

MODEL 1016.1  
Manual No. CM1016B

**PROPHET-10 SYNTHESIZER**  
**OPERATION MANUAL**

by Tom Darter

and

**POLYPHONIC SEQUENCER**  
**OPERATION MANUAL**

by Stanley Junglieb

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**PROPHET-10 SYNTHESIZER  
OPERATION MANUAL**

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Manual No. CM1010A  
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**POLYPHONIC SEQUENCER  
OPERATION MANUAL**

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Manual No. CM1016B  
Issued: September, 1981

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# SECTION 1

## GETTING STARTED

### 1-0 INTRODUCTION

The Prophet-10 contains two completely programmable polyphonic synthesizer banks, each having five complete and individual synthesizer "voices." Although each voice is keyed independently, all five voices in each polyphonic bank function from the same patch setting, and are therefore homophonous. However, each of the two 5-voice synthesizer banks can operate on a completely different program, and can be articulated independently via the two keyboard manuals. In other words, two different programs can be used at any one time. One is the UPPER program, with one 5-voice synthesizer usually tied to the upper keyboard, and the other is the LOWER program, with the other 5-voice synthesizer usually tied to the lower keyboard.

Each synthesizer voice consists of two voltage-controlled oscillators (VCOs), a white noise source, a resonant low-pass voltage-controlled filter (VCF), a voltage-controlled amplifier (VCA), two envelope generators (one wired to the VCF and one wired to the VCA) and a 3-band equalizer (EQ). In addition, there are routings (via the POLY-MOD section) that allow for oscillator B and the filter envelope generator to function as modulation sources which can be applied to the frequency or pulse-width of oscillator A, or the filter frequency. Finally, each 5-voice synthesizer bank has a single LFO which can be applied to all of its voices for various effects. The two LFOs (UPPER and LOWER) can also be combined (summed) and applied to both polyphonic synthesizers for other effects.

The Prophet also contains a microcomputer, which serves several purposes: it determines which voice is assigned to which key, it keeps the voices in tune, and (most importantly) it remembers preset voice patches which may be instantly recalled to program the voices. These preset programs are retained by the microcomputer's memory even when the Prophet is turned off, thanks to a small battery with a 10-year life.

### 1-1 SET-UP

To set up the Prophet-10, simply plug the power cord into an AC outlet and connect the instrument to an amplifier via the AUDIO OUT jacks on the back panel. Both balanced (XLR connector) and unbalanced (1/4" phone jack) outputs are provided. The MONO jack provides the output of all ten synthesizer voices. The UPPER and LOWER jacks can be used to separate the outputs of the two polyphonic synthesizer banks for stereo effects.

The fixture for the removable power cord also contains the main AC fuse, facilities for selecting between 100, 120, 220, and 240 volts AC line levels, and an AC line filter. Prophet-10s shipped in the USA will be set at 120, those shipped to Europe will be set at 220, and those shipped to Japan will be set at 100. The fuse used should match the AC setting: A 2-amp slo-blo fuse should be used for 110 and 120-volt operation, and a 1-amp slo-blo fuse should be used for 220- and 240-volt operation. (These specifications are indicated on the power cord fixture.)

As with most electronic equipment, the Prophet comes with a three-prong power plug to insure safe grounding with other pieces of equipment in use. The ground prong is connected to the chassis of the instrument. It is up to you to check the ground connections of the Prophet and all other instruments and equipment you use, to prevent potentially lethal shocks. As you probably know, many older buildings and clubs are not known for their quality AC wiring, so we urge you to use one of the several "ground-checking" devices available on the market to verify AC connections.

Because of the AC ground, a “ground loop” will often exist when a cable is plugged between the Prophet and an amplifier; as a result, low-level hum will often occur. Defeating the AC ground with a two-prong adapter will usually eliminate the noise, but it can also set up a shock hazard between the pieces of equipment. The amount of hum is dependent on where the two units are connected to AC.

For minimal hum, use the same outlet for both the Prophet and its amplifier; with this set-up, the hum will be low enough below the signal level to be acceptable. The further away from each other the plugs are connected to AC, the more hum will occur. The quality of wiring in the wall and wall socket will also affect the amount of hum.

Here is a summary of recommended procedures to follow when setting up the Prophet-10:

- 1) Plug the Prophet into a three-prong outlet. Don't defeat the AC-ground.
- 2) Plug all other connected equipment (amplifiers, volume pedals, effects devices, and other accessories) into the same outlet. (Warning: do not overload. When in doubt, consult an electrician.)
- 3) Verify all equipment grounding with a ground tester.

*Sequential Circuits is not responsible for any equipment failure due to incorrect AC connections, and is not liable for any personal injury due to electrical shocks as a result of poor grounding.*

## **1-2 TURN-ON AND INITIAL TUNING**

The Prophet is turned on via the POWER switch on the rear panel. After the instrument is turned on, the front panel will be dark — except for the TUNE switch — for approximately 15 seconds while the computer tunes the oscillators. When tuning is complete the front panel will light up and the BANK-PROGRAM indicator (the digital display) in the PROGRAMMER section of the front panel will display “1-1” for both the UPPER and LOWER programming sections. This indicates that the Prophet-10 is ready to play and that its voices are programmed according to the settings stored in those locations in the computer's memory. In addition, the UPPER panel switch in the programming section will be lit, indicating that the UPPER program is displayed on (and connected to) the front panel patch controls. (Although separate UPPER and LOWER programs can be used at any time, there is only one set of front panel controls. Hence, only one of the two programs can be connected to the front panel controls at a time.)

## **1-3 MASTER OUTPUT CONTROLS**

The MASTER VOLUME knob is used to adjust the overall volume of the Prophet-10's output.

The BALANCE knob is used to adjust the relative volume of the upper and lower synthesizer banks.

The A-440 switch activates a built-in, crystal-referenced A-440 oscillator which is accurate to .1 Hz in any environment. This reference oscillator is enabled by hitting the switch — the LED indicator in the switch will light. To turn the tone off, hit the switch again. (The A-440 signal is routed independently to both the upper and lower synthesizer banks. In order to be heard, the programmable VOLUME, MASTER VOLUME, and BALANCE knobs must all be set correctly — as well as any AMP footpedals.)

The MASTER TUNE knob is used to adjust the overall tuning of the Prophet-10's output. Tune by holding down a key (e.g. middle A) and matching either the A-440 reference or an outside pitch source.

## 1-4 PRESET SELECTION

When turned on, the Prophet automatically enters PRESET mode, meaning that it is ready to set up the synthesizer's voices according to preset patches stored in the memory of the Prophet's computer. Both the UPPER and LOWER presets are arranged in four banks of eight programs each (UPPER = 32 programs, and LOWER = 32 programs, for a total of 64 programs). These programs may be selected via the switches in the programmer section on the front panel. The switches marked BANK SELECT will step through the banks in order, and the two sets of eight switches marked PROGRAM SELECT (numbered 1 through 8) allow immediate selection of a particular program within a bank. To choose a program for either the UPPER or LOWER polyphonic synthesizer bank, step through the banks until you reach the bank you want, then hit the PROGRAM SELECT switch for the exact program you wish. The selected bank will be indicated by the digital display in the programmer section, and the selected program will be indicated both by the digital display and by the LEDs embedded in the PROGRAM SELECT switches. You will be able to see which program is selected for both the UPPER and the LOWER synthesizer bank. The PANEL select switches will allow you to choose which of these two programs you wish to have displayed on (and connected to) the front panel patch controls.

Since the Prophet is shipped with a full complement of 64 factory programs it will be ready to play as soon as it has been turned on and the initial tuning procedure has ended. For information on these factory-loaded patches, see SECTION 7, THE FACTORY PRESET PROGRAMS. For information on MANUAL operation, see SECTION 3, THE PATCH CONTROLS.

## 1-5 PITCH AND MOD WHEELS

The pitch wheel (PITCH) and modulation wheel (MOD) are located to the left of the upper keyboard. Normally, both wheels affect all voices simultaneously. The PITCH wheel has a center detent position, from which the pitch may be varied up or down by about a 5th. Both wheels can be "disconnected" from the LOWER program by holding the LOWER TRANSPOSE DOWN switch and hitting the LOWER TRANSPOSE UP switch. Repeating this procedure will re-connect the wheels. This is useful when using the poly-sequencer.

The MOD wheel determines, for the most part, the amount of modulation to be routed via the MONO-MOD settings of a particular program. The total amount of modulation to be routed is determined by the sum of the settings of: 1) the programmable LFO AMOUNT knob in the MONO-MOD section on the front panel; 2) the MOD wheel; and 3) the voltage supplied from PEDAL 1 (if it is programmed to affect the MONO-MOD section). Note that the MOD wheel may have different results on the upper and lower programs, since the MONO-MOD sections may be programmed differently. For information on the effects that may be engaged via the MOD wheel relative to the various factory-programmed patches, see the notes accompanying each patch diagram in SECTION 7.

## 1-6 TRANSPOSE SWITCHES

These switches allow instant octave transposition of either UPPER or LOWER programs, within an overall four-octave range. Each touch of the switch will raise or lower the program by an octave. The relationship between this overall range and the TRANSPOSE switches is determined by the settings of the FREQUENCY knobs in the oscillator sections of the front panel. These knobs also have a four-octave range; and if, for instance, both oscillators were set at the top of their frequency range in a particular program, the TRANSPOSE UP switch would have no effect (the TRANSPOSE DOWN switch would in this case have a four-octave range). In addition, the TRANSPOSE switches always operate to the limit of their range. If you begin with a program that has the oscillators tuned an octave apart, and continue to hit the TRANSPOSE UP switch, both oscillators will end up in unison at the top of their range.

The computer remembers the number of times you strike a particular TRANSPOSE switch, even if it has ceased to have an effect on the oscillators. Here is an example of what this means in actual use: You begin with both oscillators set two octaves up (with their respective FREQUENCY knobs); then you hit the TRANSPOSE UP switch five times. The last three strokes will no longer transpose the oscillators, but the computer is still counting, so in order to transpose down again, you will have to hit the TRANSPOSE DOWN switch three times before anything happens. On the fourth stroke the oscillators will transpose down an octave.

If the KEYBOARD switch on OSCILLATOR B is off, the TRANSPOSE will have no effect on that oscillator. OSCILLATOR A will always be affected.

If the KEYBOARD switch in the FILTER section of the patch panel is lit, the TRANSPOSE switches will also connect to the CUTOFF FREQUENCY of the filter. Since this parameter has a much greater range than that of the oscillators (10 octaves), successive strokes of the TRANSPOSE switches may continue to alter the CUTOFF setting after the oscillators have reached the limit of their range.

None of the transpose operations performed with the TRANSPOSE switches can be recorded as part of a program. In order to change octaves permanently, you must adjust the FREQUENCY controls on the oscillators (and perhaps the CUTOFF control on the filter).

To return quickly to the original programmed octave after transpositions via the TRANSPOSE switches, simply hit the PROGRAM switch for the program you are playing or change to a new program. (Adjusting either FREQUENCY knobs will also cancel the effects of the TRANSPOSE switches.)

## 1-7 VOICE ASSIGNMENT

The assignment of voices to keys played on the keyboard is done by the Prophet's computer. If the same key is struck repeatedly, the computer will continue to assign the same voice. If more than five keys are held down at the same time on either keyboard in NORMAL keyboard mode, the computer will reassign the earliest used voices first; for example, playing C, D, E, F, G, and A in succession and holding all six keys down will cause D, E, F, G, and A to be sustained — the C will disappear when the A is played. In other words, the Prophet normally operates on a "last-note priority" system: each new note played is assigned to the earliest-used voice. In DOUBLE keyboard mode, reassignment will begin if more than five keys are held down (total) on both keyboards. In SINGLE and ALTERNATE keyboard modes reassignment will occur if more than ten keys are held down on both keyboards.

There are two exceptions to this system. First, if the UNISON switch is on, all five voices are assigned to a single key. UNISON assigns priority to the highest key held. This is particularly useful in DOUBLE keyboard mode. (In UNISON mode, the keyboard operates in single trigger fashion: there will not be a new trigger unless there is a space between key depressions.)

The second exception to normal voice assignment is provided for the occasion when a voice may become "unplayable" due to component failure. In such cases, a VOICE DEFEAT allows you to eliminate the bad voice from the assignment system. The Prophet can then be played normally, with the remaining voices. The VOICE ASSIGNMENT lights allow you to see which voice is failing.

To defeat a voice, hold the key currently assigned to it with one hand while holding UPPER PROGRAM SELECT 1 and pressing UPPER PROGRAM SELECT 8 with the other hand. The voice will be defeated, the corresponding light will go out, and the voice will remain defeated until the Prophet's power is switched off.



Defeating a voice in one synthesizer bank will also defeat the corresponding voice in the other bank. For instance, defeating voice 4 in the UPPER synthesizer will also defeat voice 9 in the LOWER synthesizer.

If power is turned off, then on again — the voice will have to be defeated again (if it is still bad).

## **1-8 RETUNING**

Although the computer tunes the oscillators when the Prophet is first turned on, it may become necessary to retune, particularly during the first few minutes of operation since the oscillators need time to stabilize. After 20 minutes or so the instrument should not have to be retuned very often, unless there is a radical temperature change in the room.

Hitting the TUNE switch will tell the computer to retune the oscillators. When this is done the front panel will go dark — except for the TUNE switch — for approximately 15 seconds, and then will return to the previous front panel status.

# SECTION 2

## BASIC PROCEDURES

### 2-0 INTRODUCTION: THE FRONT PANEL

The Prophet-10's front panel controls are color-coded to clarify the modes of operation and the function of the computer's memory. All black knobs and switches are programmable; that is, their settings can be recorded into memory and recalled in PRESET mode.

The silver knobs (MASTER VOLUME, BALANCE, and MASTER TUNE) and grey switches (PRESET, A-440, TUNE, and TRANSPOSE switches, and the entire PROGRAMMER section) are not programmable. The PITCH and MOD wheels are also not programmable. The RECORD switch is orange, so that it can easily be distinguished.

All of the switches except BANK SELECT and TRANSPOSE have LED indicators embedded in them. And, except for the two sets of 8 PROGRAM SELECTS, PANEL, KEYBOARD MODE, and TUNE, all LED switches are alternate action: one push turns them on, the next push turns them off. For example, the PRESET switch LED when lit indicates PRESET mode. The LED goes off when the Prophet is switched to MANUAL mode, by pushing the (lit) PRESET switch.

### 2-1 MODES OF OPERATION

In PRESET (PRESET switch LED lit) the Prophet-10's synthesizers will be patched according to the programs stored in the locations indicated on the digital display. In this mode, entire patches can be changed instantaneously using the BANK SELECT and PROGRAM SELECT switches in the programmer section.

In addition to PRESET, the Prophet has MANUAL and RECORD modes of operation. In MANUAL mode a patch can be formed entirely "from scratch." RECORD is a momentary mode for storing or relocating programs. A "patch" becomes a "program" when recorded. Custom programs can therefore be created in two ways: 1) by recording manually-formed patches or 2) recording edited programs. (Edited programs can be recorded into the original location if the original program is not desired, or into a new location.)

In MANUAL mode the control panel always indicates the status of the patch under construction. You can see exactly what signal paths are closed by (lit) switches. The knob settings reflect their actual values. As you select different programs in PRESET the switch LEDs still indicate how the switches are programmed. Note that the knobs cannot move with program changes, but stay where they were last set. So, in PRESET the knobs do not normally indicate their "current" setting. However as soon as you move a knob to EDIT a program, that knob converts to MANUAL operation. So only the knobs you move will actually indicate their current setting: the parameters controlled by unmoved knobs do not change.

This EDIT feature of PRESET mode is a powerful tool that allows you to experiment with changes in programs, using the patch controls. The original program remains unchanged and can be restored at any time by simply hitting its PROGRAM SELECT again.

For example, suppose you like program 3-3 but want to change OSC A pitch and prefer a brighter tone. In PRESET mode, select BANK 3 - PROGRAM 3, adjust OSC A FREQUENCY to the desired pitch and increase the FILTER CUTOFF to the desired brightness. You can cancel any changes and return to the original program by hitting PROGRAM SELECT 3. If you want to permanently change program 3-3 to your edited version, record it in 3-3. Or, if both the original and edited versions are wanted, record the edited program in a new location. Remember that even though two programs (UPPER and LOWER) can be selected at a time, only the program indicated by the PANEL select switches can be altered via the front panel patch controls. However, edited changes are remembered when the UPPER and LOWER PANEL switches are hit. Hence, one can select UPPER and edit the UPPER program, and select LOWER and edit the LOWER program independently as desired. Both programs will play in their edited form, even if you switch back and forth a number of times.

NOTE — If a particular patch is programmed with the RELEASE switch off but with a programmed amplifier envelope RELEASE setting that will have an audible effect, this release can be engaged (while in PRESET mode) by switching the RELEASE switch on, or using the footswitch. Further modifications (non-permanent changes) to the preset programs can be brought about through the use of other accessories which connect to the Prophet via jacks in the back panel. For information on these possibilities, see SECTION 4 ACCESSORIES. Remember that the RELEASE switch and knob settings may be different on the upper and lower programs. Hence, the footswitch may have an effect on one program and not the other depending on the different settings.

## 2-2 RECORDING PROGRAMS

In general, to record a manually-formed patch or edited program, the RECORD switch is pressed on, then the desired destination BANK and PROGRAM are selected. NOTE — To protect existing programs, RECORD mode can only be entered if the back panel RECORD ENABLE/DISABLE switch is up (ENABLE). It is suggested that the switch be left in the DISABLE position until the modes of operation and control functions are understood. This will prevent the accidental erasure of the factory preset programs (Remember also that an accidental erasure is not a disaster, since by referring to the diagrams in SECTION 7 you can always patch a factory program manually, and re-record it).

The exact RECORD procedure is as follows:

- 1) Set the back panel RECORD ENABLE/DISABLE switch to the ENABLE (up) position.
- 2) Switch on the orange RECORD switch in the PROGRAMMER SECTION.
- 3) Select the desired general location (UPPER or LOWER) by using the PANEL select switches.
- 4) Select the desired bank using the BANK SELECT. (Ignore this step if current BANK is desired).
- 5) At this point you can abort RECORD mode by switching the RECORD switch off. The memory will not be affected.
- 6) Otherwise, pressing any PROGRAM SELECT will cause the patch or edited program to be recorded at the corresponding location in the selected bank. NOTE — Make sure to hit the correct PROGRAM SELECT switch or you may erase a program you wanted to keep.
- 7) When a PROGRAM SELECT switch has been hit, the RECORD switch LED will automatically go off and the Prophet will return to the mode it was in before recording.
- 8) After recording a patch it is always a good idea to return to PRESET mode and check that the program is correctly recorded in the desired location.

To move a program from one location to another (edited or not), the procedure is as follows:

- 1) Select the program to be moved (set PANEL, BANK, PROGRAM).
- 2) Edit the program (if desired).
- 3) Hit RECORD switch (latches up current program).
- 4) Change PANEL if necessary (for moving from UPPER to LOWER or vice-versa).
- 5) Select destination BANK (if necessary).
- 6) Hit desired PROGRAM SELECT.
- 7) This new location now has the old program stored in it. In order to play the program, it is necessary to hit the PROGRAM SELECT a second time to "load" the program.

### **2-3 KEYBOARD MODES AND THE UPPER/LOWER PANEL SWITCHES**

The four programmable KEYBOARD MODE switches are an important part of the basic operation of the Prophet-10, since they determine the relationship between the two 5-voice polyphonic synthesizers and the two keyboard manuals. They offer a great range of possibilities for playing the programs stored in the Prophet's UPPER and LOWER program sections.

**NORMAL Mode:** The UPPER five voices (connected to the UPPER program) play on the upper keyboard, while the LOWER five voices (connected to the LOWER program) play on the lower keyboard.

**SINGLE Mode:** All ten voices will be assigned and will play their own UPPER or LOWER program. Usually the UPPER and LOWER programs are set up to be the same. The notes can be played on either keyboard in any combination.

**DOUBLE Mode:** Hitting a key (on either keyboard) will engage one voice with the UPPER program and one voice with the LOWER program. Only five keys can be played at one time (since each key is connected to *both* of the 5-voice synthesizer banks).

**ALTERNATE Mode:** Every new key hit will alternate between the UPPER and LOWER programs.

As can be seen, NORMAL is the only mode in which it makes a difference which keyboard is physically played. In the other three modes the keyboards can be used interchangeably — together or separated.

So, these switches determine how the Prophet-10 will be played. There is also another factor in setting up the playing mode of the instrument: the choice of program being displayed on the front panel patch controls. Since the KEYBOARD mode switches are programmable, their status is recorded along with each patch. At any given time, there will be two selected programs (UPPER and LOWER), but the KEYBOARD mode operation will be determined *only* by the program that is displayed on the front panel patch controls. Therefore, the UPPER/LOWER PANEL switches also play a role in determining the playing configuration on the Prophet. For example, look at programs U-1-1 and L-1-1 — both are patches with a brass sound. If U-1-1 is displayed, the Prophet will operate in NORMAL keyboard mode, but if L-1-1 is displayed, the Prophet will operate in DOUBLE keyboard mode.

These interrelations can be used to enhance the flexibility of the Prophet-10 as a live performance instrument.

# SECTION 3

## THE PATCH CONTROLS

### 3-0 INTRODUCTION: THE FRONT PANEL

This section explains the functions of the patch controls comprising the “modules” (e.g. VCO, LFO, VCF, and VCA) outlined on the front panel. The alternatives of each switch and ranges of each knob are described relative to the overall signal flow of the voices and to the modulation circuitry.

In SECTION 1 and SECTION 2, we described the basic operation of the Prophet using the factory programs accessible through the UPPER and LOWER PROGRAMMER. It is true that the Prophet can be used exclusively in PRESET mode, in which case the voice and modulation patch controls would not be used very often. However it is also true that using the instrument in this way would defeat a large part of its overall purpose, which is to allow synthesists to create and record their own programs for immediate use. The creation of satisfying custom programs depends entirely on your familiarity with the patch controls.

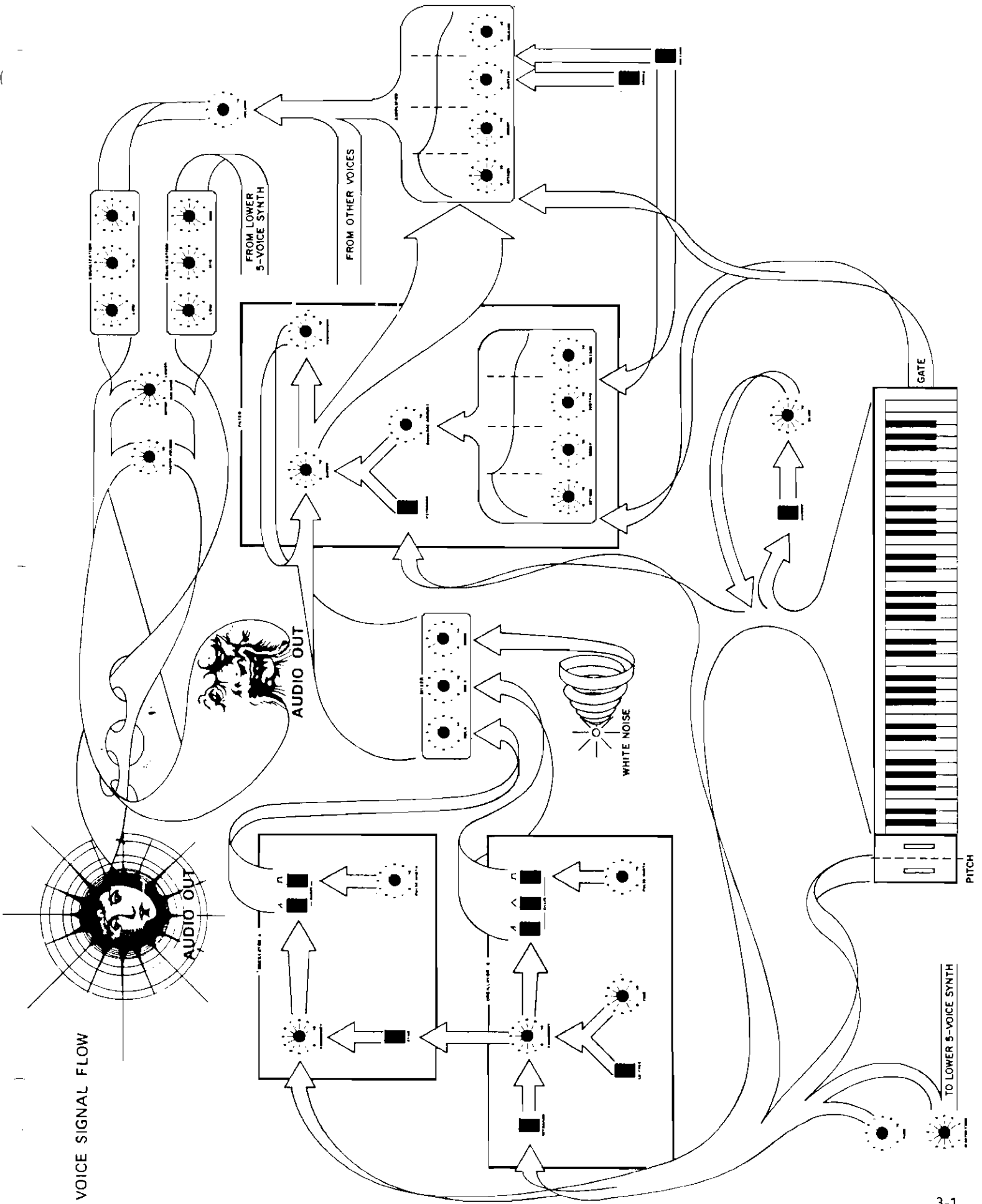
By the way, in describing the controls this section will not attempt to be a manual of synthesis technique. However by referring to the patch diagrams in SECTION 7 while playing through the factory programs, you will soon grasp some of the sonic possibilities the Prophet makes available. As explained in SECTION 7, we particularly encourage you to EDIT the factory programs (see paragraph 2-1, MODES OF OPERATION). This is the best way to gain familiarity with the patch controls.

