TRI)^3$
TRI4	$(TRI)^4$
TRIR2	$(TRI)^{0.5}$
TRIR3	$(TRI)^{0.33}$
TRIR4	$(TRI)^{0.25}$
SAW	sawtooth wave
SAW2	$(SAW)^2$
SAW3	$(SAW)^3$
SAW4	$(SAW)^4$
SAWR2	$(SAW)^{0.5}$
SAWR3	$(SAW)^{0.33}$
SAWR4	$(SAW)^{0.25}$
SQ	square wave
NOISE	white noise
NOISE2	$(NOISE)^2$
NOISE3	$(NOISE)^3$
NOISE4	$(NOISE)^4$
NOISER2	$(NOISE)^{0.5}$
NOISER3	$(NOISE)^{0.33}$
NOISER4	$(NOISE)^{0.25}$

Table 4. PSPSeq Oscillator types.

Appendix A provides plots of each of these waveforms.

Each of the generator, effect, and envelope types along with the custom instruments are described below.

BAM - Bi-Oscillating Audio Module Generator

A BAM is essentially a simplified standard 2-oscillator synthesizer. The oscillators (along with the frequency warp LFO) have a wide range of oscillator types mapped to them. The parameters that control a BAM are:

SH1	Sets a sample and hold amount on the first audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates its location within the wavetable, preserving the fundamental frequency.
FREQ1	Sets the frequency of the first oscillator. Configurable to be either an absolute frequency or a 12-tone value through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
WTTYPE1	Sets the wavetable waveform tied to the first oscillator. The full list of all oscillator types is in Table 2.
SH2	Sets a sample and hold amount on the second audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates it location within the wavetable, preserving the fundamental frequency.
OFFSET	Sets a frequency by specifying an offset between the first and second oscillator. If this value is greater than 1.0 the second oscillator's pitch is higher than the first oscillator and if it is less than 1.0 the second oscillator's pitch is lower than the first oscillator.
WTTYPE2	Sets the wavetable waveform tied to the second oscillator. The full list of all oscillator types is in Table 2.
OSCSYNC	Sets whether the phase of the second oscillator resets when the first oscillator passes through its wavetable.
OSCMIX	Sets the mix between the first and second oscillator. For example, if OSCMIX is 1.0 the output is purely the first oscillator, if it is 0.0 it is purely the second oscillator, and if it is 0.5 it is equally mixed between the two oscillators.
RINGMIX	Sets the level of ring modulation (multiplication of the two oscillators) on the output. If set to 0.0 ring modulation is off and if set to 1.0 full ring modulation is enabled.
WARP	Sets the amount of frequency warp (an LFO on FREQ1). If set to 0.0 the frequency is not warped at all and if set to 1.0 the full frequency warp is enabled.
WARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.

Table 5. BAM Parameters.

Setting BAM to very high frequency values can cause outputs which do not match what might be expected. Depending on the waveform and frequency, the output may sound like it is getting lower rather than higher for certain instruments. This is due aliasing distortion from the synthesis method used in PSPSeq for wavetable instruments and is a known limitation of the program.

BFM - BAM FM Generator

The BAM FM synthesizer is a 2-operator FM synthesizer where both the carrier and modulator are BAM generators. BFM is configured as a typical 2-operator FM synthesizer where the modulator is passed through a DADSR envelope and used to modulate the frequency of the carrier generator. BFM is also unique among generators and FX in that not all parameters fit on a single screen; to access the two pages of parameters modify the FMPARAMS parameter. A full list of all parameters are given below.

FMPARAMS	Sets whether or not the screen displays the carrier or modulator parameters. When this value is modified the menu changes to display the appropriate set of values.
CSH1	Sets a sample and hold amount on the carrier's first audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates its location within the wavetable, preserving the fundamental frequency.
CFREQ1	Sets the frequency of the carrier's first oscillator. Configurable to be either an absolute frequency or a 12-tone value through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
CWTTYPE1	Sets the wavetable waveform tied to the carrier's first oscillator. The full list of all oscillator types is in Table 2.
CSH2	Sets a sample and hold amount on the carrier's second audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates it location within the wavetable, preserving the fundamental frequency.

COFFSET	Sets a frequency by specifying an offset between the first and second oscillator. If this value is greater than 1.0 the second oscillator's pitch is higher than the first oscillator and if it is less than 1.0 the second oscillator's pitch is lower than the first oscillator.
CWTTYPE2	Sets the wavetable waveform tied to the second oscillator. The full list of all oscillator types is in Table 2.
COSCSYNC	Sets whether the phase of the second oscillator resets when the first oscillator passes through its wavetable.
COSCMIX	Sets the mix between the first and second oscillator. For example, if OSCMIX is 1.0 the output is purely the first oscillator, if it is 0.0 it is purely the second oscillator, and if it is 0.5 it is equally mixed between the two oscillators.
CRINGMIX	Sets the level of ring modulation (multiplication of the two oscillators) on the output. If set to 0.0 no ring modulation is present and if set to 1.0 full ring modulation is enabled.
CWARP	Sets the amount of frequency warp (an LFO on CFREQ1). If set to 0.0 the frequency is not warped at all and if set to 1.0 the full frequency warp is enabled.
CWARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.
MODINDEX	Sets the level of modulation in the synthesizer. The MODINDEX value is multiplied by the carrier frequency. A modulation index of 0.0 corresponds to no modulation. The larger the modulation index, the more pronounced the FM effect.
FBTYPE	Select one of 4 configurations for feedback in FM carrier and modulator oscillators: MM: output of modulator feeds to modulator and carrier MC: output of modulator fed into modulator, output of carrier fed into carrier CM: output of modulator fed into carrier, output of carrier fed into modulator CC: output of carrier fed into modulator and carrier
CARRFB	Sets the amount of feedback from carrier. Only used in MC, CM, and CC feedback modes.
MODFB	Sets the amount of feedback from modulator. Only used in MC, CM, and MM feedback modes.

Table 6. BFM Carrier Parameters.

FMPARAMS	Sets whether or not the screen displays the carrier or modulator parameters. When this value is modified the menu changes to display the appropriate set of values.
MSH1	Sets a sample and hold amount on the modulator's first audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates its location within the wavetable, preserving the fundamental frequency.
MFREQ1	Sets the frequency of the modulator's first oscillator. This frequency is set as a ratio of the carrier's frequency. For example, 1.0 means the modulator has the same frequency as the carrier and 2.0 means the frequency is double the carrier.

MWTTYPE1	Sets the wavetable waveform tied to the modulator's first oscillator. The full list of all oscillator types is in Table 2.
MSH2	Sets a sample and hold amount on the modulator's second audio oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the BAM oscillator still updates it location within the wavetable, preserving the fundamental frequency.
MOFFSET	Sets a frequency by specifying an offset between the first and second oscillator. If this value is greater than 1.0 the second oscillator's pitch is higher than the first oscillator and if it is less than 1.0 the second oscillator's pitch is lower than the first oscillator.
MWTTYPE2	Sets the wavetable waveform tied to the second oscillator. The full list of all oscillator types is in Table 2.
MOSCSYNC	Sets whether the phase of the second oscillator resets when the first oscillator passes through its wavetable.
MOSCMIX	Sets the mix between the first and second oscillator. For example, if OSCMIX is 1.0 the output is purely the first oscillator, if it is 0.0 it is purely the second oscillator, and if it is 0.5 it is equally mixed between the two oscillators.
MRINGMIX	Sets the level of ring modulation (multiplication of the two oscillators) on the output. If set to 0.0 no ring modulation is present and if set to 1.0 full ring modulation is enabled.
DELAY	Sets the delay time in seconds for the modulator's audio envelope.
ATTACK	Sets the time in seconds for the modulation level to reach its peak.
DECAY	Sets the time in seconds for the modulation level to reach DECAYMIN.
DECAYMIN	Sets the level for the SUSTAIN portion of the envelope. 1.0 represents full-scale and 0.0 represents no output.
SUSTAIN	Sets the time in seconds to hold the output scalar at DECAYMIN.
RELEASE	Sets the time in seconds for the modulator's frequency to go from DECAYMIN to no output.

