AMRL-TR-67-140
VOL. II

THE MAINTENANCE TASK SIMULATOR (MTS-2): A DEVICE FOR ELECTRONIC MAINTENANCE RESEARCH

VOLUME II: MAINTENANCE DATA

THOMAS K. ELLIOTT

FOREWORD

This study was initiated by the Behavioral Sciences Laboratory of the Aerospace Medical Research Laboratories, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. It represents a portion of the exploratory development program conducted under Project 1710, "Human Factors in the Design of Training Systems," Task 171004, "Techniques for Training, Aiding, and Evaluating the Performance of Technical Tasks." Dr. Gordon A. Eckstrand was project scientist. This research was begun in April 1966 and was completed in April 1967.

This report covers part of the research conducted under Contract AF 33(615)-3966 by Applied Science Associates, Inc. Dr. John D. Folley, Jr. was principal investigator. Mr. John P. Foley, Jr. of the Technical Training Branch, Behavioral Sciences Laboratory, monitored the contract.

This technical report has been reviewed and is approved.

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Technical Director
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ABSTRACT

This report contains schematics, theory of operations, parts location, and interconnection tables for the MTS-2 maintenance task simulator. The data includes front panel modules and circuit modules, but excludes commercial items incorporated intact in the device.

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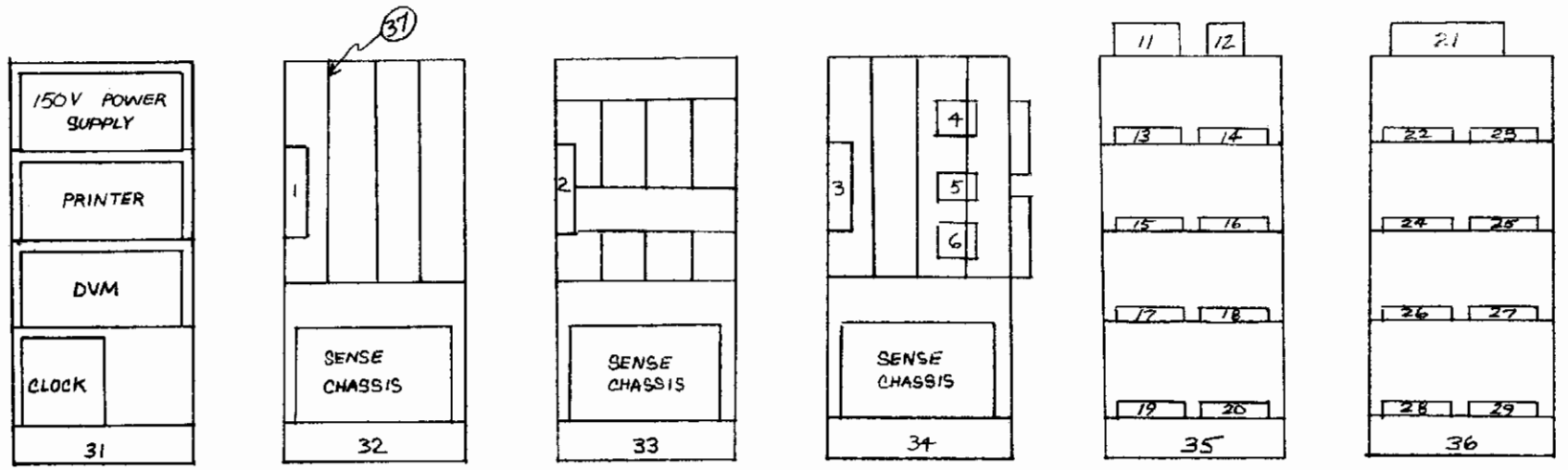
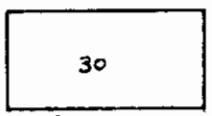
SECTION I

INTRODUCTION

This report contains schematics, theory of operation, parts location and interconnection tables for the MTS-2 including front panel modules and circuit modules, but excluding the commercial items which are incorporated intact in the device. Additional information on these items will be found in the manufacturers' manuals listed in the reference section of this report.

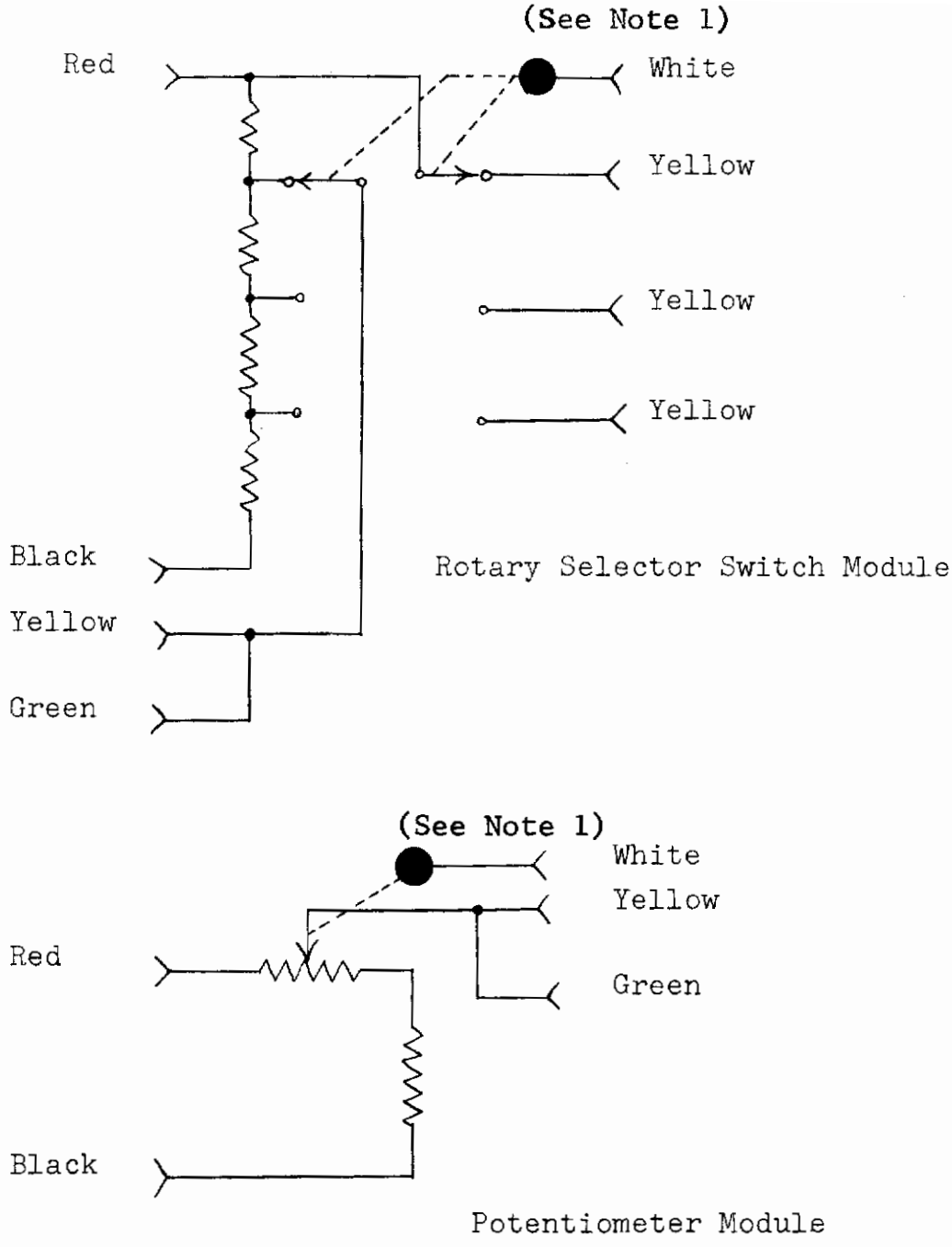
It is suggested that when this report is used as a reference document in maintenance, entry through the index at the end of this section will be most convenient. For those unfamiliar with the MTS-2, knowledge of the material contained in "Volume I: Application and Operation" (reference 1) will be found to be of help. Reference is made to that volume in the maintenance index where appropriate.





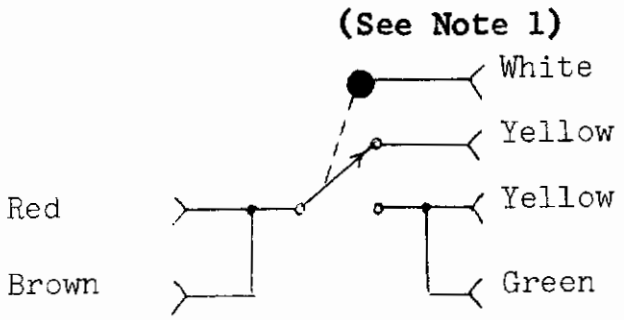
1) Internal patch board
2) " " "
3) " " "
4) Accessory Unit
5) " "
6) " "
7) Patch board I
8) " " II
9) " " III
10) Patch board IV
11) + 18 VDC power supply
12) Low voltage transformer
13) Module chassis 1
14) " " 2
15) " " 3
16) " " 4
17) " " 5
18) " " 6
19) Module chassis 7
20) " " 8
21) -18 VDC power supply
22) Module chassis 9
23) " "
24) " "
25) " "
26) Relay chassis 1
27) " " 2
28) Relay chassis
29) No-print warning
30) Master control Panel
31) Cabinet 6
32) " 1
33) " 2
34) " 3
35) " 4
36) " 5
37) Supports for control, display modules

Figure 1. Major Units of the MTS-2

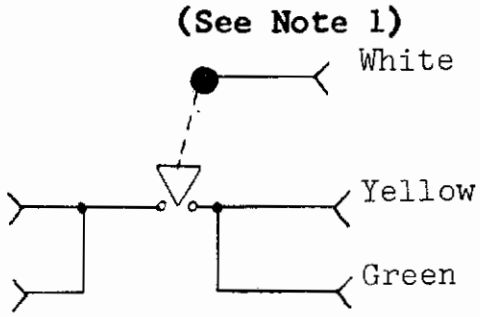


Note 1. ● **Indicates control knob or handle, which provides sense circuit inputs.**

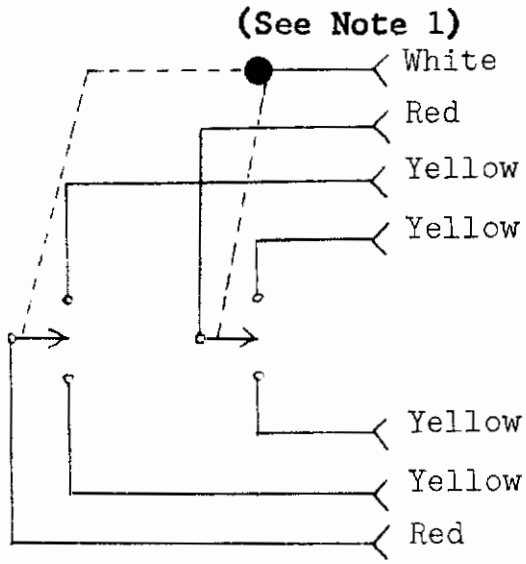
Figure 2. Example Control and Display Module Schematics



SPDT Switch Module

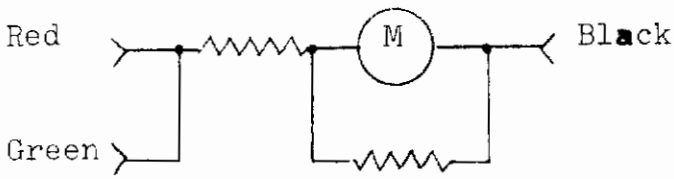


SPST Momentary Switch Module

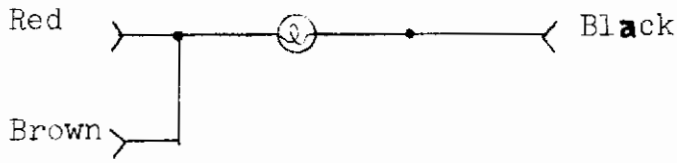


DPDT Momentary Rotary Switch Module

Note 1. ● **Indicates control knob or handle which provides sense circuit inputs.**

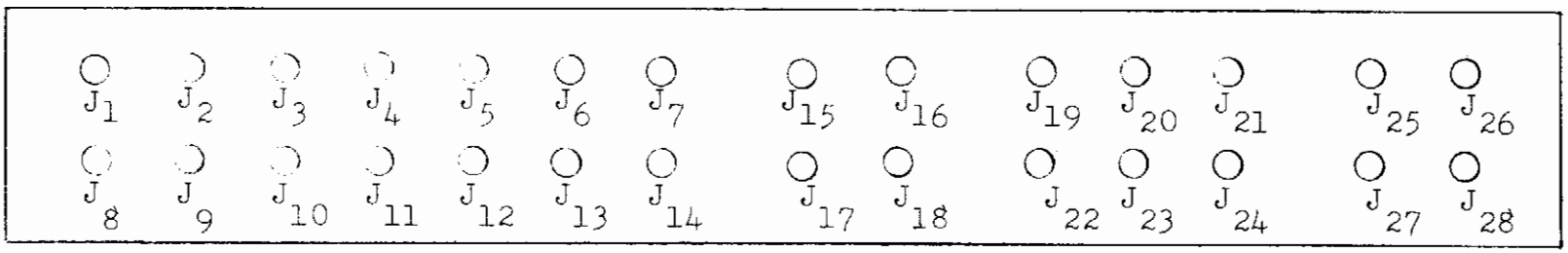


Meter Module



Lamp Module

Figure 2. (cont'd) Example Control and Display Module Schematics



J_1-J_3	Attemuator relay coils
J_4-J_7	Input relay coils
J_8-J_{11}	Sweep Speed relay coils
J_{12}	Sweep generator relay coil
J_{13}	Unused
J_{19}	Intensity control shaft
J_{20}	Y position control shaft
J_{21}	X position control shaft
J_{22}	X amplitude control shaft

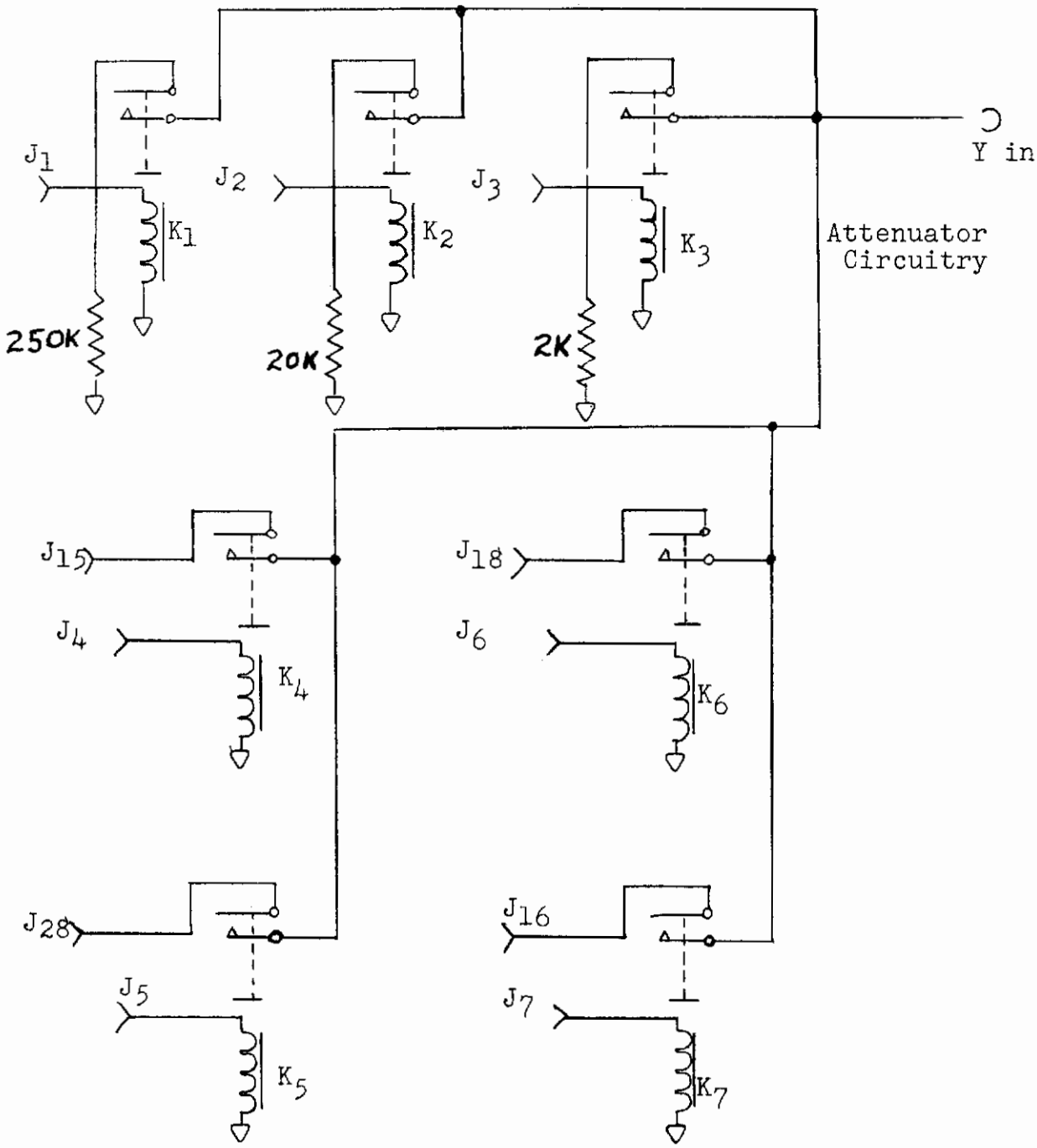
J_{15} & J_{16}	Inputs
J_{17}	Power relay coil
J_{18}	Input
J_{28}	Input
J_{25}-J_{27}	Ground

Note: The box presenting the above jacks contain relays which are wired into the scope circuitry. The following schematics show the connections of these relays.

Operation of scope requires:

1. ground at J_{25}
2. an input at one of the input jacks
3. 18 VDC or the appropriate input relay coil
4. 18 VDC at J_{12}
5. 18 VDC at J_{17}
6. 18 VDC at J_8, J_9, J_{10}, J_{11}

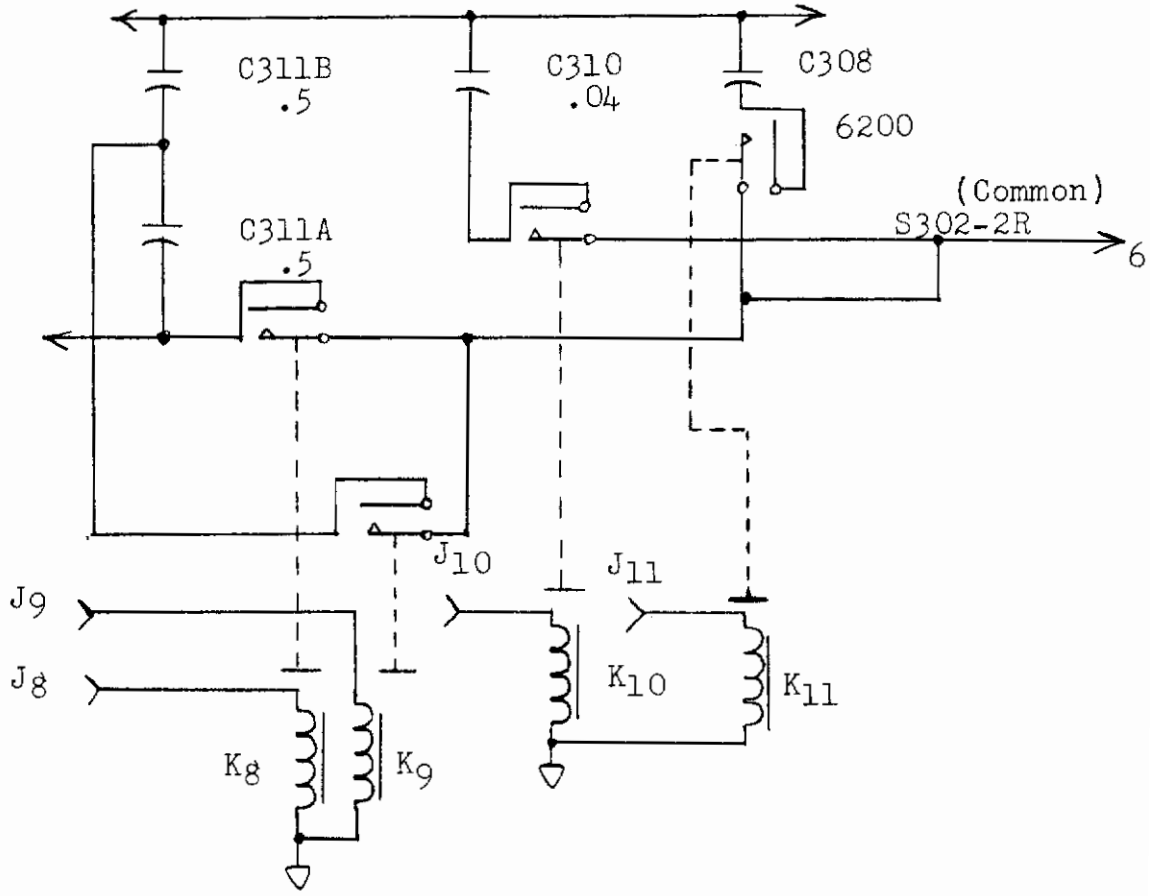
Figure 3. Oscilloscope Module Connector



Note: ⏚ **is common return.**

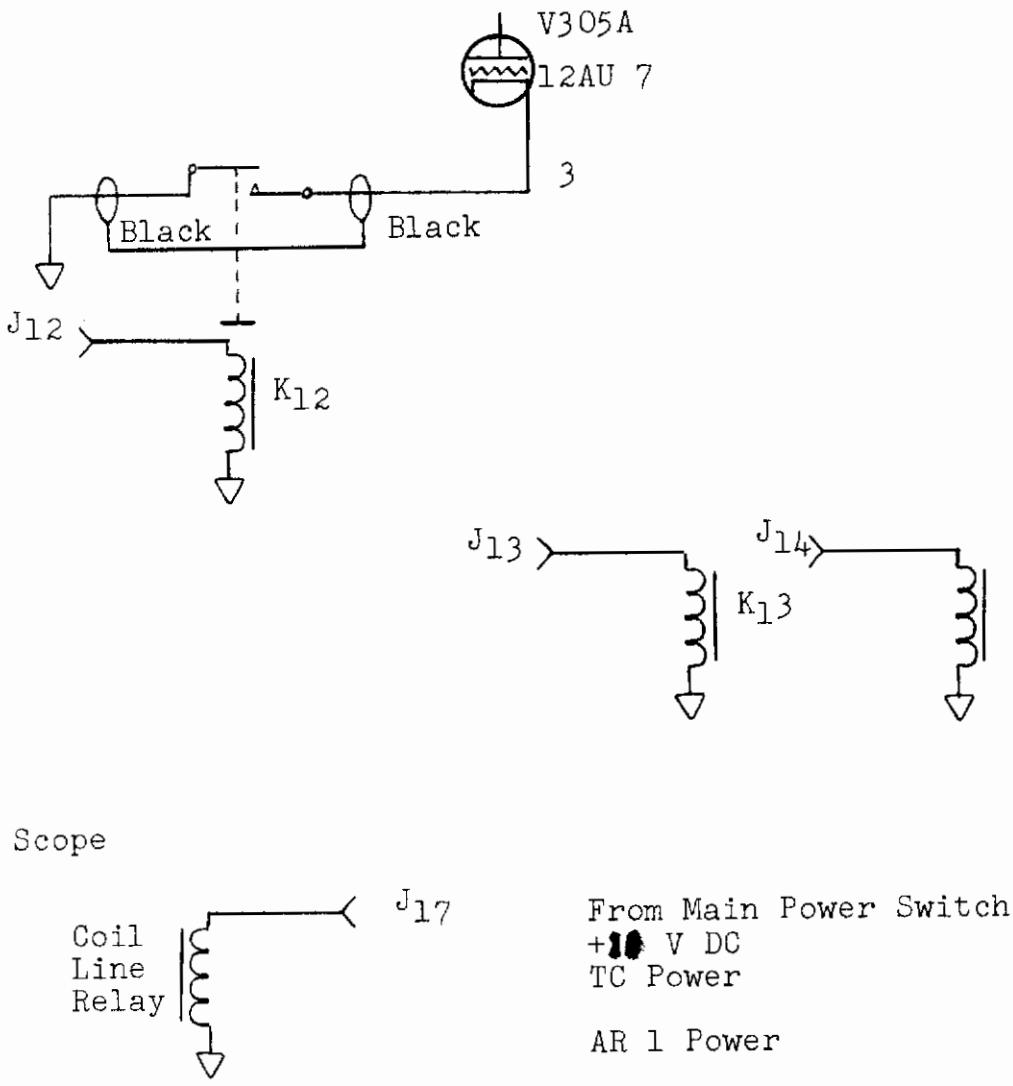
Figure 4. Scope Input Circuitry

Note: See schematic in Manual Sweep Generator Section



Note: ⏚ is common return.

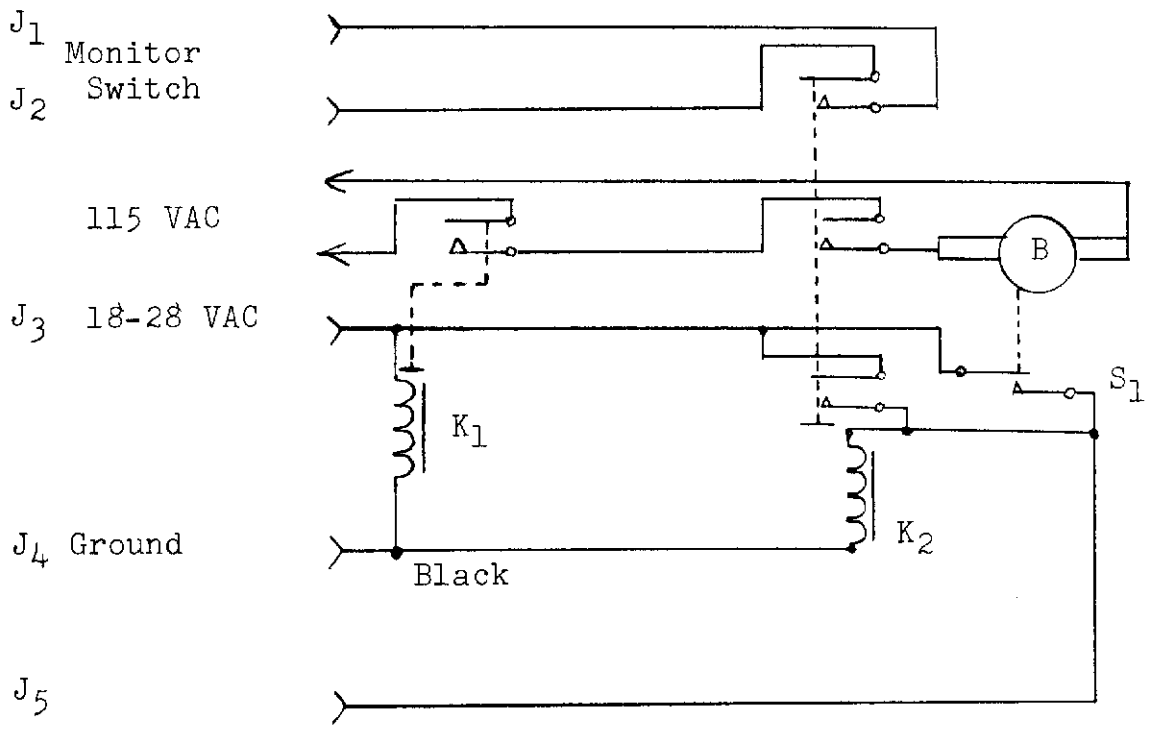
Figure 5. Sweep Speed Control Scope



Note: ⏚ is common return.

Figure 6. Oscilloscope Control Relays

ACCESSORY UNIT SCHEMATICS



Notes:

1. 115 Volts AC is permanently connected to J_3 and J_4.
2. When +28 Volts DC is applied at J_5, K_1 picks and time delay begins. after the selected time a cam on the motor closes the contacts of S_1 and K_2 picks. This turns off the motor which returns to start and closes the monitor switch.

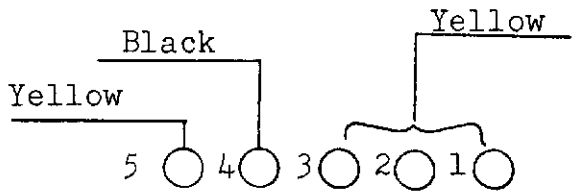
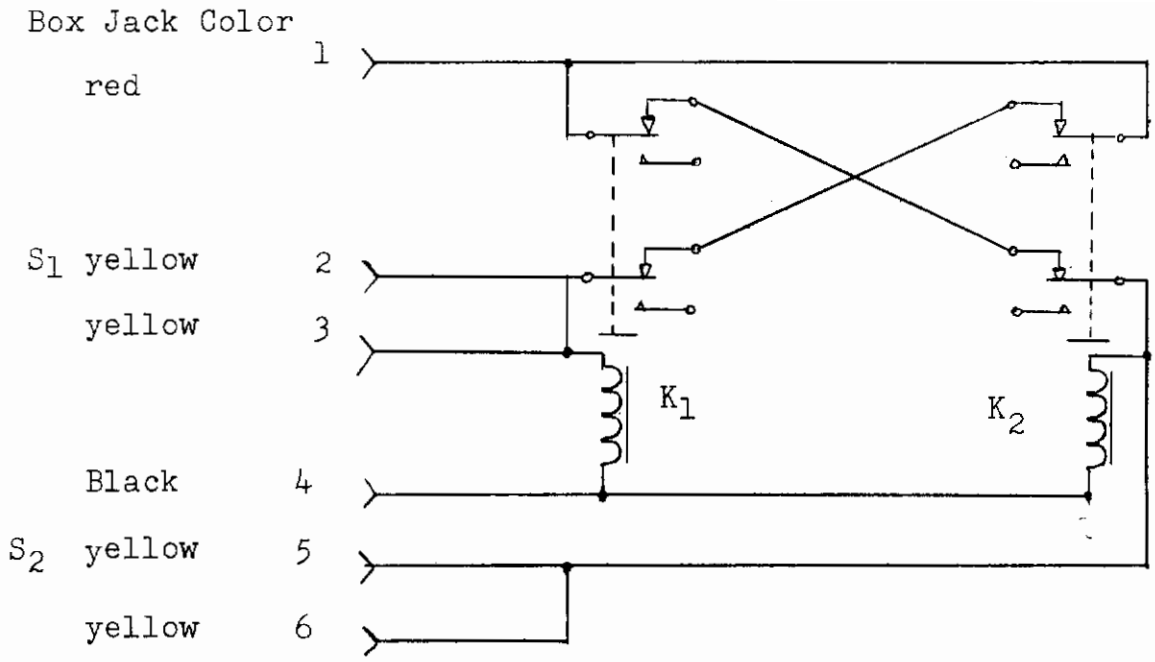


Figure 7. Time Delay Unit



Notes:

1. 18-28 volts DC supply
2. Momentarily switched supply
3. Ground
4. Momentarily switched supply
5. Jacks 3 8 6 have supply voltage on them when their respective relays are picked up

Connection

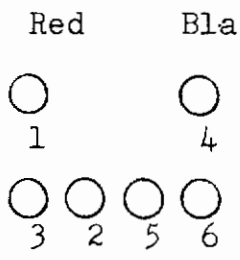
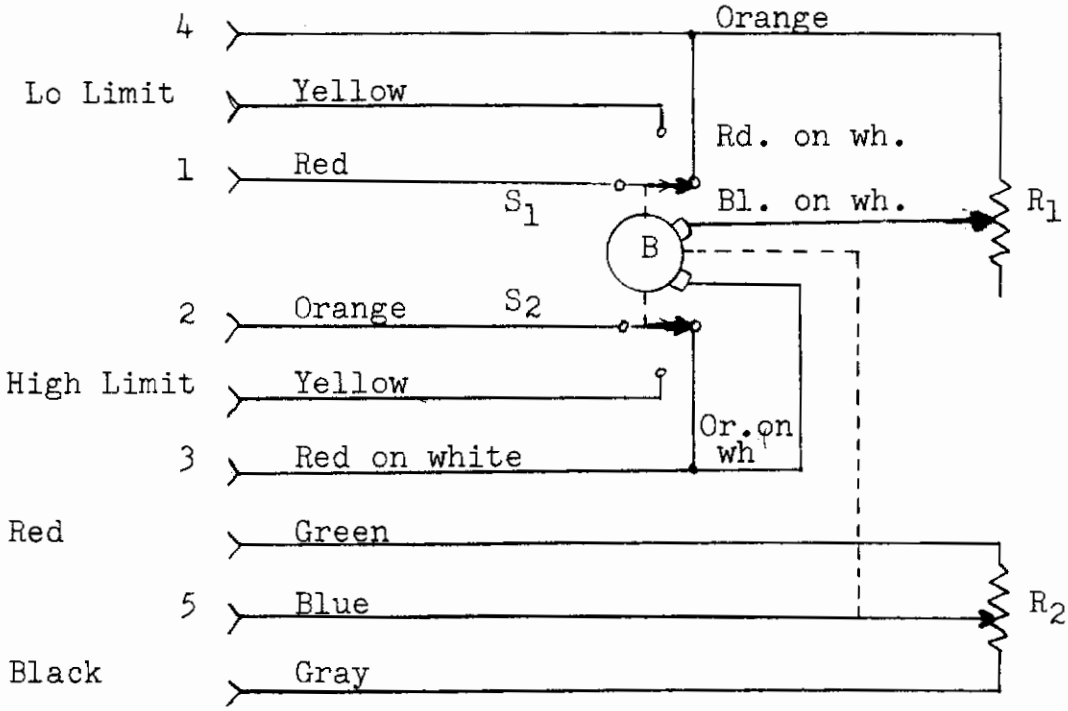


Figure 8. Flip-Flop Unit



Notes:

1. +18 -28 supply VDC on red jack
2. Ground on black jack
3. S_1 & S_2 snap action switches cam operated by ground shaft.
4. R_1 200 Ω variable resistor motor speed control
5. R2 10K Ω 2W variable pot **mechanically connected to motor**
6. To decrease voltage at 5 make 1 supply & 3 Ground
7. To increase voltage at 5 make 2 supply & 4 Ground

Controls & Connectors

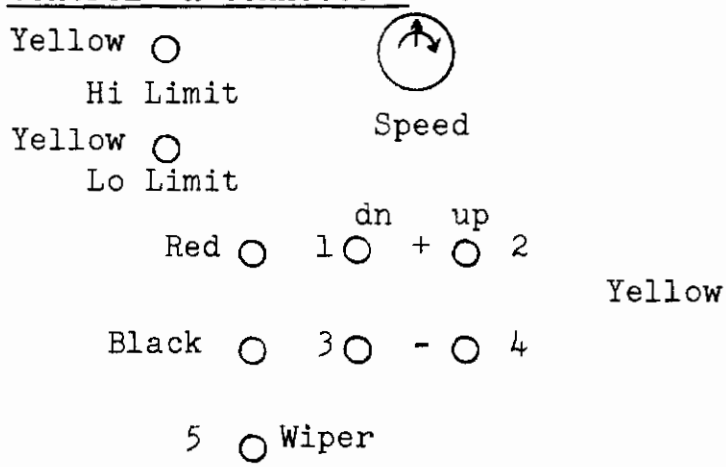


Figure 9. Tuning Motor Unit

CIRCUIT OPERATION

The operator is connected at J_1 (Figure 10) producing a voltage spike on the grid of thyratron V_1 causing it to go into conduction. This energizes K_1 and K_p. S_3 of K_p opens, stopping conduction through V_1 by opening its cathode circuit and the cathode circuits of all channel relays (K_2 - K_{60}). Thus, no other relay may be energized. However, K_1 is held in through the action of C_1 discharging through its coil. Through the contacts of K_1S_4, V_1 obtains its own unique ground and returns to conduction.

When K energized, movement of K_pS_1 produced a voltage step which was applied to the sample command circuitry of the DVM. K_1S_1 and K_2S_2 each applied bias to one digit on the units and tens print wheel respectively in the printer. The combination of digits (the channel name) is unique to the channel.

Approximately 150ms after K_p energized, the digital voltmeter has read the voltage on the control to which K_1S_4 is connected and delivers a print command to the printer which then prints the appropriate information.

When the operator disconnects at J_1, V_1 goes out of conduction and K_p drops out immediately -- providing sufficient time has elapsed to permit C_d to charge to a level which will hold V_1 off. K_1, however, is held in for about 200ms by the action of C_1 to permit the sampling of the DVM and operation of the printer resulting from the switching of K_pS_1. The full cycle is now complete and any channel may be activated.

The MTS has a capacity of 60 front panel sense channels; there being 20 channels on each of the identical sense chassis in the bottom of cabinets 1, 2, and 3 respectively. Since each channel is identical to all other channels no wiring diagram is provided for the relatively simple circuit inside the sense chassis. However, voltage C supply and interconnection information will be found in the interconnection tables.

Circuit Module Response Sensing and Recording Operation

When a test plug is inserted into a module, the switch which is part of the test jack (see the module connector diagram wiring) connects the gate supply voltage at A (on the reference schematic). This voltage step is differentiated through C_2 and R_4 and coupled to the gate of SCR_1 causing it to conduct in a forward direction picking K_n. The contacts of print K_n apply front wheel bias to a unique combination of number wheels in columns 9 and 10 in the printer, identifying the circuit module sensing channel which is activated. A switch in the module test jack also applies the gate supply voltage to the incheck or outcheck buss, depending on which test jack is used. K_n is also picked when the module is removed or

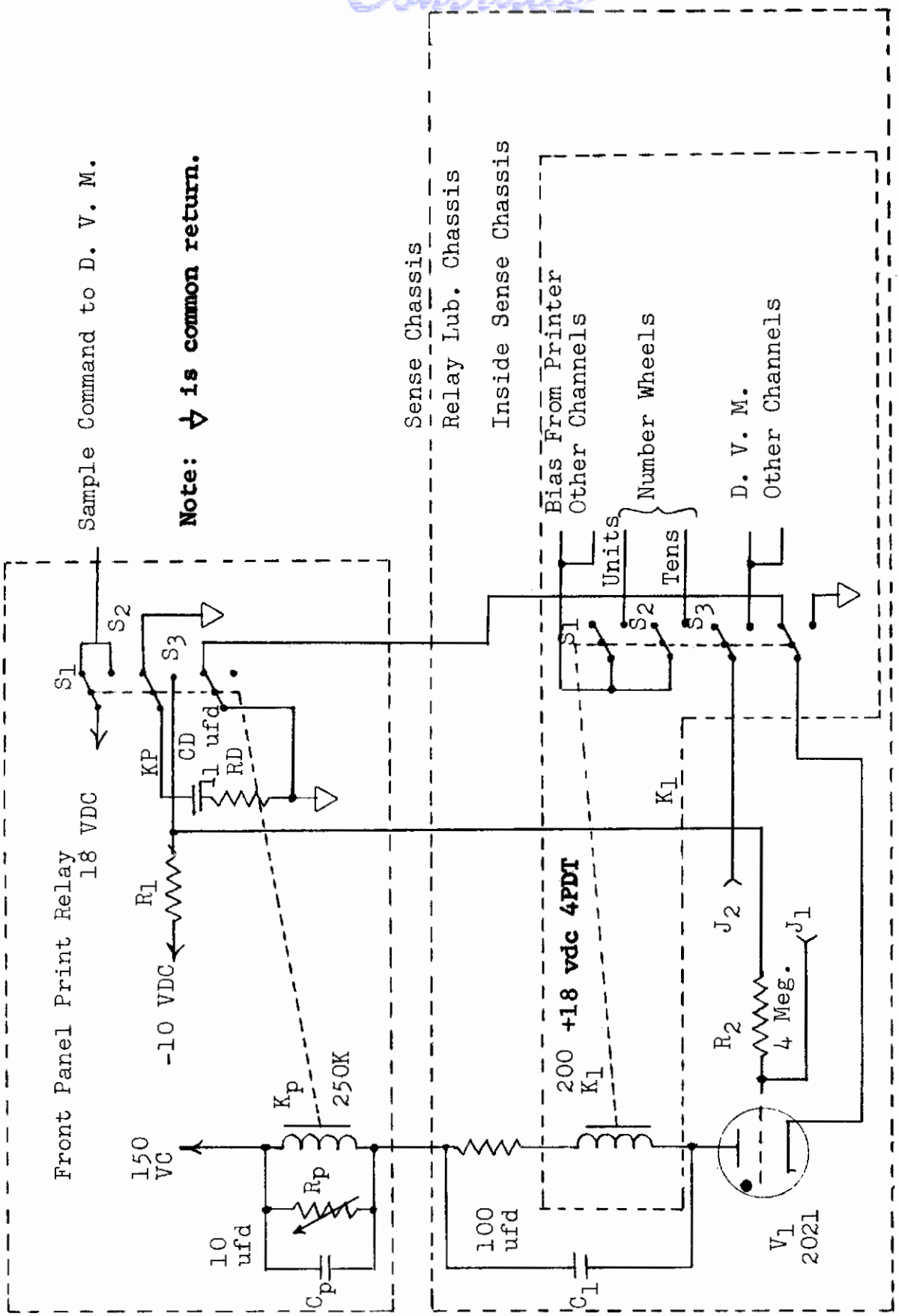


Figure 10.

Front Panel Sense Circuitry - System Integration

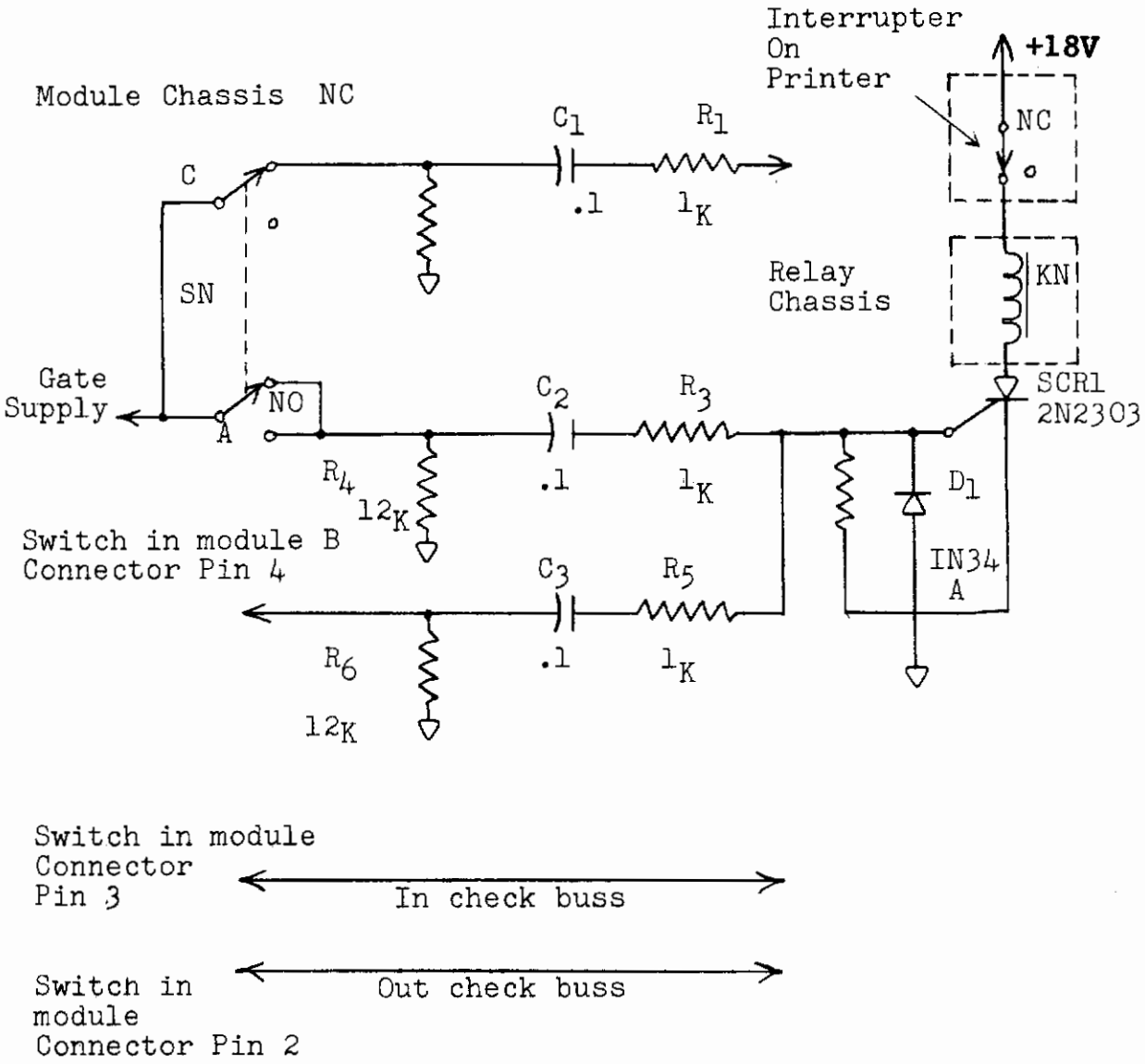
replaced through the action of S_n (operated by a pin attached to the module and protruding through the module chassis when the module is installed) which produces a transient at A which in turn is differentiated by C_2 and R_4 and applied to the gate of SCR_1.

Picking up any K_n (name relay) causes the DVM to sample and initiate a print cycle. At the end of the print cycle an interrupter switch on the printer drive shaft interrupts the positive 18 volts applied to all name relays for a few milliseconds, turning them off and completing the full cycle.

The interlock line which runs through all module connectors in series holds an 18 volt relay as long as no module is out of the system. When a module is removed the relay drops out lighting a lamp on the master control panel indicating that a module is out of the system. This indication is in addition to the printer indication.

Figure 12, the circuit module sensing system integration diagram contains the circuitry common to all channels. This circuitry is located on relay chassis 3. Relay chassis 1 and 2 contain only name relays. When any name relay picks K_{p2} in series with all name relays (K_n) is energized and sends a voltage step to the DVM. The other set of contacts on K_{p2} applies print wheel bias to the contacts of the incheck relay. If this relay is picked as a result of application of a transient to the incheck buss line, turning on the incheck SCR and picking the incheck relay, then print wheel bias is applied to print wheel 5 indicating the action performed was insertion of a test probe in the input test point of some module. If the input relay is not picked, print wheel bias is applied to the outcheck relay which acts similarly. If it is not picked, print wheel bias is applied in turn to the remove relay. If it is not picked, bias is applied to print wheel 5 indicating installation as a result of a name relay being picked (thus a print command) with no action relay picked. If the remove relay is picked, however, print wheel bias is applied to a different digit, on print wheel 5 indicating that a removal of a module has taken place. Note: A print command from the front panel print relay does not energize K_{p2} and a "dash" is printed in column 5.

When it picks K_{p2} also applies 18 volts to the coil of K_x. K_x in turn sends 18 volts to the coil of K_y and to the coil of K_r. K_r does not pick, however, because its return circuit is blocked by the SCR. The capacitor in the gate circuit of the SCR charges slowly through a 25 kohm pot which is adjusted so that the SCR will turn on a short time after the print cycle should have been completed. When this happens a buzzer in the master control box indicates that some action has been performed on a module, but that action has not been recorded. If, however, the print cycle does occur as required, the interrupter switch in the printer drops out K_{p2} which in turn drops K_x removing the voltage from the coil of K_r and completing the circuit to ground through the contacts of K_y which discharge the capacitor in the SCR gate circuit, permitting the charging circuit to start from zero on the next cycle.



