INSTRUCTION MANUAL

model 132 A

PULSE GENERATOR

Serial No. ______________________

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(A)

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Units, abbreviations and prefixes of the International system of Units (SI) are used in this manual. Discrepancies may be noted between the terms used in the text and the instrument panel markings (e.g.; hertz, kilohertz, megahertz for cps, kilocycles, megacycles, etc.)

The National Bureau of Standards announced its approval of the SI in February 1964, and subsequently the document was adopted by congress as a national standard.

WARRANTY

E-H instruments are warranted to be free from defects in material and workmanship for one year. For in-warranty repair of this instrument, contact E-H Research Laboratories, Inc., Customer Service Department and provide:

a. Instrument model number and serial number.

b. Details concerning the nature of the malfunction.

Shipping instructions, or repair information and parts will be sent to you promptly.

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LIST OF ILLUSTRATIONS

Figure 1-1 Model 132A Pulse Generator

SECTION 1
SPECIFICATIONS

1-1 HOW TO USE THIS INSTRUCTION MANUAL

Each section of the manual begins with a general description of the instrument oriented toward the subject matter in that section. Section 1 contains the electrical and mechanical specifications for the instrument. For the operator, Section 2 contains a complete description of controls and procedures, including first-time turn-on. In Section 3, the theory of peration is described. The instrument is described on three levels of increasing depth: the basic block diagram, the functional block diagram, and the schematics.

The schematics are located on tabbed pull-outs at the back of the manual. Section 6, in which the schematics are located, also contains photographs of printed circuit boards and other subassemblies. Individual components are identified on these photographs. For purposes of replacement, components and subassemblies are completely described in the parts lists in Section 5. Location of the text reference to individual circuits is included near the circuit on the schematic diagram; the physical location of the circuit is also shown.

Section 4 contains maintenance and alignment procedures. It is strongly recommended that the repair technician read Section 3 and become familiar with the location of the various types of information in this manual before attempting any of the procedures in Section 4. Techniques are oriented strongly toward preventive maintenance and include routine visual checks, voltage and signal tests, and general notes on the use of test equipment with this instrument.

1-2 GENERAL INFORMATION

The E-H Model 132A Pulse Generator provides fast risetime, high current pulses of either polarity with adjustable pulse width and repetition rate. Provision is made for externally driven or gated operation. A trigger signal is supplied at a front panel connector, and the interval between trigger signal and output pulse is controllable. Either one or two pulses are available during each output cycle, and pulse risetime and amplitude are adjustable. Automatic overload protection limits maximum average output current to protect output circuitry.

1-3 SPECIFICATIONS (All specifications assume a 50Ω resistive load.)

a. **Pulse Repetition Frequency**. 5 Hz to 3.5 MHz from an internal clock; 0 to 3.5 MHz when externally driven. The internal clock repetition rate is adjustable over six decade ranges from 5 Hz to 3.5 MHz. A vernier control provides continuous adjustment over each range with overlap into the djacent ranges.

1-3 Continued

b. **Output Pulse Amplitude**. 0.4 to 50 V, either polarity. The output pulse amplitude is adjustable over five attenuation ranges of 2:1, 5:1, 10:1, 20:1, and 50:1, and one unattenuated range. A vernier control provides continuous adjustment over each range with overlap into the adjacent ranges.

c. **Pulse Width**. Less than 100 ns to more than 10 ms. The output pulse width is adjustable in five decade ranges from less than 100 ns to more than 10 ms. A vernier control provides continuous adjustment over each range with overlap into the adjacent ranges.

d. **Pulse Delay**. More than 100 ns to less than 10 ms. The time interval between the trigger signal and the pulse output is adjustable in five ranges from less than 100 ns to more than 10 ms. A vernier control provides continuous adjustment over each range with overlap into the adjacent ranges.

e. **Duty Factor**. Maximum average output current limited to 250 mA by automatic overload protection.

f. **Waveform Distortion**. Pulse-top distortion less than 5% peak-to-peak in either polarity at maximum amplitude. Waveform distortion includes all amplitude departures from an ideal waveform such as overshoot, ringing, and droop.

g. **Risetime**. (10% to 90%) Positive pulse risetime adjustable from less than 12 ns to more than 100 ns; negative pulse risetime adjustable from less than 10 ns to more than 100 ns.

h. **External Drive Input**. -5 V into approximately 2 kΩ, 0 to 3.5 MHz.

i. **Gate Input**. -5 V into approximately 2 kΩ. The gate signal blocks the output of the internal clock to the timing circuits, providing asynchronous gating.

j. **Trigger Output**. -4 V into 2 kΩ; width approximately 30 ns.

k. **Double-Pulse Operation**. Switch selectable at frequencies up to 500 kHz. First pulse occurs approximately 30 ns after trigger output, and time interval between pulses is set by delay controls. At minimum output pulse width, minimum spacing is 300 ns.

l. **Single-Cycle Operation**. Initiated by a front panel

1-3 Continued

pushbutton when the FREQUENCY switch is in the EXT position.

m. Power, Cooling, and Fuse Requirements. 105 to 125 Vac, 50 to 60 Hz, 300 VA. The Model 132A is cooled by an internal fan which operates whenever the instrument is turned on. Fuses: 3A slo-blo. For conversion to 234 V ac operation, See Subsection 2-5.

n. Dimensions. Height: 17.78 cm (7 in.); width: 48.26 cm (19 in.); maximum extension behind front panel: 28.58 cm (11.25 in.); maximum extension in front of front panel: 3.81 cm (1.5 in.); weight: 9.9 kg (22 lb). The Model 132A is supplied in a rack-mount configuration. End frames are available for bench use.

1-4 ACCESSORIES

The E-H Model 132A is shipped with one copy of the instruction manual and a three-conductor power cord. For accessories compatible with the Model 132A, refer to the E-H Research Laboratories Catalog. For modifications to this instrument, consult the factory or an E-H Representative.

SECTION 2
OPERATING INFORMATION

2-1 GENERAL INFORMATION

This section of the Instruction Manual gives installation procedures, and describes the operating controls and modes of operation.

The Performance Verification Procedure given in Section 4 of this manual serves as a receiving inspection. All of the operating controls are shown on the Block Diagram in Section in relation to the functional elements of the instrument. Specifications from Section 1 which directly affect operation of the instrument are reiterated in this section.

Names of front panel controls are shown in capital letters (e.g., DELAY); the controlled parameter (e.g., "delay time") is shown in lower case.

2-2 INITIAL INSPECTION AND INSTALLATION

a. **Unpacking.** Unpack the instrument and verify that it is intact and as ordered. Ensure that any accessories (as listed at the end of Section 1) that should accompany the instrument are present. Inspect the instrument for any physical damage. If damage of any sort is found, a claim should be filed immediately with the carrier. As soon as possible, the instrument should be given a thorough electrical inspection. The Performance Verification Procedure given in Section 4 is recommended for this purpose. If the instrument fails to operate properly or does not meet specifications, contact an E-H Representative.

2-2 Continued

NOTE

Unauthorized repair or parts replacement during the warranty period may void the warranty. The warranty and instructions for in-warranty repair of this instrument are given on Page II of this manual, opposite the Table of Contents.

b. **Installation.** The E-H Model 132A is supplied in a rack-mount configuration. Power connection and fuse requirements are silk-screened on the rear panel. Input ac power is connected via the three-conductor power cord (supplied) to rear panel connector J101. The POWER switch should be turned off (down) prior to plugging in the instrument. The instrument is cooled by an internal fan that operates when the POWER switch is turned on. The top and bottom covers should remain in place when the instrument is in use to provide proper flow of cooling air.

2-3 DESCRIPTION OF FRONT PANEL CONTROLS AND CONNECTORS

a. **General.** Refer to Figure 2-1. All of the controls for operating the Model 132A are located on the front panel. The line fuse and ac input connector are located on the rear panel. Four BNC connectors on the front panel serve as terminals for external drive and gate inputs and for trigger and pulse outputs.

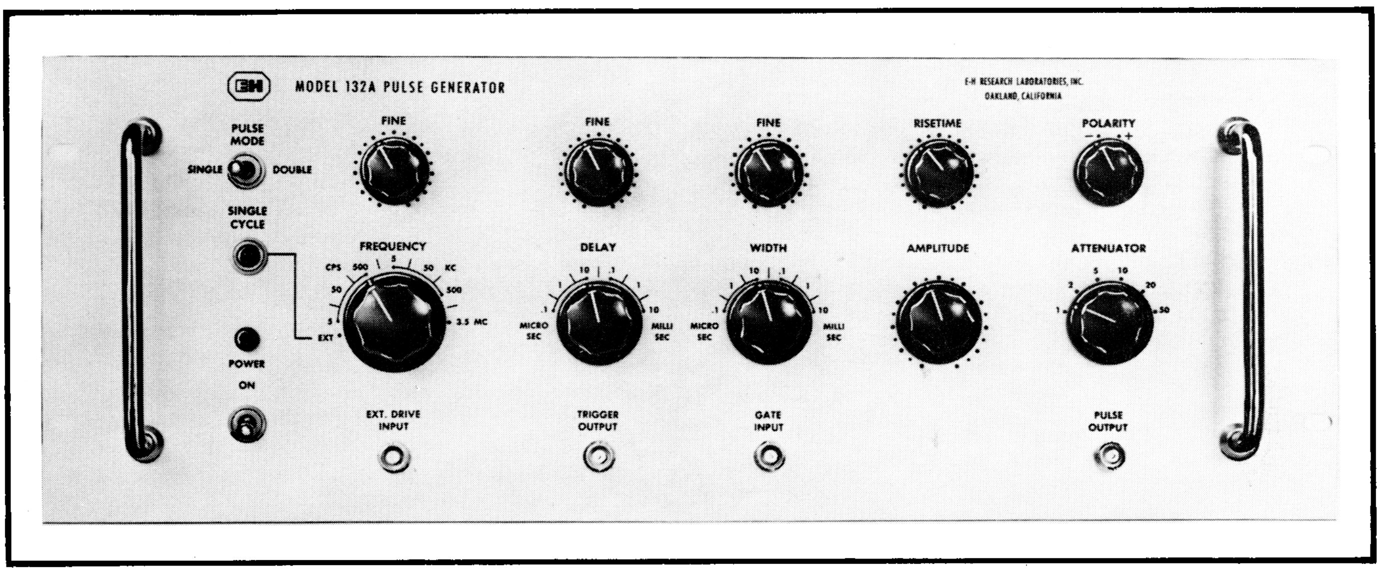


Figure 2-1 Front Panel Controls and Connectors

2-3 Continued

b. **FREQUENCY.** 7-position rotary switch; selects one of six internally generated repetition rate ranges or the external drive function. The internal repetition rate range limits are in a decade sequence from 5 cps to 3.5 MC (5 Hz to 3.5 MHz). External drive range limits are 0 to 3.5 MHz, or the instrument cycle may be started with the SINGLE CYCLE button.

