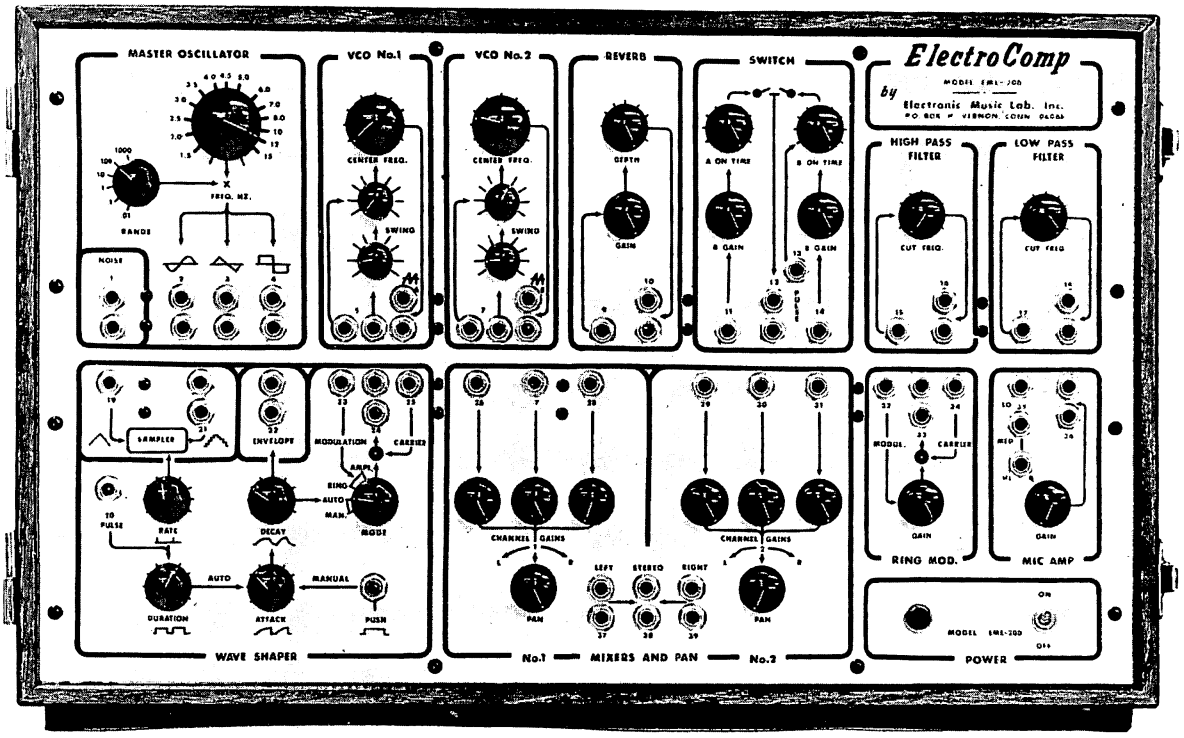
THIS SYNTHESIZER STARTED A REVOLUTION!



Our studio synthesizer started a revolution in music. It was the first synthesizer priced under a thousand dollars. It permitted musicians at all levels to get involved in electronic music that could not afford the multi-thousand dollar price tags of earlier synthesizers.

It began in 1969 when the Connecticut State Department of Education asked Electronic Music Labs to design a synthesizer for use in Connecticut Public Schools. Their requirements were quite unique.

They wanted a synthesizer suited to the needs of the beginning electronic composer. They wanted a synthesizer that could stand up to young exploring hands and 10 hours a day use. It was composition they wanted, not merely exposure to the latest sounds available.

These requirements produced a virtually indestructable, low cost synthesizer configured to permit you and your students to produce electronic composition.

The complexities of the synthesizer were reduced by modeling the 200 after equipment used by early electronic composers, where each synthesizer function is independent and permits a building block approach to the creating of sounds.

The 200's success spread rapidly and created a demand for larger configurations by colleges, universities, and recording studios. This forced the development of a series of keyboards to permit larger, more capable synthesizer configurations. When you combine the 200 with our 101 Keyboard Synthesizer, you have capabilities that can only be matched by synthesizers costing many times its $2445 price.

Anywhere people want to control sound, you'll find a 200. Its versatility is unmatched. Take a few minutes and read some of the more interesting applications on the back cover. Creating your own revolution may be a synthesizer away.

ElectroComp 200 $950

ElectroComp 200

SPECIFICATIONS

1. NOISE GENERATOR.

The Noise Generator is a sound source for producing wind, thunder, and percussive effects. It produces white noise which contains all the audible frequencies.

The Noise Generator can be used to produce random triggers and pitches when used in combination with the other synthesizer functions.

2. MASTER OSCILLATOR.

The Master Oscillator is a wide range, manually tunable oscillator. It produces a pitch proportional to the setting of its range switch and tuning control. Six overlapping ranges are provided covering both the audio and subaudio spectrums — .01 to 18,000 cycles per second. Three waveforms are simultaneously available — sine, triangle and square.

3. VOLTAGE CONTROLLED OSCILLATORS.

The two Voltage Controlled Oscillators cover the audio range and produce sawtooth waveforms.

Each oscillator has two control inputs with attenuators. The Master Oscillator, Sampler, Envelope Generator and any of the optional keyboards may be used at these inputs to produce variations in pitch.

The Master Oscillator could be used to produce various types of vibratos of different speeds. The Sampler to generate a series of ordered or random pitches. The Envelope Generator to produce sweeping pitches. The Keyboards to produce discrete pitches of fixed interval. The pitch of the VCO's can also be adjusted manually.

4. REVERB.

The Reverb is used to delay any audio signal connected to its input. In the process it adds body and depth to the original signal. The Reverb contains a depth control for proportioning the amount of reverberated and unreverberated signal and an output attenuator for adjusting the volume. The Reverb may also be used as a waveform inverter.

5. ELECTRONIC SWITCH.

The Electronic Switch alternates two audio sound sources to a single output. The duration of each source at the output is independently adjustable and is determined by an internal variable ratio oscillator. This ratio may be varied over a 300 to 1 range. External triggers may be used in place of the internal oscillator.

6. HIGH PASS FILTER.

The High Pass Filter passes the highs and weakens the lows present in any audio source connected to its input. The cutoff frequency (where the lows start to be attenuated) is manually adjustable over a 30 to 1 range.

7. LOW PASS FILTER.

The Low Pass Filter passes the lows and weakens the highs present in any audio sound source connected to its input. The cutoff frequency is adjustable over a 30 to 1 range.

The High Pass and Low Pass filters may be combined to produce band pass or band reject filters.

8. MICROPHONE AMPLIFIER.

The Microphone Amplifier permits the introduction of external sound sources through the use of microphones and electric pickups.

9. MODULATORS.

There are two Modulators within the synthesizer. Each of them is capable of producing ring modulation. They both have a D.C. coupled input and therefore can be used in combination with the Envelope Generators to produce amplitude modulation.

10. STEREO MIXERS.

The two Mixers each have 3 inputs with volume attenuators. Through use of the Pan controls, the two mixers may be combined into a single mixer with six inputs.

11. PAN CONTROLS.

The Pan Controls permit any portion of the left mixer to be added to the right, or any portion of the right mixer to be added to the left, and therefore can be used to produce crossing effects.

12. ENVELOPE GENERATOR.

The Envelope Generator produces a waveform for shaping pitch and loudness. It may be triggered by the Sampler's internal oscillator, a manual trigger, keyboard or other oscillators.

13. SAMPLER.

The Sampler produces a waveform for generating random or ordered sequences of tones. A variable ratio oscillator is provided in the sampler for determining the sampling speed and to trigger the Sampler's associated envelope generator.

14. PATCH PANEL.

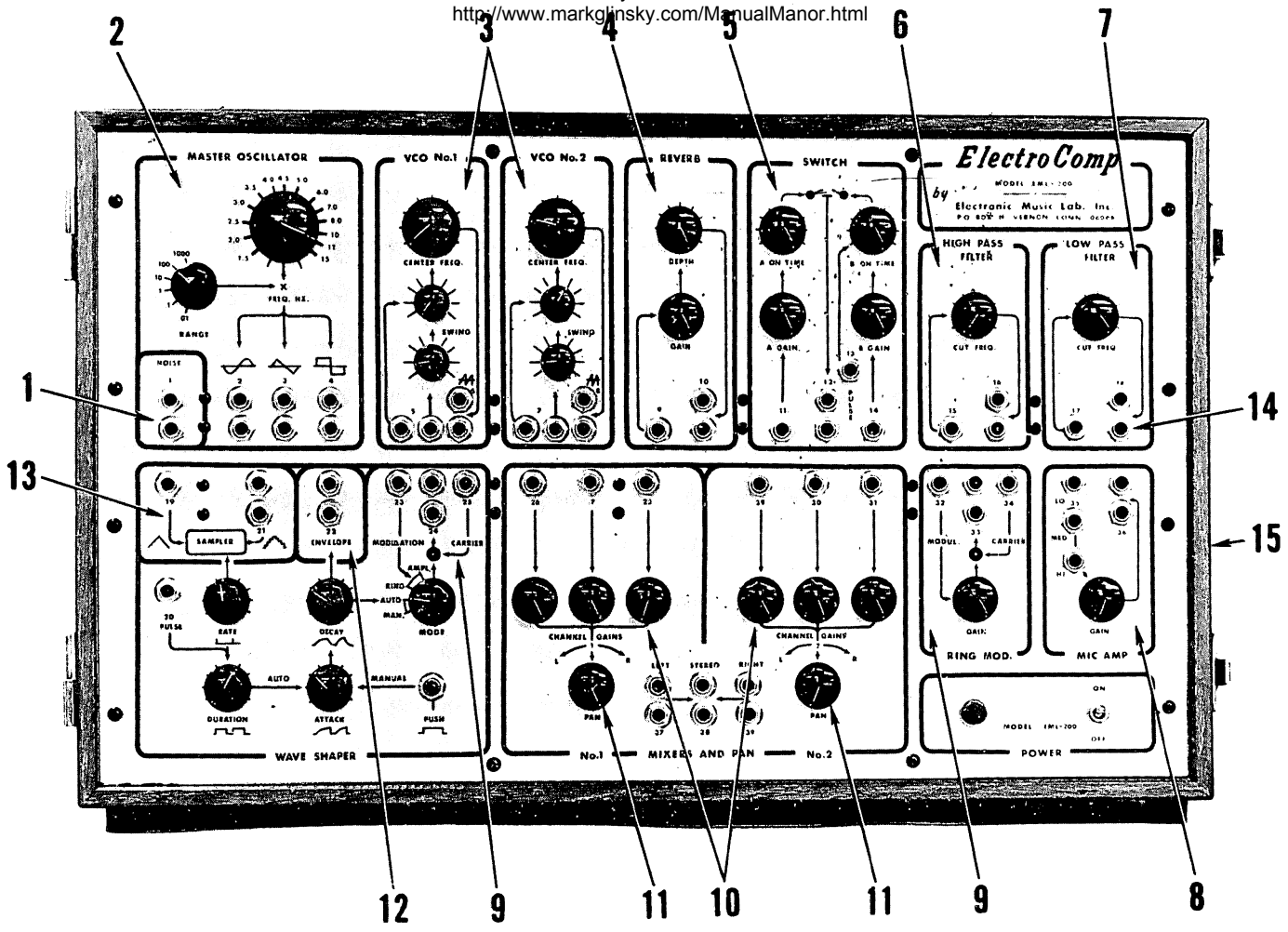
The Patch Panel provides inputs and outputs for every function contained within the synthesizer. This is particularly handy for the beginning electronic composer because it permits him to concentrate on one dimension at a time.