For more information on synthesis technique, refer to the books and magazines listed in SECTION 6.

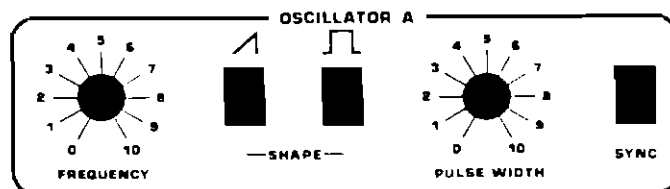
### 3-1 VOICE SIGNAL FLOW

The Prophet's audio output results from several stages of signal generation, combination, and modification. The front panel is divided into VOICE and MODULATION sections. (MODULATION controls are covered in paragraph 3-8). It should be kept in mind that although only one voice is depicted on the panel, the voice controls simultaneously patch five voices in parallel. The figure diagrams signal flow in a single voice. Basically, the MIXER sets OSCILLATOR (VCO) A, B and NOISE levels sent to the FILTER (VCF) and AMPLIFIER (VCA) where, roughly speaking, the timbre and dynamics are shaped. The EQUALIZER section further modifies the frequency spectrum. Then the voices of each 5-voice synthesizer bank are combined and their overall level and tuning are set by the VOLUME and TUNE controls. Finally the two synthesizer banks are combined, and the instrument's overall level and tuning are set by the MASTER VOLUME, BALANCE, and MASTER TUNE controls.

VOICE SIGNAL FLOW



### 3-2 OSCILLATOR A



**FREQUENCY knob:** Controls pitch (oscillator tuning). Stepped (quantized) in semitones over a four-octave range. (Exact pitch is set with the MASTER TUNE knob.)

NOTE:

— OSC A pitch is always under keyboard control.

**SAWTOOTH WAVESHAPESwitch:** When on, a sawtooth wave (containing all the harmonics) is supplied as OSC A's output.

**PULSE WAVESHAPESwitch:** When on, a pulse wave is supplied as OSC A's output. Harmonic content is dependent on the setting of the PULSE WIDTH knob.

NOTES:

— When both the sawtooth and pulse switches are on, sawtooth and pulse waves are mixed at full level and supplied as OSC A's output.

— When neither waveshape switch is on, no signal is supplied as OSC A's output.

**PULSEWIDTH knob:** Sets OSC A pulse width from approximately 1% to 99%. (Varies harmonic content of pulse output.)

NOTES:

— The extreme settings of this knob (0 and 10) may cause the OSC A signal to degenerate to DC, resulting in no output signal (of course, this knob will only have this effect if the pulse waveshape is selected).

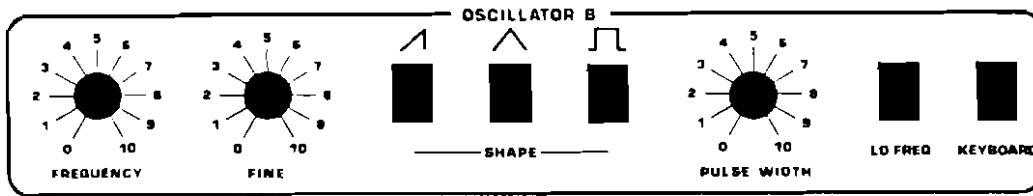
— An exact square wave (having only odd harmonics) may be obtained by setting this knob to approximately 5 and adjusting by ear for the drop out of the 2nd harmonic (the octave).

**SYNC switch:** when on, OSC A becomes "hard" synchronized to OSC B, and will therefore tune only to harmonic frequencies of OSC B. Intermediate frequency settings will produce unusual waveforms (and therefore unusual timbres) at the next lower harmonic of OSC B. To gain an understanding of the effect of SYNCING, check the following factory preset programs: 1-4, 1-7, 3-2, and U-4-3.

NOTES:

— When a pulse shape with a wide pulse width is selected for OSC A in sync with OSC B, and if OSC B's frequency is set much higher than that of OSC A, the signal from OSC A may degenerate into DC since the pulse is not given a chance to discharge before being re-synced.

### 3-3 OSCILLATOR B



**FREQUENCY knob:** Controls pitch (oscillator tuning). Stepped (quantized) in semitones over a four octave range. (Exact pitch is set with the MASTER TUNE knob.)

**NOTE:**

— If the KEYBOARD switch is off, the FREQUENCY knob will have a range of nine octaves.

**FINE knob:** Continuously varies pitch over a semitone range (up from the basic pitch setting of the FREQUENCY knob). This knob is useful for detuning of OSC B relative to OSC A. When no detuning is desired, the FINE knob should be set at 0.

**SAWTOOTH WAVESHAPESwitch:** When on, a sawtooth wave (containing all harmonics) is supplied as OSC B's output.

**TRIANGLE WAVESHAPESwitch:** When on, a triangle wave (containing only odd harmonics) is supplied as OSC B's output.

**PULSE WAVESHAPESwitch:** When on, a pulse wave is supplied as OSC B's output (harmonic content is dependent on the setting of the PULSE WIDTH knob).

**NOTES:**

— When two or three of the waveshape switches are on, the selected waveshapes are mixed at full level and supplied as OSC B's output.

— When no waveshape switch is on, no signal is supplied as OSC B's output. However, the overall pitch range of a particular patch may still be determined by the FREQUENCY knob setting of OSC B, if OSC A is in SYNC with it.

**PULSE WIDTH knob:** Sets OSC B pulse width from approximately 1% to 99%. (Varies harmonic content of pulse output.)

**NOTES:**

— The extreme settings of this knob (0 and 10) may cause the OSC B signal to degenerate to DC, resulting in no output signal (of course, this knob will only have this effect if the pulse waveshape is selected).

— An exact square wave (having only odd harmonics) may be obtained by setting this knob to approximately 5 and adjusting by ear for the drop out of the 2nd harmonic (the octave).

**LO FREQUENCY switch:** When on (with the KEYBOARD switch off), OSC B will function as a low frequency oscillator (LFO), ranging from approximately .4 Hz (or 2.5 seconds-per-cycle) into low audio frequencies. This function is usually used in conjunction with the POLY-MOD section (see paragraph 3-8).

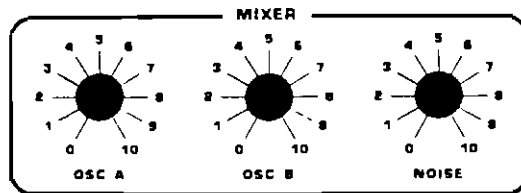


**KEYBOARD switch:** When on, the frequency of OSC B is controlled by the keyboard. When off, the frequency of OSC B will not be controlled by the keyboard.

NOTES:

- If the KEYBOARD switch is off and the LO FREQ switch is off, OSC B will act as a drone in the audio range. Set the pitch of this drone with the FREQUENCY knob after the KEYBOARD switch is turned off (otherwise you may have to retune).
- The use of OSC B as a modulation source for the POLY-MOD will be discussed in paragraph 2-8. Normally, when OSC B is being used as an audio signal source, the LO FREQ switch will be off and the KEYBOARD switch will be on. ~~(For exceptions to this general rule, check some of the patch diagrams for the factory presets loaded in bank 5.)~~

### 3-4 MIXER



**OSC A knob:** Determines the amount of OSC A's output sent to the filter.

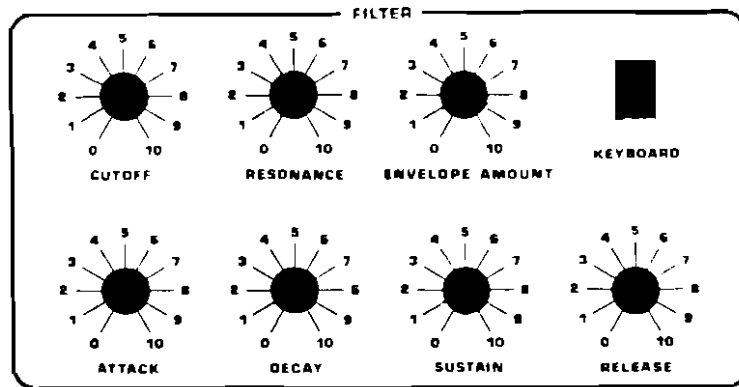
**OSC B knob:** Determines the amount of OSC B's output sent to the filter.

**NOISE knob:** Determines the amount of white noise (combination of all frequencies) sent to the filter.

NOTES:

- These mixer amount knobs are also used to program overall volume of the patch so that when switching from one program to another in PRESET mode one program won't be wildly different in volume than the others.

### 3-5 FILTER



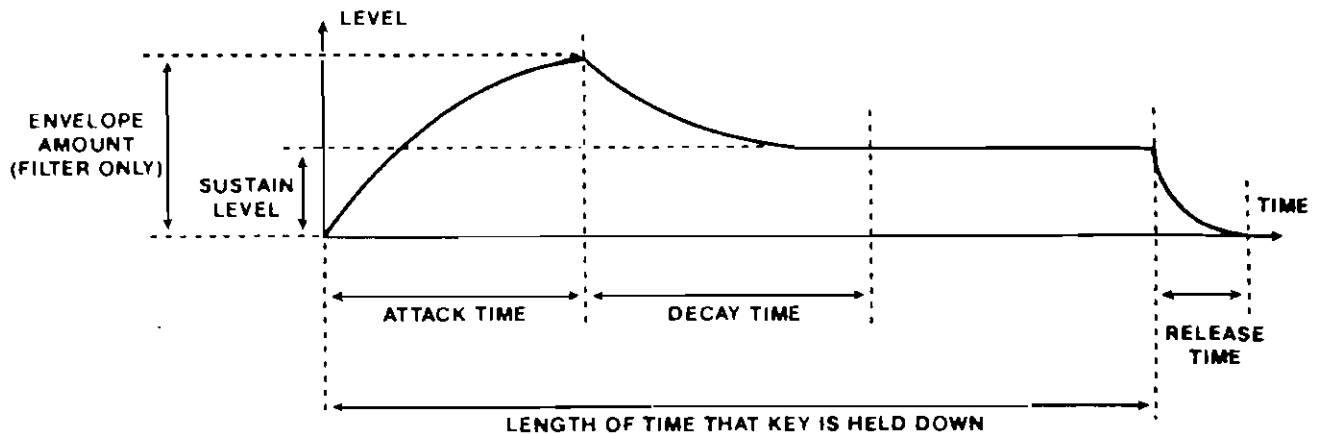
**CUTOFF knob:** The Prophet's filters are 4-pole, 24 dB-per-octave low-pass filters and therefore the cutoff knob sets the frequency below which all elements of the signal are let through. The higher frequency components of the signal (i.e. the frequencies above the cutoff frequency) are suppressed. The higher the knob is set, the more frequencies are allowed through the filter. In general terms, the CUTOFF knob may be thought of as a tone control.

**RESONANCE knob:** As the setting of this knob is increased from 0 to approximately 7, the amount of resonance ("emphasis", "regeneration", or "Q") applied to those signal frequencies at the cutoff frequency will increase (as the resonance increases, the frequencies far below the cutoff frequency will be less audible relative to the frequencies being resonated). If the setting is increased beyond 7, the filter will break into oscillation and will act as a sine wave audio source whose pitch is determined by the cutoff frequency.

**ENVELOPE AMOUNT knob:** The filter cutoff frequency may be contoured (shaped) electronically in a pattern determined by the settings of the ATTACK, DECAY, SUSTAIN, and RELEASE knobs (these are the controls for the ADSR envelope generator that is connected to the filter). The envelope amount knob determines the amount (but not the shape) of this contouring that is applied to the filter's cutoff frequency.

#### NOTES on the ENVELOPE GENERATORS:

- The ADSR envelope generators whose controls appear as the ATTACK, DECAY, SUSTAIN, and RELEASE knobs in the filter and amplifier sections generate voltage patterns that can be used to contour timbre (via the filter's cutoff frequency) and loudness (via the VCA, see paragraph 3-6) respectively. The voltage patterns generated have four stages (one for each knob) as illustrated. The entire contour pattern is initiated when a key is depressed and proceeds through the attack and decay stages at rates determined by the settings of those knobs. The sustain level is determined by the setting of the SUSTAIN knob, and is maintained as long as the key is held down. When the key is released the release stage is activated and proceeds at a rate determined by that knob.
- In the FILTER section, the ENVELOPE AMOUNT knob functions as an attenuator on the voltage patterns from the filter's envelope generator. There is no comparable attenuator connected to the VCA's envelope generator.



**ATTACK knob:** Determines the length of time it takes the envelope generator's contour to go from 0 level (at initial key depression) to maximum level.

**DECAY knob:** Determines the length of time it takes the envelope generator's contour to go from maximum level to sustain level. If SUSTAIN is set at maximum then the DECAY knob setting is irrelevant.

**SUSTAIN knob:** Determines the sustain level of the envelope generator's contour. Remember, this is a level setting, not a time setting; the sustain time is determined by the key being held down.

**RELEASE knob:** Determines the length of time it takes the envelope generator's contour to drop from the sustain level to 0 level after the key is released. If the key is released before the attack and decay stages of the envelope are complete, the RELEASE knob setting will determine the length of time for the contour to drop from its level at the time of key release to 0 level. If the sustain is set at 0 and the attack and decay stages are complete (while the key is still depressed) then the release setting is irrelevant.

NOTES:

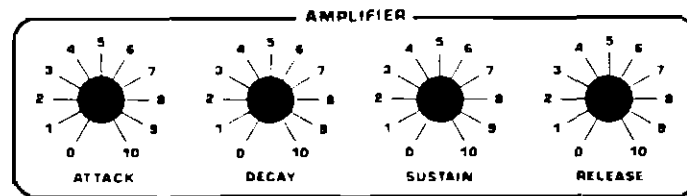
- The time range on the ATTACK, DECAY, and RELEASE knobs is approximately 1 millisecond to 30 seconds. Since the response to the knob is exponential, the durations as set on these knobs will not be linear; for example, setting 5 on these knobs gives a period of approximately 1/2 second.
- Remember that, for the FILTER only (not the VCA), the overall level of the envelope generator's contour is determined by the ENVELOPE AMOUNT knob. If the envelope amount is set at 9 then the envelope will have no effect on the filter's cutoff frequency.

**KEYBOARD switch:** When on, the control voltage from the keyboard will be applied to the filter's cutoff frequency (just as it is normally applied to the frequency of the oscillators). This patch maintains the cutoff frequency at a constant level relative to the notes played on the keyboard, and therefore creates a consistency of tone color over the entire range of the keyboard. When this switch is off, notes played higher on the keyboard will have more of their overtones suppressed than notes played lower on the keyboard; as a result, notes played in the higher register of the keyboard will be less bright in tone color than those notes played in the lower register of the keyboard.

NOTES:

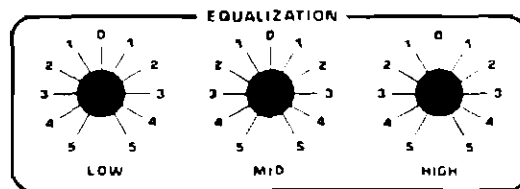
- If the filter RESONANCE is set so that the filter is in oscillation (i.e. generating a sine wave), then switching the KEYBOARD switch on will allow the frequency of this sine wave to be controlled from the keyboard. Unless a complex effect is desired when playing the filter's sine wave in this way, the envelope generator setting will normally be set at 0; the ENVELOPE AMOUNT knob should also be set at zero in this case (in order to maintain a steady response from voice to voice).

### 3-6 AMPLIFIER



The **ATTACK**, **DECAY**, **SUSTAIN**, and **RELEASE** controls in the amplifier section determine the settings for the amplifier's ADSR envelope generator. For details on the function of these knobs, see the "NOTES on the ENVELOPE GENERATOR" and the notes on the **ATTACK**, **DECAY**, **SUSTAIN**, and **RELEASE** knobs in paragraph 3-5.

### 3-7 EQUALIZATION

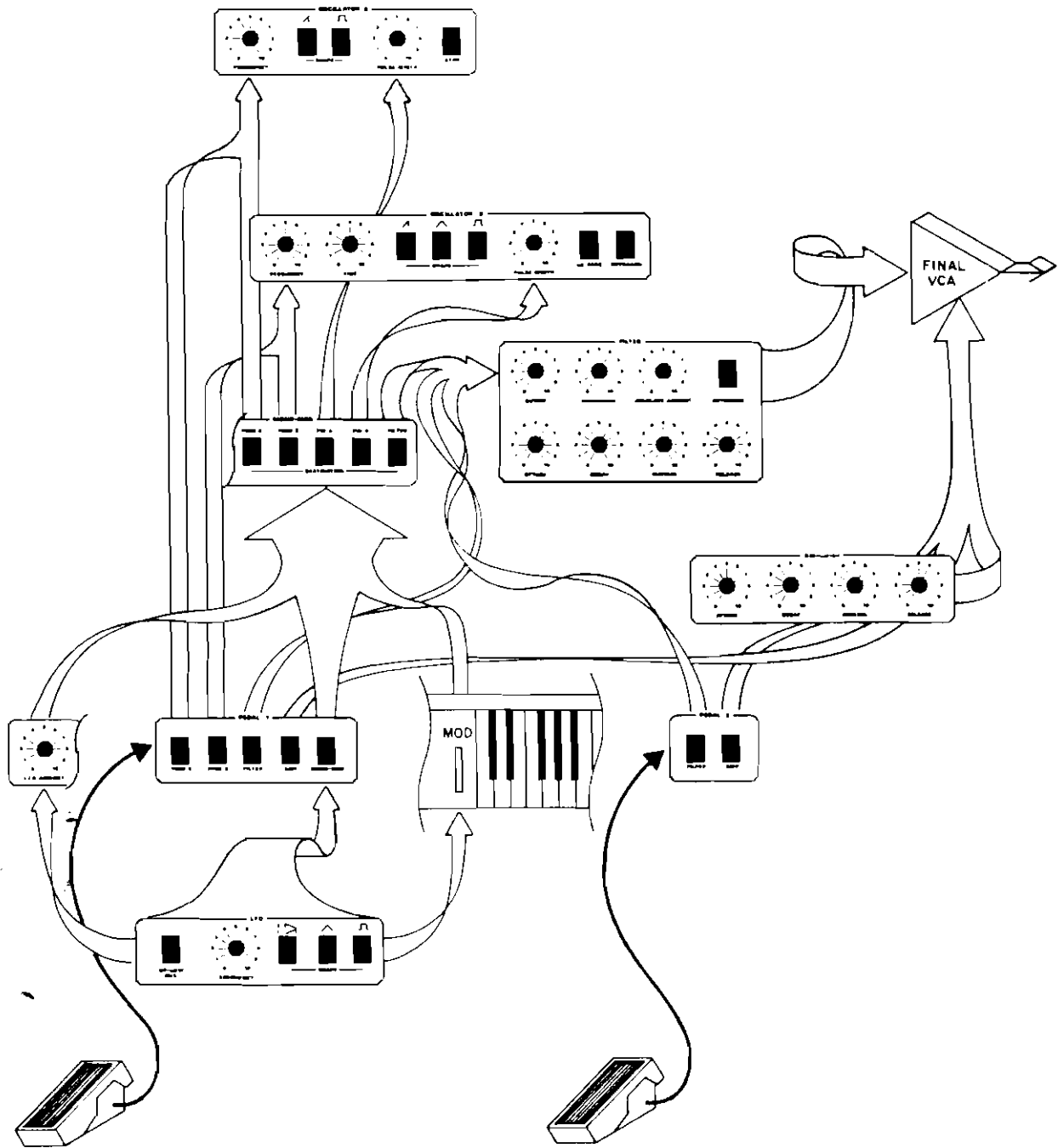


**LOW knob:** provides cut/boost facilities for lower frequency signals.

**MID knob:** provides cut/boost facilities for mid-range frequency signals.

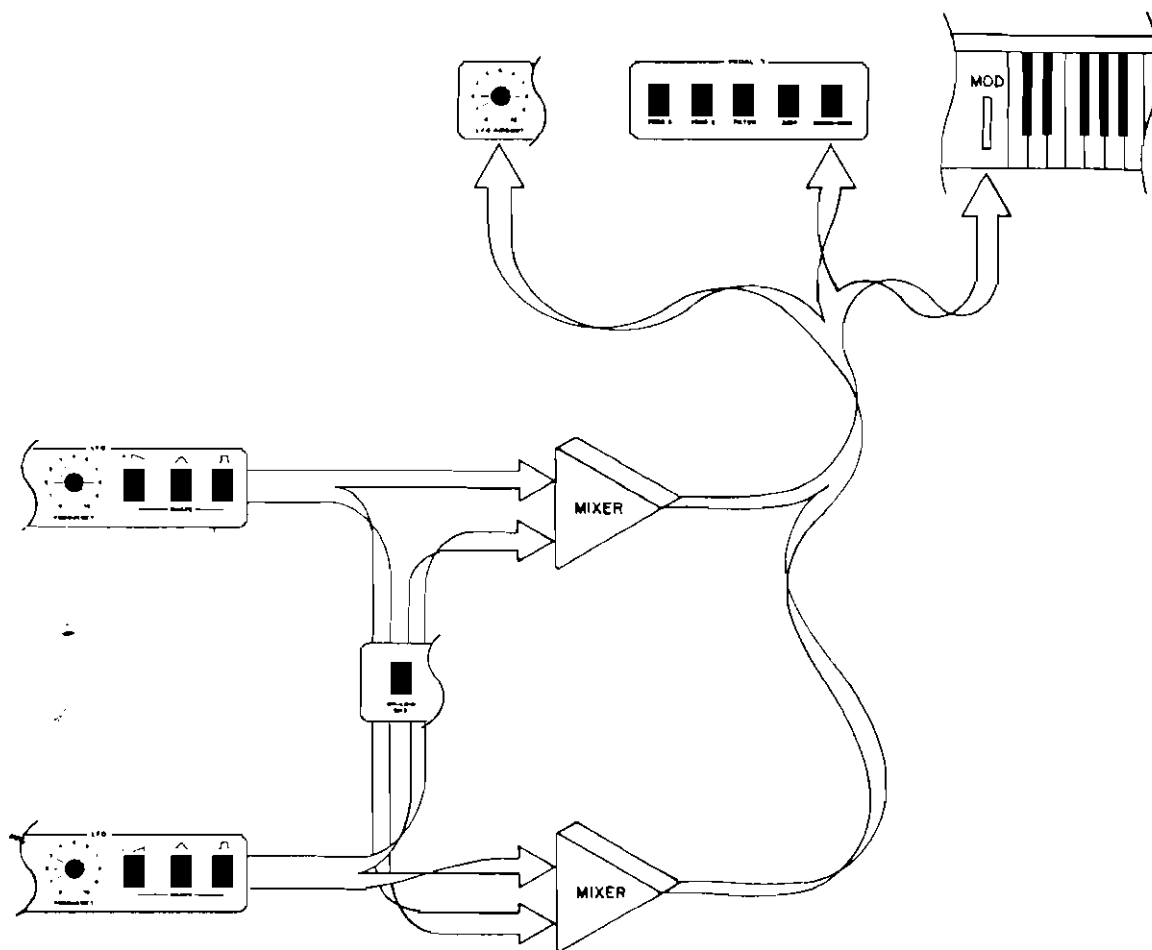
**HIGH knob:** provides cut/boost facilities for high frequency signals.

### 3-8 MODULATION

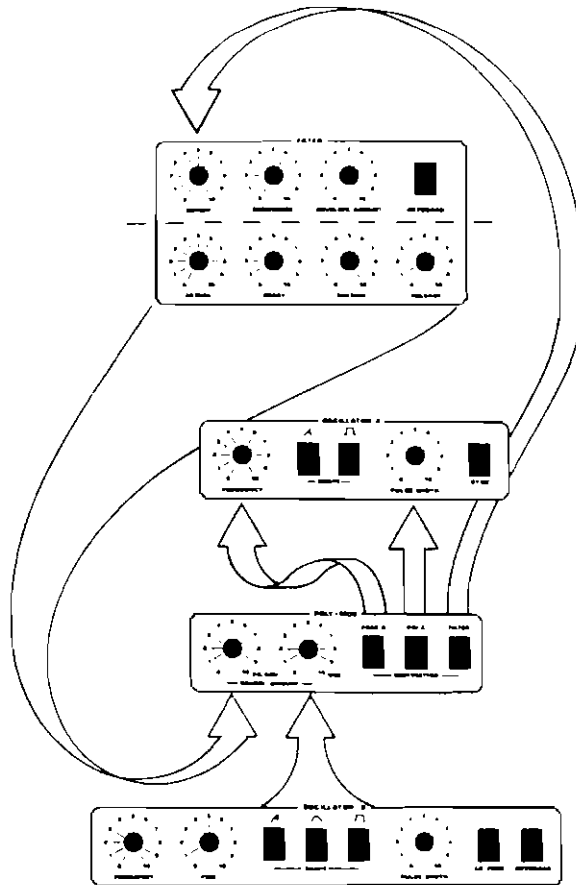


The Prophet provides two distinct modulation systems, MONOphonic-MOD and POLYphonic MOD. Modulation involves a source and a destination; the destination is modulated (changed) in a pattern determined by the source. The MONO-MOD system, diagrammed above, uses a low-frequency oscillator (LFO) with sawtooth, triangle, and square waves as source material. Note that the UPPER synthesizer bank provides a descending sawtooth wave as a modulation source, while the LOWER synthesizer bank has an ascending sawtooth wave. These modulation sources can be routed to the frequency and pulse-width of OSC A (FREQ A, PW A), the frequency and pulse-width of OSC B (FREQ B, PW B), the filter's cutoff frequency (FILTER), or any combination thereof.

