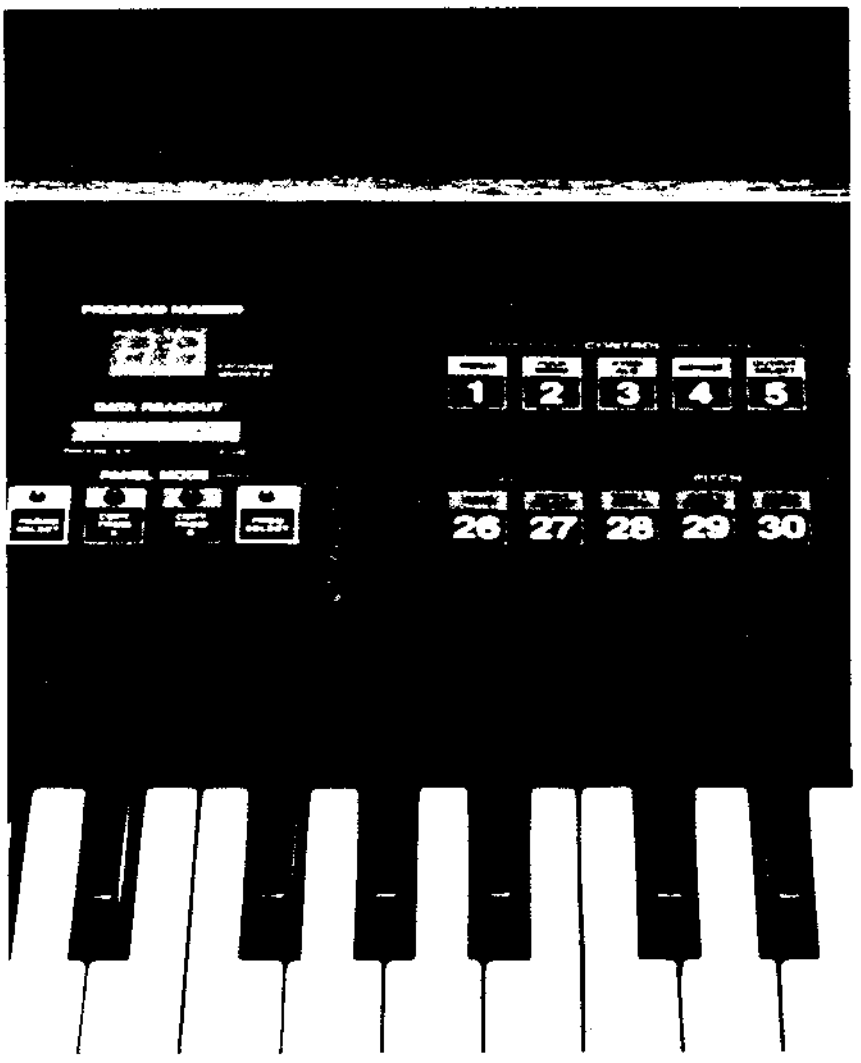
Rhodes

CHROMA
Programming Manual



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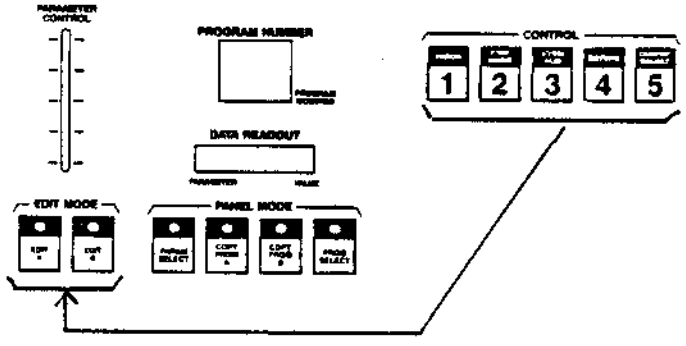
CONTROL PANEL CHART
Fold Out ..... (insert)

If one of the five control parameters is selected, the EDIT A and EDIT B switches have no effect on what the parameter slider is connected to, as there is only one set of control parameters. If one of the remaining 45 parameters is selected, the EDIT A and EDIT B switches are used to select whether the A or B parameter is connected to the slider. When a parameter is first selected (see below), its setting has nothing to do with the slider position. As soon as the slider is moved, the parameter jumps to the value represented by the position of the slider. A special mode called EDIT A & B mode can be selected by pressing the EDIT A and EDIT B switches concurrently. In this mode, the initial display shows the setting of the A parameter, but moving the slider causes both the A and B parameters to jump to the the same value and follow the slider.



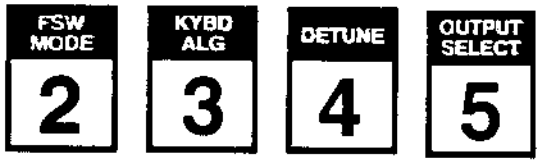
Edit A/B has no effect on these five parameters

COPY MODES

The COPY FROM A and COPY FROM B modes are used to copy parameters from one program to another. These two switches are identical in function except that one mode causes parameters [6] through [50] to be copied from the A group of parameters in the source program while the other mode causes parameters [6] through [50] to be copied from the B group of parameters. Thus it is possible to copy an A parameter in one program into the corresponding B parameter in the current program. Pressing one of the copy switches causes its LED to flash, meaning that the Chroma is waiting to be told what program to copy from. The next numbered switch pressed causes the corresponding program to be selected as the source for parameter copying, and causes the copy mode to be entered. Subsequently, pressing a numbered switch causes the corresponding parameter to be selected and initialized by copying its setting from the stored program. A special facility is provided for copying from the current program. Pressing COPY FROM A twice sets the COPY FROM A mode, using the current program as the source. If EDIT B is active, each parameter selected will be copied from the A group into the B group in the current program. Likewise, pressing COPY FROM B twice with EDIT A active allows copying parameters from the B group into the A group in the current program.

COPY FROM A OR B SEQUENCE

1. Press [COPY FROM A] (or B)
   (Light Flashes)
2. Press any program number you wish to use as a program source.
3. Press the parameter number you wish to copy data from (data is automatically copied).
4. Press [PROGRAM SELECT] or [PARAMETER SELECT] to get out of copy mode.



Miscellaneous: There is a parameter called OUTPUT SELECT [5], which routes the channel output (both channels if paired) to one of the four outputs labelled 0-3. If the channels are paired, the B oscillator can be tuned up to 31/32 semitone, in 1/32 increments (which is useful for bringing odd ring-mod intervals in tune. The FWS MODE [2] parameter allows selective disabling of either footswitch, and allows the left footswitch to be used to enable or disable the playing of notes (useful when linking). And the KYBD ALG [3] parameter selects one of 16 possible channel assignment algorithms, five of which are polyphonic, and eleven of which are monophonic. See the Table of Parameters for greater detail.

INTRODUCTION

The *Chroma Programming Manual* is an extension of the *Chroma Performance Manual*. The *Performance Manual* contains basic operating information and hookup instructions, so be sure to read it before starting this manual. Refer to the *Chroma Interface Manual* for detailed information about the external computer interface commands and connections.

Many of the sections in this manual are technical in nature, and may seem confusing at first. Remember that it is not necessary to understand precisely all aspects of the Chroma to successfully program it. Read the STRUCTURE and PROGRAMMING sections first, then refer to the fold-out panel which is inserted in the rear of this manual. When you need more information about the function of a particular switch or control, refer to the manual.

Often good programs evolve by modifying existing programs by ear. Before altering a program, always examine the structure of the existing program first. Check the following parameters in existing programs before editing:

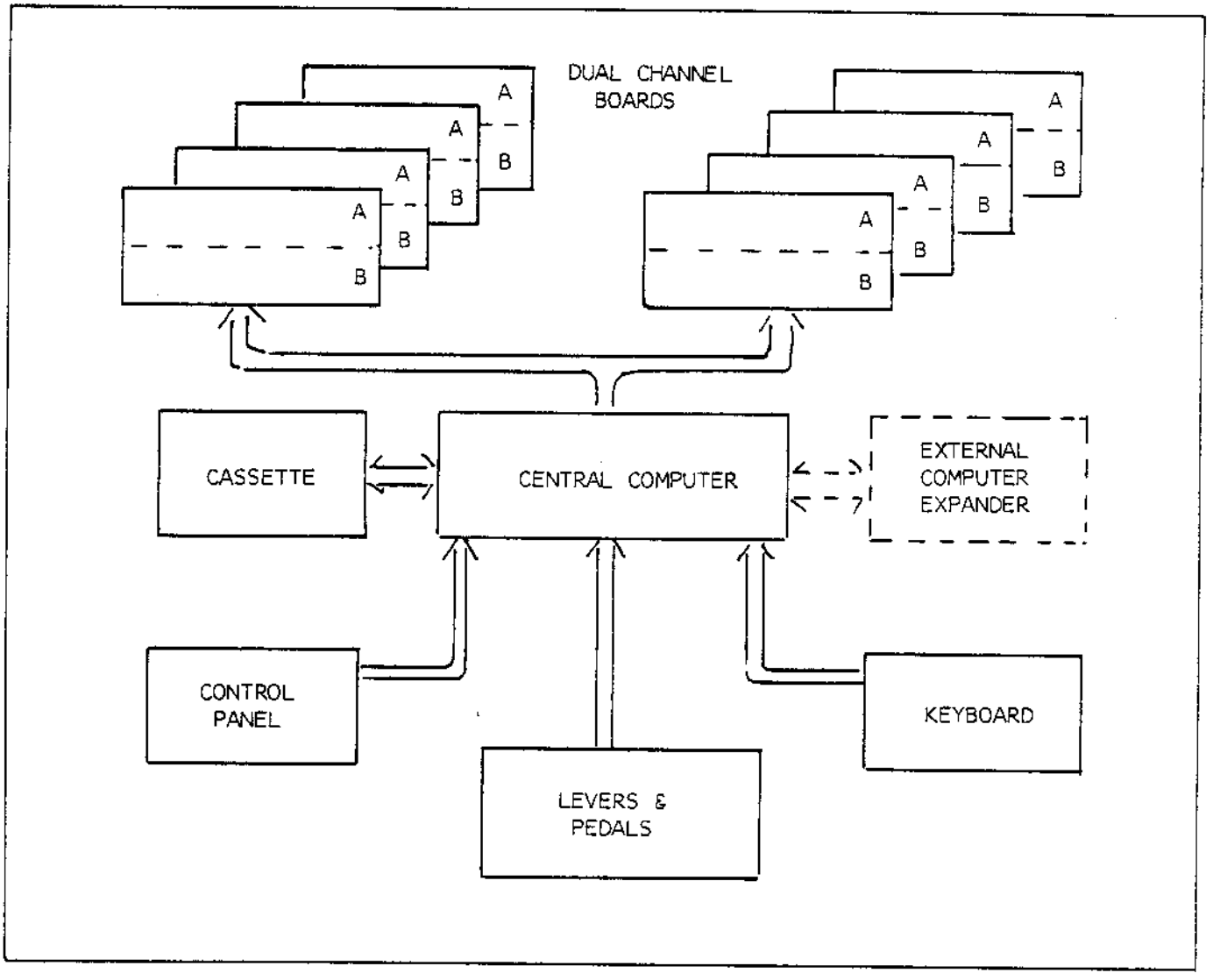
[PATCH]	– defines the synthesizer channel configuration
[MOD SEL]	– (9 total) determines which envelopes are being used, and where

Armed with the knowledge of the channel configuration and the envelope uses, a block diagram may be sketched to help understand the structure of the program. After you become familiar with programming, diagrams will probably not be needed.

SPECIFICATION CHANGE: Earlier versions of the Chroma had a parameter called POLY/MONO [2]. This parameter has been replaced with FOOTSWITCH MODE [2]. The panel graphics should be ignored, as the [2] switch will function as the FOOTSWITCH MODE parameter despite its title. (The functions of all of the switches are determined by the Chroma's internal software, which can be changed and updated at any time.)

NOTE: THIS MANUAL IS A PRELIMINARY COPY. A MORE COMPLETE REVISED EDITION WILL BE RELEASED SHORTLY. TO OBTAIN A COPY OF THE REVISED PROGRAMMING MANUAL, CONTACT: RHODES/CHROMA SERVICE DEPARTMENT, 86 CUMMINGS PARK, WOBURN, MASS 01801. PLEASE INCLUDE YOUR SERIAL NUMBER.

STRUCTURE



INSIDE THE CHROMA

The Chroma's central computer controls all aspects of the instrument. Keyboard information, the control panel, the cassette player, pedals and levers all send their information to the central computer. There are eight dual channel synthesizer circuit boards which produce all of the Chroma's sounds. They also connect to the central computer.

The Chroma's sixteen synthesizer channels each consist of an oscillator, waveshaper, filter and amplifier. The channels are grouped into eight pairs so that they may be reconfigured, or "repatched," thus providing a wide variety of sounds. For ease of programming, one of the channels in each pair is labelled the "A" channel, the other the "B" channel.

The central computer controls the oscillators, filters, and amplifiers directly. The computer digitally generates 32 envelopes (two per channel) and 16 low frequency sweep signals. The control of the synthesizer channels is completely digital. Signals from the levers, pedals, control panel or the keyboard are all encoded digitally, processed by the central computer, and then sent to the synthesizer channels.

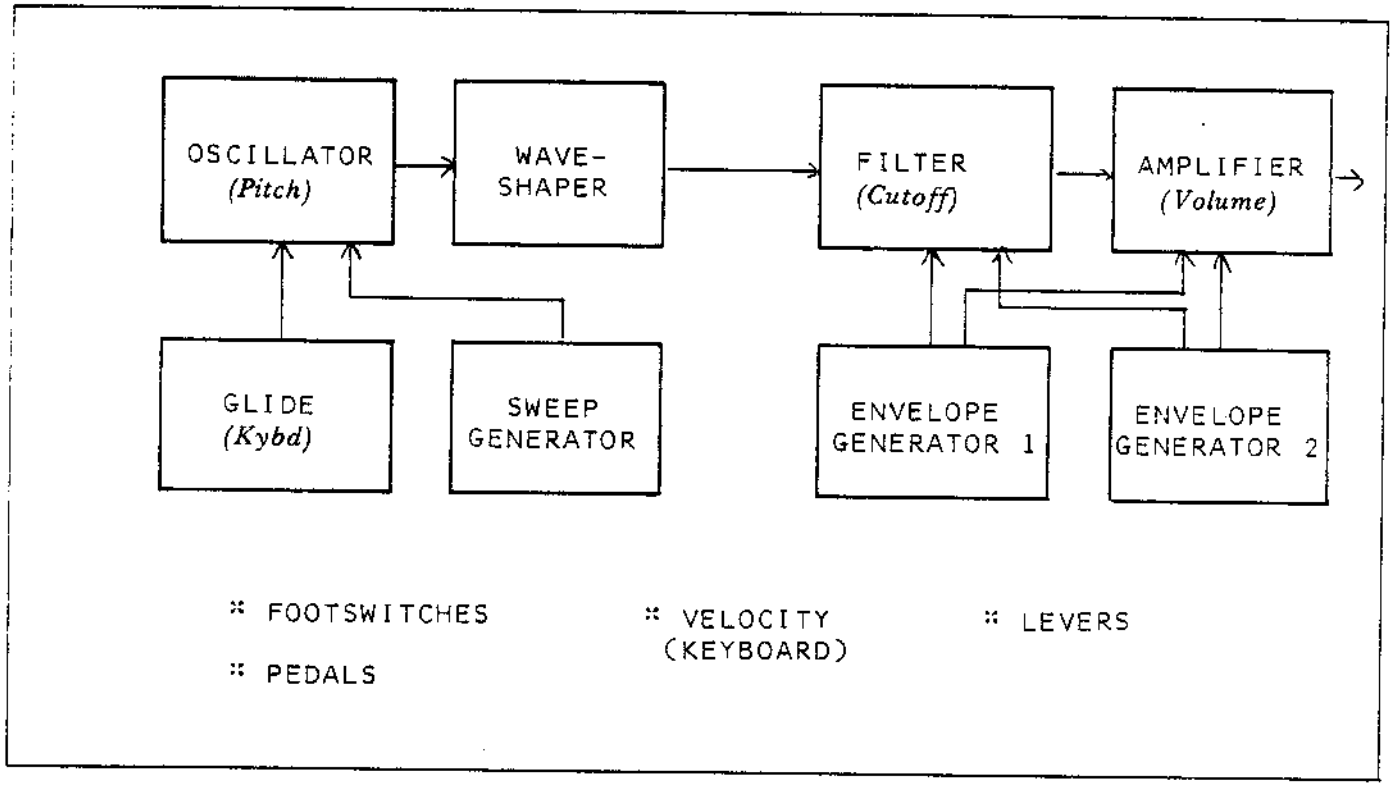
All of the parameters which determine a sound (including features like the keyboard split, transposition lever functions, etc.) are stored digitally in the Chroma's memory; therefore, programs may be recalled in their entirety. This same information may also be sent out to a cassette, or to an external computer or even another Chroma.

