3. SIGNAL GENERATORS

3.1 OSCILLATORS

The Buchla has four oscillators arranged in two identical pairs. Each pair forms a module labeled PROGRAMMABLE COMPLEX WAVEFORM GENERATOR and they are located just above the keyboard. Each module contains a PRINCIPAL OSC., with various waveshaping controls, and a MODULATION OSC. which has some pre-patched connections to the PRINCIPAL OSC.. Both have signal outputs and control voltage inputs, and the MODULATION OSC. has a control voltage output as well. It is important to realize that both these oscillators can be used completely independently of one another. They can both produce audio and sub-audio frequencies and their roles as "PRINCIPAL" or "MODULATION" oscillators are set up as a convenience and not as a requirement.

3.1.1 Principal Oscillator

3.1.1.1 Outputs

The PRINCIPAL OSC. occupies the right-hand half of each module. It has four signal outputs across the top. The sine and square wave outputs are unaffected by any of the waveshaping controls or inputs from the MODULATION OSC. except pitch modulation. The two FINAL outputs are identical variable waveshape outputs and represent all control voltages influencing the oscillator.

3.1.1.2 Phase lock

The PHASE LOCK jack, just below the signal outputs, is an input with attenuator pot which phase locks the frequency of this oscillator with the frequency of the input signal. If the frequency of the input signal is close to or lower than that of the oscillator it will cause the oscillator to "lock" onto the frequency of the input signal. If the input

has a higher frequency the oscillator will "lock" onto the nearest sub-harmonic of the input frequency. This can be used to eliminate "beating" between two oscillators tuned in unison, octaves or harmonics.

3.1.1.3 Frequency control

Beneath the PHASE LOCK input and functionless AUTOTUNE switch are the coarse and fine tuning frequency control pots. The scale on the coarse tuning knob indicates frequency in Hertz and marks off octaves starting from "A"=27.5 Hz. (the lowest "A" on the piano). As indicated by its calibration the coarse tuning pot gives the oscillator a range of about eight octaves but this can be greatly extended with a control voltage. The fine tuning pot has a range of about a fifth. The two LED's beside the pitch control pot on each oscillator are meant for use with the computer and, despite the fact that they occasionally turn on and off, they indicate nothing.

3.1.1.4 Pitch modulation

Both the PRINCIPAL and MODULATION oscillators have the same three frequency modulation inputs. These are the jacks just beneath the tuning pots. The jack with attenuator pot on the left accepts an AC signal for frequency modulation. This is one of the few places on the synthesizer where a signal can be used as a control voltage. The banana-jack in the centre has a special attenuator which **inverts** the input signal if it is turned to the left (-) side. This pot, and others like it elsewhere on the machine, are extremely sensitive and give a very wide range of voltage control. The jack on the right, labeled KEYBOARD has a fixed sensitivity of 2.4 volts per octave which is the same as the output of the keyboard. In otherwords, if you want the keyboard to play recognizable intervals, this is the jack to use.

3.1.1.5 Waveshape controls

Along the right-hand side of the PRINCIPAL OSC. are some fairly elaborate waveshaping controls. These are split into two sections labeled HARMONICS and TIMBRE. It is worth noting that these controls are labeled according to the audible effect they produce and **not** the changes in waveshape they

cause. These changes are quite complex and are best observed on an oscilloscope for those who are interested. It is quite sufficient just to associate these controls with their audible effect.

The HARMONICS section consists of two controls, each with an unattenuated control voltage input. The top pot, labeled SYMMETRY, determines the mix of odd and even harmonics in the final output. The LED indicator will get brighter as the odd harmonics get stronger. The ORDER control emphasizes either low or high harmonics. Its indicator gets brighter as more high harmonics are added. This determines the relative "brightness" of the sound.

The bottom section labeled TIMBRE simply determines the strength of the harmonics present in the final output. With the TIMBRE pot turned all the way to the left the final output is almost a sine wave. As the pot is turned to the right the harmonic content, as determined by the SYMMETRY and ORDER controls, increases. The timbre control has a control voltage input with an inverting attenuator the same as on the pitch modulation input.

