spirit

OWNER'S MANUAL

CRUMAR®

sound design for the creative musician

AUDIO HOOKUP

BEFORE POWERING UP THE SPIRIT, CHECK THE PLATE ON THE REAR PANEL FOR THE APPROPRIATE OPERATING VOLTAGE (117 Volt Model is for use in U.S.A.). DO NOT CONNECT A 117 VOLT MODEL INTO EUROPEAN (220 Volts) MAINS WITHOUT AN APPROPRIATE ADAPTER.

AFTER CHECKING THE SPIRIT FOR APPROPRIATE OPERATING VOLTAGE, DO THE FOLLOWING:

A. Plug the Spirit power cord into a conventional power outlet.
B. Connect the ADSR/MIX AUDIO OUT jack on the Spirit rear panel to your amplifier input. The Spirit output is high level.
   Choose the least sensitive amplifier input, probably marked "high level." Keep your amplifier volume knob to zero "O" to avoid connection thump.
C. Flip the power switch (near power cord) on the Spirit's rear panel up (on).
D. Continue to GETTING A SOUND/TUNEUP section of this manual.

GETTING A SOUND/TUNEUP

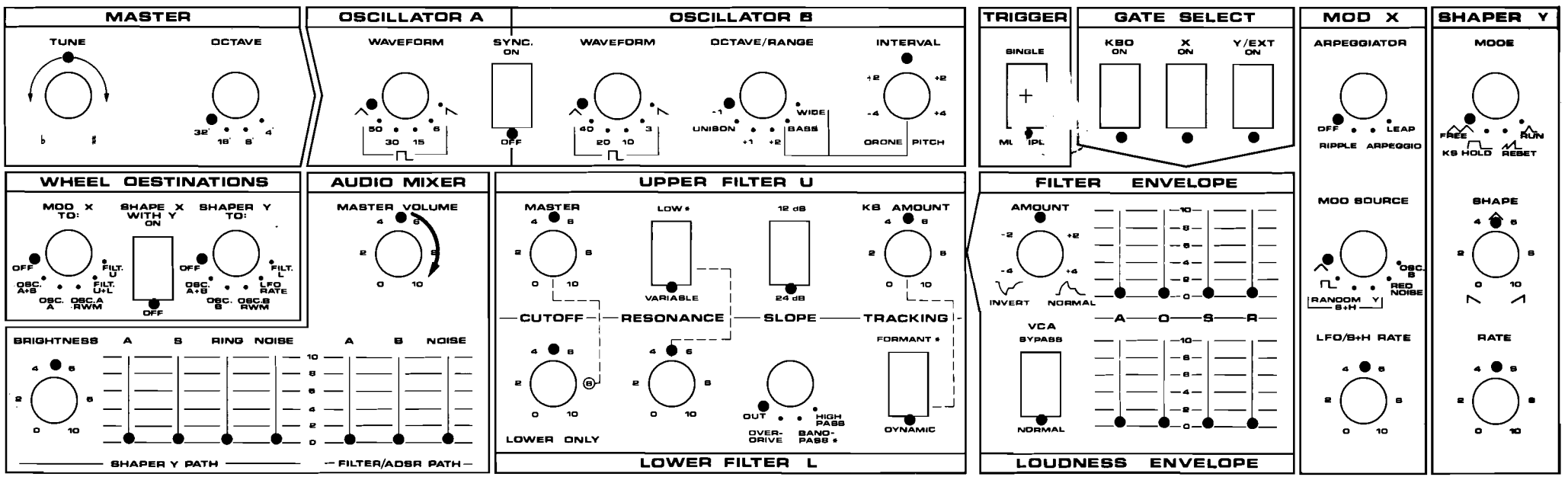
THE FOLLOWING IS A SOUND CHECK/TUNEUP: A QUICK AND SURE WAY TO GET A SOUND FROM THE SPIRIT.

FIRST ...

Do the following to "prepare" the Spirit:

1. (Follow instructions in AUDIO HOOKUP section of the manual.)
2. Turn all Spirit rotary pots (smooth turning knobs) to 12 o'clock position — —"straight up."
3. Switch all rotary switches fully to the left.
4. Switch all rocker switches down.
5. Push all slidepots fully down.
6. Center the PITCH BEND wheel, and move the MOD X and SHAPER Y wheels fully back toward you.

PREPARATORY PATTERN



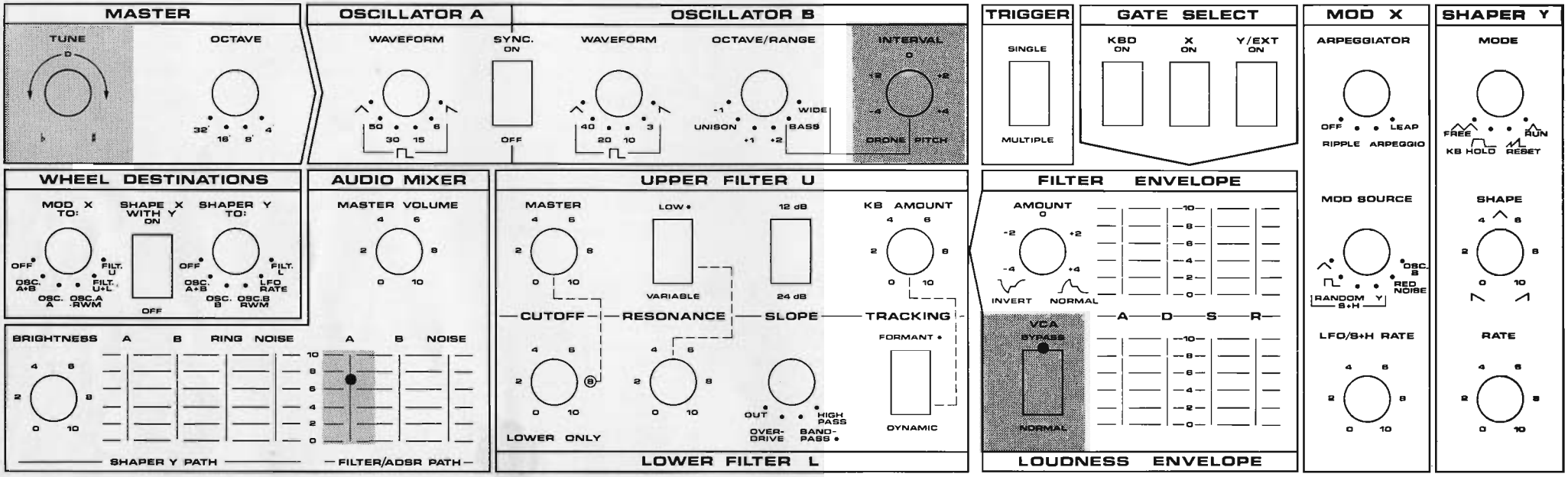
Rotary pots to **12 o'clock.** Rotary switches to **left.** Rocker switches **down.** Sliders **down.**

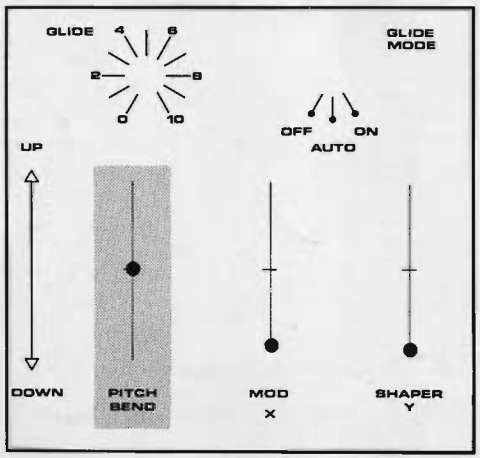
This Preparatory Pattern produces no sound. It is simply an easily remembered starting point.

THEN... GETTING A SOUND ...

7. Switch VCA switch in LOUDNESS EVELOPE section to BYPASS.
8. Push FILTER/ADSR PATH slider A up. (sound).

TUNEUP





NOW... TO TUNE THE SPIRIT...

BEFORE TUNING ALWAYS CHECK TO SEE THAT THE PITCH BEND WHEEL IS CENTERED.

9. Depress the key you want to match and tune using the TUNE control in the MASTER section. You may want to select a brighter sound for tuning; to do so, use the OSCILLATOR A WAVEFORM switch.
10. Push FILTER/ADSR slider B (next to A) up.
11. Use the OSCILLATOR B INTERVAL control to produce beatfree tuning between B and A. (Note: Osc B is presently one octave lower that A. Change OCTAVE/RANGE to UNISON to match pitches.) Once again, you may want to listen to a brighter waveform; to do so, change the WAVEFORM switch for Oscillator B.

When you start from the Preparatory Pattern it is easy to get a sound: switch VCA to BYPASS and raise the A slider. When tuning, tune A first using the MASTER TUNE control, then tune B relative to A using the INTERVAL control and OCTAVE/RANGE switch.

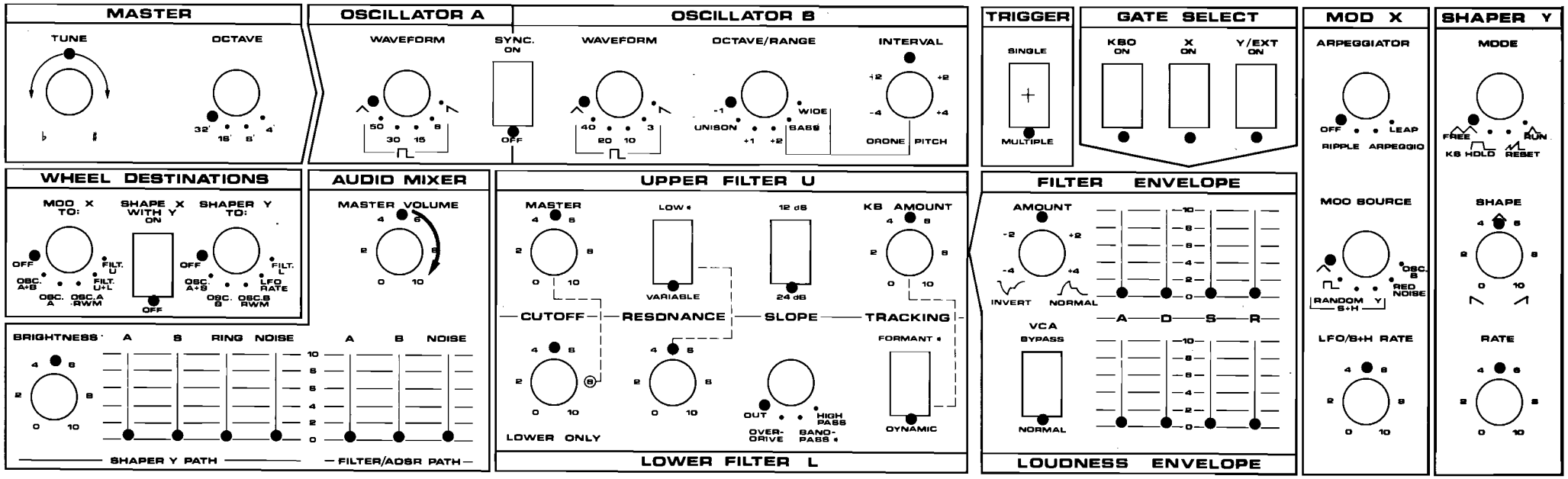
For best signal — to — noise ratio, place MASTER VOLUME high (at least 5), use reasonalby high slider positions (at least 6), and adjust your amplifier loudness to a comfortable listening level.

SOUND CHARTS

THIS SECTION SHOWS YOU HOW TO CREATE SOUNDS EASILY BY DUPLICATING SOUND CHART SETTINGS ON THE CONTROL PANEL OF THE SPIRIT, AND HELPS YOU LEARN THROUGH EXPERIMENTATION.

