E-mu Systems, Inc.

SE

RETRO

Spectrum Interpolation
Digital Synthesis

Emax SE Manual

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Digital Synthesis

Emax SE™ Update Manual

TABLE OF CONTENTS

HOW TO UPDATE YOUR EMAX TO EMAX SE

READ THIS FIRST!
This Emax SE product update allows you to update *one* Emax to an Emax SE. It also allows you to make copies of the disks and software that will run on your Emax. Sound disks formatted on your updated Emax can be loaded into a regular Emax, however they will not boot the non-SE unit. To avoid the error message "Different Software Rev.", and so that you will have backup copies of the software, you should update all your sound disks with the SE software.

Your SE Update includes:

- SE Update Manual
- Emax SE Update/Development Disk
- Spectrum Synthesis Sound Disk
- Transform Multiplication ^{TM} Sound Disk

To Update Your Emax:
1. Locate the Emax SE Retrofit disk. This disk contains the SE software.
2. Make sure that the write protect window is closed (Unprotected).
3. Boot up your Emax with the SE Retrofit disk.
4. The SE update will be done automatically and Emax will display:
   "SE Updated. Please Re-boot".
5. Remove the SE Retrofit disk and switch off Emax.
   Switch power on again and re-insert the disk.
6. Emax will now boot the SE software and you can update the software on your disk library.

You already know how to update the software on your disk library, but just in case you need a refresher, here it is again:

1. Boot up your Emax with the SE Retrofit disk.
2. Activate **MASTER**, then **Special (8)**, and select function 1. Copy Software.
3. The display will ask you if it's "OK to erase memory?" and you, of course, reply **YES.**
4. The display now asks you to insert the source disk. It's already in the drive, so press **ENTER.**
5. When the display prompts you, insert an unprotected disk in the drive and press **ENTER** again.
6. Continue to update your entire library.

To Update Your Emax HD

1. Locate the Emax HD SE Retrofit disk. This disk contains the SE software.
2. Make sure that the write protect window is closed (Unprotected).
3. Insert the SE Retrofit disk into the drive and power up your Emax.
4. The SE update will be done automatically.
    The Emax will display "SE updated. Please Re-boot".
5. Remove the SE Retrofit disk and switch off the Emax. Turn the power on again and re-insert the disk.
6. Activate **MASTER**, then Special **(0), and** select function 1. Copy Software.
7. The display will ask you **if** it's "OK to erase memory?' Press **YES.**
8. The display now says, "Copy Software From:" Select "From floppy".
9. The SE Retrofit disk is already in the drive, so press **ENTER.**
10. The display now says "Copy Software To:" Select "To hard disk", and press **ENTER.**
11. Update your floppy disks as well so that you have at least two SE backup disks.

ONE MORE THING!

Your Footswitch jacks may have been uncalibrated by the SE update procedure. It would be a good idea at this time to go to the recalibrate menu (located under MASTER, Special) and check to see if the footswitch polarity has changed and if so, change it back to the correct polarity for your footswitches.

INTRODUCTION
This product update reflects our ongoing commitment to bring you the best possible musical instruments. We have included a number of new and very powerful features in this update, (including a complete digital synthesizer!) and have eliminated a few nagging "bugs". (We know – it's hard to believe that your Emax isn't *totally* perfect!) Listed below is an overview of the update, followed by a user guide to explain the new features and how they operate.

Spectrum Interpolation Synthesis: A complete digital additive synthesizer is the basis of this update. At last...additive synthesis that is user friendly! Never before have the dynamic timbres of digital synthesis been so easy to create. Simply define up to 24 *Spectrums* (or select them from the on board palette of 100), place them at any or all of the *Time Slice* locations, and enter the "Synthesize!" command. Sounds may be any length (up to the maximum memory) and can be customized by using the sophisticated compliment of edit parameters that are included. After a sound has been created it may be spliced, combined, and processed in the same manner as a sound that has been sampled into the Emax. The Spectrum Synthesizer features Spectrum drawing/editing, Tuning of Partial Ratios, Definable Amplitude and Pitch Contours, Time Slice creation and editing, and above all - Great Sound

Digital Signal Processing: Three DSP functions are now available:

> **Transform Multiplication^{TM}** a method of creating unique timbres by multiplying together the frequency spectrums of two different sample files.

> **Sample Rate Conversion** allows a sample taken at any sample rate to be converted to another rate. (Great for memory management!)

> **Digital Pitch Conversion** allows a sample's original pitch to be digitally converted to a new pitch. This is a real bonus when doing splice/ combine functions.

Stack Preset Mode: This function allows you to stack up to four presets on each key of the keyboard. This is used to create very "fat", rich sounds.

Load HD Bank through MIDI: Program change commands can now be used to load an entire HD bank.

CD-ROM: The new Emax SE includes software that allows the Emax to interface with Optical Media International's CD-ROM. The CD-ROM is an optical form of storage that holds over 500 banks of Emax sounds on one compact disc.

MIDI Preset Change Receive On/Off: A command has been added to the MIDI menu allowing program change receive to be on or off in each

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Taper: The digital taper curve is now linear instead of exponential.

Global MIDI Channel: This function allows you to set the MIDI channel on your Emax without having to change each preset individually.

Finer Resolution of Velocity to Pitch: Allows the user more expression when *emulating* acoustic instruments. (Ha! We knew we'd get that word in!)

Expanded Delay Times: Delay mode times now range from 8 ms. to 8 secs.

VCA Envelopes: Improved the amplitude modulation response through all volume ranges.

Rack Arpeggiator: The rack mount units will now arpeggiate notes received over MIDI.

Harder Test Mode Access: Test mode (for service and diagnostics) is much more difficult to access, thereby reducing the possibility of accidental recalibration.

Improved MIDI Overflow Mode: Now any number of Emax keyboards or racks can be overflowed together.

Channel Output Volume Trims Stored to EEPROM: Don't ask!! O.K. Since you asked... The volume output of each voice channel may now be calibrated and stored along with other trim calibrations. If your channels are of uneven volume, you may now have a service center calibrate them.

Other Improvements:

- When using *Performer*^TM software by Mark of the Unicorn, the Emax no longer misses the first few notes of sequence information.

- Arpeggiator no longer latches when using the transpose function.

- MIDI sample dump now works properly with SP-1200 tiles.

- Splice and erase functions may now be used together with no corruption of the spliced voice.

- Realtime control "level" can now amplify as well as attenuate.

DIGITAL EFFECTS

1. Activate DIGITAL PROCESSING 9. The display will say:

> Digital Effects
> (1-6) / Slider

Use the data slider or increment buttons to catalog the various options.
Functions 3 - 6 have been added to the menu.