Output impedances are 470 ohms and are well matched for all professional equipment. All outputs are short circuit proof. For your convenience and reliability, standard size phone jacks and plugs are used throughout.

The Patch Panel also permits you to inexpensively expand your studio by adding keyboards and sequencers as your budget permits.

15. CASE.

The 200's case consists of a rugged, aluminum splined mahogany core, covered with wood-grained formica. It comes with a cover and weighs 32 pounds.



OPTIONAL KEYBOARDS.

The 200 Studio Synthesizer is also available with any of three optional keyboards. Their capabilities cover the entire range from non-equal tempered to equal tempered microtonal. Their prices vary from $325 to **$1495.**

Most importantly, the three keyboards give you a wide choice. A choice we'd be pleased to discuss with you.

ELECTRO COMP 300 MANUAL CONTROLLER.

The 300 was originally suggested by a professional composer who wanted to escape from the traditional keyboard with its equal temperment and the patterns it suggests. Inspired by his request, the 300 was developed.

The 300 provides a keyboard which is similar in appearance to an adding machine keyboard. Its sixteen keys are arranged in a 4 x 4 matrix. Each key has a separate control, also arranged in a matrix, for adjusting pitch. The pitch of each key may be adjusted over a considerable portion of the audio range.

The 300 also contains a voltage controlled oscillator, envelope generator and voltage controlled amplifier. These three functions work together to produce shaped tones with each key depression. In addition, their outputs are available for use in the 200.

The output of the 300's keyboard is also available for controlling various functions of the 200. Two additional manual gates and a trigger are provided.

The Manual Controller has found wide application in Junior and Senior High Schools where its "adding machine like keyboard" has helped both the traditionally trained, performance oriented musician and the untrained, non-music student to produce original composition. Many colleges and universities also use the 200/300 combination to lead their students away from the traditional keyboard.

ELECTROCOMP 101 KEYBOARD SYNTHESIZER.

The 101 is a premium quality, keyboard synthesizer and can be fully integrated with the 200. The 101/200 combination has extensive ability to generate and modify sounds.

This combination provides an unusually large number of sound sources — 6 voltage controlled oscillators, 2 noise generators, and 2 microphone amplifiers.

It contains the means to modify these sources — a multimode voltage controlled filter, 2 manual filters, a reverb, 3 ring modulators, and a voltage controlled amplifier.

It has numerous controllers to shape these sounds — a two-voice polyphonic keyboard, 2 sample and holds, 3 envelope generators, 4 control oscillators, 6 mixers, panning, and an electronic switch.

The 101/200 can be found in numerous colleges and universities, recording studios and high schools interested in truly large synthesizer capability. The price of the **101 is $1495.**

ELECTROCOMP 500 KEYBOARD SYNTHESIZER.

The 500 is a simplified version of the 101 and does not have the full patch panel of the 101. For this reason, it cannot be fully integrated with the 200.

The lack of a patch panel does not inhibit the 500's keyboard abilities and it is possible to play the 500 through the 200 and to use the 200 to modify the 500. Its price is $895.

YOU CAN DO IT WITH A 200!

The 200 is a plain, no nonsense synthesizer found everywhere from junior high schools to recording studios. Its work horse design has made it the largest selling classroom synthesizer for the last three years. During this period it has been equally popular in recording studios and on the university campus.

Many purchasers have imaginatively used the 200.

IN THE CLASSROOM. Today this doesn't seem to be too imaginative, but think back three or four years. Then, the idea had entered the minds of very few people. One of the earliest pioneers was the Connecticut State Department of Education. They saw the opportunity to get involved in a creative aspect of music — composition. They did not limit their experiment to music students, but reached out to non-music students as well.

They were soon knee deep in original compositions and many of them startling good. We feel very fortunate in being involved in one of the first and most successful programs in electronic composition in America's public schools.

People often ask why the 200 has been so successful in public schools. We believe that it's due to its lack of complexity. True, the 200 is not as sophisticated as our larger keyboard instruments, but its ability to generate sounds is sufficient for most young composers and its complexity is not baffling. The students understand how to get the sounds they want and can spend more of their effort organizing them into composition, the real task at hand.

NEW POETRY. Many people have used the synthesizer as a sound effects machine to reinforce poetry readings. Recently, a number of poets familiar with the capability of the synthesizer have discovered that poetry as well as being read with a synthesizer background could be read through the synthesizer. Opening a new dimension for the poet in his endeavor to express himself.

SOUND EFFECTS. Team a 200 with a creative student and a school play. You'll get wind, rain, thunder, an old fashioned steam train, a waterfall, sirens, a computer, churchbells — simply, it's just what you make it. Surely, not the most glamorous use, but it's there when you need it and it does the job.

A FOUNDATION FOR LARGER STUDIOS. Many colleges, universities and recording studios saw the 200 as the central element in larger electronic studios. This led to the development of the 101 keyboard synthesizer. The 101/200 combination produces an instrument with immense capabilities.

Soon this pair will be joined by a powerful sequential synthesizer.

ROCK MUSIC. We've had rock musicians perform without using the more traditional keyboard synthesizers — just turning knobs and pushing buttons. Other rock musicians play traditional instruments through the 200 for special effects.

PSYCHOLOGY OF SOUND. One major university uses a 200 to selectively modify and scramble nursery rhymes. They then take the resultant tapes and give very young children a choice between the original and the modified nursery rhyme. The researchers study the child's preference and use the results to further their understanding of children's listening patterns and subsequent speech development.

MUSIC DEPARTMENT TEACHES PHYSICS. One high school music department uses its synthesizer to teach physics students a basic course in sound.

ELECTRONIC STUDENTS LEARN MUSICAL ELECTRONICS. Most high schools, colleges and universities recruit one or more students interested in working in the electronic studio to maintain, explain and build equipment. Simultaneously giving them the opportunity to use and expand their skills and for you to expand your studio.

MUSIC APPRECIATION THROUGH COMPOSITION. One western college had an elective music appreciation course taken primarily by engineering and pre-med students whose course participation was low.

The professor considered the problem and concluded — why not take advantage of their scientific direction and get them involved with synthesizers and music through electronic composition.

ART AND ELECTRONIC MUSIC. Numerous people have worked with a synthesizer connected to an oscilloscope to produce visual realizations of music. Many more have produced light shows, movies and modern dance to compliment electronic compositions. A few examples of the interdepartmental uses of the synthesizer.

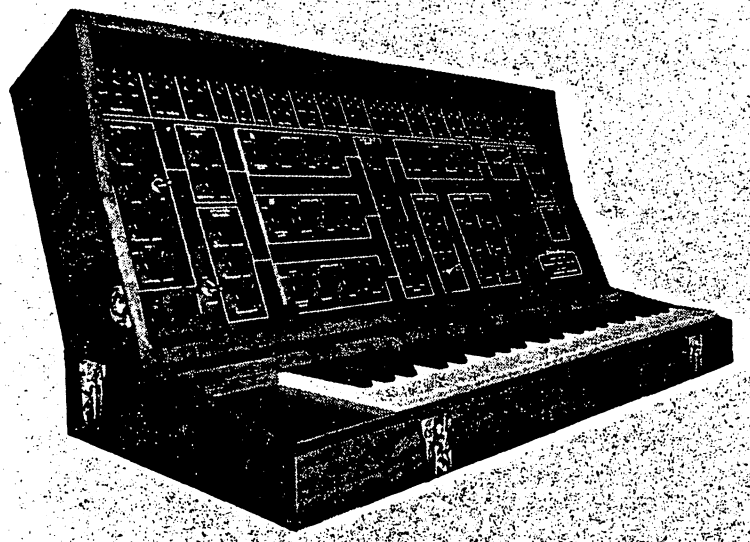
AND IT DOESN'T COST MUCH. No, the 200 can't do everything, but it's done a lot. The cost of a 200 is only $950. This is a low per pupil cost when compared to any traditional instrument. Add a 101 to the 200, bringing the cost up to **$2445.** This is a small price to pay for a synthesizer with as much capability as this combination.

If you think a 200 fits into your future, give us a call. We've had plenty of experience and would be pleased to share it with you.

electronic music laboratories, inc.

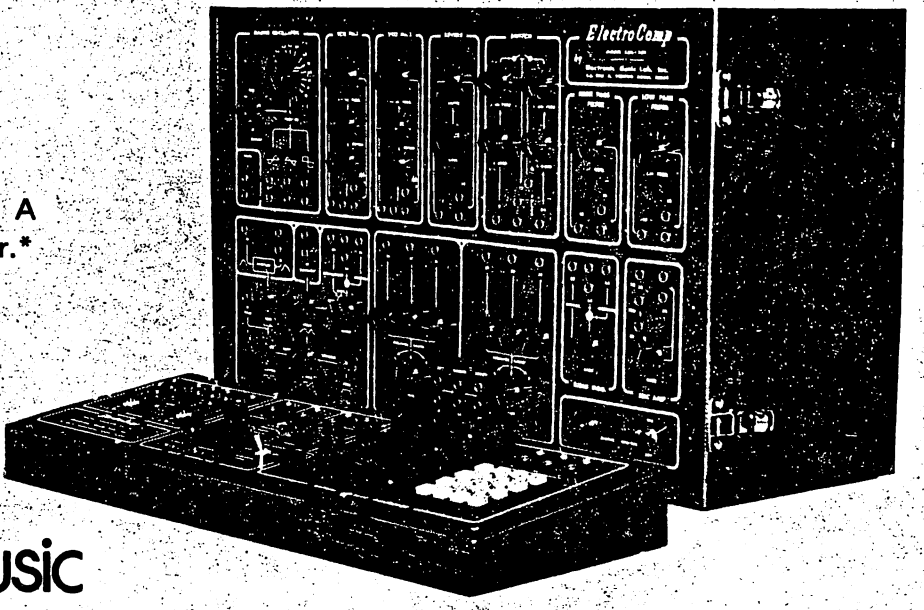
P.O. Box H, Vernon, Connecticut 06066 Tel: (203) 875-0751

the 100...



The ElectroComp 100. A keyboard synthesizer. . $1095.

the 200...



The ElectroComp 200. A classical studio synthesizer.* $995.

electronic music laboratories, inc.

P.O. Box H, Vernon, Connecticut 06066/Tel: (203) 875-0751

"Learning Through Participation"

THE ELECTROCOMP USERS MANUAL

PREFACE

The purpose of this manual is to develop the skills necessary for the use of the ElectroComp in the generation of electronic music.

"Learning Through Participation" develops the skills required for using the ElectroComp by: 1. presenting a rudimentary description of the characteristics of musical tones, 2. presenting a brief description of the ElectroComp and its individual modules, and 3. presenting a series of experiments designed to engage the user in discovery through use.

CHARACTERISTICS OF MUSICAL TONES

Sound is the sensation resulting from the detection of changes in air pressure by the ear and is characterized by: 1. frequency, or pitch, 2. amplitude, or volume, 3. duration, 4. attack and decay, and 5. timbre, or overtone content.

The FREQUENCY, or pitch of a musical sound is the rate of repetition of the fundamental. The fundamental is the lowest tone present in the sound and is recognized as the pitch due to its large amplitude in comparison to any overtones that may be present.

The AMPLITUDE, or volume of a sound is its relative loudness.

The DURATION of a sound is the length of time that it persists.

The ATTACK of a sound refers to the time required for the sound to reach its maximum amplitude.

The DECAY of a sound refers to the time required for a tone to decrease to its minimum amplitude.

