V100

MODEL V-100

LOWREY®

SERVICE MANUAL

Micro Genie

V100

TECHNICAL INFORMATION

SERVICE INFORMATION

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LOWREY
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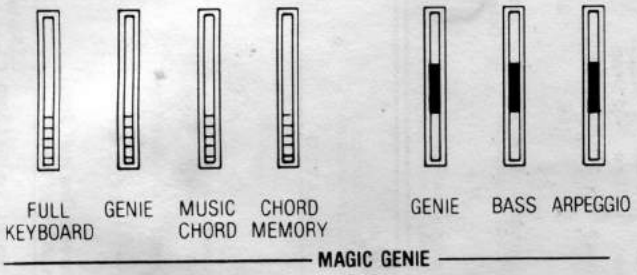


Switches	– Schematic 1
Genie Volume	– Schematic 4
Bass Volume	– Schematic 5
Arpeggio Volume	– Schematic 4
Genie Filter	– Schematic 4
Bass Filter	– Schematic 5
Arpeggio Filter	– Schematic 4

MAGIC GENIE

This section provides control of the C1 through F#2 keys. The Full Keyboard, Genie and Music Chord switches cross cancel. The Chord Memory switch is a push-on/push-off type.

FULL KEYBOARD - Up to eight keys may be played on the keyboard with preset voicing.

GENIE - Up to four notes may be played from C1 through F#2. The Genie Volume Control regulates the volume. These notes have a high note priority. The lowest note played also plays the genie bass note. When the rhythm is playing, the genie notes are modulated in the accompaniment pattern and the genie bass alternates between the lowest and highest keys played.

MUSIC CHORD - Pressing a key from C1 through F#2 plays a three-note chord. The organ has the capability of playing major, minor, seventh and minor seventh chords. Because only three notes may be played, the fifth of the chord will not play when a seventh or minor seventh chord is played. The Genie volume control regulates the volume. The chord has a high note priority. When the rhythm is playing the chord is modulated in the accompaniment pattern and the swing bass pattern is played.

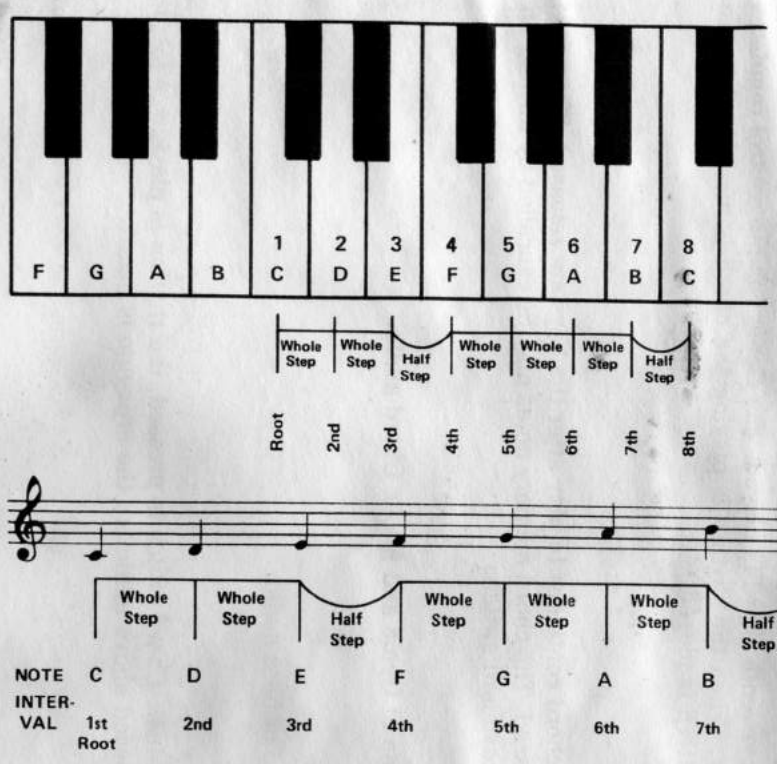
CHORD MEMORY - The genie notes or music chord continues to play after the keys are released. The notes being played are updated each time a key is pressed. The chord memory notes may be cancelled by turning off the chord memory switch or pressing the full keyboard switch.

GENIE VOLUME CONTROL - Regulates volume of Genie and Music Chord audio.

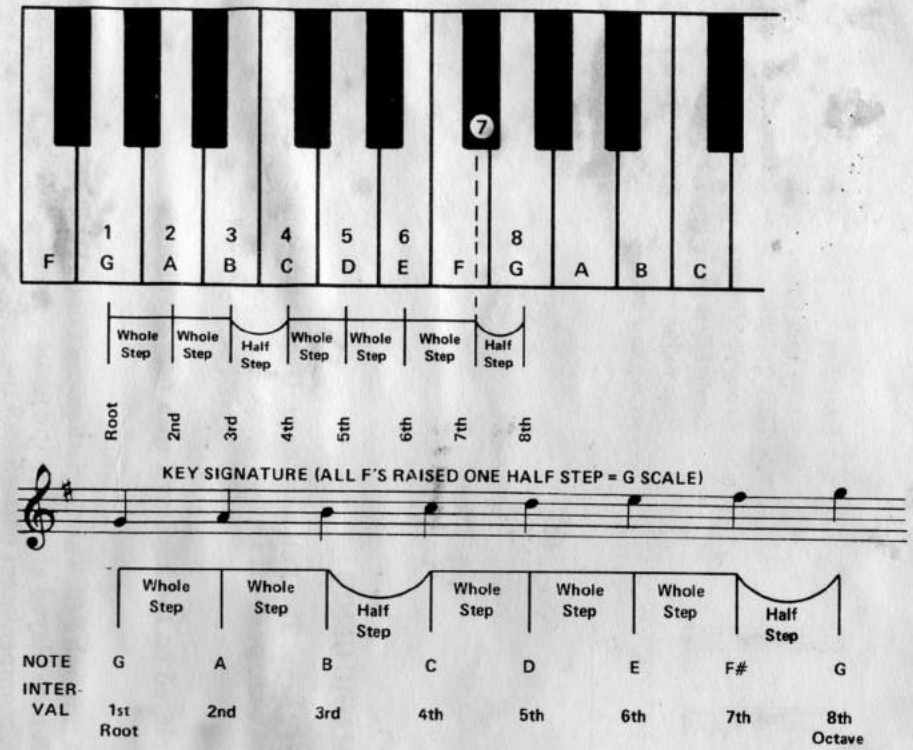
BASS VOLUME CONTROL - Regulates volume of bass audio.

ARPEGGIO VOLUME CONTROL - When the Music Chord switch is pressed, the rhythm is playing, a magic genie chord is playing and this control is increased above minimum the arpeggio is heard.

CHORD RECOGNITION CHART



EXAMPLE OF C MAJOR SCALE



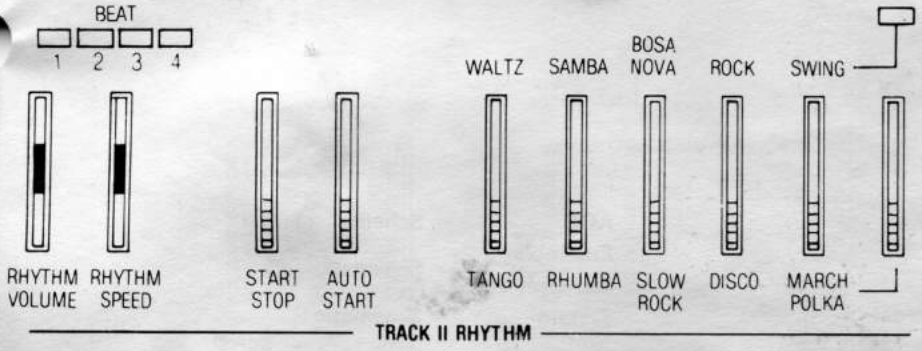
EXAMPLE OF G MAJOR SCALE

MAJOR SCALES – The following procedure will construct any Major Scale.
NOTE: All keys (Black and White) must be counted.

1. The Root or First note of any scale is the key from which the scale is named, (i.e., C scale = C key or G scale = G key).
2. Count 2 physical keys (whole step) to right to arrive at 2nd
   – then –
3. Count 2 physical keys (whole step) to right to arrive at 3rd
   – then –
4. Count 1 physical key (half step) to right to arrive at 4th
   – then –
5. Count 2 physical keys (whole step) to right to arrive at 5th
   – then –
6. Count 2 physical keys (whole step) to right to arrive at 6th
   – then –
7. Count 2 physical keys (whole step) to right to arrive at 7th
   – then –
8. Count 1 physical key (half step) to right to arrive at 8th or octave.

CHORD STRUCTURE – To make chords on any scale

CHORD NAME	STRUCTURE (STANDARD)	PLAYED	
MAJOR	Root 3rd 5th	Root	
MINOR	Root 3rd Lowered One Half Step 5th	Root 3rd Lowered One Half Step	
7TH	Root 3rd 5th 7th Lowered One Half Step	Root 7th Lowered One Half Step (2 keys to left of Root)	
MINOR 7TH	Root 3rd Lowered One Half Step 5th 7th Lowered One Half Step	Root 3rd Lowered One Half Step 7th Lowered One Half Step (2 keys to left of Root)	Note: 5th does not sound



Rhythm Volume Control	– Schematic 3
Rhythm Speed Control	– Schematic 1
Switches	– Schematic 1
LEDs	– Schematic 1
Rhythm Filters	– Schematic 3

TRACK II RHYTHM

This section controls the rhythm. One of ten rhythms may be played at a time. The rhythm switches cross cancel each other and have a left priority. The start/stop switch is momentary contact. The Auto Start and Track Select switches are push-on push-off.

RHYTHM VOLUME - Controls the volume of the rhythm instruments.

RHYTHM SPEED - Controls the speed of the rhythm pattern.

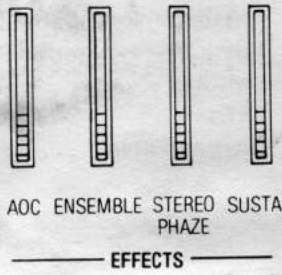
START/STOP - Pressing this switch starts or stops the rhythm.

AUTO START - When this switch is pressed, the rhythm may be started and stopped according to the conditions listed in the table below.

FULL KEYBOARD	GENIE OR MUSIC CHORD	CHORD MEMORY	TO START THE RHYTHM	TO STOP THE RHYTHM
1	0	X	Press any key from C1 through F#2 or press Start/Stop.	Release all C1-F#2 keys then press Start/Stop.
0	1	0	Press any key from C1 through F#2.	Release all C1-F#2 keys.
0	1	1	Press any key from C1 through F#2 or press Start/Stop.	Release all C1-F#2 keys then press Start/Stop or switch off the Chord Memory.

TRACK SELECT - The Light Emitting Diode above this switch is normally on indicating that the top row of rhythms may be selected. When this switch is pressed, the LED switches off and the bottom row of rhythms may be selected.

BEAT - These four light emitting diodes continuously display the rhythm speed. When a rhythm is started, the display resets to the first beat.



AOC — Schematic 1
Ensemble — Schematic 2, 5
Stereophaze — Schematic 2, 5
Sustain — Schematic 2

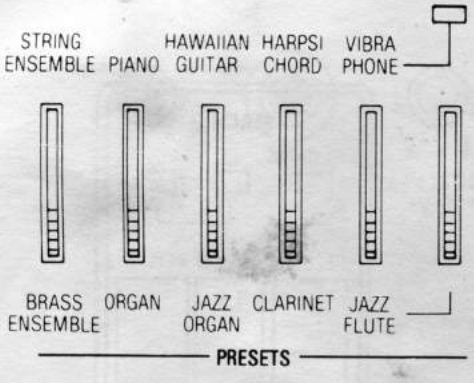
EFFECTS

AOC - Automatic Organ Computer couples the genie notes or music chord to the notes being played with the right hand. The AOC has a range of nine notes. For example, press the Genie switch (Magic Genie section). Then play a C note in the right-hand section and play the C1 through C2 keys in the Magic Genie section. The nine notes C# through A will play along with the C note being played on the right hand.

ENSEMBLE - Adds fast phase modulation to all voices except bass. Has priority over stereo-phaze effect. Adds medium sustain to right-hand presets.

STEREO PHAZE - Adds slow phase modulation to all voices except bass.

SUSTAIN - Adds long sustain to right-hand presets.



Filters — Schematic 4
Effects Switches — Schematic 2

PRESETS

The presets provide the selection of voices for the right-hand keys (G2-C5) and the full keyboard when the Full Keyboard switch (Magic Genie section) has been pressed. These voices are selected one at a time. The preset switches cross cancel each other. The light emitting diode above the Row Select switch is normally on, selecting the top row of presets. When the Row Select switch is pressed, the LED turns off and the bottom row of presets may be selected.

Top Row Presets

STRING ENSEMBLE - 8-foot Sawtooth audio with slow attack, delayed vibrato, ensemble (phase modulation) and medium sustain effects.

PIANO - 8-foot Sawtooth audio with percussive envelope and short sustain (decay) when playing staccato. When playing legato, the decay envelope has medium sustain.

HAWAIIAN GUITAR - 8-foot Sawtooth audio with delayed vibrato and a percussive envelope. Playing staccato results in a short sustain (decay). Playing legato produces a medium sustain (decay).

HARPSICHORD - 8-foot Sawtooth and 16-foot Square Wave audio with a percussive envelope. Playing staccato results in a short sustain (decay). Playing legato produces a medium sustain (decay).

VIBRA PHONE - 16-foot Flute, 4-foot Flute and 2-foot Square Wave audio with a percussive envelope and long sustain. The audio has a tremolo effect.

Bottom Row Presets

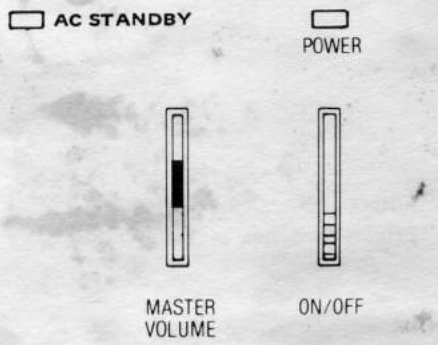
BRASS ENSEMBLE - 8-foot Sawtooth audio with a voltage controlled filter sweep at keydown. The audio has ensemble (phase modulation), delayed vibrato and medium sustain.

ORGAN - A combination of 4-, 8- and 16-foot Flute (triangle wave) audio.

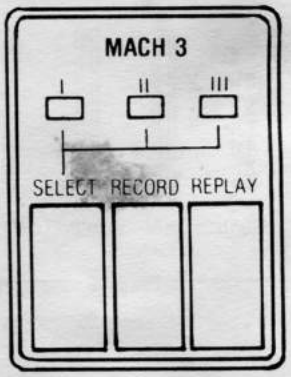
JAZZ ORGAN A combination of 4-, 8- and 16-foot Flute (triangle wave) audio with a short burst of noise at the initial keydown.

CLARINET - 8-foot Square wave audio with slow attack and delayed vibrato.

JAZZ FLUTE - 8-foot Flute audio with delayed tremolo modulation and a percussive attack consisting of 4-foot Flute audio and noise.



—CONTROLS—



Volume Control	– Schematic 5
On/Off	– Schematic 6
AC Standby	– Schematic 6

CONTROLS

AC STANDBY - This light emitting diode is illuminated whenever the organ is connected to a wall outlet regardless of whether the organ is on or off.

MASTER VOLUME - Controls the overall maximum volume of the organ.

ON/OFF - This momentary switch turns the organ on or off. If the organ is turned on but has not been played for over five minutes, it will automatically switch off.

MACH III

This feature permits up to three chord progressions to be pre-recorded then played back automatically.

To program a chord progression:

1. Press the Music Chord switch (and Chord Memory if desired).
2. Select the desired rhythm pattern.
3. Start the rhythm and adjust the rhythm speed control to the desired tempo.
4. Press the Auto Start switch.
5. Press the Record switch. (Record light and one of the three select lights turn on).
6. Press the Select switch until the desired Mach III channel is selected.
7. Play the chord progression.
8. When the chord progression has been recorded, press Start/Stop switch to stop rhythm and recording.

To play back a chord progression:

1. Press Music Chord switch.
2. Press Replay switch (one of the three select lights turns on).
3. Press the Select switch until the desired Mach III channel is selected.
4. Press Start/Stop switch to start or stop the Mach III playback.

Notes:

a. The rhythm may be changed and/or the select switch pressed while the Mach III pattern is being played back.

b. If the replay switch is pressed during playback, the Mach III feature will shut off but the rhythm will continue to play.

c. The C1 through F#2 keys will not sound during Mach III playback. However, Mach III may be auto started from these keys when the Auto Start switch has been pressed prior to starting the rhythm.

Mic Volume — Schematic 4
Mic Input — Schematic 4
Pitch — Schematic 2

LEFT SIDE

MIC VOL - Microphone volume sets the volume of an optional microphone.

MIC IN - Microphone input accepts a standard microphone with 1/4 inch phone plug.

PITCH - Permits the organ to be tuned up to a quarter step sharp or flat. (i.e. C can be tuned to from halfway between B and C to halfway between C and C#.)

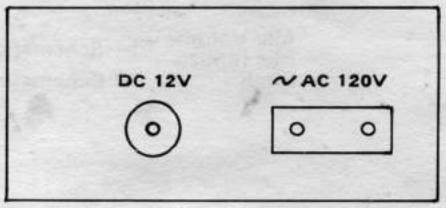
— Schematic 5

RIGHT SIDE

EXP PEDAL - Input for optional expression pedal. The expression pedal range is from minimum volume to the level set by the master volume control.

AUX OUT - Left and right channel outputs to connect organ to an external amplifier or recorder.

HEADPHONE - An output for a stereo headphone. Internal speakers are disabled.



— Schematic 6

REAR PANEL

DC 12V - Connects a car battery (with optional adapter) to organ.

AC 120V - AC line voltage input.

Internal Batteries - A panel on the bottom of the instrument may be removed to permit installation of eight D-cell batteries.

DIMENSIONS

Height — 90mm (3.5 inches)
Width — 860mm (33.875 inches)
Depth — 286mm (11.25 inches)
Weight — 6.8Kg (15 lbs.)

OVERVIEW - The Lowrey V100 is a microprocessor-controlled self-contained portable organ with a forty-nine note keyboard, rhythm, music chord, presets, Mach III accompaniment recorder and two amplifiers to produce a stereo effect.

The microprocessor scans the keyboard, genie switches, rhythm switches and Mach III switches. The keyswitch data are processed into right-hand key and AOC information, left-hand chord and bass information then output to a programmable tone synthesizer.

The programmable tone synthesizer puts out the bass and arpeggio audio plus a combination of up to either eight keyboard notes (full keyboard switch pressed), four genie notes and four right-hand notes (genie switch pressed) or three music chord notes and five right-hand notes (music chord switch pressed). The audio signals are output to the presets filters where they are voiced. The voiced audio may be phase modulated. The audio signal is applied equally to the left and right amplifiers.

The rhythm patterns are stored in read only memory look-up tables. Interrupt pulses are counted until the microprocessor determines that a rhythm beat is to play. A byte of data encoded with rhythm trigger information is output to the rhythm instrumentation causing the appropriate rhythm voices to play.

The Mach III accompaniment stores up to three chord progressions in random access memory. When recalled, the music chord progression will play automatically in a pattern determined by the rhythm style selected. A 47,000 microfarad capacitor provides sufficient voltage and current to permit the random access memory to retain the patterns for up to fourteen days with the organ power turned off.

The three-way power supply can operate from AC line voltage, an external 12 volt DC source (car battery) or internal batteries. When a power source is connected to the instrument, DC voltage is applied to the power switching circuitry. When the on/off switch is pressed, switching transistors apply power to the organ. Not playing the organ for over five minutes will cause the power switching circuitry to switch off power to the organ.

SCHEMATIC 1

CENTRAL PROCESSING SYSTEM

The central processing system consists of four major integrated circuits. These are the microprocessor IC1, the random access memory/input output IC2, a programmable tone synthesizer IC3 and the scan decoder IC4.

IC1 MICROPROCESSOR - This integrated circuit is an 8049 microprocessor. It has an internal 2048 byte read only memory (ROM) and a 128 byte random access memory (RAM). The ROM has been programmed with the sequence of instructions required to obtain the desired outputs and control of the organ based on the input data. The RAM provides temporary storage for data being processed.

IC4 Y-SCAN DECODER - This 1 of 10 decoder is controlled by the microprocessor. The scan decoder and its associated circuits provide the microprocessor with the switch status of the keyboard, rhythm, Magic Genie and Mach III. The x-scan lines are held high by pull-up resistors. The microprocessor selects each y-scan line in turn. The selected y-scan line switches low. If any of the switches connected to that y-scan have been pressed, the corresponding x-scan line is pulled low. The microprocessor inputs the x-scan at port 1. If a change in switch status is detected by the microprocessor it will take the appropriate action to change the keyswitch, rhythm, Magic Chord or Mach III information as required.

IC2 RAM/IO - This integrated circuit contains a 256 byte random access memory (RAM), a programmable timer/counter, two eight-bit input/output (I/O) ports and a six-bit (I/O) port. The RAM is used to store the three magic accompaniment chord (Mach III) progressions. The memory is retained for up to fourteen days when the organ is off due to the extremely slow discharge time of the 47,000 microfarad capacitor at pin 40 of IC2. When the organ is switched off, transistor Q1 cuts off. Voltage from the memory hold capacitor is applied to pin 4 of IC2. This resets all outputs of IC2 to a high impedance state. The amount of current required to retain the RAM content is very small. This gives the 47,000 microfarad capacitor a discharge time of about fourteen days.

The timer/counter counts pulses from the vibrato oscillator. This frequency is input to IC2 at pin 3. The audio amplifier signal is monitored by an audio detector connected to the TØ input of the microprocessor (IC1 pin 1). The microprocessor checks this pin to determine if the organ is being played. As long as the organ is being

played the microprocessor resets the counter within IC2 preventing it from reaching its terminal count. If the organ has not been played for over five consecutive minutes, the counter reaches its terminal count and the timer output (IC2 pin 6) switches low. Transistor Q2 saturates applying a pulse to the power switching trigger circuit which turns off the organ power.

NOTE: If the organ is played at minimum volume, one note at a time, the microprocessor may not recognize a "being played" condition and the organ will shut off when the counter reaches its terminal count.

The I/O ports of IC2 are used as outputs to control the rhythm and Mach III light emitting diodes (LED) and the rhythm, chord and bass trigger pulses.

IC3 PROGRAMMABLE TONE SYNTHESIZER - This integrated circuit generates the bass, arpeggio and up to eight keyboard notes which are split between the Magic Genie Chords and the right-hand melody. The notes are divided as follows:

Full keyboard - up to eight notes may be played with preset voicing.
Genie - four genie notes (left-hand) and four preset notes (right-hand).
Music Chord - three music chord notes (one-finger left-hand) and five preset notes (right-hand).

The master oscillator (Schematic 2) provides a one megahertz clock to IC3. Ten frequency dividers within IC3 are controlled by the microprocessor. When the microprocessor communicates with IC3 a four bit nibble (half a byte) is output from port 1 of the processor to the data inputs (pins 16-19) of IC3. The microprocessor puts out a strobe pulse to latch the data into IC3 then applies clock pulses to IC3 shifting the data into IC3. Data transfer continues in this manner until all the update information is transferred. Each frequency divider divides the two megahertz clock frequency by the programmed value. The pedal and arpeggio audio each pass through a digital to analog converter and an envelope generator and are output to their respective filters. Each of the eight frequency dividers outputs audio signal as 2-, 4-, 8- and 16-foot square waves. Additional circuits combine the square waves into 4-, 8- and 16-foot triangle waves and 8- and 16-foot sawtooth waves. The above mentioned nine waveforms are applied to the upper keyboard (right-hand) digital to analog converter and envelope generator. If the frequency divider is to output lower keyboard (left-hand) audio, the square waves are switched into circuits that provide lower keyboard 4- and 8-foot square waves, an 8-foot triangle and a signal to an internal genie modulator. The lower keyboard signal is applied to a digital to analog converter and an envelope generator. In this organ, only the right-hand outputs, the music chord/genie output, arpeggio and bass outputs are used.

The Music Chord/Genie Keyer Q8 controls the envelope of the music chord/genie audio. When a rhythm is playing pulses are applied to the base of Q8 gating control voltage to IC3.

The voltage applied to pin 13 of IC3 controls the sustain length. As the voltage increases, the sustain length increases.

SCHEMATIC 2
DC CONTROL

The circuits shown on this schematic include the master oscillator, vibrato oscillator, sustain control and percussion decay control.

