KEYBOARD CONTROL AND REAL-TIME EFFECTS

March 21, 1985

CONTENTS OF THIS MANUAL

In the Introduction you learned how to make a simple patch for
real-time effects with the velocity and pressure expression inputs.
In this section you will learn how to

- use all of the expression input buttons;
- adjust filters to the pressure and ribbon controller inputs; and
- do special real-time effects programming.

This section also describes how to program the keyboard itself. You
will learn how to

- change the tuning of the keyboard; and
- split the keyboard so that two different timbres can be on the
  keyboard simultaneously.

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Synclavier (R) is a registered trademark of New England Digital
Corporation.

KEYBOARD CONTROL

SPECIAL KEYBOARD TUNING

The standard Western scale divides the octave into twelve pitches separated by equal intervals. The Synclavier (R) keyboard uses the equal-tempered scale with the fourth A on the keyboard assigned the standard frequency of 440.0 hertz.

You can change this standard tuning by tuning the entire keyboard up or down from the 440 A standard tuning; by changing the ratio between notes to establish, for example, quarter-tone or whole-tone scales; or by changing the relative pitch of any note within a scale.

Here is a summary of the buttons used to establish special tuning.

BUTTON	USE	FUNCTION
OVERALL TUNING	Press button, turn knob.	Changes overall pitch of keyboard in .1 hertz increments.
	Press button repeatedly.	Makes octave jumps in tuning.
OCTAVE RATIO	Press button, turn knob.	Changes octave ratio.
	Press button twice.	Resets octave ratio to normal scale.
SCALE ADJUST: PITCH CLASS*	Press button.	Assigns scale adjust function to HARMONIC CONTROL buttons.
HARMONIC CONTROL Buttons	Press button, turn knob.	When SCALE ADJUST:PITCH CLASS button is lit, changes tuning of pitch class corresponding to selected button.
HARMONIC SELECT	Press button.	Restores harmonic coefficient function to HARMONIC CONTROL buttons.
SCALE ADJUST KEY ONLY**	Hold button, press key, turn knob.	Changes tuning of selected key.
SCALE RESET	Press twice	Restores tempered tuning for all pitches.

* In future releases, you will be able to use the PITCH CLASS button with the control knob to change the tuning of all keys of that pitch class.

** This function will be available in future releases.

Special Tunings

Whenever you load the Synclavier (R) operating system, the keyboard will be perfectly tuned to the 440 A, regardless of changes in temperature or humidity. You can change the tuning of the Synclavier (R) to play along with analog or acoustic instruments that may be tuned above or below a 440 A.

To change the overall pitch of the keyboard, follow these instructions:

1. Press the OVERALL TUNING button in the second panel. In the display window you will see

   440.0 HERTZ

2. Turn the control knob to dial in a new frequency for the tuning base, middle A. Any frequency between 00.0 and 1760 hertz can be dialed in, in 0.1 hertz increments.

3. Press OVERALL TUNING again to return the tuning base to 440 A.
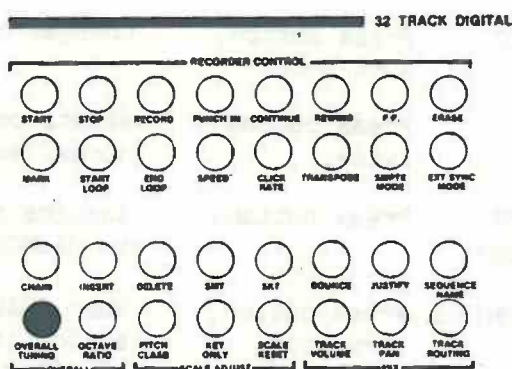
You can also use the OVERALL TUNING button itself to make instant octave changes in pitch. The first time you press OVERALL TUNING, you assign the overall tuning function to the control knob. Each additional time you press OVERALL TUNING, you will step the tuning in octaves through the cycle

   110.0   220.0   440.0   880.0   1760.0   Hz

The new tuning remains in computer memory until you change it or turn off the system. It will affect any notes you play in real time and any sequences you recall from a sequence file and play back.

When you tune Synclavier (R), you change it to an out-of-the-ordinary tuning for a special situation, rather than adjust it to standard pitch as you do with acoustic instruments. Synclavier (R) is automatically tuned to standard pitch. Therefore, changes in overall tuning are not saved when you store a sequence on diskette. And when a sequence is recalled, it will be played in the current tuning.

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+------------------------------------------------------------------+
|                  Changing the Overall Tuning                     |
|                                                                  |
|   1. Press OVERALL TUNING.                                        |
|                                                                  |
|      The OVERALL TUNING button will light up.  The display       |
|      window will show                                            |
|                                                                  |
|         440.0 HERTZ                                               |
|                                                                  |
|      indicating that the overall pitch of Synclavier (R) is      |
|      tuned to A 440 hertz.                                        |
|                                                                  |
|   2. Turn the knob to the left to lower the pitch; turn it to     |
|      the right to raise it.                                       |
|                                                                  |
|      You will hear the changes instantly.                        |
|                                                                  |
|   3. Press OVERALL TUNING again.                                  |
|                                                                  |
|      The number in the digital display window return to 440.0.   |
|                                                                  |
|   4. Press OVERALL TUNING once again.  The number in the display  |
|      window will now be 880.0.                                    |
|                                                                  |
|   5. Press OVERALL TUNING repeatedly until the keyboard is        |
|      returned to the A-440 tuning.                                |
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Changing the Octave Ratio

On the Synclavier (R), the octave ratio determines the relationship between the keyboard octave and the actual tonal octave. With the standard octave ratio of 1.000, every keyboard octave will also produce the perfect tonal octave, or a doubling in frequency. By changing this ratio, you can expand or contract the frequency range defined by the keyboard octave. The interval between any two adjacent keys as well as the overall range of the keyboard will be affected. The pivot pitch around which the range will expand or contract is middle A (440.0 hertz).

To change the octave ratio,

1. press the OCTAVE RATIO button in the second panel;

2. dial a new ratio between .000 and 4.000.

To return the setting to 1.000, press OCTAVE RATIO again.
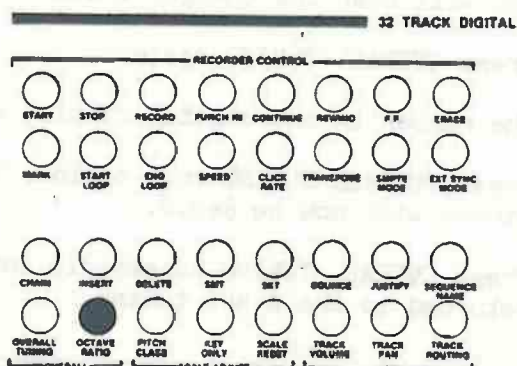
If you dial a ratio of 4.000, there will be a frequency range of four octaves for every keyboard octave and the interval between any two adjacent keys will be one/third of an octave, or four semitones.

If you dial a ratio of 2.000, there will be a range of two octaves for every keyboard octave; the interval between any two adjacent keys will be one/sixth of an octave, or a whole tone.

Microtonal scales can be established by dialing octave ratios of less than 1.000. With an octave ratio of .0000, every key on the keyboard will produce the same pitch, a 440 A.

The table below lists some useful OCTAVE RATIO settings. The intervals indicated are between adjacent keys on the keyboard.

INTERVAL	SETTING
Semitone	1.000
Whole-tone	2.000
Quarter-tone	.500
Microtones	.001 to .999

The octave ratio will remain in computer memory until you change it, recall a sequence, or turn off the system. You can re-establish the twelve-toned, equal-tempered keyboard at any time by pressing the OCTAVE RATIO button twice. When you store a sequence, the current octave ratio will be saved along with it.

Establishing Quarter-Tone and Whole-Tone Scales

1. Recall Timbre 1-1-1.

2. Press OCTAVE RATIO.

   The number 1.000 in the display window indicates the standard octave ratio.

3. Dial 0.500.

   The interval between any two keys on the keyboard is now half of a semitone, a quarter tone.

4. Dial 2.000.

   Now the interval between any two keys is a whole tone.

5. Press OCTAVE RATIO again. The equal tempered scale will be restored.

Establishing Special Scales

Besides changing the intervals between all the keys, you can change
the individual pitch of any note within the scale. With equal
tempered tuning, the notes in the octave starting with middle C have
the following fundamental frequencies:

C	261.6
C#	277.1
D	293.7
D#	311.1
E	329.5
F	349.3
F#	370.1
G	391.9
G#	415.5
A	440.0
A#	466.1
B	493.9
C	523.0

Each of the twelve keys can be assigned any frequency in the middle
octave range by using the SCALE ADJUST:PITCH CLASS button in the
second panel with the buttons under HARMONIC CONTROL in the first
panel of buttons.*

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* In later releases, you will dial in a new scale by pressing SCALE
ADJUST: PITCH CLASS and dialing in a new tuning.