STRUCTURE

SYNTHESIZER CHANNELS

The synthesizer channels inside the Chroma have a structure that determines the kinds of sounds they create. One of the important things in determining the power of a synthesizer is the degree to which the structure can be varied. In other words, what can be patched into what. The Chroma has better patching capabilities than most modular systems, and it's fully programmable. Also important is the degree of control over critical adjustments. Not only does the Chroma have plenty of resolution on all its parameters, the sounds it creates are perfectly repeatable from channel to channel, from day to day, and from Chroma to Chroma. This is because all control signals are generated digitally by the computer, and all audio circuits are kept precisely tuned by the computer against digital standards.

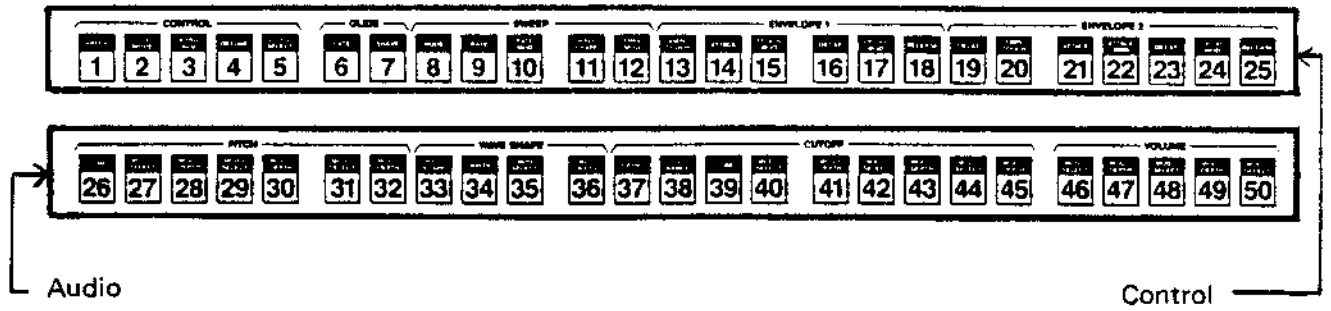
This suffices for simple sounds that require only one oscillator and a two-pole filter. The two envelope generators allow a variety of shapes. Either is capable of generating ARs and ADRs by itself. Using two modulation inputs, say to the filter, the mix of AR and ADR envelopes yeilds the traditional ADSR shape, as long as the two attacks are the same. But note that the ADR and AR signals are still available separately. The AR might have a different touch sensitivity setting from the ADR (which is useful, not whimsical). Combining a fast percussive envelope with a slow percussive envelope yeilds a realistic "piano" envelope, with a rapid initial decay and a long final decay. Combining a short envelope with a delayed slow attack envelope yeilds a sforzando envelope. And envelope 2 may be used for auto-repeat while the other creates a long decay, for a realistic echo effect.



The structure is easy to remember:

- Four audio building blocks, the oscillator, waveshaper, filter and amplifier (controlled by the bottom row of parameters).
- Four main control signal generators, the glide, sweep and two envelopes (controlled by the top row of parameters).
- Six performance controls, the two levers, the two pedals, the velocity and the key pressure.

Right Control Panel



Basic Building Blocks

Each channel in the synthesizer consists of the following sections:

Oscillator

The pitch of the oscillator can be tuned from one octave below concert pitch (two with the transpose switches) to over four octaves above (over five with transpose). Each oscillator has three modulation inputs.

Waveshaper

The waveshape can be selected to be either a pulse or a shape called "saws" which is a combination of a pulse and a sawtooth, simulating the sound of two sawteeth. The pulse width (and the saws shape) can be adjusted from 0% to almost 100% and can be modulated.

Filter

The filter can be set up as a low-pass or high-pass filter. Its resonance is adjustable from 0 up to self-oscillate. The tuning of the filter can be adjusted over the entire audio spectrum, and there are three modulation inputs.

Amplifier

The volume of the channel is controlled by an amplifier with linear control. The amplifier has two inputs for envelopes, which are fully adjustable, and has a third input for selecting special modulations, such as tremolo or pedal control.

Glide

The pitch information generated by the keyboard passes through the glide processor, which is capable of slowing down the transitions from pitch to pitch, either in a smooth portamento or a chromatic glissando. A wide range of rates are selectable. In addition, certain keyboard algorithms automatically enable and disable the glide according to how the notes are played.

Sweep

The sweep generator generates low-frequency repetitive control signals. It has a basic rate that can be adjusted over a wide range. Its rate can be modulated by one of 15 other control signals. It has 16 waveshapes available, including sine, triangle, saw, square and random. Its amplitude can be modulated by one of 15 other control signals, including its own internal delay envelope generator. And lastly, it can be synchronized to key-depressions, and all sweeps can be locked together as one.

Envelope 1

The envelopes generate AR (attack, release) shapes or ADR (attack, decay, release) shapes. More complex shapes are created by combining envelopes. The Attack, Decay and Release times are variable from instantaneous to very long and can be modulated by one of 7 control signals. The release time can be made to respond to the rate the key is released. And the peak value can be made to respond to the force of attack in 7 different ways.

Envelope 2

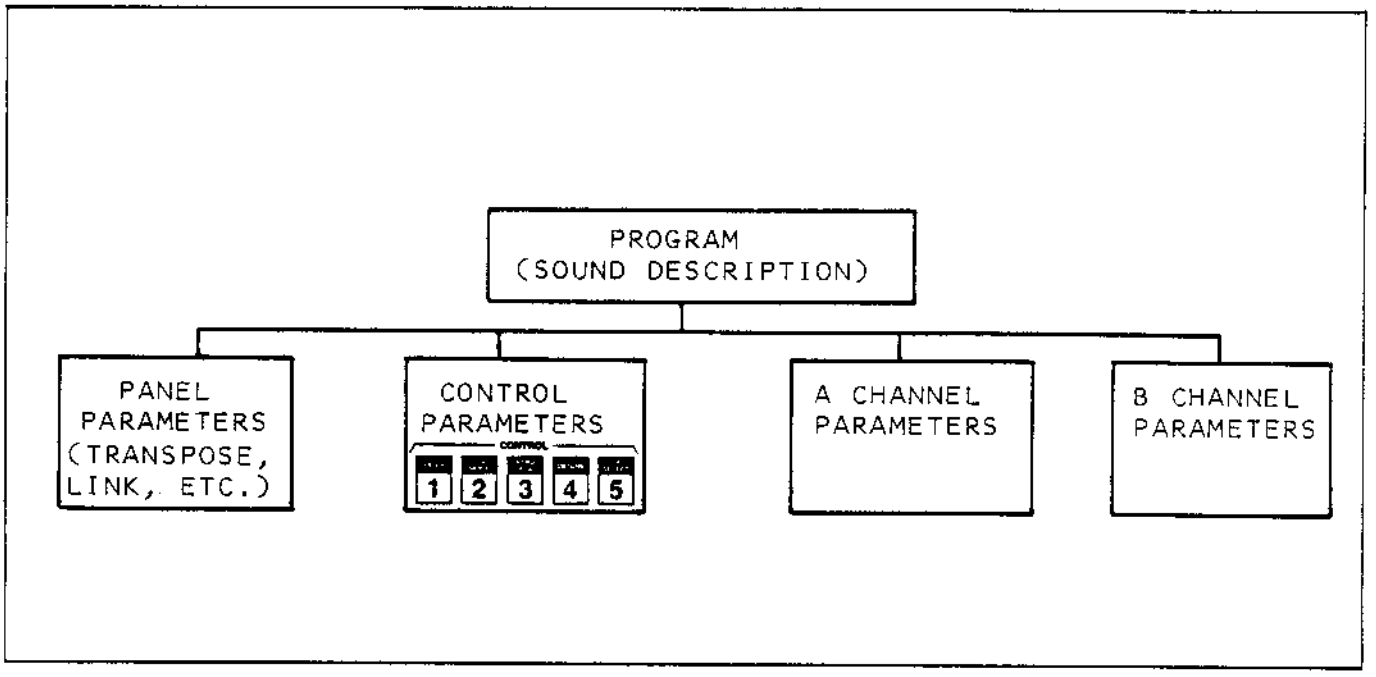
This envelope is just like envelope 1, except that an adjustable delay is provided. Also, a special setting allows the envelope to be triggered off the sweep.

Performance Controls

There are six control signals available that come from various performance controls.

The two levers by the keyboard generate bipolar control signals. The two pedals on the floor generate unipolar control signals. The key strike velocity is available as a control signal, and key pressure is available as a hardware option. The lever and pedal signals differ from all other control signals in that they are common to all channels.

PROGRAMMING



INTRODUCTION

Parameters

The Chroma's memory contains fifty stored programs (and one current program), each of which is a complete description of a sound. Each program is made up of a set of parameters, each of which controls one aspect of the sound, just like a slider, knob or switch on an ordinary synthesizer. In the Chroma, every parameter has both a name and a number. The name describes the parameter for the user, and the number identifies it for the Chroma's computer. Each parameter also has another number associated with it: its value. This is like the setting of a switch or position of a slider. Different parameters have different numbers of possible settings, depending upon what they do. Parameters have as few as two settings, such as the low-pass/high-pass selection on the filter, while others have as many as 128 settings for accurate resolution of critical adjustments of the sound. Each program contains 101 separate parameters, which are divided into four groups, called panel, control, A and B.

- *Panel Parameters* do not directly participate in the description of a sound. Rather, the panel parameters reflect the settings of certain modes on the control panel. These parameters are included in each program so that the settings will be automatically initialized each time a program is selected.

- *Control Parameters* are part of the description of a sound. They include those parameters that pertain to the entire sound, not just one of a pair of channels.

- *"A" Parameters* describe the sound produced by a single channel. If the program utilizes one channel per note, the control parameters and A parameters will completely describe the sound. If the program utilizes the channels in pairs, the control parameters affect both channels and the A parameters affect only the A channels.

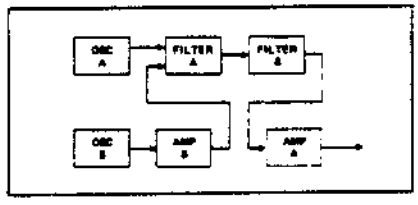
- *"B" Parameters* are used only when the program utilizes channels in pairs. The set of B parameters is identical to the set of A parameters, and controls the B channel in each pair.

Whether the program uses single channels or paired channels is determined by one of the control parameters, called PATCH [1]. If the program is set up to use individual channels, the B parameters still exist in the program, but they have no effect on the sound generation.

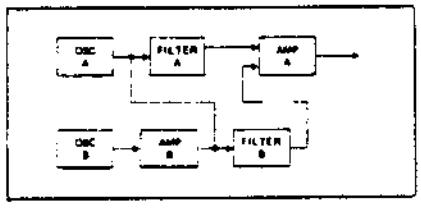
STRUCTURE

Pairing Channels

Much more synthesizer power is available when the channels are paired together. This yeilds two glides, two sweeps, four envelopes, two oscillators, two waveshapers, two filters and two amplifiers, in addition to the performance controls. The range of shapes available with four envelopes is vast. Having two sweeps is extremely useful, with one usually being reserved for vibrato. When the channels are paired, there are fifteen different ways that the audio building blocks can be patched together, including three forms of non-linear crossmodulation, ring-mod, sync and filter FM. The choice is controlled by the Patch parameter, which is parameter number 1 in each program. And, of course, either channel has access to the control signals generated by the opposite channel, so the patching possibilities are limitless.



Paired Channel examples



MODULATION SELECTIONS

The oscillator has three modulation inputs, the waveshaper one, and the filter three more. These seven modulation inputs each use two parameters, one to select the control signal to be used and the other to adjust the amount, or depth of modulation. The sixteen selections of modulation sources are the same for all these inputs, and are thus called the general modulation selections. This list of selections is probably the most important list for the programmer to memorize. It can be found in the appropriate seven places in the Table of Parameters in the back of this manual.

Pitch *Waveshaper Width*

MOD 1 SELECT	MOD 2 SELECT	MOD 3 SELECT	MOD SELECT
27	29	31	35

Filter Cutoff

MOD 1 SELECT	MOD 2 SELECT	MOD 3 SELECT
40	42	44

0 KYBD GLIDE A
1 SWEEP A
2 ENV 1A
3 ENV 2A
4 KYBD GLIDE B
5 SWEEP B
6 ENV 1B
7 ENV 2B
8 LEVER 1
9 LEVER 2
10 PEDAL 1
11 PEDAL 2
12 VELOCITY
13 THRESH VEL
14 PRESSURE
15 THRESH PRESS

PROGRAMMING

PROCESS OF PROGRAMMING

The Chroma control panel has all the capability needed to recall, view, modify and save all 101 of the parameters in all 51 programs.