Table 7. BFM Modulator Parameters.

Warning: Setting very high values for carrier frequency (CFREQ1), modulator frequency (MFREQ1), and modulator index (MODINDEX) can potentially lead to processing overload in PSPSeq. If this happens, the sequencer will halt and the screen may not update properly. To recover from this situation, press left on the D-pad to exit the menu system (there may be some odd menu artifacts at this point). Once the red selector is available, either modify CFREQ1, MFREQ1 or MODINDEX to smaller values and try restarting the sequencer in the transport. The other option is to delete the entire synthesizer via SYNTH->DEL SYNTH.

FM - Simple FM Generator

FM is a more simplistic FM synthesizer as compared to BFM. Rather than using two BAM generators for the modulator and carrier waveforms, a single oscillator is used for both of these waveforms. One difference between BFM and FM generators is in how the sample and hold mechanism is handled. In BFM the wavetable location is always updated regardless of whether or not the output is held. This helps keep the fundamental frequency of a generator when a sample and hold value of greater than 1 is used. In the FM generator, the wavetable's location is not updated when the output is held. This means that the frequency of the waveform is divided by the value in the sample and hold parameter. This capability can be useful for creating certain specific effects, especially when used in the modulator's oscillator. The parameters for FM are given below:

CARRSH	Sets a sample and hold amount on the carrier oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the location within the wavetable is not updated.
CARRFREQ	Sets the frequency of the carrier oscillator. Configurable to be either an absolute frequency or a 12-tone value through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
CARRWT	Sets the wavetable waveform tied to the carrier oscillator. The full list of all oscillator types is in Table 2.
CARRWARP	Sets the amount of frequency warp (an LFO on CARRFREQ). If set to 0.0 the frequency is not warped at all and if set to 1.0 the full frequency warp is enabled.
CARRWARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.
MODINDEX	Sets the level of modulation in the synthesizer. The MODINDEX value is multiplied by the carrier frequency. A modulation index of 0.0 corresponds to no modulation. The larger the modulation index, the more pronounced the FM effect.
DELAY	Sets the delay time in seconds for the modulator's audio envelope.
ATTACK	Sets the time in seconds for the modulation level to reach its peak.
DECAY	Sets the time in seconds for the modulation level to reach DECAYMIN.
DECAYMIN	Sets the level for the SUSTAIN portion of the envelope. 1.0 represents full-scale and 0.0 represents no output.
SUSTAIN	Sets the time in seconds to hold the output scalar at DECAYMIN.

RELEASE	Sets the time in seconds for the modulator's frequency to go from DECAYMIN to no output.
MODSH	Sets a sample and hold amount on the modulator oscillator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated. If the sample value is held, the location within the wavetable is not updated.
MODFREQ	Sets the frequency of the modulator oscillator. This frequency is set as a ratio of the carrier's frequency. For example, 1.0 means the modulator has the same frequency as the carrier and 2.0 means the frequency is double the carrier.
MODWT	Sets the wavetable waveform tied to the modulator's first oscillator. The full list of all oscillator types is in Table 2.
FBTYPE	Select one of 4 configurations for feedback in FM carrier and modulator oscillators: MM: output of modulator feeds to modulator and carrier MC: output of modulator fed into modulator, output of carrier fed into carrier CM: output of modulator fed into carrier, output of carrier fed into modulator CC: output of carrier fed into modulator and carrier
CARRFB	Sets the amount of feedback from carrier. Only used in MC, CM, and CC feedback modes.
MODFB	Sets the amount of feedback from modulator. Only used in MC, CM, and MM feedback modes.

Table 8. FM Parameters.

Warning: Setting very high values for carrier frequency (CARRFREQ), modulator frequency (MODFREQ), and modulator index (MODINDEX) can potentially lead to processing overload in PSPSeq. If this happens, the sequencer will halt and the screen may not update properly. To recover from this situation, press left on the D-pad to exit the menu system (there may be some odd menu artifacts at this point). Once the red selector is available, either modify CFREQ1, MFREQ1 or MODINDEX to smaller values and try restarting the sequencer in the transport. The other option is to delete the entire synthesizer via SYNTH->DEL SYNTH.

KS - Karplus-Strong Generator

The Karplus-Strong generator creates a wide variety of pitched noises as well as plucked string sounds. It consists of a buffer filled with white noise which is repeatedly run through a filtering algorithm. The filtering algorithm has a number of parameters which are probabilities that the filter will behave in one fashion or another (with 0.0 meaning a 100% chance of one operation happening, 1.0 meaning a 100% chance of another operation happening, and any value in-between is a mixed percentage of the two operations), along with setting the averaging factor and the length of the buffer. The formula which governs the filter is:

output = (+/-)(AVEFAC)*((input(n) +/- input(n-1))

Each parameter for KS is covered in more detail below:

FILTPROB	Sets the probability that the output is generated from the Karplus-Strong filter or if the output is read directly from the noise buffer without any filtering. Setting this parameter to 0.0 causes the buffer to never be filtered while setting it to 1.0 causes the buffer to always be filtered.
ASPROB1	Sets the probability that the samples are either added or subtracted (the second +/- in the equation above). If the samples are subtracted the equation generally acts as a high pass filter while if they are added the equation generally acts as a low pass filter. Setting this parameter to 0.0 causes the samples to always be subtracted and setting it to 1.0 causes the samples to always be added.
ASPROB2	Sets the probability that the averaging factor is either a positive or negative number. This affects the timbre of the output. Setting this parameter to 0.0 forces AVEFAC to always be negative and setting this parameter to 1.0 forces AVEFAC to always be positive.
AVEFAC	Sets the averaging factor of the generator. Because the Karplus-Strong algorithm processes its input buffer repeatedly, it is quite easy to saturate the output of the generator. Values of AVEFAC which force this state depend on the values of the other parameters. *Warning: if KS saturates, the output is quite loud!*
FREQ	Sets the frequency of the output. The value can either be an absolute or 12-tone value. This mode is set through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
WARP	Sets the amount of frequency warp (an LFO on FREQ). If set to 0.0 the frequency is not warped at all and if set to 1.0 full frequency warp is enabled.
WARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.

Table 9. KS Parameters.

To generate plucked string sounds from KS, set FILTPROB to 1.0, ASPROB1 to 1.0, ASPROB2 to either 0.0 or 1.0, and AVEFAC close to 0.5. There are a wide variety of sounds possible from KS. Experimentation is key, but as mentioned above, some combinations of parameter values can lead to very loud output, so please be careful! KS contains an internal clipping function on its noise buffer; if the output sounds similar to a square wave there is a good chance that AVEFAC is set too high and

the buffer values are saturating. If this is not the desired tone then try lowering the value in AVEFAC.