Unlike the traditional arranger, who chooses from a group of instruments with somewhat fixed characteristics, the synthesist is confronted by a continuous spectrum of instrumental and non-instrumental sound textures. Because the sounds of the synthesizer are not as fixed and well-known as many other instruments, we have developed a notation system that shows what the front panel of the instrument looks like when a particular sound is produced — — the sound chart. A sound chart is only an approximation. To get the most from these sound charts several ideas may be helpful:

PREPARATORY PATTERN

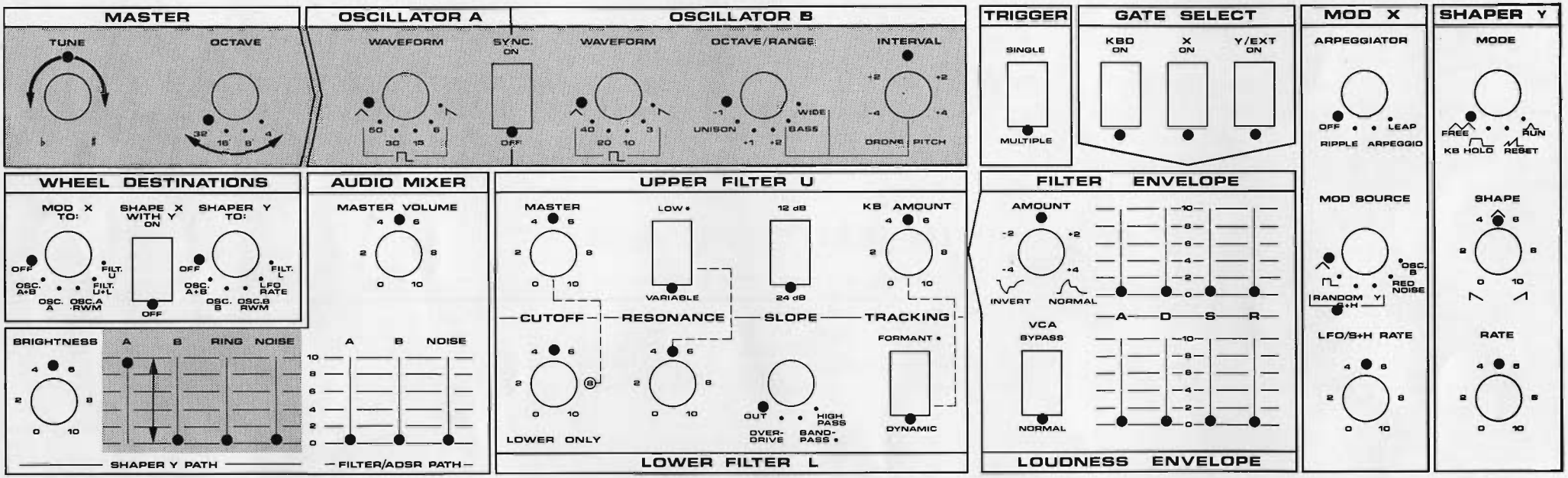


Rotary pots to **12 o'clock.** Rotary switches to **left.** Rocker switches **down.** Sliders **down.**

1. Start from the **Preparatory Pattern.**
   This assures that controls that do not play a part in the sound will not interfere.
2. Set up the sound chart accurately.
3. Change the MASTER CUTOFF control to alter tone color.
4. Adjust ENVELOPE settings, especially "A" and "D."
5. When simulating orchestral instruments, place the synthesized sound in context by playing in the appropriate pitch range, and select musical lines that could be played on that instrument.
6. Don't forget you are playing a soloistic instrument; such instruments are played expressively. Use the PITCH BEND wheel and the MOD X wheel to do what solo instruments do best: bend pitch and vary vibrato.

The following sound charts illustrate some of the Spirit's sound world. Play with them in any order. Try them by the book first, and then experiment.

SOUND SOURCES

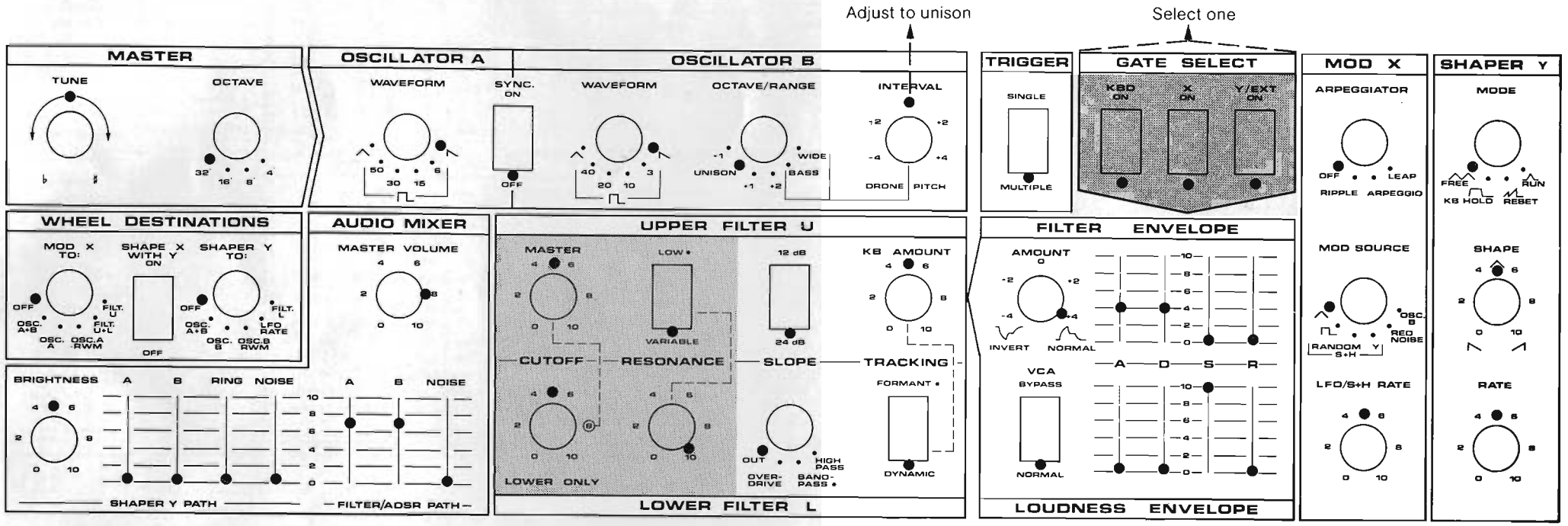


EXPLORATION OF RAW AUDIO SIGNALS.

1. Start from the Preparatory Pattern.
2. Push slider A in SHAPER Y PATH up.
   (Sound is articulated repeatedly).
3. Strike highest note on keyboard.
4. Play with each control — — individually — — in the MASTER, OSCILLATOR A, and OSCILLATOR B sections. Return each control to its original position after you play with it.
5. Repeat step 4, with (only) slider B pushed up.
6. Switch Osc B OCTAVE/RANGE to WIDE.
   Push RING slider (only) up. Play with INTERVAL and Octave.
7. Push NOISE slider (only) up.

YOU LEARNED: The MASTER section affects both oscillators. There are individual controls for A and B. Each oscillator has its own WAVESHAPE control, which changes the basic tone color. RING can produce bell-like sounds; WAVEFORM controls have no effect on RING, or Ring Modulator output. NOISE sounds like static — — has no definite pitch.

FAT FILTER



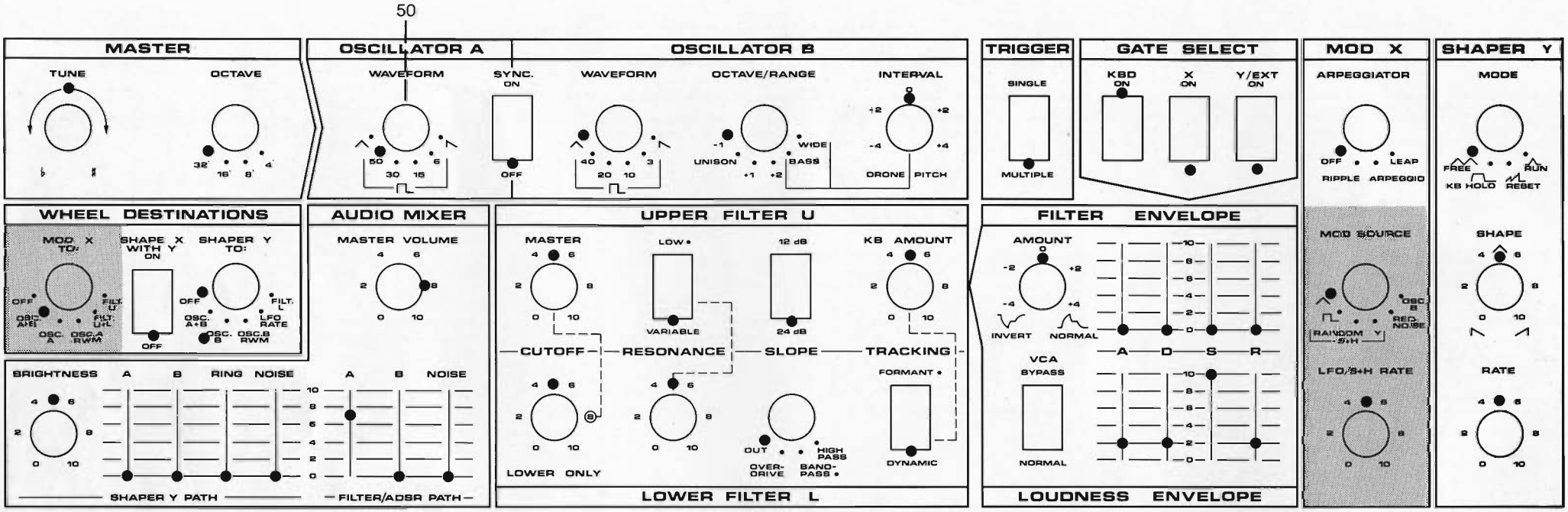
EXPLORATION OF GATING AND UPPER FILTER FEATURES.

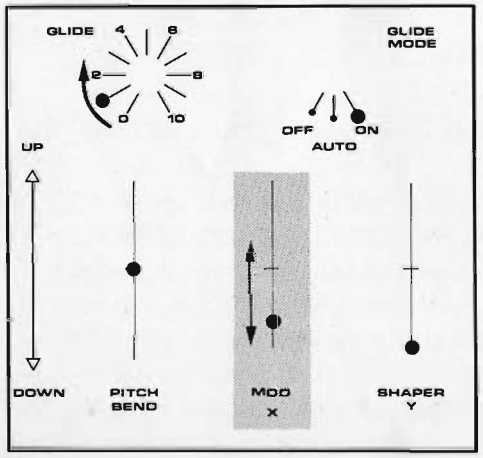
1. Play... (no sound). Switch GATE SELECT KBD switch ON. Play!
2. Try GATE SELECT switches individually and in combination.
3. Place (only) KBD switch ON.
4. Hold key and listen. Switch UPPER FILTER RESONANCE switch between VARIABLE and LOW and compare. Return to VARIABLE position.
5. Experiment with LOWER FILTER RESONANCE control. Return to 10.
6. Alter setting of MASTER CUTOFF. Play. Return to original position.
7. Do same with LOWER ONLY CUTOFF.

YOU LEARNED: Must have one GATE SELECT switch ON to articulate sound in FILTER/ADSR PATH. Sound can be gated by MOD X, SHAPER Y, or keyboard.

Filter resonance affects sound greatly. Resonance of UPPER FILTER is varied by (lower) RESONANCE control when VARIABLE position selected above. MASTER CUTOFF sets filter "starting point." LOWER ONLY CUTOFF inoperable when Lower Filter is OUT (look again).

MOD WHISTLE



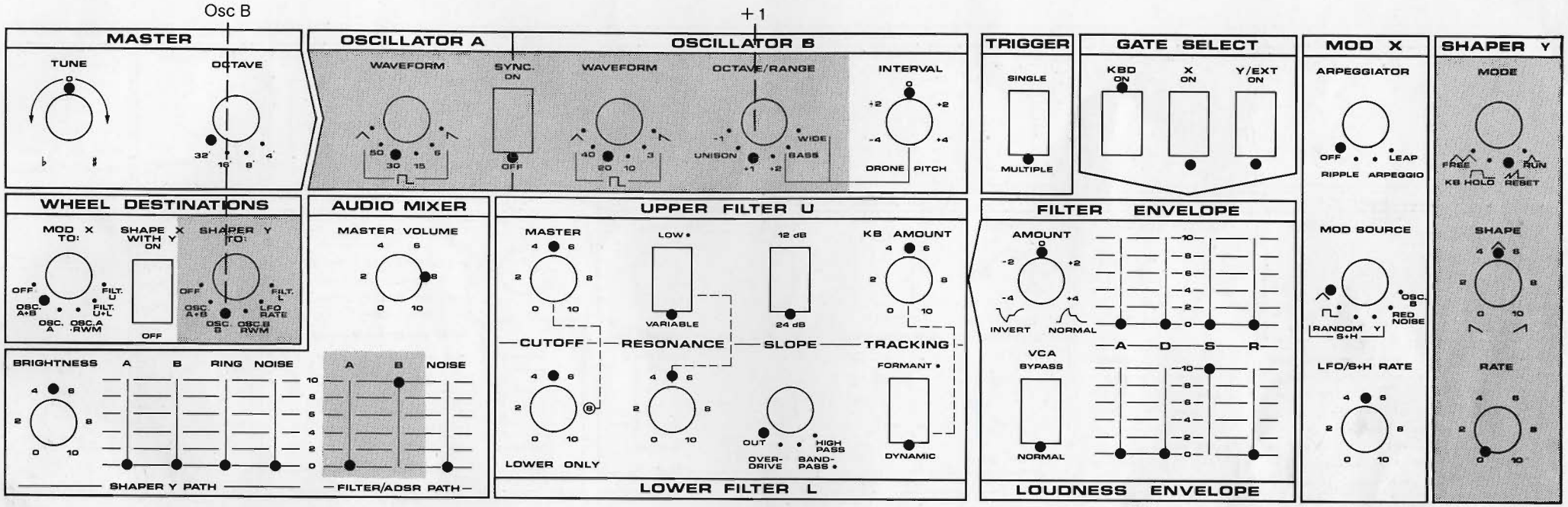


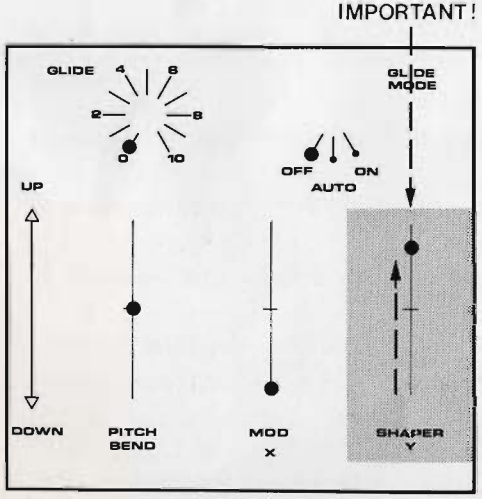
EXPLORATION OF X MODULATIONS

1. Play. MOD X wheel controls vibrato amount.
2. Adjust vibrato speed with LFO/S+H control.
3. Try all MOD X TO: positions; for each, move MOD X wheel fully forward and back.
4. Repeat step 3 for each MOD SOURCE position.

