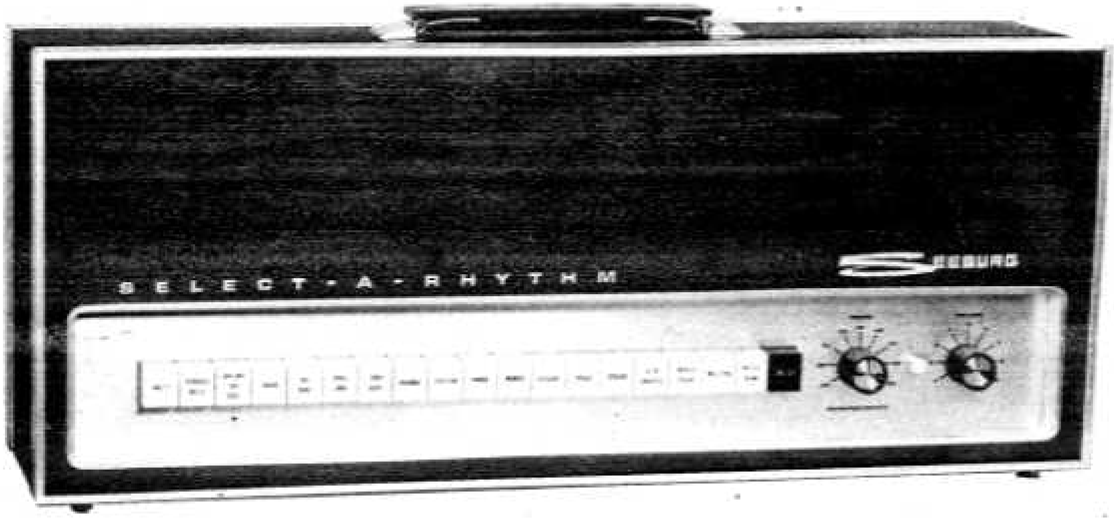
SEEBURG

PORTABLE SELECT-A-RHYTHM



Service Manual

MANUAL NO. 55594

THE SEEBURG SALES CORPORATION
CHICAGO, ILLINOIS, 60622 U.S.A.

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1 PORTABLE SELECT-A-RHYTHM

1.1 General Description

The Seeburg Select-A-Rhythm is an all electronic rhythm device which creates 18 authentic rhythms containing electronically generated sounds of 10 percussion instruments.

All the controls of the Select-A-Rhythm are located on the Control Panel, with the exception of the Foot Pedal. These controls are:

1. Selector Switch
2. Tempo Control
3. Volume Control

The Selector Switch is a 19 position pushbutton switch; 18 of these switches are rhythm selectors and one is an On/Off switch. When a rhythm selector button is depressed, the Select-A-Rhythm plays the rhythm chosen. This switch also allows the musician to depress two or more buttons simultaneously, resulting in the creation of some truly unique rhythms. The On/Off switch is located on the left-hand side of the switch bank. When the switch is depressed, the Select-A-Rhythm is turned On.

The Tempo control allows the musician to control the tempo of the selected rhythm. The range of the Tempo control is such that the Metronome speed is variable from 40 to 120 beats per minute.

The Volume control allows the operator to set the desired volume level of the Select-A-Rhythm output.

In addition to the above controls, there is a Downbeat Indicator Lamp which flashes on the first beat of each measure of the rhythm selected.

The Foot Pedal allows the operator to reset the Select-A-Rhythm so when the pedal is operated, the Select-A-Rhythm will start on a downbeat.

1.2 Specifications

Pedal Switch
Assembly No. 664061

Commutator & Logic
Assembly No. 664025

19 Button Switch Wired
Assembly No. 664015

19 Harness
Assembly No. 655220

Preamplifier
Assembly No. 664014

Tempo - 500K
Assembly No. 651072

Volume - 25K
Assembly No. 651012

Indicator Lamp (Downbeat)
Assembly No. 655219

POWER SUPPLY

Transformer
Assembly No. 663281

2 - Rectifier
Assembly No. 654036

2 - 250 mf Capacitor
Assembly No. 653010

1 - 600 mf Capacitor
Assembly No. 653001

200 2w Resistor
Assembly No. 651017

100 2w Resistor
Assembly No. 651003

Depth	5-1/4 inches
Height	10-1/8 inches
Width	23-1/4 inches
Net Weight	17-3/4 lbs.
Shipping Weight	21-3/4 lbs.

Finish
Brown Vinyl
Walnut Vinyl

SELECT-A-RHYTHM
Block Diagram

Select-A-Rhythm - Basic Block Diagram

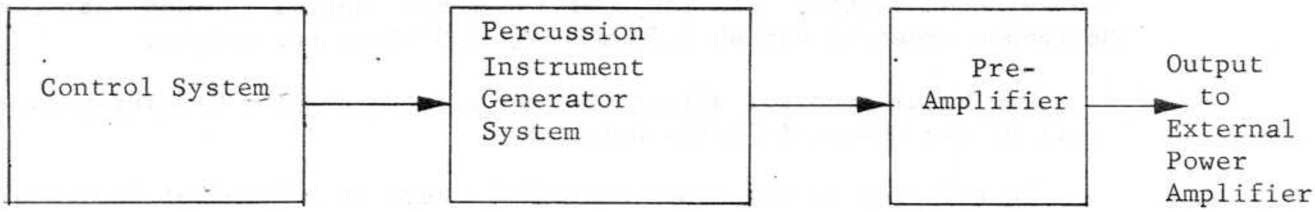


Figure 1

The Select-A-Rhythm consists of three major sections and a power supply. The first major section is the Control Section, which consists of the Rhythm Generator and Selection system. The second major section is the Percussion Instrument Generator and the third major section is the Audio Preamplifier, refer to Figure 1.

The Control Section comprises those parts of the Select-A-Rhythm which generate and control the rhythm pulses. The rhythm pulses activate the Percussion Instrument Generator. The Percussion Instrument Generator system comprises those parts of the Select-A-Rhythm which generate the instrument sounds heard in the outputs of the Select-A-Rhythm. The Instrument Generator sounds are amplified by the Preamplifier and the output is connected to a conventional phono plug for power amplification by an External Amplifier.

Select-A-Rhythm - Detailed Block Diagram

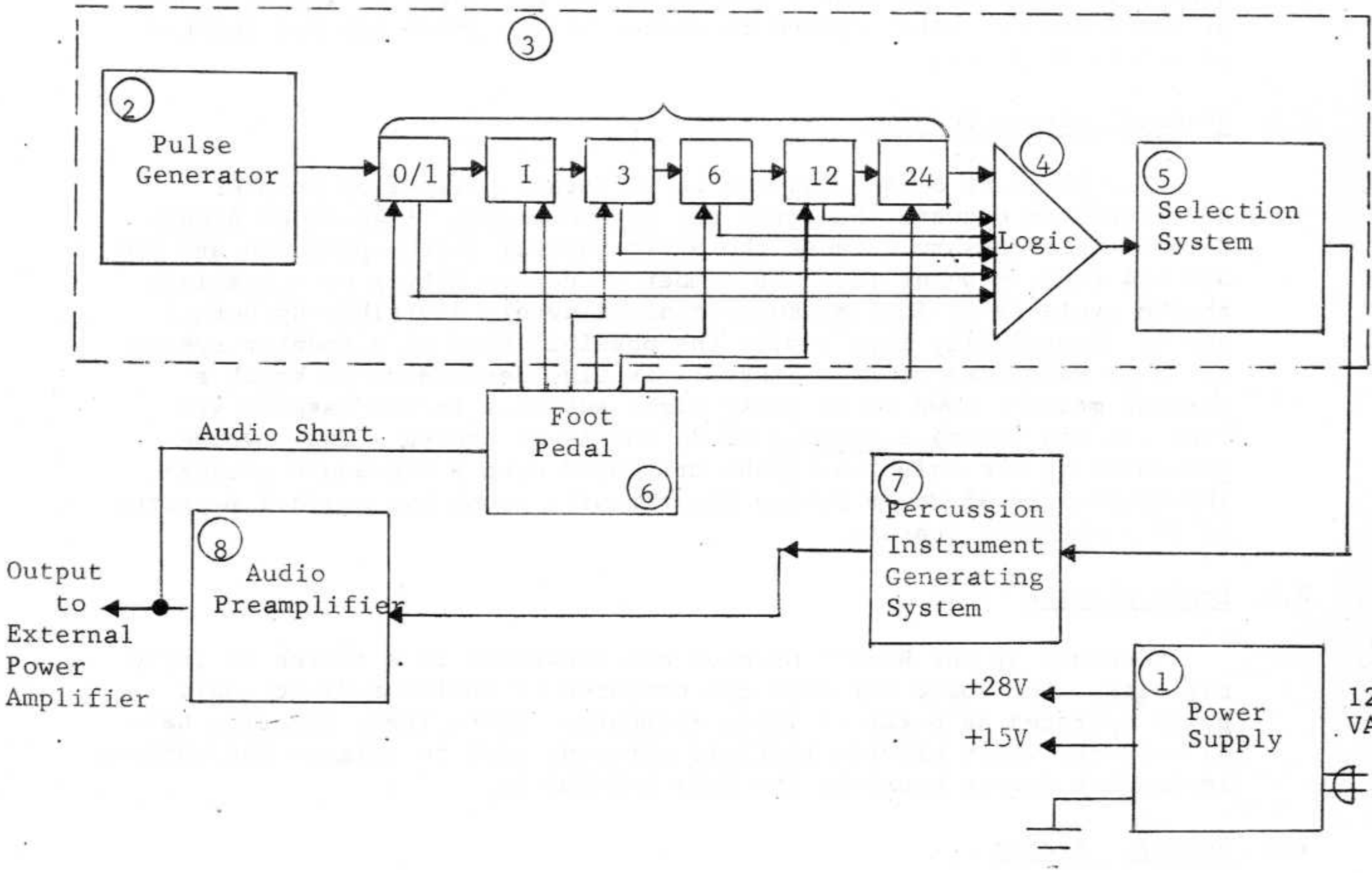


Figure 2

As seen in the detailed block diagram, Figure 2, there are eight sub-sections to the Select-A-Rhythm. These are:

1. Power Supply
2. Pulse Generator
3. 48 - Count Binary Counter
4. Logic Circuits
5. Selection System
6. Reset Control Pedal
7. Percussion Instrument Generator
8. Audio Preamplifier

2 SELECT-A-RHYTHM - BLOCK DIAGRAM EXPLANATION

2.1 Power Supply

The Power Supply furnishes +15 volts and +28 volts to all of the sub-sections of the Select-A-Rhythm that require these potentials.

2.2 Pulse Generator

The Pulse Generator System consists of a unijunction relaxation oscillator which generates a series of timing pulses. The pulse repetition frequency of the unijunction relaxation oscillator controls the tempo of the Select-A-Rhythm. The actual pulse repetition frequency is variable between 8 and 48 pulses per second. The frequency of the Pulse Generator System is varied by the Tempo control located on the fromt panel.

2.3 48-Count Binary Counter

The 48-Count Binary Counter is a 6-stage, flip-flop counter with feedback between the first and second stage. A 48-Count Binary Counter is necessary because the basic musical rhythm patterns are 3/4 and 4/4 time, meaning that the number of pulses making up a complete rhythm cycle (a musical measure) must be evenly divisible by both 3 and 4. Numerically this limits the possibilities of a counter system to 12 or multiples of 12. Since it is also desireable to break a musical measure down to at least eight subunits in the case of 4/4 time (to 8th notes) a minimum of 24 counts is needed. The rhythms generated by the Select-A-Rhythm are based upon a 2-measure pattern. Therefore, the 48-Count Binary Counter will count two musical measures of 24 counts per measure.

2.4 Logic Circuit

Outputs of the Binary Counter are connected to a series of logic circuits. The logic circuits are composed of resistor-diode logic gates operated as negative logic elements. These logic circuits have 41 outputs, which provide rhythmic patterns used to trigger the various instrument sounds heard in the Select-A-Rhythm.

2.5 Selector System

The Selector System consists of the Selector Switch located on the Control Panel and its associated electronics. The inputs to the Selector Switch are the 41 logic outputs. The Selector Switch controls the logic circuit outputs and feeds them to the voicing system to obtain the rhythmic pattern or patterns which are selected by the Selector Buttons.

2.6 Foot Pedal

The Foot Pedal is a push On - push Off switch which allows the operator to start the SAR1 on the downbeat of the selected rhythm. When the switch is Off, the audio output of the Select-A-Rhythm is disabled, preventing spurious output when the instrument is not operating.

2.7 Percussion Instrument Generator

The Percussion Instrument Generator consists of both passive elements (resistors, capacitors and inductors) and active elements (transistors and diodes) which create the 10 instrument sounds heard in the Select-A-Rhythm. These sounds are:

1. Sand Block
2. Brush
3. Snare Drum
4. Tambourine
5. Clave
6. Cow Bell
7. High Conga Drum
8. Low Conga Drum
9. Bass Drum
10. Cymbal

The inputs to the Percussion Instrument Generator are the switched logic pulses from the Selector System. The outputs of the Percussion Instrument Generator are fed through the Select-A-Rhythm volume control to the preamplifier where the sounds are amplified.

2.8 Audio Preamplifier

The preamplifier amplifies the Percussion Instrument sounds for use with an External Power Amplifier.

3 LOGIC CIRCUITS THEORY OF OPERATION

There are three main sections and one subsection in the Commutator and Logic assembly. The main sections are: 1) the Pulse Generator, 2) the Binary Counter and Logic circuits, and 3) the Main Logic circuitry. The subsection is the Downbeat Indicator Lamp.

Since the operation of the Select-A-Rhythm depends upon the operation of logic circuits, it is necessary for the technician to have a general understanding of these circuits in order to understand the Select-A-Rhythm. After a generalized discussion of basic logic circuits, a detailed description of the Commutator and Logic assembly is included.

3.1 Basic Logic

In basic logic circuits, there are two operations to be considered. These are the operations AND and OR. Either of these operations may be performed as positive or negative logic, which indicates a desired output polarity in respect to the logic reference potential. There will always be one of two possible inputs to the logic input, either positive or negative. This designation holds true even if both possible inputs are more positive than ground. For the time being only negative logic shall be considered. A negative logic OR gate has a negative output when any of its inputs are negative. The symbol for an OR gate is shown in Figure 3A.

LOGIC: A+B

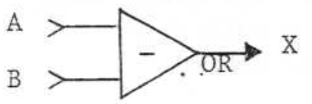


Figure 3A

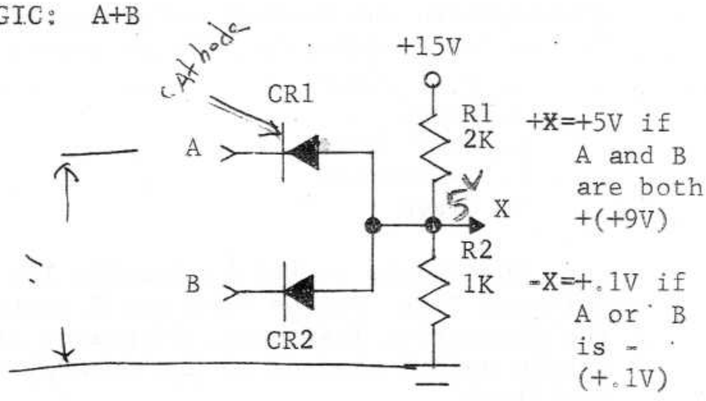


Figure 3B

As seen in the figure, there are two inputs to this circuit, A and B. There is an output from the OR gate if either input A or B (or both) is negative. The inputs to this gate are +9V (positive signal) or +.1V (Negative signal). The OR gate si shown schematically in Figure 3B. The gate consists of two diodes, CR1 and CR2, and a voltage divider network, R1 and R2. The voltage divider furnishes the gate reference potential, which is +5 volts in the example shown. It can be seen that if either A or B is negative (i.e., +.1V) Diode CR1 or CR2 will conduct, causing the output (X) to go to the negative input level (+.1 volt). The output (X), which is taken across resistor R2, is then considered to be negative. The only time that there will NOT be a negativeoutput (+.1 volt) appearing across R2 is when both inputs are positive (+9 volts). An OR gate is represented by the symbol +; therefore, the logic in Figure 3 can be written A+B, which is read A or B.

A negative AND gate is shown symbolically in Figure 4A. As before the inputs to the gate are A and B.

Figure 4A

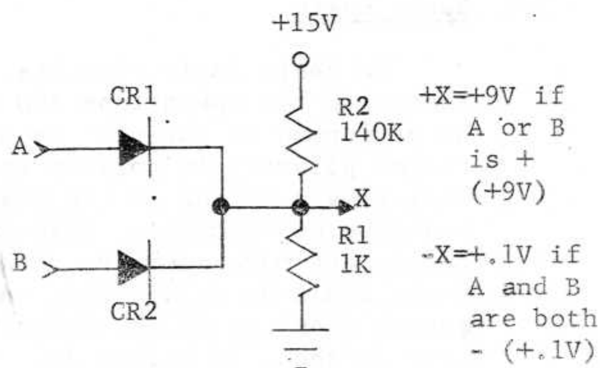


Figure 4B

The operation of a negative AND gate is such that there is a negative output from the gate only when BOTH inputs are negative. The inputs are +9 volts (Positive) or +.1 volt (Negative) to represent negative inputs. The circuit for an AND gate is shown schematically in Figure 4B. The outputs are developed across resistor R1.

If either of the inputs A or B is positive (+9 volts), the associated diode CR1 or CR2 will conduct and the output (across R1) will be positive. However, if both inputs A and B are negative (+.1 volt) there can be no current flow through the diodes and the output will go to +.1 volt, the negative reference point in this example. Normally there is no symbol shown in writing the output of an AND logic operation. The inputs are simply written next to each other. Therefore, the AND logic shown in Figure 4 will be written AB, which is read A and B.

There are many instances in the Select-A-Rhythm where it is desired to have a logic output only when a particular signal is changing state (i.e. going from positive to negative or vice versa). Symbolically, this situation is shown in Figure 5B.

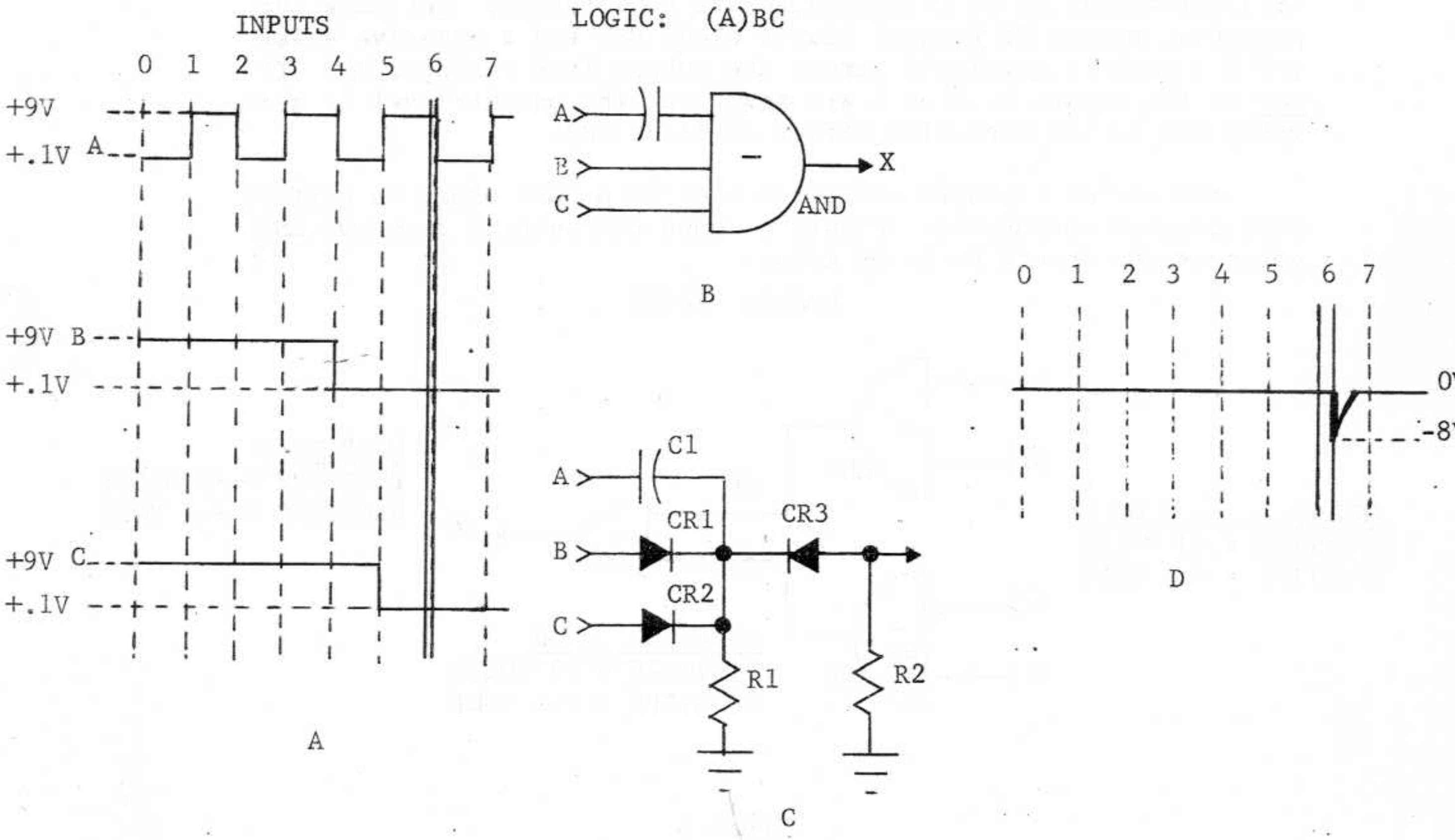


Figure 5

Figure 5B shows a negative AND gate with inputs A, B and C. Input A changes state at every time interval. B is positive until time 4 and negative thereafter. Input C is positive from time zero, until time 5 and negative thereafter. Normally there would be an output from the AND gate between times 6 and 7, see Figure 5D, since all inputs are negative in that time. However, capacitor C1 in the A input circuit acts as a differentiating circuit and prevents any output from the AND gate unless inputs B and C are both negative and input A is negative going. This only occurs at time 6, which is the only time input A changes from a positive to a negative state, while both B and C are negative. When a differentiation operation is shown, as in this example, the differentiated input is enclosed in brackets (). In the example shown in Figure 5B, the logic operation is written (A)BC. Differentiation circuitry is shown schematically in Figure 5C. Input levels at points A, B and C are +9 volts (positive input) or +.1 volt (negative input). The negative inputs at points B and C (+.1 volt) are not of sufficient positive amplitude to forward bias their associated diodes CR1 or CR2. The only time there will be an output (X) is when both diodes CR1 and CR2 are not conducting (Both inputs negative) and point A is going from positive (+9 volts) to negative (+.1 volt). This negative going signal has its D.C. component removed by capacitor C1 and causes a -8.9 volt pulse to be developed across resistor R1. The negative potential across R1 forward biases diode CR3 and a negative pulse (-8.9 volts) is developed across the output load resistor R2. If any of the inputs A, B or C are positive, the output level is zero volts due to the isolation effect of diode CR3.