1.   Gain/Atten
2.   Reverse Sound
3.   **Change SmpRate**
4.   **Change Pitch**
5.   **Transform Mult**
6.   **Spectrum Synth**

3. CHANGE SAMPLE RATE
This digital effect allows you to digitally resample a sound at a different sample rate. **Applications**: Conserve memory space by converting a sound to a lower sample rate or convert a sound that has been digitally transferred via MIDI Sample Dump to an Emax sample rate, or convert to match another sound you wish to splice or combine it with.

1. Press **ENTER** to return to the Digital Processing menu, then **9** to return to **Digital Effects.** Choose **3** from the menu. The display says:

    > OldRate   NewRate
    > Xxxxx   yyyYY

    Where XXXXX can be any sample rate from 7000 Hz to 50000 Hz and YYYYY can be any Emax sample rate. Two new sample rates, 22,050 Hz and 44,100Hz, have been added. If the sample came via MIDI Sample Dump, then the 'OldRate" displayed may need correcting.

2. When the sample rates have been selected, press ENTER. The display warns:

    > Modifies Sample &
    > Takes XX min. OK?

XX is the time it takes the Emax to do the calculations for the conversion. Press **YES** to convert**, NO** to return to the module identifier.

Please note that the rates given in the NewRate column are the actual Emax sample rates. The sample rates shown in the Sample module are approximations. When doing sample rate conversions to conserve memory, be sure to use the actual Emax rates in the Old Rate column. Also note that Sample Rate Conversion requires memory space to perform its calculations. In some cases there may not be enough memory left to convert the sound, in which case the display warns you.

4. CHANGE PITCH
This digital effect allows you to digitally change the pitch of a sound. **Applications:** Change the pitch of a sound in order to splice or combine it with another sound of a different pitch. Offset the pitch of a copied sample by a few cents, then combine with the original for flange and chorus effects. Transpose a sound up further on the keyboard than is normally allowed by making a copy of the sound, changing the pitch upwards, and reassigning the new sample to the keyboard.

1.   Select Digital **Effects** 4 and the display will say:

> Change Pitch
> +<u>00</u>.00 semitones

The Pitch Change range is +/-35 semitones, 99 cents. Use the cursor keys to select between semitones and cents.

2.   When the amount of pitch change has been selected, press **ENTER and** the display warns:

> Modifies Sample &
> Takes XX min. OK?

XX is the time it takes the Emax to do the calculations for the pitch change. Press **YES** to change the pitch, **NO** to return to the module identifier.

Note: Pitch Change requires memory space to perform its calculations. In some cases there may not be enough memory left to convert the sound, in which case the display warns you.

5. TRANSFORM MULTIPLICATION TM

A New Way to Combine Sounds. Transform Multiplication is a powerful and fascinating Digital Signal Processing function available exclusively on Emax SE. Transform Multiplication or (TM **TM**) is a sample-by-sample computation performed on two digital sounds, resulting in a single sound which contains common frequency components of the two sources. Be cause of this, TM works best when both sounds are rich in harmonics, or the two sounds are similar in harmonics. The effect is hard to describe and the results of TM are hard to predict. Nevertheless, Transform Multiplication is an extremely powerful tool and the sounds produced will not sound like anything that you have ever heard before. Examples of some TM sounds can be heard on the Transform Multiplication disk supplied with your SE update. Using Transform Multiplication is easy! Simply select two interesting voices and let Emax do the rest. The length of the resulting sound will be equal to the length of the current voice.

1. After selecting the current voice, select **Digital Effects 5.**
    The display will say:

    > TranMult with P01
    > Select a Preset

2. Use the slider to select the preset containing the second voice to be Transform Multiplied, press **ENTER.** The display will say:

    > Key: XX   28kHz
    > Select a Voice

3. Play a key to select a voice, then press **ENTER**.
    If the size of both of the voices exceeds 32K, the display will inform you that there is "Not Enough Sample Memory!" and you will be returned to the module identifier. If both of the voices do not exceed 32K the display will say:
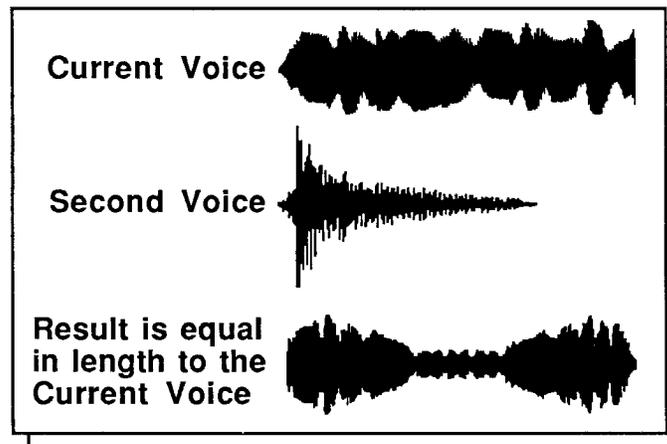

> Modifies Sample &
> Takes XX min. OK?

XX being the time it takes to do the calculations for the Transform Multiplication.

Press **YES** to continue, **NO** to return to the module identifier.

Now it's time for that well deserved break, as "This Will Take Awhile".

Note: *The 32Kbyte size limitation as we/las the long computation time is due to the large number of complex calculations required for Transform Multiplication.*

APPROACHING TRANSFORM MULTIPLICATION

Transform Multiplication is a form of synthesis that until now has only been available at large electronic music research facilities using super-computers. Because of this, the territory of sounds produced with Transform Multiplication remains largely unexplored. As you wait for Transform Multiplication to complete its millions of computations, you will gain an appreciation for the early electronic music pioneers who had to wait days to hear the results of their efforts. TM does take time to do its thing. Because of this, it can be considered an advanced application for those willing to take the time to come up with something completely different. We suggest you begin your experiments with short percussion sounds or the InstAttacks on the Spectrum Synthesis disk, as these will give good initial results. Later you can move on to room impulse response experiments or ???

TRANSFORM MULTIPUCATION EXPERIMENTS AND HINTS

- If you truncate a sound, taper the ends to avoid spectral smearing.

- Sample a popping balloon in a tiled bathroom. This will be the current voice. Choose any other interesting voice and perform Transform Multiplication. This is a basic impulse response experiment; in this case, the impulse response of the room.

- Play a sample of a popping balloon through a reverb or delay unit. Resample the resulting sound. Now use this impulse response to perform Transform Multiplication with another sound.

- Use speech as one of the voices, a pitched sound for the other. Via TM it is possible to "speak from within" violins, bassoons, cymbals, etc. Try using the same sound for both voices.

- Use sounds created with Spectrum Synthesis as TM sound sources. Experiment with the effects different spectrums have on the result.

- Splicing silence to the beginning or ends of very short sounds can change the spectral characteristics of the result.

- Splicing silence to the end of the current voice will also lengthen the final result.