YOU LEARNED: MOD SOURCE determines the shape of modulation signal; MOD X wheel controls the amount; MOD X TO: determines where the signal goes.
GLIDE smoothes pitch transitions.

SYNC



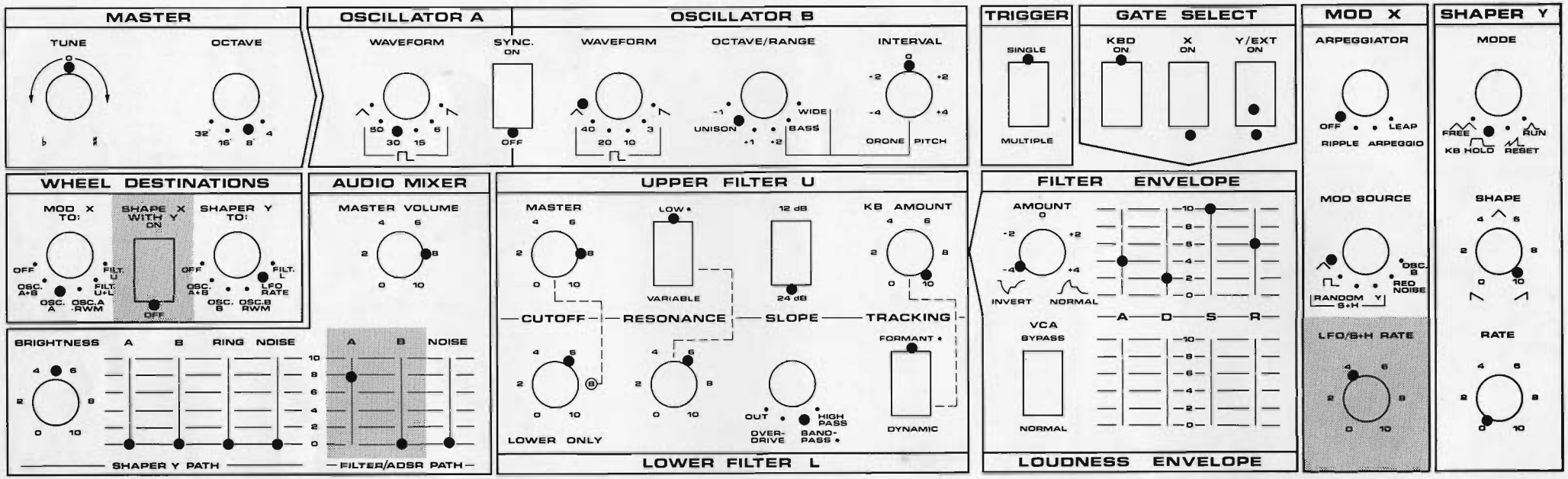


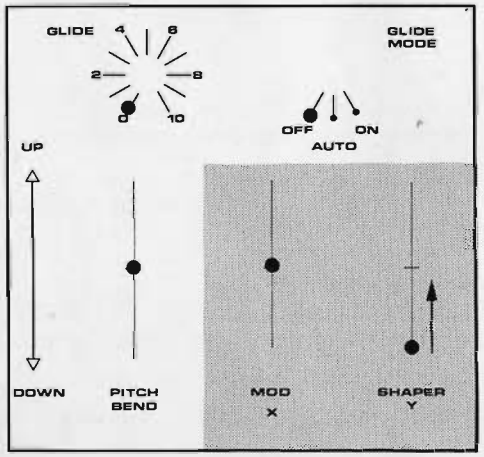
EXPLORATION OF OSCILLATOR SYNC

1. Play (siren). Put SYNC switch ON.
   Play (sync sound).
2. Play — — change Oscillator controls in shaded area. Return to original positions. (Important!)
3. Put SHAPER Y TO: switch to OFF.
   Play (no sync sound). Return to OSC B.
4. Move SHAPER Y wheel fully back toward you. Play (no sync sound). Move wheel forward.
5. Experiment with — — one at a time — — the SHAPER Y section controls.
6. Repeat steps 1 through 5 with only the A slider up.

YOU LEARNED: The sync sound is heard when SYNC is ON, Osc B is listened to, and B pitch is moved. It is important to tune Osc B pitch higher than A to get a strong sync sound.
Osc A WAVEFORM doesn't influence sound heard at slider B. Osc B WAVERFORM does somewhat.

SHAKE SHAPE



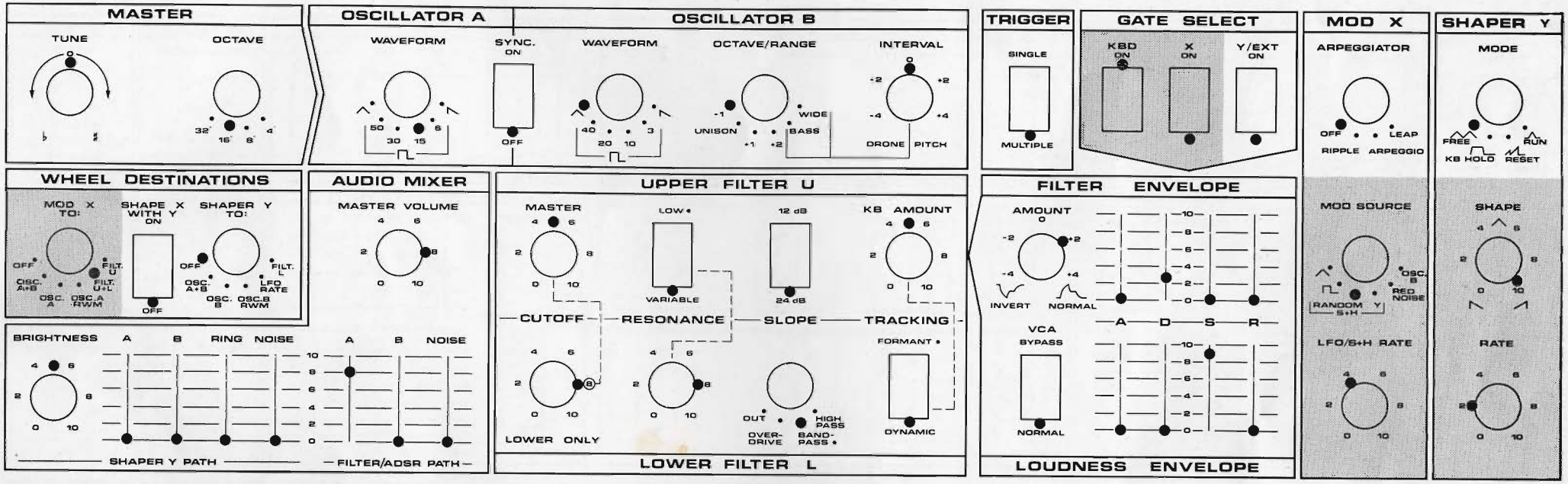


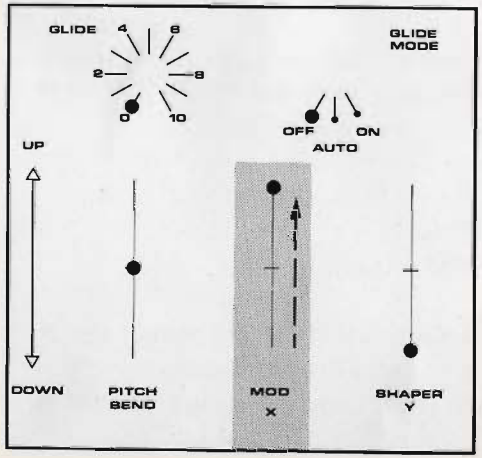
EXPLORATION OF SHAPER Y VIBRATO AMOUNT/RATE CONTROL

1. Hold any key down. (Immediate vibrato).
2. Switch SHAPE X WITH Y SWITCH ON. Play. (Vibrato amount is shaped by Y).
3. Switch SHAPE X WITH Y SWITCH OFF.
4. Move SHAPER Y wheel to midpoint. Play. (Vibrato rate is increased by Y).
5. Try different SHAPER Y wheel and LFO—S+H RATE settings; experiment.
6. Adjust MOD X wheel for desired vibrato depth. Repeat step number 2.

YOU LEARNED: MOD X wheel determines the maximum depth of modulation routed to MOD X TO: switch. SHAPE X WITH Y switch shapes within that maximum.
Shaper Y alters MOD X rate when SHAPER Y TO: switch is to LFO RATE. The Y wheel sets fastest rate; LFD/S+H RATE sets slowest (beginning) rate.

SAMPLE & HOLD



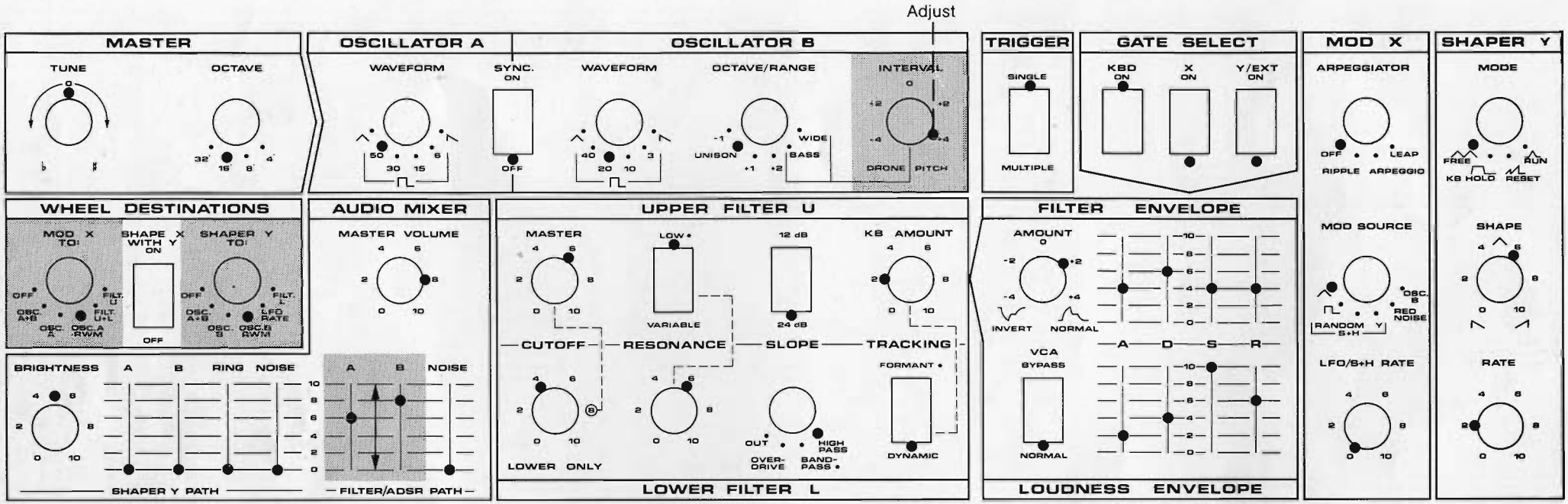


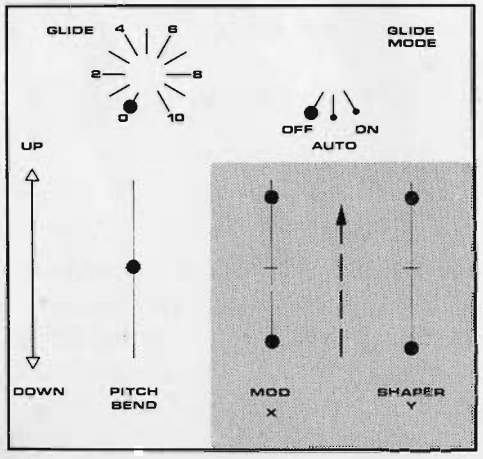
EXPLORATION OF SAMPLE AND HOLD MODES

1. Hold any key down. (Filter effect).
2. In GATE SELECT section put switch X ON. (Auto-repeat).
3. Change MOD X TO: the OSC A+B position.
4. Change MOD SOURCE to position Y. (The pattern is now regular, not random.)
5. Vary SHAPE, then RATE in SHAPER Y section.
6. Vary MOD X RATE.

YOU LEARNED: S&H effects are routed through the MOD X wheel. Therefore, the MOD X TO: switch selects destination of S&H pattern, determining whether S&H effects pitch, tone color, etc.
MOD X LFO/S+H RATE determines S&H rate. SHAPER Y output determines S&H pattern when MOD X is in Y position. RANDOM MOD X position causes random sample and hold pattern.