AND and OR circuits are often used with each other to perform more complex operations. Figure 6 shows the outputs from two AND gates as the inputs to an OR gate.

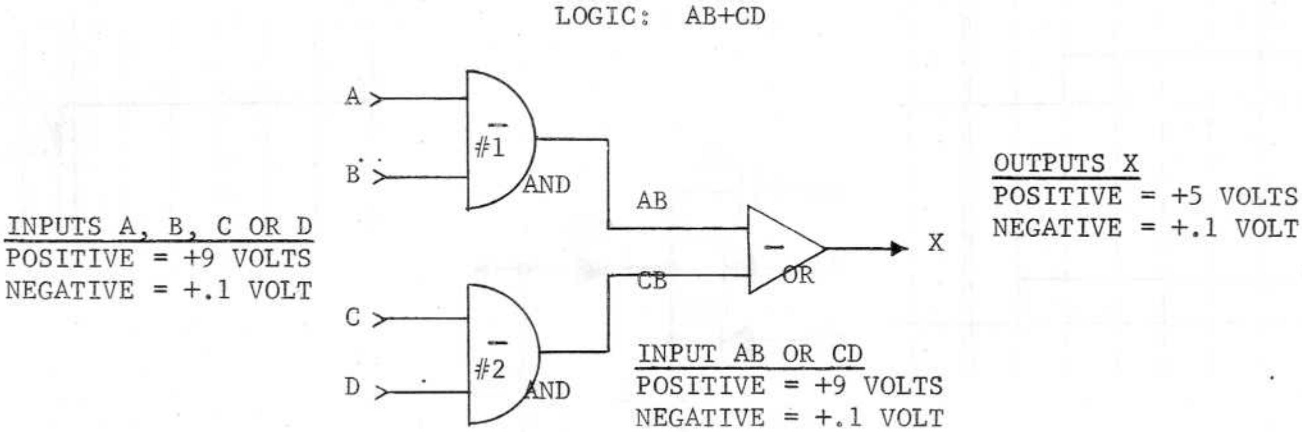


Figure 6

In this configuration, if inputs A and B are both negative (+.1 volt), there will be a negative output from AND gate #1 (+.1 volt). If input C and D are both negative (+.1 volt), there will be a negative output from AND gate #2 (+.1 volt). Since the two AND gates act as inputs to the OR gate, there is a negative output from the OR gate when either of the AND gates has a negative output. There will be a negative output signal (+.1 volt) from the circuit whenever A and B or C and D are negative (or all four negative). Symbolically this is represented as AB+CD. This is read A and B, or C and D.

LOGIC: NEGATIVE TRANSMISSION GATE: -T

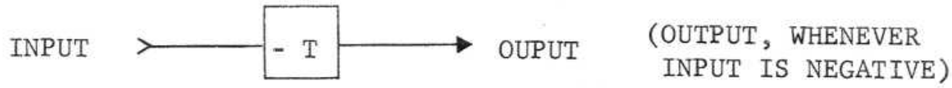


Figure 7

To maintain consistency in the logic diagrams, a third symbol is used, which is shown in Figure 7. This is the symbol used for a negative transmission gate. This consists of a single diode connected so that with a negative polarity input signal, there is an output. This circuit is usually used to isolate the output from the succeeding circuitry.

Only negative logic has been disucssed. Positive logic is identical in all respects except that all polarities, including diodes, are reversed. The majority of the circuits in the Seeburg Select-A-Rhythm use negative logic gates.

3.2 Power Supply

The power supply, shown in Figure 8, supplies the +15 V and +28 V required for the operation of the SAR1. The supply uses a full wave rectifier with a RC type filter. Transformer T-2601 supplies approximately 70 VAC center tapped to the rectifiers CR2601 and CR2602. The 100 ohm resistor, R2601, and capacitors C2601 and C2602 act as the filter network for the +28 V supply.

POWER SUPPLY
Schematic Diagram

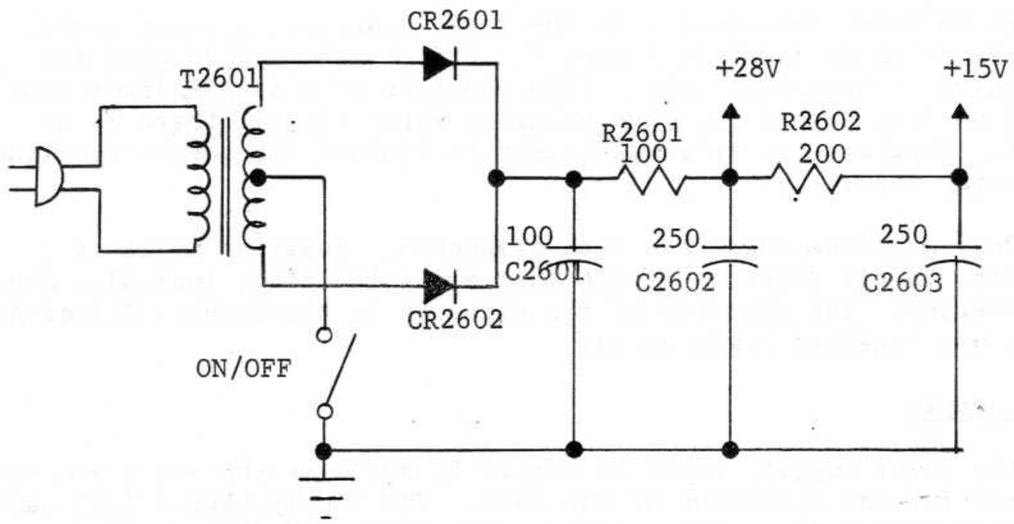


Figure 8

Since the +15V supply draws approximately 65 ma, there is a 13V drop across the 200 ohm resistor, R2602, giving an output of approximately +15V. Additional filtering for the +15V supply is supplied by C2603. The On/Off switch removes the ground from the transformer center tap, which turns the supply Off.

4. PULSE GENERATOR

The Pulse Generator in the Select-A-Rhythm consists of a unijunction transistor, connected as a relaxation oscillator, and associated circuitry. The output of the Pulse Generator is a series of timing pulses which control the speed, or tempo of the rhythms of the Select-A-Rhythm. In the Pulse Generator block diagram, Figure 9, the Tempo control adjusts the operating frequency of a unijunction relaxation oscillator. The equivalent circuit for a unijunction relaxation oscillator is shown in Figure 10A.

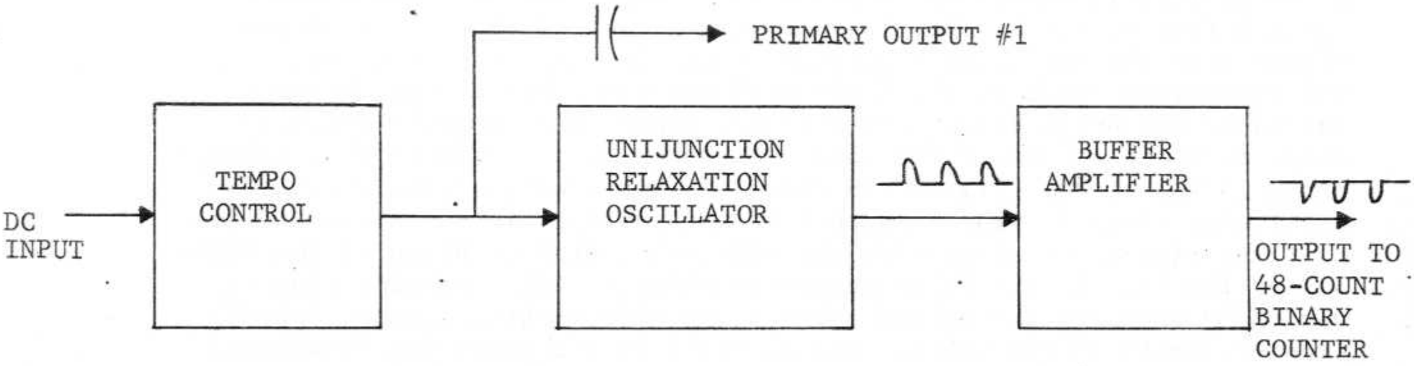


Figure 9

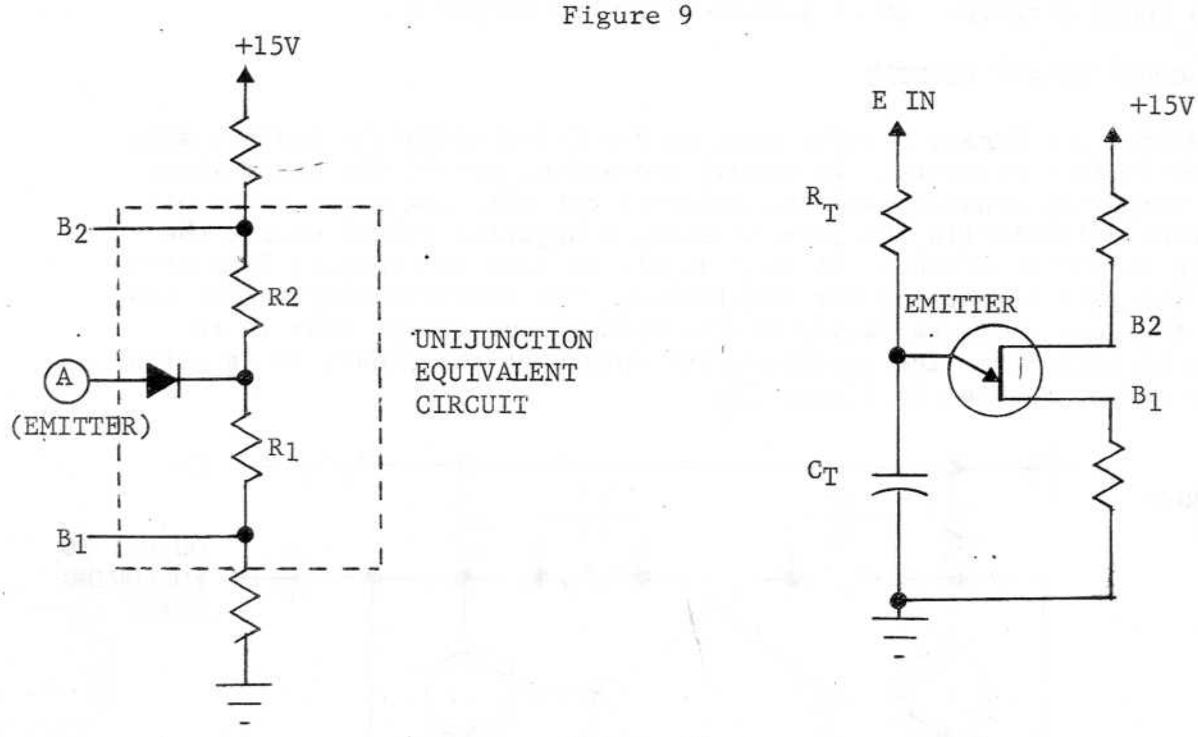


Figure 10

This equivalent circuit consists of two series resistors, one of which is variable, and a diode connected at the junction. Normally there is conduction through the unijunction transistor at all times. The base contacts, B_1 and B_2 are nonrectifying. The emitter junction is a rectifying contact near the center point of the silicon bar from which the transistor is made. If base 2 is connected to a positive voltage, the diode is reverse biased and appears as a nearly infinite impedance at point A (the emitter). If, however, the potential at point A becomes higher than the potential appearing at the junction of the R1 and R2 of the equivalent circuit, the diode will conduct. Due to the characteristics of the unijunction, resistor R1, shown as a variable resistor, drops in value to just a few ohms resistance while conduction is taking place in the diode. Figure 10B shows the basic unijunction relaxation oscillator circuit. The frequency of this circuit is determined by the charging time of C_t along with the physical characteristics of the transistor itself. In the Pulse Generator circuit, this charging time is varied by changing the voltage with a variable control (tempo control) from +15 volts to +28 volts, thus controlling its operating frequency. The output of the unijunction Pulse Generator is taken from the junction of base 1 and the loading resistor. This output is in the form of a very sharp positive going pulse.

The output of the oscillator is coupled to the buffer amplifier and the pulse is amplified and inverted. The amplified and inverted output of the buffer amplifier is used to d~~rove~~ the 48-Count Binary Counters. There is an additional output taken from the Pulse Generator; this is a sawtooth wave form appearing at the emitter. This is differentiated and coupled to the main logic circuit. It is labelled primary output #1.

5. 48-COUNT BINARY COUNTER

The 48-Count Binary Counter used in the Select-A-Rhythm employs six, flip-flop divider circuits. In normal operation, one of the transistors in each flip-flop conducts and the other is cut off. An input pulse of the correct polarity (in the present case, a nagative pulse) causes the flip-flop to switch states. It is possible to take two outputs from each binary, the main output and its complement. The complementary output has exactly the same characteristics as the main output except that it is opposite in polarity. The complementary output of the binary is labelled with the prime as shown in Figure 11.

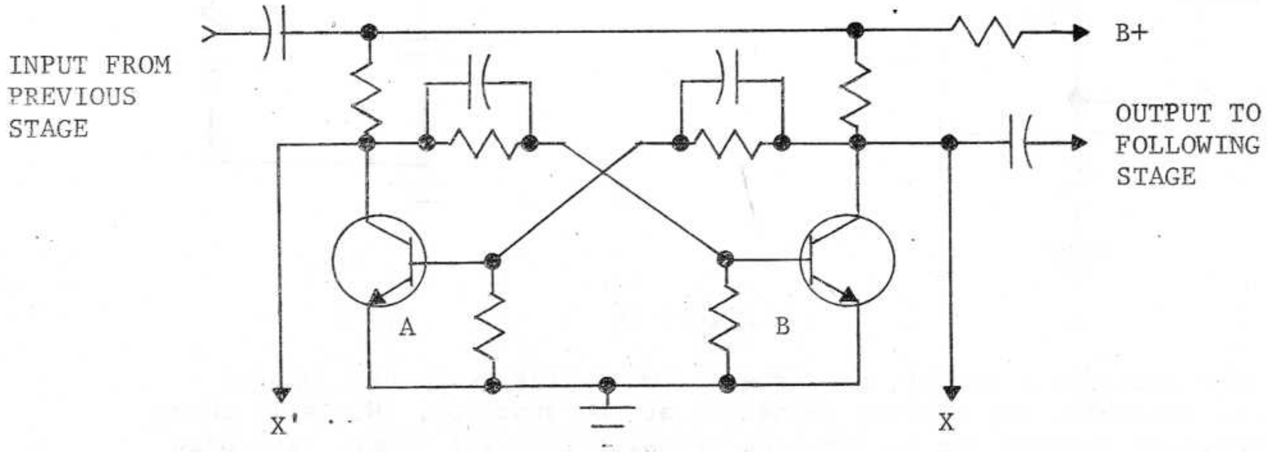


Figure 11

If the main output is taken from the B transistor and called X, then the complementary output is taken from the A transistor and is called X'.

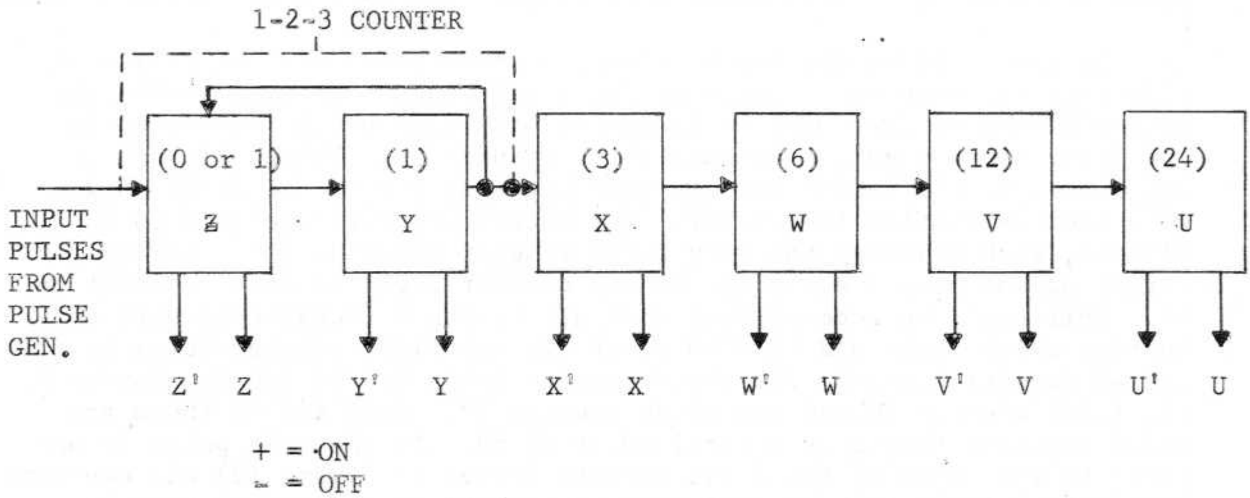


Figure 12

Figure 12 shows the six-stage binary counter used in the Select-A-Rhythm. The first two stages are connected as a scale of 3 counter, rather than the more usual scale of 4 counter. This is accomplished by a feedback loop from the output of the second binary to the input of the first. When the second binary changes state (goes negative) there is an additional pulse fed back to the input of the first binary, which changes its state independently of the input pulse from the Pulse Generator.

Assume transistor A, Figure 11, is cut off and transistor B is conducting or saturated. Transistor B is held in saturation by the positive potential on its base. The base potential is established from the +10 volts on the collector of transistor A, which is cut off, through the resistor to the base of transistor B and through the base resistor to ground. Because transistor B is saturated the potential at its collector is approximately zero. There is not a forward bias potential to cause transistor A to conduct, thus it will remain cut off. As an input signal is applied through the coupling capacitor to the common point of the two collector load resistors and the common load resistor to B+, the transistors change state. Transistor A conducts, (goes to saturation) and transistor B cuts off. Operation is as follows: the input signal is a negative-going pulse that is very short at the leading edge, causing the potential at the collector of transistor A to drop from 10 volts down to approximately zero volts. This potential change appears on the base of transistor B, cutting transistor B off. Because the pulse was of very short duration, when transistor B cuts off, a positive potential is established at its collector and coupled back causing transistor A to conduct.. Transistor A saturates and remains in saturation from the positive potential on its base. Thus the transistors have changed state. When the next negative input pulse is applied, the transistors will again change state. Each time transistor B goes from cut-off to saturation, the collector will be going from +10 volts to zero volts and establishing a negative pulse through the output coupling capacitor. This pulse will trigger the next stage binary counter.

As can be seen, the second binary counter stage will be triggered only once for each two changes of the first stage. In other words the second binary counter will be triggered only when the B transistor in the first counter goes from cut-off to saturation. There will not be any change in the second counter when transistor B of the first stage goes from saturation to cut-off. The binary counters are used as a divider, each dividing the very first trigger pulse by two. During normal operations, a six stage binary counter would be able to count to 64. This would be accomplished when all of the B transistors were conducting which would add to a total of 63, the first counter being 1, the second counter being 2, the third counter being 4, the fourth counter 8, the fifth counter 16 and the sixth counter 32. When all of these are added together they give a total count of 63. As the next pulse is applied to the input of the first counter (refer to Figure 12) all counters will change state back to their zero position and the count would be zero, thus making a total of 64 counts. The Seeburg Select-A-Rhythm, however, uses a 48-Count Binary Counter to establish the proper rhythm patterns required. This is accomplished by a feedback network in the first two counters so that the first two counters are in count three, rather than the normal count four.

The counting technique is accomplished in the following manner: assume the first two stages of counters have the B transistors cut off (1-1). When a negative trigger pulse is applied to the first binary counter transistor B will conduct and the collector potential will go from a +10 volts to zero volts (negative going). The signal is coupled to the second counter where transistor B conducts. The negative going signal would be coupled to the third stage in the case of three or more stages. Transistor A in the second stage went from a zero potential to +10 volts. This positive going pulse is coupled back to transistor A of the first stage causing this transistor to conduct once again. Conduction of transistor A causes this potential to revert back to zero and transistor B to cut off again. For one input pulse the first stage changed states and then instantly reverted back to its previous state, while the second stage went through its normal operation of reversing states once. The counter is now conditioned so that the first stage has transistor B again cut off, and the second stage has transistor B conducting (1-0). As the second trigger pulse is applied to the first stage, transistor B will change state and conduct. A negative going is coupled to the second stage, thus causing the second stage transistor B to cut off. Because transistor B was going from conduction to cut-off, a positive pulse was established at its collector, which does not affect any succeeding stage. As transistor A in the second stage went from cut-off to conduction, a negative going signal was established at its collector. This negative going signal, although being coupled back to transistor A of the first stage, has no effect on the first stage because transistor A is already cut off. Thus after the second input pulse, transistor B of the stage will be conducting, and transistor B of the second stage will be cut off (0-1). As the third trigger pulse is applied to the first stage the transistors will change state and because transistor B is going from conduction to saturation, the positive going signal established at its collector will not affect the following stages (1-1). As the fourth pulse is applied to the first stage the cycle of operation is repeated. As can be seen, the counters count to four for every three (3) input pulses. For this reason they are called 1-2-3 counters rather than 1-2-3-4 counters.

This gives the 6-stage counter a total of 48 counts rather than the 64 counts it would have were it not for the feedback circuit. The binary counter condition chart, Figure 13, shows the states of the various counters with input pulses from 1 through 48 and also indicates the state of the main output of the binary counters in the SAR at the times indicated. These times correspond to the input pulses from the Pulse Generator.

NOTE

The complementary outputs (i.e. X') have opposite polarity.

Zero and one in the chart indicate the polarity of the particular output. A "1" means the output is positive (+10V), and "0" means approximately 0 potential on the output, (referred to as negative).