To dial in a new scale, follow these instructions:

1. Press SCALE ADJUST:PITCH CLASS to assign the pitch control function to the twelve buttons under HARMONIC CONTROL.

2. Press HARMONIC CONTROL Button 1 and turn the control knob to change the pitch of middle C. The programmable frequency range for this key, and for all the others in the middle octave, is from 261.6 through 523.0 hertz.

3. Press HARMONIC CONTROL Button 2 and turn the control knob to change the pitch of C# above middle C.

4. Continue in the same manner with the other buttons under HARMONIC CONTROL.

When you adjust the pitch of a note, the frequencies of the other eleven keys in the middle octave will remain unchanged. The frequencies of the same note in all other keyboard octaves will be changed to preserve the octave intervals.

The adjusted tunings will be stored in computer memory until you turn off the system, change the tunings, or recall a sequence,

You can restore the tempered tuning of any individual note by pressing the numbered button under HARMONIC CONTROL that corresponds to it twice. All notes of that name will be readjusted.

You can restore the entire keyboard to tempered tuning by pressing SCALE RESET twice. To restore the harmonic coefficient function to the HARMONIC CONTROL buttons, press HARMONIC SELECT.

Unlike overall tuning, you can store special scales in sequence files. Whenever you store a memory recorder sequence, the current scale is also stored. Or, you can save the adjusted scale as a sequence, even if there are no actual notes played in the sequence.

There are many systems of tuning and temperament which can be precisely created on Synclavier (R).* Following are several keyboard tunings that musicians may be interested in creating for compositional or performance purposes.

Pythagorean Tuning

Pythagoras derived a theoretical scale from the frequency ratios of tones considered to be consonant to the ancient Greek ear, namely the unison, the octave, the fifth and the fourth. By mathematically manipulating these ratios (1:1, 2:1, 3:2 and 4:3), a seven-tone scale resulted with whole tone intervalic ratios of 9:8 and semitone ratios of 256:243. The Pythagorean third, with a ratio of 81:64 to the fundamental, is considerably sharper than the equal-tempered third.

Just Tuning

In just tuning, a system of tuning popular in the Renaissance, the intervals of the scale are derived from the 3:2 ratio of the fifth and the 5:4 ratio of the third.

Just tuning has the advantage of having acoustically perfect tonic, subdominant and dominant triads in the scale for which it is tuned. That is, in a just tuning for the key of C, the C, F and G chords will each have the ratio 4:5:6 and will thus be more euphonious than the same chords in tempered tuning. However, the same major scale will have two different whole tones (one with a 9:8 ratio and one with a 10:9 ratio) and a dissonant fifth between D and A (40:27 ratio).

Modulation, of course, is impossible, as each different scale requires its own just tuning.

Overtone Scale

The overtone scale, popular with some composers today, is derived from the first 16 harmonics of any given fundamental frequency. These 16 harmonics contain the frequencies of notes equivalent to the fundamental plus seven other tones. This results in an eight-tone scale derived by dividing each harmonic frequency by two until a frequency in the range of the fundamental and the octave above it is achieved.

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* For more on this subject, see J. M. Barbour, Tuning and Temperament, (Michigan State College Press, East Lansing, 1953).

The table below gives the Synclavier (R) settings for these three diatonic scales with a base of middle C. The equal tempered scale is included for comparison.

FOUR DIATONIC SCALES WITH A BASE OF C

NOTE	EQUAL TEMPERED	PYTHAGOREAN	JUST	OVERTONE
C	261.6	261.6	261.6	261.6
D	293.7	294.3	294.3	294.3
E	329.5	331.1	328.1	328.1
F	349.3	348.8	348.8	359.6
G	391.9	392.4	392.4	392.4
A	440.0	441.5	435.9	425.1
B	493.9	496.6	490.6	490.4

The overtone scale's eighth note, A#, has a tuning of 457.8 hertz with this base of C.

Combining Keyboard Tuning Functions

The three keyboard tuning functions, OVERALL TUNING, OCTAVE RATIO and SCALE ADJUST:PITCH CLASS, can be combined.

If you dial in a new scale and then establish a different octave ratio, the frequencies of the notes will, of course, change as the intervals are contracted or expanded. The numbers in the display window that represent the frequencies of these notes, however, will remain as you dialed them in.

You can also use the OVERALL TUNING button to adjust the overall pitch of a keyboard that has been redefined by the octave ratio and scale adjust functions. The entire keyboard of frequencies, with any established overall range or scale relationships, can be tuned up or down in .1 hertz increments. Again, the numbers displayed for each individual note will remain as you dialed them in.

Establishing a Just Tuning in the Key of C

1. Recall Instruction Timbre 1-1-1.

2. Press SCALE ADJUST:PITCH CLASS The PITCH CLASS button will light up and the HARMONIC CONTROL buttons will now be assigned to the twelve pitches of the middle octave.

3. Press Button 8. You will see the tuning of G above middle C in the display window:

   391.9 HERTZ

4. While holding down the C and the G keys on the keyboard, slowly dial 392.4 hertz. You will be able to hear the interval transform from the equal tempered tuning into the acoustically pure fifth.

5. Play the other G's above and below on the keyboard. You will notice that all the G keys track middle G as you change its frequency. Their frequencies will remain a perfect octave apart.

6. Press Button 5, the E button, under HARMONIC CONTROL.

7. While holding down the C and the E, tune the E to 328.1 hertz. The interval between the C and the E will become an acoustically pure major third.

8. Dial in the other frequencies for D, F, A and B (Buttons 3, 6, 10 and 12) using the table on the preceding page. Play the just tuned scale.

9. Press OCTAVE RATIO and dial in a setting of 2.00. The intervalic ratios for the just intonation have been doubled.

10. Press OVERALL TUNING twice to tune the entire keyboard up an octave. The just tuned intervals remain the same.

11. Press SCALE RESET twice to restore equal temperment.

12. Press OCTAVE RATIO twice to restore original octave ratio.

13. Press OVERALL TUNING repeatedly to step through the cycle or octave tunings to 440.0 hertz.

14. Press HARMONIC SELECT to restore the harmonic coefficient function to the HARMONIC CONTROL buttons.

Special Equal Tempered Tunings

There may be times when you want to create a special tuning that uses only pitches of the equal tempered scale. You can change the pitch of any note to any other equal tempered pitch in the following way:

1. Press SCALE ADJUST:PITCH CLASS to assign the pitch control function to the twelve buttons under HARMONIC CONTROL.

2. Press and holding down the appropriate HARMONIC CONTROL button.

3. Play a different note on the keyboard.

The pitch of the key corresponding to the HARMONIC CONTROL button will be changed to the pitch of the played key.

For example, if you press Button 5 under HARMONIC CONTROL while holding down an E flat, all the E's on the keyboard will sound like E flats.

If you have tuned the keyboard to a special scale, the pitch of the key corresponding to the held button will be changed to the normal tempered tuning of that key, regardless of its actual sounding pitch.

This method of retuning the keyboard can be used to quickly change tunings to perform, for example, chordal glissandos.

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+--------------------------------------------------------------------+
|                                                                    |
|              Creating a C Minor Ninth Chordal Keyboard             |
|                                                                    |
|   1.  Press Button 5 (corresponding to E) under HARMONIC CONTROL   |
|       and hold it down while you. . .                              |
|                                                                    |
|   2.  . . .play an E flat on the keyboard.                         |
|                                                                    |
|   3.  Press Button 6 (corresponding to F) and hold it down while   |
|       you. . .                                                     |
|                                                                    |
|   4.  . . .play a G on keyboard.                                   |
|                                                                    |
|   5.  Press and hold Button 10 (A) while playing a B flat.         |
|                                                                    |
|   6.  Press and hold Button 12 (B) while playing a C.              |
|                                                                    |
|   7.  Play a glissando on the white keys of the keyboard.  You     |
|       will hear a C minor ninth arpeggio with a doubled C and G.   |
|                                                                    |
|   8.  Press SCALE RESET twice to restore tempered tuning.          |
|                                                                    |
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THE SPLIT KEYBOARD

The Synclavier (R) keyboard can be split into upper and lower
sections with a different timbre active on each section. You can
selectively replace either timbre and choose the key on the keyboard
where you want the timbre to change.

Here is a summary of the buttons used to establish a split keyboard.

BUTTON	USE	FUNCTION
SPLIT*	Press once and recall timbre	Places selected timbre on upper keyboard
SPLIT	Press twice and recall timbre	Places selected timbre on lower keyboard
SPLIT	Press once or twice, press key on keyboard, then press STOP	Changes split point to selected key

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:* In software released prior to February 1, 1985, this function is
performed by the SKT key.