PARALLEL RECTANGLES



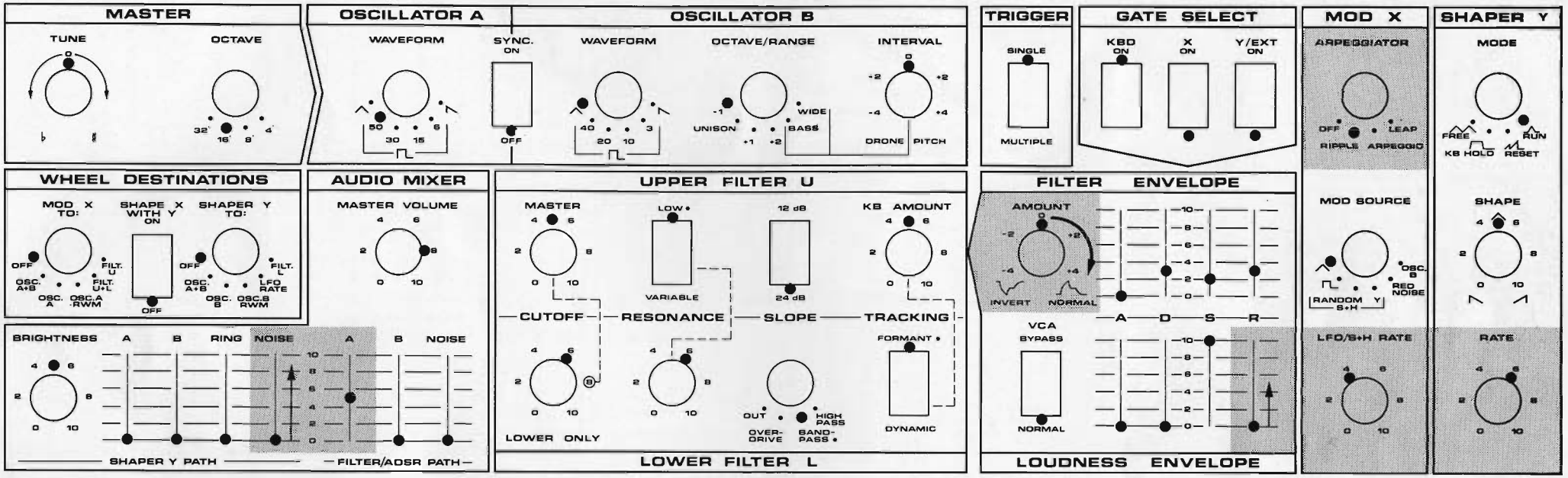


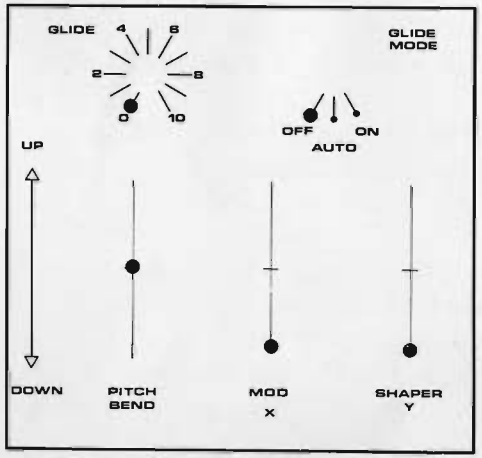
EXPLORATION OF OSCILLATOR TUNING AND RECTANGULAR WAVE MODULATION

1. Hold highest note on keyboard. Adjust INTERVAL control to create interval of perfect fifth between oscillators. Use MASTER VOLUME sliders to listen to each Oscillator individually, then together.
2. Raise Slider A only. Push MOD X wheel fully forward and listen.
3. Raise Slider B only. Push SHAPER Y wheel fully forward and listen.
4. Raise Sliders A and B. Adjust wheels. Play.
5. Repeat experiment. Try all WAVEFORM settings.

YOU LEARNED: Osc B can be tuned to an interval above (or below) Osc A. RWM is Rectangular Width Mudulation; it has no effect on Triangular and Sawtooth waveforms. Osc A and Osc B RWM can be done independently (see WHEEL DESTINATIONS).

ARPEGGIO



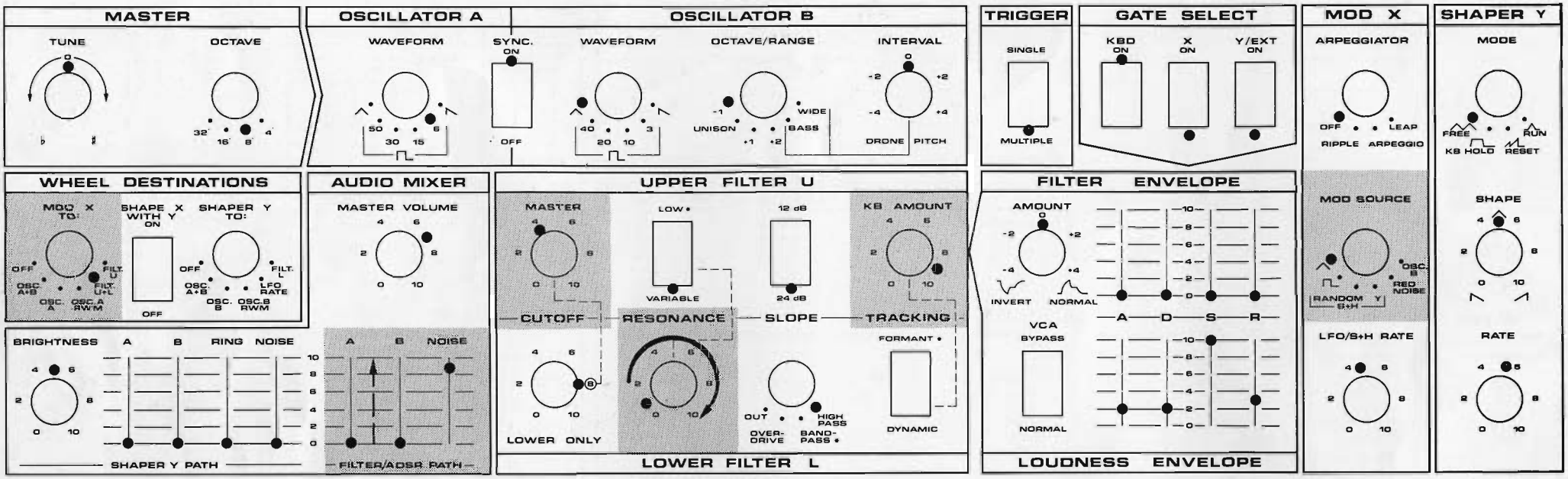


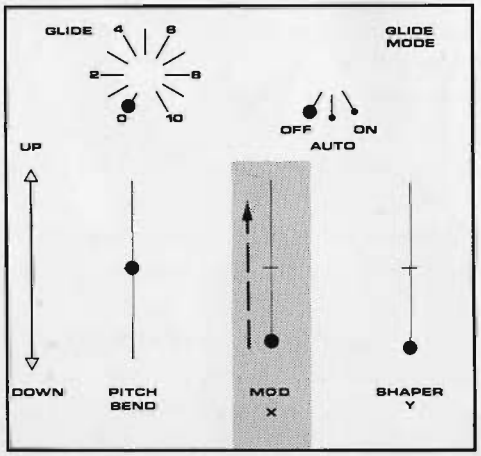
EXPLORATION OF MOD X ARPEGGIATOR

1. Play and hold a three-note chord in middle of keyboard.
2. Try different ARPEGGIATOR modes while holding chord.
3. Push LOUDNESS ENVELOPE slider R to "4."
   Turn FILIER ENVELOPE AMOUNT to "+4."
4. Raise NOISE slider in SHAPER Y PATH.
5. Change LFO/S+H RATE; watch X and Y RATE lights.

YOU LEARNED: The Spirit will make a sequence of notes played on the keyboard when the ARPEGGIATOR is on. Octave changes occur in the ARPEGGIO and LEAP modes.
Sound produced may be enveloped by FILTER ENVELOPE and LOUDNESS ENVELOPE.
ARPEGGIATOR modes cause SHAPER Y RATE to synchronize with LFO/S+H RATE. (Exception: FREE MODE).

NOISE SCALE



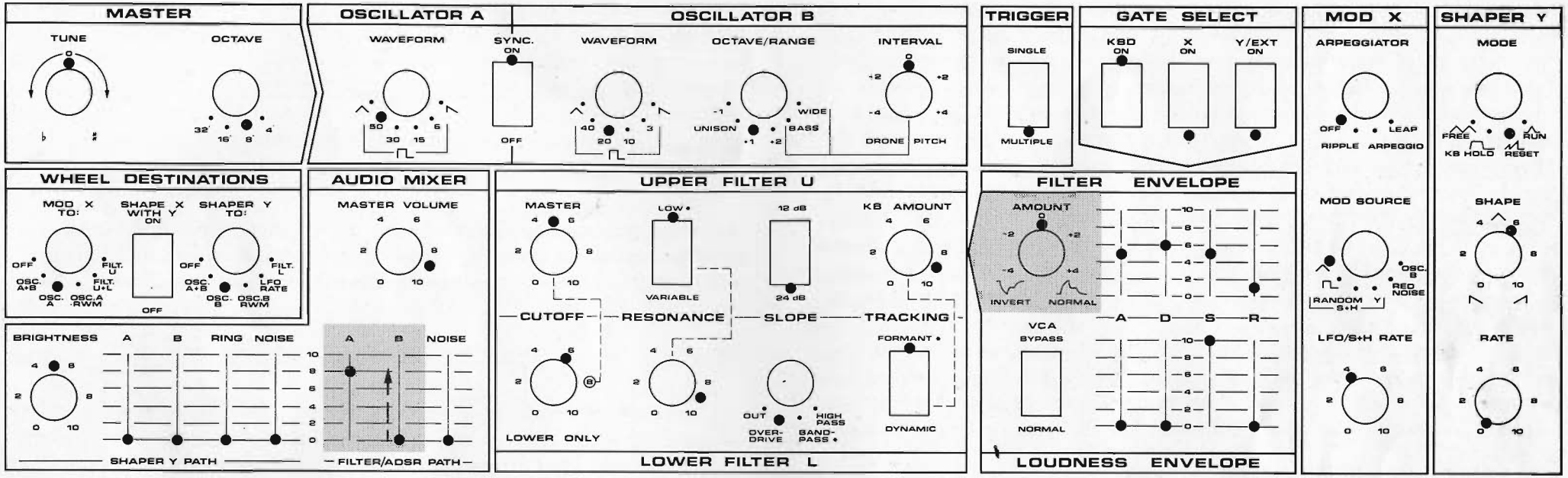


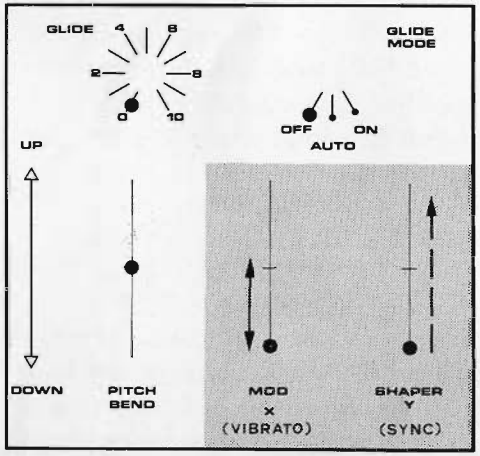
EXPLORATION OF NOISE AS SOUND SOURCE

1. Play keyboard. Turn RESONANCE to "10." Play!
2. Compare noise pitch to Osc A pitch. Use Slider A only, then NOISE Slider only.
3. Hold lowest key and "tune" noise to Osc A pitch using MASTER CUTOFF. Adjust keyboard scale (interval size) using KB AMOUNT TRACKING control.
4. Play. Push MOD X wheel forward. Note position of MOD X TO: switch.
5. Put MOD X wheel fully forward. Change MOD SOURCE. Play. Vary LFO/S+H RATE.

YOU LEARNED: Noise takes on the pitch of filter cutoff frequency when resonance is maximum. KB AMOUNT TRACKING causes the filter cutoff to move, or "track" the keyboard.
Filter modulations sound like pitch changes when filter resonance is maximum. (Because the cutoff frequency determines pitch, and it is being moved.)

INVERTED GUITAR





EXPLORATION OF NORMAL/INVERTED FILTER ENVELOPES

1. Hold a note in middle of keyboard for 10 seconds.
2. Turn FILTER ENVELOPE AMOUNT to "+ 4." (NORMAL). Repeat step number 1.
3. Turn FILTER ENVELOPE AMOUNT to "— 4." (INVERT).
4. Turn FILTER ENVELOPE AMOUNT to — 2.
5. Push B Slider up and SHAPER Y wheel forward. Play.
6. Use MOD X wheel to introduce vibrato.

YOU LEARNED: NORMAL filter envelopes cause the filter cutoff to rise, then fall. INVERT (ed) filter envelopes cause the filter cutoff to fall, then rise.

The Spirit synthesizer has balls.

SYNTHESIZER BASICS

The synthesizer offers the performer new ways to deal with the properties of sound: pitch, timbre (tone color), and loudness. With electronic musical instruments, form need not follow function. That is, the physical construction, size and shape of the synthesizer doesn't dictate the sounds it produces. The way its electronic elements are connected, controlled and calibrated does.