c. **FINE (FREQUENCY).** Potentiometer; a 10:1 vernier control which continuously adjusts the internally generated repetition rate over the selected range, with overlap into the adjacent ranges.

d. **SINGLE CYCLE.** Pushbutton; initiates one complete output pulse pattern when depressed.

e. **DELAY.** 5-position rotary switch; selects one of five delay ranges, where the delay is the time between the trigger signal and the output pulse. Delay range limits are in a decade sequence from 0.1 micro sec to 10 milli sec (0.1 μs to 10 ms). In the double-pulse mode, the DELAY switch and its associated FINE control adjust pulse separation.

f. **FINE (DELAY).** Potentiometer; a 10:1 vernier control which continuously adjusts the delay interval over the selected range, with overlap into the adjacent ranges.

g. **PULSE MODE.** Toggle switch; selects single-pulse or double-pulse operation. In the single pulse mode, one output pulse is produced (at the end of the delay interval) for each cycle of the clock. In the double-pulse mode, two pulses are produced during each clock cycle. The first pulse is fixed in time, occuring approximately 30 ns after the trigger signal. The second pulse occurs after a period of time determined by the DELAY switch and its associated FINE control. At minimum output pulse width (less than 0.1 μs), minimum pulse separation is 185 ns. For other pulse widths, minimum pulse separation is a function of timing considerations. The highest repetition rate range (500 kHz - 3.5 MHz) is inoperative with the PULSE MODE switch in the DOUBLE position.

h. **WIDTH.** 5-position rotary switch; selects one of five pulse width ranges. Width range limits are in a decade sequence from 0.1 μs to 10 ms.

i. **FINE (WIDTH).** Potentiometer; a 10:1 vernier control which continuously adjusts pulse width over the selected range, with overlap into the adjacent ranges.

j. **ATTENUATOR.** 6-position rotary switch; selects one of five output pulse amplitude resistive attenuation ranges or an unattenuated (straight-through) signal path.

k. **AMPLITUDE.** Potentiometer; a 2.5:1 vernier control which continuously adjusts output pulse amplitude over the selected range, with overlap into the adjacent ranges. Typical amplitude limits for each range are shown below:

ATTENUATOR SETTING	AMPLITUDE RANGE
1	19 to > 50 V
2	9.5 to 27 V
5	3.8 to 10.5 V
10	1.9 to 5.3 V
20	0.95 to 3.7 V
50	< 0.40 to 1.05 V

2-3 Continued

l. **RISETIME.** Potentiometer; adjusts output pulse risetime from less than 10 ns (negative pulse) or 12 ns (positive pulse) to more than 100 ns in either polarity. Increasing risetime to more than output pulse width will result in a reduction in amplitude and distortion of the output pulse.

m. **POLARITY.** 2-position rotary switch; selects output pulse polarity.

n. **EXT. DRIVE INPUT.** BNC connector; input terminal for external drive signals (-4 V into ≈ 2 kΩ). With the FREQUENCY switch in the EXT position, the Model 132A can be externally driven at frequencies from 0 to 3.5 MHz. (Fine frequency control must be fully counterclockwise.)

o. **TRIGGER OUTPUT.** BNC connector; output terminal for trigger signals (- 4 V into ≈ 2 kΩ, ≈ 30 ns wide). The trigger signal occurs at the beginning of the output cycle.

p. **GATE INPUT.** BNC connector; input terminal for external gate signals (- 5 V into ≈ 2.4 kΩ). The gate signal interrupts the clock input to the timing circuits, resulting in asynchronous gating.

q. **PULSE OUTPUT.** BNC connector; output terminal for pulse train. Output terminating impedance = 50 Ω.

r. **POWER.** Toggle switch and neon indicator. With the line cord connected to the appropriate power source and the POWER switch turned ON, power is applied to all internal circuitry and the indicator is lighted. When the POWER switch is turned off (down), line voltage is present only on J101, the line fuse, and one side of the POWER switch.

2-4 OPERATING NOTES

a. **Duty Factor Considerations.** To prevent damage to the Model 132A output circuitry, an automatic overload protection circuit holds maximum average output current to 250 mA. This means that at maximum amplitude and repetition rate, a 25% duty factor can be achieved. When the output is unattenuated, the Model 132A operates as a current source for negative pulses and as a voltage source for positive pulses. The PULSE OUTPUT should always be terminated in a 50Ω resistive load. The power dissipating capabilities of the load should always be a prime consideration when connecting the instrument to a system or device under test.

NOTE

Minimum pulse width (0.1 μs) at maximum frequency (3.5 MHz) produces a duty factor of ≈ 35%. Thus maximum amplitude cannot be achieved at frequencies in excess of 2.5 MHz.

b. **Timing Considerations.** Timing considerations are based on the recovery-time requirements of the circuits which generate the delay and width time intervals. Typically, this is 125% of the minimum setting in any delay or width range (e.g., 1.25 μs in the 1-to-10 μs range), but not less than 185 ns. If the delay or width interval is increased until that circuit no longer has sufficient time to recover, the output will become erratic. No damage to the instrument will result.

For any particular delay or width, adding 125% of range minimum to the particular interval will give the period of the

-4 Continued

minimum repetition rate achieveable at that setting. For example, if pulse width is set at 4 μs, the WIDTH switch must be in the 1–to–10 micro sec position; recovery time therefore is 1.25 μs. The sum of pulse width and recovery time is 5.25 μs. This is the period of the minimum repetition rate (190 kHz) for a stable output at that width.

If repetition rate is known, subtracting recovery time from period will result in maximum useable width and delay. For example, if repetition rate is set at 200 kHz, period is 0.5 ms. The maximum available recovery time in that period is 0.125 ms (on the 0.1-to1 ms range). Subtracting recovery time from period gives the maximum useable width and delay (0.375 ms) at that frequency.

Recovery time on the fastest timing range is 185 ns, rather than 125% of range minimum. On any range, the delay and width recovery times are independent of each other. That is, if a particular value of pulse width has been computed as maximum for a certain frequency, the delay interval may be 'multaneously increased to that same value without degrading the output. Timing for double-pulse operation is discussed in Paragraph 2-4e. If the desired delay or width time lies in the overlap area between two timing ranges, the lower range should be used.

With the FREQUENCY switch in the EXT position, the clock multivibrator becomes a trigger circuit driven via the EXT. DRIVE INPUT connector. The external drive signal should be - 4 V into approximately 2 kΩ. Also in the EXT position, the SINGLE CYCLE pushbutton can be used to initiate generator operation. When the button is depressed, the instrument produces one complete pulse pattern at the output. Pulse characteristics (other than repetition rate) are determined by the front panel controls.

c. **Gating, Triggering, and Single Cycle Operation.** The GATE INPUT signal blocks the output of the clock multivibrator. Since the clock continues to run during the gated interval, the first pulse of the succeeding burst may not occur coincident with removal of the gate signal. The gating signal only blocks the clock output. Therefore, if a delay interval has started before the gate signal is applied, that cycle /ill be completed and an output pulse produced before lockout occurs.

d. **Use of the TRIGGER OUTPUT.** The trigger signal from the Model 132A is - 4 V in amplitude and approximately 30 ns wide. Terminating the trigger signal in an impedance less than approximately 2 kΩ will result in a reduction in amplitude. For example, amplitude into a 50Ω termination is approximately - 2.5 V.

e. **Double-pulse Operation.** In the double-pulse mode of operation, there are two identical pulses produced at the PULSE OUTPUT. The first pulse is fixed in time and occurs approximately 30 ns after the signal at the TRIGGER OUTPUT. The time interval until the occurance of the second pulse is set by the DELAY switch and its associated FINE control.

Figure 2-2 shows the time relationships involved in double-pulse operation. The approximately 30 ns delay between the trigger signal and the first pulse is the propagation time through that portion of the instrument following the trigger generator. As the delay interval is shortened, width recovery time 1 sets the limit of minimum primary separation.

2-4 Continued

Separation between the second pulse in a pair and the first pulse in the succeeding pair may be determined by either width recovery time 2 or delay recovery time.

In the diagram, pulse width is small compared to pulse period and separation is large. Both width and delay are shown in the same range, resulting in similar recovery times. If the delay range were increased to gain additional primary separation, delay recovery time would increase as shown by the dotted line. In that situation, delay recovery time limits secondary separation. If the delay or width interval required lies in the overlap between two timing ranges, the lower range should be used to minimize recovery time.

If any of the separation requirements are not met, the output will be erratic. No damage to the instrument will result. Timing considerations for single-pulse operation are discussed in Paragraph 2-4b.

f. **Operation at Increased Risetimes.** The RISETIME control can slow the output pulse risetime to more than 100 ns. At minimum pulse width, maximum risetime can exceed width, resulting in a distorted output pulse.

2-5 234 VOLT OPERATION

a. **General.** The Model 132A power transformer primary is normally connected for 117 V service. For use with 234 V service, the primary must be reconnected. This is accomplished by altering the input connections and jumpers on the ac input terminal strip, TS101. Proper connections for either type of service are shown on Schematic 5 in Section 6.

b. **Reconnection Procedure.**

(1) Check the rear panel "Power Data" chart to determine the existing power connection.

(2) Disconnect the power cord and remove the bottom cover using the procedure given in Subsection 4-4.

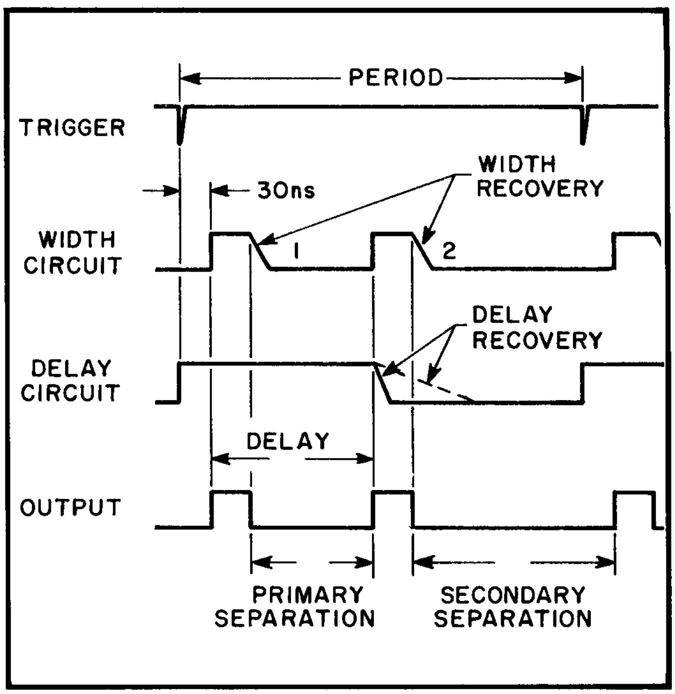


Figure 2-2 Double Pulse Timing

2-6 Continued

(3) Locate TS101 on the bottom chassis layout photo in Section 6.

(4) Remove the jumper wires and reposition them for the type service available. Use only enough heat to loosen the wires. Overheating will damage the terminal strip.