The amount of modulation directed to these destinations is determined by the programmable LFO AMOUNT knob, the non-programmable MOD wheel, and PEDAL 1 (if it is programmed to control MONO-MOD). The amounts from these three sources are summed, determining the total amount of modulation. The FREQUENCY knob in the LFO section determines the LFO frequency (or rate), the overall range being approximately .04 Hz (or 25 seconds-per-cycle) to 20 Hz. The SHAPE switches determine the waveforms used as the LFO portion of the modulation source. (When more than one waveshape switch is on, the selected waveshapes are mixed at full level.)



The UP-LOW MIX switches allows the UPPER LFO and the LOWER LFO to be mixed (at full level) and applied to both the UPPER and LOWER program selected. This is useful for performing “double modulation” effects. If you wish to apply one LFO to both UPPER and LOWER, simply program one LFO as desired, program nothing on the other LFO (all shape switches off) and program UP-LOW MIX on. This is useful when synchronized modulation is desired on both UPPER and LOWER programs.



In the Prophet's unique POLY-MOD section, five LFOs (OSC B in LO FREQ mode) or five filter envelope generators—one from each of the five voices in either polyphonic synthesizer bank—can be used as modulation sources (see above). Although the modulation routing will be the same for each voice, the minute differences between the voices (the phase relationships of the oscillators, for instance) will create modulation effects that will be slightly different from voice to voice and from note to note. This is in direct contrast to the WHEEL-MOD section where, since a single modulation source is applied equally to all five voices, the modulation effect is exactly the same from note to note.

As said above, OSC B and the filter envelope generator are the possible sources for modulation in the POLY-MOD section. The amounts of each source are determined by the SOURCE AMOUNT knobs. The possible destinations are frequency of OSC A (FREQ A), pulse-width of OSC A (PW A), and the filter's cutoff frequency (FILTER). There will be no modulation via the POLY-MOD section if the SOURCE AMOUNT knobs are set at 0 or if all destination switches are off.

POLY-MOD with OSC B as source is useful for creating clangorous sounds such as bells, chimes, percussive sounds, and "ring modulation" type sounds. Various pitch and timbre sweeps may be obtained using the filter's envelope generator as source. The LO FREQ switch *on* and/or KEYBOARD switch *off* settings in the OSC B module are primarily for use when OSC B is used as a POLY-MOD source rather than a signal source.

In order to get an idea of some of the modulation possibilities offered by the POLY-MOD section of the Prophet, study its use in some of the factory preset programs.

### 3-9 MISCELLANEOUS

**RELEASE switch:** When off, the amplifier and filter release times are approximately 0 (instant release). (Actually, the release time is set at about 2 when the RELEASE switch is off, so there won't be an audible "whack" when the key is released — which would be caused by the instantaneous closing down of the VCA).

#### NOTES:

— This switch must be off to allow for the operation of the RELEASE footswitch (see SECTION 4 ACCESSORIES).

— Remember that this switch is separately programmable for UPPER and LOWER programs, even though only one setting is visible. This is important relative to the use of the RELEASE footswitch.

**DRONE switch:** When on, the amplifiers on all voices (within the programmed synthesizer bank) will stay on for continuous sound once they are engaged via the keyboard. If the SUSTAIN in the AMPLIFIER section is set to zero, you will not get a drone effect.

**UNISON switch:** When on, the Prophet will assign all five voices (within the programmed synthesizer bank) to the highest played note. In other words, in UNISON mode the Prophet becomes a very "fat" monophonic synthesizer.

**GLIDE knob:** Effective only in UNISON mode, this knob determines the rate of glide (portamento) between notes played on the keyboard.

#### NOTES:

— Remember that these controls are programmed separately for the UPPER and LOWER synthesizer banks. Only one program status will be visible, but both will be operative.

— In UNISON mode the synthesizer bank will function on a high-note priority system. This is useful for DOUBLE mode lead-line-plus-chord effects. (UPPER program in UNISON, LOWER program not in UNISON).

**TUNE knob:** For detuning one synthesizer bank relative to the other; will vary pitch continuously over a semitone range (up from the basic pitch setting of the oscillators). If no detuning is desired, the TUNE knob should always be set at 0.

**VOLUME knob:** For setting the overall level of programs relative to one another within one synthesizer bank. This will allow for equal volume levels from program to program within a given series of programs.

#### NOTES:

— If the MIXER, EQUALIZATION, and VOLUME knobs are all set at full level, the synthesizer may distort. There are many levels of volume control on the Prophet-10, and they should be used judiciously.



**PEDAL 1 & PEDAL 2:** These programmable switches allow for the routing of two external control voltages to various destinations. (The Prophet-10 is shipped with two pedals for this purpose, but other voltage sources may be used as well; see SECTION 4, ACCESSORIES.) PEDAL 1 may be routed to the FREQUENCY of OSC A (FREQ A), the FREQUENCY of OSC B (FREQ B), the CUTOFF frequency of the filter (FILTER), the VCAs (AMP), the MONO-MOD section, or any combination of the above. PEDAL 2 may be routed to the CUTOFF frequency of the filter (FILTER, the VCAs (AMP), or both. The amount of voltage applied to these sources will be determined by the position of the pedal (or by the output of any other control-voltage device used).

NOTES:

- Remember once again that the routings for these pedals can be different for the UPPER program and the LOWER program: the same pedal could have an entirely different function, depending on which keyboard manual you play (and on which keyboard mode you are on). Only one routing will be displayed, but both the UPPER and LOWER routing will be functional.
- If you do not plan to connect the pedals to the Prophet-10, it is best to program all of these switches off. *If the AMP switch is engaged for either pedal and no pedal is plugged in, the VCAs for that synthesizer bank will remain closed and no sound will come from the instrument.*

# SECTION 4

## ACCESSORIES AND THE BACK PANEL

### 4-0 INTRODUCTION

The Prophet-10 is shipped from the factory with two foot pedals and two foot switches, all of which can be connected to the instrument via the back panel to provide many different kinds of nuance control over the output of the synthesizer banks. Other interface capabilities are also provided, which may be used if desired to create even more external control.

### 4-1 CONTROL VOLTAGE IN — PEDALS 1 AND 2

The two voltage pedals shipped with the Prophet are connected to it via the two ¼" jacks labeled CV IN. The routings of these two pedals are determined by the programmable switches on the front panel labeled PEDAL 1 and PEDAL 2 (see SECTION 3, paragraph 3-9). These voltage pedals are the most common devices for use in this context, but various other devices (such as a ribbon controller, and x/y joystick controller, or a sample-and-hold module) will also provide for control of various interesting effects. All voices within a given synthesizer bank will be affected equally by the input voltages. Note that these inputs are *not* calibrated at 1 v/octave.

### 4-2 FOOTSWITCHES

The ¼" jack labeled RELEASE allows for footswitch control of the release portion of the filter and amplifier envelope generators. It functions in much the same manner as the RELEASE switch on the front panel, and is only operative when the RELEASE switch is off. It then takes the place of the RELEASE switch: when pushed, the programmed amplifier release time is engaged; when not pushed, the programmed amplifier release time is not engaged. In that respect, it is similar to a piano sustain pedal. The footswitch for use in this context comes standard with every Prophet-10.

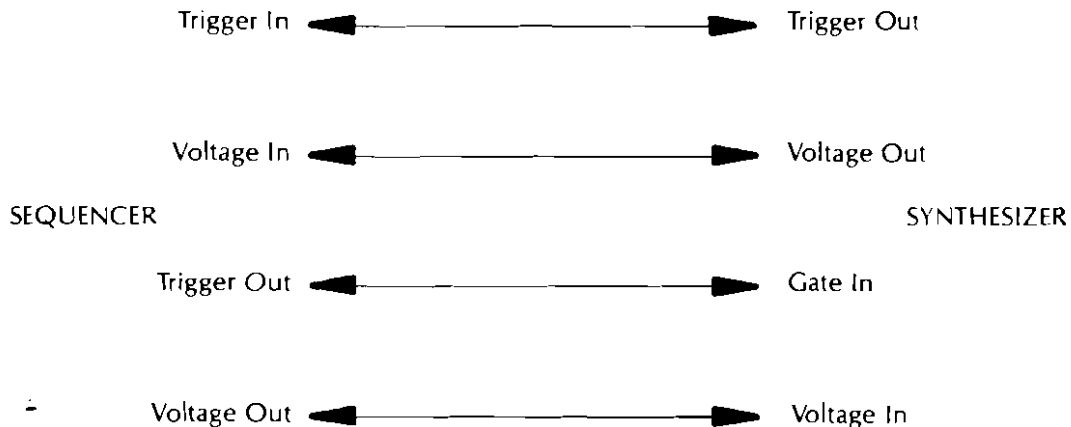
The ¼" jack labeled PROGRAM INCREMENT can be used to step through the programs in a particular program bank (both UPPER and LOWER) while both hands are engaged in other performance activities. Each time the footswitch is depressed, both the UPPER and LOWER programs will increment one position. This will most often be used to increment from one set of conceptually-linked programs to another (e.g., U-1-1 and L-1-1 would increment to U-1-2 and L-1-2), but the increment switch will work on both program banks regardless of their relative position (e.g., U-1-3 and L-2-4 would increment to U-1-4 and L-2-5). If the currently selected program is an 8, the increment footswitch will cycle back to 1 (U-1-8 would increment to U-1-1). The increment footswitch will never change banks; it will only cycle through the eight programs of the selected bank (for both UPPER and LOWER programs). The footswitch for use in this context comes standard with every Prophet-10.

The ¼" jack labeled SEQUENCER is for use in connection with the optional POLYPHONIC SEQUENCER. It serves the same function as the STOP/CONTINUE switch on the sequencer's front panel. Its function will be described in SECTION 5 POLYPHONIC SEQUENCER.

### 4-3 MONOPHONIC SEQUENCER INTERFACE

The four ¼" jacks in the SEQUENCER section of the back panel (VOLTAGE IN, GATE IN, VOLTAGE OUT, GATE OUT) are provided to allow for the interfacing of a Sequential Circuits Model 800 digital sequencer to the Prophet-10. The Prophet, when connected to a Model 800, devotes voice 5 of the UPPER synthesizer bank to the sequencer; the other four voices of the UPPER synthesizer can be played "live" while the sequencer is controlling voice 5. *NOTE: When a Model 800 is connected to a Prophet-10 and is therefore controlling voice 5, the corresponding voice on the LOWER synthesizer, voice 10, will be disabled.* Even if the keyboard is in DOUBLE mode, the sequencer will only play voice 5 — voice 10 will be disabled whenever the Model 800 is connected to the Prophet-10.

The diagram below shows how the Model 800 should be connected to the Prophet-10. The Model 800 TRIGGER IN and VOLTAGE IN switches should be in the up (1) position; the TRIGGER OUT switch should be in the center (2) position. When recording a sequence, the Prophet-10 will send each note played to the sequencer, together with a trigger; when playing back a sequence, the Prophet will route all input control voltages and gates to the same voice (voice 5).



These four jacks can also be used for other functions: the OUT jacks can be used to control other synthesizers (most common 1-volt-per-octave synthesizers), while the IN jacks can be used to apply other controllers (such as analog sequencers, sample-and-hold units, guitar synthesizer pitch followers, etc.) to voice 5 of the Prophet. However, since VOLTAGE IN is "digitized" by the microcomputer to maintain tuning with the other voices, the external controller will not be able to "glide." Also, the voltage will only be converted on a new gate edge. Both VOLTAGE jacks are exactly 1-volt-per-octave. The GATE OUT is a +15 volt gate, and GATE IN can be any signal which switches through at least 3.5 volts.

**NOTE:** Any time a plug is inserted into the GATE IN jack on the Prophet-10, the computer disconnects voice 5 and voice 10 from the keyboards; the instrument becomes essentially two 4-voice synthesizers, with voice 5 reserved for the external input (if any) and voice 10 disabled. The monophonic sequencer interface cannot operate if voice 5 or voice 10 has been disabled (see paragraph 1-7).

# POLYPHONIC SEQUENCER OPERATION MANUAL

## SUB-SECTION 1

### BASIC OPERATION

#### 1-0 INTRODUCTION

The Model 1015 Polyphonic Sequencer within the Prophet-10 uses the storage capabilities of a second microcomputer system to allow you to directly record and edit your own instrumentals. It allows ten-voice polyphony, a 2600-note capacity, wide range of playback speed and of transposition, "multi-track" editing, operation in either Real-Time or Single-Step modes, recordable synthesizer program selections, and permanent storage of sequences and synthesizer programs on digital cassettes.

You probably already know that when you play the Prophet-10, you are actually providing "data" to a microcomputer which in turn controls the synthesizer voices. The basic idea of real-time sequencing is fairly simple. Basically, the Sequencer contains a clock, microprocessor, and memory. The clock generates 50 to 500 pulses per second (Hz) as adjusted by the SPEED knob. To record, every time a clock pulse occurs the microprocessor obtains from the Prophet-10 data signifying what keys are being held on the Lower keyboard. By comparing each keyboard "sample," the microprocessor discovers what keys are going on and off. It records in memory the number of the clock pulse (or, step) at which each event (a note going on, or off, or a program change) occurs. For playback, the microprocessor counts elapsed clock pulses and brings each event out of memory as the clock count matches the sequence step numbers. The microprocessor converts each event from memory into the same type of keyboard sample data which it received and sends it back to the Prophet. The Prophet's computer interprets this data just as if it were the original "live" data from its own Lower keyboard.

The Polyphonic Sequencer, then, substitutes for the lower keyboard which is in turn programmed by the Prophet-10's KEYBOARD MODE controls. If keyboard mode is NORMAL, the Sequencer will drive only the Lower five voices programmed by the current Lower program. The Upper manual can then be used "live." If the mode is SINGLE (and the Upper and Lower programs are identical), the Sequencer will be able to play up to ten notes at once. If in DOUBLE mode, the Sequencer will simultaneously drive both the Upper and Lower voices to the five-voice limit. In ALTERNATE mode, the Sequencer will alternately assign up to ten notes at once to the Upper and Lower voices.

Unlike the Prophet, the Sequencer memory does not save its contents when power is turned off. The digital cassette deck is used for permanently saving the data in the Sequencer memory and for loading the memory with sequences when power is turned on. It takes less than a minute to load a sequence cassette, during which time the Prophet can be played normally.

This section contains instructions for basic operation. You can play the demonstration sequences by following para. 1-1. The remainder of the section explains basic Real-Time recording, playback, and editing. Read also Sub-Section 2, which discusses use of the digital cassette deck.

The Sequencer has two main modes of operation: Real-Time and Single-Step. Activities such as recording, playback, and editing are performed within one of these modes. In Real-Time Mode the Sequencer records as you play on the lower keyboard. The internal clock automatically supplies the reference timing pulses. In Single-Step Mode, keys are held for as long as it takes to manually "clock-in" the desired number of timing pulses. If your interest is orchestration, you will find Single-Step Mode most useful. But Real-Time operation should first be mastered, since Single-Step Mode calls for patience and practice using the more extensive control functions. These are explained in Sub-Section 3, which details all modes of operation, and Sub-Section 4, which gives practical suggestions for creating sequences in Single-Step Mode.

The Sequencer's power input is controlled by the Prophet's back-panel power switch. While the Prophet is in TUNE Mode the Sequencer TRANSPOSE light-emitting diode (LED) blinks. When tuning is completed, only the STOP/CONTINUE LED lights, indicating the Sequencer's Idle Mode.

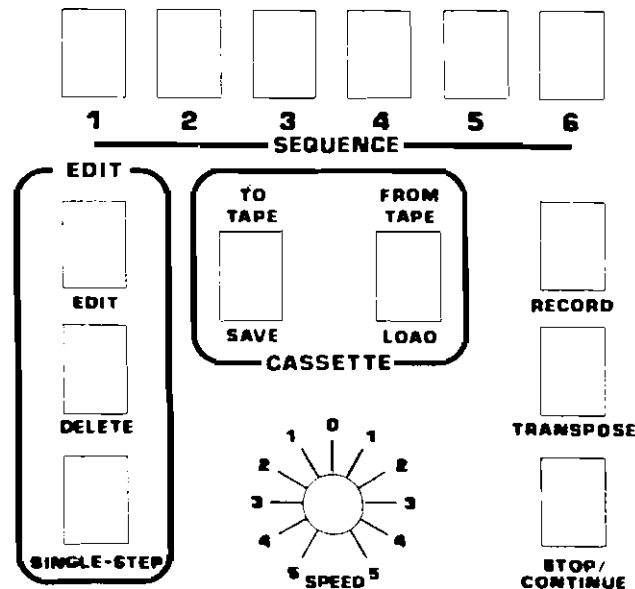


Figure 1-0  
SEQUENCER CONTROL PANEL

You can play the demonstration sequences as explained in the following paragraph or see para. 1-2 to begin recording and playing back your own sequences. Remember that unlike the Prophet, the Sequencer memory does not endure while power is off. Therefore it is a good idea to store your sequences often by saving to tape (see Sub-Section 2).

## 1-1 Playing The Demonstration Sequences

In addition to the blank data cassettes provided with the Sequencer we have included a (write-protected) cassette prerecorded with demonstration sequences created by Tom Darter.

Before proceeding, you should be aware that whenever you load from tape, the Prophet's current programs will be replaced by those on the sequence cassette if the Prophet's back-panel RECORD switch is set to ENABLE. In the case of the demonstration cassette, the loaded programs are the original "factory programs."

1. Enable the Prophet's back-panel RECORD switch. (If you do not enable RECORD, the demonstration sequences will play with your programs--and who knows what that will sound like?)
2. Open the cassette deck door by pressing the eject button.
3. The magnetic head is located in the bottom of the door itself. Choose the "A" cassette side (up) and orient cassette so exposed tape faces down. Slide the cassette into the slot in the door, and push the door closed.
4. Assuming the Sequencer is in Idle Mode (that is, only the STOP LED is lit), press the RECORD switch. It will blink.
5. Press the LOAD FROM TAPE switch. It lights. The deck automatically rewinds the tape, then switches itself forward. The tape loading process takes about 55 seconds. When done, the Sequencer returns to Idle Mode.
6. Check that the SPEED knob is pulled up and set to 0.
7. Press SEQUENCE 1 (S1) switch. The first sequence, Bach Two-Part Invention No. 8 will start. Adjust SPEED if necessary. The sequence will play through once, then continue to "loop." This sequence has no Prophet-10 program changes recorded in it, so you can select any program during playback. If you want to let the sequence play to the end and stop, just press SEQUENCE 1. To stop the sequence immediately, press SEQUENCE 1, then STOP. Practice starting and stopping the sequence these two ways.
8. Press SEQUENCE 2. (Increase SPEED slightly.) This position contains eight Single-Step sequences each of which uses different Prophet programs. Note the automatic program changes. Techniques of sequencing the Mozart 40th Symphony opening (program 1-2) and the Bach Partita No. 1 (program 1-6) are discussed in Sub-Section 4.
9. Push the SPEED knob down and adjust to "0." Play SEQUENCE 3. This position contains several Real-Time sequence ideas.
10. Remove the demonstration cassette when done. Use a new cassette for storing your sequences.

## RECORD

<u>Enter Interlock</u>	RECORD		
<u>Erase</u>	SEQa	STOP	
<u>Record</u>	SEQa	Play	
<u>S-S Record</u>	SEQa	S-S	Play/S-S
<u>To Idle</u>	RECORD		
<u>To Playback</u>	CONTINUE		

## PLAYBACK

<u>Start loop</u>	SEQa		
<u>Pause/Resume</u>	STOP	CONTINUE	
<u>Transpose On/Off</u>	TRANSPOSE	TRANSPOSE	
<u>Enter Interlock</u>	RECORD		
<u>Truncate</u>	STOP		
<u>Append</u>	SEQc		
<u>Real-Time Edit</u>	EDIT	Add voices	
<u>S-S Edit</u>	STOP	S-S/Add voices	CONTINUE
<u>S-S Event Delete</u>	STOP(Hold)	S-S/DELETE events	CONTINUE
<u>Exit Edit</u>	EDIT		
<u>Stop at End</u>	SEQc		
<u>Stop Now</u>	SEQc	STOP	
<u>New Sequence</u>	SEQn		

SEQa=Any sequence  
 SEQc=Current sequence  
 SEQn=Not current sequence

**Figure I-1**  
**Quick Command Guide**

## 1-2 REAL-TIME USE

These brief instructions are intended just to get you started using the Sequencer in Real-Time Mode. Please refer to Figure 1-1 as required.

1. Check that the SPEED knob is pushed down and set to 0. (Pulling the SPEED knob up selects the low-speed clock range, which is only used for Single-Step sequences.)
2. Press RECORD, then the SEQUENCE number, and start playing on the Lower keyboard. Nothing is recorded until you start to play.
3. When done playing (30 seconds or so should do at first), press the CONTINUE switch in time with the desired ending and the sequence will play back from the beginning.
4. If your sequence was a bass line, for example, you can now "overdub" harmonizing voices as the sequence loops by pressing RECORD, then EDIT. Play against what you have previously recorded. You'll hear the additional voices during the next sequence loop.
5. When done editing, press EDIT. This returns you to normal Playback Mode.
6. To stop the sequence immediately, press the current SEQUENCE switch, then STOP. If you want to let the sequence play to the end and stop, just press the current SEQUENCE switch.

## 1-3 PITCH and MOD Wheel Disconnect

When playing-along with the Sequencer, it is necessary to be able to pitch-bend or modulate the solo line without doing the same thing to the accompanying, sequenced voices. Therefore the wheels can be disconnected from the Lower manual. To disconnect, hold the TRANSPOSE LOWER DOWN switch, while pressing the UP switch once. To reconnect the wheels, repeat this action.

## 1-4 Footswitch

The included footswitch can be connected via the ¼-inch phone jack on the Prophet's back panel. In Real-Time Mode the footswitch functions the same as the STOP/CONTINUE switch. In Single-Step Mode, the footswitch functions as the SINGLE-STEP switch, leaving the hands free to play.

## 1-5 Overflow

If more than about 2600 total notes are recorded between the six sequences, all of the LEDs will blink, indicating that you have reached the Sequencer's memory capacity. Take the Sequencer out of Record Mode by pressing the STOP or RECORD switch. If in Edit Mode, press the EDIT switch to exit. Up to the point of overflow, all of the information stored in the memory will be saved. You can create more space by removing notes through Single-Step Event Delete Mode (para. 3-12), or by using Truncate Mode (see para. 3-8) to delete the ending of any sequence in that group, or by completely erasing a sequence (see para. 3-3). You won't be able to record any additional notes without using one of these operations to create more space.



In rare instances it is possible that an overflow indication will result from attempting to insert too many events at once during Edit Mode, even though the memory is not filled to capacity. If you have been editing-in rapid passages, and an overflow indication occurs, while you are sure you have not recorded more than 2600 notes, you may restore normal operation by simply going out of EDIT, then back into EDIT (see para. 3-10).

## 1-6 External Clock

An external clock source can be connected to the Sequencer through the phone jack on the front panel. When using an external clock source, you will obviously have to control the clock speed at the external source--the SPEED knob on the Sequencer panel will not function. Do not use an external clock speed greater than 400 - 500 pulses per second, since the Sequencer may lose its mind if you clock it too fast.

In complex installations with many audio and clock cables, hum or digital noise is sometimes produced by a ground-loop between the EXT CLOCK input and other instruments. This can usually be fixed by modifying the external clock cable. Detach the shield from the ground connection on the plug only at one end of the cable.

## 1-7 GATE/CV OUT

If the Prophet is placed in DOUBLE mode, the Polyphonic Sequencer drives the Prophet-10 GATE/CV OUT (as would the Lower keyboard, normally).

## 1-8 Trouble?

The Polyphonic Sequencer is a sophisticated instrument which may take a little getting used to. Before you conclude that it is malfunctioning please examine all relevant parts of this manual to be sure you aren't making an operational error.

Always make switch operations with a specific goal in mind. If you press switches randomly you will eventually destroy the sequence in progress. In addition to making sure you are pressing the correct switch for the operation you are planning, try to make all switch actions clean and deliberate. Neither hit the switches too hard nor too slowly. Otherwise, you could cause the switch contacts to bounce, effectively making two switch actions, which could have an undesired result.

During playback and/or editing of extremely complex sequences, switches on the Prophet-10 or the Sequencer may not work instantaneously. Simply hold the switch until it takes effect, or turn down the clock speed. If the Sequencer has seemingly stopped in Playback or Edit Mode, press the current sequence switch, which will start the sequence again from the beginning in Playback Mode.

Although the Sequencer's software has been highly refined and tested, there remains a slight possibility that the Sequencer program will "hang-up"--not respond to commands--under unusual conditions. To restore normal operation it will be necessary to reset by switching power off then back on. Unfortunately, any sequences in memory will be lost (this is a good reason to save to tape often). If malfunctions occur repeatedly, under specific conditions, please contact our Service Department with a full description of the problem.

# POLYPHONIC SEQUENCER OPERATION MANUAL

## SUB-SECTION 2

### TAPE OPERATION

#### 2-0 INTRODUCTION

The Sequencer's cassette deck allows you to store sequences and Prophet programs on compact, digital cassettes. Each cassette side stores one set of six sequences and one complete file of 64 programs.

#### 2-1 PRECAUTIONS

The Prophet-10 may be played normally while a SAVE TO TAPE or LOAD FROM TAPE routine is in progress, but in either case its TUNE switch is automatically disabled.

Be careful with cassettes. Do not touch the tape itself (with your oily fingers). Don't leave them in direct sunlight or freeze them overnight in a car.

Make sure there is no tape sticking out of the cassette when inserting into machine.

Protect cassettes from the (slight) possibility of magnetic transients by removing them from the deck when switching power on and off.

To prevent the Sequencer from loading new programs into the Prophet, switch the back-panel RECORD switch to DISABLE.

Save sequences and/or programs to tape as soon as they are complete. After the Sequencer has verified that the information on the cassette is correct, protect the material from accidental erasure by removing the tab over the hole in the side opposite the one you are protecting (see Figure 2-0).