N - White Noise Generator

N is a simple white noise generator. It is different from the white noise wavetable in the BAM/BFM/FM generator because the random values are constantly changing, rather than a fixed series of random numbers in a wavetable array. N has the following parameter:

SAMPHOLD	Sets a sample and hold amount on the noise generator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated.
EXPMULT	Sets an exponential value that the SAMPHOLD value is repeatedly multiplied against. If this value is less than 1.0 SAMPHOLD decays over time; if this value is greater than 1.0 SAMPHOLD increases over time; and if is value is 1.0 SAMPHOLD remains constant.
ENDOFFSET	Sets the final SAMPHOLD value of the generator after being affected by EXPMULT. This value is multiplied by the starting SAMPHOLD value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.

Table 10. N Parameter.

PSQ - Square Wave with Adjustable Pulse Width

PSQ is a 2 oscillator square wave generator with adjustable pulse width on each oscillator. The parameters which govern the operation of this generator are as follows:

FREQ1	Sets the frequency of the first square wave generator. The value can either be an absolute or 12-tone value. This mode is set through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
PW1	Sets the duty cycle/pulse width of the first pulse wave oscillator. For example, if PW1 is set to 0.1 the waveform is 10% high and 90% low and if it is set to 0.9 it is 90% high and 10% low. Modifying PW1 does not change the frequency of this oscillator.

OFFSET2	Sets the frequency of oscillator 2 as a ratio of oscillator 1. If OFFSET2 is 1.0, both oscillators have the same frequency. If OFFSET 2 is < 1.0, oscillator 2's frequency is less than that of oscillator 1 and if it is > 1.0 oscillator 2's frequency is greater than that of oscillator 1.
PW2	Sets the duty cycle/pulse width of the first pulse wave oscillator. For example, if PW2 is set to 0.1 the waveform is 10% high and 90% low and if it is set to 0.9 it is 90% high and 10% low. Modifying PW2 does not change the frequency of this oscillator.
MIX	Sets the mix between the two oscillators.
WARP	Sets the amount of frequency warp (an LFO on FREQ1). If set to 0.0 the frequency is not warped at all and if set to 1.0 the full frequency warp is enabled.
WARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.

Table 11. PSQ Parameters.

ROT - Rotational Generator

ROT is a rotational synthesizer, a simple and unique way of generating lo-fi audio. It works through rotating a 16-bit binary number at a specific rate to create a periodic (pitched) output. ROT is configured with the following parameters:

FREQ	Sets the frequency of ROT which can either be an absolute or 12-tone value. This is set through the FREQMODE menu option.
EXPMULT	Sets an exponential value that the frequency value is repeatedly multiplied against. If this value is less than 1.0 the frequency decays over time; if this value is greater than 1.0 the frequency increases over time; and if is value is 1.0 the frequency remains constant.
ENDOFFSET	Sets the final frequency of the generator after being affected by EXPMULT. This value is multiplied by the starting frequency value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
DIST	Sets the distance of rotation in ROT. This parameter ranges from 1-15 (as ROT rotates a 16 bit value).
VAL	Sets the actual value being rotated.
WARP	Sets the amount of frequency warp (an LFO on FREQ). If set to 0.0 the frequency is not warped at all and if set to 1.0 the full frequency warp is enabled.
WARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.

Table 12. ROT Parameters.

WAV - WAV File Generator

WAV is a WAV file player used for playing back samples within PSPSeq. The following limitations exist for this generator:

1. All WAV files must be placed in the .\WAV subdirectory.
2. All WAV files must have the .WAV file extension.
3. All filenames must be 8 characters or less (not including the .WAV file extension).
4. Only one WAV file can be mapped to a track. Modifying the WAV file name in the synthesis parameter menu causes the name to be modified across all steps and loops in the song.
5. The total size of all WAV files loaded into PSPSeq must be less than approximately 7.0MBytes. This memory can be used to allocate one or more WAV files. This is roughly 80 seconds of 16-bit mono audio sampled at 44.1kHz, and 875 seconds of 8-bit mono audio samples at 8kHz.
6. If a stereo waveform is used, PSPSeq must first load the waveform into memory, mix the two channels to a single channel, and the store the final mixed data to memory. Because of this, if memory is running short there may an instance where PSPSeq will not be able to load a stereo WAV file (because it cannot find the intermediate memory to perform the mixing function) but it would be able to load a mono WAV equivalent.

The WAV generator can handle both mono and stereo WAV files of any standard sampling rate, along with 8-bit and 16-bit data types. Since all synthesizers in PSPSeq are mono, stereo WAV files are mixed to a mono equivalent.

When changing the WAV file name in the SYNTH submenu, it is necessary to press X to force the actual WAV file to be loaded and mapped to that track.

The WAV file generator has the following parameters:

FILENAME	Select the WAV file to load into this generator. The list of WAV files is created when PSPSeq is first started. Once the appropriate WAV file is found, press X to load the WAV file in the generator.
BPMSYNC	Boolean value which sets whether the rate the WAV file is played is dependent on the BPM of the song. If it is off, the BPMSTEPS value is ignored.
BPMSTEPS	Sets the number of steps to play the WAV file over if BPMSYNC is on. The final play speed is also dependent on RDSPEED; to force a perfect sync of the WAV file to the selected BPMSTEPS, make sure RDSPEED is set to 1.0. The final play speed is *not* dependent on STARTLOC and ENDLOC. This is a change from versions 2.01 and older of PSPSeq.
RDSPEED	Sets the playback speed. If set to 1.0, the WAV file is played back at the original rate. Setting this value less than 0.0 plays the sample in reverse.
EXPMULT	Sets an exponential value that RDSPPED is repeatedly multiplied against. If this value is less than 1.0 RDSPPED decays over time; if this value is greater than 1.0 RDSPPED increases over time; and if is value is 1.0 RDSPPED remains constant.

ENDOFFSET	Sets the final RDSPPED of the generator after being affected by EXPMULT. This value is multiplied by the starting RDSPPED value to determine the final frequency. If ENDOFFSET and EXPMULT contradict each other (EXPMULT > 1.0 and ENDOFFSET < 1.0 or vice versa) no exponential calculations are performed.
STARTLOC	Sets the start location of playback. STARTLOC is a percentage value which sets how far into the sample playback begins. For example if a sample has a length of 2 seconds and STARTLOC is 0.25, playback begins 0.5 seconds into the sample.
ENDLOC	Sets the end location of playback. ENDLOC is a percentage value which sets how far sample playback progresses before the end of playback is reached. For example if a sample has a length of 2 seconds and ENDLOC is 0.8, playback ends 1.6 seconds into the sample.
PLAYTYPE	Sets whether the sample is looped or played once. If it is looped, playback location is set based on the value in STARTLOC.
WARP	Sets the amount of frequency warp (an LFO on RDSPEED). If set to 0.0 the frequency is not warped at all and if set to 1.0 full frequency warp is enabled.
WARPWT	Sets the LFO oscillator type. The full list of available types is in Table 2.

Table 13. WAV Parameters.

Overviews of PSPSeq effects are given below:

CLP - Clamper FX

CLP clamps the output of a generator. The following parameters control its operation:

TYPE	Sets whether the output is forced to clamp above or below the MAX value. If it is set as OVER the output is forced to be above the MAX value; if it is set as UNDER the output is forced to be below the MAX value.
MAX	Sets the actual clamping value.
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 14. CLP Parameters.