Note: ⏚ **is common return.**

Figure 11. Circuit Module Response Sensing Circuitry

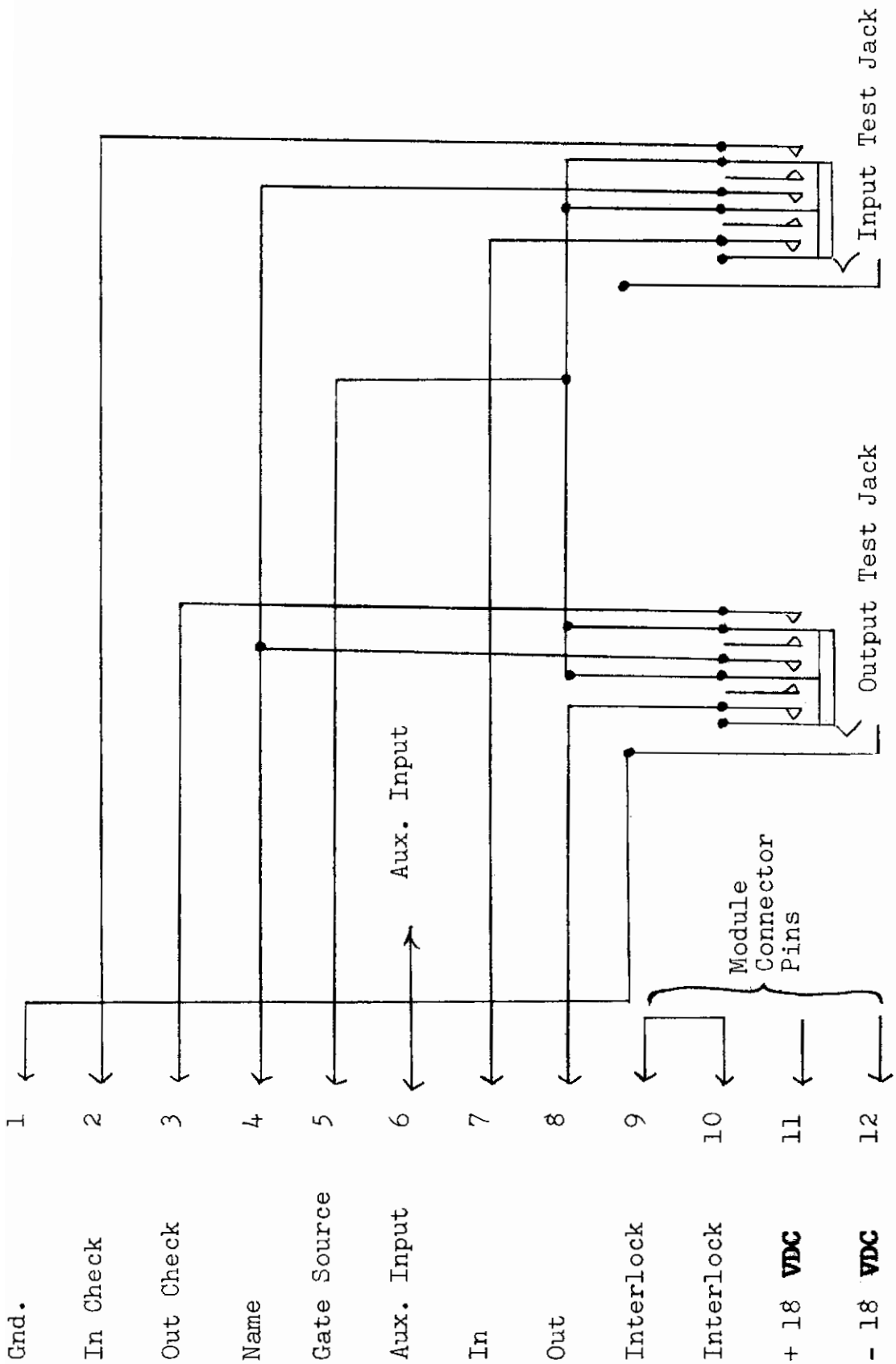


Figure 12. Module Connector Wiring

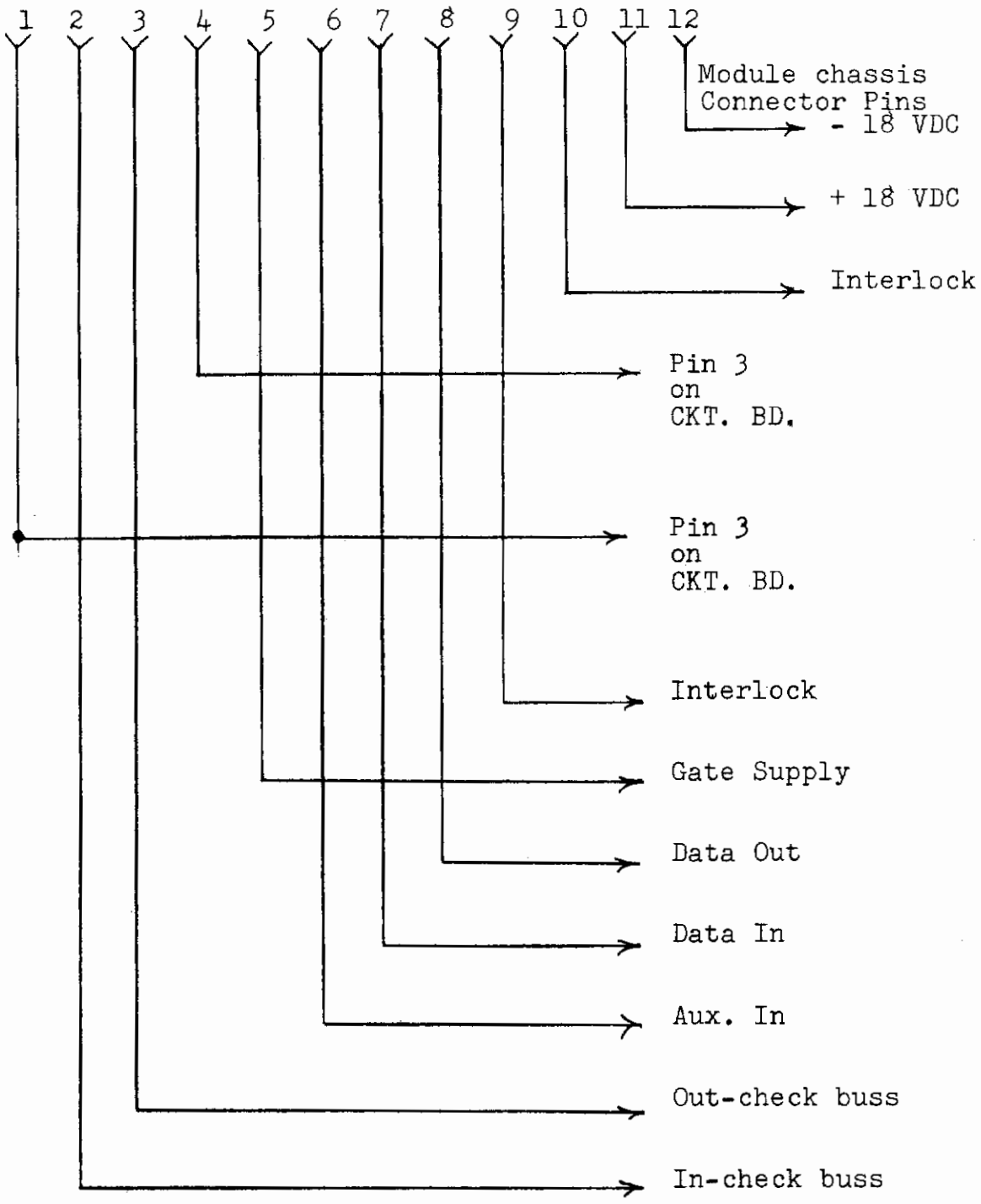


Figure 13. Module Chassis Connector Wiring

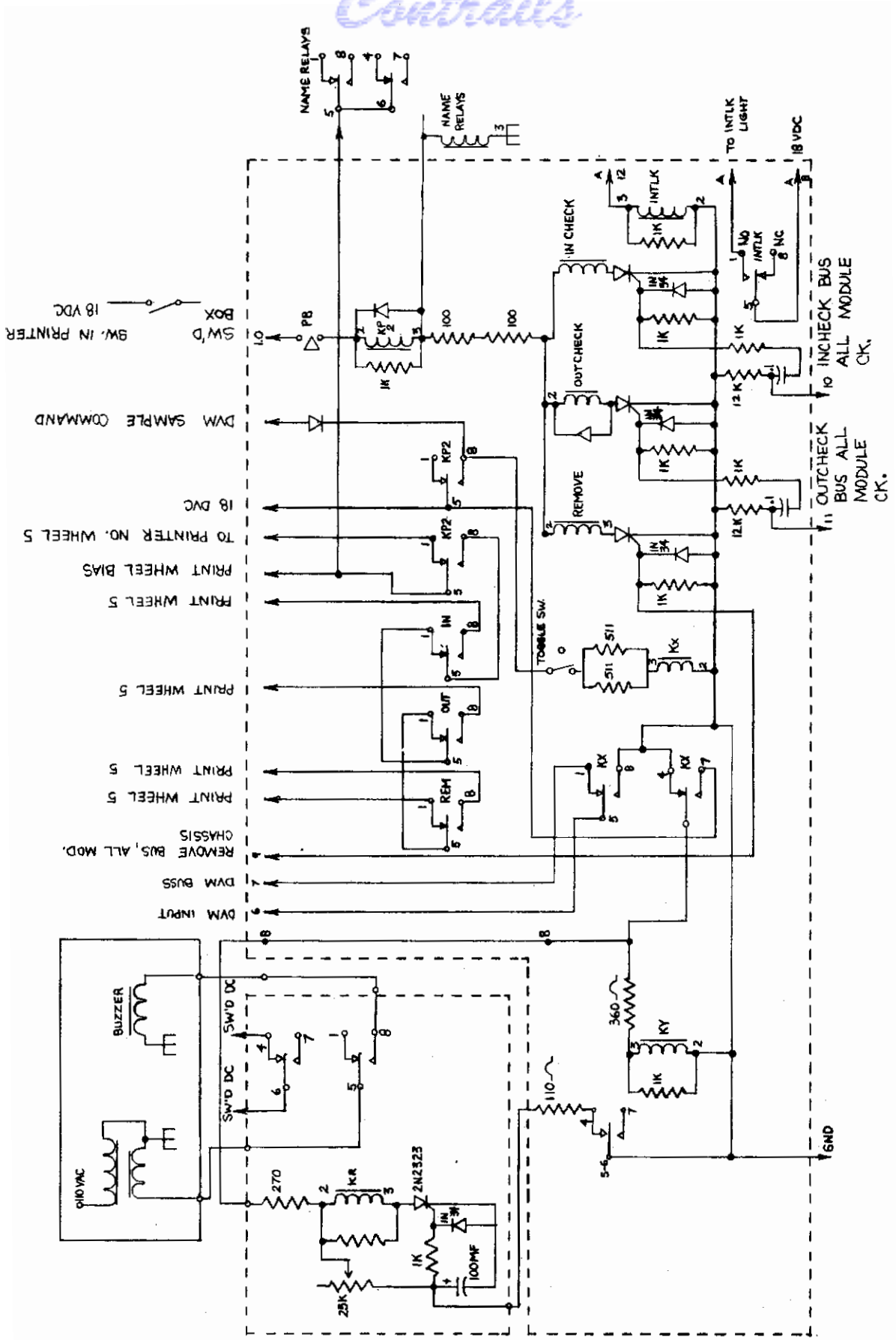


Figure 14. Circuit Module Sense Circuitry - System Integration

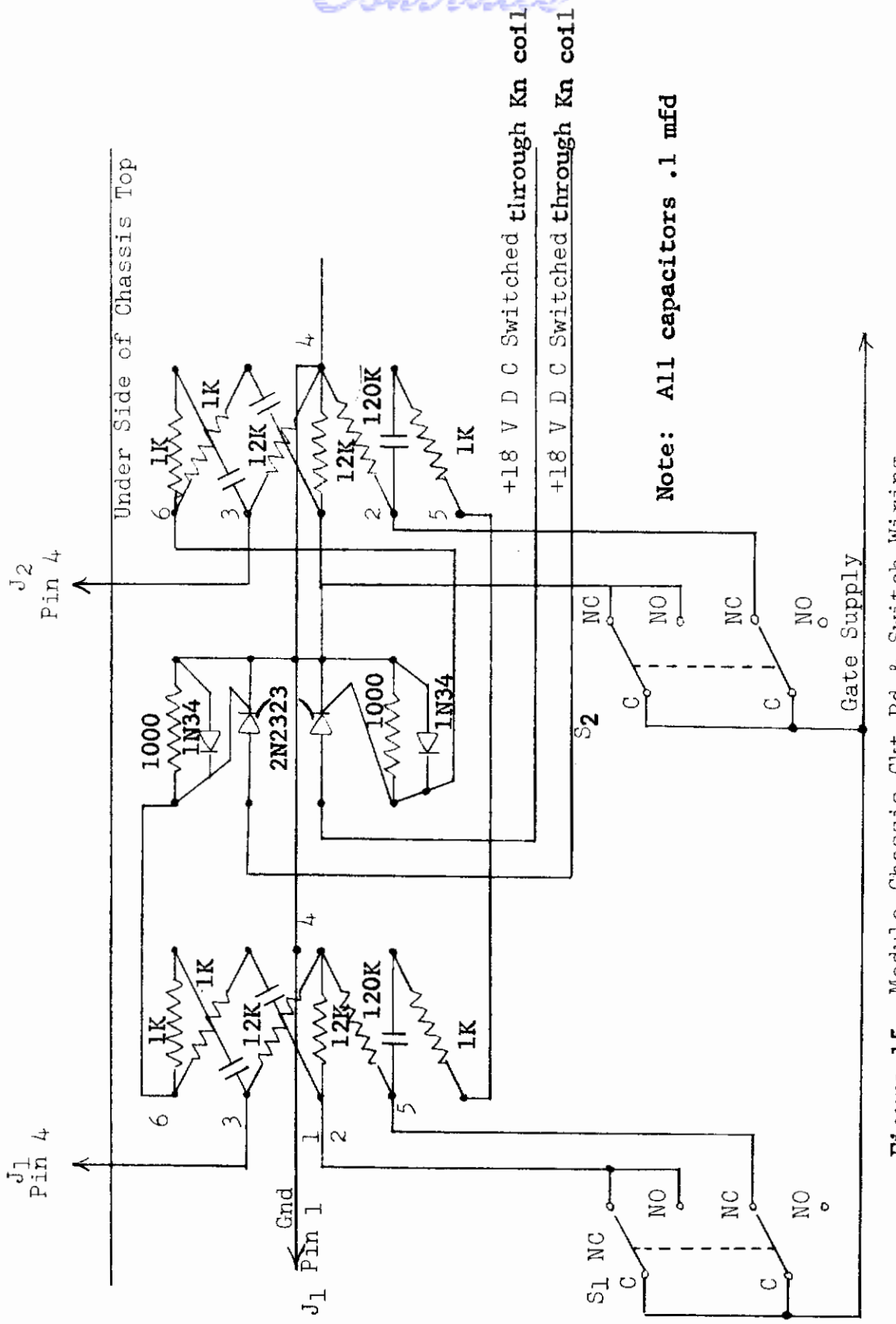
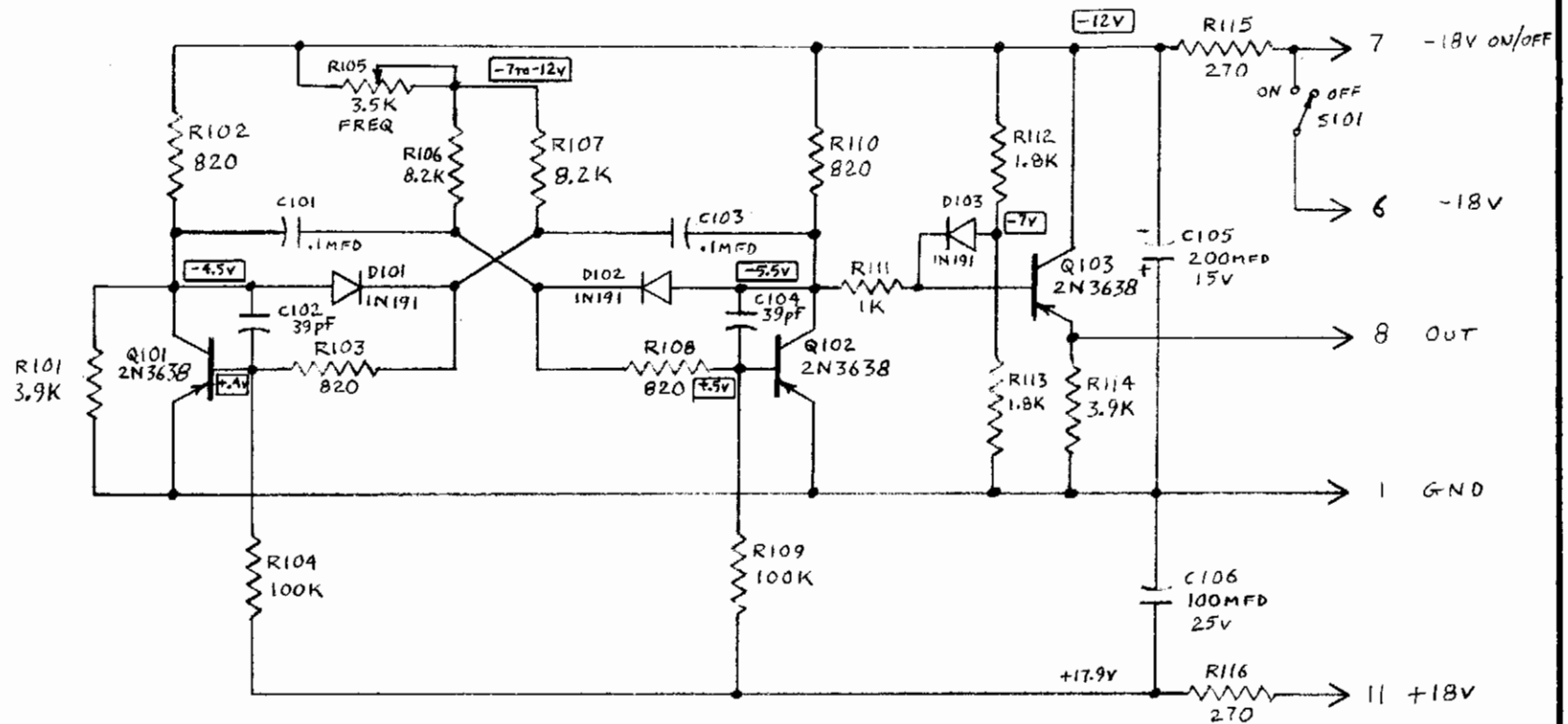


Figure 15. Module Chassis Ckt Bd & Switch Wiring

CIRCUIT MODULE SCHEMATICS



NOTES:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A512ASA1002M
   b. Parts List - Dwg. No. A512ASA1003M
3. Voltage Measurements by 20KΩ/Volt Meter with respect to ground, R105 at Min. Resistance, 5101 ON, ± 18V Applied, D.C. unless otherwise noted.
4. Waveforms using Tektronix 545 Scope with Probe and taken with respect to ground - R105 at Min. Resistance.

Supply Req: -18V @ 26 ma.
+18V @ 0.4 ma.

Freq. Range: 800 cps to 1KC

Output Load: 1K Max.

Free Running, Variable Frequency Multivibrator, Module No. 100		
		Schematic Diagram
12/16/65	RAM/	A512ASA1001M

FREE RUNNING VARIABLE FREQUENCY MULTIVIBRATOR

Module 100

Module 100 is an astable multivibrator followed by an emitter follower to isolate the output circuit. Q101 and Q102 with their associated components form the multivibrator, Q103 the emitter follower.

When power is applied to the circuit by turning S101 on, or by applying a -18V to Pin #7, the two transistors in the multivibrator will alternately turn on and off, producing a symmetrical square wave at their collectors. This waveform is coupled through the emitter follower to the output (Pin #8).

Due to slight mismatches of the individual components, either Q101 or Q102 will begin to conduct and become saturated when power is first applied to the circuit. Assume that Q101 has just turned off and Q102 has just become fully saturated. At this point C103 will begin to charge through R107 and R105. The base of Q101 is held slightly positive by the current through R104. As C103 begins to charge, the voltage at the junction of R107, R103, and C103 will become increasingly negative. This voltage is coupled through R103 to the base of Q101 where eventually it will become sufficiently negative to overcome the positive bias and cause Q101 to conduct. As Q101 begins to conduct, its collector current flowing through R102 causes a decrese in its collector voltage, which is coupled through C101 and R108 to the base of Q102 causing Q102 to decrease its conduction. As Q102's collector current decreases, its collector voltage will become more negative, and this increasing negative voltage is coupled through C103 and R103 to the base of Q101. This further increases the conduction of Q101 which further decreases its collector voltage. The decrease is coupled to the base of Q102 which further decreases the current in Q102 causing its collector voltage to rise more. This cross coupling results in a rapid turn on of Q101 and turn off of Q102.

With Q102 turned off, C101 will begin to charge through R106 and R105. C101 will continue to charge until the negative voltage coupled through R108 to the base of Q102 is sufficient to overcome the positive bias established by the current through R109. At this point Q102 will begin to conduct and the cross coupling will result in a rapid turn on of Q102 and turn off of Q101.

Since no permanent stable state exists for either Q101 or Q102, they will continue to alternately turn on and off producing a square wave at their collectors. Since the circuit components are symmetrical, the wave forms for each transistor will be symmetrical but 180° out of phase.

R101 shunts the collector to emitter circuit of Q101 to compensate for the loading of the emitter follower on the collector of Q102. Since both C101 and C103 charge through R105, if R105 is varied, it will effect

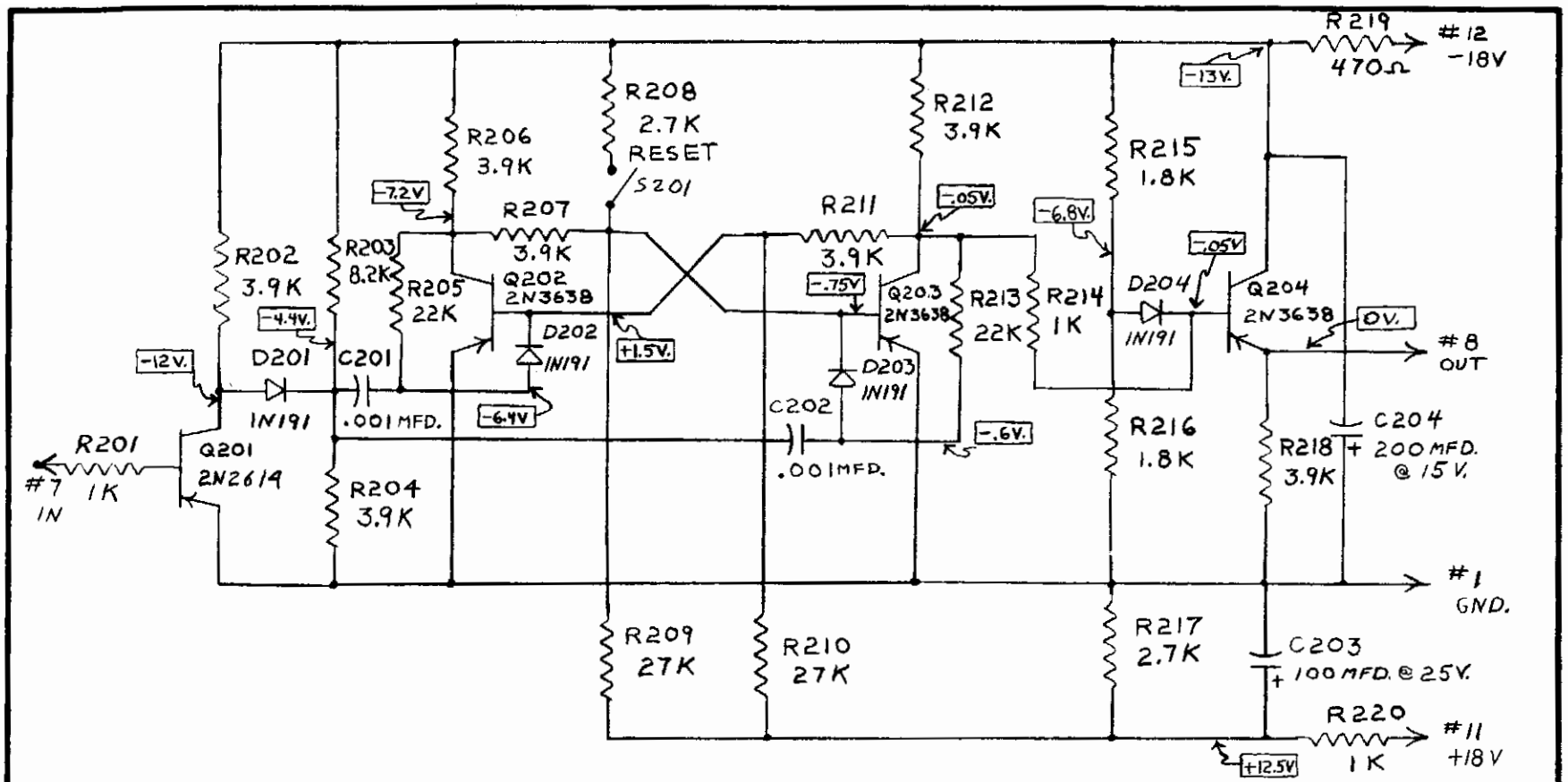
the charging time constant of both capacitors and thus changes the frequency at which the two transistors switch states.

D101 and D102 provide a rapid discharge path for C101 and C103. C102 and C104 provide negative feedback at the higher frequencies.

The wave form at the collector of Q102 is coupled through R111 to the base of Q103. R112 and R113 form a voltage divider to establish a constant voltage at the anode of D103. D103 will conduct any time its cathode voltage becomes more negative than the constant voltage on its anode; thus, D103 will clip the wave form fed to the base of Q103 at its anode potential (-7 volts).

Q103 operates as an emitter follower with R114, its emitter resistor. The output of Q103 is fed to Pin #8.

R114, C105, and R116, C106 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - A601AS61057M
   b. Parts List - A601AS61058M
   c. Waveforms - A601AS61059M
3. Voltage measurements with 20KΩ/V meter with no input and reset to zero (Pin 8 0V)

Supply Req.: -18V @ 10.6 ma.
+18V @ 5.5 ma.

Trigger: Neg shift from zero to -2V.

Frequency: 20KC

Bistable Multivibrator Module 200		
		Schematic Diagram
1/26/66	RAM/	A601AS61056M

BISTABLE MULTIVIBRATOR

Module 200

Module 200 is a bistable multivibrator with an amplifier to isolate the input and an emitter follower to isolate the output.

Q202 and Q203 with their associated circuits form the bistable multivibrator. Q201 and its circuit form the input amplifier; Q204 with its associated circuitry form the output emitter follower.

With the circuit on and no input, closing the reset switch "S202" couples a negative voltage to the base of Q203 causing it to turn on. When Q203 turns on, its collector current flowing through R212 causes the collector voltage to approach zero.

The voltage on the base of Q202 is determined by the voltage divider action of R210, R211, and R212. When the collector of Q203 is at 0V, the base of Q202 will become slightly positive. Since its emitter is connected to ground, Q202 will be cut off and its collector voltage will be a -7V determined by the voltage divider action of R206, R207, and R209. The circuit will remain in this state until a trigger pulse is fed into the input Pin #7.

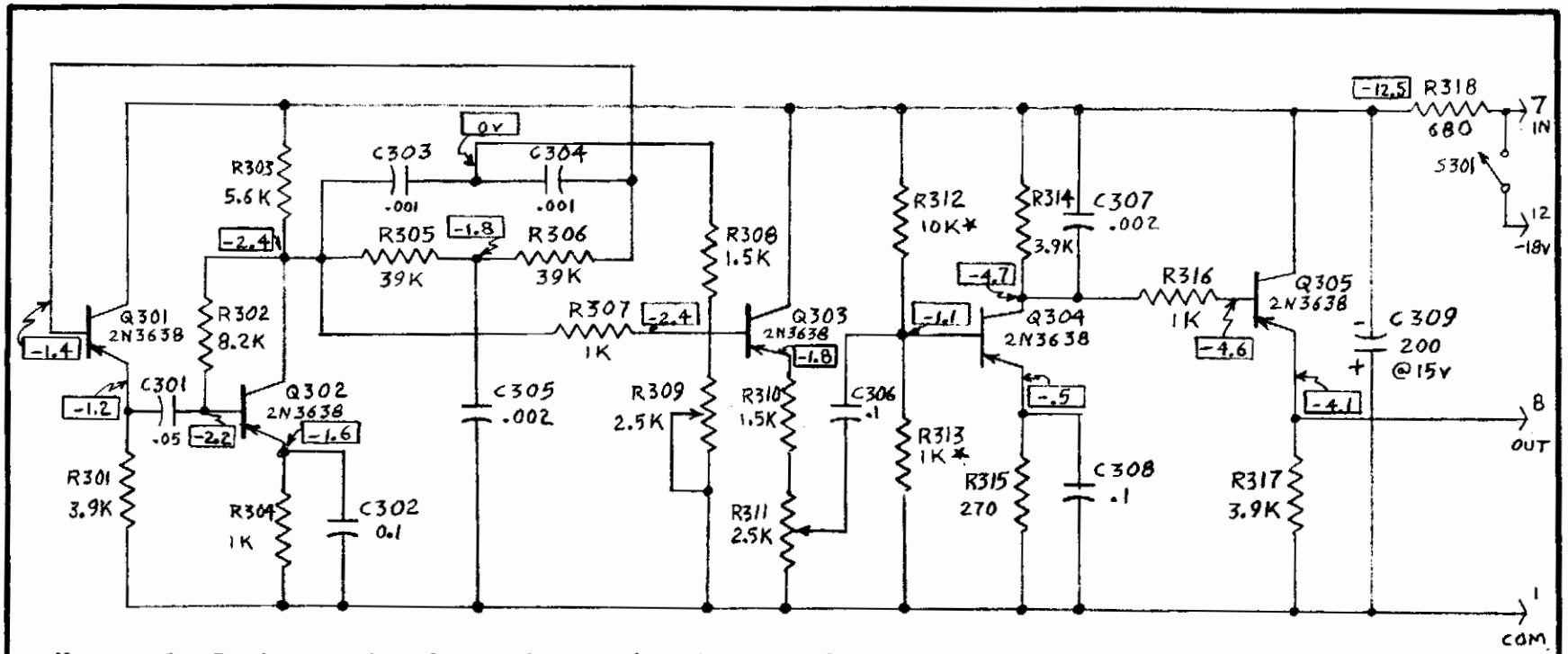
When a negative going signal is fed into Pin #7, it is coupled through R201 to the base of Q201. When the base of Q201 goes negative, it turns on causing the collector voltage to rise to 0V. This positive going waveform is coupled through D201 as long as it is less negative than the bias voltage of -4V established by the voltage divider action of R203 and R204. Since the base of Q202 is positive, and the voltage being coupled through D202 (although positive going) is less positive than zero, D202 is back biased and the waveform cannot be coupled through C201 and D202. D203 is forward biased and the positive going waveform appearing at the cathode of D201 is coupled through C202 and through D203 to the base of Q203.

A positive going signal on the base of Q203 causes it to start to turn off which makes its collector more negative, resulting in a more negative signal being coupled through R211 to the base of Q202. Q202 begins to conduct causing its collector to rise towards zero. This positive transition is coupled through R207 to the base of Q203 making Q203 turn off even more. A very rapid switching action results from the cross coupling which ends up with Q202 turned on and Q203 turned off. Once in this state the two transistors will remain this way until either another trigger pulse is fed into the input or until the circuit is reset by S201.

When the next pulse appears at the input it will now be coupled through D202 and start to turn Q202 off. Again, cross coupling will result in rapid switching that ends with the on transistor off and the off transistor on. The collectors of the two transistors will alternate between zero and -7V.

The waveform appearing at the collector of Q203 is fed through R214 to the base of Q204. R215 and R216 form a voltage divider to establish a constant -7V at the anode of D204. Whenever the waveform from Q203 becomes more negative than the anode voltage of D204, it will conduct, acting as a clipper at the base of Q204. This clipped signal appears across the emitter resistor of Q204 and is fed to the output Pin #8. R217 is used to load the positive supply bus to obtain essentially equal positive and negative supply voltages for proper biasing of the multivibrator.

R219, C204, and R220, C203 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes: 1. **Resistors in ohms unless otherwise noted**

2. **Reference Dwgs:**
   a. **Parts Layout - Dwg. No. A601AS61002M**
   b. **Parts List - Dwg. No. A601AS61003M**
   c. **Waveforms - Dwg. No. A601AS61004M**

3. **Voltage measurements by 20KΩ/V meter with respect to ground, R309 @ min. (max. Freq.) & R311 set for 6V p-to-p, pin 8 to com and ext. 2.2KΩ load.**

*Selected Value for proper output

Supply Req. - 18V @ 8 ma.
Freq. Range: 10 to 13 KC
Output Load: 1 KΩ Max.

VARIABLE FREQUENCY, VARIABLE AMPLITUDE SINUSOIDAL OSCILLATOR MODULE No. 300

SCHEMATIC DIAGRAM

12/18/65 | RAM/RAM | A601AS61001M

VARIABLE FREQUENCY - VARIABLE AMPLITUDE SINUSOIDAL OSCILLATOR

Module 300

Module 300 is composed of a twin T feedback sinusoidal oscillator followed by a three stage amplifier to isolate and amplify the oscillator output.

Q302, with its associated circuit, forms the oscillator stage with Q301 serving as an emitter follower in the feedback circuit to prevent loading of the oscillator. Q303, Q304, and Q305 form a three stage inverting amplifier.

When power is applied to Pin #7 or when S301 is turned on the current disturbance at the base of Q302 will be amplified and appear at its collector. R305, R306, R308, R309, C303, C304, and C305 form a twin T feedback network. This network has a very narrow frequency pass band and thus permits feedback of one frequency only.

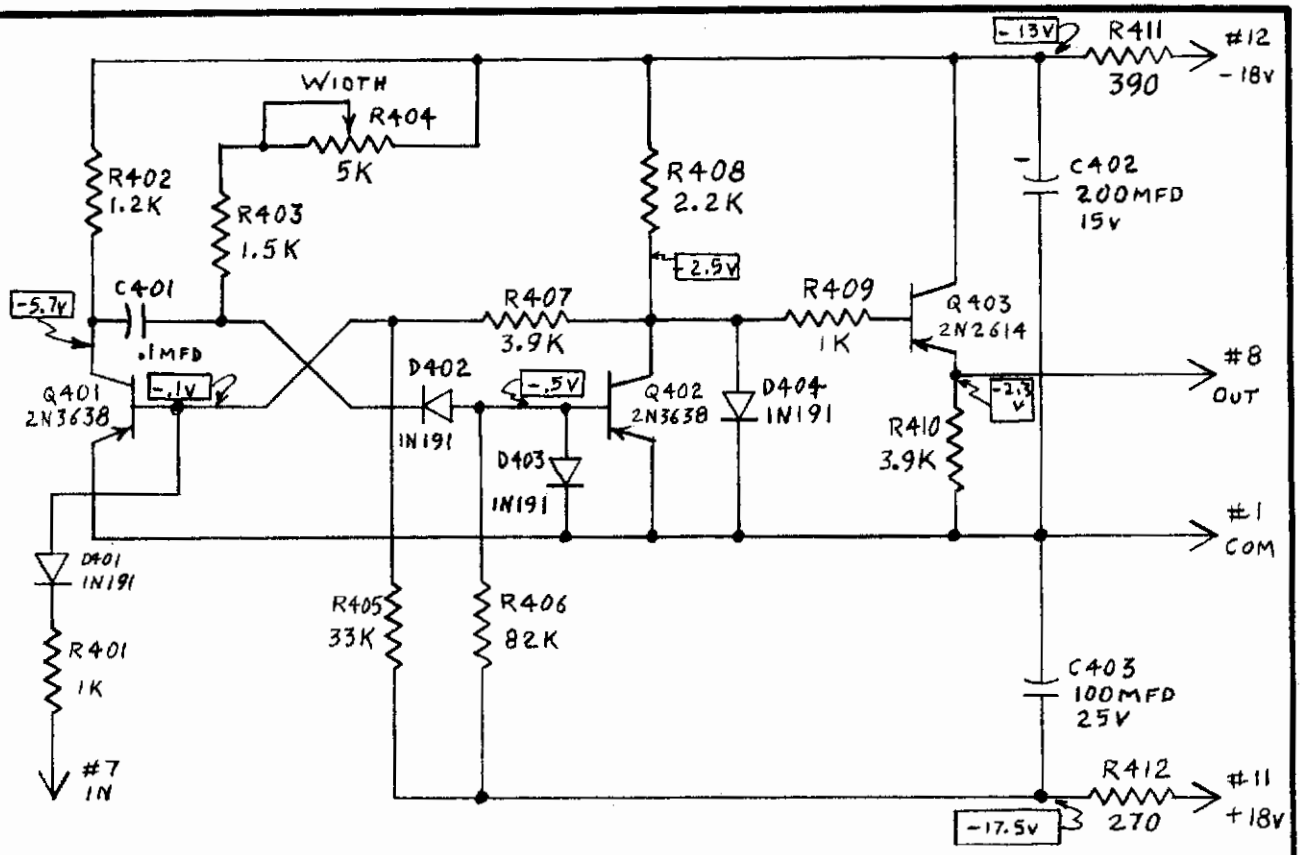
The feedback signal is fed to the base of Q301 which acts as an emitter follower to prevent loading of the twin T network by the oscillator input. R309 provides an adjustment of the frequency by varying the center frequency of the twin T network. The feedback signal appearing at the base of Q301 is developed across the emitter load resistor R301 and then coupled through C301 to the base of the oscillator transistor Q302. Since this signal is in phase at the oscillator frequency, it will reinforce the amplifier, sustaining the oscillations.

The collector signal of Q302 also feeds through R307 to the base of Q303. Q303 is also an emitter follower to reduce loading effects on the oscillator. The signal is developed across the emitter resistors R310 and R311. R311 provides a variable amplitude control. The selected amplitude is fed from the arm of R311 through C306 to the base of Q304.

Q304 is biased in the linear range of its operation by the voltage divider action of R312 and R313. R313 is selected for maximum amplitude with minimum distortion. Q304 also obtains a part of its bias from the small negative voltage developed across R315. C308 acts as a filter to prevent degenerative feedback at the oscillator's frequency. The signal appearing at the base of Q304 is amplified and developed across the collector load resistor R314. C307 acts as a noise filter to remove high frequency components from the waveform.

The signal developed at the collector of Q304 is fed through R116 to the base of Q305. Q305 acts as an output emitter follower to isolate the amplifier from the external circuit. The signal is developed across the emitter load resistors R317 and fed to Pin #8.

R318 and C309 form a decoupling network to prevent signal variations from being fed between modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61013M
   b. Parts List - Dwg. No. A601AS61014M
   c. Waveforms - Dwg. No. A601AS61015M
3. Voltage measurements with 20KΩ/V meter
4. Voltages and waveforms with respect to ground, R404 max R, trigger applied at pin NO. 7

Supply Req.:	-18v @ 13 ma. +18v @ 1.5 ma.
Pulse width:	.10 to .40 msec
Minimum trig:	Neg going from 0v to at least 2.2v neg.
Output Load:	1 KΩ max.

Triggered One Shot, Variable Width Module 400		
		Schematic Diagram
1/13/66	RAM/Rlm	A601AS61012M

VARIABLE WIDTH TRIGGERED ONE SHOT

Module 400

Module 400 is a monostable multivibrator with a variable width control followed by an emitter follower. Q401 and Q402 form the multivibrator and Q403 the output emitter follower.

The multivibrator is designed such that it has one stable state and after being triggered into its other state, will return to its original condition without additional trigger or reset signals. The time it remains in its unstable state is determined by the resistor-capacitor time constant of the cross coupling.

In the steady state position, Q401 is held off and Q402 is held on. Since the emitter of both transistors are grounded, Q401 is held off by the voltage divider action of R407 and R405. With Q402 on, its collector voltage is near zero, and since R405 is returned to the positive supply the voltage at the base of Q401 will be slightly positive. Q402 is held on by the voltage divider action of R404, R403, D402, and R406. When a negative going input pulse is fed into Pin #7, it is coupled through R401 and D401 to the base of Q401, causing Q401 to turn on. As Q401 begins to turn on, its collector voltage will rise toward zero. This positive going transition is coupled through C401 and D402 to the base of Q402, causing Q402 to start to turn off. As Q402 begins to turn off, its collector voltage will become more negative. R407 couples this negative transition to the base of Q401 where it increases the turn on rate of Q401. Due to the cross coupling, a rapid switching action is obtained which ends with Q401 on and Q402 off.

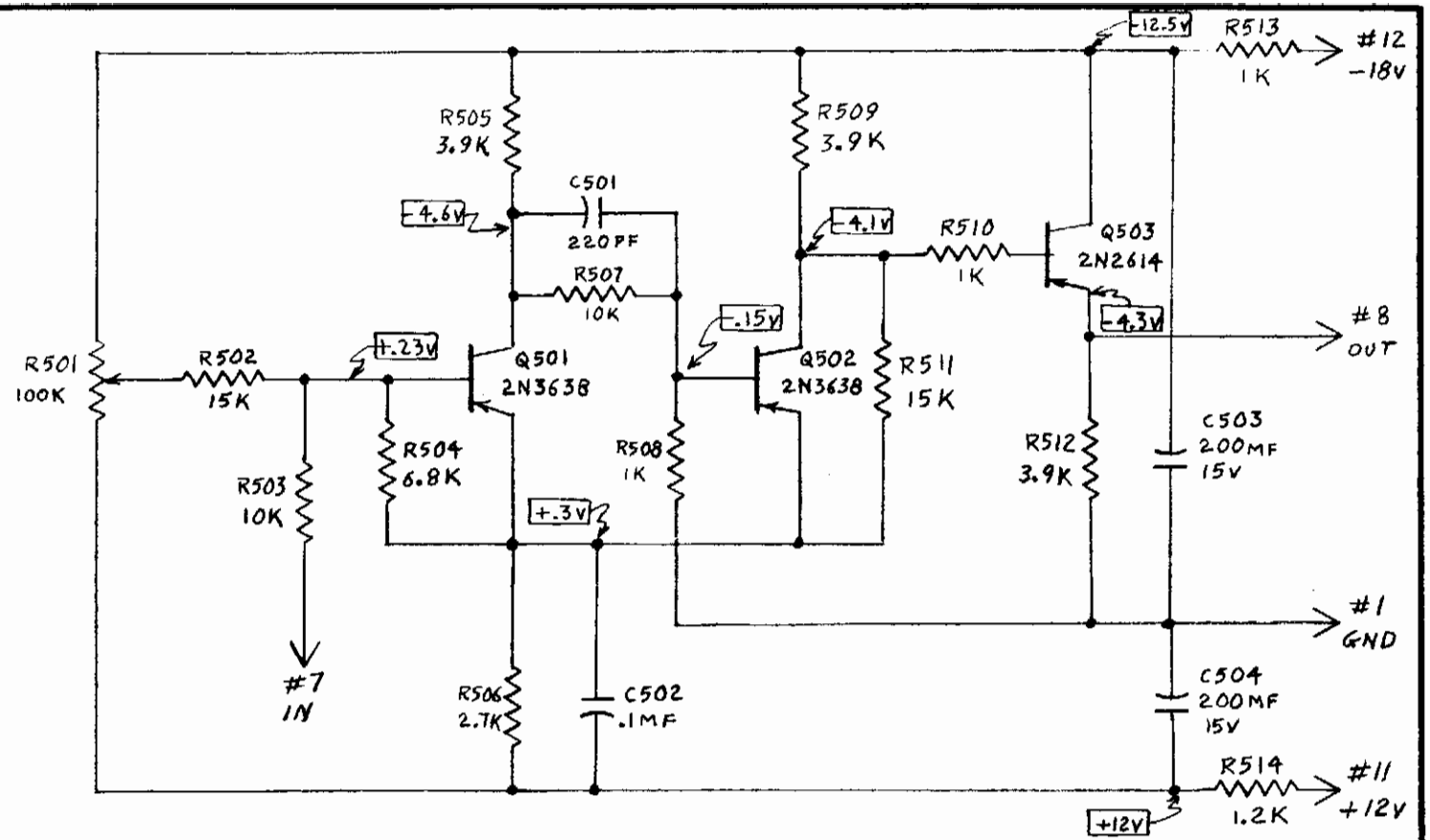
C401, which was discharged during this switching action, will now begin to charge through R403 and R404. The rate at which C401 can charge can be adjusted by varying the width control R404.

Eventually C401 will charge up enough to make the voltage at the cathode of D402 sufficiently negative to cause Q402 to begin to turn on. As Q402 begins to turn on, its collector voltage will rise toward zero. R407 couples this positive going transition to the base of Q401 which causes Q401 to begin to turn off. As Q401 turns off, its collector voltage rises and the negative transition is coupled through C401 and D402 to the base of Q402, where it increases the turn-on rate of Q402. Again cross coupling results in a rapid switching action which ends with the two transistors in their original states (401 off and 402 on). Q401 and Q402 will remain in this condition until another trigger pulse is fed into the input.

The waveform appearing on the collector of Q402 is coupled through R409 to the base of Q403. D404 maintains the most positive going portion of the waveform at zero volts since any time the collector of Q402 becomes positive with respect to zero D404 will conduct, shorting out the more

positive portion. The signal appearing at base of Q403 (the output emitter follower) also appears across its emitter resistor R410 and the output Pin, #8.

R411, C402, and R412, C403 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61029M
   b. Parts List - Dwg. No. A601AS61030M
   c. Waveforms - Dwg. No. A601AS61031M
3. Voltage measurements with 20KΩ/V meter, 9V p-p sine wave in and THRESHOLD Adj. set for symetrical output.
4. Follow with Attenuator module (Mod. 500) when loading or waveform deterioration is encountered.

Output Load: 4.7KΩ
Supply Req.: -18v @ 6.5ma
+18v @ 5 ma.
Trigger Range: -10v to +6.5v
Hysterisis: 0.3v

Variable Threshold Schmidt Trigger		Module 500
		Schematic Diagram
12/21/65	RAM/Rlm	A601AS61028M

VARIABLE THRESHOLD SCHMIDT TRIGGER

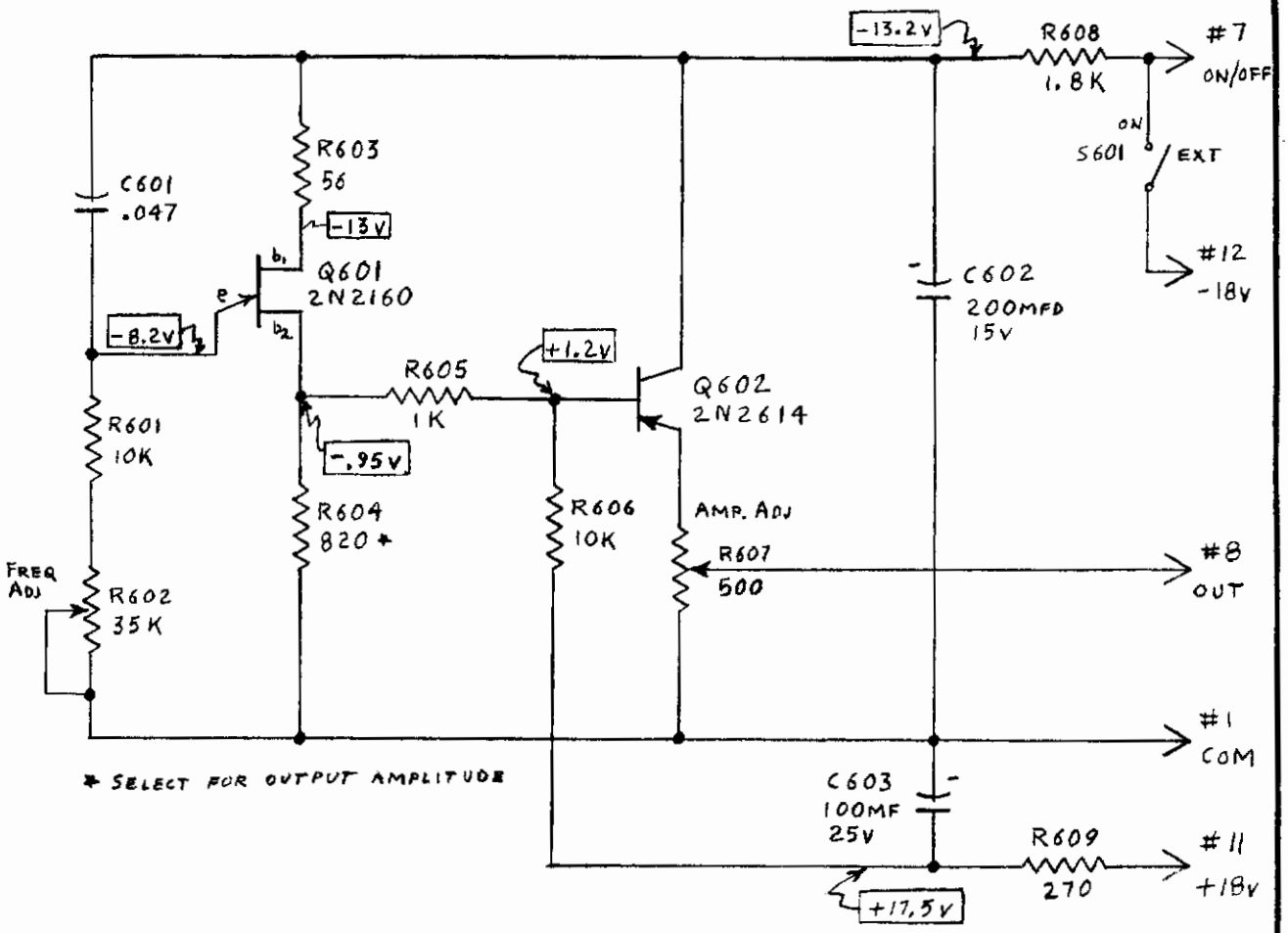
Module 500

Module 500 is composed of a Schmidt trigger with an adjustable reference input and a signal input. An emitter follower isolates the output from loading effects of the circuit.

Q501 and Q502 form a Schmidt trigger circuit where positive feedback is used to obtain rapid switching action. Q503 acts as the emitter follower.

R201 is connected between the negative and positive power supplies and is used to obtain a positive and negative reference voltage. R502 and R503 act as summing resistors to add the reference and input voltages at the base of Q501.

When the circuit is first turned on, with no input present and the trigger control set in the middle of its range (zero volts), the voltage divider formed by R505, R507, and R508 will make the base of Q502 negative with respect to its emitter, turning on Q502. As Q502 turns on, its emitter current increases causing an increase in the voltage developed across R506 and making the emitter of Q501 positive. This in turn reverse biases Q501, preventing it from turning on. With the circuit in this stage, an increasingly negative voltage applied to Pin #7 will cause the transistors to switch states.



Notes:

1. Resistors in ohms unless otherwise noted
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61009M
   b. Parts List - Dwg. No. A601AS61010M
   c. Waveforms - Dwg. No. A601AS61011M
3. Voltage measurements by 20KΩ/V meter with respect to ground, R602 & R607 @ max., (min. freq & max. output voltage).

Supply Req.:	-18v @ 2.7 ma. +18v @ 1.5 ma.
Freq. Range:	500cps to 1.5 KC
Output Load:	1 KΩ Max.

Variable Frequency, Variable Amp. Trigger Generator Module 600		
		Schematic Diagram
1/13/66	RAM/	A601AS61008M

VARIABLE FREQUENCY AND AMPLITUDE TRIGGER GENERATOR

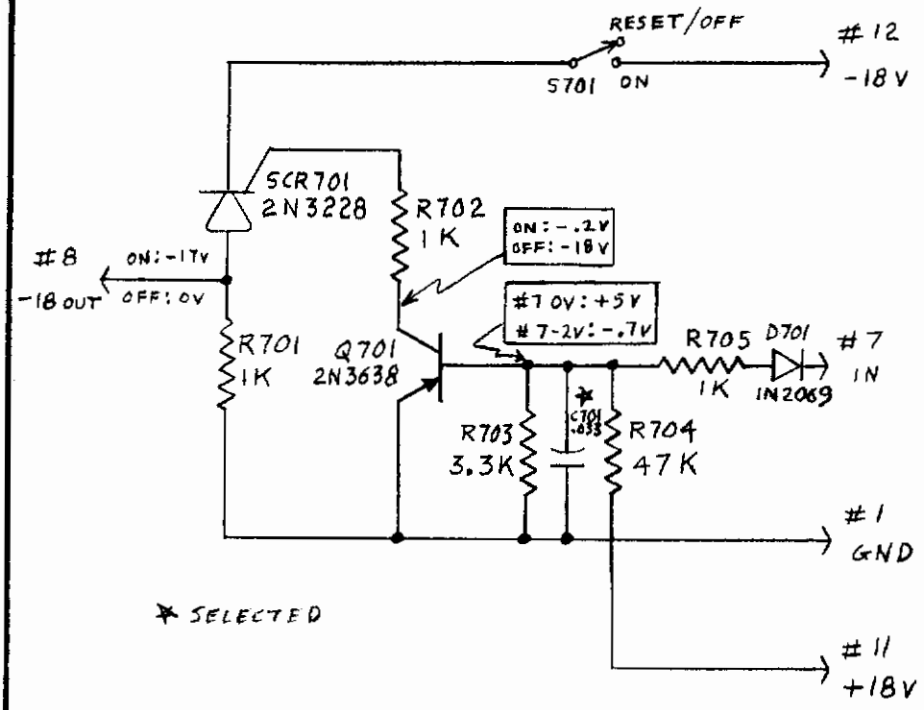
Module 600

Module 600 is composed of a unijunction trigger generator followed by an emitter follower with a variable amplitude control in its emitter circuit.

When power is first applied to the circuit through either S601 or by applying a -18V to Pin #7, C601 in the emitter of the unijunction transistor will begin to charge through R601 and the variable resistor R602. R602 adjusts the length of time it takes to exponentially build up the emitter voltage.

When the emitter voltage becomes high enough to overcome the back bias, the emitter-base one junction will become forward biased, and the dynamic resistance between the emitter and base one will drop to a low value. C801 then discharges through the emitter and R603 until the emitter voltage becomes too small to maintain conduction. During this interval, Q601 will conduct heavily and the sharp current pulse develops a voltage across R604. R603, C601, and the dynamic resistance of the emitter to the base one represents a very short time constant; therefore, the pulse developed across R604 will be coupled through R605 to the base of Q602. Q602 is biased normally nonconducting by R606 being returned to the positive supply. When the negative pulse appears at its base, Q602 will conduct and operate as an emitter follower developing a negative going spike across R607 to ground. The amplitude of the output pulse fed to Pin #8 is determined by the setting of R607.

R608, C602, and R609, C603 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes:
1. Resistors in ohms unless otherwise noted
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61006M
   b. Parts List - Dwg. No. A601AS61007M
3. Voltage measurements by 20KΩ/V meter with respect to ground, S701 ON, and SCR ON or OFF as indicated, no external load.
4. SCR ON and voltage at pin #8 = -17V when voltage at pin #7 is more negative than -2V
5. For continuous DC inputs (@ pin #7), do not exceed ± 8V.

Supply Req.:
No Load, SCR Off - -18V @ 0.5 ma.
+18V @ 0.4 ma.
SCR On - -18V @ 40 ma.
+18V @ 0.4 ma.

Max. Output Load - 1.5 Amp

SWITCH (LATCHING)		Module No. 700
		Schematic Diagram
1/10/66	RAM/	A601AS61005M

LATCHING SWITCH

Module 700

Module 700 is composed of a SCR controlled by a transistor amplifier.

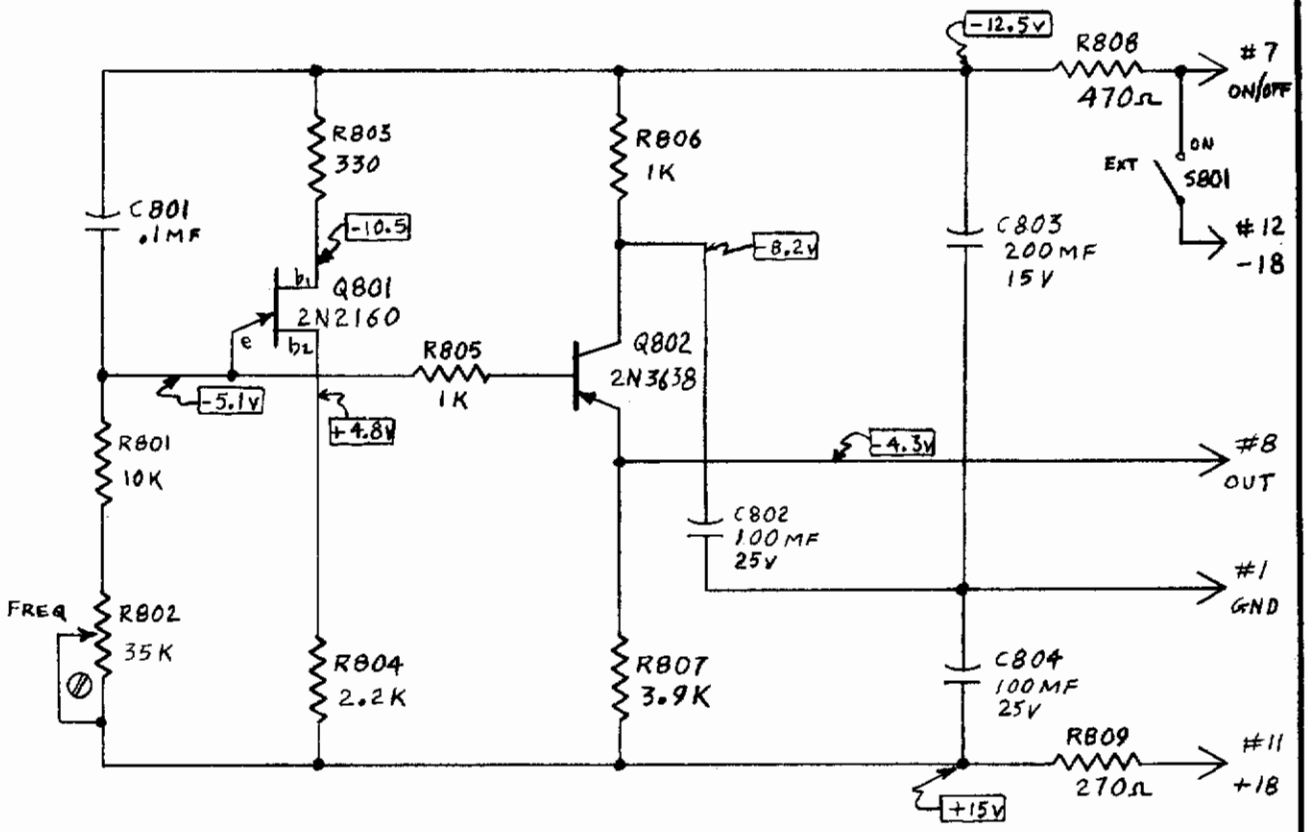
Q701 forms an amplifier circuit which applies the proper gate current to turn on the SCR.

A voltage divider composed of R703 and R704 maintains the base of Q701 at a positive voltage when the input signal is zero. To keep Q701 cut off, the input is applied through diode D701 and resistor R705 to the base of Q701. D701 prevents the accidental application of the wrong polarity signal to the base of Q701 while R705 limits the input current.

Whenever the input signal becomes more negative than -2V it will overcome the positive bias at the base of Q701 causing it to conduct. When Q701 conducts it will apply a voltage (positive with respect to the cathode) at the gate of the silicon controlled rectifier (SCR 701). If the reset switch S701 is in on position, SCR 701 will turn on when its gate becomes more positive than its cathode. When the SCR is on, the voltage at its anode will be -17V since the anode to cathode resistance of the SCR is very low.

Once the SCR has been turned on by the proper signal at the gate, it can be turned off only by opening S701 causing the anode current to drop below its holding value. When the SCR is in the off condition its anode to cathode resistance is high and the voltage at the output will go to zero due to R701 which is connected to ground.

Since the gate has no control on the SCR, after once firing the unit, it requires only a momentary pulse more negative than two volts applied at Pin #7 to turn the switch on and cause it to latch in the on position.



Notes:

1. Resistors in ohms unless otherwise noted

2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61017M
   b. Parts List - Dwg. No. A601AS61018M
   c. Waveforms - Dwg. No. A601AS61019M

3. Voltage measurements by 20KΩ/V meter with respect to ground, R802 min. R, max. freq.

Supply Req.:	-18v @ 12 ma. +18v @ 10.1 ma.
Freq. Range:	625cps to 2 KC
Output Load:	1 KΩ Max.

Variable Frequency Sawtooth Generator Module 800		
		Schematic Diagram
1/17/66	RAM	A601AS61016M

VARIABLE FREQUENCY SAWTOOTH GENERATOR

Module 800

Module 800 is composed of a unijunction sawtooth generator followed by an emitter follower.

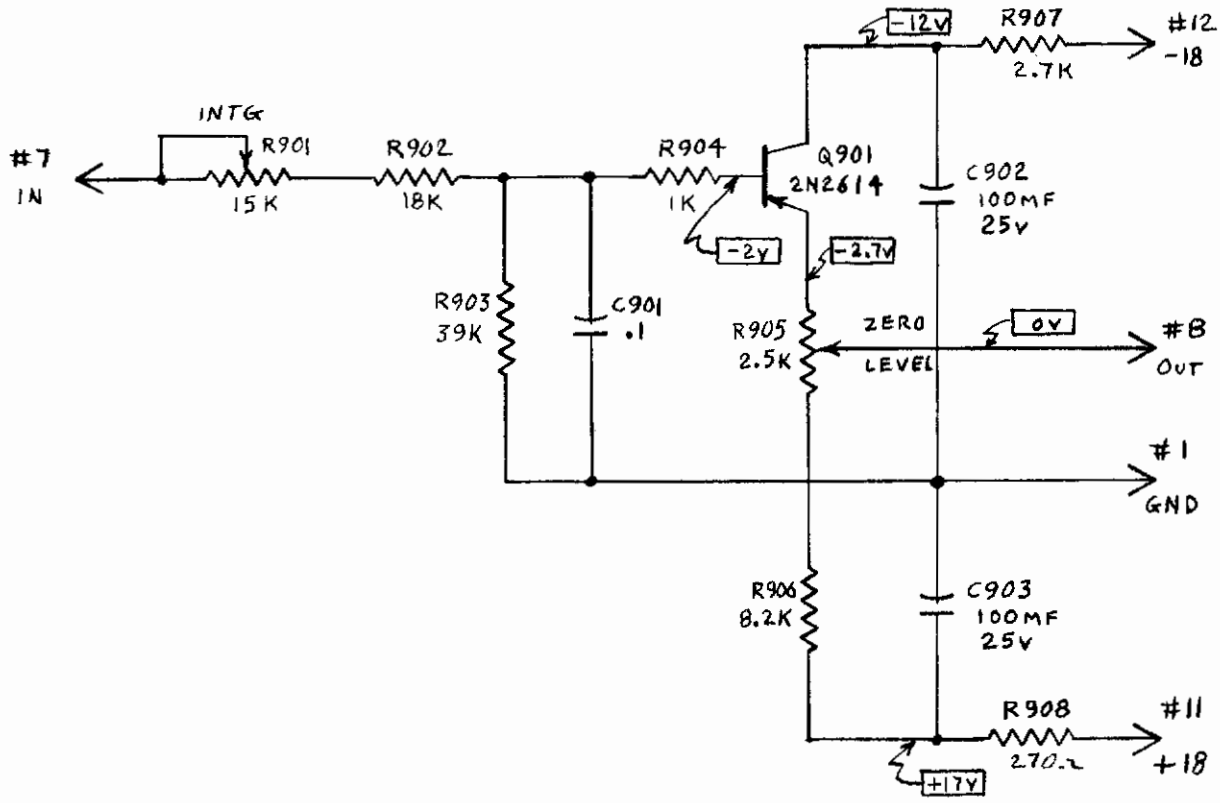
When power is first applied to the circuit through either S801 or by applying a -18 volts to Pin #7, C801 in the emitter of the unijunction transistor will begin to charge through R801 and R802. R802 is a variable resistor used to adjust the length of time it takes to build up a voltage exponentially on the emitter.

Whenever the emitter voltage becomes high enough to overcome the back-bias of the emitter-base one junction, the emitter will become forward-biased and the dynamic resistance between the emitter and base one will drop to a low value. C801 then discharges through the emitter and R803 until the emitter voltage becomes too small to maintain conduction. Q801 will stop conducting and at this point the cycle will begin to repeat.

R804 provides the proper voltage and load for base two. The voltage on the emitter will be a sawtooth voltage starting at the minimum emitter voltage and rising toward a maximum voltage where the unijunction breaks into conduction. At this point there is a rapid drop back to the minimum voltage which repeats for every cycle. This emitter wave form is coupled through R805 to the base of Q802.

Q802 is an emitter follower which is connected between the positive and negative supplies. R806 provides the proper DC operating voltage for the collector and is by-passed to ground through C802. The emitter load resistor R807 is returned to the positive supply. The output voltage from the emitter of Q802 is fed to Pin #8.

R808, C803, and R809, C804 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted

2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61021M
   b. Parts List - Dwg. No. A601AS61022M
   c. Waveforms - Dwg. No. A601AS61023M

3. Voltage measurements by 20KΩ/V meter with respect to ground.

4. Voltage and waveform measurements with R901 set for max. integration, R905 set for 0V DC Pin No. 8 to ground.

Supply Req.: -18v @ 2.3 ma.
+18v @ 3.3 ma.

Output Load: 1 KΩ Max.