If you are working on a complex sequence, make cassettes of work in progress. It is best to use two different backup cassettes, alternately saving to one, then the other. This protects you from mechanical failures.

Back-up important cassettes by making a duplicate and storing it in a safe place. Duplicates can be created by LOADING the original, then SAVING to the backup.

The Sequencer always records everything that is currently in its memory (including null sequences) onto the cassette. For example, if you have completed a sequence 1 and have saved it, be sure the memory contains this sequence 1 before trying to save a sequence 2. This means that if power has been interrupted, you should reload the memory from the cassette. Otherwise, if you just turn the Sequencer on, record sequence 2, then save it on a previously-recorded cassette, you'll erase sequence 1 from the cassette by saving a null sequence over it.

Like any other tape recorder, the head should be cleaned periodically. This will help insure against errors and losses. Any standard head cleaning kit can be used.

If for some reason the Sequencer "hangs up" completely and refuses to respond, you must reset by switching power off then back on. The Sequencer should then work normally. Remember to make cassettes of sequences-in-progress, so that resetting won't cause you to lose valuable time, labor, and nearly-completed sequences.

## 2-2 SAVE TO TAPE

This routine normally takes 1 minute 55 seconds. It always stores the Prophet's current programs.

1. Check that the Sequencer is in Idle Mode.
2. Insert the cassette with the side to be recorded up.
3. Press the RECORD switch. It blinks.
4. Press the SAVE TO TAPE switch. If the cassette has been write-protected, the Sequencer will return to Idle Mode. Otherwise, the SAVE LED will light. The routine starts by rewinding the cassette, if necessary. After writing data onto the tape, the Sequencer verifies the recording by rewinding the tape, then reading it in comparison with the actual memory contents. During this period, the LOAD FROM TAPE LED will light. You can abort the save routine during rewind by pressing STOP. If rewind is done and writing or verification has started (as indicated by forward tape movement), the routine can only be aborted by resetting.
5. If the recording verifies, the LOAD FROM TAPE LED will go out and the Sequencer will enter Idle Mode. The sequences and programs have been recorded, and the cassette may be removed. You may want to write-protect the cassette from accidental erasure by opening the slot opposite of the side to be protected (see Figure 2-0). Write protection can later be reversed by taping over the slot.

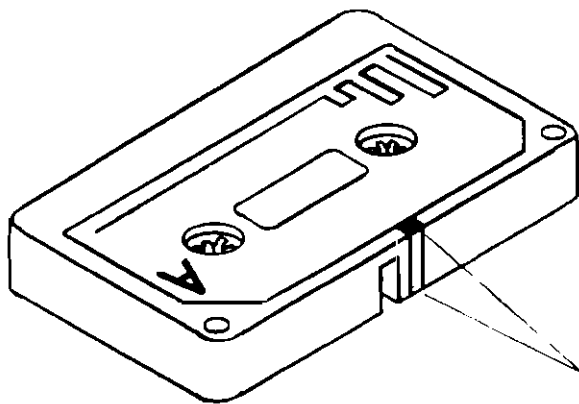


Figure 2-0  
WRITE PROTECT

TO WRITE PROTECT SIDE A,  
REMOVE TAB ON SIDE B.

TO WRITE PROTECT SIDE B,  
REMOVE TAB ON SIDE A.

WRITE  
PROTECT  
TABS

—Error Detection—

6. If the SAVE TO TAPE LED instead blinks, an error has occurred. There is a slight possibility that a tape can record adequately, yet occasionally fail the verification test. To recheck verification, press LOAD FROM TAPE.
7. If the tape again fails the verification test, repeat the SAVE operation, from step 4.
8. If step 7 fails, press STOP to return to Idle Mode, and try from step 2 again, using a new cassette.

### 2-3 LOAD FROM TAPE

This routine normally takes 55 seconds.

1. Check that the Prophet's back panel RECORD switch is ENABLED to load programs from this cassette, or DISABLED, to retain the current programs.
2. Check that the Sequencer is in Idle Mode.
3. Insert cassette with side to be loaded up.
4. Press RECORD. It blinks.
5. Press LOAD FROM TAPE. It lights. The routine starts by rewinding the cassette if necessary. If you accidentally press LOAD FROM TAPE without having inserted a cassette, the Sequencer will go to Idle Mode. If you realize that this tape is blank, you can abort the load routine while it is rewinding by pressing STOP. If rewind is done and loading has started (as indicated by forward tape movement), the routine can only be aborted by resetting.
6. If the tape loads correctly, the LOAD FROM TAPE LED will go out and the Sequencer will enter Idle Mode. The sequences and program information have been loaded, and the cassette may be removed. If new Prophet programs have been loaded, the current program will not be changed until you hit its PROGRAM SELECT switch.

—Error Detection—

7. If the LOAD FROM TAPE LED instead blinks, an error has occurred. There is a slight possibility that a tape can read erroneously one time, then read correctly the next time. To check this possibility, press LOAD FROM TAPE.
8. If the tape again fails to load, nothing can be done. Perhaps the cassette has been damaged. Press STOP to return to Idle Mode.
9. Try another cassette, from step 3. If all of a sudden none of your cassettes will load, this is of course a malfunction.
10. If the EDIT and LOAD FROM TAPE or the SAVE TO TAPE LEDS blink, the tape is blank. To clear this indication and proceed, press STOP.

# POLYPHONIC SEQUENCER OPERATION MANUAL

## SUB-SECTION 3

### MODES OF OPERATION

#### 3-0 INTRODUCTION

This section completely describes all operations available on the Sequencer. These are graphically summarized in Figure 1-1.

#### 3-1 Power-On

Whenever the Prophet is in TUNE Mode the TRANSPOSE LED will blink. Once the Prophet "comes up," the Sequencer enters Idle Mode.

#### 3-2 IDLE MODE

Idle Mode is indicated when only the STOP/CONTINUE LED is on. Idle Mode is the "standby" condition of the Sequencer. The Record or Playback Modes are entered from Idle Mode as described below. When done recording or playing-back, you'll return to Idle Mode.

From Idle Mode, to record or erase a sequence, first press the RECORD switch which then blinks, indicating Record Interlock. This is a safety stage preventing the accidental erasure or other modification of a sequence. If you want to return to Idle Mode at this point without having affected any sequence, press the RECORD switch. Otherwise, you'll select the desired SEQUENCE switch, which will light. Instead of blinking, the RECORD LED will light, indicating Record Mode.

Besides recording, the other thing to do from Idle Mode is to playback or edit a sequence. Press the desired SEQUENCE switch. The SEQUENCE LED will light, the STOP LED will go off, and Playback Mode will be entered with the sequence playing from its beginning.

A null sequence is one without notes, in other words, an empty SEQUENCE position. If a null sequence is selected for playback, the Sequencer returns to Idle Mode.

#### 3-3 RECORD MODE

Before playback and editing, let's cover the specific ways sequences get recorded in the first place. Recall that Record Mode is entered from Idle Mode by pressing RECORD, then the desired SEQUENCE switch. The Sequencer is now ready to record whatever you play in real-time.

If a sequence has already been recorded in this position and you now start to play, the new material will be recorded over the original sequence. So you don't have to erase sequences before recording. The only reason you might need to erase a sequence would be to create more room (after an OVERFLOW). To erase a sequence, press RECORD

and the SEQUENCE switch to enter Record Mode, then press either STOP or RECORD. This records a null sequence and returns you to Idle Mode.

You now must decide whether you want to record in Real-Time or Single-Step Modes. Let's first assume that you'll be recording in Real-Time. Check that the SPEED knob is pushed down and centered at "0" on the dial. This position of the clock knob switches it to operate from about 50-500 Hz. In other words, if set in the middle, the Sequencer will be clocked about 250 times each second. Sampling the Prophet's lower keyboard at this rate gives much better timing accuracy than if, for example, the keyboard were being sampled only 10 times each second, because you have 250 opportunities each second to turn a note on or off, as opposed to 10 of these opportunities.

### 3-4 Initializing Synthesizer Programs

The Sequencer does not begin to Real-Time record until you actually start playing on the lower keyboard. This allows you to decide whether you want this sequence to always start playing with specific Prophet programs. This will very often be the case. However, once you initialize a Real-Time sequence with a specific program, it becomes rather difficult to later change the initial program number(s). The Prophet will always jump to the initial program(s) as the sequence loops through its beginning (without interrupting the sequence timing). Therefore since program changes can always be edited-in later (see para. 3-10), it is probably better to leave a sequence uninitialized when first recording in Real-Time Mode. This allows you to hear it played-back in various programs.

If you do want to initialize a sequence with programs, first select the desired Upper and Lower BANKS if they are not current, then press the appropriate PROGRAM SELECTs, whether they are current or not.

### 3-5 Real-Time Recording

Since Real-Time recording only begins the instant you start playing, you can't record rests before the first note. (This can be done in Single-Step Record Mode, however. See para. 3-6.) So now you play away. One thing you'll want to watch out for is to never play more than five keys at a time in Normal or Double Modes nor more than ten keys at a time in Single or Alternate Modes. If you do, the Sequencer will record all six or seven or twelve (or up to 64) keys, but the Prophet may not be able to play them all back. In playback, whenever over five or ten notes appear (again, depending on the Keyboard Mode), some notes will be prematurely turned off. And this "voice stealing" is not easily predictable.

There is a further consideration. This Sequencer is fundamentally identical to the Model 1005 Polyphonic Sequencer for the Prophet-5. Therefore sequences created on the Prophet-10 can be played on the Prophet-5. Because of the difference in program storage and keyboard operation, programs or recorded program selections cannot be compatible between the two instruments. However, the fundamental note timing is compatible, so if you anticipate using Prophet-10 sequences with a Prophet-5, you'll want to limit these sequences to five simultaneous voices. You will probably want to also not record program changes in these sequences until you have created a cassette which contains both the Prophet-10 sequences and the appropriate Prophet-5 programs.

If you want to record a program change while playing, just select the desired BANK and PROGRAM. Program changes should be planned with the envelope settings in mind. Let

the last notes of the previous program release completely before switching programs, or there may be an audible pop as the Prophet is reprogrammed.

If you plan to change the playback speed of the sequence, keep in mind that the envelope times are completely independent of playback speed. For example, if you sequence a string program with long attack and release times and then significantly accelerate it during playback, you'll probably just hear mush because the envelopes aren't given a chance to develop before they're retriggered.

If no other sequences are recorded, you can record up to about 2600 notes in the current sequence. (The exact method of calculating note capacity is discussed in para. 3-12.) Paragraph 1-5 discussed the OVERFLOW condition which will result if you exceed the 2600-note capacity between all the sequences. For example, if sequences 1 through 5 use a total of 2500 notes, you will be limited to about 100 notes while recording in sequence 6. If OVERFLOW does occur, all sequences in memory up to the point of the overflow will remain intact.

When you've finished recording, press RECORD to go to Idle Mode. Or if you wish immediate playback, press CONTINUE. Since recording does not conclude until you press one of these switches, try to switch on the exact beat you want the sequence to end. On the other hand it is very easy to trim-up the ending of a Real-Time sequence through a Truncate operation (see para. 3-8). It is also possible to extend a Real-Time sequence using Append (see para. 3-9) but this is somewhat more tricky.

### 3-6 Single-Step Recording

Now consider Single-Step recording. This mode is very similar to Real-Time recording, the main exception being that instead of using the automatic clock, timing is referenced to pulses which you supply through the SINGLE-STEP switch or footswitch. Since the overall number of clock pulses of a Single-Step sequence is a fraction of what there would be if the same sequence were Real-Time recorded, the playback clock speed will be much slower. In preparation, pull the SPEED knob up. This selects a clock range from 1/4 Hz to over 50 Hz. When you turn the SPEED knob to the left of 0, the STOP LED blinks at the clock rate. (If the SPEED is too fast, the STOP LED will appear to be off.) Press SINGLE-STEP to actually put you in Single-Step Record Mode. Rather than blink, the STOP LED stays lit, indicating that the automatic clock has been disabled.

To initialize the Single-Step sequence with programs, switch banks if necessary. Then press the desired Upper PROGRAM SELECT and press SINGLE-STEP once, then press the desired Lower PROGRAM SELECT and press SINGLE-STEP once. This records the program information but does not affect the timing of the sequence.

Normally, a PROGRAM SELECT has not been pressed, and the Sequencer records each SINGLE-STEP switch depression as a timing pulse. For visual feedback, the STOP LED will blink in concert with the SINGLE-STEP timing pulses. Any keys that are held on the lower keyboard when you press the SINGLE-STEP switch will be recorded as being on during that timing pulse. When a key that was held for at least one step is subsequently released, the Sequencer records a GATE OFF for that note on the next step. This allows you to control the precise beginning (GATE ON), duration, and ending (GATE OFF) of all notes. If no keys are held, a rest is recorded for that step. (This makes it possible to record rests at the beginning of a sequence.)

Actual use can be illustrated with a few examples. Consider this simple melody:



Figure 3-0

You must first find the shortest rhythmic value in the music. It is strongly recommended that you use a minimum of 2 clock steps for this shortest note. In this case, then, the sixteenth-note is assigned 2 steps, eighth-notes are 4 steps, and quarter-notes will use 8 steps.



Figure 3-1

Since this is not Real-Time recording, you do not have to play the melody in correct rhythm. You just have to make sure that each key is held down before the SINGLE-STEP switch or footswitch is pressed. Figure 3-2 shows the way to record the melody shown above. The duration of the notes is shown graphically in relation to the strokes of the SINGLE-STEP switch.

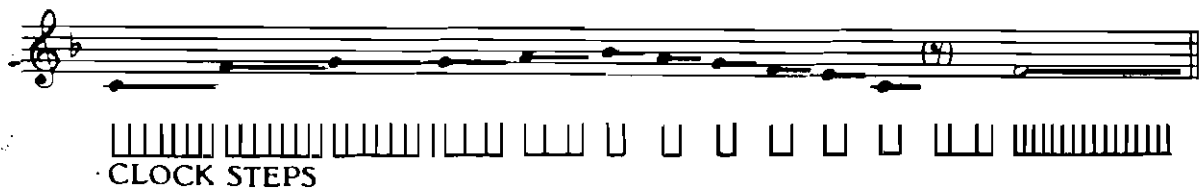


Figure 3-2



The matter of how many clock pulses or steps to assign to notes in a Single-Step sequence requires thoughtful consideration of the specific music to be sequenced. This is discussed in more detail in Sub-Section 4 on Single-Step Applications. However, there are two principles to be kept in mind at all times. First, notice in this example that the quarter-note G in the third bar was given only 7 clock steps, followed by 1 step with no keys pressed. This is because the next note in the melody is also a G. If the quarter-note G were recorded for 8 clock steps, and then followed by the 4 clock steps of the G eighth-note, there would be no GATE OFF recorded for the first G, and therefore no new attack for the second G. In other words, whenever a note is repeated, it must first be turned off for at least 1 step so that it will be triggered when it goes on again. Otherwise, the note will sound held, rather than repeated.

The second principle to be remembered arises from the fact that on the very last recorded step of a sequence, the Sequencer records a GATE OFF for all notes. (Otherwise they could drone into the first notes of the next loop.) So if the last note of a sequence is only recorded for one step, it will not be heard at all during playback. To be heard, the last note must be recorded with a minimum of 2 steps. Therefore if the last note of the sequence also happens to have the shortest rhythmic value, you will have to use a minimum of 2 steps per note.

While Single-Step recording, you can record program selections in the same way as for initialization. That is, select the BANK, press the desired PROGRAM SELECT switch and press SINGLE-STEP once. Whenever the program changes, the Sequencer records the change without advancing to a new step.

Single-Step recording is concluded in the same way as Real-Time recording. To go to Idle Mode, press RECORD. If you wish immediate playback, press CONTINUE.

### 3-7 PLAYBACK MODE

Playback Mode is entered from Idle by pressing the desired SEQUENCE switch, or from Record Mode by pressing CONTINUE. In either case, the current sequence starts from its beginning and repeats itself, or "loops," until stopped (as described below). If this sequence was Real-Time recorded, you would probably use the fast clock setting (knob down). If Single-Step recorded, you will probably pull the knob up to select the slow speed range. These aren't rules. In Playback you can use any clock speed you like.

To immediately switch to another sequence, just press the desired new sequence switch. If the new sequence is null, the Sequencer returns to Idle Mode. Otherwise, the Sequencer will loop from the beginning of the new selection.

If you want the current sequence to stop at the end of this loop, press its switch at any time during the loop. To stop the sequence immediately, press its switch, then press STOP.

The STOP/CONTINUE switch is used to interrupt a sequence which you will then want to resume from the same point. Press STOP once to pause. Resume the sequence by pressing CONTINUE. Or, instead of resuming the current sequence you can start a new one by pressing its select switch.

To change the pitch of a sequence while in Playback Mode, press the TRANSPOSE switch. Then, by playing a single key on the lower keyboard, you can transpose the entire sequence up or down by an amount equal to the interval between middle C (C2) and the key played. The range of transposition is of course limited to the nine-octave range of the Prophet. So the overall range will depend on the oscillator FREQUENCY settings in the program(s). Within Transpose Mode, you can restore the tonic key by pressing C2. To exit Transpose Mode, press TRANSPOSE. This also restores the tonic.

If not in Transpose Mode, keys played on the lower keyboard will be played by the Prophet and shared with the notes coming from the Sequencer according to the synthesizer's regular voice assignment scheme--which is last-note priority. These notes will not be recorded with the sequence.

In Playback, either Real-Time or Single-Step sequences can be shortened or lengthened through Truncate or Append Modes, while the Edit Mode allows you to "overdub" new voices for bass, harmony, counterpoint, or melodies (see below). "Tracks" can be added as the sequence loops, up to the ten-voice limit of the Prophet. Truncate and Edit are protected through the Record Interlock. Press RECORD to proceed. To abort the edit, press RECORD again.

### 3-8 Truncate

The instance of needing to remove an untimely pause from the end of a Real-Time sequence was mentioned above. This requires a Truncate operation. As the sequence is playing (and the RECORD LED is blinking), press STOP at the exact end point you desire. The sequence will be correspondingly shortened and will continue its loop.

### 3-9 Append

If on the other hand you want to lengthen the sequence, this takes an Append operation. After Record Interlock is entered, press the current sequence switch when the last desired event is heard. The sequence will be shortened to this point and the Sequencer automatically enters Record Mode. As before, the Sequencer will only start to record the appended material when you start to play. Note that you'll have to play in the same timing as the original sequence for the appending to be transparent, and that this will be impossible if you alter the clock SPEED. (It will be worthwhile to have a metronome on hand for this operation.)

Truncate and Append operate similarly with Single-Step sequences. You can either use the automatic clock at very low speed, or manually clock with the SINGLE-STEP switch.

### 3-10 EDIT MODE

Edit Mode is your third choice after activating Record Interlock in Playback Mode. Press the EDIT switch. It will light, while the RECORD LED will go off.

The current sequence will loop throughout Edit Mode. It can be stopped by first moving to Playback, or by selecting another sequence. The quickest way to go directly to Idle is to press a null sequence switch.

If the sequence is Real-Time recorded, editing can take place at normal playback speed. Any keys played on the lower keyboard will be added to the sequence. On the next loop, the notes will be heard as you played them. Program changes are edited-in in the same way. Select the desired BANK and/or PROGRAM and the change will be recorded at that point. For example, moving from 1-1 to 3-2 will unavoidably record program 2-1 in the sequence when the BANK is first incremented. But if nothing is being played this momentary program of course won't be heard.

For obvious reasons, be careful not to edit-in more than five or ten voices (depending on the Keyboard Mode) at any point. You'll also want to watch exactly where voices cross over the same key. If a note is held in the sequence then duplicated in the edit, the latter GATE OFF will be recorded, thus turning off the note (which is supposedly being held).

Although not recommended, Single-Step sequences can be edited in the same way as Real-Time sequences by using a very slow clock and making sure you key the added notes just before the clock pulse on which you want them to trigger.

### 3-11 Single-Step Edit

Single-Step sequences should be edited in Single-Step Edit Mode, where the clock is manually supplied. (Real-Time sequences can also be edited this way, although many more steps will have to be manually clocked.) To Single-Step edit, press STOP after entering Edit normally. This disables the automatic clock and activates Single-Step Edit Mode. Step through the sequence with the SINGLE-STEP switch. Add desired keys or select the desired PROGRAM before clocking the step to be edited. When finished editing, press CONTINUE to enable the automatic clock.

### 3-12 Single-Step Event Delete

The removal of voices from a sequence can only be accomplished through a Single-Step Event Delete operation. Hold the STOP switch to enter Single-Step Event Delete Mode. While holding the STOP switch, pressing the SINGLE-STEP switch will move you through recorded events.

An event is a note going on, going off, or a program change. The Sequencer functions by timing these events in terms of clock pulses (steps) from the sequence start. It can record 5239 such events. Since it takes two events to record a note, the exact maximum note capacity is 2619. If program changes have been recorded, you can calculate the total note storage by subtracting the number of program changes from 5239, and dividing the remainder by 2.

To see how Event Delete works, consider how a simple sequence looks in computer memory.

Event 1	STEP: 1	Select Lower Program 3-2
Event 2	STEP: 1	Key #5 on
Event 3	STEP: 1	Key #8 on
Event 4	STEP: 1	Key #10 on
Event 5	STEP: 6	Key #8 off
Event 6	STEP: 10	Key #5 off
Event 7	STEP: 10	Key #10 off
Event 8	STEP: 12	STOP

In this sequence, the lowest E, G, and A on the keyboard are played on step 1. Each note going on is a separate event. Notice that Events 1, 2, 3, and 4 all occur at the same step. When several notes start at the same step, the Sequencer organizes the event memory so the lowest note is always taken as the first event for that step. At Event 5, the G is released on the sixth step. Events 6 and 7 also occur on the same step. They are likewise organized with the lower note being assigned to the lower-number event.

It is very important to be clear on the difference between steps and events if you intend to use Event Delete. In this mode, as you clock the SINGLE-STEP switch you will advance between events, not steps. So, taking the above example, as you press SINGLE-STEP you'll hear the E go on (Event 2), then the G (Event 3), then the A (Event 4), even though you recorded them all going on at once. Likewise, the E will turn off before the A as you clock through Events 6 and 7.

To edit, just after you hear the undesired event, press the DELETE switch. This will remove the event from the sequence. When you delete the event in which an undesired note goes on, the note will still sound because you have not yet advanced to the event in which it is recorded off. This is normal. You won't hear the note during the next loop. Take care not to accidentally delete a note-off event, or the note will drone until a second note-off event (for that note) happens to occur. (To cancel one of these "infinite sustain" notes, edit-in a GATE OFF by playing the note on top of itself, and releasing it at the proper point.)

It is not possible to delete or add clock pulses, except by shortening or lengthening the sequence itself through a Truncate or Append operation.

To exit this mode after deleting, release the STOP switch, then press CONTINUE once. You will remain in Edit Mode and can go to the next point where Single-Step Editing is required.

# POLYPHONIC SEQUENCER OPERATION MANUAL

## SUB-SECTION 4

### SINGLE-STEP APPLICATIONS

#### 4-0 INTRODUCTION

When Real-Time recording, the Prophet's sound provides you with the "feedback" you need to adjust your technique to the current program. Because you can hear the exact attack and release times involved, you aren't concerned with the number of steps for each event.

In Single-Step Mode the situation is reversed. Without actually performing, you have to assign specific numbers of steps for each note. Instead of responding to the actual envelope timings in use, your technique is realized through the allotment of steps. Since the art is to anticipate the effect of the programs at normal playback speed and to orchestrate convincing program changes, it follows that questions of defining notes, editing voices, and switching programs are of special interest for Single-Step applications.

#### 4-1 DEFINING NOTES AS STEPS

To determine how to relate steps to the rhythm of a particular piece, you must examine the rhythmic values of the entire piece. Below is the beginning of the Bach Partita No. 1.



Figure 4-0

Now, the ornamental figure in bar 1 is usually played like this:

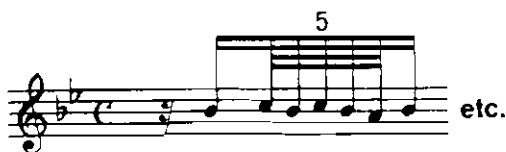


Figure 4-1

Therefore, you will need at least 5 steps for each sixteenth-note. But then how will you play the thirty-second-notes in bar 2? They must have half the value of the sixteenths, but they can't last 2½ steps. The answer is to give each sixteenth-note 10 steps. Then everything works out: thirty-second-notes get 5 steps each, and the quintuplet sixty-fourths get 2 steps each. (This sequence is recorded on the demonstration cassette, see para. 1-1.)

It is advisable to survey the entire music to be Single-Step sequenced for rhythmic challenges. Take a difficult section and try stepping a few measures in an unused bank. You may find ornaments or odd meters which have to be provided for. Polyrythms can be figured as the least-common multiple, such as 12 steps required to sequence 3 notes against 4, or 28 steps to sequence 7 against 4.

Unless you plan to manipulate the SPEED knob, you'll have to multiply or divide clock pulses to change tempo. (That is, to accelerate, you'll have to work backwards from the fastest passage to find the appropriate number of steps at the beginning.) Ultimately, by using sufficient numbers of steps it is possible to introduce complex rhythms, rubato, accelerando, and decelerando.

It was explained in para. 3-6 that to repeat a note, (that is, to retrigger the envelope generators) the GATE must first be turned off--so that it can be turned back on. If a certain note is defined as 2 steps and is to be repeated, the first note would have to be 1 step on, 1 step off. The second note could then be 2 steps on. But for the first note, the GATE will only be on 50% of the time. The 50% time that the GATE is off will have to be accounted for audibly through the envelope release time.