TIMBRE refers to the frequency content of a sound and is expressed in terms of the fundamental and overtones. The fundamental is the lowest tone present and is recognized, normally, as the pitch of the sound due to its normally large amplitude in comparison to the amplitude of the overtones. The overtones, technically called harmonics, are whole number frequency multiples of the fundamental; generally of reduced amplitude with respect to the fundamental.

There are three other easily recognizable characteristics achievable in sound: 1. frequency modulation, or vibrato, 2. amplitude modulation, or tremolo, and 3. frequency shifting, or ring modulation.

FREQUENCY MODULATION, or vibrato is a variation in pitch of a musical sound. Traditionally frequency modulation occurs at about seven cycles per second. Electronically, it can occur at any frequency, and if done very rapidly, about 200 cycles per second, sounds very similar to ring modulation. In frequency modulation, the overtones maintain their whole number frequency relationship with the fundamental.

AMPLITUDE MODULATION, or tremolo is a variation in the loudness or volume of a sound.

CHARACTERISTICS OF MUSICAL TONES

FREQUENCY SHIFTING, or ring modulation is a variation in pitch where each frequency component, fundamental and overtones, is shifted by the same amount. The harmonics or overtones do not maintain their whole number relationship with the fundamental, thereby affecting a change in timbre.

Frequency shifting is accomplished by combining two tones in a device called a ring modulator. The tone to be shifted is called the carrier, the tone doing the shifting is called the modulator. The resultant of this combination is the sum and difference frequencies of the two tones.

THE ELECTROCOMP

Visual inspection of the ElectroComp reveals that the system is divided into two sections, upper and lower, and that each of these sections is further divided by the use of outlining into individual modules. Examination of an individual module reveals three primary constituants: 1. jacks for accepting inputs and distributing outputs, 2. control knobs for managing module function, and 3. lettering and guidelines indicating function and organization.

Jack arrangement on the front panel always assumes one of two configurations. The single jack indicates an input. The double jack indicates an output with the same signal available at both jacks for distribution to more than one input.

Control knobs manage system function in any of the following fashions depending upon the module being discussed: 1. control the gain, or volume, of a signal, 2. control the frequency of a signal, 3. control the duration of a signal, or 4. control the function of a module.

Lettering and guidelines indicate function and organization. The lettering can be divided into the three catagories of: 1. module name, 2. control knob function, and 3. jack numbering. The guidelines present on each module indicate the flow of signals from input to output.

Master Oscillator

The Master Oscillator generates sine, square and triangle waveforms simultaneously over the range of .012 to 18,000 cycles per second. There are two controls that operate in a multiplicative fashion to select the output frequency. The range control selects one of six decade ranges, while the frequency control selects the desired frequency within that range

The distinguishing characteristics of the three waveforms are their overtone content and instantaneous amplitudes.

There are six output jacks available, two for each waveform.

White Noise Generator

The White Noise Generator produces a pitchless sound due to the random combination of all frequencies; much like the sound of rushing air.

There are two output jacks available.

THE ELECTROCOMP

Voltage Controlled Oscillators

The Voltage Controlled Oscillators provide a sawtooth waveform in the audio range where the output frequency follows a changing input signal.

There are two controls, center frequency and swing. The center frequency control determines the output frequency of the voltage controlled oscillator (VCO). If there is no input present, the VCO maintains the frequency set by the center frequency control. If there is an input present, the output frequency increases and decreases with the changing input signal. The amount of change is dictated by the swing control. The frequency of the input signal determines the rate of change of the output.

There is one input jack for the control voltage input and two jacks for the sawtooth output.

Reverberator

The reverberator provides the capability of modifying the timbre of an input frequency by use of a spring type mechanical delay. There are two controls available, gain and depth. The gain control determines the volume of the output, while the depth control determines the proportion of reverberated to unreverberated signal appearing at the output.

There are one input and two output jacks.

Electronic Switch

The Electronic Switch provides the capability of alternating two signals, A and B, to a single output. The duration of each signal at the output is independently adjustable over a 300 to 1 range by means of A and B channel duration controls. As well as the duration controls, each input has an associated gain control.

There are two input jacks, one for each channel, and two output jacks.

High Pass Filter

The High Pass Filter modifies the timbre of an input frequency by passing through to the putput all frequencies above the cutoff frequency and attenuating all frequencies below the cutoff frequency. The cutoff frequency is adjustable with the cut frequency control. One input and two output jacks are provided.

THE ELECTROCOMP

Low Pass Filter

The Low Pass Filter modifies the timbre of an input frequency by passing through to the output all frequencies below the cut frequency and attenuating all frequencies above the cut frequency.

The cutoff frequency is adjustable with the cut frequency control.

One input and two output jacks are provided.

Band Pass and Band Reject Filters.

If the two filters are connected in series a Band Pass Filter will be formed where those frequencies between the high and low cut frequencies will be passed through to the output. The connection of the two filters in parallel will form a Band Reject Filter where those frequencies above the High Pass Filter's cut frequency and those frequencies below the Low Pass Filter's cut frequency will pass to the output.

Waveshaper

The Waveshaper consists of three modules in one, a Sampler, an Envelope Generator and a Modulator. Due to the complexity, these three devices will be described separately.

The Sampler

The Sampler is a device which inspects a continuously varying input, such as a triangle wave, and converts it into an incrementally varying function, such as an ascending and descending staircase. This output functions as a Voltage Controlled Oscillator input. There are two controls associated with this device which together control the sampling interval of the staircase.

There is one input and two output jacks.

The Envelope Generator

The Envelope Generator provides the capability of generating a waveform with controlled attack and decay. This waveform can be generated synchronously from the sampling rate of the sampler or from a manual pushbutton. Either of these modes are selectable by means of the Modulators's Mode Select switch. The attack and decay are controllable in duration by means of two controls labelled attack and decay.

THE ELECTROCOMP

Envelope Generator

The Envelope Generator output, available at two jacks, is useful in conjunction with the modulators for amplitude modulation. It may also be used a VCO input.

The Modulator

The Modulator can operate in four separate modes as determined by the Mode Select switch. The first of these modes is Amplitude Modulation where the Modulator will accept a modulating frequency, such as a low frequency sine wave, and a carrier, such as white noise, and shape it in intensity or volume. The second mode of operation is Ring Modulation where the sum and difference frequencies of the carrier and modulator are produced at the output. The third and fourth modes of operation are also forms of Amplitude Modulation, however, the output of the Envelope Generator is used to shape the carrier frequency in amplitude. When in this mode, the connection from the envelope generator output to the modulator input is made automatically.

The Modulator contains two input jacks, carrier and modulator, and two output jacks.

Dual Mixers

The Dual Mixers provide for the summing of three input signals per channel with each input having its own gain control. As well, any portion of the output of either mixer can be routed to the other channel by means of a pan control.

There is one input jack available for each input. There are six output jacks, two for each channel and two wired for stereo headphone use. (Note: Headphones of 200 ohm impedance may be used at any system output to monitor.)

Ring Modulator

The Ring Modulator provides the capability of accepting two input, arrier and modulator, and profucing the sum and difference frequencies at the output. As well, the Ring Modulator will accept the output of the Envelope Generator at its modulation input, allowing Amplitude Modulation.

The Ring Modulator contains two input jacks, modulator and carrier, and two output jacks.

THE ELECTROCOMP

Microphone Amplifier

The Microphone Amplifier is a low distortion amplifier designed to bring low level signals up to the standard level used in the ElectroComp. An input gain, volume, control is provided.

There is one input jack and two output jacks.

EXPERIMENTS

This section consists of a group of experiments designed to develop an understanding of the capabilities of the ElectroComp. Each experiment will consist of three parts - purpose, procedure and result.

The following general comments should be understood before beginning the experiments:

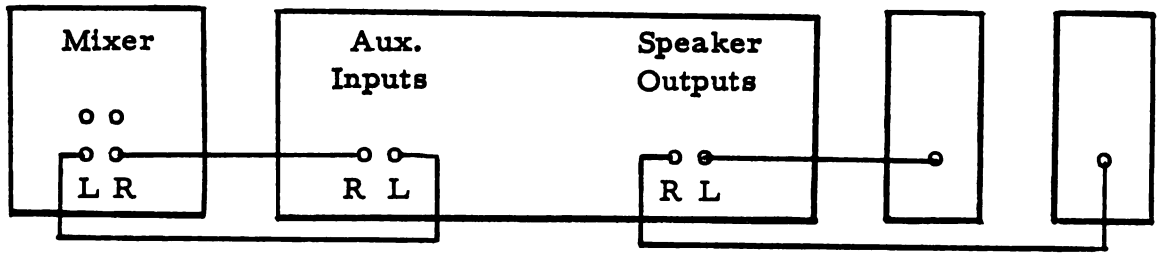
1. There are no combinations of connections within the ElectroComp that can possibly do any harm to the user or equipment.

2. The system should never be disassembled or modified without permission from the factory.

3. Generally, when a function fails to function as expected it will be found that one of the following conditions exsist:

   a. gain, or volume, turned off.
   b. frequency of sound source not in hearing range.
   c. no output connection made.

4. The output device for the experiments can be either an amplifier and associated speakers, as shown below, or stereo headphones of 200 ohms or greater.



ELECTROCOMP AMPLIFIER SPEAKERS

EXPERIMENTS

1. Character of White Noise.

Purpose - to note the characteristic pitchless sound of White Noise.

Procedure - a. connect jack 1. White Noise Generator output, to jack 26, a left Mixer input.
b. adjust the gain control of Mixer input 26 to a comfortable hearing level.
c. rotate the left pan control.

Result - note the pitchless sound of white noise and the fact that its presence does not produce the weariness of a constant tone. Note that varying the gain control of the Mixer is the simplest form of amplitude modulation and if done with proper motion, can simulate ocean waves. Note that rotating the pan control moves the output from the left to right speakers.

2. Harmonic content of the Master Oscillator's waveforms.

Purpose - to note the relative volume of the sine, triangle and square waves at 400, 8,000, and 12 cycles per second.

Procedure - a. set the frequency of the Master Oscillator at 400 cycles per second (range control at 100 and frequency control at 4).
b. connect jack 2, sine wave output, to jack 26, Mixer input, - listen.
c. move jack 2, sine wave output, to jack 3, triangle wave output, - listen.
d. move jack 3, triangle wave output, to jack 4, square wave output, - listen.
e. repeat the above sequence with the frequency set at 8000 and 12 cycles per second.

Result - note that at 400 cycles the relative volume of the harmonic-less sine tone is less than both the triangle and square. However, at 8,000 cycles they sound identical in volume due to the fact that the first harmonic, 24,000 cycles, of both the square and triangle is beyond our hearing range. At the other end of the hearing range, 12 cycles or less, we can no longer detect the pure sine tone; but can still detect the triangle and square due to the higher harmonics present in each of these waveforms.

EXPERIMENTS

3. VCO Center Frequency Control.

Purpose - to develop an understanding of the use of the center frequency control.

Procedure - a. turn the center frequency control full counterclockwise (CCW).
b. connect jack 6, VCO output, to jack 26, left Mixer input.
c. slowly rotate the center frequency control clockwise (CW).

Result - note the apparant increase in pitch with CW rotation and the difference in timbre of the sawtooth as compared to the sine, triangle and square waves.

4. VCO Swing Control.

Purpose - to develop an understanding of the use of the swing control.