RC Integrator Module 900		
		Schematic Diagram
1/17/66	RAM/Rlw	A601AS61020M

RC INTEGRATOR

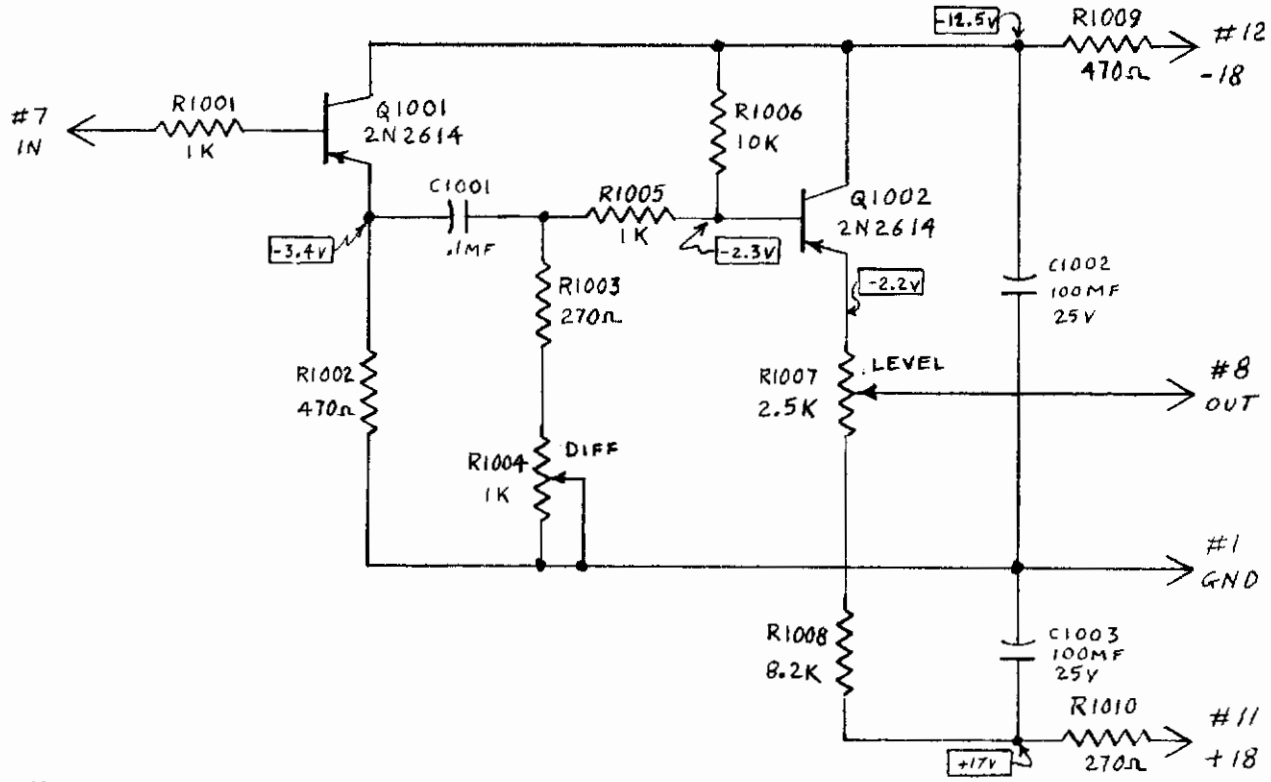
Module 900

Module 900 is composed of RC integrator circuit followed by an emitter follower with an adjustable DC output level control.

The RC integrator is made up of the variable resistor R901 and the resistors R902 and C901. The sum of the resistance of R901, R902, and C901 represents a long time constant. Because of the high resistance in the charge path of C901, it is not capable of following fast changes and thus tends to integrate the input signal. R903 provides a DC path from the base of Q901 to ground.

Q901 is an emitter follower which is connected between the minus and plus supplies in order to permit both positive and negative output signals. The output of the integrator circuit is fed through R904 to the base of Q901. The emitter is coupled through the variable resistor R905 and through the resistor R906 to the positive supply. By varying the arm of R905, it is possible to change the DC output level at Pin #8 with a minimum effect on the AC signal.

R907, C902, and R908, C903 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:
1. Resistors in ohms unless otherwise noted
2. Reference Dwgs.
   a. Parts Layout - Dwg. No. A601AS61033M
   b. Parts List - Dwg. No. A601AS61034M
   c. Waveforms - Dwg. No. A601AS61035M
3. Voltage measurements with 20KΩ/V meter, signal in, max DIFF (min resistance R1004), LEVEL set for zero at base line of output
4. Waveforms R1004 & R1007 as in 3 above, input as shown on waveforms

Supply Req.: -18v @ 12 ma.
+18v @ 4 ma.

Output Load: 1 KΩ max

R C Differentiator Module 1000		
		Schematic Diagram
1/17/66	RAM	A601AS61032M

RC DIFFERENTIATOR

Module 1000

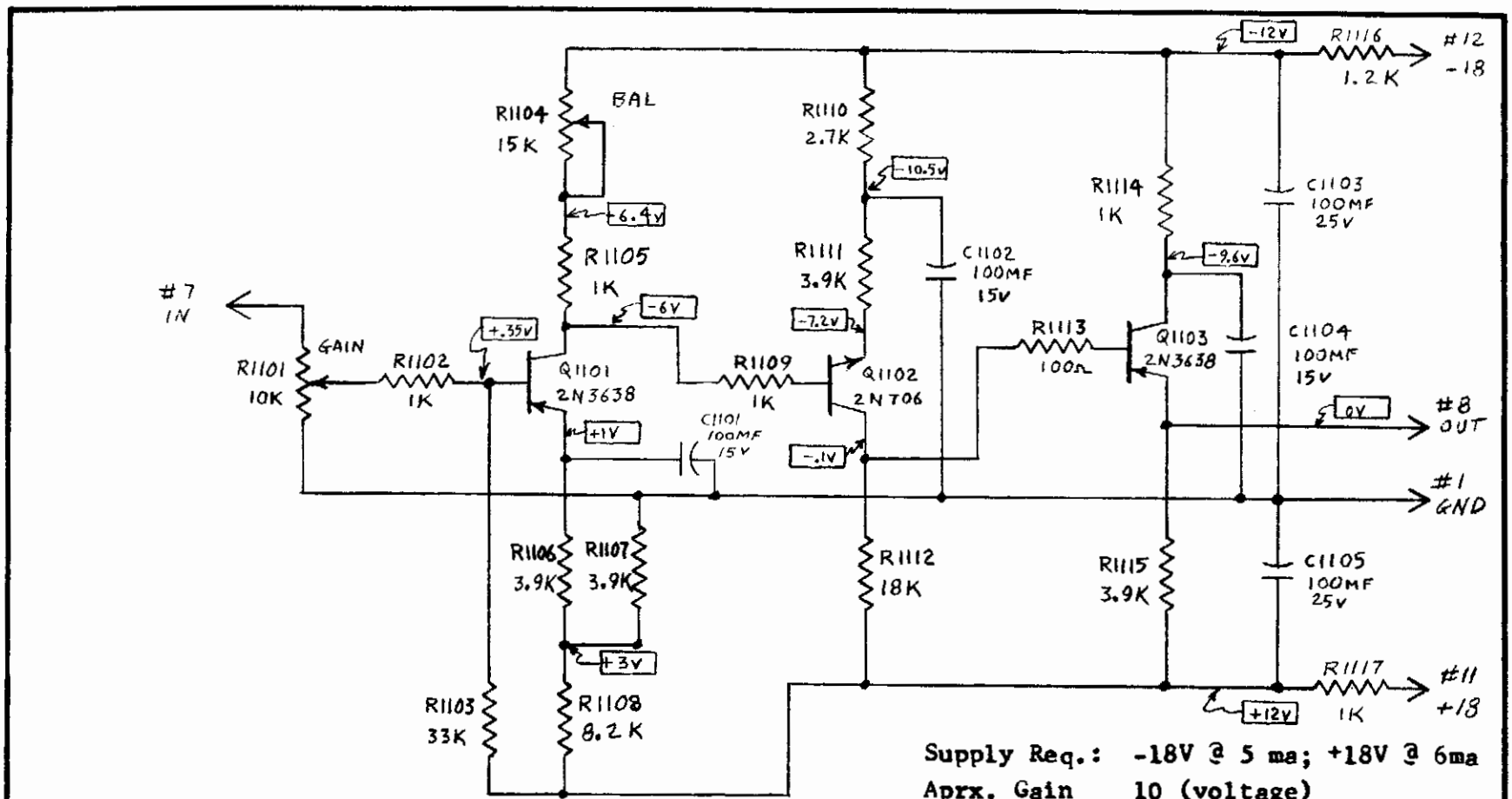
Module 1000 is a variable RC differentiator circuit with emitter followers to isolate both the input and output of the circuit.

The input emitter follower is composed of Q1001, R1001, and emitter resistor R1002. The signal is applied through the current limiting resistor R1001 to the base of Q1001.

The differentiator circuit is composed of C1001, R1003, and variable resistor R1004. By varying the arm of R1004, the amount of resistance can be increased or decreased, thus changing the time constant of the circuit. Since C1001 is relatively small and the sum of R1003 and R1004 is small, the circuit will have a short time constant which will prevent the passage of low frequency signals.

R1005 couples the signal to the base of the output emitter follower while R1006 provides a negative bias to maintain Q1002 in the linear portion of its operation. The emitter of Q1002 is connected through the variable resistor R1007 and the resistor R1008 to the positive supply. R1007 provides a method of adjusting the output DC level with a minimum effect on the AC signal.

R1009, C1002, and R1010, C1003 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Supply Req.: -18V @ 5 ma; +18V @ 6ma
Aprx. Gain 10 (voltage)
Output Swing ±5V
Output Load 3.3KΩ max
Frequency DC to 20KC

Notes:
1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61025M
   b. Parts List - Dwg. No. A601AS61026M
   c. Waveforms - Dwg. No. A601AS61027M
3. Voltage measurements by 20KΩ/V meter with respect to ground with input shorted.
4. Voltage and Waveform measurements - BAL set for OV out with input shorted, - with 9V p-p in.

Variable Gain, Non-inverting Amplifier		Module 1100
		Schematic Diagram
1/18/66	RAM/	A601AS61024M

VARIABLE GAIN NON-INVERTING AMPLIFIER

Module 1100

Module 1100 is a two-stage DC coupled amplifier with a variable resistor at the input to provide a variable gain adjustment and an emitter follower output stage. It is composed of a PNP stage followed by another PNP stage. By alternating transistor types, the problem of overcoming the quiescent DC voltage balance is simplified.

The first stage (Q1101) is a conventional common emitter PNP amplifier which is connected between the positive and negative 18V supply to permit proper biasing. The input signal at Pin #7 is developed across the variable resistor R1101. R1103 provides a slight positive bias at the base of the transistor and a voltage divider composed of R1107 and R1108 between the positive supply and ground establishes the DC emitter potential. C1101 bypasses the AC signal to ground.

R1106 in the emitter circuit is used to provide degenerative feedback to increase the amplifier's stability. The collector circuit is composed of R1105 and R1104 (the balance control). R1104 sets the DC output voltage to zero when the input is shorted.

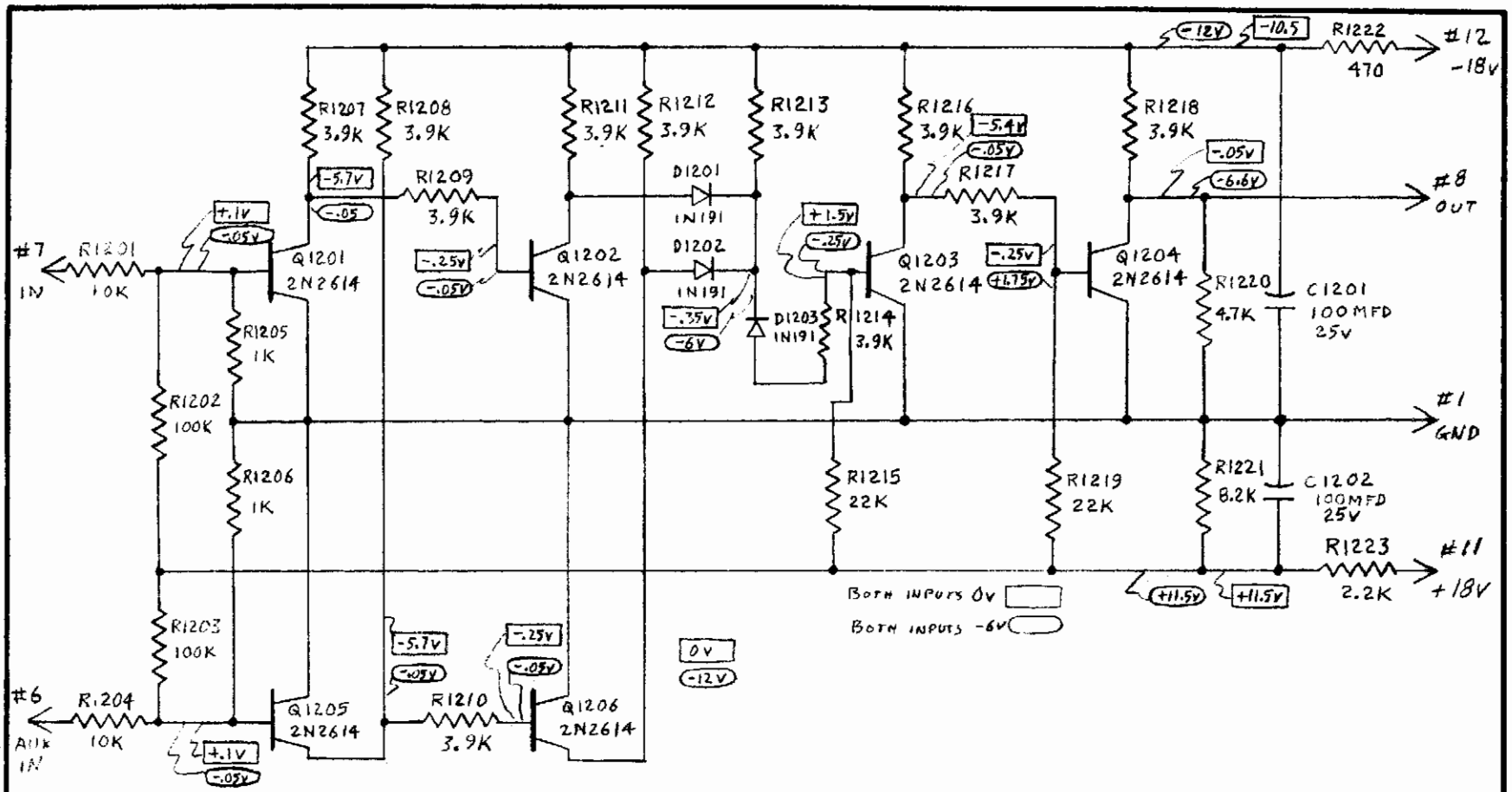
As R1101's arm is moved away from ground, more signal will be fed through R1102 to the base of Q1101. This signal will be amplified and appear on the collector from whence it will be coupled through R1109 to the next stage.

Q1102 forms an NPN common emitter amplifier stage whose operation is essentially the same as the first stage. The emitter is connected through R1111 and R1110 to the negative supply with R1110 being bypassed for AC signals with C1102. The collector resistor (R1112) is connected to the positive supply and does not have provision for DC balancing.

The input signal applied to the base of Q1102 is amplified and appears on the collector where it is coupled through R1113 to the base of Q1103.

The last stage is an emitter follower which is connected between the plus and minus supplies to permit the output to swing both positive and negative. R1114 provides a DC voltage for the collector and is bypassed for AC with C1104. The output is developed across the emitter load resistor R1115 and fed to Pin #8.

R1116, C1103, and R1117, C1105 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61071M
   b. Parts List - Dwg. No. A601AS61072M
   c. Waveforms - Dwg. No. A601AS61073M
3. Voltages measured with 20KΩ/V Meter with respect to ground and input conditions as noted above.
4. Both inputs -6V, Output is -6V; either or both inputs 0V, Output 0V.

Supply Req.: -18V @ 16 ma.
+18V @ 3 ma.

+ And Gate		Module 1200
		Schematic Diagram
1/27/66	RAM/RDM	A601AS61070M

POSITIVE AND-GATE

Module 1200

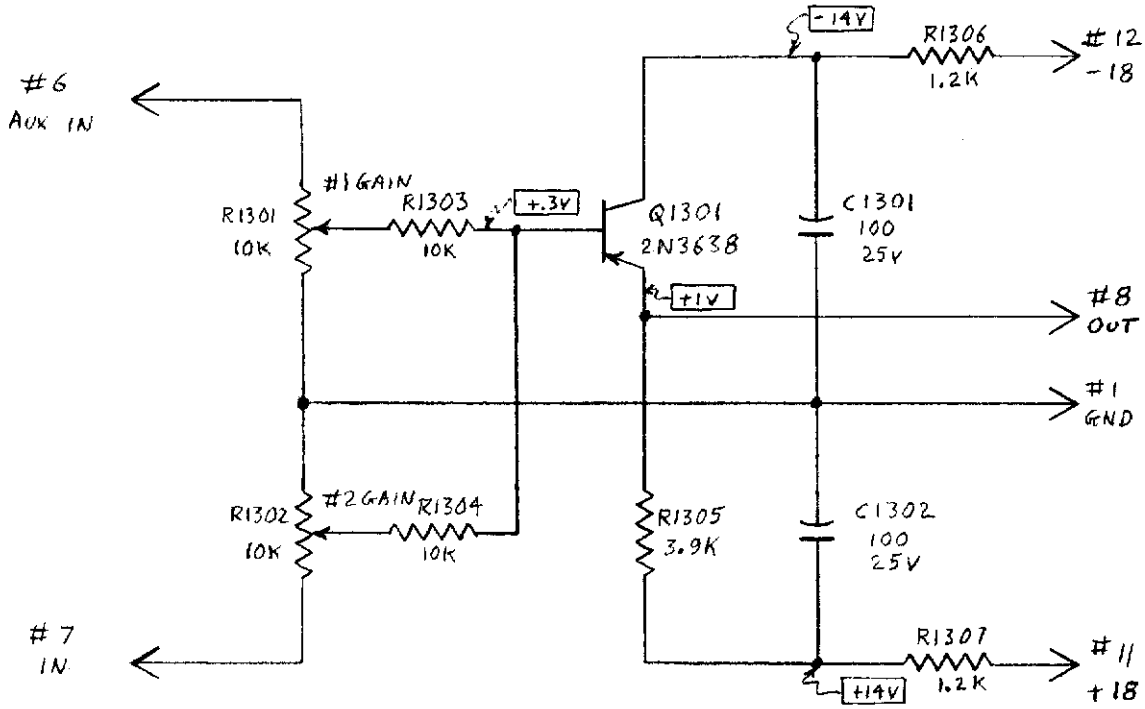
Module 1200 is composed of two non-inverting amplifiers feeding into a diode and-gate whose output is isolated with a third non-inverting amplifier. Q1201 and Q1202 form the amplifier for inputs fed to Pin #7. Q1205 and Q1206 form the amplifier for inputs fed into Pin #6. These amplifiers are connected to a diode and-gate composed of D1202 and D1203. The diode and-gate is then coupled to the third non-inverting amplifier composed of Q1203 and Q1204.

The input amplifiers are identical so a description of the operation of one should suffice. Q1201 is biased in the off condition by the voltage divider R1202 and R1205 which maintains a slight positive voltage at its base when the input is zero. Under this condition its collector current is zero and the resistors, R1207 and R1209, will apply a negative bias to Q1202, turning it on. When on, Q1202 represents a short circuit between its collector and ground holding the collector voltage (the junction of R1211 and the anode of D1201) at zero. This makes the anode of D1201 positive with respect to its cathode causing it to conduct, and hold the junction of the cathodes of the diodes D1201, D1202, and D1203 at zero volts. With this junction at zero the voltage divider formed by R1215 and R1214 makes the base of Q1203 slightly positive, cutting this transistor off. With Q1203 cut off, the voltage divider action of R1216, R1217, and R1219 makes the base of Q1204 slightly negative causing it to conduct and drop the voltage on its collector (the onput voltage) to zero. With the voltage at Pin #7 at zero, as just described, it does not matter whether the voltage applied to Pin #6 is zero or -6 volts, since diode D1201 causes the junction of the cathodes of the and-gate to be zero volts. If D1202 were conducting it would also tend to make that junction zero, which would have no effect on the output. If D1202 were not conducting it would represent an open circuit and still would have no effect on the onput.

If the applied input to Pin #7 is -6 volts, the current through R1201 and R1205 would be sufficient to overcome the positive bias provided by the voltage divider R1202 and R1205. When the positive bias is overcome, transistor Q1201 will turn on, causing the collector voltage to go to zero. This in turn, turns off Q1202 making its collector negative and opening diode D1201. If the input applied to Pin #6 is also -6 volts, diode D1202 will be open through the same action on the other input amplifier. If both diodes are open the voltage at the junction of their cathodes will be pulled negative due to the current flow through R1213 to the minus supply. This current flow overcomes the positive bias at the base of Q1203 turning it on and dropping its collector voltage to zero. When the collector of Q1203 becomes zero, the voltage divider action of R1219 and R1217 makes the base of Q1204 slightly positive causing it to turn off. When Q1204 turns off, the voltage appearing at Pin #8 of the output will be determined by the voltage divider R1218 and R1220. R1220 is slightly larger than R1218 to com-

pensate for the loading caused by external circuits connected to the output. This loading will generally cause the combined impedance of the load, R1220, to be about equal to R1218, making the output approximately half the supply voltage, or approximately -6 volts.

R1222, C1221 and R1223, C1202 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:
1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61061M
   b. Parts List - Dwg. No. A601AS61062M
   c. Waveforms - Dwg. No. A601AS61062MA
3. Voltage measurements with 20KΩ/V meter with zero input.

Supply Req.: -18V @ 3.5 ma
+18V @ 3.5 ma

Frequency: 20KC

Output Load: 2.2KΩ max.

Adder		Module 1300
		Schematic Diagram
1/25/66	RAM/Rlm	A601AS61060M

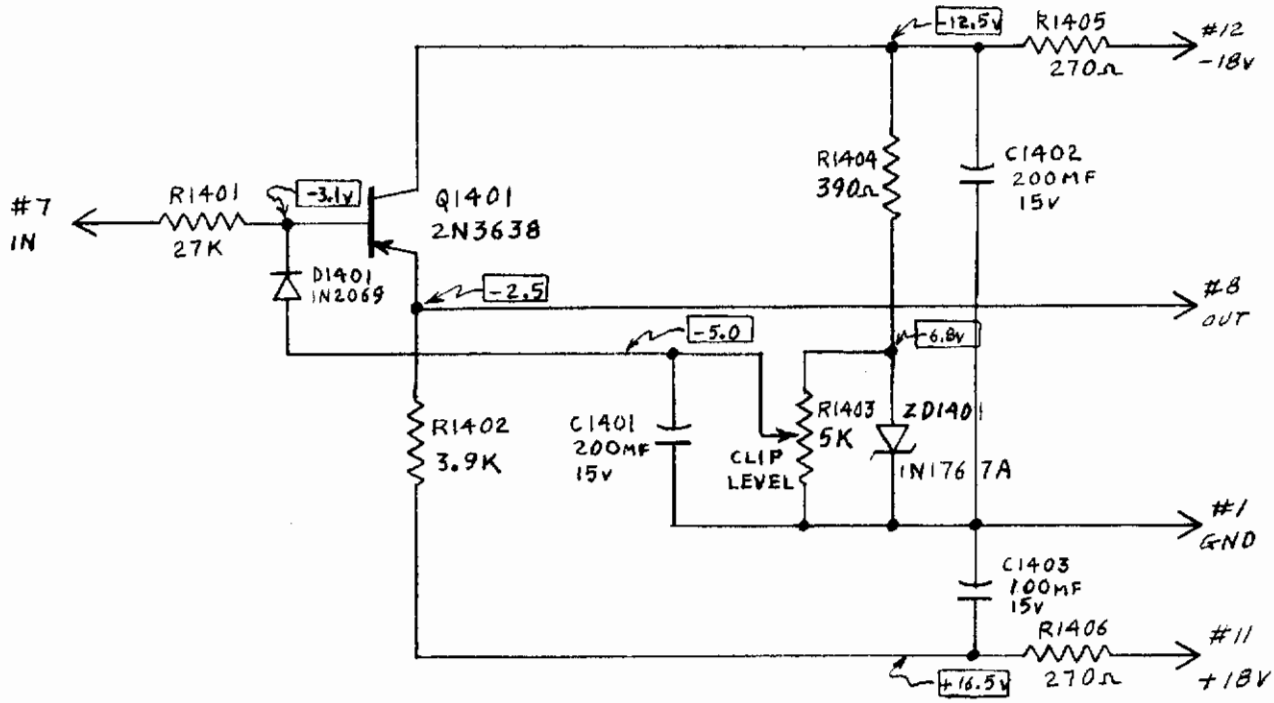
ADDER

Module 1300

Module 1300 is composed of a resistor adding network followed by an emitter follower. Input voltages are fed into Pins #6 and #7 and developed across pots R1301 and R1302 respectively. R1303 and R1304 are used to isolate each input from the other. The voltage developed across the input pots results in a current flowing through each of the two 10K series resistors which is summed at the base of Q1301.

Q1301 is a standard emitter follower presenting a relatively high input impedance to the summing junction. The voltage at the emitter will be proportional to the sum of the two base currents flowing through R1303 and R1304. Since each of these currents is proportional to the input voltages, the emitter voltage is proportional to the sum of the input voltages. The emitter of Q1301 is returned through R1305 to the positive supply so the output signal can go both positive and negative.

R1306, C1301, and R1307, C1302 are decoupling networks to prevent signals from being coupled between modules through the supplies.



Notes:
1. Resistors in ohms unless otherwise noted
2. Reference Dwgs.:
   a. Parts Layout - Dwg. No. A601AS61041M
   b. Parts List - Dwg. No. A601AS61042M
   c. Waveforms - Dwg. No. A601AS61043M
3. Voltage measurements by 20KΩ/V meter to GND with 10v p-p sine wave centered at -5v for input, R1403 set for 5v on arm.

Supply Req.:	-18v @ 24 ma. +18v @ 5.6 ma.
Clipping	0v to -5v
Output Load	2.2KΩ max.

Negative Clipper		Module 1400
		Schematic Diagram
1/18/66	RAM/R14	A601AS61040M

NEGATIVE CLIPPER

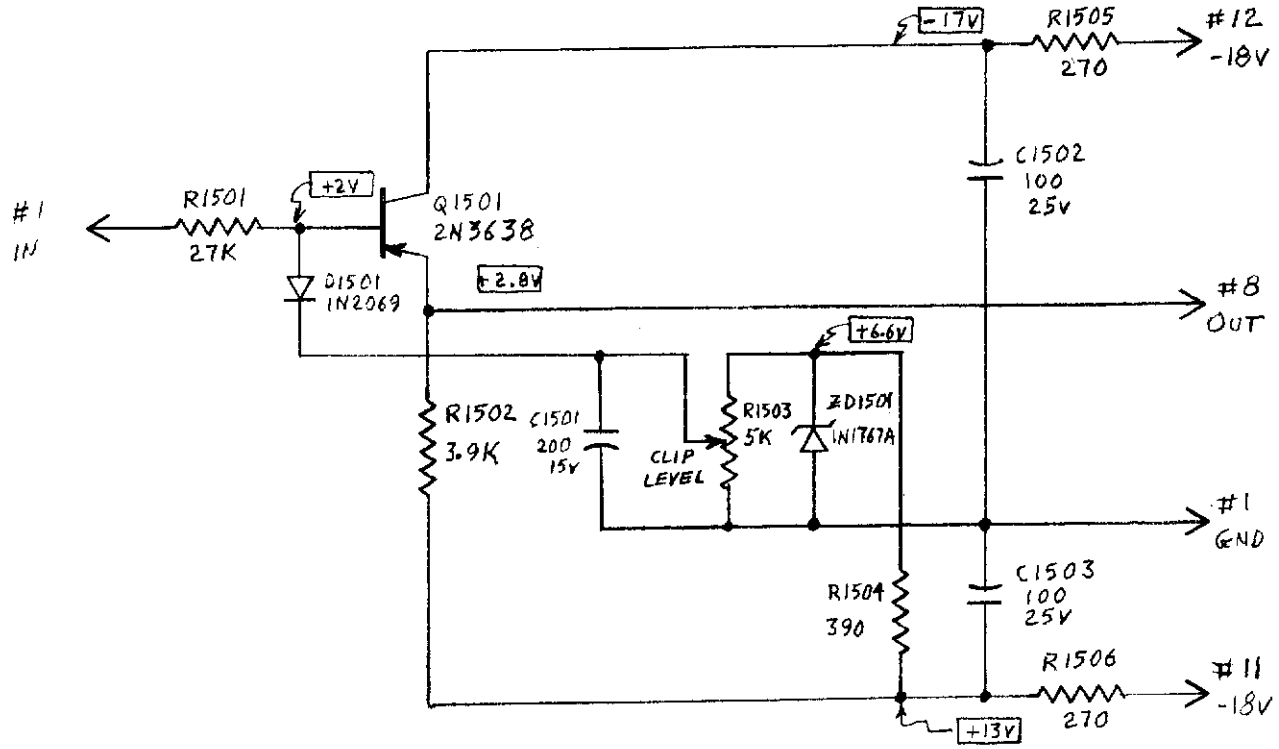
Module 1400

Module 1400 is composed of a negative clipper followed by an emitter follower. R1404 and ZD1401 form a voltage divider between the -18V supply and ground. The zener diode (ZD1401) acts as a voltage regulator to maintain a constant voltage across the "clip level" pot (R1403). As the arm of R1403 is moved away from ground, an increasing negative voltage will be developed across C1401 establishing a negative voltage level at the anode of D1401.

The input signal is fed through R1401 to the cathode of the diode D1401. When the voltage at the cathode of D1401 is negative with respect to its anode, D1401 will conduct shorting the signal to ground through C1401. This clips the negative portion of the signal on the base of Q1401 at the voltage established across C1401.

Q1401 is used as an emitter follower. Its emitter is connected through R1402 to the +18V supply to permit the emitter to go both negative and positive. Since the emitter will attempt to follow the voltage applied at the base, the output signal appearing at Pin #8 will be essentially the same as the clipped signal on the base of Q1401.

R1405, C1402, R1406, and C1403 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes: 1. Resistors in ohms unless otherwise noted.

2. Reference Dwgs:
   a. Parts Layout - A601AS61045M
   b. Parts List - A601AS61046M
   c. Waveforms - A601AS61047M

3. Voltages measured with 20KΩ/V meter, 9V p-p sine wave in, arm of R1503 set @ 3V.

Supply Req.: -18V @ 3.8 ma.
+18V @ 18.5 ma.

Output Load: 4.7 max.

Positive Clipper Module 1500		
		Schematic Diagram
1/20/66	RAM/Rdm	A601AS61044M

POSITIVE CLIPPER

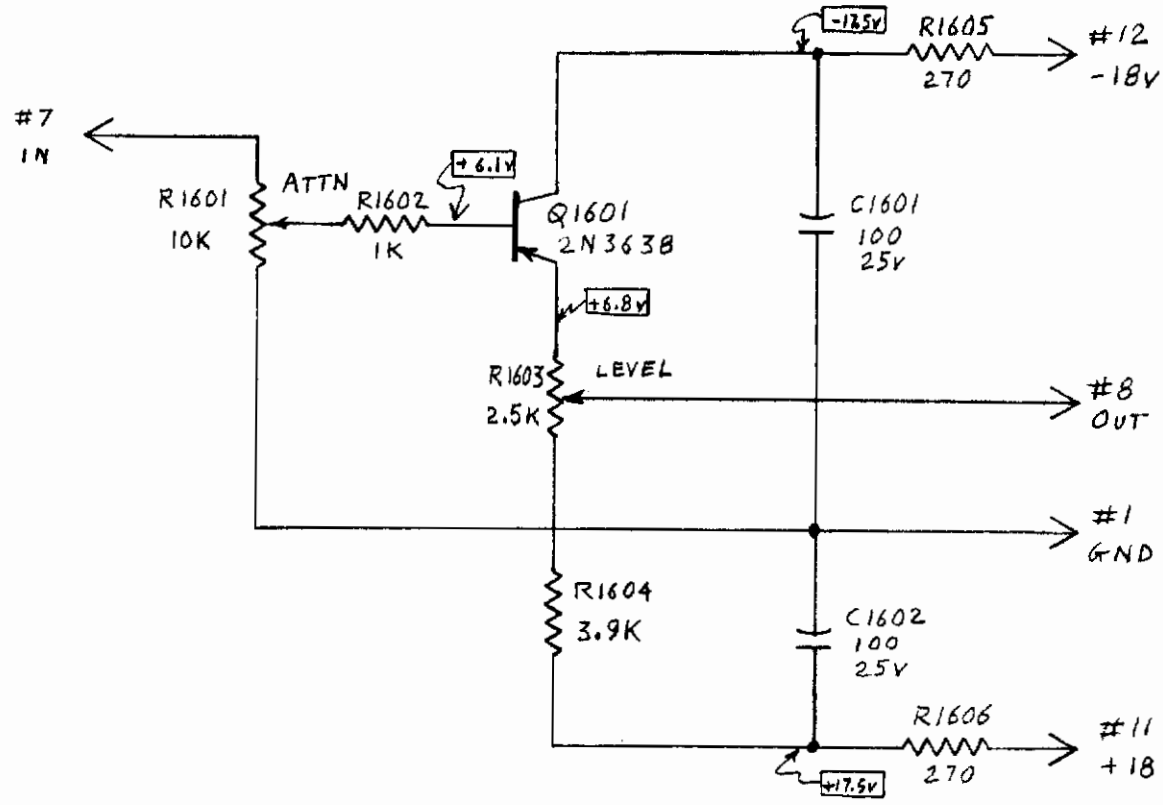
Module 1500

Module 1500 is composed of a positive clipper followed by an emitter follower. R1504 and ZD1501 form a voltage divider between the +18 volts supply and ground. The zener diode (ZD1501) acts as a voltage regulator to maintain a constant voltage across the "clip level" pot R1503. As the arm of R1503 is moved away from ground, an increasing voltage will be developed across C1501 establishing a positive voltage level at the cathode of D1501.

The input signal is fed through R1501 to the anode of the diode D1501. When the voltage at the anode of D1501 is positive with respect to its cathode, D1501 will conduct, shorting the signal on the base of Q1501 at the voltage established across C1501.

Q1501 is used as an emitter follower. Its emitter resistor R1502 is returned to the +18 volts supply to permit the output signal to go positive with respect to ground. The signal appearing at the output (Pin #8) will be essentially the same as that applied to the input except that the clipping action of D1501 prevents positive excusions from exceeding the voltage level established by the setting of the "clip level" pot.

R1505, C1502, R1506, and C1503 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61053M
   b. Parts List - Dwg. No. A601AS61054M
   c. Waveforms - Dwg. No. A601AS61055M
3. Voltage measurement with 20KΩ/V meter with sine wave in.

Supply Req.:	-18V @ 2 ma. +18V @ 2 ma.
Max Input:	20V p to p.
Output Load:	4.7K max.

Attenuator		Module 1600
		Schematic Diagram
1/21/66	RAM/[illegible]	A601AS61052M

ATTENUATOR

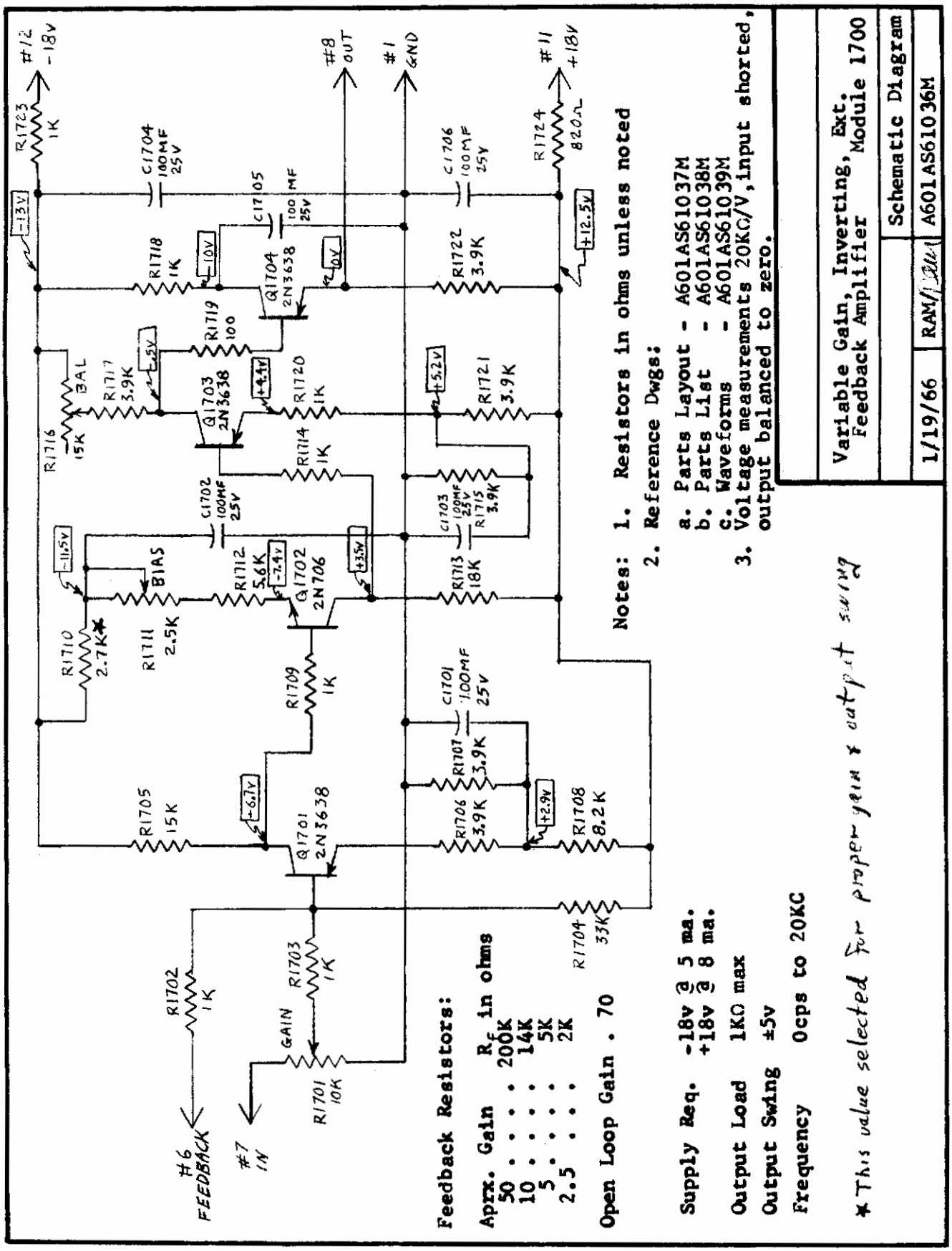
Module 1600

Module 1600 is an emitter follower with a variable gain input and an adjustable output DC level.

The input signal is developed across R1601 to ground. Since the emitter follower (Q1601) has high input impedance, the amount of signal fed to its base through the current limiting resistor R1602 will be proportional to the setting of the arm of R1601. As the arm of R1601 is moved closer to the input (Pin #7) the signal fed into the emitter follower is increased.

The emitter of Q1601 is connected through the level pot R1603 and the resistor R1604 to the +18V supply. As the level pot is adjusted, the DC that appears at output Pin #8 can be varied with a minimum effect on the signal amplitude.

R1605, C1601, and R1606, C1602 form decoupling networks to prevent variations in module current from being coupled between modules through the supplies.



VARIABLE GAIN, INVERTING, EXTERNAL FEEDBACK AMPLIFIER

Module 1700

Module 1700 is a four stage DC-coupled variable gain inverting amplifier with provisions for external feedback by connecting an appropriate resistor between Pin #7 and the output Pin #8.

Q1701 with its associated components forms the first stage of the amplifier. The input signal fed into Pin #7 is developed across R1701 to ground. By varying the setting of R1701, the amount of the input signal fed through R1703 to the base of Q1701 can be increased or decreased. In addition, the feedback signal, if used, is fed into Pin #6 and through R1702 to the base of Q1701. The net signal appearing at the base of Q1701 will be the sum of the currents due to the feedback and input signals. R1704 returns the base of Q1701 to the positive supply to provide bias.

Q1701 is connected through R1705 to the negative supply and through R1706 and R1708 to the positive supply. This permits operation of the circuit near zero volts with respect to ground. The emitter circuit has a fixed bias due to the voltage divider action of R1708 and R1707. C1701 bypasses this junction to prevent AC signal variations from changing the bias voltage. R1706 provides a small amount of degenerative feedback to help improve circuit linearity. The signal developed at the collector of Q1701 is DC-coupled through R1709 to the base of the second stage Q1702.

Q1702 is a NPN transistor used to restore the DC offset caused by the collector to base drop of Q1701. The emitter of Q1702 is returned through R1712, R1711, and R1710 to the negative supply. By choosing R1710 for proper output swing, adjusting R1711 permits small operating adjustments to compensate for circuit changes due to component aging. C1702 bypasses the junction of R1710 and R1711 to prevent AC signal variations at this point thus establishing the proper DC levels for the second stage.

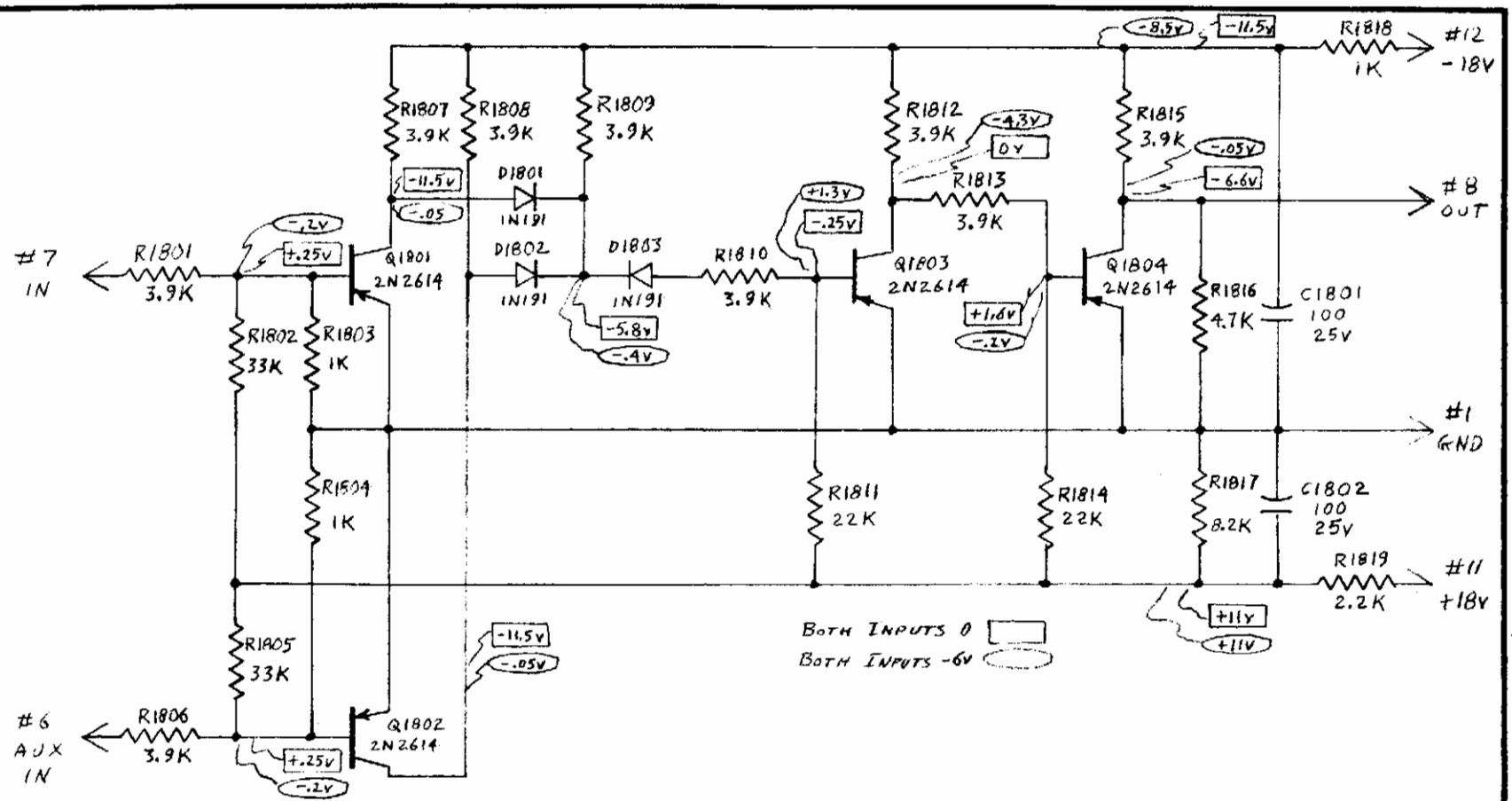
The collector of Q1702 is returned through R1713 to the positive supply. The signal appearing at the collector is coupled through R1714 to the base of the third stage Q1703.

Q1703 is a PNP stage like the first one. The emitter of Q1703 is returned through R1720 and R1721 to the positive supply. Again, a voltage divider formed by R1721 and R1715 and bypassed by C1703 establishes a constant emitter bias. R1720 provides a small amount of degenerative feedback to improve circuit linearity. The collector of Q1703 is returned through R1717 and R1716 to the negative supply. By adjusting R1716, this stage can be balanced to obtain an output signal

which varies linearly about zero volts with respect to ground. The signal appearing at the collector of Q1703 is coupled through R1719 to the base of the last stage Q1704.

Q1704 is an emitter follower to prevent the output circuit from loading the third stage of the amplifier. The collector is held at a constant voltage by R1718 and its bypass capacitor C1705. The emitter is returned through its load resistor R1722 to the positive supply. By connecting its collector and its emitter circuit in this manner, when the remainder of the amplifier is properly balanced and the input signal is zero, the emitter of Q1704 will also be zero. The emitter of Q1704 is connected to the output Pin #8.

R1723, C1704, and R1724, C1706 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - A601AS61067M
   b. Parts List - A601AS61068M
   c. Waveforms - A601AS61069M
3. Voltages measured with 20KΩ/V meter with respect to ground and input conditions as noted above.
4. Both inputs zero, output is -6V; either or both inputs -6V, output is 0V.

Supply Req.: -18V @ 9.5 ma.
+18V @ 3.2 ma.

Frequency: 20 KC

- And Gate		
		Module 1800
		Schematic Diagram
1/27/66	RAM/Allen	A601AS61066M

NEGATIVE AND-GATE

Module 1800

Module 1800 is a negative and-gate. If both inputs are zero, the output will be -6V. If either or both inputs are -6V the output will be zero.

It is composed of two inverting amplifiers whose output is fed into a diode and-gate. The output of this gate is then fed through a two-stage non-inverting amplifier. Q1801 and Q1802 form the inverting amplifiers for the inputs fed into Pin #7 and Pin #6 respectively. Their output is fed into the and-gate composed of D1801 and D1802. Q1803 and Q1804 form the non-inverting amplifier that isolates the output of the and-gate.

The two input amplifiers are identical so a description of only one will be given. R1802 and R1802 form a voltage divider network to hold the base of Q1801 slightly positive keeping it cut off. With Q1801 cut off, its collector will be very negative (approximately -12V). R1809, D1803, R1810, and R1811 form a voltage divider network which maintains the junction of the three diodes at approximately -6V providing D1801 and C1802 are open. (If the collectors of Q1801 and Q1802 are at -12V, then the anodes of D1801 and D1802 will be more negative than the junction of the three diodes and they will be open.)

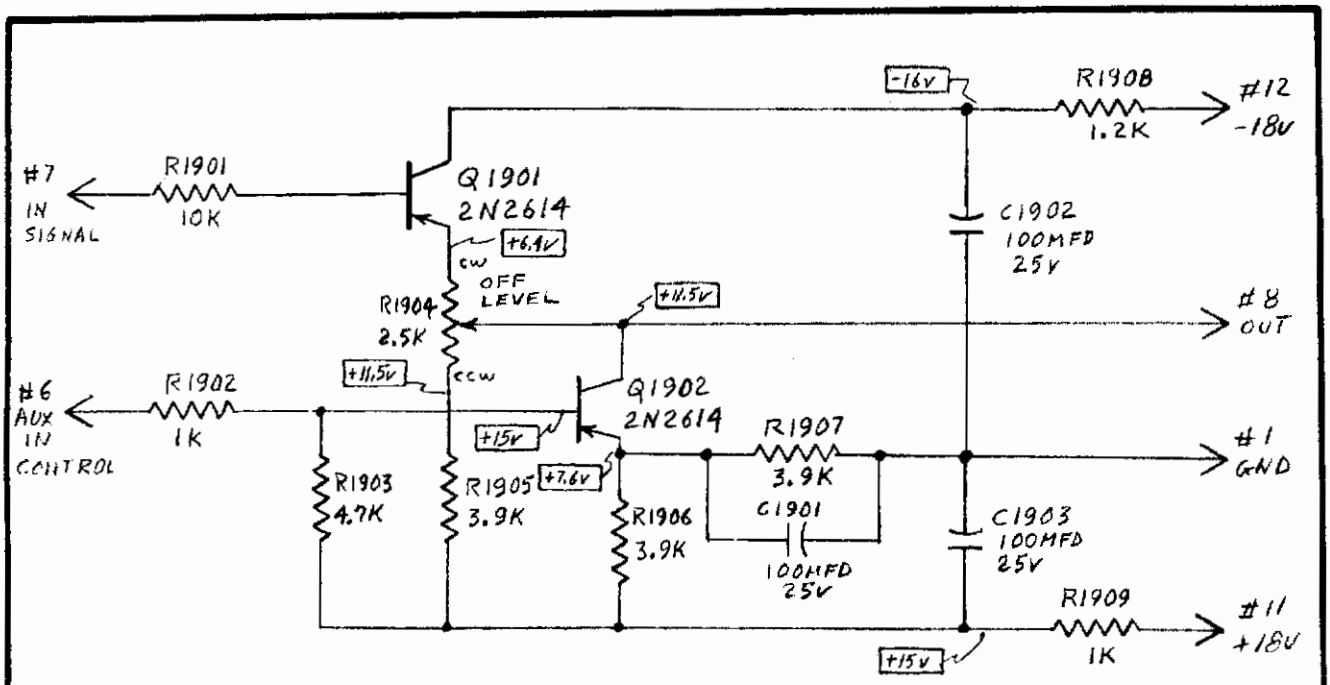
With the junction of the diodes at -6V, the base of Q1803 will be slightly negative, turning it on and causing it to conduct heavily. With Q1803 on, its collector voltage will be zero volts. The voltage divider R1813 and R1814 will cause the base of Q1804 to be slightly positive. Since its emitter is returned to ground, this transistor will be cut off.

R1815 and R1816 form a voltage divider between the power supply and ground such that when Q1804 is off, the output at Pin #8 will be -6V. Thus, if both inputs are zero, both diodes of the and-gate are back-biased, and the output is -6V.

Should either input be -6V, the output will be zero volts. This can be seen by assuming the input to Pin #7 is -6V. The input current will overcome the slight positive bias on the base of Q1801 causing it to turn on and dropping its collector voltage to zero. Since the junction of the three diodes is at a negative potential, D1801 will have zero volts on the anode, and a negative voltage on the cathode causing it to conduct and pull the voltage at its cathode down to zero volts. With this junction zero volts, D1803, R1810, and R1811 form a voltage divider to make the base of Q1803 slightly positive, causing Q1803 to turn off and its collector to go negative. This negative voltage is divided through R1813 and R1814 to the base of Q1804 causing it to go slightly negative and turn on Q1804. When Q1804 turns on, its

collector voltage will go to zero shorting out the voltage that would normally appear across R1816 and bringing the output voltage to zero.

R1818, C1801, and R1819, C1803 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.

2. Reference Dwgs:
   a. Parts Layout - A601AS61078M
   b. Parts List - A601AS61079M
   c. Waveforms - A601AS61080M

3. Voltage measurements with 20KΩ/V meter with respect to ground, R1904 set completely CCW and 0V in both inputs.

Supply Req.:	-18V @ 1.7 ma +18V @ 3 ma
Signal Input	6V p-p max between +3V and -6V
Control Input	On @ 0V Off @ -6V
Frequency	20KC

Signal Gate		Module 1900
		Schematic Diagram
2/1/66	RAM/	A601AS61077M

SIGNAL GATE

Module 1900

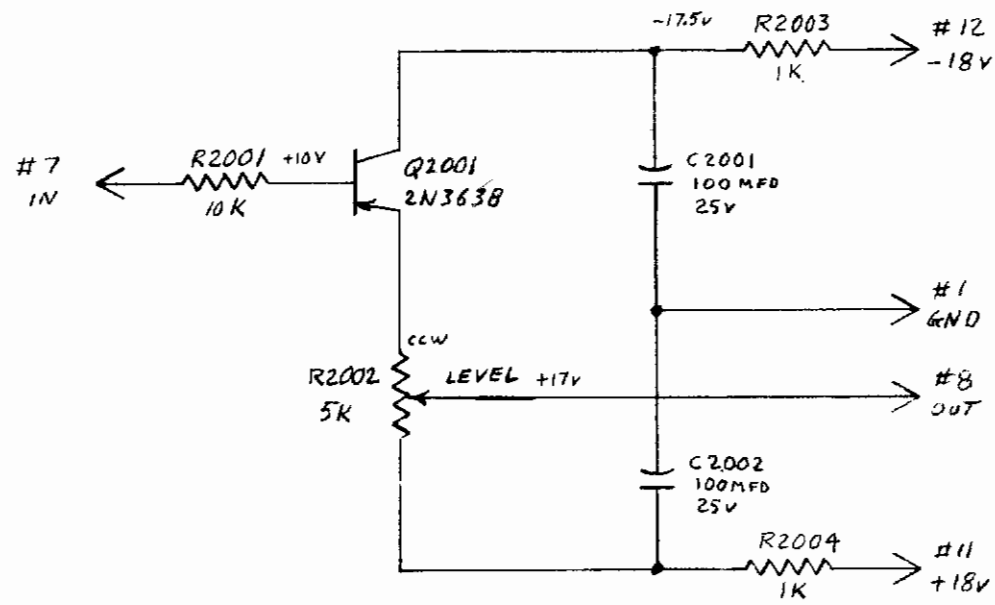
Module 1900 is composed of an emitter follower whose output is shunted by a common emitter amplifier. The common emitter amplifier is turned on and off by an external control signal applied to Pin #6. When this stage is off, it permits the signal to pass through the gate module.

The signal to be gated is fed into Pin #7 and through R1901 to the base of the emitter follower Q1901. The emitter of Q1901 is connected through R1904 and R1905 to the positive supply in order to permit the output signal to swing both positive and negative. R1904 acts as an amplitude control to permit setting the off level of the signal.

Q1902 is connected across the output from the emitter follower. R1907 and R1906 form a voltage divider between the +18V and ground, holding the emitter at a slight positive voltage (about +7V when not conducting). The base of Q1902 is held slightly positive by R1903. The gate control input is fed into Pin #6 and through R1902 to the base of Q1902. When this signal is zero, the positive potential on the base of Q1902 prevents the transistor from conducting. When the transistor (Q1902) is turned off, it represents a high impedance between the output (Pin #8) and ground.

When the control input becomes negative, the input current overcomes the positive bias at the base of Q1902 causing it to conduct and saturate. With Q1902 turned full on, the signal at the arm of Q1904 is shorted to ground through Q1902 and C1901.

R1908, C1902, and R1909, C1903 form decoupling networks to prevent signal variations from being fed between modules through the supplies.



Notes:
1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61049M
   b. Parts List - Dwg. No. A601AS61050M
   c. Waveforms - Dwg. No. A601AS61051M
3. Voltages measured with 20KΩ/V Meter, level pot full CCW, and no input.

Supply Req.: -18V @.5 ma.
+18V @.5 ma.

Level Shifter	Module 2000
	Schematic Diagram
1/24/66 RAM/	A601AS61048M

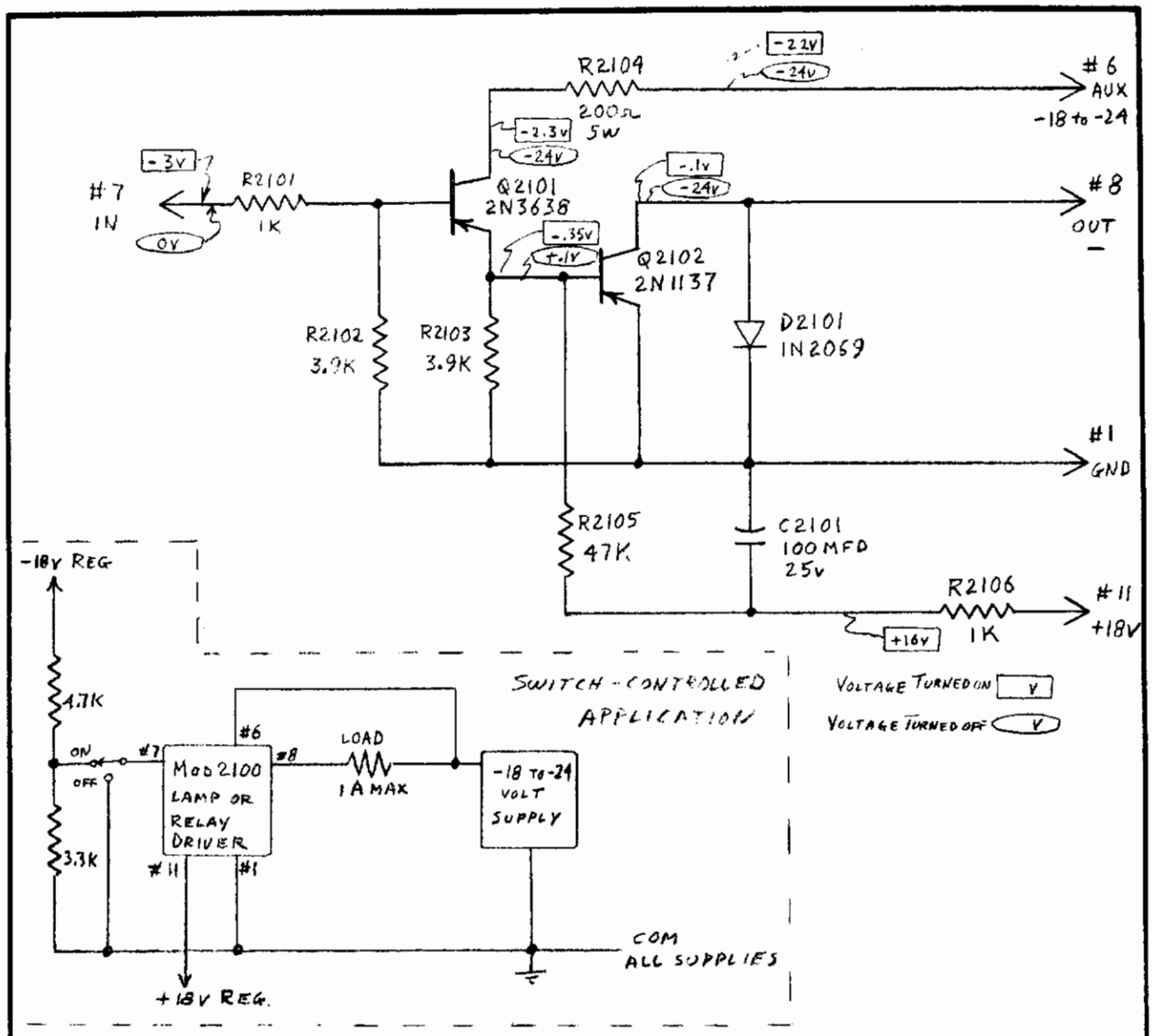
LEVEL SHIFTER

Module 2000

Module 2000 is an emitter follower with a variable resistor in the emitter circuit to permit adjustment of the DC output level.