(5) Replace the bottom cover on the instrument. Note the change in power connection on the rear panel "Power Data" chart. Change the line fuse, F101, to correspond with the power connection.

2-6 FIRST-TIME TURN-ON

a. **Equipment Required.**

(1) Test oscilloscope, Tektronix Model 541A with Type L plug-in
(2) Test pulse generator, E-H Model 132A
(3) 100:1 tap-off, E-H Model 960
(4) 50Ω, 40 W termination
(5) 3 50Ω coaxial cables with BNC connectors
(6) BNC/GR-874 adapters

b. **Procedure.** Connect the 50Ω termination to the PULSE OUTPUT connector of the Model 132A via the tap-off. Connect a 50Ω co-ax from the 100:1 tap-off to the input of the scope. Trigger the scope externally from the Model 132A TRIGGER OUTPUT, using another 50Ω co-ax. Connect the Model 132A to an appropriate power source and position the front panel controls as follows:

POLARITY	+
ATTENUATOR	1
RISETIME	ccw
AMPLITUDE	cw
WIDTH	.1–to–1 micro sec
FINE	ccw
DELAY	.1–to–1 micro sec
FINE	ccw
FREQUENCY	500 KC–to–3.5 MC
FINE	cw
PULSE MODE	SINGLE
POWER	ON

Position the oscilloscope controls for a negative external trigger, 0.1 μs/cm sweep speed, and 1 V/cm vertical sensitivity. Adjust the oscilloscope for a stable, centered display.

Reduce the repetition rate with the FINE (FREQUENCY) control. Observe the automatic increase in amplitude as duty factor falls to 25% and less.

2-5 Continued

Place the FREQUENCY switch in the 50–to–500 KC position and adjust the associated FINE control to produce a repetition rate of 100 kHz. Decrease oscilloscope sweep speed to 2 μs/cm. Place the WIDTH switch in the 1–to–10 micro sec position and adjust the associated FINE control to produce a 2 μs pulse width. Set the DELAY switch to the 1–to–10 micro sec position and adjust the associated FINE control to produce a 4 ns delay. Switch the PULSE MODE switch to the DOUBLE position. Output pulse amplitude will automatically be reduced when the second pulse appears. Vary the DELAY and WIDTH controls and observe the affect on the pulses.

Return the PULSE MODE switch to the SINGLE position. Reduce delay time to minimum. Place the WIDTH switch in the .1–to–1 micro sec position. Increase test oscilloscope sweep speed to 0.1 μs/cm. Adjust the FINE (WIDTH) control for a 0.5 μs pulse. Rotate the RISETIME control clockwise and observe the affect on the leading edge of the pulse. Vary the positions of the POLARITY switch and AMPLITUDE control and note the affects on the output.

Set the test oscilloscope sweep speed to 2 ms/cm. Decrease the Model 132A repetition rate to the minimum obtainable from the internal clock. Increase the delay interval to maximum. Set the WIDTH switch to the 1–to–10 milli sec position and adjust the associated FINE control for a 4 ms pulse. Place the PULSE MODE switch in the DOUBLE position. Turn the FREQUENCY switch to the EXT position. Depress the SINGLE CYCLE pushbutton. One complete output pattern (two pulses) is produced each time the button is pressed.

Connect the output of the test pulse generator to the EXT. DRIVE INPUT connector of the Model 132A, observing all termination constraints. The external drive signal should be -4 V in amplitude. The Model 132A can be driven at frequencies from 0 to 3.5 MHz. Output pulse characteristics (other than repetition rate) are determined by the Model 132A front panel controls.

Return the Model 132A and test oscilloscope to the original set-up in this procedure. Set up the test pulse generator to produce a train of -4 V, 1 μs-wide pulse at 250 kHz. Connect this signal to the GATE INPUT connector of the Model 132A with a piece of 50Ω co-ax. Set the test oscilloscope sweep speed to 1 μs/cm. The output will be 3 μs bursts of 3.5 MHz pulses with 1 μs gated periods between bursts.

This concludes the turn-on procedure.

SECTION 3
THEORY OF OPERATION

3-1 GENERAL INFORMATION

This section of the manual contains an electrical description of each circuit in the E-H Model 132A Pulse Generator. The discussion is on three levels: the basic block diagram, the functional block diagram, and the schematics. The basic block diagram is included in this section; the remaining drawings are in Section 6.

3-2 BASIC BLOCK DIAGRAM

a. **General.** The Model 132A is composed of two general circuit groups as shown in Figure 3-1: the timing circuits which affect the signal time parameters, and the output circuits which affect the signal voltage/current parameters. Each circuit group has its own controls.

b. **Timing.** Output pulse timing is determined by three elements in the timing circuitry: the clock multivibrator, the delay multivibrator, and the width multivibrator. Each has an independently adjustable period set by panel mounted controls.

The clock multivibrator can be operated free-running, triggered, or gated. Operation is dependent on the position of the FREQUENCY switch, and the waveforms applied to the GATE INPUT and EXT. DRIVE INPUT connectors. When the FREQUENCY switch is in the EXT position, the instrument produces one complete output pulse pattern for each negative input at the EXT. DRIVE INPUT connector or each operation of the SINGLE CYCLE pushbutton.

When the FREQUENCY switch is in any other position, the clock free-runs at a frequency determined by its panel mounted controls. Output from the clock is interrupted by a negative signal at the GATE INPUT connector. In any of its

3-2 Continued

modes of operation, the clock output keys the delay multivibrator.

A differentiated output from the clock is amplified to serve as the trigger signal. In the double-pulse mode of operation, an output from the trigger amplifier initiates the first pulse in the pulse pair via the start amplifier.

Operaton of the delay multivibrator is initiated concurrent with the trigger pulse. At the end of the delay interval, a signal from this multivibrator turns on an output pulse via the start amplifier. In the single-pulse mode, this is the only pulse that is produced; in the double-pulse mode, this is the second pulse in the pulse pair. The signal from the start amplifier also keys the width multivibrator.

The width multivibrator is triggered by the signal from the start amplifier in both the single- and double-pulse modes of operation. At the end of the width time interval, a signal from this multivibrator turns off the output pulse.

c. **Output.** The output circuitry consists of a latch which is turned on and off by the timing signals, a polarity switch, and an attenuator. Output pulse amplitude is controlled by varying the screen grid voltage on the output tube. Risetime is slowed by increasing the series resistance in the signal path to the output tube control grid.

3-3 FUNCTIONAL BLOCK DIAGRAM

a. **General.** The block diagram in Section 6 shows the signal flow paths through the Model 132A. On the schematics, circuits represented as functional blocks are shown as shaded green areas. Commencing with Paragraph b. below, the

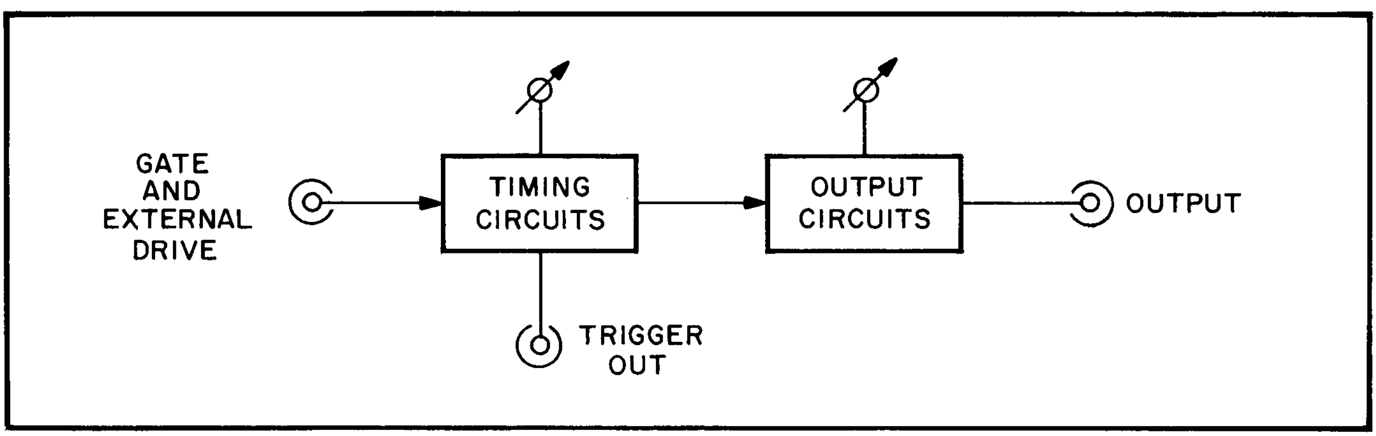


Figure 3-1 Basic Block Diagram

3-3 Continued

paragraphs in this subsection bear a one-to-one correspondence to the blocks on the diagram. A similarly lettered paragraph in Subsection 3-4 describes circuit operation.

b. **Clock Multivibrator.** Figure 3-2 shows the relationship of the timing and trigger signals. The Clock Multivibrator is the internal clock for the Model 132A. Repetition rate is determined by the FREQUENCY switch and its associated FINE control. In the externally driven mode, the multivibrator is converted to a trigger circuit which is keyed by a negative signal at the EXT DRIVE INPUT connector or by pressing the SINGLE CYCLE button. Clock Multivibrator output is differentiated and fed to the Gated Amplifier.

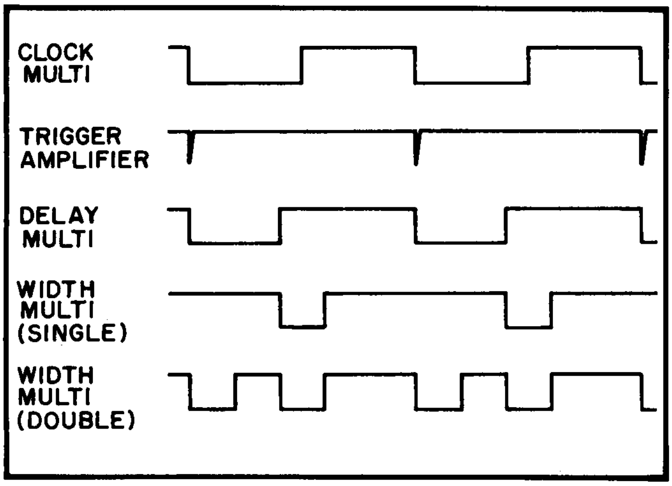


Figure 3-2 Timing Diagram

c. **Gated Amplifier.** The Gated Amplifier amplifies the differentiated output of the Clock Multivibrator as long as no gate signal is applied to the GATE INPUT connector. If a negative signal is present at that connector, the timing signal path is blocked. The output of the Gated Amplifier is sent to the Delay Multivibrator and the Trigger Amplifier.

d. **Trigger Amplifier.** The Trigger Amplifier further amplifies the output of the Gated Amplifier to provide the signal at the TRIGGER OUTPUT connector. A second output from the Trigger Amplifier is enabled only when the PULSE MODE switch is in the DOUBLE position. In the double-pulse mode, this signal to the Start Amplifier starts the initial pulse in the pulse pair.