- Use the digital effect "Change Pitch" to match the fundamental pitches of the two sounds, or use "Change Sample Rate" to match the two sample rates.
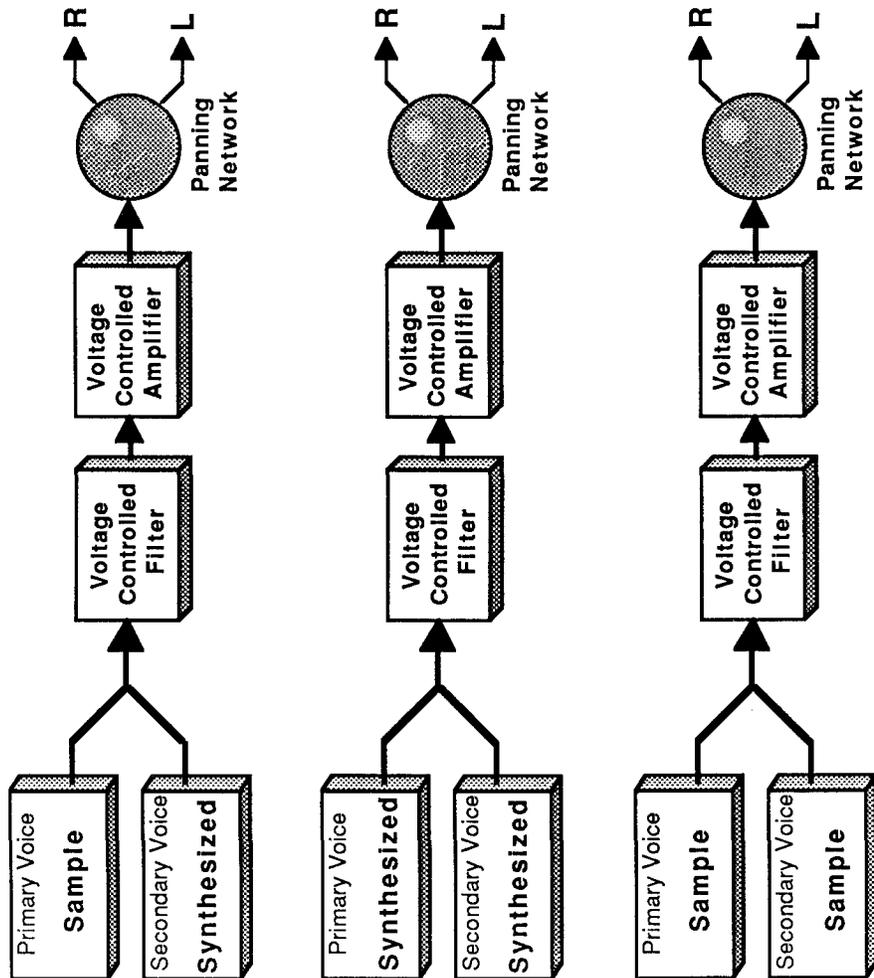
6. SPECTRUM SYNTHESIS

Spectrum Synthesis vs. Additive Synthesis.

Sine waves are the most basic components of sound. All waveforms can be broken down to their component sine waves. Additive synthesis is the process of constructing sounds by adding sine waves together in varying amounts. The pitch of any sound is determined by its Fundamental Frequency. The fundamental is the lowest frequency component and usually the one with the greatest amplitude. The other components of a complex sound are known as Partials. The way the different partials are mixed together with the fundamental frequency deter mines the tonal quality of a sound. Normally the partials are based on whole number multiples of the fundamental, 1x, 2x, 3x, etc.. When partials are whole number multiples of the fundamental, they are called harmonics. Partials do not have to be exact multiples of the fundamental. In fact, most natural sounds have some partials that are not exact multiples. Bells and cymbal's are examples of sounds in which many of the partials are detuned from a normal harmonic relationship.

So, sine waves can be added together in various amounts in order to form complex waves. But the waveform of most natural sounds varies quite dramatically over time. Simply being able to create any waveform is not enough. The waveform of a sound must vary over time or the sound is static and uninteresting. Enter the Time Slice. Emax Spectrum Synthesis allows you to specify up to 24 complex waveforms, (called Spectrums) and to either step or fade through them during the course of the sound. The 24 waveform locations are called *Time Slices,* since they represent the waveform at that slice of the sound. This allows much more complex and interesting sounds to be created. In addition, each partial (sine wave) can have a 24 point envelope that determines the pitch of that partial over the course of the sound.

Each Emax SE voice can consist of two synthesized timbres, a synthesized timbre and a sampled sound, or two sampled sounds. The resulting voice can then be processed using the Emax's extensive Analog Processing features, and then placed anywhere in the stereo field. This is accomplished using Emax's Dual Mode tm, which allows two voices to share the same analog parameters while preserving eight-note polyphony. For example, the primary voice could be the attack of an overblown flute, and the secondary voice could be a synthesized timbre of your own creation. When played together, the total effect is that of a natural sound, but a *totally new* natural sound. The possibilities are indeed endless.

1. Select Digital Effects 6 and the display will say:

> Synth Changes
> Data ! OK ?

If it's OK to write over the current voice, press **YES**. If not press **NO** to return to the module identifier. If you pressed **YES,** the display will now say:
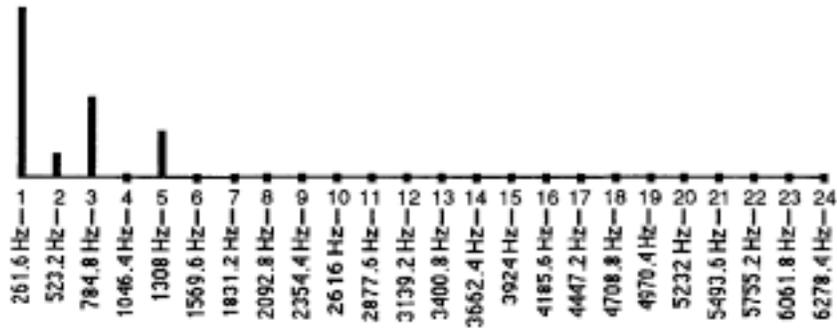
> Synth Options
> [0-9] / Slider

2. Use the slider to catalog the various options.

    1. Freq. Spectrum
    2. Time Slice
    3. Ampl. Contour
    4. Pitch Contour
    5. Pitch/Ratios
    6. Interpolate
    7. Load Backup
    8. Save Backup
    9. Erase
    0. Synthesize!