Either a signal or a DC voltage applied at the input (Pin #7) is fed through R2001 to the base of Q2001. The emitter of Q2001 is coupled through the variable resistor R2002 to the +18V supply. The output from the arm of this pot can be adjusted both negative and positive with respect to ground with a minimum effect on the signal as long as Q2001 is conducting.

R2003, C2001, and R2004, C2002 form decoupling networks to prevent signal variations from being fed between the modules through the supplies.



Notes:

1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - A601AS61064M
   b. Parts List - A601AS61065M
3. Voltage measurements with 20KΩ/Volt meter and resistive 1 amp load to ext -24V power supply.

Supply Req.:	+18V @ 2 ma.
Load:	1 Amp resistive max.
Input:	0V to +3V for OFF -2V @ 3 ma. min for ON.

Lamp & Relay Driver		Module 2100
		Schematic Diagram
1/22/66	RAM/	A601AS61063M

LAMP AND RELAY DRIVER

Module 2100

Module 2100 is an emitter follower coupled to a power amplifier which operates as an on-off switch. The emitter follower is composed of Q2101 and the resistors, R2101, R2102, R2103, and R2104. R2101 and R2102 provide an input divider to prevent damage to the transistors in the event of excessive input voltage. R2104 is a series-limiting resistor to prevent excessive current through the emitter follower.

When the input voltage applied to pin #7 is between zero and +3 volts, the base of Q2101 will be back-biased and held off. As the input voltage swings more negative than -2 volts, the emitter follower will be turned on and the emitter will attempt to follow the voltage applied to the base.

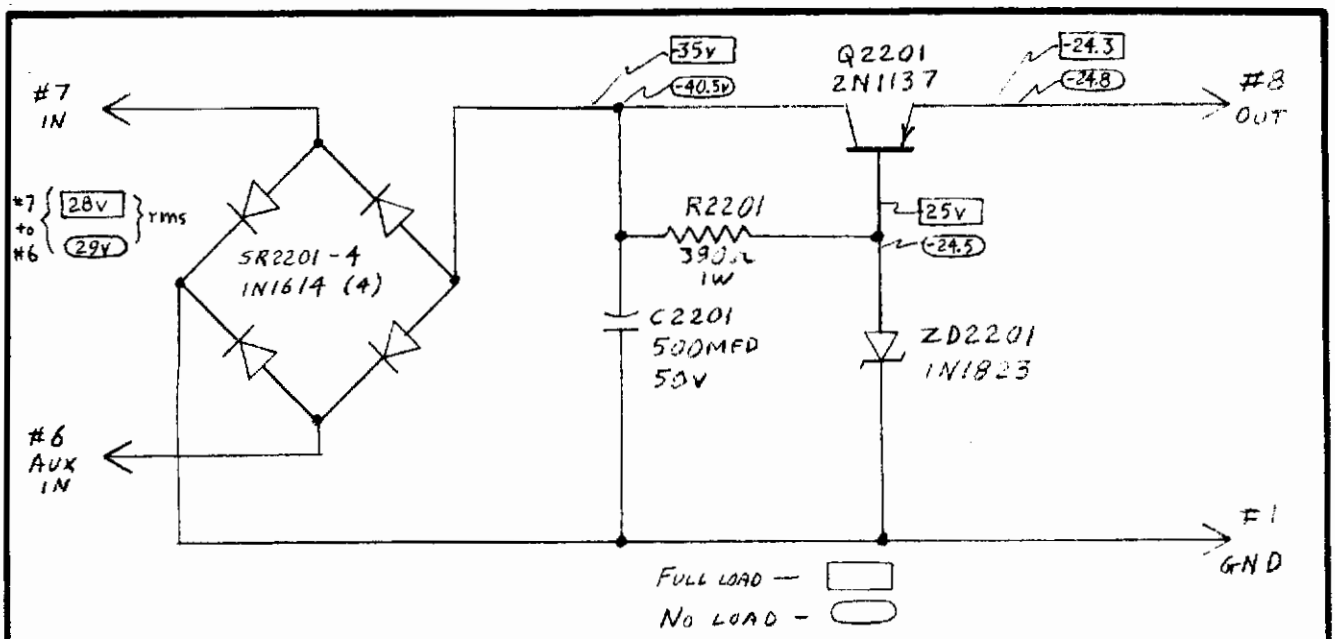
R2105 and R2103 form a voltage divider between the +18 volts and ground. As long as no current is flowing through R2103 due to Q2101 conducting, the base of Q2102 will be slightly positive.

When the input signal becomes negative, turning on Q2101, the emitter current will increase to the point where the voltage at the base of Q2102 will become slightly negative permitting it to turn on. Since the emitter of Q2102 is connected directly to ground, only a small voltage is necessary at the base to completely saturate the transistor. The turn-on action occurs fairly rapidly due to the large input voltages compared to the small bias voltage.

The collector of Q2102 is tied to an output load through Pin #8. The output load is then connected to a suitable supply voltage between the range of -18 and -24 volts.

When Q2102 saturates, it represents a very low impedance between Pins #1 and #8; thus, the load is essentially connected to ground. When Q2102 is off it represents a high impedance to ground, holding the load current to near zero. Diode 2101 is placed backwards across Q2101 to prevent any transient from causing a large reverse voltage to appear across the transistor and damage it.

R2106 and C2101 form a decoupling network to prevent module signals from being coupled through the power supply.



Notes:
1. Resistors in ohms unless otherwise noted.
2. Reference Dwgs:
   a. Parts Layout - Dwg. No. A601AS61075M
   b. Parts List - Dwg. No. A601AS61076M
3. DC Voltages measured with 20KΩ/volt meter with respect to ground.

Regulation (0 to full load):	- ± .5V
Max Load	- 1 Amp
Ripple	- .5 volts p-p

Full Wave Bridge and Regulator Module 2200		
		Schematic Diagram
1/22/66	RAM/[illegible]	A601AS61074M

FULL WAVE BRIDGE AND REGULATOR

Module 2200

Module 2200 is a standard full wave rectifier followed by a series regulator. AC power is applied to the input pins, #6 and #7. When Pin #7 is positive with respect to Pin #6, the upper left and lower right diodes will conduct (the other two are turned off) and current will flow in such a manner as to charge capacitor C2201 so the junction with R2201 is negative.

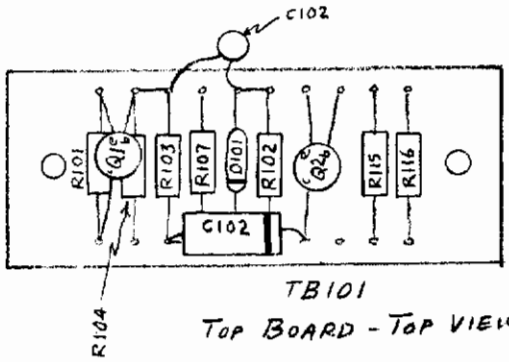
When the input is such that Pin #7 is negative with respect to Pin #6, the upper right and lower left diodes will be conducting while the other two diodes are turned off. Again current will flow in such a manner as to charge C2201 in the same direction.

R2201 and ZD2201 form a voltage divider across C2201. ZD2201 is a zener diode. When it is placed in a circuit reversed biased (anode to the negative side and cathode to the positive side) it will present a high impedance until the applied voltage reaches the breakdown voltage of the diode. From this point on as the applied voltage increases, the impedance of the diode will change in such a manner as to maintain a constant potential drop across the diode. This maintains a constant voltage at the base of Q2201. R2201 serves to limit the current through the zener diode and to drop the excessive voltage.

The collector of Q2201 is connected to the negative side of the full wave bridge, the base connected to the constant voltage provided by the zener diode and the emitter is connected directly to the load which appears across output terminal #8 and ground (terminal #1). Q2201 acts as an emitter follower where the load is its emitter resistor.

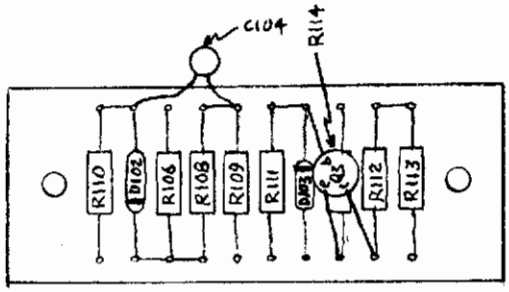
The constant voltage applied to the base of transistor Q2201 tends to hold its emitter at a voltage slightly less, thus the output voltage is held relatively constant at a voltage somewhat less than the zener reference voltage regardless of changes in the applied input AC.

This simple type of regulator regulates best for input voltage changes, but will also provide some regulation for changes in output loads due to their effects on the voltage appearing across C2201. Circuit regulation will maintain the output voltage from zero to the full load of 1 amp at ±.5 volts.



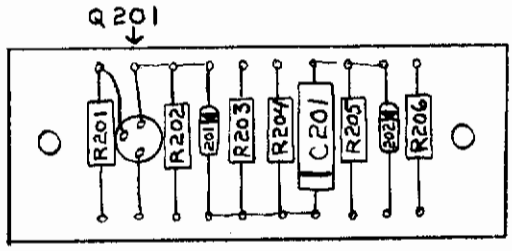
TB101
TOP BOARD - TOP VIEW

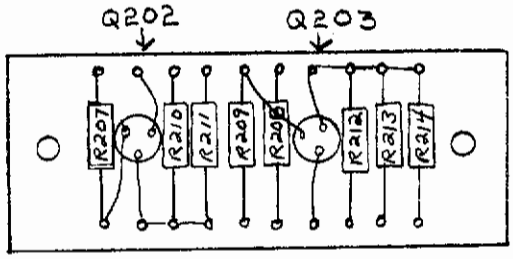
C101, 5, & 6 MOUNTED ON TB101 BUT NOT SHOWN

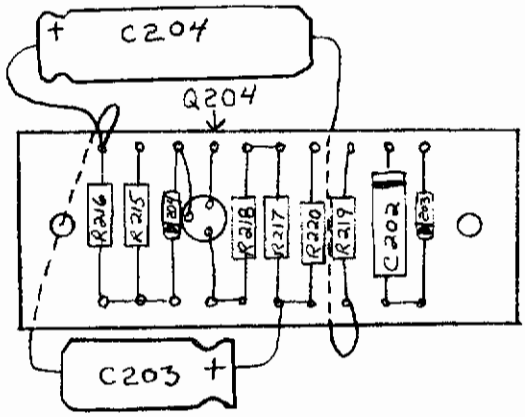


TB102
BOTTOM BOARD - TOP VIEW

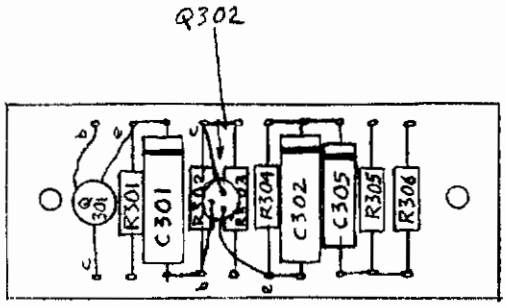
Free Running, Variable Frequency Multivibrator, Module No. 100		
		Parts Layout
12/16/65	RAM/	A512ASA1002M





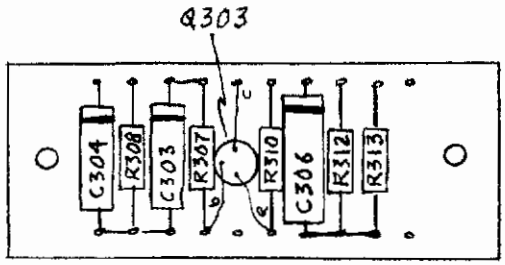


Bistable Multivibrator Module 200		
		Parts Layout
1/26/66	RAM/	A601AS61057M



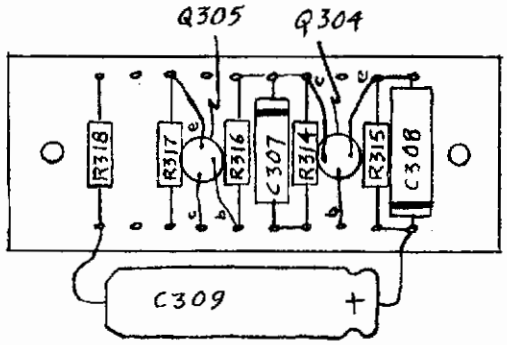
TB 303

TOP BOARD



TB 302

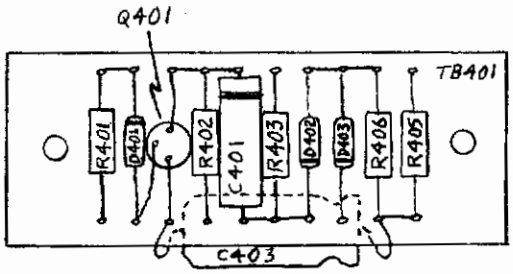
MIDDLE BOARD



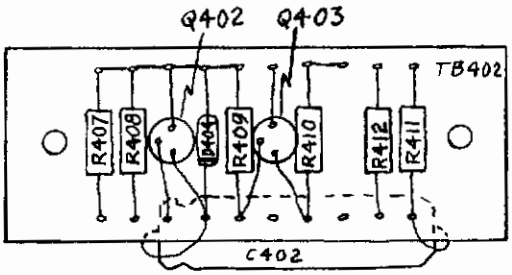
TB 301

BOTTOM BOARD

VARIABLE FREQUENCY, VARIABLE AMPLITUDE SINUSOIDAL OSCILLATOR MODULE No 300		
		PARTS LAYOUT
12/18/65	RAM/RLM	A601AS61002M

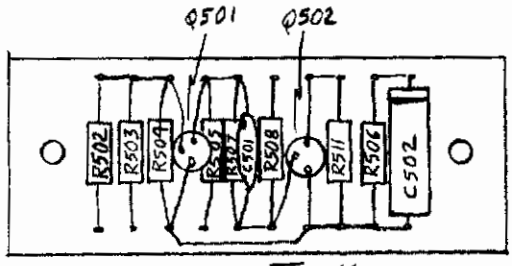


TOP BOARD - TOP VIEW



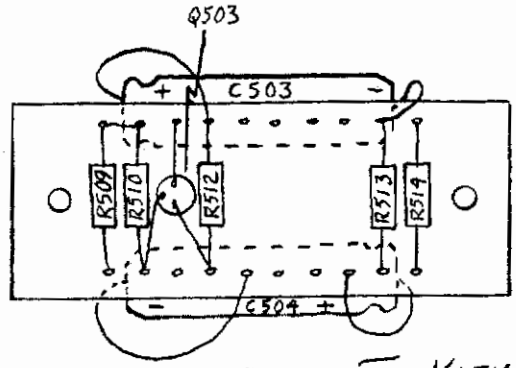
BOTTOM BOARD - TOP VIEW

Triggered One Shot, Variable Width Module 400		
		Parts Layout
1/13/66	RAM/	A601AS61013M



TB501

TOP BOARD TOP VIEW

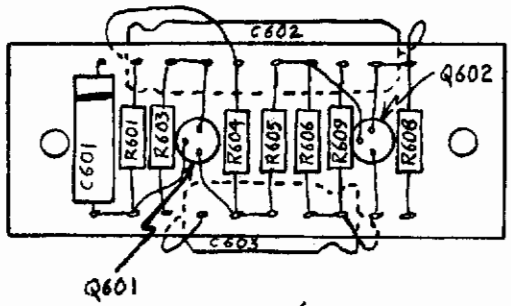


TB502

BOTTOM BOARD TOP VIEW

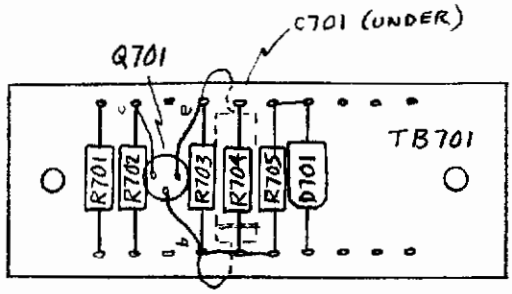
Variable Threshold Schmidt Trigger		Module 500
		Parts Layout
12/21/65	RAM/	A601AS61029M

TB601

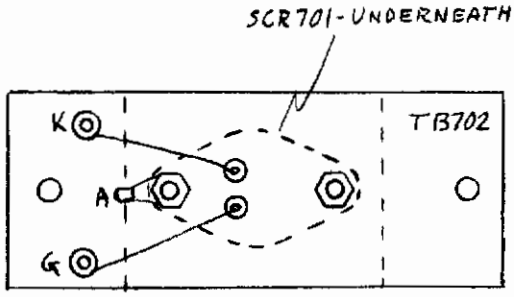


TOP VIEW

Variable Frequency, Variable Amp. Trigger Generator Module 600		
		Parts Layout
1/13/66	RAM/[illegible]	A601AS61009M

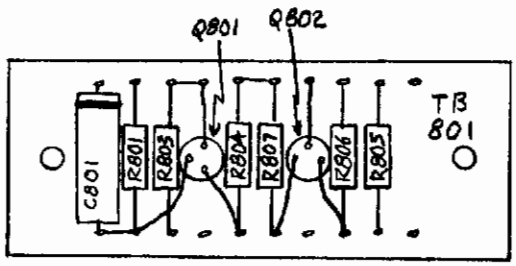


TOP BOARD - TOP VIEW

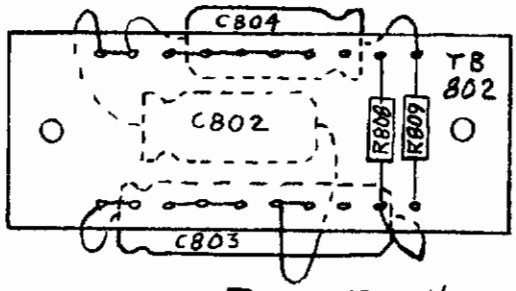


BOTTOM BOARD - TOP VIEW

SWITCH (LATCHING) Module No. 700		
		Parts Layout
1/10/66	RAM	A601AS61006M

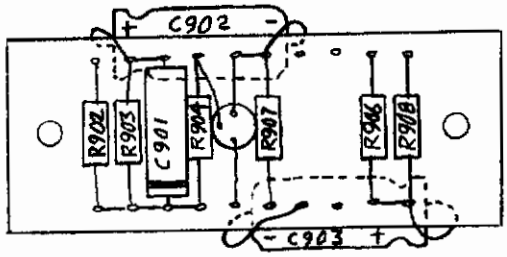


TOP BOARD - TOP VIEW

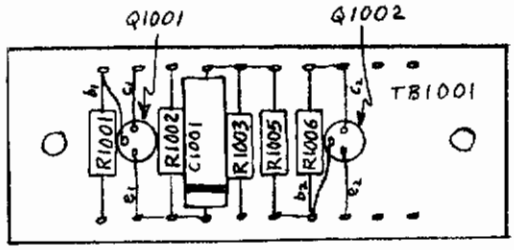


BOTTOM BOARD - TOP VIEW

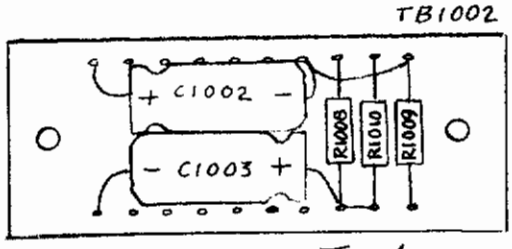
Variable Frequency Sawtooth Generator Module 800		
		Parts Layout
1/17/66	RAM/	A601AS61017M



RC Integrator		Module 900
		Parts Layout
1/17/66	RAM/	A601AS61021M

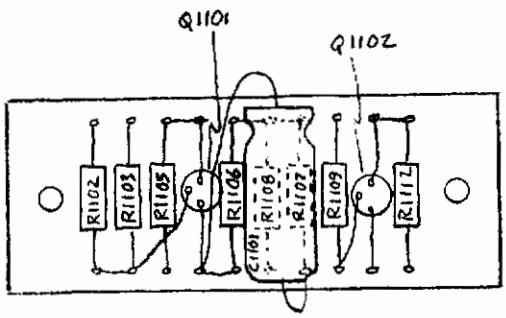


TOP BOARD TOP VIEW



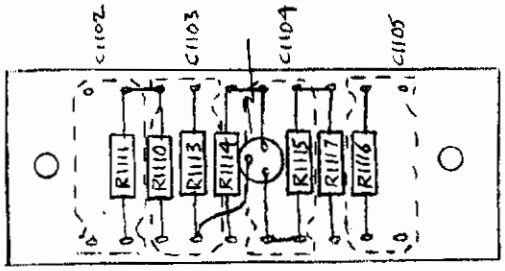
BOTTOM BOARD TOP VIEW

R C Differentiator Module 1000		
		Parts Layout
1/17/66	RAM/	A601AS61033M



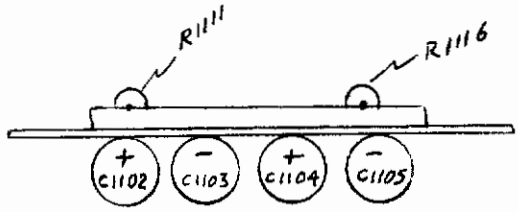
TB1101

TOP BOARD TOP VIEW



TB1102

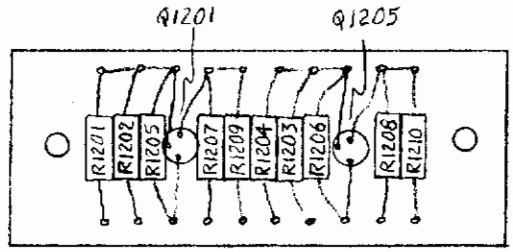
BOTTOM BOARD TOP VIEW



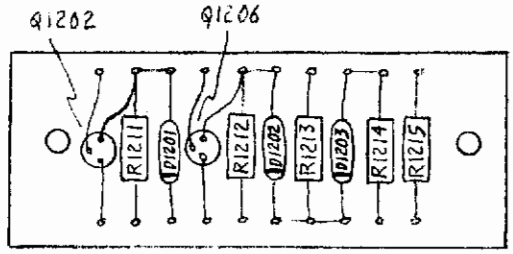
TB1102

BOTTOM BOARD SIDE VIEW

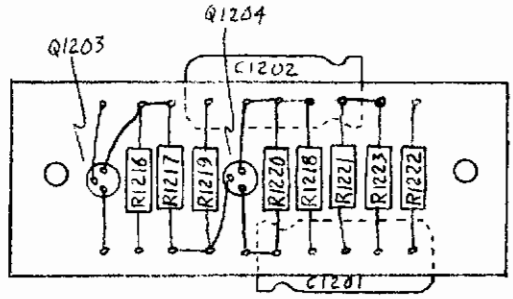
Variable Gain, Non-inverting Amplifier		Module 1100
		Parts Layout
1/18/66	RAM/	A601AS61025M



TB 1201
Top Board
Top View

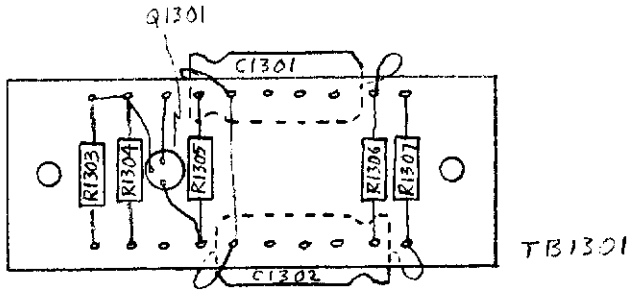


TB 1202
Middle Board
Top View

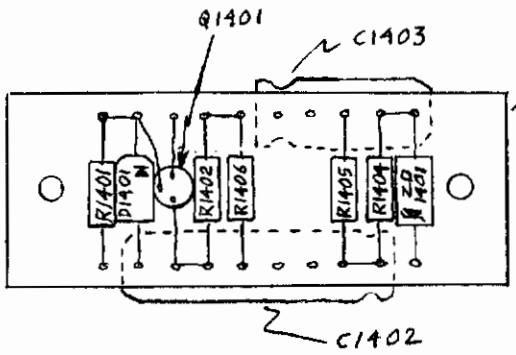


TB 1203
Bottom Board
Top View

+ And Gate		Module 1200
		Parts Layout
1/27/66	RAM/[illegible]	A601AS61071M



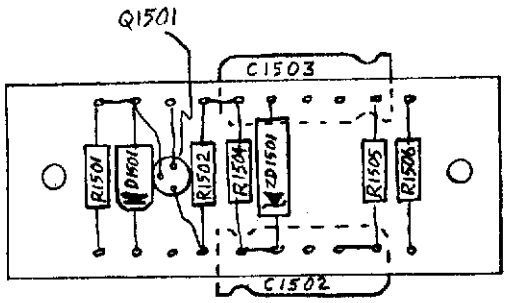
Adder		Module 1300
		Parts Layout
1/25/66	RAM/	A601AS1061M



C1401 MOUNTED ON POT (R1403)

TOP VIEW

Negative Clipper		Module 1400
		Parts Layout
1/18/66	RAM/[illegible]	A601AS61041M

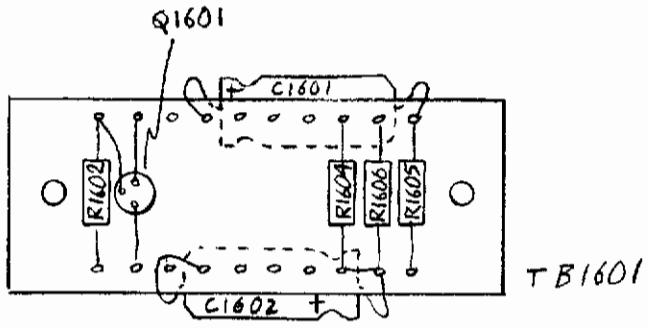


C1501 ON R1503

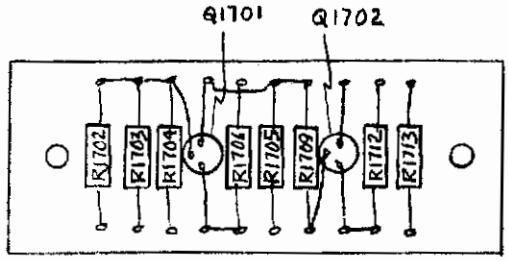
TB1501

TOP VIEW

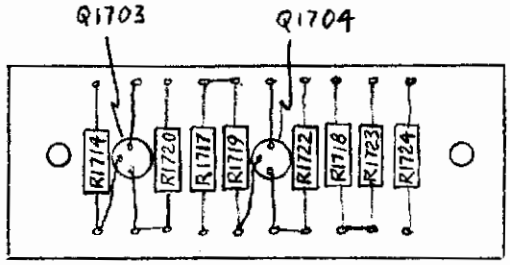
Positive Clipper		Module 1500
		Parts Layout
1/20/66	RAM/ROM	A601AS61045M



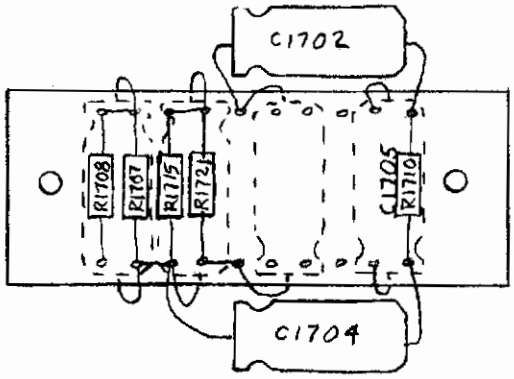
Attenuator		Module 1600
		Parts Layout
1/21/66	RAM/Rlm	A601AS61053M



TB 1701
TOP VIEW
TOP BOARD

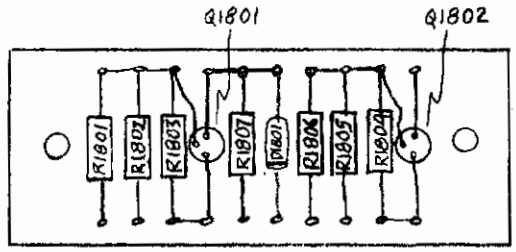


TB 1702
MIDDLE BOARD
TOP VIEW

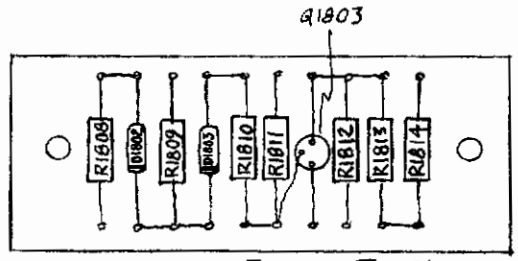


TB 1703
BOTTOM BOARD
TOP VIEW

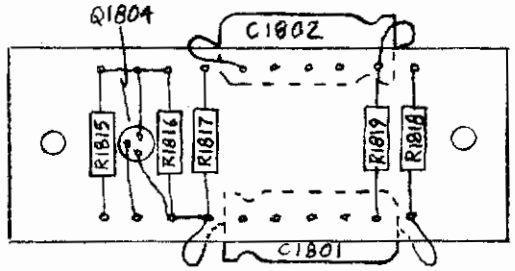
Variable Gain, Inverting, External Feedback Amplifier		Module 1700
		Parts Layout
1/19/66	RAM/	A601AS61037M



Top Board Top View

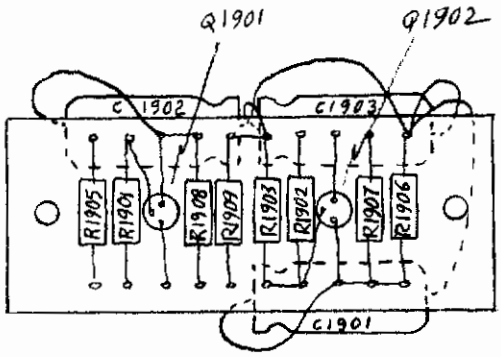


Middle Board Top View



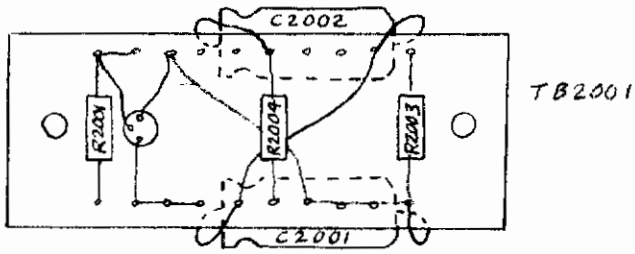
Bottom Board Top View

- And Gate		Module 1800
		Parts Layout
1/27/66	RAM	A601AS61067M



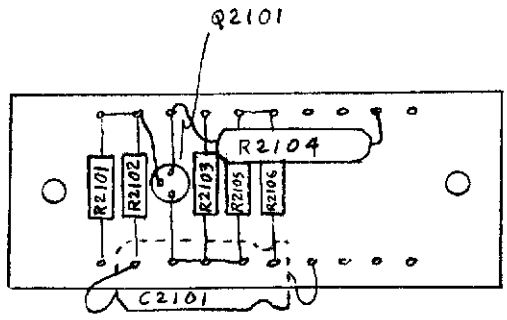
TB1901
TOP VIEW

Signal Gate		Module 1900
		Parts Layout
2/1/66	RAM/Rlw	A601AS61078M

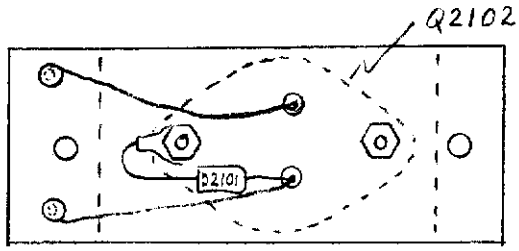


Top View

Level Shifter		Module 2000
		Parts Layout
1/24/66	RAM/RAM	A601AS61049M

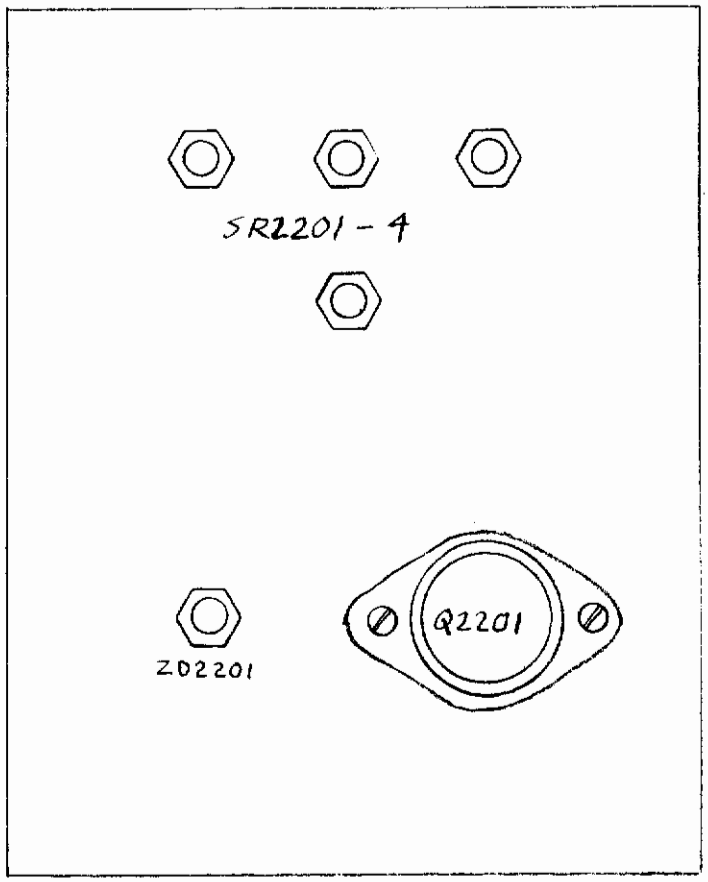


TOP BOARD TOP VIEW



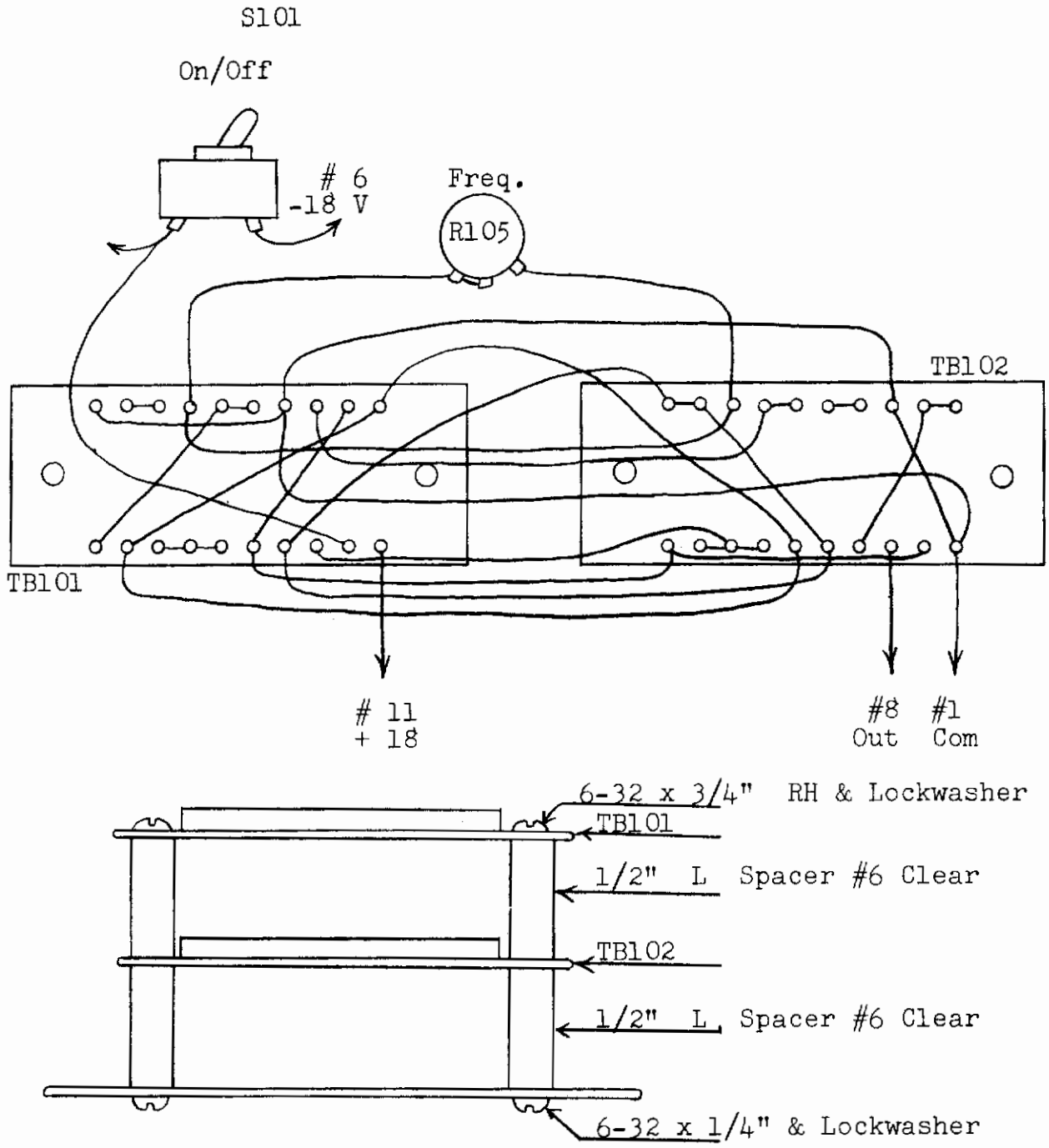
BOTTOM BOARD TOP VIEW

Lamp & Relay Driver Module 2100		
		Parts Layout
1/22/66	RAM/	A601AS61064M



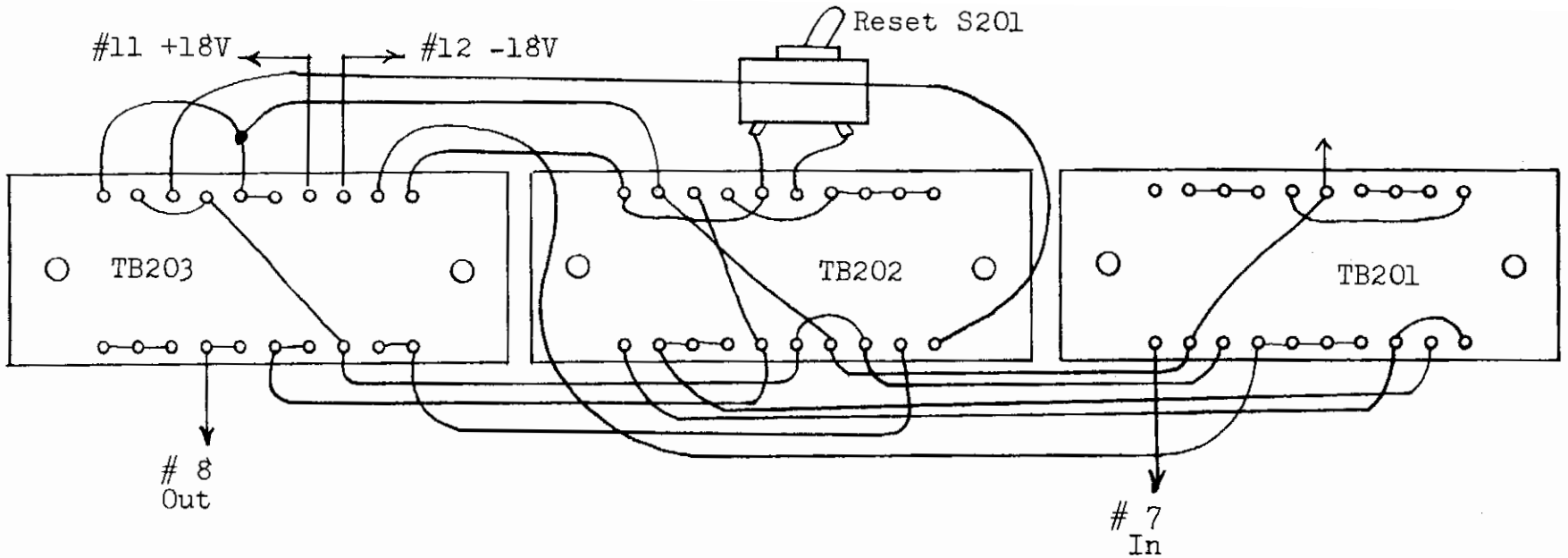
HEAT SINK VIEW FROM BACK OF MODULE

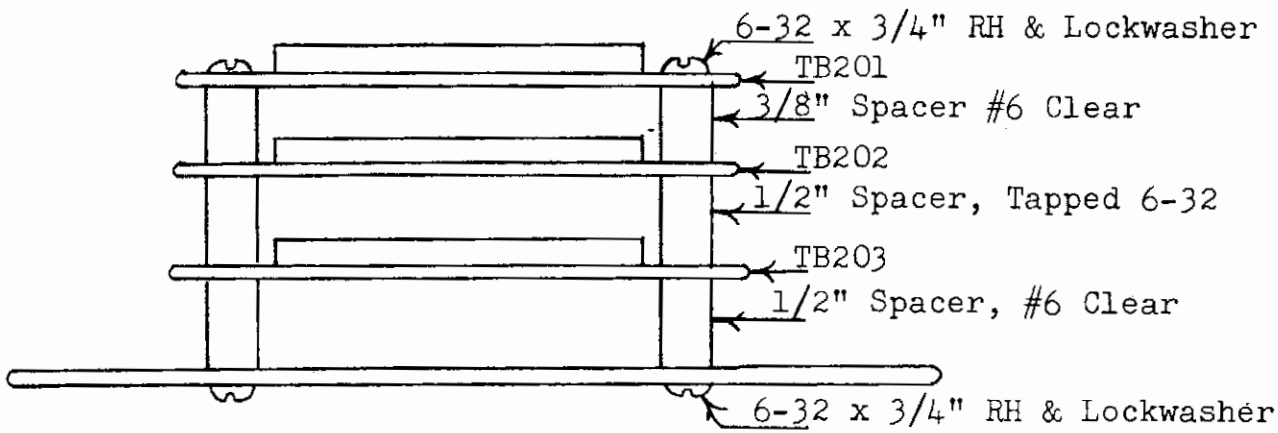
Full Wave Bridge and Regulator Module 2200		
		Parts Layout
1/22/66	RAM/	A601AS61075M