DEC - Decimator and Sample & Hold FX

DEC is both a decimator and sample & hold effect unit. The following parameters control its operation:

SAMPHOLD	Sets a sample and hold amount on the input generator. If this value is 0 or 1 then the output is directly generated every sample. If it is greater than 1, the output is held at the same value for that number of samples until it is updated.

NQUANTS	Sets the number of possible output "levels" from the input. As an example, if NQUANTS is set to 2, the output is forced to be either full scale positive or full scale negative (i.e. 1-bit output). As another example, if NQUANTS is 256, this simulates the sound quality of an 8-bit output (2^8 possible outputs).
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 15. DEC Parameters.

MSK - Bitmasker FX

MSK is a bitwise masker. The following parameters control its operation:

TYPE	Sets the mask type. MSK has the following mask types: OR: bitwise OR AND: bitwise AND XOR: bitwise XOR NOT: bitwise NOT
MASKVAL	Sets the value which the input is masked against.
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 16. MSK Parameters.

PCF - Previous/Current Filter FX

PCF is a unique filter that works off of the previous and current sample from that instrument, combining them in interesting ways to create new sounds. The follow parameters control its operation:

FILTTYPE	Sets the filtering method. PREVCURRFILTFX provides the following filter types: MINDIFF: forces a minimum value distance between samples PC-XOR: XOR with mixing between samples PC-OR: OR with mixing between samples PC-AND: AND with mixing between samples PC-NOT: NOT with mixing between samples PC-RM: ring modulation with mixing between samples
CONTROL	Controls the filter. Its behaviour is dependent on the FILTTYPE chosen.
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 17. PCF Parameters.

RD - Reverse Dynamics FX

RD reverses the magnitude of the values of the input; if the input sample value is small it is made large and vice versa. The follow parameter controls its operation:

MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 18. RD Parameter.

SHP - Waveshaper FX

SHP applies a simple waveshaper to the input. In some cases SHP uses some of the basic waveforms from Table 2; mapping the input against the first 32 samples (first quarter) of the selected waveform. The following parameters control its operation:

TYPE	Sets the waveshaper type. SHP provides the following types: CUBE0: out = in^3 CUBE1: out = in^3 + in - 1 SINE: out -> SINE[0...31] SINE2: out -> SINE2[0...31] SINE3: out -> SINE3[0...31] SINE4: out -> SINE4[0...31] SINER2: out -> SINER2[0...31] SINER3: out -> SINER3[0...31] SINER4: out -> SINER4[0...31] TRI2: out -> TRI2[0...31] TRI3: out -> TRI3[0...31] TRI4: out -> TRI4[0...31] TRIR2: out -> TRIR2[0...31] TRIR3: out -> TRIR3[0...31] TRIR4: out -> TRIR4[0...31]
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 19. SHP Parameters.

SVF - State Variable Filter FX

SVF is a State-Variable Filter. The following parameters control its operation:

FREQTRACK	Sets whether the filter will track the frequency of the generator (assuming the generator has a frequency component).
OFFSET	Sets the offset between the frequency of the generator and the frequency of the filter. This value is meaningful only when FREQTRACK is ON and if the generator has a FREQ value associated with it (all except N and WAV).

RES	Sets the level of resonance in the filter. The higher the number the steeper the resonance of the filter output. As this value approaches 1.0 the filter can act as an oscillator.
FREQ	Sets the cutoff frequency of the filter. This value is directly set only when FREQTRACK is OFF.
TYPE	Sets the filter type. SVFFX supports the following filter types: HIGH: highpass filter BAND: bandpass filter LOW: lowpass filter NOTCH: notch filter
MIX	Sets the level to mix the effect with the input signal. 0.0 sets the output to be purely the input signal and 1.0 sets the output to be purely the processed signal.

Table 20. SVF Parameters.

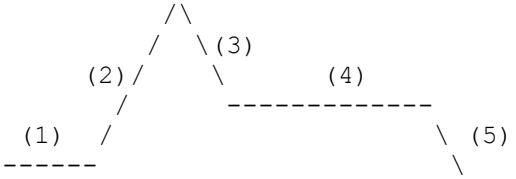
As mentioned above, the SVF has two modes of operation; a frequency tracking mode and a directly set frequency mode. When FREQTRACK is set to ON, the filter will follow the frequency of the generator it is associated with. Note that the noise generator (N) and WAV generator (WAV) do not have a frequency component. Therefore, setting FREQTRACK to ON for either of these instruments is meaningless.

Important: At times the SVF does not behave as expected at the limits of resonance or filter cutoff frequency. The filter may generate distorted output. If the output sounds different than you expect, try slightly adjusting the RES or FREQ parameter by using the D-pad and L-trigger to move the parameter away from and back to the desired value.

PSPSeq contains a single envelope function, but that function has two different output envelope types embedded in it; a delay-attack-decay-sustain-release (DADSR) envelope and an exponential decay/attack envelope (EXP). Both envelopes are accessed by selecting the ENV option after picking a specific instrument in the SYNTH menu. The first parameter (ENVTYPE) controls which envelope is active. The envelope type and all parameters are all configurable for every step on a track. Each envelope type is covered in more detail below:

DADSR Output Envelope

DADSR is a standard Delay/Attack/Decay/Sustain/Release envelope. The five stages are represented below:



(1) Delay, (2) Attack, (3) Decay, (4) Sustain, (5) Release

The following parameters control its operation:

DELAY	Sets the delay time in seconds.
ATTACK	Sets the time in seconds for the attack to reach its peak.
DECAY	Sets the time in seconds for the decay to reach DECAYMIN.
DECAYMIN	Sets the minimum value of decay portion of the envelope and the level of the sustain stage of envelope. If this value is set close to 1.0 the sustain portion will be near full-scale and if it is set to 0.0 the decay stage goes all the way to no output. 0.5 represents a 6db attenuation between the maximum at the end of the attack stage and the level of the sustain stage.
SUSTAIN	Sets the time in seconds to hold the output scalar at DECAYMIN.
RELEASE	Sets the time in seconds for the output to go from DECAYMIN to no output.
VOL	Sets the volume of the hit at this step.
PAN	Sets the pan of the hit at this step.

Table 21. DADSR Envelope Parameters.

Note that when changing the DECAYMIN value, the DECAY and RELEASE values may also change. As DECAYMIN moves downward, the DECAY time automatically increases and the RELEASE time decreases.

EXP Output Envelope

EXP is an exponentially generated envelope. The following parameters control its operation:

DECAY	Sets the delay time in seconds.
EXPMULT	Sets the exponential value. If this value is less than 1.0 the envelope is exponentially decreasing, and if the value is greater than 1.0 it is exponentially increasing (up to full-scale where the scalar clamps).
VOL	Sets the volume of the hit at this step.
PAN	Sets the pan of the hit at this step.

Table 22. EXP Envelope Parameters

Its general shape is one of two types, depending on the value of the EXPCONST parameter:

Note that due to the exponential nature of this function, it is very easy to create exponential curves which reach either full scale or zero output very quickly. Generally speaking the EXPCONST value should be

between 0.99 and 1.01 to create exponential envelopes that can be heard as something other than an immediate full-scale<->zero transition.