e. **Delay Multivibrator.** The Delay Multivibrator is keyed by the signal from the Gated Amplifier, and determines the time interval between the trigger signal and the start of the output pulse. Delay Multivibrator output is differentiated and fed to the Start Amplifier. In the double-pulse mode, this signal starts the second pulse in the pulse pair.

f. **Start Amplifier.** The Start Amplifier amplifies the signal from the Delay Multivibrator and, in the double-pulse mode, from the Trigger Amplifier. One output from the Start Amplifier keys the Width Multivibrator; the other output turns on the Output Latch.

g. **Width Multivibrator.** The Width Multivibrator determines output pulse width. In the single-pulse mode, the Width Multivibrator is keyed at the end of the delay interval by the differentiated output of the Delay Multivibrator via the Start Amplifier. In the double-pulse mode, the Width

3-3 Continued

Multivibrator is keyed twice: once concurrent with the trigger signal by the pulse from the Trigger Amplifier, and at the end of the delay interval. Output from the Width Multivibrator is differentiated and fed to the Stop Amplifier.

h. **Stop Amplifier.** The Stop Amplifier amplifies the differentiated output of the Width Multivibrator and feeds the signal to the Output Latch.

i. **Output Latch.** The Output Latch is a bistable circuit which is turned on by the signal from the Start Amplifier and turned off by the signal from the Stop Amplifier. An output tube is the final element in the latch circuitry. Output pulse amplitude and risetime are adjusted by controlling input parameters to this tube. Both positive and negative signals are delivered to the POLARITY switch.

j. **Attenuator.** The POLARITY switch selects either the positive or negative signal from the Output Latch. The Attenuator places increasing amounts of resistance in the signal path as the attenuation is increased. A straight-through (unattenuated) path is also provided. The PULSE OUTPUT connector should be terminated in 50Ω.

3-4 CIRCUIT DESCRIPTION

a. **General.** The following discussion makes reference to the schematic diagrams in Section 6 and the waveforms on the schematics. Conditions under which the waveform photographs were made are given in Subsection 6-2.

b. **Clock Multivibrator (Schematic 2).** Transistors Q1 and Q2 comprise an astable multivibrator. The free-running repetition rate is determined by the value of timing capacitor selected by FREQUENCY switch S1 and FINE potentiometer R2. If the selected timing capacitor is charged to some positive voltage, Q1 will be turned off. The negative potential on the base of Q2 (via R3, D3, and R9) brings Q2 into conduction. The timing capacitor now begins to discharge through R2, L10, and R8. When the voltage on the base of Q2 reaches a point where the base-emitter drop of Q2 is less than that of Q2, Q1 is coupled through D3 to the base of Q2 and Q2 turns off. The timing capacitor now begins to recharge. When the base of Q2 becomes sufficiently positive, the transistors change state and the entire procedure is repeated.

In the double-pulse mode, the clock multivibrator is prevented from operating in the fastest repetition rate range (500 kHz to 3.5 MHz). This is accomplished by coupling a positive voltage to the base of Q1 via S1, R50, and one section of S7. The positive potential on the base of Q1 turns that transistor off and prevents the multivibrator from free-running.

When S1 is in the EXT position, the clock multivibrator is converted to a trigger circuit. The positive voltage on the base of Q1 (via R10) prevents the multivibrator from free-running. When a negative signal is introduced at J1, the EXT DRIVE INPUT connector, the positive bias on Q1 and the clock operates through one half cycle. Since the clock output is differentiated and only one "edge" is required by the subsequent circuitry, this half cycle is sufficient to initiate an output pulse pattern. When the negative drive signal is removed, the clock returns to its quiescent state. When the Model 132A is being externally driven, R2 should be set at maximum resistance (fully ccw). When the base potential of Q1 approaches that of Q2, as when R2 is at minimum, the

4 Continued

clock will free-run.

The SINGLE CYCLE button, S6, can also provide a negative trigger to the clock with the FREQUENCY switch in the EXT position. Capacitor C57 prevents switch contact bounce from causing more than a single output. The RC network composed of R11, R42, and C52 damps oscillations in the switch circuitry and wiring which might cause multiple triggering.

c. **Gated Amplifier (Schematic 2).** The output from the clock multivibrator is a square wave. Capacitor C12 and diode D4 form a selective differentiator which presents only a negative spike to the base of Q3. When no gating signal is present at J3, the GATE INPUT connector, the differentiated clock output is amplified and fed to the delay multivibrator and trigger amplifier. In the absence of a gating signal, transistor Q4 is turned off. When a negative signal is applied to J3, Q4 turns on. The negative signal is coupled through the common emitter circuit, holding Q3 off and preventing passage of the clock signal.

iodes D8 and D9 protect Q4 from wrong-polarity inputs. Zener diode D7 protects the transistor from gating signals of too great an amplitude.

d. **Trigger Amplifier (Schematic 2).** Since there is no isolation between the trigger amplifier and delay multivibrator, the multivibrator signal appears on the amplifier output. Capacitor C15 and diode D11 form a selective differentiator which feeds only a positive spike to the base of Q5. This signal is inverted, amplified, and fed to the primary of T3. The signal is inverted through the transformer and, from one secondary, is fed through a final differentiating network (C53 and D32) to Q17. The signal at the collector of Q17 is fed to the TRIGGER OUTPUT connector, J2, via C14.

In the single-pulse mode one end of the other secondary of T3 is ungrounded. With PULSE MODE switch S7 in the DOUBLE position, this secondary is grounded and a positive pulse (concurrent with the trigger signal) is coupled through D33 to the base of Q13. This signal initiates the first pulse in the pulse pair in the double-pulse mode. Diode D33 prevents the differentiated output of the delay multivibrator from being ›upled back to T3 and causing a second trigger signal.

e. **Delay Multivibrator (Schematic 3).** Transistors Q6, Q7, and Q8 comprise the delay multivibrator. In the stable state, Q6 is turned off and Q7 and Q8 are conducting; the selected timing capacitor is charged to a small negative voltage. When the differentiated clock output (a positive spike) appears at the base of Q8, Q8 turns off and a positive signal is fed through the selected timing capacitor to the base of Q7. Transistor Q7 turns off, turning on Q6. The collector of Q6 is coupled back to the base of Q8 so that the action is regenerative and Q8 remains off.

The timing capacitor begins to discharge through R25, R26 (the FINE control), and R27. When the potential at the base of Q7 reaches ground, the multivibrator reverts to its quiescent state.

f. **Start Amplifier (Schematic 3).** Capacitor C38 and diode D15 form a differentiating network which presents only the positive spike at the end of the delay interval to the base of Q13. In the single-pulse mode, this signal initiates the one pulse ›roduced during each period; in the double-pulse mode, this is ›e second pulse in the pulse pair. There are two outputs from

3-4 Continued

the start amplifier: one to the primary of T2, and one via Q9 to the width multivibrator.

g. **Width Multivibrator (Schematic 3).** Capacitor C40 and diode D13 differentiate the output of the start amplifier. Transistor Q9 isolates the delay signal to T2 from the square wave produced by the width multivibrator. The output from Q19 is one positive pulse in the single-pulse mode and two positive pulses in the double-pulse mode.

Operation of the width multivibrator is similar to that of the delay multivibrator. In the quiescent state, transistor Q10 is turned off and Q11 and Q12 are conducting; the selected timing capacitor is charged to some small negative voltage. When the signal from Q9 (a positive spike) appears at the base of Q12, Q12 turns off and a positive signal is fed through the selected timing capacitor to the base of Q11. Transistor Q11 turns off, turning on Q10. The collector signal of Q10 is coupled back to the base of Q12 so that the action is regenerative and Q12 remains off.

The timing capacitor now discharges through R38, R39 (the FINE control), and R40. When the potential at the base of Q11 reaches ground, Q11 turns on and the multivibrator returns to its quiescent state.

h. **Stop Amplifier (Schematic 3).** Capacitor C36 and diode D16 differentiate the output of the width multivibrator, and provide a positive pulse to the stop amplifier at the end of the width interval. Output from the stop amplifier is a negative pulse which is fed to the primary of T1. The waveform at the collector of Q16 also contains a positive spike at the beginning of the width interval. This is the start signal coupled back through T1 from the secondary of T2.

i. **Output Latch (Schematic 4).** The output latch is composed of transistors Q14 and Q15 and output tube V1. These elements and the associated components form a bistable circuit which is quiescently off until driven on, and then remains on until driven off. In the following discussion, assume the polarity switch to be in the "+" position. In this condition the +185 V supply is at its rated voltage and V_O is at ground.

In the quiescent condition, transistor Q14 is off and Q15 is on. Diode D28 holds the control grid of V1 at approximately -39 V so that no current flows in the output tube. The negative signal from the collector of Q13 in the start amplifier is coupled uninverted through T2. Appearing at the base of Q14, this signal turns the transistor on. As the collector of Q14 rises, so does the control grid of V1. Output tube V1 turns on and the amount of output current is determined by the level of the screen supply. In the positive mode, the output is taken from the cathode.

At the end of the width interval, a positive pulse from Q16 in the stop amplifier is coupled through T1 and D21 to the base of Q15. This signal turns on Q15 and the resulting negative signal at the collector returns the control grid of V1 to -39 V. A second signal from T1 is coupled through D23 to the base of Q14. This speeds up output turn-off by forcing Q14 back to its quiescent condition. The RISETIME control, R60, increases the resistance in the signal path to V1. This has the effect of increasing the amount of time required to charge the interelectrode capacitance of V1 and slowing the turn-on time of the tube.

To produce a negative output pulse, the signal is taken from

3-4 Continued

the plate of V1, rather than the cathode. The dummy load (R63-R66, R88 and R89) is switched into the cathode circuit by POLARITY switch S4. At the same time, the output of the +185 V supply is grounded and V_O becomes -185 V relative to the supply output. Inductor L9 in the filament lines to V1 reduces the coupling of the output signal back to the power supplies.

j. **Attenuator (Schematic 4).** The attenuator provides steps of resistive attenuation in the output signal path. In the unattenuated mode, the output is a current source for negative outputs and a voltage source for positive outputs. Although the impedance at the PULSE OUTPUT connector is not 50Ω, the Model 132A is designed to operate into a 50Ω load.

k. **Power Supply Rectifiers (Schematic 5).** There are three power supply rectifiers: the ±12 V rectifier (referenced to chassis ground), the +280 V rectifier, and the ±350 V rectifier (the latter two referenced to V_O). The low voltage rectifier is composed of diodes D107-D110 and rectifies the output of the 20 V secondary of T101. The output of this rectifier feeds the ±5.1 V regulators.

Diodes D103 and D104 comprise the +280 V rectifier. The output of this rectifier feeds the +185 V power supply. Diodes D101, D102, D105, and D106 form the high voltage rectifier. The positive output of this rectifier is the source for the screen supply; the negative output is the source for the -150 V supply.