FREE RUNNING, VARIABLE FREQUENCY MULTIVIBRATOR

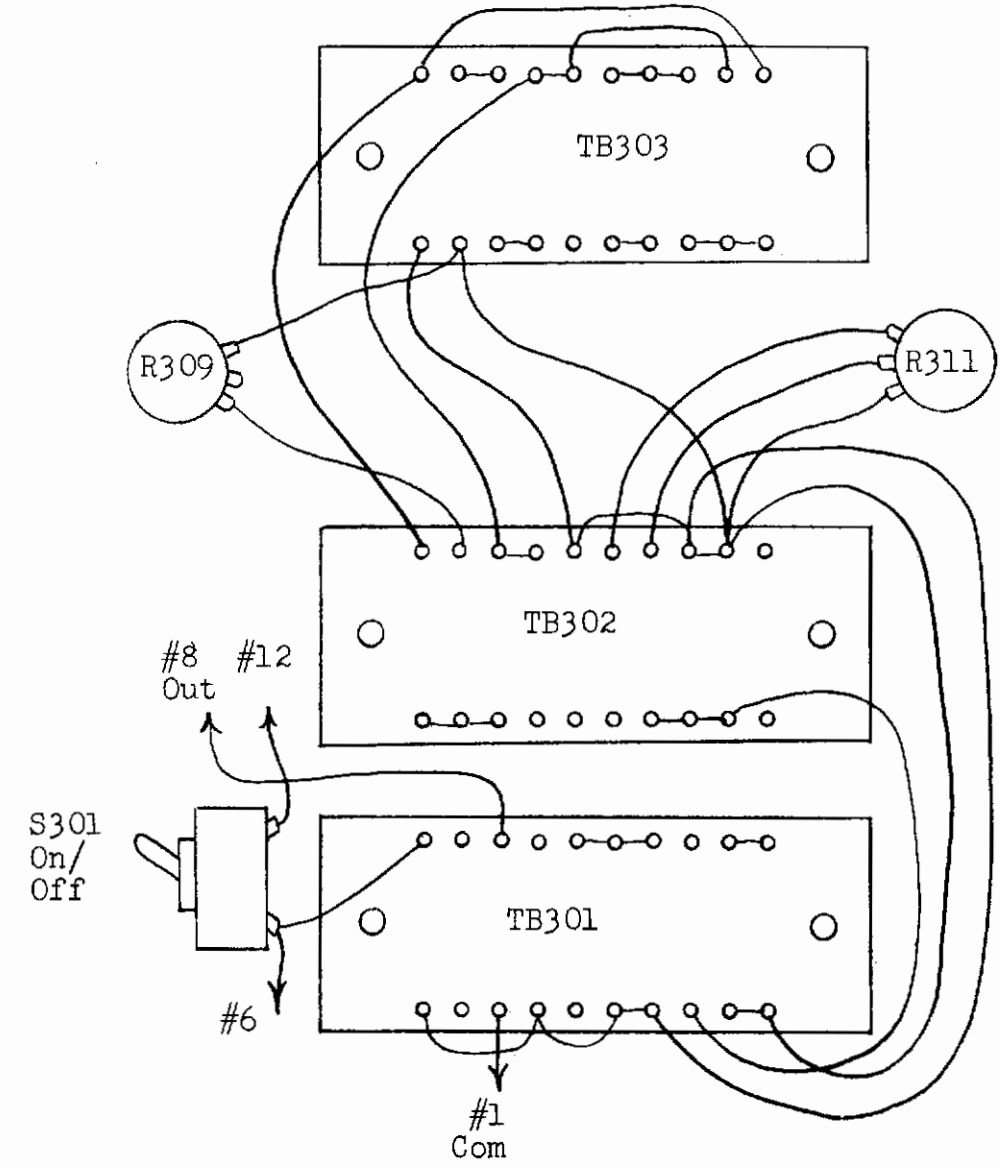
Module 100

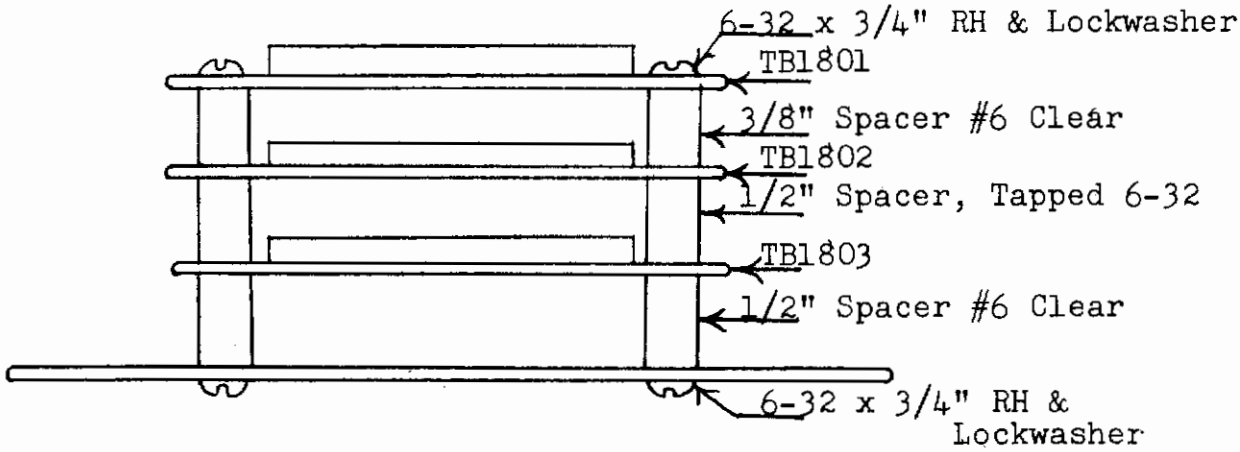




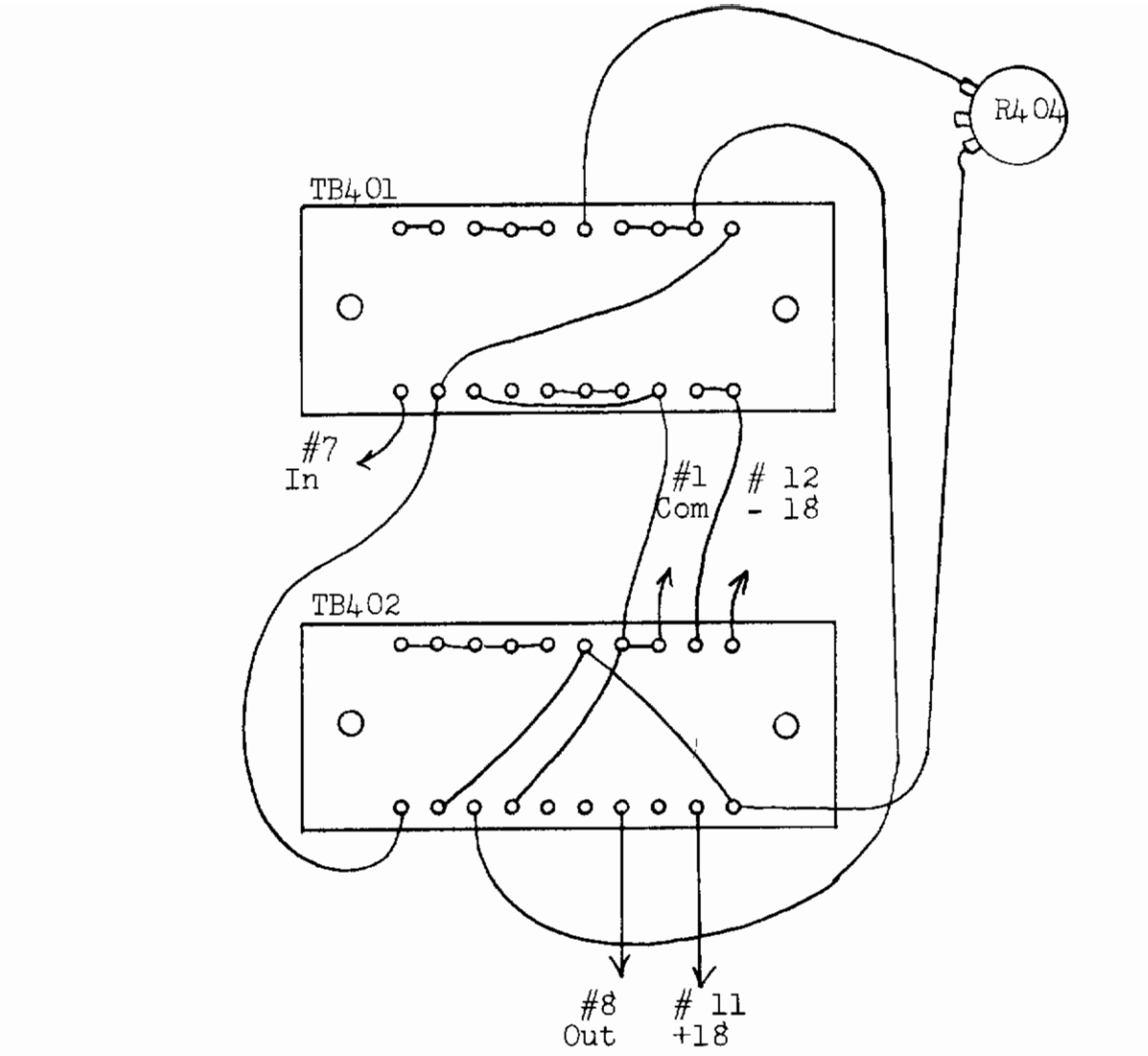
BI-STABLE MULTIVIBRATOR

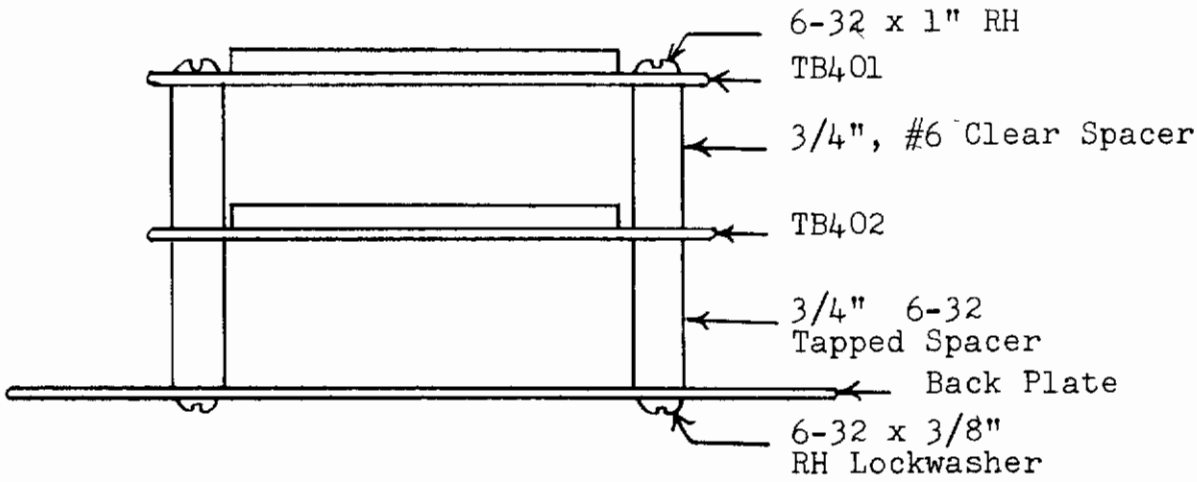
Module 200





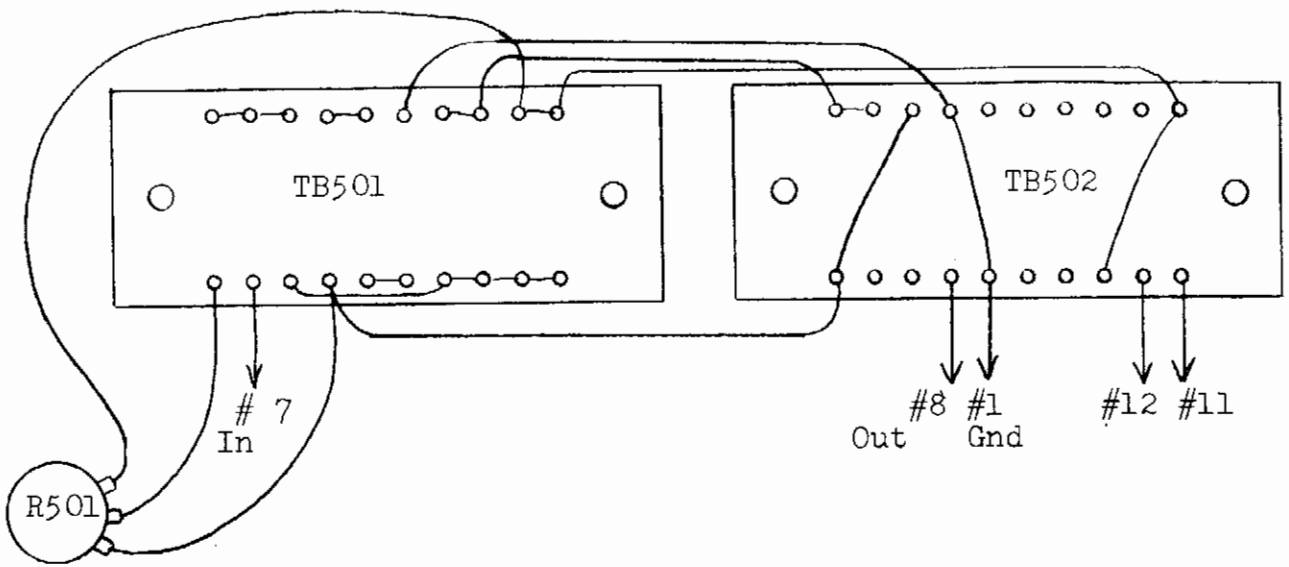
SINUSOIDAL OSCILLATOR
Module 300

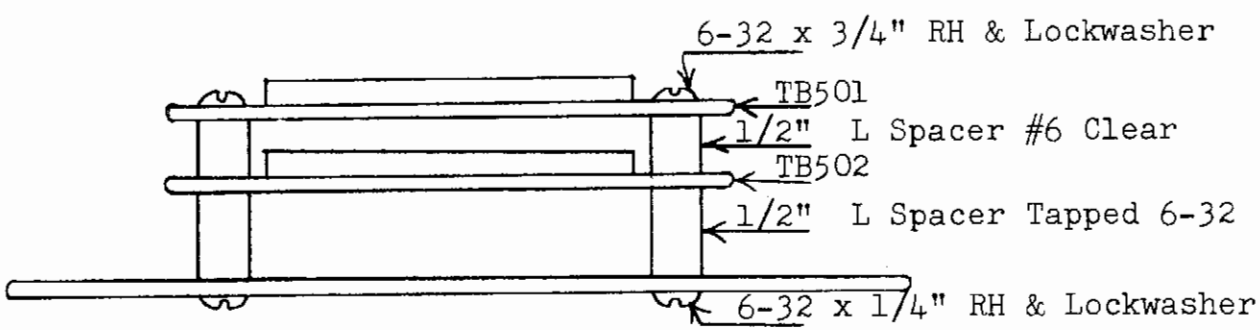




TRIGGERED ONE SHOT

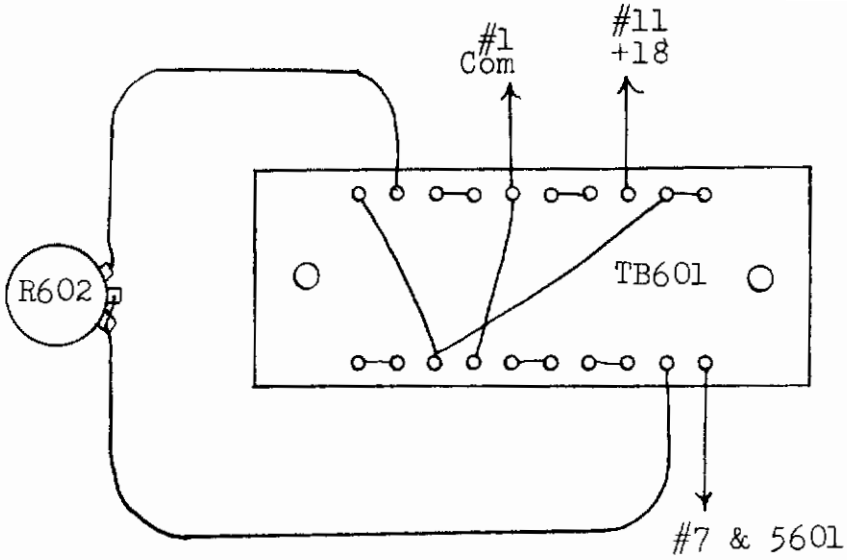
Module 400

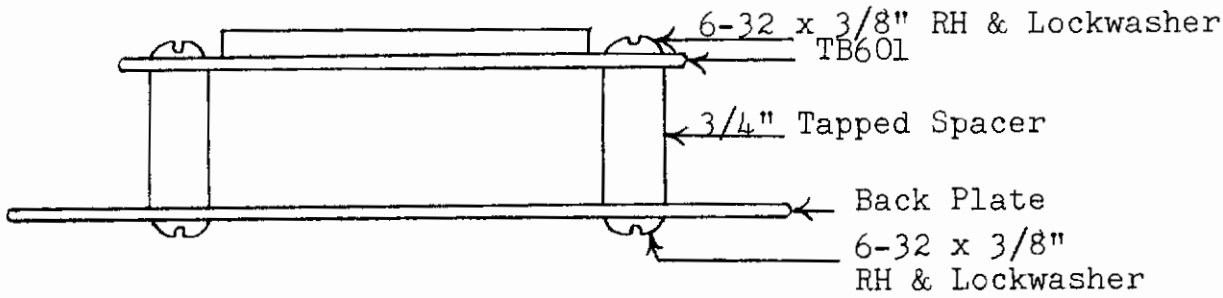




VARIABLE THRESHOLD SCHMIDT TRIGGER

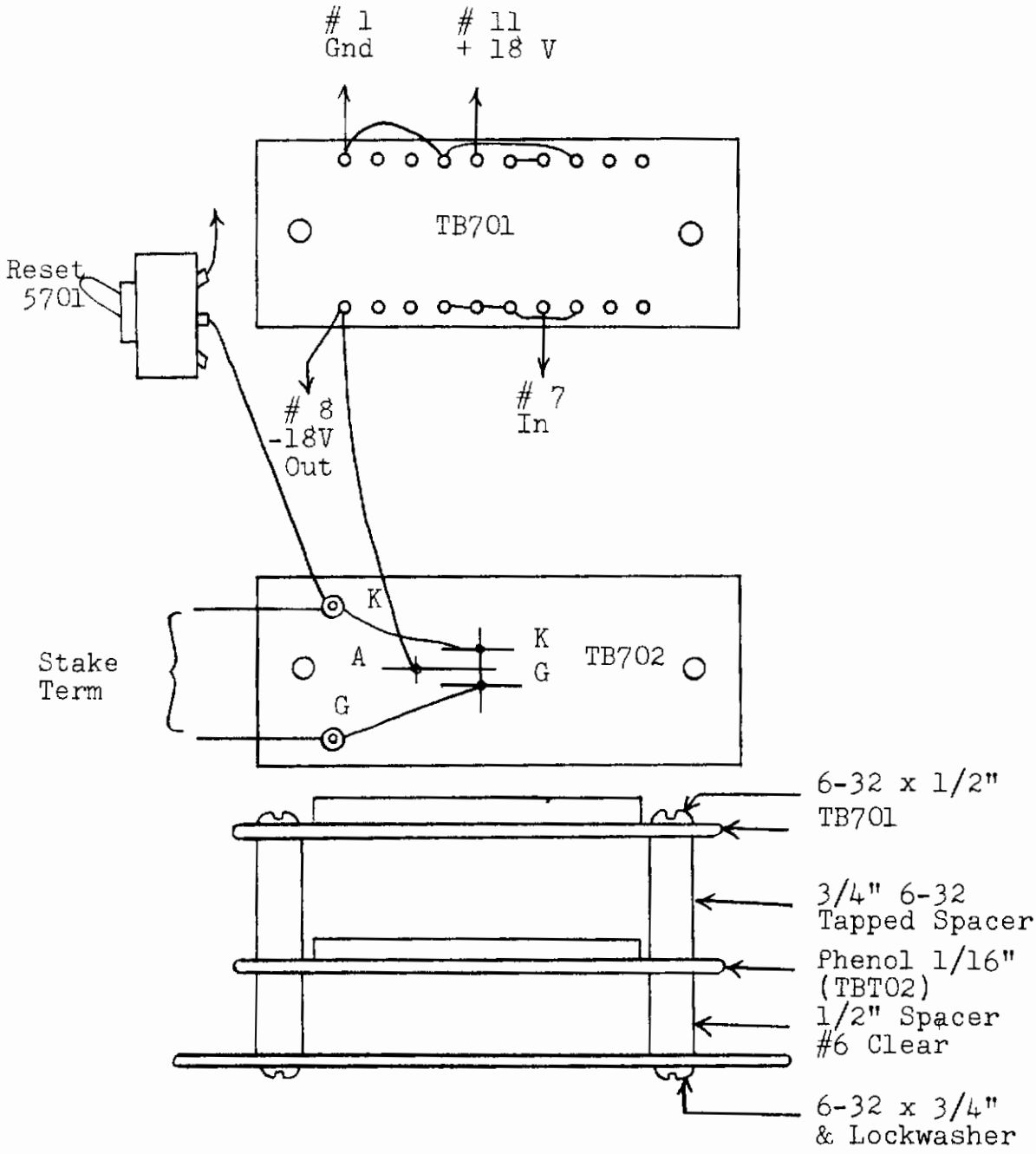
Module 500



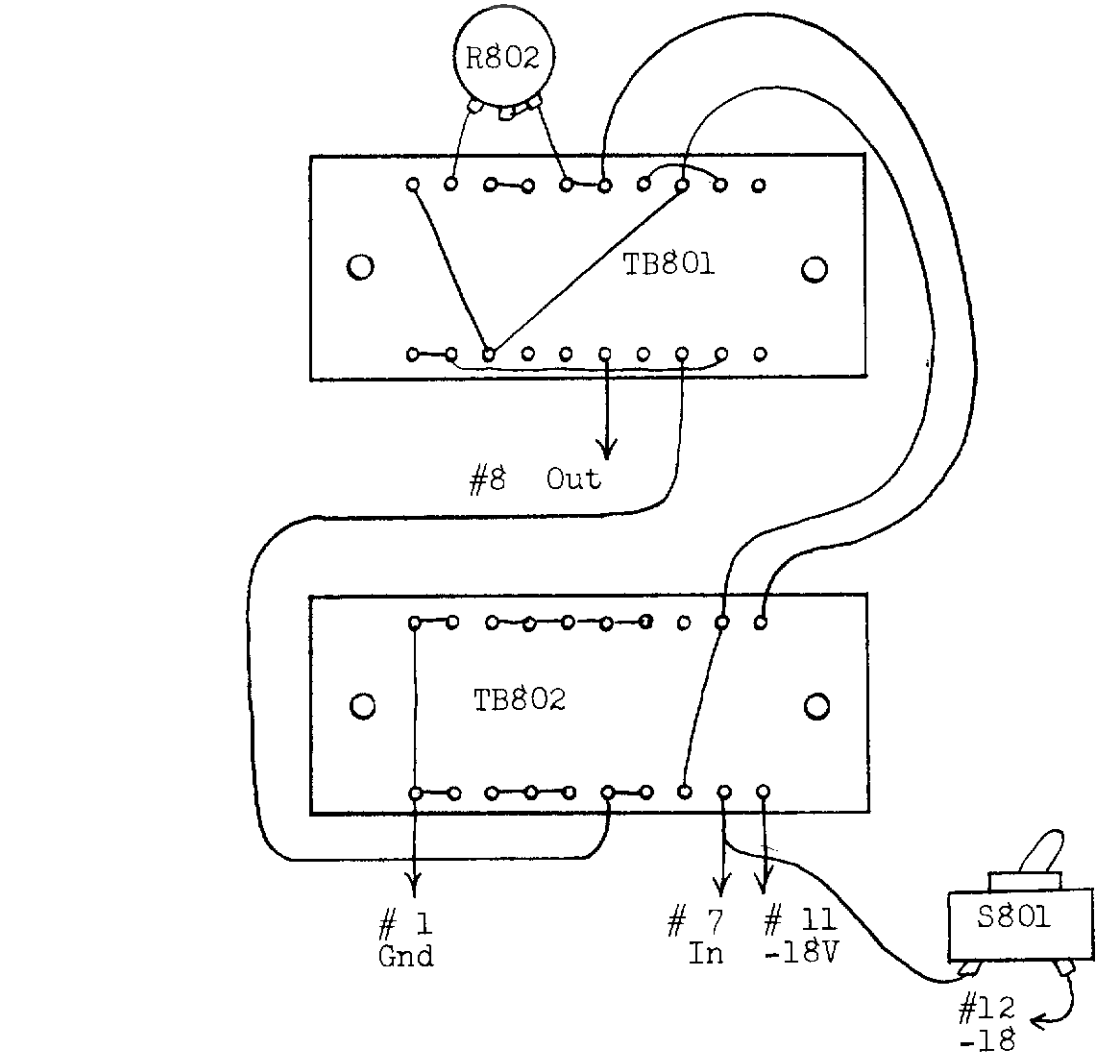


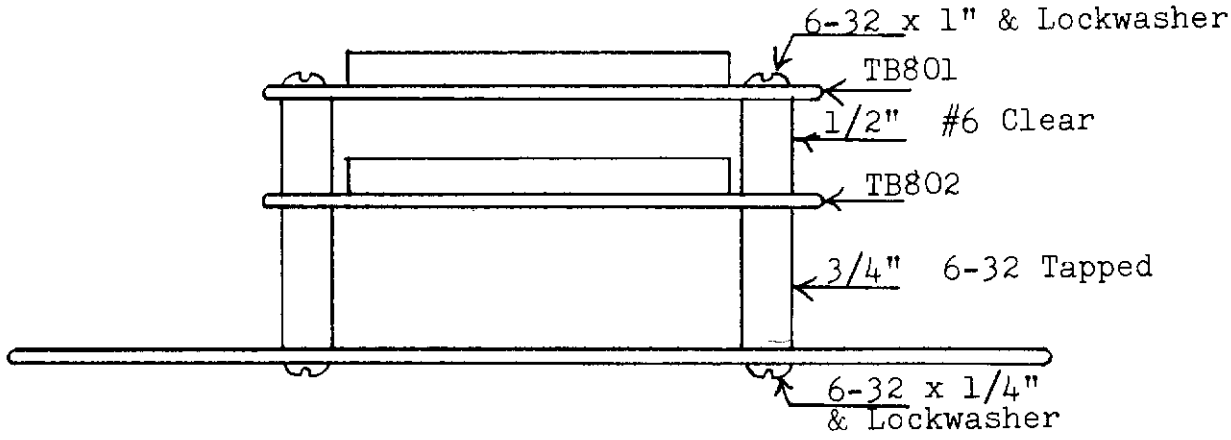
VARIABLE FREQUENCY TRIGGER GENERATOR

Module 600



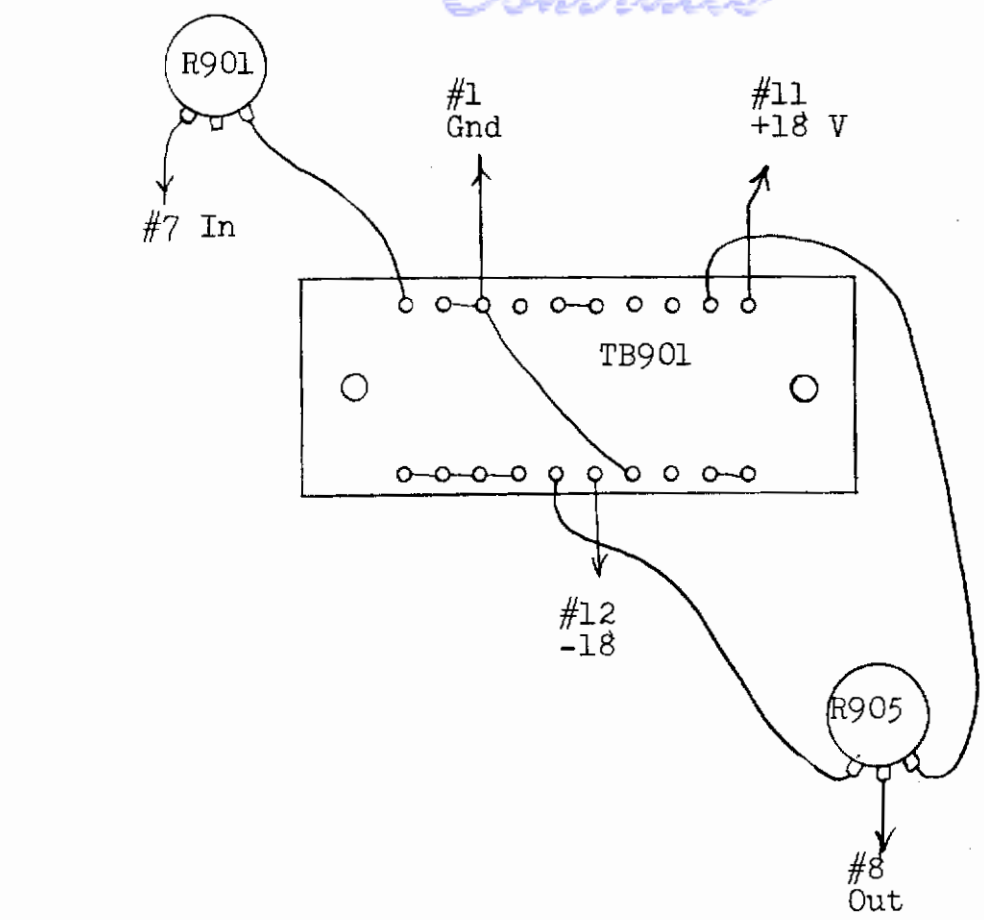
LATCHING SWITCH
Module 700

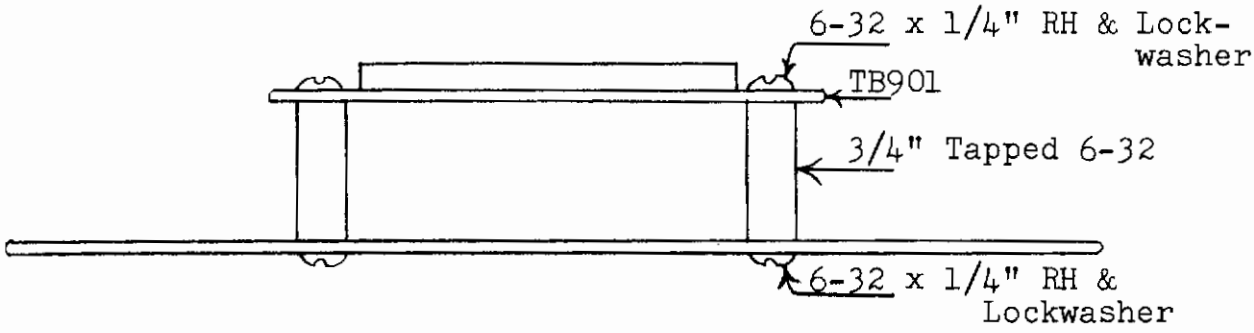




SAWTOOTH GENERATOR

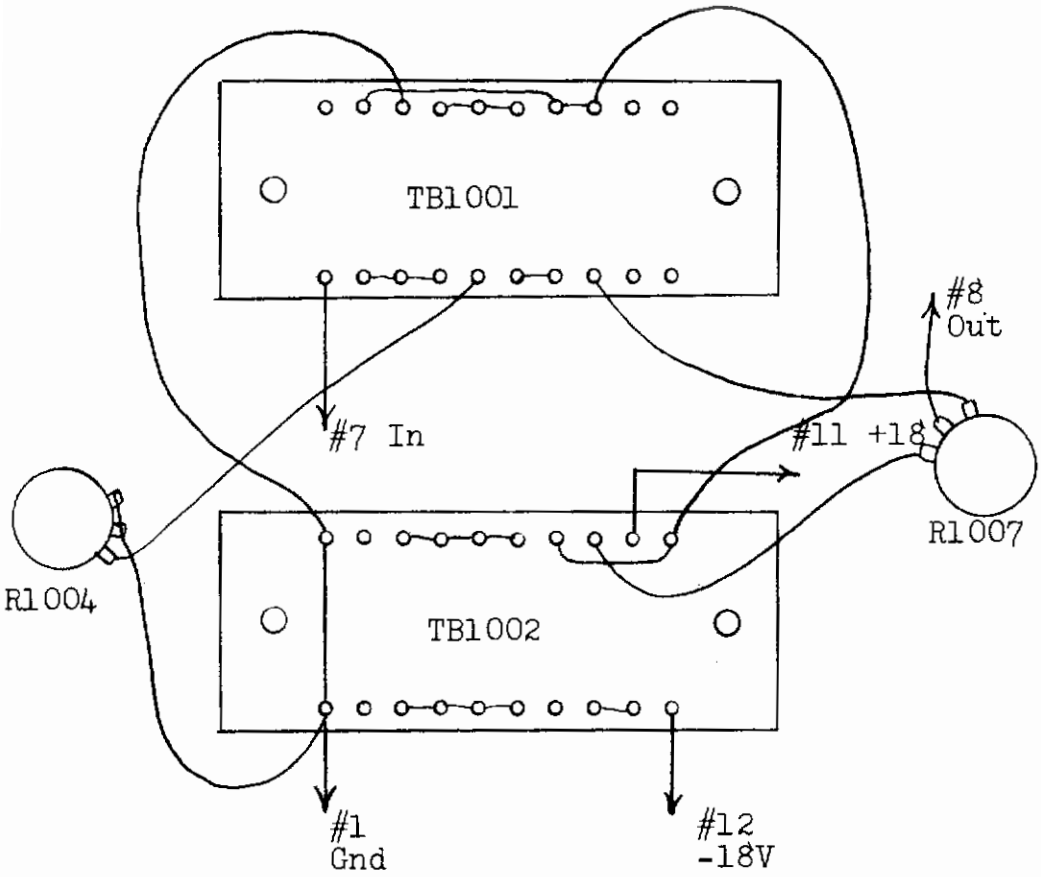
Module 800

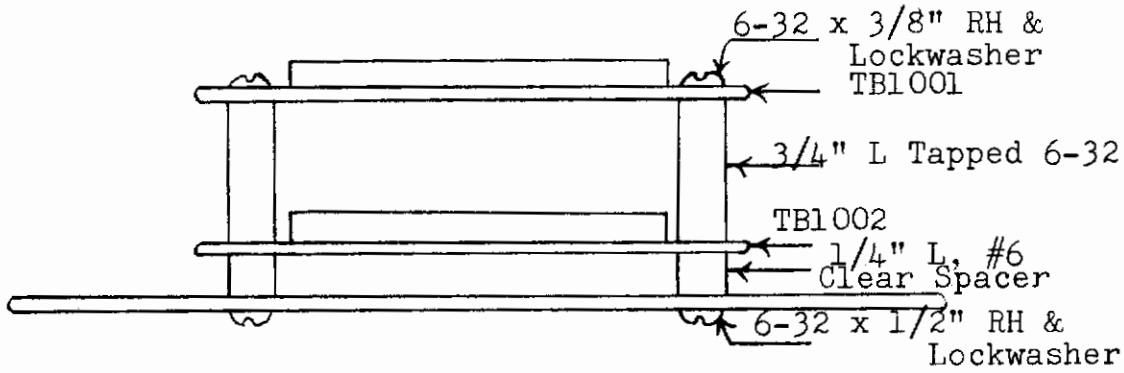




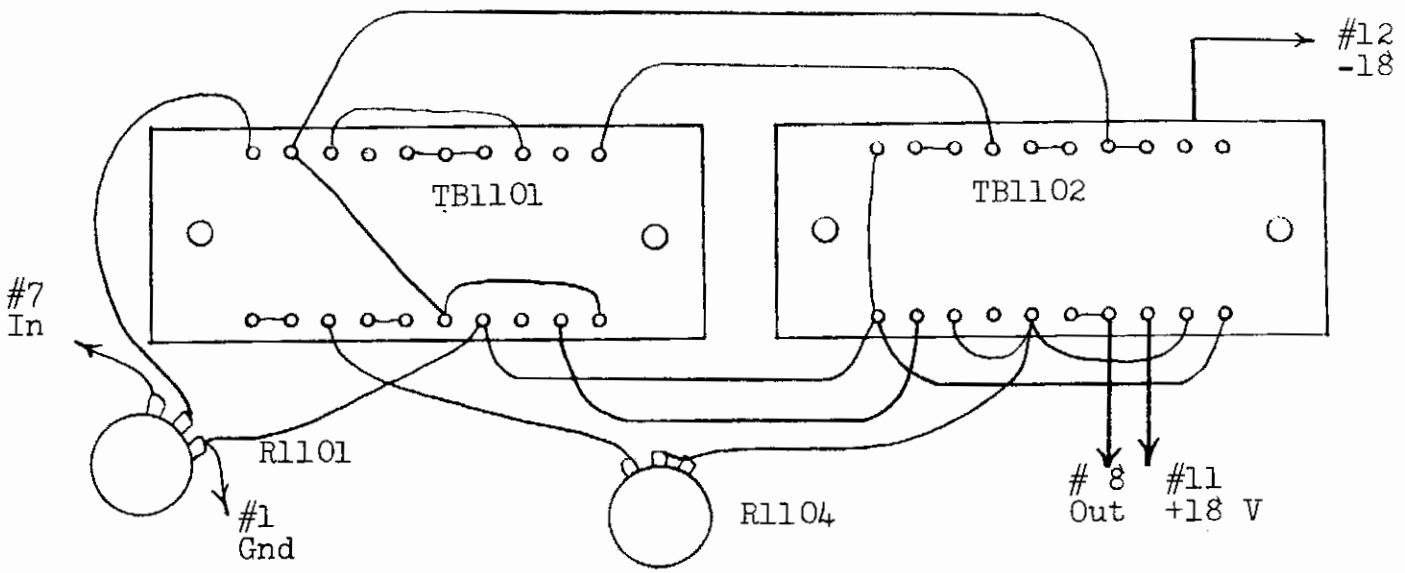
RC INTEGRATOR

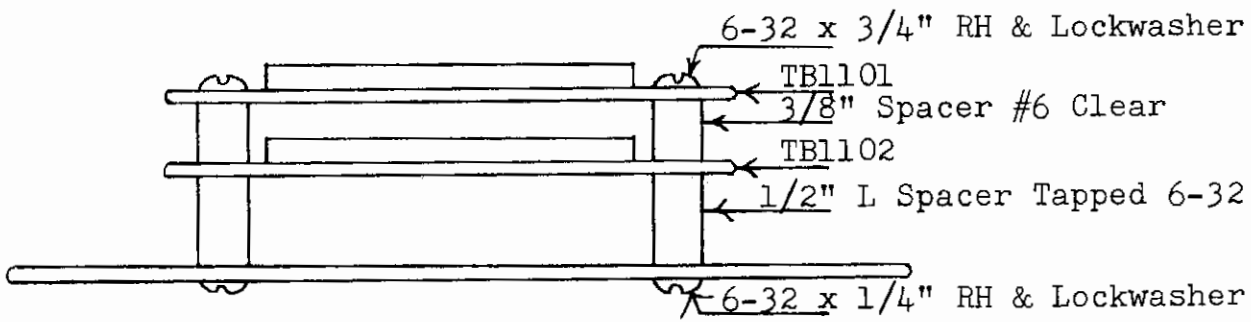
Module 900





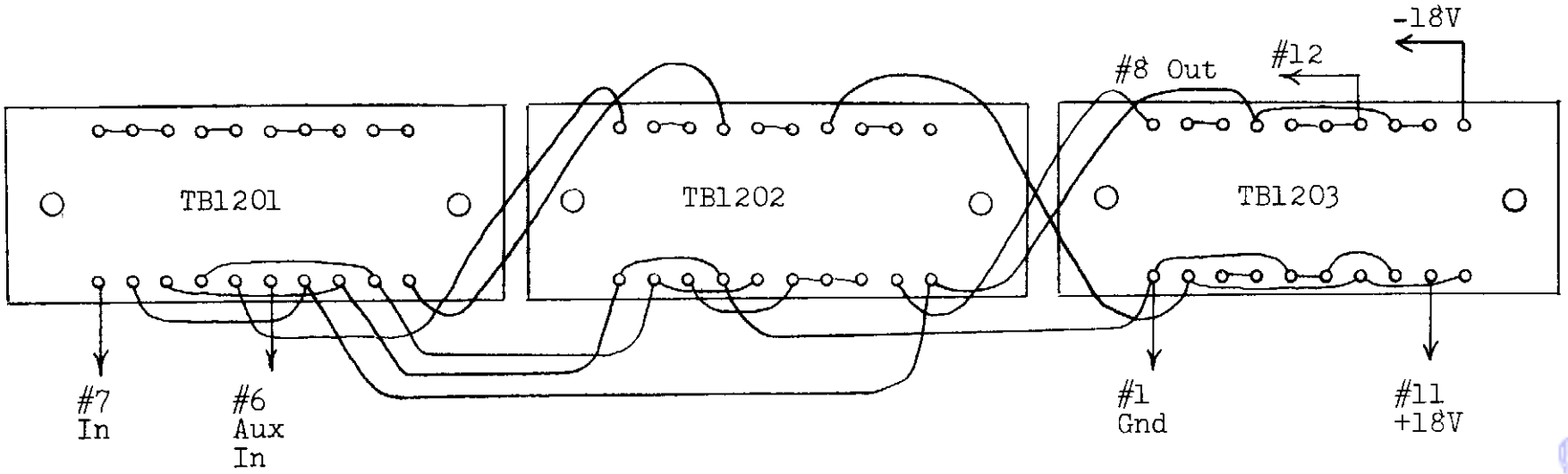
RC DIFFERENTIATOR
Module 1000

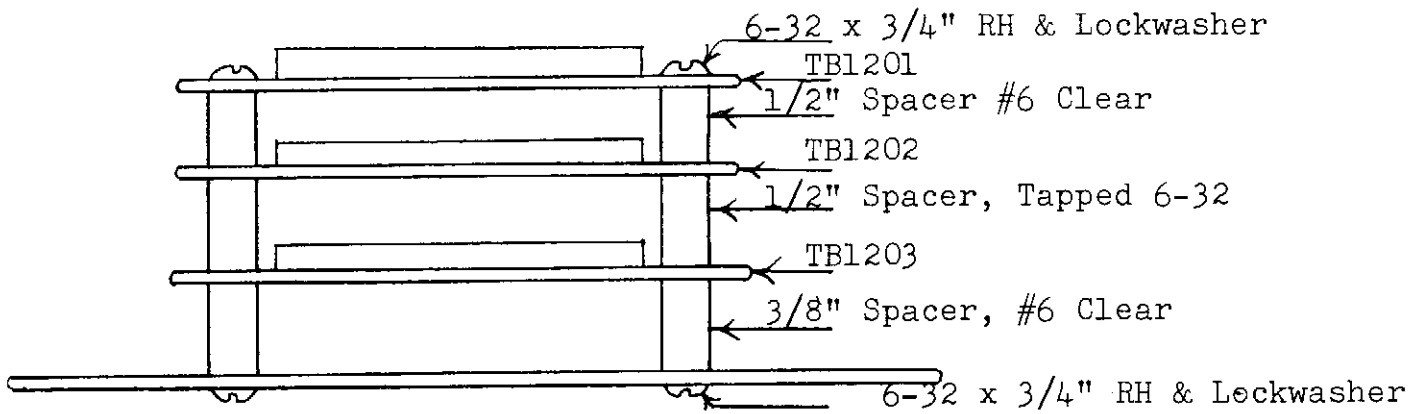




VARIABLE GAIN NON-INVERTING AMPLIFIER

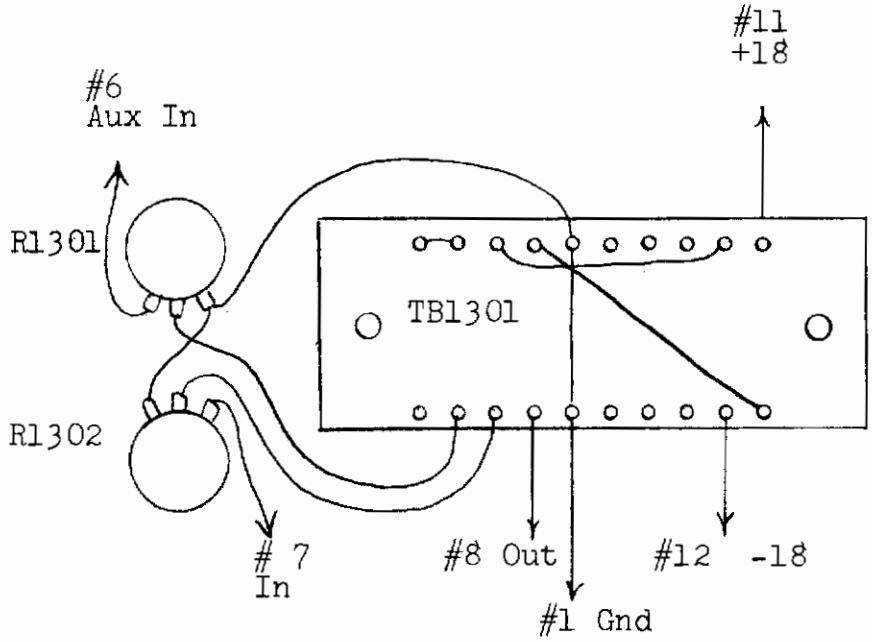
Module 1100

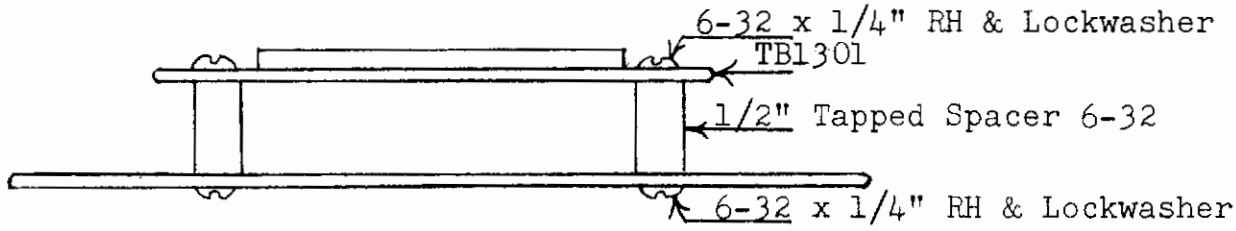




+ AND GATE

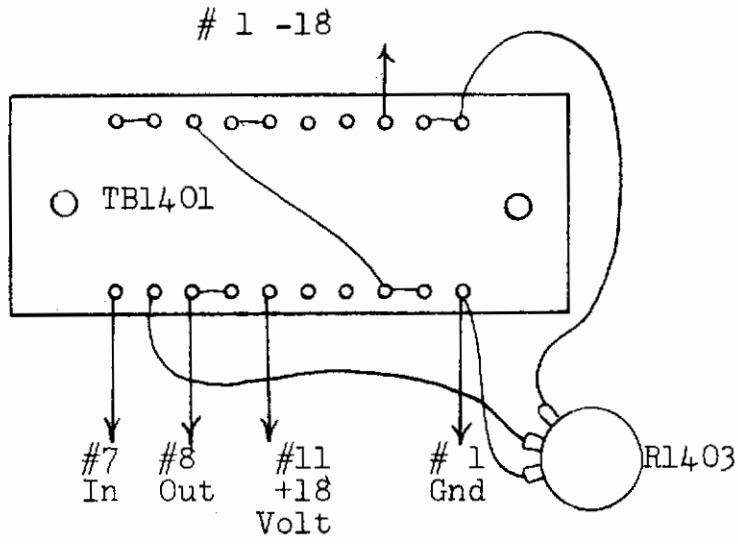
Module 1200

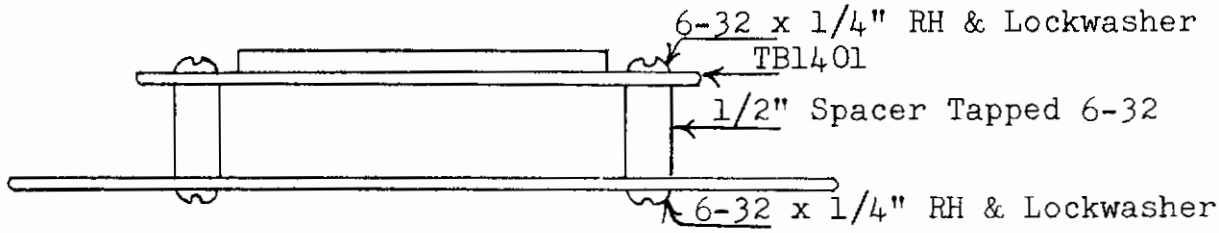




ADDER

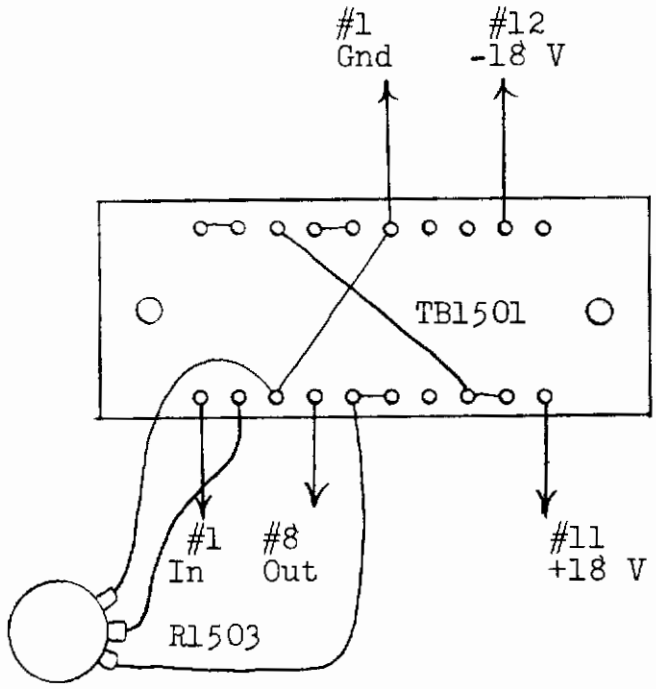
Module 1300

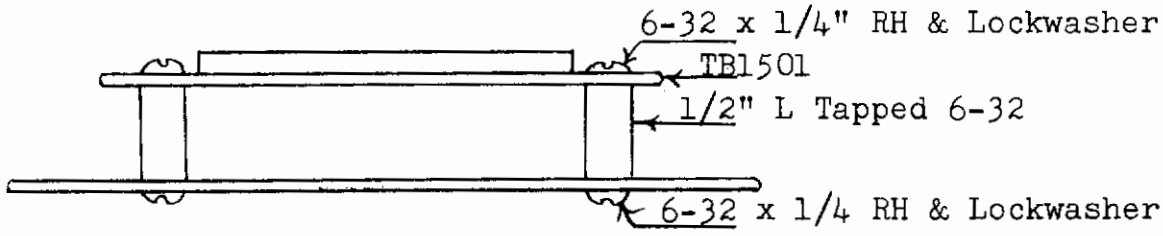




NEGATIVE CLIPPER

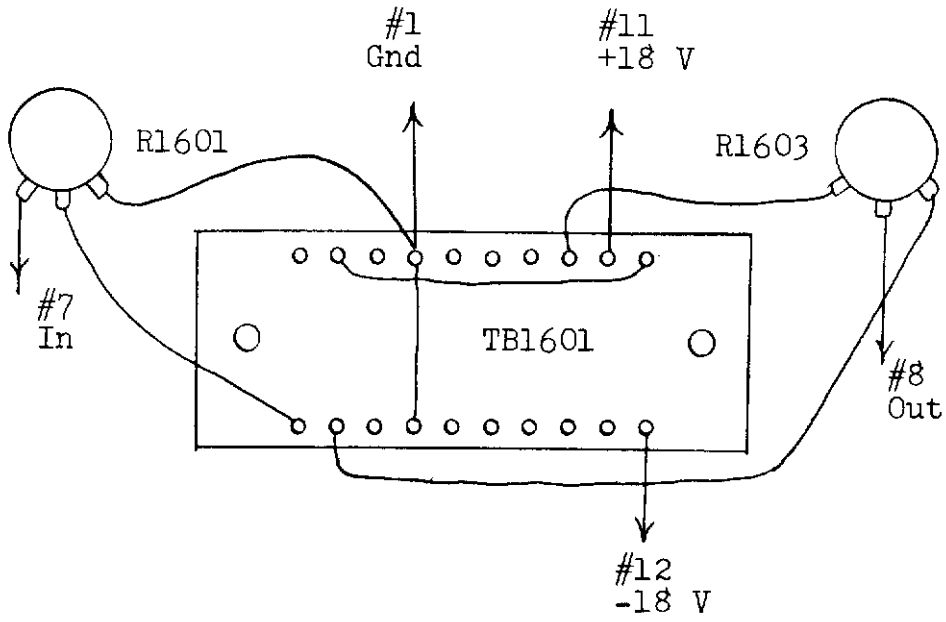
Module 1400

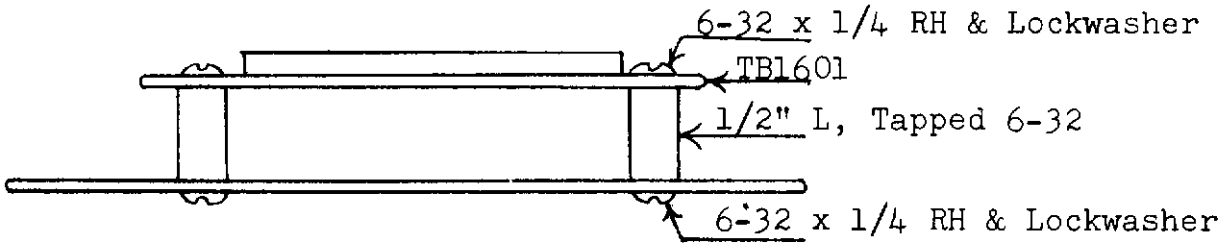




POSITIVE CLIPPER

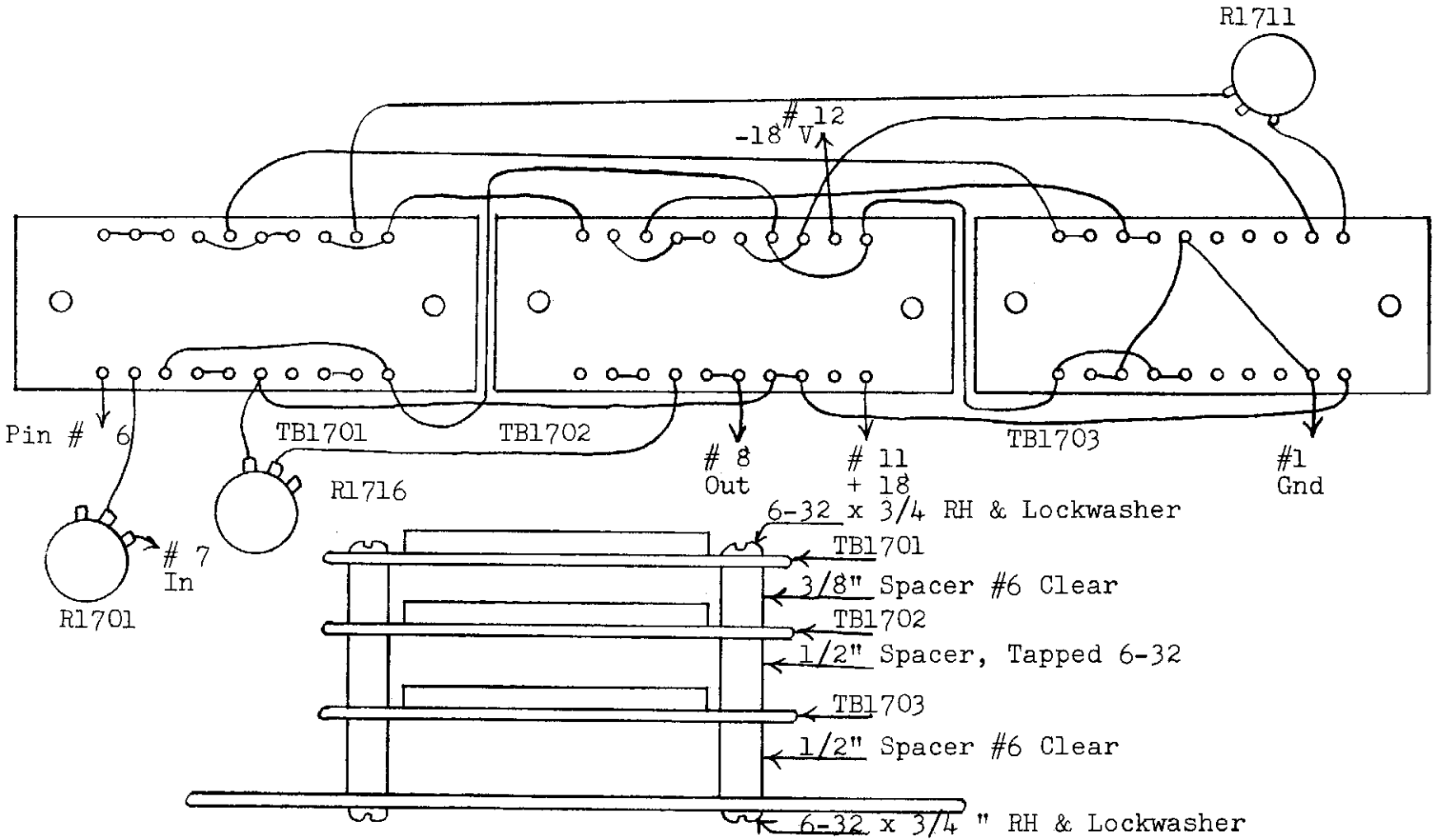
Module 1500





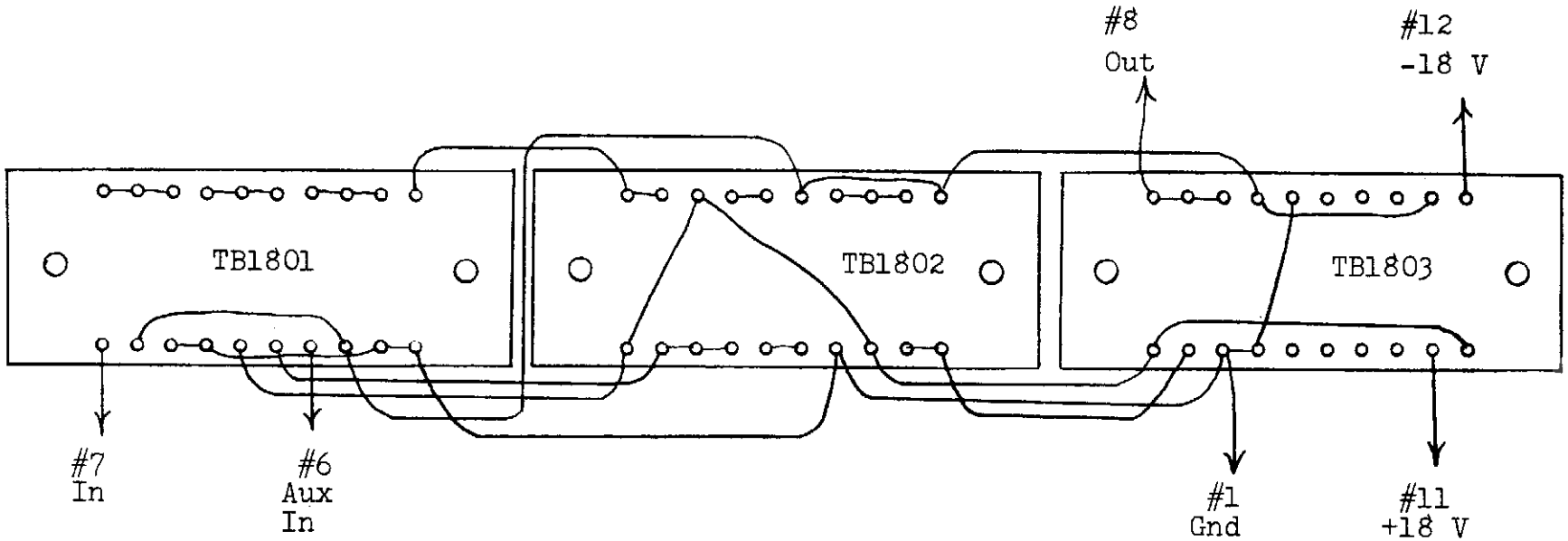
ATTENUATOR

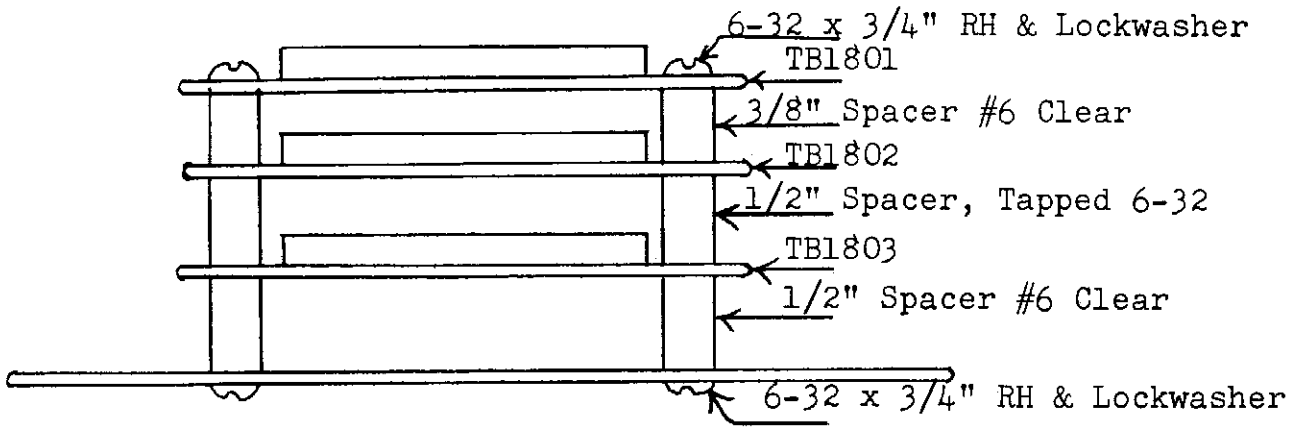
Module 1600



VARIABLE GAIN INVERTING EXT. FEEDBACK AMP

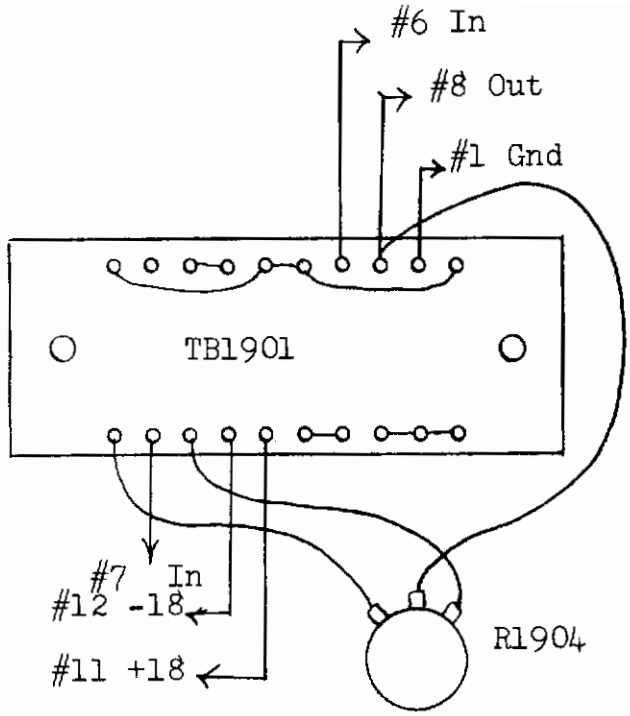
Module 1700

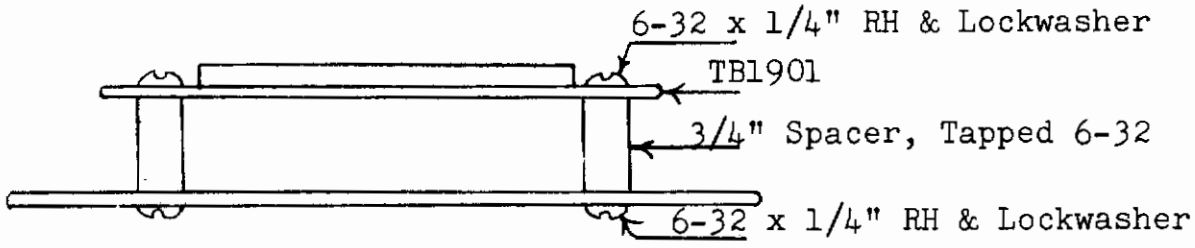




AND GATE

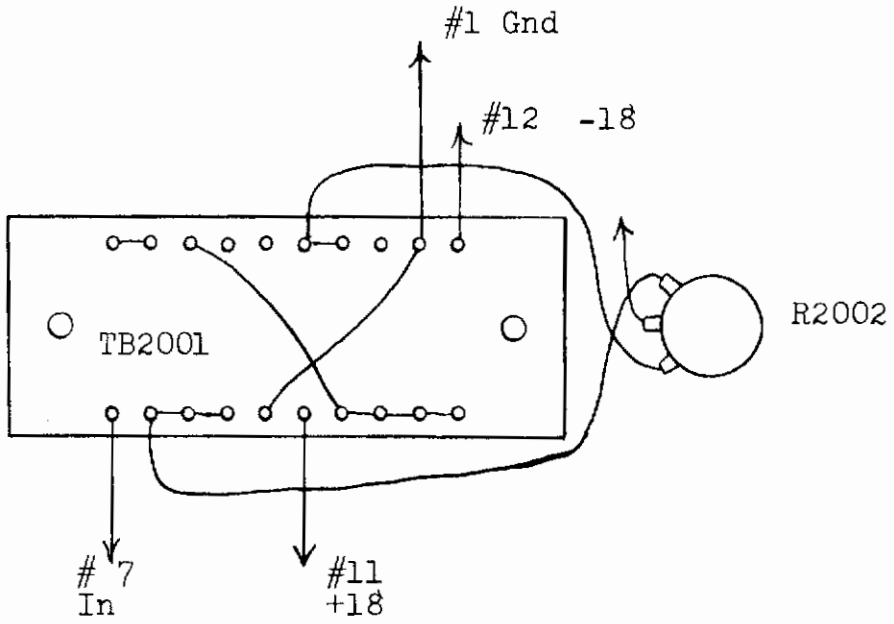
Module 1800

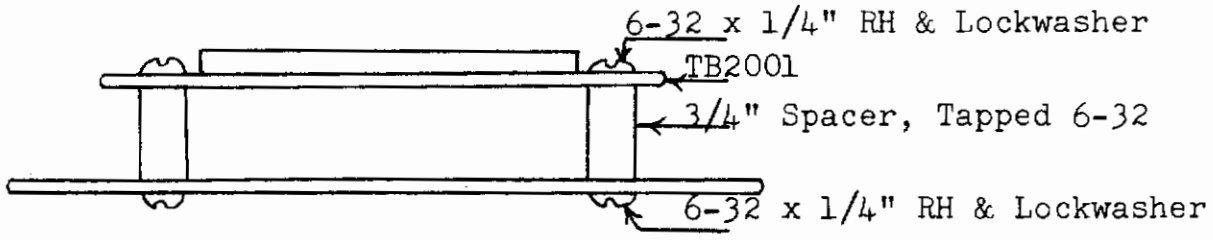




SIGNAL GATE

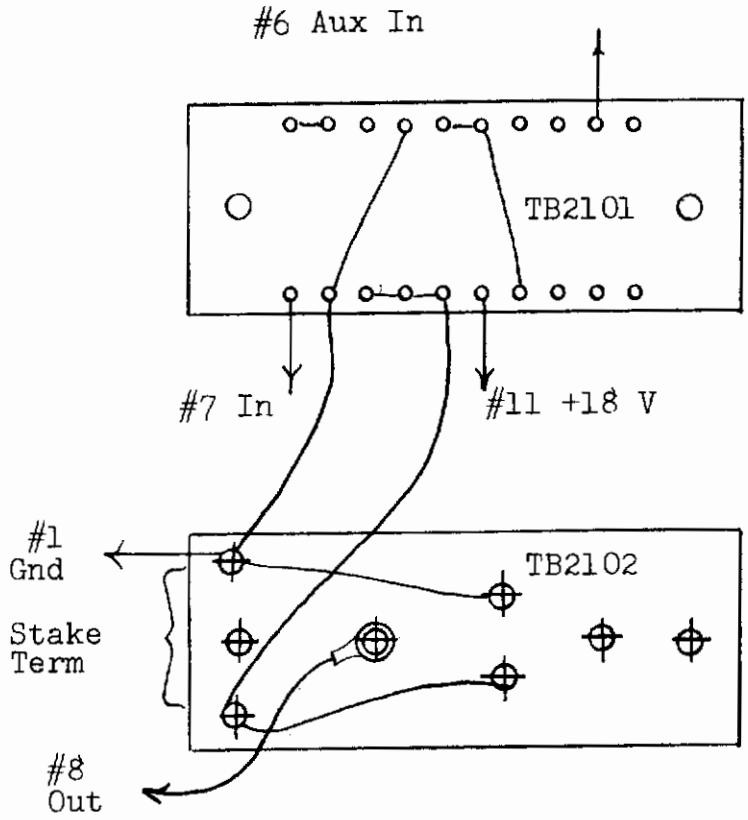
Module 1900

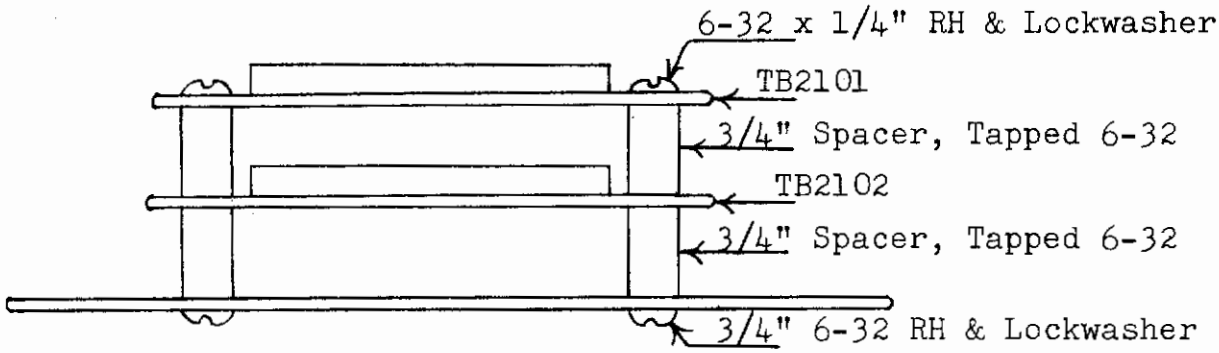




LEVEL SHIFTER

Module 2000





LAMP AND RELAY DRIVER
Module 2100

INTERCONNECTION TABLES*

*Note: All TB's are numbered by cabinet (1-6) by TB number (1-N) by Terminal (1-12). Thus, 5-37-9 reads "Terminal 9 on Terminal Board 37 in cabinet 5".