BINARY COUNTER CONDITIONS

	COUNTERS						
Time	Z	Y	X	W	V	U	
START	1	0	0	0	0	0	(Downbeat measure 1)
1	0	1	0	0	0	0	
2	1	1	0	0	0	0	
3	1	0	1	0	0	0	
4	0	1	1	0	0	0	
5	1	1	1	0	0	0	
6	1	0	0	1	0	0	
7	0	1	0	1	0	0	
8	1	1	0	1	0	0	
9	1	0	1	1	0	0	
10	0	1	1	1	0	0	
11	1	1	1	1	0	0	
12	1	0	0	0	1	0	
13	0	1	0	0	1	0	
14	1	1	0	0	1	0	
15	1	0	1	0	1	0	
16	0	1	1	0	1	0	
17	1	1	1	0	1	0	
18	1	0	0	1	1	0	
19	0	1	0	1	1	0	
20	1	1	0	1	1	0	
21	1	0	1	1	1	0	
22	0	1	1	1	1	0	
23	1	1	1	1	1	0	
24	1	0	0	0	0	1	(Downbeat measure 2)

1 = Positive Output

0 = Negative Output (0 Volts)

	COUNTERS					
Time	Z	Y	X	W	V	U
25	0	1	0	0	0	1
26	1	1	0	0	0	1
27	1	0	1	0	0	1
28	0	1	1	0	0	1
29	1	1	1	0	0	1
30	1	0	0	1	0	1
31	0	1	0	1	0	1
32	1	1	0	1	0	1
33	1	0	1	1	0	1
34	0	1	1	1	0	1
35	1	1	1	1	0	1
36	1	0	0	0	1	1
37	0	1	0	0	1	1
38	1	1	0	0	1	1
39	1	0	1	0	1	1
40	0	1	1	0	1	1
41	1	1	1	0	1	1
42	1	0	0	1	1	1
43	0	1	0	1	1	1
44	1	0	1	1	1	1
45	1	0	1	1	1	1
46	0	1	1	1	1	1
47	1	1	1	1	1	1
48	start					

Figure 13

6. RESET CIRCUIT

The reset circuit is shown in simplified form in Figure 14. When the foot pedal is in the Off position, transistor Q2023 is saturated by the forward bias on its base. Bias is developed from the +15 volt supply through the two 22K resistors, R2031 and R2032. The relatively high value of the collector resistor, R2033 (100K), causes the potential at the collector of Q2023 to be very nearly zero.

RESET CIRCUIT

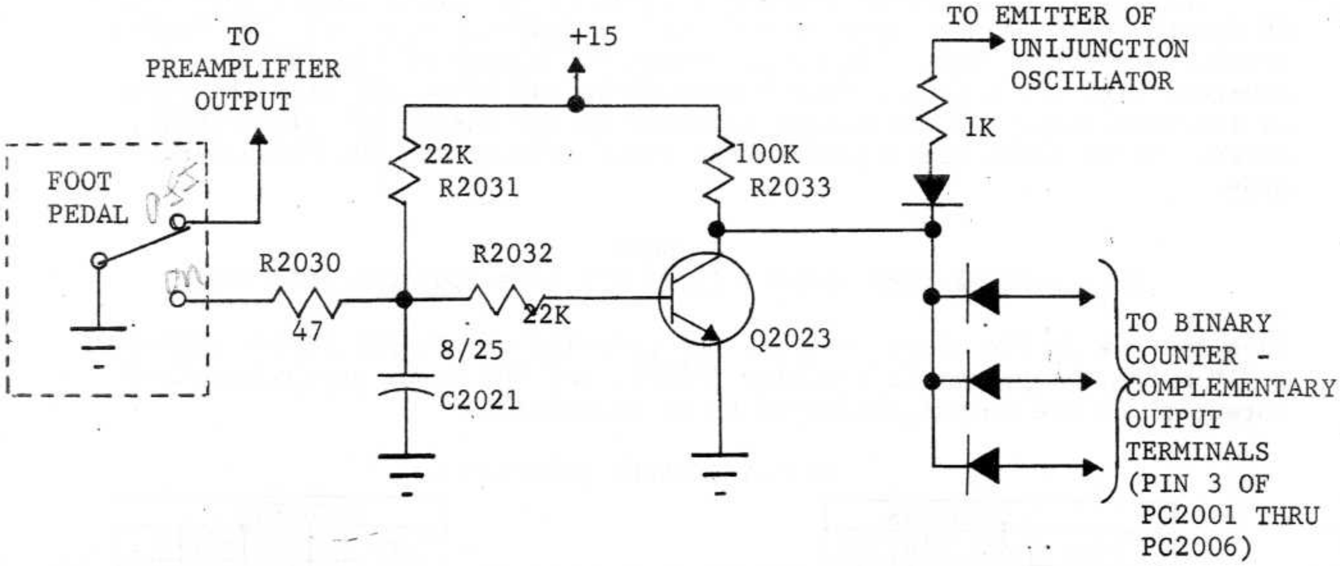


Figure 14

In turn, the diodes in the collector circuit of C2023 will conduct whenever the voltage at their anodes (connected to complementary output terminals of the binary counter) rises above zero. This action forces the output, or count of the binary counter to be 000000 at the complementary output; this is equivalent to an output or count at the main output of 111111, or count 47 of the 48 count counter. This insures that the next count of the counter will be the start, or "downbeat" count. The reset circuit also disables the unijunction oscillator by placing a low impedance path between the emitter and ground.

When the foot pedal is in the On position, the forward bias on transistor Q2023 is removed, and the transistor cuts off. This causes the collector voltage to go to +15V and in turn, prevents the diodes in the collector circuit from conducting. Therefore, operation of the binary counter will be normal. The 8 mfd capacitor, C2021, and the 47 ohm resistor, R2030, prevents the transistor from going from saturation to cut off instantaneously, which could result in transients being developed.

7. PRIMARY LOGIC

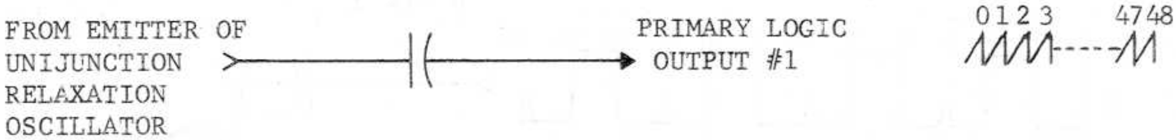
There are, in addition to the first primary logic output (which is the output of the pulse generator), six additional pulse outputs from the primary logic circuitry. These outputs are numbered according to the time at which the first output pulse appears, and are numbered 2, 3, 4, 8, 9 and 10.

Each of the six primary logic circuits consists of a negative AND gate with three inputs. Two of the inputs are direct-coupled outputs of the binary counter circuit. One of the inputs to the primary logic circuits is a differentiated primary logic pulse. An output will occur from each of the primary logic circuits only when the two main inputs are negative, and the differentiated input is negative going. The primary logic circuits are shown in Figures 15 through 21. For each primary logic circuit (except #1) there will be four output pulses in the 48 count cycle. Each pulse is separated from each succeeding pulse in the primary logic circuits by 12 time units so that the primary logic output #2 has outputs at times 2, 14, 26 and 38. The times of the outputs are shown below.

Primary Logic Number	Output Pulse at Times
2	2-14-26-38
3	3-15-27-39
4	4-16-28-40
8	8-20-32-44
9	9-21-33-45
10	10-22-34-46

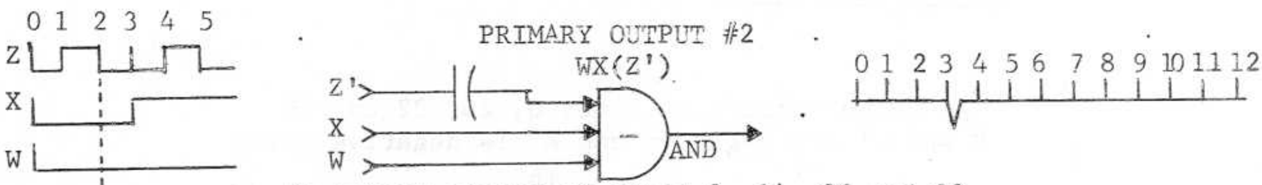
The outputs of the primary logic circuits, along with the outputs of the binary counters are shown in Figure 22, the Select-A-Rhythm Output Time Reference Chart.

PRIMARY OUTPUT #1



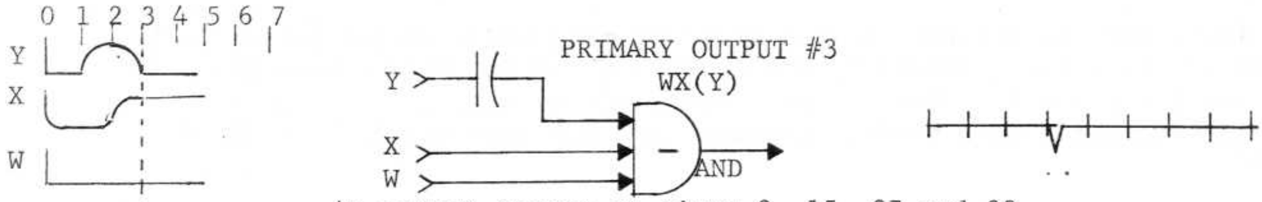
There is an output pulse for each cycle of the unijunction relaxation oscillator (i.e. outputs occur at times 1 through 48).

Figure 15



An output occurs at times 2, 14, 26 and 38.
X and W are negative and Z' is negative going.

Figure 16

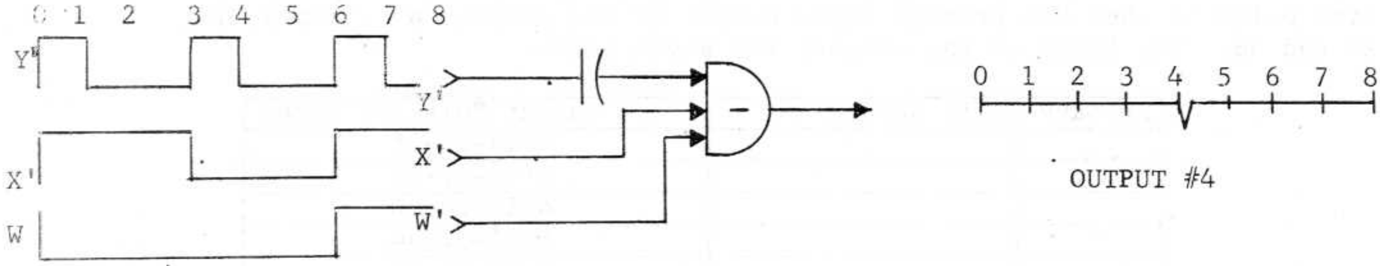


An output occurs at times 3, 15, 27 and 39.
X and W are negative and Y is negative going.

NOTE: Inputs Y & X are rounded off, or sloppy, meaning input Y will actually go negative enough to produce an output at time 3 before input X goes positive enough to prevent the output.

Figure 17

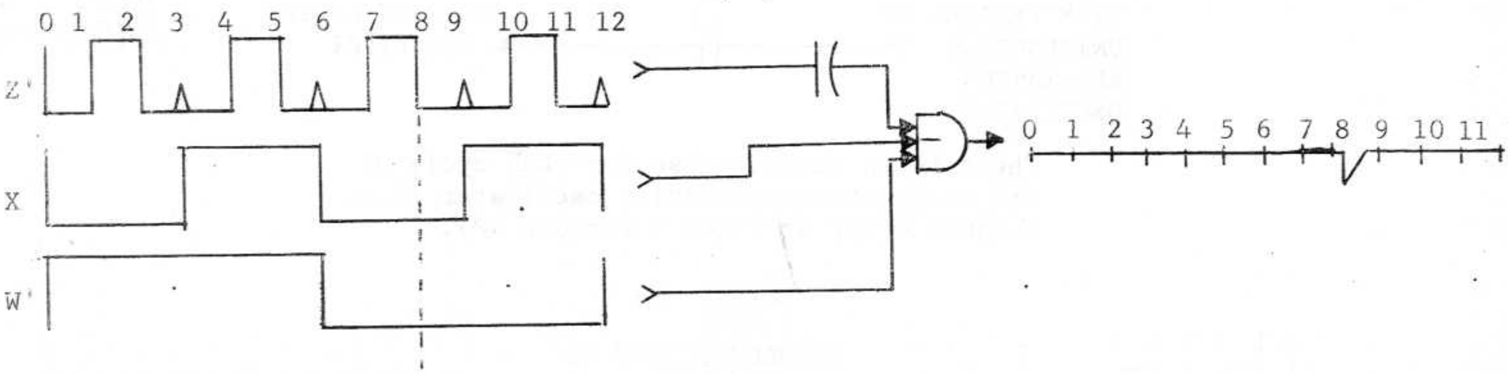
PRIMARY OUTPUT #4
WX'(Y')



An output occurs at times 4, 16, 28 and 40.
X' and W are negative and Y' is negative going.

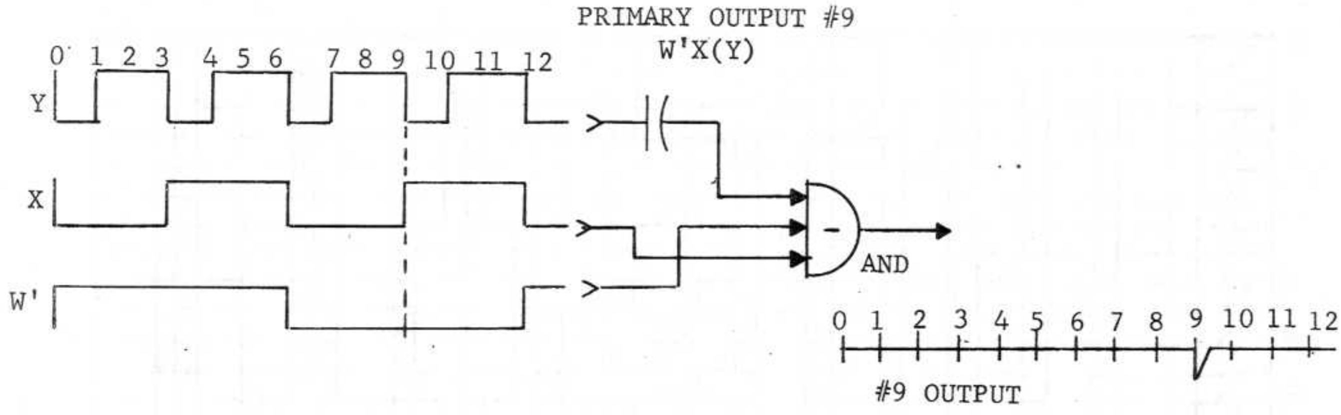
Figure 18

PRIMARY OUTPUT #8
W'X(Z')



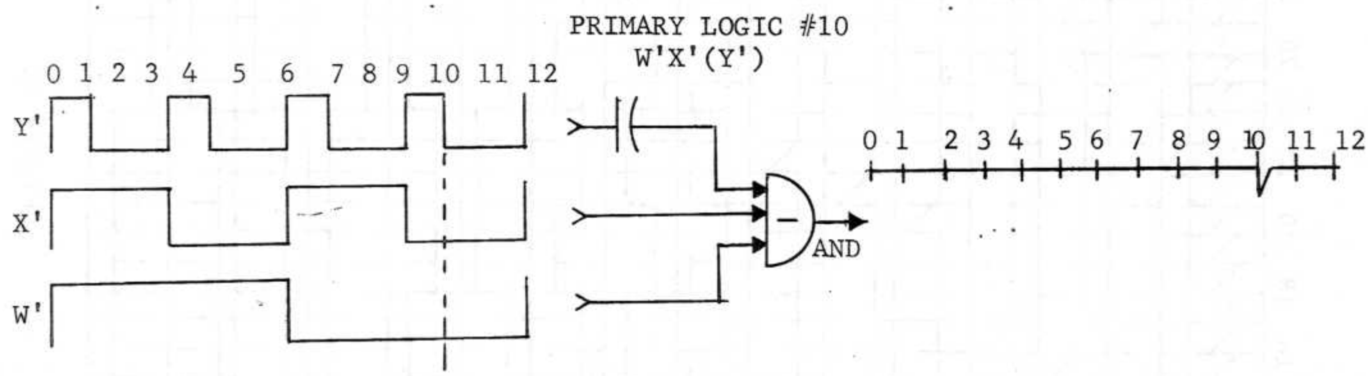
An output occurs at times 8, 20, 32 and 45
X and W' are negative and Z' is negative going.

Figure 19



An output occurs at times 9, 21, 33 and 45.
A and W' are negative and Y is negative going.

Figure 20



An output occurs at times 10, 22, 34 and 46.
X' and W' are both negative and Y' is negative going.

Figure 21

SELECT-A-RHYTHM OUTPUT TIME REFERENCE CHART

The chart on page 20 shows the timing relationship of the 48-Count Binary Counter and the outputs of the primary logic circuits. These timing pulses are the inputs to the Select-A-Rhythm main logic.

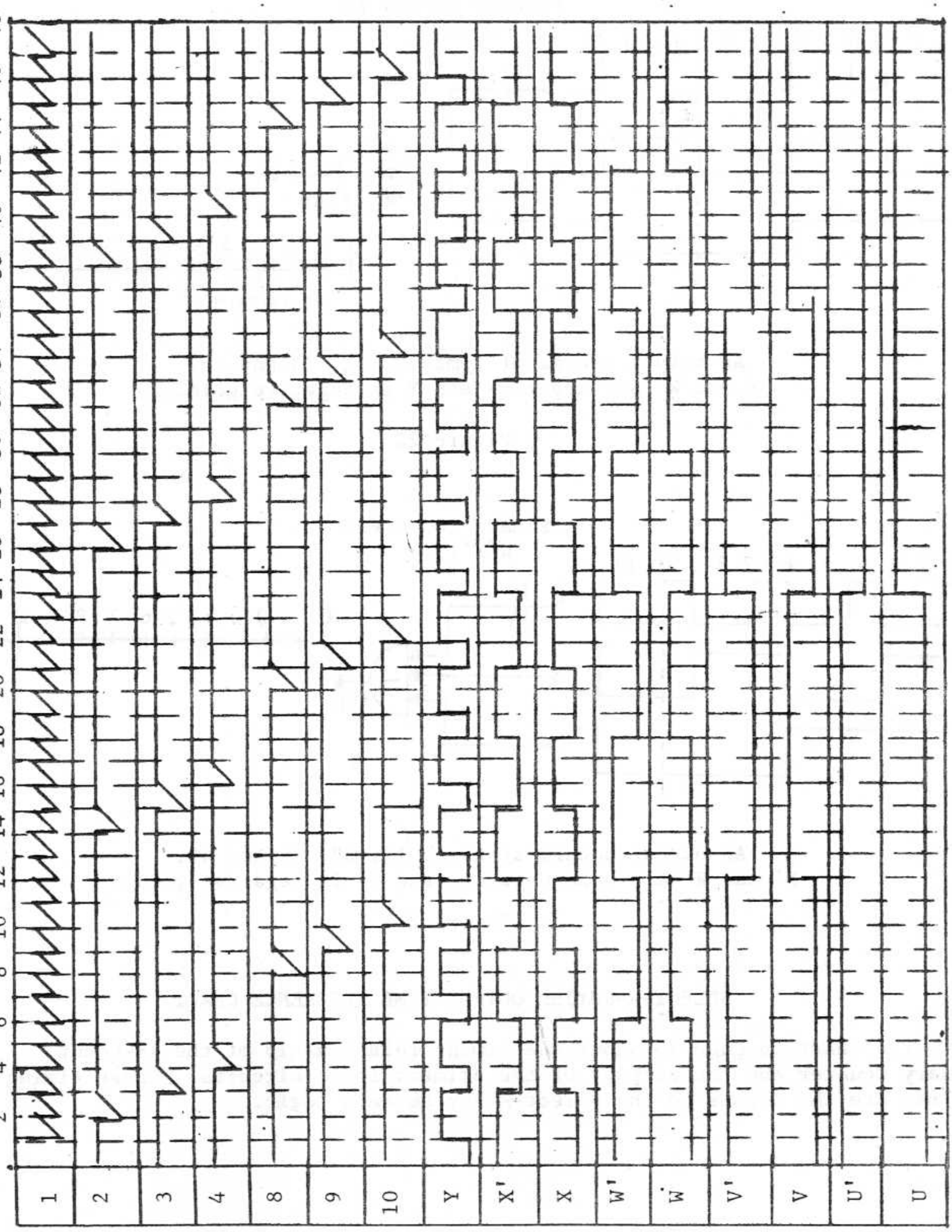

48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
1
2
3
4
8
9
10
Y
X'
X
W'
W
V'
V
U'
U

Figure 22

8. MAIN LOGIC

The main logic of the Select-A-Rhythm comprises those circuits which supply the pulse inputs to the selection system. There are three types of outputs: (1) the output from the differentiation circuits and (2) "AND" logic outputs, and (3) "OR" logic outputs. There are also two sustain outputs, that is, circuits whose outputs are present for more than 1 time unit. All the outputs from the main logic are negative pulses with the exception of the two sustain outputs, which are positive. The 40 logic outputs are shown in Figures 25 through 64. Logic output numbers 2 and 3 are the sustain outputs. In the case of #2 logic, there is a positive output only when inputs W and V are both positive; in the case of logic output #3 (which is simply the binary counter output W) there is an output only when W is positive.

Figure 23 is a sample of the "AND" gate used in the main logic.

SAMPLE "AND" GATE LOGIC OUTPUT = U'V(W')

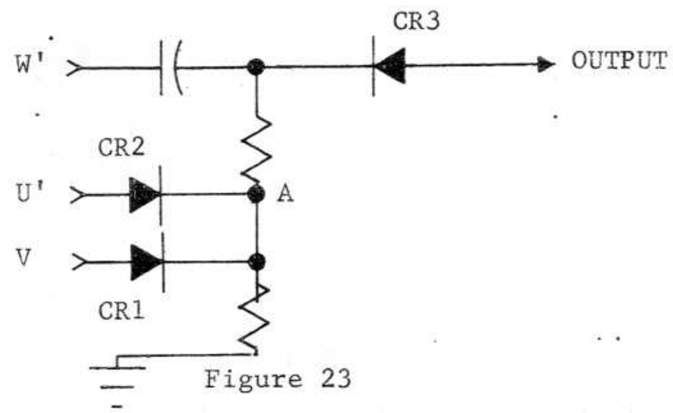


Figure 23

As can be seen in Figure 23 if U' or V are positive, the diodes CR1 or CR2 will conduct. A positive potential will be established as the common point between the capacitor and diode CR3. The W' signal will have no effect on the output because this positive voltage holds CR3 reversed biased even when W' goes negative. However, if both U' and V are negative the diodes CR1 and CR2 will be reverse biased and the potential at the common point between the capacitor and CR3 will be zero. As the negative pulse is applied, CR3 will conduct and the pulse will appear at the output. At this point between the capacitor and CR3, positive going pulses of W' would also appear but will not reach the output because they will be blocked by CR3.

Figure 35 shows logic output 12. This logic circuit is a typical OR gate. The inputs to the OR gate are the differentiated U' and the output of a negative AND gate whose inputs are W, V and U'. There is an output from the negative AND gate only when inputs V and U' are both negative and W is negative going. This happens only at time 36 as explained previously for AND gate operation. U' goes negative only at time 24. Since the presence of only one of the inputs is required to give an output of the OR gate, there is an output from the OR gate when there is an output from the AND gate or U' is negative going; therefore, there is an output for logic circuit #12 at time 24 and another at time 36. The operation of the OR gate portion is as follows: when U' is negative going it is coupled to the diode which passes the signal to the output. When W is negative going, along with V and U' being negative, there is an output from the AND gate which is passed by the other diode in the OR gate giving an output. Refer to Figure 24.