The low voltage secondary of T101 power the filaments of the high voltage regulator and output tubes. A voltage divider composed of R120 and R121 on the High Voltage Regulator Board contributes a dc bias to the filament circuit. This bias is always ≈ 65 V more positive than V_O.

l. **Low Voltage Regulator (Schematic 5).** The low

3-4 Continued

voltage regulator is composed of Q102-Q105. This regulator supplies ±5.1 V to the timing circuitry. Potentiometer R134 sets the level at which the positive regulator operates. If +5.1 V output tends to go more positive, the change is coupled uninverted through Q102 to the base of Q105. Transistor Q105 is the series regulator whose output counteracts the original tendency to change. The -5.1 V regulator is referenced to the +5.1 V supply via the voltage divider on the base of Q103. Any change in the negative output is inverted through Q103 and fed back to the output via Q104 to counteract the original change.

m. **Screen Supply (Schematic 5).** The output from the screen supply is under the control of the manual AMPLITUDE control and the automatic output current limiting circuit. So long as output current does not exceed 250 mA the voltage at the cathode of V106 is a function of the setting of R128. Output current is sampled across R125 and a charge is built up on C105 and C106 as a function of that current. The resulting bias on the base of Q101 results in some voltage being supplied to the control grid of V104. If output current tends to exceed 250 mA, the resulting signal to the grid of V106 counteracts the tendency and holds output current at 250 mA.

n. **-150 V Supply (Schematic 5).** The -150 V is shunt regulated by gas diode V105.

o. **+185 V Supply (Schematic 5).** The +185 V supply consists of V101, V102, and V103. These tubes form a conventional series regulator. Output level is set by R112. Any tendency to change is sensed on the control grid of V103, inverted, and fed to the grids of the series regulator tubes. The signal at the cathodes of V101 and V102 counteract the tendency to change. By grounding either the +185 V output or V_O at the POLARITY switch, outputs of either polarity are achieved.

SECTION 4
MAINTENANCE

4-1 GENERAL INFORMATION

This section of the manual gives maintenance notes and alignment procedures for the E-H Model 132A. The instrument requires a minimum amount of maintenance; however, normal aging of electronic components may eventually cause abnormal operation. Use of the following procedures should forestall many minor malfunctions, or permit their detection before a major repair is required.

4-2 PREVENTIVE MAINTENANCE

a. **Cleaning and Visual Inspection.** A regular program of inspection and maintenance is recommended to minimize down-time. The operating environment and amount of usage will dictate how often the instrument should be cleaned; in the absence of more stringent conditions, inspection every four to six months is recommended. Check the instrument in the following manner:

(1) Disconnect the power cord. Inspect the exterior of the instrument for broken knobs, switches, or connectors.

(2) Remove the top and bottom covers using the disassembly procedure in Subsection 4-4. If the internal surfaces and components have an excessive amount of dust deposited on them, use a low-pressure stream of air and a soft brush to remove the foreign material.

CAUTION

Do not clean the printed circuit boards with solvents, since damage to the circuits may result.

(3) Check the physical integrity of components and wiring. Look for evidence of loose tubes or connections, broken terminals, leakage of insulation compounds, and heat damage. In most cases, the source of a visually detected trouble is easily located. In the case of heat damage however, care should be taken to locate the original cause of the overheating before the instrument is put back in service.

b. **Voltage Checks.** It is difficult to make meaningful resistance measurements in solid-state circuitry. For that reason, the following voltage tests are used to aid in locating possible trouble spots. The wiring terminals are shown on the printed circuit board photographs in Section 6. In the unlikely event of a malfunction, these measurements can be used in conjunction with the reference levels on the schematic waveforms. The following measurements were made with a Simpson Model 262 volt-ohm-milliammeter; any substitute meter should be rated at 20 kilohms per dc volt and ±2% accuracy.

4-2 Continued

RECTIFIER AND LOW VOLTAGE REGULATOR BOARD
(all measurements reference to chassis ground)

Terminal	Voltage
A	270 V ac
B	205 V ac
C	205 V ac
D	- 11.5 V dc
E	10 V ac
F	10 V ac
G	11.5 V dc
H	- 5.1 V dc
J	Ground
K	5.1 V dc
L	355 V dc
M	- 270 V dc
N	- 355 V dc

HIGH VOLTAGE REGULATOR BOARD

Terminal	Voltage
A	- 355 V dc
B	- 270 V dc
C	7.5 V dc
D	≈ 5 V dc
E	- 40 V dc
F	0 (+) or 200 V dc (-)
H	355 V dc
J	+ 130 V dc
K	+ 130 V dc
L	- 150 V dc
M	
N	
P	
R	
S	
T	Varies

4-3 PERFORMANCE VERIFICATION PROCEDURE

a. **General.** The following procedure serves as both a "covers on" receiving inspection and a check of instrument specification. In the former sense, this check should be performed as soon as possible after receipt of the instrument. In the latter sense, the procedure can be used to verify the effectiveness of repairs or alignment. A first-time turn-on procedure is contained in Subsection 2-6.

b. **Recommended Test Equipment.** The following is a list of the test equipment recommended for verifying proper

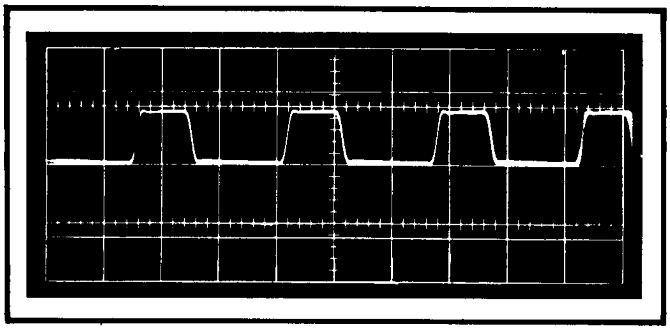


Figure 4-1 Initial Waveform Presentation

4-3 Continued

operation of the E-H Model 132A Pulse Generator.

(1) Oscilloscope. Tektronix Model 541A with Type L, 1A1, and 1S1 plug-ins. The fast-risetime plug-in can be used to observe all parameters except distortion for which the 1S1, with its 50Ω input environment and dc offset capability, is better suited. Delay is observed with the dual-trace plug-in.

(2) Pulse Generator. E-H Model 132A. The test pulse generator is used to generate gating and external drive signals.

(3) 4 lengths of 50Ω coaxial cable. These cables are used to interconnect the Model 132A and test oscilloscope and test pulse generator. Two of the BNC/BNC cables should be the same length.

(4) 50Ω 40 W termination.

(5) 100: 1 Tap-off. The tap-off will be used to connect the termination to the Model 132A and provide a terminal at which the output may be observed. Operating into the high-impedance plug-ins, the tap-off ratio is 50:1.

c. **Initial Set-up**. The function of front panel controls and connectors is described in Subsection 2-3. During the check of any particular function, controls for the other functions may be varied as necessary to maintain a meaningful presentation on the test oscilloscope. Initial set-up of controls on the Model 132A should be as follows:

PULSE MODE	SINGLE
POWER	OFF
FREQUENCY	500 KC/3.5 MC
FINE	cw
DELAY	.1/1 micro sec
FINE	ccw
WIDTH	.1/1 micro sec
FINE	ccw
RISETIME	ccw
AMPLITUDE	cw
POLARITY	+
ATTENUATOR	5

Install the Type L plug-in in the test oscilloscope. Using one length of BNC/BNC co-ax, connect the TRIGGER OUTPUT of the Model 132A to the trigger input of the test oscilloscope. Use a BNC/GR adapter to connect the 100:1 tap-off to the Model 132A PULSE OUTPUT; connect the 40 W termination to the tap-off. Connect a GR/BNC cable from the 100:1 tap to the signal input of the Type L plug-in. Set up the test oscilloscope as follows:

Vertical sensitivity	0.2 V/cm
Input	dc-coupled
Sweep speed	0.1 μs/cm
Trigger	dc mode, EXTERNAL NEGATIVE

4-3 Continued

Turn on the Model 132A and the test oscilloscope, and obtain a stable presentation on the scope. The presentation should look like Figure 4-1.

d. **Repetition Rate Check.** Requirement: internal clock frequency continuously variable from less than 5 Hz to more than 3.5 MHz. The initial set-up leaves the Model 132 operating at maximum frequency with minimum delay interval and pulse width. At maximum frequency, output pulse period is less than 286 ns. Rotate the FINE (FREQUENCY) control counter-clockwise and observe that, as repetition rate decreases, amplitude increases slightly. The decrease in amplitude at duty factors greater than 25% is caused by automatic current limiting circuitry which protects the output circuits.

Turn the FREQUENCY switch counter-clockwise and observe smooth operation of the associated FINE control over each range. In general, for each position counter-clockwise that the FREQUENCY switch is turned, the DELAY and WIDTH switches can be turned one position clockwise. Test oscilloscope sweep speed should also be reduced. At the lowes repetition rate (less than 5 Hz), rotate the FINE (WIDTH) control clockwise to make the test oscilloscope presentation easier to read. At minimum frequency, output pulse period is more than 200 ms.

e. **Amplitude Check.** Requirement: continuously variable from more than 50 V to less than 0.4 V. Amplitude may be checked at any repetition rate. The following procedure describes a set-up which will produce a presentation of a single 0.5 μs pulse at a 200 kHz rate.

NOTE

If output signal duty factor is increased to more than 25% at any repetition rate, some reduction in amplitude occurs automatically.

Increase test oscilloscope sweep speed to 0.5 μs/cm and decrease input sensitivity to 0.5 V/cm. On the Model 132A, set the DELAY and WIDTH switches to the .1/1 micro sec position and turn the associated FINE controls fully counter-clockwise. Turn the FREQUENCY switch to the 50/500 KC position and adjust the associated FINE control to provide an output repetition rate of 200 kHz (4 μs period). Increase pulse width to 0.5 μs with the FINE (WIDTH) control. Turn the DELAY switch to the 1/10 micro sec position and increase the delay interval with the FINE (DELAY) control to center one pulse on the scope face. Turn the ATTENUATOR to the 1 position. The oscilloscope presentation should look similar to Figure 4-2.

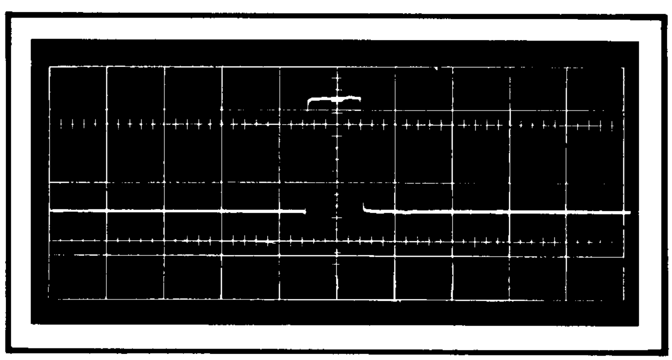


Figure 4-2 Amplitude Check Waveform

-3 Continued

Rotate the AMPLITUDE control counter-clockwise and observe the smooth reduction in output pulse amplitude. Change the position of the POLARITY switch, noting that the amplitude is the same in either polarity. Increase the attenuation and check for smooth amplitude control over each range.

f. **Width Check.** Requirement: output pulse width continuously variable from less than 0.1 μs to more than 10 ms. Rotate the FINE (WIDTH) control fully counter-clockwise. Set the DELAY switch to the .1–to–1 micro sec position and turn the associated FINE control fully counter-clockwise. Set the FREQUENCY switch to the 500 KC–to–3.5 MC position and rotate the associated FINE control fully counter-clockwise. Increase the test oscilloscope sweep speed to 0.1 μs/cm.