Patchboard I Inside Cabinet 2 Sector:	Terminal	Patchboard I Outside Cabinet 3 Sector:
IA-1	2-4-1	IA-1
IB-1	2-4-2	IB-1
IC-1	2-4-3	IC-1
ID-1	2-4-4	ID-1
IE-1	2-4-5	IE-1
IF-1	2-4-6	IF-1
IG-1	2-4-7	IG-1
IH-1	2-4-8	IH-1
IJ-1	2-4-9	IJ-1
IK-1	2-4-10	IK-1
IA-2	2-4-11	IA-2
IB-2	2-4-12	IB-2
IC-2	2-3-1	IC-2
ID-2	2-3-2	ID-2
IE-2	2-3-3	IE-2
IF-2	2-3-4	IF-2
IG-2	2-3-5	IG-2
IH-2	2-3-6	IH-2
IJ-2	2-3-7	IJ-2
IK-2	2-3-8	IK-2
IA-3	2-3-9	IA-3
IB-3	2-3-10	IB-3
IC-3	2-3-11	IC-3
ID-3	2-3-12	ID-3
IE-3	2-2-1	IE-3
IF-3	2-2-2	IF-3
IG-3	2-2-3	IG-3
IH-3	2-2-4	IH-3
IJ-3	2-2-5	IJ-3
IK-3	2-2-6	IK-3
IA-4	2-2-7	IA-4
IB-4	2-2-8	IB-4
IC-4	2-2-9	IC-4
ID-4	2-2-10	ID-4
IE-4	2-2-11	IE-4
IF-4	2-2-12	IF-4
IG-4	2-1-1	IG-4
IH-4	2-1-2	IH-4
IJ-4	2-1-3	IJ-4
IK-4	2-1-4	IK-4
IA-5	2-1-5	IA-5
IB-5	2-1-6	IB-5
IC-5	2-1-7	IC-5
ID-5	2-1-8	ID-5
IE-5	2-1-9	IE-5

Patchboard I Inside Cabinet 2 Sector:	Terminal	Patchboard I Outside Cabinet 3 Sector:
IF-5	2-1-10	IF-5
IG-5	2-1-11	IG-5
IH-5	2-1-12	IH-5
IJ-5	2-8-1	IJ-5
IK-5	2-8-2	IK-5
IA-6	2-8-3	IA-6
IB-6	2-8-4	IB-6
IC-6	2-8-5	IC-6
ID-6	2-8-6	ID-6
IE-6	2-8-7	IE-6
IF-6	2-8-8	IF-6
IG-6	2-8-9	IG-6
IH-6	2-8-10	IH-6
IJ-6	2-8-11	IJ-6
IK-6	2-8-12	IK-6
IA-7	2-7-1	IA-7
IB-7	2-7-2	IB-7
IC-7	2-7-3	IC-7
ID-7	2-7-4	ID-7
IE-7	2-7-5	IE-7
IF-7	2-7-6	IF-7
IG-7	2-7-7	IG-7
IH-7	2-7-8	IH-7
IJ-7	2-7-9	IJ-7
IK-7	2-7-10	IK-7
IA-8	2-7-11	IA-8
IB-8	2-7-12	IB-8
IC-8	2-6-1	IC-8
ID-8	2-6-2	ID-8
IE-8	2-6-3	IE-8
IF-8	2-6-4	IF-8
IG-8	2-6-5	IG-8
IH-8	2-6-6	IH-8
IJ-8	2-6-7	IJ-8
IK-8	2-6-8	IK-8
IA-9	2-6-9	IA-9
IB-9	2-6-10	IB-9
IC-9	2-6-11	IC-9
ID-9	2-6-12	ID-9
IE-9	2-5-1	IE-9
IF-9	2-5-2	IF-9
IG-9	2-5-3	IG-9
IH-9	2-5-4	IH-9
IJ-9	2-5-5	IJ-9
IK-9	2-5-6	IK-9
IA-10	2-5-7	IA-10
IB-10	2-5-8	IB-10
IC-10	2-5-9	IC-10
ID-10	2-5-10	ID-10
IE-10	2-5-11	IE-10
IF-10	2-5-12	IF-10

Patchboard I Inside Cabinet 2 Sector:	Terminal	Patchboard I Outside Cabinet 3 Sector:
IG-10	2-10-1	IG-10
IH-10	2-10-2	IH-10
IJ-10	2-10-3	IJ-10
IK-10	2-10-4	IK-10
IA-11	2-10-5	IA-11
IB-11	2-10-6	IB-11
IC-11	2-10-7	IC-11
ID-11	2-10-8	ID-11
IE-11	2-10-9	IE-11
IF-11	2-10-10	IF-11
IG-11	2-10-11	IG-11
IH-11	2-10-12	IH-11
IJ-11	2-9-1	IJ-11
IK-11	2-9-2	IK-11
IA-12	2-9-3	IA-12
IB-12	2-9-4	IB-12
IC-12	2-9-5	IC-12
ID-12	2-9-6	ID-12
IE-12	2-9-7	IE-12
IF-12	2-9-8	IF-12
IG-12	2-9-9	IG-12
IH-12	2-9-10	IH-12
IJ-12	2-9-11	IJ-12
IK-12	2-9-12	IK-12
IA-13	2-12-1	IA-13
IB-13	2-12-2	IB-13
IC-13	2-12-3	IC-13
ID-13	2-12-4	ID-13
IE-13	2-12-5	IE-13
IF-13	2-12-6	IF-13
IG-13	2-12-7	IG-13
IH-13	2-12-8	IH-13
IJ-13	2-12-9	IJ-13
IK-13	2-12-10	IK-13
IA-14	2-12-11	IA-14
IB-14	2-12-12	IB-14
IC-14	2-11-1	IC-14
ID-14	2-11-2	ID-14
IE-14	2-11-3	IE-14
IF-14	2-11-4	IF-14
IG-14	2-11-5	IG-14
IH-14	2-11-6	IH-14
IJ-14	2-11-7	IJ-14
IK-14	2-11-8	IK-14
IA-15	2-11-9	IA-15
IB-15	2-11-10	IB-15
IC-15	2-11-11	IC-15
ID-15	2-11-12	ID-15

Patchboard I Inside Cabinet 2 Sector:	Terminal	Patchboard I Outside Cabinet 3 Sector:
IE-15	2-13-1	IE-15
IF-15	2-13-2	IF-15
IG-15	2-13-3	IG-15
IH-15	2-13-4	IH-15
IJ-15	2-13-5	IJ-15
IK-15	2-13-6	IK-15
IA-16	2-13-7	IA-16
IB-16	2-13-8	IB-16
IC-16	2-13-9	IC-16
ID-16	2-13-10	ID-16
IE-16	2-13-11	IE-16
IF-16	2-13-12	IF-16
IG-16	2-14-1	IG-16
IH-16	2-14-2	IH-16
IJ-16	2-14-3	IJ-16
IK-16	2-14-4	IK-16

Patchboard II Inside Cabinet 3 Sector:	Terminal	Patchboard II Outside Cabinet 3 Sector:
IIA-1	3-1-1	IIA-1
IIB-1	3-1-2	IIB-1
IIC-1	3-1-3	IIC-1
IID-1	3-1-4	IID-1
IIE-1	3-1-5	IIE-1
IIF-1	3-1-6	IIF-1
IIG-1	3-1-7	IIG-1
IIH-1	3-1-8	IIH-1
IIJ-1	3-1-9	IIJ-1
IIK-1	3-1-10	IIK-1
IIA-2	3-1-11	IIA-2
IIB-2	3-1-12	IIB-2
IIC-2	3-2-1	IIC-2
IID-2	3-2-2	IID-2
IIE-2	3-2-3	IIE-2
IIF-2	3-2-4	IIF-2
IIG-2	3-2-5	IIG-2
IIH-2	3-2-6	IIH-2
IIJ-2	3-2-7	IIJ-2
IIK-2	3-2-8	IIK-2
IIA-3	3-2-9	IIA-3
IIB-3	3-2-10	IIB-3
IIC-3	3-2-11	IIC-3
IID-3	3-2-12	IID-3
IIE-3	3-3-1	IIE-3
IIF-3	3-3-2	IIF-3
IIG-3	3-3-3	IIG-3
IIH-3	3-3-4	IIH-3
IIJ-3	3-3-5	IIJ-3

Patchboard I Inside Cabinet 3 Sector:	Terminal	Patchboard II Outside Cabinet 3 Sector:
IIK-3	3-3-6	IIK-3
IIA-4	3-3-7	IIA-4
IIB-4	3-3-8	IIB-4
IIC-4	3-3-9	IIC-4
IID-4	3-3-10	IID-4
IIE-4	3-3-11	IIE-4
IIF-4	3-3-12	IIF-4
IIG-4	3-4-1	IIG-4
IIH-4	3-4-2	IIH-4
IIJ-4	3-4-3	IIJ-4
IIK-4	3-4-4	IIK-4
IIA-5	3-4-5	IIA-5
IIB-5	3-4-6	IIB-5
IIC-5	3-4-7	IIC-5
IID-5	3-4-8	IID-5
IIE-5	3-4-9	IIE-5
IIF-5	3-4-10	IIF-5
IIG-5	3-4-11	IIG-5
IIH-5	3-4-12	IIH-5
IIJ-5	3-5-1	IIJ-5
IIK-5	3-5-2	IIK-5
IIA-6	3-5-3	IIA-6
IIB-6	3-5-4	IIB-6
IIC-6	3-5-5	IIC-6
IID-6	3-5-6	IID-6
IIE-6	3-5-7	IIE-6
IIF-6	3-5-8	IIF-6
IIG-6	3-5-9	IIG-6
IIH-6	3-5-10	IIH-6
IIJ-6	3-5-11	IIJ-6
IIK-6	3-5-12	IIK-6
IIA-7	3-6-1	IIA-7
IIB-7	3-6-2	IIB-7
IIC-7	3-6-3	IIC-7
IID-7	3-6-4	IID-7
IIE-7	3-6-5	IIE-7
IIF-7	3-6-6	IIF-7
IIG-7	3-6-7	IIG-7
IIH-7	3-6-8	IIH-7
IIJ-7	3-6-9	IIJ-7
IIK-7	3-6-10	IIK-7
IIA-8	3-6-11	IIA-8
IIB-8	3-6-12	IIB-8
IIC-8	3-7-1	IIC-8
IID-8	3-7-2	IID-8
IIE-8	3-7-3	IIE-8
IIF-8	3-7-4	IIF-8
IIG-8	3-7-5	IIG-8
IIH-8	3-7-6	IIH-8

Patchboard II Inside Cabinet 3 Sector:	Terminal	Patchboard II Outside Cabinet 3 Sector:
IIJ-8	3-7-7	IIJ-8
IIK-8	3-7-8	IIK-8
IIA-9	3-7-9	IIA-9
IIB-9	3-7-10	IIB-9
IIC-9	3-7-11	IIC-9
IID-9	3-7-12	IID-9
IIE-9	3-8-1	IIE-9
IIF-9	3-8-2	IIF-9
IIG-9	3-8-3	IIG-9
IIH-9	3-8-4	IIH-9
IIJ-9	3-8-5	IIJ-9
IIK-9	3-8-6	IIK-9
IIA-10	3-8-7	IIA-10
IIB-10	3-8-8	IIB-10
IIC-10	3-8-9	IIC-10
IID-10	3-8-10	IID-10
IIE-10	3-8-11	IIE-10
IIF-10	3-8-12	IIF-10
IIG-10	3-9-1	IIG-10
IIH-10	3-9-2	IIH-10
IIJ-10	3-9-3	IIJ-10
IIK-10	3-9-4	IIK-10
IIA-11	3-9-5	IIA-11
IIB-11	3-9-6	IIB-11
IIC-11	3-9-7	IIC-11
IID-11	3-9-8	IID-11
IIE-11	3-9-9	IIE-11
IIF-11	3-9-10	IIF-11
IIG-11	3-9-11	IIG-11
IIH-11	3-9-12	IIH-11
IIJ-11	3-10-1	IIJ-11
IIK-11	3-10-2	IIK-11
IIA-12	3-10-3	IIA-12
IIB-12	3-10-4	IIB-12
IIC-12	3-10-5	IIC-12
IID-12	3-10-6	IID-12
IIE-12	3-10-7	IIE-12
IIF-12	3-10-8	IIF-12
IIG-12	3-10-9	IIG-12
IIH-12	3-10-10	IIH-12
IIJ-12	3-10-11	IIJ-12
IIK-12	3-10-12	IIK-12
IIA-13	3-11-1	IIA-13
IIB-13	3-11-2	IIB-13
IIC-13	3-11-3	IIC-13
IID-13	3-11-4	IID-13
IIE-13	3-11-5	IIE-13
IIF-13	3-11-6	IIF-13

Patchboard II Inside Cabinet 3 Sector:	Terminal	Patchboard II Outside Cabinet 3 Sector:
IIG-13	3-11-7	IIG-13
IIH-13	3-11-8	IIH-13
IIJ-13	3-11-9	IIJ-13
IIK-13	3-11-10	IIK-13
IIA-14	3-11-11	IIA-14
IIB-14	3-11-12	IIB-14
IIC-14	3-12-1	IIC-14
IID-14	3-12-2	IID-14
IIE-14	3-12-3	IIE-14
IIF-14	3-12-4	IIF-14
IIG-14	3-12-5	IIG-14
IIH-14	3-12-6	IIH-14
IIJ-14	3-12-7	IIJ-14
IIK-14	3-12-8	IIK-14
IIA-15	3-12-9	IIA-15
IIB-15	3-12-10	IIB-15
IIC-15	3-12-11	IIC-15
IID-15	3-12-12	IID-15
IIE-15	3-13-1	IIE-15
IIF-15	3-13-2	IIF-15
IIG-15	3-13-3	IIG-15
IIH-15	3-13-4	IIH-15
IIJ-15	3-14-1	IIJ-15
IIK-15	3-14-2	IIK-15
IIA-16	3-14-3	IIA-16
IIB-16	3-14-4	IIB-16
IIC-16	3-14-5	IIC-16
IID-16	3-14-6	IID-16
IIE-16	3-14-7	IIE-16
IIF-16	3-14-8	IIF-16
IIG-16	3-14-9	IIG-16
IIH-16	3-14-10	IIH-16
IIJ-16	3-14-11	IIJ-16
IIK-16	3-14-12	IIK-16

Patchboard III Sector:	Terminals		Module Chassis - Position - Pin
IIIA-1	4-12-1	4-24-1	1-1-7
IIIB-1	4-12-3	4-24-3	1-5-7
IIIC-1	4-12-5	4-24-5	1-2-7
IIID-1	4-12-7	4-24-7	1-6-7
IIIE-1	4-12-9	4-24-9	1-3-7
IIIF-1	4-12-11	4-24-11	1-7-7
IIIG-1	4-13-1	4-25-1	1-4-7
IIIH-1	4-13-3	4-25-3	1-8-7
IIIJ-1	4-13-5	4-27-1	2-1-7

	Patchboard III Sector:	Terminals		Module Chassis - Position - Pin
	IIIK-1	4-13-7	4-27-3	2-5-7
	IIIA-2	4-13-9	4-27-5	2-2-7
	IIIB-2	4-13-11	4-27-7	2-6-7
	IIIC-2	4-14-1	4-27-9	2-3-7
	IIID-2	4-14-3	4-27-11	2-7-7
	IIIE-2	4-14-5	4-28-1	2-4-7
	IIIF-2	4-14-7	4-28-3	2-8-7
	IIIG-2	4-14-9	4-30-1	3-1-7
	IIIH-2	4-14-11	4-30-3	3-5-7
	IIIJ-2	4-15-1	4-30-5	3-2-7
	IIIK-2	4-15-3	4-30-7	3-6-7
	IIIA-3	4-15-5	4-30-9	3-3-7
	IIIB-3	4-15-7	4-30-11	3-7-7
	IIIC-3	4-15-9	4-31-1	3-4-7
	IIID-3	4-15-11	4-31-3	3-8-7
	IIIE-3	4-16-1	4-33-1	4-1-7
	IIIF-3	4-16-3	4-33-3	4-5-7
Inputs	IIIG-3	4-16-5	4-35-5	4-2-7
	IIIH-3	4-16-7	4-33-7	4-6-7
	IIIJ-3	4-16-9	4-33-9	4-3-7
	IIIK-3	4-16-11	4-33-11	4-7-7
	IIIA-4	4-17-1	4-34-1	4-4-7
	IIIB-4	4-17-3	4-34-3	4-8-7
	IIIC-4	4-17-5	4-36-1	5-1-7
	IIID-4	4-17-7	4-36-3	5-5-7
	IIIE-4	4-17-9	4-36-5	5-2-7
	IIIF-4	4-17-11	4-36-7	5-6-7
	IIIG-4	4-18-1	4-36-9	5-3-7
	IIIH-4	4-18-3	4-36-11	5-7-7
	IIIJ-4	4-18-5	4-37-1	5-4-7
	IIIK-4	4-18-7	4-37-3	5-8-7
	IIIA-5	4-18-9	4-39-1	6-1-7
	IIIB-5	4-18-11	4-39-3	6-5-7
	IIIC-5	4-19-1	4-39-5	6-2-7
	IIID-5	4-19-3	4-39-7	6-6-7
	IIIE-5	4-19-5	4-39-9	6-3-7
	IIIF-5	4-19-7	4-39-11	6-7-7
	IIIG-5	4-19-9	4-40-1	6-4-7
	IIIH-5	4-19-11	4-40-3	6-8-7
	IIIJ-5	4-20-1	4-42-1	7-1-7
	IIIK-5	4-20-3	4-42-3	7-5-7
	IIIA-6	4-20-5	4-42-5	7-2-7
	IIIB-6	4-20-7	4-42-7	7-6-7
	IIIC-6	4-20-9	4-42-9	7-3-7
	IIID-6	4-20-11	4-42-11	7-7-7
	IIIE-6	4-21-1	4-43-1	7-4-7
	IIIF-6	4-21-3	4-43-3	7-8-7
	IIIG-6	4-21-5	4-45-1	8-1-7

	Patchboard III Sector:	Terminals		Module Chassis - Position - Pin
Inputs	IIIH-6	4-21-7	4-45-3	8-5-7
	IIIJ-6	4-21-9	4-45-5	8-2-7
	IIIK-6	4-21-11	4-45-7	8-6-7
	IIIA-7	4-22-1	4-45-9	8-3-7
	IIIB-7	4-22-3	4-45-11	8-7-7
	IIIC-7	4-22-5	4-46-1	8-4-7
	IIID-7	4-22-7	4-46-3	8-8-7

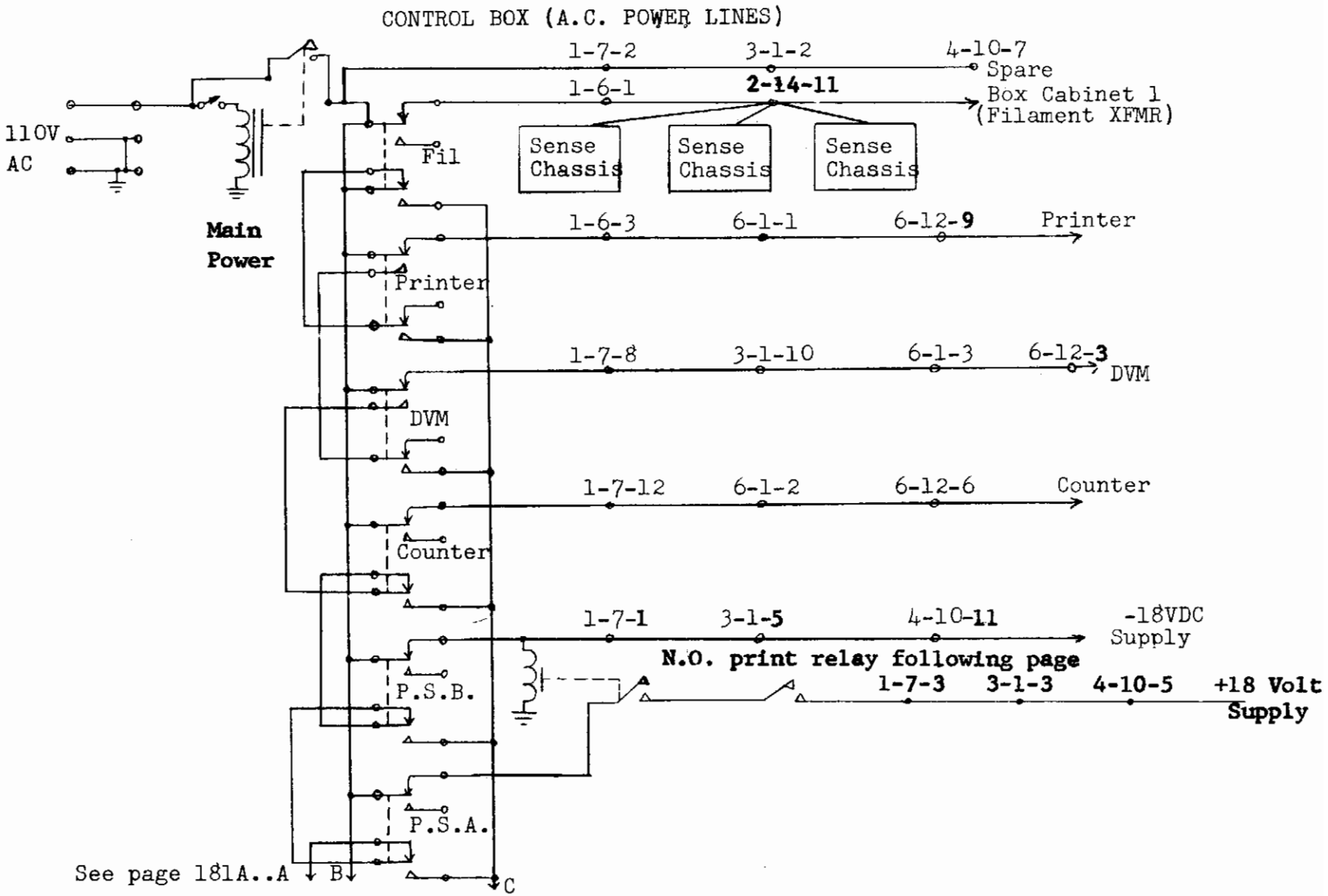
	Patchboard II Sector:	Terminals		Module Chassis - Position - Pin
	IVA-9	5-48-1	5-19-11	9-1-6
	IVB-9	5-48-2	5-19-12	9-2-6
	IVC-9	5-48-3	5-44-1	9-3-6
	IVD-9	5-48-4	5-44-2	9-4-6
	IVE-9	5-48-5	5-44-3	9-5-6
	IVF-9	5-48-6	5-44-4	9-6-6
	IVG-9	5-48-7	5-44-5	9-7-6
	IVH-9	5-48-8	5-44-6	9-8-6
	IVJ-9	5-48-9	5-19-7	10-1-6
	IVK-9	5-48-10	5-19-8	10-2-6
	IVA-10	5-48-11	5-19-9	10-3-6
	IVB-10	5-48-12	5-19-10	10-4-6
	IVC-10	5-47-1	5-19-11	10-5-6
	IVD-10	5-47-2	5-19-12	10-6-6
	IVE-10	5-47-3	5-22-11	10-7-6
	IVF-10	5-47-4	5-22-12	10-8-6
	IVG-10	5-47-5	5-25-11	11-1-6
	IVH-10	5-47-6	5-25-12	11-2-6
Auxiliary Inputs	IVJ-10	5-47-7	5-45-1	11-3-6
	IVK-10	5-47-8	5-45-2	11-4-6
	IVA-11	5-47-9	5-45-3	11-5-6
	IVB-11	5-47-10	5-45-4	11-6-6
	IVC-11	5-47-11	5-45-5	11-7-6
	IVD-11	5-47-12	5-45-6	11-8-6
	IVE-11	5-46-1	5-45-7	12-1-6
	IVF-11	5-46-2	5-45-8	12-2-6
	IVG-11	5-46-3	5-45-9	12-3-6
	IVH-11	5-46-4	4-45-10	12-4-6
	IVJ-11	5-46-5	5-45-11	12-5-6
	IVK-11	5-46-6	5-45-12	12-6-6
	IVA-12	5-46-7	5-28-11	12-7-6
	IVB-12	5-46-8	5-28-12	12-8-6

	Patchboard III Sector:	Terminals		Module Chassis - Position - Pin
	IIIA-8	4-13-2	4-24-2	1-1-8
	IIIB-8	4-13-4	4-24-4	1-5-8
	IIIC-8	4-13-6	4-24-6	1-2-8
	IIID-8	4-13-8	4-24-8	1-6-8
	IIIE-8	4-13-10	4-24-10	1-3-8
	IIIF-8	4-13-12	4-24-12	1-7-8
	IIIG-8	4-14-2	4-25-2	1-4-8
	IIIH-8	4-14-4	4-25-4	1-8-8
	IIIJ-8	4-14-6	4-27-2	2-1-8
	IIIK-8	4-14-8	4-27-4	2-5-8
	IIIA-9	4-14-10	4-27-6	2-2-8
	IIIB-9	4-14-12	4-27-8	2-6-8
	IIIC-9	4-15-2	4-27-10	2-3-8
	IIID-9	4-15-4	4-27-12	2-7-8
	IIIE-9	4-15-6	4-28-2	2-4-8
	IIIF-9	4-15-8	4-28-4	2-8-8
	IIIG-9	4-15-10	4-30-2	3-1-8
	IIIH-9	4-15-12	4-30-4	3-5-8
	IIIJ-9	4-16-2	4-30-6	3-2-8
	IIIK-9	4-16-4	4-30-8	3-6-8
	IIIA-10	4-16-6	4-30-10	3-3-8
	IIIB-10	4-16-8	4-30-12	3-7-8
	IIIC-10	4-16-10	4-31-2	3-4-8
	IIID-10	4-16-12	4-31-4	3-8-8
Outputs	IIIE-10	4-17-2	4-33-2	4-1-8
	IIIF-10	4-17-4	4-33-4	4-5-8
	IIIG-10	4-17-6	4-33-6	4-2-8
	IIIH-10	4-17-8	4-33-8	4-6-8
	IIIJ-10	4-17-10	4-33-10	4-3-8
	IIIK-10	4-17-12	4-33-12	4-7-8
	IIIA-11	4-18-2	4-34-2	4-4-8
	IIIB-11	4-18-4	4-34-4	4-8-8
	IIIC-11	4-18-6	4-36-2	5-1-8
	IIID-11	4-18-8	4-36-4	5-5-8
	IIIE-11	4-18-10	4-36-6	5-2-8
	IIIF-11	4-18-12	4-36-8	5-6-8
	IIIG-11	4-19-2	4-36-10	5-3-8
	IIIH-11	4-19-4	4-36-12	5-7-8
	IIIJ-11	4-19-6	4-37-2	5-4-8
	IIIK-11	4-19-8	4-37-4	5-8-8
	IIIA-12	4-19-10	4-39-2	6-1-8
	IIIB-12	4-19-12	4-39-4	6-5-8
	IIIC-12	4-20-2	4-39-6	6-2-8
	IIID-12	4-20-4	4-39-8	6-6-8
	IIIE-12	4-20-6	4-39-10	6-3-8
	IIIF-12	4-20-8	4-39-12	6-7-8
	IIIG-12	4-20-10	4-40-2	6-4-8
	IIIH-12	4-20-12	4-40-4	6-8-8
	IIIJ-12	4-21-2	4-42-2	7-1-8
	IIIK-12	4-21-4	4-42-4	7-5-8

	Patchboard III Sector:	Terminals		Module Chassis - Position - Pin
	IIIA-13	4-21-6	4-42-6	7-2-8
	IIIB-13	4-21-8	4-42-8	7-6-8
	IIIC-13	4-21-10	4-42-10	7-3-8
	IIID-13	4-21-12	4-42-12	7-7-8
	IIIE-13	4-22-2	4-43-2	7-4-8
	IIIF-13	4-22-4	4-43-4	7-8-8
Outputs	IIIG-13	4-22-6	4-46-2	8-1-8
	IIIH-13	4-22-8	4-46-4	8-5-8
	IIIJ-13	4-22-10	4-46-6	8-2-8
	IIIK-13	4-22-12	4-46-8	8-6-8
	IIIA-14	4-23-2	4-46-10	8-3-8
	IIIB-14	4-23-4	4-46-12	8-7-8
	IIIC-14	4-23-6	4-47-2	8-4-8
	IIID-14	4-23-8	4-47-4	8-8-8

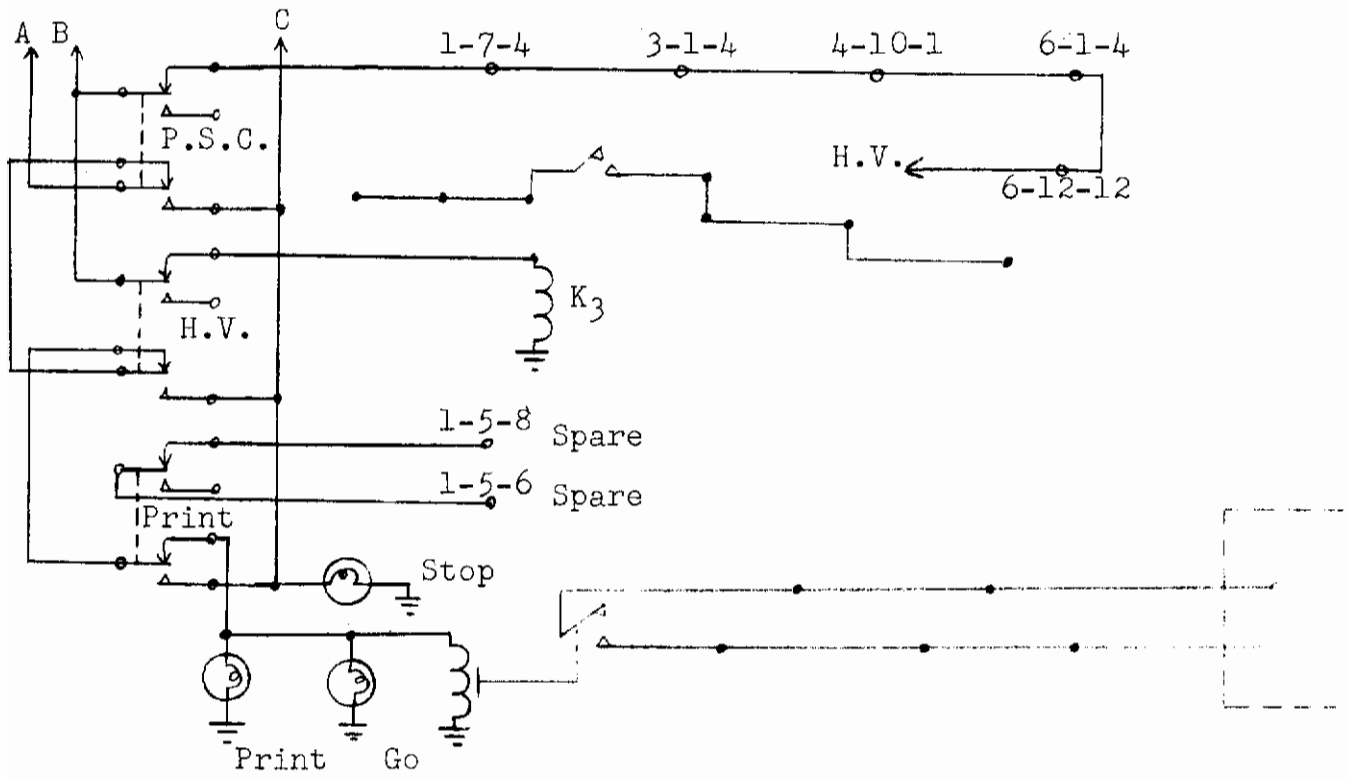
	Patchboard IV Sector:	Terminals		Module Chassis - Position - Pin
	IVA-5	5-1-2	5-17-2	9-1-8
	IVB-5	5-1-4	5-17-4	9-5-8
	IVC-5	5-1-6	5-17-6	9-2-8
	IVD-5	5-1-8	5-17-8	9-6-8
	IVE-5	5-1-10	5-17-10	9-3-8
	IVF-5	5-1-12	5-17-12	9-3-8
	IVG-5	5-2-2	5-18-2	9-4-8
	IVH-5	5-2-4	5-18-4	9-8-8
	IVJ-5	5-2-6	5-20-2	10-1-8
	IVK-5	5-2-8	5-20-4	10-5-8
	IVA-6	5-2-10	5-20-6	10-2-8
	IVB-6	5-2-12	5-20-8	10-6-8
	IVC-6	5-3-2	5-20-10	10-3-8
	IVD-6	5-3-4	5-20-12	10-7-8
Outputs	IVE-6	5-3-6	5-21-2	10-4-8
	IVF-6	5-3-8	5-21-4	10-8-8
	IVG-6	5-3-10	5-23-2	11-1-8
	IVH-6	5-3-12	5-23-4	11-5-8
	IVJ-6	5-4-2	5-23-6	11-2-8
	IVK-6	5-4-4	5-23-8	11-6-8
	IVA-7	5-4-6	5-23-10	11-3-8
	IVB-7	5-4-8	5-23-12	11-7-8
	IVC-7	5-4-10	5-24-2	11-4-8
	IVD-7	5-4-12	5-24-4	11-8-8
	IVE-7	5-5-2	5-26-2	12-1-8
	IVF-7	5-5-4	5-26-4	12-5-8
	IVG-7	5-5-6	5-26-6	12-2-8
	IVH-7	5-5-8	5-26-8	12-6-8
	IVJ-7	5-5-10	5-26-10	12-3-8
	IVK-7	5-5-12	5-26-12	12-7-8
	IVA-8	5-6-2	5-27-2	12-4-8
	IVB-8	5-6-4	5-27-4	12-8-8

	Patchboard IV Sector:	Terminals		Module Chassis - Position - Pin
	IVA-1	5-1-1	5-17-1	9-1-7
	IVB-1	5-1-3	5-17-3	9-5-7
	IVC-1	5-1-5	5-17-5	9-2-7
	IVD-1	5-1-7	5-17-7	9-6-7
	IVE-1	5-1-9	5-17-9	9-3-7
	IVF-1	5-1-11	5-17-11	9-7-7
	IVG-1	5-2-1	5-18-1	9-4-7
	IVH-1	5-2-3	5-18-3	9-8-7
	IVJ-1	5-2-5	5-20-1	10-1-7
	IVK-1	5-2-7	5-20-3	10-5-7
	IVA-2	5-2-9	5-20-5	10-2-7
	IVB-2	5-2-11	5-20-7	10-6-7
	IVC-2	5-3-1	5-20-9	10-3-6
	IVD-2	5-3-3	5-20-11	10-7-7
Inputs	IVE-2	5-3-5	5-21-1	10-4-7
	IVF-2	5-3-7	5-21-3	10-8-7
	IVG-2	5-3-9	5-23-1	11-1-7
	IVH-2	5-3-11	5-23-3	11-5-7
	IVJ-2	5-4-1	5-23-5	11-2-7
	IVK-2	5-4-3	5-23-7	11-6-7
	IVA-3	5-4-5	5-23-9	11-3-7
	IVB-3	5-4-7	5-23-11	11-7-7
	IVC-3	5-4-9	5-24-1	11-4-7
	IVD-3	5-4-11	5-24-3	11-8-7
	IVE-3	5-5-1	5-26-1	12-1-7
	IVF-3	5-5-3	5-26-3	12-5-7
	IVG-3	5-5-5	5-26-5	12-2-7
	IVH-3	5-5-7	5-26-7	12-6-7
	IVJ-3	5-5-9	5-26-9	12-3-7
	IVK-3	5-5-11	5-26-11	12-7-7
	IVA-4	5-6-1	5-27-1	12-4-7
	IVB-4	5-6-3	5-27-3	12-8-7

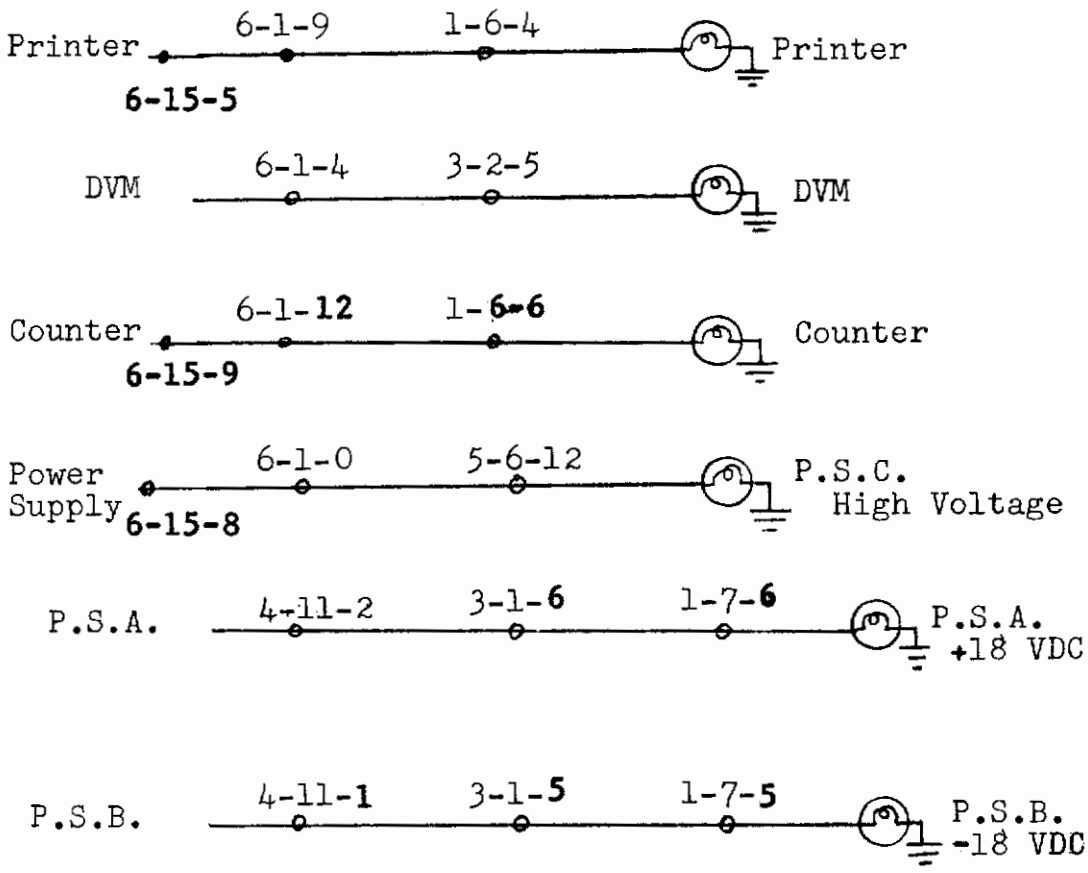


CONTROL BOX (A.C. POWER LINES) Cont.

See page 181

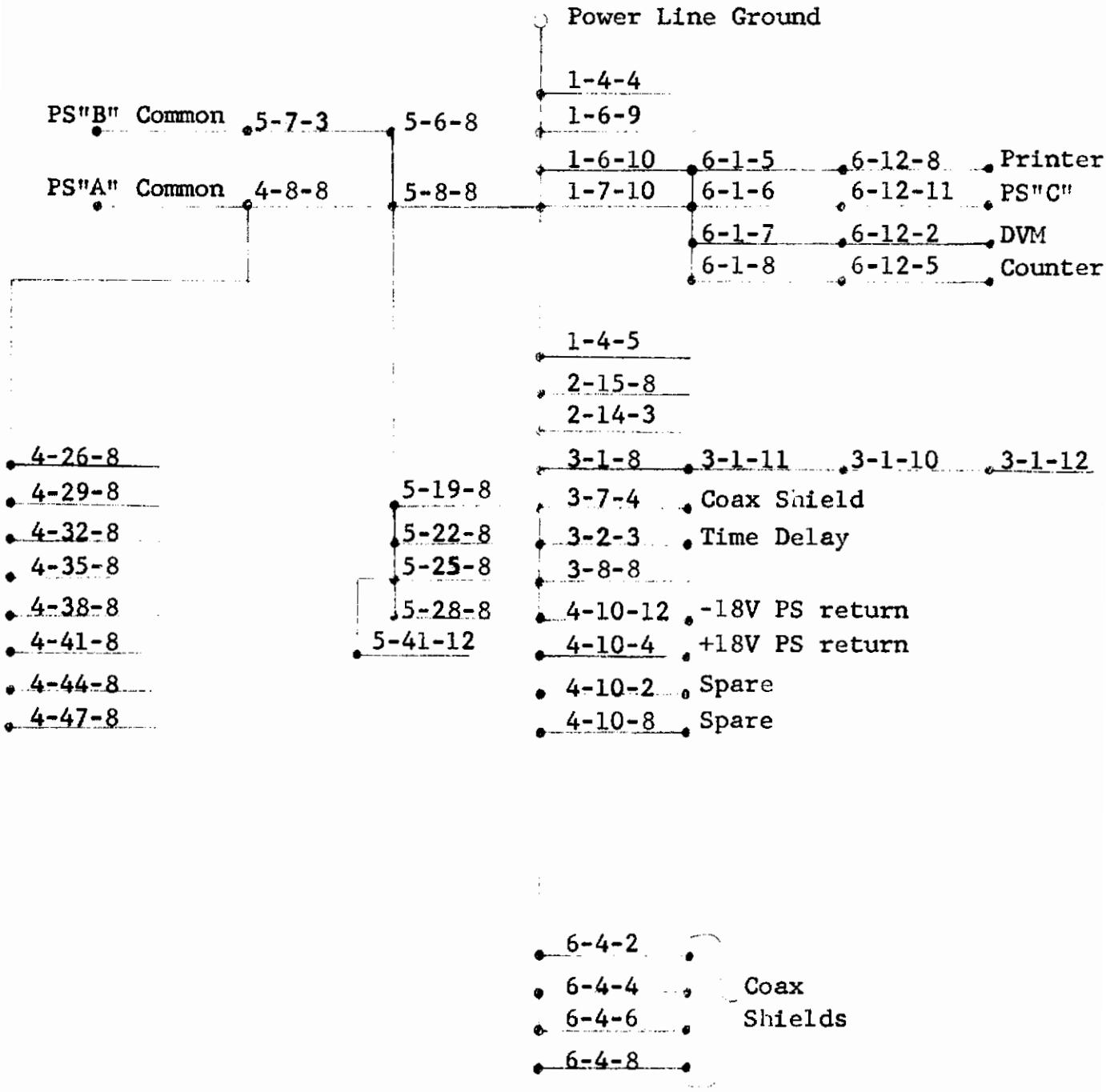


FUSE INDICATORS



Note: All indicators located in control box.

SYSTEM GROUND

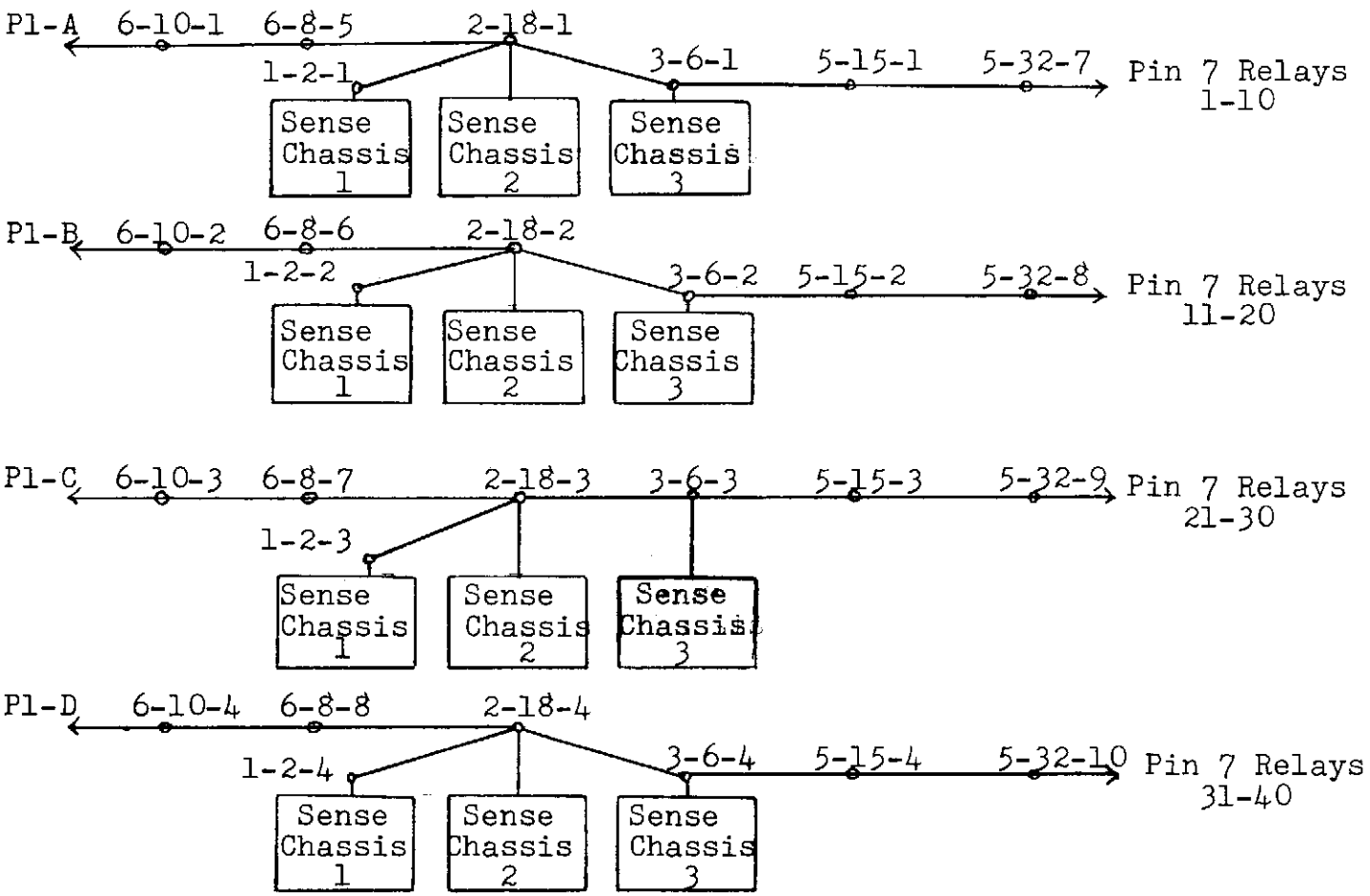


Printer Input Connectors: Wiring and Drive

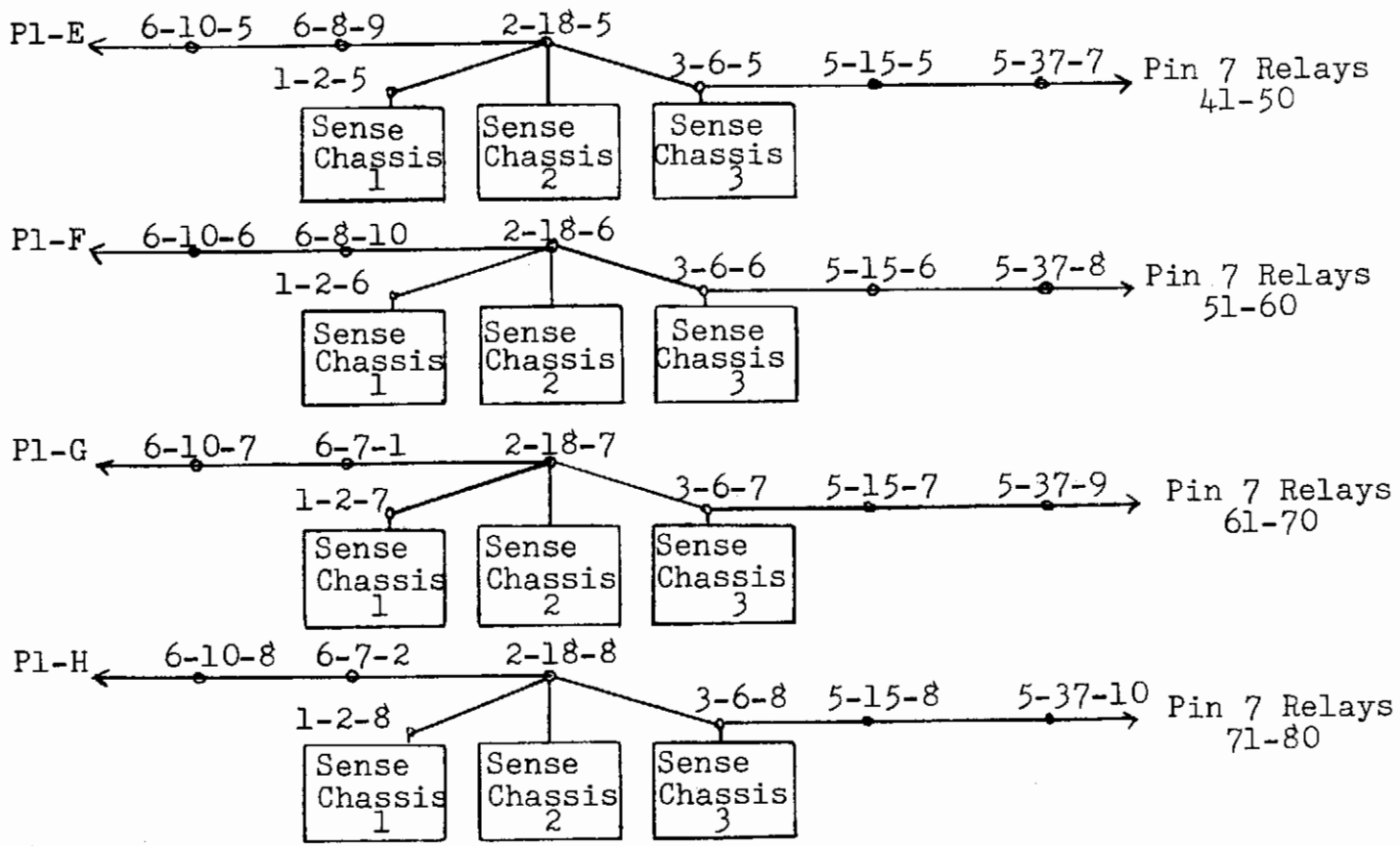
Connector*		Wire Color	Drive	
	A	Black	print wheel	0
	B	Brown	print wheel	1
	C	Red	print wheel	2
	D	Orange	print wheel	3
J1, J2, J3	E	Yellow	print wheel	4
	F	Green	print wheel	5
	G	Blue	print wheel	6
	H	Violet	print wheel	7
	I	Grey	print wheel	8
	J	White	print wheel	9
J1, J2	K	White-Blue-Pink	print wheel	--
J3	K	Black-White	print wheel	bias

* J1, J2, J3 are identical A-K connectors. Inputs connected at J1 print in column 10, inputs connected at J2 print in column 9, and inputs connected at J3 print in column 5.