Creating Custom Synthesis Initializations

Along with the preset synthesis initializations, it is possible to create up to 4 custom preset initializations which are loaded into PSPSeq via the SYSTEM->NEW menu option. The 4 custom presets are called CUSTOM0-CUSTOM3. The 4 custom preset initializations are stored in the file custom.psi which is located in the same directory as EBOOT.PBP. When one of the CUSTOM options is chosen, a new menu appears on the screen that looks like this:

```
00:  INSTRUMENT00
01:  INSTRUMENT01
02:  INSTRUMENT02
03:  INSTRUMENT03
04:  INSTRUMENT04
05:  INSTRUMENT05
06:  INSTRUMENT06
07:  INSTRUMENT07
08:  INSTRUMENT08
09:  INSTRUMENT09
10:  INSTRUMENT10
11:  INSTRUMENT11
12:  INSTRUMENT12
13:  INSTRUMENT13
14:  INSTRUMENT14
15:  INSTRUMENT15
LD:  number
```

Listing 1. CUSTOM instrument listing and processor load.

Each instrument is one of the preset instruments in PSPSeq. If no instrument is selected for a track, that line has '-------' rather than the instrument name. The last line is 'LD:' and a number which gives the percentage processing load for PSPSeq to handle the given list of instruments. If this value is greater than 100.0, PSPSeq will not be able to safely handle the list of instruments and does not allow the list of instruments to be loaded into the sequencer. Please note that these processor loading values are just an estimate; it may be possible to create an instrument listing whose estimated load is less than 100% but when actually executed on the PSP, it overloads the capabilities of the system. In that case the sequencer will halt (the blue dot above the tracks stops and the transport changes from PLAY to STOP). If this happens, open the custom synthesis menu again and remove or modify instruments from the list of synthesizers and try again.

The CUSTOM instrument listing is navigated and modified similar to other menus in PSPSeq. To access a particular track press the D-pad up or down. Note that all instruments must be sequentially listed in the custom synthesis initialization screen. To modify the current instrument on a track hold the triangle button while pressing the D-pad up or down. As the instrument changes, the LD value at the bottom of the menu also changes as different generators and FX have different processing requirements.

To remove an instrument from the instrument listing press the square button. This can only be done with the last active instrument in the listing, as all instruments must be sequential in the sequencer.

Pressing X causes PSPSeq to reset the sequencer and create the selected instruments. Along with creating a new set of instruments, PSPSeq also saves the list of instruments back to custom.psi. Therefore when that CUSTOM option is chosen again the previously created list of instruments is the initial state of the CUSTOM menu.

If custom.psi does not exist, the custom initializations will not work. Instead, selecting the CUSTOM option causes PSPSeq to return back to Stepedit Mode. To fix this problem copy custom.psi from the original PSPSeq300.zip file to the same location as EBOOT.PBP.

PSPSeq Hints and Tips

PSPSeq is a powerful and unique program for creating music. Here are a few tips to help harness the capabilities and improve the overall quality of music made with this program:

1. Play around with panning instruments in PSPSeq. Even though each instrument is mono, placing them somewhere off center pan opens up the stereo field. Also try using the STEREOIZE function to create a simulated stereo sound. In some cases it sounds good (hihats and noisy instruments), and in some cases it does not (kick drums and lower pure tones generated from BAM). Additionally, triggering two of the same instruments with different L/R panning and slightly different parameters can create a very rich stereo sound.

2. The generator and FX modules in PSPSeq are fairly different from standard electronic instruments. Please experiment with them, exploring the boundaries of what they were designed to do, as some rather interesting and unexpected sounds exist within them.

3. To make evolving sounds, take advantage of the "force parameter update without audio envelope retrigger" capability in the sequencer (press X and up/down on the D-pad on a step with a TRIG value greater than 0) after a full audio envelope is retriggered. Then add small parameter modifications to the notes where the audio envelope isn't retriggered. Also, using this parameter update without retriggering along with the interpolation capability in the EDIT SYNTH menu allows for (moderately) smooth parameter changes in a synth. One way to use control-only steps with presets is to save start and end values to separate preset locations, load them to the start and end steps of a synth you want to modify, and then interpolate between the start and end steps to create more interesting sounds.

4. Because there isn't an UNDO feature, be sure to save your songs often. This is particularly true when modifying instrument parameters in the SYNTH menus as it is possible to accidentally modify all settings for a particular loop by accident (via using the triangle and O buttons).

5. To force the "cut" of an instrument at a particular step, set the TRIG value to 100 and VOL value to 0 at that step.

6. Play around with the probabilistic sequencing capabilities in PSPSeq. Try setting TRIG to a value between 0-100 for some instruments. In particular, this works well for rhythmic instruments such as kick drums and hihats. By forcing high probabilities on common steps (such as quarter note steps for the kick) and lower probabilities on other steps, it's possible to easily create non-repeating rhythmic loops that sound interesting even if the same values are used for many measures.

7. The longer PSPSeq is run and the more times new instrument groups are chosen via the SYSTEM->NEW menu, the slower PSPSeq runs. If songs which previously ran fine are no longer running when loaded, try exiting and restarting PSPSeq and reloading the song as soon as the program starts. This problem is less severe with versions 2.00 and upwards of PSPSeq, but it can still happen from time to time.

8. A number of generators consist of 2 copies of a simpler oscillator where the second oscillator's frequency is calculated as multiple of the first oscillator. Specifically this exists in BAM, BFM, and PSQ. Once way to use this feature is to create either 2 note chords or an in-tune sub-oscillator of the first oscillator. The table below gives example values to set the frequency offset to in order to create a specific offset (using the equal temperament tuning common on keyboard instruments):

Scaled Difference Between Freqs	**Oscillator Offset**
-12 semitones	0.50000
-11 semitones	0.52973
-10 semitones	0.56123
-9 semitones	0.59460
-8 semitones	0.62995
-7 semitones	0.66741
-6 semitones	0.70709
-5 semitones	0.74914
-4 semitones	0.79368
-3 semitones	0.84087
-2 semitones	0.89087
-1 semitones	0.94384
0 semitones	1.00000
+1 semitones	1.05946
+2 semitones	1.12246
+3 semitones	1.18921
+4 semitones	1.25992
+5 semitones	1.33483
+6 semitones	1.41421
+7 semitones	1.49831
+8 semitones	1.58740
+9 semitones	1.68179
+10 semitones	1.78180
+11 semitones	1.88775
+12 semitones	2.00000

Table 23. Semitones and Oscillator Offsets.

As an example, if you have a BAM generator and you want the 2nd oscillator to be used to play a major 3rd for this generator (i.e.: if the first oscillator is playing a C_4 the second oscillator plays an E_4) then set the offset to +4 semitones or 1.25992. If you want the 2nd oscillator to play one octave below the main oscillator then set the offset to 0.5.

Lastly, the oscillator offset feature can be used to create detuned synthesizers with MIDI frequency control. If you want to detune an oscillator set the offset to something very close to 1.0000 and set the mix between the two oscillators such that it only plays the second oscillator. The downside is that it does not allow for two oscillators playing in a generator; however by mixing in a small portion of the first (in-tune) oscillator you can give the generator an interesting sound while still keeping it primarily a detuned synth.

Appendix A: PSPSeq Waveforms

PSPSeq contains a number of waveforms for generating sound and modulating frequencies. These are used as base waveforms in the BAM, BFM, and FM synthesizers and are also available in the WARPWT parameter in all pitched synthesizers.

The NOISE waveforms are provided as an example of what each one can look like. Every time PSPSeq is run the NOISE waveforms are randomly generated.