Pulse width is measured at 50% of amplitude. Rotate the FINE (WIDTH) control clockwise, observing the smooth increase in pulse width, and decreasing test oscilloscope sweep speed as necessary. For each position that the WIDTH switch is turned clockwise, the FREQUENCY switch should be turned counter-clockwise one position. This prevents erratic outputs which would result from exceeding the width circuit recovery-time requirements.

g. **Delay Check.** Requirement: time interval between trigger signal and pulse output continuously variable from less than 0.1 μs to more than 10 ms. Replace the Type L plug-in with the Type 1A1 dual trace plug-in. Connect the signal from the tap-off to channel 2 and set vertical sensitivity to 0.2 V/cm. Connect the Model 132A trigger signal to channel 1 and set vertical sensitivity to 5 V/cm. The two input cables to the test oscilloscope should be of equal length. Set the plug-in to display alternate channels. Connect the signal from the channel 1 trigger output on the plug-in to the trigger input on the test oscilloscope. Set the oscilloscope to accept a positive external trigger. Increase sweep speed to 0.1 μs/cm. Return the Model 132A to the initial set-up condition. The scope presentation should be similar to Figure 4-3.

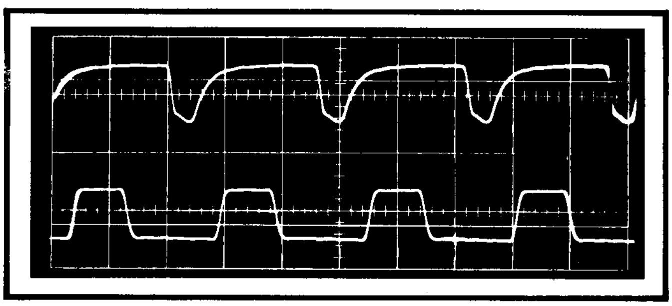


Figure 4-3 Delay Check Waveform

Turn the FINE (FREQUENCY) control fully counter-clockwise. This will leave one trigger signal and one output pulse displayed on the test oscilloscope. Delay interval, measured from leading edge of trigger to leading edge of pulse, is at minimum (less than 0.1 μs). Rotate the FINE (DELAY) control clockwise, observing the smooth increase in delay interval. Decrease test oscilloscope sweep speed as necessary. Increase delay range, turning the FREQUENCY switch counter-clockwise one position for each position the DELAY switch is turned clockwise. Check operation of the FINE (DELAY) control over each range. Pulse width may be

4-3 Continued

increased as necessary to make the pulse easier to see. At low sweep speeds the narrow trigger signal will disappear. At these sweep speeds, delay can be measured from the start of the trace on the test oscilloscope presentation.

h. **Risetime and Distortion Check.** Requirements: risetime continuously variable from less than 12 to more than 100 ns (positive) and less than 10 to more than 100 ns (negative); pulse-top distortion less than 5% peak-to-peak at 50 V in either polarity. Disconnect the signal and trigger leads from the test oscilloscope and replace the 1A1 plug-in with the 1S1 sampling plug-in.

Return the Model 132A to the initial set-up condition. Place the 10x BNC attenuator at the trigger input of the plug-in and connect the trigger signal from the Model 132A to the attenuator with a BNC/BNC cable. Connect the signal from the tap-off to the signal input of the plug-in with a GR/GR cable.

NOTE

With the tap-off operating into a 50Ω environment, it will exhibit a 100:1 reduction ratio.

Set up the plug-in as follows:

Trigger	EXTERNAL NEGATIVE
Sweep speed	50 ns/cm
Vertical sensitivity	50 mV/cm

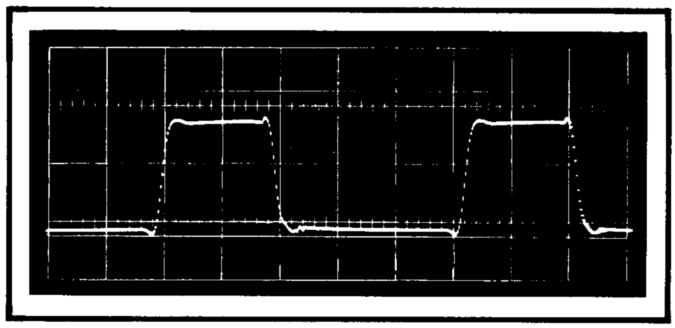


Figure 4-4 Risetime and Distortion Check Waveform

The test oscilloscope presentation should be similar to Figure 4-4.

Risetime is measured between the 10% and 90% amplitude points on the leading edge of the output pulse at 50 V amplitude. Since risetime can be increased to more than 100 ns, pulse width should be at least 300 ns to avoid distorting the output pulse. To achieve this pulse width, repetition rate must be reduced. Proceed as follows: Decrease test oscilloscope input sensitivity and sweep speed. On the Model 132A, turn the ATTENUATOR to the 1 position. Rotate the FINE (FREQUENCY) control counter-clockwise until output repetition rate is 500 kHz (2 μs period). Rotate the FINE (WIDTH) control clockwise until pulse width is more than 0.3 μs, but not to the point where automatic amplitude limiting occurs.

Increase test oscilloscope sweep speed to 10 ns/cm. On the Model 132A, rotate the FINE (DELAY) control clockwise until the leading edge of the output pulse is visible on the scope presentation. Using the time magnifier on the plug-in, expand the leading edge until a meaningful measurement can

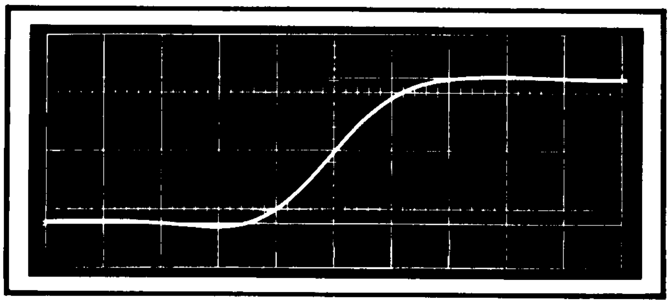


Figure 4-5 Expanded Risetime Waveform

4-3 Continued

be made. Figure 4-5 shows an expansion to 5 ns/cm. Check minimum risetime in both polarities.

Remove the time magnification and decrease test oscilloscope sweep speed until the entire trace is longer than 100 ns. Again display the leading edge of the output pulse. On the Model 132A, rotate the RISETIME control clockwise and observe the smooth increase of risetime to more than 100 ns. Check this feature in both output polarities of the Model 132A. Figure 4-6 shows maximum negative risetime at a sweep speed of 20 ns/cm.

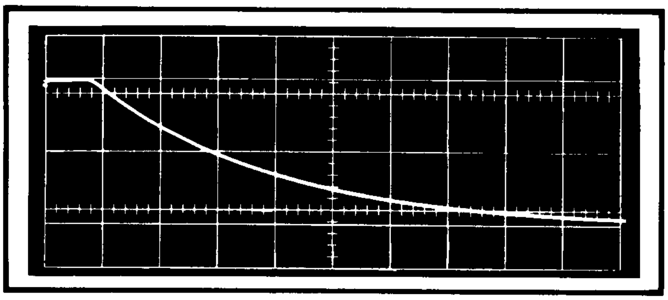


Figure 4-6 Expanded Risetime, Negative Pulse

On the Model 132A, reduce delay and width time intervals to minimum and increase repetition rate to maximum. Turn the RISETIME control fully counter-clockwise. Increase test oscilloscope sweep speed until a single output pulse is displayed. Increase plug-in input sensitivity, simultaneously offsetting the waveform until only the pulse top is displayed at least 10 mV/cm.

NOTE

When output pulse amplitude is 50 V, 5% distortion would be 2.5 V. The tap-off reduces this to 25 mV. At 10 mV/cm, 2.5 cm of distortion would be 5%.

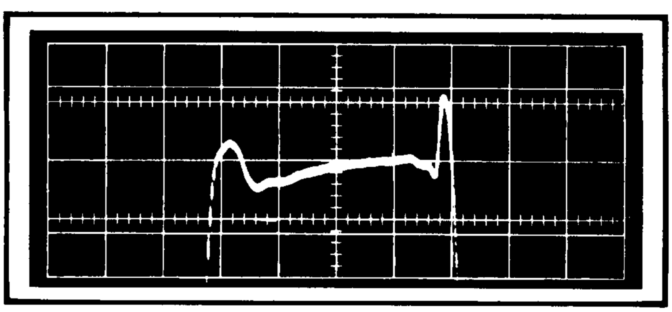


Figure 4-7 Pulse Top Distortion

4-3 Continued

Figure 4-7 shows a positive pulse-top. Peak-to-peak distortion is approximately 16 mV or slightly more than 3%. Replace the sampling plug-in with the Type L plug-in and return the test oscilloscope and the Model 132A to the initial set-up condition.

i. **External Drive and Single-cycle Check.** Requirement: externally driven from 0 to 3.5 MHz by -5 V (input impedance ≈ 2 kΩ). Set up the test pulse generator to produce a 3.5 MHz -5 V output. Place the FREQ. RANGE switch on the Model 132A in the EXT position and turn the associated FINE control counter-clockwise. Connect the output of the test pulse generator to the EXT. DRIVE INPUT connector of the Model 132A. Observe the 132A output while varying the repetition rate of the test pulse generator.

With the FREQ. RANGE switch still in the EXT position, turn the WIDTH switch to the 1–to–10 milli sec position. Decrease test oscilloscope sweep speed to 0.5 ms/cm. Depress the SINGLE CYCLE pushbutton and observe the single output cycle. Place the PULSE MODE switch in the DOUBLE position and increase the delay interval sufficiently to produce two pulses.

NOTE

Single-cycle operation is available at any pulse width or delay interval. The specific values for this test were chosen to make this type of operation easy to display.

j. **Gate Check.** Requirement: output pulse train asynchronously gated by -5 V signal at GATE INPUT connector. Return the test oscilloscope and Model 132 to the initial set-up condition. Decrease test oscilloscope sweep to 1 μs/cm. Set up the test pulse generator to produce a 250 kHz pulse train with pulses 2.5 μs wide and -5 V in amplitude. Apply this signal to the GATE INPUT connector of the Model 132A.