Procedure - a. set the frequency of the Master Oscillator at . 2 cycles per second (range switch at . 1 and frequency control at 2).
b. set swing control full CCW and center frequency at 12:00.
c. connect jack 6, VCO output, to jack 26, Mixer input.
d. connect jack 5, VCO input, to jack 2, sine output.
e. slowly rotate swing control CW.

Result - note that as the swing control is rotated CW, the amount of frequency change above and below the center frequency increases. By using the triangle and square waves in place of the sine wave, it will become apparant that the VCO follows the shape of the input signal with corresponding changes in pitch.

5. VCO Rate Control

Purpose - to determine the affect of rate changes of the input signal on the VCO's output.

EXPERIMENTS

5. VCO Rate Control.

Procedure - a. maintain the setup of the previous experiment.
b. set the swing control at 9:00.
c. vary the frequency control of the Master Oscillator.

Result - note that the rate of oscillation of the control input determines the rate of change of the VCO. If the range switch of the Master Oscillator is set at 100, it will be noted that the VCO's output will appear to have changed in timbre due to rapid frequency modulation.

6. Reverberator Delay.

Purpose - to observe the delaying affects of the Reverberator.

Procedure - a. turn the gain and depth controls full CW.
b. connect jack 8, VCO output, to jack 9, Reverb input.
c. connect jack 10, Reverb output, to jack 26, Mixer input.
d. move jack 9, Reverb input, in and out.

Result - note that the sound persists after the removal of jack 9, Reverb input, indicating that the input signal is delayed in its passage through the reverb.

7. Reverb Depth Control.

Purpose - to determine the affect of depth control on Reverb output.

Procedure - a. maintain the setup of the previous experiment.
b. connect jack 2, sine output, to jack 7, VCO input.
c. set the Master Oscillator to 1 cycle per second.
d. rotate the depth control CCW.

Result - note that rotation of the depth control CCW mixes the reverberated and unreverberated sawtooth of the VCO.

EXPERIMENTS

8. Electronic Switching.

Purpose - to determine the capability of the Electronic Switch to alternate two tones to a single output and the method for controlling their duration at this output.

Procedure - a. set the output frequency of the Master Oscillator and the first VCO in the audio range.
b. turn the duration controls, A on time and B on time, full CW.
c. connect jack 2, sine output, to jack 11, switch input.
d. connect jack 6, VCO output, to jack 14, switch input.
e. connect jack 12, switch output, to jack 26, Mixer input.
f. slowly rotate each duration control CCW.
g. remove connection between jack 6, VCO output, and jack 14, Switch input.
h. rotate duration controls.

Result - note that it is possible to control the rate and duration of alternation of two tones to a single output or one tone and silence. Interesting affects can be achieved by rotating the frequency controls of the sound sources while the switch is alternating tones.

9. Square Wave Filtering - High Pass.

Purpose - to modify the harmonic content of a square wave by use of the High Pass Filter.

Procedure - a. set the frequency of the Master Oscillator at 400 cycles.
b. connect jack 4, square wave ouput, to jack 15, High Pass Filter input.
c. connect jack 16, High Pass output, to jack 26, Mixer input.
d. rotate the cut frequency control CCW.

Result - note the change in volume and timbre of the tone due to the attenuation of the fundamental and lower harmonics.

EXPERIMENTS

10. Square Wave Filtering - Low Pass Filter.

Purpose - to modify the harmonic content of the square wave by use of the Low Pass Filter.

Procedure - a. set the frequency of the Master Oscillator at 400 cycles per second.
b. connect jack 4, square wave output, to jack 17, Low Pass Filter input.
c. connect jack 18, Low Pass Filter output, to jack 26, Mixer input.
d. rotate the cut frequency control CW.

Result - note the change in volume and timbre due to the attenuation of the higher harmonics and that full CW rotation changes the square wave into a sine wave.

11. Scale Generation.

Purpose - to develop an understanding of the Sampler when used as a control voltage for the VCO's.

Procedure - a. turn the rate and duration controls of the Sampler full CW.
b. turn the swing control of the VCO to 12:00.
c. set the frequency of the Master Oscillator to .2 cycles per second.
d. connect jack 3, triangle wave output, to jack 19, Sampler input.
e. connect jack 21, Sampler output, to jack 5, VCO input.
f. connect jack 6, VCO output, to jack 26, Mixer input.
g. vary rate and duration of the Sampler.

Result - note the staircase of tones generated by the VCO output due to the conversion of the triangle wave from a continuously varying function to an incrementally varying function. Note that the time interval between notes is determined by the rate and duration controls.

12. VCO Control using the Envelope Generator.

Purpose - to use the Envelope Generator to control the VCO's output frequency.

Procedure - a. turn attack and decay controls full CW.
b. turn center frequency control full CCW.
c. turn duration and rate controls to 12:00.
d. select manual mode.
e. connect jack 22, envelope output, to jack 5, VCO input.
f. connect jack 6, VCO output, to jack 26, Mixer input.
g. depress Manual Button in and out.
h. slowly rotate decay CCW.
i. push button.
j. rotate attack CCW.
k. push button.
l. select automatic mode.
m. vary attack and decay.
n. vary rate and duration.

Result - note that the VCO follows the shape of the Envelope Generators output in frequency. Also note that the rate of envelope generation can be controlled automatically or manually.

13. Amplitude Modulation using the Envelope Generator.

Purpose - to use the Envelope Generator to amplitude modulate White Noise.

Procedure - a. turn the duration and rate controls of the sampler to 12:00.
b. select manual mode.
c. turn attack and decay controls CW.
d. connect jack 1, White Noise output, to jack 25, carrier input.
e. connect jack 24, Modulator output, to jack 26, Mixer input.
f. push manual button in and out at a slow rate.
g. add attack and decay - push button.
h. select automatic mode.
i. vary attack and decay.

EXPERIMENTS

13. Amplitude Modulation using the Envelope Generator.

Result - note that in the manual mode and with the attack and decay full CW, depressing the pushbutton merely passes the carrier signal to the output. However, by adding attack and decay, it is possible to shape the volume of the tone. Selecting the automatic modes allows the shaping to occur at a rate set by the rate and duration controls. This should be repeated with the sawtooth and sine waves as carrier inputs.

14. Ring Modulation.

Purpose - to use the Modulator as a Ring Modulator.

Procedure - a. select the Ring mode.
b. set the frequency of the VCO to 10:00.
c. set the frequency of the Master Oscillator to ~~120~~ 250 cycles per second.
d. connect jack 2, sine output, to jack 23, modulation input.
e. connect jack 6, VCO output, to jack 25, carrier input.
f. connect jack 24, modulator output, to jack 26, Mixer input.
g. rotate the Master Oscillator over its decade range. ℓ VCO,

Result - note that as the Master Oscillator is rotated CW, the output of the Modulator appears to have two separate tones, one increasing with CW rotation and the other decreasing with CW rotation. These are the sum and difference frequencies.

15. Amplitude Modulation using the Master Oscillator.

Purpose - to amplitude modulate the sawtooth with the sine wave.

Procedure - a. select the Amplitude mode.
b. connect jack 6, VCO output, to jack 25, carrier input.
c. connect jakc 2, sine output, to jack 23, modulation input.
d. connect jack 24, modulator output, to jack 26, Mixer input.
e. vary the frequency of the Master Oscillator in the 1 range.

EXPERIMENTS

15. Amplitude Modulation using the Master Oscillator.

Results - note that the Modulator produces an envelope of the VCO output. This experiment may be repeated using the triangle and square wave outputs. This experiment also should be repeated in the Ring mode.

16. Ring Modulation of external sounds.

Purpose - to Ring Modulate external sounds using the Microphone Amplifier.

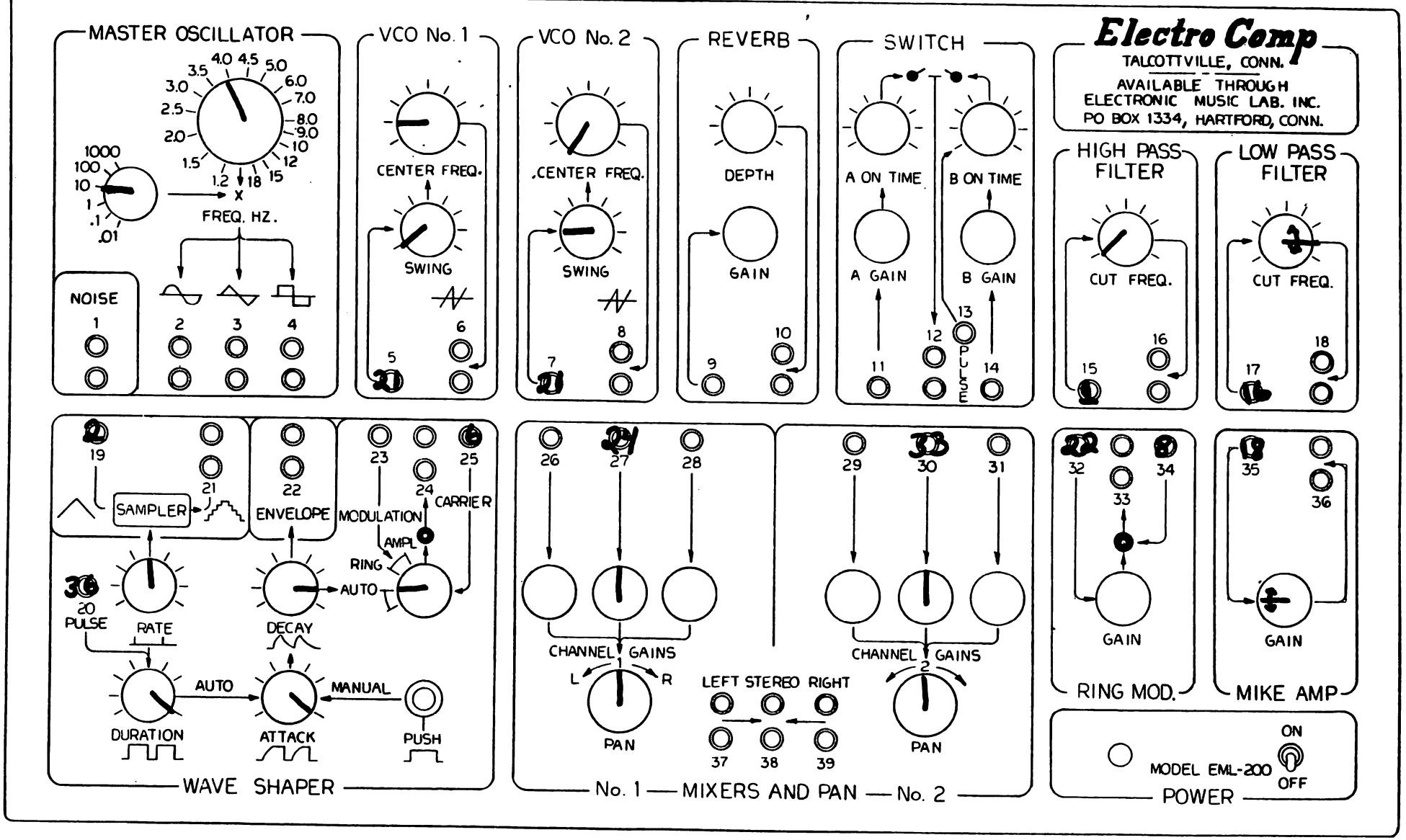
Procedure - a. connect a mike to jack 35, Microphone input.
b. connect jack 36, Microphone output, to jack 32, Ring Modulator modulating input.
c. connect jack 33, modulator output to jack 26, Mixer input.
d. connect jack 2, sine output, to jack 34, carrier input.
e. set the frequency of the Master Oscillator at 100 cycles.
f. speak into the microphone.