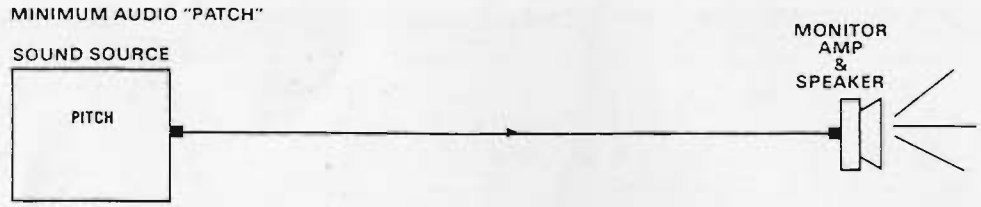
The early versions of the modern synthesizer were modular. This type has separate modules — — like stereo system components — — that provide independent and variable control over sound properties. An inexpensive and reliable way to connect these modules is with cables called "patchcords." Synthesizers designed specifically for live performances — — such as the Spirit — — let you "patch" together sections (modules) of the instrument using switches, knobs, and sliders instead of patchcords. (Even when patchcords are not used, a synthesizer control panel setup is still often referred to as a "patch.")

For the purpose of learning about synthesizers, let's continue to think of the synthesizer as a collection of modules that do different things, and require patchcord connection. Since sound has the properties of pitch, timbre, and loudness, it follows that the synthesizer has modules dealing with each property:

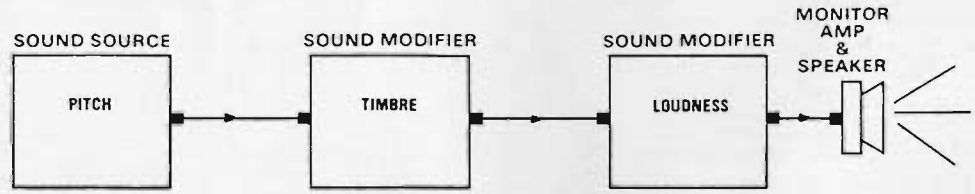
The synthesizer manipulates electronic signals — — sound is created by a speaker. Sound starts as an electronic signal capable of driving a speaker — — an audio signal. Not surprisingly, the module that does this is called an "audio signal generator." This generator is sometimes called simply a "sound source."

A sound source generates the unrefined tone or noise that can be shaped into musical sound. Take the mouthpiece of a trumpet and buzz sounds using your lips — — this is an unrefined sound source! The timbre module on most synthesizers acts somewhat like a trumpet mute — — each is a sound modifier. The loudness module is another modifier, like the bell of the trumpet. The pitch module of the synthesizer is a sound source similar to the lips, mouthpiece, and column lengths that make trumpet pitches.

We need at least two things to get sound from a synthesizer: a sound source and a speaker to translate the audio signal coming from the sound source:

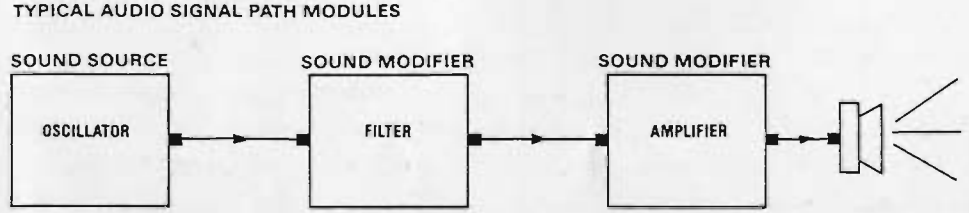


The sound produced by this most basic of "patches" is not interesting. The sound properties are static — — they don't change. Now let's insert the timbre and loudness modifiers between the sound source and the speaker:



The path from sound source through the modifiers to the speaker is called the "audio signal path." Note that the sound source has only an audio output since it actually generates the audio signal. The modifiers have both an audio input and an audio output since the signal to be modified passes through them.

Now let's use the appropriate synthesizer terminology. The pitch-generating module is called an oscillator, the timbre-modifying module is called a filter, and the loudness modifier is called an amplifier. The diagram below shows these synthesizer modules in the audio signal path that establish a pitched musical sound:



Modulation

Modulation is a change — — typically a recurring, or repetitive change. Let's consider the case of vibrato. Vibrato is a repetitive, smooth change above and below a "center" pitch. The VCO's make pitched sound; we simply must find a source that makes smooth up-and-down voltage changes around zero volts so we can control the VCO. What, not another oscillator? Right. An oscillator connected to the control input of a VCO. Of course we will want this control signal generator to run very slowly — — at about 6 Hz for vibrato speed! What we need is a "low frequency" oscillator, or LFO.

MOD X

Mod X is a source of control signals. Part of this section is our needed low frequency oscillator — — LFO. The LFO part is represented by the triangle and square waveforms on the MOD SOURCE switch. The frequency of this LFO is determined by the LFO/S + H RATE control.
When any MOD SOURCE is chosen, it is routed to the MOD X wheel where its size may be controlled (attenuated), and sent to the MOD X TO: switch in the WHEEL DESTINATIONS section. All Wheel Destinations are control inputs. All MOD SOURCES are (controller) outputs. In some cases (e.g. OSCILLATOR B), one section can be used as a sound source and/or a controller.

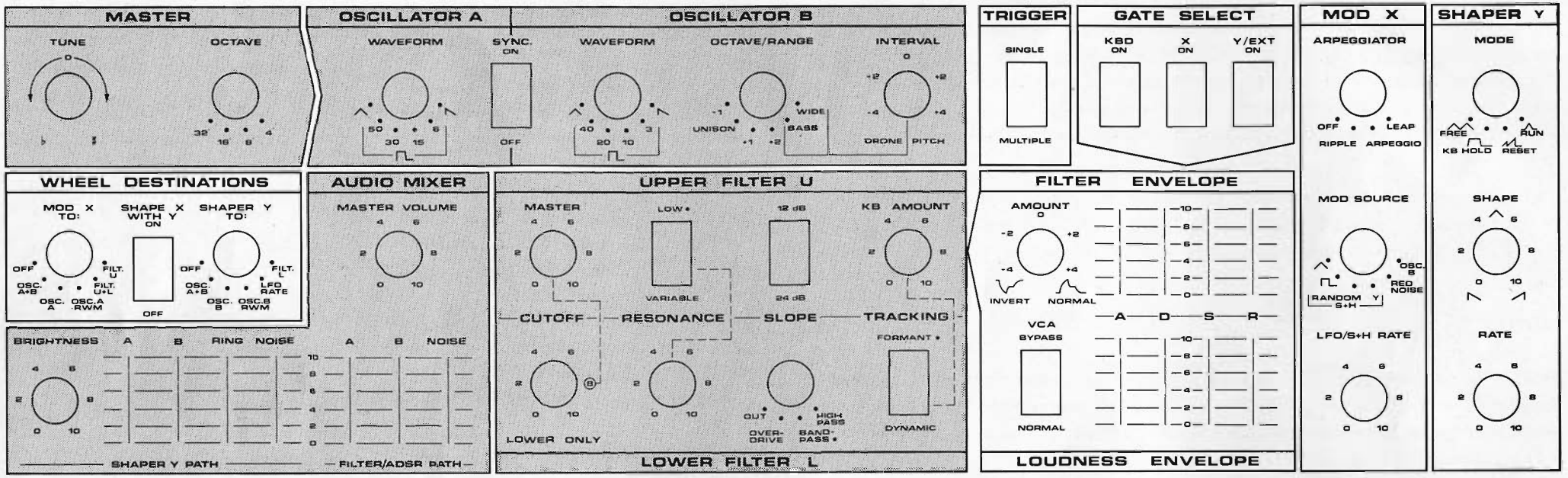
SHAPER Y

Shaper Y is a simple envelope generator in every MODE except FREE. In the FREE mode Shaper Y becomes a low frequency oscillator. In either case the symmetry or shape of the output signal is determined by the SHAPE control, as panel graphics indicate.

ATTENUATORS

An attenuator reduces the size of a signal. It is easy to hear and understand attenuation of an audio signal — — the sound gets quieter. As signals are pictured traditionally, attenuation causes the height (vertical) of the signal to be reduced. The Spirit has a number of attenuators. The most obvious are the MASTER VOLUME control and the sliders in the AUDIO MIXER, which control audio levels (signal size).
The FILTER ENVELOPE AMOUNT knob attenuates the envelope sent to the filter control inputs, allowing more subtle (smaller) movements of the cutoff frequency.
The MOD X and SHAPER Y wheel are attenuators that let you "play" the size of modulation signals such as vibrato.
It is useful to know that attenuation always occurs "toward zero." That is, signal size is attenuated toward "0" volts, whether the signal is presently a negative voltage or positive. This allows predictable attenuation of control signals — — some of which involve only positive voltage excursions (Loudness Envelope); others both positive and negative excursions (Triangle position of MOD SOURCE switch).

AUDIO



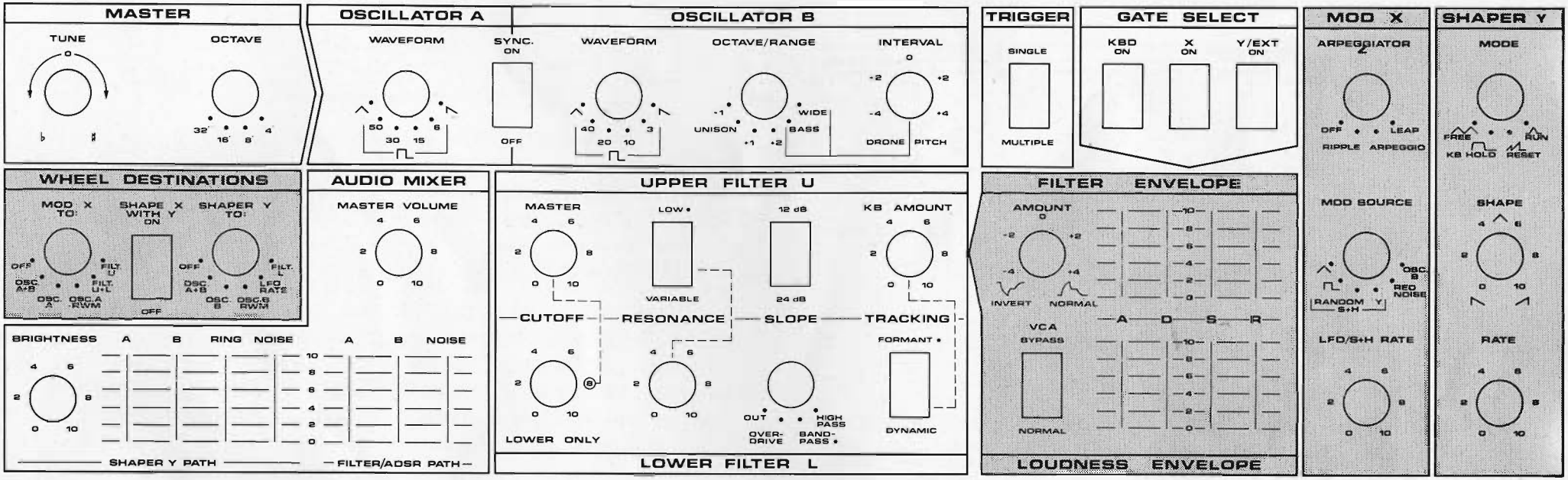
The Sound Sources of the Spirit include two tone oscillators and a noise generator. The Noise signal is a combination of white and pink random noise suitable for producing pitchless sounds. A ring modulator provides clangorous (bell-like) sounds by generating new partials (sum and difference pitches) from OSCILLATOR A&B triangle waveforms via fixed internal connections.

The audio signals follow two different paths, as the AUDIO MIXER section indicates: The SHAPER Y PATH routes a mix of all possible sound sources — — including ring mod — — through a simple 6 d B/octave BRIGHTNESS filter, then though a voltage controlled amplifier (VCA) whose gain is controlled — — "shaped" — — by the SHAPER Y section. The SHAPER Y PATH audio signal is always available at the SHAPED AUDIO OUT jack on the back panel.

The FILTER—ADSR PATH routes a mix of the tone oscillators and noise in series through dual voltage controlled filter sections — — the LOWER FILTER L and the UPPER FILTER U. The cutoff frequencies of these filters can be "enveloped," or moved by the FILTER ENVELOPE to create dynamic tone colors. This path also has a VCA that can be bypassed, or its gain may be controlled by the LOUDNESS ENVELOPE section. This signal path is available only at the ADSR/MIX AUDIO OUT jack on the rear panel.

The Spirit is a stereo instrument. The outputs of the two audio signal paths appear as separate signals at their respective audio outputs on the rear panel — — SHAPED AUDIO OUT and ADSR/MIX AUDIO OUT. However, if there is no phone plug in the SHAPED AUDIO OUT jack, a mix of both signal paths is available at the ADSR/MIX AUDIO OUT jack. When both jacks are used, a stereo mix is possible; for mono, use only ADSR/MIX AUDIO OUT to hear both signals at a single jack. The MASTER VOLUME knob controls, or "attenuates" the volume of both signal paths.

CONTROL



The Spirit has a variety of control resources. Chief among these are two dedicated ADSR envelope generators, and two sources of modulation: MOD X, and SHAPER Y.