These three waveshape controls have a tremendous effect on the final output signal and should be experimented with to discover the wide range of timbres this oscillator can produce before any signal processing.

3.1.2 Modulation Oscillator

3.1.2.1 Outputs

The MODULATION OSCILLATOR, on the left side of the oscillator module, also has four outputs across the top much like the PRINCIPAL OSC.. From left to right: a triangle wave output, a control voltage output, and two identical signal outputs. The waveshape for all but the triangle wave output is selected by the three position switch just below the outputs on the right labeled WAVESHAPE. The waveforms are as indicated; sawtooth, square, or triangle. (Note: The saw-

tooth output is actually the reverse of what the label shows. It has a short rise time and a long decay.)

3.1.2.2 Frequency control

To the left of the WAVESHAPE switch is a RANGE switch which sets the frequency range of this oscillator. It has two positions, (HIGH and LOW), with a difference between them of about six octaves plus a tritone. The AUTOTUNE position, of course, has no function. (One wonders what sort of melodies AUTO-TUNE might play.)

The coarse and fine tuning pots and the frequency modulation inputs are all exactly the same as on the PRINCIPAL OSC.. The scale on the coarse tuning knob indicates frequencies (in Hz) for the LOW and HIGH ranges and, in its HIGH range, is calibrated the same as the PRINCIPAL OSC.. This knob then, gives a range of about eight octaves in each of its two ranges. With a control voltage the frequency of this oscillator can be driven up over 20,000 Hz and down to .0003 Hz. (One cycle every two and a half hours.) Be aware that the scales on these pots are only a rough guide and it's best to use a frequency counter or your ear to do accurate tuning.

3.1.3 Pre-Patched Connections

Between each pair of oscillators are the switches and pots which control the "pre-patched" connections between the MODULATION OSC. and the PRINCIPAL OSC.. The switches are "on" to the left and "off" to the right. The appropriate LED will light to indicate a connection is made.

The top switch is a phase lock FROM the PRINCIPAL OSC. TO the MODULATION OSC. as the arrow indicates. This is primarily intended to be used to prevent "beating" between the two oscillators when they are tuned to a unison or in harmonics but can be used for other effects as well.

The remaining controls are all from the MODULATION OSC. to the PRINCIPAL OSC.. The second switch down is for amplitude modulation of the PRINCIPAL OSC.. The next switch is for pitch modulation and the bottom switch is for timbre modulation. The modulating signal is an AC signal the waveshape of which is selected by the WAVESHAPE switch.

The pot labeled MOD. INDEX controls the degree of modulation. One of the advantage of these pre-patched connections is that the MOD. INDEX is voltage controllable (by means of the control voltage input with inverting attenuator pot). This allows voltage control of the degree of amplitude, pitch, or timbre modulation between these two oscillators. There are other ways to do this (see DUAL VOLTAGE PROCESSORS) but the pre-patched connections make it very simple.

All these controls may be used together or in any combination but the modulation INDEX is the same for all of them at any one time. (Note: Even with all the modulation switches "off", if the MODULATION INDEX is turned up high, some of the signal from the MODULATION OSC. leaks through to the PRINCIPAL OSC.. If no modulation is desired the MOD. INDEX should be turned down, as well as turning off the modulation switches.)

3.2 NOISE GENERATOR

The only other signal generator on the Buchla is the NOISE SOURCE. It is located at the top of the SOURCE OF UNCERTANTY module which is just to the right of the oscillators. This noise generator consits of three different outputs labeled -3dB, FLAT, and +3dB. Each output has two identical jacks. The FLAT output is known as "pink noise" which is defined as random frequencies and amplitudes with equal energy per octave. The +3dB output is a "white noise" source. White noise has equal energy at any frequency. The -3dB output is just a minus 3dB per octave noise source.