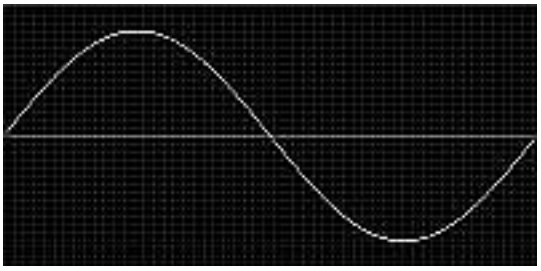


Figure 1. *SINE waveform*

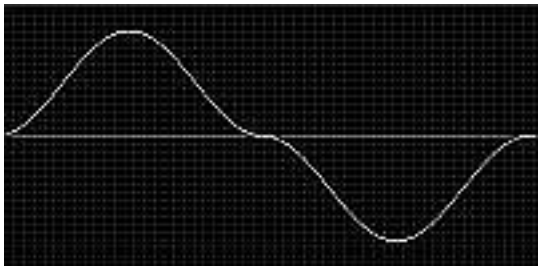


Figure 2. *SINE2 waveform*

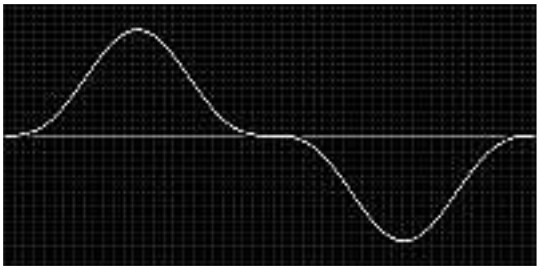


Figure 3. *SINE3 waveform*

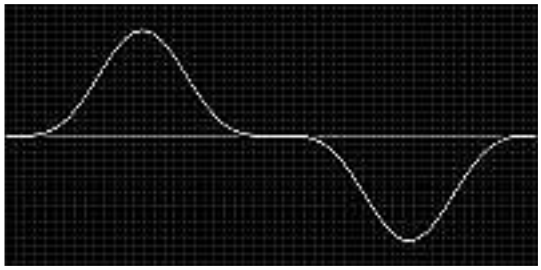


Figure 4. *SINE4 waveform*

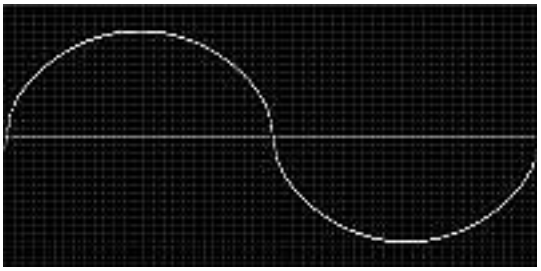


Figure 5. *SINER2 waveform*

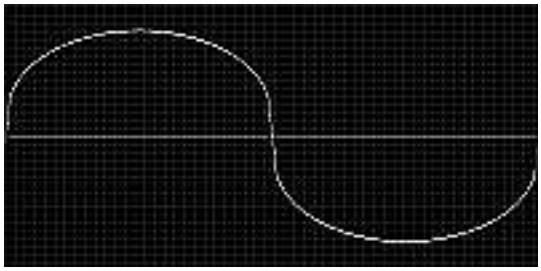


Figure 6. *SINER3 waveform*

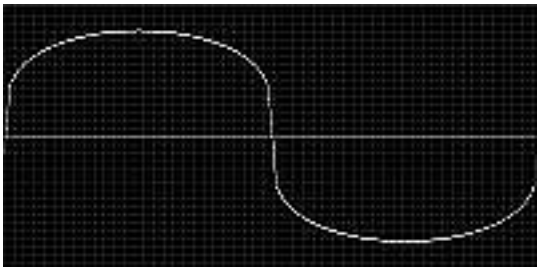


Figure 7. *SINER4 waveform*

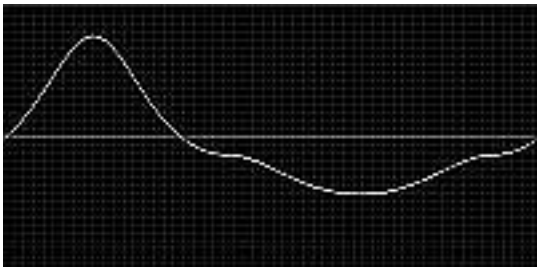


Figure 8. *ISINE2 waveform*

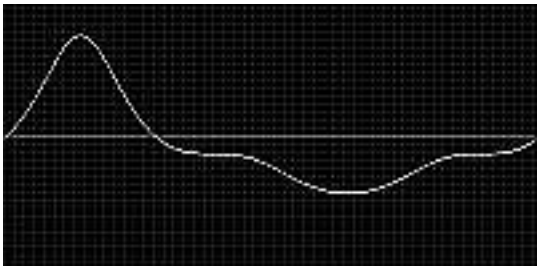


Figure 9. *ISINE3 waveform*

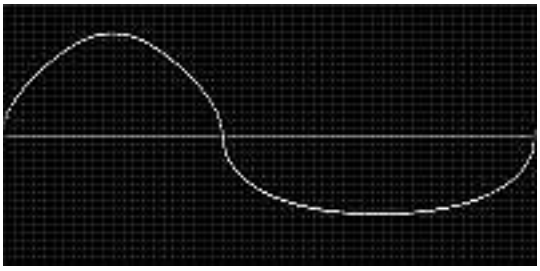


Figure 10. *ISINER2 waveform*

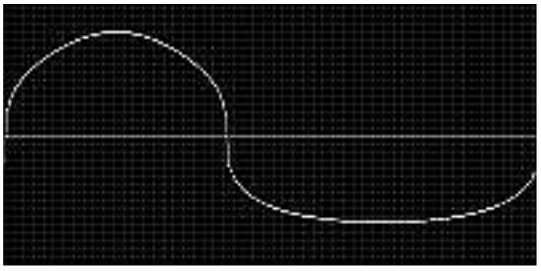


Figure 11. *ISINER3 waveform*

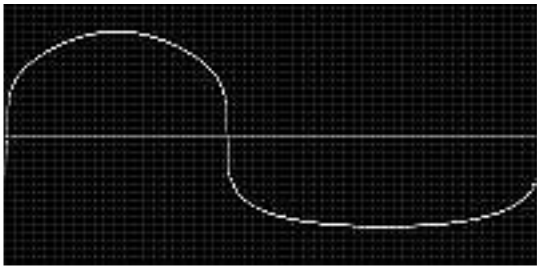


Figure 12. *ISINER4 waveform*

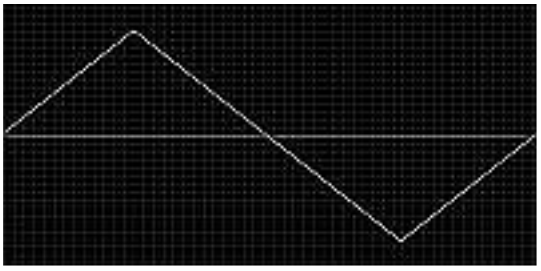


Figure 13. *TRI waveform*

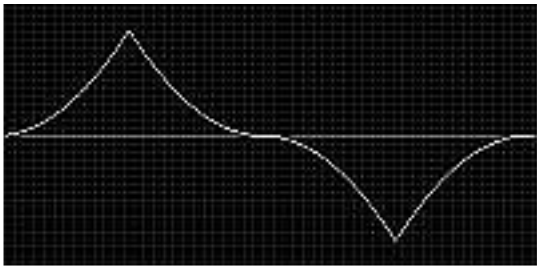


Figure 14. *TRI2 waveform*

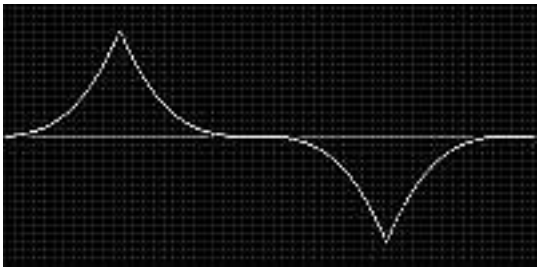


Figure 15. *TRI3 waveform*

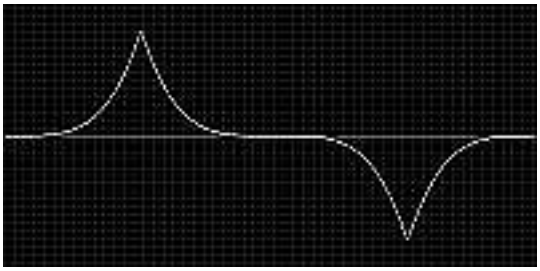


Figure 16. *TRI4 waveform*

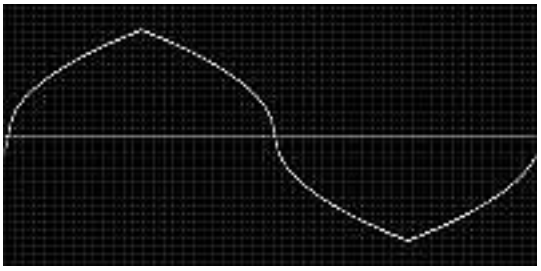


Figure 17. *TRIR2 waveform*

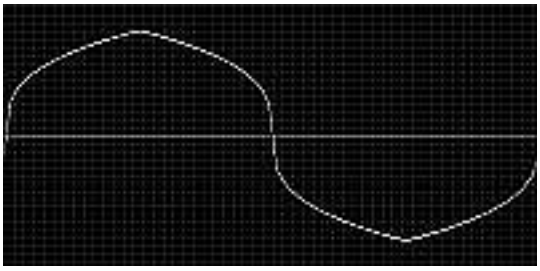


Figure 18. *TRIR3 waveform*

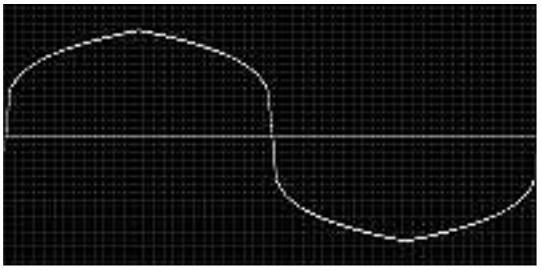


Figure 19. *TRIR4 waveform*

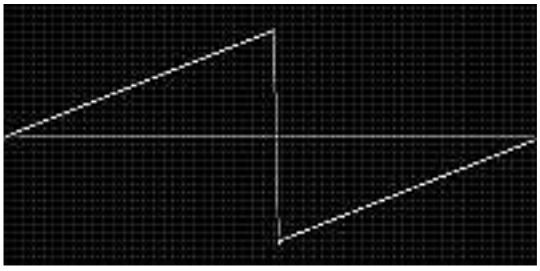


Figure 20. *SAW waveform*

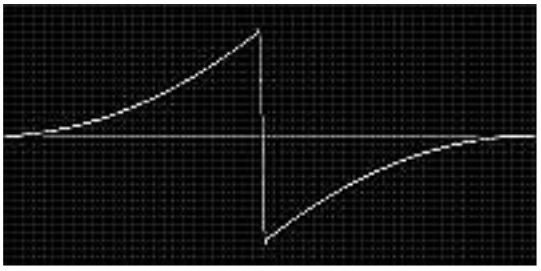


Figure 21. *SAW2 waveform*

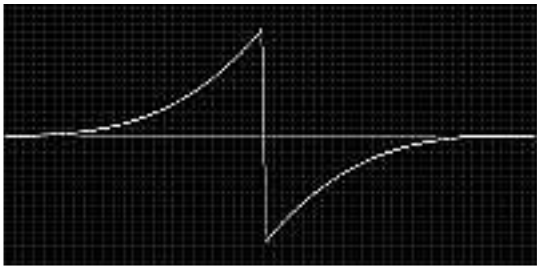


Figure 22. *SAW3 waveform*

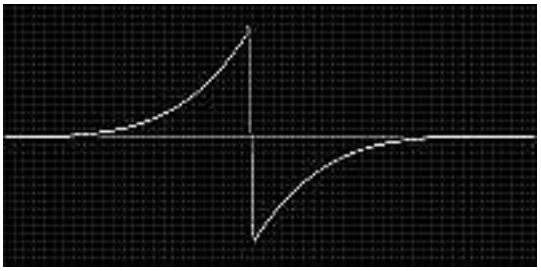


Figure 23. *SAW4 waveform*