Result - note the change in timbre and frequency content of the external sound.

Following this set of experiments are additional outlined experiments.

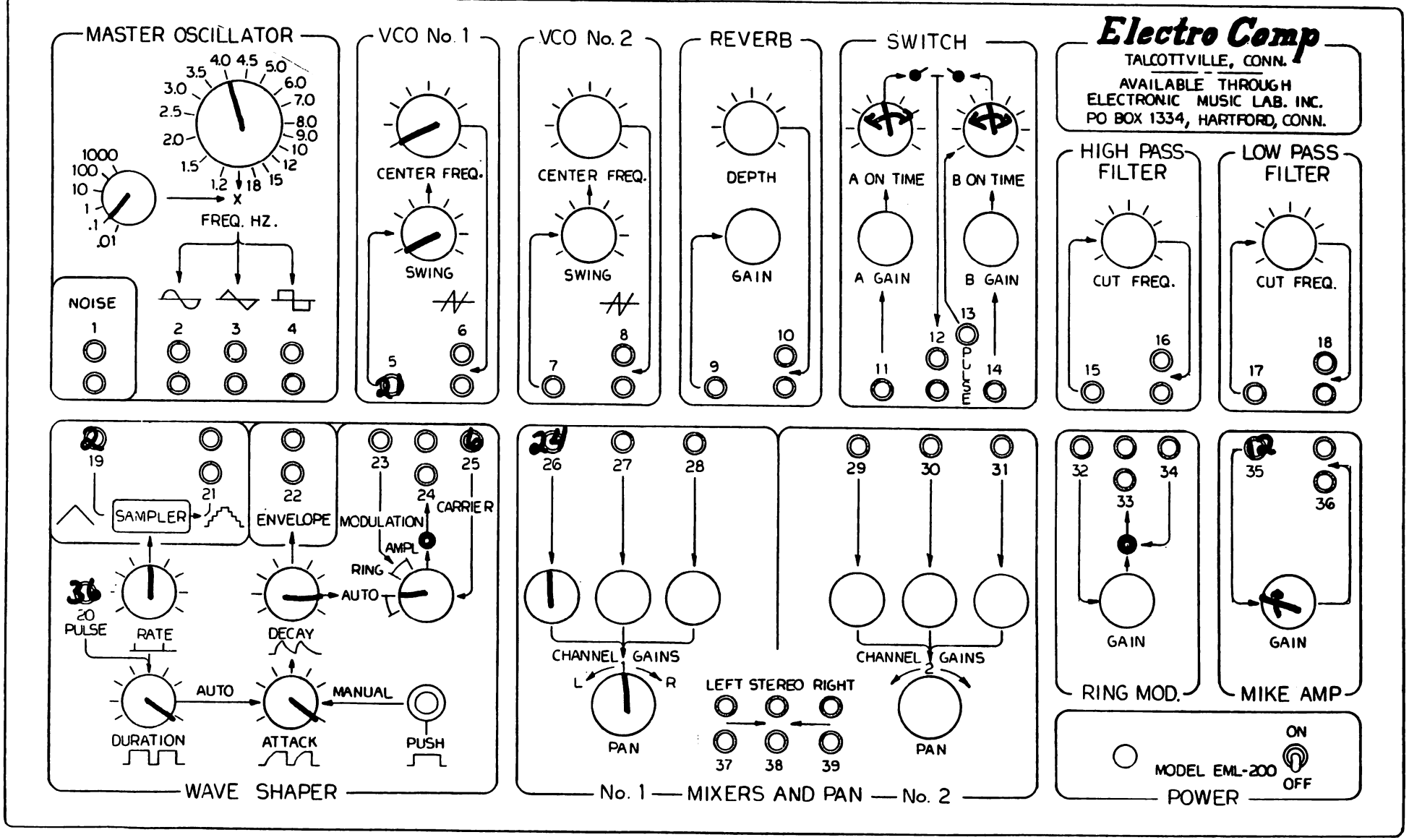
NAME _____ DATE _____

Random rythmn and tone generation.



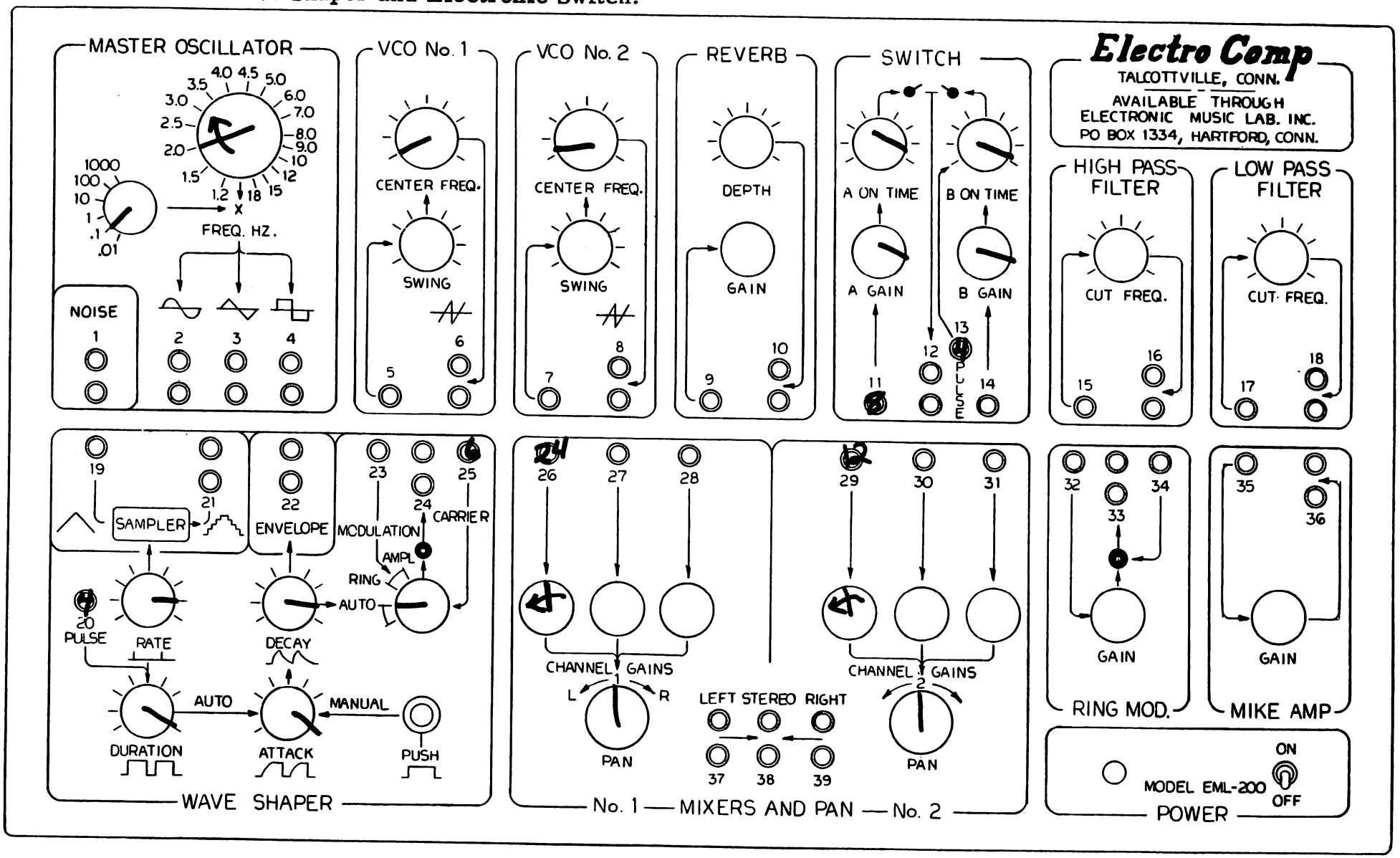
NAME _____ DATE _____

Control of Sampler from Electronic Switch.



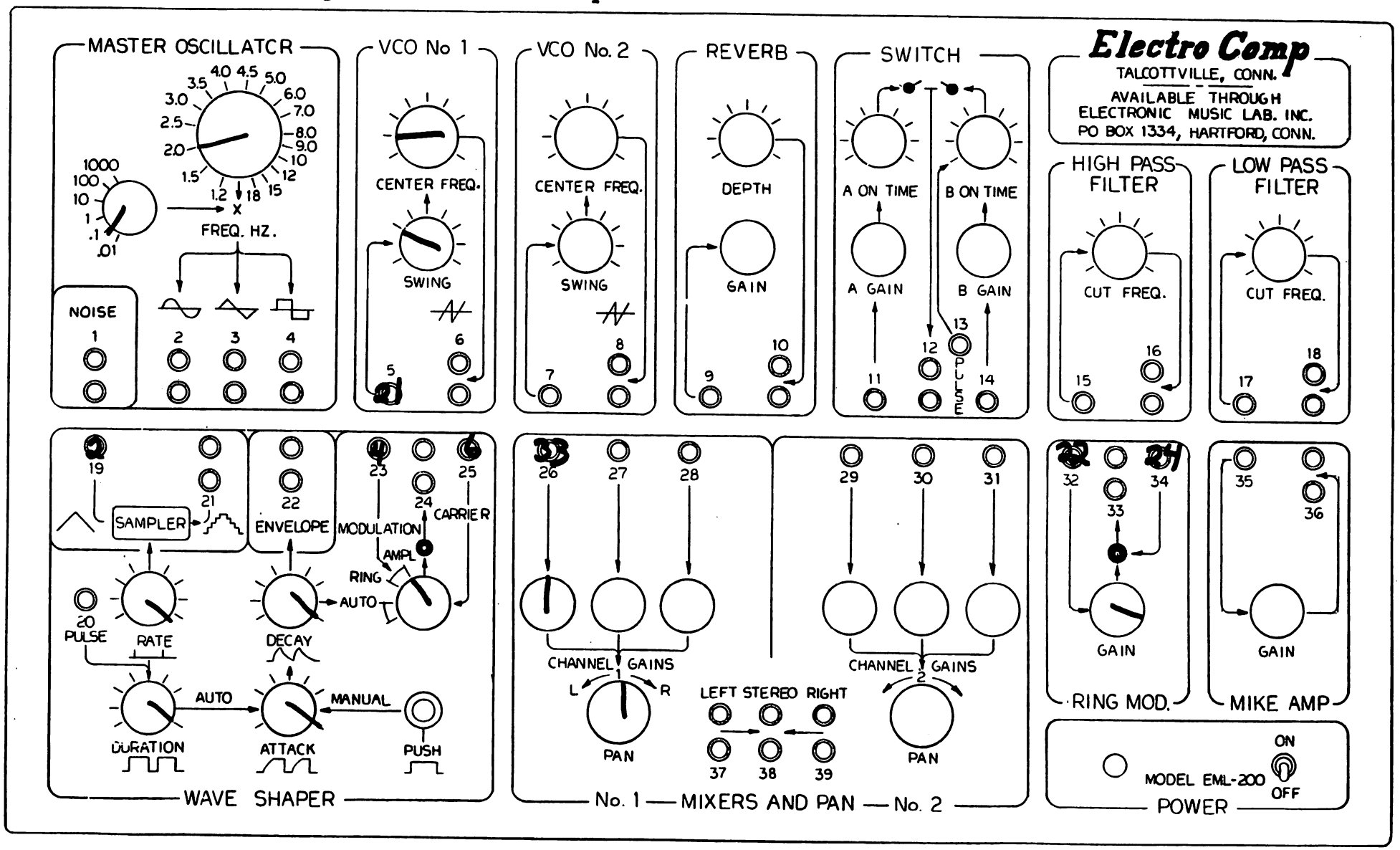
NAME _____ DATE _____

Pulse control of Wave Shaper and Electronic Switch.