MOD X is the primary source of modulations on the Spirit. All periodic/clocked modulations from MOD X are controlled in rate by a low frequency oscillator (LFO), which is also the sample-and-hold clock. The ARPEGGIATOR section creates repeating pitch patterns according to which keys are depressed on the digitally-scanned keyboard and which arpeggiation mode is selected. In addition, slow-moving random (red noise) and Oscillator B are among the MOD SOURCE selections.

SHAPER Y is used primarily to create "one-shots," or envelopes with a simple shape. In the FREE MODE it becomes a secondary LFO, a source of low frequency variable symmetry waveforms.

Each selected MOD X and SHAPER Y signal is routed through its respective wheel on the performance panel; each wheel is an attenuator that lets you control signal size. X and Y attenuated signals are routed to various destinations by respective rotary switches in the WHEEL DESTINATIONS section.

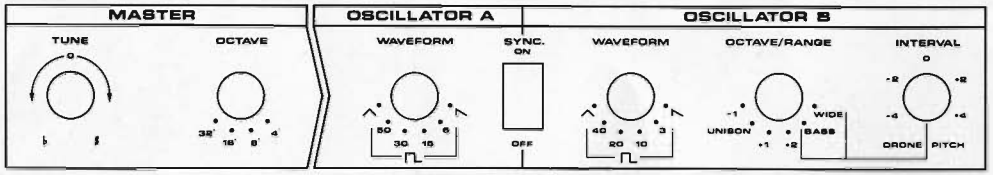
In addition, the SHAPE X WITH Y switch allows "second order" modulation; in this case the SHAPER Y section shapes the size of the MOD X signal. This allows automatic shaping of vibrato depth, for instance.

The FILTER ENVELOPE is permanently connected to the cutoff frequency control input of the UPPER FILTER U. It is connected to the LOWER FILTER L only when the TRACKING switch is in the DYNAMIC position. The signal from the FILTER ENVELOPE is attenuated (controlled in size) by the AMOUNT control. The NORMAL side of AMOUNT provides a "positive" envelope that rises and falls; the INVERT side provides an inverted, or mirror-image version that falls and rises. In either case the envelope straddles the cutoff frequency set by the CUTOFF control. An unattenuated envelope moves the cutoff frequency from 2.5 octaves below to 2.5 octaves above its cutoff setting.

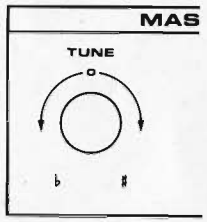
The LOUDNESS ENVELOPE is permanently connected to the VCA in the FILTER/ADSR audio signal path. When VCA BYPASS is on, the VCA is biased fully open; that is, LOUDNESS ENVELOPE ADSR settings have no effect in BYPASS mode and sounds will not be articulated, but uninterrupted.

DESCRIPTION OF THE CONTROLS

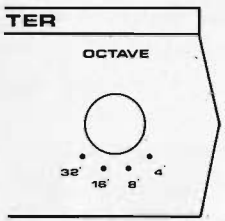
TONE OSCILLATORS



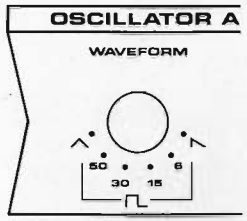
Oscillator controls are divided into a MASTER section that affects both oscillators, and individual OSCILLATOR A and OSCILLATOR B sections.



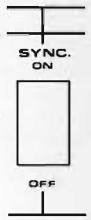
MASTER TUNE is the overall tuning control for the entire instrument over a narrow (+/— minor 3rd) span. Use this control to match the pitch level of the Spirit to other instrumentsl. (Although this control affects both oscillators equally, tune by listening exclusively to Oscillator A, since Oscillator B might be detuned widely due to its INTERVAL control setting. After tuning while listening to Oscillator A, tune Oscillator B to match A, or to desired interval above or below A.)



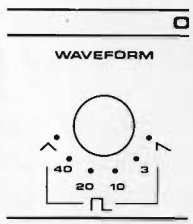
MASTER OCTAVE transposes both oscillators in octave steps. The footage designations 32' 16' 8' 4' are adapted from pipe organ terminology; at the 8' position, the C one octave from the bottom of the keyboard will sound middle C. (This is always true for Oscillator A, and is true of Oscillator B when its OCTAVE/RANGE switch is in the UNISON position, and INTERVAL is set to zero.) The MASTER OCTAVE switch extends the pitch span of the Spirit well beyond its three octave keyboard.



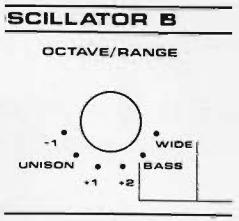
OSCILLATOR A WAVEFORM selects triangle, rectangular, and sawtooth waveforms from left-to-right as panel graphics indicate. The percentage duty cycle of each rectangular waveform is indicated by number within the bracket. Duty cycle is the percentage of time during a single cycle that the rectangular waveform stays at a high level. For instance, the selection marked "50" is a 50% duty cyle rectangular wave, known as a "square wave."



The SYNC switch hard-synchronizes Oscillator B to A. This forces B to oscillate at the same frequency as A. The familiar hard sync sound can be created by moving Osc B frequency (usually upward) in relationship to Osc A. This is most apparent when you listen to Osc B alone. In this case Osc A is "the pitch" of the sound, and Osc B creates the unusual sync sound. Sync may also be used to create "beat-free" octave tunings between the oscillators.

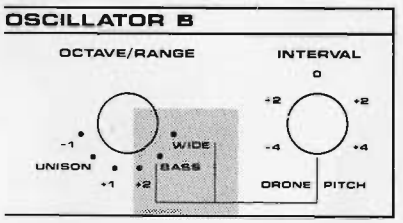


OSCILLATOR B WAVEFORM selects Oscillator B waveforms and functions like its Oscillator A counterpart. Note, however, that the rectangular widths, or selection of duty cycles is not the same as for Oscillator A. This feature provides more tone color possibilities.



OSCILLATOR B OCTAVE/RANGE is used to tune Osc B relative to Osc A. The first four switch positions provide tuning in octave steps. Osc B can be tuned to the sameoctave (UNISON), one octave lower or higher, or two octaves higher than Osc A.

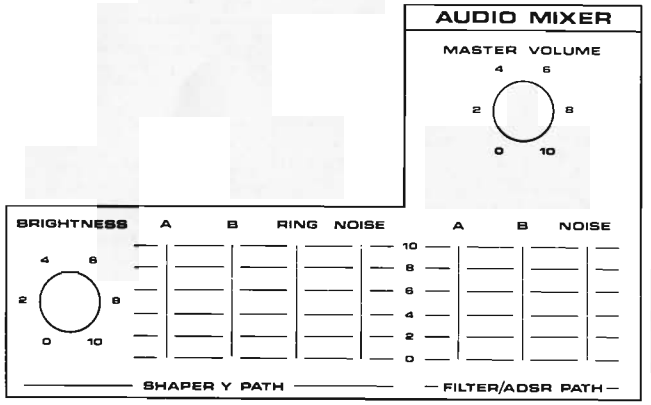
The BASS and WIDE positions cause Oscillator B to become disconnected from all manual tuning controls other than the INTERVAL control. That is, the keyboard, MASTER TUNE, MASTER OCTAVE, and PITCH BEND wheel now have no influence on Osc B pitch. (MOD X, SHAPER Y, and the rear panel OSC B PEDAL input work normally). In the BASS position, the INTERVAL control tunes Osc B from 30 to 300 Hz; in the WIDE position, from 2 to 10,000 Hz. BASS and WIDE positions make it possible to create an Osc B "drone," or unvarying pitch that sounds as you play, while Osc A follows the keyboard.



OSCILLATOR B INTERVAL transposes Osc B up or down as much as a perfect fifth when the adjacent OCTAVE/RANGE is in one of the first four "octave step" positions. The center zero position causes no transposition; slight deviations from center create the slight mistuning between the oscillators that adds warmth and fatness to the sound.

As discussed above, the INTERVAL control becomes a continuous tuning control for Osc B (only) when the BASS or WIDE position on the adjacent OCTAVE/RANGE control is selected. When BASS is selected, the INTERVAL Control spans four octaves in the bass (lower) pitch range. When WIDE is selected, the INTERVAL control spans the 12 octaves of Osc B range.

AUDIO MIXER



Controls in this section let you combine the sound sources available to both audio signal paths, adjust brightness in the SHAPER Y PATH, and adjust overall volume of both paths.

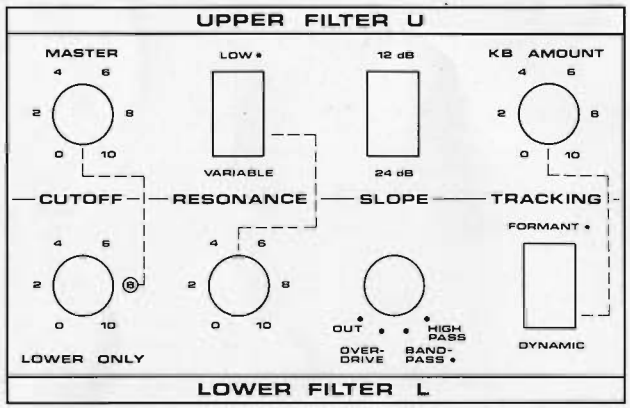
BRIGHTNESS adjusts the overtone content of SHAPER Y PATH signals. This control changes the cutoff frequency of a 6 dB per octave lowpass filter. This type of filter is similar to an amplifier tone control filter.

The SHAPER Y PATH sliders adjust the relative strengths of oscillators A and B, Ring Modulator, and Noise signals in the Shaper Y Path. When an external audio signal is introduced into the EXTERNAL AUDIO IN jack on the rear panel, the external signal takes the place of Noise in both audio signal and Noise is no longer available as an audio signal.

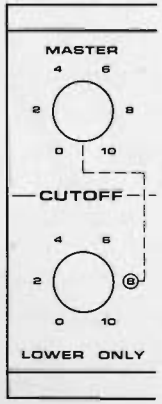
The FILTER/ADSR PATH sliders adjust the relative strengths of the Tone Oscillators A and B, and Noise signals in the Filter/ADSR Path. As indicated above, the EXTERNAL AUDIO IN jack on the rear panel is "normaled" to cause any external signal routed there to appear in place of the Noise signal; external signal strength would be adjusted using the NOISE slider in this case.

MASTER VOLUME adjusts the final loudness levels of both audio channels. This is an attenuator; for best signal-to-noise ratio use high settings and adjust your amplifier accordingly.

UPPER/LOWER FILTERS

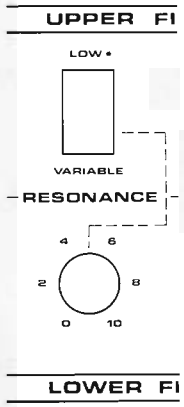


The filters in the FILTER/ADSR path may be used to create various filter responses. The Upper Filter is a lowpass resonant filter with choice of 12dB or 24dB cutoff slope.
The Lower Filter may be configured to be either a Parametric Boost or Highpass resonant filter.



Sets cutoff frequencies of both filters, always.

Sets cutoff frequency of Lower Filter only, always.



LOW position fixes Upper Filter resonance to low value (Q = 0.5).

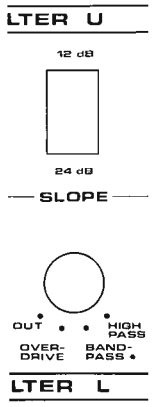
VARIABLE position provides variable Upper Filter resonance (Q), determined by pot below.

Resonance (Q) control for Upper Filter when switch above is in VARIABLE position.

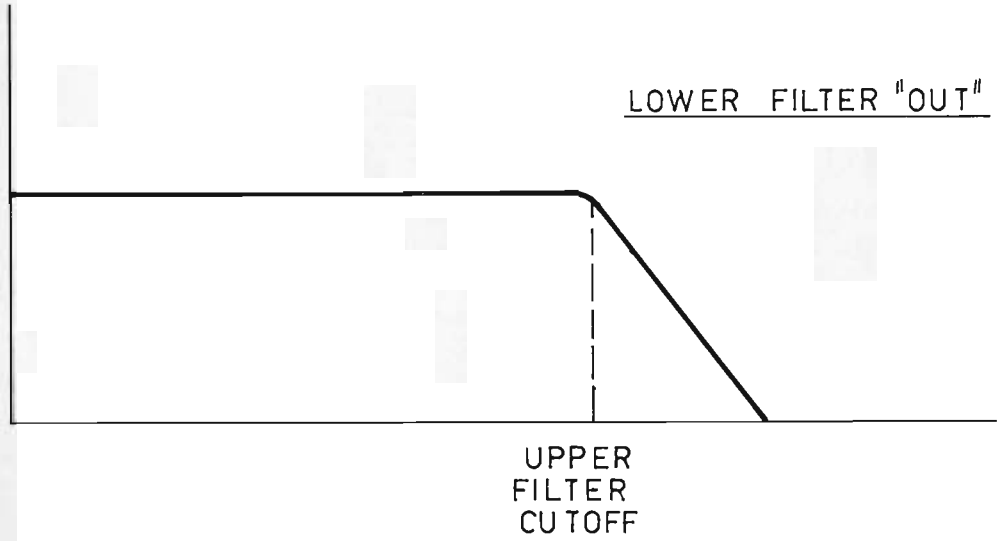
Resonance (Q) control for Lower Filter, always.