Establishing Upper and Lower Timbres

The split keyboard makes it possible to perform in real time with
different timbres for treble and bass. You can use the default split
point of middle C or change the split point to any other note on the
keyboard.

The split keyboard can be used in real time only, however, because
two different timbres cannot be stored on the same track in the
memory recorder.

To establish the timbres for the split keyboard, you will use the
SPLIT button with either the TIMBRE BANK, TIMBRE ENTRY and numbered
buttons in the fourth panel; or a TRACK button.
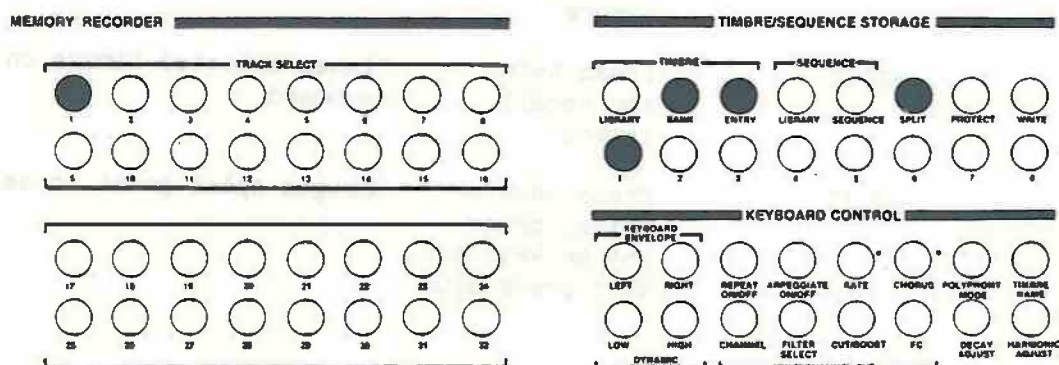
To establish the timbre for the upper keyboard,

1. press SPLIT once;

2. recall a timbre from a timbre bank in the usual way, by pressing
    TIMBRE BANK, then the number of the timbre bank that contains the
    desired timbre, then TIMBRE ENTRY, then the number of the desired
    timbre.

All notes from middle C up will use the selected timbre.

To establish the timbre on the lower keyboard,

1. press SPLIT twice;

2. recall a timbre from a timbre bank in the usual way.

All notes below middle C will be in the selected timbre.

You can also recall a timbre from a track recorded in the memory recorder. To do this,

1. press SPLIT once or twice, depending on where you want the new timbre;

2. press the numbered button under TRACK SELECT where the sequence with the desired timbre is stored.

Changing the Split Point

You can change the split point to any key on the keyboard. To do this before you split the keyboard,

1. press the SPLIT button once or twice;

2. press the key on the keyboard where you want the new split point;

3. recall a timbre.

To change the split point after you have split the keyboard,

1. press SPLIT once or twice;

2. press the desired key on the keyboard;

3. press STOP.

Splitting the Keyboard

1. Recall Timbre 1-1-8. The resynthesis trumpet will be active on the entire six-plus octaves of the keyboard.

2. Press SPLIT twice.

   The SPLIT button and the numbered buttons under TRACK SELECT and TIMBRE/SEQUENCE STORAGE will start blinking.

3. Recall Timbre 1-2-2 from the timbre bank. The blinking lights will all go out.

4. Play up and down the keyboard.

   The keyboard has been split. Timbre 1-1-8 remains active on the upper keyboard; Timbre 1-2-2 is active on the lower keyboard.

5. Recall Scarborough Fair by pressing SEQUENCE and then Button 1. Scarborough Fair is in the Memory Recorder, while the keyboard itself remains split between Timbres 1-1-8 and 1-2-2.

6. Now press SPLIT once.

7. Press Button 1 under TRACK SELECT. The string timbre on Track 1 of Scarborough Fair is now active on the upper keyboard. Timbre 1-2-2 remains active on the lower keyboard.

8. Press SPLIT once or twice, press C below middle C and then press STOP. The split point will change to C below middle C.

9. Recall Timbre 1-1-4.

   By failing to press the SPLIT button first, you have eliminated the split point. Timbre 1-1-4 is active on the entire keyboard.

SPECIAL KEYBOARD EFFECTS

There are a number of special keyboard effects that you can set up. Some of these you will apply to selected partial timbres, others to the complete timbre. You can use them in real time or record them as part of a sequence. When you store the sequence, you will store these effects also.

Once you have set these effects, they become part of the keyboard timbre definition and thus can be stored with the keyboard timbre in a timbre bank. (These effects are also covered in "Timbre Design.")

Here is a summary of the buttons you will use to create the special keyboard effects:

BUTTON	USE	FUNCTION
KEYBOARD ENVELOPE: RIGHT	Hold down button, press one key	Sets upper end of keyboard range for selected partial timbre.
	Hold down button, press two keys	Sets upper end of keyboard range for selected partial timbre with a fade-out region between the two keys pressed
KEYBOARD ENVELOPE: LEFT	Hold down button, press one key	Sets lower end of keyboard range for selected partial timbre
	Hold down button, press two keys	Sets lower end of keyboard range for selected partial timbre with a fade-out region between two keys pressed
CHORUS	Press once, turn knob	Establishes and tunes overall chorus effect
REPEAT ON/OFF	Press once	Turns on or off repeat mode
ARPEGGIATE ON/OFF	Press once	Turns on or off arpeggiate mode
RATE	Press once, turn knob	Changes repeat and/or arpeggiate rate
POLYPHONY MODE	Press once, turn knob	Specifies number of notes a timbre may play simultaneously

Keyboard Envelope

The keyboard envelope function allows you to place a partial timbre on a particular section of the keyboard. You can place different partial timbres of a whole timbre on overlapping or separate sections of the keyboard. For special effects, you can assign completely different sounding partial timbres to different sections of the keyboard. Or you can use this feature to develop whole timbres, such as piano or strings, that may be played up and down the keyboard with authenticity throughout.

The section on the keyboard to which a partial timbre is assigned is called the keyboard envelope. It consists of three parts:

- the full volume region;

- the upper tapered region or keys above the full volume region where the sound is softer the higher you play;

- the lower tapered region or keys below the full volume region where the sound is softer the lower you play.

The keyboard envelope is set using the KEYBOARD ENVELOPE buttons under KEYBOARD CONTROL in the fourth panel.
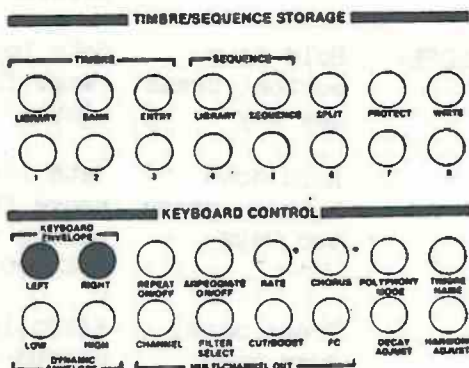
To set the upper limit of the keyboard envelope,

1. press the button labeled RIGHT under KEYBOARD ENVELOPE in the fourth panel and hold it down while you. . .

2. . . . press one key or two.

If one key is pressed, the upper limit is defined as a straight cut-off point. If two keys are pressed, then an endpoint plus an upper fade-out region is defined.

To set the lower limit of the keyboard envelope,

1. press the button labeled LEFT under KEYBOARD ENVELOPE and hold it down while you. . .

2. . . . press one key or two.

Again, if one key is pressed, the lower limit is defined as a straight cut-off point. If two keys are pressed, then an endpoint plus a lower fade-out region is defined.

You can also use the control knob to dial a number or two numbers designating the upper and lower limits and fade-out regions. The numbers can be beyond the keyboard range.