Generally, you increase the flexibility of the sequence framework by increasing the number of clock steps. Now suppose a certain note to be repeated is instead based on 4 steps instead of 2. This gives you some options in release time. The first note can then be 1 step on, 3 steps off or 2 on, 2 off or 1 on, 3 off. The choice of 75%, 50%, or 25% duty cycles would depend upon which release sounds appropriate over the 25%, 50%, or 75% GATE OFF period. It is easy to conceive of the flexibility resulting from using 16 steps/note. The range of duty cycles from 1 step on, 15 off to 15 on, 1 off would be available. Single-Step Mode contains the facilities for editing-in each of these duty-cycle options for each voice in a polyphonic sequence. All orchestration problems can then be overcome through attention to envelope settings and recorded program changes.

Although there will be numerous exceptions to this policy, it is recommended that for typical applications, rather than recording a 100% duty cycle for all notes, at least 2 GATE OFF steps be recorded at the end of each note. This allows some room to adjust envelope times by changing both Upper and Lower programs (each program change is a separate event), and helps insure that each new note gets a clean attack.

This idea can be extended to create ensemble effects that would be practically impossible in Real-Time Record Mode. Here, for example, is the beginning of Mozart's 40th Symphony (also included with the demonstration sequences):

Figure 4-2

This passage is for strings alone. To create the different articulations called for in the orchestration a step/note ratio that will allow some choice of duty cycle is required. (In actual practice, one might add the string voices in Edit Mode, but for discussion we'll assume all notes are entered in Single-Step Record Mode.)

This sequence is recorded on the demonstration cassette. The piece is very fast, and playback speed should be adjusted accordingly. It was recorded with 3 steps per eighth-note. In the violin part, the first E-flat is on for 3 steps (100% duty cycle), to create legato for the slur into the D. Because the D is repeated, the eighth-note is 2 on, 1 off (66%) so the quarter-note will be articulated. The violas were given 1 step on, 2 steps off (33% duty cycle) to get the detached sound needed for accompaniment. Since basses naturally have longer release time than the higher strings, they are recorded on for 7 steps, which is just a little longer than an actual quarter-note. These notes will then seem to release more slowly. These variations in GATE times create the ensemble effect of different envelopes being used.

## 4-2 EDITING

It is generally more efficient to record as many notes as possible the first time through, rather than just record one line then overdub the rest in Single-Step Edit Mode. Also, for this work the footswitch will be much easier to use than the SINGLE-STEP switch.

Single-step sequences are conveniently extended using Append through a technique of "overlapping" the last note. To save time you would raise the SPEED. Then gradually reduce SPEED as you hear the ending approaching. Press RECORD. Ready a finger over the current SEQUENCE switch. Within the last few notes, slow the clock way down, so you can see each clock pulse indicated by the STOP LED. Hit the current SEQUENCE switch just after the first clock pulse of the last note. Then hit the SINGLE-STEP switch. You now know the Sequencer is poised one step into the last note. If this note was to be on for 4 steps, you would continue by holding it for 3 steps, then adding the new material.

One rarely uses Truncate on a Single-Step sequence since wrong notes can be corrected through Single-Step Edit and Single-Step Event Delete. Remember, there is no way to insert or remove steps themselves.

## 4-3 PROGRAM CHANGES

Don't overlook the value of switching between programs that have only slight differences between mixer volumes or filter cutoff for dynamic and timbral expression. Crescendos and diminuendos can be easily accomplished in this manner, since the basic program sound doesn't change.

When switching between vastly different programs the changes must be carefully coordinated. For example, a string program must be allowed to release to 0 before switching to a brass program, or the switch will be audible. When faced with such a situation, it is helpful to create a second (string) program identical to the first, except with much less release. You then switch to this short-release program on the step just before the last note (before the change). Since this note will have little release, there will be minimal conflict with the new (brass) program.

On the other hand, it may not be necessary to exactly define each program in use when the sequence is entered. Instead, the basic program changes can be recorded, then the programs themselves edited at actual playback speed to produce the desired results.

Don't underestimate the number of different programs needed to realize a convincing orchestration. It may be more efficient to save shorter periods of music with the required program changes, than to spend a lot of time on a long sequence only to find in later editing that you don't have enough programs available.



## SECTION 6

# SELECTED BIBLIOGRAPHY

This abbreviated list is not intended to be complete; it is merely a short compilation of currently available materials that may prove useful to you in your exploration of synthesis through the Prophet-10. Should you wish to explore further, many of the books listed here have extensive bibliographies.

### BOOKS ON SYNTHESIS

**Appleton, John**; and **Perera, Ronald**. *The Development and Practice of Electronic Music*; Prentice-Hall, Englewood Cliffs, NJ.

*The ARP 2600 Owner's Manual*; ARP Instruments, Lexington, MA.

**Backus, John**. *The Acoustical Foundations of Music*; W.W. Norton and Company, New York, NY.

**Deutsch, Herbert**. *Synthesis*; Alfred Publishing, Sherman Oaks, CA.

**Ernst, David**. *The Evolution of Electronic Music*; Schirmer, New York, NY.

**Friess, David**; **Pearlman, Alan**; and **Piggott, Thomas**. *Learning Music With Synthesizers*; Hal Leonard Publishing, Milwaukee, WI.

**Rhea, Tom**. *The Minimoog Owner's Manual*; Moog Music, Buffalo, NY.

**Strange, Allen**. *Electronic Music*; William C. Brown Company, Dubuque, IO.

**Wells, Thomas**, and **Vogel, Eric**. *The Technique of Electronic Music*; Sterling Swift Publishing, Manchaca, TX.

### MAGAZINES ON SYNTHESIS

*Contemporary Keyboard*, 20605 Lazaneo, Cupertino, CA 95014.

*Polyphony*, Box 20305, Oklahoma City, OK 73156.

# SECTION 7

## THE FACTORY PRESET PROGRAMS

The Prophet-10 is shipped from the factory in “ready-to-play” condition with 64 factory preset programs. These programs are arranged in two sets (UPPER and LOWER) of banks, each bank containing 8 programs. The programs are selected by means of buttons in the UPPER and LOWER programmer section, and the selected bank and program numbers are indicated by the digital displays in the programmer section.

In this section of the manual you will find front-panel patch diagrams for all of the factory presets as programmed into the Prophet’s memory. This will of course allow you to recreate a program in the event that you accidentally erase a particular patch from the memory. However, the main purpose for the inclusion of these diagrams is to provide you with a frame of reference as you familiarize yourself with the Prophet’s capabilities. Knowing how each patch is set up may help you to understand the process of programming in general, and it will definitely make it easier for you to begin adjusting, fine tuning, and altering the various preset programs to suit your particular musical needs and tastes.

Along with each patch diagram you will find a set of comments and notes concerning various aspects of each patch. These notes will contain the following information:

- 1) The potential uses of the MONO-MOD section, including:
  - a) an explanation of any constant MONO-MOD effect, programmed via the LFO AMOUNT knob;
  - b) a discussion of any potential MONO-MOD effects that can be engaged via the MOD wheel (including optimum settings for the wheel to create the effects that are programmed in);
  - c) a mention of any programmed connections between PEDAL 1 and the MONO-MOD section (allowing for control of the modulation amount via the pedal).
- 2) Special considerations concerning performance on the keyboards (what range to use, whether to use a sustained, chordal approach or a staccato, detached approach, etc.) to obtain the maximum effect from the program.
- 3) An explanation of potentially-active settings, such as the 5th doubling in the Baroque Horn patch (U-1-1), which can be engaged by switching on a waveform in OSCILLATOR B.
- 4) A discussion of the programmed choices for the KEYBOARD MODE switches (which determine the connections between each set of programs and the two keyboards).
- 5) An indication of certain settings that can be adjusted to alter some aspect of the patch. This information is provided to help you fine tune the patch to suit your tastes.
- 6) A mention of the programmed (or potential) routings for PEDAL 1 and PEDAL 2. *NOTE:* PEDAL 2 is not programmed on any of the factory preset programs. In general, PEDAL 2 would function well routed to Prophet’s VCAs (AMP), providing volume control; however, if either pedal is programmed in this way and no pedal is plugged in the back panel, the VCAs will remain closed and no sound will get through. Therefore, to avoid possible confusion, all factory presets are set up without this routing. (See paragraphs 3-9 and 4-1 in sections 3 and 4 of this manual.)

Occasionally there is also some explanation of how some aspect of the patch works (representative examples: the discussions included with the U-1-4 and L-1-6 patch diagrams). These short discussions should help you understand why a particular patch is configured the way it is, and should also help you develop an approach to the creation of your own sounds.

In general, the comments and notes are most extensive for the patches in bank 1 (UPPER and LOWER), since they are (for the most part) representative instrumental timbres, and are therefore subject to adjustments and fine tuning to taste. The notes are more sketchy for the later banks in general (particularly for the sound-effects patches in bank 4) since many of those patches are dedicated to a specific effect that is either not subject to alteration (without changing the basic character of the sound) or is easy to assimilate from a study of the front-panel settings themselves.

As you play through the programmed presets, study the patch diagrams and read the accompanying notes. They will help you to get a quick grasp of some of the capabilities of the Prophet-10. (Remember to check out the different KEYBOARD MODE possibilities for each set of programs by selecting first the UPPER and then the LOWER panel select switches. And remember also that only the program connected to and displayed on the front panel can be altered via the knobs and switches on the front panel.)

★ ★ ★ ★ ★

At this point, we would like to offer a special word of acknowledgement and thanks to John Bowen, who created most of the factory preset programs for the Prophet-10.

### **BANK 1**

This bank is arranged with related sounds in each set of UPPER and LOWER programs. Whenever the PANEL display is UPPER, the programs will be in NORMAL keyboard mode; whenever the PANEL display is LOWER, the programs will be in DOUBLE keyboard mode. Play through all the programs with the PANEL displaying the UPPER program, so that you can check out the sound of each program; then go back and play through BANK 1 with the PANEL displaying the LOWER program, so that you can hear each set of paired programs operating together in DOUBLE keyboard mode. (Then try various unmatched pairs of programs in BANK 1 in DOUBLE keyboard mode, in order to find other pairings that will suit your musical needs.)

### **BANK 2**

This bank is arranged so that all programs are in DOUBLE keyboard mode. Although all sets of UPPER and LOWER program pairs are designed to be played together (in DOUBLE keyboard mode), most of them can also be of some interest when played separately (in NORMAL keyboard mode).

### **BANK 3**

This bank contains a number of different kinds of programs, involving NORMAL, SINGLE, and ALTERNATE keyboard modes. The ALTERNATE keyboard mode programs are designed to be used as sets of matched UPPER and LOWER program pairs. Both UPPER and LOWER programs must be patched the same way in SINGLE mode in order to create a full complement of 10 voices; therefore both 3-1 UPPER and 3-1 LOWER have the same patch. 3-8 UPPER and LOWER have been programmed to provide a demonstration of the UP-LOW MIX switch in the MONO-MOD section.

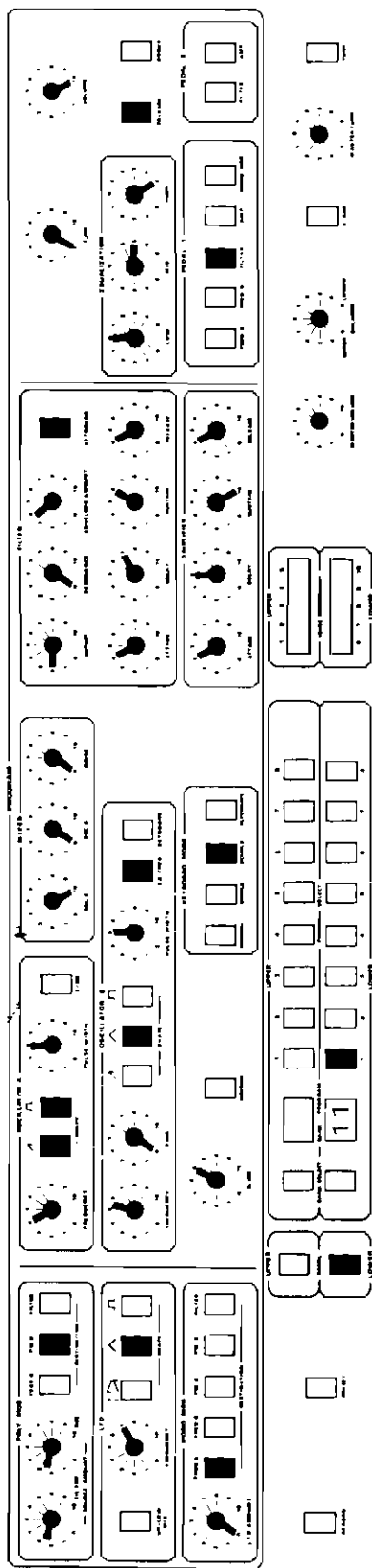
### **BANK 4**

The programs in this bank are, for the most part, more in the nature of sound effects or sonic events (rather than being instrumental voices); therefore there will be few notes. The best way to gain an understanding of how the effect is created is by studying the patch diagrams while playing the patch, and by listening for changes in the sound that occur as you change some aspect of the patch (switching waveforms, changing modulation amounts and speeds, and so on).

# PRESET PROGRAMS

		1	2	3	4	5	6	7	8
BANK 1	UPPER	U-1-1 BAROQUE HORN	U-1-2 (HIGH) STRINGS I	U-1-3 MUTED CLAV.	U-1-4 (PERCUSSIVE) ELECTRONIC PIANO I	U-1-5 FLUTES	U-1-6 HARPSICHORD II	U-1-7 SYNC I	U-1-8 PERCUSSIVE ORGAN
	LOWER	L-1-1 TRUMPET/ FLUTE	L-1-2 (LOW) STRINGS II	L-1-3 ACCORDION	L-1-4 ELECTRONIC PIANO II	L-1-5 PIPE ORGAN FLUTES	L-1-6 HARPSICHORD I	L-1-7 SLOW SYNC SWEEP	L-1-8 ORGAN WITH RESONANCE
BANK 2	UPPER	U-2-1 UNISON GLIDE	U-2-2 STRINGS DOUBLED	U-2-3 DOUBLE DELAY	U-2-4 DELAYED HARMONIC	U-2-5 SYNC III	U-2-6 PUNCHY PULSES	U-2-7 ELECTRONIC ORGAN	U-2-8 PIPE ORGAN
	LOWER	L-2-1 UNISON GLIDE	L-2-2 STRINGS DOUBLED	L-2-3 DOUBLE DELAY	L-2-4 RELEASE REPEAT	L-2-5 UNISON TRIANGLE- SQUARE WAVE	L-2-6 CLAV-TYPE	L-2-7 ELECTRONIC ORGAN	L-2-8 PIPE ORGAN
BANK 3	UPPER	U-3-1 PHASE SHIFT EFFECT	U-3-2 ALTERNATE I	U-3-3 ALTERNATE 5THS	U-3-4 ALTERNATE II	U-3-5 MUTED TOY PIANO	U-3-6 PERCUSSIVE SYNC	U-3-7 BELLS	U-3-8 UP-LOW MODULATION MIX EXAMPLE
	LOWER	L-3-1 PHASE SHIFT EFFECT	L-3-2 ALTERNATE I	L-3-3 ALTERNATE 5THS	L-3-4 ALTERNATE II	L-3-5 MUTED TOY PIANO	L-3-6 BASS	L-3-7 STEEL DRUMS	L-3-8 UP-LOW MODULATION MIX EXAMPLE
BANK 4	UPPER	U-4-1 ALIEN	U-4-2 REPEAT DRONE I	U-4-3 HELICOPTER	U-4-4 SAWTOOTH ARPEGGIATOR	U-4-5 POLY-FILTER SWEEP IN UNISON	U-4-6 SPACE ALARMS (PART I)	U-4-7 SPACESHIP LANDING	U-4-8 DUPE OF U-1-1 (BAROQUE HORN)
	LOWER	L-4-1 ALIEN	L-4-2 REPEAT DRONE II	L-4-3 SWEEPING NOISE REPEAT	L-4-4 SWEEPING RESONANCE	L-4-5 DRIPPY BIRDS	L-4-6 SPACE ALARMS (PART II)	L-4-7 SPACESHIP LANDING	L-4-8 DUPE OF L-1-6 (HARPSI- CHORD)

# L-1-1 Trumpet/Flute



## L-1-1: Trumpet/Flute

**OSC A:** up 2 octaves  
**OSC B:** LF mode

MONO-MOD section is set for a vibrato effect. Move MOD wheel up to intensify the effect.

GLIDE is programmed in for use with UNISON mode — when the patch is used as a lead line. Glide will engage if UNISON is switched on.

PULSE-WIDTH on OSC B is set at 5; this allows switching of waveforms.

OSC A is set as a square wave (set at approximately 5 and listen for the dropout of the octave — the 2nd harmonic).

### NOTES:

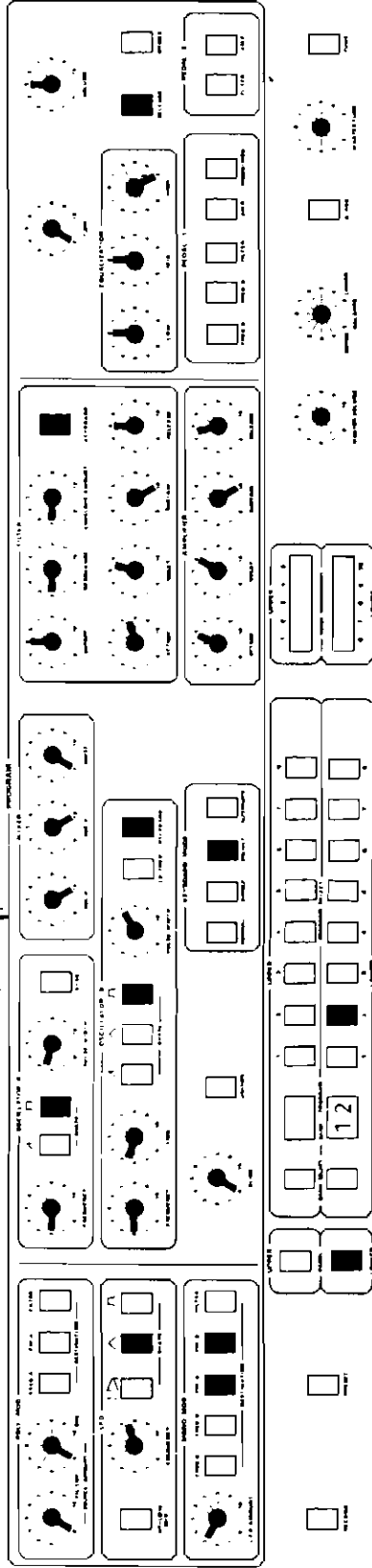
- Select different waveforms and combinations of waveforms on OSC A and OSC B to experiment with different tone colors.

- Adjust filter settings (CUTOFF and ENVELOPE AMOUNT) to alter brightness of tone.

- Adjust the EQUALIZATION settings to alter the tonal balance.

- PEDAL 1 is routed to the FILTER CUTOFF frequency; use to alter brightness of tone (or for a pseudo-wah effect).

# L-1-2 (Low) Strings II



## L-1-2: (Low) Strings II

**OSC A: up 1 octave**  
**OSC B: up 1 octave**

MONO-MOD is programmed for pulse-width modulation. Pulse-width modulation is used on both oscillators to create the animation of the sound; in combination with the detuning of OSC B, the pulse-width mod helps create the effect of a string section. The MOD WHEEL should be adjusted for different registers on the keyboard; more for playing in the higher register, less for the lower register.

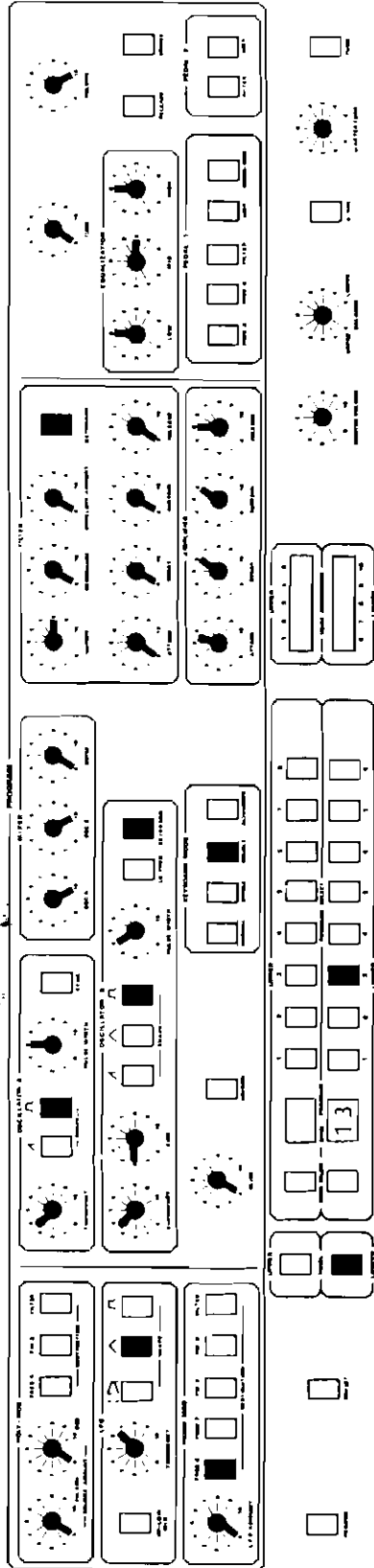
In general, the best string sound results when the keyboard is played in the bottom 3 octaves; adjust the filter CUTOFF to play consistently in the top 2 octaves.

NOTES:

— Adjust filter CUTOFF to change brightness of tone.

— Remember that in order to create the effect of a low string section you must do your part: you must play notes that are idiomatic for strings. If you play this patch with piano phrasing, it will not sound like a string section.

# L-1-3 Accordion



## L-1-3: Accordion

**OSC A:** up 2 octaves (basic pitch)

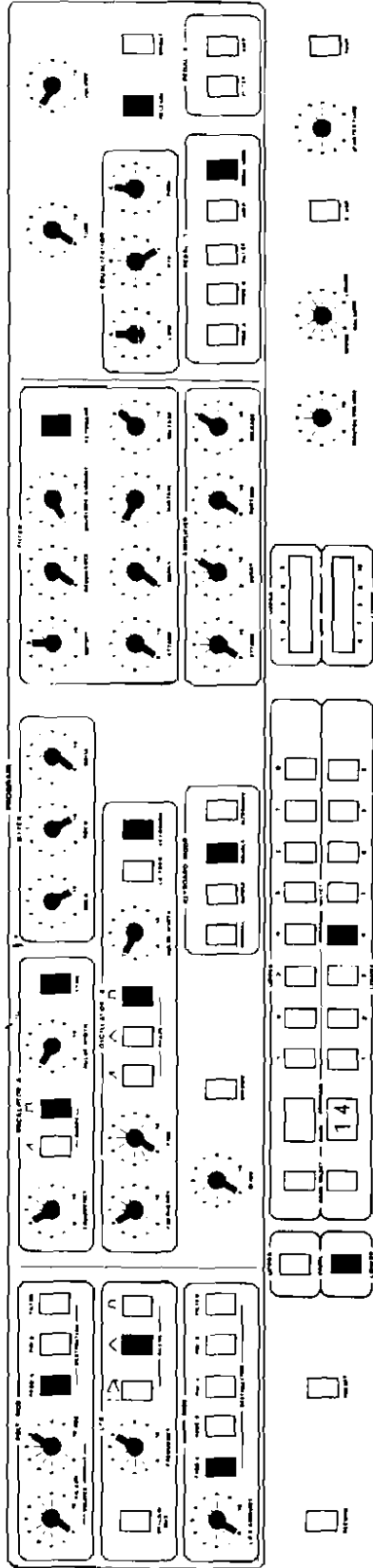
**OSC B:** up 2 octaves (basic pitch)

MONO-MOD section is programmed to create a chorusing animation-of-sound effect. Move MOD wheel up to intensify effect.

The two oscillators are detuned slightly (via the FINE tune knob in the OSCILLATOR B section) to create a "fuller" sound.

### NOTES:

- Turn on RELEASE switch to create a "harmonium" sound.



## L-1-4: Electronic Piano II

OSC A: up 2 octaves

OSC B: up 2 octaves

MOD wheel can be engaged (if desired) to create a vibraphone-like vibrato/tremolo effect via the MONO-MOD section. Move wheel on full to engage effect. PEDAL 1 is also routed to MONO-MOD.

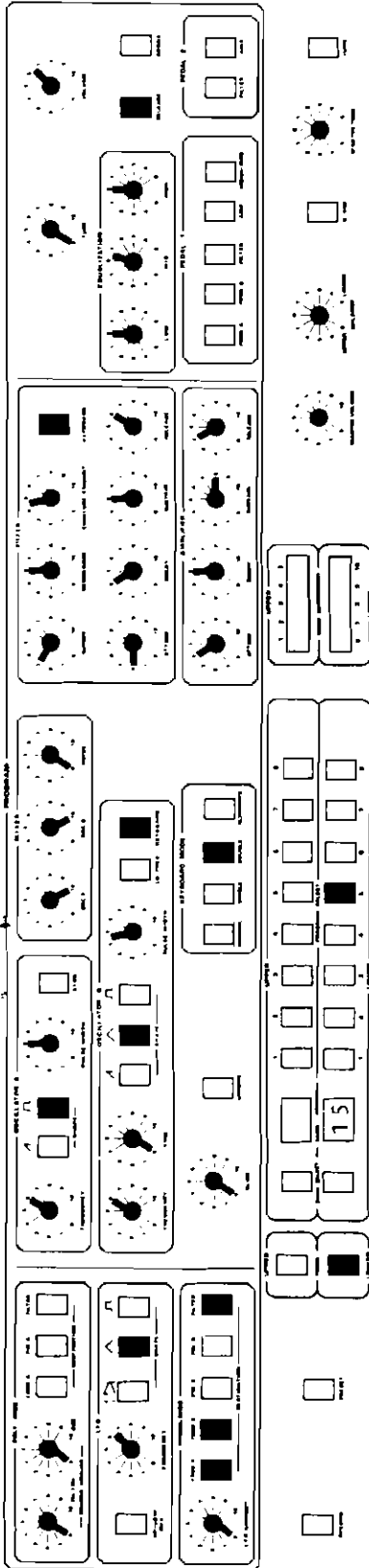
To simulate a piano sustain pedal, switch RELEASE off and use the footswitch to engage and disengage the release settings.