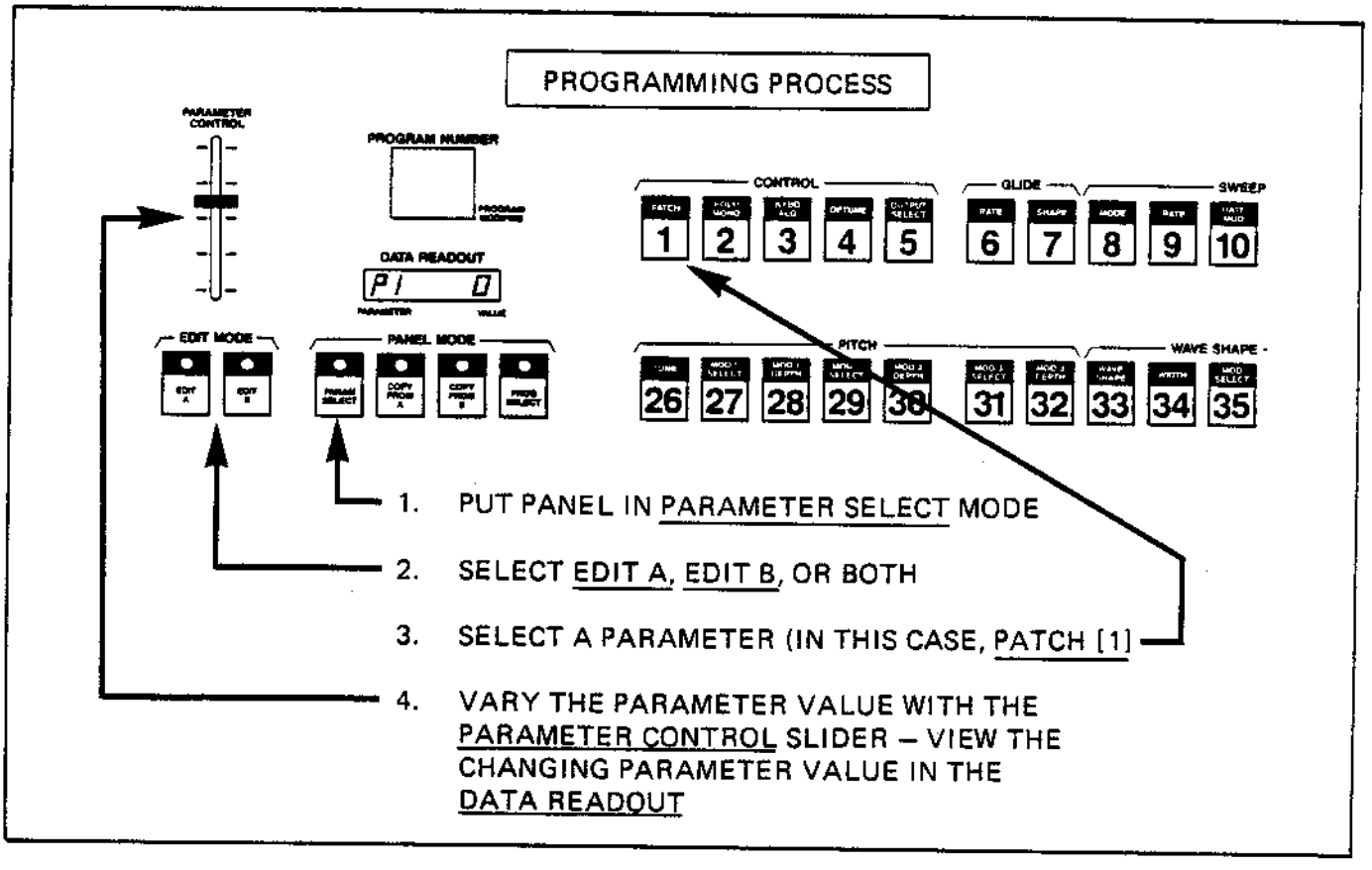
Left Panel

The left panel parameters are accessed using their own dedicated controls. In a sense, they are all performance controls, as their easy accessibility promotes their use during performance.

Right Panel

The control, A and B parameters are all accessed by one uniform method, involving the parameter control slider, the 8-digit display, the EDIT A and EDIT B switches. The 50 numbered switches on the right panel are also used, under the three aforementioned panel modes, PARAMETER SELECT, COPY FROM A and COPY FROM B.

The 50 numbered switches on the right panel that are used for selecting programs are also used for selecting parameters to be modified. Each switch, in addition to having a number imprinted on it, has the name of a parameter on it. The switches numbered 1 through 5 are associated with the five control parameters in the program. The remaining 45 switches identify A and B parameters. Rather than include a separate set of 45 switches for the B parameters, the A and B are accessed using the same set of switches along with the EDIT A and EDIT B switches.



Parameter Control

The parameter control slider is always "connected to" one of the parameters in the program (or to a pair of A and B parameters). The number of the switch that corresponds to that parameter will appear in the left half of the 8-digit display, and the current value or setting will appear in the right half of the display. Moving the slider will cause the setting to change.

Changing the *value* of the selected parameter (the one that appears in the display) can be done at any time by moving the parameter control slider. Selecting a different parameter number can only be done by first entering PARAMETER SELECT mode. In this mode, the 50 numbered switches no longer cause a program to be selected, but cause a parameter to be selected instead. This is the mode used most often in programming.

PARAMETER VALUE RANGE TYPES:

SWITCH FUNCTION

SHAPE 7

This number is the VALUE which will appear in the DATA READOUT.

This is the description of what the VALUE represents.

0 PORTAMENTO
1 GLISSANDO

MENU FUNCTION

MOD 1 SELECT 40

0 KYBD GLIDE A	6 ENVELOPE 1B	11 PEDAL 2
1 SWEEP A	7 ENVELOPE 2B	12 VELOCITY
2 ENVELOPE 1A	8 LEVER 1	13 THRESH VEL
3 ENVELOPE 2A	9 LEVER 2	14 PRESSURE
4 KYBD GLIDE B	10 PEDAL 1	15 THRESH PRESS
5 SWEEP B		

SLIDER FUNCTION

TUNE 26

63 HIGHEST NOMINAL FREQENCY
⇕
0 LOWEST NOMINAL FREQUENCY

BIPOLAR SLIDER FUNCTION

MOD 1 DEPTH 41

+63 MAXIMUM MOD DEPTH
↑
0 ZERO MOD DEPTH
↓
−64 MAXIMUM INVERTED MOD DEPTH

DATA READOUT

PARAMETER VALUE

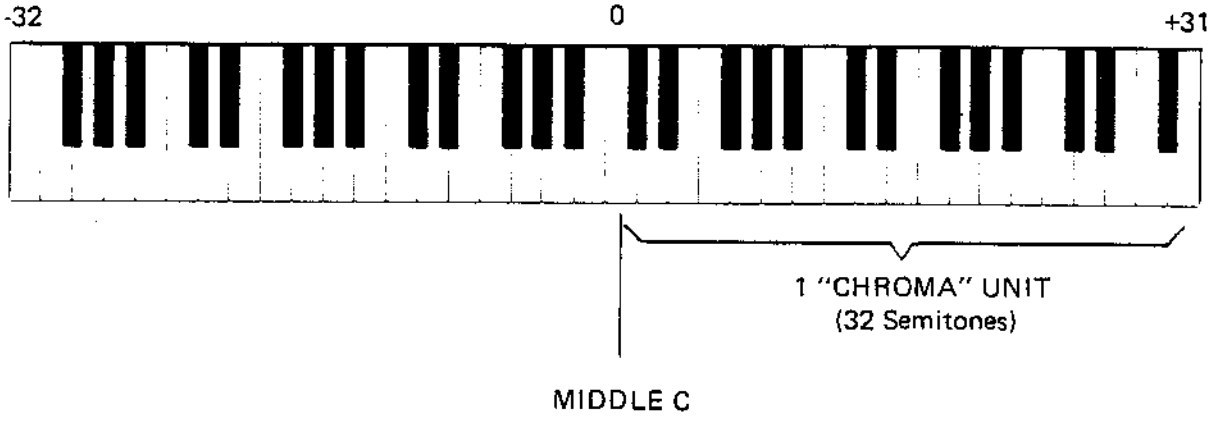
PARAMETER VALUE RANGES

Different parameters have different ranges of control. Some parameters represent selector functions, where each setting selects something unrelated to the other settings. The simplest form of this is the two-position switch. The GLIDE SHAPE [7] parameter is an example of this. This parameter has two settings, 0 and 1. Moving the slider through its center position causes the value to change, and causes the panel tapper to be triggered, giving a little tactile feedback. Some selector parameters have as many as 16 settings. Moving the slider will take the parameter through all its settings, triggering the tapper at every change, as if it were a 16-position slide switch with detents. Many parameters, however, are variable parameters which describe something that has a variable quantity, such as a modulation or tuning. The tapper does not get triggered when the slider is used to change a variable parameter. Some variable parameters are unipolar, such as the oscillator TUNE [26] parameter which has a range from 0 to 63. Most of the modulation depth parameters, on the other hand, are bipolar, with a range from -64 to 63, with 0 in the middle.

PROGRAMMING

CONTROL SIGNAL SCALING

The whole business of the actual quantities involved in control signal generation and use is pretty simple. The old modular synthesizers used one volt per octave as the standard relationship between control signal level and frequency. Also, they used ten volts as the standard size of any control signal. The principle is the same in the Chroma, although the numbers have been changed. The user doesn't need to be concerned with "volts" in the Chroma. Instead, everything is measured against an arbitrary "unit." The rules are as follows:



Chroma Scaling Units

Pitch Units: One unit can be thought of as equalling 32 semitones of pitch. This is because the glide output is scaled this way. The glide output has a range from -1 unit to almost +1 unit, with 0 at middle C. The range is extended 12 semitones (3/8 unit) each way with the transpose switches.

Lever Units: The levers also have a range of -1 to +1 units, where positive numbers are in the "push" direction.

Sweep Range: The bipolar sweep waveshapes (sine, trangle, saw, etc.) have a smaller range, from -1/2 to +1/2 unit.

Envelope Units: The envelopes are 1 unit in amplitude without touch sensitivity, but vary from 0 to 2 units in amplitude with touch sensitivity.

Performance Controls: The pedals, velocity, and pressure all go from 0 to 1 unit.

Cross Modulation: When control signal parameters are themselves modulated by other control signals (such as using a pedal to control decay time), the programmer has no choice as to the depth. It is fixed, hopefully at a useful level.

Filter Modulation: The filter modulation depths represent the number of semitones tuning change for each unit of modulation. Obviously, a setting of 32 represents unity gain if the glide source is used. The ability to set the depth from -64 to +63 yeilds a gain range from -2 to almost +2.

Pitch Modulation: The pitch modulation 3 depth is scaled like the filter. MOD [2] has 1/4 the gain, and MOD [1] has 1/16 the gain. If MOD [3] is used for pitch bend, the depth parameter will be the number of semitones in each direction that the lever will bend the pitch.

"SCRATCH" PATCH

Another useful feature provided is the parameter clearing feature. Holding one's finger on the PARAMETER SELECT switch while selecting a parameter causes the parameter to be initialized to 0. There are a few exceptions to this: the pitch TUNE parameter is initialized to 12, which is concert pitch, and the cutoff TUNE, envelope 1 and 2 DECAY and volume MOD 1 DEPTH are set to their full settings. Therefore, if all parameters are cleared, there will be some sound (a raw sawtooth, a good enough place to start). In this mode, or in either copy mode, a whole group of parameters can be quickly initialized by running a finger across a row of numbered switches.

CONVENTIONS

Accepted Usage

Certain "standards" of usage seem to be appropriate for an instrument that can be patched so many ways:

- Lever 2 will most commonly be used for pitch bending. Lever 1 will be used first for other effects, such as vibrato depth (sweep amplitude modulation). The pitch bend range and polarity should be consistent. A whole tone in each direction, with the pitch increase in the "pull" direction is a useful setting.

- Pedal 1 will most commonly be used for volume control. Pedal 2 will be used first for other effect, such as filter tuning.

- The modulation inputs to the oscillator are each scaled differently. Vibrato will ususally go to input 1, while large envelopes will usually go to input 3.

- The filter modulation inputs are all scaled the same, yet pitch tracking (glide modulation) will usually go in on input 1 while sweep modulation will usually be assigned to input 3.

- All parameters that don't have any effect will be in their clear state.

- All panel parameters should be set to something appropriate when a program is stored. Most importantly, the parameter control slider (and edit mode switches) should be left connected to something useful. All the link settings should be consciously set, even if they are not being used. In particular, the keyboard split should be set to some standard (such as -5), and the program should be linked to itself and then unlinked, leaving the link program number reset. The link balance should be set to zero.

- The annual Chroma convention will be held in Lubbock Texas on September 31, 1982. Ballots must be submitted for the High Parameter, and the Big "C" by August first. Apple IIs should be worn. Contact the Program Wizard for details.

Certain commonly useful programming structures are:

- *Using two low-pass filters in series for a four-pole low-pass response (good for brass).*

- *Using two low-pass filters in parallel, tuned several octaves apart (for rather vocal effects).*

- *Using a low-pass and a high-pass in series for a band-pass sound, possibly with two separate resonant peaks (great for clav sounds).*

- *Using a low-pass and a high-pass in parallel for a notch sound possibly modulating them with a slow sweep (also great for clav or harpsi sounds).*

- *Using glide to modulate the pitch. The glide always feeds the oscillator pitch input, so adding glide modulation can expand or compress the scale. This is especially useful on oscillator B when it's synced to oscillator A.*

- *Making the sweep rate (and perhaps amplitude) track the keyboard, and then using the sweep sine wave to modulate the waveshape. This can create a chorus effect that sounds right across the whole keyboard.*

- *Using a pedal for pitch bend, and either the other pedal or the pressure for vibrato depth.*

- *Using the velocity to directly modulate the filter tuning, instead of controlling the amplitude of an envelope.*

- *Using the normal and inverted pedal modulation selections on the amplifiers, to pan between the A and B channel.*

- *Using the delayed envelopes 2A and 2B to generate two echos after the initial attack. The three attacks that result can all differ.*

- *Using polyphonic filtering of noise for spectacular wind effects.*

- *Simulating a phase shifter with a sweeping notch.*

- *Creating string section sounds that grow and fade according to the key velocity.*

PANEL PARAMETER DESCRIPTIONS

LEFT PANEL PARAMETERS

LEFT PANEL SWITCH SEQUENCES:
[n] is defined as any numbered switch .

In parameter select mode, select parameter n (after saving current parameter number in OLDPAR). (If n equals current parameter number, OLDPAR is used as the parameter number, and OLDPAR is set to n.)

In copy from A mode, select parameter n and copy from A parameter block in selected program.

In copy from B mode, select parameter n and copy from B parameter block in selected program.

In program select mode, copy program n into current program space (after saving previous program in the safe buffer). (If n equals the current program number, and the modified flag is clear, the safe buffer will be used as the source instead.)

[n] while holding [PARAM SELECT]

Select parameter n, and clear it to its off state. All parameters have 0 as their off value except the two envelope decays, filter tuning, and volume mod 1 depths, which are set to maximum (to give the programmer something audible to start with), and the pitch tuning, which is set to 12 (concert pitch).

[NO LINK] [n]

Copy program n into current program space except for link mode, number and balance, transposes and keyboard split, which are unchanged.

[NO LINK] [NO LINK]

Clear link mode.

[LINK LOWER] [n]

Set up link to program number n, assigning all subsequent notes below keyboard split to link program.

[LINK LOWER] [LINK LOWER]

Set up link lower to program last linked to.

[LINK UNISON] [n]

Set up link to program number n, assigning all subsequent notes to both main and link programs.

[LINK UNISON] [LINK UNISON]

Set up link unison to program last linked to.

[LINK UPPER] [n]

Set up link to program number n, assigning all subsequent notes above or equal to the keyboard split to link program.

[LINK UPPER] [LINK UPPER]

Set up link upper to program last linked to.

[STORE] [n]

Store current program in location n (after storing the previous contents of program n in the safe buffer. (If n matches the current program number and the modified flag is clear, the safe buffer will be used as the source instead of the current program.) Any instruments (such as the link instrument) defined by this program will be redifined by the store.

[STORE] [STORE]

Store current program in location shown in program number display.

[STORE] [n] [n]
[n] [STORE] [n]
[n] [STORE] [STORE]

Exchange the current program with the stored program. (This only works in PROGRAM SELECT mode.)

[EDIT A]

Set edit A mode. Parameter slider will control A parameters.

[EDIT B]

Set edit B mode. Parameter slider will control B parameters.

[EDIT A] and [EDIT B] concurrently

Set edit A and B mode. Display will show A parameter value, but moving the slider will cause both A and B parameters to change to the same value.

[PARAM SELECT]

Enter parameter select mode. Also, abort any two switch sequence. Also used as a parameter clear "shift key" with the numbered switches.

[COPY FROM A] [n]

Enter copy from A mode, with program number n as source.

[COPY FROM B] [n]

Enter copy from B mode, with program number n as source.

[COPY FROM B] [COPY FROM B]

Enter copy from B mode, with current program as source.

[PROG SELECT]

Enter program select mode. Also, abort any two switch sequence.

[DOWN 1 OCT] (main or link)

If already selected, clear transpose. If not selected, transpose down one octave.

[UP 1 OCT] (main or link)

If already selected, clear transpose. If not selected, transpose up one octave.