Spectrum Interpolation Synthesis: Spectrum Synthesis can create dynamically shifting timbres using additive synthesis techniques. Virtually any imaginable waveform may be created. Up to 24 sine waves are added together to form Spectrums. Spectrums are then placed at up to 24 Time Slice locations over the length of the sound. As the sound is played, it either steps or smoothly fades through the spectrums. Sounds may be any length (up to the maximum memory) and can be customized by using the sophisticated complement of edit parameters that are included. After a sound has been created it may be spliced, combined, and processed in the same manner as a sound that has been sampled into the Emax. Using the Emax's Dual Mode TM, the attacks of sampled sounds such as flutes, horns, and vocals can be combined with synthesized sounds for L.A. or cross-wave type synthesizer sounds.
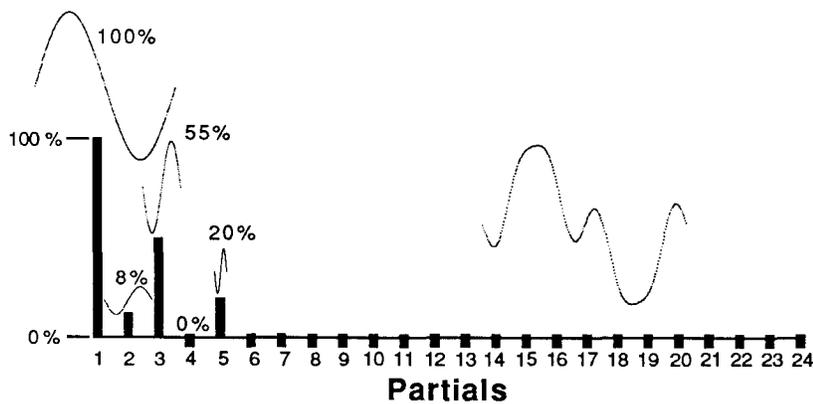
About Spectrums: The spectrum synthesizer development disk contains 95 pre-programmed spectrums for you to use, or you may create and store your own. Each spectrum may contain up to 24 sine waves, with each wave having its own specific amplitude (volume). These sine waves may be tuned

PARTIALS. This chart shows the frequencies of the 24 partials (sine waves) when they are tuned harmonically. The fundamental is set at C3.

to any ratio of the fundamental frequency. These ratios do not need to be harmonically related to the fundamental pitch of your sound; hence the sine waves are called partials, rather than harmonics. Varying the amplitude of a specific partial will result in a timbre change. Generally, the greater the amplitude of the higher partials, the brighter the resulting sound will be. A spectrum may be placed at any of the 24 Time Slice locations. Placing a spectrum at a given time slice will determine the timbre of the sound at that point in time.

About Time Slices: Once you have determined the length of the sound that you wish to synthesize, the Emax automatically divides the sound into 24 equal sections. Each section is called a Time Slice, and contains the spectrum at a given point in the sound. You can create a Time Slice and save it as a Spectrum, or place a previously created Spectrum at a Time Slice.

SPECTRUM. Adding those Partials together in these ratios produces this waveform.

CREATING SOUNDS

The best way to learn about the spectrum synthesizer is by creating a sound! Load the Spectrum Synthesis disk into your Emax and define the location and the length of the sound. This can be accomplished in one of three ways:

A. Select a preset 95-99 on the Spectrum Synthesis development disk. These contain empty samples.
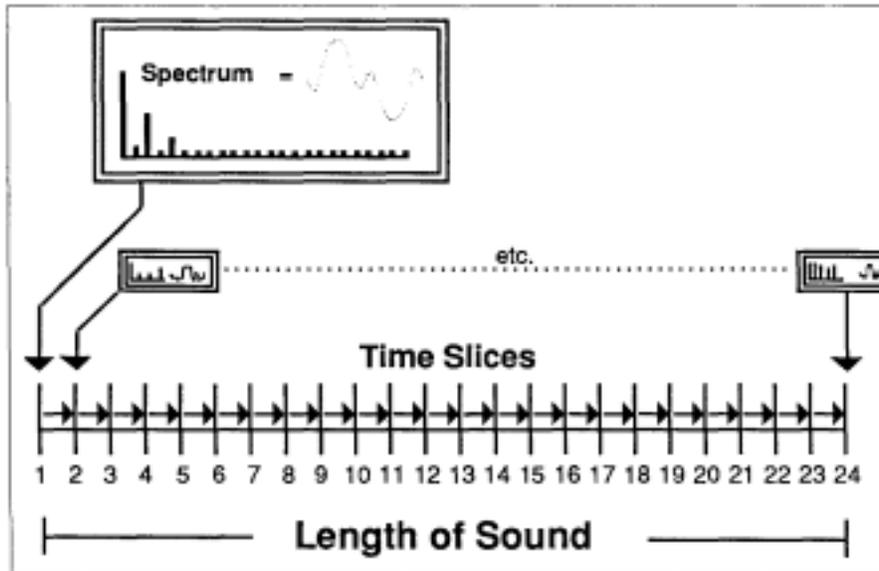
<p align="center">***or***</p>

B. 1. Clear all memory. **(Master #4)**
2. Enter the **SAMPLE** module.
3. Press **#4** on the keypad and select the length that you want the synthesized sound to be.
    Hint: The longer the sound, the more time it will take to synthesize.
4. Press **#7** on the keypad to force sampling.
5. Press the **SAMPLE** button to exit the sample module.

<p align="center">***or***</p>

C. Write over an existing sample. The synthesized sound will replace the sampled sound. *(Remember to back up the sample first!)*

Now you that you have defined a location and length for the sound, its time to start synthesizing!
1. Enter the **DIGITAL** module and select the voice you just created.
2. Press **#9** on the keypad to access the **Digital Effects** menu.
3. Press **#6** on the keypad to access "Spectrum Synth". The display will read "Synth Changes Data! OK?". Press **YES** to continue. (**NO** to exit).

TIME SLICE. Each Spectrum plays for one time slice (1/24 of the sound) or can be cross-faded between time slices. Spectrums can be placed at any time slice location.

4. Now you are in the Synth Options menu. Press **#1** (Freq. Spectrum) on the keypad and hit **ENTER**. The display will show Spectrum #1 and you will see a series of vertical lines. These lines represent the amplitudes of the 24 partials contained in the spectrum.

Note: Because of the limited display resolution, each dot in the bar graph represents 14% of full level. If a partial has a level of less than 14%, the bar will appear to be 0%.

5. Press **NO** until the display says "Spectrum ->TS Y/N", then press **YES**.
6. The display now says "Move SP01 to: TS01, and the ENTER tight will be flashing. Press **ENTER**. Spectrum #1 has been placed at Time Slice #1.

You have now defined a tonality for the beginning of the sound .To define the tonality at the end of the sound repeat steps #5 - #7 but in step #5 select

Slice #24. To fill in the "middle" of the sound, we use the "Interpolate" function. This tells the Emax to create all of the spectrums between time slices 1 and 24.

INTERPOLATION. Interpolation smoothes the harmonic movement from one

Time Slices

Time Slice to another.

1. Press **#6 Interpolate** on the keypad. The display reads 'Interpolate from:TSO1..."
2. Press **ENTER**. The display now reads "Interpolate to: TSO1. Use the slider to select Time Slice #24 and press **ENTER** to execute the interpolation.
3. Now press **#2 Time Slice** and slowly move the slider. You will see that the Emax has created Time Slices 2 - 23. These Time Slices represent the gradual transition from Time Slice #1 to Time Slice #24. Move the slider all the way to the bottom. The display will show "None - exit". Press **ENTER** to return to the Synth Options menu.