NOTES:

— Since the two oscillators are in SYNC, the effect of OSC B as a modulation source in the POLY-MOD section is minimal; if SYNC is switched off, OSC B will have a strong clangorous effect via the POLY-MOD section.



# L-1-5 Pipe Organ Flutes



## L-1-5: Pipe Organ Flutes

OSC A: up 3 octaves

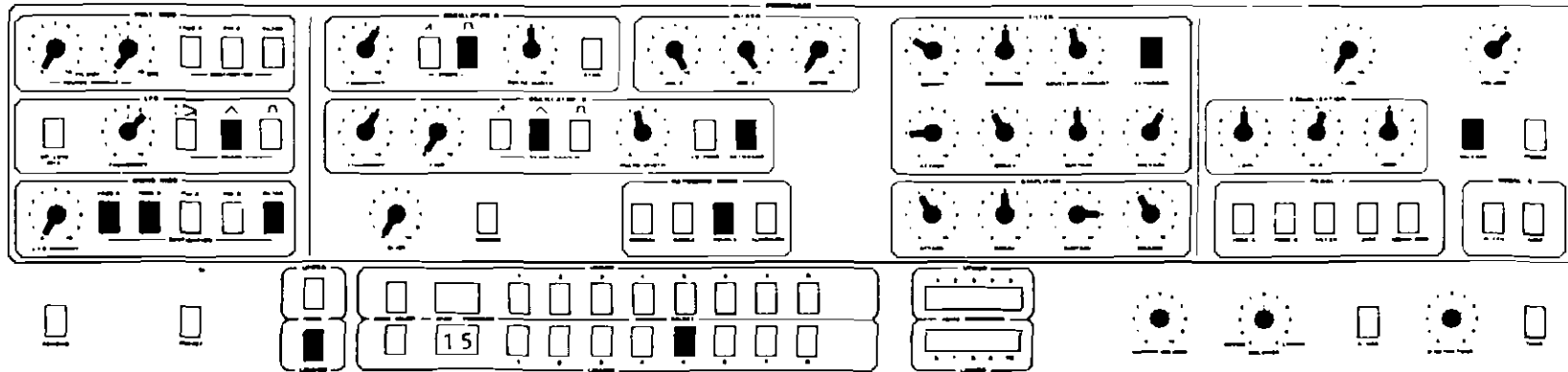
OSC B: up 3 octaves

MONO-MOD is set for a vibrato effect, and can be engaged (if desired) by moving the MOD wheel up slightly ( $\frac{1}{8}$  to  $\frac{1}{4}$ ).

PULSE-WIDTH on both oscillators is set at 5; this allows switching of waveforms on OSC B.

### NOTES:

— The wooden “chiff” effect in the initial portion of the tone (a characteristic of pipe organ attack transients) is created mainly by the settings in the FILTER section. The filter envelope generator settings (particularly the ATTACK, DECAY, and SUSTAIN), working in conjunction with the filter CUTOFF, ENVELOPE AMOUNT, and RESONANCE settings, are critical. (The use of the mellow triangle waveshape in OSC B is also important to the overall tone color.) To understand how these settings work together to create the effect, try altering them all slightly, one at a time and in combination.



## L-1-5: Pipe Organ Flutes

**OSC A:** up 3 octaves

**OSC B:** up 3 octaves

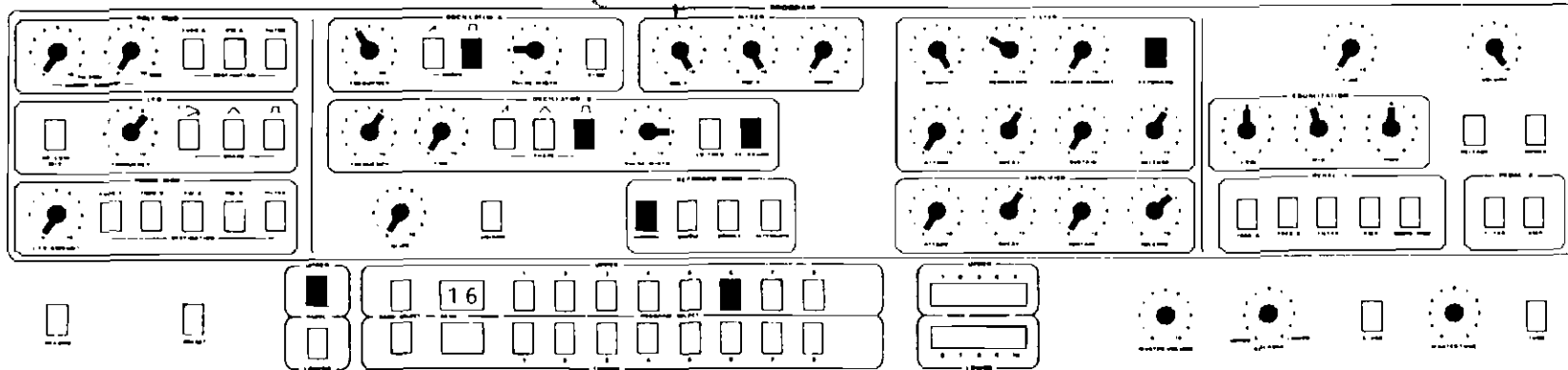
MONO-MOD is set for a vibrato effect, and can be engaged (if desired) by moving the MOD wheel up slightly ( $\frac{1}{4}$  to  $\frac{1}{2}$ ).

PULSE-WIDTH on both oscillators is set at 5; this allows switching of waveforms on OSC B.

### NOTES:

- The wooden “chiff” effect in the initial portion of the tone (a characteristic of pipe organ attack transients) is created mainly by the settings in the FILTER section. The filter envelope generator settings (particularly the *ATTACK*, *DECAY*, and *SUSTAIN*), working in conjunction with the filter *CUTOFF*, *ENVELOPE AMOUNT*, and *RESONANCE* settings, are critical. (The use of the mellow triangle waveshape in OSC B is also important to the overall tone color.) To understand how these settings work together to create the effect, try altering them all slightly, one at a time and in combination.

U-1-6  
Harpichord II

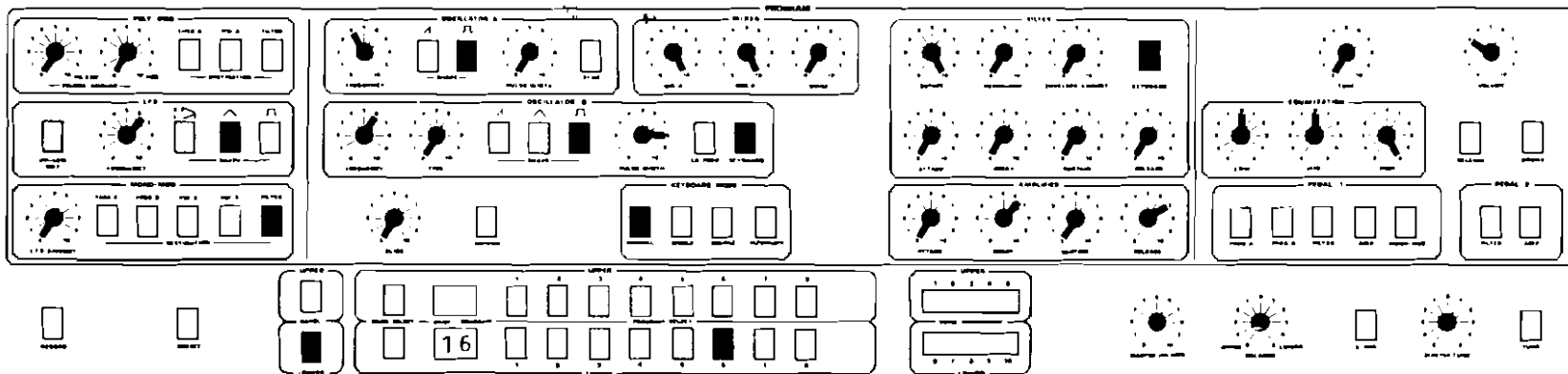


## U-1-6: Harpsichord II

OSC A: up 2 octaves

OSC B: up 3 octaves

See the notes with L-1-6: **Harpichord 1**, particularly the section entitled GENESIS OF THIS PATCH:



## L-1-6: Harpichord I

**OSC A:** up 2 octaves

**OSC B:** up 3 octaves

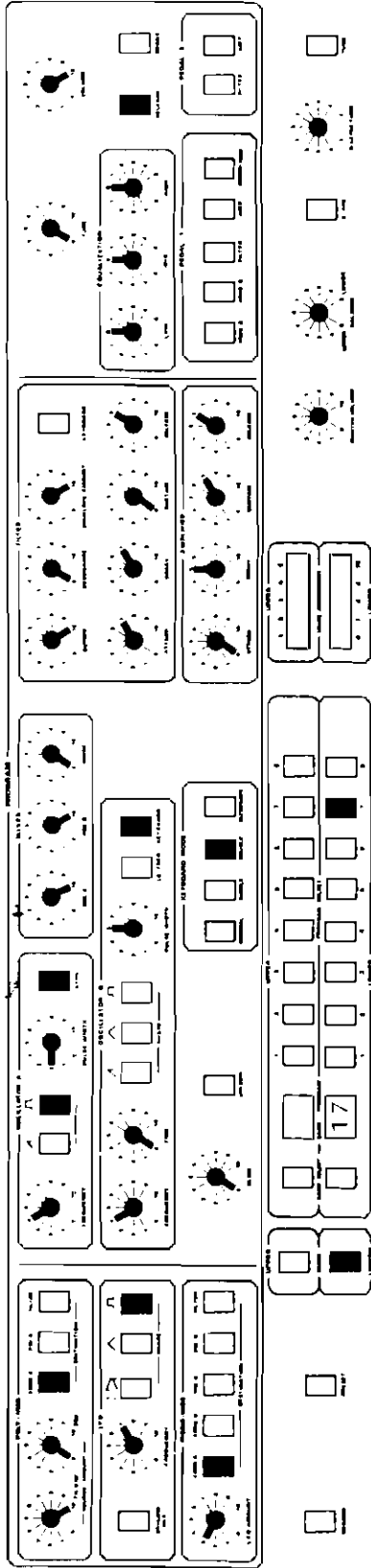
**GENESIS OF THIS PATCH:** To create the bright, nasal sound of the thin strings of a harpsichord, narrow pulse waves were selected. The **FILTER** settings are also important: brightness is insured by setting the filter **CUTOFF** fully open. The amplifier envelope generator is set to simulate a plucked string (since, in a harpsichord, the strings are plucked rather than struck). Even though there is no audible release time on a harpsichord, the **RELEASE** is set at 6 on the VCA envelope generator so there won't be an audible "whack" when the key is released (caused by the instantaneous closing down of the VCA). The oscillators are set at two different octaves to emphasize the brightness of the harpsichord (and to simulate the sound of the harpsichord with more than one of its stops selected).

**MOD** wheel can be engaged (if desired) to create a repeating effect via the **MONO-MOD** section. Move wheel up approximately  $\frac{1}{2}$  (or more) to engage the effect.

### NOTES:

- Adjust oscillators to a wider pulse-width for a fuller sound.
- For a more nasal sound, increase the amount of filter **RESONANCE**.
- To change overall tone color mix, change **MIXER** settings for **OSC A** and **B**.
- Try adding an envelope shape to the **FILTER**. Envelope generator settings should be similar to those on the amplifier section; adjust filter **CUTOFF** and **ENVELOPE AMOUNT** to engage the envelope generator at the proper level.
- When in **DOUBLE** keyboard mode, try transposing the **LOWER** program (Harpichord I) down or up 1 octave.

# L-1-7 Slow Sync Sweep



## L-1-7: Slow Sync Sweep

OSC A: up 2 octaves

OSC B: up 2 octaves

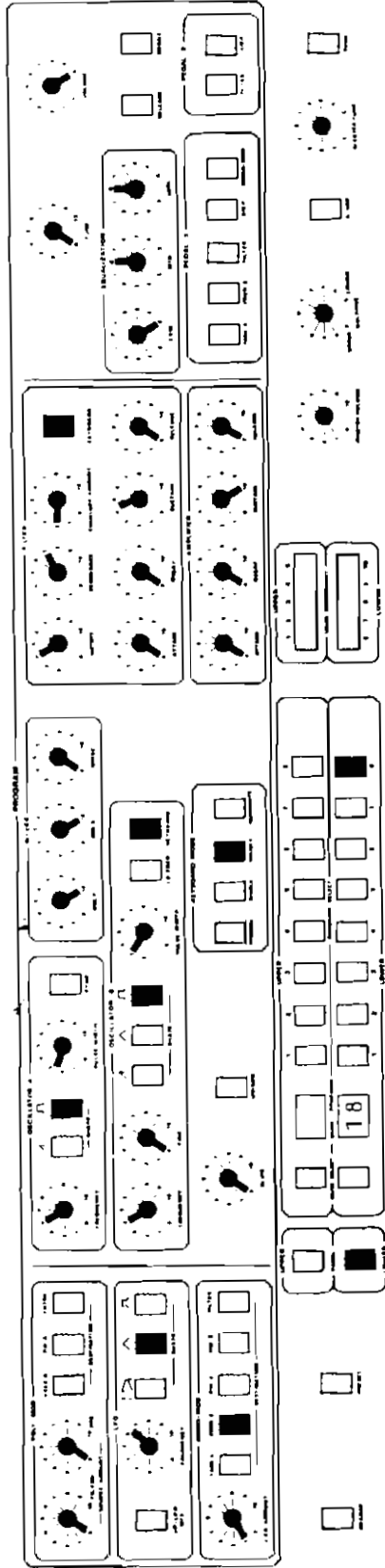
For the full sweeping effect, hold keys down (i.e. play long, sustained tones).

MONO-MOD section is set for a sync-trill effect. Move MOD wheel up to intensify the effect.

OSC B is programmed off (no waveform selected); however, the mixer section is set to allow for its addition to the sound.

PULSE-WIDTH on OSC B is set at 5; this leaves open the possibility of adding OSC B pulse wave to the sound.

# L-1-8 Organ with Resonance



## L-1-8: Organ with Resonance

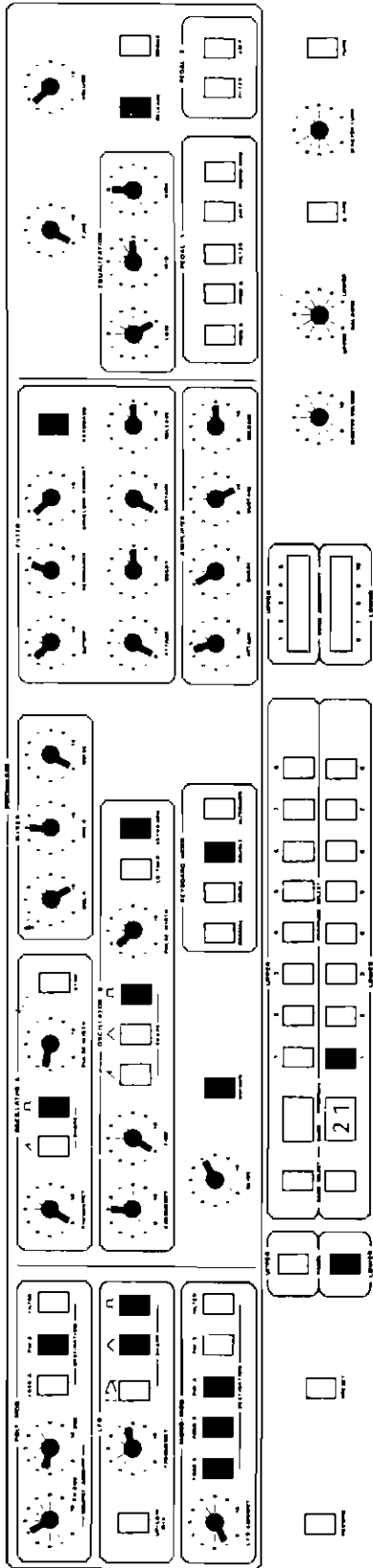
OSC A: up 2 octaves

OSC B: up 2 octaves

MONO-MOD section is set for a rotating-speaker effect. Move MOD wheel up to intensify the effect.

### NOTES:

- For a thicker sound, detune OSC B by setting FINE tune to approximately 1½.
- For a different animation-of-sound effect, try routing mod to PW A (or PW A and PW B) instead of FREQ B.
- Adjust DECAY and SUSTAIN settings on filter envelope generator to alter the organ percussion effect.



## L-2-1: Unison Glide

OSC A: up 0 octaves

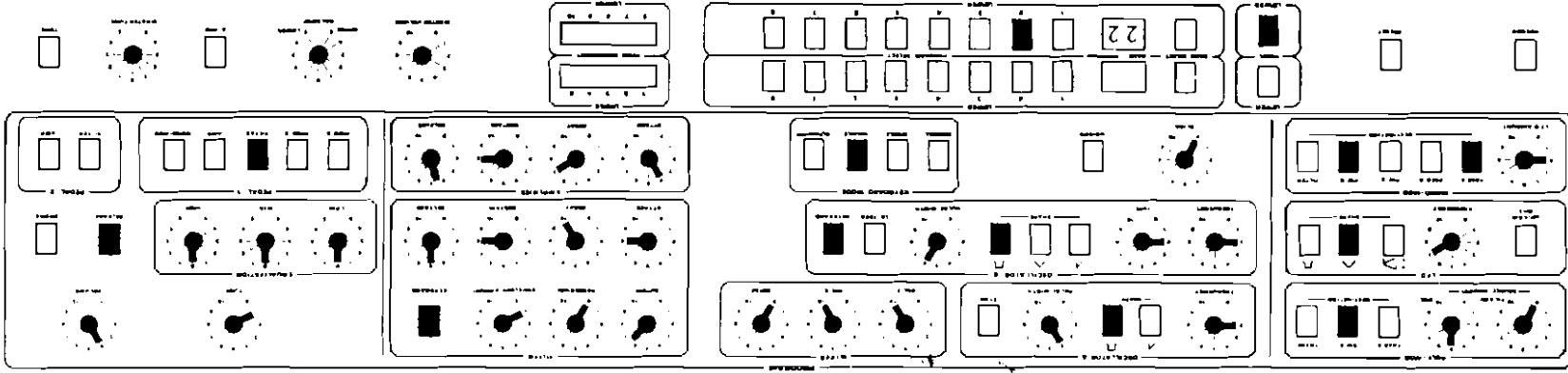
OSC B: up 2 octaves + a perfect 5th

MONO-MOD section is set for a vibrato chorusing effect. Move the MOD wheel up to intensify the effect.

NOTES:

— The combined effect of these two programs (in DOUBLE keyboard mode) is a pseudo-stereo cross-fade. This is created (mainly) by the relative envelope generator settings in the two programs, and by the routing of the POLY-MOD in the 2-1 LOWER program.

# L-2-2 Strings Doubled



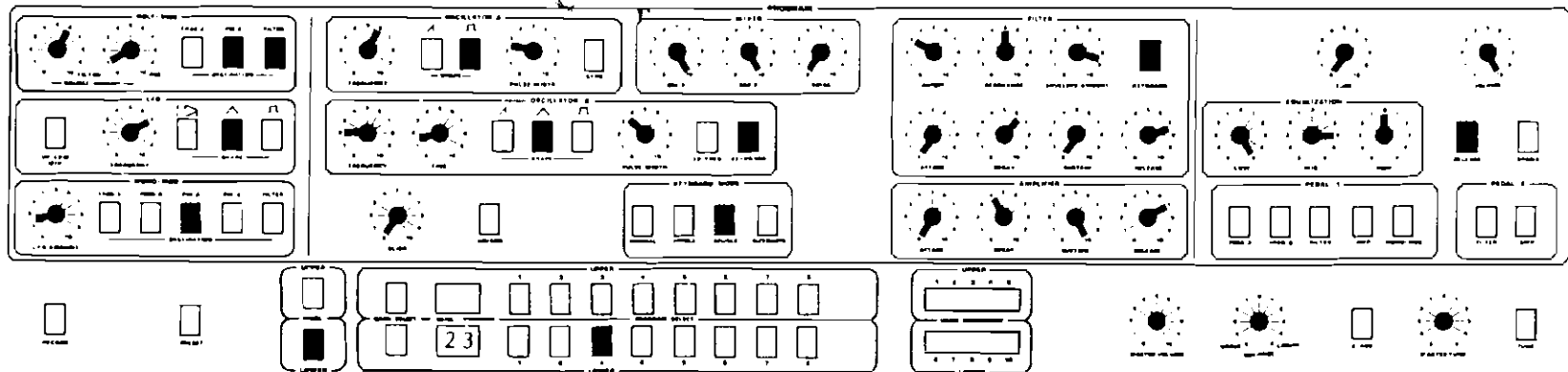
OSC A: up 1 octave  
OSC B: up 1 octave

See the notes with U-1-2 and L-1-2.

NOTES:

- L-2-2 is slightly detuned relative to U-2-2 (via the programmable TUNE knob) for added depth and animation of sound.
- Transpose either UPPER or LOWER program up one octave for different "full" sound.
- Filter pedal on Pedal 1 can be used to add brightness.





## L-2-3: Double Delay.

**OSC A:** up 3 octaves  
**OSC B:** up 1 octave

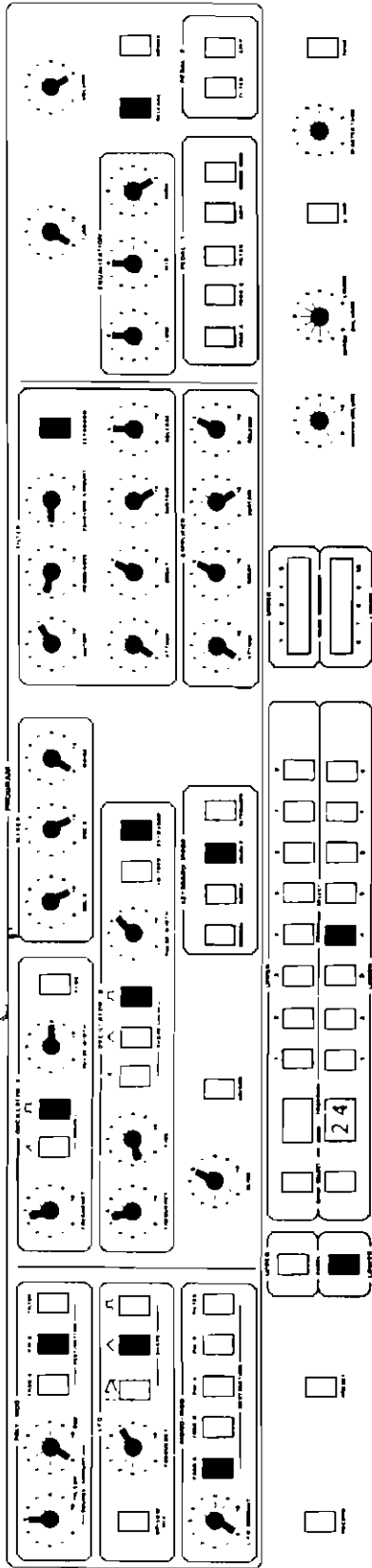
The delay effects in these programs are created by the POLY-MOD section. In both the UPPER and LOWER programs, the filter envelope generator is being used as the modulation source, routed to PW A; at the beginning of each sound, the PULSE-WIDTH of OSC A is driven to 10 and degenerates to DC — in other words, no sound is generated (by OSC A) at the beginning of each sound. As the envelope generators progress through their cycles, the PULSE-WIDTH drops below 10, and OSC A is allowed to sound. The relative setting of the UPPER and LOWER programs is such that the LOWER OSC A enters as the first delay, and then UPPER OSC A enters as the second delay. (Both UPPER and LOWER OSC B enter immediately when a key is struck, with no delay.)

MONO-MOD is set for a chorusing effect in both UPPER and LOWER programs. Move the MOD wheel up to intensify the effect.

### NOTES:

- Try UNISON mode. Also try changing the settings of the oscillators to create 4-note chords with delayed entrances.

## L-2-4 Release Repeat



### L-2-4: Release Repeat

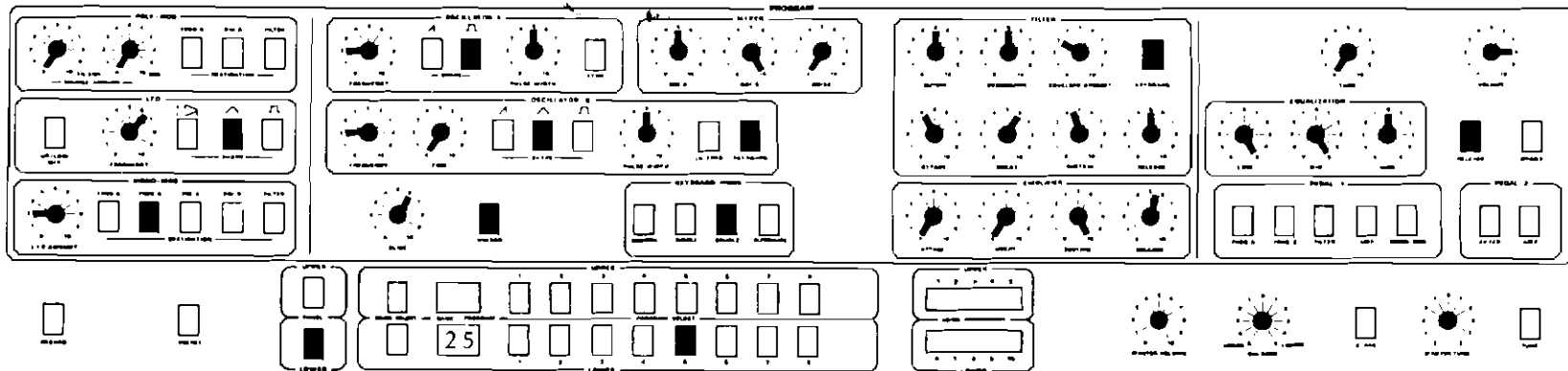
OSC A: up 2 octaves

OSC B: up 2 octaves

The release effect in this patch is created by the POLY-MOD section. The filter envelope generator is being used as the modulation source, routed to PW 1; since the SUSTAIN is set at 9, the PULSE-WIDTH of OSC 1 is driven to 10 and degenerates to DC — in other words, no sound is generated. When the key is released, the filter RELEASE is faster than the amplifier RELEASE, so that OSC 1 is allowed to sound. In other words, OSC 2 provides the sound while a key is depressed, and OSC 1 provides the repeat effect. OSC B is detuned from OSC A — this gives the “off-tune” sound to the release portion of the sound.