[SET SPLIT] followed by note

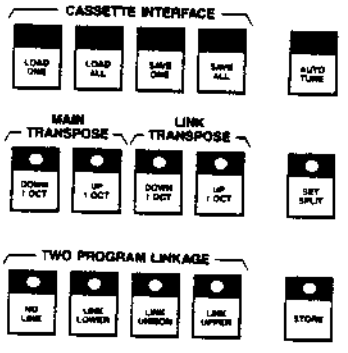
Set the split point at the note played. The split is actually between this note and the next lower note.

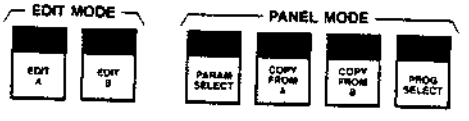
[SET SPLIT] [SET SPLIT]

Set the split point at the same point as after the last time the above command was executed.

[TUNE]

Initiate an autotune. When the tuning is complete, the numbers of any disabled boards will be displayed. If the tune switch is still held when the autotune is complete, the bad boards will still be displayed, but they will all be enabled, for diagnostic purposes.

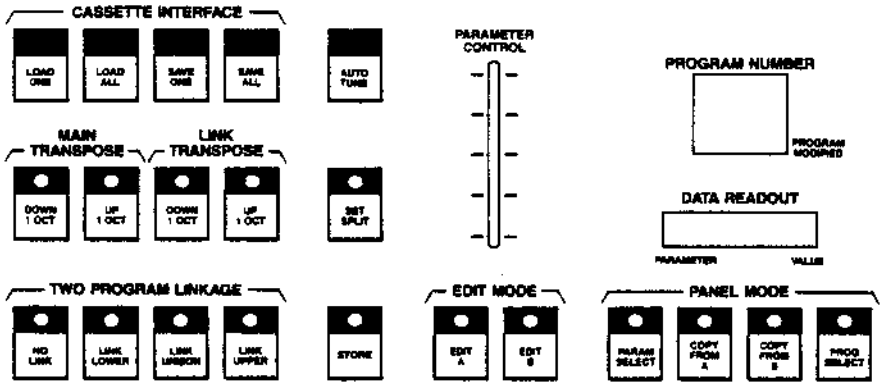




[OVERLOAD] followed by headache

By this point in the manual you are overloaded with technical information. Not to worry, the next edition of the manual will be cleaned up and will hopefully present the information a little more clearly. In the mean time, relax and enjoy the part that makes sense.

PANEL PARAMETER DESCRIPTIONS



PANEL: MAIN TRANSPOSE

This parameter causes -12, 0 or +12 to be added to the key numbers fed into the main program process. The two bits take on the Value 10 for down 1 oct, 00 for off and 01 for up 1 oct. These bits appear in the main transpose LEDs.

PANEL: LINK TRANSPOSE

This parameter is analogous to the main transpose parameter, but only affects notes given to the link process. Do not get confused: the main and link sound generation is controlled by the main and link transposes in the current program. The transposes that are stored in memory in the program that is linked to have no effect.

PANEL: KEYBOARD SPLIT

This parameter is used to determine which keys are assigned to which sounds while in link lower or upper mode. Pressing [SET SPLIT] causes the current setting to appear in the display. Pressing a key will then cause the key number to be stored in this parameter and the display to be restored to what it was before. Pressing [SET SPLIT] twice causes the split to be set to the "standard split," which is simply the most recent split selected by pressing a key on the keyboard. In other words, setting a split using [SET SPLIT] [key] causes the key number to be stored for future access using [SET SPLIT] [SET SPLIT].

PANEL: LINK MODE & PROGRAM NUMBER

Internally, the 2 msbs (most significant bits) contain the mode and the 6 lsbs (least significant bits) contain the number. The 2 msbs take on the value 00 for no link, 10 for link lower, 01 for link upper, and 11 for link unison. The remaining six bits hold the number of the program linked to (or last linked to). Externally, the link mode shows up in the LEDs over the link switches, and the program number shows up in the left half of the 8-digit display whenever the link switches are used to establish a link. Since the link information is a parameter within the program, changing the link constitutes changing the program and sets the modified flag.

PANEL: EDIT MODE & PARAMETER NUMBER

Internally, the 2 msbs contain the edit mode and the 6 lsbs contain the number of the parameter that is connected to the parameter slider. The 2 msbs take on the Value 10 in EDIT A mode, 01 in EDIT B mode, and 11 in EDIT A & B mode. The remaining six bits will be 0 for the link balance parameter, 1-5 for the control parameters, and 6-50 for the A or B parameters. Since the parameter number is itself a parameter in the program, selecting a parameter constitutes changing the program, and will set the modified flag.

PANEL: LINK BALANCE

The link balance parameter has no effect on the sound unless one of the link modes is active. In that case, the link balance represents the relative gain (in 2dB steps) of the main and link program. Set to 0, both programs run at full volume. Setting it negative, the link program is reduced in gain. Setting it positive, the main program is reduced in gain. This is the only panel parameter that uses the parameter control slider. As such, it has its own way of working. Selecting the link balance parameter is done by setting up a link. If a link is already in effect, the link balance parameter may be selected by simply pressing the link switch twice (which is like setting up the link again). As an added convenience, the performer may return to the previously selected parameter after pressing a link switch by pressing [PROG SELECT] or [PARAM SELECT]. While the link balance parameter is selected, the display contains the letter L followed by the link program number in the left side of the display, instead of the usual P and parameter number. This allows a simple means of seeing what program is linked to. This means that the performer can press a link switch to see what he is linked to, and possibly touch up the balance, and then return to the previously selected parameter by pressing [PROG SELECT] or [PARAM SELECT]. Note that the value as shown in the display (the dB value) is twice the internal value as seen by the computer interface. Also, if the parameter is set to -8 (-14 dB) by the interface, it will actually be set to -7.

PANEL: SEQUENCE PROGRAM

This parameter is used to establish which program will be selected next using the sequence program footswitch. Pressing the footswitch causes this parameter to appear in the large 2-digit display. As long as the footswitch is held, pressing one of the 50 numbered switches will cause this parameter (and the large display) to be changed accordingly. It also causes the parameter to be written into the stored program. Releasing the footswitch causes the program to be selected, if in the PROGRAM SELECT mode. In any other mode, the program is not selected, and that the sequence program parameter is set to 20. Pressing the footswitch would cause 20 to appear in the display. Releasing the footswitch would then cause program 20 to be selected. If, on the other hand, the footswitch was pressed and the performer pressed switch number 30, the number 30 would appear in the display, would be written into the current program, and would be written into program 10. Releasing the footswitch would cause program 30 to be selected. Note that this is the only parameter that can be "written" into one of the stored programs with the lock switch locked.

SEQUENCE

CONTROL PARAMETERS

PATCH [1]:

This parameter determines the configuration of the synthesizer channels. There are a total of 16 patch selections, numbered 0 through 15. This is the starting point for all programs. This parameter should be selected and its value set first, to establish the signal paths of the channel boards.

There are basically five configuration types, with subvariations:

SPLIT PATCH
16 independent channels

INDEPENDENT CHANNELS
2 per note, 2 pole, 8 note, 2-pole filtering, independent

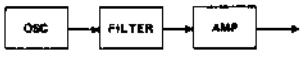
PARALLEL FILTERS
Paired channels, notch filtering

SERIES FILTERS
Paired channels, 4 pole and band-pass filter response

VARIABLE MIX
Paired channels, dual 2-pole filter effects

PATCH [1], VALUE = 0
SPLIT PATCH

This value produces the greatest number of independent notes (16). The configuration is the simplest available. In this configuration, parameters set using EDIT B have no effect. The A parameters control all 16 channels.



Applications

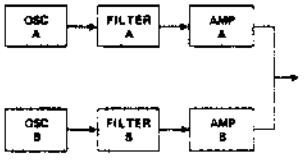
*When many notes are needed, during sustained arpeggios for example.

*Use Value 0 in place of Value 1 with an expander to double the number of notes available. First set the Chroma and the expander to the same program, then set the PATCH value to 0 on both. [SET SPLIT], [1] will temporarily set the patch to 0.

*Simple sounds.

PATCH [1], VALUE = 1
INDEPENDENT CHANNELS

Both channels (A and B) play on each note, but are separately programmed. Complex sounds may be created by using, for example, one channel for a mellow long decaying sound, and the other for a short percussive sound.



Applications

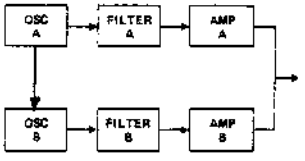
*Set one channel to high-pass filters, the other to low-pass for contrast

*Set channels to the same values (program with EDIT A and EDIT B both on), then detune the B channel using DETUNE [4] for richness.

*Tune filters and pitch differently, e.g. fifth or octave apart.

PATCH [1], VALUE = 2
INDEPENDENT CHANNELS, SYNC

The signal paths of the two channels are independent, but the frequency of the B oscillator is hard synchronized to the A oscillator. The A oscillator provides the fundamental frequency, the B oscillator the harmonic frequency. For traditional synthesizer "sync" effects, modulate the pitch of the B oscillator with an envelope generator or a sweep generator.



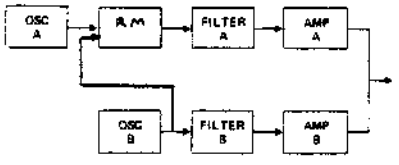
Applications

*Synthesizer "sync" sounds

*Synchronized oscillator sounds, 2-pole filter with a normal channel for added bottom.

PATCH [1], VALUE = 3
INDEPENDENT CHANNELS, RING MODULATOR

Same as Value = 1, except that a ring modulator is substituted for oscillator A. This permits a ring modulator to be used in addition to a normal channel. To set up the ring modulator, set WIDTH [34] to about 32 on both channel A and B. Vary the B TUNE [26] and the DETUNE [4] to obtain the desired ring modulator effect.



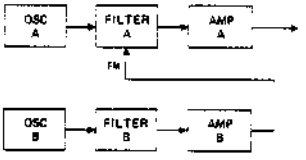
Applications

*Bell sounds, effects, metallic sounds

*Ring modulator sounds with a normal synth channel

PATCH [1], VALUE = 4
INDEPENDENT CHANNELS, FILTER FM

The channels are independent, but the output of the B channel modulates the A filter. Audio frequency modulation of filters create rich and unique harmonics. Selecting a different B channel TUNE [26] value, and different B channel WAVESHAPE [33] will produce different complex effects.



Applications

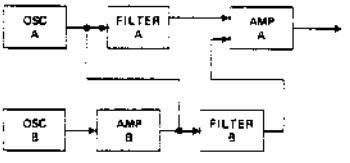
*Phase shifter effects

*Vocal effects

*Using noise as a wavshape, percussion

PATCH [1], VALUE = 5
PARALLEL FILTERS

Both the A and the B oscillators are routed to both A and B filters. The B oscillator's volume is controlled by the B amplifier, and the A amplifier governs the entire output volume. To use as a notch filter, set one filter to high-pass (LP/HP [37], value 1), and the other to low-pass (LP/HP [37], value 0). Set the TUNE [39] value on the LP channel to a low value and the other to a higher value.



Applications

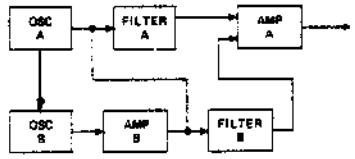
*Use for clavinet, or harpsichord-type sounds

*Modulate with a sweep control for flanging effects.

PATCH
1

PATCH [1], VALUE = 6
PARALLEL FILTERS, SYNC

Same as Value 5, but B oscillator is synchronized with the A oscillator (see Value 3 for more about sync).

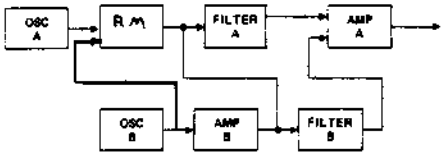


Applications

*Complex filtering of synchronized oscillators by tuning each filter separately.

PATCH [1], VALUE = 7
PARALLEL FILTERS, RING MODULATOR

Same as Value 5, but with ring modulator substituted for the A oscillator.

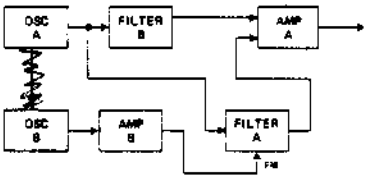


Applications

*Ring modulator effects with notch filter, bells

PATCH [1], VALUE = 8
PARALLEL FILTERS, FILTER FM

Same as Value 5, except the output of amplifier B is routed to the A filter control input for frequency modulation.

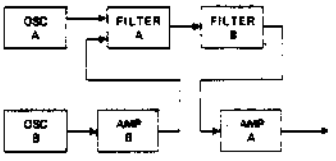


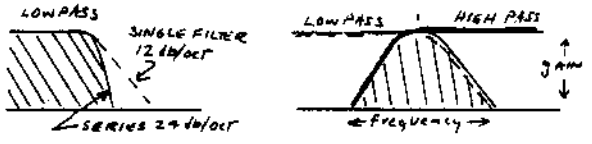
Applications

*Complex harmonics

PATCH [1], VALUE = 9
SERIES FILTER

The two oscillators feed the A filter which in turn feeds the B filter. The B amplifier controls the output of oscillator B, the A amplifier controls the overall output volume. This configuration creates a four-pole filter response, which is useful for brass or flute sounds. The higher harmonics are filtered more than in the single filtered configuration, producing better mellow sounds. The resonance settings of the A and B filters may be set to different values to increase the resonance range.





A band-pass filter response can be established by setting one of the filters to high-pass (LP/HP [37], Value = 1), and the other to low-pass (LP/HP [37], Value = 0). Start by setting the high-pass filter slightly higher than the setting of the low-pass filter.

Applications

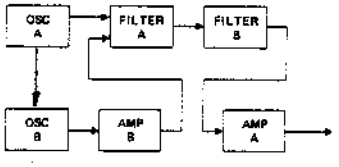
*Brass, flutes, "fat sounds," many orchestra sounds

*Band-pass; solo violins, reeds

*Band-pass; vocal sounds

PATCH [1], VALUE = 10
SERIES FILTER - SYNC

Same as Value 9, except the B oscillator is synchronized to the A oscillator. To mute the A oscillator (to hear only the B oscillator), set the A WAVESHAPE [33] to 1 (pulse), set WIDTH [34] to 0. Set the B TUNE [26] value for best effects.

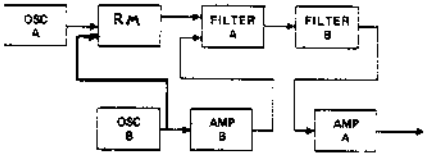


Applications

*Fat synthesizer sync sound

PATCH [1], VALUE = 11
SERIES FILTER, RING MOD

Same as Value 9, except that the A oscillator is replaced with a ring modulator (see Value 3 for ring mod set up). To mute the B oscillator, set the values of MOD [1] DEPTH [47] and MOD [2], DEPTH [49] on the B channel both to 0.

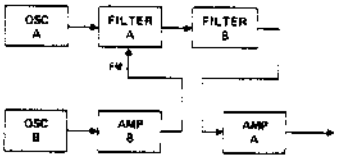


Applications

*Ring modulator, bell effects with four-pole filter

PATCH [1], VALUE = 12
SERIES FILTER,
FM MODULATION

Same as Value 9, but the output of the B amplifier modulates the frequency of the A filter.



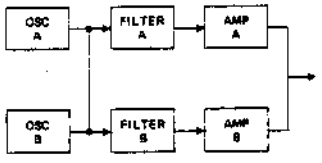
Applications

*Rich harmonics, fat sounds
*Vocal sounds

PATCH
1

PATCH [1], VALUE = 13
VARIABLE MIX FILTERS

The oscillators are mixed and then fed into both filters. Each amplifier controls the level from each filter, allowing asymmetrical notches to be created.