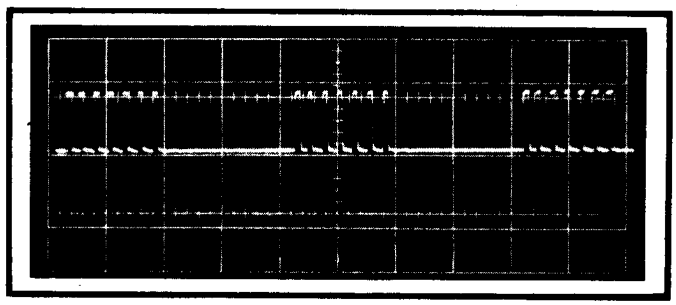


Figure 4-8 Gated Pulse Waveform

NOTE

The input impedance at the GATE INPUT is ≈ 2 kΩ. If the test pulse generator requires a 50Ω load impedance, a 50Ω feed-through termination should be inserted in the gate signal path.

The output of the Model 132A will be similar to Figure 4-8. Vary the gate signal width and frequency and observe the effect on the output. As gate signal repetition rate of pulse width approaches that of the Model 132A, gating action may become erratic.

-3 Continued

k. **Trigger Check.** Requirement: -4 V trigger signal occurring once for each clock cycle. Trigger the test oscilloscope internally and set input sensitivity to 2 V/cm. Disconnect the Model 132A output signal from the test oscilloscope; reconnect the signal from the TRIGGER OUTPUT connector to the scope input. The trigger signal will appear similar to Figure 4-9.

NOTE

The TRIGGER OUTPUT signal can be operated into a 50Ω environment without damage to the Model 132. Operation into a 50Ω terminating impedance results in a signal of reduced amplitude (≈ 2 V).

l. **Double-pulse Check.** Requirement: double-pulse operation at repetition rates up to 500 kHz. In the double-pulse mode, pulse spacing is determined by the DELAY switch. The delay interval is measured from the leading edge of the first pulse to the leading edge of the second. Timing onsiderations for double-pulse operation are discussed in Paragraph 2-4e.

Return the Model 132A and test oscilloscope to the intial set-up condition. Turn the FREQ. RANGE switch to the 50–to–500 KC position. Place the PULSE MODE switch in the DOUBLE positon and rotate the FINE (DELAY) control clockwise until the second pulse appears (≈ 300 ns delay). Decrease test oscilloscope sweep speed until several pulse pairs are displayed on the scope. Vary the delay and width time intervals and observe the effect on the output. See Paragraph 4-3i for double-pulse operation in the single-cycle mode.

This concludes the performance verification procedure.

4-4 RECALIBRATION PROCEDURE

a. **General.** The recalibration procedure should be performed following component replacement and at any time when failure to meet specifications is not traceable to component failure. Calibration should not be attempted on a ɔutine basis; routine maintenance is given in Subsection 4-2. rior to performing the recalibration procedure, read Section 3 of this manual. A thorough understanding of operating principles is necessary to obtain optimum performance from the instrument.

b. **Disassembly Procedure.**

WARNING

Dangerous voltages are present on exposed terminals in the ac power distribution when the instrument is plugged in. These voltages are also present in the power supply and output circuitry when the instrument is energized.

Before disassembly, turn off the POWER switch and disconnect the three-conductor power cord. The top/rear cover can be removed by removing the six screws on the top and four screws on the back of the instrument. The bottom cover is removed by removing the nine screws on its periphery. All of these screws mate with captive fasteners.

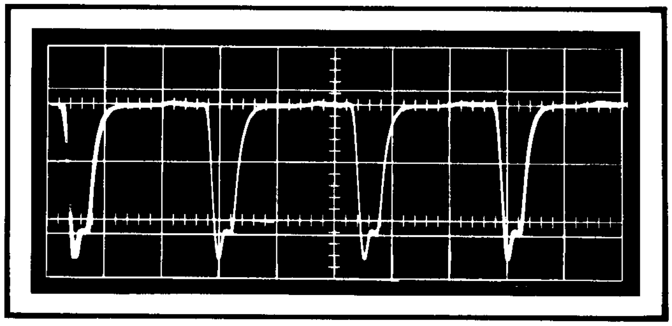


Figure 4-9 Trigger Signal Waveform

4-4 Continued

c. **Recommended Test Equipment.** In addition to the test equipment recommended for the performance verification procedure (Paragraph 4-3b), a volt-ohm-milliameter is required for power supply calibration. The dual-trace and sampling plug-ins are not required for recalibration, but are necessary for in-depth troubleshooting. The VOM should have a sensitivity of 20 kΩ/Vdc.

d. **Power Supply Adjustment.** Use the component location photograph in Section 6 to locate terminals H, J, and K on the Rectifier and Low Voltage Regulator Board. Potentiometer R134 adjusts the +5.1 V supply, which can be monitored at terminal K (referenced to ground at J). The -5.1 V supply (terminal H) is not adjustable, but should be within ±0.1 V of -5.1 V when the positive supply is properly adjusted.

Locate terminal S on the High Voltage Regulator Board and monitor the +175 V supply at that point. Potentiometer R112 is located adjacent to the board and labelled +175 ADJ.

e. **High Frequency Adjustment.** With the FREQ. RANGE switch in the 500 KC–to–3.5 MC position and the associated FINE control fully clockwise, observe the output frequency. Adjust C49 on the FREQ. RANGE switch for a repetition rate of 3.5 MHz.

This concludes the alignment procedure.

4-5 MAINTENANCE NOTES

a. **General.** Be sure that there is a malfunction before assuming a fault in the instrument. Check for proper termination and signal handling, and proper operation of the oscilloscope or device under test. Troubleshooting should proceed from power supply checks to signal tracing. The fault should first be isolated to either the timing or output circuits and from there to the failed component.

b. **Power Supply Checks.**

(1) Monitor the +5.1 V and -5.1 V power supplies at terminals K and H on the Rectifier and Low Voltage Regulator Board. These supplies are the power source for the solid-state timing circuits. The positive supply is adjustable (see recalibration procedure, Subsection 4-4); the negative should be within 0.1 V of -5.1 V when the positive supply is adjusted properly. Ripple on either supply should be less than 15 mV P-P.

(2) Observe an attenuated negative output and adjust the +175 V supply for an amplitude of -51 V. Plate voltage on V1 on the RF Deck should be +180 V and no less

4-5 Continued

than +170 V. Ripple should be less than 100 mV P-P.

(3) Monitor the -150 V supply at terminal L on the High Voltage Regulator Board. This supply is not adjustable and should be within ±5% of -150 V. Ripple should be less than 1 V P-P.

(4) Check the screen supply to V1 at terminal T on the High Voltage Regulator Board. Output from this supply is adjusted with the front panel AMPLITUDE control, and varies between +90 V and +240 V ±5%. Ripple should be less than 1 V P-P at maximum output.

c. **Signal Tracing.**

(1) Observe the start and stop signals at the collectors of Q13 and Q16 respectively (RF Deck). If these signals are present but no output is available, the trouble is in the timing circuits. If the start and stop signals are not present begin at the clock multi, using the waveforms on the schematics, and trace the location of the malfunction.

(2) Even a high-impedance oscilloscope probe may detune the timing multivibrators sufficiently to alter frequency or timing interval. If the trouble is located to a multi, simultaneous replacement of all the transistor is usually the quickest way to solve the problem.

SECTION 5
PARTS LIST

5-1 ORDERING INFORMATION

Replacement parts may be ordered through an E-H Representative or directly from the factory. To be certain of receiving the proper parts, always include the following information with the order:

a. Model Number and serial number of the instrument on which the parts will be installed.

b. Circuit reference number and subassembly name, if applicable, for which the part is intended. If the part does not have a circuit reference, the description from the parts list should be used.

c. E-H part number.

The warranty and instructions for in-warranty repair of this instrument are given on page II of this manual, opposite the Table of Contents. For factory repair, contact the Customer Service Department of E-H Research Laboratories, Inc., at the address given on the title page of this manual. Include the following information:

a. Model number and serial number of the instrument on which the work is to be performed.

b. Details concerning the nature of the malfunction; or, type of repair desired.

Shipping instructions will be sent to you promptly.

5-2 HOW TO USE THIS PARTS LIST

The parts list is divided into subsections corresponding to the physical subsections of the instrument (printed circuit boards, chassis and subassemblies, miscellaneous hardware). Component locations can be determined from the schematic diagrams and printed circuit board photographs in Section 6; each component appears only once in the parts list. At the beginning of each subsection are listed part numbers for any complete subassemblies in that category that are available as replacement parts. These subassemblies may include individually-listed components; care should be taken to locate malfunctions to the lowest possible level of replacement part and thus avoid the time and cost involved in "over-repair".

Two types of E-H part numbers appear in the parts list: hyphenated six-digit numbers and unhyphenated five-digit numbers. Components with six-digit part numbers may be replaced with components of like value and quality, providing that the replacement is of the same physical size. Components with five-digit part numbers comply with particular E-H Research Laboratories specifications; these components should be ordered through an E-H Representative or directly from the factory.

In the component descriptions, capacitor dielectrics are abbreviated as follows: polyethylene (poly.), ceramic (cer.), printed circuit (P.C.), electrolytic (elect.) and tantalum (tant.). Resistor and potentiometer values are given in ohms; the symbol for "ohm" (Ω) has been omitted. If no material is listed, resistors may be assumed to be carbon composition; other resistor types are metal film (MF) and wire-wound (WW). An asterisk following a component value indicates that the actual value is factory-selected at time of manufacture; the listed value is nominal. Procedures for re-selecting these components are given in Section 4.