MOD WHEEL section can be engaged (if desired) to create a chorusing effect on the release portion of the sound. Move wheel up to engage effect (from  $\frac{1}{8}$  to  $\frac{1}{2}$ , depending on effect desired).

GLIDE is programmed in for use with UNISON mode — when the patch is used as a lead line. Glide will engage if unison is switched on.



## L-2-5: Unison Triangle-Square Wave

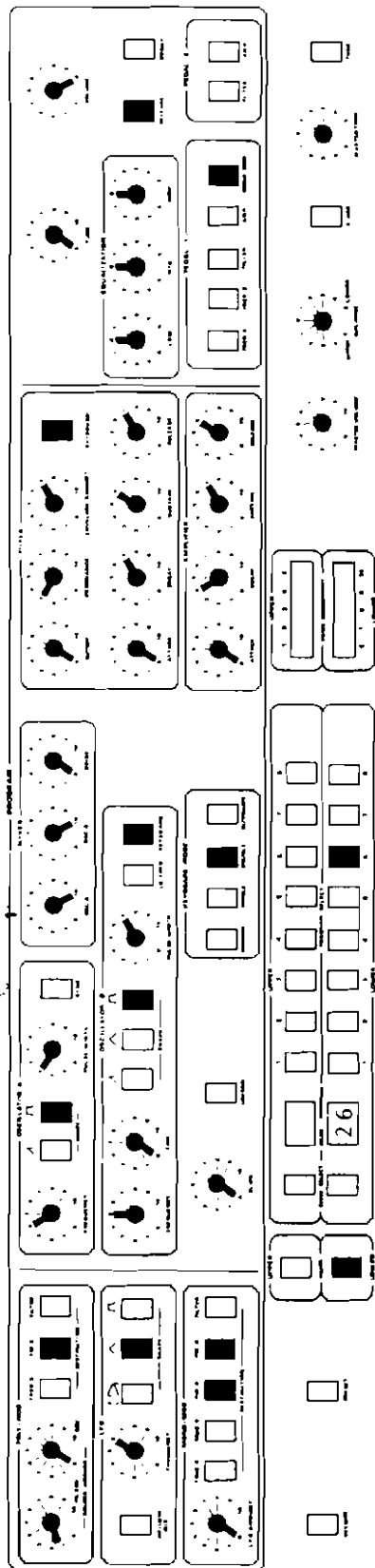
**OSC A:** up 1 octave

**OSC B:** up 1 octave

MONO-MOD for both UPPER and LOWER programs is set for a vibrato-like effect. Move MOD wheel up to intensify the effect. In addition, PEDAL 1 is routed to the MONO-MOD of the UPPER program.

### NOTES:

- If chords are played, the unison patch (L-2-5) will sound with the top note of the chord. If you are planning to play a specific melody with chordal accompaniment, you must remember to release the top note of each chord last (just slightly) — if the top note is released before some other note in the chord, the unison patch (L-2-5) will jump down to that note momentarily. Working with these two patches will help you understand how to deal with the high-note priority of UNISON mode.

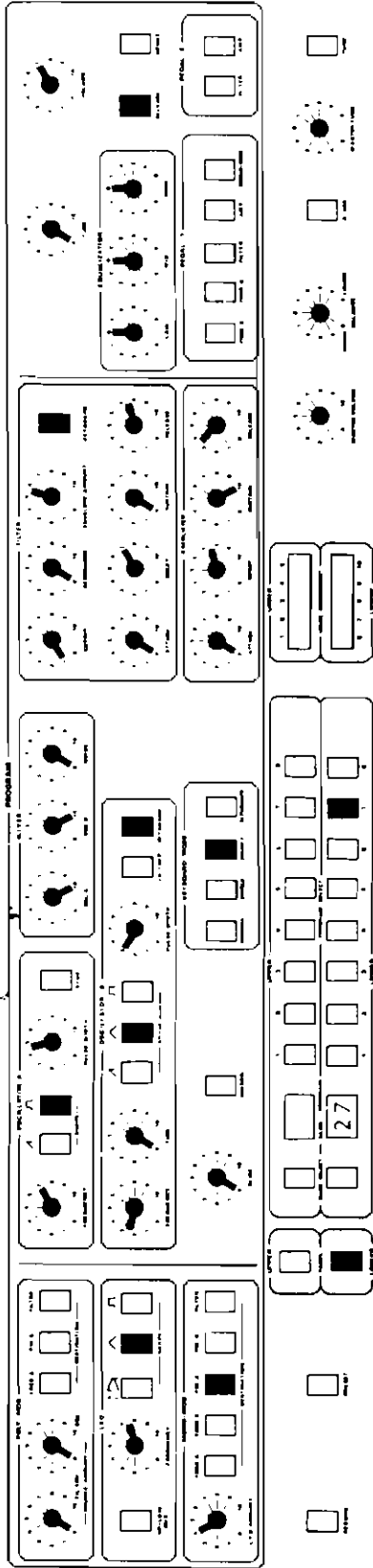


## L-2-6: Clav-Type

OSC A: up 2 octaves  
OSC 3: up 3 octaves

MONO-MOD is set for a chorus-like animation of sound, and can be engaged by moving the MOD wheel up slightly. PEDAL 1 is also routed to the MONO-MOD section.

POLY-MOD is set for pulse-width modulation of OSC A (the lower octave) by the filter's envelope generator (ENV). As a result, the lower octave begins as a nasal sound that thickens as the tone decays, in imitation of a plucked strings timbre. The setting of the ENV knob is critical; if set too high, the PW of OSC A will be driven past 10 and will degenerate into DC (and the result will be no sound from OSC A).



## L-2-7: Electronic Organ

**OSC A:** up 4 octaves

**OSC B:** up 1 octave

The selected waveshapes and octave positions selected for these two programs are combined to approximate the full ensemble sound of a “drawbar” electronic organ.

MONO-MOD is programmed for vibrato on the UPPER program, and can be engaged by moving the MOD wheel up slightly.

MONO-MOD is programmed to provide a chorus-like animation of sound on the highest oscillator (OSC A) on the LOWER program. Moving the MOD wheel up will intensify this effect.

To create a “percussion” sound, adjust the FILTER envelope generator on both programs: shorten the DECAY time, and lower the SUSTAIN level.

# L-2-8 Pipe Organ

## L-2-8: Pipe Organ

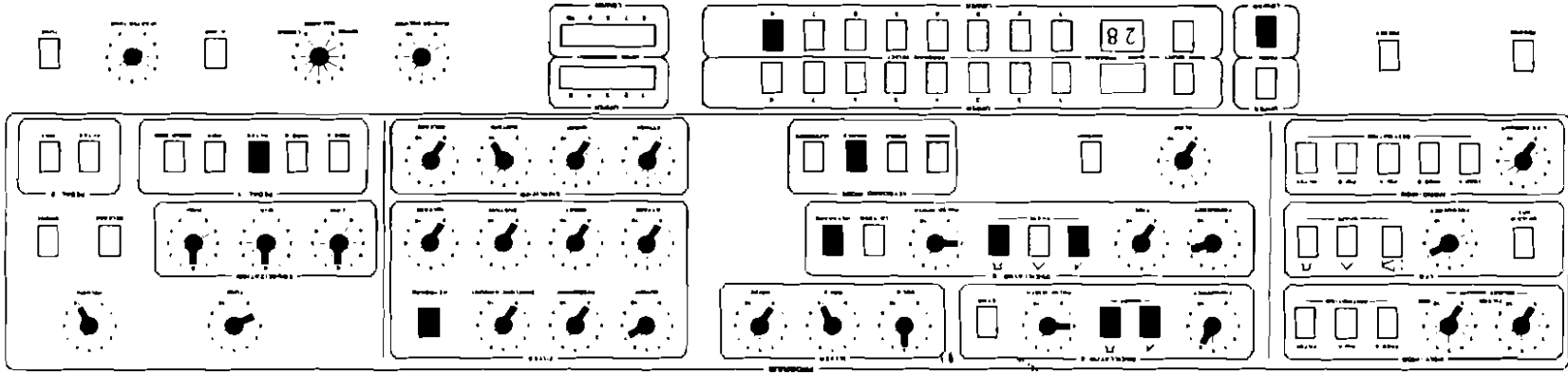
OSC A: up 3 octaves  
OSC B: up 4 octaves

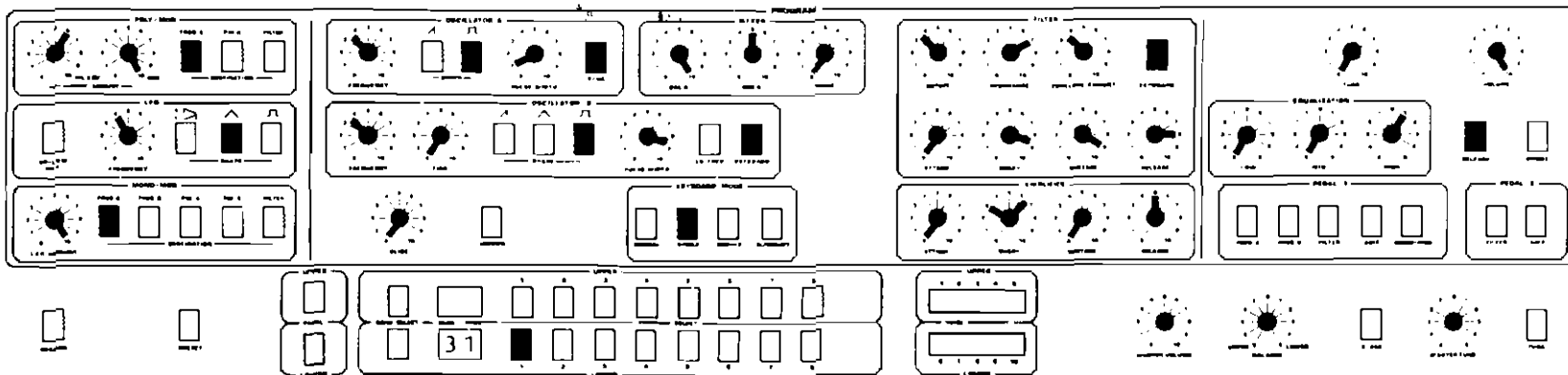
The LOWER program is detuned relative to the UPPER program via the programmable TUNE knob.

Although no waveshapes or routings are selected in the MONO-  
MOD section, a vibrato-like LFO rate has been programmed in the  
UPPER and LOWER sections, so that a vibrato or tremolo can be  
added to the sound with a waveform switch and the MOD wheel.

NOTES:

— PEDAL 1 is routed to the FILTER cutoff frequency in both the  
UPPER and LOWER programs. This can be used to alter the  
brightness of tone, or for pseudo-wah effects.





## L-3-1: Phase Shift Effect

**OSC A: up 2 octaves**

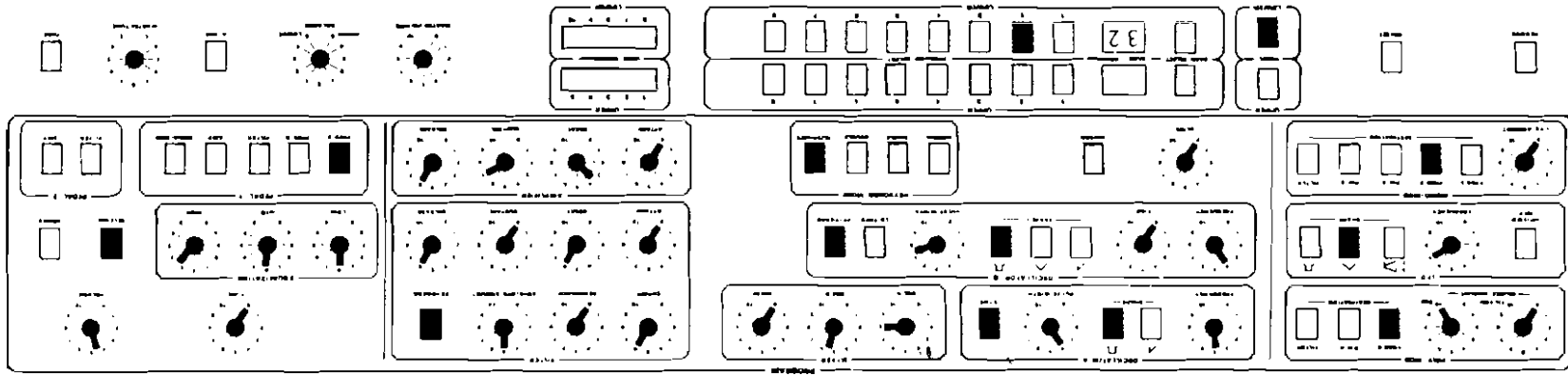
**OSC B: up 2 octaves**

The phase-shift effect is created by the combination of MONO-MOD and POLY-MOD routings to modulate OSC A; since OSC A is synced to OSC B, its overall pitch can't change, but marked changes in tone color are brought about through the modulation.

### NOTES:

- Try switching on additional waveforms of OSC B for tonal variations.
- Remember that in order to edit this sound completely (in SINGLE keyboard mode) the editing changes must be carried out (and re-programmed) with both the UPPER panel and then the LOWER panel displayed. One simple way to do this would be to make the changes on one synthesizer bank (UPPER), record those changes, and then record the entire patch onto the LOWER position.

# L-3-2 Alternate 1



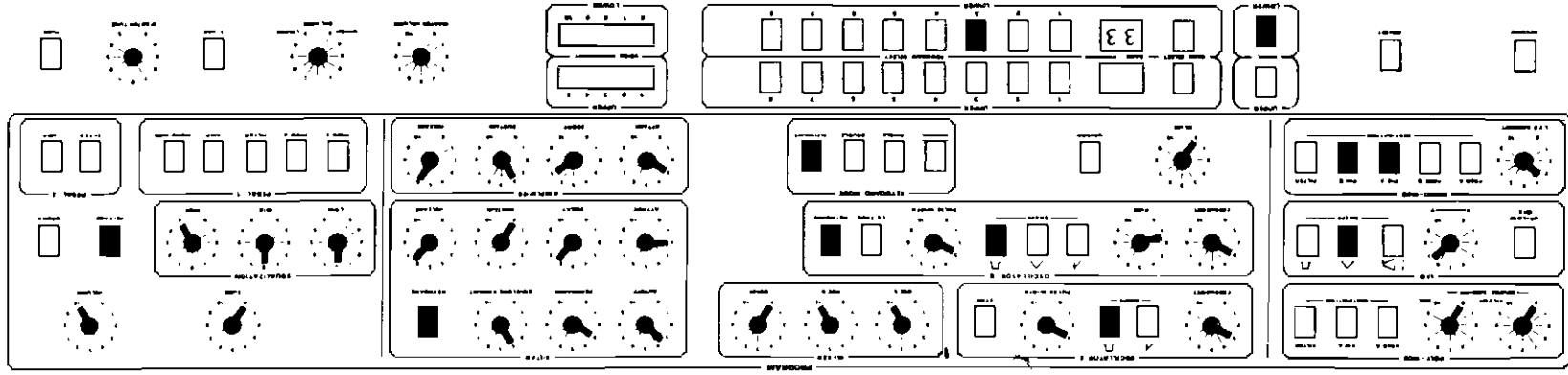
**L-3-2: Alternate 1**  
 OSC A: up 2 octaves + a tritone  
 OSC B: up 2 octaves

This patch is set up to show the basic function of ALTERNATE keyboard mode. The two patches are almost exactly the same, with only these two differences: 1) the tuning of the SYNCed oscillator (OSC A); and 2) the pulse-width of OSC B. Since the SYNCed oscillator in the UPPER program is set for an interval that has a strong harmonic relationship to OSC B, the sound is thick, while the SYNCed oscillator in the LOWER program is set for a weaker harmonic interval, and therefore has a thinner sound. Also, since OSC B in the LOWER program is set for a higher pulse width than its counterpart in the UPPER program, it has a more nasal sound. This patch should give you some idea of the importance of fine adjustments to the overall sound of a patch.

MONO-MOD (for both programs) is set for vibrato, and can be engaged by moving the MOD wheel up slightly.



# L-3-3 Alternate 5ths



## L-3-3: Alternate 5ths

OSC A: up 1 octave + a perfect 5th  
OSC B: up 1 octave + a perfect 5th

MONO-MOD is programmed to provide a chorus-like animation of sound (for both UPPER and LOWER programs). Move MOD wheel up to intensify effect.

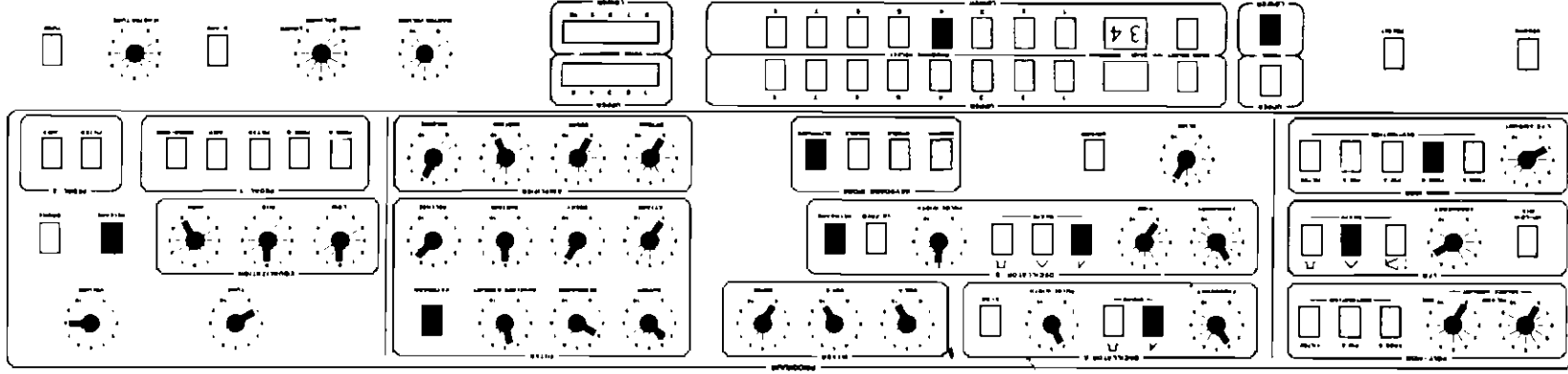
NOTES:

—The ALTERNATE keyboard mode effect in this case is a change in pitch — the two programs are tuned a 5th apart. This will create some unusual melodic effects with straightforward keyboard playing.

# L-3-4 Alternate II

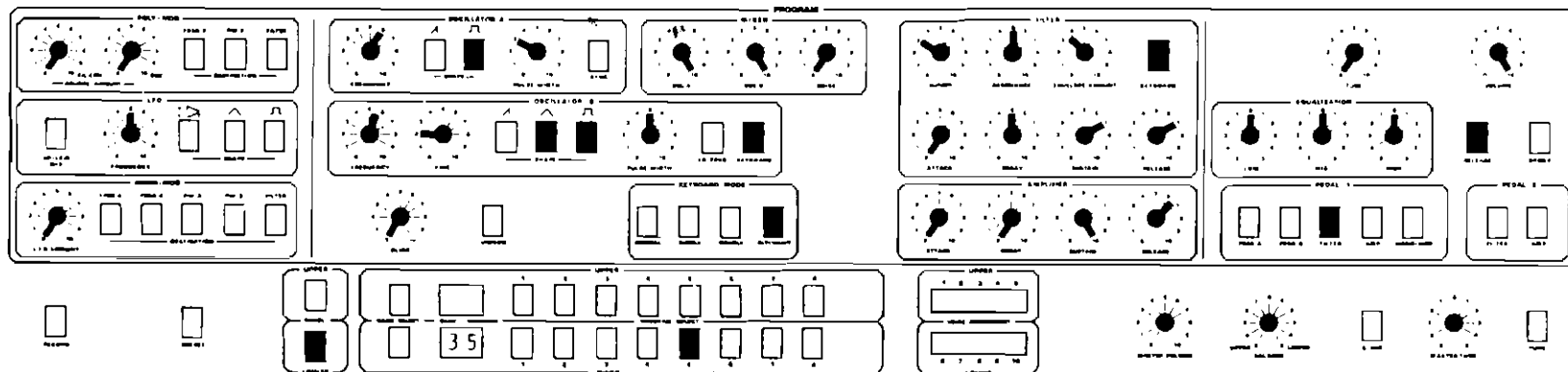
OSC A: up 2 octaves  
OSC B: up 2 octaves

## L-3-4: Alternate II



The LOWER program has been detuned relative to the UPPER program via the programmable TUNE knob. MONO-MOD for the UPPER program has been programmed to provide a vibrato effect, which can be engaged by moving the MOD wheel up slightly ( $\frac{1}{8}$  to  $\frac{1}{4}$ ).

In the UPPER program, OSC B is programmed off; this accounts for much of the timbral difference between the UPPER and LOWER programs. OSC B can be switched on to change the tone color of the UPPER program. Although no pulse waves have been selected for the oscillators in either program, the pulse-widths of OSC A (UPPER and LOWER) have been programmed at 4, and the pulse-widths of OSC B (UPPER and LOWER) have been programmed at 5. This allows switching of waveforms.



## L-3-5: Muted Toy Piano

OSC A: up 3 octaves

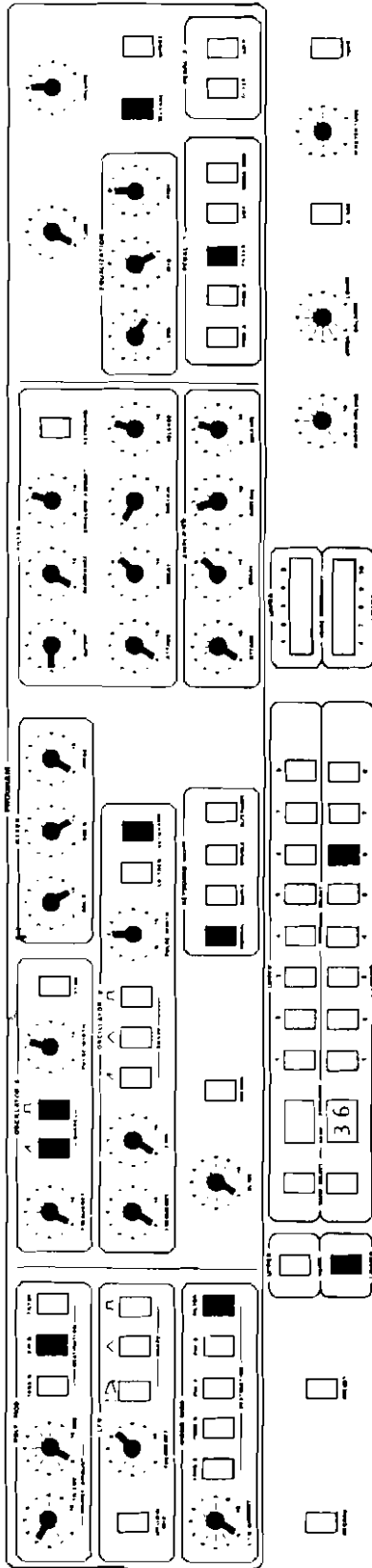
OSC B: up 3 octaves

Both UPPER and LOWER patches are the same, except that OSC B is switched off in the UPPER program. This will create volume and timbral difference when the programs are played together in either SINGLE keyboard mode or ALTERNATE keyboard mode.

MONO-MOD is set to provide a chorus-like animation of sound for the UPPER program. Move the MOD wheel up to intensify the effect. PEDAL 1 is also routed to MONO-MOD for the UPPER program.

NOTES:

- PEDAL 1 is routed to the FILTER cutoff frequency for the LOWER program (and to MONO-MOD for the UPPER program). The FILTER routing can be used to alter the brightness of tone, and to provide a pseudo-wah effect.