Q11, Q10 MASTER OSCILLATOR, TUNING DRIVER - The master oscillator frequency is adjusted to provide a center frequency of one megahertz. This frequency is applied to the programmable tone synthesizer IC3 (Schematic 1) where it is divided to provide the audio frequencies for the organ. The tuning driver (Q10) and its emitter capacitor are integral components of the oscillator's tank circuit. The bias voltage applied to the base of Q10 is controlled by the pitch control. As the position of the pitch control changes, it directly affects the bias of Q10 which increases or decreases the capacitance to ground and retunes the oscillator. When vibrato is enabled, a low frequency sine wave modulates the bias voltage via the pitch control creating vibrato (frequency modulation).

IC9D, IC9E, IC10C VIBRATO OSCILLATOR - The vibrato oscillator generates a low frequency of about seven hertz. This frequency is output to several circuits to create tremolo (amplitude modulation), vibrato (frequency modulation), a timer/counter input to IC2 (1-E10) for the automatic shut-off feature and a signal to flash the power LED when a low voltage condition exists.

IC10A, Q13, Q14, IC15A, IC4C - VIBRATO ENABLE - The output of IC10A is normally high. This high level saturates Q13 which in turn saturates Q14 grounding the vibrato/tremolo signal output from the vibrato oscillator circuit. Some of the presets enable the vibrato by applying positive voltage to the input of IC10A. Its output switches low turning off Q13 which turns off Q14 ungrounding the vibrato/tremolo signal. The tremolo signal now passes to the tremolo modulator. The vibrato signal passes through IC15A which is normally turned on and modulates the master oscillator creating vibrato (frequency modulation). When vibraphone is enabled, the output of IC4C switches low grounding the base of Q13 through D14 and switching off IC15A. This enables the vibrato/tremolo output from the vibrato oscillator; however, since IC15A is now off very little of the signal reaches the master oscillator. The net result is that the vibraphone voice has tremolo with a very slight vibrato.

IC10B, IC10E, IC10D, Q12, IC10F - ENVELOPE TRIGGERS - When a key is pressed initially (after all right-hand keys have been released) the any key down output (IC2 pin 2 1-D11) switches high and remains high until all right-hand keys have been released. IC10B inverts this voltage to a low and applies it to the following circuits.

1. Capacitor C36 develops a negative going pulse (hi-low-hi) which momentarily switches the output of IC10E high triggering the slow attack envelope.
2. Capacitor C39 develops a negative going pulse (hi-low-hi) which momentarily switches the output of IC10D high. This triggers the brass filter envelope. The vibrato/tremolo effect is disabled for the length of this pulse creating a delayed vibrato effect for the vibrato presets.
3. A negative going pulse (hi-low-hi) is developed across capacitors C37 and C38. This pulse is inverted through IC10F and applied to the four-foot percussion envelope generator. The pulse width is shortened when the jazz organ preset is enabled and disabled when vibraphone is enabled.

IC9, IC15, Q9, Q15, Q16 SUSTAIN CONTROL - The sustain length is controlled by changing the voltage reference into the programmable tone synthesizer IC3 pin 13 (1-C10). A voltage divider consisting of R67 and R68 establishes a maximum input voltage to IC3 pin 13 of about +2 volts DC. Before any switches are pressed, the voltage at the junction of R67 and R68 is grounded through Q9, the sustain switch, the ensemble switch, Q15 and Q16. Three sustain lengths are available depending on the switches selected.

Short Sustain - when a percussion preset is selected, positive voltage is applied to pin 6 of IC15C. This enables pulses from the percussion sustain decay oscillator to be applied to Q16. The average DC voltage resulting from Q16 alternately switching between cutoff and saturation gives the percussion presets a short sustain.

Medium Sustain - Transistor Q204 is biased on. When Q15 is cut off (brass or string preset on) or the ensemble switch is pressed, the emitter of Q204 switches to +.75 volt DC providing a medium sustain.

Long Sustain - Pressing the sustain switch opens the path to ground in the emitter circuit of Q9 this results in maximum sustain. When vibraphone is selected, the base of Q9 switches low. Q9 cuts off opening the path to ground which results in maximum sustain.

SCHEMATIC 3

RHYTHM INSTRUMENTATION

The rhythm instruments are controlled by the microprocessor (Schematic 1). The frequency of the rhythm clock multivibrator (Schematic 1) is controlled by the rhythm speed control. When a rhythym pattern has been selected and the rhythm has been started, the microprocessor counts pulses from the rhythm clock multivibrator. When a predetermined number of clock pulses have been counted, the microprocessor addresses the rhythm table for the selected rhythm and extracts a byte of data containing the bit pattern of the instruments that are to play at a given time point. This byte of data is transferred to IC2 (Schematic 1) and output through port A (IC2 pins 21-28) to the rhythm instruments.

The outputs of IC2 (Schematic 1) momentarily switch high for the instrument voices that are to play. This voltage is developed into a pulse across a DC isolation capacitor and applied to an instrument generator. Each instrument generator is a tuned filter. A pulse applied to the generator triggers a ringing oscillation that approximates the sound of a drum being struck.

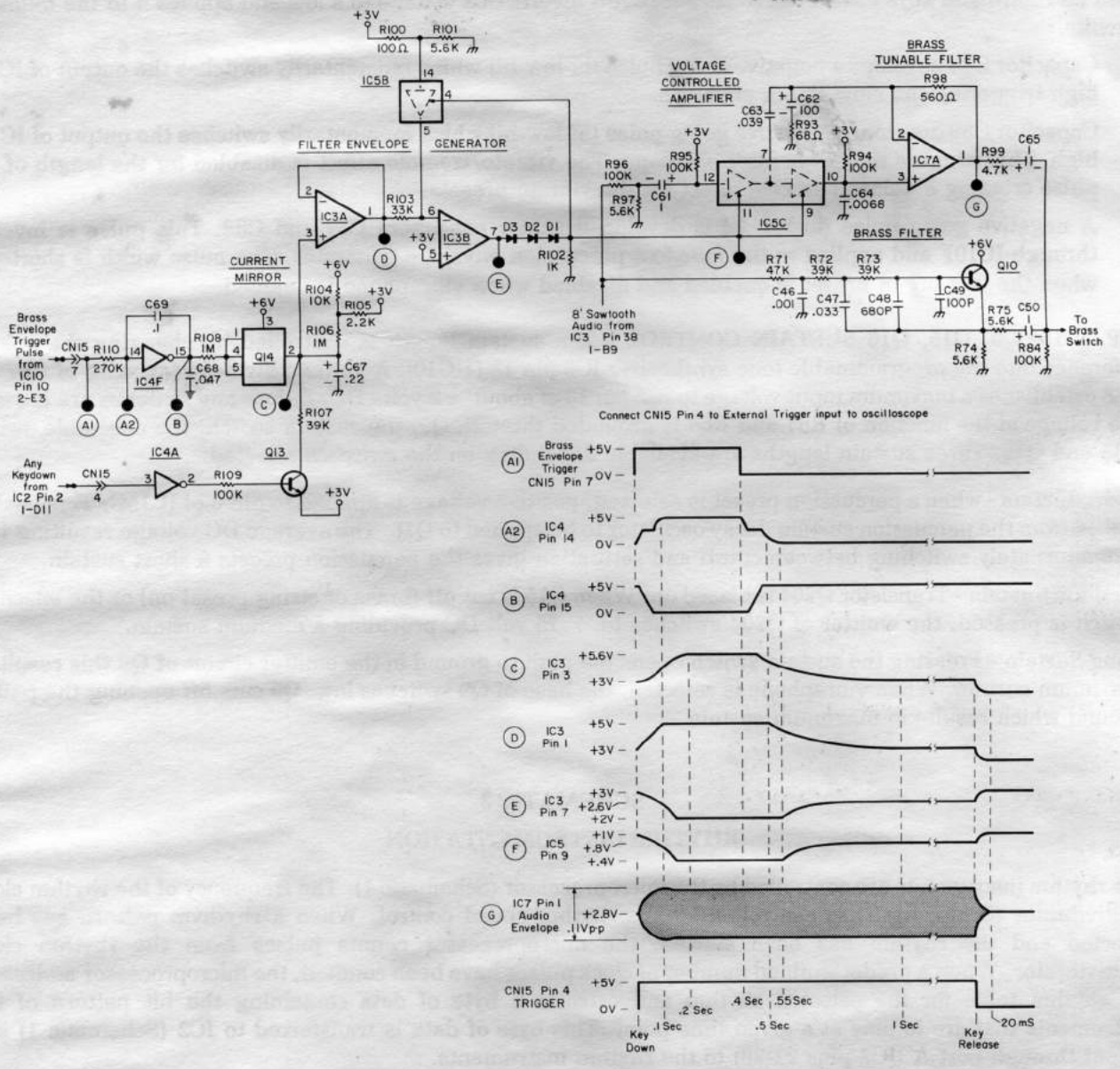
The brush and cymbal are created by first generating DC voltage envelope then applying this voltage to a noise keyer. The burst of noise approximates the sound of a cymbal or a brush striking a snare drum.

All of the rhythm instrument voices are amplified by the rhythm preamp. IC36A is switched on when the rhythm is to play and permits the rhythm audio to pass to the output preamp via the rhythm volume control.

SCHEMATIC 4

QUALITY CONTROL

The high-pass, low-pass and band-pass filters shown on this schematic shape the waveforms output from the programmable tone synthesizer (Schematic 1) to create the tonal characteristics of each instrument. Special effects are used to create the attack and decay characteristics of some of the voices.



BRASS FILTER, ENVELOPE GENERATOR - Initially, Q13 is saturated. This clamps the input voltage to IC3 pin 3 to 3 volts. IC3 "sees" +3 volts as analog ground. The output of IC3 (pin 1) is applied to IC3 pin 6 causing its output (pin 7) to be 3 volts. Diodes D3, D2 and D1 reduce this voltage to about 1 volt which is applied to the control pins of IC5 pin 4, 9 and 11. When a key is pressed, Q13 cuts off. The Envelope Trigger pulse applied to IC4 pin 14 is inverted to a low. Current mirror Q14 "reflects" this as a high causing C67 to charge to +6 volts. The voltage at pin 1 of IC3 follows the charging curve of C67. IC3B inverts the voltage then applies it through D3, D2 and D1 to the control pins of IC5B and IC5C. As the voltage becomes more negative (with respect to the

+3 volt analog ground reference), the amount of signal passing through IC5 increases. This signal mixes with unmodulated brass audio creating the brass voice.

SLOW ATTACK - The clarinet and string ensemble have a slow attack effect. The position of the string ensemble switch determines if 8-foot square wave audio (string off) or 8-foot sawtooth audio (string on) is to be applied to the clarinet/string slow attack modulator. IC6B "sees" +3 volts as an analog ground. When a key is pressed, IC5A switches on bypassing R56 and "grounding" the audio signal across C40. When IC5A switches off at the conclusion of the keydown pulse, R56 is switched in series with C40 raising the input above "ground". The input reference changes by the time constant of R56 and C40 developing the slow attack effect.

PERCUSSION ENVELOPE GENERATOR - The jazz organ and jazz flute use a short burst of noise and 4-foot flute audio as part of the characteristic of that voice. IC6A "sees" +3 volts as analog ground. IC5A is normally on "grounding" the audio input to IC6A through C89. When a key is pressed, IC5A momentarily switches off permitting a short burst of noise and four foot flute to pass to IC6A.

SCHEMATIC 5

CHORUS MODULATOR AND AMPLIFIER

The audio signals that have been enabled are applied equally to the left and right channel output preamps. If the ensemble or stereophaze switch is pressed, chorus modulated audio is applied to both output preamps. Two voltage controlled amplifiers (VCA) are contained within IC31. The voltage output from IC31 pin 2 varies from +12.8V (min) to +13V (max). Pin 1 is a current input. As the volume increases, the emitter voltage decreases from +4V to zero (max) reducing the control current which increases the volume. The audio output from the VCA is applied to the power amplifier which amplifies the signal to drive the speakers.

CHORUS MODULATOR - The chorus modulator consists of an analog shift register (IC15), a high frequency voltage controlled oscillator and a low frequency oscillator. The audio signal output from the audio collector amp (IC13A) is applied to the analog shift register. The audio signal is sampled and shifted through the 512 stage shift register at the rate of the voltage controlled oscillator (VCO). The signal that appears at the output of the shift register is a composite of the audio signal samples superimposed on the high frequency clock. The low pass filter Q27 removes the high frequency clock component and enables the audio signal to be applied to IC13 pin 6. IC13B performs two functions. When the ensemble, stereo phase, brass and string switches are off, IC10C is enabled. This connects the output of IC13B to its inverting input. The gain of an op-amp is determined by the value of the feedback resistor divided by the input resistor. Since IC10C represents a short circuit (zero ohms), there is no gain and as a result no output from IC13B. IC10C switches off when the ensemble, stereophase, brass or string switch is pressed. Resistor R233 provides the feedback resistance. The op-amp has unity gain (R233=R231), inverts the audio and applies it to the output preamps.

The triangle shaped waveform output from the low frequency oscillator causes the speed of the high frequency oscillator to increase and decrease. This varies the time delay required for the sampled audio signal to move through the shift register. The phase shift between the modulated audio and the unmodulated audio creates the chorus effect.

Q301, Q303 VOLUME REGULATOR, MUTE SWITCH - At power turn on, the capacitor at the base of mute switch Q303 appears as ground. Q303 saturates connecting IC31 pin 2 to pin 1 keeping the volume at minimum. Once the capacitor has charged, Q303 cuts off and normal control of the volume is restored. The overall volume of the organ is controlled by the volume control. Positive voltage is output from IC31 pin 2 and applied through the volume control to the base of Q301. As the volume control is moved from minimum to maximum volume, the emitter voltage of Q301 decreases from +4V to zero. The control current input to pin 1 decreases and the overall volume increases. The optional expression pedal permits control of the volume between minimum and the level set by the volume control.

IC32 POWER AMPLIFIER - Two power amplifiers are built into this integrated circuit. Each channel handles about five watts of power. The amplified signal is applied to the speakers through contacts of the headphone jack.

Q302 SIGNAL DETECTOR - When the organ is played, right channel audio signal is applied to the base of Q302. The audio is inverted and applied to the test zero (TØ) input to the microprocessor (see Schematic 1). The microprocessor checks this pin during normal operation. As long as the organ is played, it resets the timer within IC2 (Schematic 1). When the organ is not played, the timer is not reset. It reaches its terminal count after about five minutes then puts out a negative going pulse which turns the organ off.

SCHEMATIC 6

POWER SUPPLY

This instrument can operate on voltage from any of three sources. Eight D cells may be installed in the organ to provide power. An external twelve volt DC source (car battery) may be used or standard AC line voltage may be used to provide power for the instrument. The AC voltage is stepped down across the transformer then rectified into DC across the full wave bridge. Note that the "AC Standby" LED will be on whenever the organ is connected to AC. Transistor Q601 is a ripple filter to remove any AC or DC ripple that may be present. Diode D601 provides DC protection to the instrument. If the external DC power source is connected with reverse polarity D601 would be reverse biased preventing any current flow.

DC voltage is always applied to the power switching circuits (IC41, IC42) regardless of whether or not the organ is turned on. It is recommended that internal batteries be removed if the instrument will not be played for an extended period of time to conserve battery life.

POWER ON/OFF SWITCHING [INITIAL CONDITIONS] - When power is first connected to the instrument, IC41D pin 12 appears as a high and IC41D pin 13 appears as a low. Pin 11 of IC41D is high which resets IC42A and IC42B (Q outputs reset low, Q-bar outputs reset high). Once C401 charges, both inputs to IC41D are high and its output switches low. The low level output from IC42B keeps Q411 cut off. Q411 in turn keeps power enable switcher Q404 cut off which keeps Q403 cut off. This prevents the +14 volt supply from reaching any of the organ's circuits. The Q-bar output of IC42A is high. This high level causes Q402 to saturate resetting the microprocessor. The voltage output from IC42A is applied through R413 to C405. Once the capacitor charges sufficiently, the set input to IC42 (pin 6) switches high. This switches the Q-bar output low. C405 discharges through R413 to the low level at the Q-bar output of IC42A.

POWER TURN ON - When the power on/off switch is pressed, positive voltage is applied to C403. As this capacitor charges, pin 1 of IC41A becomes more positive. When the voltage at pin 1 exceeds the threshold, pin 3 of IC41A switches low (both inputs are high) causing pin 4 of IC41B to switch high. The low to high transition clocks IC42A and B. The Q output of IC42B switches high. Q411 saturates which causes Q404 to saturate causing Q403 to saturate. This supplies +14 volts to the instrument. The Q-bar output of IC42 momentarily switches high causing Q402 to saturate which resets the microprocessor. The high level output from IC41B is applied to pin 1 of IC41A. Pin 4 of IC41B will remain high as long as the power switch continues to be pressed. Once the power switch has been released, C403 begins to discharge. As the voltage drops below the threshold of IC41A pin 1, pin 3 switches high and pin 4 of IC41B returns to a low. This delay prevents the instrument from being turned on and off rapidly.

POWER TURN OFF - When the power on/off switch is pressed, the same sequence occurs as for power turn on. The only difference is that when IC42B is clocked, its output switches to a low causing the power enable switchers to cut off.

AUTOMATIC SHUT OFF - When the organ has not been played for more than five minutes, pin 6 of IC41B switches low causing pin 4 to switch high. The low to high transition clocks IC42B switching its output low cutting off the power enable switchers.

Q405, IC41C LOW VOLTAGE DETECTOR, SHUT OFF TRIGGER - Transistor Q405 is normally saturated keeping IC41C pin 8 low which holds pin 10 high. If the regulated six volt supply decreases (i.e. weak batteries) below about four volts, Q405 begins to cut off. As the transistor approaches cutoff, its collector becomes more positive. When the voltage at pin 8 reaches the threshold, pin 10 switches low. A pulse is developed across C406 momentarily switching pin 12 of IC41D low. Pin 11 of IC41D puts out a positive pulse which resets IC42A and IC42B to their off conditions, shutting off the organ.

+6 VOLT REGULATOR - Q408, Q409, Q410 and D406 work together to regulate the +6 volt supply. As long as the voltage at the collectors of Q408 and Q409 is six volts or greater, the output will be six volts.

Q406, Q407 POWER INDICATOR, LOW VOLTAGE FLASHER - When the supply voltage is greater than about nine volts, Q406 is saturated, lighting the power indicator LED. If the supply voltage drops below nine volts, Q406 begins to cut off. Q407 has pulses from the vibrato oscillator applied to its base. As Q406 begins to cut off, Q407 begins to take control of the LED causing it to flash off and on providing a low voltage warning. If the supply voltage drops below four volts, the organ automatically shuts off.

Adjustments have been made prior to shipping from the factory. An adjustment may be required after repairs have been made to a defective circuit where the adjustable component is located. All adjustment components are accessible through access holes in the printed circuit boards. All controls are at minimum and switches are off except as noted in the following procedures.

SCHEMATIC 2

L1 MASTER OSCILLATOR TUNING PROCEDURE

1. Press the organ preset switch (to disable vibrato).
2. Place the pitch control to midpoint (detent position).
3. Connect an oscilloscope to IC9 pin 6.
4. Insert a plastic tuning wand into the core of L1.
5. Adjust L1 until the oscilloscope displays a 1MHz waveform (1 microsecond (uS) period). (See waveforms.)

Alternate Method:

1. Press the organ preset switch (to disable vibrato).
2. Press the Genie switch and chord memory switch.
3. Increase the Genie Volume control to maximum.
4. Press the A1 key.
5. Adjust L1 to zero beat the A1 key with an A-220 tuning fork (or other frequency standard).

R87 KEYDOWN PULSEWIDTH ADJUSTMENT

1. Press the organ preset switch.
2. Connect oscilloscope to IC10 pin 15 (CN15-5).
3. Adjust R87 to obtain a 50 milisecond pulse at keydown.
   NOTE: When Jazz Organ is enabled, the pulse width is reduced to about 4 miliseconds.

SCHEMATIC 4

R209 OUTPUT LEVEL ADJUSTMENT

1. Press the organ preset switch.
2. Press the Genie switch and increase the Genie volume to maximum.
3. Connect oscilloscope (input coupling AC) to IC13 pin 1.
4. Press and hold the C1 key.
5. Adjust R209 for a signal amplitude of .2 volts peak to peak.

R57, R62 SLOW ATTACK ADJUSTMENT

1. Press the clarinet preset switch.
2. Connect an oscilloscope (input coupling AC) to IC13 pin 1.
3. Press and hold the C5 key.
4. Adjust R57 for maximum peak to peak amplitude.
5. Turn R57 until the signal amplitude just begins to decrease.
6. Measure the voltage at the wiper of R57 with a DC voltmeter.
7. Adjust R57 to increase the voltmeter reading by .5 volt DC.
8. Repeatedly press and release the C5 key and adjust R62 to obtain a keydown slow attack envelope of between 40 miliseconds and 60 miliseconds (50mS nominal). See waveform diagams.

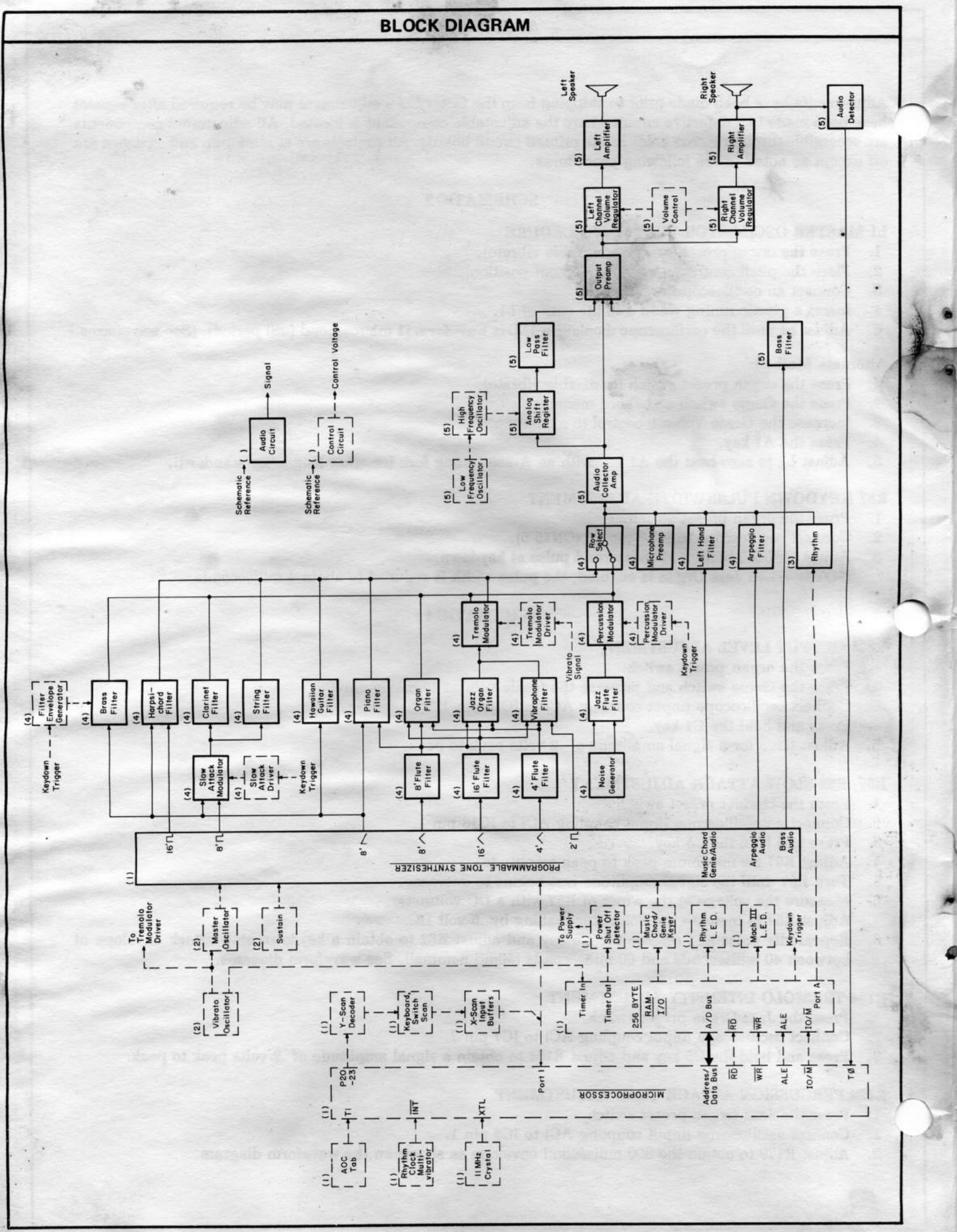
R154 TREMOLO INTENSITY ADJUSTMENT

1. Press the Jazz Organ preset switch.
2. Connect oscilloscope (input coupling AC) to IC7 pin 7.
3. Press and hold the C5 key and adjust R154 to obtain a signal amplitude of .2 volts peak to peak.