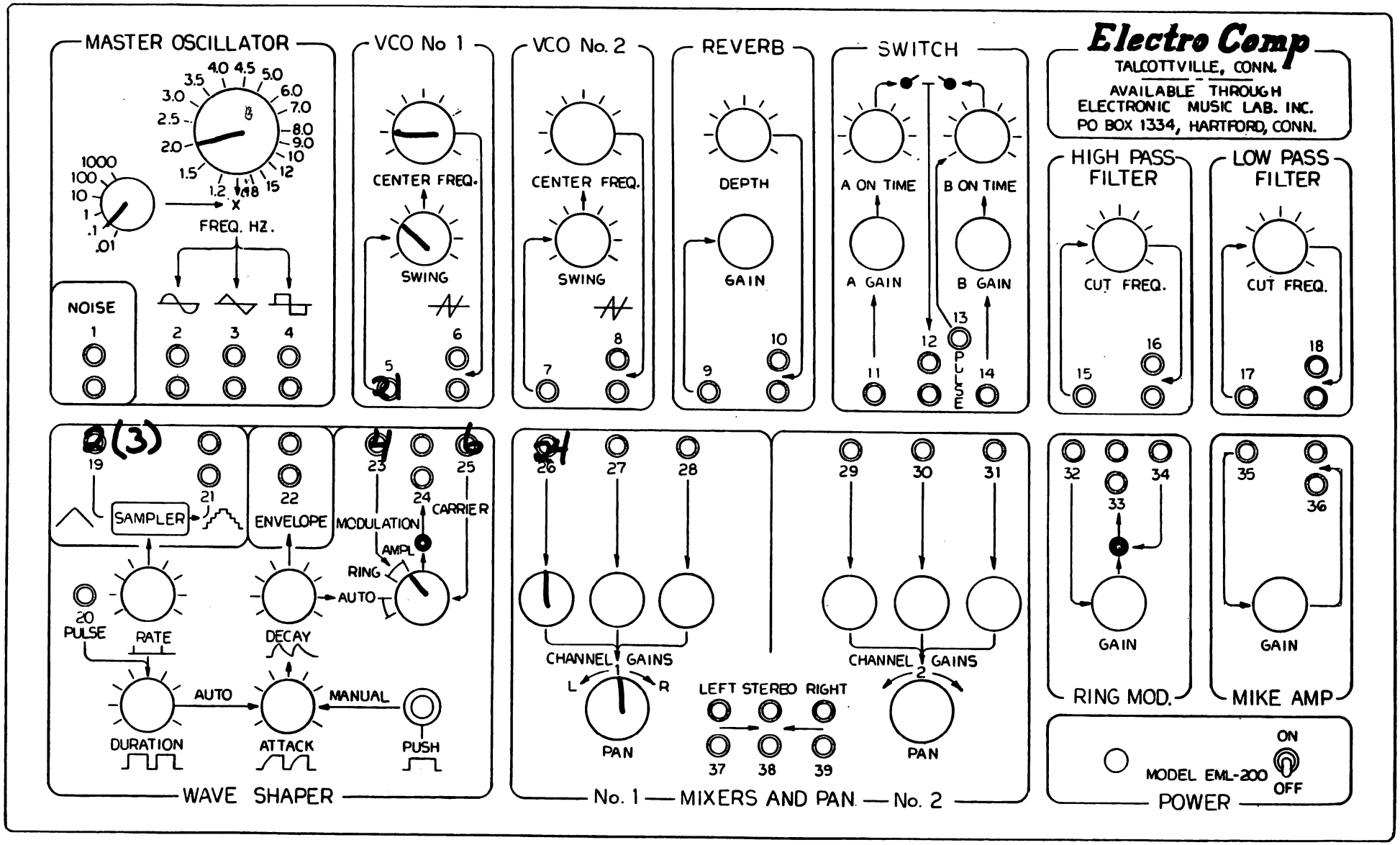
NAME_____ DATE_____

Generation of ascending staircase with envelope.



NAME _____ DATE _____

Generation of ascending (descending) staircase.



THE MANUAL CONTROLLER

Introduction

The Manual Controller is an optional keyboard for the Studio Synthesizer whose primary function is to add live performance capabilities to the Studio Synthesizer. To this end, it provides a Manual Voltage Generator for the voltage control of the Studio Synthesizer and Manual Switches for routing signals of the synthesizer. Its secondary function is to generate internally shaped tones. This function is provided by the Note Generator.

The Manual Controller is dependent upon the Studio Synthesizer and must be connected to it before it can be operated. This is accomplished by plugging the cord of the Manual Controller with its keyed octal socket into its female located in the cord storage area on the Studio Synthesizer. ('Keyed' implies that it is impossible to mis-orientate this plug.)

THE MANUAL VOLTAGE GENERATOR is composed of two sections, a 16 key matrix keyboard which is similar to an adding machine's keyboard and 16 presettable voltage sources, one for each key. The depression of a key produces two voltages and a pulse. The voltages may be used to control the pitch of the two VCOs or the amplitude (loudness) of sound from the Ring Modulators. The voltages are proportional to the setting of the depressed key's respective control. (Low voltages CCW, high voltages CW.) The output of jack 61, Sampled Voltage, remains at the selected level after the release of the key and does not change until the depression of another key. The output of jack 62, Voltage, is slightly lower than the Sampled Voltage and is only present during key depression. The Pulse output, jack 63, may be used to trigger the envelope Generator, Sampler, and Electronic Switch of the Studio Synthesizer.

Experiment 1 - Voltage Control of the VCOs.

Procedure - 1. connect the Manual Controller's Voltage output (62) to the VCO's input (5).
2. connect the VCO's output to the Mixer input (26).
3. set the Swing and Center Frequency controls to 9:00.
4. depress any key and release.
5. vary that key's presettable voltage control.
6. repeat 4.

Results - note that the VCO pitch increases upon key depression and returns to 'pre-depression' pitch after release indicating that the preset voltage is only present during key depression. This same experiment may be repeated with the Voltage output going to both VCOs with the Swing controls set differently.

Experiment 2 - Voltage Control of the Ring Modulators.

Procedure - 1. connect the Noise Generator output (1) to the Ring Modulator's carrier input (34).
2. connect the Voltage output (62) to the Ring Modulator's Modulation input (32).

Experiment 2 - (continued)

Procedure - 3. connect the Modulators output (33) to the Mixer input (26).
4. Repeat 4, 5, and 6 of experiment 1.
Results - note thtat the loudness of the Ring Modulator's output varies in direct proportion to the setting of the depressed key's control.

The Sampled Voltage output differs from the Voltage output in that it remains at the selected level until another key is depressed. (This is accomplished by a memory circuit called a 'Sampler' that at every key depression memorizes the selected voltage until the next key depression.)

Experiment 3 - Sampled Voltage Output.

Procedure - 1. repeat Experiments 1 and 2 using Sampled Voltage output (61) in place of the Voltage output (62).
Results - note that the VCO maintains its pitch after release of the key and only changes when another key is depressed. Similarly, the loudness of the Ring Modulator only changes when another key is depressed.

The Pulse output (63) of the Manual Controller is used as a trigger for the Sampler, Electronic Switch and the Envelope Generator of the Studio Synthesizer. You may have noticed in your use of the Electronic Switch and the Wave Shaper that they both have pulse inputs (13, 20). Additionally, you may have noticed that if you plugged one end of a jack into the pulse input of the Electronic Switch while it was running, it would cease to run. If you had connected the other end to a Pulse output and pushed a key, you would have heard the Switch come on once for each depression. The following experiment will develop this method of control of the Electronic Switch.

Experiment 4 - Pulse Control of the Electronic Switch.

Procedure - 1. connect the Master Oscillator's sine wave output (2) to the Electronic Switch's A input (11).
2. connect the output of the Switch (12) to the Mixer input (26). Listen!
3. plug one end of a jack in the Switch's pulse input (13). Listen!
4. connect the other end of the jack to the Manual Controller's pulse output (63). Depress a key.
5. Vary the duration of the A on time control.
6. Vary the duration of the B on time control.
Results - note that the insertions of only one end of the jack causes the Switch to cease to function automatically and that the insertion of the other end and the depression of a key causes the Switch to turn on for an amount of time determined by the A on time control. Also note that the B on time control no longer has any effect on the B on time, being entirely dependent on interval between key depression. (To check this it may be helpful to insert an audio signal in the B channel.)

Experiment 5 - Pulse Control of the Envelope Generator.

Procedure - 1. connect VCO output (6) to the Ring Modulator Carrier input (25) with the Modulator in the Auto Mode.
2. connect the Envelope Generator's output (22) to the Ring Modulator's Modulation input (23).
3. connect the Modulator output (24) to the Mixer input (26). Listen, making sure the VCO is in the audio range!
4. connect the Wave Shaper Pulse input (20) to the Manual Controller Pulse output (63). Depress a key.
5. Vary the duration.
6. Vary the attack and decay. (IMPORTANT - it is important that in the Auto Mode that the duration be longer than the attack. Always select your duration and decay and then add attack.)

Results - note that the rate control no longer has any effect on the rate and is now controlled by key depression.

Experiment 6 - the Generation of Shaped Tones.

Procedure - 1. keep Experiment 5 setup and connect Sampled Voltage output (61) to the VCO input (5).
2. Depress a key.

Results - note that the depression of a key generates a shaped tone. The second VCO and the second Modulator may be used to generate another shaped tone with the same envelope.

Between the two Manual Switches is a second Pulse output (53) which also may be used to trigger the Electronic Switch, Sampler and Envelope Generator. asynchronously with respect to the matrix keyboard.

In addition to controlling functions of the Studio Synthesizer, the Manual Voltage Generator is internally connected to the Note Generator. The matrix keyboard and presettable controls determine the pitch and duration of tones generated.

The NOTE GENERATOR performs the same function as that achieved by the patching of Experiment 6 - the generation of a shaped tone. The Sampled Voltage output (61) is connected internally to the VCO of the Note Generator and the depression of a key causes a change in pitch proportional to the position of that key's control. This may be verified by listening to the Note Generator's VCO output (59). Additionally, the VCO has an input for producing vibrato (variation in the pitch of a note during its duration). The virbrato on VCOs of an electronic music instrument can be slow like on a traditional instrument (about 7 cycles/second) or rapid (100's of cycles/second) producing an effect similar to ring modulation.

The Pulse output of the Manual Voltage Generator is also connected to the Note Generator's Envelope Generator to trigger it upon key depression. In the Manual Mode, the duration of the envelope is equal to the key depression plus the decay time. In the Automatic Mode, key depression has no effect on duration - duration being determined by the Duration control. The attack and decay may be varied with their respective controls. Minimum attack, duration, and decay are full clockwise.

The Note Generator produces shaped tones by combining the outputs of the VCO and the Envelope Generator in the Envelope Shaper (Amplitude Shaper/Ring Modulator all perform the same function when used with an Envelope Generator).

Experiment 7 - Generation of Shaped Tones with Vi brato.

Procedure - 1. connect the Envelope Shaper output (58) to the Mixer input (26).
2. depress a key, vary the attack, decay - have the mode switch in the Manual Mode.
3. set the Master Oscillator at 5 cycles/second and connect the sine wave output (2) to the Virbrato input (60). Depress a key.
4. replace the sine wave with the square wave (4).
5. increase the frequency of the Master Oscillator to 400 cycles.
IMPORTANT - make sure that the Swing control on the VCO is not full CCW. This control should be varied during 3, 4 & 5.