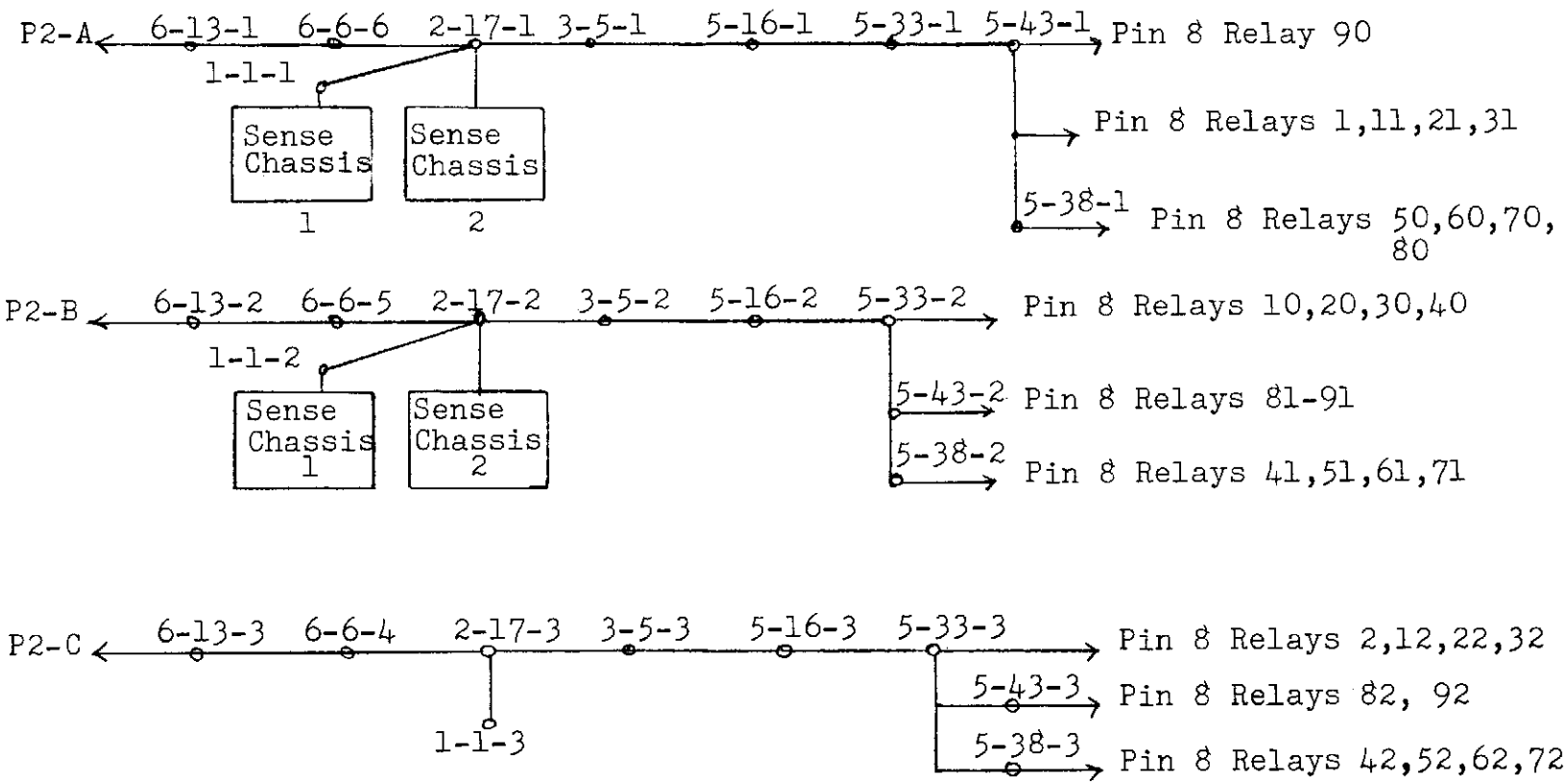
PRINT WHEEL DRIVE LINES



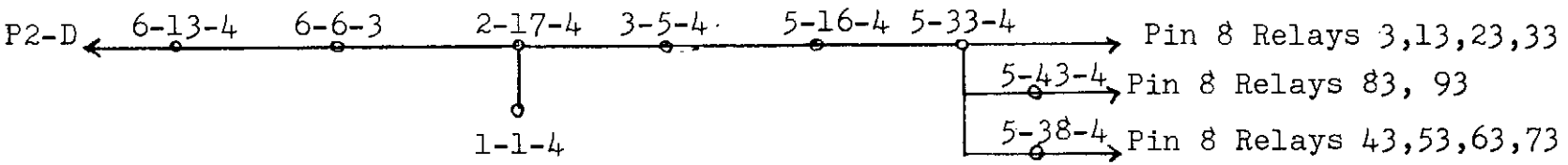
See Page 185A

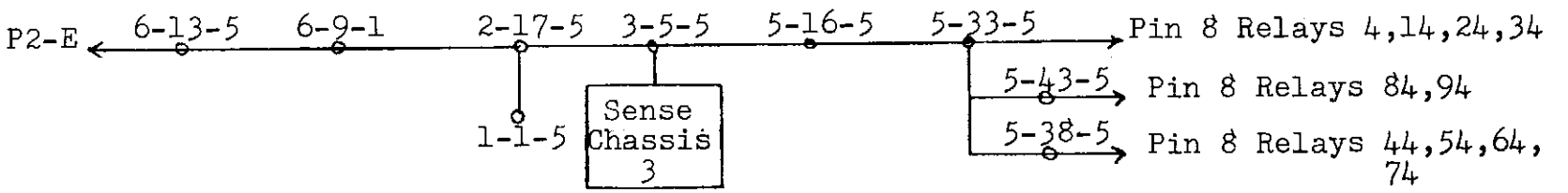


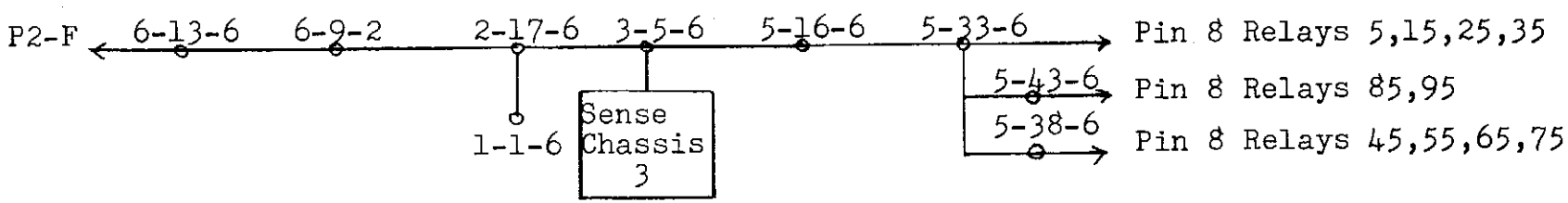
See Page 185



See Page 186A

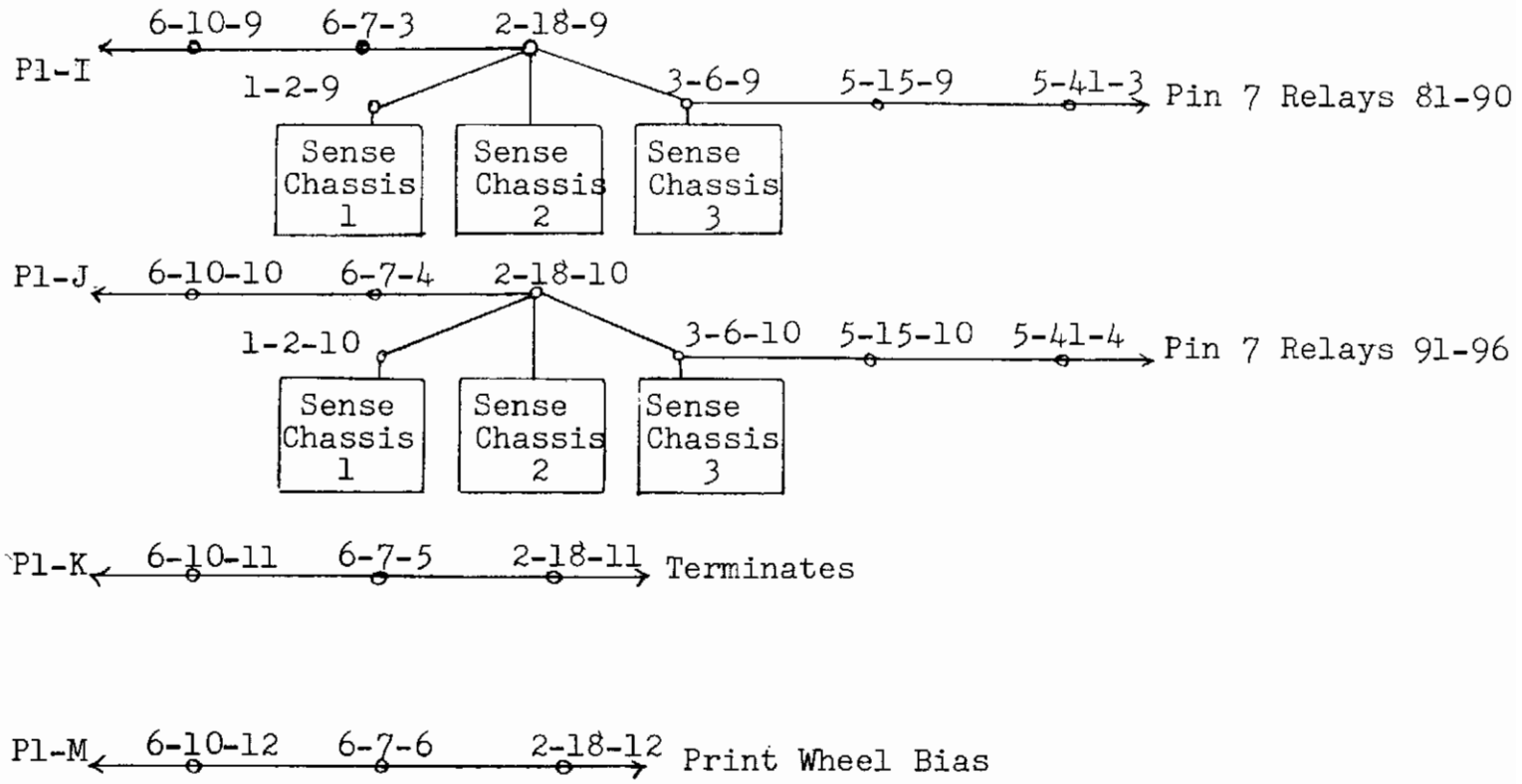




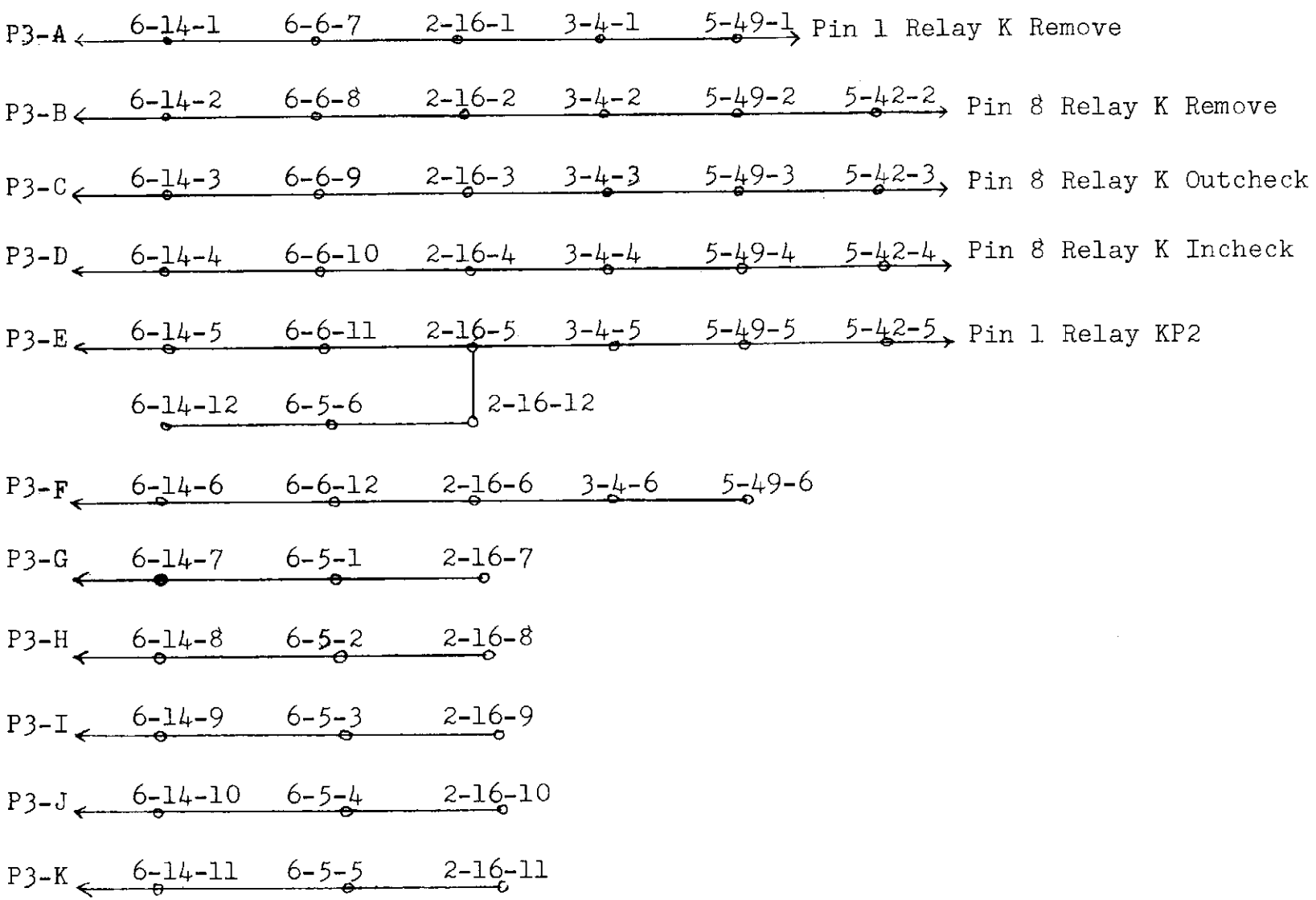


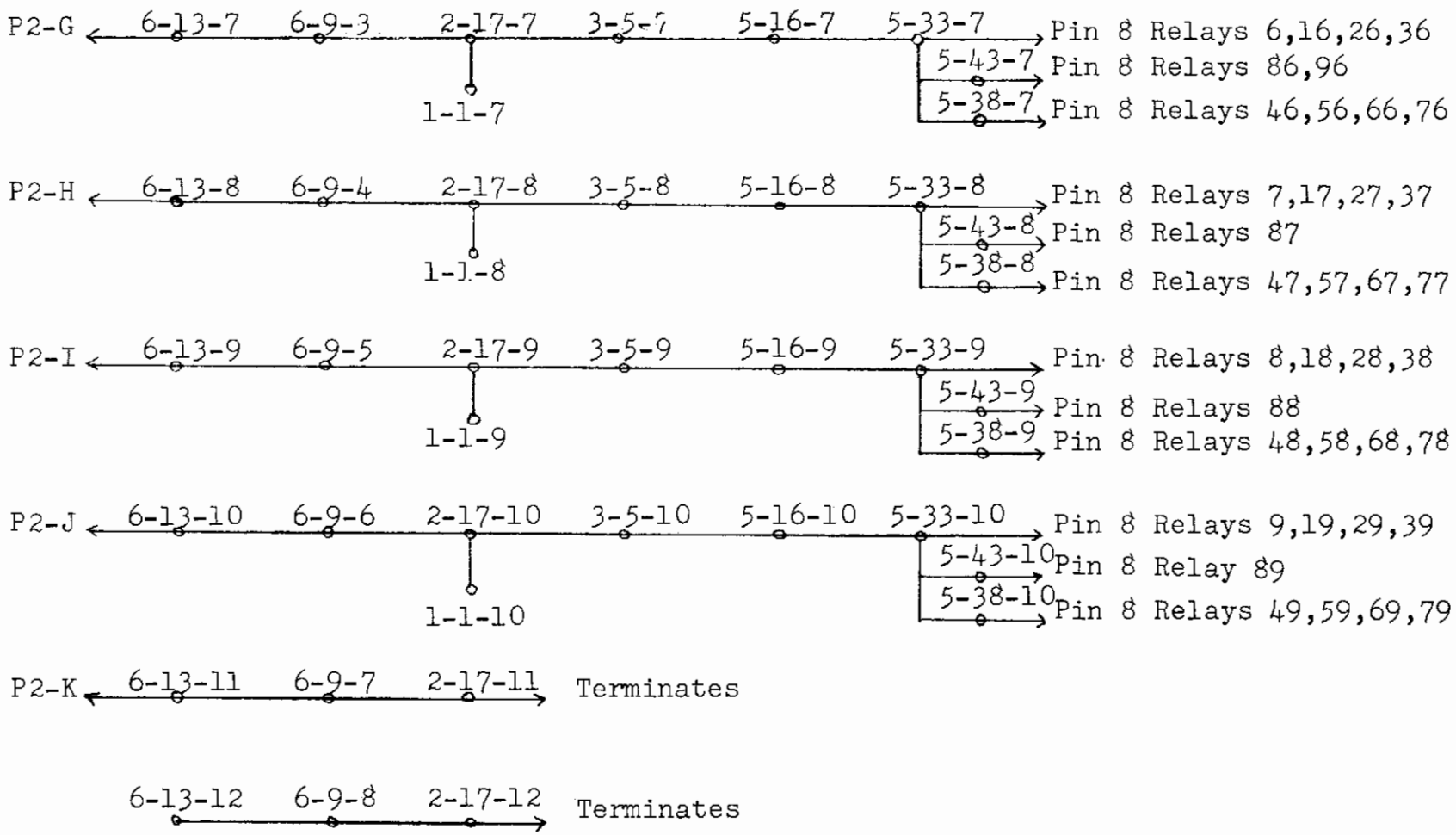
See Page 186

PRINT WHEEL DRIVE LINES Cont.

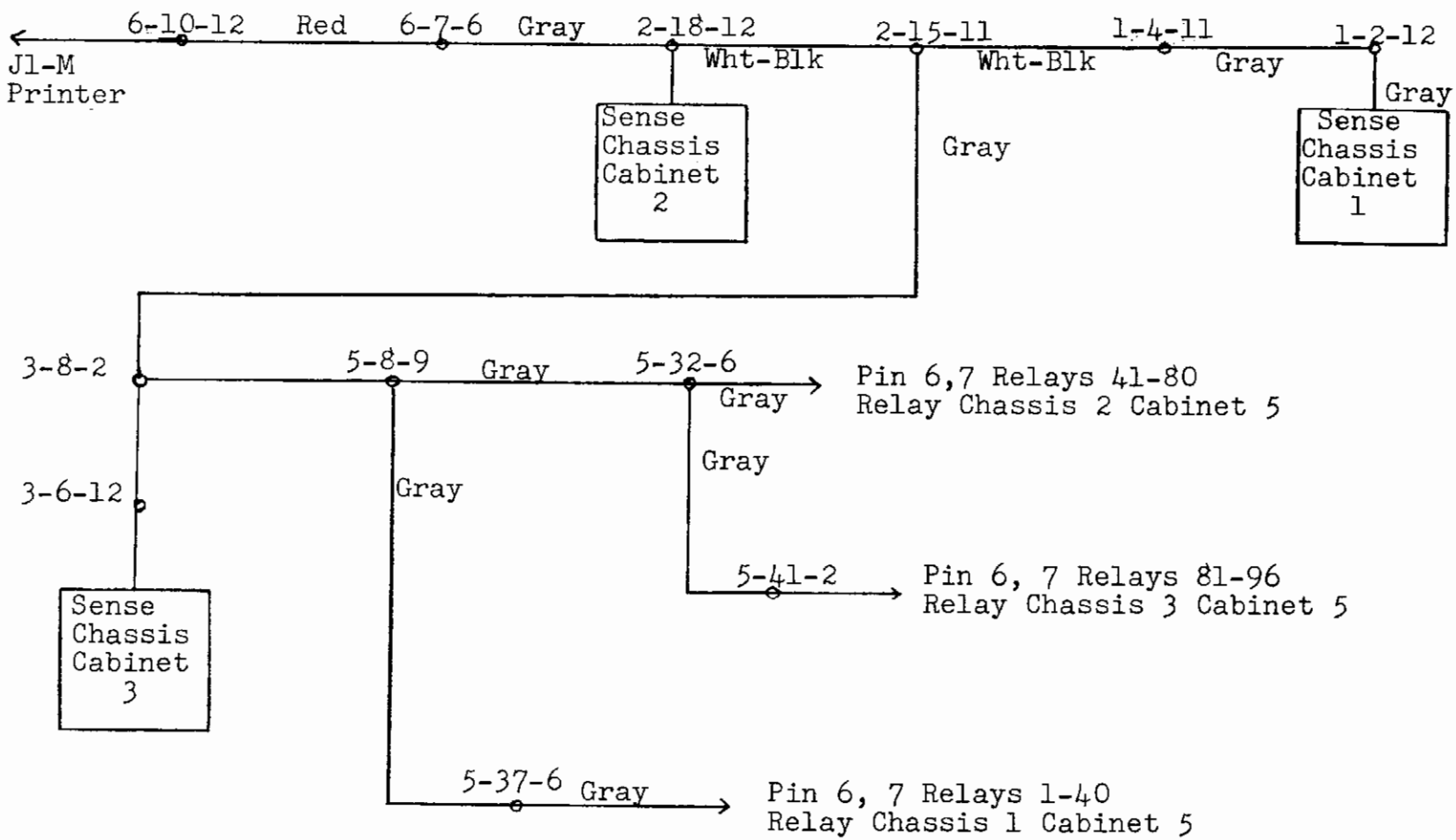


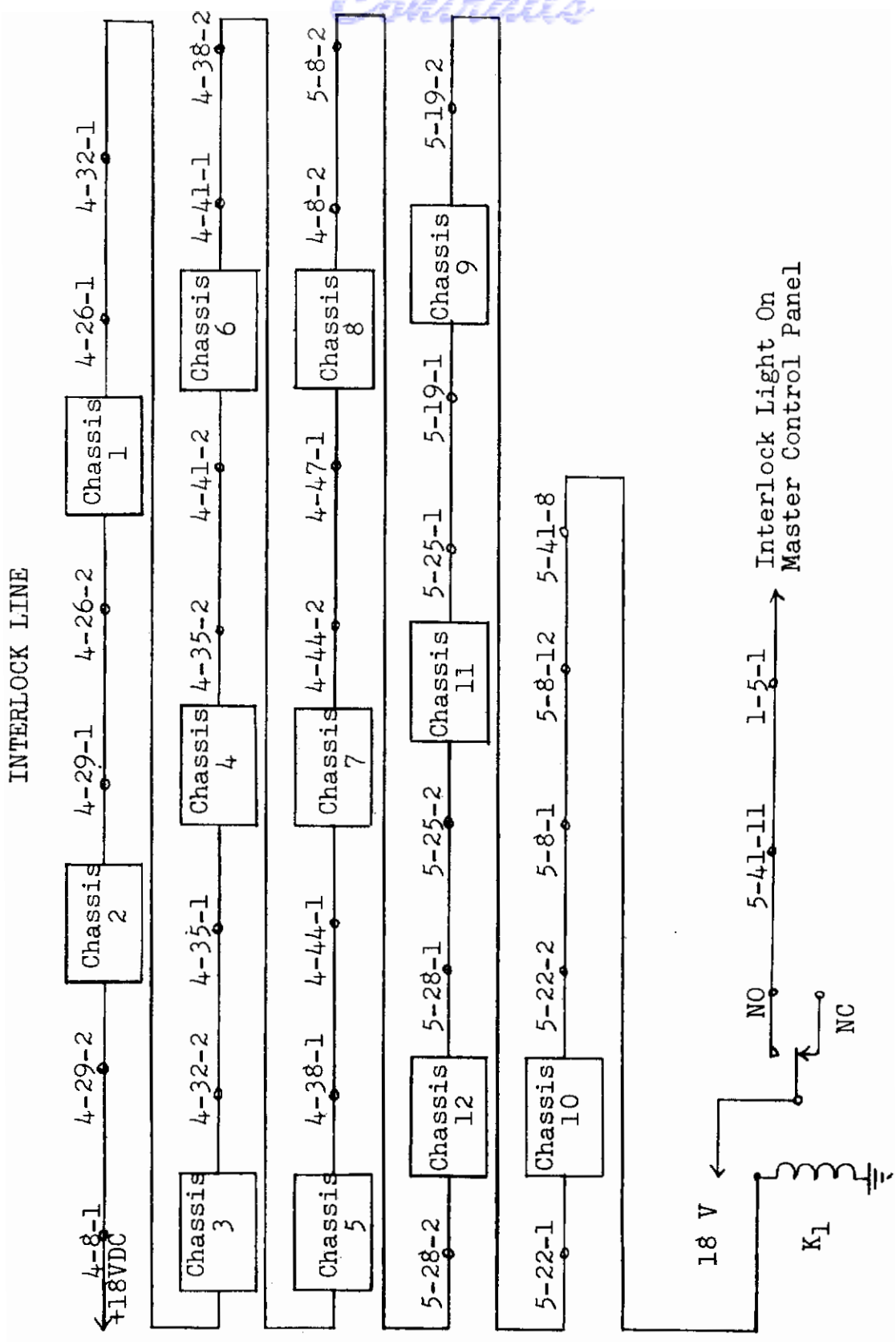
PRINTER LINES

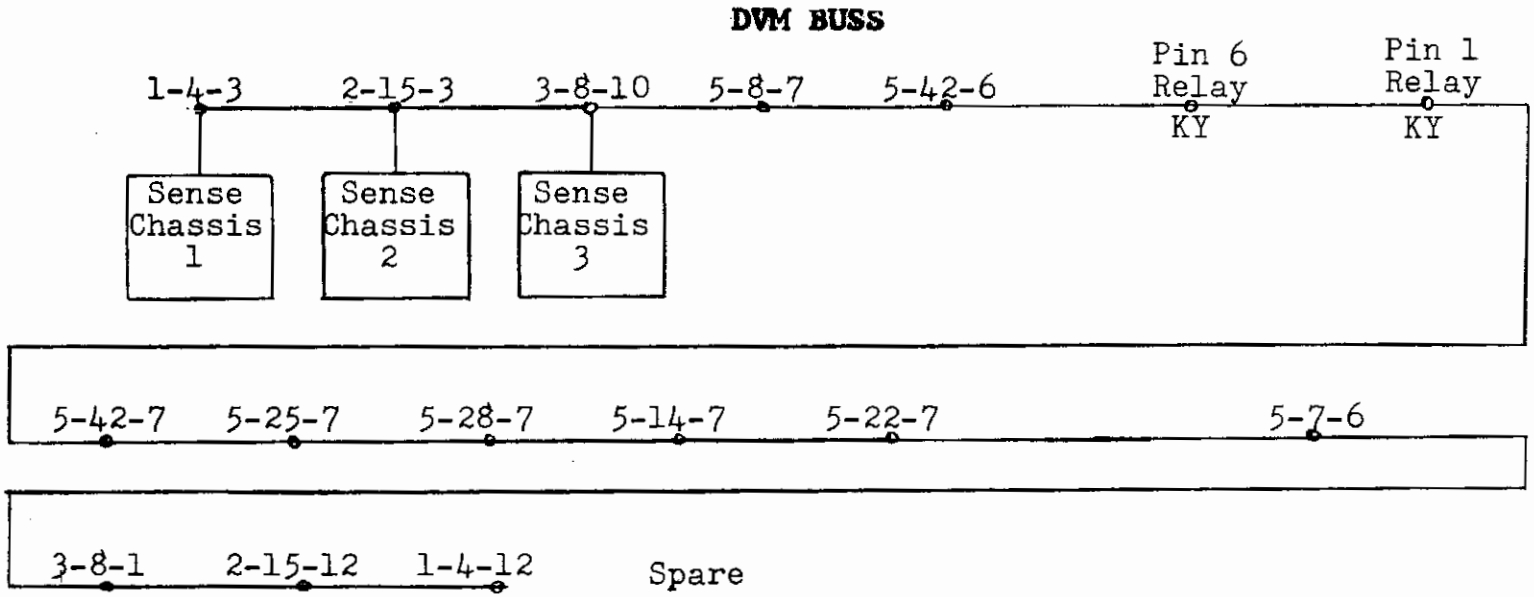




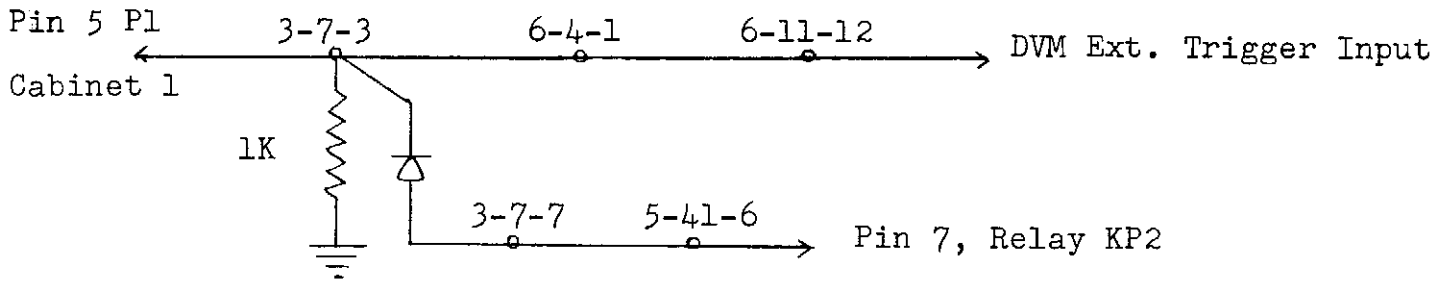
PRINT WHEEL BIAS



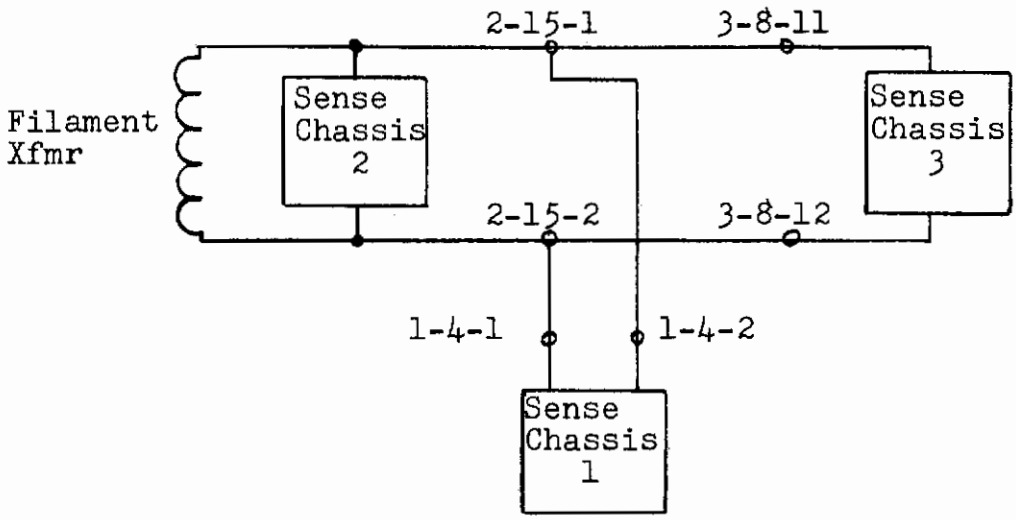




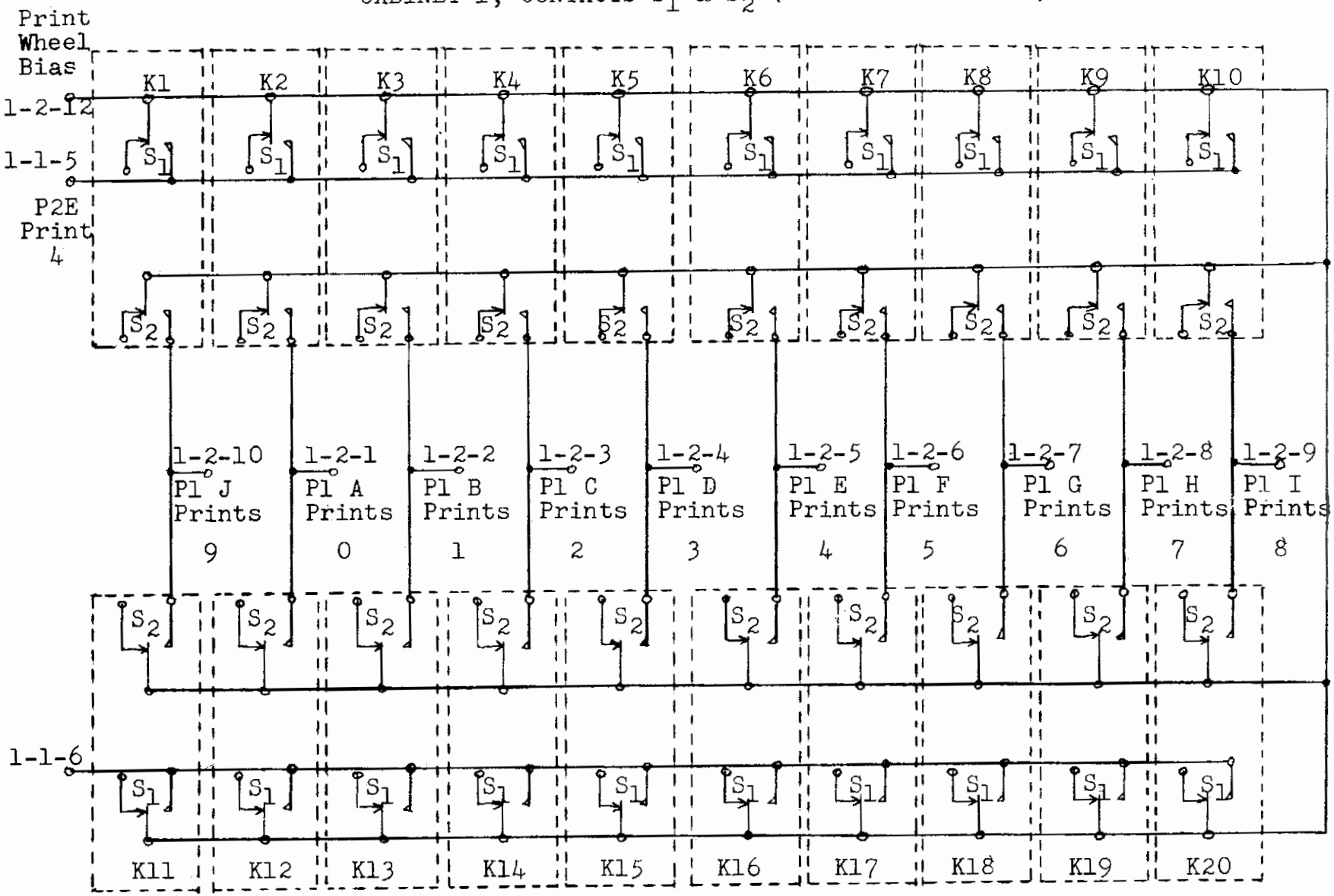
DVM TRIGGER (SAMPLE COMMAND)

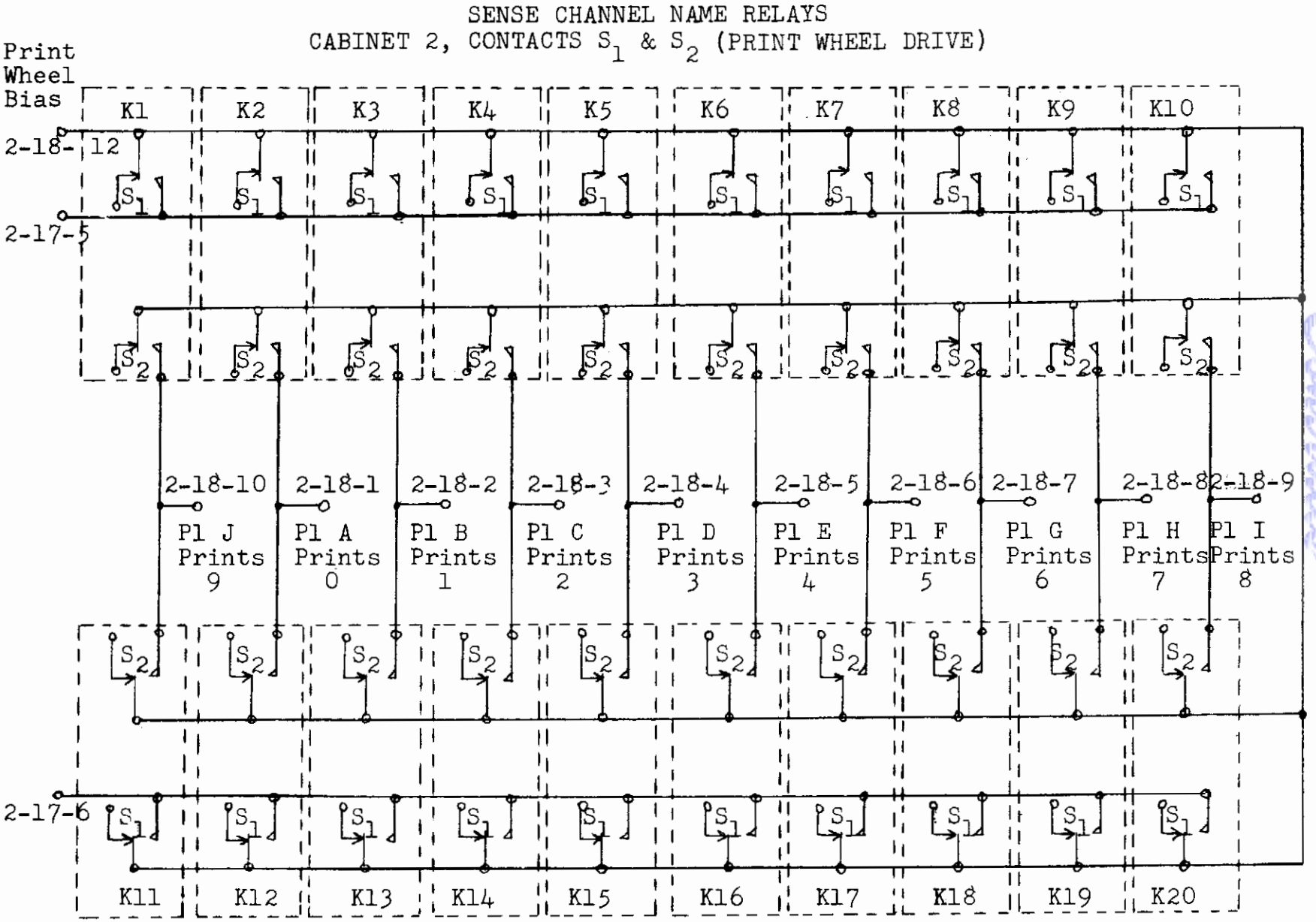


FILAMENTS



SENSE CHANNEL NAME RELAYS
CABINET 1, CONTACTS S_1 & S_2 (PRINT WHEEL DRIVE)





SENSE CHANNEL NAME RELAYS
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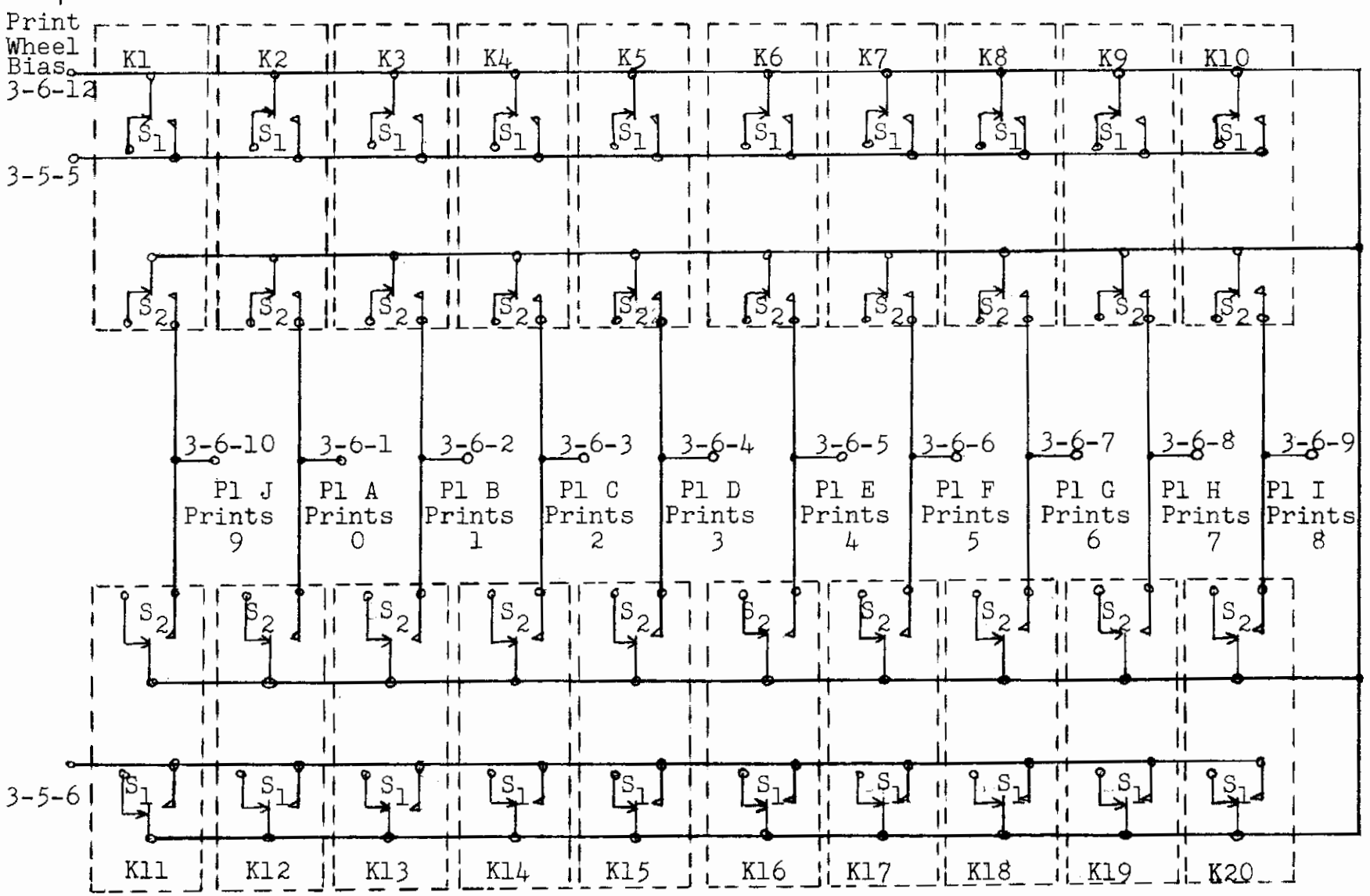
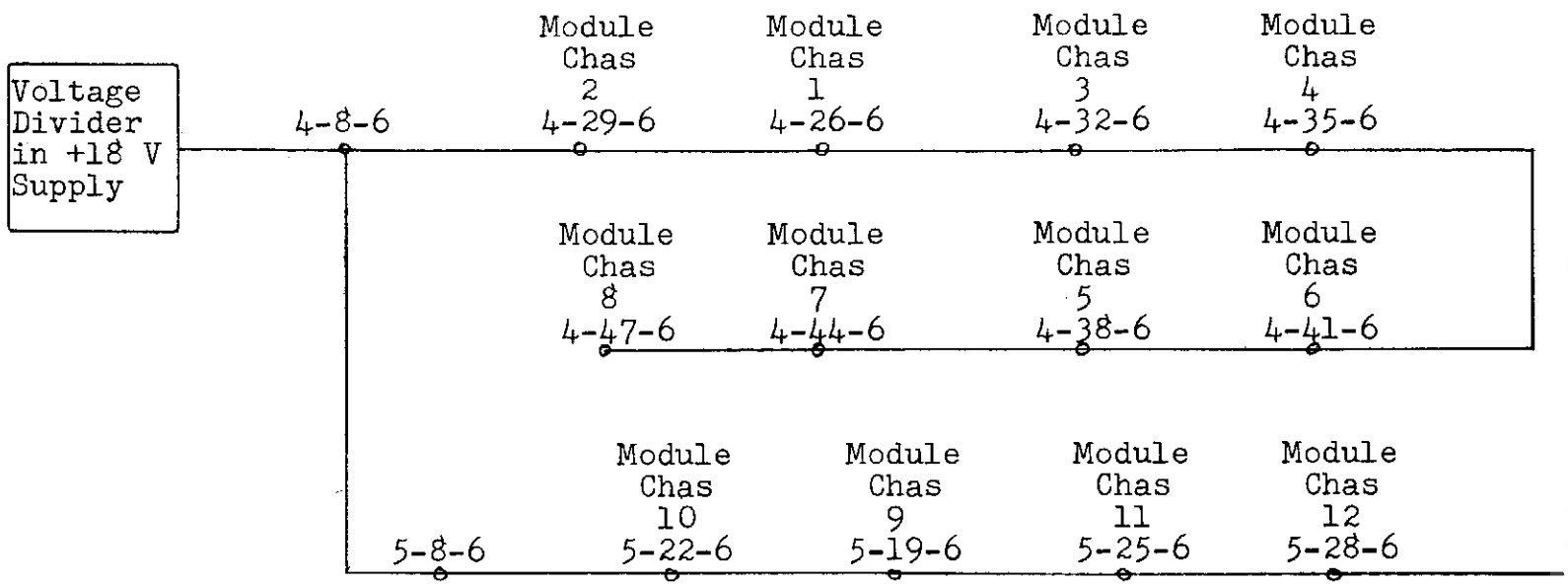
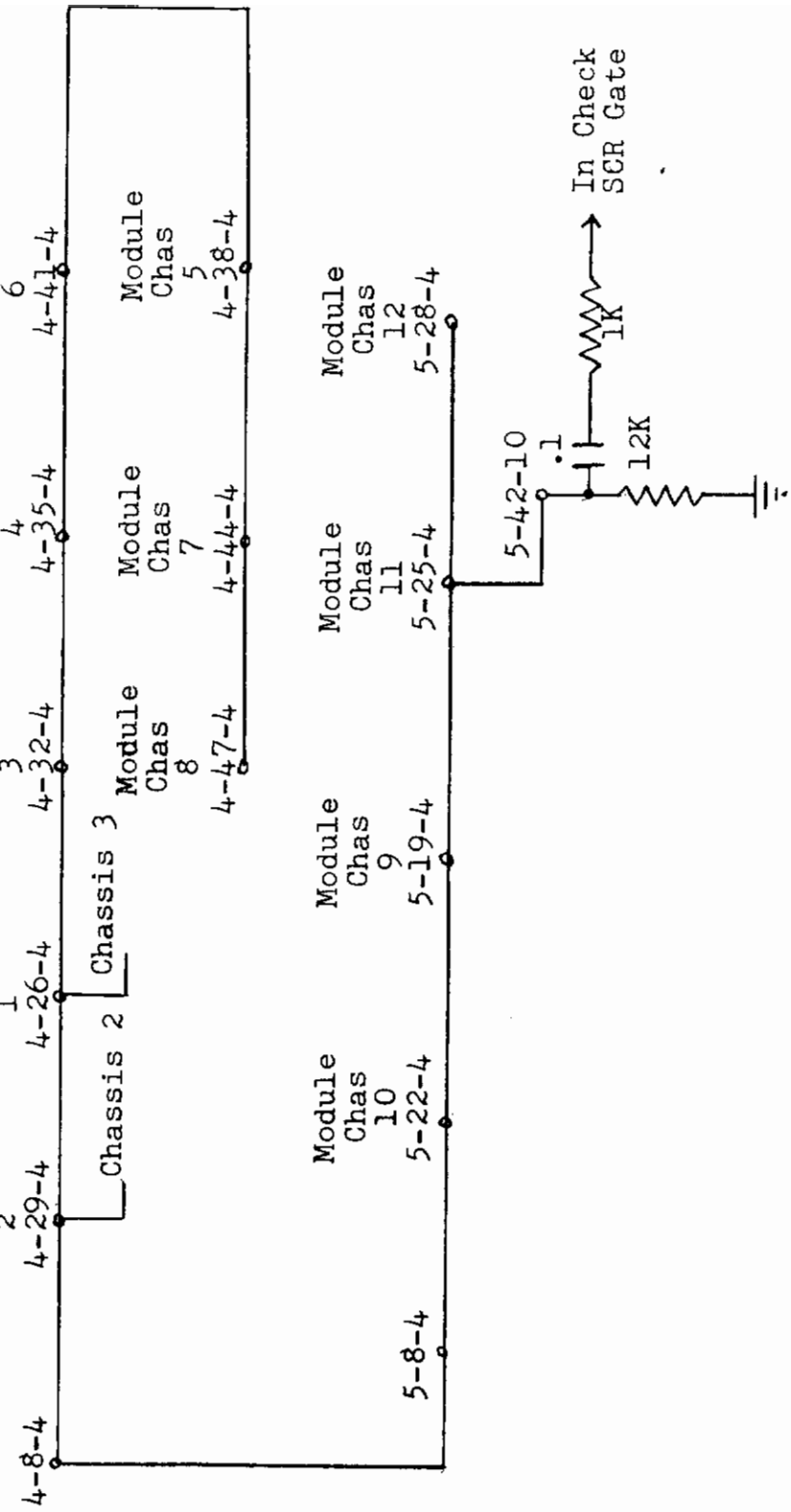


GATE SUPPLY (+5V)

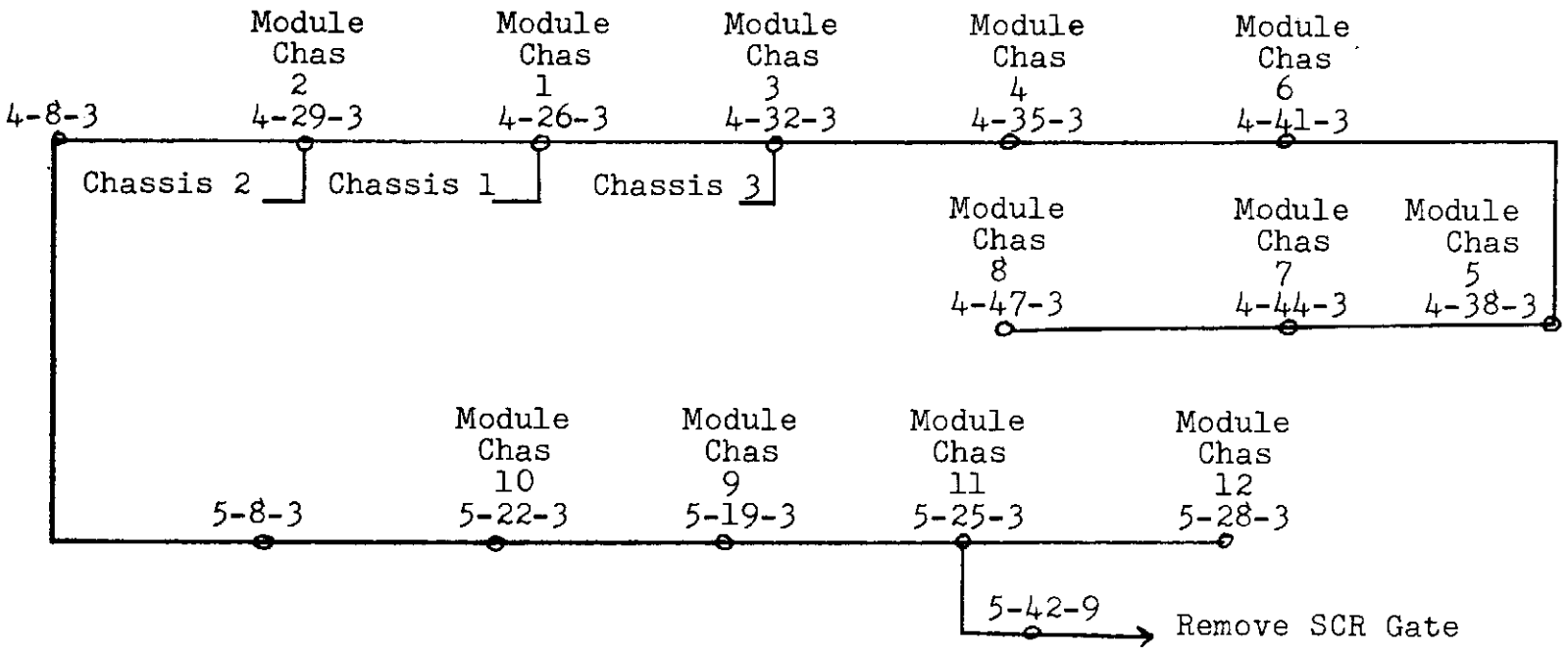


All wires go to Pin 5 on chassis positions

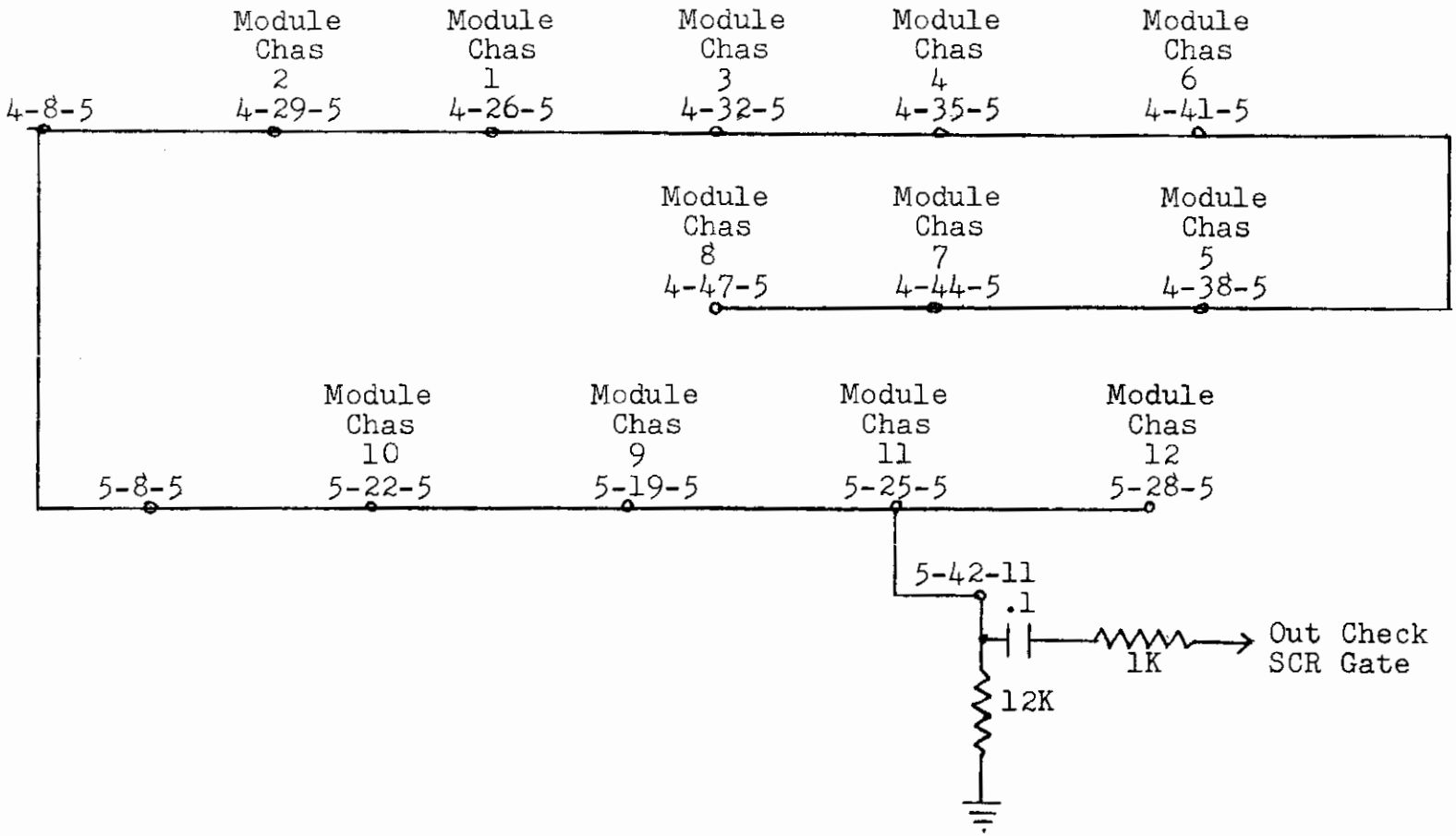
IN CHECK
WIRES GO TO PIN 3 ON CHASSIS POSITIONS



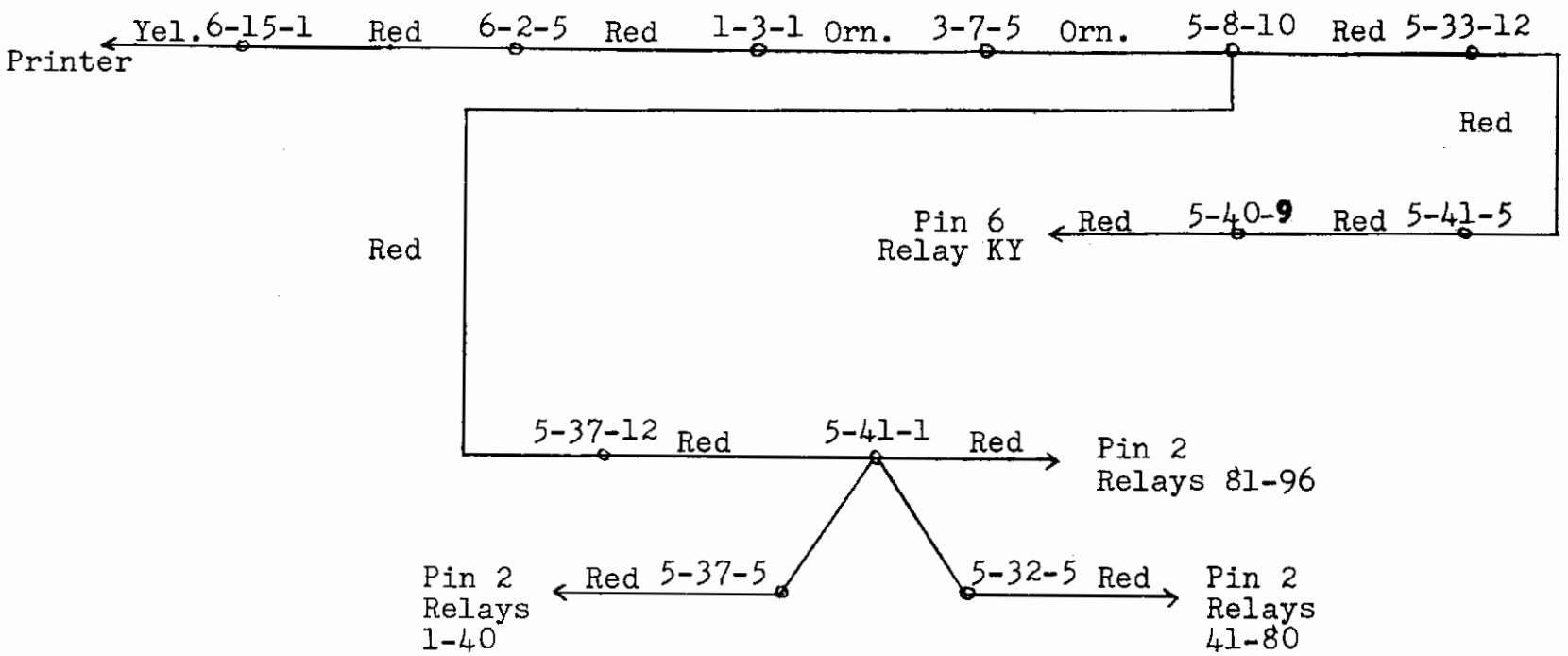
REMOVE BUSS



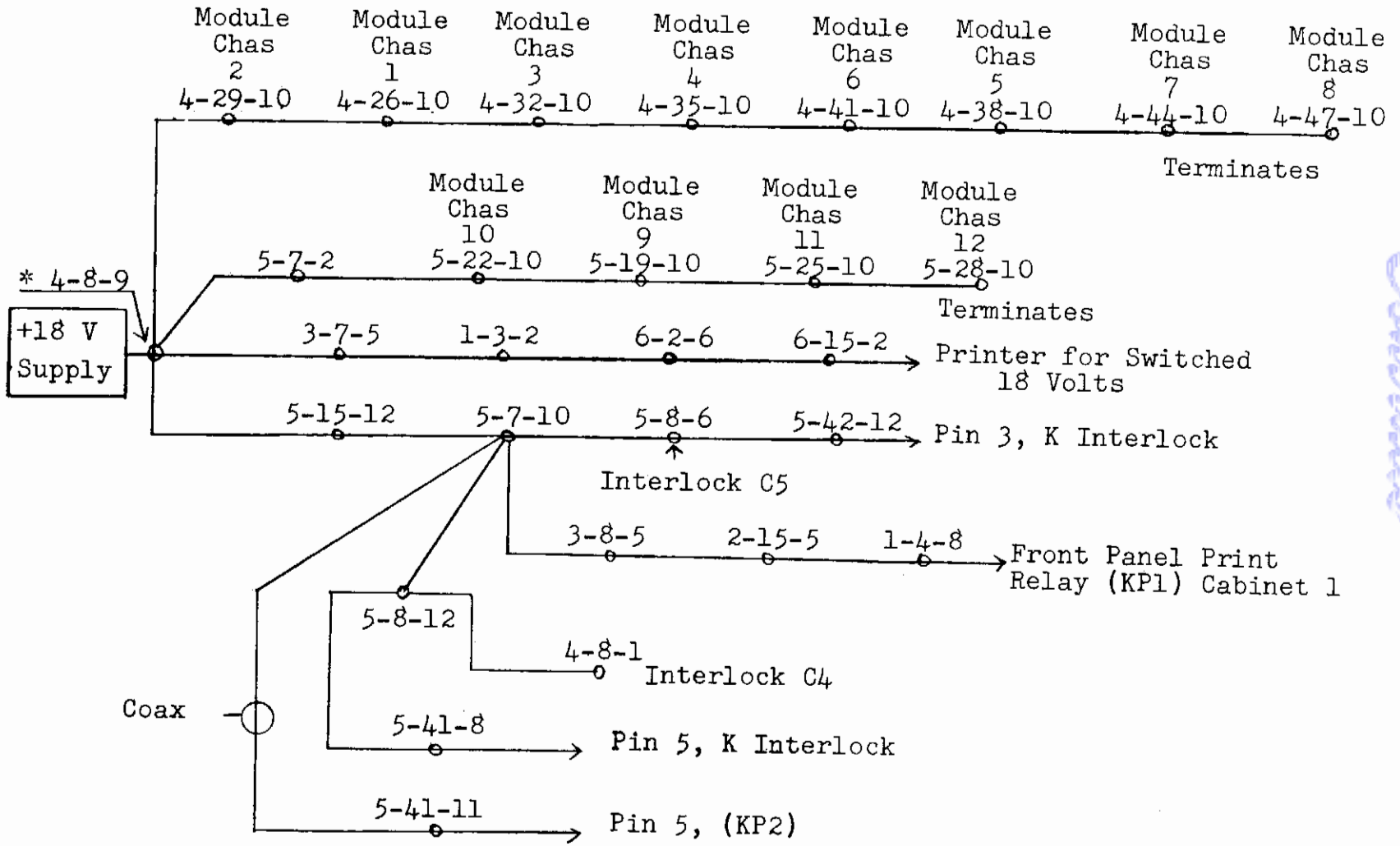
OUT CHECK
ALL WIRES GO TO PIN 3



SWITCHED +18 VOLTS

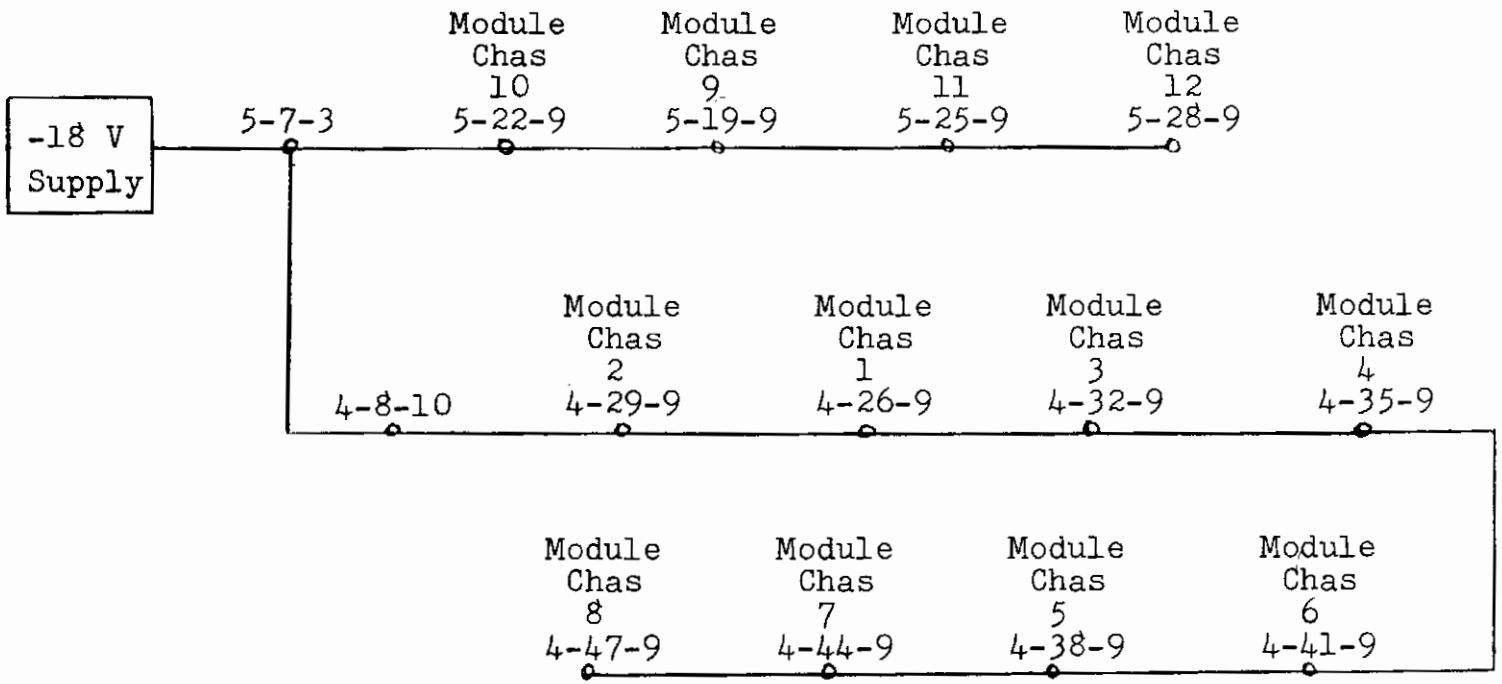


POSITIVE 18 VOLTS DC (ALL WIRES ORANGE)



* 4-8-9 Cabinet 4, Terminal Board 8, Point 9

NEGATIVE 18 VOLTS (ALL WIRES GRAY)



CIRCUIT MODULE NAME RELAY DRIVE (ALL WIRES ORANGE)

Pin 3 Relay Number					Module Chassis	Position
1	5-2-29-1*	5-9-1**	4-1-1**	4-25-5**	1	1
2	5-2-29-2	5-9-2	4-1-2	4-25-6	1	5
3	5-2-29-3	5-9-3	4-1-3	4-25-7	1	2
4	5-2-29-4	5-9-4	4-1-4	4-25-8	1	6
5	5-2-29-5	5-9-5	4-1-5	4-25-9	1	3
6	5-2-29-6	5-9-6	4-1-6	4-25-10	1	7
7	5-2-29-7	5-9-7	4-1-7	4-25-11	1	4
8	5-2-29-8	5-9-8	4-1-8	4-25-12	1	8
9	5-2-29-9	5-9-9	4-1-9	4-28-5	2	1
10	5-2-29-10	5-9-10	4-1-10	4-28-6	2	5
11	5-2-29-11	5-9-11	4-1-11	4-28-7	2	2
12	5-2-29-12	5-9-12	4-1-12	4-28-8	2	6
13	5-2-30-1	5-10-1	4-2-1	4-28-9	2	3
14	5-2-30-2	5-10-2	4-2-2	4-28-10	2	7
15	5-2-30-3	5-10-3	4-2-3	4-28-11	2	4
16	5-2-30-4	5-10-4	4-2-4	4-28-12	2	8
17	5-2-30-5	5-10-5	4-2-5	4-31-5	3	1
18	5-2-30-6	5-10-6	4-2-6	4-31-6	3	5
19	5-2-30-7	5-10-7	4-2-7	4-31-7	3	2
20	5-2-30-8	5-10-8	4-2-8	4-31-8	3	6
21	5-2-30-9	5-10-9	4-2-9	4-31-9	3	3
22	5-2-30-10	5-10-10	4-2-10	4-31-10	3	7
23	5-2-30-11	5-10-11	4-2-11	4-31-11	3	4
24	5-2-30-12	5-10-12	4-2-12	4-31-12	3	8
25	5-2-31-1	5-11-1	4-3-1	4-34-5	4	1
26	5-2-31-2	5-11-2	4-3-2	4-34-6	4	5
27	5-2-31-3	5-11-3	4-3-3	4-34-7	4	2
28	5-2-31-4	5-11-4	4-3-4	4-34-8	4	6
29	5-2-31-5	5-11-5	4-3-5	4-34-9	4	3
30	5-2-31-6	5-11-6	4-3-6	4-34-10	4	7
31	5-2-31-7	5-11-7	4-3-7	4-34-11	4	4
32	5-2-31-8	5-11-8	4-3-8	4-34-12	4	8

* Cabinet-Relay Chassis No.-Terminal Strip No.-Terminal No.