R179 PERCUSSION ATTACK TIME ADJUSTMENT

1. Press the Jazz Organ preset switch.
2. Connect oscilloscope (input coupling AC) to IC6 pin 1.
3. Adjust R179 to obtain the 300 milisecond envelope as shown on the waveform diagram.

BLOCK DIAGRAM



SCHEMATIC DRAWINGS, PRINTED WIRING BOARDS

1) The numbering on each printed wiring board begins with Q1, IC1 and D1.
2) Board locations are clearly shown in large letters.
3) Two or more components with the same reference number may be drawn on the same schematic.
4) When components from two or more printed wiring boards are drawn on the same schematic, shaded areas will separate the components and their location will be clearly identified.
5) "S" numbers refer to socket numbers which are screened on PC boards. Pins in sockets are numbered from left to right or bottom to top as board is viewed in organ.
6) All tabswitches, pushbutton switches and keyswitches are shown "off" unless otherwise specified.

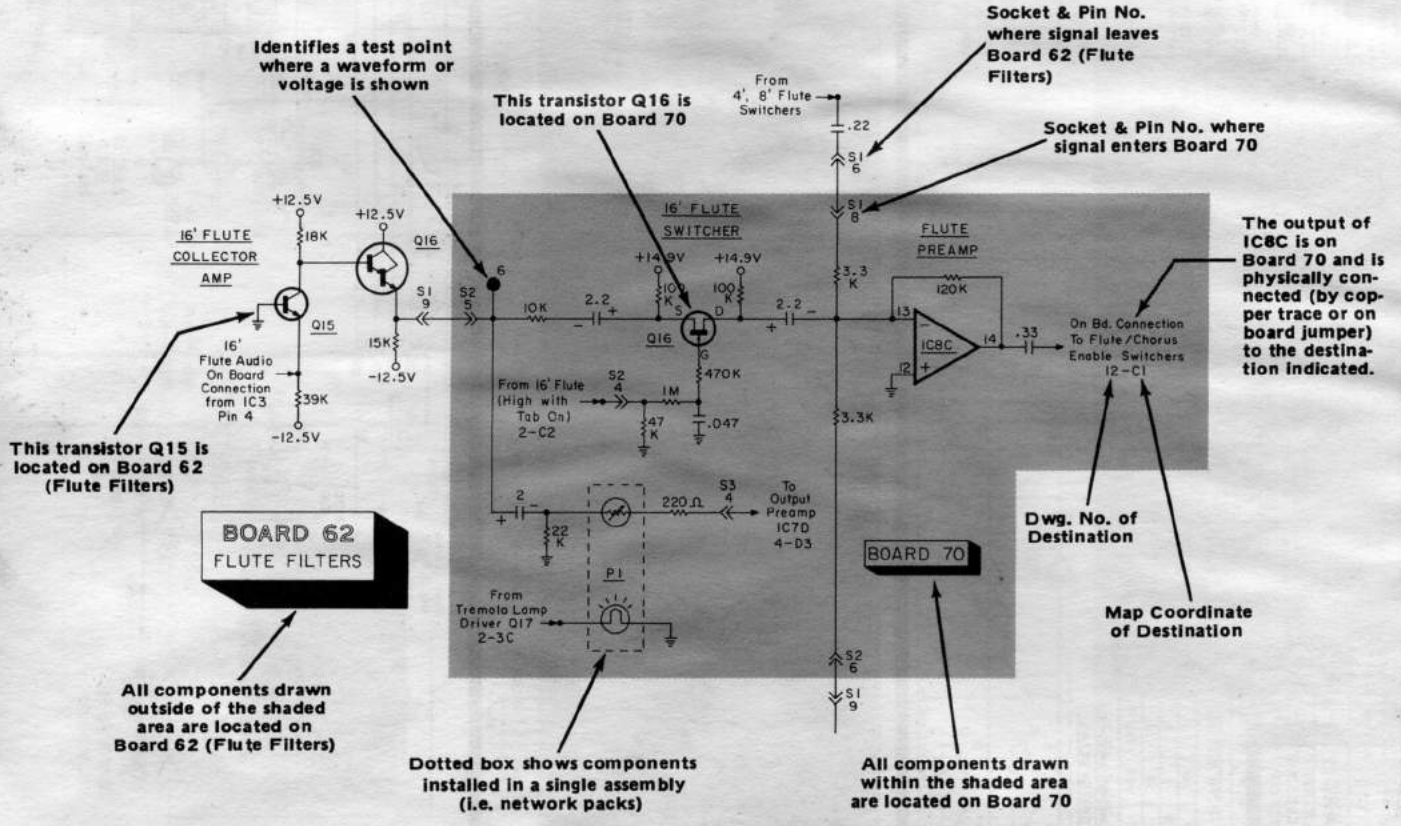
TEST EQUIPMENT

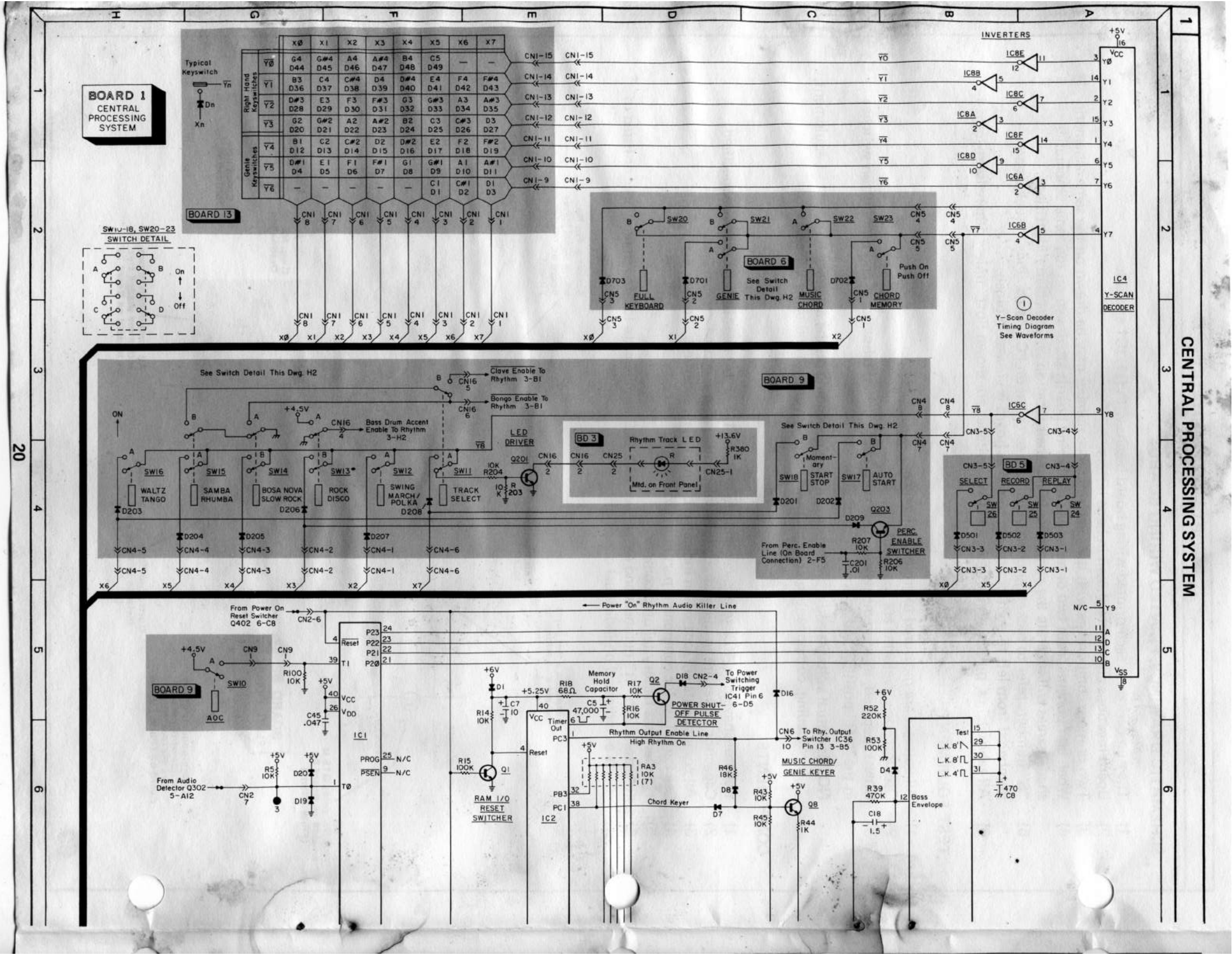
1) All voltages are measured to ground reference.
2) Oscilloscope waveforms are approximations.
3) Unless specified, measurements are made with keyswitches, tabswitches and pushbutton switches in the "off" position and controls at minimum.

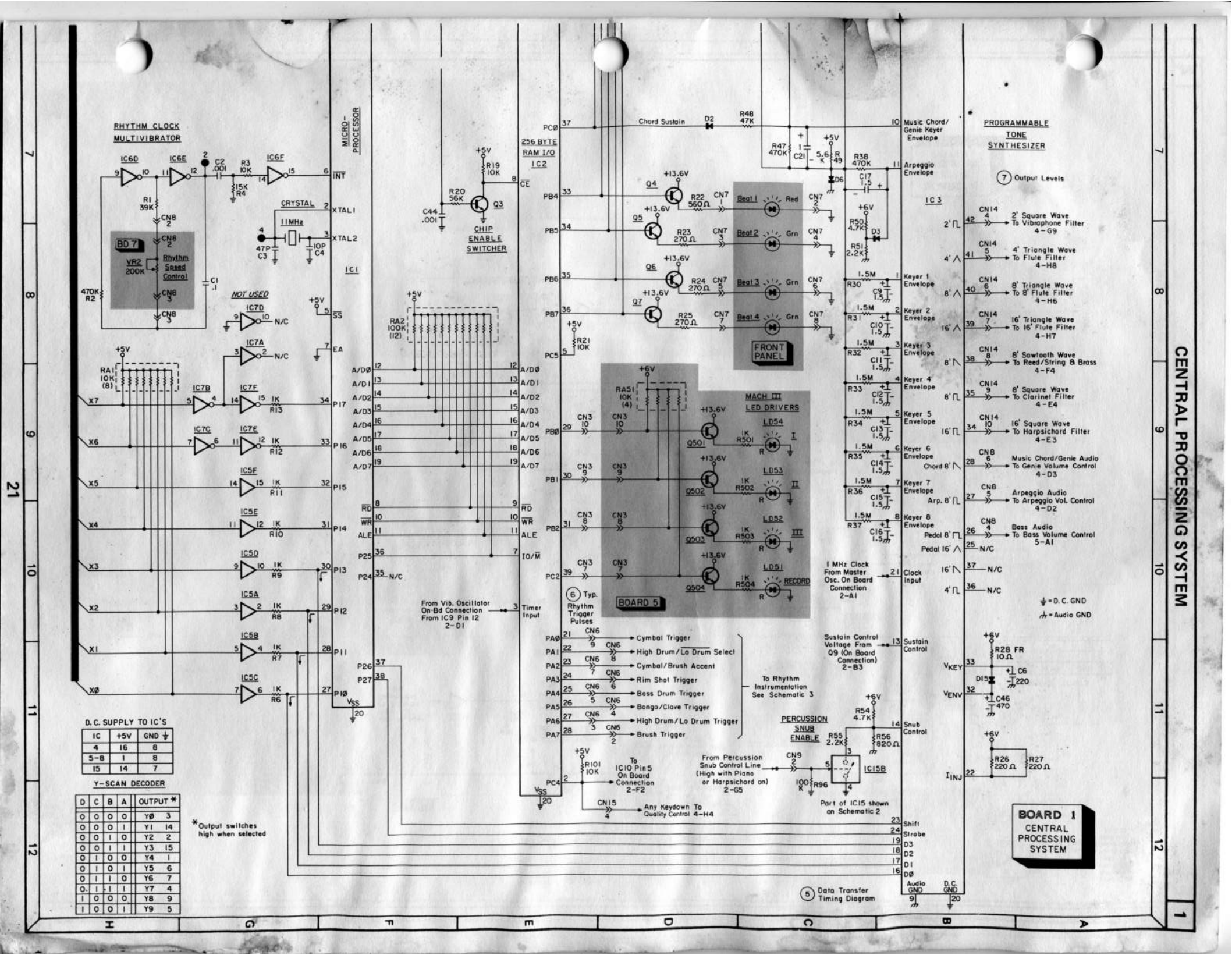
NOTE: Actual voltages and waveshapes will vary depending on the accuracy of your test equipment, loading, component tolerances, power supply voltages and other variables.

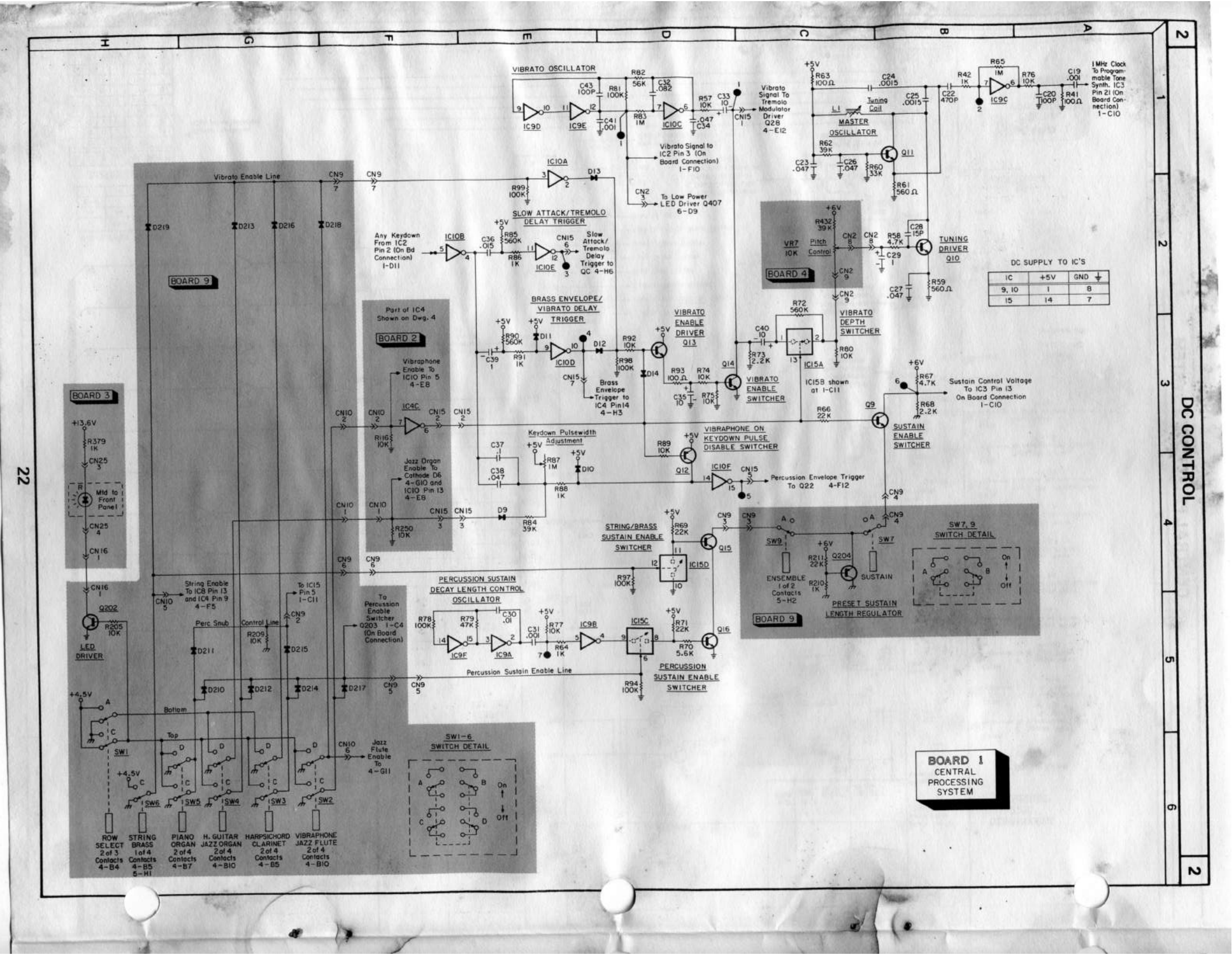
COMPONENTS

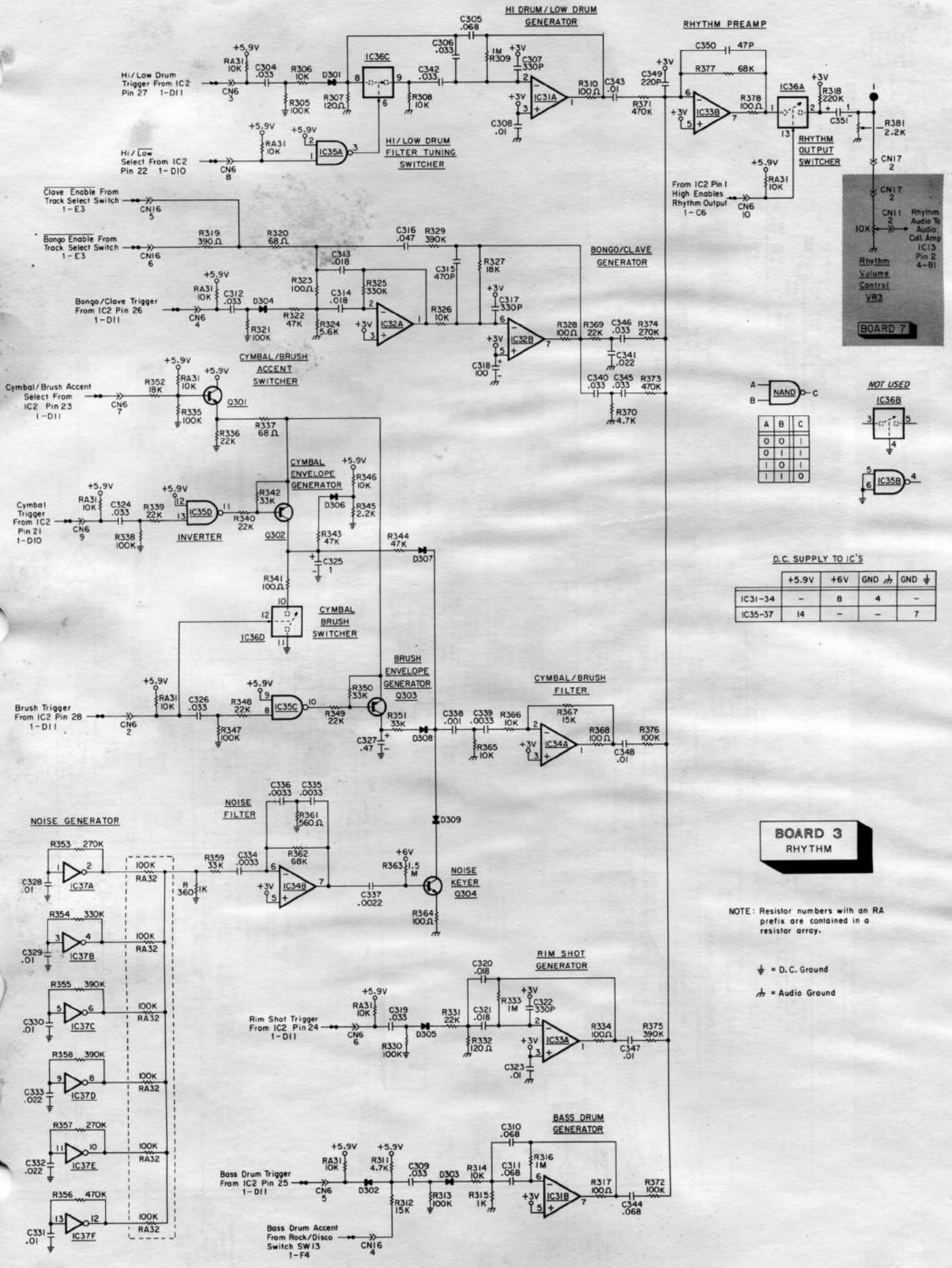
1) Resistors have 5 or 10% tolerances and are rated at 1/4 or 1/2 watt unless otherwise specified.
2) Capacitor values are in microfarads (uf) unless otherwise specified.
3) All components are located on indicated boards unless specified.
4) See Parts List for component part numbers.
5) ✠ Denotes factory-tailored component.
6) Resistors with "R" numbers and capacitors with "C" numbers are located in networks or listed in charts as indicated on individual drawings.