At this point it is time to tell the Emax to generate the sound that you have defined. This is done by pressing **#0 Synthesize!** on the keypad. There are two modes of synthesis: Smooth and Stepped. Smooth will produce a very gradual tonal change from time slice to time slice. Stepped will result in more abrupt tonal changes, as each time slice plays for exactly one twenty-fourth of the sound and then jumps to the next time slice. Select the "smooth" mode by using the **YES / NO** buttons, then press **ENTER** to begin synthesizing. The display will show how many time slices are left to synthesize, then prompt you to play the sound when the synthesis is complete.

SPECTRUM SYNTH OPTIONS MENU

There are ten options listed in the Spectrum Synthesis menu. Each of these options covers a specific function or group of functions, and some contain sub-menus and functions. When a menu option contains multiple functions, answering **YES** to the prompt " ... Y/N "will execute the function and then take you to the next level of operation. Answering **NO** to the prompt takes you to the next option in the sub-menu. The menu options are as follows:

1. Frequency Spectrum.

In this menu, spectrums may be drawn, edited, copied, and placed.

Draw a Spectrum: Use for quick and easy creation of spectrums.
a. Press **#1** on the keypad to access the Frequency Spectrum menu options.
b. Use the slider to select the number of the spectrum you wish to draw. Press **ENTER.**
c. Press **YES** to start the drawing countdown. You will see the display countdown 5...4...3...2...1... When the countdown finishes, the drawing process starts. The cursor position automatically moves from left to right -each position of the cursor denoting one partial. By raising and lowering the slider as the cursor moves across the screen, you can draw the amplitude of each of the twenty-four partials. The bar graph displays the relative amplitude of the partials.
d. Press **NO** three times to return to the Synth Options menu.

Edit a Spectrum: Use for precise definitions of spectrums and partial amplitudes.
a. Press **#1** on the keypad to access the Frequency Spectrum menu options.
b. Use the slider to select the number of the spectrum you wish to edit. Press **ENTER.**
c. Press **NO** to get to the spectrum EDIT screen. Press **YES** to edit.
d. Use the slider to enter the amplitude of the partials. Amplitude is shown in percentages on the right hand side of the screen.
e. Use the cursor (< - - >) buttons to move from partial to partial.
f. Press **ENTER** , then **NO** twice to return to the Synth Options menu.

Copy a Spectrum: Use for creating a duplicate spectrum, which can then be modified.
a. Press **#1** on the keypad to access the Frequency Spectrum menu options.
b. Use the slider to select the number of the spectrum you wish to copy. Press **ENTER.**
c. Press **NO** two times to get to the spectrum COPY screen.
d. Press **YES** to copy. The display reads "Copy SPO1 to SPO1..'.
e. Use the slider to select the number of spectrum you want to copy to ..
f. Press **ENTER** then **NO** to return to the Synth Options menu, or **YES** to make another copy.

Spectrum -> TS: Use for placing a spectrum at a Time Slice location.
  a. Press **#1** on the keypad to access the Frequency Spectrum menu
      options. b. Use the slider to select the number of the spectrum you wish
      to move. Press **ENTER**.
  c. Press **NO** three times to get to the MOVE screen.
  d. Press **YES.** The display will read "Move SPO1 to: TSO1
  e. Use the slider to select the number of the time slice where you want to
      move the spectrum.
  f. Press **ENTER** to execute the move.

Note*: After executing a function in the Frequency Spectrum options menu,
it is not necessary to exit the menu before accessing another function. For
example, you may draw a spectrum, then edit, copy, and move it before
returning to the Synth Options menu.*

2. Time Slice.
In this menu, time slices may be drawn, edited, copied, and moved. This is
exactly like creating Frequency Spectrums except that here the Spectrums
are already placed at Time Slice locations.

Draw a Time Slice: Use for quick and easy creation of time slices.
  a. Press **#2** on the keypad to access the Time Slice menu options.
  b. Use the slider to select the number of the time slice you wish to draw.
      Press **ENTER.**
  c. Press **YES** to start the drawing countdown. You will see the display
      countdown 5...4...3...2...1... When the countdown finishes, the drawing
      process starts. The cursor position automatically moves from left to
      right -each position of the cursor denoting one partial. By raising and
      lowering the slider as the cursor moves across the screen, you can
      draw the amplitude of each of the twenty-four partials. The bar graph
      displays the relative amplitude of the partials.
  d. Press **NO** three times to return to the Synth Options menu.

Edit a Time Slice: Use for precise definition of time slices and partial
amplitudes.
  a. Press **#2** on the keypad to access the Time Slice menu options.
  b. Use the slider to select the number of the time slice you wish to edit.
      Press **ENTER.**
  c. Press **NO** to get to the time slice EDIT screen. Press **YES** to edit.
  d. Use the slider to enter the amplitude of the partials. Amplitude is shown
      in percentages on the right hand side of the screen.
  e. Use the cursor (<- ->) buttons to move from partial to partial.
  f. Press **ENTER** , then **NO** twice to return to the Synth Options menu.

Copy a Time Slice: Use for placing the same time slice at two different locations, or for creating a duplicate time slice, which can then be modified.
a.   Press **#2** on the keypad to access the Time Slice menu options.
b.   Use the slider to select the number of the time slice you wish to copy. Press **ENTER.**
c.   Press **NO** two times to get to the time slice COPY screen.
d.   Press **YES** to copy. The display reads "Copy TSO1 to TSO1
e.   Use the slider to select the number of the time slice that you wish to copy to.
f.   Press **ENTER**, then **NO** to return to the Synth Options menu, or **YES** to make another copy.

TSLICE -> SP: Use for saving a time slice as a spectrum.
a.   Press **#2** on the keypad to access the Time Slice menu options.
b.   Use the slider to select the number of the time slice you wish to move. Press **ENTER.**
c.   Press **NO** three times to get to the MOVE screen.
d.   Press **YES.** The display will read "Move TSO1 to: SPO1 ..
e.   Use the slider to select the number of the spectrum where you want to move the time slice.
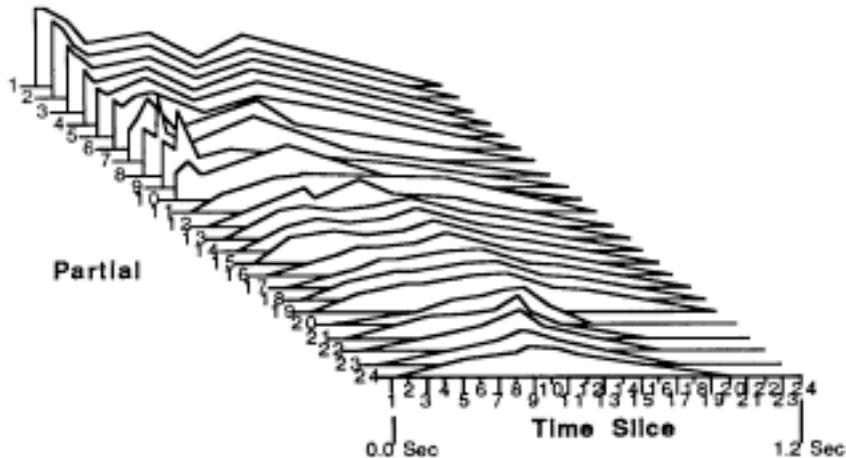f.   Press **ENTER** to execute the move.