** Cabinet-Terminal Strip No.-Terminal No.

Pin 3 Relay Number					Module Chassis	Position
33	5-2-31-9*	5-11-9**	4-3-9**	4-37-5**	5	1
34	5-2-31-10	5-11-10	4-3-10	4-37-6	5	5
35	5-2-31-11	5-11-11	4-3-11	4-37-7	5	2
36	5-2-31-12	5-11-12	4-3-12	4-37-8	5	6
37	5-2-32-1	5-12-1	4-4-1	4-37-9	5	3
38	5-2-32-2	5-12-2	4-4-2	4-37-10	5	7
39	5-2-32-3	5-12-3	4-4-3	4-37-11	5	4
40	5-2-32-4	5-12-4	4-4-4	4-37-12	5	8
41	5-1-34-1	5-12-5	4-4-5	4-40-5	6	1
42	5-1-34-2	5-12-6	4-4-6	4-40-6	6	5
43	5-1-34-3	5-12-7	4-4-7	4-40-7	6	2
44	5-1-34-4	5-12-8	4-4-8	4-40-8	6	6
45	5-1-34-5	5-12-9	4-4-9	4-40-9	6	3
46	5-1-34-6	5-12-10	4-4-10	4-40-10	6	7
47	5-1-34-7	5-12-11	4-4-11	4-40-11	6	4
48	5-1-34-8	5-12-12	4-4-12	4-40-12	6	8
49	5-1-34-9	5-13-1	4-5-1	4-43-5	7	1
50	5-1-34-10	5-13-2	4-5-2	4-43-6	7	5
51	5-1-34-11	5-13-3	4-5-3	4-43-7	7	2
52	5-1-34-12	5-13-4	4-5-4	4-43-8	7	6
53	5-1-35-1	5-13-5	4-5-5	4-43-9	7	3
54	5-1-35-2	5-13-6	4-5-6	4-43-10	7	7
55	5-1-35-3	5-13-7	4-5-7	4-43-11	7	4
56	5-1-35-4	5-13-8	4-5-8	4-43-12	7	8
57	5-1-35-5	5-13-9	4-5-9	4-46-5	8	1
58	5-1-35-6	5-13-10	4-5-10	4-8-46-6	8	5
59	5-1-35-7	5-13-11	4-5-11	4-8-46-7	8	2
60	5-1-35-8	5-13-12	4-5-12	4-8-46-8	8	6
61	5-1-35-9	5-14-1	4-6-1	4-8-46-9	8	3
62	5-1-35-10	5-14-2	4-6-2	4-8-46-10	8	7
63	5-1-35-11	5-14-3	4-6-3	4-8-46-11	8	4
64	5-1-35-12	5-14-4	4-6-4	4-8-46-12	8	8

* Cabinet-Relay Chassis No.-Terminal Strip N -Terminal No

** Cabinet-Terminal Strip No.-Terminal No.

Pin 3 Relay Number			Module Chassis	Position
65	5-1-36-1*	5-12-27-5**	12	1
66	5-1-36-2	5-12-27-6	12	5
67	5-1-36-3	5-12-27-7	12	2
68	5-1-36-4	5-12-27-8	12	6
69	5-1-36-5	5-12-27-9	12	3
70	5-1-36-6	5-12-27-10	12	7
71	5-1-36-7	5-12-27-11	12	4
72	5-1-36-8	5-12-27-12	12	8
73	5-1-36-9	5-10-21-5	10	1
74	5-1-36-10	5-10-21-6	10	5
75	5-1-36-11	5-10-21-7	10	2
76	5-1-36-12	5-10-21-8	10	6
77	5-1-37-1	5-10-21-9	10	3
78	5-1-37-2	5-10-21-10	10	7
79	5-1-37-3	5-10-21-11	10	4
80	5-1-37-4	5-10-21-12	10	8
81	5-3-39-1	5-9-18-5	9	1
82	5-3-39-2	5-9-18-6	9	5
83	5-3-39-3	5-9-18-7	9	2
84	5-3-39-4	5-9-18-9	9	6
85	5-3-39-5	5-9-18-9	9	3
86	5-3-39-6	5-9-18-10	9	7
87	5-3-39-7	5-9-18-11	9	4
88	5-3-39-8	5-9-18-12	9	8
89	5-3-39-9	5-11-24-5	11	1
90	5-3-39-10	5-11-24-6	11	5
91	5-3-39-11	5-11-24-7	11	2
92	5-3-39-12	5-11-24-8	11	6
93	5-3-40-1	5-11-24-9	11	3
94	5-3-40-2	5-11-24-10	11	7
95	5-3-40-3	5-11-24-11	11	8
96	5-3-40-4	5-11-24-12	11	8

* Cabinet-Relay Chassis No.-Terminal Strip No.-Terminal No.

** Cabinet-Terminal Strip No.-Terminal No.

APPENDIX I

CIRCUIT MODULE LOCATION AND TERMINATION

CIRCUIT MODULE LOCATION AND TERMINATION

Location	Input	Output	Number
1-1	II A1	II A8	70
2	II C1	II C8	30
3	II E1	II E8	50
4	II G1	II G8	10
5	II B1	II B8	20
6	II D1	II D8	40
7	II F1	II F8	60
8	II H1	II H8	80
2-1	II J1	II J8	90
2	II A2	II A9	71
3	II C2	II C9	31
4	II E2	II E9	51
5	II K1	II K8	00
6	II B2	II B9	21
7	II D2	II D9	41
8	II F2	II F9	61
3-1	II G2	II G9	11
2	II J2	II J9	91
3	II A3	II A10	32
4	II C3	II C10	72
5	II H2	II H9	81
6	II K2	II K9	01
7	II B3	II B10	22
8	II D3	II D10	42
4-1	II E3	II E10	52
2	II G3	II G10	12
3	II J3	II J10	92
4	II A4	II A11	73
5	II F3	II F10	62
6	II H3	II H10	82
7	II K3	II K10	02
8	II B4	II B11	23
5-1	II C4	II C11	53
2	II E4	II E11	33
3	II G4	II G11	13
4	II J4	II J11	93
5	II D4	II D11	43
6	II F4	II F11	63
7	II H4	II H11	83
8	II K4	II K11	03
6-1	II A5	II A12	74
2	II C5	II C12	34
3	II E5	II E12	54
4	II G5	II G12	14
5	II B5	II B12	24
6	II D5	II D12	44
7	II F5	II F12	64
8	II H5	II H12	84

Location	Input	Output	Number
7-1	II J5	II J12	94
2	II A6	II A13	75
3	II C6	II C13	35
4	II E6	II E13	55
5	II K5	II K12	04
6	II B6	II B13	25
7	II D6	II D13	45
8	II F6	II F13	65
8-1	II G6	II G13	15
2	II J6	II J13	95
3	II A7	II A14	76
4	II C7	II C14	36
5	II H6	II H13	[illegible]
6	II K6	II K13	05
7	II B7	II B14	26
8	II D7	II D14	46
9-1	IV A1 IV A9	IV A5	78
2	IV C1 IV B9	IV C5	38
3	IV E1 IV C9	IV E5	58
4	IV G1 IV D9	IV G5	18
5	IV B1 IV E9	IV B5	28
6	IV D1 IV F9	IV D5	48
7	IV F1 IV G9	IV F5	68
8	IV H1 IV H9	IV H5	88
10-1	IV J1 IV J9	IV J5	37
2	IV A2 IV K9	IV A6	57
3	IV A10		
4	IV E2 IV B10	IV E6	97
5	IV K1 IV C10	IV K5	47
6	IV B2 IV D10	IV B6	67
7	IV D2 IV E10	IV D6	87
8	IV F2 IV F10	IV F6	07
11-1	IV G2 IV G10	IV G6	98
2	IV J2 IV H10	IV J6	79
3	IV A3 IV J10	IV A7	39

Location	Input	Output	Number
4	IV C3 IV K10	IV C7	59
5	IV H2 IV A11	IV H6	08
6	IV K2 IV B11	IV K6	29
7	IV B3 IV C11	IV B7	49
8	IV D3 IV D11	IV D7	69
12-1	IV E3 IV E11	IV E7	56
2	IV G3 IV F11	IV G7	16
3	IV J3 IV G11	IV J7	96
4	IV A4 IV H11	IV A8	77
5	IV F3 IV J11	IV F7	66
6	IV H3 IV K11	IV H7	86
7	IV K3 IV A12	IV K7	06
8	IV B4 IV B12	IV B8	27

APPENDIX II

Circuit Module Construction Notes

1. Use mica insulating washers and silicon grease on all power semiconductors.

2. Wire with No. 26 stranded wire, colors 1 through 10.

3. Connect jumpers and leads to bottom hole in terminal strips and components in upper slots.

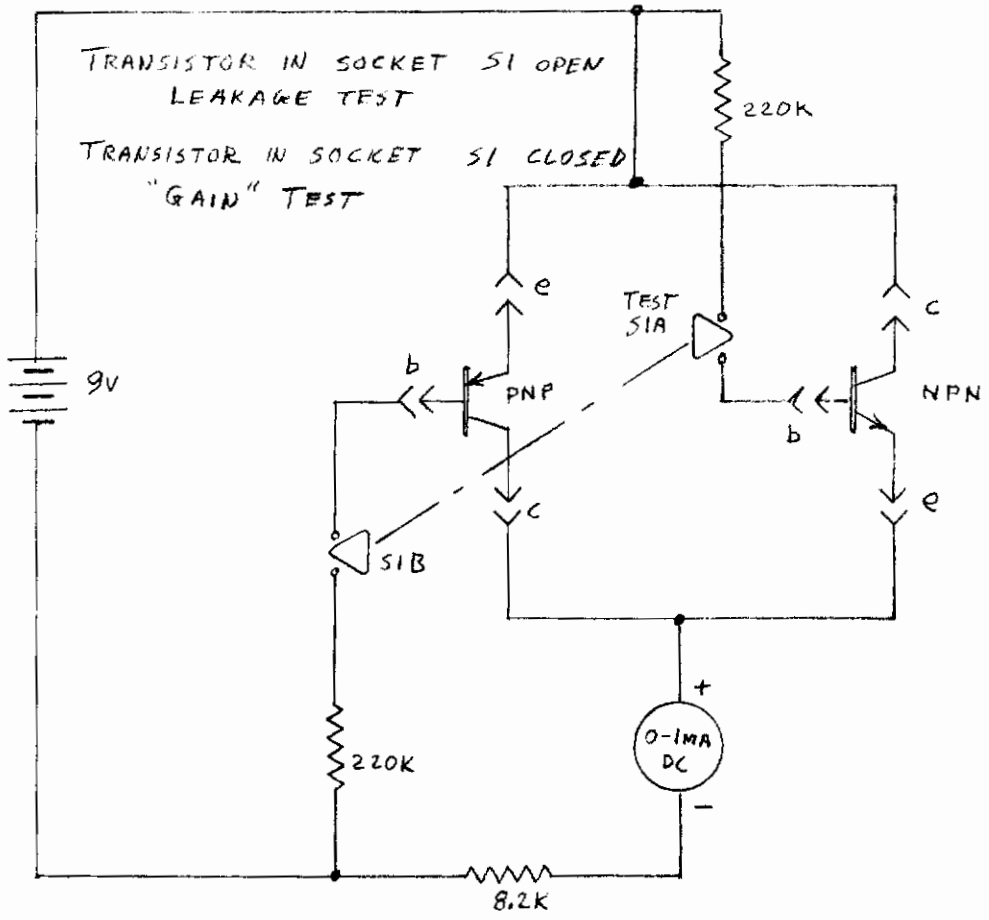
4. Test all semiconductors for gain and leadage.

5. Do not overheat semiconductor leads when soldering. Use a tweezer heat sink and a small iron or both.

6. Note selected components in modules 300 and 1700. Unijunction transistors may also have to be selected.

7. Be sure that lead length between connector in module and module front panel and circuit boards mounted on module back plate is long enough to permit the back plate to lie flat for maintenance. Also be sure that jumpers between circuit boards on module back plate permit complete separation of circuit boards for maintenance. To distribute lead flexion along the length of the wire, loose tying is preferable to cabling of bundles of leads and jumpers. However, if some form of tying is not done, reassembly of modules is most inconvenient and leads will certainly be pinched between the module and the back plate on reassembly.

8. Use a threaded spacer between terminal board nearest module back plate and the back plate. This will reduce the loss of screws and ease reinstallation of circuit board on back plate during maintenance.



Type	LEAKAGE	GAIN
2N706 NPN	≤ 0.05	≥ 0.35
2N2614 PNP	≤ 0.18	≥ 0.50
2N3638 PNP	< 0.05	≥ 0.55

TRANSISTOR PRE-SELECTION
TEST CIRCUIT

APPENDIX III

PARTS LISTS

ITEM NO	SYMBOL	MFR	REQ'D	DESCRIPTION	CAT. NO.
1	C101,103	AEROVOX	2	CAPACITOR, 0.1 MFD, 150V, MYLAR	V146XR-7
2	C102,104	CRL	2	39 pFd, 500V, CERAMIC	ID-390
3	C105	SPRAGUE	1	200MFD @ 15V	TE 1164
4	C106	SPRAGUE	1	100MFD @ 25V	TE 1211
5	D101-103	GE	3	DIODE, SIGNAL	1N191
6	Q101-103	FAIRCHILD	3	TRANSISTOR, SWITCHING, SIL, PNP	2N3638
7	R101,114	OHMITE	2	RESISTOR, 3.9K, ½w, ±10%	
8	R102,103 108,110	OHMITE	4	820Ω, ½w, ±10%	
9	R104,109		2	100K, ½w ± 10%	
10	R105		1	RESISTOR, VARIABLE, 3.5K, 2w	CLU3521
11	R106,107		2	, 8.2K, ½w, ±10%	
12	R111		1	1K, ½w, ± 10%	
13	R112,113		2	1.8K, ½w, ± 10%	
14	R115,116		2	270Ω, ½w, ± 10%	
15	S101	AH&H	1	SWITCH, SPST	81015-AW
16	TB101, 102	ERIE	2	TERMINAL BOARD, 10 TERM	3976-205-2
17		H.H. SMITH	2	SPACER, ¼" OD, ¼" L, 6-32 CLEAR HOLE	2100
18			2	SPACER, ¼" OD, ¾" L, 6-32 CLEAR HOLE	2103
19		BIR	2	SCREW, 6-32 x 1¼", STEEL, CAD PLATE	
20		BIR	2	NUT, 6-32, STEEL, CAD PLATE	
21		BIR	2	LOCKWASHER, #6, STEEL, INT. TOOTH, CAD. PL	

Free Running, Variable Frequency Multivibrator, Module No. 100

Parts List

12/16/65 RAM/ A512ASA1003M

Item No.	Symbol	MFG.	Req.	Description	Cat. No.
1	C201,2	Aerovox	2	CAPACITOR .001 MFD @ 200V.	V146XR-16
2	C203	SPRAGUE	1	100MFD @ 25V.	TE-1211
3	C204	SPRAGUE	1	200MFD @ 15V.	TE-1164
4	Q202,3,4	Fairchild	3	TRANSISTOR, PNP, Si, SW.	2N3638
5	D201,2,3,4	G.E.	4	DIODE, SIGNAL	1N191
6	R204,14,20	OHMITE	3	RESISTOR 1K, ½W. ±10%	
7	R202,4,6,7,11,12,18		7	3.9K, ½W. ±10%	
8	R203		1	8.2K, ½W. ±10%	
9	R205,13		2	22K, ½W. ±10%	
10	R208,17		2	2.7K, ½W. ±10%	
11	R209,10		2	27K, ½W. ±10%	
12	R215,16		2	1.8K, ½W. ±10%	
13	R219		1	470Ω, ½W. ±10%	
14	T.B.201,2,3	ERIE	3	TERMINAL BOARD 10 TERMINAL	3976-205-2
15		H.H.Smith	2	SPACER, ½" #6 CLEAR	
16		H.H.Smith	2	SPACER, ½" TAPPED 6-32	
17		H.H.Smith	2	SPACER, ⅜" #6 CLEAR	
18		CIR	4	SCREW, 6-32 X ¾" R.H.	
19		CIR	4	LOCK WASHER, #6 INT.	
20	Q201	RCA	1	TRANSISTOR, G, PNP	2N2614 *
21	S201	AH&H	1	SWITCH, SPST, BAT	81015-AW

Bistable Multivibrator Module 200		
		Parts List
1/26/66	RAM/RCW	A601AS61058M

ITEM NO	SYMBOL	MFG	REQ	DESCRIPTION	CAT. NO.
1	C301	AEROVOX	1	CAPACITOR, .047, 150V, MYLAR	V146XR-5
2	C302, 6, 8	AEROVOX	3	.1 @ 150V,	V146XR-7
3	C303, 4	↓	2	.001@200V MYLAR	V146XR-16
4	C305, 7	↓	2	.002@200V, MYLAR	V146XR-18
5	C309	SPRAGUE	1	↓ 200@15V	TE1146
6	Q301-305	FAIRCHILD	5	TRANSISTOR, SIL, SWITCHING, PNP	2N3639
7	R301, 314, 317	OHMITE	3	RESISTOR, 3.9K, ½w, ±10%	
8	R302	↓	1	RESISTOR, 8.2K, ½w, ±10%	
9	R303	↓	1	5.6K, ½w, ±10%	
10	R304, 307, 316	↓	3	1K, ½w, ±10%	
11	R305, 306	↓	2	39K, ½w, ±10%	
12	R308, 310	↓	2	1.5K, ½w, ±10%	
13	R309 311	↓	2	VARIABLE, 2.5K, 2w	CLU2521
14	R312	↓	1	10K*, ½w, ±10%	
15	R313	↓	1	1K*, ½w, ±10%	
16	R315	↓	1	270Ω, ½w, ±10%	
17	R318	↓	1	↓ 680Ω, ½w, ±10%	
18	S301	AH&H	1	SWITCH, SPST	81015-AW
19	TB101, 102, 103	ERIE	3	TERMINAL BOARD, 10 TERM	3976-205-2
20		H.H. SMITH	4	SPACER, ¼"OD, 3/8"L, 6-32 CLEAR HOLE	2100
21		H H SMITH	2	SPACER, ¼"OD, ½"L, 6-32 TAPPED HOLE	
22		BIR	4	SCREW, 6-32 x 3/4", STEEL, CAD PLATE	
23			2	NUT, 6-32, STEEL, CAD PLATE	
24			4	LOCKWASHER, #6, STEEL, INT TOOTH	

* Selected

VARIABLE FREQUENCY, VARIABLE AMPLITUDE SINUSOIDAL OSCILLATOR MODULE No. 200

PARTS LIST

12/16/65 | RAM/ROW | A601A561003M

ITEM No	SYMBOL	MFG.	REQ	DESCRIPTION	CAT. No.
1	D401-404	SYLVANIA	4	DIODE, GER, PC	1N191
2	C401	AEROVOX	1	CAPACITOR, 0.1MFD, 150V, MYLAR	V146XR-7
3	C402	SPRAGUE	1	↓ ,200MFD, 15V	TE1146
4	C403	SPRAGUE	1	↓ ,100MFD, 25V	TE1211
5	Q401,402	FAIRCHILD	2	TRANSISTOR, SIL, PNP	2N3638
6	Q403	RCA	1	TRANSISTOR, G, PNP	2N2614
7	R401,409	OHMITE	2	RESISTOR, 1K, 1/2W, ± 10%	
8	R402	↓	1	↓ ,1.2K, 1/2W, ± 10%	
9	R403	↓	1	↓ ,1.5K, 1/2W, ± 10%	
10	R404	↓	1	↓ ,VARIABLE, 5K, 2W	CLU 5021
11	R405	↓	1	↓ ,33K, 1/2W, ± 10%	
12	R406	↓	1	↓ ,82K, 1/2W ± 10%	
13	R407,410	↓	2	↓ ,3.9K, 1/2W, ± 10%	
14	R408	↓	1	↓ ,2.2K, 1/2W, ± 10%	
15	R411	↓	1	↓ ,390Ω, 1/2W, ± 10%	
16	R412	↓	1	↓ ,270Ω, 1/2W, ± 10%	
17	TB401, 402	ERIE	2	TERMINAL BOARD, 10 TERM	3976-205-2
18		HH SMITH	2	SPACER, 1/4" OD, 3/4" L, #6 CLEAR	
19		HH SMITH	2	SPACER, 1/4" OD, 3/4" L, TAPPED 6-32	
20		BIR	2	SCREW, 6-32 RH X 1", STEEL, CAD PL	
21		BIR	2	SCREW, 6-32 RH X 3/8", STEEL, CAD PL	
22		BIR	4	NUTS, 6-32, STEEL, CD PL	
23		BIR	4	LOCKWASHER, INT TOOTH, STEEL, CD. PL	

Triggered One Shot, Variable Width Module 400

Parts List

1/13/66 | RAM/[illegible] | A601AS61014M

ITEM No	SYMBOL	MFG	REQ	DESCRIPTION	CAT. No.
1	C501	CRL	1	CAPACITOR, 220 PF, DISC	DD221
2	C502	AEROVOX	1	.1MF, 150V, MYLAR	V146XR-7
3	C503,4	SPRAGUE	2	200MF, 15V	TE 1164
4	Q501,2	FAIRCHILD	2	TRANSISTOR, PNP, SIL, SW	2N3638
5	Q503	RCA	1	TRANSISTOR, PNP, G,	2N2614
6	R501	OHMITE	1	RESISTOR, VARIABLE, 100K, 2W	CLU1041
7	R502,11		2	,15K, 1/2W, ±10%	
8	R503,7		2	,10K, 1/2W, ±10%	
9	R504		1	,6.8K, 1/2W, ±10%	
10	R505,9,12		3	,3.9K, 1/2W, ±10%	
11	R506		1	,2.7K, 1/2W, ±10%	
12	R508,10,13		3	,1K, 1/2W, ±10%	
13	R514		1	,1.2K, 1/2W, ±10%	
14	TB501,2	ERIE	2	TERMINAL BOARD, 10 TERM	3976-205-2
15		H H SMITH	2	SPACER, 1/2"L, 6-32 TAPPED	
16		H. H. SMITH	2	SPACER, 1/2"L, #6 CLEAR	
17		BIR	2	SCREW, 6-32 x 3/4" R.H	
18		BIR	2	SCREW, 6-32 X 1/4" RH	
19		BIR	4	LOCKWASHER, #6, INT.	

Variable Threshold Schmidt Trigger		Module 500
		Parts List
12/21/65	RAM/	A601AS61030M

ITEM NO	SYMBOL	MFG.	REQD	DESCRIPTION	CAT NO.
1	C601	AEROVOX	1	CAPACITOR, .047MFD, 150V, MYLAR	V146XR-
2	C602	SPRAGUE	1	200MFD, 15V	TE1164
3	C603	SPRAGUE	1	100MFD, 25V	TE1211
4	Q601	G-E	1	TRANSISTOR, UNJ	2N2160
5	Q602	RCA	1	, G, PNP,	2N2614
6	R601, 606	OHMITE	2	RESISTOR, 10K, ½W, 10%	
7	R602		1	, VARIABLE, 35K, 2W	CLU 3531
8	R603		1	56Ω, ½W, ±10%	
9	R604		1	820Ω, ½W, ±10%	
10	R605		1	1K, ½W, ±10%	
11	R607		1	VARIABLE, 500Ω, 2W	CLU5011
12	R608		1	1.8K, ½W, ±10%	
13	R609		1	270Ω, ½W, ±10%	
14	S601	AH&H	1	SWITCH, SPST	81015-AW
15	TB601	ERIE	1	TERMINAL BOARD, 10 TERM	3976-205-2
16		H H SMITH	2	SPACER, ¼" OD, ¾"L, TAPPED 6-32	
17		BIR	2	SCREW, 6-32 RH X ⅜", STEEL, CAD PL	
18		BIR	2	SCREW, 6-32 RH X ⅜", STEEL, CAD PL	
19		BIR	4	LOCKWASHER, INT. TOOTH, #6, CD. PL	

Variable Frequency, Variable Amp.
Trigger Generator Module 600

Parts List

1/13/66 RAM/ A601AS61010M

ITEM NO	SYMBOL	MFG	RQD	DESCRIPTION	CAT NO.
1	Q701	FAIRCHILD	1	TRANSISTOR, SWITCHING, SIL, PNP	2N3638
2	D701	TI	1	DIODE, SIL.	IN2069
3	R701, 702, 705	OHMITE	3	RESISTOR, , ½w, ± 10%	
4	R703	↓	1	↓ 3.3K, ½w, ± 10%	
5	R704	↓	1	↓ 47K, ½w, ± 10%	
6	S701	AH+H	1	SWITCH, SPST	B1015-AW
7	SCR701	RCA	1	CONTROLLED RECTIFIER	2N3228
8	TB701	ERIE	1	TERMINAL BOARD, 10 TERM.	3976-205-2
9	TB702	DONART	1	TERMINAL BOARD, 3 TERM. w HEAT SINK	AS61-001HS
10		BIR	4	SCREWS, 6-32 x 3/4", STEEL, CAD PLATE, RH	
11		BIR	2	SCREWS, 4-40 - 3/8", STEEL, CD. PL, RH	
12		BIR	4	NUTS, 6-32, STEEL, CD. PL	
13		BIR	4	LOCKWASHERS, INT. TOOTH, STEEL, CD. PL. #6	
14		BIR	2	NUTS, 4-40, STEEL, CD. PL.	
15		BIR	2	LOCKWASHERS, INT TOOTH, STEEL, CD. PL. #4	
16		H.H. SMITH	2	SPACER, 1/4" OD x 1/2" L, 6-32 CLEAR HOLE	
17		H.H. SMITH	2	SPACER, 1/4" OD X 3/4" L, 6-32 TAPPED	
18	C701	AEROVOX	1	CAPACITOR, .033, * 150V, MYLAR	

* NOMINAL - SELECTED FOR SMALLEST TO ELIMINATE TRANSIENT FIRING OF CKT,

SWITCH (LATCHING)
Module No. 700

Parts List

1/10/66 | RAM | A601AS61007M

ITEM No	SYMBOL	MFG.	REQ	DESCRIPTION	CAT. No.
1	C801	AEROVOX	1	CAPACITOR, 0.1 MFD., 150 V, MYLAR	V146XR-7
2	C802, 804	SPRAGUE	2	100 MFD, 25 V	TE1211
3	C803	SPRAGUE	1	200 MFD, 15 V	TE1164
4	Q801	GE	1	TRANSISTOR, UNJ, SIL	2N2160
5	Q802	FAIRCHILD	1	TRANSISTOR, SWITCH., SIL, PNP	2N3638
6	R801	OHMITE	1	RESISTOR, 10K, 1/2W, ±10%	
7	R802		1	, VARIABLE, 35K, 2W	CLU3531
8	R803		1	, 330Ω, 1/2W, ±10%	
9	R804		1	, 2.2K, 1/2W, ±10%	
10	R805, 806		2	, 1K, 1/2W, ±10%	
11	R807		1	, 3.9K, 1/2W, ±10%	
12	R808		1	, 470Ω, 1/2W, ±10%	
13	R809		1	, 270Ω, 1/2W, ±10%	
14	TB801, 802	ERIE	2	TERMINAL BOARD, 10 TERM.	3976-205-2
15	S801	AH&H	1	SWITCH, SPST	81015-AW
16		H.H. SMITH	2	SPACER, 1/4" OD, 1/2" L, #6 CLEAR	
17		H H SMITH	2	SPACER, 1/4" OD, 3/4" L, 6-32 TAPPED	
18		BIR	2	SCREW, 6-32 x 1" RH	
19		BIR	2	SCREW, 6-32 x 1/4" RH	
20		BIR	4	LOCKWASHER, #6, INT TOOTH	

Variable Frequency Sawtooth Generator Module 800		
		Parts List
1/17/66	RAM	A601AS61018M

ITEM No	SYMBOL	MFG	REQ	DESCRIPTION	CAT No
1	C901	AEROVOX	1	CAPACITOR, 0.1 MFD, 150V, MYLAR	V146XR-7
2	C902, 903	SPRAGE	2	↓ 100MFD, 25V	TE1211
3	Q901	RCA	1	TRANSISTOR, PNP, Ge	2N2614
4	R901	OHMITE	1	RESISTOR, VARIABLE, 15K, 2W	CLU1531
5	R902	↓	1	↓ , 18K, ½W, ± 10%	
6	R903		1	, 39K, ½W, ± 10%	
7	R904		1	, 1K, ½W, ± 10%	
8	R905		1	, VARIABLE, 2.5K, 2W	CLU2521
9	R906		1	, 8.2K, ½W, ± 10%	
10	R907		1	, 2.7K, ½W, ± 10%	
11	R908	↓	1	↓ , 270Ω, ½W, ± 10%	
12	TB901	ERIE	1	TERMINAL BOARD, 10 TERM	3976-205-2
13		H.H.SMITH	2	SPACER, ¼" OD, ¾" L, TAPPED 6-32	
14		BIR	4	SCREW, 6-32 x ¼" RH	
15		BIR	4	LOCKWASHER, #6, INT TOOTH	

RC Integrator Module 900

Parts List

1/17/66 RAM/1 A601AS61022M

ITEM No	SYMBOL	MFG	REQ	DESCRIPTION	CAT No.
1	C1001	AEROVOX	1	CAPACITOR, .1MF, 150V, MYLAR	V146XR-7
2	C1002,3	SPRAGUE	2	↓ , 100MF, 25V	TE1211
3	Q1001, 2	RCA	2	TRANSISTOR, G, PNP	2N2614
4	R1001,5	OHMITE	2	RESISTOR, 1K, 1/2W, ±10%	
5	R1002,9	↓	2	↓ , 470Ω, 1/2W, ±10%	
6	R1003,10		2	, 270Ω, 1/2W, ±10%	
7	R1004		1	, VARIABLE, 1K, 2W	CLU1021
8	R1006		1	, 10K, 1/2W, ±10%	
9	R1007		1	, VARIABLE, 2.5K, 2W	CLU2521
10	R1008		1	, 8.2K, 1/2W, ±10%	
11	TB1001,2	ERIE	2	TERMINAL BOARD, 10 TERM.	3976-205-2
12		H.H.SMITH	2	SPACER, 1/4"OD, 3/4"L, TAPPED 6-32	
13		↓	2	SPACER, 1/4"OD, 1/4"L, #6 CLEAR	
14		BIR	2	SCREW, 6-32 x 3/8" RH	
15		BIR	2	SCREW, 6-32 x 1/2" RH	
16		BIR	4	LOCKWASHER, #6, INT TOOTH	

R C Differentiator
Module 1000

Parts List

1/17/66 RAM/ltw A601AS61034M

ITEM NO	SYMBOL	MFG	REQ	DESCRIPTION	CAT. NO
1	C1101 THRU C1105	SPRAGUE	5	CAPACITOR, 100 MFD, 25V	TE1211
2	Q1101,3	FAIRCHILD	2	TRANSISTOR, SIL, PNP	2N3638
3	Q1102	RCA	1	TRANSISTOR, SIL, NPN	2N706
4	R1101	OHMITE	1	RESISTOR, VARIABLE, 10K, 2w	CLU1031
5	R1102,5,9, 14,17		5	RESISTOR, 1K, ½w, ± 10%	
6	R1103		1	, 33K, ½w, ± 10%	
7	R1104		1	, VARIABLE, 15K, 2w	CLU1531
8	R1106,7,11, 15		4	, 3.9 K, ½w, ± 10%	
9	R1108		1	, 8.2K, ½w, ± 10%	
10	R1110		1	, 2.7K, ½w, ± 10%	
11	R1112		1	, 18 K, ½w, ± 10%	
12	R1113		1	, 100Ω, ½w, ± 10%	
13	R1116		1	, 1.2K, ½w, ± 10%	
14	TB1101,2	ERIE	2	TERMINAL BOARD, 10 TERM	3976-205-2
15		HH SMITH	2	SPACER, 3/8" L, #6 CLEAR	
16		HH SMITH	2	SPACER, 1/2" L, TAPPED 6-32	
17		BIR	2	SCREW, 6-32 x 3/4" RH	
18		BIR	2	SCREW, 6-32 x 1/4" RH	
19		BIR	4	LOCKWASHER, #6, INT	

Variable Gain, Non-inverting Amplifier
Module 1100

Parts List

1/18/66 | RAM/[illegible]W | A601AS61026M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT NO
1	C1201,2	SPRAGUE	2	CAPACITOR, 100 MFD, 25V	TE1211
2	D1201,2,3	SYLVANIA	3	DIODES, SIGNAL	1N191
3	Q1201-6	RCA	6	TRANSISTOR, G. PNP	2N2614
4	R1201,9	CHICAGO	2	RESISTOR, 10K, 1/2W, ± 10%	
5	R1202,3		2	,100K, 1/2W, ± 10%	
6	R1205,6		2	,1K, 1/2W, ± 10%	
7	R1207-14, 16, 17, 18		11	,3.9K, 1/2W, ± 10%	
8	R1215,19		2	,22K, 1/2W, ± 10%	
9	R1220		1	,4.7K, 1/2W ± 10%	
10	R1221		1	,2.2K, 1/2W, ± 10%	
11	R1222		1	470Ω, 1/2W, ± 10%	
12	R1223		1	,2.2K, 1/2W, ± 10%	
13	TB1201,2,3	ERIE	3	TERMINAL BOARD, 10 TERM	3976-205-2
14		HH SMITH	2	SPACER, 1/4" OD, 3/8"L, #6 CLEAR	
15			2	,1/2"L, #6 CLEAR	
16			2	,1/2"L, TAPPED 6-32	
17		BIR	4	SCREW, 6-32 X 3/4" RH	
18			4	LOCKWASHER, #6, INT	

+ And Gate		Module 1200
		Parts List
1/27/66	RAM/	A601AS61072M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT. No.
1	C1301,2	SPRAGUE	2	CAPACITOR, 100MFD, 25V	TE1211
2	Q1301	FAIRCHILD	1	TRANSISTOR, SIL, PNP	2N3638
3	R1301,2	OHMITE	2	RESISTOR, VARIABLE, 10K, 2W	CLU1031
4	R1303,4	↓	2	RESISTOR, 10K, 1/2W, ±10%	
5	R1305	↓	1	↓, 3.9K, 1/2W, ±10%	
6	R1306,7	↓	2	↓, 1.2K, 1/2W, ±10%	
7	TB1301	ERIE	1	TERMINAL BOARD, 10 TERM	3976-205-2
8		H.H.SMITH	2	SPACER, 1/4"OD, 1/2"L, TAPPED 6-32	
9		BIR	4	SCREW, 6-32 x 1/4" RH	
10		BIR	4	LOCKWASHER, #6, INT	

Adder		Module 1300
		Parts List
1/25/66	RAM/DW	A601AS1062M

Item No	Symbol	Mfg	Req	Description	Cat. No.
1	C1401, 2,	Sprague	2	Capacitor, 200 mfd., 15v	TE1164
2	D1401	TI	1	Diode, Sil, G.P.	1N2069
3	Q1401	Fairchild	1	Transistor, Sil, PNP	2N363B
4	R1401	Ohmite	1	Resistor, 27K, 1/2w, ± 10%	
5	R1402	↓	1	↓ , 3.9K, 1/2w, ± 10%	
6	R1403		1	, Variable, 5K, 2w	CLU5021
7	R1404		1	, 390Ω, 1/2w, ± 10%	
8	R1405, 6		2	, 270Ω, 1/2w, ± 10%	
9	TB1401	Erie	1	Terminal Board, 10 term	3976-205-2
10	ZD1401	IR	1	Zener Diode, 6.8v, 5%	1N1767A
11		H H Smith	2	Spacer, 1/4" OD, 1/2" L, Tapped 6-32	
12		Bir	4	Screw, 1/4" 6-32 RH	
13		Bir	4	Lockwasher, #6, Int Tooth	
14	C1403	Sprague	1	Capacitor, 100 mfd, 25 v	TE1211

Negative Clipper		Module 1400
		Parts List
1/18/66	RAM/RAM	A601AS61042M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT. NO.
1	C1501	SPRAGUE	1	CAPACITOR, 200 MFD, 15V	TE1164
2	C1502,3	↓	2	↓ 100 MFD, 25V	TE1211
3	D1501	TI	1	DIODE, SIL, GP	1N2069
4	Q1501	FAIRCHILD	1	TRANSISTOR, SIL, PNP	2N3638
5	R1501	OHMITE	1	RESISTOR, 27K, 1/2W, ±10%	
6	R1502	↓	1	↓ 3.9K, 1/2W, ±10%	
7	R1503		1	VARIABLE, 5K, 2W	CLU5021
8	R1504		1	390Ω, 1/2W, ±10%	
9	R1505,6	↓	2	↓ 270Ω, 1/2W, ±10%	
10	TB1501	ERIE	1	TERMINAL BOARD, 10 TERM	3376-205-2
11	ZD1501	IR	1	ZENER DIODE, 6.8V, 1W, 5%	IN1767A
12		HH SMITH	2	SPACER, 1/4" OD, 1/2" L, TAPPED 6-32	
13		BIR	4	SCREW, 6-32 x 1/4" RH	
14		BIR	4	LOCKWASHER, #6, INT TOOTH	

Positive Clipper Module 1500		
		Parts List
1/20/66	RAM/Ben	A601AS61046M

ITEM	SYMBOL	MFR.	REQ	DESCRIPTION	CAT. NO.
1	C1601, 2	SPRAGUE	2	CAPACITOR, 100MFD, 25V	TE1211
2	R1601	OHMITE	1	RESISTOR, VARIABLE, 10K, 2W	CLU1031
3	R1602	↓	1	,1K, ½W, ±10%	↓
4	R1603	↓	1	,VARIABLE, 2.5K, 2W	CLU2521
5	R1604	↓	1	,3.1K, ½W, ±10%	↓
6	R1605, 6	↓	2	,270Ω, ½W, ±10%	↓
7	Q1601	FAIRCHILD	1	TRANSISTOR, SIL, PNP	2N3638
8	TB1601	ERIE	1	TERMINAL BOARD, 10 TERM.	3376-205-2
9		H.H. SMITH	2	SPACER, ¼" OD, ½" L, TAPPED 6-32.	
10		BIR	4	SCREW, 6-32 x ¼" RH	
11		BIR	4	LOCKWASHER, #6, INT	

Attenuator		Module 1600
		Parts List
1/21/66	RAM/[illegible]	A601AS61054M

ITEM No	SYMBOL	MFR.	REQ	DESCRIPTION	CAT. No.
1	C1701 THRU C1706	SPRAGE	6	CAPACITOR, 100MFD, 25V	TE1211
2	Q1701,3,4	FAIRCHILD	3	TRANSISTOR, SIL, PNP	2N3638
3	Q1702	RCA	1	TRANSISTOR, SIL., NPN	2N706
4	R1701	OHMITE	1	RESISTOR, VARIABLE, 10K, 2W	CLU1031
5	R1702,3,9, 14,18,20,23		7	1K, 1/2W, ± 10%	
6	R1704		1	33K, 1/2W, ± 10%	
7	R1705		1	15K, 1/2W, ± 10%	
8	R1706,7,15 17,21, 22		6	3.9K, 1/2W, ± 10%	
9	R1708		1	8.2K, 1/2W, ± 10%	
10	R1710		1	2.7K*, 1/2W, ± 10%	
11	R1711		1	VARIABLE, 2.5K, 2W	CLU2521
12	R1712		1	5.6K, 1/2W, ± 10%	
13	R1713		1	18K, 1/2W, ± 10%	
14	R1716		1	VARIABLE, 15K, 2W	CLU 1531
15	R1719		1	100Ω, 1/2W, ± 10%	
16	R1724		1	820Ω, 1/2W, ± 10%	
17	TB1701,2,3	ERIE	3	TERMINAL BOARD, 10 TERM	3976-205-2
18		H.H. SMITH	2	SPACER, 1/4" OD, 3/8" L, #6 CLEAR	
19			2	SPACER, 1/4" OD, 1/2" L, #6 CLEAR	
20			2	SPACER, 1/4" OD, 1/2" L, TAPPED 6-32	
21		BIR	4	SCREWS, 6-32 x 3/4", RH	
22		BIR	4	LOCKWASHERS, INT., #6	

* Selected

Variable Gain, Inverting, External Feedback Amplifier Module 1700		
		Parts List
1/19/66	RAM/	A601AS61038M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT NO
1	C1801,2	SPRAGUE	2	CAPACITOR, 100MFD, 25V	TE1211
2	D1801,2,3	SYLVANIA	3	DIODE, SIGNAL	1N191
3	Q1801,-4	RCA	4	TRANSISTOR, G, PNP,	2N2614
4	R1801,6-10, 12,13,15	OHMITE	9	RESISTOR, 3.9K, 1/2W, ±10%	
5	R1802,5	↓	2	, 33K, 1/2W, ±10%	
6	R1803,4,18		3	, 1K, 1/2W, ±10%	
7	R1811,14		2	, 22K, 1/2W, ±10%	
8	R1816		1	, 4.7K, 1/2W, ±10%	
9	R1817		1	, 8.2K, 1/2W, ±10%	
10	R1819	↓	1	, 2.2K, 1/2W, ±10%	
11	TB1801,2,3	ERIE	3	TERMINAL BOARD, 10 TERM	3976-205-2
12		HHSMITH	2	SPACER, 1/4"OD, 3/8"L, #6 CLEAR	
13			2	, 1/2"L, #6 CLEAR	
14			2	, 1/2"L, TAPPED 6-32	
15		BIR	4	SCREW, 6-32 x 3/4" RH	
16		BIR	4	LOCKWASHER, #6, INT	

- And Gate

Module 1800

Parts List

1/27/66 RAM/Rau A601AS61068M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT NO
1	C1901-3	SPRAGUE	3	CAPACITOR, 100 MFD, 25V	TE 1211
2	Q1901-2	RCA	2	TRANSISTOR, G, PNP	2N2614
3	R1901	OHMITE	1	RESISTOR, 10K, ½w, ± 10%	
4	R1902,3	↓	2	↓ , 1K, ½w, ± 10%	
5	R1903	↓	1	↓ , 4.7K, ½w, ± 10%	
6	R1904	↓	1	↓ , VARIABLE, 2.5K, 2w	CLU2521
7	R1905,6,7	↓	3	↓ , 3.9K, ½w, ± 10%	
8	R1908	↓	1	↓ , 1.2K, ½w, ± 10%	
9	TB1901	ERIE	1	TERMINAL BOARD, 10 TERM	3976-205-2
10		HH SMITH	2	SPACER, ¼"OD, ¾"L, TAPPED 6-32	
11		BIR	4	SCREWS, 6-32 x ¼" RH	
12		BIR	4	LOCKWASHER, #6, INT	

Signal Gate

Module 1900

Parts List

2/1/66 RAM **A601AS61079M**

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT. NO.
1	C2001,2	SPRAGUE	2	CAPACITOR, 100MFD, 25V	TE1211
2	Q2001	FAIRCHILD	1	TRANSISTOR, SIL, PNP	2N3638
3	R2001	CHALITE	1	RESISTOR 10K, 1/2W, ± 10%	
4	R2002	↓	1	↓ , VARIABLE, 5K, 2W	[illegible]5021
5	R2003,4	↓	2	↓ , 1K, 1/2W ± 10%	
6	TB2001	ERIE	1	TERMINAL BOARD, 10 TERM	3376-205-2
7		H.H. SMITH	2	SPACER, 1/4" OD, 3/4" L, TAPPED 6-32	
8		BIR	4	SCREW, 6-32 x 1/4" RH	
9		BIR	4	LOCKWASHER, #6, H.T.	

Level Shifter

Module 2000

Parts List

1/24/66 RAM/[illegible]

A601AS61050M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT. NO.
1	C2101	SPRAGUE	1	CAPACITOR, 100MFD, 25V	TE1211
2	D2101	T I	1	DIODE, SIL, GP	1N2069
3	Q2101	FAIRCHILD	1	TRANSISTOR, SIL, PNP, SWITCH	2N3638
4	Q2102	[illegible]	1	TRANSISTOR, G, PNP, POWER	2N1137
5	R2101,6	OHMITE	2	RESISTOR, 1K, 1/2W, ± 10%	
6	R2102,3	↓	2	RESISTOR, 3.9K, 1/2W, ± 10%	
7	R2104		1	↓ , 200Ω, 5W	AX-5
8	R2105		1	↓ , 47K, 1/2W, 10%	
9	TB2101	ERIE	1	TERMINAL BOARD, 10 TERM	3376-205-2
10	TB2102	DONART	1	TERMINAL BOARD WITH HEAT SINK	
11		HH SMITH	2	SPACER, 1/4" OD, 3/4", TAPPED 6-32	
12		↓	2	↓ ↓ , 1/2", #6 CLEAR	
13		BIR	2	SCREW, 6-32 x 1/4" RH	
14			2	6-32 x 3/4" RH	
15			2	4-40 x 1/2" RH	
16			2	NUT, 4-40	
17			2	LOCKWASHER, #4, INT.	
18			2	LOCKWASHER, #6, INT	

Lamp & Relay Driver Module 2100		
		Parts List
1/22/66	RAM/[illegible]	A601AS1065M

ITEM	SYMBOL	MFG	REQ	DESCRIPTION	CAT NO
1	C2201	AEROVOX	1	CAPACITOR, 500MFD, 50V	PRS-1390
2	Q2201	BENDIX	1	TRANSISTOR, G., PNP, POWER	2N1137
3		DONART	1	HEAT SINK	
4	R2201	OHMITE	1	RESISTOR, 390Ω, 1W, ± 10%	
5	SR2201-4	TI	4	RECTIFIER, SILICON	1N1614
6	ZD2201	TI	1	ZENER DIODE, 24V, 10W	1N1823

Full Wave Bridge and Regulator
Module 2200

Parts List

1/22/66 RAM/DAM A601AS61076M

CIRCUIT MODULE RESPONSE SENSING AND RECORDING EQUIPMENT PARTS LIST

Part	Part Number
Steel Cabinet, 3" x 4" x 5"	Bud, CU-728B
Telephone jack	Switchcraft XA-16807
Plug	Jones, P312AB
Socket	Jones, S312AB
0.1 ufd capacitor 200 WVDC	Rpc, 2PM-P10
Switch	Microswitch, DT-2RV-A7
Relay DPDT	Sigma, 42RO-200-G-Sil
Silicon Control Rectifier	GE2N2323
Diode	(Syl) 1N34A
Terminal Board	1100B
Resistor, carbon 1/2 w 120kohm 10%	OHmite
Resistor, carbon 1/2 w 1000 ohm 10%	OHmite
Resistor, carbon 1/2 w 12k ohm 10%	OHmite
Socket	Amperex 1-77-MIP8FK

SUBJECT INDEX

SUBJECT INDEX
(cont'd.)

	Schematic Drawing	Theory of Operations	Waveforms	Parts Layout and Board Wiring	Interboard and Ext. Wiring	Parts List	Brief Module Description	Application Notes	Installation and Patching	Connector Wiring	Response Sensing Theory	Wiring Diagram	Location and Termination
Module 100 - Free Running, Variable Frequency Multivib.	22	23	Vol. I	72	94	165	Vol. I	Vol. I	Vol. I	16	13	94	159-161
Module 200 - Bi-Stable Multi-Vib.	25	26	Vol. I	73	95	166	Vol. I	Vol. I	Vol. I	16	13	95	159-161
Module 300 - Sinusoidal Oscillator	28	29	Vol. I	74	96	167	Vol. I	Vol. I	Vol. I	16	13	96	159-161
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Module 600 - Variable Frequency and Amp. Trigger Generator	35	36	Vol. I	77	99	170	Vol. I	Vol. I	Vol. I	16	13	99	159-161
Module 700 - Latching Switch	37	38	Vol. I	78	100	171	Vol. I	Vol. I	Vol. I	16	13	100	159-161
Module 800 - Variable Frequency Sawtooth Generator	39	40	Vol. I	79	101	172	Vol. I	Vol. I	Vol. I	16	13	101	159-161
Module 900 - RC Integrator	41	42	Vol. I	80	102	173	Vol. I	Vol. I	Vol. I	16	13	102	159-161
Module 1000 - RC Differentiator	43	44	Vol. I	81	103	174	Vol. I	Vol. I	Vol. I	16	13	103	159-161
Module 1100 - Variable Gain Non-inverting Amplifier	45	46	Vol. I	82	104	175	Vol. I	Vol. I	Vol. I	16	13	104	159-161
Module 1200 - + And Gate	47	48	Vol. I	83	105	176	Vol. I	Vol. I	Vol. I	16	13	105	159-161
Module 1300 - Adder	50	51	Vol. I	84	106	177	Vol. I	Vol. I	Vol. I	16	13	106	159-161
Module 1400 - Negative Clipper	52	53	Vol. I	85	107	178	Vol. I	Vol. I	Vol. I	16	13	107	159-161
Module 1500 - Positive Clipper	54	55	Vol. I	86	108	179	Vol. I	Vol. I	Vol. I	16	13	108	159-161

	Schematic Drawing	Theory of Operations	Waveforms	Parts Layout and Board Wiring	Interboard and Ext. Wiring	Parts List	Brief Module Description	Application Notes	Installation and Patching	Connector Wiring	Response Sensing Theory	Wiring Diagram	Location and Termination
Module 1600 - Attenuator	56	57	Vol. I	87	109	180	Vol. I	Vol. I	Vol. I	16	13	109	159-161
Module 1700 - Variable Gain, External Feedback, Inv. Amp.	58	59	Vol. I	88	110	181	Vol. I	Vol. I	Vol. I	16	13	110	159-161
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MAINTENANCE INDEX

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*Manufacturers' manual reference will be found in the Reference section, page 193

REFERENCES

1. Elliott, Thomas K. The Maintenance Task Simulator (MTS-2): A Device for Electronic Maintenance Research. Volume I: Application and Operation AMRL TR-67-140. Wright-Patterson Air Force Base, Ohio, August 1967.

2. Elliott, Thomas K. & Folley, John D., Jr. The Maintenance Task Simulator-1 (MTS-1): A Device for Electronic Maintenance Research. AMRL TR-64-99, Wright-Patterson Air Force Base, Ohio, October 1964.

3. Du Mont Cathode-ray Oscillograph - Types 304-A and 304-AR - Operating and Maintenance Manual. Allen B. Du Mont Laboratories, Clifton, New Jersey, 1960.

4. Hewlett-Packard Company 405C/CR Automatic DC Digital Voltmeter - Operating and Service Manual. Palo Alto, California, 1961.

5. Hewlett-Packard Company 561B Digital Recorder - Serials Prefixed: 038 - Operating and Service Manual. Palo Alto, California, 1960.

6. Hewlett-Packard Company 521A/C/D/E/G Electronic Counters - Serials Prefixed: 032 - Operating and Service Manual. Palo Alto, California, 1959.

7. Hewlett-Packard Company AC-4 Decade Counters - Operating and Service Manual. Palo Alto, California, 1956.

8. Hewlett-Packard Company Printer Mechanism - Operating and Service Manual. Palo Alto, California, 1960.

9. Hewlett-Packard Company 712A - Power Supply - Operating and Service Manual. Palo Alto, California, 1962.

10. Sorenson - Model QB Nobatrons - Instruction Manual. Sorensen/A Unit of Raytheon, South Norwalk, Connecticut, November 1963.

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13. ABSTRACT

This report contains schematics, theory of operations, parts location, and interconnection tables for the MTS-2 maintenance task simulator. The data includes front panel modules and circuit modules, but excludes commercial items incorporated intact in the device.

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Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
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Electronics training device						
Task analysis device						
Electronic equipment simulation						
Simulators						