SAMPLE "OR" GATE LOGIC

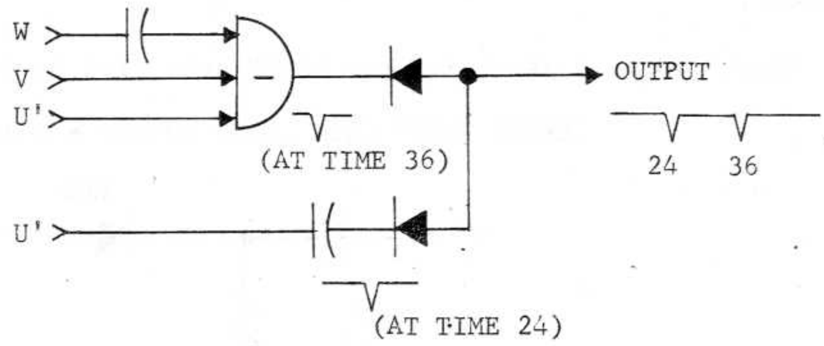


Figure 24

Note that the AND gate shown in Figure 24 is actually the same one that is shown in Figure 23. This same AND gate is also used with other OR gates, as in logic output #4 shown in Figure 27. When this is done the output diode (CR3 of Figure 23) is duplicated for, and forms a part of each following OR gate. This can be seen in the full schematic diagram, Figure 70.

LOGIC OUTPUT BY NUMERICAL CODING

Figure 25 through 64 show the logic outputs of the Select-A-Rhythm Commutator and Logic assembly according to numerical coding. For the times at which these outputs occur, refer to Logic Output Timing Chart, Figure 25.

NOTE
There is no Logic output #1

#2 LOGIC: WV

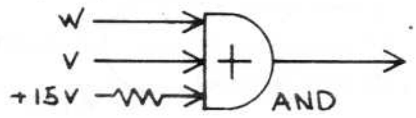


Figure 25

#3 LOGIC: W(POSITIVE)

Figure 26

#4 LOGIC: (U)+UV'(W')+U'V(W)+U'V(W')+UV9

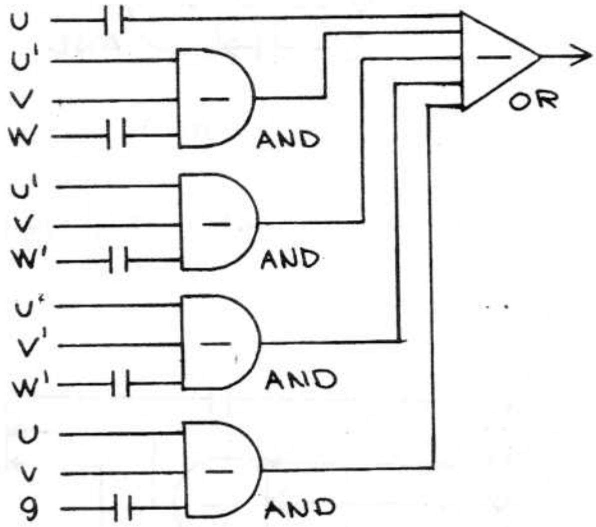


Figure 27

#5 LOGIC: U'V9

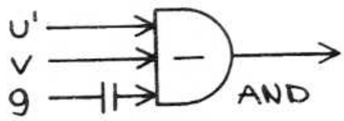


Figure 28

#6

LOGIC: U'V3

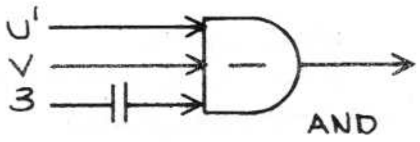


Figure 29

#7

LOGIC: U'V'4

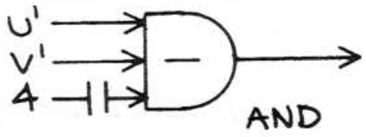


Figure 30

#8

LOGIC: U'V'2

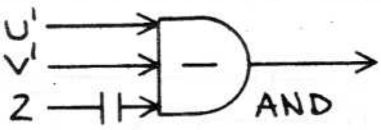


Figure 31

#9

LOGIC: (W)+U'V9+UV'3

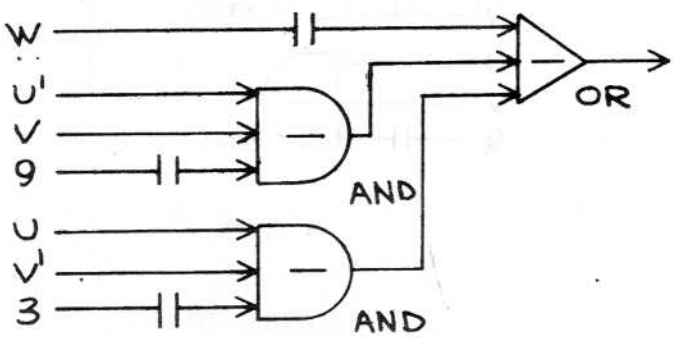


Figure 32

#10

LOGIC: (W)+U'V'(W')

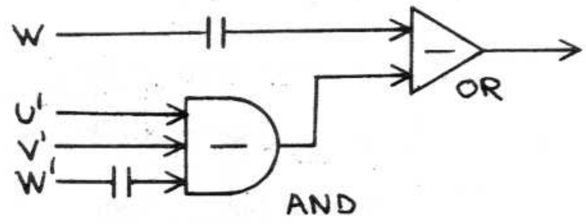


Figure 33

#11

LOGIC: (U')+V3+U'V9+U'V(W)+U'V'(W')

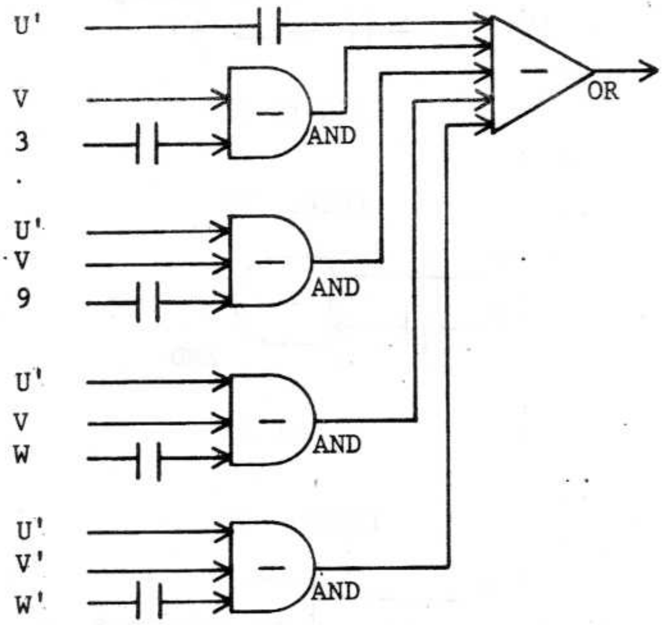


Figure 34

#12

LOGIC: (U)+U'V(W)

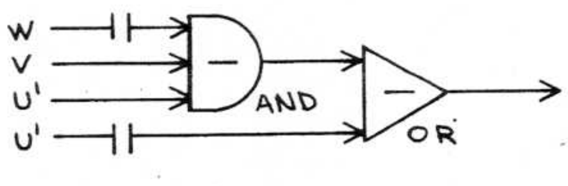


Figure 35

#13

LOGIC: (V)+V(W')

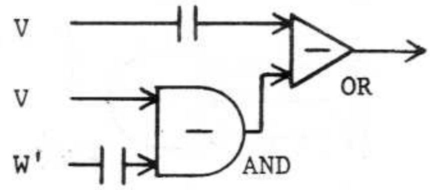


Figure 36

#14

LOGIC: V(W')

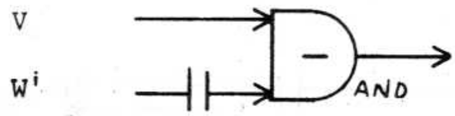


Figure 37

#15

LOGIC: V9

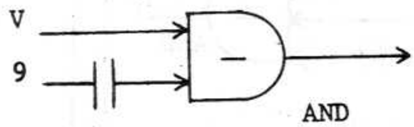


Figure 38

#16

LOGIC: V8

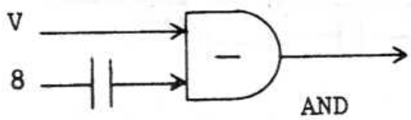


Figure 39

#17 LOGIC: 9+(W')+V4+V'3

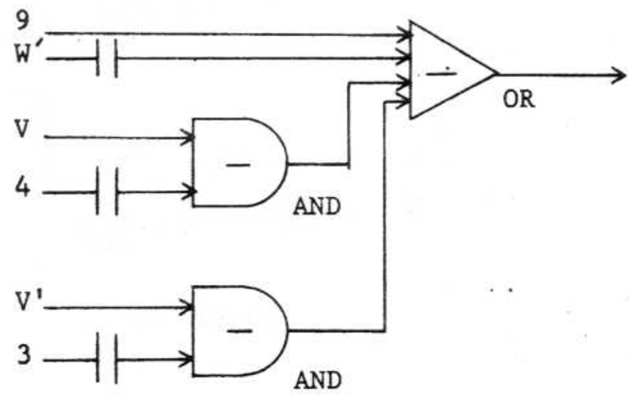


Figure 40

#18 LOGIC: V'3

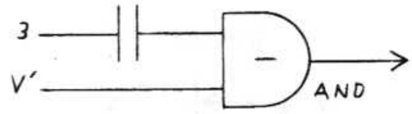


Figure 41

#19 LOGIC: V4+V'10

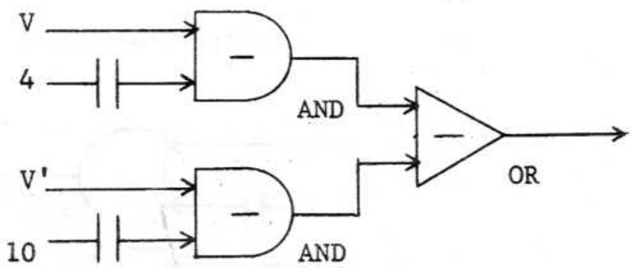


Figure 42

#20 LOGIC: V'10

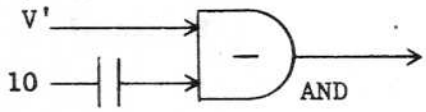


Figure 43

#21

LOGIC: V'(W')+V(W)

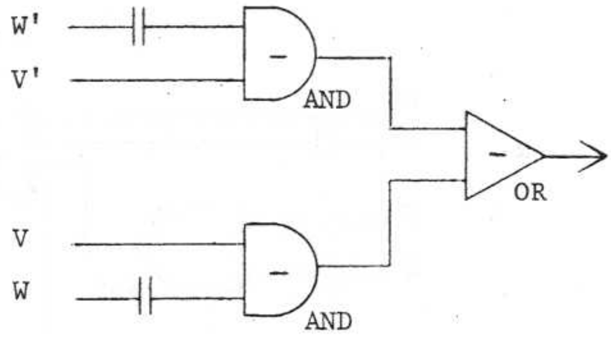


Figure 44

#22

LOGIC: V'(W')

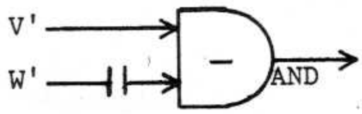


Figure 45

#23

LOGIC: V'4

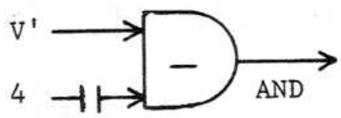


Figure 46

#24

LOGIC: V'4+V'(W')

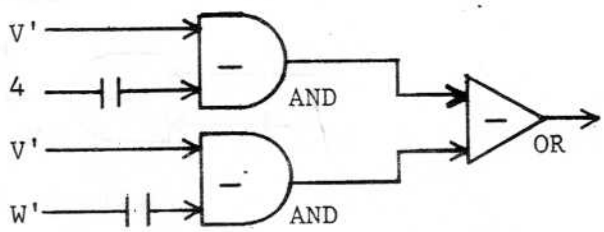


Figure 47

#25

LOGIC: V'9+V'(W')

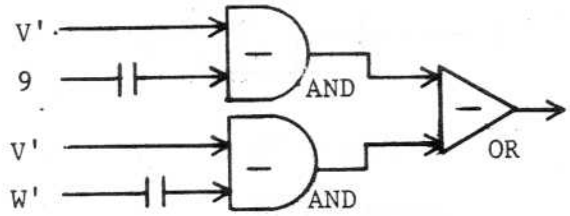


Figure 48

#26

LOGIC: (W')+V'9

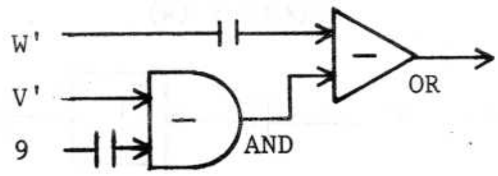


Figure 49

#27

LOGIC V'9

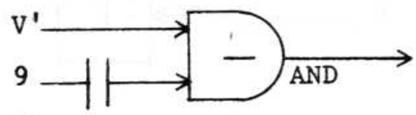


Figure 50

#28

LOGIC: (W)+V'(W')

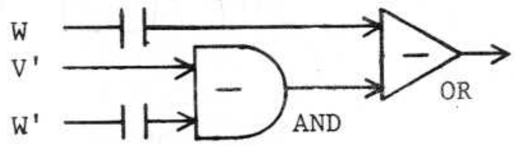


Figure 51

#29

LOGIC: (V)

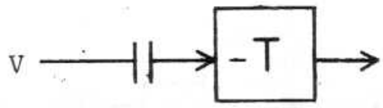


Figure 52

#30

LOGIC : (V')

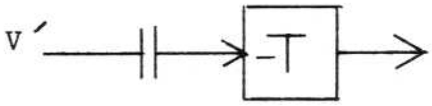


Figure 53

#31

LOGIC : (W)

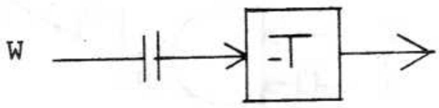


Figure 54

#32

LOGIC : (W')

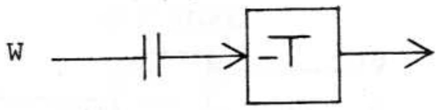


Figure 55

#33

LOGIC : (X)

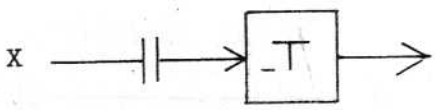


Figure 56

#34

LOGIC : (X')

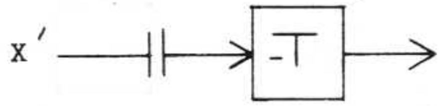


Figure 57

#35

LOGIC : (Y)

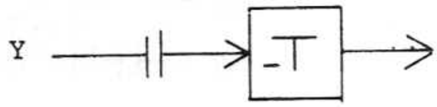


Figure 58

#36

LOGIC : (W')+(V)+9

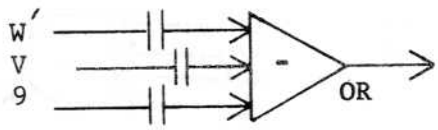


Figure 59

#37

LOGIC : 4+10

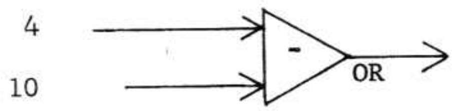


Figure 60

#38

LOGIC : 10

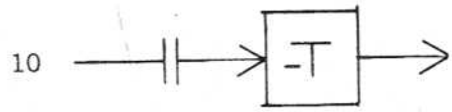


Figure 61

#39 LOGIC: 8

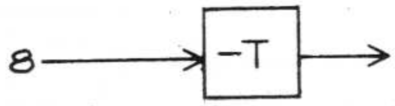


Figure 62

#40 LOGIC: 3+W

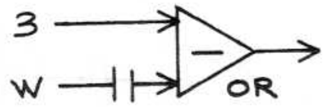


Figure 63

#41 LOGIC: UV'W'1

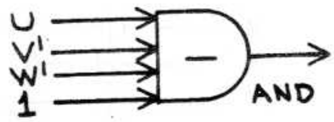
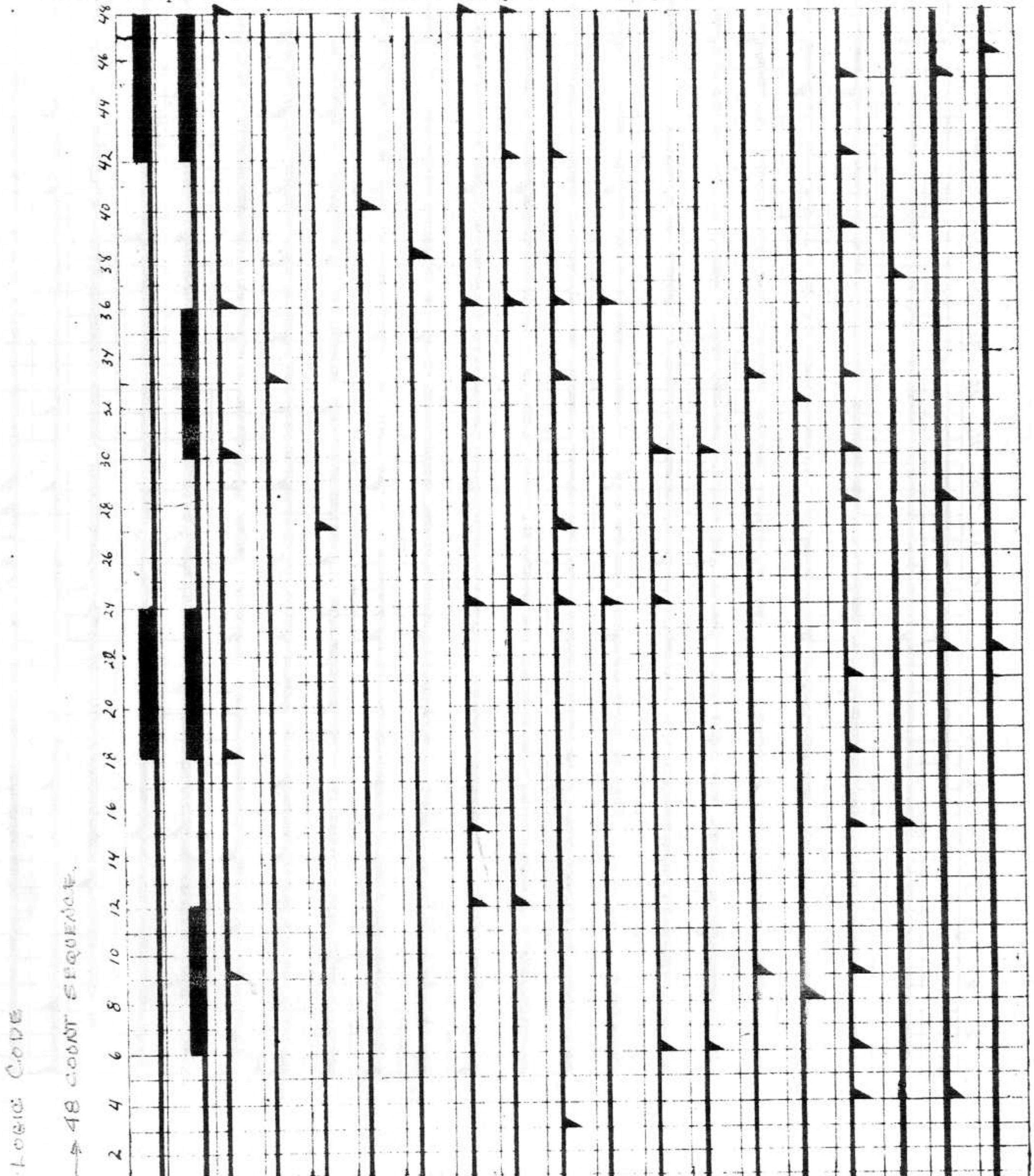


Figure 64

LOGIC OUTPUT TIMING CHART

Figure 65 shows the logic outputs according to their numerical coding (2 through 41). Output logic is shown as negative pulses occurring at the times indicated. These times are the 48-Count Binary Counter cycle time.

NOTE: Outputs 2 and 3 are sustained positive outputs.



LOGIC OUTPUT TIMING CHART (CONT'D)

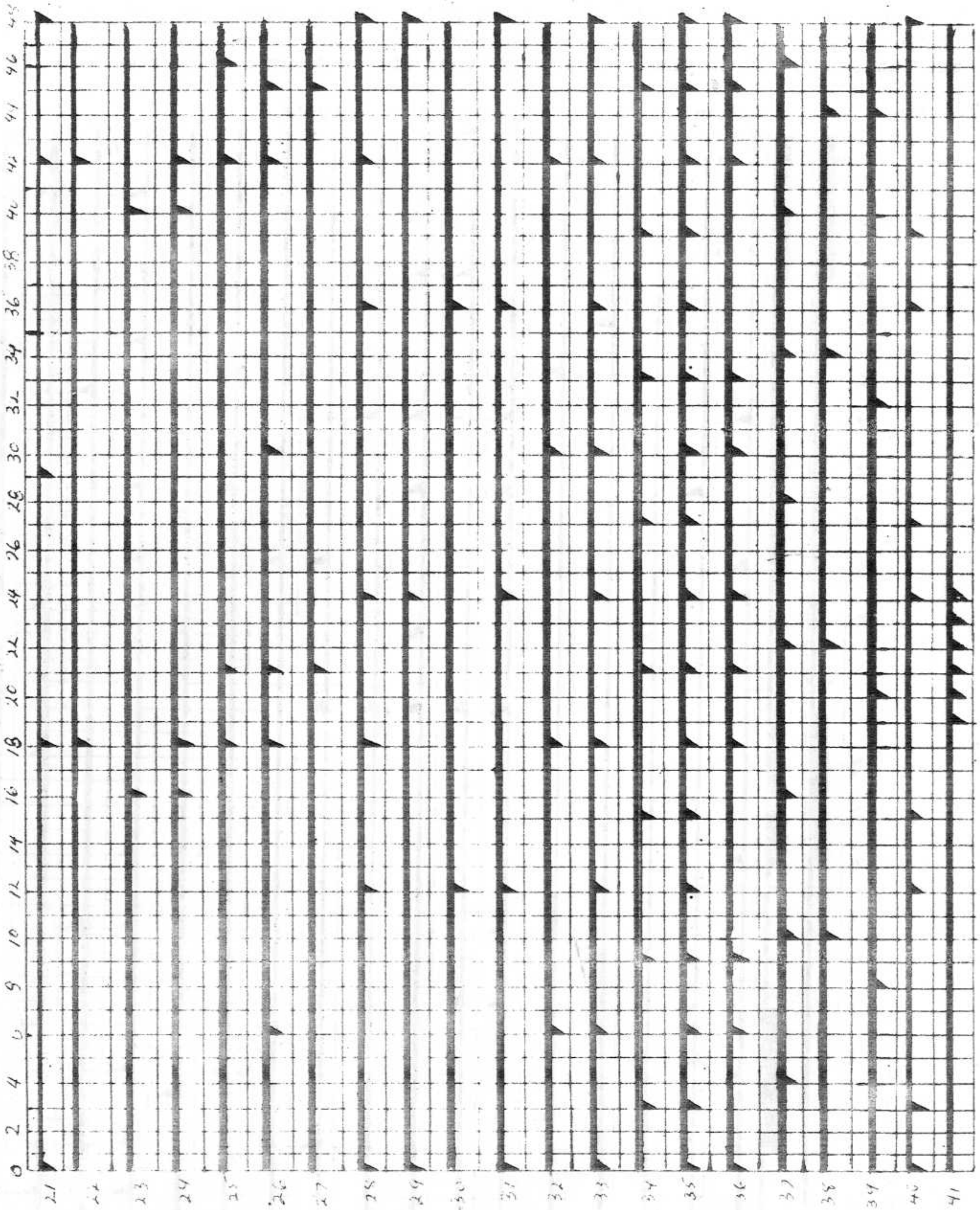


Figure 65 (Cont'd)

9. THE DOWNBEAT LAMP

The Downbeat Lamp is activated by two transistors connected as a Darlington amplifier. (Refer to Figure 66). The input to the Downbeat Lamp is from binary output V'. When the input V' goes positive, a positive going signal is coupled to the base of transistor Q2021, due to the action of the differentiating circuit consisting of the .1 mfd capacitor and the 2-100K resistors. This occurs at times 0 and 24. This positive going signal causes transistor Q2021 to conduct heavily. This action causes a positive voltage to appear at the base of Q2022 causing it to conduct heavily. This lowers the collector-emitter impedance of Q2022 causing the lamp to fire momentarily. The 1000 mfd capacitor and the 1K resistor act as a decoupling network to prevent the pulses from the lamp circuit from appearing elsewhere in the Select-A-Rhythm.