Note: Moving a time slice to a Spectrum does not erase the time slice. After executing a function in the time slice options menu, it is not necessary to exit the menu before accessing another function. For example, you may draw a time slice, then edit, copy, and move it before returning to the Synth Options menu.

3. Amplitude Contour. In this menu you may draw, edit, and copy the amplitude envelope of specific partials.

Draw a Partial's Amplitude Contour: Use for quick and easy creation of the volume envelope of a specific partial.
a.   Press **#3** on the keypad to access the Amplitude Contour menu options.
b.   Use the slider to select the number of the partial whose amplitude contour you wish to draw. Press **ENTER**.
c.   Press **YES** to start the drawing countdown. You will see the display countdown 5. ..4. ..3.. .2... 1 ... When the countdown finishes, the drawing process starts.The cursor position automatically moves from left to right -each position of the cursor denoting one time slice. By raising and lowering the slider as the cursor moves across the screen, you can draw the amplitude of the partial at each of the 24 time slice locations. The bar graph displays the relative amplitude of the partial at

each time slice.

d. Press **NO** twice to return to the Synth Options menu.

Edit a Partial's Amplitude Contour: Use for precise definition of partial amplitudes.
a. Press **#3** on the keypad to access the Amplitude Contour menu options.
b. Use the slider to select the number of the partial whose amplitude contour you wish to edit. Press **ENTER.**
c. Press **NO** to get to the amplitude contour EDIT screen. Press **YES** to edit. d. Use the slider to enter the amplitude of the partial at each time slice. Amplitude is shown in percentages on the right hand side of the screen.
e. Use the cursor (< - - >) buttons to move from time slice to time slice. f. Press **ENTER** , then **NO** twice to return to the Synth Options menu.

Copy a Partial's Amplitude Contour: Use for copying the amplitude contour of a partial to one or more partials.
a. Press **#3** on the keypad to access the Amplitude Contour menu options.
b. Use the slider to select the number of the partial whose amplitude contour you wish to copy. Press **ENTER**.
c. Press **NO** two times to get to the amplitude contour COPY screen.
d. Press **YES** to copy. The display reads "Copy ACO1 to ACO1 ...".
e. Use the slider to select the number of the partial that you wish to copy the amplitude contour to.
f. Press **ENTER** to execute the copy.
g. Press **YES** to make another copy, or NO to return to the Synth Options menu.

Note: After executing a function in the Amplitude Contour options menu, it is not necessary to exit the menu before accessing another function. For example, you may draw an amplitude contour, then edit and copy it before returning to the Synth Options menu.

4. Pitch Contour. In this menu you may draw, edit, and copy the pitch envelope of specific partials.

Draw a Partial's Pitch Contour: Use for quick and easy creation of the pitch envelope of a specific partial.

a. Press **#4** on the keypad to access the Pitch Contour menu options.
b. Use the slider to select the number of the partial whose pitch contour you wish to draw. Press **ENTER.**
c. Press **YES** to start the drawing countdown. You will see the display countdown 5.. .4.. .3.. .2... 1... When the countdown finishes, the drawing process starts.The cursor position automatically moves from left to right -each position of the cursor denoting one time slice. By raising and lowering the slider as the cursor moves across the screen, you can draw the pitch of the partial at each of the 24 time slice locations. The bar graph displays the relative pitch of the partial at each time slice, from minus one semitone to plus one semitone.
d. Press **NO** twice to return to the Synth Options menu.

Edit a Partial's Pitch Contour: Use for precise definition of partial pitches.

a. Press **#4** on the keypad to access the Pitch Contour menu options.
b. Use the slider to select the number of the partial whose pitch contour you wish to edit. Press **ENTER.**
c. Press **NO** to get to the pitch contour EDIT screen. Press **YES** to edit.
d. Use the slider to enter the pitch of the partial at each time slice. Pitch is shown in cents on the right hand side of the screen, from minus 99 to plus 98 cents.
e. Use the cursor buttons to move from time slice to time slice.
f. Press **ENTER,** then **NO** twice to return to the Synth Options menu.

Copy a Partial's Pitch Contour: Use for copying the pitch contour of a partial to one or more partials.

a. Press **#4** on the keypad to access the Pitch Contour menu options.
b. Use the slider to select the number of the partial whose pitch contour you wish to copy. Press **ENTER.**
c. Press **NO** two times to get to the pitch contour COPY screen.
d. Press **YES** to copy. The display reads "Copy PCO1 to PCO1
e. Use the slider to select the number of the partial that you wish to copy the

f.   Press **ENTER** to execute the copy.
g.   Press **YES** to make another copy, or **NO** to return to the Synth Options menu.

Note: After executing a function in the Pitch Contour options menu, it is not necessary to exit the menu before accessing another function. For example, you may draw a pitch contour, then edit and copy it before returning to the Synth Options menu.

5. Pitch / Ratios. In this menu you may determine the pitch of the note you are synthesizing, and define the ratios of all of the partials. Original pitch may range from C0 to C5. Partials may be any ratio to the fundamental pitch from 1.00 to 40.99. The default pitch is C3 (middle C). The default ratio tunings of the partials are harmonics 1 through 24.

To Define the Pitch of the sound you wish to synthesize:
a.   Press **#5** on the keypad to access the Pitch / Ratios menu. Partial #1 appears on the screen and shows a default pitch of C3.
b.   Press the right cursor button to move the cursor under the C3.
c.   Use the slider or the **YES/NO** buttons to select the desired pitch.
d.   Press **ENTE**R to return to the Synth Options menu.

To Define Partial Ratios: Use for tuning partials to ratios other than the first 24 in harmonic series.
a.   Press **#5** on the keypad to access the Pitch / Ratios menu.
b.   Use the slider to select the partial whose ratio you wish to define.
c.   Press the right cursor button to select the partial tuning lens" column.
d.   Use the slider, **YES/NO** buttons on the keypad to enter the ratio you desire.
e.   Press the right cursor button to select the partial tuning "hundredths" column.
f.   Use the slider, **YES/NO** buttons or the keypad to enter the ratio you desire.
g.   Press **ENTER** to return to the Synth Options menu.

Note: After defining a pitch or ratio tuning in the Pitch / Ratios options menu, it is not necessary to exit the menu before accessing another partial. For example, you may define the pitch of the synthesized sound, then set the ratios of up to 24 different partials before returning to the Synth Options menu.