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+-------------------------------------------------------------------------+
|                                                                         |
|                          Keyboard Envelope                              |
|                                                                         |
|    1.  Recall Timbre 1-2-6.                                             |
|                                                                         |
|    2.  Solo Partial Timbre 1.                                          |
|                                                                         |
|    3.  Press KEYBOARD ENVELOPE LEFT and hold it down while              |
|        you. . .                                                         |
|                                                                         |
|    4.  . . . press the C an octave below middle C and the C below       |
|        that.  The notes can be played separately or                     |
|        simultaneously.                                                  |
|                                                                         |
|    5.  Press KEYBOARD ENVELOPE RIGHT and hold it down while             |
|        you. . .                                                         |
|                                                                         |
|    6.  . . . press G below middle C and G above middle C.              |
|                                                                         |
|    7.  Play the partial timbre through its full range.                  |
|                                                                         |
|    8.  Solo Partial Timbres 2 and 3.                                    |
|                                                                         |
|    9.  Press KEYBOARD ENVELOPE LEFT and hold it down while              |
|        you. . .                                                         |
|                                                                         |
|   10.  . . . press G above middle C and G below middle C.              |
|                                                                         |
|   11.  Press KEYBOARD ENVELOPE RIGHT and hold it down while             |
|        you. . .                                                         |
|                                                                         |
|   12.  . . . press the C two octaves above middle C and the C          |
|        above that.                                                      |
|                                                                         |
|   13.  Unsolo the two partial timbres and play a series of notes,       |
|        using the full range of the keyboard.  You will hear the         |
|        timbre change as you play in the different ranges.               |
|                                                                         |
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Chorus

You can activate a chorus function to reproduce all the active
partial timbres on additional synthesizers by using the CHORUS button
in the fourth panel.*
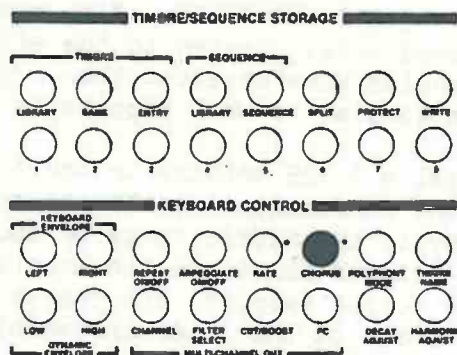
The chorus function adds another voice to each of the partial timbres
in the keyboard timbre. When you use the chorus effect, you double
the number of voices required to play the timbre. A timbre with one
partial timbre with chorus will require two voices. A timbre with
two partial timbres with chorus will require four voices, and so on.

To activate the chorus function,

1. press CHORUS;

2. turn the control knob to set the chorus ratio, or interval.

You can dial any ratio from 0.000 to 10.000. To return the setting
to 1.000, or unison, press CHORUS again.

A setting of 1.000 doubles each partial timbre at its fundamental
frequency. A setting of 2.000 adds voices with frequencies
corresponding to the second harmonic of each partial timbre (the
octave). A setting of 3.000 adds voices with frequencies
corresponding to the third harmonic. And so on. (A table of
harmonic ratios is in the section "Adding Chorus" in the tabbed
section "Timbre Design.")

Non-integer settings above 1.000 tune the added voices to inharmonic
frequencies. Settings less than 1.000 tune the added voices to
frequencies below the fundamental of each partial timbre.

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* There is also a partial timbre chorus function that creates an
additional voice for a specific partial timbre. See "Designing New
Timbres" in the preceding tabbed section "Timbre Design."

Chorus

1. Recall Instruction Timbre 1-1-8.

2. Press the CHORUS button and experiment with settings between 0.990 and 1.010. Play some rapid notes and then a sustained note. Listen to the effect the two close frequencies have on each other. This is called "beating" and is similar to what happens in frequency modulation.

3. Now dial a 0.125 setting to add a tuba (three octaves lower than the fundamental) to the trumpet sound. You will need to play in the middle range or above since the chorus is three octaves below the fundamental. If you play A below middle C, for example, the chorus fundamental will be at 27.5 hertz, at the lower threshhold of hearing.

Repeating Notes and Arpeggios

The repeat and arpeggiate functions cause multiple notes to be
triggered by each pressing of a key. With the repeat function alone,
the same note or chord will be repeated at the established rate, over
and over until you take your finger off the key or keys. With the
arpeggiate function alone, pressing two or more keys will cause the
notes to sound one after another at the established rate. Combining
the two functions creates repeating arpeggios.

You program the repeat and arpeggiate using the REPEAT ON/OFF,
ARPEGGIATE ON/OFF and RATE buttons under KEYBOARD CONTROL in the
fourth panel.
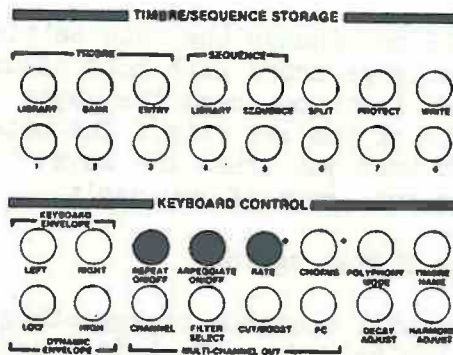
To activate the repeat mode,

1. press REPEAT to turn on the repeat function;

2. press the RATE button and dial the desired rate, from 0.00 to
    100.0 hertz.

To activate the arpeggiate mode,

1. press ARPEGGIATE to turn on the arpeggiate function;

2. press the RATE button and dial the desired rate, from 0.00 to
    100.0.

The same rate button is used for both functions. If both REPEAT and
ARPEGGIATE buttons are lit, the arpeggio will be repeated at the rate
established so long as you hold down the keys.

Repeat and Arpeggiate

1. Recall Instruction Timbre 1-2-4. This vibes timbre has been programmed with a repeat/arpeggiate rate of 10.79 hertz.

2. Press REPEAT to turn on the repeat function. You will notice that as soon as you lift your finger, the repeat will stop and the note will go into final decay.

3. Turn off the repeat function by pressing REPEAT.

4. Press ARPEGGIATE. Press several keys and hold them down. The notes will arpeggiate at the established rate.

5. Press RATE and change the rate setting to 5.00 hertz. Try hitting a large chord with both hands all at once. No matter how fast you press the keys, the notes will always arpeggiate at the set rate. The notes will be played in the order that you press the keys. The computer can always pick this out, even if you can't.

6. Now press REPEAT again.

   The notes will continue arpeggiating at the set rate as long as you hold down the keys. As you press more keys, those notes will be added to the arpeggio. If you lift your finger from a key, that note will be subtracted.

7. Press REPEAT ON/OFF and ARPEGGIATE ON/OFF to turn off the repeat and arpeggiate function.

Adding Portamento

When the portamento function is active, glissandos will be produced between notes. You program portamento by using the three PORTAMENTO buttons under TIMBRE CONTROL in the fifth panel.
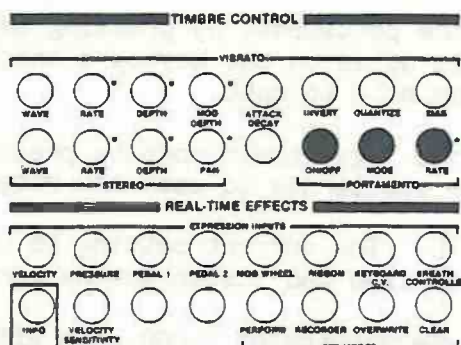
To add portamento to a partial timbre,

1. turn on the portamento effect by pressing the ON/OFF button under PORTAMENTO.

2. select the logarithmic mode, if desired, by pressing the PORTAMENTO MODE button (if button is not lit, the portamento will be linear);

3. set the portamento rate by pressing the PORTAMENTO RATE button and dialing in a number from 0.000 to 1.000.

The PORTAMENTO RATE button controls the rate of the change in pitch, and thus the duration of the glissandos. At a rate of 0.000, it will take almost a minute for a pitch to travel from one end of the keyboard to the other. Smaller changes in pitch will occur at the same rate. At a rate of 1.000, the change between one pitch and the next will be instantaneous.

The portamento rate can be linear or logarithmic. A linear portamento rate will change the pitch at the same rate throughout the entire glissando. A logarithmic portamento rate will accelerate the change in pitch.

When the MODE button is lit, the portamento rate will be logarithmic. When the MODE button is not lit, the rate will be linear.

The portamento on/off function can also be controlled by one of the switches on the foot pedal. To do this, connect either switch output jack on the pedal to the jack labeled PORTAMENTO on the back of the keyboard unit. Make sure the PORTAMENTO ON/OFF button is set to OFF on the keyboard control panel.

Whenever the pedal switch is down, the portamento function will be on and notes played on the keyboard will slide from one to the next at the rate established in each partial timbre.

```
+-----------------------------------------------------------------------+
|                                                                       |
|                            Portamento                                 |
|                                                                       |
|    1.  Recall Instruction Timbre 1-1-4.  This violin timbre has a     |
|        portamento rate of 0.400 programmed into all four of its       |
|        partial timbres.                                               |
|                                                                       |
|    2.  Turn on the portamento by pressing ON/OFF under PORTAMENTO.    |
|        Play a few notes on the keyboard and listen to the sound       |
|        glide from note to note.                                       |
|                                                                       |
|    3.  Turn on the logarithmic mode by pressing MODE and listen to    |
|        the glide accelerate to each new note.                         |
|                                                                       |
|    4.  Press RATE.  The current setting is .400.  Dial a rate         |
|        setting of .200 and listen to the very slow glide.             |
|                                                                       |
|    5.  Dial a rate setting of 1.000.  In effect, this turns off       |
|        the portamento since the pitch change is instantaneous.        |
|        Compare the sound with the sound when the portamento           |
|        function is turned off.                                        |
|                                                                       |
|    6.  If you have a foot pedal, connect one of the switch jacks      |
|        to the jack labeled PORTAMENTO on the back of the keyboard     |
|        unit.                                                          |
|                                                                       |
|    7.  Repeat this exercise using the foot switch to turn the         |
|        portamento function on and off.                                |
|                                                                       |
+-----------------------------------------------------------------------+
```

Keyboard Polyphony Control

With the keyboard polyphony control function, you can limit the
number of notes that can be played at the same time on the keyboard
or on a specific memory recorder track.