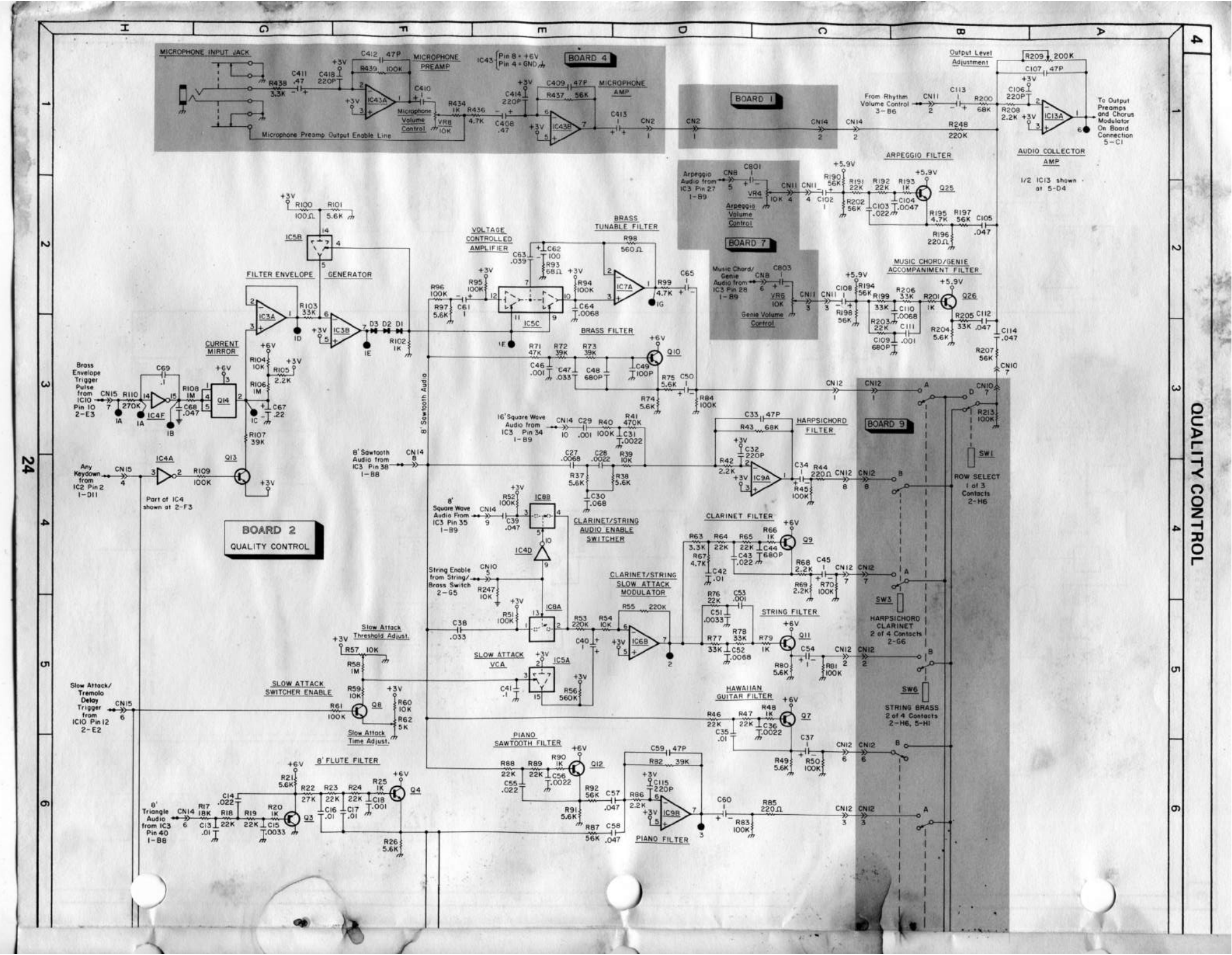


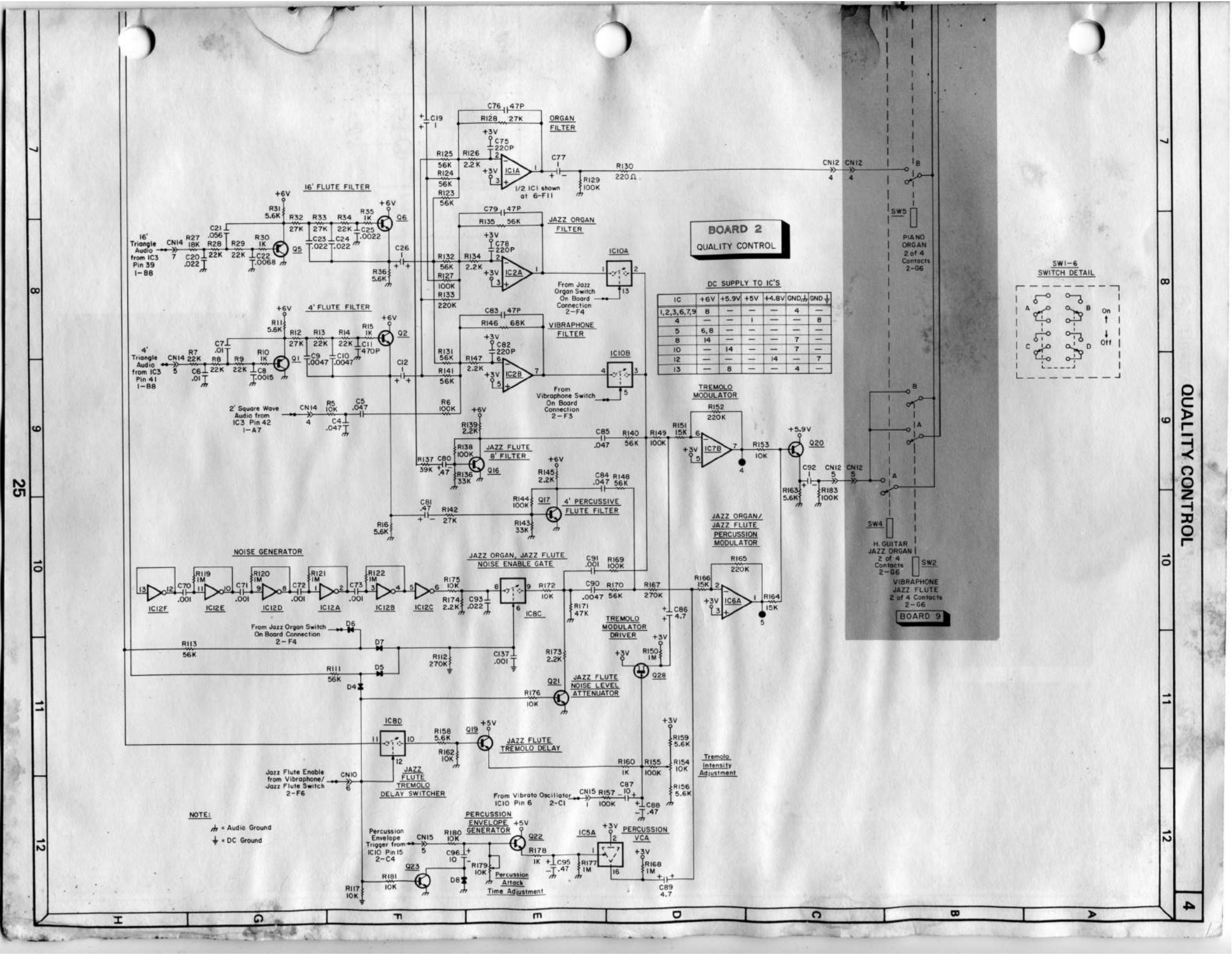

BOARD 1
CENTRAL PROCESSING SYSTEM
CENTRAL PROCESSING SYSTEM
BOARD 13
Typical Keyswitch
Right Hand Keyswitches
Genie Keyswitches
SW10-18, SW20-23 SWITCH DETAIL
INVERTERS
IC8E
IC8B
IC8C
IC8A
IC8F
IC8D
IC6A
IC6B
IC6C
IC4 Y-SCAN DECODER
Y-Scan Decoder Timing Diagram See Waveforms
BOARD 6
See Switch Detail This Dwg. H2
SW20
SW21
SW22
SW23
FULL KEYBOARD
GENIE
MUSIC CHORD
CHORD MEMORY
Push On Push Off
BOARD 9
See Switch Detail This Dwg. H2
Clave Enable To Rhythm 3-B1
Bongo Enable To Rhythm 3-B1
Bass Drum Accent Enable To Rhythm 3-H2
LED DRIVER
BD 3
Rhythm Track LED
Mtd. on Front Panel
SW16 WALTZ TANGO
SW15 SAMBA RHUMBA
SW14 BOSA NOVA SLOW ROCK
SW13 ROCK DISCO
SW12 SWING MARCH/ POLKA
SW11 TRACK SELECT
SW18 Momentary START STOP
SW17 AUTO START
BD 5
SELECT
RECORD
REPLAY
PERC. ENABLE SWITCHER
From Perc. Enable Line (On Board Connection) 2-F5
From Power On Reset Switcher Q402 6-C8
Power "On" Rhythm Audio Killer Line
BOARD 9
SW10
AOC
IC1
From Audio Detector Q302 5-A12
RAM I/O RESET SWITCHER
Memory Hold Capacitor
POWER SHUT-OFF PULSE DETECTOR
To Power Switching Trigger IC41 Pin 6 6-D5
Rhythm Output Enable Line
High Rhythm On
To Rhy. Output Switcher IC36 Pin 13 3-B5
MUSIC CHORD/ GENIE KEYER
Chord Keyer
IC2
Bass Envelope
Test
L.K. 8'
L.K. 8'
L.K. 4'

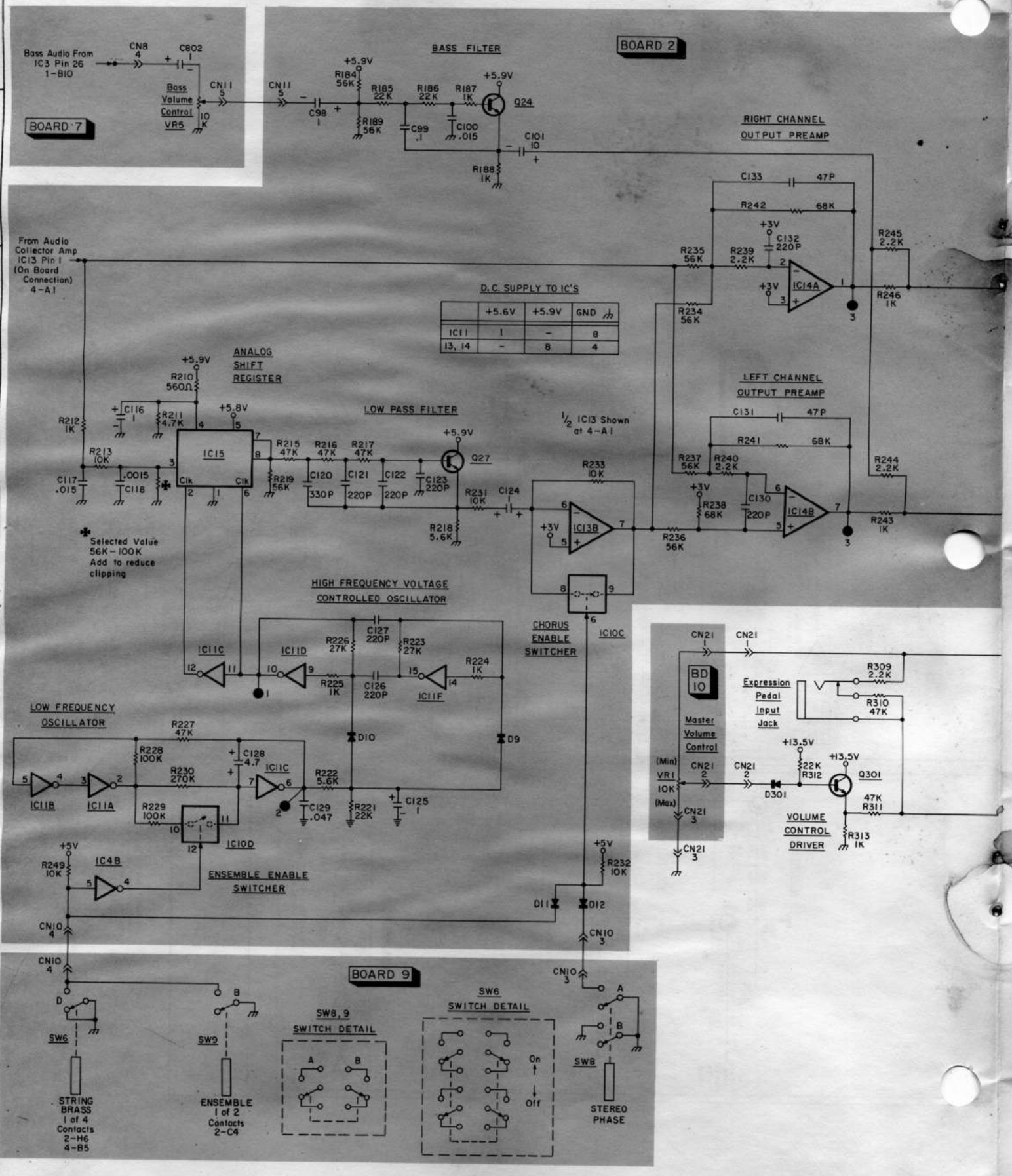

CENTRAL PROCESSING SYSTEM
RHYTHM CLOCK MULTIVIBRATOR
MICRO-PROCESSOR
256 BYTE RAM I/O IC2
CHIP ENABLE SWITCHER
CRYSTAL
11MHz
Rhythm Speed Control
NOT USED
MACH III LED DRIVERS
FRONT PANEL
BOARD 5
PROGRAMMABLE TONE SYNTHESIZER
Output Levels
Chord Sustain
Music Chord/ Genie Keyer Envelope
Arpeggio Envelope
Keyer 1 Envelope
Keyer 2 Envelope
Keyer 3 Envelope
Keyer 4 Envelope
Keyer 5 Envelope
Keyer 6 Envelope
Keyer 7 Envelope
Keyer 8 Envelope
Clock Input
Sustain Control
Snub Control
Shift
Strobe
Audio GND
D.C. GND
Cymbal Trigger
High Drum/Lo Drum Select
Cymbal/Brush Accent
Rim Shot Trigger
Bass Drum Trigger
Bongo/Clave Trigger
High Drum/Lo Drum Trigger
Brush Trigger
To Rhythm Instrumentation See Schematic 3
Sustain Control Voltage From Q9 (On Board Connection) 2-B3
1 MHz Clock From Master Osc. On Board Connection 2-A1
From Vib. Oscillator On-Bd Connection From IC9 Pin 12 2-D1
Timer Input
Typ. Rhythm Trigger Pulses
PERCUSSION SNUB ENABLE
From Percussion Snub Control Line (High with Piano or Harpsichord on) 2-G5
Part of IC15 shown on Schematic 2
To IC10 Pin 5 On Board Connection 2-F2
Any Keydown To Quality Control 4-H4
Data Transfer Timing Diagram
2' Square Wave To Vibraphone Filter 4-G9
4' Triangle Wave To Flute Filter 4-H8
8' Triangle Wave To 8' Flute Filter 4-H6
16' Triangle Wave To 16' Flute Filter 4-H7
8' Sawtooth Wave To Reed/String & Brass 4-F4
8' Square Wave To Clarinet Filter 4-E4
16' Square Wave To Harpsichord Filter 4-E3
Music Chord/Genie Audio To Genie Volume Control 4-D3
Arpeggio Audio To Arpeggio Vol. Control 4-D2
Bass Audio To Bass Volume Control 5-A1
= D.C. GND
= Audio GND
BOARD 1 CENTRAL PROCESSING SYSTEM
D.C. SUPPLY TO IC'S
IC | +5V | GND
4 | 16 | 8
5-8 | 1 | 8
15 | 14 | 7
Y-SCAN DECODER
D C B A | OUTPUT *
0 0 0 0 | Y0 3
0 0 0 1 | Y1 14
0 0 1 0 | Y2 2
0 0 1 1 | Y3 15
0 1 0 0 | Y4 1
0 1 0 1 | Y5 6
0 1 1 0 | Y6 7
0 1 1 1 | Y7 4
1 0 0 0 | Y8 9
1 0 0 1 | Y9 5
*Output switches high when selected


DC CONTROL
BOARD 1
CENTRAL PROCESSING SYSTEM
BOARD 2
BOARD 3
BOARD 4
BOARD 9
VIBRATO OSCILLATOR
MASTER OSCILLATOR
SLOW ATTACK/TREMOLO DELAY TRIGGER
BRASS ENVELOPE/ VIBRATO DELAY TRIGGER
VIBRATO ENABLE DRIVER Q13
VIBRATO ENABLE SWITCHER
VIBRATO DEPTH SWITCHER
VIBRAPHONE ON KEYDOWN PULSE DISABLE SWITCHER
SUSTAIN ENABLE SWITCHER
STRING/BRASS SUSTAIN ENABLE SWITCHER
PERCUSSION SUSTAIN DECAY LENGTH CONTROL OSCILLATOR
PERCUSSION SUSTAIN ENABLE SWITCHER
PRESET SUSTAIN LENGTH REGULATOR
TUNING DRIVER Q10
LED DRIVER
SW1-6 SWITCH DETAIL
SW7, 9 SWITCH DETAIL
DC SUPPLY TO IC'S
IC | +5V | GND
9, 10 | 1 | 8
15 | 14 | 7
ROW SELECT 2 of 3 Contacts 4-B4
STRING BRASS 1 of 4 Contacts 4-B5 5-H1
PIANO ORGAN 2 of 4 Contacts 4-B7
H. GUITAR JAZZ ORGAN 2 of 4 Contacts 4-B10
HARPSICHORD CLARINET 2 of 4 Contacts 4-B5
VIBRAPHONE JAZZ FLUTE 2 of 4 Contacts 4-B10
ENSEMBLE 1 of 2 Contacts 5-H2
SUSTAIN
1 MHz Clock To Programmable Tone Synth. IC3 Pin 21 (On Board Connection) 1-C10
Vibrato Signal To Tremolo Modulator Driver Q28 4-E12
Vibrato Signal to IC2 Pin 3 (On Board Connection) 1-F10
To Low Power LED Driver Q407 6-D9
Any Keydown From IC2 Pin 2 (On Bd Connection) 1-D11
Slow Attack/ Tremolo Delay Trigger to QC 4-H6
Vibrato Enable Line
Vibraphone Enable To IC10 Pin 5 4-E8
Jazz Organ Enable To Cathode D6 4-G10 and IC10 Pin 13 4-E8
Brass Envelope Trigger to IC4 Pin14 4-H3
Keydown Pulsewidth Adjustment
Percussion Envelope Trigger To Q22 4-F12
Sustain Control Voltage To IC3 Pin 13 On Board Connection 1-C10
IC15B shown at 1-C11
String Enable To IC8 Pin 13 and IC4 Pin 9 4-F5
To IC15 Pin 5 1-C11
To Percussion Enable Switcher Q203 1-C4 (On Board Connection)
Percussion Sustain Enable Line
Jazz Flute Enable To 4-G11
Part of IC4 Shown on Dwg. 4
Mtd to Front Panel
Perc Snub
Control Line


HI DRUM / LOW DRUM GENERATOR
RHYTHM PREAMP
Hi/Low Drum Trigger From IC2 Pin 27 1-D11
Hi/Low Select From IC2 Pin 22 1-D10
HI/LOW DRUM FILTER TUNING SWITCHER
RHYTHM OUTPUT SWITCHER
From IC2 Pin 1 High Enables Rhythm Output 1-C6
Rhythm Volume Control VR3
Rhythm Audio To Audio Coll. Amp IC13 Pin 2 4-B1
BOARD 7
Clave Enable From Track Select Switch 1-E3
Bongo Enable From Track Select Switch 1-E3
Bongo/Clave Trigger From IC2 Pin 26 1-D11
BONGO/CLAVE GENERATOR
Cymbal/Brush Accent Select From IC2 Pin 23 1-D11
CYMBAL/BRUSH ACCENT SWITCHER
CYMBAL ENVELOPE GENERATOR
Cymbal Trigger From IC2 Pin 21 1-D10
INVERTER
CYMBAL BRUSH SWITCHER
BRUSH ENVELOPE GENERATOR
Brush Trigger From IC2 Pin 28 1-D11
CYMBAL/BRUSH FILTER
NOISE GENERATOR
NOISE FILTER
NOISE KEYER Q304
RIM SHOT GENERATOR
Rim Shot Trigger From IC2 Pin 24 1-D11
BASS DRUM GENERATOR
Bass Drum Trigger From IC2 Pin 25 1-D11
Bass Drum Accent From Rock/Disco Switch SW13 1-F4
NAND
NOT USED
IC36B
D.C. SUPPLY TO IC'S
IC31-34 +5.9V 8 GND 4
IC35-37 14 GND 7
BOARD 3 RHYTHM
NOTE: Resistor numbers with an RA prefix are contained in a resistor array.
= D.C. Ground
= Audio Ground

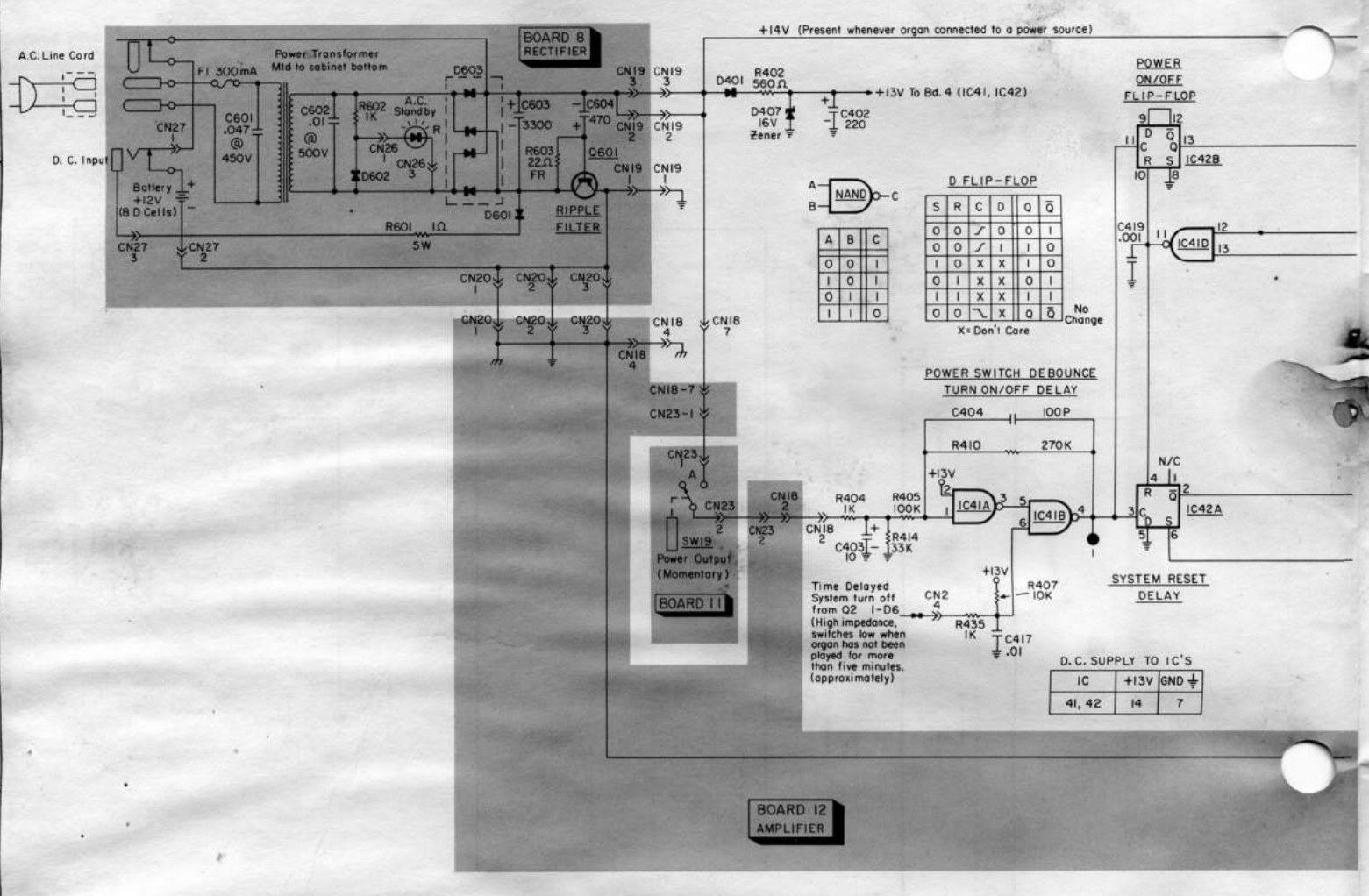

QUALITY CONTROL
BOARD 2
QUALITY CONTROL
BOARD 4
BOARD 1
BOARD 7
BOARD 9
MICROPHONE INPUT JACK
MICROPHONE PREAMP
MICROPHONE AMP
Microphone Preamp Output Enable Line
Microphone Volume Control
Output Level Adjustment
From Rhythm Volume Control 3-B6
To Output Preamps and Chorus Modulator On Board Connection 5-C1
AUDIO COLLECTOR AMP
1/2 IC13 shown at 5-D4
ARPEGGIO FILTER
Arpeggio Audio from IC3 Pin 27 1-B9
Arpeggio Volume Control
MUSIC CHORD/GENIE ACCOMPANIMENT FILTER
Music Chord/Genie Audio from IC3 Pin 28 1-B9
Genie Volume Control
VOLTAGE CONTROLLED AMPLIFIER
BRASS TUNABLE FILTER
FILTER ENVELOPE GENERATOR
CURRENT MIRROR
BRASS FILTER
8' Sawtooth Audio
Brass Envelope Trigger Pulse from IC10 Pin 10 2-E3
Any Keydown from IC2 Pin 2 1-D11
Part of IC4 shown at 2-F3
16' Square Wave Audio from IC3 Pin 34 1-B9
8' Sawtooth Audio from IC3 Pin 38 1-B8
HARPSICHORD FILTER
8' Square Wave Audio From IC3 Pin 35 1-B9
CLARINET/STRING AUDIO ENABLE SWITCHER
CLARINET FILTER
String Enable from String/Brass Switch 2-G5
CLARINET/STRING SLOW ATTACK MODULATOR
STRING FILTER
Slow Attack Threshold Adjust.
SLOW ATTACK VCA
SLOW ATTACK SWITCHER ENABLE
Slow Attack Time Adjust.
Slow Attack/Tremolo Delay Trigger from IC10 Pin 12 2-E2
HAWAIIAN GUITAR FILTER
PIANO SAWTOOTH FILTER
PIANO FILTER
8' FLUTE FILTER
8' Triangle Audio from IC3 Pin 40 1-B8
ROW SELECT 1 of 3 Contacts 2-H6
HARPSICHORD CLARINET 2 of 4 Contacts 2-G6
STRING BRASS 2 of 4 Contacts 2-H6, 5-H1


QUALITY CONTROL
BOARD 2
QUALITY CONTROL
16' FLUTE FILTER
4' FLUTE FILTER
ORGAN FILTER
JAZZ ORGAN FILTER
VIBRAPHONE FILTER
JAZZ FLUTE 8' FILTER
4' PERCUSSIVE FLUTE FILTER
NOISE GENERATOR
JAZZ ORGAN, JAZZ FLUTE NOISE ENABLE GATE
TREMOLO MODULATOR
TREMOLO MODULATOR DRIVER
JAZZ ORGAN/ JAZZ FLUTE PERCUSSION MODULATOR
JAZZ FLUTE NOISE LEVEL ATTENUATOR
JAZZ FLUTE TREMOLO DELAY
JAZZ FLUTE TREMOLO DELAY SWITCHER
PERCUSSION ENVELOPE GENERATOR
PERCUSSION VCA
Tremolo Intensity Adjustment
Percussion Attack Time Adjustment
DC SUPPLY TO IC'S
SW1-6 SWITCH DETAIL
PIANO ORGAN 2 of 4 Contacts 2-G6
H. GUITAR JAZZ ORGAN 2 of 4 Contacts 2-G6
VIBRAPHONE JAZZ FLUTE 2 of 4 Contacts 2-G6
BOARD 9
NOTE:
= Audio Ground
= DC Ground
QUALITY CONTROL
25
4