## L-3-6: Bass

OSC A: up 0 octaves

OSC B: up 0 octaves

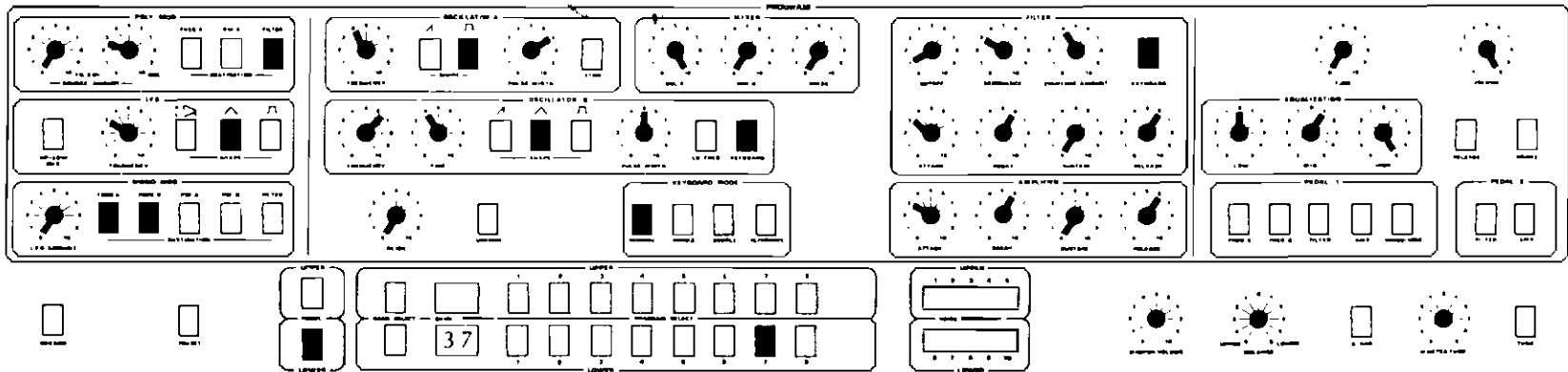
MONO-MOD is routed to the FILTER cutoff frequency, but no waveshapes are selected in the LFO section. Try experimenting with the various waveshapes and the effects they create.

### NOTES:

— OSC B is programmed off (no waveforms selected); however, pulse-width is set at 5 to allow adding OSC B pulse wave. Add OSC B (with various waveshapes selected) to create a thicker bass sound.

— Try UNISON mode.

— PEDAL 1 is routed to the FILTER, and can be used to alter the brightness of tone (or for pseudo-wah effects).



## L-3-7: Steel Drums

**OSC A:** up 2 octaves

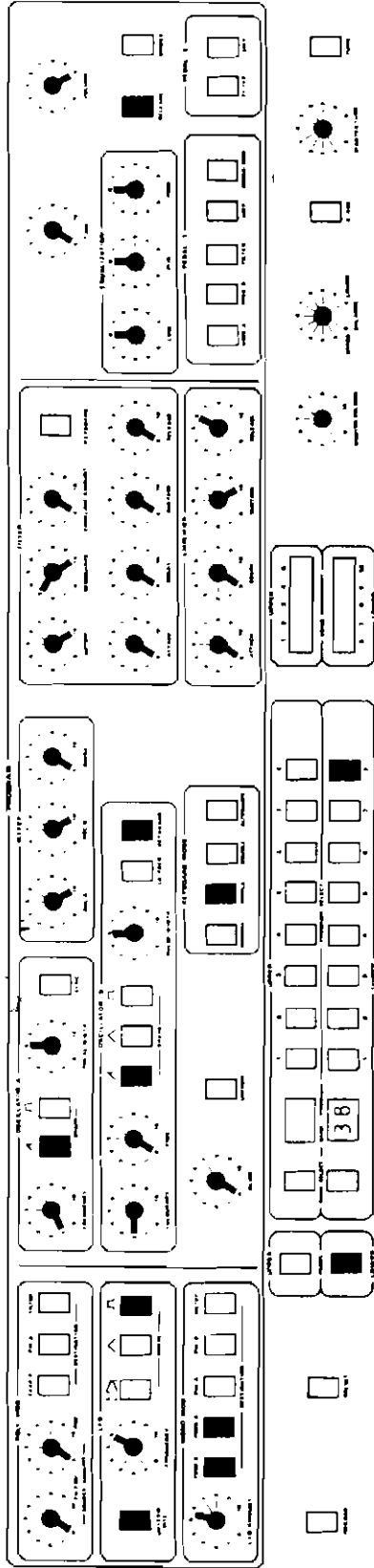
**OSC B:** up 3 octaves + a perfect 4th

The sound of this patch is created by audio oscillator modulation of the filter's cutoff frequency (via the POLY-MOD section). Although OSC B is not part of the sound source for the patch, the precise pitch setting is important for the steel drum timbre that results. (Try adjusting the FREQUENCY knob for OSC B over its whole range and listen to the resultant sounds.)

MONO-MOD is programmed to provide minute swoops in the pitch, in imitation of the minute pitch changes heard when steel drums are played. Move MOD wheel up to engage this effect.

### NOTES:

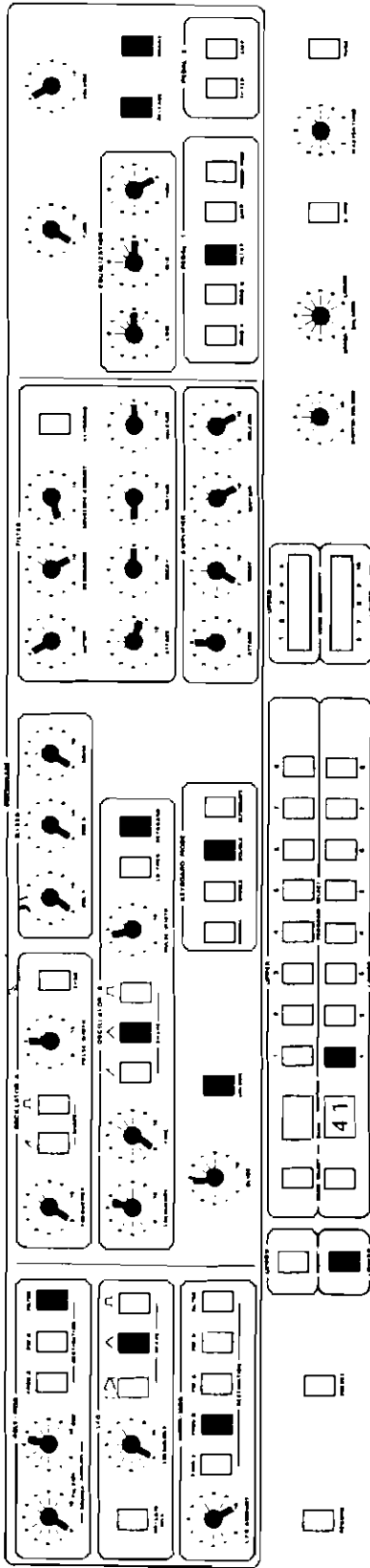
- To alter the “metallic overtones,” adjust the FINE tune knob of OSC B and/or the OSC B amount knob in the POLY-MOD section.



### L-3-8: Up-Low Modulation Mix Example

OSCA: up 1 octave  
 OSCB: up 3 octaves

To understand how the UP-LOW MIX switch mixes the UPPER and LOWER LFO waveforms, switch off then on, listening to the difference in sound. Also try altering the settings on one or both LFOs.



## L-4-1: Alien

OSC A: up 0 octaves

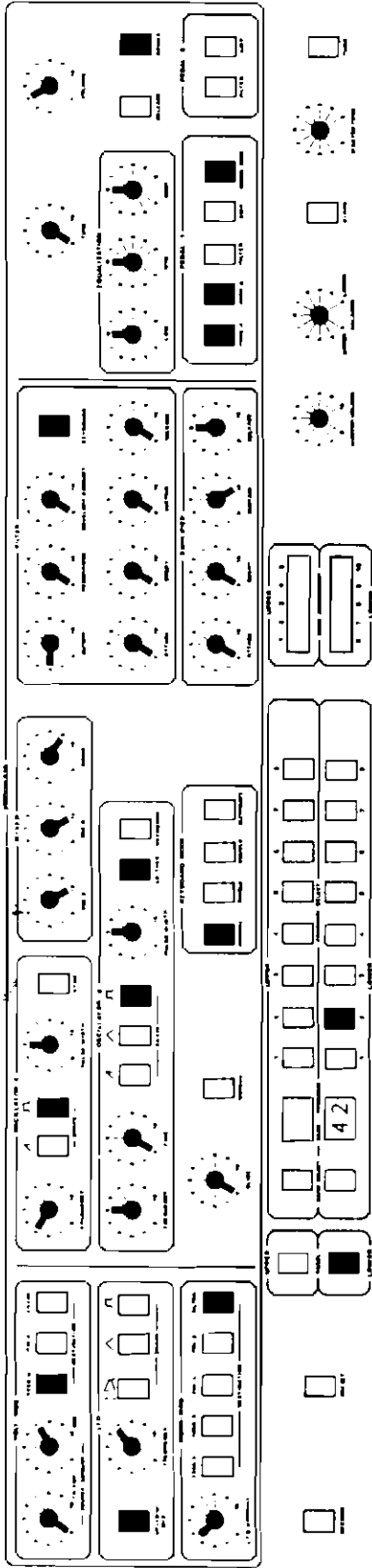
OSC B: up 4 octaves (plus FINE tune on 10)

To allow time for full effect to develop, hold key down for a long time (approximately 30 seconds).

### NOTES:

- For extra effect, route MONO-MOD to FILTER in addition to FREQ 2.
- Increase filter ENVELOPE AMOUNT to exaggerate effect.
- You may want to try switching on the UP-LOW MIX switch in the LFO section for a more uniform sweep.

# L-4-2 Repeat Drone II



## L-4-2: Repeat Drone II

OSC A: up 1 octave + a perfect 5th

OSC B: LF mode

In this patch, the LFO square waves of OSC B are modulating OSC A; since this is accomplished via the POLY-MOD section, the modulations occur at slightly different rates of speed, setting up the thick texture you hear. NOISE is also part of the sound source of this patch.

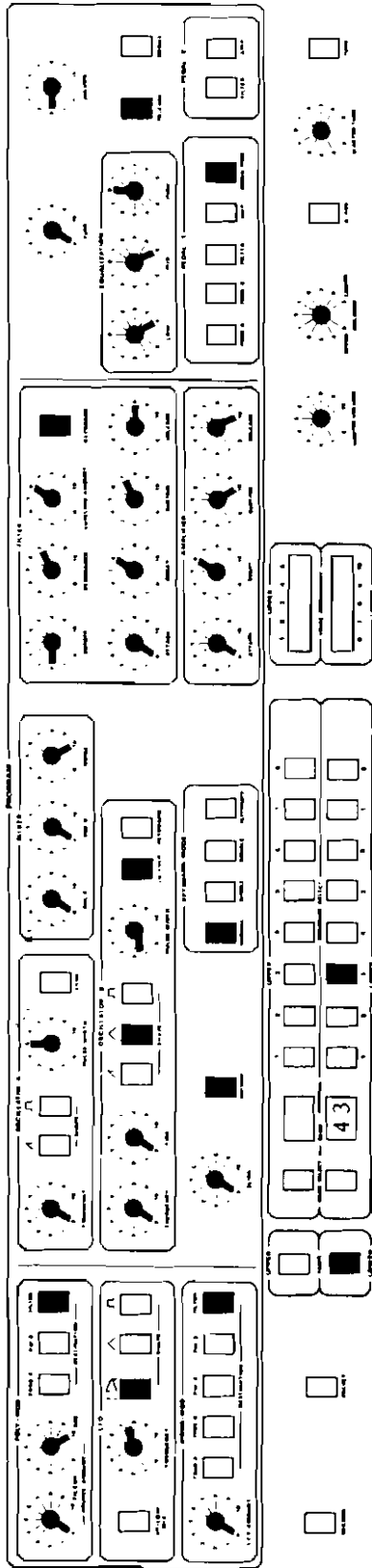
MONO-MOD is routed to the FILTER cutoff frequency, but no waveshapes are selected in the LFO section. Try selecting different waveforms, and notice the effect they have on the overall sound (particularly the NOISE source).

NOTES:

- Try PEDAL 1 and notice the difference in the overall effect. Select fewer routings and notice how the effect changes.



# L-4-3 Sweeping Noise Effect



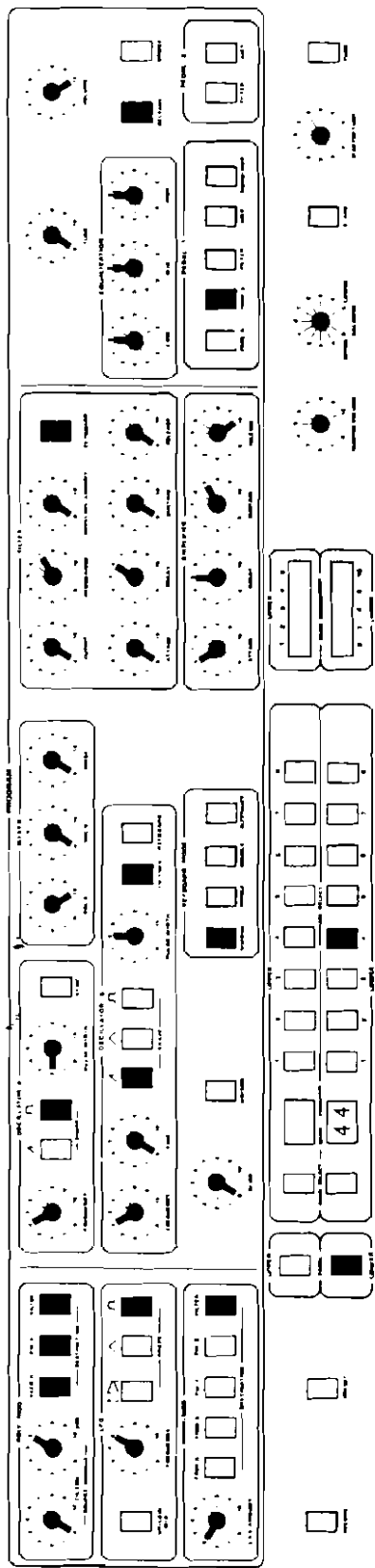
## L-4-3: Sweeping Noise Effect

The oscillators are not part of the sound source for this patch.

This patch creates a texture of noise sweeps via the POLY-MOD section (modulation of the FILTER cutoff frequency by OSC B in LF mode). Notice how the POLY-MOD sets up five independent sweeps (one for each voice in the synthesizer bank).

MONO-MOD is programmed for another kind of FILTER cutoff frequency modulation, and can be engaged by moving the MOD wheel up. PEDAL 1 is also routed to MONO-MOD.

## L-4-4 Sweeping Resonance



### L-4-4: Sweeping Resonance

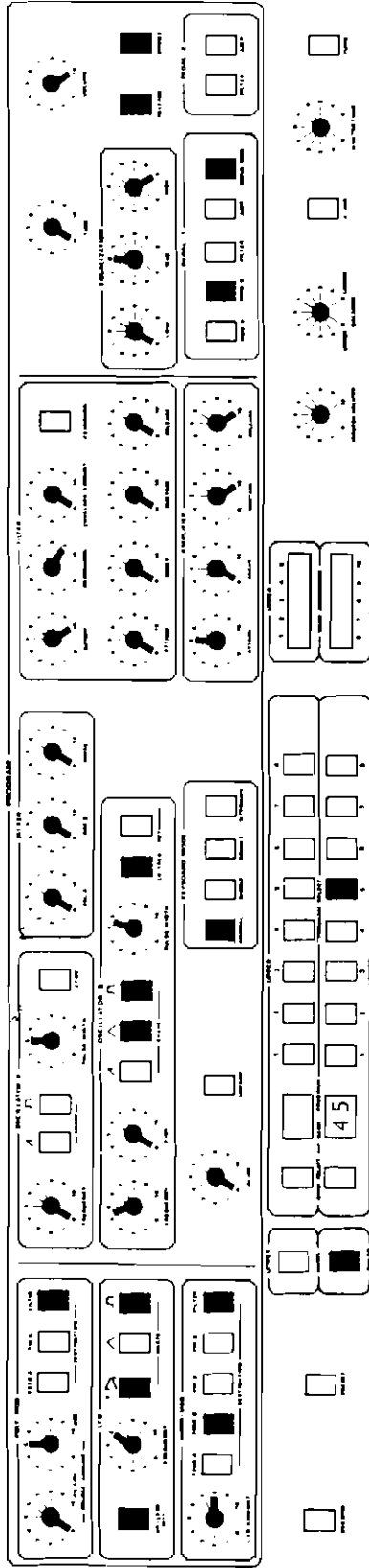
OSC A: up 2 octaves

OSC B: LF mode

The effect of this patch is created by the POLY-MOD and MONO-MOD sections. The POLY-MOD routing of OSC B sets up the pitch sweep and the changes in tone color. The MONO-MOD provides the on/off effect: since the FILTER cutoff frequency is programmed at 0, sound is only let through during the up portion of the LFO square wave cycle.

NOTES:

— PEDAL 1 is routed to OSC B, and can be used to alter the rate of the pitch sweep.



## L-4-5: Drippy Birds

OSC A: off

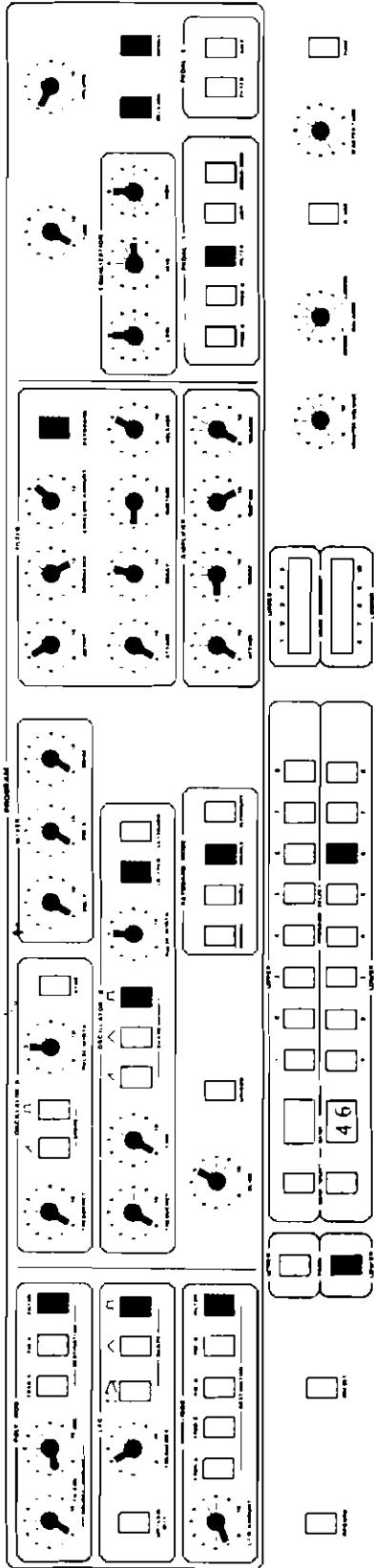
OSC B: LF mode

Oscillators are not part of the sound source of this patch.

The overall effect of this patch is caused by multiple modulations of the filter, which is set to resonate: the filter is the sound source.

NOTES:

- Turn UP-LOW MIX switch on and off for a change of rate. PEDAL 1 (routed to OSC B and MONO-MOD) can be used for the same type of change (but smoother).



## L-4-6: Space Alarms II

OSC A: off  
OSC B: LF mode

Work out the effects created by this patch by studying the UPPER and LOWER programs separately. Isolate the contributions of the oscillators, the modulation sections, the filter, and other elements.

NOTES:

— RESONANCE on LOWER program is adjusted so that only 3 of the 5 filters are in oscillation.

## **U-4-8: Dupe of U-1-1 (Baroque Horn)**

## **L-4-8: Dupe of L-1-6 (Harpsichord I)**

These duplicate presets have been included for several reasons: 1) to leave open pivot points to allow you to move the factory presets to different locations for your particular needs; 2) to give you space to store your first programs and live with them for a while before storing them in another location (in place of one of the factory presets); 3) to allow you to practice working with the factory presets in order to fine tune them to suit your tastes; and 4) to let you trace the development of certain of the factory preset sounds (Baroque Horn and Harpsichord I) so that you can begin to work out your own methods for creating programmed sounds. Let us look at these various things one at a time.

It is easy to change the positions of the factory presets using either U-4-8 or L-4-8 as a pivot point. For instance, let us say that we want to move Sync I from U-1-7 to L-2-5 (so it will be paired with Sync II), Unison Tri./Sq. Wave from L-2-5 to L-1-3 (so it will be paired with Muted Clav.), and Accordion from L-1-3 to U-1-7 (so it will be paired with Slow Sync Sweep). Use the following procedure:

- 1) Put the back panel RECORD ENABLE/DISABLE switch in the ENABLE position.
- 2) Switch PRESET mode on.
- 3) Select L-2-5 and press the RECORD switch.
- 4) Select U-4-8. You have now recorded Unison Tri./Sq. Wave in location U-4-8.
- 5) Select U-1-7 and press the RECORD switch.
- 6) Select L-2-5. You have now recorded Sync I in location L-2-5.
- 7) Select L-1-3 and press the RECORD switch.
- 8) Select U-1-7. You have now recorded Accordion in location U-1-7.
- 9) Select U-4-8 and press the RECORD switch.
- 10) Select L-1-3. You have now recorded Unison Tri./Sq. Wave in location L-1-3, and have completed this round of location juggling.

If the above procedure is followed carefully, you will never erase a program accidentally, because each program that is about to be erased from one location also exists in another location. Of course, you should be careful to hit the correct BANK and PROGRAM buttons when you are in RECORD mode — if you hit the wrong button you may erase a program that is not duplicated.

It is true that if you erase a factory program you can duplicate it using the patch diagrams provided in this manual; however, if you erase one of your own programs, you will have to start again from scratch unless you have kept a record of your front panel settings for that program. For this reason, we have provided you with a number of blank front panel diagrams at the end of this manual, and we recommend that you keep a record of your favorite programs.

Before replacing U-4-8 or L-4-8, it might be good to use the duplicate programs to familiarize yourself with techniques of fine-tuning a program. Edit U-4-8 and RECORD those adjustments, then switch back and forth between U-1-1 (the original patch) and U-4-8 (the patch as you have edited it). This will allow you to make some very direct comparisons between various settings, and will help you to understand how to go about adjusting various aspects of a patch in order to get the sound you want.

Use a similar approach in working with the L-4-8 dupe of the Harpsichord program. Read the notes accompanying the Harpsichord patch diagram (L-1-6) particularly those under the heading "GENESIS OF THIS PATCH." Experiment with some of the critical adjustments on the FILTER; change the PULSE-WIDTH settings of the two oscillators. RECORD some of your alterations on the patch in location L-4-8 and compare them with the original patch at location L-1-6 and use L-4-8 for a new purpose.

By the way, you need not limit yourself to Baroque Horn and Harpsichord sounds when experimenting in this way: any of the factory presets can be duplicated in location U-4-8 or L-4-8 to allow for this kind of experimental comparison.

**SECTION 8**  
**BLANK PATCH DIAGRAMS**

# PRESET PROGRAMS

1	2	3	4	5	6	7	8
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B A N K 1	UPPER	U-1-1	U-1-2	U-1-3	U-1-4	U-1-5	U-1-6	U-1-7	U-1-8
	LOWER	L-1-1	L-1-2	L-1-3	L-1-4	L-1-5	L-1-6	L-1-7	L-1-8

B A N K 2	UPPER	U-2-1	U-2-2	U-2-3	U-2-4	U-2-5	U-2-6	U-2-7	U-2-8
	LOWER	L-2-1	L-2-2	L-2-3	L-2-4	L-2-5	L-2-6	L-2-7	L-2-8

B A N K 3	UPPER	U-3-1	U-3-2	U-3-3	U-3-4	U-3-5	U-3-6	U-3-7	U-3-8
	LOWER	L-3-1	L-3-2	L-3-3	L-3-4	L-3-5	L-3-6	L-3-7	L-3-8

B A N K 4	UPPER	U-4-1	U-4-2	U-4-3	U-4-4	U-4-5	U-4-6	U-4-7	U-4-8
	LOWER	L-4-1	L-4-2	L-4-3	L-4-4	L-4-5	L-4-6	L-4-7	L-4-8

# PRESET PROGRAMS

		1	2	3	4	5	6	7	8
<b>B A N K  1</b>	UPPER	U-1-1	U-1-2	U-1-3	U-1-4	U-1-5	U-1-6	U-1-7	U-1-8
	LOWER	L-1-1	L-1-2	L-1-3	L-1-4	L-1-5	L-1-6	L-1-7	L-1-8
<b>B A N K  2</b>	UPPER	U-2-1	U-2-2	U-2-3	U-2-4	U-2-5	U-2-6	U-2-7	U-2-8
	LOWER	L-2-1	L-2-2	L-2-3	L-2-4	L-2-5	L-2-6	L-2-7	L-2-8
<b>B A N K  3</b>	UPPER	U-3-1	U-3-2	U-3-3	U-3-4	U-3-5	U-3-6	U-3-7	U-3-8
	LOWER	L-3-1	L-3-2	L-3-3	L-3-4	L-3-5	L-3-6	L-3-7	L-3-8
<b>B A N K  4</b>	UPPER	U-4-1	U-4-2	U-4-3	U-4-4	U-4-5	U-4-6	U-4-7	U-4-8
	LOWER	L-4-1	L-4-2	L-4-3	L-4-4	L-4-5	L-4-6	L-4-7	L-4-8



# PRESET PROGRAMS

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

<b>B A N K 1</b>								
UPPER	U-1-1	U-1-2	U-1-3	U-1-4	U-1-5	U-1-6	U-1-7	U-1-8
LOWER	L-1-1	L-1-2	L-1-3	L-1-4	L-1-5	L-1-6	L-1-7	L-1-8

<b>B A N K 2</b>								
UPPER	U-2-1	U-2-2	U-2-3	U-2-4	U-2-5	U-2-6	U-2-7	U-2-8
LOWER	L-2-1	L-2-2	L-2-3	L-2-4	L-2-5	L-2-6	L-2-7	L-2-8

<b>B A N K 3</b>								
UPPER	U-3-1	U-3-2	U-3-3	U-3-4	U-3-5	U-3-6	U-3-7	U-3-8
LOWER	L-3-1	L-3-2	L-3-3	L-3-4	L-3-5	L-3-6	L-3-7	L-3-8

<b>B A N K 4</b>								
UPPER	U-4-1	U-4-2	U-4-3	U-4-4	U-4-5	U-4-6	U-4-7	U-4-8
LOWER	L-4-1	L-4-2	L-4-3	L-4-4	L-4-5	L-4-6	L-4-7	L-4-8