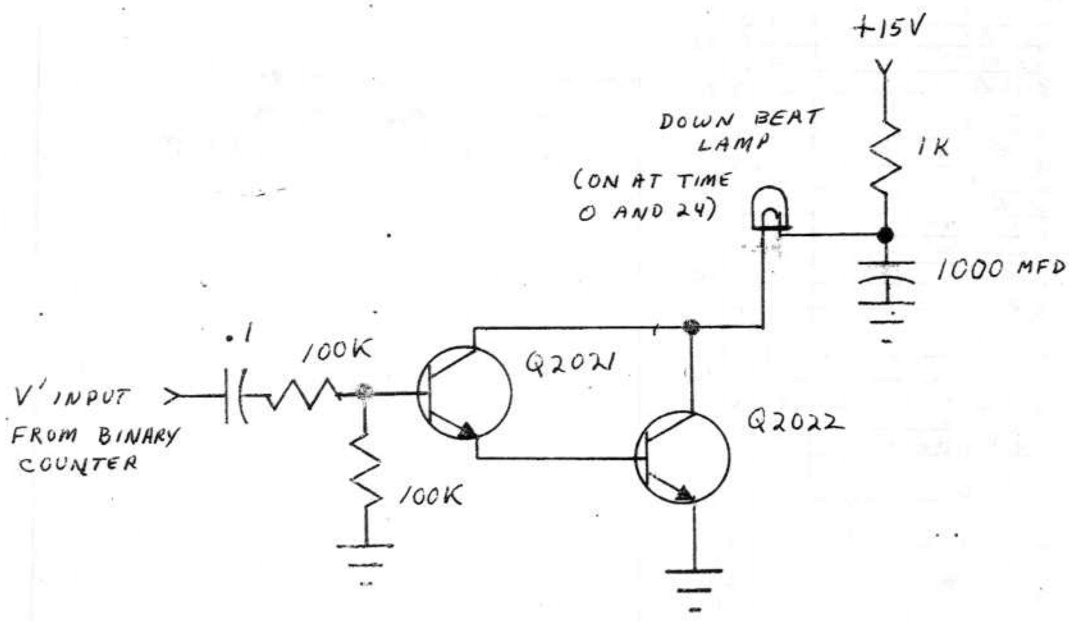


Figure 66

PORTABLE SELECT-A-RHYTHM

Commutator and Logic Assembly

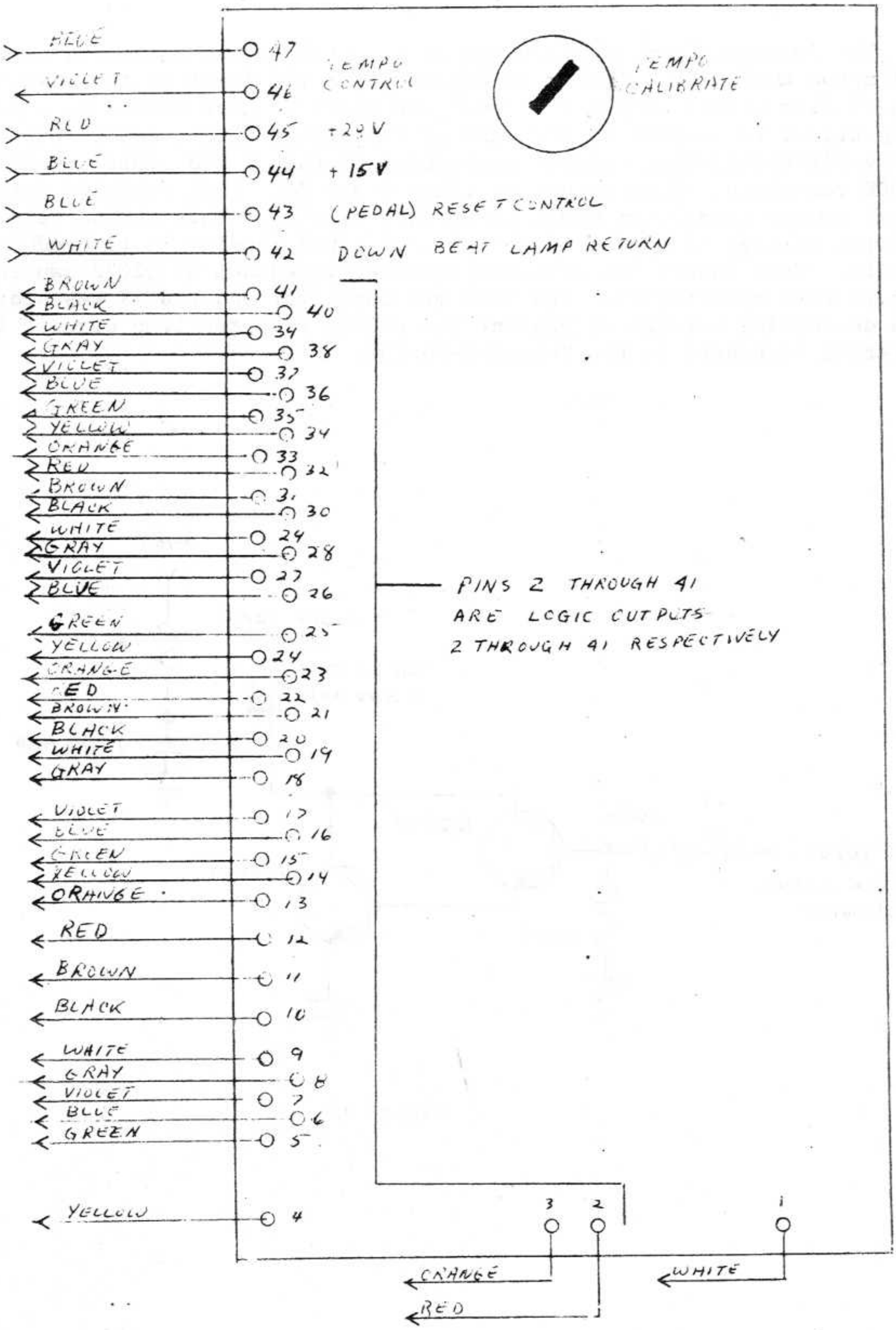


Figure 67

10 COMMUTATOR AND LOGIC TERMINATION CHARTS

Brackets indicate inter-connections from the input points by means of jumper wires on the switch. When there is more than one input to a terminal they will be listed in order of harness connections (no brackets).

PIN	COLOR	FUNCTION	TERMINATION
1	White	Downbeat Lamp Return	Downbeat Lamp
2	Red	Logic Output #2	Selector Switch Terminal 1H
3	Orange	Logic Output #3	Selector Switch Terminal 6K(4B)
4	Yellow	Logic Output #4	Selector Switch Terminal 8M(12F)
5	Green	Logic Output #5	Selector Switch Terminal 16H
6	Blue	Logic Output #6	Selector Switch Terminal 13H(11K)
7	Violet	Logic Output #7	Selector Switch Terminal 3K(4D, 5D, 6D)14B
8	Gray	Logic Output #8	Selector Switch Terminal 14H
9	White	Logic Output #9	Selector Switch Terminal 8K
10	Black	Logic Output #10	Selector Switch Terminal 14F
11	Brown	Logic Output #11	Selector Switch Terminal 13B
12	Red	Logic Output #12	Selector Switch Terminal 16B
13	Orange	Logic Output #13	Selector Switch Terminal 10K
14	Yellow	Logic Output #14	Selector Switch Terminal 2D(2H)12D
15	Green	Logic Output #15	Selector Switch Terminal 11M97M & 13M)
16	Blue	Logic Output #16	Selector Switch Terminal 2B(1K)
17	Violet	Logic Output #17	Selector Switch Terminal 8D
18	Gray	Logic Output #18	Selector Switch Terminal 9B
19	White	Logic Output #19	Selector Switch Terminal 10M
20	Black	Logic Output #20	Selector Switch Terminal 5K
21	Brown	Logic Output #21	Selector Switch Terminal 9D(9K)
22	Red	Logic Output #22	Selector Switch Terminal 11B
23	Orange	Logic Output #23	Selector Switch Terminal 1F(1D & 2M)
24	Yellow	Logic Output #24	Selector Switch Terminal 10H
25	Green	Logic Output #25	Selector Switch Terminal 12H
26	Blue	Logic Output #26	Selector Switch Terminal 7D
27	Violet	Logic Output #27	Selector Switch Terminal 11D
28	Gray	Logic Output #28	Selector Switch Terminal 8F, 12M(13F & 11H)
29	White	Logic Output #29	Selector Switch Terminal 2F(1M)-17F-9F
30	Black	Logic Output #30	Selector Switch Terminal 17D(17K & R2307 to 17H)
31	Brown	Logic Output #31	Selector Switch Terminal 16F(15B - 15H,16M,18D) 3M(5B)10F(9M)
32	Red	Logic Output #32	Selector Switch Terminal 3F(3B,4H,5H,6B,6H,7B,7H) 16D
33	Orange	Logic Output #33	Selector Switch Terminal 5M(6F,6M,4F,4K)11F,13H - 15M(15D-15K-14M)
34	Yellow	Logic Output #34	Selector Switch Terminal 12K
35	Green	Logic Output #35	Selector Switch Terminal 7K(10B-12B)
36	Blue	Logic Output #36	Selector Switch Terminal 8H
37	Violet	Logic Output #37	Selector Switch Terminal 15F

Figure 68

PIN	COLOR	FUNCTION	TERMINATION
38	Gray	Logic Output #38	Selector Switch Terminal 4M(5F)14D(13K & 10D)
39	White	Logic Output #39	Selector Switch Terminal 14K(17B)
40	Black	Logic Output #40	Selector Switch Terminal 8B
41	Brown	Logic Output #41	Selector Switch Terminal 13D
42	White	Logic Output #1 Return	Downbeat Lamp
43	Blue	Binary Counter Reset Control	Foot Pedal (Reset)
44	Blue	+15 Volts	+15 Volts from Power Supply
45	Red	+28 Volts	+28 Volts from Power Supply
46	Violet	Tempo Control	Tempo Control
47	Blue	Tempo Control	Tempo Control

Figure 68 (Cont'd)