Most of the timbres on the system diskette are programmed to be fully
polyphonic on the keyboard. With these timbres, you can
simultaneously play notes until you use up all the voices in your
system. Thus, the maximum keyboard polyphony depends on both the
number of voices in your system and the voices used in the keyboard
timbre.

With maximum keyboard polyphony, the system will play any new note by
assigning it to unused voices. If there are not enough unused voices
to play the note, the system will try to free up voices by cutting
off any notes in final decay. If there are still not enough voices,
the new note will not play and bars will appear in the display
window.

Timbres can be programmed for less than maximum keyboard polyphony.
A polyphony number of 1 makes the timbre monophonic on the keyboard.
As you learned in the introduction, each new note will cut off the
previous note in monophonic timbres. You will be able to play clean
trills or other fast sequences, even if the timbre has many timbre
frames or a long final decay. But you will not be able to play a
chord.

To activate the polyphony control, you

1. press POLYPHONY MODE in the fourth panel;

2. dial the number of desired simultaneous notes with the knob.
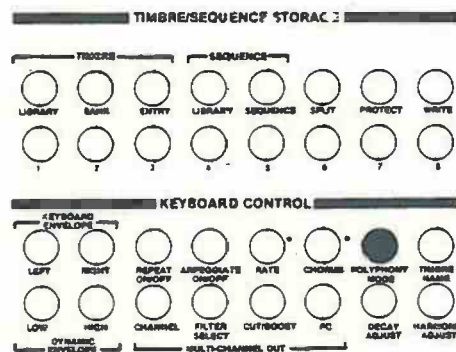
Keyboard Polyphony Control

1. Continue with Instruction Timbre 1-2-4 again. The timbre has a final decay of over two seconds.

2. Press POLYPHONY MODE. The number 128 will appear in the display window. This is the maximum number of voices possible in any Synclavier (R) system.

3. Play some notes rapidly and listen to the overlapping final decays.

4. Now dial in a keyboard polyphony control setting of 1 to make the timbre monophonic on the keyboard.

5. Play some more rapid notes and listen. Only one key will sound at a time. Each succeeding note cuts off the preceding note. Only the last note played will have full final decay.

6. Hold down a key while striking another. The sound of the first will cut off as soon as the second is pressed.

7. Now dial 2 and experiment with scales and arpeggios. At any one time only two voices will be heard. When you play the third note in a sequence, it will cut off the first.

FOOT SWITCHES

The two output switches on the Morley pedal can be connected to any of eight input jacks on the Synclavier (R) back panel:

HOLD **REPEAT** **PORTAMENTO** **PUNCH IN/OUT**

—————— FOOT SWITCHES ——————

SUSTAIN **ARPEGGIATE** **PHRASE** **MUTE**
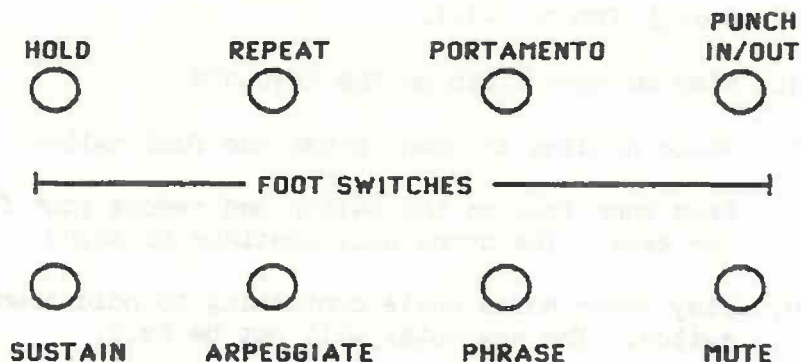
You learned how to use the foot switches for the repeat, arpeggiate and portamento functions in the previous section and for the punch in/punch out function in the tabbed section "Memory Recorder."

The remaining functions are described below.

Hold

When the HOLD switch is down, the note or chord that is sounding on the keyboard will continue to sound after you remove your fingers from the keyboard. As long as you keep your foot on the switch, the sound will be held. You can play new notes, which will not be held, on top of the held notes.

The sustain volume and FM levels of the active partial timbres will be used for the held sound. If the sustain levels are zero, there will be no held sound.

```
+-------------------------------------------------------------------------------+
¦                            Holding Notes                                       ¦
¦                                                                               ¦
¦   1.  Connect one of the foot switch jacks to the HOLD jack on                ¦
¦       the back of the keyboard unit.                                           ¦
¦                                                                               ¦
¦   2.  Recall Timbre 1-1-7.                                                     ¦
¦                                                                               ¦
¦   3.  Play an open fifth on the keyboard.                                      ¦
¦                                                                               ¦
¦   4.  While holding it down, press the foot switch.                            ¦
¦                                                                               ¦
¦   5.  Keep your foot on the switch and remove your fingers from                ¦
¦       the keys.  The drone will continue to sound.                             ¦
¦                                                                               ¦
¦   6.  Play other notes while continuing to hold down the foot                  ¦
¦       switch.  The new notes will not be held.                                 ¦
¦                                                                               ¦
¦   7.  Release the foot switch.  The drone will be cut off.                     ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

Sustain

The sustain function will hold all notes, those held when the switch is pressed down as well as those succeeding notes, for as long as you hold down the switch. As with the hold function, the volume and FM sustain levels are used for the sustained sounds.

If the partial timbre volume sustain level and final decay time are both set at zero, you can use the SUSTAIN switch much like the sustain pedal on a piano to place decays on some notes and not on others. When the SUSTAIN switch is "on," the notes will be sustained for the complete initial decay time (while the volume falls from peak to zero sustain level). When the SUSTAIN switch is "off", the notes will be cut off as soon as you release the keys.