The Envelope output of the Note Generator can be used to shape tones of the Studio Synthesizer similar to Experiments 5 and 6 by connecting its output (57) to either Modulator's modulation input. In addition, it is possible to generate a third envelope by combining the triggered (from the Manual Controller) Envelope of the Studio Synthesizer and the Envelope of the Note Generator in a mixer and taking the output of the Mixer and using it in the Modulator's modulation input. (Make sure that the mixer used has its pan control adjusted so that all output is passing to its output.)

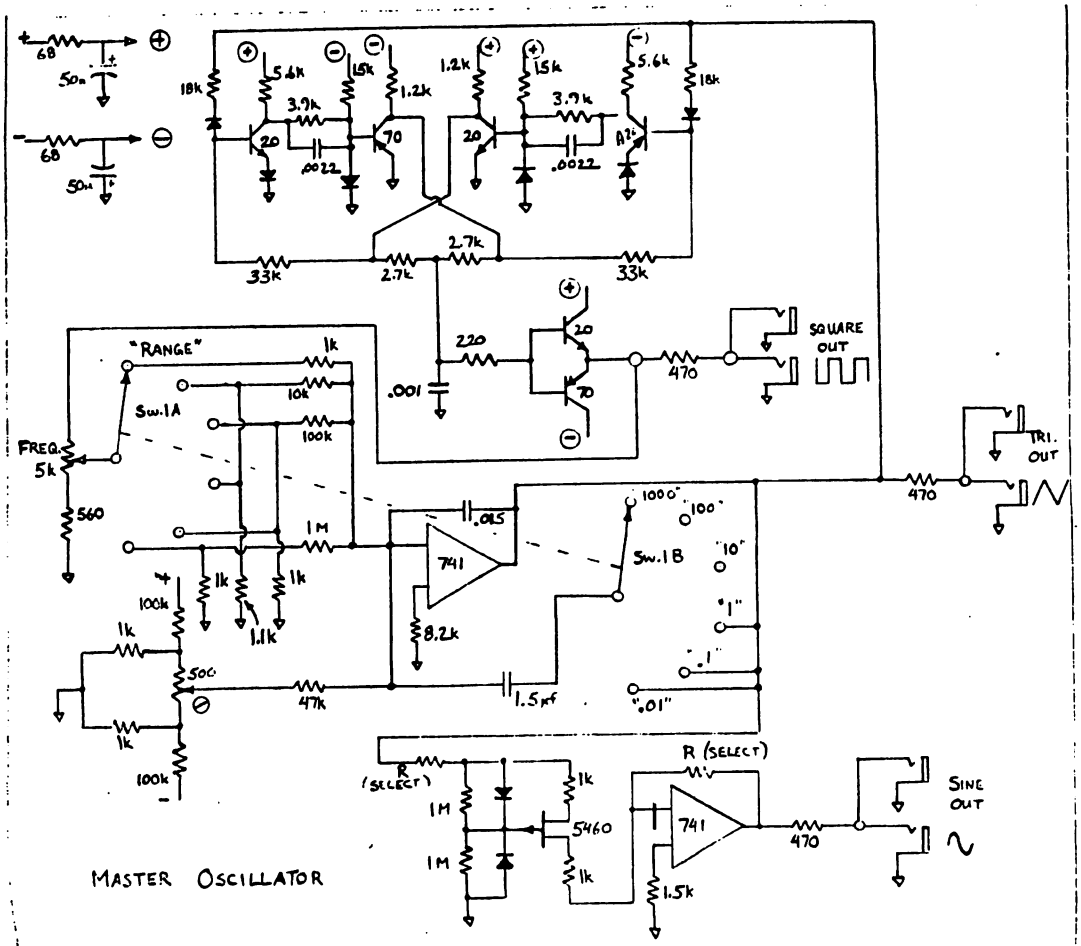
The MANUAL SWITCHES perform as Amplitude Shapers (Ring Modulators when used with an envelope). They are primarily used for routing signals between inputs and outputs in the Studio Synthesizer. The Manual Switches can rout either of two audio or control signals or none to a single input of the Studio Synthesizer or, due to their bi-directional characteristics, rout a single signal to either of two outputs or none.

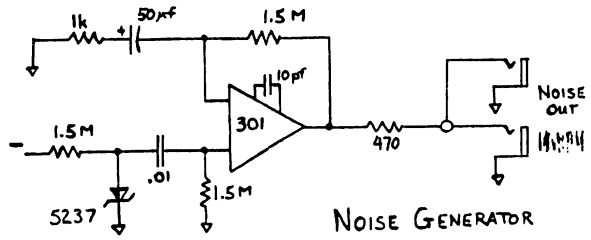
Experiment 8 - Routing the Note Generator's output.

Procedure - 1. connect the Envelope Shaper output (58) to the Manual Switch's input (55). IMPORTANT - the Manual Switches jacks can be either inputs or outputs due to their bi-directional nature.
2. connect one of the Manual Switch's outputs (56) to the High Pass Filter's input (15).
3. connect the remaining output (54) to the Low Pass Filter's input (17). Connect both filter ouputs (16 & 18) to Mixer inputs (26 & 27).
4. Move the Manual Switch to the right and left while depressing keys. Adjust the filters so that they are modifying the timbre of the Note Generator's shaped tone.

Result - note that the shaped tone moves between the two filters depending upon the position of the switch.

The bi-directional characteristics may be used by taking the sine wave output (2) and the sawtooth output (6) and putting them into the Manual Switches inputs (54 & 56) and taking the output (55) into one input of the Electronic Switch (11) and monitoring the Electronic Switch's output.





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TOP PANEL

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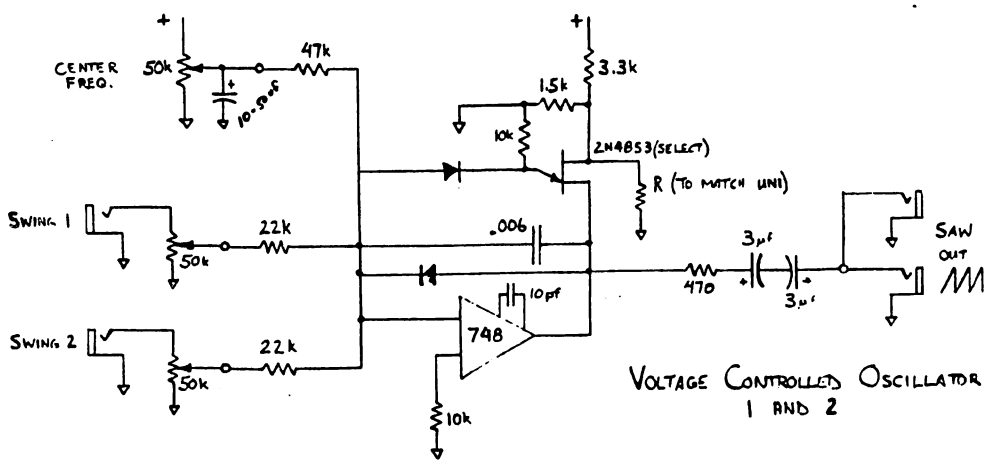