COMMUTATOR AND LOGIC ASSEMBLY

Schematic Diagram #1
Pulse Generator and Binary Reset System

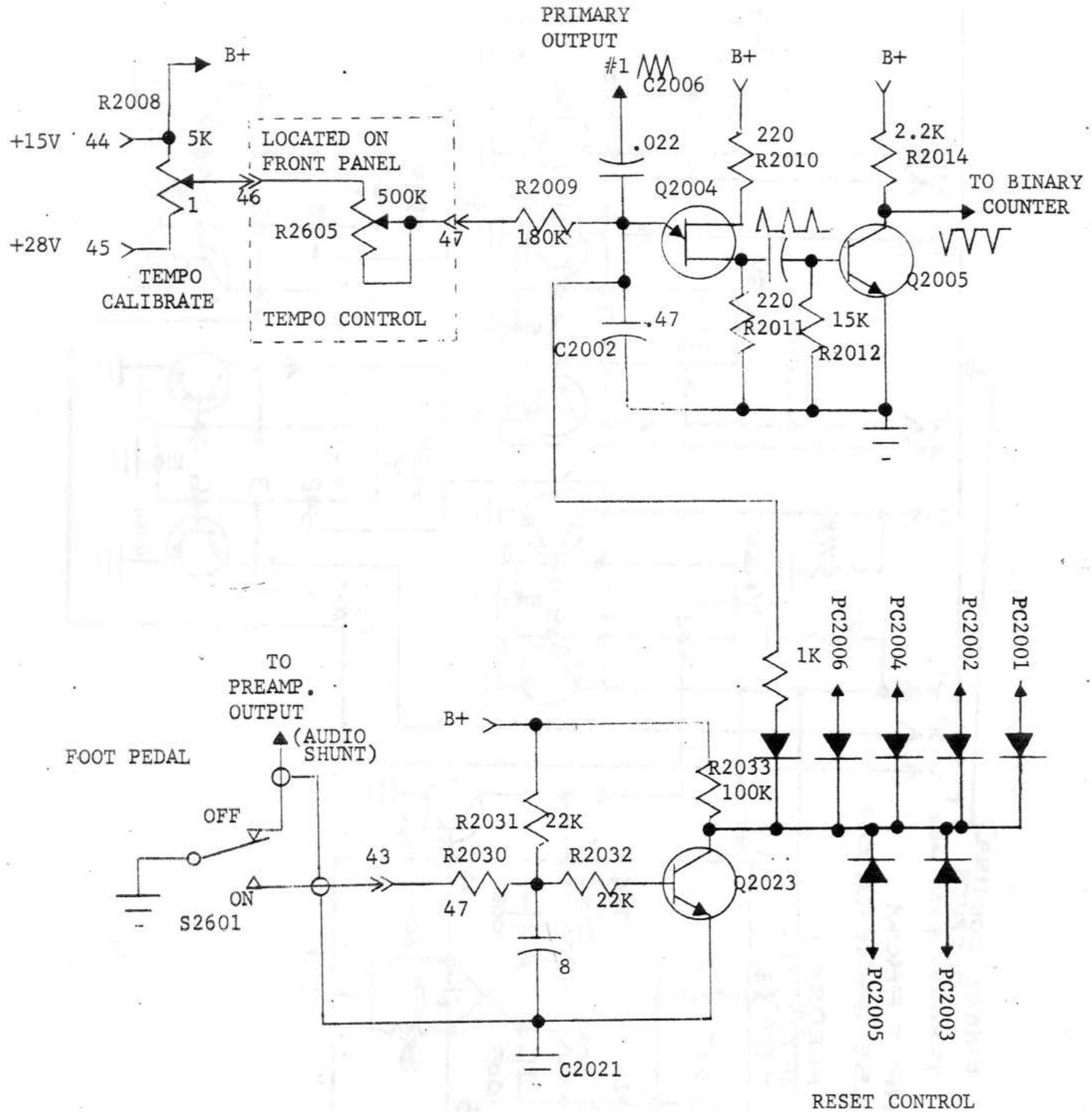


Figure 69

Schematic Diagram #2
48-Count Binary Counter

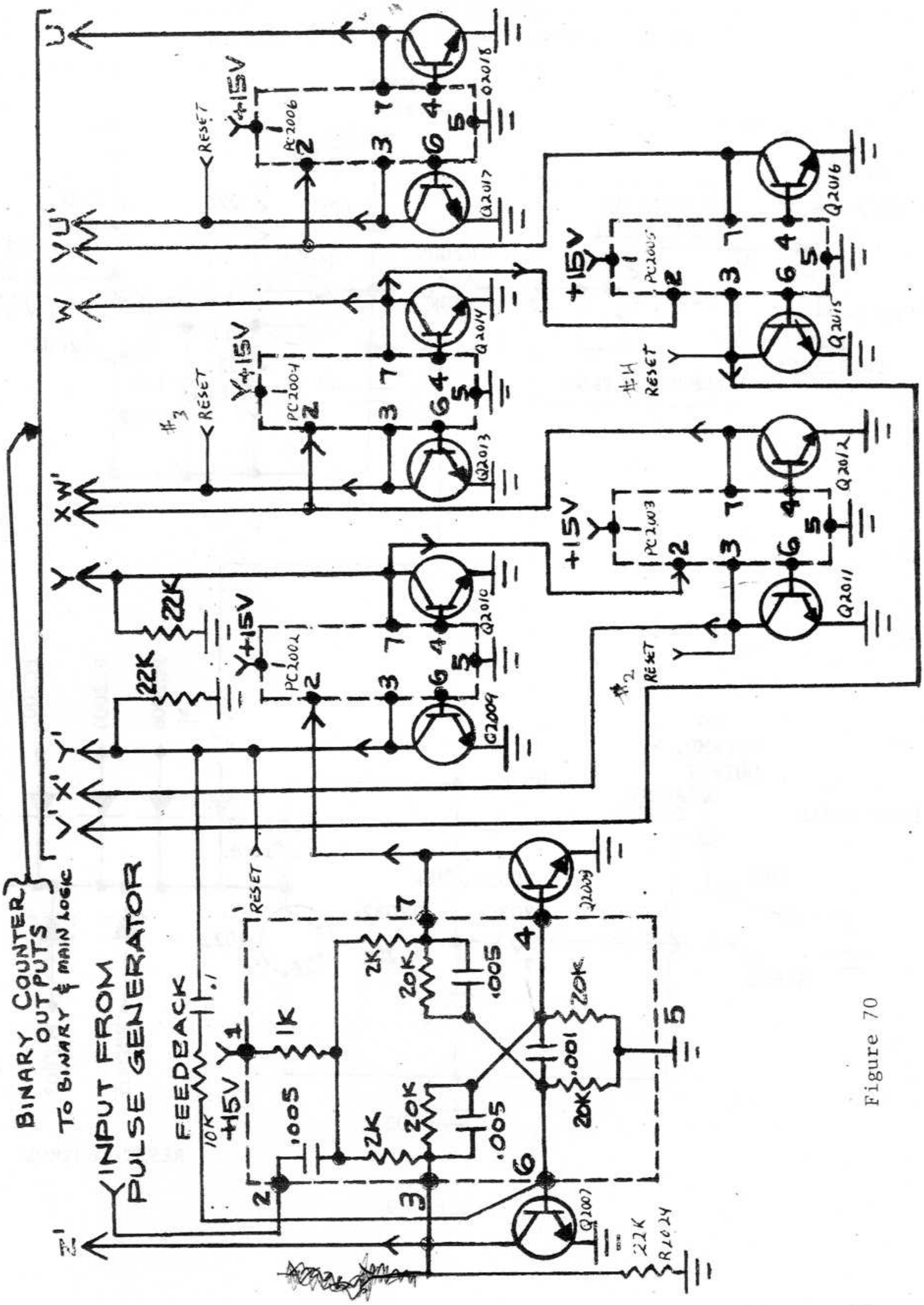


Figure 70

Schematic Diagram #3
Primary Logic

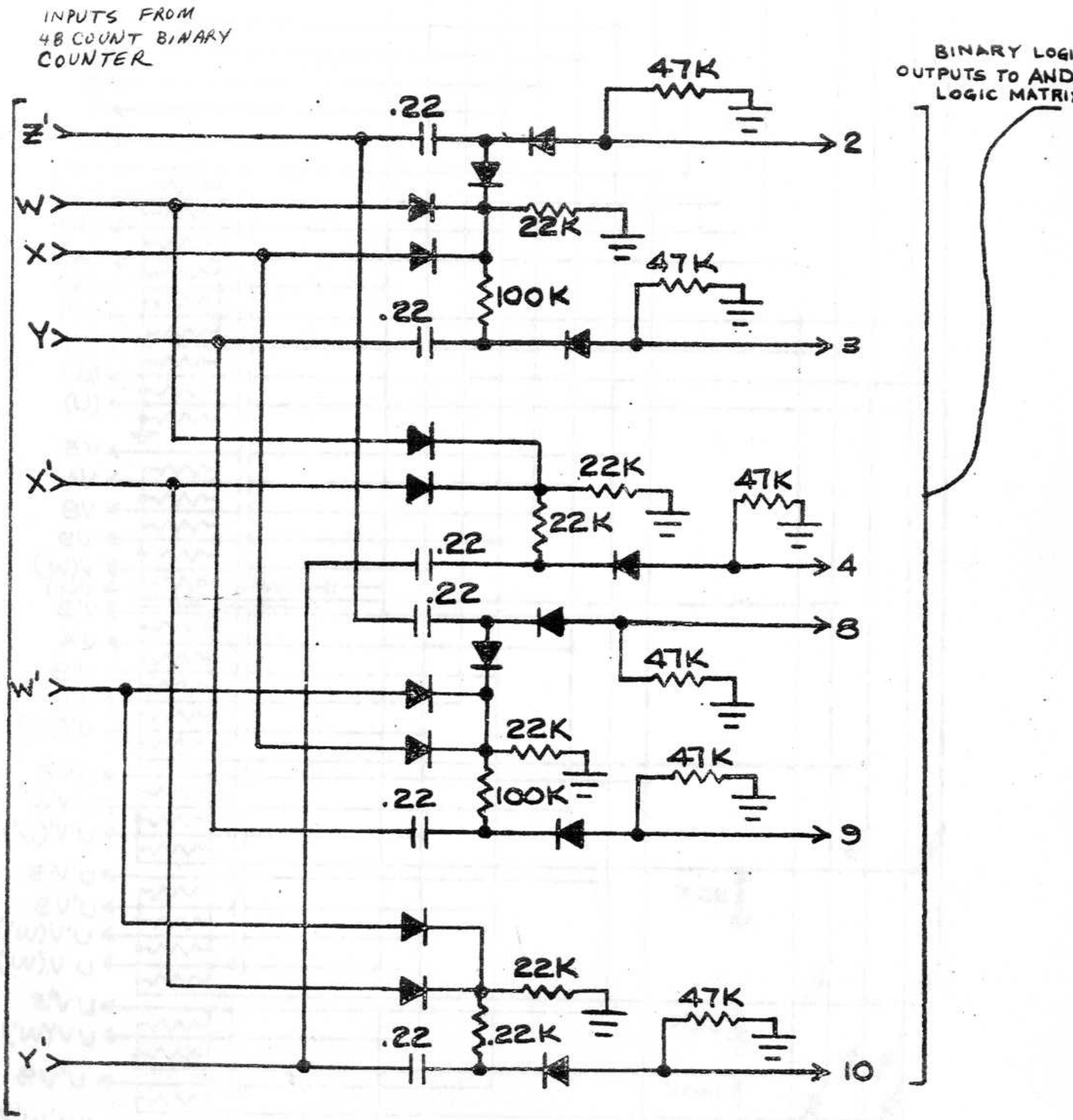


Figure 71

Schematic Diagram #4
AND Logic Matrix

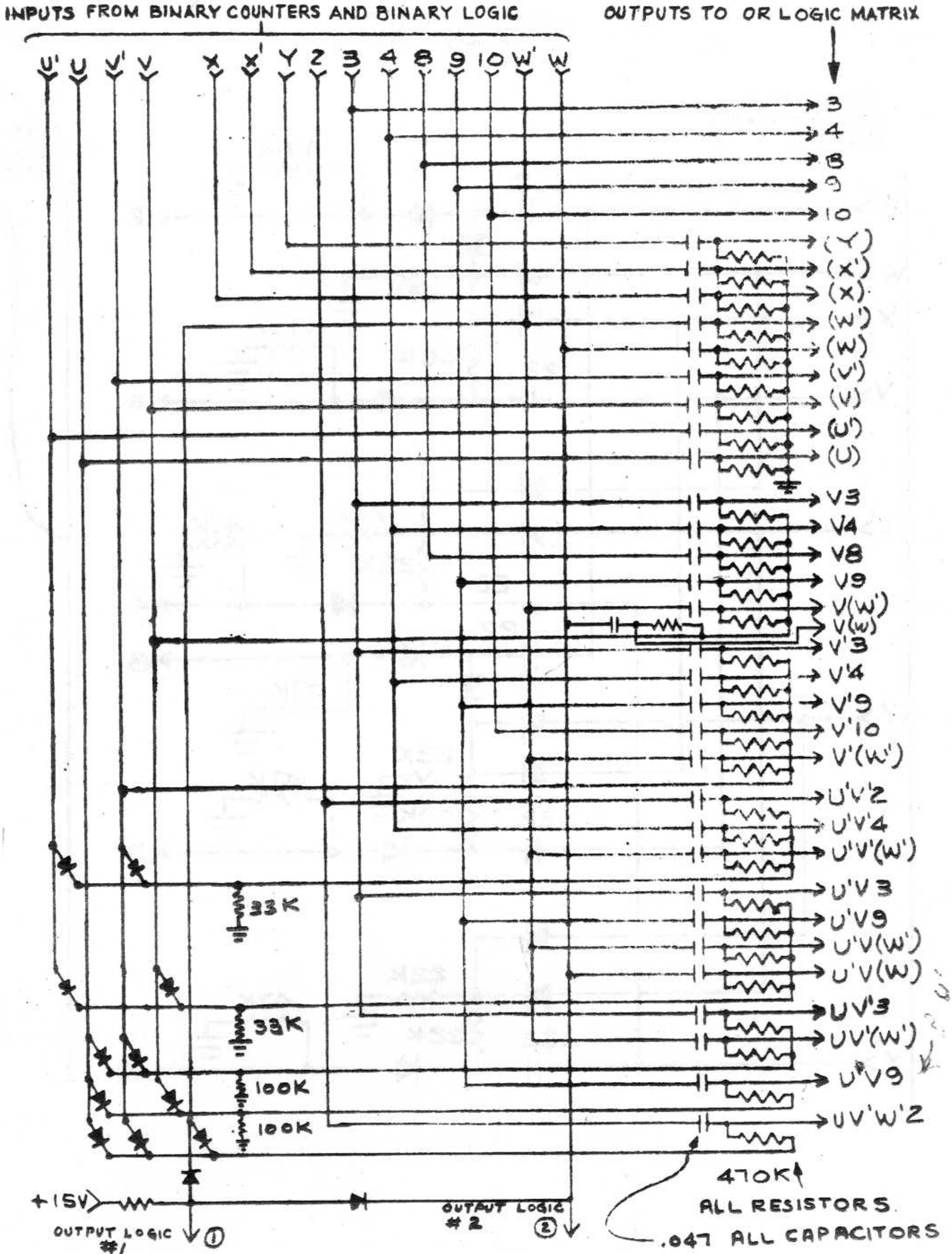


Figure 72

Schematic Diagram #5
OR Logic Matrix

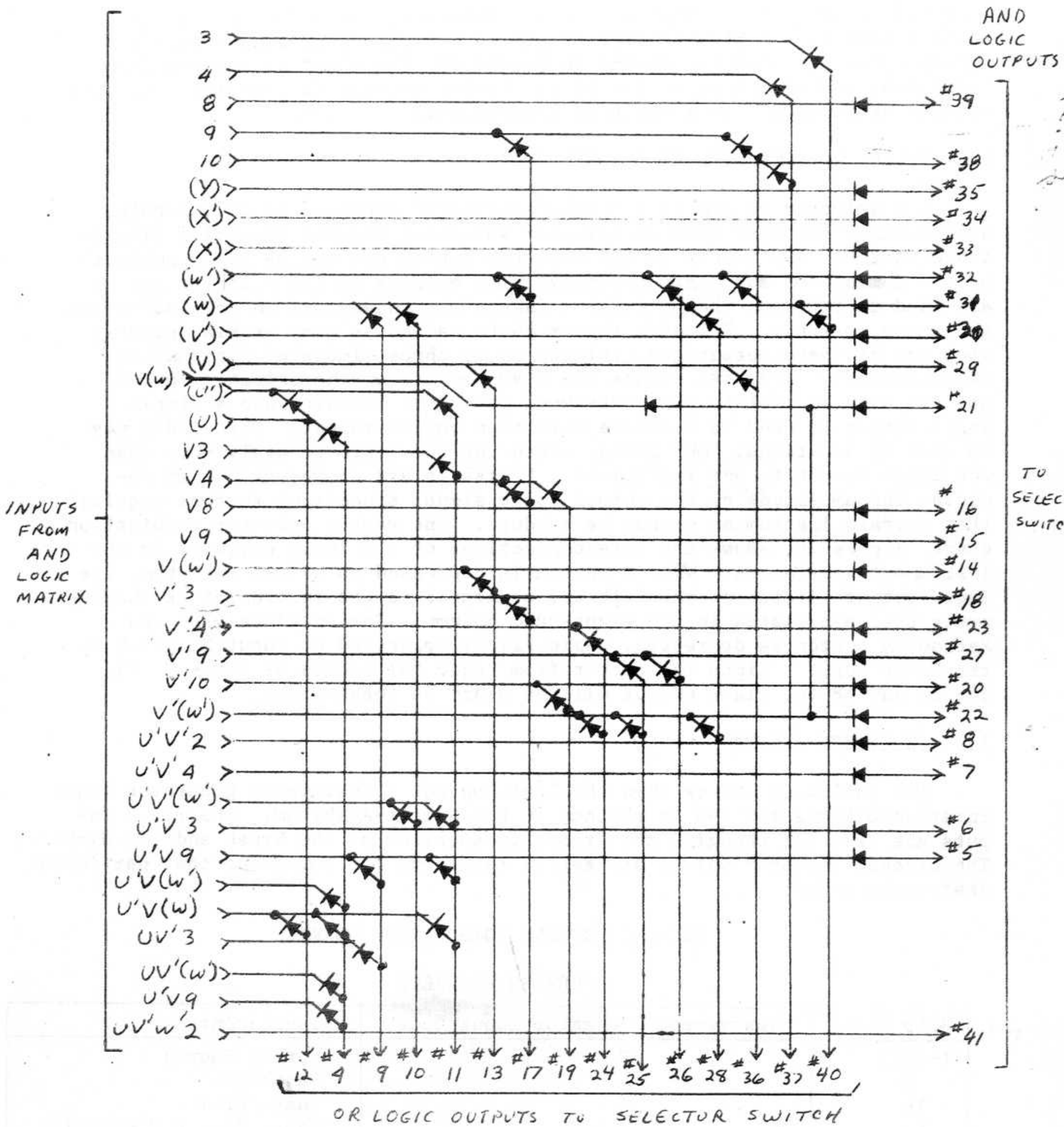


Figure 73

NOTE: Logic Outputs are on corresponding pin numbers (i.e., Logic Output #3 is on Pin 3 etc.)

11 FOOT PEDAL

The foot pedal in the SAR1 consists of a foot operated "push On - push Off" SPDT switch. When in the Off position, the switch shorts the audio output of the preamplifier to ground and simultaneously resets the binary counter. When the switch in turned On, the short is removed from the audio, and normal operation of the binary counter is restored, with the counter starting off at a count of 1 (downbeat).

12 SELECTOR SYSTEM THEORY OF OPERATION

The selector system of the Select-A-Rhythm consists of 18 six-pole, single-throw switches (Rhythm selector switches) and one two-pole, single-throw switch. The inputs to the selector system are the 39 logic outputs of the Commutator and Logic assembly. The outputs of the selector system are used to activate the percussion instrument generators in the instrument generator assembly. For each rhythm there can be as many as six outputs; each one of these outputs may activate up to three simulated instruments simultaneously. Several diodes are also mounted on the selector switch and are used to isolate the instrument generator circuit when a single logic output is used to activate more than one instrument. The diodes may be used as additional "OR" gates, extending the logic to apply more than one logic output to one instrument. Resistors are on the switch to decrease the amplitude of the output logic signal since some rhythms require that certain instrument sounds be subdued. The rhythm selector combination chart, Figure 74, shows the interconnections of the logic circuits to the instrument generators. When a button is depressed to select a rhythm, the logic outputs listed on the left are connected to the instrument or instruments that are listed in the right-hand column. For instance when the Metronome button is depressed, Logic #31 is connected to input H, which is the Clave input. Since the output from Logic #31 occurs at times 0, 12, 24, 36 and 48 the Clave output will be heard at these times.

13 SELECTION SYSTEM

The following charts show the logic output - instrument generator input interconnections for the 18 rhythms in the Select-A-Rhythm. The +15 V inputs are used for changing the frequency spectrum of the Brush and the Cymbal. The bracket resistor values are series resistors for softening that particular instrument sound.

SELECTOR SYSTEM COMBINATION CHARTS

RHYTHM #1 WALTZ

Logic Code	Instrument Generator Input Code	Instrument
(+15V)	T	(Brush Shunt)
2	A	Sandblock
16	D	Snare Drum
23	D & F	Snare Drum & Tambourine
29	P	Bass Drum

Figure 74

SELECTOR SYSTEM COMBINATION CHARTS (CONT'D)

RHYTHM #2 VIENNESE WALTZ

Logic Code	Instrument Generator Input Code	Instrument
(+15V)	S	(Cymbal Shunt)
14	R & D	Cymbal & Snare Drum
16	R	Cymbal
23	D	Snare Drum
29	P	Bass Drum

RHYTHM #3 BALLAD FOX TROT

Logic Code	Instrument Generator Input Code	Instrument
7	D	Snare Drum
31	P	Bass Drum
32	D & R	Snare Drum & Cymbal
33	D (100K)	Soft Snare Drum

RHYTHM #4 SWING

Logic Code	Instrument Generator Input Code	Instrument
3	A	Sandblock
7	D	Snare Drum
32	R (33K)	Soft Cymbal
33	D & P	Snare Drum & Bass Drum
38	D	Snare Drum

RHYTHM #5 BIG BAND

Logic Code	Instrument Generator Input Code	Instrument
7-20 & 32	D	Snare Drum
31	R	Cymbal
33	P	Bass Drum
38	R (100K)	Soft Cymbal

RHYTHM #6 DIXIE LAND

Logic Code	Instrument Generator Input Code	Instrument
3	A	Sandblock
7	D	Snare Drum
32	B & J	Brush, Clave-Snare Drum and Bass Drum
33	D (100K)	Soft Bass Drum

Figure 74 (Cont'd)

SELECTOR SYSTEM COMBINATION CHARTS (CONT'D)

RHYTHM #7 TEEN BEAT

Logic Code	Instrument Generator Input Code	Instrument
15 & 31	P	Bass Drum
32	B & K (22K)	Brush and Soft Cow Bell
26	D	Snare Drum
33	R (100K)	Soft Cymbal

RHYTHM #8 RHUMBA

Logic Code	Instrument Generator Input Code	Instrument
4	H	Clave
9	K	Cow Bell
17	D (47K)	Soft Snare Drum
28	P	Bass Drum
36	M	Low Conga
40	P	Brush

RHYTHM #9 CHA CHA

Logic Code	Instrument Generator Input Code	Instrument
21 & 18	J	Clave, Snare Drum and Bass Drum
21	K	Cow Bell
29	P	Bass Drum
31	D	Snare Drum

RHYTHM #10 SAMBA

Logic Code	Instrument Generator Input Code	Instrument
13	L	High Conga
19	P & L	Bass Drum and High Conga
24	M	Low Conga
30	J & F	Clave, Snare Drum, Bass Drum and Tambourine
35	B	Brush
38	G	Cow Bell, Tambourine and Snare Drum

Figure 74 (Cont'd)

SELECTOR SYSTEM COMBINATION CHARTS (CONT'D)

RHYTHM #11 MAMBO

Logic Code	Instrument Generator Input Code	Instrument
6-15-27 & 33	L & K	High Conga and Cow Bell
22	M	Low Conga
28	E	Snare Drum, Bass Drum and Cymbal

RHYTHM #12 BEGUINE

Logic Code	Instrument Generator Input Code	Instrument
4	H	Clave
14	L	High Conga
25	M	Low Conga
28	N	Bass Drum and Cow Bell
34	D	Snare Drum
35	B	Brush

RHYTHM #13 TANGO

Logic Code	Instrument Generator Input Code	Instrument
6	D	Snare Drum
11	F	Tambourine
15	H & D	Clave and Snare Drum
28	J	Snare Drum, Clave and Bass Drum
38	H	Clave
41	D	Clave and Snare Drum

RHYTHM #14 BOLERO

Logic Code	Instrument Generator Input Code	Instrument
7-8-33-38 & 39	D & M	Snare Drum and Low Conga
10	C	Brush. Clave and Bass Drum

RHYTHM #15 6/8 SHUFFLE

Logic Code	Instrument Generator Input Code	Instrument
31	B & K	Brush and Cow Bell
33	D, R & P	Snare Drum, Bass Drum and Cymbal

Figure 74 (Cont'd)

SELECTOR SYSTEM COMBINATION CHARTS (CONT'D)

RHYTHM #16 MARCH POLKA

Logic Code	Instrument Generator Input Code	Instrument
12-5 & 32 31	D & H R & P	Snare Drum and Clave Cymbal and Bass Drum

RHYTHM #17 WESTERN

Logic Code	Instrument Generator Input Code	Instrument
30	H, K & L (100K)	Clave, Cow Bell and Soft High Conga
29	P	Bass Drum

RHYTHM #18 METRONOME

Logic Code	Instrument Generator Input Code	Instrument
31	H	Clave

Figure 74 (Cont'd)

SELECTION SYSTEM
Selector Switch Layout
(Top View)

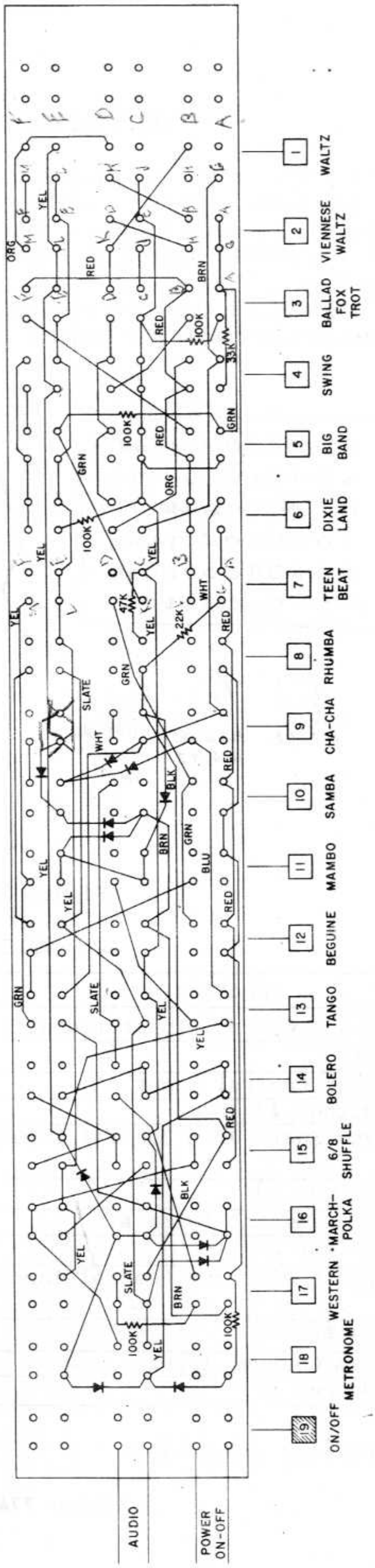


Figure 75

TERMINATION CHARTS

The following charts show the actual interconnections made when the rhythm button is depressed. Rhythm buttons on the selector switch are numbered from 1 to 18, to correspond to the number headings on the charts in Figure 77, and the On/Off button is #19. The terminals on the switch are labelled according to Figure 76. Each terminal is given a letter and this letter is prefixed with the number or correspond to the button number. The illustration faces the switch from the contact side.

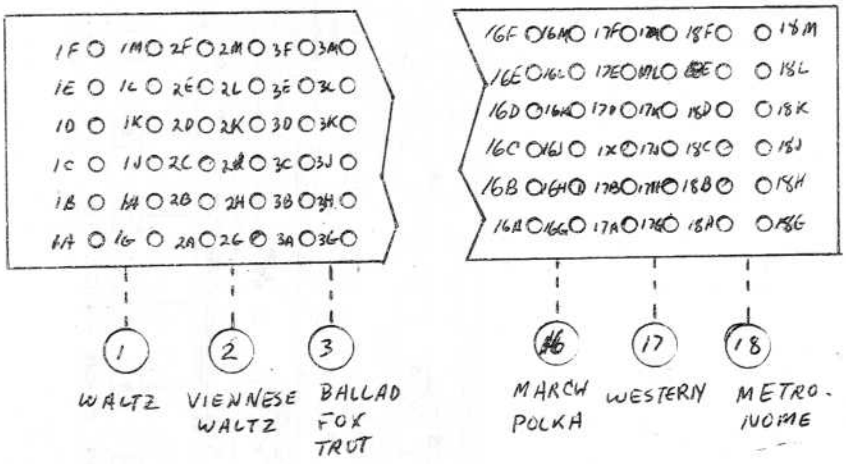


Figure 76

1. WALTZ

Terminal	Function	Terminations
* 1A	Brush Shunt Control Input (Input T +15V)	Instrument Generator Pin 19
1B	+15 Volts	Switch 19B
* 1C	Tambourine Control Input F	Instrument Generator Pin 6
1D	Logic Output 23	Commutator and Logic Pin 23
1E	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
* 1F	Logic Output 23	Commutator and Logic Pin 23
1G	Sandblock Control Input A	Instrument Generator Pin 1
* 1H	Logic Output 2	Commutator and Logic Pin 2
1J	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
1K	Logic Output 16	Commutator and Logic Pin 16
1L	Bass Drum Control Input	Instrument Generator Pin 14
1M	Logic Output 29	Commutator and Logic Pin 29

* Denotes cable harness connection.

Figure 77A

Termination Charts (Cont'd)

2. VIENNESE WALTZ

Terminal	Function	Termination
* 2A	Cymbal Control Input R	Instrument Generator Pin 15
* 2B	Logic Output #16	Commutator and Logic Pin 16
2C	Brush and Snare Drum Control (Input D)	Diode CR2302
* 2D	Logic Output #14	Commutator and Logic Pin 14
2E	Bass Drum Control Input P	Instrument Generator Pin 14
* 2F	Logic Output #29	Commutator and Logic Pin 29
2G	Cymbal Control Input R	Instrument Generator Pin 15
2H	Logic Output #14	Commutator and Logic Pin 14
2J	Cymbal Shunt Control Input	Instrument Generator Pin 20
2K	+15 Volts	Switch 19B
2L	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
2M	Logic Output #23	Commutator and Logic Pin 23

Figure 77B

3. BALLAD FOX TROT

Terminal	Function	Termination
3A	Cymbal Control Input B	Instrument Generator Pin 15
3B	Logic Output #32	Commutator and Logic Pin 32
* 3C	Cymbal Shunt Control	Instrument Generator Pin 20
3D	+15 Volts	Switch 19B
3E	Brush and Snare Drum Control	Diode CR2301 Instrument Generator Pin 4
* 3F	Logic Output #32	Commutator and Logic Pin 32
3G	Soft Brush and Snare Drum	R2301 (Diode CR2302) Instrument Generator Pin 4
3H	Logic Output #33	Commutator and Logic Pin 33
3J	Brush and Snare Drum (Control Input D)	Diode CR2302 Instrument Generator Pin 4
* 3K	Logic Output #7	Commutator and Logic Pin 7
3L	Bass Drum Control Input P	Instrument Generator Pin 14
* 3M	Logic Output #31	Commutator and Logic Pin 31

Figure 77C

* Denotes cable harness connection.