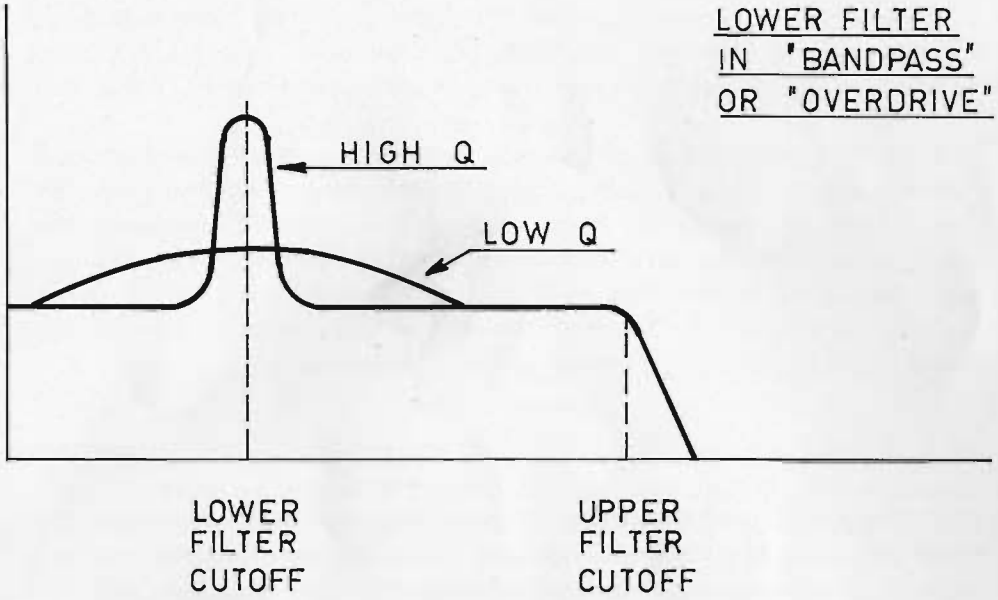
Makes Upper Filter slope = 12dB/ Octave.

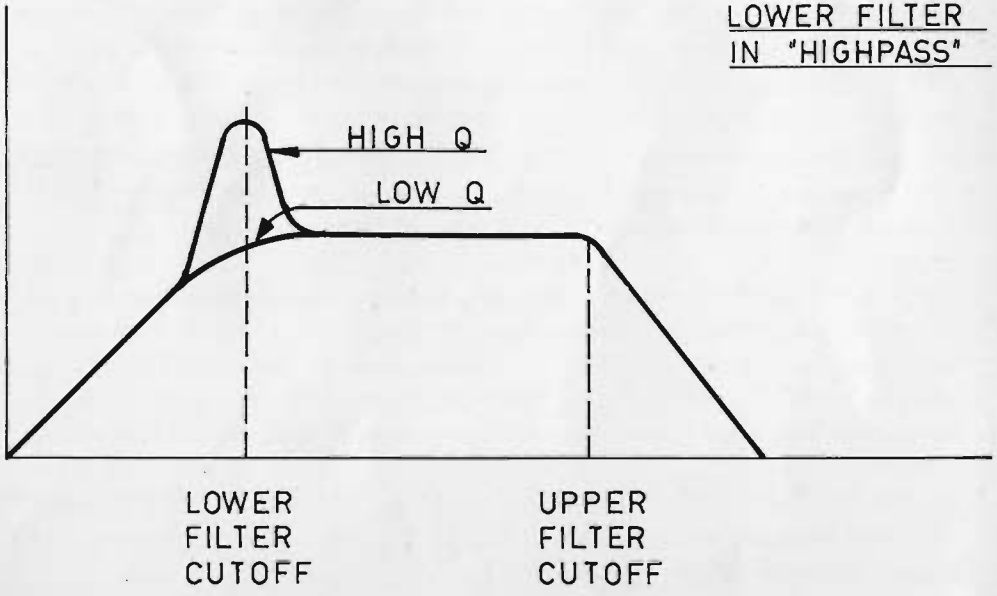
Makes Upper Filter slope = 24 dB/ Octave.



Selects Lower Filter response mode. OUT position removes Lower Filter from audio signal path.





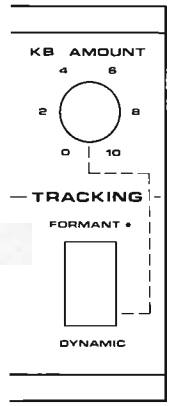


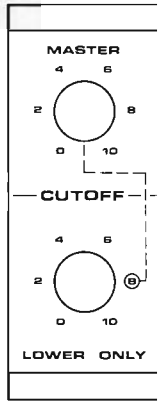
Extent that Upper Filter tracks keyboard, always.

Extent that Lower Filter tracks keyboard when DYNAMIC switch position selected.

FORMANT position disconnects the Lower Filter from keyboard, FILTER ENVELOPE, modulation — — X and Y, and FILTER PEDAL input on the rear panel.

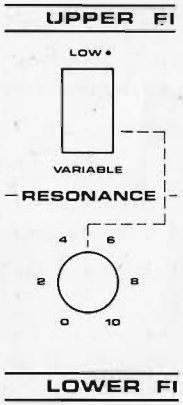
DYNAMIC position connects control signal sources mentioned above.





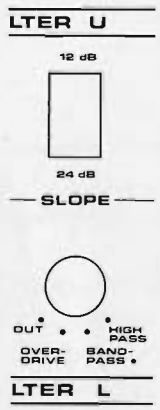
MASTER CUTOFF moves the cutoff frequencies of all filter sections through the audio range. The cutoff frequency of the Lower Filter coincides with that of the Upper Filter when the LOWER ONLY control is set to 8.

LOWER ONLY CUTOFF moves the cutoff of the Lower Filter relative to the Upper Filter. When this control is set to 8, both filter cutoff frequencies are the same. When LOWER ONLY CUTOFF is less than 8, the cutoff frequency of the Lower Filter is set lower than the Upper Filter. This allows you to use the Lower Filter to create a "formant" or peak of energy below the Upper cutoff; you can also create twin filter peaks, and other interesting filter responses.



RESONANCE always determines the amount of resonance, or "Q" on the Lower Filter. It also determines the amount of Upper Filter resonance when the LOW-VARIABLE switch is to VARIABLE, for both 12dB and 24dB modes.

The LOW-VARIABLE RESONANCE switch determines whether the Upper Filter response will be "low resonance" (low Q), or whether its Q will be determined by the rotary RESONANCE control.
The 12 dB-24 SLOPE switch changes the slope of the Upper Filter. When switched to 24dB the Upper Filter becomes a 24 dB/Octave Lowpass Filter. To create the "typical" synthesizer high-resonance filter sound, the LOW-VARIABLE switch must be placed to VARIABLE so resonance, or filter Q can be increased.



The LOWER FILTER SLOPE switch is most important in filter mode selection on the Spirit. Its positions provide filter responses as follows:

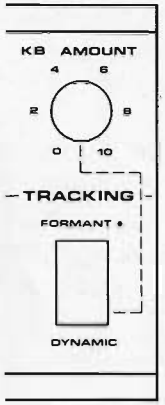
OUT removes the Lower Filter from the signal path. This leaves a standard lowpass resonant filter with "two-pole" or "four-pole" response, selectable by 12 dB or 24 dB position respectively on the Upper Filter SLOPE switch.

OVERDRIVE introduces a soft distortion circuit between Lower and Upper Filters, giving a fuzz-y, raunchy sound quality. This mode also places the Lower Filter into Parametric Boost mode; that is, a peak is introduced at its cutoff without attenuation of frequencies far from this cutoff. This peak will occur below the Upper Filter cutoff frequency when the LOWER ONLY CUTOFF setting is less than 8. The height of this peak is increased as the Lower Filter RESONANCE control setting is increased.

The BANDPASS position puts the Lower Filter into the same Parametric Boost mode, but the distortion circuit is not connected. This filter response may be described as "double-peak", lowpass-resonant. (The MASTER CUTOFF control sets the high peak; the LOWER ONLY CUTOFF sets the location of the lower peak relative to the higher peak. When the MASTER CUTOFF is moved, both peaks will move; the distance between peaks is set by the LOWER ONLY CUTOFF. The sharpness of the lower peak is always determined by the RESONANCE control; the sharpness of the upper peak is determined by the same control only when the associated switch is set to VARIABLE.)

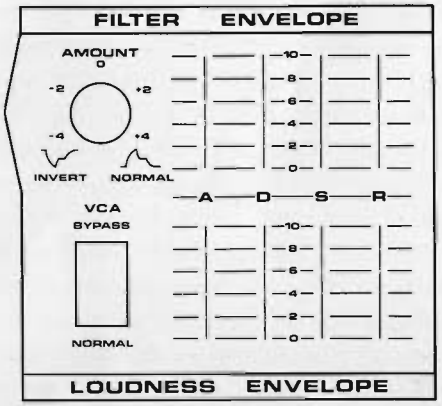
The HIGHPASS position puts the Lower Filter into Highpass-resonant mode. In this case the "lower peak" attenuates frequencies lower than its cutoff frequency. The overall response is double-peak, highpass-lowpass.

KB AMOUNT determines the extent to which the keyboard voltage is used to control the cutoff (s) of the filter sections. Filter cutoff frequencies "track" oscillator pitch perfectly at a setting slightly less than 10. That is, when this control is set to 10, the filter cutoffs move slightly more than one octave when you play one octave on the keyboard. (When the TRACKING switch in the Lower Filter is set to FORMANT, the Lower Filter does not track the keyboard. This lets you use the Lower Filter to create a formant — — which does not move as pitch changes. This formant, or filter peak does not track the keyboard.)



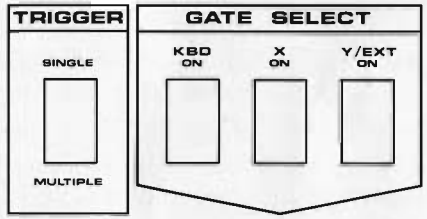
When the FORMANT-DYNAMIC TRACKING switch is placed in the FORMANT position, the Lower Filter is disconnected from (1) the keyboard control voltage; (2) any modulation — — X or Y; (3) the FILTER ENVELOPE ADSR; (4) any signal routed to the FILTER PEDAL input on the rear panel. The purpose of this is to immobilize a variable-peak frequency resonance (formant) that can be produced by the Lower Filter. A formant situated at the proper frequency (CUTOFF settings), and having the proper "bandwidth," (RESONANCE) setting, will enhance the simulation of an acoustic instrument. (Or create interesting new sounds!) In this case the Lower Filter creates the formant and the Upper Filter articulates the sound.
The switch positions involved in formant production are starred (*) on the front panel to remind you of the proper configuration for the entire Filter section. The settings let you vary the Upper Filter with the Filter Envelope, keyboard control voltage, modulations, and/or filter pedal without changing the characteristic resonant formant produced by the Lower Filter. This combination of switch settings is particularly useful when simulating brass and woodwind colors.

ENVELOPING



FILTER ENVELOPE and LOUDNESS ENVELOPE sections are conventional (A) Attack, (D) Decay, (S) Sustain, (R) Release envelope generators. A, D, and R controls cover the range from 5 milliseconds to 10 seconds. The LOUDNESS ENVELOPE S (Sustain) settings cause the VCA to sustain sound from silence (0) to full gain (10). The BYPASS position of the VCA switch causes the VCA to be held fully open (maximum gain).
The FILTER ENVELOPE SUSTAIN control may be used to determine the frequency at which the filter cutoffs will sustain indefinitely while a key is depressed; that is, their resting point after the Attack and Decay portions of the envelope have occurred. The AMOUNT control determines the amount of FILTER ENVELOPE signal that is allowed to change Filter cutoff frequency. When this pot is turned to zero (its midpoint), the Filter Envelope has no effect on the filters. Positive (NORMAL) settings of this control will cause cutoff frequency to rise and then fall; negative settings, to fall and then rise (inverted envelope).

TIMING SIGNALS



Timing signals (gates) initiate the action of the envelope generators and the Shaper. These signals may be caused by the performer, using the keyboard, be generated by "clock" circuitry that comprises a part of LFO circuits, or be introduced to the Spirit from external sources, or the Shaper.

GATE SELECT determines which sources of gate signals will be applied to the Envelope Generators (and Shaper). NOTE: AT LEAST ONE SWITCH IN THIS SECTION MUST BE ON IN ORDER FOR THE ENVELOPE GENERATORS TO BE ACTIVATED.

KBD selects the keyboard as a source of gates. A gate will be produced when any key is depressed. The X switch selects the LFO square wave as a gate source (MOD X section).

The Y/EXT switch selects the gate produced by the SHAPER Y section. If an externally-generated gate is plugged into the EXTERNAL GATE IN jack on the rear panel, that gate is selected by the Y/EXT switch in place of normal Y gates.