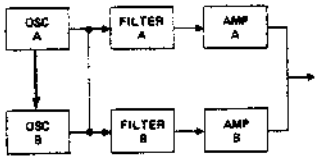


Applications

*Phase shifter, flanger effects (sweeping notch)
*Duo timbre by voicing each channel separately in low-pass mode.

PATCH [1], VALUE = 14
VARIABLE MIX FILTERS, SYNC

Same as Value 13, except the B oscillator is synchronized to the A oscillator (see Value 2 for sync description).

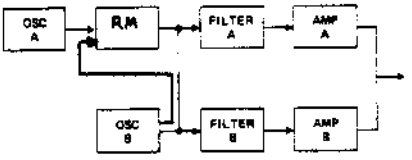


Applications

*Sync effects with notch
*Duo timbre effects

PATCH [1], VALUE = 15
VARIABLE MIX FILTERS, RING MOD

Same as Value 13, except the A oscillator is replaced by a ring modulator.



Applications

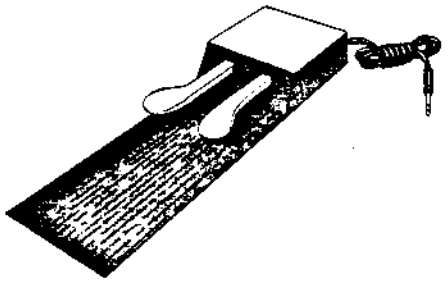
*Ring modulator, bell effects with notch
*Duo timbre effects

FSW MODE 2

FOOTSWITCH MODE [2]

This parameter establishes the mode of the dual footswitch assembly. The right switch is FSW 1 and the left switch is FSW 2. The right switch is normally used as a sustain pedal, and the left switch as a latch. There are eight different modes which change the operation of these switches:

VALUE	SUSTAIN FSW 1 (R)	LATCH FSW 2 (L)
0	Enabled	Enabled
1	Disabled	Enabled
2	Enabled	Disabled
3	Disabled	Disabled
4	Enabled	Note Gate
5	Disabled	Note Gate
6	Enabled	Inverted Gate
7	Disabled	Inverted Gate



When NOTE GATE is selected, notes are only heard when the Left Pedal is held down. When INVERTED NOTE GATE is used, notes are only heard when the left pedal is not held down.

These modes are useful when set differently for Main and Link programs. For example, when using a LINK LOWER set up, it may be desirable to disable the sustain function for the lower part of the keyboard [LINK], and to disable the latch function on the upper part. For this example, the Main program should have FSW MODE [2], Value = 2, and the Link program should be FSW MODE [2], Value = 1.

Note that the operation of either footswitch may be reversed by powering the Chroma with the switch held down, or by pressing [SET SPLIT] [50] while holding down the switch. This makes the switch operate as though it is normally on instead of normally off. Press [SET SPLIT] [50] to restore the switches to their normal condition.

KYBD ALG 3

KEYBOARD ALGORITHM [3]

This parameter defines the way in which the Chroma assigns synthesizer channels to notes. There are two groups of assignment modes: Monophonic and Polyphonic. The monophonic modes use only one pair of channels, leaving seven pairs to be used for another program. The Polyphonic modes will use all available channels.

The monophonic modes are usually setup for a program which is linked to a polyphonic program. This allows the polyphonic program to use the maximum number of channels [14], and have a lead or bass line which is programmed to a different sound.

KYBD ALG [3], VALUE = 0
POLYPHONIC - LEAST RECENTLY USED

A note is assigned first to a channel set to the same note. Restriking a key will use the same channel. A channel will be assigned second to the longest released channel (the oldest note). The longest held note will be assigned third. The left footswitch latches notes already held, allowing subsequent notes to be played. When a note is latched (and held), a new channel will be assigned to the same note if played.

KYBD ALG [3], VALUE = 1
PITCH ORDERED

Chords are assigned from the top note down to the most recently released channels. This algorithm is most useful with polyphonic glides, as it will permit chords to slide from one position on the keyboard to another with the notes in the same order.

NOTE: When using this value, the LEFT FOOTSWITCH will function as a GLIDE ON/OFF. The left pedal MUST BE DEPRESSED for the glide to function.

KYBD ALG [3], VALUE = 2
POLYPHONIC CHORD BUFFER

Playing a chord causes the notes to be remembered (but not played). When the Left footswitch is pressed, the chord will play. The chord buffer remains intact until all keys are released and a new key is depressed, allowing a new chord to be entered while the previous one still sounds.

This mode is useful for "cueing" a chord during performance. The chord may be loaded when time permits, and "played" with the footswitch while playing a different instrument. Also, the chord

buffer may be used in a program which is linked to another program. This way, a chord can be played and then "echoed" by another program when the footswitch is depressed.

KYBD ALG [3], VALUE = 3
ALL CHANNELS (POLYPHONIC)

The most recently played note will be assigned to all channels so that all synthesizer channels play at the same time. If two notes or more are held, the channels are divided among the keys played (up to eight notes, or sixteen if PATCH [1] = 0).

KYBD ALG [3], VALUE =4
ALL CHANNELS (MONOPHONIC)

Only the most recently played note is heard, and is assigned to all available channels.

KYBD ALG [3], VALUE = 5
MONOPHONIC LAST NOTE, SINGLE TRIG

Only the most recently played note will be heard. The envelope generators are single triggered; they will not trigger unless all keys are first released. (Only one pair of channels is used.)

KYBD ALG [3], VALUE = 6
MONOPHONIC LAST NOTE, MULT TRIG

Only the most recently played note will be heard. The envelope generators are multiple triggered; they will trigger on every key depression.

KYBD ALG [3], VALUE =7
MONOPHONIC FIRST NOTE

The first note of a group is heard. All keys must be released in order to hear the next note. Good for bringing out inner voices when linked to polyphonic programs.

KYBD ALG [3], VALUE = 8
MONOPHONIC BOTTOM NOTE

The lowest note of any chord is heard. Good for bass lines when linked to polyphonic programs.

KYBD ALG [3], VALUE = 9
MONOPHONIC TOP NOTE

Only the top note of a chord is heard. Good for lead line programs when linked to polyphonic programs.

KYBD ALG [3], VALUE = 10
MONOPHONIC ARPEGGIATE UP

The notes of a held chord will arpeggiate up at a rate determined by the A Sweep RATE [9]. The notes will be stored with key velocity information as long as the sustain footswitch or a key is held. New velocity values may be established by restriking notes. Latch (left) footswitch will latch the arpeggiating notes.

KYBD ALG [3], VALUE = 11
MONOPHONIC ARPEGGIATE DOWN

Same as Value 10, but arpeggiates down.

KYBD ALG [3], VALUE = 12
MONOPHONIC ARPEGGIATE UP AND DOWN

Same as Value 10, but arpeggiates up, then down.

KYBD ALG [3], VALUE = 13
MONOPHONIC ARPEGGIATE DOWN AND UP

Same as Value 10, but arpeggiates down, then up.

KYBD ALG [3], VALUE = 14
MONOPHONIC SEQUENCE ARPEGGIATION

Notes are played and remembered in the order in which they were played. They are heard at a rate set by the A Sweep RATE [9]. Keyboard velocity values are remembered, and the memory length is about 195 notes. Notes will be remembered as long as the sustain footswitch or a key is held, or as long as the latch switch is depressed. For as long as a key is depressed, or as long as the sustain is held, notes may be added to the list. Releasing all keys and the sustain stops the sequence, and a new sequence may be loaded.

KYBD ALG [3], VALUE = 15
MONOPHONIC RANDOM ARPEGGIATION

Notes played are remembered and heard randomly at a rate set by A Sweep RATE [9]. Playing a note more than once increases its chances of being played.

DETUNE [4], VALUE = 0 to 31

Tunes the B channel oscillator sharp with respect to the A channel. The displayed value is the number of 32nds of a semitone sharp. Since this parameter only affects the B channel, it has no effect when PATCH [1], Value 0 is selected.

Applications

*Use to detune the A and B channels for chorus effect.

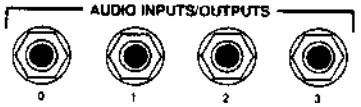
*Use with TUNE [26] as a fine tune control when using a ring modulator patch.

OUTPUT SELECT [5], VALUE = 0 to 3

Routes the channels to one of four audio outputs on the rear panel (0, 1, 2, or 3). The four outputs are normally summed together and sent out the mono output jacks via the rings of these jacks. The jacks may be used as send/receive jacks by inserting a ¼" phono plug: send the signal to the effect (such as a phaser, reverb, etc.) from the tip of the plug, and route the output of the effect back into the ring.

To setup stereo modes automatically (from within a program), set the OUTPUT SELECT on the Main program to one output, and the OUTPUT SELECT on the Link program to a different value. Store each program after making the change. Note: to use both XLR output jacks, it is suggested that the Link program be set to OUTPUT SELECT [5], Value 3.

The OUTPUT SELECT routes the outputs of channel pairs, and the routing is established for the entire program. In other words, both the A and B channels will always be routed to only one output. Two outputs may be used at the same time only when a Link is established.



RATE
6

GLIDE PARAMETERS

Keyboard pitch information is passed through the glide processor, which is capable of slowing down the transitions from pitch to pitch. There are two modes: portamento and glissando. Portamento creates a smooth transition from any pitch to another. In both cases, the rate of change is controlled by the RATE [6] parameter.

Certain keyboard algorithms automatically enable and disable the glide according to how the notes are played.

RATE [6], VALUE 0 to 31

The rate settings for the glide depend upon the GLIDE SHAPE:

IF SHAPE = PORTAMENTO
Value 0 = No Portamento
1 = 10 millisecond portamento
31 = 10 second portamento

IF SHAPE = GLISSANDO
Value 0 = No Glissando
1 = 25 steps per second
31 = 1 step per second

SHAPE
7

SHAPE [7], VALUE = 0 to 1

Selects the shape of the glide output:

Value 0 = PORTAMENTO (Smooth slide)
Value 1 = GLISSANDO (Chromatic steps)

The sweep generator generates low-frequency repetitive control signals. It is used to modulate functions like pitch (for vibrato, or trills), waveform (pulse width modulation), cutoff (tremolo). It has a basic rate that can be adjusted over a wide range. In addition, it can be modulated by 15 other control sources. There are 16 different waveshapes available, and an amplitude modulation selection which includes a dealyed sweep envelope. The sweep generator may run independently, or be synchronized to key depressions. Each note may have its own sweep generator, or they may be locked together.

There are a total of 16 separate sweep generators (A and B), and both may be used with different settings within a program. The A sweep generator is used to trigger other functions, such as the arpeggiator used in KYBD ALG [3].

MODE [8], VALUE, = 0 to 3

Controls the type of synchronization among a bank of sweeps.

VALUE = 0: ASYNCHRONOUS

The sweeps are free running and independent. In fact, the computer forces them to run at slightly different rates. Use when a high degree of note independence is desirable, such as a string chorus.

VALUE = 1: INDIVIDUAL KEY-SYNCED

The sweeps are independent of each other, yet each is restarted at the beginning of its cycle when the channel is assigned a new note. Use with patterns or trills so as to obtain a predictable response when keys are first played. When [AMPL MOD] is set to one of the delayed sweep values, the [MODE] value will automatically default to Value 1. The value in the DATA READOUT will not be changed, however.

VALUE = 2: SINGLE FREE RUNNING

All the sweeps (from all channels) function as one, and run freely. The rate modulation always comes from the most recently assigned channel. In this mode, it is like having only one sweep generator for the entire instrument and is useful for synchronizing specific sweep effects like patterns.

VALUE = 3: SINGLE KEY-SYNCED

Same as Value 3, except that the sweep is restarted at the beginning of its cycle when new notes are played.

SWEEP RATE [9], VALUE 0 through 63

Controls the sweep rate (unmodulated) 0 to 63, (0.12Hz. to 12Hz.).

RATE MOD 10

SWEEP RATE MOD [10], VALUE 0 through 15

Selects the modulation of the sweep rate. The amount of modulation is fixed at a predetermined value. Positive modulation increases the rate, inverted values decrease the rate.

Value
- 0: No modulation
- 1: Pressure (optional)
- 2: Keyboard (higher notes increase the rate, lower notes decrease the rate).
- 3: Inverted Keyboard (higher notes decrease rate).
- 4: Velocity (notes struck hard increase the rate).
- 5: Inverted Velocity (notes struck hard decrease the rate).
- 6: Envelope 2 (rate increases and decreases according to envelope shape).
- 7: Inverted Envelope (rate decreases, and increases according to envelope shape).
- 8: Pedal 1 (pedal increases sweep rate).
- 9: Inverted Pedal 1 (Pedal decreases rate).
- 10: Pedal 2 (pedal increases sweep rate).
- 11: Inverted Pedal 1 (pedal decreases rate).
- 12: Lever 1 (pushing lever forward increases rate).
- 13: Inverted Lever 1 (pushing lever forward decreases rate).
- 14: Lever 2 (pushing lever forward increases rate).
- 15: Inverted Lever 2 (pushing lever forward decreases rate).

WAVE SHAPE 11

SWEEP WAVESHAPE [11], VALUES = 0 through 15

Establishes the waveshape generated by the sweep. The quantities are in standard Chroma pitch units (1 unit = 32 semitones).

VALUE	DESCRIPTION	TYPICAL USES
0	SINE	Vibrato, tremolo
1	COSINE	"
2	OFFSET SINE	Filter mod, waveshape mod
3	HALF SINE	"
4	TRIANGLE A	"
5	TRIANGLE B	"
6	SAWTOOTH	Pitch or Freq mod, Effects
7	LAG SQUARE	Effects
8	SQUARE	Trills
9	PATTERN A	Repeat patterns, S/H effects
10	PATTERN B	"
11	PATTERN C	"
12	PATTERN D	"
13	PATTERN E	"
14	PATTERN F	"
15	RANDOM	S/H effects

AMPLITUDE MODULATION [12]
VALUES = 0 through 15

Controls the modulation of the sweep amplitude. The waveshapes generated by the sweep generator normally have a fixed amplitude. When these waveforms are used to modulate other functions, such as pitch or cutoff, the depth modulation is set and is not changed thereafter. The sweep AMPLITUDE MODULATION permits the sweep waveform's amplitude to be modified at the sweep generator source by any of 15 other control functions. The depth of AMPLITUDE MODULATION is fixed.

Value
- 0: No modulation
- 1: Pressure (optional pressure sensor)
- 2: Keyboard (amplitude increases with higher notes).
- 3: Inverted Keyboard (amplitude decreases with higher notes).
- 4: Velocity (amplitude increases with harder notes).
- 5: Inverted Velocity (amplitude decreases with harder notes).
- 6: Envelope 1 (Env 1 increases amplitude).
- 7: Inverted Envelope 1 (Env 1 decreases amplitude).
- 8: Pedal 1 (pedal increases amplitude).
- 9: Pedal 2 (pedal decreases amplitude).
- 10: Lever 1 (lever 1 increases amplitude).
- 11: Lever 2 (lever 2 increases amplitude).
- 12: 0.85 sec. delay (delayed envelope).
- 13: 1.3 sec. delay (delayed envelope).
- 14: 2.6 sec. delay (delayed envelope).
- 15: 5.1 sec. delay (delayed envelope).

The delay envelopes may be used for creating an automatic delayed vibrato. There are four delay lengths to choose from. The four delay values will automatically put the sweep in the independent key triggered mode, even if MODE [8] is set to a different value.