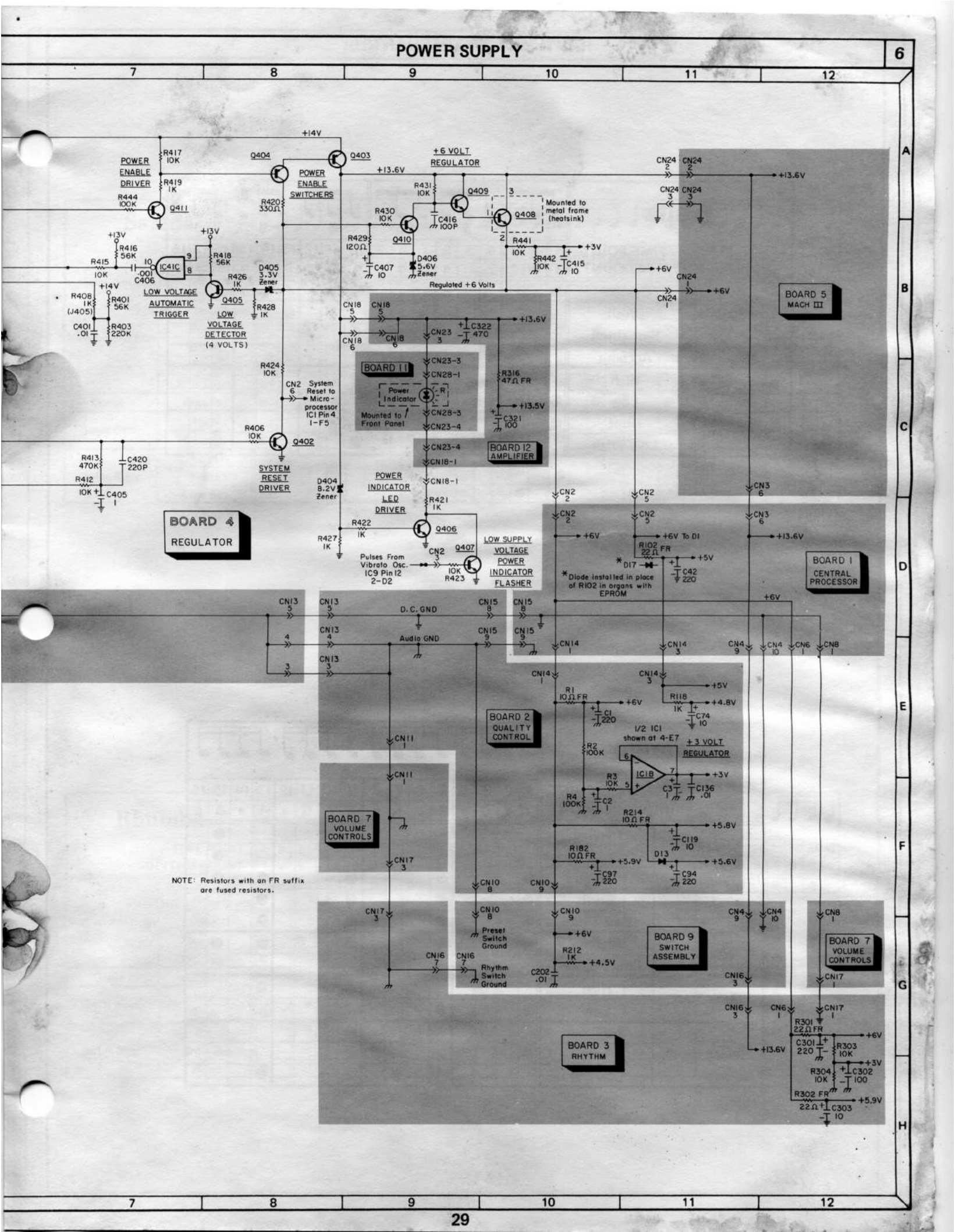

BOARD 7
Bass Audio From IC3 Pin 26 1-B10
CN8 4
C802 1
Bass Volume Control VR5 10K
CN11 5
BOARD 2
BASS FILTER
+5.9V
R184 56K
R185 22K
R186 22K
R187 1K
Q24
C98 1
R189 56K
C99 .1
C100 .015
C101 10
R188 1K
RIGHT CHANNEL OUTPUT PREAMP
C133 47P
R242 68K
+3V
C132 220P
R235 56K
R239 2.2K
R245 2.2K
IC14A
R246 1K
R234 56K
From Audio Collector Amp IC13 Pin 1 (On Board Connection) 4-A1
D.C. SUPPLY TO IC'S
+5.6V
+5.9V
GND
IC11
IC13, 14
ANALOG SHIFT REGISTER
+5.9V
R210 560Ω
C116 1
R212 1K
R211 4.7K
+5.8V
LOW PASS FILTER
IC15
R213 10K
C117 .015
.0015
C118
Clk
Clk
R215 47K
R216 47K
R217 47K
R219 56K
C120 330P
C121 220P
C122 220P
C123 220P
Q27
R231 10K
C124 1
R218 5.6K
Selected Value 56K-100K Add to reduce clipping
1/2 IC13 Shown at 4-A1
R233 10K
IC13B
R236 56K
LEFT CHANNEL OUTPUT PREAMP
C131 47P
R241 68K
R237 56K
R240 2.2K
R244 2.2K
C130 220P
IC14B
R238 68K
R243 1K
HIGH FREQUENCY VOLTAGE CONTROLLED OSCILLATOR
C127 220P
R226 27K
R223 27K
IC11C
IC11D
R224 1K
R225 1K
C126 220P
IC11F
CHORUS ENABLE SWITCHER
IC10C
LOW FREQUENCY OSCILLATOR
R227 47K
R228 100K
R230 270K
C128 4.7
IC11C
R222 5.6K
D10
D9
IC11B
IC11A
R229 100K
C129 .047
R221 22K
C125 1
IC10D
ENSEMBLE ENABLE SWITCHER
IC4B
R249 10K
+5V
R232 10K
D11
D12
CN10 4
CN10 3
CN21 1
BD 10
Master Volume Control
(Min) VR1 10K (Max)
CN21 2
CN21 3
Expression Pedal Input Jack
R309 2.2K
R310 47K
+13.5V
22K R312
Q301
D301
47K R311
VOLUME CONTROL DRIVER
R313 1K
BOARD 9
SW6
SW9
SW8, 9 SWITCH DETAIL
SW6 SWITCH DETAIL
SW8
On
Off
STRING BRASS 1 of 4 Contacts 2-H6 4-B5
ENSEMBLE 1 of 2 Contacts 2-C4
STEREO PHASE

BOARD 12
POWER AMPLIFIER

POWER SUPPLY



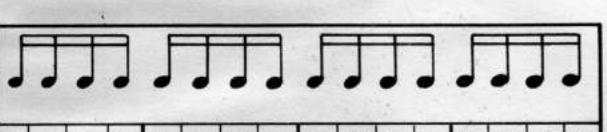
IC	+13V	GND ⏚
41, 42	14	7


+14V
POWER ENABLE DRIVER
R417 10K
R419 1K
R444 100K
Q411
Q404
Q403
POWER ENABLE SWITCHERS
+13.6V
+6 VOLT REGULATOR
R420 330Ω
R431 10K
Q409
R430 10K
C416 100P
Q408
Mounted to metal frame (heatsink)
R429 120Ω
Q410
C407 10
D406 5.6V Zener
R441 10K
R442 10K
C415 10
+3V
Regulated +6 Volts
+13V
R416 56K
R418 56K
R415 10K
.001 C406
IC41C
D405 3.3V Zener
R426 1K
R428 1K
Q405
LOW VOLTAGE AUTOMATIC TRIGGER
LOW VOLTAGE DETECTOR (4 VOLTS)
R408 1K (J405)
R401 56K
R403 220K
C401 .01
CN24
+6V
BOARD 5 MACH III
CN18
C322 470
CN23
BOARD 11
CN23-3
CN28-1
Power Indicator
Mounted to Front Panel
CN28-3
CN23-4
R316 47Ω FR
C321 100
BOARD 12 AMPLIFIER
CN18-1
R424 10K
CN2 6 System Reset to Micro-processor IC1 Pin 4 1-F5
R406 10K
Q402
SYSTEM RESET DRIVER
R413 470K
C420 220P
R412 10K
C405 1
D404 8.2V Zener
POWER INDICATOR LED DRIVER
R421 1K
R422 1K
Q406
R427 1K
Pulses From Vibrato Osc. IC9 Pin 12 2-D2
CN2 3
Q407
10K R423
LOW SUPPLY VOLTAGE POWER INDICATOR FLASHER
BOARD 4 REGULATOR
CN2
+6V To D1
R102 22Ω FR
+5V
D17
C42 220
*Diode installed in place of R102 in organs with EPROM
BOARD 1 CENTRAL PROCESSOR
CN3
CN13
D.C. GND
Audio GND
CN15
CN14
CN4
CN6
CN8
R1 10Ω FR
C1 220
R118 1K
C74 10
+4.8V
BOARD 2 QUALITY CONTROL
1/2 IC1 shown at 4-E7
+3 VOLT REGULATOR
IC1B
R2 100K
R3 10K
R4 100K
C2 1
C3 1
C136 .01
CN11
BOARD 7 VOLUME CONTROLS
R214 10Ω FR
+5.8V
C119 10
R182 10Ω FR
+5.9V
D13
+5.6V
C97 220
C94 220
CN17
CN10
Preset Switch Ground
Rhythm Switch Ground
CN16
BOARD 9 SWITCH ASSEMBLY
R212 1K
+4.5V
C202 .01
BOARD 3 RHYTHM
R301 22Ω FR
C301 220
R303 10K
R304 10K
C302 100
R302 FR 22Ω
C303 10
NOTE: Resistors with an FR suffix are fused resistors.

Waltz

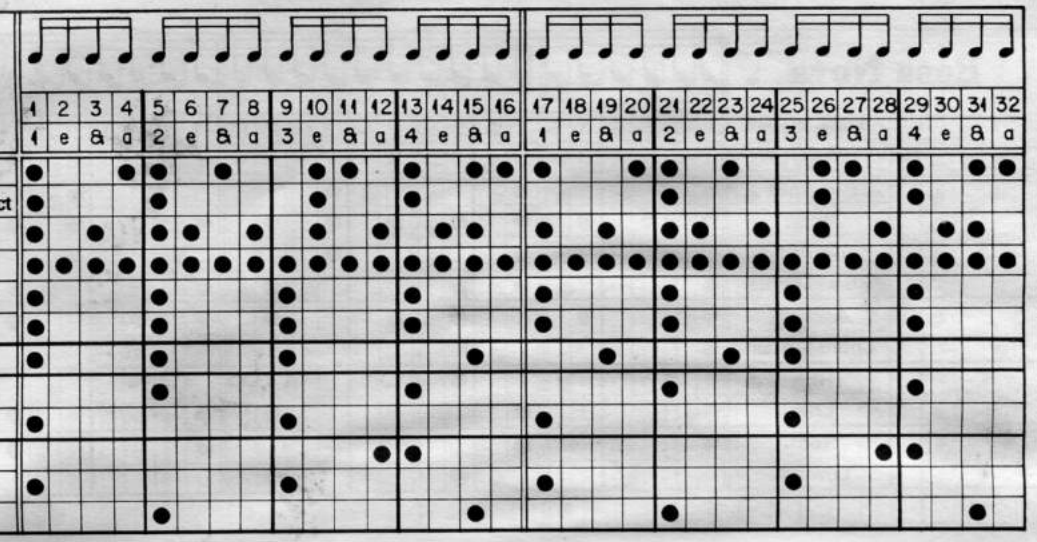
TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RHYTHM COUNT	1	&	a	2	&	a	3	&	a	1	&	a	2	&	a	3	&	a
Instrumentation — Cymbal	●									●								
Instrumentation — Brush				●			●						●			●		
Instrumentation — Bass Drum	●									●								
Genie — Accomp.				●			●						●			●		
Genie Bass — High										●								
Genie Bass — Low	●																	
Swing Bass — Root	●																	
Swing Bass — Low Fifth										●								

Tango



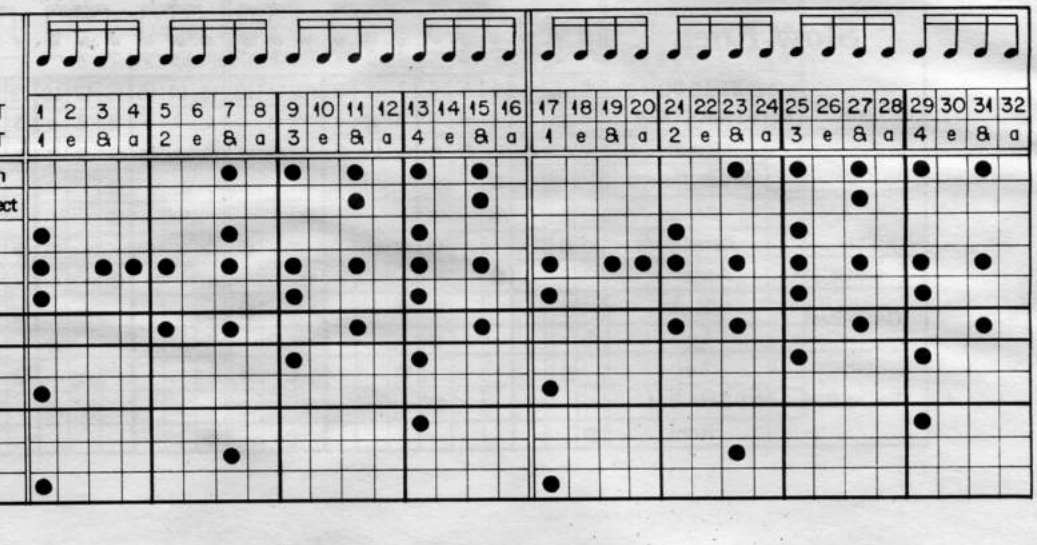
TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation — Cymbal															●	
Instrumentation — Cym/Brush Accent															●	
Instrumentation — Bongo	●				●				●				●		●	
Instrumentation — Brush	●				●				●				●			
Instrumentation — Bass Drum	●				●				●				●			
Genie — Accomp.	●				●				●				●		●	
Genie — Chord Sustain															●	
Genie Bass — High									●				●			
Genie Bass — Low	●				●											
Swing Bass — 3rd/–3rd									●							
Swing Bass — Root	●															
Swing Bass — Low 5th							●						●			

Samba



	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Hi/Low Drum	●			●	●		●			●	●		●		●	●	●			●	●		●			●	●		●		●	●
	Hi/Lo Drum Select	●				●					●			●								●					●			●			
	Bongo	●		●		●	●		●		●		●		●	●		●		●		●	●		●		●		●		●	●	
	Brush	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Brush Accent	●				●				●				●				●				●				●				●			
	Bass Drum	●				●				●				●				●				●				●				●			
Genie	Accomp.	●				●				●						●				●				●		●							
Genie Bass	High					●								●								●								●			
	Low	●								●								●								●							
Swing Bass	Fifth												●	●															●	●			
	Root	●								●								●								●							
	Low 5th					●										●						●										●	

Rhumba



	TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Hi/Low Drum							●		●		●		●		●								●		●		●		●		●	
	Hi/Lo Drum Select											●		●		●												●					
	Clave	●						●						●								●				●							
	Brush	●		●	●	●		●		●		●		●		●		●		●	●	●		●		●		●		●		●	
	Bass Drum	●								●				●				●								●				●			
Genie	Accomp.					●		●				●				●						●		●				●				●	
Genie Bass	High									●				●												●				●			
	Low	●																●															
Swing Bass	5th													●																●			
	3rd/–3rd							●																●									
	Root	●																●															

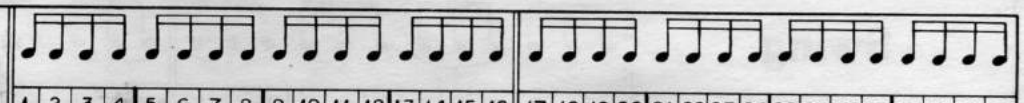
Bosa Nova

		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Rim Shot		●						●						●								●						●					
	Brush		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Accent		●						●						●								●						●					
	Bass Drum		●						●		●						●		●						●		●						●	
Genie	Accomp.		●				●				●		●				●				●				●				●		●			
	Chord Sustain		●								●										●								●					
Genie Bass	High										●																●						●	
	Low		●						●								●		●						●									
Swing Bass	Root		●						●										●						●									
	Low 5th										●						●										●						●	

Slow Rock

		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	Brush		●	●●	●	●	●	●	●	●●	●	●	●	●	●	●●	●	●	●	●	●	●●	●	●	●	●
	Brush Accent					●						●						●						●		
	Bongo					●						●						●						●		
	Bass Drum		●					●	●					●	●					●	●					●
Genie	Accomp.					●						●						●						●		
Genie Bass	High								●					●							●					●
	Low		●					●							●					●						
Swing Bass	5th								●					●							●					●
	3rd/–3rd							●				●								●				●		
	Root		●												●											

Rock



		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Brush		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Brush Accent						●								●								●								●			
	Bongo						●								●								●								●			
	Bass Drum		●						●		●						●		●						●		●						●	
Genie	Accomp.						●								●								●								●			
Genie Bass	High										●						●										●						●	
	Low		●						●										●						●									
Swing Bass	8th																						●						●		●			
	7th																																●	
	5th										●						●				●													
	Root		●						●										●															

Disco

		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Cymbal			●				●				●				●		
	Brush					●				●				●				
	Brush Accent					●								●				
	Bongo					●								●				
	Bass Drum	●				●				●				●				
Genie	Accomp.			●		●				●				●				
Genie Bass	High					●								●				
	Low	●								●								
Swing Bass	5th													●				
	Root	●								●								
	Low 5th					●											●	

Swing

		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		RHYTHM COUNT	1	&	a	2	&	a	3	&	a	4	&	a	1	&	a	2	&	a	3	&	a	4	&	a
Instrumentation	Cymbal		●			●		●	●			●		●	●			●		●	●			●		●
	Bongo					●						●						●						●		
	Bass Drum		●			●			●			●			●			●			●			●		
Genie	Accomp.					●						●						●						●		
Genie Bass	High								●			●									●			●		
	Low		●			●									●			●								
Swing Bass	8th					●																				
	5th								●															●		
	3rd/–3rd											●									●					
	2nd																	●								
	Root		●												●											

March-Polka

		TIME POINT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		RHYTHM COUNT	1	e	&	a	2	e	&	a	3	e	&	a	4	e	&	a
Instrumentation	Cymbal		●				●				●				●			
	Brush				●				●				●				●	
	Bongo				●				●				●				●	
	Bass Drum		●				●				●				●			
Genie	Accomp.				●				●				●				●	
Genie Bass	High						●								●			
	Low		●								●							
Swing Bass	3rd/–3rd										●							
	Root		●															
	Low 5th						●								●			

OSCILLOSCOPE USAGE

An oscilloscope provides a visual image of events which occur too rapidly to be measured with a voltmeter. When properly used, the oscilloscope becomes a valuable aid in troubleshooting electronic organs.

INPUT COUPLING

The input coupling on most oscilloscopes can be switched between direct (DC) or decoupled (AC).

Direct Coupling [DC]

1. The probe is connected directly to the input of the oscilloscope.
2. Once a zero reference is established, positive and negative voltage measurements can be made.
3. Unless otherwise specified, all waveforms shown on the schematics are made using direct coupling.

Decoupled [AC]

1. A capacitor is placed in series with the probe to block any DC voltage which may be present in the AC signal.
2. The image on the oscilloscope will deflect above and below the established zero reference.

Input - DC
Vertical - 5 Volts per Division
Trigger - Auto

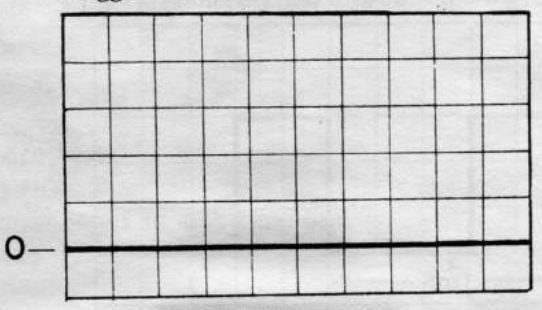


Fig. 6A - Establish Zero Reference

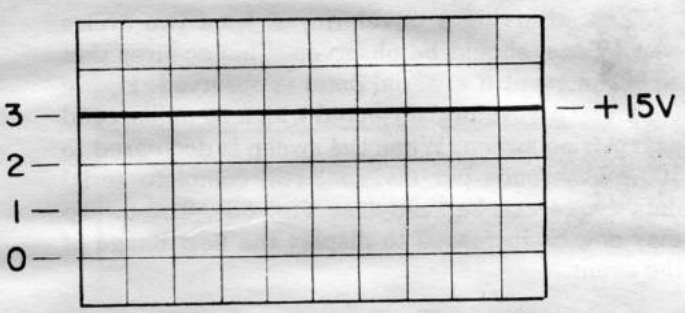


Fig. 6B - Three Division Deflection

CALIBRATION

Any oscilloscope may be calibrated as follows:

1. Set vertical deflection to 5 volts/division (or similar range).
2. Ground the input to the oscilloscope.
3. Align the trace with a horizontal graticule (see Fig. 6A).
4. Unground the input to the oscilloscope, trace should not move.
5. Connect oscilloscope input to a known DC voltage source (i.e. +15 volts).
6. Trace should deflect three divisions in a vertical direction [3 division x 5 volts = 15 volts]. (See Fig. 6B.)
7. Adjust calibration control to obtain a three division (15 volt) deflection.
8. Oscilloscope is now calibrated.

NOTE: If a ten-to-one (or other) attenuator probe is used, the vertical deflection should be multiplied by ten (or other). For example: With a ten-to-one probe, the vertical deflection would have to be set to .5 volts per division to obtain a three division deflection when measuring a 15 volt source.

.5V x 3 Div. = 1.5V 1.5V x 10 atten. = 15V

TIME BASE

Most oscilloscopes have a horizontal time base which controls the movement (sweep) of the trace across the screen from a few seconds to several microseconds.

Frequency and time are inverse functions. As frequency increases, time decreases. The mathematical formula for determining the frequency of a waveform is $F = \frac{1}{t}$ where frequency (F) is in cycles and time (t) is in seconds.

To determine the frequency of a waveform:

1) Determine the time it takes for the waveform to complete one cycle.
2) In Figure 7, a cycle of the waveform takes five divisions. The sweep is set for 200 microseconds per division. The time required for a single cycle is 200uS x 5 divisions or 1000 microseconds = 1 millisecond = .001 second.
3) Using the formula $F = \frac{1}{t}$, the frequency of the waveform is:

$$F = \frac{1}{.001}$$

$$F = 1000\text{Hz}$$

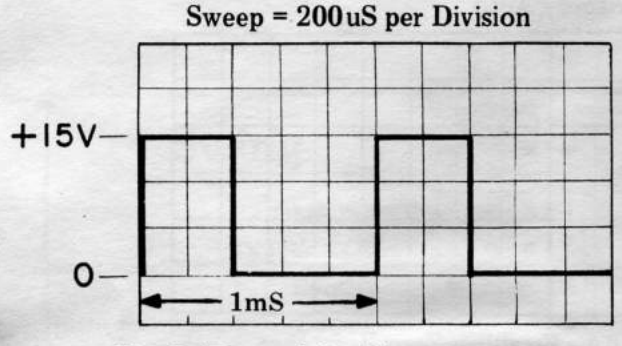


Fig. 7 - Determining Frequency

When observing a waveform, at least two cycles (repetitions) should be observed. This ensures that all of the event (i.e. serial data) is observed. Figure 8A shows a waveform observed with a 20 millisecond per division sweep. When the sweep is decreased to 100 milliseconds per division, two complete serial data cycles can be seen (see Fig. 8B). The sweep may now be increased to display the best image of the event.