TRIGGER

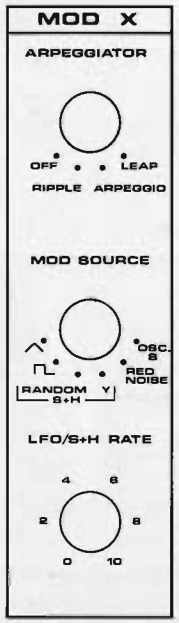
The SINGLE-MULTIPLE switch determines the mode of keyboard response. In the MULTIPLE position, the gate signal sent to the envelope generators is reset each time a new key is depressed. In the SINGLE position, the gate signal stays on whenever at least one key is down; a new gate is generated only after all keys are released, and then a new key is depressed.

Multiple triggering tends toward uniformity, and is especially useful for playing deeply enveloped, explosive sounds rapidly.

Single triggering, on the other hand, lets you "play within the envelope." If you alternate between a connected, or legato style and a detached, or staccato style, "phrasing" will result. That is, some groups of notes will fall within the attack and decay cycles of an envelope, and others will start a new envelope.

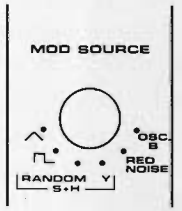
MODULATION

Modulation is a variation in sound; this variation is typically recurrent or repetitive. Vibrato, tremolo, and trill are common musical modulations. On the Spirit, there are two modulation sections — — MOD X and SHAPER Y. Modulation selected here may be controlled using the MOD X and SHAPER Y performance wheels to the left of the keyboard, and then routed to various destinations using the WHEEL DESTINATION switches.



MOD X controls determine modulation shape and rate of LFO (low frequency oscillator) sources, permit selection among keyboard arpeggiation modes, and selection of other modulation sources.

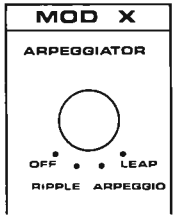
LFO/S + H RATE determines LFO modulation, SAMPLE AND HOLD' AND ARPEGGIATION RATE' Rate may be varied from less than one per second to approximately 50 per second. This control has no effect when the RED NOISE or OSC B positions on the MOD SOURCE switch are selected. (These modulation sources are not clocked by the MOD X section LFO.



The MOD SOURCE SELECTOR selects one of six possible modulation types: LFO triangle wave; LFO square wave; S + H RANDOM (red noise sampled); S+ H Y (Shaper Y signal sampled); RED NOISE (continuous red noise random signal); and OSC B (triangle wave output). The selected signal is always routed to the MOD X wheel to the left of the keyboard, where modulation amount is controlled.

The sample-and-hold creates a series of voltage steps in a metronomic fashion with a rate determined by LFO/S + H RATE. To understand how the sample-and-hold works, let's make an analogy to a camera. A camera "samples" (photographs) motion and "holds" a fixed instant in time (the print). The sample-and-hold "photographs" (samples) a moving voltage signal and "prints" (holds) a fixed voltage level. When a sample of a moving voltage signal is taken, the voltage sensed at that instant is held until the next sample is taken. The LFO/S + H RATE controls determines how often samples are taken.

When MOD SOURCE is set to RANDOM, random red noise is sampled. A series of random voltages steps will be produced. When MOD SOURCE is set to Y, the output of SHAPER Y will be sampled. In this case, SHAPER Y controls will play a large part in the resulting pattern, since they determine the shape and rate of Y output.

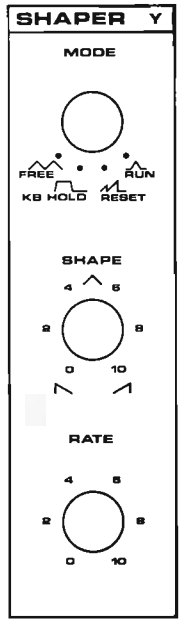


The ARPEGGIATOR switch selects one of three arpeggiation modes. In all modes the keyboard is repeatedly scanned chromatically from bottom-to-top. Any group of keys depressed is sounded sequentially from lowest to highest. The sequence is ',wrapped around," or repeated without delay after the highest key depressed sounds. The speed of this sequence is determined by the MOD X LFO/S + H RATE control setting — — each note occupies a clock cycle, or one "blink" of the rate lamp. Synchronous gates from X may be routed to the Envelope generators (GATE SELECT X ON) for each clock cycle, making it possible to determine the envelope of the sound that is sequenced in pitch.

The RIPPLE mode simply makes a sequence of any keys depressed as described.

The ARPEGGIO mode first scans the keyboard and sounds the sequence of keys depressed. It then repeats the same sequence (given you haven't changed which keys are depressed) twice; first, one octave higher, than one octave lower than the original. In other words, the ARPEGGIO mode repeats the sequence at different octaves.

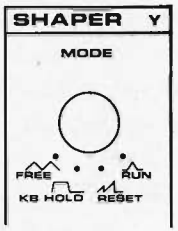
The LEAP mode changes the octave of notes individually in a sequence. Each successive note is either played as held or transposed in this pattern: (1) played in octave depressed; (2) played one octave higher than depressed; (3) played one octave lower than depressed. These three steps are endlessly repeated. If you depress three keys it will be easy to hear a pitch/octave pattern that coincides. When you depress, say a four note chord, you'll hear the chord members appear in different octaves, and the octave/pitch pattern will be so long it will be difficult to recognize. That is, octavation is always a three step pattern; the pitch pattern is determined by how many keys you depress — — interesting patterns can result.



SHAPER Y controls determine shaper output symmetry and rate, and response to keyboard gates.

RATE determines the timing of either the envelope or modulation that the SHAPER Y section generates. For modulations (when in FREE MODE), repetition rate may be varied from several cycles per minute (very slow!) to more than twenty per second. In the other three (envelope) MODES, the RATE control varies total envelope rise and fall time.

SHAPE determines the symmetry of the waveform or envelope that is produced. At "0" the output will have a faster rise than fall; at "5" the output will be symmetrical; and at "10" the output will have a slow rise and a quick fall. (See panel graphics). SHAPE does not influence the total time an envelope will take, or the period of a modulation waveform; but it does determine the relative percentage of total time that the rise and fall segments will occupy.



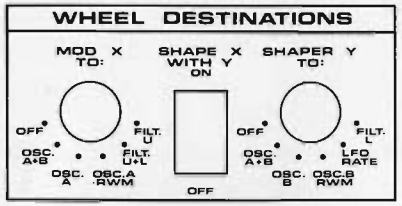
The MODE switch determines how the Shaper will respond to gates:

FREE causes the shaper to act like a free-running low frequency oscillator. The output in this case is symmetrical around zero volts, like Mod X triangle wave output. This lets you modulate tone oscillator pitch with Y without getting an irritating change of pitch "center." (Pitch goes both above and below pitch center symmetrically).

KBD HOLD allows the shaper output to remain at zero until a gate goes on. When gated, the output rises and holds at a maximum level as long as the gate is on. The rise time is a function of the interaction of RATE and SHAPE controls; that is: "How fast do I go, and at what slope?"

In RESET the Shaper output goes through a single cycle of rise and fall (no hold), starting at zero. Each time the gate is reset, the shaper output is clamped to zero, and starts again. (Note: SHAPER Y is always in the "multiple trigger" mode, regardless of the setting of the TRIGGER section switch. Consequently, everytime you hit a key, the Shaper will reset to zero in this mode.)

RUN is an "unconditional" mode; the rising segment of a single cycle is always 100% completed when a gate is applied. Subsequent gates will not restart the envelope until it has completed the rising segment of its cycle. This mode lets you take your hand from the keyboard (and use elsewhere!) while the Shaper Y section continues to do something for you — — for instance, raising the Filter cutoff.



WHEEL DESTINATIONS are the places that modulation signals are routed after passing through the MOD X and SHAPER Y wheels.

MOD X TO: routes the signal selected by the MOD SOURCE switch that passes through the MOD X wheel to various control inputs. The (six) switch positions from left-to-right send the X signal to: (1) OFF (nowhere); (2) OSC A + B (frequency control input, both oscillators); (3) OSC B (Osc B frequency control input); (4) OSC A RWM (rectangular width control, Osc A); (5) FILT U + L (cutoff frequency control input, both filters); (6) FILT U (Upper filter cutoff frequency control input).

SHAPE X WITH Y switch, when ON causes the X signal to be enveloped by the Y signal. The MOD X wheel setting will then determine the maximum size that X can be, and Y will shape X within that limit. Typical applications are "enveloped" vibrato, or vibrato that dynamically changes its depth (automatically).

SHAPER Y TO: routes the signal coming from the SHAPER Y wheel to various control inputs. The (six) switch positions from left-to-right send the Y signal to: (1) OFF (nowhere); (2) OSC B (Osc B frequency control input); (3) OSC A + B (both Oscs frequency control inputs); (4) OSC B RWM (Osc B rectangular width control input); (5) LFO RATE (LFO frequency control input); (6) FILT L (Lower Filter cutoff frequency control input).

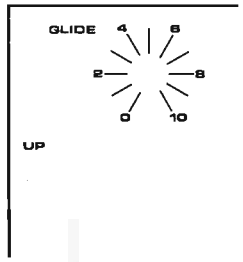
KEYBOARD

The Spirit keyboard provides "last note" pitch keying. It plays the latest note you have struck even if you haven't fully released its predecessor. It doesn't care whether the latest note is higher or lower. However, unlike some keyboards with this type of keying, the Spirit's design takes into account realworld performance conditions. For instance, Spirit keyboard circuitry always plays the latest key if two are being held — — that is typical for this kind of keying. More important, if only one key is down, the Spirit will always play that note.

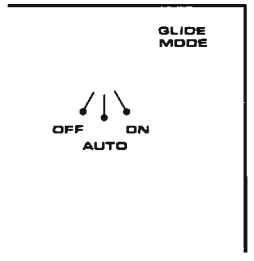
If this sounds obvious, consider what might happen — — and does with some instruments — — if you intend to depress a certain key and accidentally brush a closeby key as well. Which did you hit last? The one you wind up holding? Not necessarily. The last note scheme on some instruments will jump to the last note you brush — — and ignore the only note you are holding!

The Spirit lets you play faster than blazes. This intelligent keying priority tells the circuitry both what you have hit, and what you are holding. Use it in conjunction with multiple triggering and you can play articulated passages like a machine gun if you want!

GLIDE is a keyboard function. When there is no glide the keyboard signal moves in discrete steps. When the keyboard signal is applied to the tone oscillators discrete pitch steps are produced. When glide is introduced, the keyboard signal is slowed down when moving from step to step, and those sharp step corners are rounded. Now pitches won't change as quickly, but will glide.

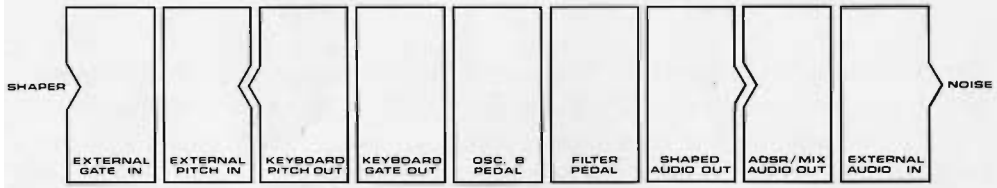


The GLIDE control (knob) is completely conventional. That is, higher settings produce "more" (slower) glide.



The GLIDE MODE switch offers a choice of OFF (no glide), AUTO (glide occurs only when more than one key is depressed, allowing you to introduce glide selectively from the keyboard), and ON (glide on all the time, regardless of keyboard technique).

REAR PANEL INPUT/OUTPUT



EXTERNAL GATE IN accepts external gates and routes them to the Y/EXT switch in the GATE SELECT section. When a phone plug is placed into this input, Y gates are no longer available at the Y/EXT switch.

EXTERNAL PITCH IN accepts a control signal that takes the place of the internal keyboard signal, for pitch control of both tone oscillators. When a phone plug is placed into this input, the internal keyboard signal is disabled.

KEYBOARD PITCH OUT outputs a unscaled version of the internal keyboard control signal. This signal may be used, (with an attenuator) to control the pitch of external tone oscillators, for instance. When a phone plug is placed into this output, the Spirit works normally internally, and merely outputs a copy of its internal keyboard signal.

KEYBOARD GATE OUT outputs keyboard gating information; that is, a signal that can tell external envelope generators when you depress and release keys on the keyboard.

OSC B PEDAL accepts a control voltage that changes the pitch of Osc B only. This is particularly useful when oscillators are synced, and you wish to move the pitch of B only to create the typical sync sound.

FILTER PEDAL accepts a control voltage that is always routed to the control input of the Upper Filter. This external signal is routed to the Lower Filter as well, when the TRACKING switch is in the DYNAMIC position.

SHAPED AUDIO OUT always outputs the SHAPER Y audio path. When a phone plug is placed in this jack, the SHAPER Y audio signal is removed from the ADSR/MIX AUDIO OUT jack.

ADSR/MIX AUDIO OUT always outputs the FILTER/ADSR PATH audio signal. When no phone plug is placed in the SHAPER Y jack, both audio signal paths appear at the ADSR/MIX AUDIO OUT jack.

EXTERNAL AUDIO IN accepts external audio signals that are routed to the NOISE sliders in both audio signal paths. External signals placed here have nothing to do with the pitch of the Spirit's tone oscillators. External signals merely act as sound sources that appear at the AUDIO MIXER for processing by the filter (s) and VCAs.

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