ENVELOPE PARAMETERS

There are two envelope generators per channel, labelled 1 and 2. This means there are two envelopes for the A channel (1A and 1B), and two for the B channel (2A and 2B). The envelope shapes are either AR (Attack, Release), or ADR (Attack, Decay, Release). More complex shapes are created by combining envelopes by using modulation inputs to the Cutoff, Pitch or Amplitude functions. Each envelope has the following parameters which may be varied:

AMPLITUDE TOUCH

Sets the envelope peak as a function of key velocity.

ATTACK TIME

Sets the **ATTACK TIME** from key down to envelope peak.

ATTACK MODULATION

Alters the **ATTACK TIME** value as a function of other control sources such as sweep or keyboard.

DECAY TIME

Sets the **DECAY TIME** from the peak of the envelope.

DECAY MODULATION

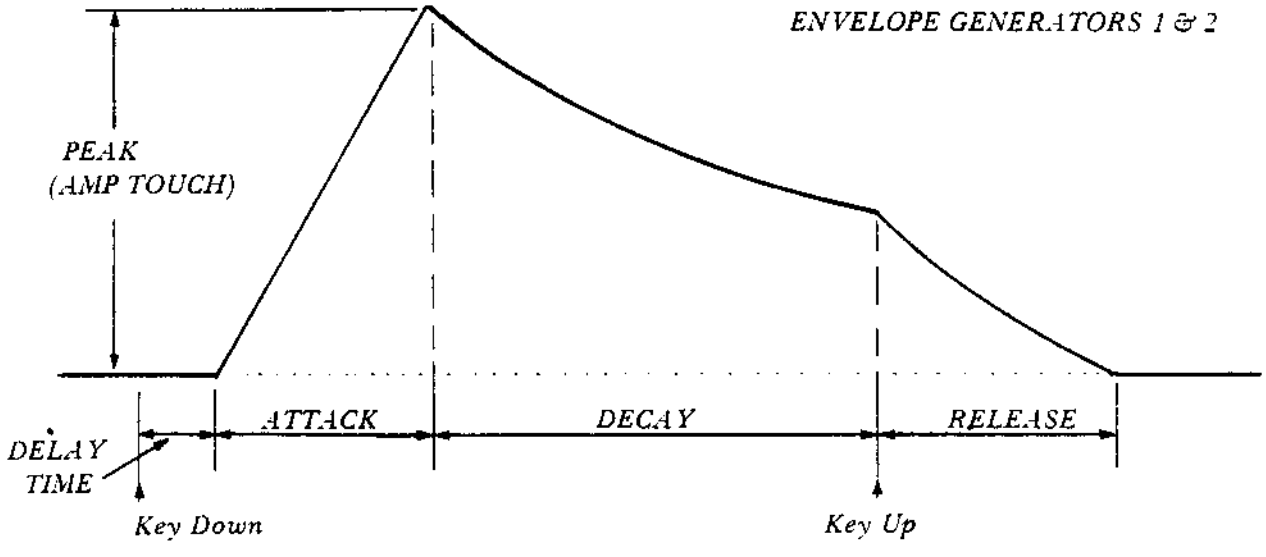
Alters the **DECAY TIME** value as a function of other control sources.

RELEASE TIME

Sets the **RELEASE TIME** from the time a key is released.

DELAY (Env No. 2 only)

Delays the onset of an envelope from the time a key is pressed from 0 up to 3 seconds.



AMPLITUDE TOUCH [13], VALUES = 0 through 7

Controls the relationship between keystrike velocity and the envelope amplitude (peak). When a key is struck, the Chroma records the key velocity in memory. Depending upon the setting of the AMPLITUDE TOUCH, this velocity value can produce different results. When the value is set to 0, there is no effect, and the amplitude is constant regardless of how hard keys are struck. Values 1 through 5 produce different degrees of sensitivity as a function of key velocity; Values 6 and 7 produce two amplitude values switched at a present velocity threshold (see below).

Value 0: No amplitude modulation
1: Low sensitivity
2: Medium low sensitivity
3: Medium sensitivity
4: Medium high sensitivity
5: High sensitivity
6: THRESHOLD
7: INVERTED THRESHOLD

THRESHOLD VALUES:

For Values 6 and 7, the point above which the keystrike is considered a "hard strike" is called the attack threshold. Above this threshold, envelopes will have the normal fixed amplitude (1 "Chroma" unit); below the threshold, the amplitude will be zero (no envelope). Using [SET SPLIT], [21] causes the threshold to be set to whatever number is in the DATA READOUT value, regardless of what parameter is selected. Setting the threshold close to zero will cause all but the very softest keystrikes to be considered "hard strikes." Setting the threshold close to 31 will cause all but the very hardest strikes to be considered "soft strikes." Values from 10 to 25 are useful.

Using the threshold values, programs may be established which cause the envelopes to "switch" from one type to another as a function of how hard you play. This on hard strikes, or to mute a sound as you strike harder.

ATTACK [14], VALUES = 0 through 21

Controls the unmodulated time the envelope takes to reach its peak value.

Value 0: Instant
1: 10 msec.

31: 10 seconds

ATTACK MOD [15], VALUES = 0 through 7

Controls the modulation of the attack time. The amount of modulation is fixed at a (hopefully) useful value. Positive modulation decreases the attack time; negative modulation increases the attack time.

Value 0: No modulation
1: Pressure (optional)
2: Keyboard (attack time decreases with higher notes).
3: Inverted Keyboard (attack time increases with higher notes).
4: Velocity (attack time decreases with hard keystrikes).
5: Inverted Velocity (attack time increases with hard keystrikes).
6: Pedal 1
7: Pedal 2

DECAY [16],
VALUES = 0 through 31

Controls the unmodulated decay time constant. When set to maximum, the envelope will remain at peak value for as long as a key is held.

Value 0: Instant
1: 10 msec.

31: 10 seconds
32: Infinite sustain

DECAY MOD [17],
VALUES = 0 through 7

Controls the modulation of the decay time constant. The amount of modulation is fixed at a (hopefully) useful value. Positive modulation increases the decay time; negative modulation decreases the decay time.

Value 0: No modulation
1: Pressure (optional)
2: Keyboard (the decay time increases with higher notes on the keyboard).
3: Inverted Keyboard (the decay time decreases with higher notes on the keyboard).
4: Velocity (the decay time increases with hard keystrikes).
5: Inverted Velocity (the decay time decreases with hard keystrikes).
6: Pedal 1
7: Pedal 2

RELEASE [18]
VALUES = 0 through 31

Controls the release time constant. Value 31 has two preset release times (see below).

Value 0: Instantaneous
1: 10 msec.

30: 10 seconds
31: THRESHOLD RELEASE (see below)

RELEASE THRESHOLD [SET SPLIT], [22]

When the envelope's release parameter is set to 31, the release time constant becomes touch sensitive. Release velocities below a certain threshold yeild one release time while velocities above the threshold yeild a different release time. The threshold is a number from 0 to 13, and is set by pressing [SET SPLIT], [22]. Pressing [SET SPLIT], [22] causes the threshold to be set to whatever number is in the DATA READOUT (value), regardless of what parameter is selected.

SLOW RELEASE RATE [SET SPLIT], [23]

Using [SET SPLIT], [23] sets the slow release rate. As with the threshold, pressing [SET SPLIT], [23] causes the release time for slow key release to be set to whatever number is in the DATA READOUT, regardless of the parameter selected. The range is from 0 to 31.

FAST RELEASE RATE [SET SPLIT], [24]

Using [SET SPLIT], [24] sets the fast release rate. This is the rate at which an envelope will release for a fast key release. Pressing [SET SPLIT], [24] causes the release time for fast release notes to be set to whatever number is in the DATA READOUT, regardless of the parameter selected. The range is from 0 to 31.

DELAY
19

ENVELOPE 2

DELAY [19],
VALUES 0 through 31

Delays the onset of envelope 2 up to 2.4 seconds, or can cause the A sweep generator to trigger the onset of envelope 2 at the beginning of each sweep cycle.

Value 0: No delay
1: 80 msec. delay
(80 msec. increments)
30: 2.4 seconds
31: A sweep triggered

AMPL TOUCH
20

AMPLITUDE TOUCH [20],
VALUES = 0 through 7

Controls the relationship between keystrike velocity and the envelope amplitude (peak). When a key is struck, the Chroma records the key velocity in memory. Depending upon the setting of the AMPLITUDE TOUCH, this velocity value can produce different results. When the value is set to 0, there is no effect, and the amplitude is constant regardless of how hard keys are struck. Values 1 through 5 produce different degrees of sensitivity as a function of key velocity; Values 6 and 7 produce two amplitude values switched at a present velocity threshold (see below).

Value 0: No amplitude modulation
1: Low sensitivity
2: Medium low sensitivity
3: Medium sensitivity
4: Medium high sensitivity
5: High sensitivity
6: THRESHOLD
7: INVERTED THRESHOLD

THRESHOLD VALUES:

For Values 6 and 7, the point above which the keystrike is considered a "hard strike" is called the attack threshold. Above this threshold, envelopes will have the normal fixed amplitude (1 "Chroma" unit); below the threshold, the amplitude will be zero (no envelope). Using [SET SPLIT], [21] causes the threshold to be set to whatever number is in the DATA READOUT value, regardless of what parameter is selected. Setting the threshold close to zero will cause all but the very softest keystrikes to be considered "hard strikes." Setting the threshold close to 31 will cause all but the very hardest strikes to be considered "soft strikes." Values from 10 to 25 are useful.

Using the threshold values, programs may be established which cause the envelopes to "switch" from one type to another as a function of how hard you play. This on hard strikes, or to mute a sound as you strike harder.

ATTACK
21

ATTACK [21],
VALUES = 0 through 21

Controls the unmodulated time the envelope takes to reach its peak value.

Value 0: Instant
1: 10 msec.

31: 10 seconds

ATTACK MOD
22

ATTACK MOD [22],
VALUES = 0 through 7

Controls the modulation of the attack time. The amount of modulation is fixed at a (hopefully) useful value. Positive modulation decreases the attack time; negative modulation increases the attack time.

Value 0: No modulation
1: Pressure (optional)
2: Keyboard (attack time decreases with higher notes).
3: Inverted Keyboard (attack time increases with higher notes).
4: Velocity (attack time decreases with hard keystrikes).
5: Inverted Velocity (attack time increases with hard keystrikes).
6: Pedal 1
7: Pedal 2

DECAY [23],
VALUES = 0 through 31

Controls the unmodulated decay time constant. When set to maximum, the envelope will remain at peak value for as long as a key is held.

Value 0: Instant
1: 10 msec.

31: 10 seconds
32: Infinite sustain

DECAY MOD [24],
VALUES = 0 through 7

Controls the modulation of the decay time constant. The amount of modulation is fixed at a (hopefully) useful value. Positive modulation increases the decay time; negative modulation decreases the decay time.

Value 0: No modulation
1: Pressure (optional)
2: Keyboard (the decay time increases with higher notes on the keyboard).
3: Inverted Keyboard (the decay time decreases with higher notes on the keyboard).
4: Velocity (the decay time increases with hard keystrikes).
5: Inverted Velocity (the decay time decreases with hard keystrikes).
6: Pedal 1
7: Pedal 2

RELEASE [25],
VALUES = 0 through 31

Controls the release time constant. Value 31 has two preset release times (see below).

Value 0: Instantaneous
1: 10 msec.

30: 10 seconds
31: THRESHOLD RELEASE (see below)

RELEASE THRESHOLD [SET SPLIT], [22]

When the envelope's release parameter is set to 31, the release time constant becomes touch sensitive. Release velocities below a certain threshold yeild one release time while velocities above the threshold yeild a different release time. The threshold is a number from 0 to 13, and is set by pressing [SET SPLIT], [22]. Pressing [SET SPLIT], [22] causes the threshold to be set to whatever number is in the DATA READOUT (value), regardless of what parameter is selected.

SLOW RELEASE RATE [SET SPLIT], [23]

Using [SET SPLIT], [23] sets the slow release rate. As with the threshold, pressing [SET SPLIT], [23] causes the release time for slow key release to be set to whatever number is in the DATA READOUT, regardless of the parameter selected. The range is from 0 to 31.

FAST RELEASE RATE [SET SPLIT], [24]

Using [SET SPLIT], [24] sets the fast release rate. This is the rate at which an envelope will release for a fast key release. Pressing [SET SPLIT], [24] causes the release time for fast release notes to be set to whatever number is in the DATA READOUT, regardless of the parameter selected. The range is from 0 to 31.

PITCH PARAMETERS

TUNE [26],
VALUES = 0 through 63

Controls the unmodulated pitch of the oscillator relative to the glide keyboard output. The range is in semitones, where 12 represents concert pitch. Therefore, the range is from 1 octave below concert pitch to 4 1/4 octaves above.

MODULATION 1 SELECT [27],
VALUES = 0 through 15

Selects a control signal for the No. 1 modulation input into the oscillator.

Value 0: Keyboard Glide A
1: Sweep A
2: Envelope 1A
3: Envelope 2A
4: Keyboard Glide B
5: Sweep B
6: Envelope 1B
7: Envelope 2B
8: Lever 1
9: Lever 2
10: Pedal 1
11: Pedal 2
12: Velocity
13: Threshold velocity
14: Pressure
15: Threshold pressure

Note: If the split patch is being used, selections 4–7 default to the A sources, as there are no B sources.

MODULATION 1 DEPTH [28]
VALUES = -64 through +63

Adjusts the gain depth of modulation for the No. 1 modulation input into the oscillator. The value represents the number of 1/16 semitone increments for each unit of modulation.

Note: The three pitch modulation depths have different gain ranges.

MODULATION 2 SELECT [29]
VALUES = 0 through 15

Selects a control signal for the No. 2 modulation input into the oscillator.

(SAME AS PARAMETER [27])

MODULATION 2 DEPTH [30],
VALUES = -64 through +63

Adjusts the gain for the No. 2 modulation input into the oscillator. The value represents the number of 1/4 semitone increments for each unit of modulation.

Note: The three pitch modulation depths have different gain ranges.

MODULATION 3 SELECT [31],
VALUES = 0 through 15

Selects a control signal for the No. 3 modulation input into the oscillator.

(SAME AS PARAMETER [27])

MODULATION 3 DEPTH [32],
VALUES = -64 through +63

Adjusts the gain for the No. 3 modulation input into the oscillator. The value represents the number of semitone increments for each unit of modulation.

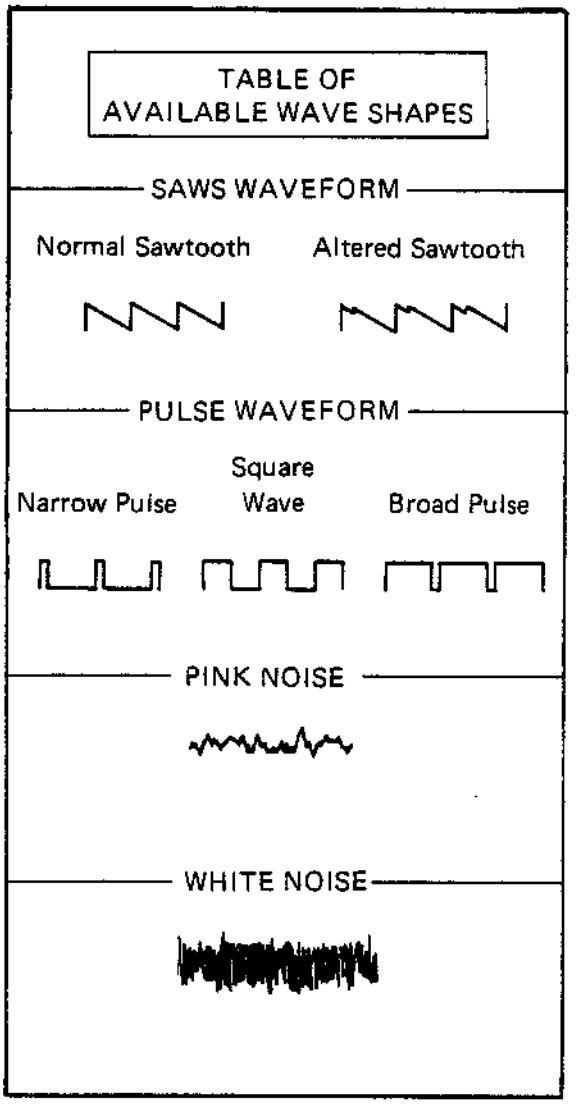
Note: The three pitch modulation depths have different gain ranges.