6. Interpolate. Use for creating spectrums between time slices, or for smoothing out the harmonic movement from one time slice to another.
  a. Press **#6** on the keypad to access the Interpolation screens.
  b. Use the slider to select the time slice you wish to interpolate from.
  c. Press **ENTER.**
  d. Use the slider to select the time slice you wish to interpolate to.
  e. Press **ENTER** to return to the Additive Options menu.

Note: An easy way to create a sound is to place a spectrum at time slice #1, place another spectrum at time slice #24, then Interpolate from time slice #1 to time slice #24. This fills in time slices #2 through #23. If there is no spectrum at a given time slice, then there will be no sound generated when that time slice is played. It is necessary to define a spectrum at each time slice, or interpolate across blank time slices to synthesize an uninterrupted sound.

7. Load Parameters. Use to load Time Slices, Amplitude Contours, and Pitch Contours from one of the three backup banks into the current memory.
  a. Press **#7** on the keypad to access the Load Parameters function.
  b. Use the slider to select the backup bank you wish to load. (The display will show whether the bank is empty or full.)
  c. Press **ENTER** to execute the load and return to the Synth Options menu.

8. Save Parameters. Use to save Time Slices, Amplitude Contours, and Pitch Contours (All Parameters) into one of the three backup banks from the current memory.
  a. Press **#8** on the keypad to access the Save Parameters function.
  b. Use the slider to select the backup bank you wish to save the current memory to. (The display will show whether the bank is empty or full.)
  c. Press **ENTER** to execute the save and return to the Synth Options menu.

Please note that parameters are not saved to disk until you have "Saved Bank". Also note that the parameters of a sound are not automatically loaded when that sound file is selected in Digital Processing. If you believe that it will be necessary to edit a sound after you have already started working on another one, it is advisable to first save the parameters of the sound before starting on the new one. This is the only way that the sound's original parameters can be restored. Failure to save these parameters will prevent you from re-creating your sound!

9. Erase. The following items may be erased:
> None
> Backup #1
> Backup #2
> Backup #3
> Current Parameters
> Spectrums (entire palette)
> All! (everything listed above)

To Erase:
   a. Press **#9** on the keypad to access the Erase screens.
   b. Use the slider to access the erase option you desire.
   c. Press **ENTER** and then **YES** to execute the erase and return to the Synth Options menu.

0. Synthesize! Use to generate the sound that you have defined.
   a. Press **#0** on the keypad to access the Synthesize! menu.
   b. Use the slider to select "smooth" or "stepped".
   c. Press **ENTER** to begin synthesizing.
   d. When the Emax is done calculating, play the sound on the keyboard.
   e. Press **ENTER** again to return to the Synth Options menu.

Note: After returning to the Synth Options menu, the sound is no longer active on the keyboard. The only time you will hear your sound is after "Synthesize!" or when you leave the Synth module entirely.

There are two modes of synthesis - "Smooth" and "Stepped". "Smooth" will produce a very gradual tonal change from time slice to time slice. "Stepped" will result in more abrupt tonal changes, as each time slice plays for exactly one twenty-fourth of the sound and then jumps to the next time slice. A sound may be synthesized in one mode and then synthesized again in the other mode. Use the mode that best suits the type of sound you are trying to create.

APPROACHING SPECTRUM SYNTHESIS

As with any type of synthesis, there are many ways of approaching the creation of sound. No matter how long you have worked with any synthesizer there are always new sounds that have yet to be created. The palette of possible sounds is just so large that whole categories are bound to be missed. And remember that some of the best sounds are created by accident or chance. Spectrum Synthesis (and the Emax in general) can be thought of as a powerful audio laboratory; Spectrum Synthesis being just one of the tools in your lab. We have presented some ideas so you will have a starting point with regard to your own experiments. Remember to turn in your lab notebook by Friday.

SPECTRUM SYNTHESIS EXPERIMENTS

- Start with a Spectrum at Time Slice location 01 and one at location 24. Interpolate between them, then synthesize. Add Spectrums to the sound in order to add complexity.

- Create sounds by using the Amplitude Contour function. This may be a more intuitive way for you to synthesize sounds. Amplitude Contour lets you draw the amplitude envelope for each partial as shown in the Amplitude Contour diagram. Use combinations of Time Slicing and Amplitude Contouring.

- Insert wildly varying Spectrums at each Time Slice location and synthesize using the stepped function for wavetable synthesizer sounds.

- Splice the sampled attack portion of a sound onto the beginning of your synthesized sound. Preset 01 (InstAttacks') of the Spectrum Synthesis disk contains a full range of various attacks just for this purpose. The attack portion of a sound carries a great deal of information to your ears about the nature of a sound. That sampled flute chiff might be just what your synthesized sound needs. If you don't want to permanently splice the two sounds together, use Dual Mode with the sampled attack as the primary sound and the synthesized sustain as the secondary sound. This is very similar to the synthesis techniques used in L.A. or cross-wave synthesizers.

- Use the Pitch/Ratio function to set the upper 12 partials so that they are just slightly detuned from the first 12. For instance, set the ratio of partial 13 to 1.06, partial 14 to 2.06 and so on. This will cause beating between the oscillators and fatten up the sound just as it does on an analog synth. Spectrums 11 through 20 (marked "1-12" in their titles) on the Spectrum Synthesis development disk have their partials set up in this way.

- Use the Pitch/Ratio function to change the ratios of the partials so that they are not whole number multiples of the fundamental. This will get you into the realm of bells and clangorous noises. Try changing the ratios of just one or two partials and note the effects.

- Each partial has its own 24-stage pitch envelope. Many natural sounds have pitch variations occurring at various points during their evolution. For instance, plucked string instruments start off a little sharp, and then return to pitch. Experiment by pitch bending different partials and noting the effect.

Mathematics and music always seem to be closely related. Try applying mathematical ratios and number series to the creation of sound. For instance, interpolate between prime numbered harmonics and non-prime numbered harmonics. Fibonacci sequences, i.e. 1,1,2,3,5,8,13,21...., or squares, cubes etc. You name it.

If you have *Sound Designer^{TM}* by Digidesign, try taking a sampled sound and running a frequency analysis on it. Next, make a print out of the frequency plot and try to copy the partial envelopes using the Amplitude Contour function in Spectrum Synthesis. It probably won't sound exactly like the real sound but will put you into the general area for further experiments.

OTHER TIPS

1. Save Time. You have noticed that the Emax takes time to perform the thousands of calculations necessary for Spectrum Synthesis. You can save your valuable time by working on short sounds (0.6 sec to 1.2 sec), then lengthening it when it sounds the way you want. You will still be able to hear the sound's characteristics and the calculation time will be cut dramatically. Also bear in mind that the fewer partials that are in the sound, the less time it will take to synthesize. Interesting sounds can be created with just a few partials.

2. Multi-Sample. Resynthesize your sound at a minimum of 4 pitches and place them across the keyboard to minimize the negative effects of pitch shifting.