Termination Charts (Cont'd)

4. SWING

Terminal	Function	Termination
4A	Sandblock Control Input A	Instrument Generator Pin 1
4B	Logic Output #3	Commutator and Logic Pin 3
4C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
4D	Logic Output #7	Commutator and Logic Pin 7
4E	Bass Drum Control Input P	Instrument Generator Pin 14
4F	Logic Output #33	Commutator and Logic Pin 33
4G	Low Cymbal Input R	R2023 Instrument Generator Pin 15
4H	Logic Output #32	Commutator and Logic Pin 32
4J	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
4K	Logic Output #33	Commutator and Logic Pin 33
4L	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
* 4M	Logic Output #38	Commutator and Logic Pin 38

Figure 77D

5. BIG BAND

Terminal	Function	Termination
5A	Cymbal Control Input R	Instrument Generator Pin 15
5B	Logic Output #31	Commutator and Logic Pin 31
5C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
5D	Logic Output #7	Commutator and Logic Pin 7
5E	Soft Cymbal Control Input R	R2303 Instrument Generator Pin 15
5F	Logic Output #38	Commutator and Logic Pin 38
5G	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
5H	Logic Output #32	Commutator and Logic Pin 32
5J	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
* 5K	Logic Output #20	Commutator and Logic Pin 20
5L	Bass Drum Control Input P	Instrument Generator Pin 14
* 5M	Logic Output #33	Commutator and Logic Pin 33

Figure 77E

* Denotes cable harness connection

Termination Charts (Cont'd)

6. DIXIELAND

Terminal	Function	Termination
6A	Snare Drum, Clave and Bass Drum Control Input J	Instrument Generator Pin 9
6B	Logic Output #32	Commutator and Logic Pin 32
6C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
6D	Logic Output #7	Commutator and Logic Pin 7
6E	Bass Drum Control Input P	Instrument Generator Pin 14
6F	Logic Output #33	Commutator and Logic Pin 33
6G	Brush Control Input B	Instrument Generator Pin 2
6H	Logic Output #32	Commutator and Logic Pin 32
* 6J	Sandblock Control Input A	Instrument Generator Pin 1
* 6K	Logic Output #3	Commutator and Logic Pin 3
6L	Soft Brush and Snare Drum Control Input D	R2304 (Diode CR2302) Instrument Generator Pin 4
6M	Logic Output #33	Commutator and Logic Pin 33

Figure 77F

7. TEEN BEAT

Terminal	Function	Termination
7A	Brush Control Input B	Instrument Generator Pin 2
7B	Logic Output #32	Commutator and Logic Pin 32
7C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
* 7D	Logic Output #26	Commutator and Logic Pin 26
7E	Bass Drum Control Input P	Instrument Generator Pin 14
* 7F	Logic Output #31	Commutator and Logic Pin 31
7G	Cow Bell Control Input K	Instrument Generator Pin 10
7H	Logic Output #32	Commutator and Logic Pin 32
7J	Soft Cymbal Control Input R	R2303 Instrument Generator Pin 15
* 7K	Logic Output #35	Commutator and Logic Pin 35
7L	Bass Drum Control Input P	Instrument Generator Pin 14
7M	Logic Output #15	Commutator and Logic Pin 15

Figure 77G

* Denotes cable harness connection

Termination Charts (Cont'd)

8. RHUMBA

Terminal	Function	Termination
8A	Brush Control, Input B	Instrument Generator Pin 2
* 8B	Logic Output #40	Commutator Logic Pin 40
8C	Soft Brush and Snare Drum Control Input D	R2305 (Diode CR2302) Instrument Generator Pin 14
* 8D	Logic Output #17	Commutator and Logic Pin 17
8E	Bass Drum Control Input P	Instrument Generator Pin 14
* 8F	Logic Output #28	Commutator and Logic Pin 28
8G	Low Conga Control Input M	Instrument Generator Pin 12
* 8H	Logic Output #36	Commutator and Logic Pin 36
8J	Cow Bell Control Input K	Instrument Generator Pin 10
* 8K	Logic Output #9	Commutator and Logic Pin 9
8L	Clave Control Input H	Instrument Generator Pin 8
* 8M	Logic Output #4	Commutator and Logic Pin 4

Figure 77H

9. CHA CHA

Terminal	Function	Termination
9A	Snare Drum, Clave and Bass Drum Control Input J	Instrument Generator Pin 9
* 9B	Logic Output #18	Commutator and Logic Pin 18
9C	Cow Bell Control Input K	Instrument Generator Pin 10
* 9D	Logic Output #21	Commutator and Logic Pin 21
9E	Bass Drum Control Input P	Instrument Generator Pin 14
* 9F	Logic Output #29	Commutator and Logic Pin 29
9G	Not Used	None
* 9H	Tie Point for Tambourine Input	Instrument Generator Pin 6
9J	Snare Drum, Clave and Bass Drum Control Input J	Instrument Generator Pin 9
9K	Logic Output #21	Commutator and Logic Pin 21
9L	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
9M	Logic Output #31	Commutator and Logic Pin 31

Figure 77I

* Denotes cable harness connection

Termination Charts (Cont'd)

10. SAMBA

Terminal	Function	Termination
10A	Brush Control Input B	Instrument Generator Pin 12
10B	Logic Output #35	Commutator and Logic Pin 35
* 10C	Snare Drum, Tambourine and Cow Bell Control Input G	Instrument Generator Pin 9
10D	Logic Output #38	Commutator and Logic Pin 38
10E	Tambourine Control Input F and Snare Drum, Clave and Bass Drum Input J	Diode CR2304 - Instrument Generator Pin 9 - and Diode CR2305 - Instrument Generator Pin 6
* 10F	Logic Output #31	Commutator and Logic Pin 31
10G	Low Conga Control Input M	Instrument Generator Pin 12
* 10H	Logic Output #24	Commutator and Logic Pin 24
10J	High Conga Control Input L	Instrument Generator Pin 11
* 10K	Logic Output #13	Commutator and Logic Pin 13
10L	Bass Drum Control Input P and High Conga Input L	Diode CR2306 - Instrument Generator Pin 14 and Diode CR2307 Instrument Generator Pin 11
* 10M	Logic Output #19	Commutator and Logic Pin 19

Figure 77J

11. MAMBO

Terminal	Function	Termination
11A	Low Conga Control Input M	Instrument Generator Pin 12
* 11B	Logic Output #22	Commutator and Logic Pin 22
11C	High Conga Control Input L and Cow Bell Control Input K	Diode CR2308 - Instrument Generator Pin 11 and Diode CR2308 Instrument Generator Pin 10
* 11D	Logic Output #27	Commutator and Logic Pin 27
11E	Same as 11C	Same as 11C
* 11F	Logic Output #33	Commutator and Logic Pin 33
* 11G	Snare Drum, Bass Drum and Cymbal Control Input E	Instrument Generator Pin 5
11H	Logic Output #28	Commutator and Logic Pin 28
11J	Same as 11C	Same as 11C
11K	Logic Output #6	Commutator and Logic Pin 6
11L	Same as 11C	Same as 11C
* 11M	Logic Output #15	Commutator and Logic Pin 15

Figure 77K

* Denotes cable harness connection

Termination Charts (Cont'd)

12. BEGUINE

Terminal	Function	Termination
12A	Brush Control Input B	Instrument Generator Pin 2
12B	Logic Output #35	Commutator and Logic Pin 35
12C	High Conga Control Input L	Instrument Generator Pin 11
* 12D	Logic Output 14	Commutator and Logic Pin 14
12E	Clave Control Input H	Instrument Generator Pin 8
12F	Logic Output #4	Commutator and Logic Pin 4
12G	Low Conga Control Input M	Instrument Generator Pin 12
* 12H	Logic Output #25	Commutator and Logic Pin 25
12J	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
* 12K	Logic Output #34	Commutator and Logic Pin 34
* 12L	Bass Drum and Cow Bell Control Input N	Instrument Generator Pin 13
* 12M	Logic Output #28	Commutator and Logic Pin 28

Figure 77L

13. TANGO

Terminal	Function	Termination
13A	Tambourine Control Input F	Instrument Generator Pin 6
* 13B	Logic Output #11	Commutator and Logic Pin 11
13C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
* 13D	Logic Output #41	Commutator and Logic Pin 41
13E	Snare Drum, Clave and Bass Drum Control Input J	Instrument Generator Pin 9
13F	Logic Output #28	Commutator and Logic Pin 28
13G	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
* 13H	Logic Output #6	Commutator and Logic Pin 6
13J	Clave Control Input H	Instrument Generator Pin 8
13K	Logic Output #38	Commutator and Logic Pin 38
13L	Brush and Snare Drum Control Input D and Clave Control Input H	Diode CR2309 Instrument Generator Pin 4 Diode CR2310 Instrument Generator Pin 8
13M	Logic Output #15	Commutator Logic Pin 15

Figure 77M

* Denotes cable harness connection

Termination Charts (Cont'd)

14. BOLERO

Terminal	Function	Termination
14A	Soft Low Conga Control Input H and Brush and Snare Drum Control Input D	Diode CR2311 (R2308) Instrument Generator Pin 12 and Diode CR2312
* 14B	Logic Output #7	Instrument Generator Pin 4 Commutator and Logic Pin 7
14C	Same as 14A	Same as 14A
* 14D	Logic Output #38	Commutator and Logic Pin 38
14E	Brush, Clave and Bass Drum Control Input C	Instrument Generator Pin 3
* 14F	Logic Output #10	Commutator and Logic Pin 10
14G	Same as 14A	Same as 14A
* 14H	Logic Output #8	Commutator and Logic Pin 8
14J	Same as 14A	Same as 14A
* 14K	Logic Output #39	Commutator and Logic Pin 39
14L	Same as 14A	Same as 14A
14M	Logic Output #33	Commutator and Logic Pin 33

Figure 77N

15. 6/8 SHUFFLE

Terminal	Function	Termination
15A	Cow Bell Control Input K	Instrument Generator Pin 10
15B	Logic Output #31	Commutator and Logic Pin 31
15C	Brush and Snare Drum Control Input D	Diode CR2302 Instrument Generator Pin 4
15D	Logic Output #33	Commutator and Logic Pin 33
15E	Brush and Snare Drum Control Input D	Diode CR2301 Instrument Generator Pin 4
* 15F	Logic Output #37	Commutator and Logic Pin 37
* 15G	Brush Control Input B	Instrument Generator Pin 2
15H	Logic Output #31	Commutator and Logic Pin 31
15J	Cymbal Control Input R	Instrument Generator Pin 15
15K	Logic Output #33	Commutator and Logic Pin 33
15L	Bass Drum Control Input P	Instrument Generator Pin 14
* 15M	Logic Output #33	Commutator and Logic Pin 33

Figure 77O

* Denotes cable harness connection

Termination Charts (Cont'd)

16. MARCH POLKA

Terminal	Function	Termination
16A	Clave Control Input H and Brush and Snare Drum Control Input D	Diode CR2310 - Instrument Generator Pin 8 - Diode CR2309 Instrument Generator Pin 4
* 16B	Logic Output #12	Commutator and Logic Pin 12
16C	Same as 16A	Same as 16A
* 16D	Logic Output #32	Commutator and Logic Pin 32
16E	Bass Drum Control Input P	Instrument Generator Pin 14
* 16F	Logic Output #31	Commutator and Logic Pin 31
16G	Same as 16A	Same as 16A
* 16H	Logic Output #5	Commutator and Logic Pin 5
16J	Tie Point	Tie Point of Instrument Generator Pin 4
16K	Tie Point..	Tie Point of Instrument Generator Pin 4
* 16L	Cymbal Control Input R	Instrument Generator Pin 15
16M	Logic Output #31	Commutator and Logic Pin 31

Figure 77P

17. WESTERN

Terminal	Function	Termination
* 17A	Low Conga Control Input M	Instrument Generator Pin 12
17B	Logic Output #39	Commutator and Logic Pin 39
* 17C	Cow Bell Control Input K	Instrument Generator Pin 10
* 17D	Logic Output #30	Commutator and Logic Pin 30
* 17E	Bass Drum Control Input P	Instrument Generator Pin 14
* 17F	Logic Output #29	Commutator and Logic Pin 29
* 17G	Soft High Conga Control Input L	Instrument Generator Pin 11
17H	Logic Output #30	R2309 Commutator and Logic Pin 30
17J	Clave Control Input H	Instrument Generator Pin 8
17K	Logic Output #30	Commutator and Logic Pin 30
17L	Not Used	Not Used
17M	Not Used	Not Used

Figure 77Q

* Denotes cable harness connection

Termination Charts (Cont'd)

18. METRONOME

Terminal	Function	Termination
18A	Not Used	None
18B	Not Used	None
* 18C	Clave Control Input H	Instrument Generator Pin 8
18D	Logic Output #31	Commutator and Logic Pin 31
18E	Not Used	None
18F	Not Used	None
18G	Tie Point	R2308-CR2311 Tie Point
18H	Not Used	None
18J	Tie Point	CR2311 and CR2313 Tie Point
18K	Not Used	None
* 18L	Tie Point	CR2312 Tie Point
18M	Not Used	None

Figure 77R

19. ON/OFF

Terminal	Color	Function	Termination
* 19A		On/Off AC	Center Tap of Power Transformer Secondary
19B	Black	On/Off AC	Chassis Ground
* 19C		Not Used	None
* 19D		Not Used	None

Figure 77S

* Denotes cable harness connection

14 SELECT-A-RHYTHM INSTRUMENT GENERATOR

The Instrument Generator Assembly electrically simulates the 10 percussion instrument sounds heard in the audio output of the Select-A-Rhythm. These instruments are:

1. Sandblock
2. Brush
3. Snare Drum
4. Tambourine
5. Clave
6. Cow Bell
7. Hi Conga Drum
8. Lo Conga Drum
9. Bass Drum
10. Cymbal

The signals which activate the various instrument sounds are the switched logic outputs of the selection system. The selection system directs the logic outputs from the Commutator and Logic assembly, to the proper instrument inputs in the correct time sequence. The net result is a rhythm voiced to authentically represent the rhythms selected.

The operation of the instrument generator can be more easily understood if a comparison is made between the actual percussion instruments and the electrical circuits which simulate them. There are two basic percussion sound types. These are: (1) the uniform vibration that results when a drum head is struck, and (2) a non-uniform clanging or metallic sound, as a cymbal. The logic input pulses are analogous to the action of striking a percussion instrument. Every percussion instrument sound is composed of one or both of these basic sound types. The electrical equivalent of these two sound types are a resonant tank circuit (drum) and pulse circuits with superimposed noise (metallic sound).

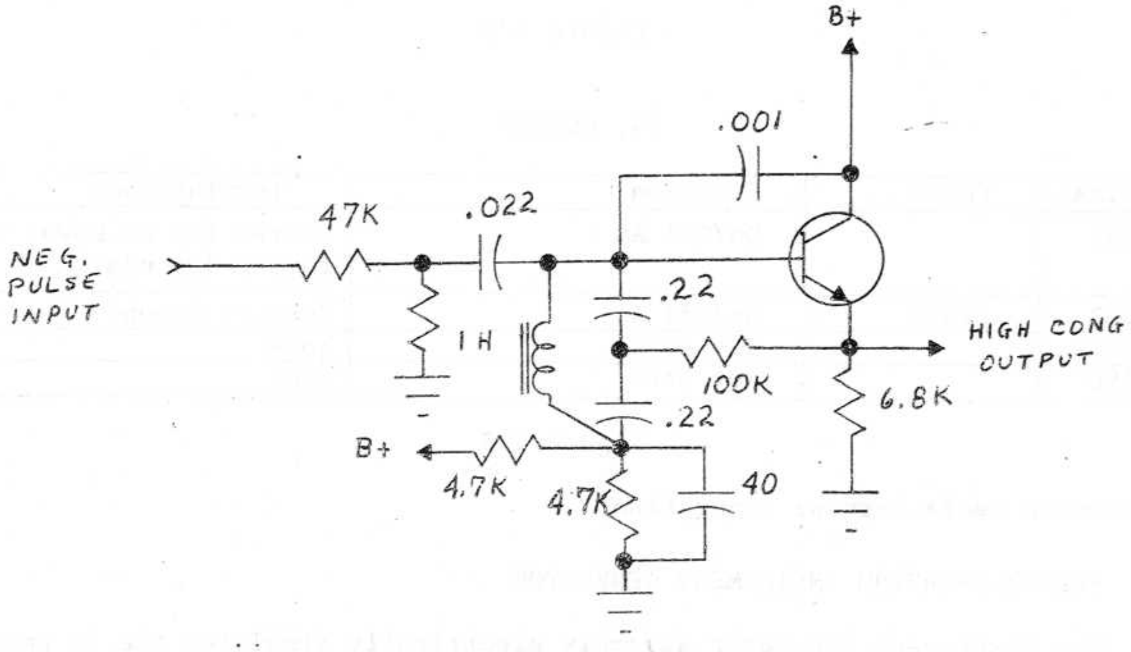


Figure 78

Figure 78 is a simplified schematic diagram of the Hi Conga drum generator. A negative input pulse shock excites the resonant tank circuit, composed of the 1 henry Inductor and the two .22 mfd capacitor. This circuit generates a sound the equivalent of striking a drum head. The entire circuit is somewhat similar to a Colpitt's oscillator. However, there is insufficient feedback to maintain oscillations indefinitely and in effect, the transistor merely acts as a Q multiplier in that it maintains the oscillations in the tank circuit for a relatively long time after excitation. In addition to its actions as a Q multiplier, the transistor also serves as the output emitter follower circuit of the Hi Conga Drum generator. The .001 capacitor between the collector and base suppresses any tendency of the circuit to break into parasitic oscillations.

The type of sound associated with the cymbal is a ringing, metallic type of sound. When a cymbal is struck, it vibrates at many frequencies simultaneously. Electrically this is duplicated by generating pulses with superimposed white noise. Figure 79 shows a simplified schematic diagram of the brush generating circuit.

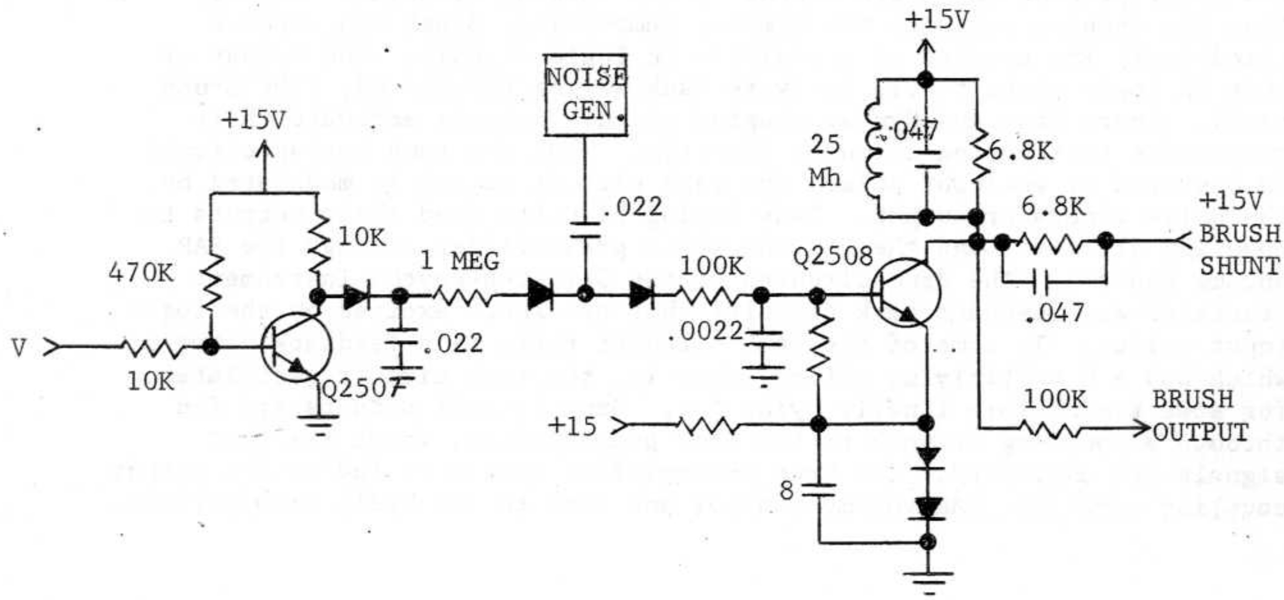


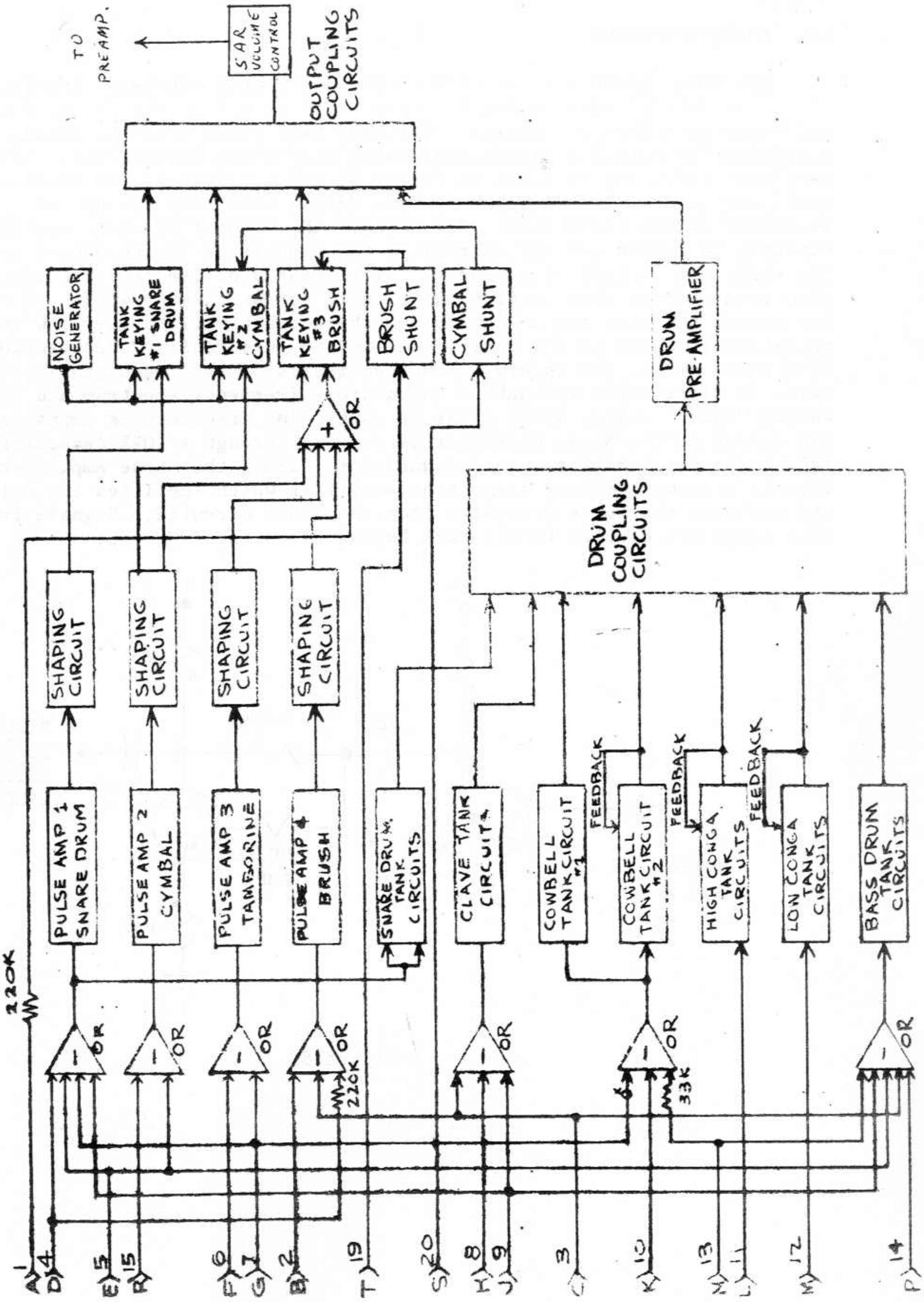
Figure 79

The brush sound of the Select-A-Rhythm imitates the sound of the Hi-Hat Cymbal being struck with the brush. A negative pulse cuts off the normally saturated transistor Q2507, permitting the .022 mfd capacitor to charge. When the pulse has passed, the diode blocks the capacitor from discharging back through Q2507 so it discharges more slowly through the resistor-diode network to the base of Q2508. Q2508 is normally cut off. However, when the .022 mfd capacitor is charged its discharge current, which is combined with noise from the noise generator, causes Q2508 to conduct and amplify the noise. The amount of amplification is dependent on the base current and falls off gradually as the capacitor discharges. The L-C resonant circuit in the collector of Q2508 serves to emphasize a relatively narrow bank of noise frequencies and to by-pass the others. Completing the brush-shunt circuit to +15 volts will both lower the resonant frequency and broaden the pass band.