```
+----------------------------------------------------------------------+
|                                                                      |
|                         Sustaining Notes                             |
|                                                                      |
|                                                                      |
|  1.  Connect one of the foot switches to the SUSTAIN jack on the     |
|      back of the keyboard unit.                                      |
|                                                                      |
|  2.  Continue with Timbre 1-1-7.                                     |
|                                                                      |
|  3.  Play the same open fifth.                                       |
|                                                                      |
|  4.  While holding it down, press the foot switch.                   |
|                                                                      |
|  5.  Remove your fingers from the keys.  As before, the drone        |
|      will be held.                                                   |
|                                                                      |
|  6.  Keep your foot on the foot switch and play some more notes.     |
|      The additional notes will also be held.                         |
|                                                                      |
|  7.  Release the foot switch.  Set the volume sustain level to       |
|      0.0.  Note that the initial decay for this timbre is 583        |
|      milliseconds.                                                   |
|                                                                      |
|  8.  Play a fast passage.  Each note will be cut off as soon as      |
|      you lift your finger from the key.                              |
|                                                                      |
|  9.  Press the foot switch and play another fast passage.  The       |
|      notes will be slightly sustained as the sound decays from       |
|      peak volume to the zero sustain level.                          |
|                                                                      |
|  10. Dial in a new initial decay of 1000 milliseconds.  Notice       |
|      that when you play the same fast passage, the notes are         |
|      sustained longer as the peak volume takes almost twice as       |
|      long to decay to the zero sustain level.                        |
|                                                                      |
+----------------------------------------------------------------------+
```

Phrase

The phrase function is used to slur notes together. It is most
effective when used with monophonic timbres or when playing a single
melodic line. With chords, its use is highly unpredictable.

When the switch is "on," each new note is "phrased" to the preceding
note. That is, the pitch of the old note changes to the new pitch
but the attack is not rearticulated. This has the same effect as,
for example, a violinist playing several notes in a single bow.

+--+
| |
| Slurring Notes |
| |
| 1. Connect one of the foot switches to the PHRASE jack on the |
| back of the keyboard unit. |
| |
| 2. Recall Timbre 1-1-4. |
| |
| 3. Play a note, then press the foot switch down, then play |
| another note. You will hear the first note merge into the |
| second. |
| |
| 4. Continue to hold the foot switch down while you play a |
| series of notes. As each new note is played, the preceding |
| one will change its pitch to the new note. |
| |
+--+

Mute

In future releases, the mute function will be available.

REAL-TIME EFFECTS

REAL-TIME EFFECTS PATCHING

The Synclavier (R) allows you to change the dynamics and/or
expression of a timbre while playing, just as you would on an
acoustic instrument. Depending on which real-time input device you
use and how you use it, you can change the characteristic sound of a
timbre on a note-by-note basis. Each note you play can have a timbre
slightly different from the one preceding it and the one following
it. When you record a sequence, each nuance of the timbre created
with real-time effects is stored in memory.

There are eight devices that sense dynamic differences in input.
Here are the buttons you will use to "patch" each device to
particular partial timbre(s) and timbre parameter(s).

BUTTON	USE	FUNCTION
VELOCITY	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of velocity input
PRESSURE	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of pressure input
PEDAL1	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of input to pedal connected to PEDAL 1 INPUT on keyboard back panel
PEDAL2	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of input to pedal connected to PEDAL 2 INPUT on keyboard back panel
MOD WHEEL	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of input of inside control wheel to left of keyboard
RIBBON	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of input of black velvet ribbon located above keyboard

BUTTON	USE	FUNCTION
KEYBOARD C.V.	Press and hold, then select partial timbre (s) and timbre parameter(s)	Sets up patching of keyboard control voltage input
	Press and hold, press two keys	Sets lower and upper limits for range of keyboard control voltage
BREATH CONTROLLER	Press and hold, then select partial timbre(s) and timbre parameter(s)	Sets up patching of breath controller input
VELOCITY SENSITIVITY	Press button, turn knob	Changes velocity sensitivity parameter
DYNAMIC ENVELOPE: LOW	Press button, turn knob	Sets lower limit of dynamic envelope
DYNAMIC ENVELOPE: HIGH	Press button, turn knob	Sets upper limit of dynamic envelope

An additional real-time effects device, the pitch bend wheel, is the wheel to the left of the mod wheel. Without setting up any patching, this wheel allows you to sharpen or flat a note as you play it.

Real-Time Effects Patching

The expression device buttons are all located on the fifth panel.
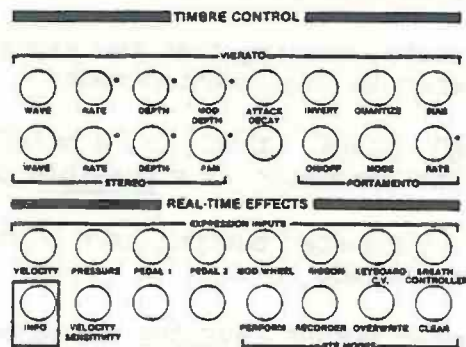
To use the keyboard for real-time effects, you patch one or more
expression input devices, such as velocity or pressure, both to the
partial timbre you want to affect and to a timbre parameter, such as
partial volume.

Thus, a three-way patch is set up:
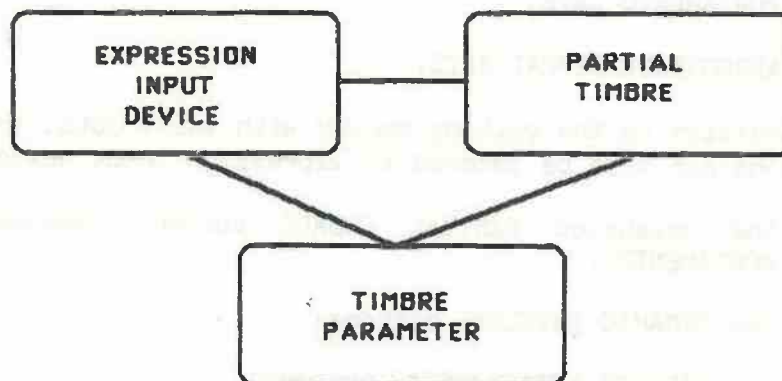
Whenever you press any one of the expression input device buttons,
the display window will show

    PRESS BUTTONS
    FOR RTE PATCHING

As you hold down the expression input device button, it will light up
and the partial timbre button or buttons to which that device is
patched will be lit or blinking.

In addition, all the timbre parameter buttons will be in one of the following states:

- an "on-steady" state, meaning that the expression input is already routed to that parameter in the normal fashion;

- a "blinking" state, meaning that the expression input is routed to that parameter in the inverted mode;

- a "flickering" state (that is, a brief flash once per second) meaning that the parameter is a possible patch.

Most of the timbre parameter buttons have a white dot to the right of the button. These include

- all buttons under VOLUME ENVELOPE and HARMONIC ENVELOPE;

- PARTIAL TUNING and PARTIAL VOLUME;

- FM RATIO;

- RATE, DEPTH and MOD DEPTH under VIBRATO;

- RATE, DEPTH and PAN under STEREO;

- PORTAMENTO RATE;

- ARPEGGIATE/REPEAT RATE.

In addition to the buttons marked with white dots, the following buttons can also be patched to expression input devices:

- the unlabeled PARTIAL CHORUS button (between STEREO and PORTAMENTO);

- the DYNAMIC ENVELOPE buttons;

- the VIBRATO ATTACK/DECAY button.

To set up a real-time effects patch, follow these directions:

1. Press one of the expression input buttons and hold it down while you. . .

2. . . .select the partial timbre you want the real-time effects routed to. The default is "on" for all four partial timbres.

3. Continue to hold down the expression input device button while you. . .

4. . . .select the desired timbre parameter.

You can also set up a real-time effects patch in the "inverted" mode. When you do this, the relationship between the input device and the timbre parameter is reversed. For example, if you patch PRESSURE to PARTIAL VOLUME in the normal fashion, then the harder you press the keys, the louder the sound. If you patch PRESSURE to PARTIAL VOLUME in the inverted fashion, then the harder you press the keys, the softer the sound will be.

To set up a patch in the inverted mode:

1. Press the desired expression input button and hold it down while you. . .

2. . . .select the partial timbre you want the real-time effects routed to.

3. Continue to hold down the expression input button while you. . .

4. . . .press the desired timbre parameter button <u>twice</u> so that it is blinking.

Removing Real-Time Effects Patches

The CLEAR button is used to remove real-time effects patching from any of the following:

- a particular expression input,

- a particular partial timbre,

- a particular parameter.

To use the CLEAR button, follow this procedure:

1. Press and hold the CLEAR button.

2. Press the button of the expression input, partial timbre, or parameter you want to clear.

To remove all real time effects patching,

1. press and hold the CLEAR button;

2. swipe a finger across all eight expression input buttons. The RTE patchings will be cleared while the routings between partial timbres and timbre parameters will remain unaffected.

To remove real-time effects from all partials,

1. press and hold the CLEAR button;

2. press all four PARTIAL SELECT buttons (one at a time, simultaneously, or in any fashion). All partial timbre patchings will be cleared while routings between expression input devices and timbre parameters will be remain unaffected.

VELOCITY AND PRESSURE INPUTS

When you patch the velocity input to a partial timbre and one or more timbre parameters, the dynamics or expression of the timbre will vary according to how quickly or slowly each key is depressed.

For example, if VELOCITY is patched to PARTIAL VOLUME, the more quickly you play, the louder the notes will sound.

When you patch the pressure input to a timbre parameter, the dynamics or expression of the timbre will vary according to how much pressure is applied after the key is all the way down. So if PRESSURE is patched to PARTIAL VOLUME, the volume of the notes will swell as you press harder and harder on the key.

Patching the velocity input to a partial timbre affects the attack of a note. Pressure, on the other hand, is an after-touch control. Although any expression input can be patched to any timbre parameter, some patchings make little sense.

For example, you will hear no effect if you patch PRESSURE to VE ATTACK, since by the time you are able to vary the pressure of a key, the attack of the timbre will have already sounded.

On the other hand, if you patch velocity to PARTIAL TUNING, you will get different pitches each time you press a key but you won't be able to bend the note, since the time to bend a note is after it has begun to sound.

Some real-time effects, such as the attack, the decay or a portamento, occur only once during a note. For these, velocity input is the better choice.

Other effects, such as volume swell or vibrato depth or rate, act throughout a note's duration. For these, pressure input is the better choice.

Velocity Sensitivy

The VELOCITY SENSITIVITY button allows you to set just how responsive
to your touch the keyboard will be.

When you press this button for the first time in a keyboard seesion,
the default setting of 40 will appear in the display window. You can
dial in settings anywhere from 10 to 500. In general, the lower the
setting, the more responsive to your touch the keyboard will be; the
higher the setting, the less sensitive.

The new velocity sensitivity setting will remain in memory until you
leave the Real-Time module or turn off the system.

+--+
| |
| Using the Velocity Sensitivity Function |
| |
| 1. Select Timbre 1-1-6, the oboe. |
| |
| 2. Press PORTAMENTO RATE. You will see |
| |
| 0.600 GLIDE |
| |
| in the display window. This means that, if the portamento |
| function were turned on, it would take a little over half a |
| second for a pitch to travel from one end of the keyboard |
| to another. |
| |
| 3. Turn on the portamento function by pressing PORTAMENTO |
| ON/OFF. |
| |
| 4. Play some notes on the keyboard, noting how the portamento |
| sounds. |
| |
| 5. Press VELOCITY and hold it down while you. . . |
| |
| 6. . . .press PORTAMENTO RATE. |
| |
| 7. Play some notes on the keyboard, varying your attack. Play |
| some of the notes very slowly and notice how much time the |
| glide takes. |
| |
| 8. Press VELOCITY SENSITIVITY. You will see |
| |
| 40 VEL SENS |
| |
| in the display window. Dial in a new setting of 400. |
| |
| 9. Play the keyboard, again varying your attack. You will |
| notice that, even when you press a key very slowly, the |
| glide doesn't take much longer than when there is no |
| VELOCITY patching. |
+--+

Pressure Response Filter

When you press PRESSURE for the first time, you will see in the
display window

    0.200 RESPONSE
    SELECT PATCHING

The top message is the default setting for the Pressure Response
Filter, a filter used to smooth out the effects of abrupt pressure
changes on the real time effects.

With the control knob, you can dial in settings from 0.000 to 1.000.
A 1.000 setting gives the fastest possible response with any
variation in pressure creating an instant change in the timbre
parameter patched to PRESSURE. Lower settings give slower responses,
making possible very long crescendos or diminuendos or very slow
pitch changes. With a setting of 0.000, you will get no response at
all, no matter how hard you press the key.

+--+
| |
| Using the Pressure Response Filter |
| |
| 1. Select Timbre 1-1-7. |
| |
| 2. Press PRESSURE and hold it down while you. . . |
| |
| 3. . . .press PARTIAL TUNING. |
| |
| 4. Turn the control knob to dial in a setting of 1.000 for the|
| pressure response filter. |
| |
| 5. Play some notes and apply pressure to some to bend the |
| pitch. You will hear the pitch sharpen as soon as you |
| increase your pressure. |
| |
| 6. Now dial in a setting of 0.050. |
| |
| 7. Play the keyboard again. The pitch of the notes you bend |
| will sharpen very gradually. |
| |
+--+

THE PEDAL INPUTS

There are two pedal input jacks on the back panel of the
Velocity/Pressure Keyboard Unit. Although either one can be used for
any kind of patching, you may find it convenient to reserve one pedal
for overall volume control and the other for other kinds of real-time
changes in the partial timbres.

Volume Control

When the pedal is patched to PARTIAL VOLUME in the normal fashion and
is not turned on, no sound will be heard. Nor will there be any
sound while the pedal is in the "up" position.

To increase the volume, push the pedal down. Maximum volume is
reached when the pedal is pushed all the way down. Volume changes
will occur instantly, even in the middle of a note.

You can use the pedal for overall volume changes during keyboard
performances or during recording. You cannot use it to affect the
playback of a sequence recorded in the memory recorder.

Other Real-Time Effects

With the first pedal reserved for volume changes, the second pedal
can be patched to other real-time effects.

In general, the pedal will be most effective when patched to timbre
parameters that occur throughout the duration of a note, such as
PARTIAL TUNING (for pitch bending or sliding notes), VIBRATO RATE or
DEPTH or STEREO RATE. Patching the pedal to FM parameters, such as
HARMONIC SUSTAIN or FM RATIO, is also effective, as is patching it to
REPEAT/ARPEGGIATE RATE.

If the patching is done in the normal fashion, then when the pedal is
in the "up" position, all selected real-time effects will be set at
0. As you press the pedal down, the values for the selected RTE
parameters will be gradually increased. When the pedal is all the
way down, the RTE parameters will equal the time intervals or levels
originally dialed in on the timbre parameter.