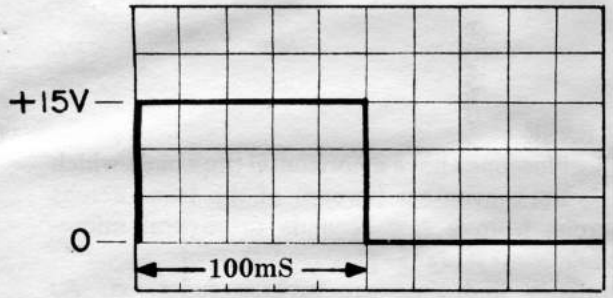


Fig. 8A - Serial data observed with 20mS per Division sweep

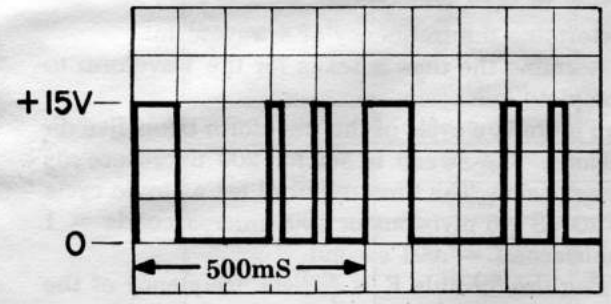


Fig. 8B - Serial data observed with 100mS per Division sweep

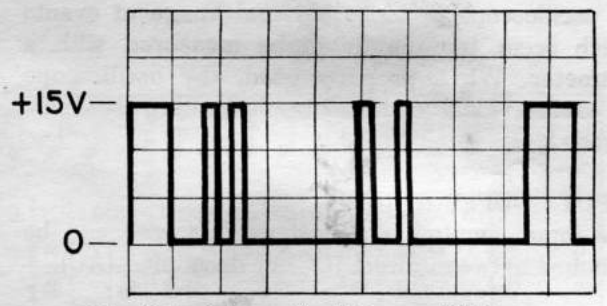


Fig. 9A - Internally Triggered Data

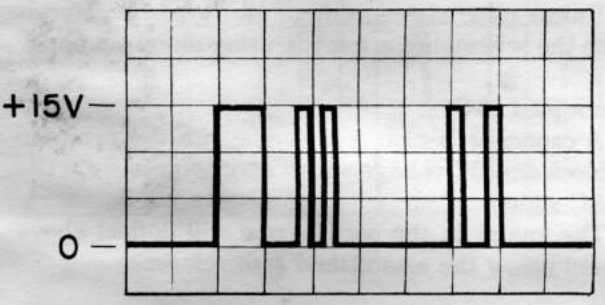


Fig. 9B - Externally Triggered Data

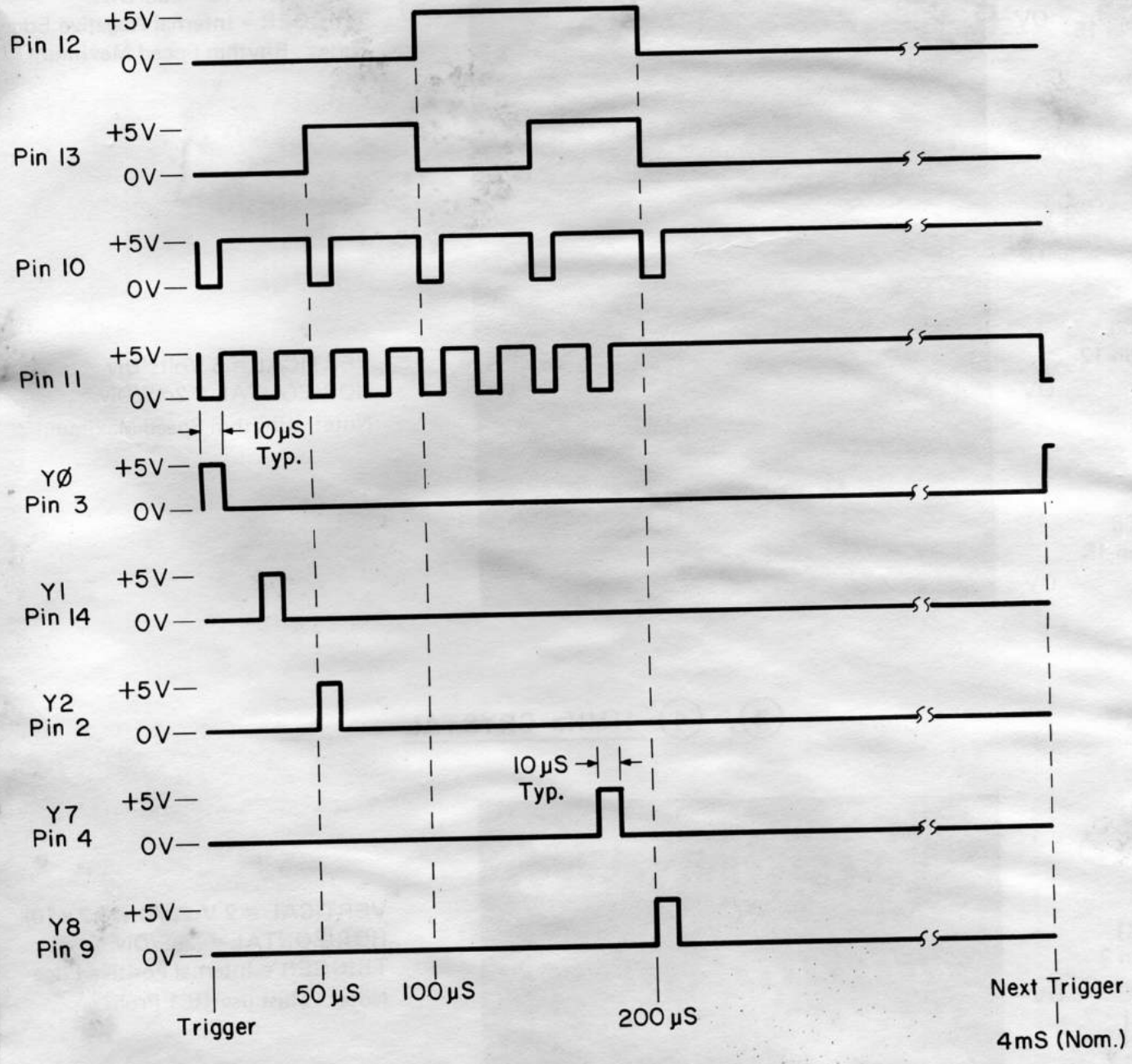
TRIGGERING

Some oscilloscopes have triggered sweep. There are two common types of triggered sweep. Internal triggering relies on the positive or negative going edge of the waveform to start the sweep. The trigger level is controlled by a potentiometer which will cause the sweep to start at the selected voltage level. External triggering is most useful for observing events which occur in a specific relationship to time. Serial data from the Chord Function Generator or Flute Encoder would be an example. Figure 9A shows data being triggered internally. As data bits are added or subtracted from the serial data stream, the image on the oscilloscope will shift dependent on the first data bit (farthest left) used for triggering. The pattern in Figure 9B is externally triggered using the positive edge of the T1 time frame. As data bits are added or subtracted, they will always appear in the same position with respect to the triggering source.

SCHEMATIC 1, BOARD 1

① Y-SCAN DECODER TIMING DIAGRAM

All pin references are to IC4
Input coupling DC
Connect IC4 Pin 3 to External Trigger input to oscilloscope
Trigger — Positive Edge

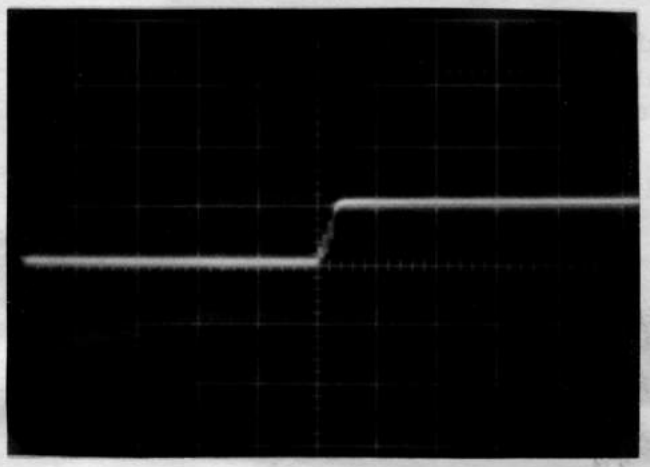


SCHEMATIC 1, BOARD 1

② RHYTHM TRIGGER PULSES

IC6
Pin 15

OV–



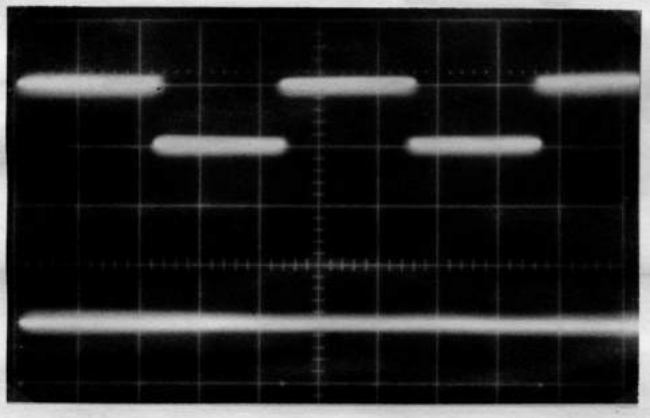
VERTICAL = 5 Volts/Div.
HORIZONTAL = 2uS/Div.
TRIGGER = Internal Negative Edge
Note: Rhythm Speed Maximum

IC6
Pin 12

OV–

IC6
Pin 15

OV–



VERTICAL = 5 Volts/Div.
HORIZONTAL = 2mS/Div.
Note: Rhythm Speed Maximum

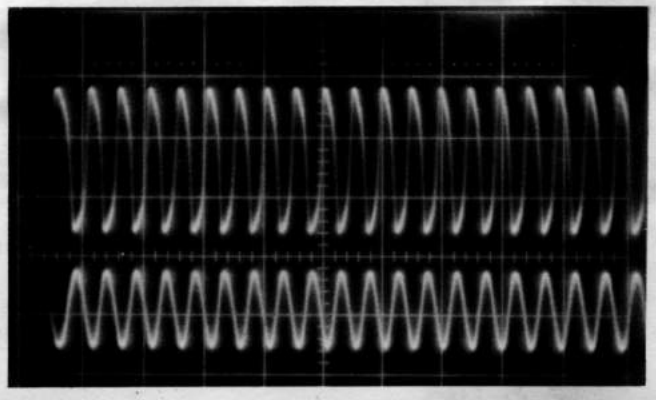
③, ④ 11MHz CRYSTAL

IC1
Pin 3

OV–

IC1
Pin 2

OV–

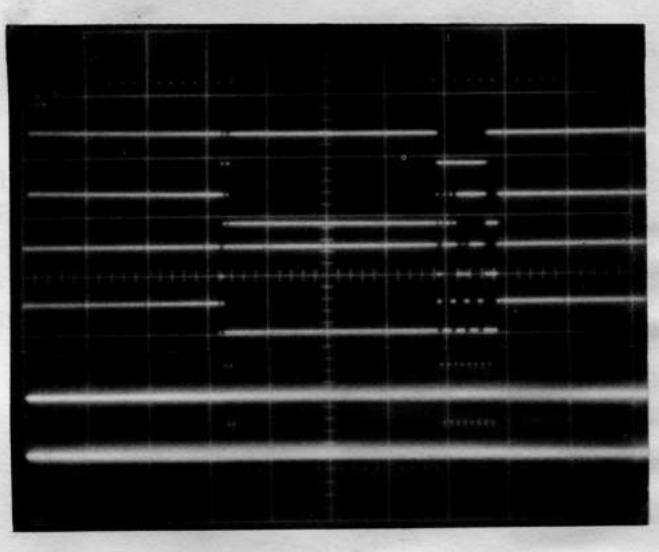


VERTICAL = 2 Volts/Div. (.2 x 10)
HORIZONTAL = .2uS/Div.
TRIGGER = Internal Positive Edge
Note: Must use 10:1 Probe.

SCHEMATIC 1, BOARD 1

(5) PROGRAMMABLE TONE SYNTHESIZER DATA INPUT TIMING

D3 Pin 19
D2 Pin 18
D1 Pin 17
D0 Pin 16
Shift Pin 23
Strobe Pin 24

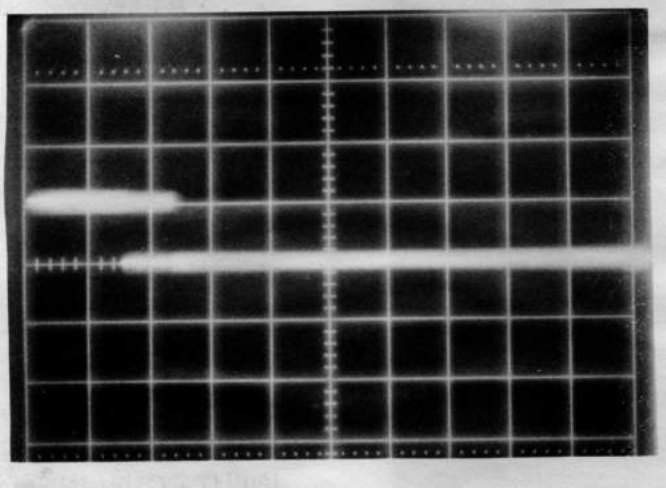


VERTICAL = 10 Volts/Div.
HORIZONTAL = .5mS/Div.
TRIGGER = External Pos.
INPUT COUPLING = DC

Notes:
1. All pin references to IC3
2. Press and release at least eight different keys to fully program the P.T.S.
3. Connect IC4 pin 3 to external trigger input.

(6) TYPICAL RHYTHM TRIGGER PULSE

+5V —
0V —



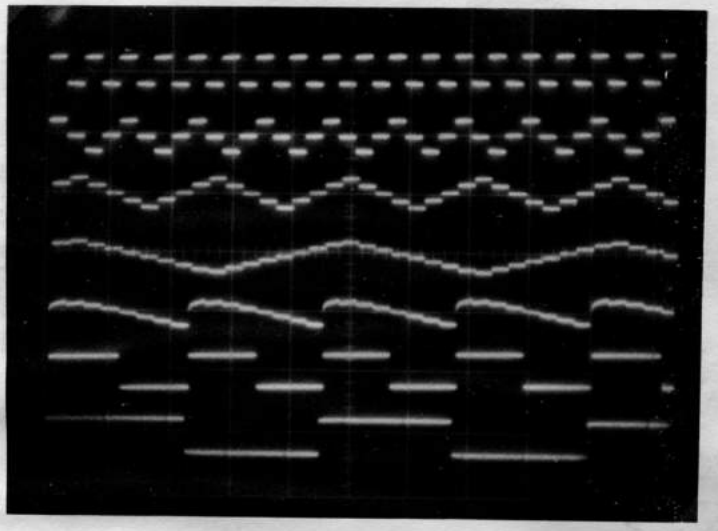
VERTICAL = 5 Volts/Div.
HORIZONTAL = 5mS/Div.
TRIGGER = Internal Positive
Note: Repetition rate varies w/rhythm selected and speed

SCHEMATIC 1, BOARD 1

⑦ PROGRAMMABLE TONE SYNTHESIZER OUTPUT LEVELS

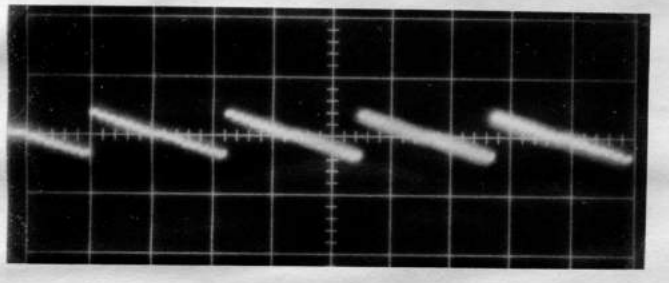
Connect Oscilloscope CN14

Pin 4
Pin 5
Pin 6
Pin 7
Pin 8
Pin 9
Pin 10



VERTICAL = .5 Volt/Div.
HORIZONTAL = .5mS/Div.
TRIGGER = Internal Positive
INPUT COUPLING = AC
Note: A4 key pressed and held.

CN8 Pin 6 OV –

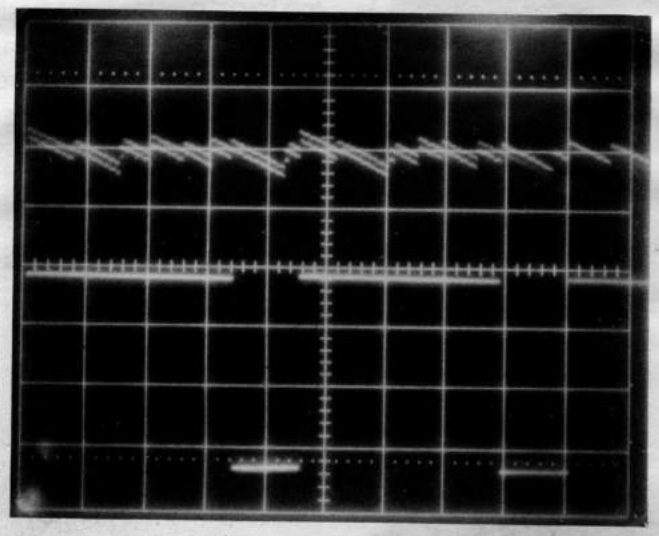


VERTICAL = .2 Volt/Div.
HORIZONTAL = 2mS/Div.
INPUT COUPLING = AC
Note: Genie switch pressed, A1 key pressed and held.

CN8 Pin 6 OV –

Bass

CN8 Pin 4 OV –



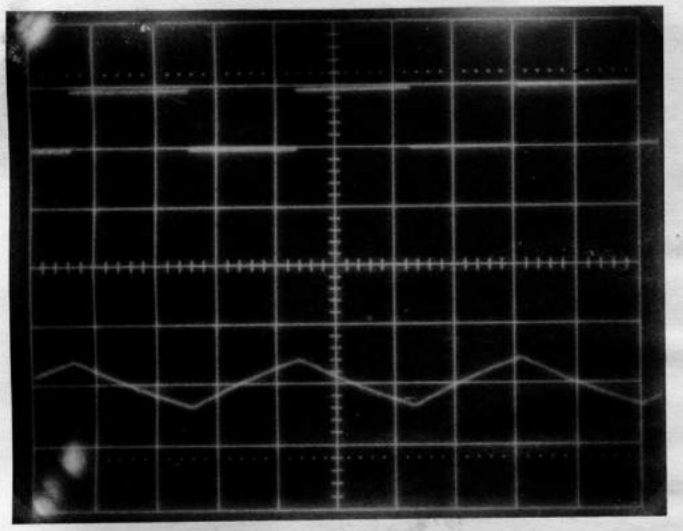
VERTICAL = .5 Volt/Div.
HORIZONTAL = 2mS/Div.
INPUT COUPLING = AC
Note: Music Chord switch on, A1 key pressed and held.

SCHEMATIC 2, BOARD 1

① VIBRATO OSCILLATOR

IC9
Pin 12 OV —

Collector
Q14 OV —

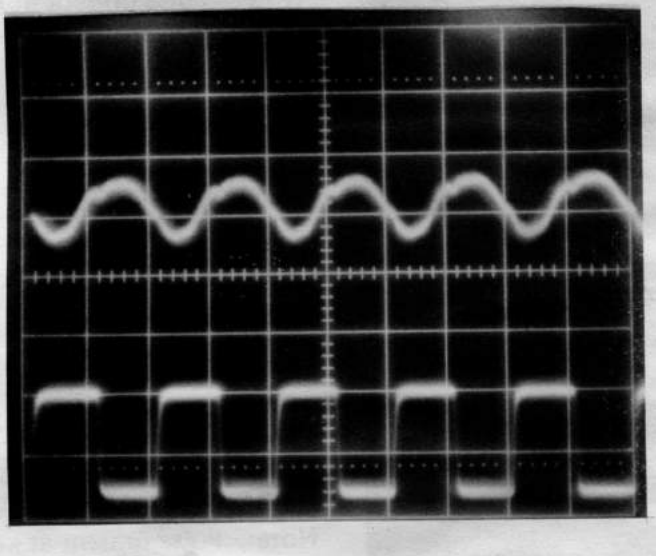


VERTICAL = 5 Volts/Div. (IC9 Pin 2)
VERTICAL = .5 Volt/Div. (Collector Q14)
HORIZONTAL = 50mS/Div.
Note: String ensemble preset on.

② 1 MHz MASTER OSCILLATOR

IC9
Pin 7 OV —

IC9
Pin 6 OV —

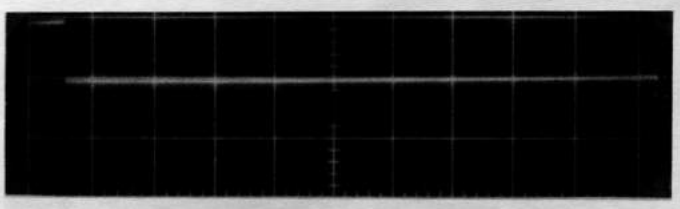


VERTICAL = .2 Volt/Div.
HORIZONTAL = .5uS/Div.
Note: 10:1 probe used.
each division =
.2 Volts/Div. x10 = 2 Volts/Div.

SCHEMATIC 2, BOARD 1

③ SLOW ATTACK TRIGGER

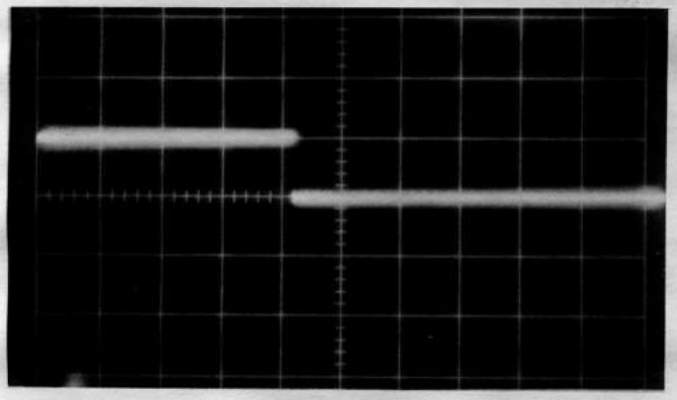
IC10
Pin 12 OV—



VERTICAL = 5 Volts/Div.
HORIZONTAL = 10mS/Div.
Note: Pulse present at keydown.

④ BRASS ENVELOPE TRIGGER

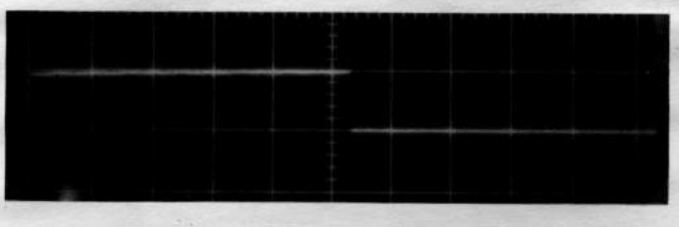
IC10
Pin 10 OV—



VERTICAL = 5 Volts/Div.
HORIZONTAL = .1 Sec/Div.
Note: Pulse present at keydown

⑤ PERCUSSION ENVELOPE TRIGGER

IC10
Pin 15 OV—



VERTICAL = 5 Volts/Div.
HORIZONTAL = 10mS/Div.
Note: Pulse present at keydown.

SCHEMATIC 2, BOARD 1

⑥ SUSTAIN CONTROL VOLTAGE LEVELS

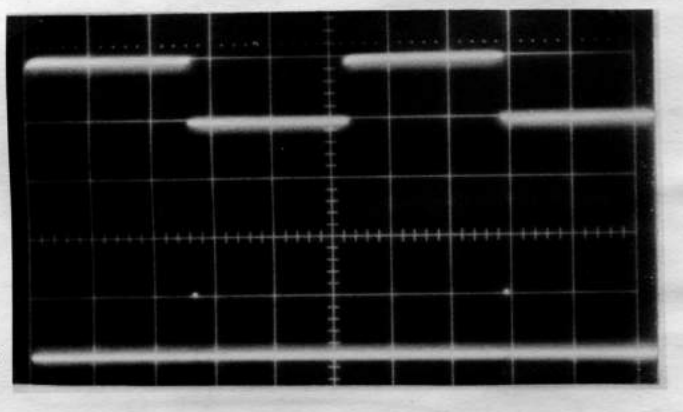
Connect DC Voltmeter to Collector Q9.