Over-all operation of the Instrument Generator is shown in the block diagram, Figure 80. Inputs to the Instrument Generator are the switched logic outputs from the Selector Switch. Note that several of these inputs activate two or three instruments simultaneously; for example, the Snare Drum, Bass Drum and Cymbal will all sound when there is a pulse present at input E.

Inputs from the Selector Switch, with the exception of A, L and M (the inputs for the Sandblock, Lo Conga, and Bass Drum) are connected to negative OR logic circuits. These logic circuits prevent cross coupling of the inputs. Since the inputs are negative pulses, the OR input logic circuits have an output pulse for each input pulse. The four pulse amplifiers (Snare Drum, Cymbal, Tambourine and Brush) amplify and invert the input pulses, which are shaped by the shaping circuits. Outputs from the shaping circuits for Cymbal, Tambourine, Brush and Input A (Sandblock) are coupled to a positive OR logic circuit. The output of this OR logic circuit will activate tank keying circuit #3, (the Brush tank). Snare Drum and Cymbal shaping circuit outputs activate their respective tank keying circuits directly. When the tank keying circuit is operated by an input pulse, the tank circuit output is modulated by the noise generator output. Tank keying circuits feed their outputs to coupling circuits, and then to the audio preamplifier through the SAR volume control. The drum circuits of the Select-A-Rhythm Instrument Generator are resonant tank circuits that are shock excited by the logic input pulses. In some of the tank circuits there is a feedback network which has a Q multiplying effect, that is, the tank circuit oscillates for some time before finally dying out. Drum circuit outputs are fed through a coupling network to the Drum preamplifier, where the Drum signals are amplified. The Drum preamplifier output is fed to the output coupling circuits, SAR volume control and then to the audio preamplifier.

INSTRUMENT GENERATOR
Block Diagram



15 NOISE GENERATOR

The Noise Generator circuits of the Instrument Generator provides the basic "white" noise which is keyed and filtered in the Brush, Cymbal and Snare Drum Keying circuits. The wide band noise after filtering simulates the metallic sounds associated with these instruments. Noise Generator circuitry is shown in Figure 81 and consists of two transistors, Q2501 and Q2502. The Noise Generator, Q2501, uses only two of the electodes of the transistor. The base of the transistor is connected directly to ground and the emitter of the transistor is the output terminal. The collector is left disconnected. The transistor used in this circuit, when connected in this configuration, will act as a Zener diode. Since the series resistor has a high value, the current will be very low and operation is close to the Zener knee, and in this region, creates wide band noise due to the internal characteristics of the transistor. This noise is distributed throughout the audible frequency spectrum and is called "white" noise, which means no particular frequency is emphasized. The output of the Noise Generator is coupled through a .022 capacitor and fed to the input of the second transistor, Q2502, the Noise Amplifier. This is a common emitter transistor amplifier which amplifies the noise and isolates the Noise Generator from the other circuits. Signals from this stage are coupled to the tank keying circuits.

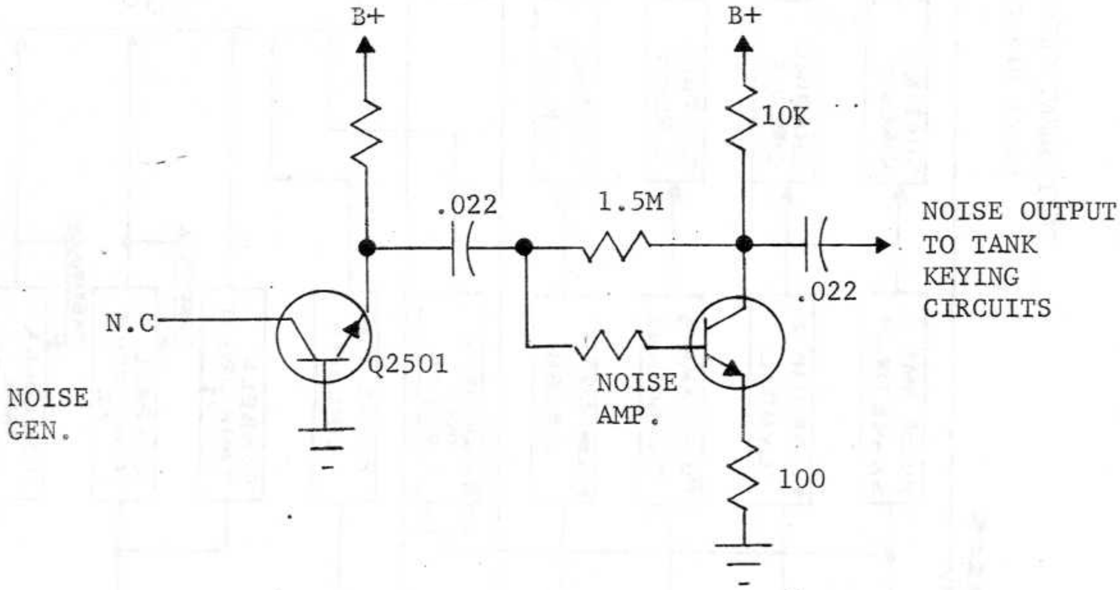


Figure 81

Interconnection Diagram

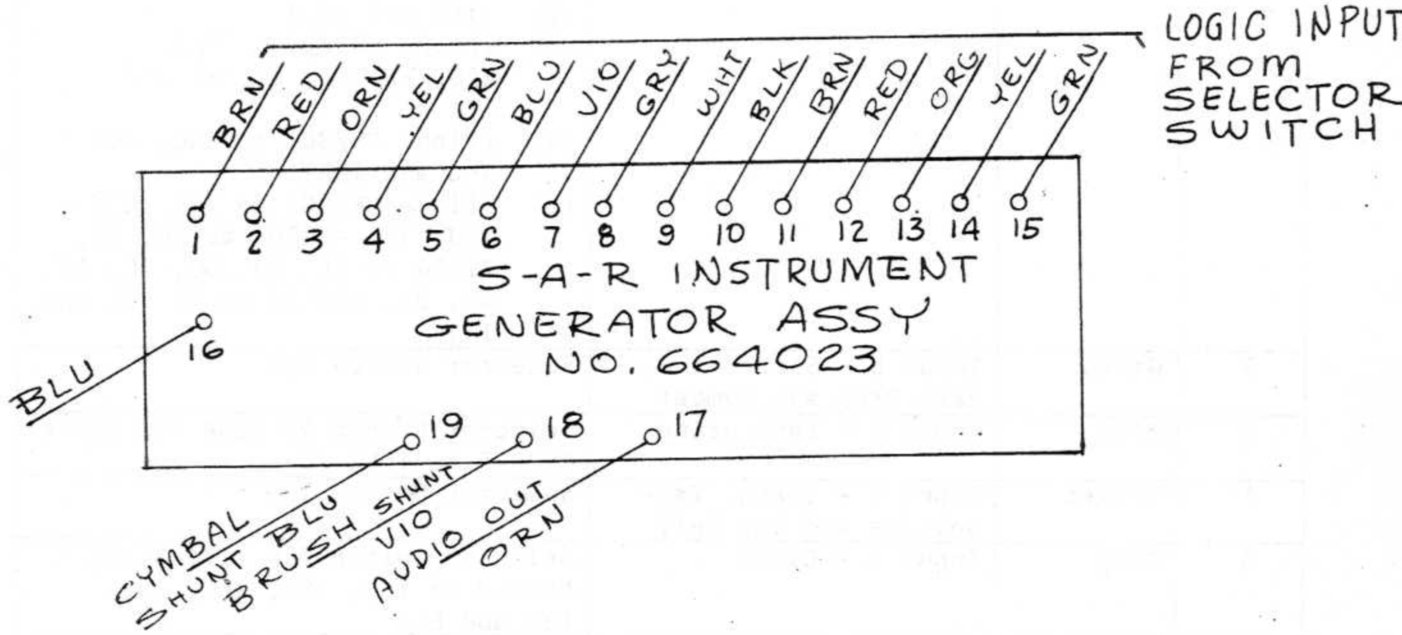


Figure 82

Figure 82 is the Interconnection Diagram for the Instrument Generator Assembly. Wiring from this assembly terminates at the Selector Switch, each wire being listed in the termination chart, Figure 83.

The termination charts, Figure 83, are read as follows: the first terminal listed in the termination chart is the connection made in the cable harness. Terminals in parenthesis are Selector Switch internal jumpers.

INSTRUMENT GENERATOR ASSEMBLY TERMINATION CHART

PIN	COLOR	FUNCTION	TERMINATION
1	Brown	Input A - Sandblock	Selector Switch 6J (4A and 1G)
2	Red	Input B - Brush	Selector Switch 15G (12A, 10A, 8A, 7A and 6G)
3	Orange	Input-Brush, Clave and Bass Drum	Selector Switch 14E
4	Yellow	Input D - Brush and Snare Drum	Selector Switch 18L (1) (Diode CR2312 to 18J, 14G, 14A, 14J, 14C and 14L) (2) (16K and 16J) (3) (Diode CR2301 to 15E, 15G, 9L, 4L, 3E, 2L and 1E) (4) (Diode CR2309 to 16G, 16A, 16C and 13L) (5) (Diode CR2302 to 15C, 13C, 12J, 7C, -R2305 to 8C, 6C, R2304 to 6L, 5J, 5G, 5C, 4J, 4C, 3J, -R2301 to 3G, 2C and 1J)
5	Green	Input E - Snare Drum, Bass Drum and Cymbal	Selector Switch 11G
6	Blue	Input F - Tambourine	Selector Switch 9H (13A and Diode CR2305 to 10E) 1C
7	Violet	Input G - Snare, Tambourine and Cow Bell	Selector Switch 10C
8	Gray	Input H - Clave	Selector Switch 18C (17J Diode CR2310 to 16G, 16A, 16C, 13J, 12E and 8L)
9	White	Input J - Snare Drum, Clave and Bass Drum	Selector Switch 9J, (9A, 6A, Diode CR2304 to 10E and 13E)
10	Black	Input K - Cow Bell	Selector Switch 17C (15A, 9C Diode CR2303 to 11C. 11J, 11E, 11L, 8J, R2306 to 7G
11	Brown	Input L - High Conga	Selector Switch 17G (12C, 10J, Diode CR208 to 11E, 11L, 11J and 11C, diode CR2307 to 10L)
12	Red	Input M - Low Conga	Selector Switch 17A (R2308 to 18G to CR2311 to 18J-14G-14A-14J-14C-14L, 12G, 11A, 10C and 8G)
13	Orange	Input N - Bass Drum and Cow Bell	Selector Switch 12L
14	Yellow	Input P - Bass Drum	Selector Switch 17E (16E, 15L, 9E, Diode CR2306 to 10L, 8E, 7L, 7E, 6E, 5L, 4E, 3L, 2E and 1L)

Figure 83

INSTRUMENT GENERATOR ASSEMBLY TERMINATION CHART (CONT'D)

PIN	COLOR	FUNCTION	TERMINATION
15	Green	Input R - Cymbal	Selector Switch 16L (15J) 2A(2G, 3A, R2302 to 4G, 5A R2303 to 5E and 7J)
16	Blue	+15 Volts Input	Commutator and Logic Pin 40
17	Orange	Audio Output	Selector Switch 20B
18	Violet	Input T - Brush Shunt	Selector Switch 1A
19	Blue	Input S - Cymbal Shunt	Selector Switch 3C (2J)

Figure 83 (Cont'd)

PULSE AMPLIFIES AND SHAPES

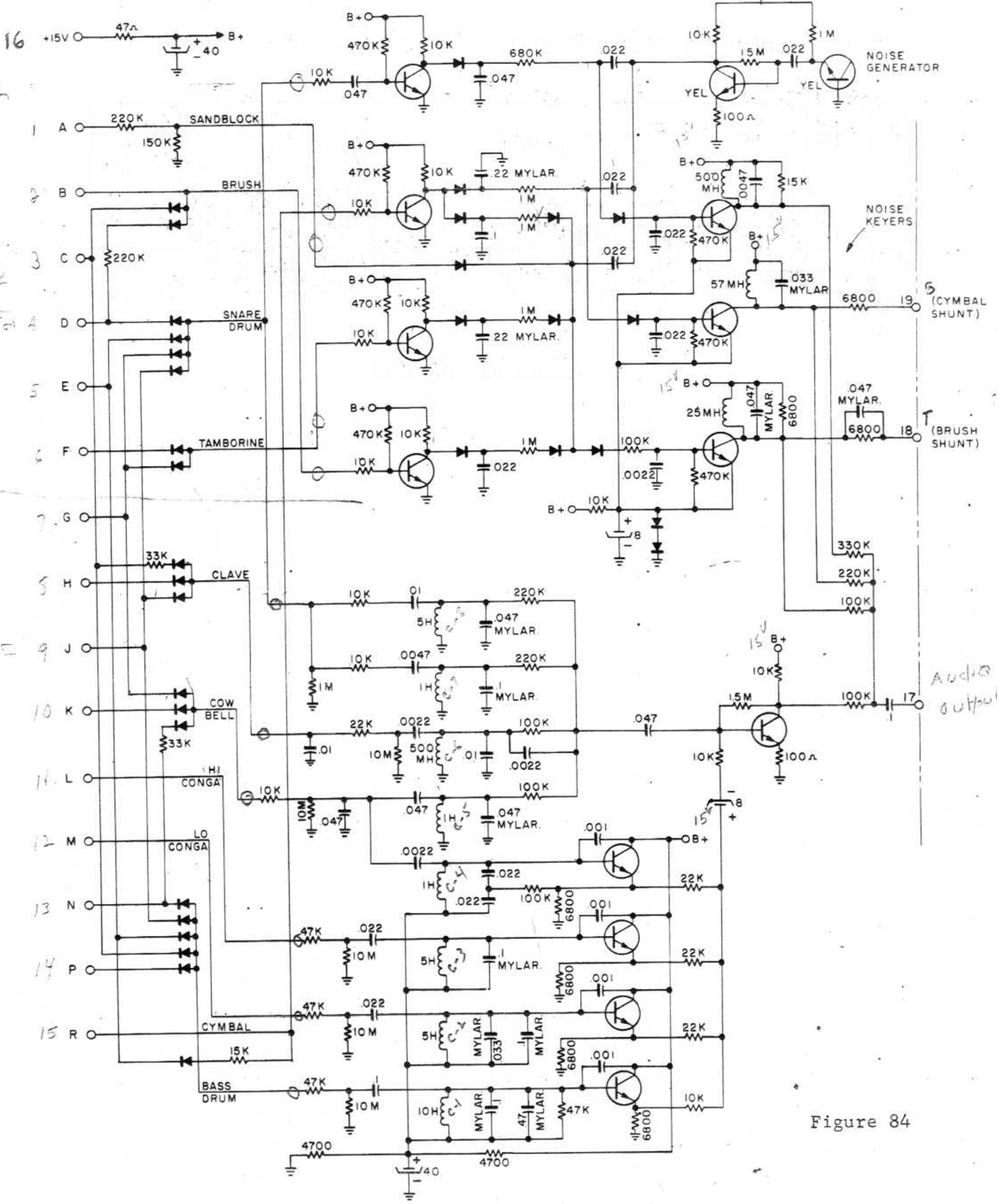


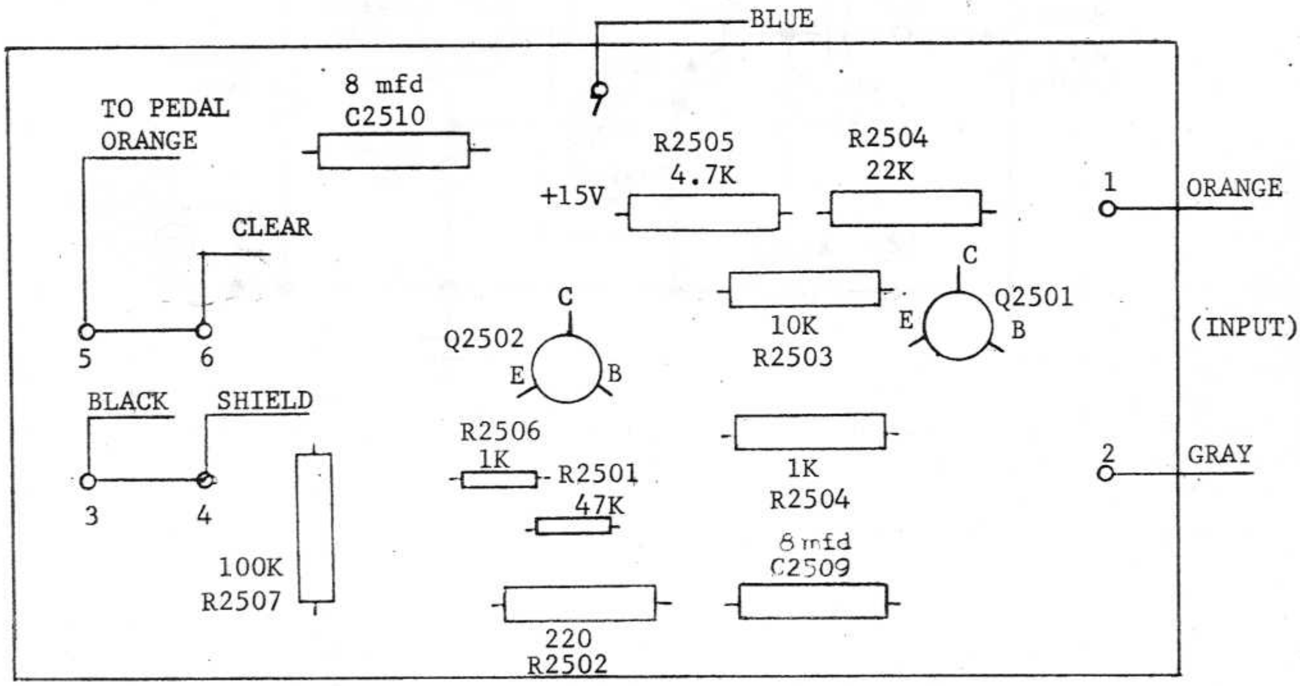
Figure 84

16 PREAMPLIFIER

The preamplifier is used to amplify the output of the Instrument Generator and is shown schematically in Figure 86. Interconnections are shown in Figure 85. Preamplifier circuitry consists of two direct coupled, common emitter stages with two feedback networks. A fixed feedback resistor, R2503, insures a clean response from the amplifier. The Preamplifier output is coupled to the input terminal by an 8 mfd capacitor, C2501.

The foot pedal, when in the Off position, shorts the output of the preamplifier to ground to prevent unwanted noise in the output when the SAR1 is not operating

SAR1 AUDIO PREAMPLIFIER
Interconnection Diagram
Assembly No. 664014



PIN	COLOR	TERMINATIONS	
1	Orange	Audio Input	Volume Control Wiper
2	Gray	Audio Feedback	Volume Control Low End
3	Black	Pedal Ground	Ground
4	Shield	Audio Ground	Ground
5	Orange	Pedal Shunt	Pedal
6	Clear	Audio Output	P2501
7	Blue	+15 V Input	Power Supply

Figure 85

SAR1 AUDIO PREAMPLIFIER
Schematic Diagram
Assembly No. 664014

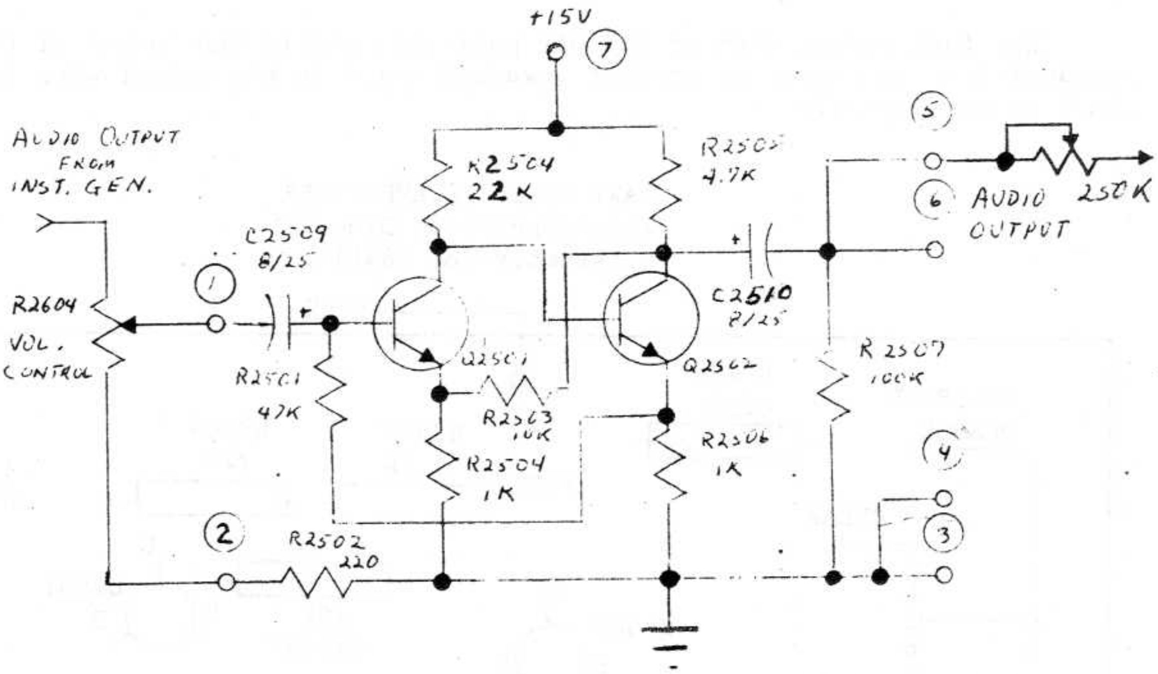


Figure 86