WAVE SHAPE
33

WAVESHAPE [33], VALUES = 0 through 3

Selects the waveshape produced by the oscillator.

Value
- 0: Saws: This shape is the equivalent of the sum of two time-shifted sawteeth. It is created by mixing the basic sawtooth signal with a variable width pulse derived from it.
- 1: Pulse: This shape is the equivalent of the difference between two time-shifted sawteeth. It is derived from the sawtooth. It is DC restored by mixing it with the pulse width control signal.
- 2: Pink Noise: The pink noise generator is used as the signal source, and the oscillator is not used. All channels are fed from a single noise generator.
- 3: White Noise: The white noise generator is used as the signal source, and the oscillator is not used. All channels are fed from a single noise generator.



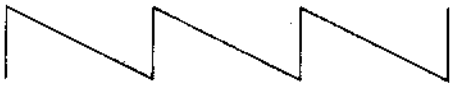
- Pulse Output: When the **WIDTH [34]** value is set to 0 and the **WAVESHAPE [33]** is set to pulse (1), the oscillator will have no output. This is handy as a means of turning off the oscillator, for example when it is being used to modulate a filter, or for ring modulator effects when you may not want to hear the unmodulated oscillator.
- Sawtooth: To obtain a normal sawtooth waveform, set the **WIDTH [34]** to 0. If the value is greater than 0, the pulse output will mix with the sawtooth producing a different (and often useful) shape.
- Ring Modulator: If one of the ring mod patches is selected, the waveshape parameter on the A channel has no effect, as the A oscillator signal is replaced by the binary ring mod of the two oscillators' pulses.

WIDTH
34

PULSE WIDTH [34],
VALUES = 0 through 63

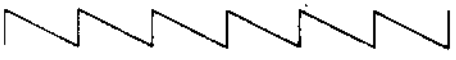
Adjusts the unmodulated pulse width or phase difference between the two sawteeth. The range is in increments of roughly 1.5%. A setting of 32 represents a width of 50%, which yeilds either a sawtooth of twice the oscillator frequency or a square wave depending upon the waveform value. A setting of 0 represents a width of 0%, which yeilds either a single sawtooth or no pulse.

Basic Sawtooth Wave

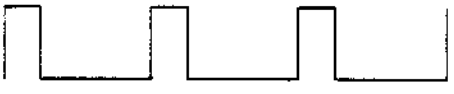


Square Wave

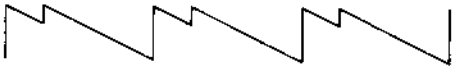
Sawtooth Wave altered by Square Wave



Narrow Pulse Wave



Sawtooth Wave altered by Narrow Pulse Wave



MOD SELECT
35

PULSE MODULATION SELECT [35],
VALUES = 0 through 15

Selects a control signal for the modulation input into the waveshaper.

Value
0: Keyboard Glide A
1: Sweep A
2: Envelope 1A
3: Envelope 2A
4: Keyboard Glide B
5: Sweep B
6: Envelope 1B
7: Envelope 2B
8: Lever 1
9: Lever 2
10: Pedal 1
11: Pedal 2
12: Velocity
13: Threshold velocity
14: Pressure
15: Threshold pressure

Note: If the split patch is being used, selections 4–7 default to the A sources, as there are no B sources.

MOD DEPTH
36

PULSE MODULATION DEPTH [36],
VALUES = -64 through +63

Adjusts the gain depth of modulation for the modulation input into the waveshaper. The value represents the number of 1.5% width increments for each unit of modulation.

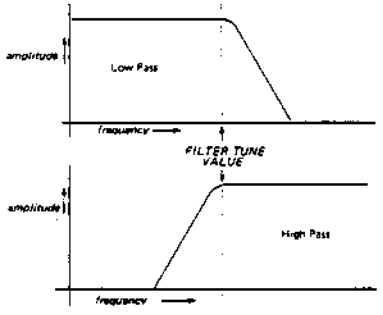
CUTOFF PARAMETERS

LP/HP 37

LOW PASS/HIGH PASS FILTER [37], VALUES = 0 and 1

Selects the mode of the filter.

Value 0: Low-pass
1: High-pass



RESO-NANCE 38

FILTER RESONANCE [38], VALUES = 0 through 7

Adjusts the resonance, or Q, of the filter. The resonance ranges form 0 (no resonance) through 7 (self-oscillate).

TUNE 39

FILTER TUNE [39], VALUES = 0 through 63

Adjusts the unmodulated tuning of the filter. The range is in whole tone increments, starting at C (16 Hz.).

Note: The filter does not track the keyboard unless it is modulated by the keyboard glide.

MOD 1 SELECT 40

FILTER MODULATION 1 SELECT [40], VALUES = 0 through 15

Selects a control signal for the No. 1 modulation input into the filter.

Value 0: Keyboard Glide A
1: Sweep A
2: Envelope 1A
3: Envelope 2A
4: Keyboard Glide B
5: Sweep B
6: Envelope 1B
7: Envelope 2B
8: Lever 1
9: Lever 2
10: Pedal 1
11: Pedal 2
12: Velocity
13: Threshold velocity
14: Pressure
15: Threshold pressure

Note: If the split patch is being used, selections 4–7 default to the A sources, as there are no B sources.

MOD 1 DEPTH 41

FILTER MODULATION 1 DEPTH [41], VALUES = -64 through +63

Adjusts the gain for the No. 1 modulation input into the filter. The value represents the number of semitone increments for each unit of modulation.

Note: When using the glide as a modulation source, a setting of 32 causes the filter to track the pitch perfectly.

MOD 2 SELECT
42

FILTER MODULATION 1 SELECT [42],
VALUES = 0 through 15

(SAME AS PARAMETER [40])

MOD 2 DEPTH
43

FILTER MODULATION 2 DEPTH [43],
VALUES = -64 through +63

(SAME AS PARAMETER [41])

MOD 3 SELECT
44

FILTER MODULATION 3 SELECT [44],
VALUES = 0 through 15

(SAME AS PARAMETER [40])

MOD 3 DEPTH
45

FILTER MODULATION 3 DEPTH [45],
VALUES= -64 through +63

(SAME AS PARAMETER [41])

AMPLITUDE PARAMETERS

AMPLITUDE MODULATION 1 SELECT [46],
VALUES = 0 through 3

Selects an envelope for the No. 1 modulation input into the amplifier.

Value 0: Envelope 1A
1: Envelope 2A
2: Envelope 1B
3: Envelope 2B

Note: If the split patch is being used, selections 2 and 3 default to the A sources, as there are no B sources.

AMPLITUDE MODULATION 1 DEPTH [47],
VALUES = 0 through 15

Adjusts the gain of the No. 1 modulation input into the amplifier. The range is exponential, in approximate 2dB steps. A setting of 0 shuts off the amplifier.

Note: At least one of the two modulation inputs must be used in order to get anything out of the amplifier.

AMPLITUDE MODULATION 2 SELECT [48],
VALUES = 0 through 3

Selects an envelope for the No. 2 modulation input into the amplifier.

Value 0: Envelope 1A
1: Envelope 2A
2: Envelope 1B
3: Envelope 2B

Note: If the split patch is being used, selections 2 and 3 default to the A sources, as there are no B sources.

AMPLITUDE MODULATION 2 DEPTH [49],
VALUES = 0 through 15

Adjusts the gain of the No. 2 modulation input into the amplifier. The range is exponential, in approximate 2dB steps. A setting of 0 shuts off the amplifier.

AMPLITUDE MODULATION 3 SELECT [50],
VALUES = 0 through 7

Selects a fixed post-modulation for the amplifier.

Values 0: None. Gain fixed at 1.
1: Pressure. Gain = 1/2 to 1.
2: Keyboard. Gain = 1 at bottom to 1/2 at top.
3: Sweep. Gain = (1/4 x sweep) + 3/4.
4: Pedal 1. Gain = 0 to 1.
5: Inverted Pedal 1. Gain = 1 to 0.
6: Pedal 2. Gain = 0 to 1.
7: Inverted Pedal 2. Gain = 1 to 0.

Note: The first two modulation inputs are added, then multiplied by this modulation input. Settings 1 and 4 through 5 use performance controls. Setting 2 is to compensate for the increase in volume at high pitches that results when the filter tracks the pitch. Setting 3 is for a tremolo effect.

HIDDEN FUNCTIONS

[SET SPLIT] FUNCTIONS

The following functions can be accessed by pressing [SET SPLIT] then a numbered switch [n].

TEMPORARY STEREO SETUPS

[SET SPLIT], [1] LINK PATCH to 0

Set the link patch to 0. This is useful if the link is set up with identical A and B channels (patch 1) and more voices are desired, at the expense of some richness in sound. The patch change is only temporary, and does not affect the setting of the patch parameter in memory.

[SET SPLIT], [2] LINK to 0

Route the link channels to output 0. This temporarily overrides the output select parameter in the link program.

[SET SPLIT], [3] LINK to 1

Route the link channels to output 1.

[SET SPLIT], [4] LINK to 2.

Route the link channels to output 2.

[SET SPLIT], [5] LINK to 3

Route the link channels to output 3.

SUBROUTINES

[SET SPLIT], [15] OUTPUT SUBROUTINE

Output a subroutine packet to the cassette interface. This is used at the factory to prepare software patches to be read in and executed.

[SET SPLIT], [25] EXECUTE SUBROUTINE

Execute a subroutine read in from the cassette. The purpose of this is to allow a small software patch to be loaded from cassette and then executed by the Chroma computer. This function has no effect unless a valid subroutine packet has just been loaded from the cassette.

DIAGNOSTICS

[SET SPLIT], [6] BATTERY

Display the memory battery voltage.

[SET SPLIT], [7] DISABLE BOARD

One channel board is disabled. It is always the lowest priority board belonging to the main instrument, which means that if any notes are latched, the most recent one will be killed, or if any notes are held, the most recent one will be killed, otherwise, the most recently released note will be killed. In general, the way to kill a board is to play one note at a time until the bad one sounds, and then use this function.

[SET SPLIT], [8] DISPLAY DISABLED BOARDS

Display the number of any disabled boards.

[SET SPLIT], [9] TAPPER ON/OFF

Toggle the tapper enable/disable.

[SET SPLIT], [29] MUTE ALL

Mute the oscillators, for diagnostic purposes. The oscillators continue to run, but they are disconnected from the filter inputs.

[SET SPLIT], [30] TEST LEDs

Turn on all LEDs and display segments. This is used for testing at the factory. Pressing any other switch will restore all but the program number display, which is restored whenever a program is selected.

[SET SPLIT], [50] RESET

Reset the Chroma main computer.

PROGRAMMING AIDS

[SET SPLIT], [26] MUTE A

Mute A channel. This is useful when in EDIT B mode, for working on one channel of a pair, without hearing the other. The effect of this is temporary, and can be cleared with [SET SPLIT], [28].

[SET SPLIT], [27] MUTE B

Mute B channel. Similar to [SET SPLIT], [26].

[SET SPLIT], [28] UNMUTE

Unmute channels. This undoes [SET SPLIT], [26], [27] and [29].

CASSETTE FUNCTIONS

[SET SPLIT], [10] CASSETTE MODE

Toggle the cassette mode. The normal mode involves sensing and controlling the cassette motor. The other mode allows use with cassettes that do not have motor control. To tell which mode the cassette interface is in, press one of the four cassette interface switches on the panel with no cassette connected. If nothing happens, the normal mode is in effect, as the Chroma can tell there is no cassette connected. If the panel goes blank, the non-sensing mode is in effect, in which case the Chroma will assume that a cassette is connected and running. To restore the Chroma in this case, press the cassette interface switch again.

[SET SPLIT], [11] CASSETTE PACK NO. 0

Output a program No. 0 packet to the cassette interface.

[SET SPLIT], [12] CASSETTE PACKET NO. 1

Output a program No. 1 packet to the cassette interface.

[SET SPLIT], [13] CASSETTE PACKET NO. N

Output a program number packet including the current program number (as shown in the display) to the cassette interface.

[SET SPLIT], [14] CASSETTE STOP PACKET

Output a stop packet to the cassette interface.

INTERFACE COMMANDS

[SET SPLIT], [16] PERFORMANCE OFF

Turn off the performance switch.

[SET SPLIT], [17] PERFORMANCE ON

Turn on the performance switch, for transmitting to another Chroma.

[SET SPLIT], [18] PANEL OFF

Turn off the panel switch.

[SET SPLIT], [19] PANEL ON

Turn on the panel switch, for transmitting to another Chroma.

[SET SPLIT], [20] SEND PROGRAM

Send a WRPG (Write Program) command, along with the current program, for setting up a remote Chroma.

ENVELOPE PARAMETERS

[SET SPLIT], [21] ATTACK THRESHOLD

Set the attack threshold. There is a general modulation source called threshold velocity which puts out 0 for soft keystrikes or 1 unit for hard keystrikes. The Threshold Velocity is also used by an envelope when its amplitude touch parameter is set to 6 or 7 (see Table of Parameters). The point above which the keystrike is considered a hard strike is called the attack threshold. Using [SET SPLIT], [21] causes the threshold to be set to whatever number is in the parameter display, regardless of what parameter is selected. Setting the threshold close to zero will cause all but the very softest keystrikes to be considered hard keystrikes. Setting the threshold close to 31 will cause all but the very hardest keystrikes to be considered soft keystrikes. Values from 10 to 25 are useful.

[SET SPLIT], [22] RELEASE THRESHOLD

Set the release threshold. When an envelope's release parameter is set to 31, the release becomes touch sensitive. Release velocities below a certain threshold yeild one release time while velocities above the threshold yeild a different release time. The threshold is a number from 0 to 31, and can be set in a manner similar to the attack threshold.

[SET SPLIT], [23] SLOW RELEASE

Set the slow release rate. This is the rate at which an envelope will release for a slow key release when the release parameter is set to 31. It is set to a value between 0 and 31 in a manner similar to the two thresholds above.

[SET SPLIT], [24] FAST RELEASE

Set the fast release rate. This is the rate at which an envelope will release for a fast key release when the release parameter is set to 31. It is set to a value between 0 and 31 as described above.

Sample Program

The following is a step-by-step example of creating a new program. The example given is for a brass chorus sound. You may wish to tailor the program to your own tastes once you have initially set all of the parameter values.

The first step is to clear a program. Press both [EDIT A] and [EDIT B], then press *and hold* the [PARAMETER SELECT] switch. While holding this switch, press each of the numbered switches (1 through 50). When you play the keyboard, a raw, sawtooth sound should be heard.