Preset or Effect	Volts DC	Key Pressed and Held
Piano Hawaiian Guitar Harpsichord	+ .88	+ .91
String Ensemble Brass Ensemble	+ .88	+ .92
Ensemble	+1.82	+2.21
Sustain	+1.82	+2.21
Vibraphone	+1.82	+2.21

⑦ PERCUSSION SUSTAIN DECAY CONTROL OSCILLATOR

IC9 Pin 2 OV –

IC9 Pin 4 OV –

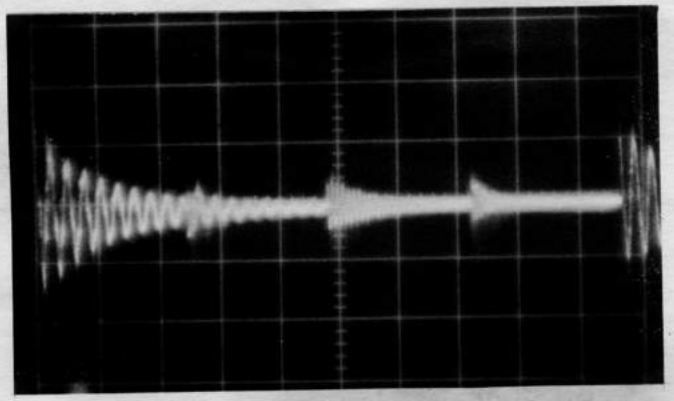


VERTICAL = 5 Volts/Div.
HORIZONTAL = .2mS/Div.
Note: Pulsewidth at IC9 Pin 4 = 7uS

SCHEMATIC 3, BOARD 3

① TYPICAL RHYTHM PULSES

CN11 Pin 2 OV –

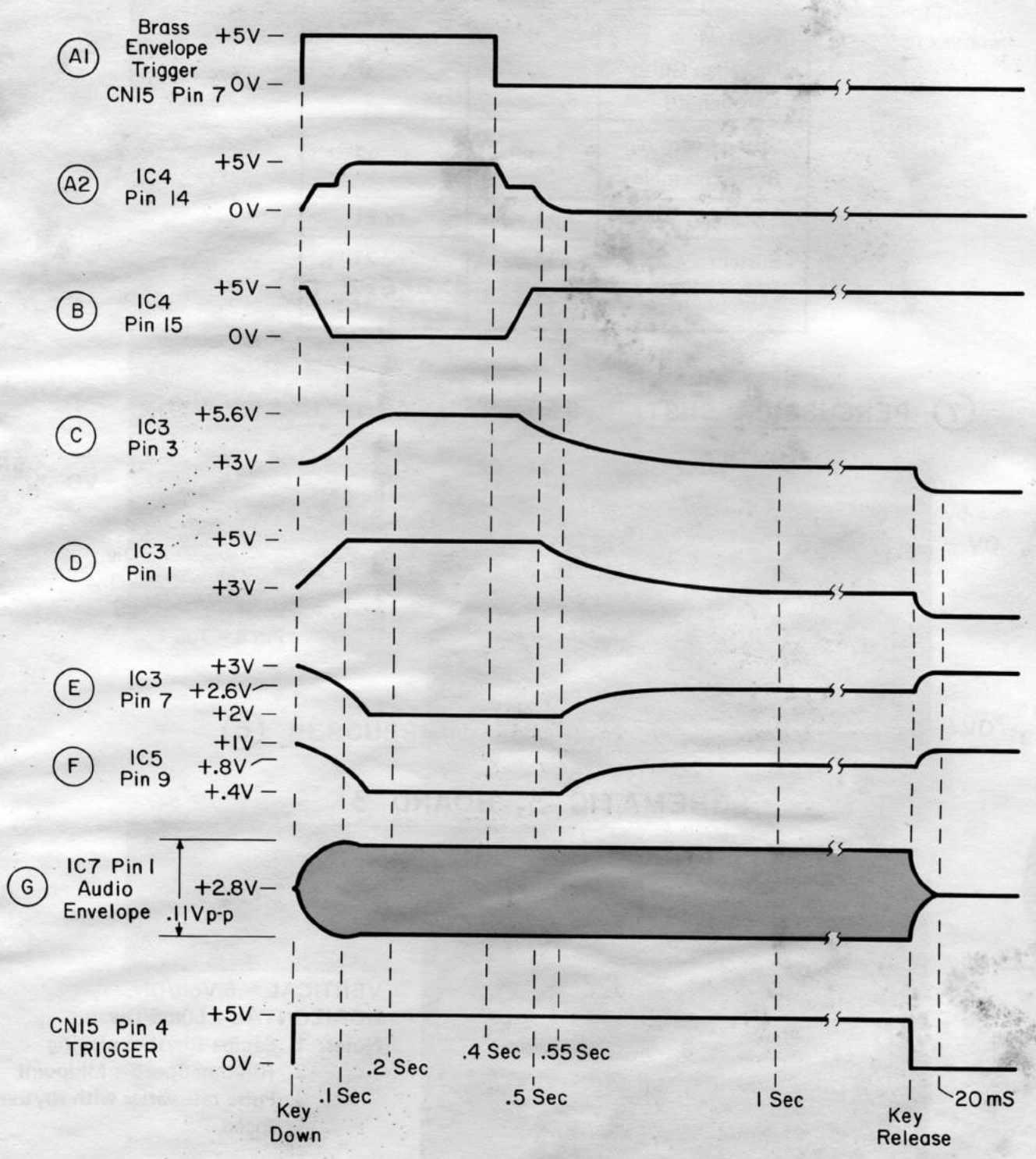


VERTICAL = .5 Volt/Div.
HORIZONTAL = 50mS/Div.
Notes: 1. Samba Rhythm playing
2. Rhythm Speed = Midpoint
3. Pulse rate varies with rhythm speed.

SCHEMATIC 4, BOARD 2

① BRASS ENVELOPE GENERATOR TIMING DIAGRAM

Connect CN15 Pin 4 to External Trigger input to oscilloscope

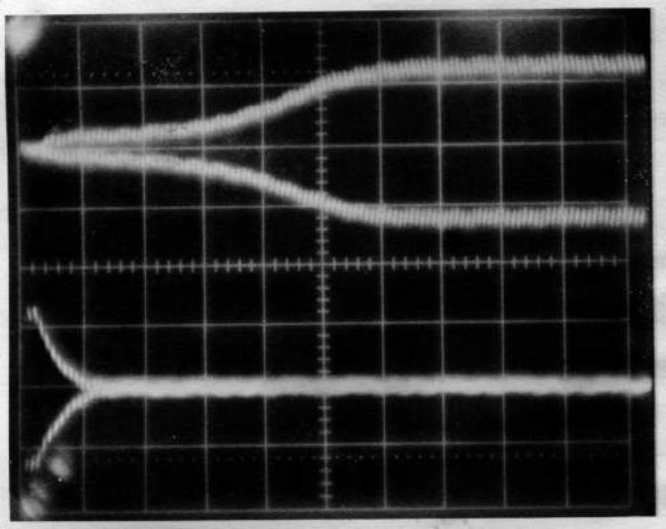


SCHEMATIC 4, BOARD 2

(2) SLOW ATTACK ENVELOPE

IC6
Pin 7
Attack OV—
(Keydown)

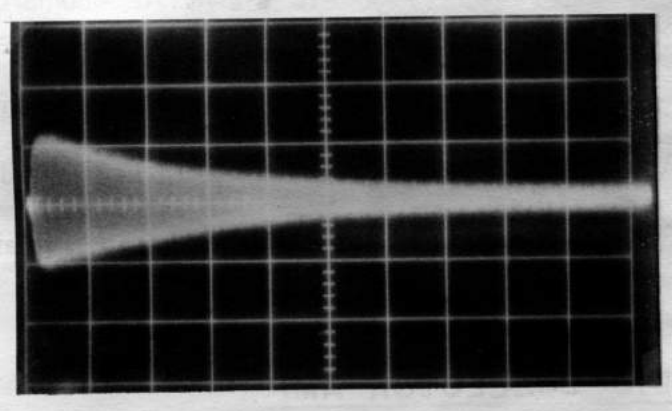
Key
release OV—



VERTICAL = .1 Volt/Div.
HORIZONTAL = 10mS/Div.
INPUT COUPLING = AC
TRIGGER = External
Connect to = CN15-4
Attack = Positive
Release = Negative
Note: Clarinet preset on

(3) PIANO ENVELOPE

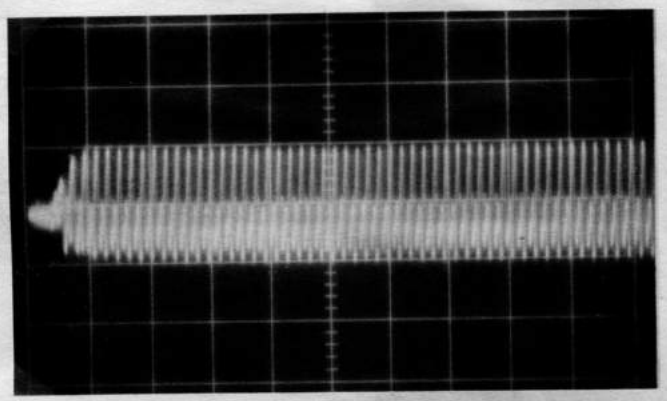
IC9
Pin 7 OV—



VERTICAL = .1 Volt/Div.
HORIZONTAL = 50mS/Div.
TRIGGER = External Positive
INPUT COUPLING = AC
Notes: 1. Connect trigger input to CN15-4
2. Piano preset on, C5 key pressed
3. Pulse present at keydown

(4A) TREMOLO MODULATOR

IC7
Pin 7 OV—



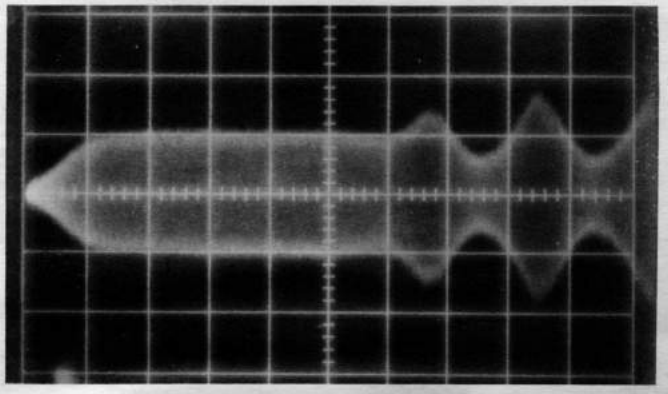
VERTICAL = .1 Volt/Div.
HORIZONTAL = 10mS/Div.
TRIGGER = External Positive
INPUT COUPLING = AC
Notes: 1. Connect external trigger input to CN15-4
2. Press C5 key
3. Jazz organ preset on

SCHEMATIC 4, BOARD 2

(4B) TREMOLO MODULATOR

IC7
Pin 7

OV–

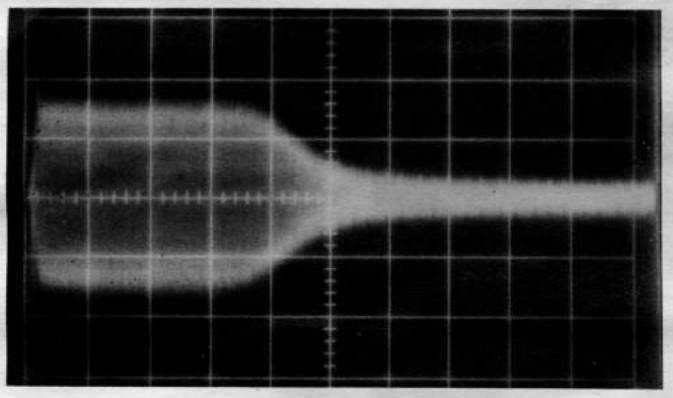


VERTICAL = .1 Volt/Div.
HORIZONTAL = .1 Sec/Div.
TRIGGER = External Positive
INPUT COUPLING = AC
Notes: 1. Connect external trigger input to CN15-4
2. Press C5 key
3. Jazz flute preset on

(5) PERCUSSION MODULATOR

IC6
Pin 1

OV–



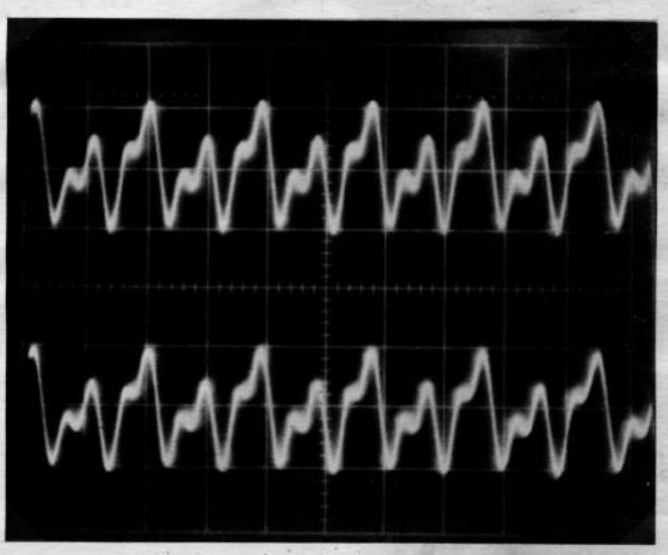
VERTICAL = 50mV/Div.
HORIZONTAL = 50mS/Div.
TRIGGER = External Positive
INPUT COUPLING = AC
Notes: 1. Connect external trigger to CN15-4
2. C5 key pressed as required
3. Jazz organ preset on
4. Pulse present at keydown

(6) AUDIO COLLECTOR AMP

.2Vpp

IC13
Pin 1

OV–



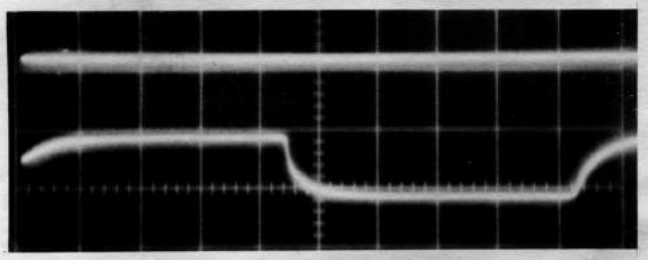
VERTICAL = .1 Volt/Div.
HORIZONTAL = 1mS/Div.
INPUT COUPLING = AC
Notes: 1. Organ preset on.
2. C5 key pressed.

SCHEMATIC 5, BOARD 2

(1A) HIGH FREQUENCY VCO OUTPUT

IC11
Pin 6 OV–

IC11
Pin 10 OV–

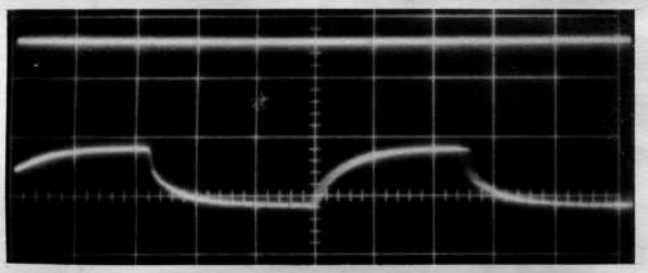


VERTICAL = 5 Volts/Div.
HORIZONTAL = 1uS/Div.
Note: VCO speed minimum.

(1B) HIGH FREQUENCY VCO OUTPUT

IC11
Pin 6 OV–

IC11
Pin 10 OV–



VERTICAL = 5 Volts/Div.
HORIZONTAL = 1uS/Div.
Note: VCO speed maximum.

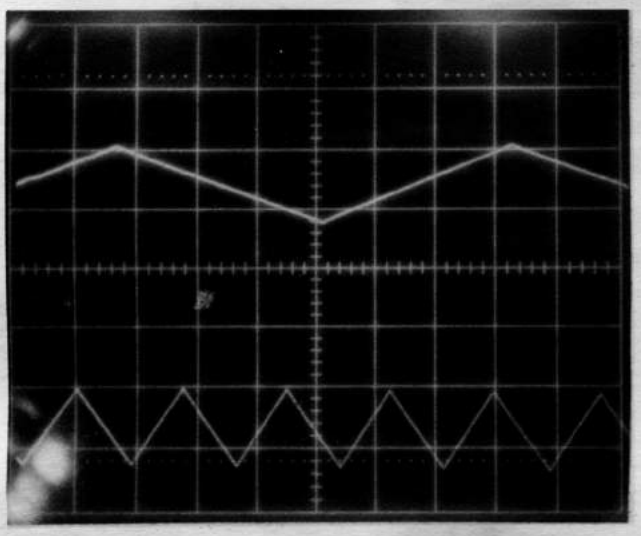
(2) LOW FREQUENCY OSCILLATOR

Stereophaze

OV–

Ensemble

OV–



VERTICAL = 2 Volts/Div.
HORIZONTAL = .5 Sec/Div.

SCHEMATIC 5, BOARD 2

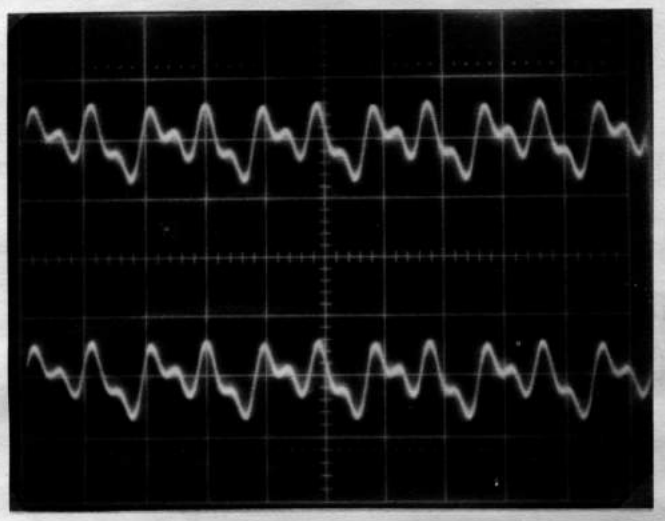
③ OUTPUT PREAMPS

Right

OV-

Left

OV-



VERTICAL = .2 Volt/Div.
HORIZONTAL = 1mS/Div.
INPUT COUPLING = AC
Notes: 1. Organ preset selected.
2. C5 key pressed.

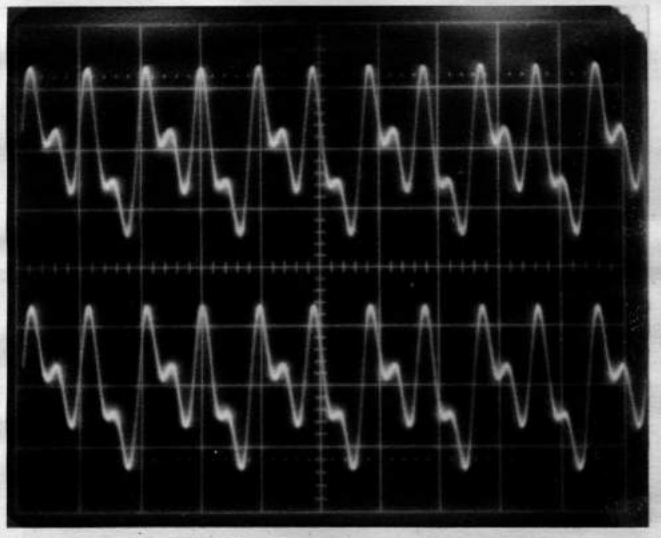
④ AMPLIFIER OUTPUT LEVELS

Right

OV—

Left

OV—



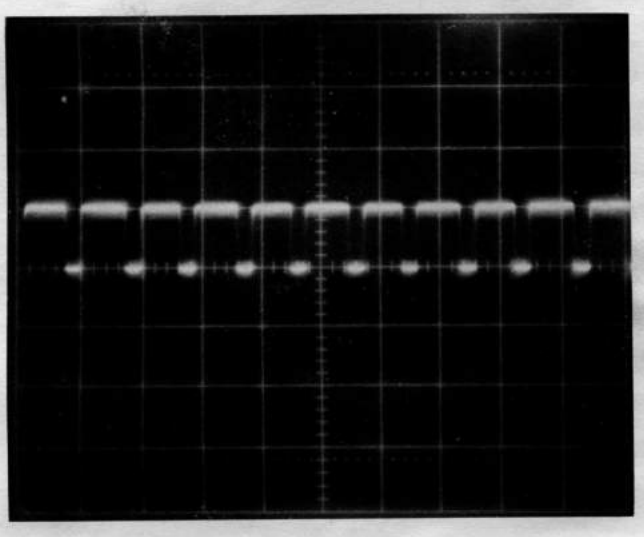
VERTICAL = .5 Volt/Div.
HORIZONTAL = 1mS/Div.
Notes: 1. Master volume control max.
2. Organ preset selected.
3. C5 key pressed.

SCHEMATIC 5, BOARD 12

(5) AUDIO DETECTOR

Collector
Q302

OV —



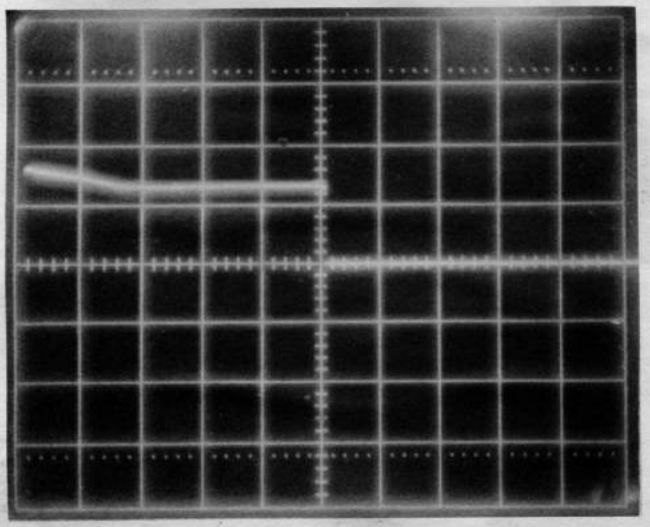
VERTICAL = 5 Volts/Div.
HORIZONTAL = 1mS/Div.
Notes: 1. Volume control max.
2. Organ preset on.
3. C5 key pressed and held.