```
+-----------------------------------------------------------------------------+
|                               Using the Pedal                               |
|                                                                             |
|   1.  Make sure the pedal is connected to the PEDAL1 INPUT jack             |
|       on the back panel of the Velocity/Pressure Sensitive                  |
|       Keyboard Unit.  Turn the switch on the pedal to ON.                   |
|                                                                             |
|   2.  Select Timbre 1-1-4.  This violin timbre is programmed for           |
|       FM in the sustain portion of the envelope.                            |
|                                                                             |
|   3.  Press PEDAL1 and hold it down while you. . .                         |
|                                                                             |
|   4.  . . .press HE SUSTAIN.                                                |
|                                                                             |
|   5.  Start playing with the pedal all the way up, then slowly             |
|       press the pedal down.  You will hear the sound begin as a            |
|       pure sawtooth wave, then gradually change as more and more           |
|       frequency components are added in.                                    |
|                                                                             |
+-----------------------------------------------------------------------------+
```

NOTE: In general, when patching real-time effects to HARMONIC
ENVELOPE PEAK or SUSTAIN, you can use a longer initial decay time
(50-200 ms) to smooth out the steps. A very long initial decay time
(4-5 seconds) can be used for special effects.

THE MOD WHEEL

To the left of the keyboard, there are two wheels. The outside wheel is the pitch bend wheel, which you will learn about later. The inside wheel controls the mod wheel expression input device and can be patched to any timbre parameter.

When you turn the wheel away from you, the settings for the timbre parameter will increase. When you turn it toward you, the settings will decrease. When you release the wheel, the timbre parameter will return to its original setting.