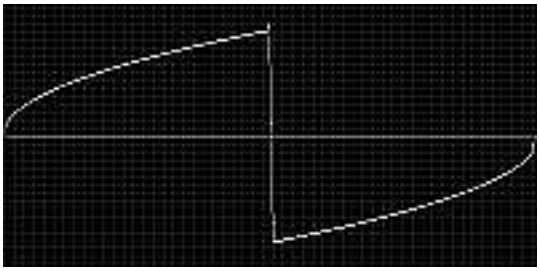


Figure 24. *SAWR2 waveform*

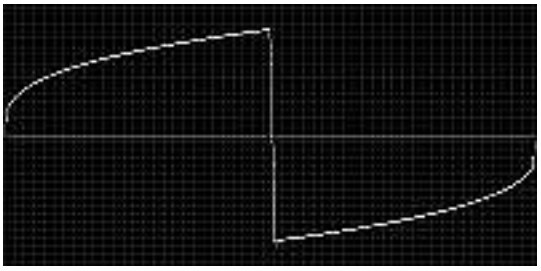


Figure 25. *SAWR3 waveform*

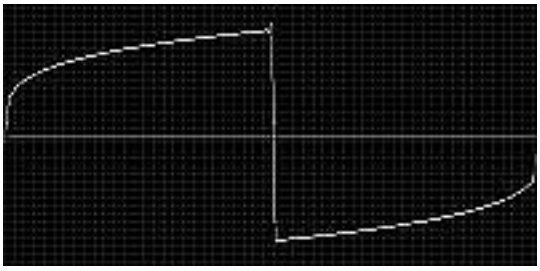


Figure 26. *SAWR4 waveform*

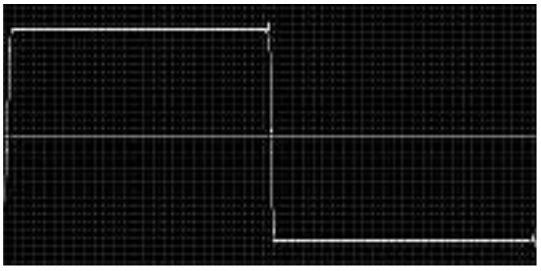


Figure 27. *SQ waveform*

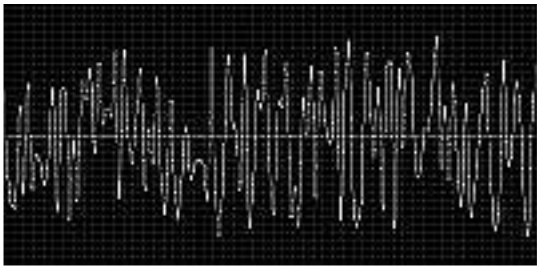


Figure 28. *NOISE waveform*

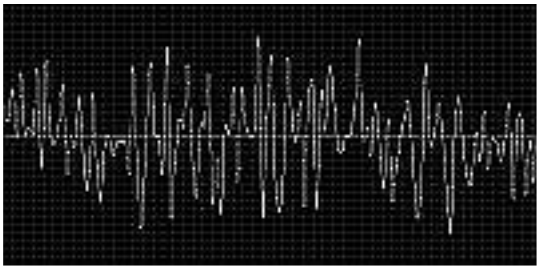


Figure 29. *NOISE2 waveform*

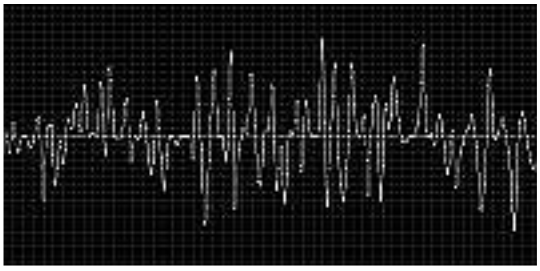


Figure 30. *NOISE3 waveform*

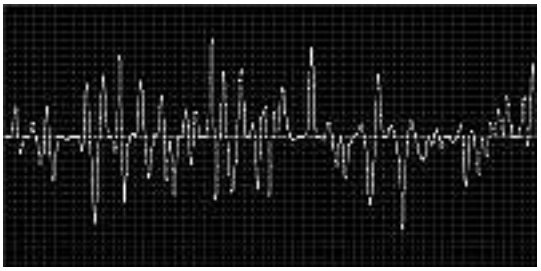


Figure 31. *NOISE4 waveform*

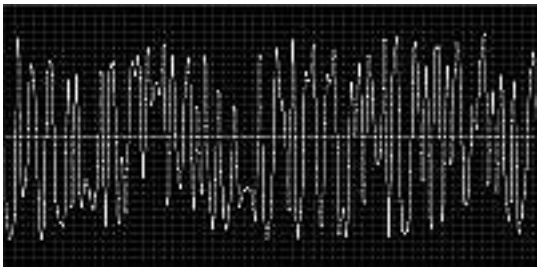


Figure 32. *NOISER2 waveform*

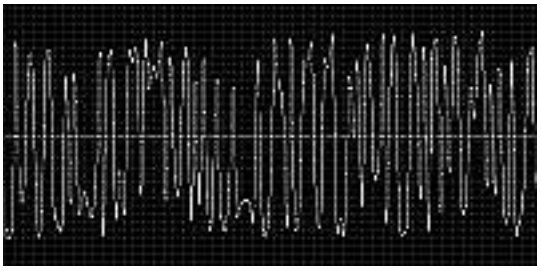


Figure 33. *NOISER3 waveform*

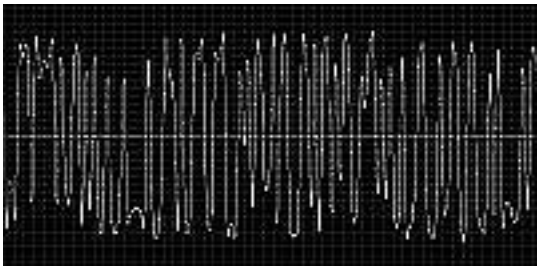


Figure 34. *NOISER4 waveform*

Appendix B: Frequencies of MIDI Notes

Every synthesizer that can be tuned to a specific frequency (BAM, BFM, FM, KS, PSQ, ROT) can be set for either traditional 12-tone MIDI tuning or absolute frequencies. If it is set to MIDI tuning the frequency in the GEN menu is a symbol like "A_4". This means it is an "A" in the 5th octave. The table below shows the actual frequency for each MIDI note.

MIDI Name	Freq (Hz)	MIDI Name	Freq (Hz)	MIDI Name	Freq (Hz)
C_0	8.17579891	G_3	97.9988589	D_7	1174.65907
CS_0	8.66195721	GS_3	103.826174	DS_7	1244.50793
D_0	9.17702399	A_3	110.000000	E_7	1318.51022
DS_0	9.72271824	AS_3	116.540940	F_7	1396.91292
E_0	10.3008611	B_3	123.470825	FS_7	1479.97769
F_0	10.9133822	C_4	130.812782	G_7	1567.98174
FS_0	11.5623257	CS_4	138.591315	GS_7	1661.21879
G_0	12.2498573	D_4	146.832383	A_7	1760.00000
GS_0	12.9782717	DS_4	155.563491	AS_7	1864.65504