SCHEMATIC 6, BOARD 4

(1) SWITCH DEBOUNCE DELAY PULSE

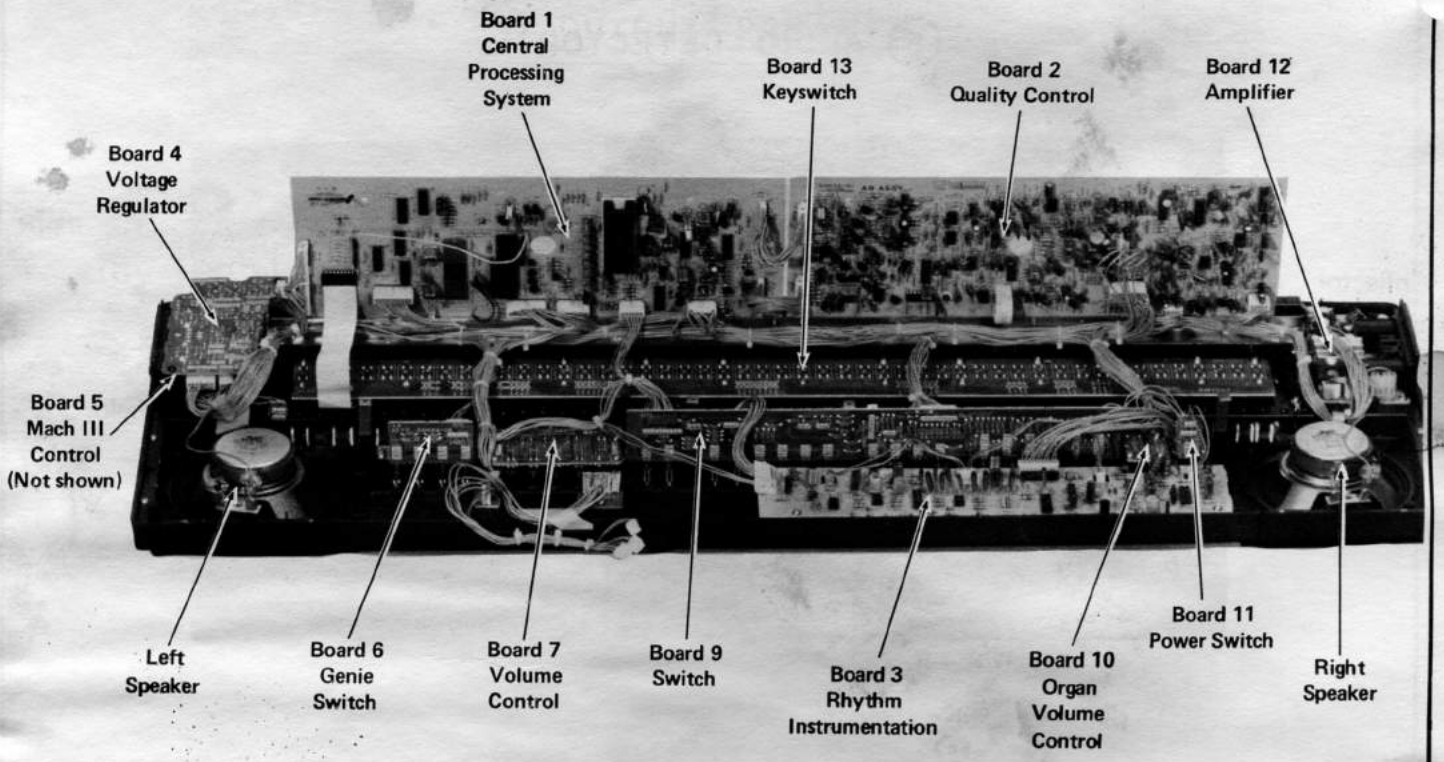
IC41
Pin 4

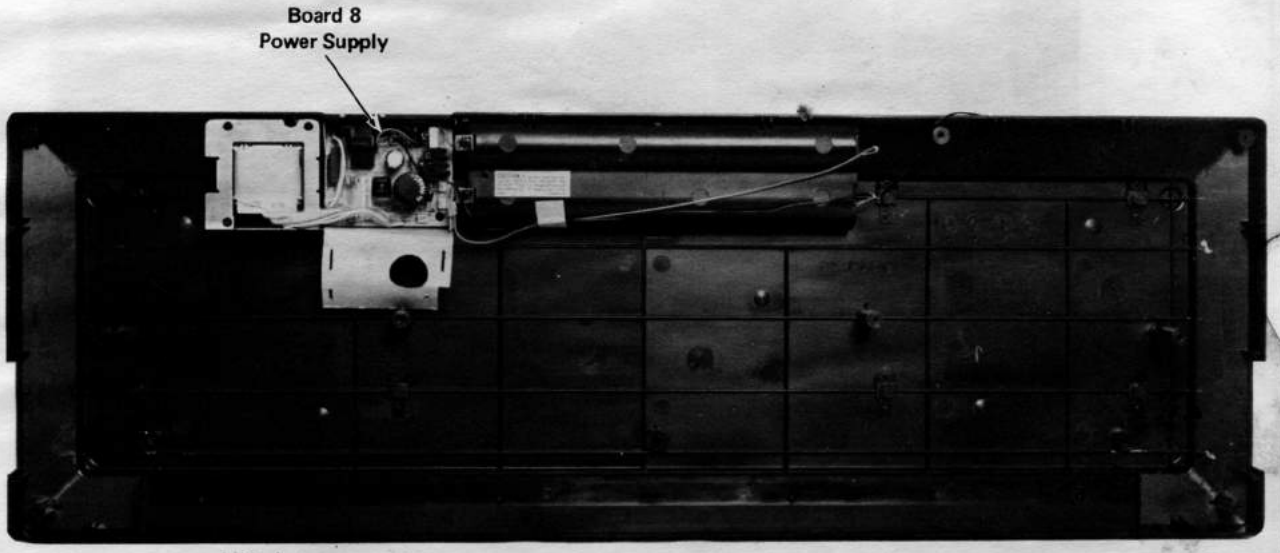
OV —

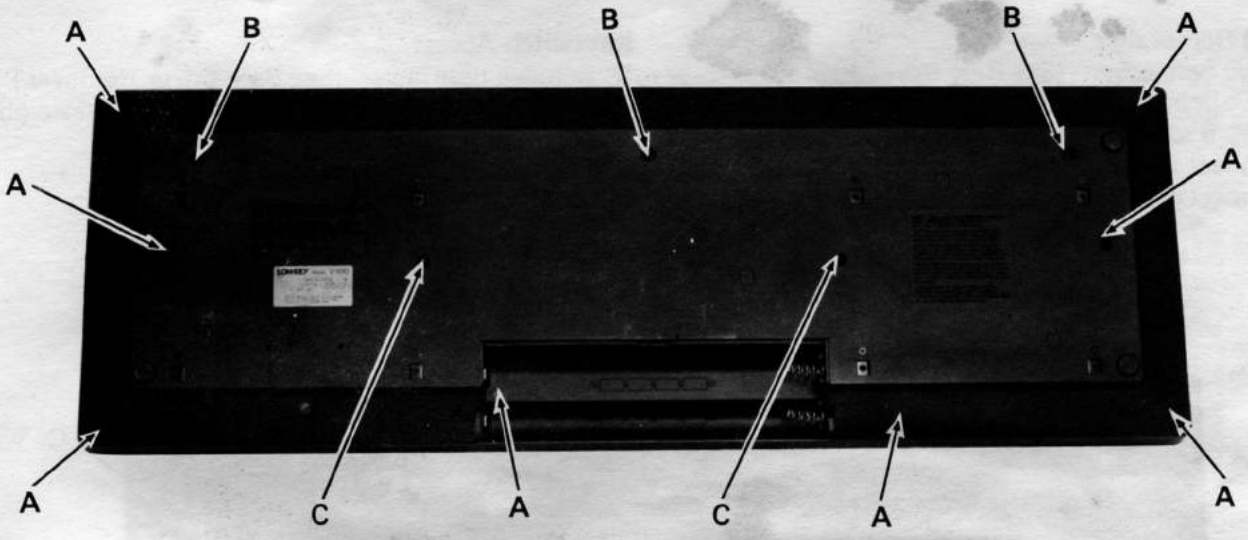


VERTICAL = 10 Volts/Div.
HORIZONTAL = .2 Sec/Div.
Note: Pulse present when on/off switch pressed and released.

BOARD LOCATION

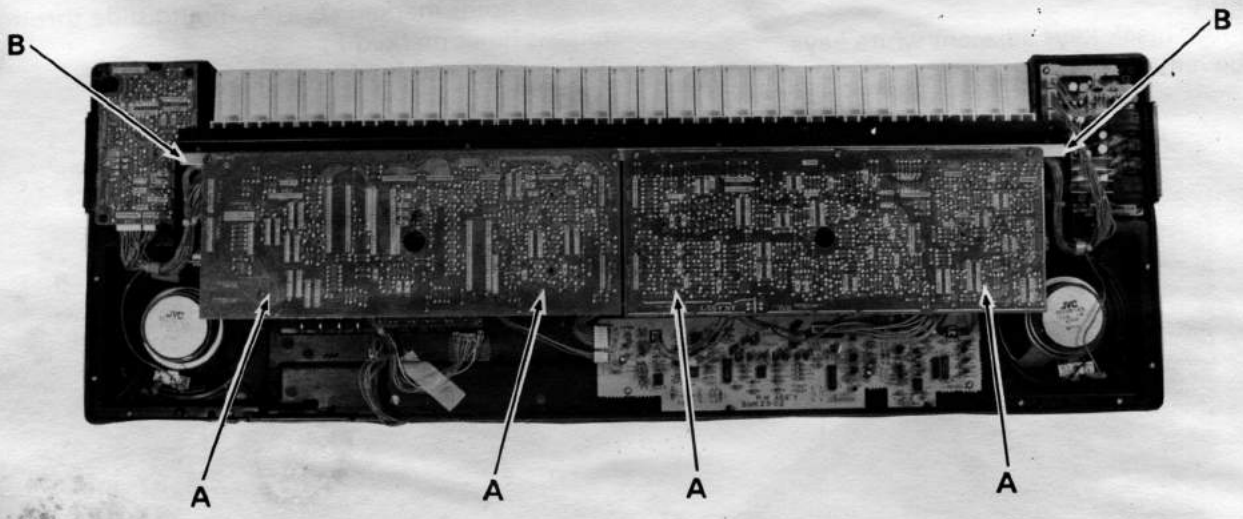






Base Cover Removal

1. Remove 8 screws (plastic tapping) marked A.
2. Remove 3 screws (steel tapping with washers) marked B.
3. Remove 2 screws (steel tapping) marked C.
4. Lift base cover from unit carefully so that power supply cables are not damaged.



Board Panel Disassembly

1. Remove base cover. (See Base Cover Removal.)
2. Remove 4 screws marked A.
3. Board panel will now raise and fold back into service position.
4. Remove 2 screws marked B at ends of board panel bracket.

Keyboard Removal

1. Remove base cover. (See Base Cover Removal.)
2. Remove board panel. (See Board Panel Disassembly.)
3. Remove 6 screws marked A.
4. Disconnect Q408 by removing screw marked B.
5. Disconnect ground wire by removing screw marked C.

Keyswitch Access

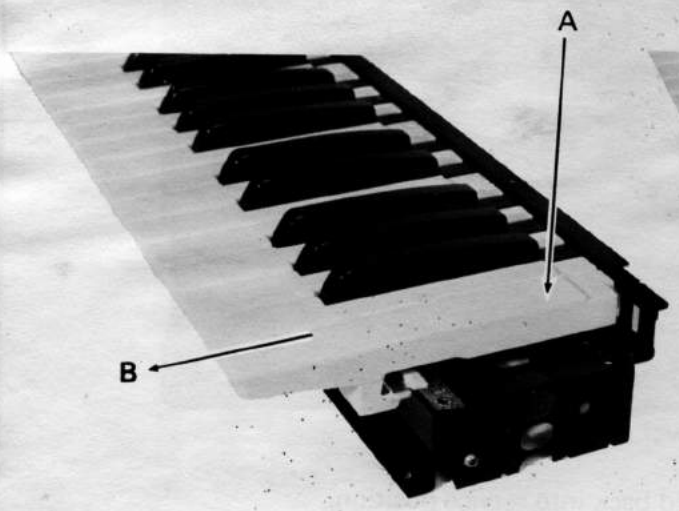
1. Remove base cover. (See Base Cover Removal.)
2. Remove board panel. (See Board Panel Disassembly.)
3. Disconnect ribbon cable.
4. Remove all 25 screws (with spacers).

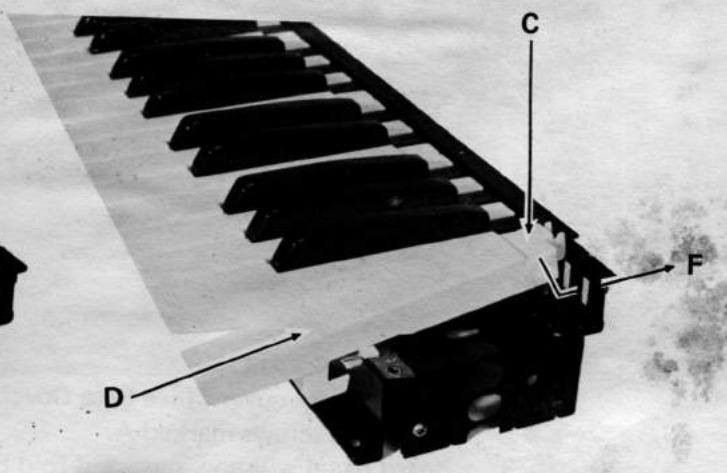
Key Removal

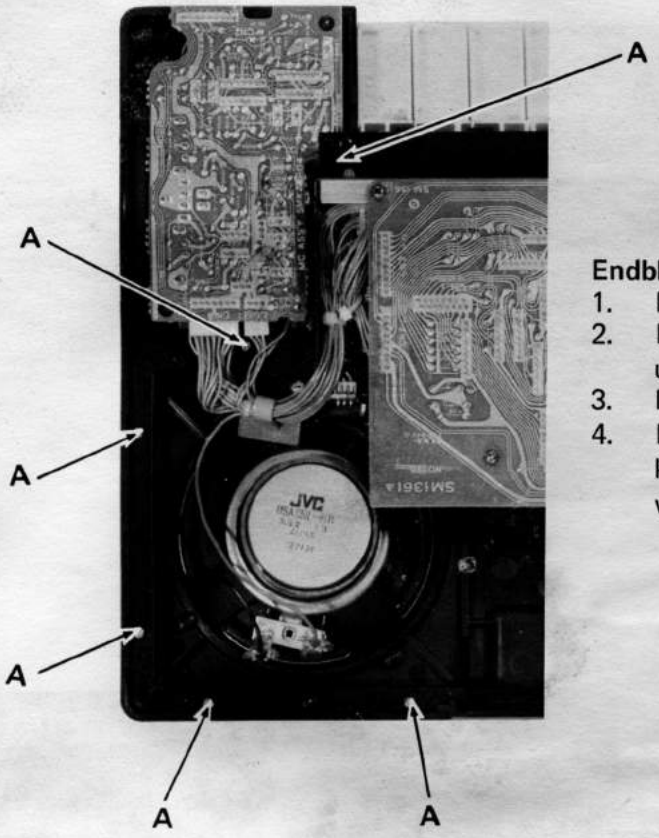
1. Remove keyboard assembly. (See Keyswitch Access.)
2. Depress key at point A and pull in direction of point B.
3. To remove black keys adjacent white keys must be removed first.

Key Installation

1. Insert key over key guide allowing the compression spring to rest on the boss.
2. Depress key at point marked C and push in direction of point marked D. Key should slide through chassis holes marked F.
3. Release key and it will snap into position.





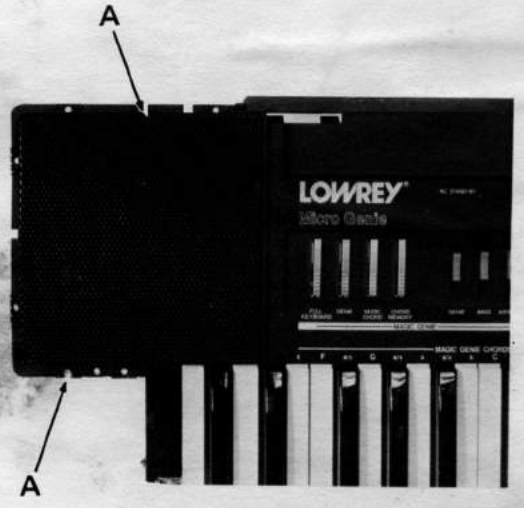


Endblock Disassembly

1. Remove base cover. (See Base Cover Removal.)
2. Remove 6 screws marked A. (Left endblock used as example.)
3. Disconnect cables.
4. Left endblock requires Q408 to be disconnected from keyboard chassis and right endblock requires ground wire to be disconnected from keyboard chassis.

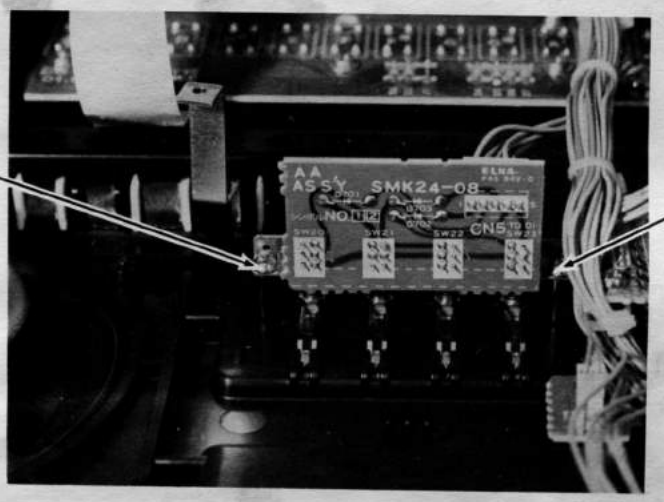
Speaker Grille Disassembly

1. Remove endblock. (See Endblock Disassembly.)
2. Remove 2 screws marked A.



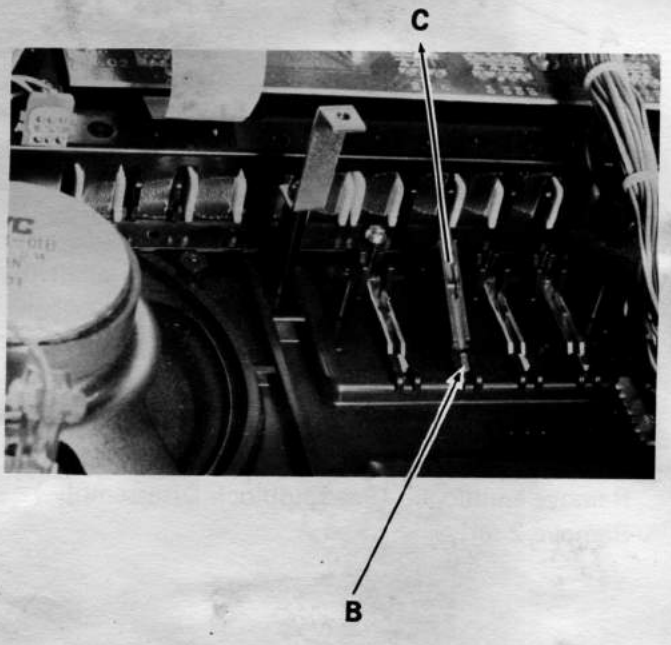
Speaker Removal

1. Remove endblock. (See Endblock Disassembly.)
2. Remove speaker grille. (See Speaker Grille Disassembly.)
3. Carefully remove grille cloth.
4. Remove 4 screws marked A.



Pushswitch Knob Replacement

1. Remove base cover. (See Base Cover Removal.)
2. Place board panel into service position. (See Board Panel Disassembly.)
3. Remove 2 screws marked A. (Board 6 used as example.)
4. Slide switch assembly toward keys and at same time lift upward.
5. Lift knob at point marked B and slide in direction of point marked C.



Potentiometer Knob Replacement

1. Place cloth on panel as illustrated.
2. Insert screwdriver in groove and remove knob by lifting up.

PARTS ORDERING PROCEDURE

Call: (800) 323-3532. In Illinois dial 312-759-5104. The toll-free number is available 24 hours a day, 7 days a week. During working hours, it is answered by Parts Department personnel.

or

Write: LOWREY SERVICE PARTS DEPARTMENT
1300 Naperville Drive
Romeoville, IL 60441

In Canada Call: (416) 752-5020

or

Write: LOWREY ORGAN COMPANY
A Division of Norlin Industries Ltd.
7 Credit Union Drive
Toronto, Ontario, Canada M4A 2S6

Be sure to include the following information:

1. Your name and address
2. Your account number
3. Shipping preference
4. Complete Part Number
5. A brief description of the part

If you wish to have the parts billed to one address and shipped to another, it is necessary to have the full name, address and account number of the store being billed.

If unknown and not in the service manual, provide a complete description of the part.

AVOID DELAYS BY USING COMPLETE PART NUMBERS

THE PARTS LIST CONTAINS THE FOLLOWING INFORMATION:

1. Name of Part
2. Value, Tolerance and Code (When Important)
3. Brief description
4. Where the part is found (assembly, printed circuit board, etc.)
5. Schematic Reference Number
6. PART NUMBER — USE IT!

This parts list includes all standard stock replacement parts. No attempt has been made to include every nut, bolt and screw. If the necessity for a non-listed part arises, please write describing the parts location and function as well as model and serial number of the unit.

BOARD 1
Central Processing System

Coil		
L1	Tuning	452-034842-000
Crystal		
X1	11MHz	421-034845-000
Diodes		
All		419-034823-000
Integrated Circuits		
IC1	MSM80C49RS	491-034814-000
IC2	MSM81C55RS	491-034815-000
IC3	VC4050BH	491-034813-000
IC4	TC4028BP	491-034807-000
IC5	TC4050BP	491-034809-000
IC6-10	TC4049BP	491-034808-000
IC15	TC4066BP	491-034810-000
Networks		
RA1	10Kx8	449-034830-000
RA2	100Kx12	449-034827-000
RA3	10Kx8	449-034830-000
Potentiometer		
R87	1M	425-034835-004
Transistors		
Q1-11		491-034819-000
Q12		491-034817-000
Q13-16		491-034819-000

BOARD 2
Quality Control

Diodes		
All		419-034823-000
Integrated Circuits		
IC1-3	NJM4558DD	491-034803-000
IC4	TC4049BP	491-034808-000
IC5	LM8942	491-034802-000
IC6, 7	NJM4558DD	491-034803-000
IC8	TC4066BP	491-034810-000
IC9	NJM4558DD	491-034803-000
IC10	TC4066BP	491-034810-000
IC11	TC4049BP	491-034808-000
IC12	TC4069UBP	491-034811-000
IC13, 14	NJM4558DD	491-034803-000
IC15	MN3204	491-034804-000

BOARD 2 (Continued)

Potentiometers		
R57	10K	425-034835-000
R62	5K	425-034835-002
R154, 179	10K	425-034835-000
R209	200K	425-034835-001
Transistors		
Q1		491-034817-000
Q2		491-034819-000
Q3		491-034817-000
Q4		491-034819-000
Q5		491-034817-000
Q6-13		491-034819-000
Q14		491-034816-000
Q16, 17, 19-27		491-034819-000
Q28	FET	491-034821-000

BOARD 3
Rhythm Instrumentation

Diodes		
All		419-034823-000
Integrated Circuits		
IC31-34	NJM4558BDD	491-034803-000
IC35	TC4011BP	491-034805-000
IC36	TC4066BP	491-034810-000
IC37	D4584BC	491-034812-000
Networks		
RA31	10Kx9	449-034832-000
RA32	100Kx6	449-034829-000
Resistors		
R1,R2	Fused	424-034846-000
Transistors		
Q301		491-034819-000
Q302, 303		491-034817-000
Q304		491-034819-000

BOARD 4
Voltage Regulator

Diodes		
D401		419-034823-000

BOARD 4 (Continued)

Diodes

D404	Zener 8.2V ½W. .	419-034826-002
D405	Zener 3.3V ½W. .	419-034826-000
D406	Zener 5.6V ½W. .	419-034826-001
D407	Zener 16V ½W . .	419-034826-003

Integrated Circuits

IC41	TC4011BP	491-034805-000
IC42	TC4013BP	491-034806-000
IC43	NJM4558DD ...	491-034803-000

Jack	Microphone	410-034867-000

Potentiometers

VR7, 8	10K	425-034834-000

Transistors

Q402	.....	491-034819-000
Q403	.....	492-034818-000
Q404	.....	491-034817-000
Q405-407 409-411	.....	491-034819-000

BOARD 5
Mach III Control

Diodes

LED	Red	419-034822-001
All others	.....	419-034823-000

Network

RA51	10Kx4	449-034828-000

Switches

SW24-26	.....	460-034841-000

Transistors

Q501-504	.....	491-034819-000

BOARD 6
Genie Switch

Diodes

All	.....	419-034823-000

Switch

Genie Switch Assembly	SW20-23	460-034838-000

BOARD 7
Volume Control

Potentiometers

VR2	200K	425-034833-001
VR3-6	10K	425-034833-000

BOARD 8
Power Supply

Diodes

D601	.....	419-034825-000
D602	.....	419-034823-000
D603	.....	419-034824-000

Fuse	300mA Slo-Blo. .	439-034843-000

Jacks

AC	.....	410-034863-000
DC	.....	410-034864-000

Resistors

R601	1 ohm 5W.....	424-034847-000
R603	Fused	424-034846-000

Transistor

Q601	.....	492-034818-000

BOARD 9
Switch

Diodes

All	.....	419-034823-000

Switch Assemblies

Effect and Preset	S1-S10	460-034836-000
Rhythm	S11-S18	460-034837-000

Transistors

Q201-203	.....	491-034819-000
Q204	.....	491-034817-000

BOARD 10
Organ Volume Control

Potentiometer

VR1	10K	425-034833-000

BOARD 11
Power Switch

Switch	Power	460-034839-000

BOARD 12
Amplifier

Diodes		
All		419-034823-000
Integrated Circuits		
IC31	AN5733	491-034800-000
IC32	LA4125T	491-034801-000
Jacks		
Aux. Out		410-034869-000
Expression		410-034868-000
Headphone		410-034867-000
Resistor		
R16	Fused	424-034846-000
Transistors		
Q301,302		491-034819-000
Q303		491-034817-000

BOARD 13
Keyswitch

Diodes		
All		419-034823-000
Switch		
Keyswitch		460-034840-000

CONSOLE ASSEMBLY

Base Cover		466-034874-000
Battery Cover		464-034850-000
Battery Holder	Cylinder	464-034856-000
Contact	Compression	475-034849-000
Cord	Power	489-034865-000
Diodes	LED	
	Green	419-034822-000
	Red	419-034822-001
Endblocks	Left-Hand	466-034860-001
	Right-Hand	466-034860-000
Foot	Felt	414-034848-000
Grille	Speaker	
	Left-Hand	466-034858-001
	Right-Hand	466-034858-000
Grille Cloth		478-034859-000

CONSOLE ASSEMBLY (Continued)

Jack Plates	Left-Hand	464-034853-000
	Right-Hand	464-034852-000
	Rear	464-034861-000
Knobs		
Mach III	Silver	415-034855-000
Potentiometers		
	Blue	415-034862-002
	Red	415-034862-001
	Silver	415-034862-000
Push-	Blue	415-034854-002
switch	Red	415-034854-000
	Silver	415-034854-001
Lens Bezel	Mach III	464-034851-000
Rack	Music	478-034857-000
Speaker	4-inch 3.5 ohm	485-034844-000
Transformer	Power	454-034866-000

KEYBOARD ASSEMBLY

Guides		
Key	12-position	471-034872-000
Key	13-position	471-034872-001
Keys	Black	464-034871-000
	White A	464-034870-001
	White B	464-034870-002
	White C	464-034870-003
	White D	464-034870-004
	White E	464-034870-002
	White F	464-034870-003
	White G	464-034870-005
	White High C	464-034870-006
Spring	Compression	475-034873-000
Transistor		
Q408		492-034820-000

ACCESSORIES

EXPRESSION PEDAL

Control Arm		471-034878-000
Cord Assembly		489-034880-000
Foot		464-034876-000
Potentiometer	50K	425-034875-000

KEYBOARD STAND

Cap		464-034879-000
Foot		464-034877-000

V100

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