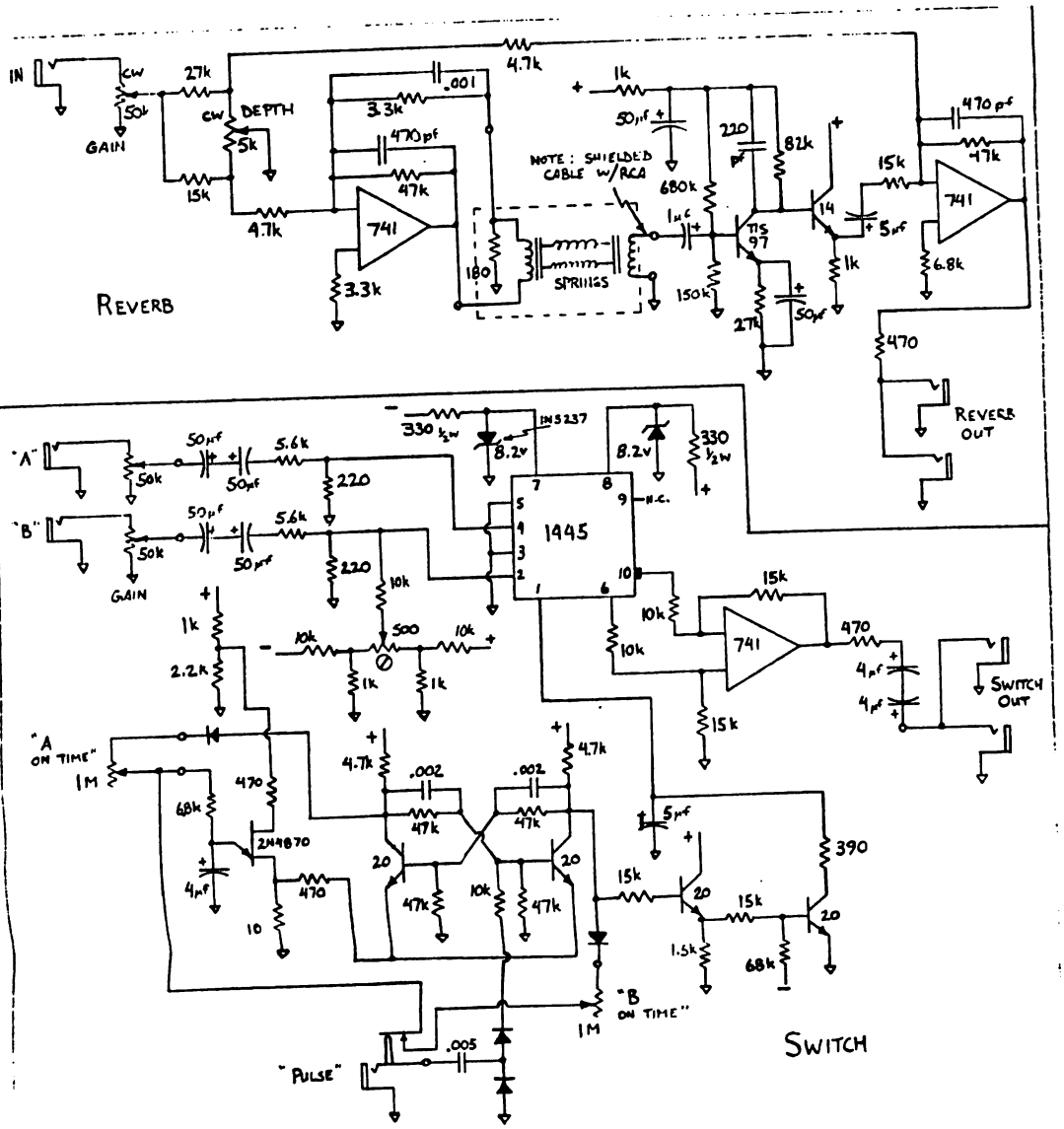

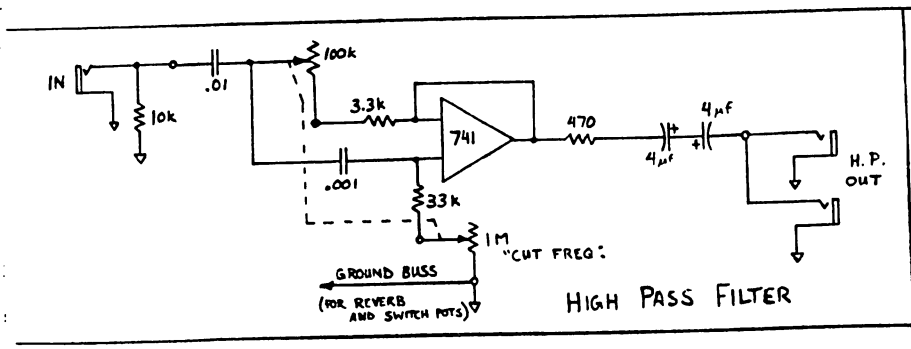

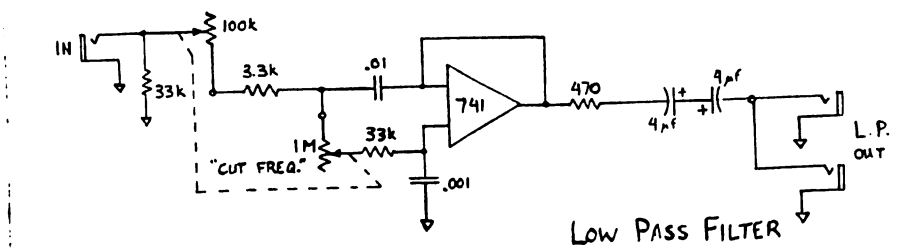

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TOP PANEL

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JVP

EML-200 TOP PANEL CIRCUITS

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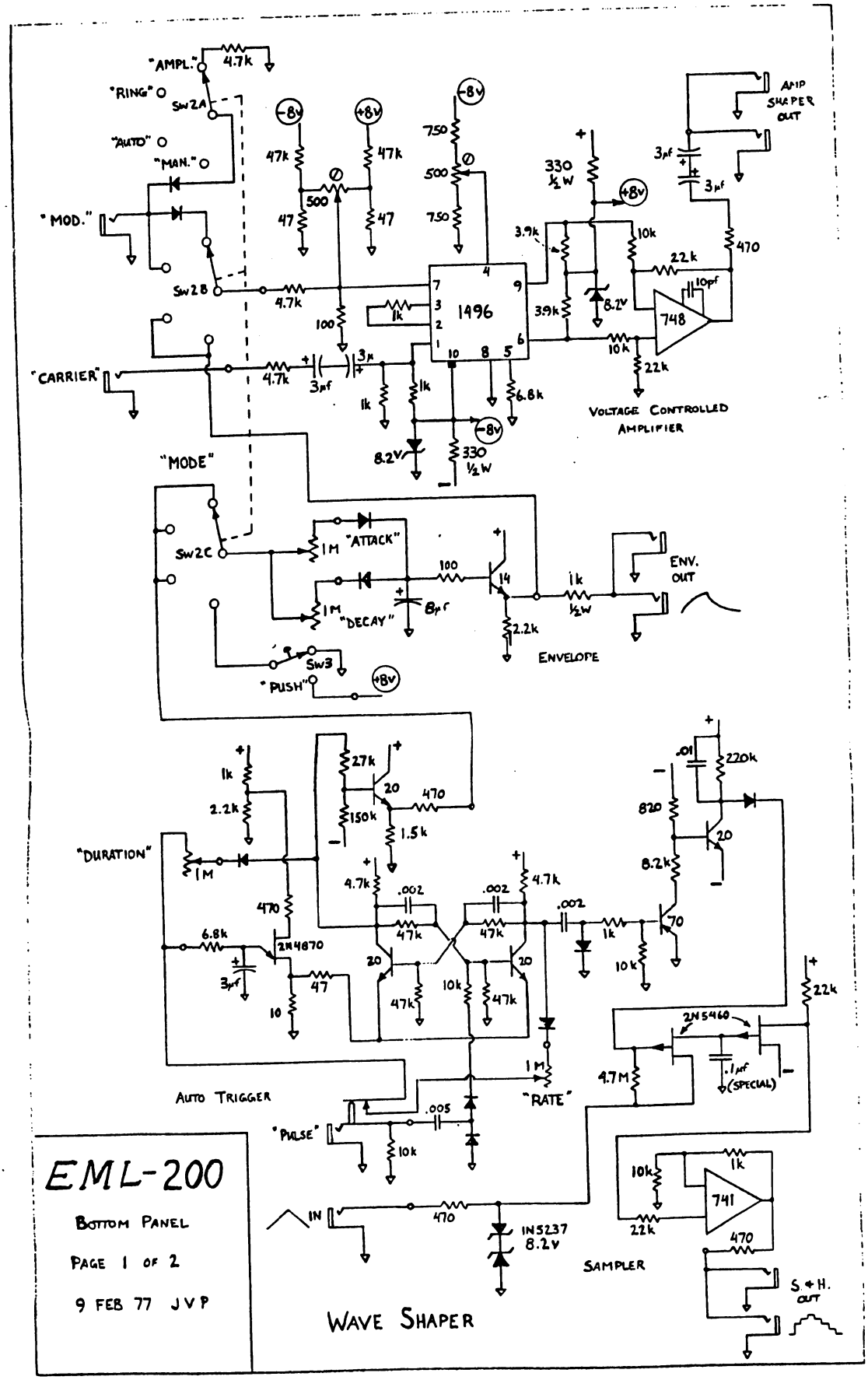
7/8 FEB 77

SHEET 1 OF 2



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BOTTOM PANEL

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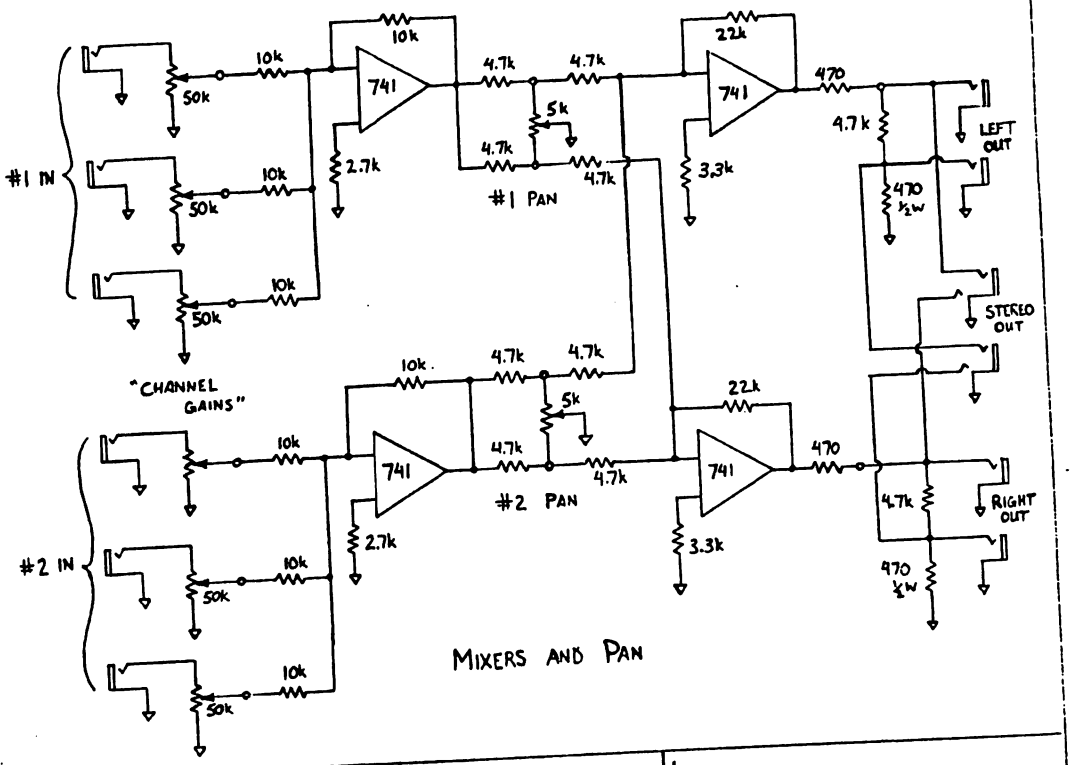

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BOTTOM PANEL
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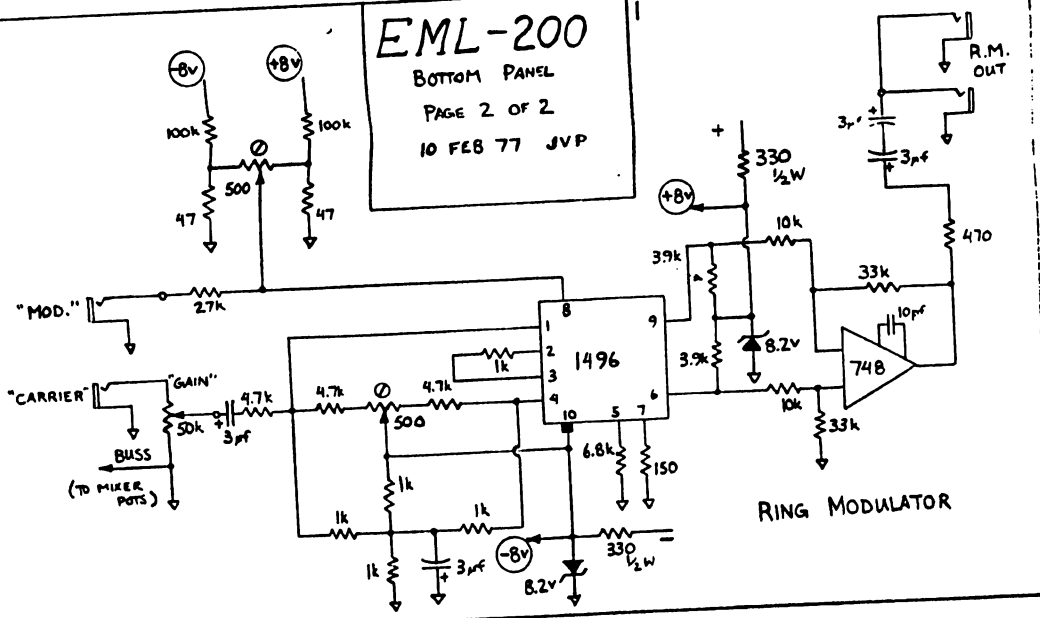

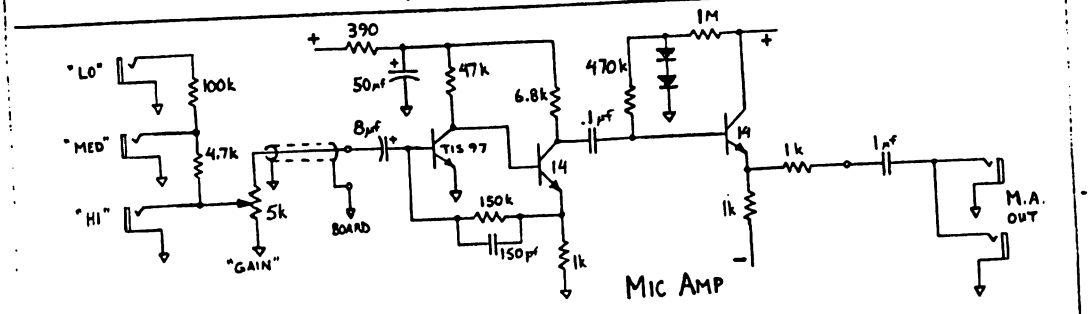

EML-200 BOTTOM PANEL CIRCUITS

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SHEET 2 OF 2