PRESS	SET PARAM VALUE	EXPLANATION
1 PATCH	9	This value establishes a four-pole filter response, ideal for brass.
39 TUNE	0	Tunes the filters down.
42 MOD 2 SELECT	2	Selects Envelope 1A to modulate the filter.
43 MOD 2 DEPTH	19	Sets the depth of filter modulation by the envelope.
40 MOD 1 SELECT	0	Selects keyboard glide so that the filter can change tuning with pitch.
41 MOD 1 DEPTH	19	Determines how much the filter tuning will increase as you go up the keyboard, in this case, slightly less than the rate of the Pitch (32 = same as Pitch).
14 ATTACK	2	Medium fast attack time, Envelope 1.
16 DECAY	27	Medium slow decay time.
18 RELEASE	7	Medium fast release rate.
13 AMP TOUCH	3	Medium touch sensitivity, Envelope 1.
21 ATTACK	4	Medium fast attack time, Envelope 2.
23 DECAY	30	Medium long decay time, Envelope 2.
25 RELEASE	6	Medium fast release.
44 MOD 3 SELECT	3	Select Envelope 2 to modulate filter.
45 MOD 3 DEPTH	43	Adds Envelope 2 to filter input resulting in an "ADSR" envelope function.
38 RESONANCE	1	Sets a small amount of resonance.
27 MOD 1 SELECT	1	Select Sweep A to modulate pitch (for vibrato).
28 MOD 1 DEPTH	3	Sets a small amount of pitch modulation.
9 RATE	54	Sets vibrato rate.
8 MODE	1	Sets independent vibrato mode.
12 AMPL MOD	13	Produces a delayed vibrato.
4 DETUNE	2	Detunes the A and B oscillators.

Note: all switches not mentioned are assumed to be in the "default" state (usually zero). Press and hold [PARAMETER SELECT] and then press the parameter switch to set it to the default value.

CASSETTE

INTERFACE NOTES

1. During cassette operations, turning off the cassette or pressing any one of the four cassette interface switches on the Chroma will abort the operation. During a LOAD ALL, the program number will show the number of the program being read, if the abort occurred during a program packet, or the number of the program about to be read, if the abort occurred between packets.

2. At the end of every cassette operation, the cassette is turned off by the Chroma. To reenable the cassette's own controls, simply press the stop switch on the cassette. The Chroma detects this and immediately reenables the cassette for rewinding or whatever.

3. The LOAD ALL function makes no assumptions about which programs it is to load. It simply follows the instructions on the cassette. The SAVE ALL puts a program number 1 packet at the beginning and stop packet at the end of the recording, and these tell the LOAD ALL where to start and stop. If an error occurs during a LOAD ALL, and the tape was recorded with gaps between the cassette, the user may press LOAD ALL again to continue with the next packet. However, if the user manipulates the cassette controls, the Chroma will detect this and assume that the user backed up the cassette one packet, so the Chroma backs up the program number too. This allows retrying the offending packet. If the user backs up the tape up to the beginning, the Chroma will at first assume that the tape was backed up one packet only, but the program number 1 packet will, what occurs at the beginning of the sequence will override this assumption.

[LOAD ONE]

Attempt to read one packet from the cassette. If an error occurs, the display will show "Error." If a program packet is read, it will be loaded into the current program (program 0) so that it can be auditioned, and possibly stored someplace. If a stop packet is read, the display will show "OFF," and if a program number packet is read, the display will show "Pr no" followed by the program number. The lock switch has no effect. If a subroutine packet is read, the display will show "Subr."

[SAVE ONE]

Write one program packet to the cassette from current program with four seconds of space before it.

[LOAD ALL]

Begin reading packets from the cassette into the Chroma. A program number packet will set the program number appropriately. A stop packet will terminate the operation. A program packet will cause the program to be written into the memory location specified by the current program number, and then causes the program number to be incremented, with wraparound from 50 to 1. If the lock switch is locked, program packets will be checked for errors, but not placed in memory. If an error occurs, the program number display will show the number of the program about to be read, which is usually one greater than the number of the program that contained the error. If a subroutine packet is encountered, the cassette will stop, leaving the subroutine in the cassette buffer where it can be executed with [SET SPLIT], [25].

[SAVE ALL]

Write a program number 1 packet, 50 program packets containing programs 1 through 50, and a stop packet to the cassette. About four seconds of space will be placed between each packet, unless the lock switch is locked, in which case no spaces will be provided.

GLOSSARY

BOARD – A board consists of a pair of CHANNELS. The system contains eight boards, and each board is independent of the other boards. That is, the sound produced by each board has nothing to do with, and no effect on, the sounds produced by the other boards. Each board has two OSCILLATORs, two WAVESHAPERs, two FILTERs and two VOLUME CONTROLs, all implemented as conventional analog synthesizer circuitry. Each board also includes two GLIDE generators, two SWEEP generators and four ENVELOPE generators, all of which are implemented as computer software processes, not as analog hardware.

CHANNEL – A channel consists of an OSCILLATOR, a WAVESHAPER, a FILTER and a VOLUME CONTROL, supported by a GLIDE generator, a SWEEP generator and two ENVELOPE generators. Often, channels are paired for greater tonal complexity. See BOARD.

CURRENT PROGRAM – In addition to the fifty stored PROGRAMs in the Chroma's memory, there is the current program, sometimes called Program 0. This program always controls the sound of the synthesizer (or of the main INSTRUMENT when LINKING). In addition, the programming controls function on the current program, not on the fifty stored programs. This means that the current program is a form of workspace in which all programming is done. If the programmer wishes to keep a sound he has created for future use, he must use the Store switch to store the current program into one of the fifty positions in the Choma's memory. In order to listen to one of the stored programs, it is necessary to select the program, which actually causes the stored program to be copied into the current program space. Even though the current program is not considered a "stored" program, it does reside in the Chroma's battery back-up memory. This means that the instrument can be turned off today and then turned on tomorrow and the current program will be remembered, along with the fifty stored programs.

EDIT MODE – Since the CHANNELs in the Chroma are often used in pairs, two complete sets of parameters are required to completely define the sound of an INSTRUMENT. These are the A PARAMENTERs (which are used even when the channels are not paired) and the B PARAMETERs (which are only used when the channels are paired). In order to access these two sets of parameters (without having another fifty switches on the panel) the two edit mode switches are provided. In Edit A mode, the display and parameter control slider are connected to the A parameter. In Edit B mode, the display and slider are connected to the B parameter. In Edit A & B mode (entered by pressing both edit switches at the same time), the display will show the A parameter's value, yet as soon as the slider is moved both the A and B parameter will be set to the value determined by the slider position. Since the edit mode and (parameter) number is itself a PANEL PARAMETER in the CURRENT PROGRAM, the edit mode and number can be stored so that the slider is automatically connected to a particular parameter whenever a particular program is selected.

ENVELOPE – Any aspect of a musical tone, such as its pitch or its volume, can be described in quantitative terms. One can say that a tone's pitch is middle C and its volume is -15dB, or whatever. However, if an aspect of the sound varies with time, it's not that simple. Fortunately, the time-variations of an aspect of a tone can often be reduced to a simple pattern or combination of patterns. An envelope is one of these types of patterns. In many synthesizers, envelopes are of the type called ADSR, for Attack Decay Sustain Release, which are the four PARAMETERs that describe the shape of the envelope. In the Chroma, this has been simplified to ADR, meaning that each envelope has an ATTACK time, a DECAY time and a RELEASE time. In addition, each envelope can be made larger or smaller in magnitude in response to how hard the key that triggers it is struck. When a key is pressed, the computer inside the Chroma decides which CHANNEL(s) will be used for the note, and then sets the envelopes for those channels to their attack phase. The envelope generators will then proceed to generate their programmed shape, consisting of a rising attack and a falling decay, until the key is released, at which time the envelope generator will be forced to generate a falling release, which

is similar to decay, yet usually faster. The shape of the envelope by itself does not produce any sound, yet it can be used to dynamically modulate aspects of the sound such as volume or filter cutoff.

GLIDE – Most synthesizers have provisions for causing the pitch of an oscillator to slide from one note to the next, and in most synthesizers, this function is called PORTAMENTO. The Chroma, however, uses what is called a glide generator, which is capable of generating PORTAMENTOs (smooth slides) or GLISSANDOs (chromatic runs).

GLISSANDO – The GLIDE generators in the Chroma are capable of causing the transitions from one note to the next to be done by a series of chromatic steps. This is called Glissando. A wide range of glissando rates is available.

INSTRUMENT – Although the Chroma is, of course, a musical instrument, the term "instrument" is used here to refer to that group of BOARDs and PARAMETERs that causes the Chroma to create a particular sound. The Chroma is capable of creating two different sounds at once by LINKING, or eight at once using the computer interface. Therefore, from the programmer's point of view, the Chroma can be thought of as containing several "instruments," and though they do not have discrete physical identities (they are all inside the same box), they have distinct identities as data structures.

KEYBOARD SPLIT – When using the LINKING feature, it is possible to make the Chroma function as two INSTRUMENTs at the same time. If link lower or link upper mode is selected, the keyboard split will determine which keys control which instrument. Since the keyboard split is a PANEL PARAMETER, it need not be setup every time a link is setup. Rather, it can be stored along with the link information and all the other parameters, and automatically setup whenever the appropriate program is selected. However, it can be altered quickly using the Set Split switch. See the SWITCH APPENDIX for details.

LINKING – Normally, the Chroma functions as a single INSTRUMENT, whose sound is defined by the CURRENT PROGRAM. To enhance the versatility of the instrument, there is a special PANEL PARAMETER that is accessible from the control panel that allows the Chroma to function as two instruments. In this mode, the main instrument is still controlled by the current program, while the link instrument is controlled by one of the fifty stored programs. The stored program that controls the sound of the link instrument cannot be directly accessed by the programmer without selecting that program (making it the current program). The link feature has four modes, no link, link lower, link unison and link upper. In no link mode, the linking feature is not used. In link lower mode, keys below the KEYBOARD SPLIT cause the link instrument to sound and keys above or equal to the split cause the main instrument to sound. In link unison mode, each key will cause both instruments to sound, which of course reduces the apparent number of VOICEs available, yet produces extremely rich sounds. In link upper mode, keys above or equal to the keyboard split cause the link instrument to sound while keys below the split cause the main instrument to sound. The linking can be quickly setup from the panel (see CHROMA SWITCH DESCRIPTIONS). In addition, since the link mode and number is in fact a PARAMETER within the CURRENT PROGRAM, the link can be stored so that it will automatically be setup whenever the program containing the link is selected.

MODIFIED FLAG – Since the CURRENT PROGRAM is only a copy of one of the stored programs, and since the current program can be modified, independently of the stored program, by the programming controls, an indication of whether or not the current program equals the stored program is shown at all times. The units decimal point in the large two-digit display is used for this purpose. Whenever a program is selected or stored, the program number display will be set to the appropriate number and the modified flag will be turned off. Whenever the current program is changed, the modified flag will be turned on, telling the user that what he is hearing (as controlled by the current pro-

gram) is not the same as what is in the Chroma's memory (in the stored program). Note that, since the parameter number, edit mode, link, etc., are all parameters, changing any of these will set the modified flag.

PANEL MODE – The Chroma's control panel can operate in four basic modes. The mode determines the function performed when one of the fifty numbered switches on the right side of the panel is depressed. The mode used most often during performance is Program Select mode. In this mode, depressing one of the fifty switches on the right panel will copy an entire PROGRAM into the CURRENT PROGRAM, and also setup the PANEL PARAMETERs and establish any LINKING specified by the program. The mode used most often during programming is Parameter Select mode. In this mode, depressing one of the fifty switches selects one of the CONTROL PARAMETERs or, depending on the EDIT MODE, either one of the A PARAMETERs or one of the B PARAMETERs. When a parameter is selected, its number and value are shown in the eight-digit display. In addition, moving the PARAMETER CONTROL SLIDER causes the value of the parameter to change to whatever the programmer wishes. The remaining two modes are called Copy From A and Copy From B. In these modes, depressing switches on the right panel causes the appropriate parameter to be selected, and copies its value from a program whose number was selected when the Copy mode was first entered. The panel mode (including the program number being copied from the Copy modes) is stored in the battery-backup memory so that the instrument will always power up in the same state it was when it was last shut-off.

PANEL PARAMETER – There are six panel parameters in each program. They do not directly affect the sound created by the INSTRUMENTs. Rather, they are extra parameters that automatically initialize certain things that are accessible from the control panel. The panel parameters include the Link Balance, the Link Mode & Number, the Edit Mode & Number, the Main Transpose, the Link Transpose and the Keyboard Split. Although these panel parameters do end up affecting the sound, they do so by other means than by altering the INSTRUMENT that is creating the sound. For instance, the Main Transpose transposes the notes that are played on the keyboard before they are given to the main instrument process inside the computer. The part of the computer that generates the sound does not know (and does not care) whether you play middle C with no transpose or low C while transposed up 1 octave.

PARAMETER – A parameter is a single numerical quantitiy that controls one specific aspect of the operation of the Chroma, usually an aspect of the sound that is being created. Each parameter has a number that identifies what it controls, and a value that specifies the setting for the particular control. For instance, filter tuning is parameter number 39, and it has a value that can range from 0 to 63, representing tunings that span the entire audio spectrum in whole-tone increments. This particular parameter represents the tuning of the filters that it controls before any modulation is added to the tuning. For a complete list of parameters and what they represent, consult the section entitled TABLE OF PARAMETERS. The parameters fall into four categories, however, called the PANEL PARAMETERs, the CONTROL PARAMETERs, the A PARAMETERs and the B PARAMETERs, all defined elsewhere in this glossary.

PATTERN – The SWEEP is capable of generating typical LFO waveshapes such as sine, square, triangle, etc. In addition, it is capable of generating stepped patterns. These patterns consist of a short sequence of values that repeats at a regular rate. In fact, the square wave that the sweep generates is actually a two-state pattern. There is also a random "pattern" that sounds like a conventional synthesizer with noise feeding a sample & hold.

PORTAMENTO – The GLIDE generator is capable of generating a smooth sliding transition from one note to the next. This is called Portamento. A wide range of portamento rates is available.

PROGRAM – A program is a set of PARAMETERS used to describe the sound that will be created by the Chroma (or, more precisely, by an INSTRUMENT within the Chroma). There are 101 parameters in each program, most of which directly control the sound. The Chroma's memory is large enough to contain 50 stored programs, plus one "current program," which is the program that is currently controlling the synthesizer and is accessible to the programmer. Programs can be moved around the Chroma's memory by SELECTING or by STORING. A secondary program can be called upon, in order to get two sounds at a time, by LINKING programs.

SWEEP – One of the dynamically varying quantities that can control an aspect of a sound is called the sweep. In other synthesizers, it is often called the LFO, for Low Frequency Oscillator. However, in the Chroma there are not any oscillators for this function. Rather, this control function is generated by the Chroma's computer. So, it is given the term SWEEP instead of LFO. The sweep has several parameters that control its operation, including its rate and its waveshape. Like the ENVELOPEs, the sweep produces no sound of its own, yet can be used to dynamically vary an aspect of the sound being created, such as the volume or pitch.

TEMP MODE – Short for Temporary Panel Mode. In addition to the four PANEL MODEs which determine the function of the right panel switches, there are eight temporary modes, indicated by a blinking LED on the panel, that determine the function to be performed by the next depression of one of the right panel switches. As soon as a right panel switch is pressed, its temporary function will be performed and the temp mode will be cleared, returning the Chroma to its previously set panel mode. In some cases, use of a temp mode will result in the panel mode being changed. The specifics of these modes can be found under the section entitled SWITCH APPENDIX. The temp mode, like the PANEL MODE, is stored in the Chroma's battery-backup memory, so that the Chroma will always power up in the same state it was when it was last shut-off.

VOICE – The term "voice" has several meanings in the synthesizer industry. However, the term has very specific meaning as far as the Chroma is concerned. A voice is the total sound you hear as a result of pressing one key. The number of voices a synthesizer has is determined by how many tone generators it has (16 in the Chroma) as well as how many tone generators are required for each note (anywhere from 1 to 16 in the Chroma, typically 2). This means that the Chroma can function as a synthesizer that has anywhere from 16 voices down to 1 voice, usually 8, depending how it's programmed. The term "voice" does NOT refer to how many different sounds the instrument can remember. That is the number of PROGRAMs that the synthesizer can store in its memory.