3. Save Parameters. When you have created an interesting sound, use the "Save Parameters" function to save it to one of the three backups. You can recall the parameters later and use them as a starting point to create new sounds. Remember to "Save Bank" or the parameters will be lost forever.

STACK PRESETS

Located in the Preset Definition module at 0., this function allows you to stack up to four presets on each key of the keyboard.

In Stack Preset mode, the current preset can be "Stacked" with up to three adjacent presets above it. For instance; if the current preset is 01, then presets 02, 03, and 04 may be stacked up so that one key will sound all four presets. The polyphony of Emax will vary according to the voice architecture of each preset in the stack.

1. Select the Current Preset. This preset will contain the stack information.

2. Activate PRESET DEFINITION 0. The display says:

```
Stack Presets
XX thru YY
```

Where XX is the current preset and YY is the last preset that will be stacked. Use the slider to select the number of presets to be stacked. Press ENTER after making your choice, and Emax will return to the Module Identifier.

GLOBAL MIDI CHANNEL

This function allows you to set the MIDI channel on your Emax without having to change each preset individually. Sometimes too much programmability can be a drag. All you wanted to do was change the MIDI channel and you have to modify every preset? No more. MIDI channel can now be controlled globally.

1.   Activate **MASTER, Special 2. MIDI Master**.

2.   The display says:

```
Chnl        Overflow
off         off
```

3.   Use the slider to select the MIDI channel. Your Emax is now in poly mode on that channel. (Supermode still overrides this mode.) Selecting "off" allows the Current Preset to determine the MIDI channel.

4.   Move the cursor to Overflow to turn MIDI Overflow on or off. Overflow mode, as you know, transmits notes over MIDI only when Emax runs out of

LOAD HD BANK THROUGH MIDI

This function allows you to load a hard disk bank via MIDI command. HD versions of Emax have an extra option under the MIDI Master menu. HD bank allows you to load a hard disk bank via a MIDI program change (actually via two MIDI program changes). HD bank is set to a "Key" preset that is used to tell Emax that the next preset change command will change the hard disk bank number. If an invalid bank number is sent, Emax will return to normal preset mode.

1.   Activate **MASTER, Special 2. MIDI Master**.

2.   The display says:

> | Chnl | Overflow | HDbank |
> |------|----------|--------|
> | off | off | off |

3.   Place the cursor under HDbank and move the slider. Presets 00-99 may be selected as the "Key" preset. For example, if preset 32 was selected under HD bank, a preset change command of 32 followed by a preset change command of 10 would load bank 10 from the hard disk.

     As a bonus, if the second preset change number is 00, the Emax will load Bank 0, which is the floppy drive.

InstAttacks (Preset 00) SOUND CHART

Key	Sound
C1	Pitz Bass
D1	Pitz Violin
E1	Spic Cello
F1	Spic Viola
G1	Spic Violin
A1	El Bass Slap
B1	Stratocaster
C2	El. Guitar Mute
D2	Nylon Guitar
E2	Hammered Dulcimer
F2	Koto
G2	Sitar
A2	Harp
B2	Piano
C3	Harpsichord
D3	Rhodes
E3	Bassoon
F3	Clarinet
G3	English Horn
A3	Flute
B3	Tenor Sax
C4	Timpani
D4	Bell
E4	Marimba
F4	Drum 1
G4	Log Drum
A4	Cowbell
B4	Ahhh
C4	Pan Pipe
D4	Calliope Lo
E4	Calliope Hi

Note to Frequency Conversion Chart

Note	Frequency	Note	Frequency	Note	Frequency
C0	32.70 Hz	G2#	207.65Hz	E5	1318.51 Hz
C0#	34.65 Hz	A2	220.00Hz	F5	1396.91 Hz
D0	36.71 Hz	A2#	233.08Hz	F5#	1474.98 Hz
D0#	38.91 Hz	B2	246.94Hz	G5	1567.98 Hz
E0	41.20 Hz	C3	261.63Hz	G5#	1661.22 Hz
F0	43.65 Hz	C3#	277.18Hz	A5	1760.00 Hz
F0#	46.25 Hz	D3	293.67Hz	A5#	1864.66 Hz
G0	49.00 Hz	D3#	311.13Hz	B5	1975.53 Hz
G0#	51.91 Hz	E3	329.63Hz	C6	2093.01 Hz
A0	55.00 Hz	F3	349.23Hz	C6#	2217.46 Hz
A0#	58.27 Hz	F3#	369.99Hz	D6	2349.32 Hz
B0	61.74 Hz	G3	392.00Hz	D6#	2489.02 Hz
C1	65.41 Hz	G3#	415.31Hz	E6	2637.02 Hz
C1#	69.30 Hz	A3	440.00Hz	F6	2793.83 Hz
D1	73.42 Hz	A3#	466.16Hz	F6#	2959.96 Hz
D1#	77.78 Hz	B3	493.88Hz	G6	3135.96 Hz
E1	82.41 Hz	C4	523.25Hz	G6#	3322.44 Hz
F1	87.31 Hz	C4#	554.37Hz	A6	3520.00 Hz
F1#	92.50 Hz	D4	587.33Hz	A6#	3729.31 Hz
G1	98.00 Hz	D4#	622.25 Hz	B6	3951.07 Hz
G1#	103.83 Hz	E4	659.26 Hz	C7	4186.01 Hz
A1	110.00 Hz	F4	698.46 Hz	C7#	4434.92 Hz
A1#	.116.54Hz	F4#	739.99 Hz	D7	4698.64 Hz
B1	123.47 Hz	G4	783.99 Hz	D7#	4978.03 Hz
C2	130.81 Hz	G4#	830.61 Hz	E7	5274.04 Hz
C2#	138.59 Hz	A4	880.00 Hz	F7	5587.65 Hz
D2	146.83 Hz	A4#	932.33 Hz	F7#	5919.91 Hz
D2#	155.56 Hz	B4	987.77 Hz	G7	6271.93 Hz
E2	164.81 Hz	C5	1046.50 Hz	G7#	6644.88 Hz
F2	174.61 Hz	C5#	1108.73 Hz	A7	7040.00 Hz
F2#	185.00 Hz	D5	1174.66 Hz	A7#	7458.62 Hz
G2	196.00 Hz	D5#	1244.51 Hz	B7	7902.13 Hz

Emax Sample Rates

10,000
15,625
20,000
22,050
27,778
31,250
41,667
44,100

$$\frac{\text{Sample Rate}}{\text{Frequency}} = \text{Number of Bytes for a Single Cycle Loop}$$

■ EMAX SE UPDATE REGISTRATION

Emax Serial Number

Emax Model Number

☐ 1000 Keyboard
☐ 1010 HD Keyboard
☐ 1020 Rack
☐ 1021 HD Rack

If you own more than one Emax, please indicate.

Your Name:

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Telephone:

Dealer's Name:

Comments:

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