A_0	13.7500000	E_4	164.813778	B_7	1975.53320
AS_0	14.5676175	F_4	174.614115	C_8	2093.00452
B_0	15.4338531	FS_4	184.997211	CS_8	2217.46104
C_1	16.3515978	G_4	195.997717	D_8	2349.31814
CS_1	17.3239144	GS_4	207.652348	DS_8	2489.01586
D_1	18.3540479	A_4	220.000000	E_8	2637.02045
DS_1	19.4454364	AS_4	233.081880	F_8	2793.82585
E_1	20.6017223	B_4	246.941650	FS_8	2959.95538
F_1	21.8267644	C_5	261.625565	G_8	3135.96348
FS_1	23.1246514	CS_5	277.182630	GS_8	3322.43758
G_1	24.4997147	D_5	293.664767	A_8	3520.00000
GS_1	25.9565435	DS_5	311.126983	AS_8	3729.31009
A_1	27.5000000	E_5	329.627556	B_8	3951.06641
AS_1	29.1352350	F_5	349.228231	C_9	4186.00904
B_1	30.8677063	FS_5	369.994422	CS_9	4434.92209
C_2	32.7031956	G_5	391.995435	D_9	4698.63628
CS_2	34.6478288	GS_5	415.304697	DS_9	4978.03173
D_2	36.7080959	A_5	440.000000	E_9	5274.04091
DS_2	38.8908729	AS_5	466.163761	F_9	5587.65170
E_2	41.2034446	B_5	493.883301	FS_9	5919.91076
F_2	43.6535289	C_6	523.251130	G_9	6271.92697
FS_2	46.2493028	CS_6	554.365261	GS_9	6644.87516
G_2	48.9994294	D_6	587.329535	A_9	7040.00000
GS_2	51.9130871	DS_6	622.253967	AS_9	7458.62018
A_2	55.0000000	E_6	659.255113	B_9	7902.13282
AS_2	58.2704701	F_6	698.456462	C_10	8372.01808
B_2	61.7354126	FS_6	739.988845	CS_10	8869.84419
C_3	65.4063913	G_6	783.990871	D_10	9397.27257
CS_3	69.2956577	GS_6	830.609395	DS_10	9956.06347
D_3	73.4161919	A_6	880.000000	E_10	10548.0818
DS_3	77.7817459	AS_6	932.327523	F_10	11175.3034
E_3	82.4068892	B_6	987.766602	FS_10	11839.8215
F_3	87.3070578	C_7	1046.50226	G_10	12543.8539
FS_3	92.4986056	CS_7	1108.73052		

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Thanks and I hope you enjoy!

Ethan Bordeaux