```
+------------------------------------------------------------------+
|                                                                  |
|                      Using the Mod Wheel                         |
|                                                                  |
|   1.  Continue with Timbre 1-1-4.                                |
|                                                                  |
|   2.  Set up stereo effects on this timbre by pressing STEREO PAN|
|       and dialing in a setting of 50.                            |
|                                                                  |
|   3.  Press MOD WHEEL and hold it down while you . . .           |
|                                                                  |
|   4.  . . .press STEREO PAN.                                     |
|                                                                  |
|   5.  Play a note on the keyboard and hold it while you turn the |
|       mod wheel back and forth.  As you turn it away from you,   |
|       the sound will come from the right speaker; as you turn it |
|       toward you, the sound will come from the left speaker.     |
|                                                                  |
+------------------------------------------------------------------+
```

THE RIBBON CONTROLLER

The ribbon controller is the black velvet ribbon located just above
the keyboard. When you use it, you will run your finger along the
depressed middle area. (You must press it firmly to maintain a good
contact.) The point at which you first press it will become the pivot
point for the real-time effect patched to the RIBBON input device.

For example, if you want to bend a note, patch RIBBON to PARTIAL
TUNING and press a key. Then, place your finger anywhere on the
ribbon. As you move your finger to the right, the note you are
playing will rise in pitch. As you move your finger to the left, the
note will lower in pitch. As you pass the point at which you first
pressed the ribbon, the note will pass through its original pitch.
It will return to its original pitch when you lift your finger from
the ribbon.

The ribbon controller can be used as a before-touch as well as
after-touch device. For example, if you wanted to use the ribbon to
control portamento, you would patch RIBBON to PORTAMENTO RATE, run
your finger along the ribbon and then play two notes. The first note
would glide to the second at a rate determined by how far you moved
your finger along the ribbon.

Ribbon Controller Filter

The ribbon controller filter operates similarly to the pressure
response filter. It is most often used to control the response when
you release the ribbon controller.

When you first press RIBBON, the display window will show

    0.400 RESPONSE
    SELECT PATCHING

The upper message is the default setting for the ribbon controller
filter. Dial in a higher setting for a faster response or a lower
one for a slower response. The range is from 0.000 to 1.000.

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|                                                                  |
|                    Using the Ribbon Controller                   |
|                                                                  |
|   1.  Select Timbre 1-2-3.                                        |
|                                                                  |
|   2.  Press RIBBON and hold it down while you. . .               |
|                                                                  |
|   3.  . . .press the RATE button in the fourth panel, under      |
|       KEYBOARD CONTROL.                                           |
|                                                                  |
|   4.  Press REPEAT ON/OFF and ARPEGGIATE ON/OFF to turn on the   |
|       repeat and arpeggiate functions.                           |
|                                                                  |
|   5.  Play a chord.  You will hear only one note of the chord.   |
|       With no input from the ribbon controller, the effective    |
|       rate for repeating and arpeggiating is zero.               |
|                                                                  |
|   6.  Place your finger at the lower end of the ribbon           |
|       controller, press down and slowly slide your finger to the |
|       right.  You will hear the chord repeat and arpeggiate      |
|       faster and faster.                                         |
|                                                                  |
|   7.  Turn the control knob to set the response filter to 0.050. |
|                                                                  |
|   8.  Sustain a chord and again move your finger along the ribbon|
|       control.  No matter how quickly or slowly you slide your   |
|       finger, the change in rate will be very gradual.           |
|                                                                  |
|   9.  Continue to hold down the chord and lift your finger from  |
|       the ribbon controller.  The repeating arpeggio will slow   |
|       down very gradually.                                        |
|                                                                  |
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KEYBOARD CONTROL VOLTAGE

When the keyboard control voltage device is patched to a timbre
parameter, the parameter will change according to where you are
playing on the keyboard. There will be less voltage supplied the
lower you play on the keyboard and more supplied the higher you play.
Thus, the settings of the parameter will approach maximum on the
upper range of the keyboard and zero on the lower range.

To use the keyboard control voltage most effectively, left and right
keyboard limits should be entered.

The left key limit establishes the key corresponding to 0 volts.
Keys to the left of this key will also use 0 for the keyboard control
voltage.

The right key limit establishes the key corresponding to maximum
voltage. Keys to the right of this key will also use maximum
voltage.

To set the left and right keyboard control voltage limits, follow
this procedure:

1. Press and hold the KEYBOARD C.V. button.

2. Play two notes on the Synclavier (R) keyboard. The notes can be
   played simultaneously or one at a time. The lower note will
   establish the left limit; the higher note will establish the
   right limit.

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| |
| Using Keyboard Control Voltage |
| |
| In this exercise you will add vibrato to a timbre as well as |
| use the keyboard control voltage function. |
| |
| 1. Recall Timbre 1-1-8. |
| |
| 2. Press VIBRATO DEPTH. You will see |
| |
| 0.10 SEMITONES |
| |
| in the display window. |
| |
| 3. Dial in a vibrato depth of 0.50 semitones. |
| |
| 4. Press and hold KEYBOARD C.V. |
| |
| 5. Play the C below middle C and the C above. |
| |
| 6. Continue to hold down KEYBOARD C.V. while you. . . |
| |
| 7. . . .press VIBRATO DEPTH. |
| |
| 8. Play the C below middle C and hold it. You will hear no |
| vibrato. Then play the C above middle C. You will hear |
| the full quarter-tone vibrato. |
| |
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BREATH CONTROLLER

On the back panel of the keyboard unit is a jack labeled BREATH
CONTROLLER. When a Yamaha BC1 Breath Controller is plugged into this
jack, you can patch the breath controller expression input to
selected partial timbres and timbre parameters.

To use the breath controller most effectively, cover the hole on the
bottom of the breath controller with your thumb or a piece of tape
and suck your cheeks in and out to vary pressure. You may want to
adjust the trim pot located on the bottom of the breath controller
with a screw driver.

PITCH BENDING

You already know how to change the pitch of a note by patching
PARTIAL TUNING to any expression input device. The devices most
effective for pitch bending are the after-touch devices:

    PRESSURE
   PEDAL
    MOD WHEEL
    RIBBON CONTROLLER

There are two additional ways to bend a note. You can

- use the pitch bend wheel, the wheel located farthest to the left
  of the keyboard;

- use the control knob when the SCALE RESET button is lit.

Once you have selected your method for bending notes, you can perform
pitch bends on any note in real time. You can record pitch bends but
you cannot perform pitch bends on a sequence being played back from
the memory recorder.

Controlling Depth of Pitch Bends

You can increase or decrease the pitch bend range. The maximum pitch
bend depth of all pitch bend devices is established by using the
SCALE RESET button in the second panel.
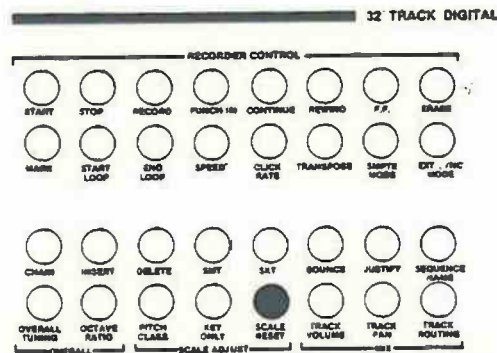
When you first press SCALE RESET,

    2.00 SEMITONES

will appear in the display window. This means that if you perform a
pitch bend, the most the note will rise or fall from its original
pitch will be two semitones.

To change the maximum depth of a pitch bend to any integer number of
semitones, press SCALE RESET repeatedly. The number in the display
window will step through the twelve semitones in an octave.

To change the maximum depth of a pitch bend to any fractional number
of semitones, press SCALE RESET and hold it down while you dial in a
new number. The adjustment can be to within 0.01 semitone.

The Pitch Bend Wheel

The pitch bend wheel is the outermost wheel to the left of the
keyboard. It works exactly like the mod wheel, except that no patch
need be set up to use it. Turning it away from you raises the pitch
of the note being played; turning it toward you lowers the pitch.
When you release the wheel, the note will return to its original
pitch.

Performing Pitch Bend with the Control Knob

The control knob can also be used to perform pitch bends provided the
SCALE RESET button is lit.

Turning the knob to the right increases the pitch of the notes being
played; turning it to the left lowers the pitch. Turning the knob
all the way to the right or the left will raise or lower the pitch
the maximum pitch bend depth.

When you press any other button on the Synclavier (R) control panel
that affects timbre control (such as any button under VOLUME ENVELOPE
or HARMONIC ENVELOPE), the control knob will be returned to its
function of setting parameters.

Performing Pitch Bends

1. Recall Timbre 1-2-7, the bass timbre.

2. Play a note and hold it while you turn the pitch bend wheel first all the way away from you, then all the way toward you, then release it. The note will rise in pitch to a maximum of two semitones, then return to its original pitch, then fall two semitones and finally return to its original pitch again.

3. Press SCALE RESET. The display window will show

      2.00 SEMITONES

4. Press SCALE RESET repeatedly until

      12 SEMITONES

   appears in the display window.

5. Play a note while you turn the control knob to the right and to the left. The note will rise in pitch an octave and then fall through its original pitch to the octave below.

6. Press SCALE RESET one more time and hold it down. The setting of

      1.00 SEMITONE

   will appear in the window.

7. Continue to hold down SCALE RESET and turn the control knob until 0.50 appears inthe window.

8. Press RIBBON and hold it down while you. . .

9. . . . .press PARTIAL TUNING.

10. Play a note on the keyboard and bend it using the ribbon controller. The most you will be able to bend it will be a quartertone up or down.

DYNAMIC ENVELOPE

The dynamic envelope is used to select exactly which partial timbres should be synthesized based on the dynamic level of the note. This feature can be used to provide brighter or more "punchy" timbres for louder notes. A wide variety of special effects can be created in this manner.

The DYNAMIC ENVELOPE buttons can be effectively patched to these expression input devices:

VELOCITY
RIBBON
KEYBOARD C.V.
PEDAL
PRESSURE

In order to activate a dynamic envelope, the keyboard timbre must contain more than one partial timbre. Each partial timbre will be set to a particular dynamic range, with a high level and a low level.

To set up a dynamic envelope for a partial timbre,

1. press the desired PARTIAL TIMBRE SELECT button;

2. press DYNAMIC ENVELOPE:LOW and dial a number from 0 to 8.

3. press DYNAMIC ENVELOPE:HIGH and dial a number from 0 to 8.

Each partial timbre can have a dynamic range completely separate from each other partial timbre. Or the partial timbres can overlap.

For example, the following limits might be set on three partial timbres.

        Partial Timbre 1   low limit = 0
                            high limit = 2

        Partial Timbre 2   low limit = 3
                            high limit = 5

        Partial Timbre 3   low limit = 6
                            high limit = 8

Partial Timbre 1 will be synthesized when there is a low level input, Partial Timbre 2 at a mid-level input, and Partial Timbre 3 at a high-level input.

Once the dynamic envelope for a timbre is set, one of the appropriate expression inputs must be patched to either LOW or HIGH (both buttons will light up).

Using the Dynamic Envelope

1. Recall Timbre 1-2-6, the "3 Partials" timbre.

2. Press Button 1 under PARTIAL TIMBRE SELECT so that it's blinking.

3. Press DYNAMIC ENVELOPE:LOW.

        0 DYN LEVEL

   will appear in the display window. Leave the partial timbre at this setting.

4. Press DYNAMIC ENVELOPE:HIGH and turn the control knob until

        2 DYN LEVEL

   appears in the display window. The dynamic range for Partial Timbre 1 is now set from 0 to 2.

5. Repeat this process for Partial Timbre 2, setting the dynamic range from 3 to 5.

6. Repeat the process for Partial Timbre 3, setting the dynamic range from 6 to 8.

7. Unsolo Partial Timbre 3.

8. Patch PEDAL1 to DYNAMIC ENVELOPE. You can press either the HIGH or LOW button. Both will light up.

9. Play the keyboard, varying the pressure on the pedal. When the pedal is all the way up, the first partial timbre will sound. When it is part-way down, the second will sound. When it is all the way down, the third will sound.

10. Patch some of the other expression input devices to the dynamic envelope and experiment with the sound.