5-3 R.F. Deck

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C8	Cap.,25μF,25V,Cer.	316-028
C9	Cap.,0.01μF,Cer.	311-012
C10	Cap.,25μF,25V,Cer.	316-028
C11	Cap.,0.01μF,Cer.	311-012
C12	Cap.,10pF,Cer.	311-001
C13	Cap.,100pF,Cer.	311-007
C14	Cap.,0.01μF,Cer.	311-012
C15	Cap.,150pF,Cer.	311-008
C21	Cap.,25μF,25V,Cer.	316-028
C22	Cap.,0.01μF,Cer.	311-012
C23	Cap.,25μF,25V,Cer.	316-028
C24	Cap.,0.01μF,Cer.	311-012
C25	Cap.,25μF,25V,Cer.	316-028
C26	Cap.,0.01μF,Cer.	311-012
C27	Cap.,25μF,25V,Cer.	316-028
C28	Cap.,0.01μF,Cer.	311-012
C34	Cap.,0.01μF,Cer.	311-012
C35	Cap.,25μF,25V,Cer.	316-028
C36	Cap.,100pF,Cer.	311-007
C37	Cap.,150pF,Cer.	311-008

5-3 Continued

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C38	Cap.,100pF,Cer.	311-007
C39	Cap.,0.001μF,Cer.	311-010
C40	Cap.,50pF,Cer.	311-006
C41	Cap.,0.01μF,Cer.	311-012
C42	Cap.,25μF,25V,Cer.	316-028
C43	Cap.,0.1μF,75V,Cer.	311-014
C44	Cap.,0.1μF,500V,Cer.	311-023
C51	Cap.,0.01μF,Cer.	311-012
C52	Cap.,0.01μF,Cer.	311-012
C53	Cap.,100pF,Cer.	311-007
C54	Not Used	
C55	Not Used	
C56	Not Used	
D2	Not Used	
D3	Diode,1N751	374-022
D4	Diode,1N914B	376-022
D5	Diode,1N270	376-031
D6	Diode,1N270	376-031
D7	Diode,1N746A	374-017
D8	Diode,1N270	376-031
D9	Diode,1N270	376-031
D10	Diode,1N270	376-031
D11	Diode	11742
D12	Diode	11742
D13	Diode	11742
D14	Diode,1N270	376-031
D15	Diode	11742
D16	Diode	11742
D17	Diode,1N270	376-031
D18	Diode	11742
D19	Diode,1N270	376-031
D20	Not Used	
D21	Diode	11742
D22	Not Used	
D23	Diode	11764
D24	Diode	11764
D25	Diode,1N914B	376-022
D26	Diode,1N914B	376-022
D27	Diode,1N914B	376-022
D28	Diode,1N3803A	374-001
D29	Diode,1N914B	376-022
D30	Diode,1N914B	376-022
D31	Diode,1N270	376-031
D32	Diode,1N270	376-031
D33	Diode	11742
L1	Filter Assembly	11564
L2	Filter Assembly	11564
L3	Filter Assembly	11564
L4	Filter Assembly	11564
L5	Filter Assembly	11564
L6	Filter Assembly	11564
L7	Filter Assembly	11564
L8	Filter Assembly	11564

5-3 Continued

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
L10	Choke,1.5μH	335-001
L11	Choke,1.5μH	335-001
L12	Choke,1.5μH	335-001
L13	Choke,1.5μH	335-001
Q1	Transistor,2N966	663-032
Q2	Transistor,2N966	663-032
Q3	Transistor,2N966	663-032
Q4	Transistor,2N966	663-032
Q5	Transistor,2N706A	663-022
Q6	Transistor,2N966	663-032
Q7	Transistor,2N966	663-032
Q8	Transistor,2N966	663-032
Q9	Transistor,2N966	663-032
Q10	Transistor,2N966	663-032
Q11	Transistor,2N966	663-03
Q12	Transistor,2N966	663-032
Q13	Transistor,2N2369	663-009
Q14	Transistor,2N3468	663-052
Q15	Transistor,2N4047	663-096
Q16	Transistor,2N834	663-028
Q17	Transistor,2N706A	663-022
R3	Resistor,100,1/2W,5%	596-101
R4	Resistor,10,1/2W,5%	596-100
R5	Resistor,180,1/2W,5%	596-181
R6	Resistor,10,1/2W,5%	596-100
R7	Resistor,150,1/2W,5%	596-151
R8	Resistor,200,1/2W,5%	596-201
R9	Resistor,1k,1/2W,5%	596-102
R10	Resistor,3k,1/2W,5%	596-302
R11	Resistor,1M,1/2W,5%	596-105
R12	Resistor,22k,1/2W,5%	596-223
R13	Resistor,300,1/2W,5%	596-301
R14	Resistor,18k,1/2W,5%	596-18
R15	Resistor,2.4k,1/2W,5%	596-24
R16	Resistor,180,1/2W,5%	596-181
R17	Resistor,220,1/2W,5%	596-221
R18	Resistor,30k,1/2W,5%	596-303
R19	Resistor,75,1/2W,5%	596-750
R20	Resistor,750,1/2W,5%	596-751
R21	Resistor,330,1/2W,5%	596-331
R22	Resistor,430,1/2W,5%	596-431
R23	Resistor,180,1/2W,5%	596-181
R24	Resistor,51,1/2W,5%	596-510
R28	Resistor,220,1/2W,5%	596-221
R29	Resistor,1k,1/2W,5%	596-102
R30	Resistor,2k,1/2W,5%	596-202
R31	Resistor,300,1/2W,5%	596-301
R32	Resistor,330,1/2W,5%	596-331
R33	Resistor,430,1/2W,5%	596-431
R34	Resistor,750,1/2W,5%	596-751
R35	Resistor,75,1/2W,5%	596-750
R36	Resistor,51,1/2W,5%	596-51
R37	Resistor,160,1/2W,5%	596-161

5-3 Continued

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
R40	Resistor,510,1/2W,5%	596-511
R41	Resistor,180,1/2W,5%	596-181
R42	Resistor,110,1/2W,5%	596-111
R45	Resistor,2M,1/2W,5%	596-205
R46	Resistor,3.3k,1/2W,5%	596-332
R47	Resistor,330,1/2W,5%	596-331
R48	Resistor,5.1k,1/2W,5%	596-512
R49	Resistor,430,1/2W,5%	596-431
R51	Resistor,22k,1W,5%	597-223
R52	Resistor,16k,2W,5%	598-163
R53	Resistor,16k,2W,5%	598-163
R54	Resistor,56k,1/2W,5%	596-563
R55	Resistor,4.3k,1/2W,5%	596-432
R56	Not Used	
R57	Resistor,33k,2W,5%	598-333
R58	Resistor,33k,2W,5%	598-333
R59	Resistor,33k,2W,5%	598-333
R60	Potentiometer,500,2W,10%	550-029
R61	Resistor,5.1,1/2W,5%	596-051
R62	Resistor,110,1/2W,5%	596-111
R84	Resistor,82k,1/2W,5%	596-823
R85	Resistor,2.7k,1/2W,5%	596-272
R86	Resistor,43k,1/2W,5%	597-433
R87	Resistor,1k,1/2W,5%	596-102
T1	Transformer	13767
V1	Tube 7534	10485

5-4 Rectifier & Low Voltage Regulator

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C111	Cap.,250μF,12V,Elect.	316-031
C112	Cap.,250μF,12V,Elect.	316-031
C113	Cap.,250μF,12V,Elect.	316-031
C114	Cap.,250μF,12V,Elect.	316-031
D101	Diode,1N4005	376-034
D102	Diode,1N4005	376-034
D103	Diode,1N4005	376-034
D104	Diode,1N4005	376-034
D105	Diode,1N4005	376-034
D106	Diode,1N4005	376-034
D107	Diode,1N4005	376-034
D108	Diode,1N4005	376-034
D109	Diode,1N4005	376-034
D110	Diode,1N4005	376-034
D111	Diode,1N753	374-019
Q102	Transistor,2N1306	663-018
Q103	Transistor,2N1309	663-021
Q104	Transistor	11705
Q105	Transistor	11705
R101	Resistor,30,5%,1W	597-300
R102	Resistor,5,10W,WW	610-017
R103	Resistor,30,5%,1W	597-300
R130	Resistor,2.7,5%,1W	597-027

5-4 Continued

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
R131	Resistor,2.7,5%,1W	597-027
R132	Resistor,150,5%,1/2W	596-151
R133	Resistor,150,5%,1/2W	596-151
R134	Potentiometer,200	551-017
R135	Resistor,510,5%,1/2W	596-511
R136	Resistor,510,5%,1/2W	596-511
R137	Resistor,510,5%,1/2W	596-511
R138	Resistor,510,5%,1/2W	596-511
R139	Resistor,750,5%,1/2W	596-751
R140	Resistor,510,5%,1/2W	596-511
R141	Resistor,15,5%,1/2W	596-150
R142	Resistor,511,1%,1/2W,MF	618-002
R143	Resistor,475,5%,1/2W,MF	618-015

5-5 High Voltage Regulator Board

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C104	Cap.,1μF,200V,Mylar	320-010
C105	Cap.,0.1μF,75V,Cer.	311-014
C106	Cap.,250μF,12V,Elect.	316-031
C107	Cap.,500pF,1kV,Cer.	311-009
C115	Cap.,0.25μF,200V	320-021
Q101	Transistor,2N1309	663-021
R104	Resistor,4k,10W,5%,WW	610-020
R105	Resistor,62k,1/2W,5%	596-623
R106	Resistor,160k,1/2W,5%	596-164
R107	Resistor,360k,1/2W,5%	596-364
R108	Resistor,100,1/2W,5%	596-101
R109	Resistor,22,1/2W,5%	596-220
R110	Resistor,30k,1W,5%	597-303
R111	Resistor,150k,1/2W,5%	596-154
R113	Resistor,160k,1/2W,5%	596-164
R114	Resistor,22,1/2W,5%	596-220
R115	Resistor,100,1/2W,5%	596-101
R116	Resistor,100,1/2W,5%	596-101
R117	Resistor,22,1/2W,5%	596-220
R118	Resistor,22,1/2W,5%	596-220
R119	Resistor,100,1/2W,5%	596-101
R120	Resistor,100k,1/2W,5%	596-104
R121	Resistor,51k,1/2W,5%	596-513
R122	Resistor,180,1/2W,5%	596-181
R123	Resistor,27k,2W,5%	598-273
R124	Resistor,10k,1/2W,5%	596-103
R125	Resistor,5,3W,5%,WW	610-003
R126	Resistor,100k,1/2W,5%	596-104
R127	Resistor,160k,1/2W,5%	596-164
R129	Resistor,150k,1/2W,5%	596-154
R147	Resistor,150,1/2W,5%	596-151
V101	Tube,6080	670-017
V102	Tube,6080	670-017
V103	Tube,6AU6	670-010
V104	Tube,6AU6	670-010
V105	Tube,OA2	670-007
V106	Tube,7119	670-021

5-6 Chassis-Mounted Components

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C45	Cap.,0.01μF,Cer.	311-012
C46	Cap.,1μF,Mylar	320-011
C47	Cap.,0.01μF,Mylar	320-012
C48	Cap.,0.01μF,Cer.	311-012
C101	Cap.,250μF,300V,Elect.	316-040
C102	Cap.,100μF,450V,Elect.	316-008
C103	Cap.,100μF,450V,Elect.	316-008
C108	Cap.,100-100μF,350V,Elect.	316-022
C109	Cap.,4000μF,15V,Elect.	316-003
C110	Cap.,4000μF,15V,Elect.	316-003
F101	Fuse,3A, slo-blo	698-003
J101	Receptacle,power	700-018
L9	Choke,filament,RF,	10559
R63	Resistor,240,2W,5%	598-241
R64	Resistor,240,2W,5%	598-241
R65	Resistor,240,2W,5%	598-241
R66	Resistor,240,2W,5%	598-241
R67	Resistor,100,2W,5%	598-101
R68	Resistor,100,2W,5%	598-101
R69	Resistor,100,2W,5%	598-101
R70	Resistor,100,2W,5%	598-101
R71	Resistor,240,2W,5%	598-241
R72	Resistor,240,2W,5%	598-241
R73	Resistor,240,2W,5%	598-241
R74	Resistor,240,2W,5%	598-241
R75	Resistor,240,2W,5%	598-241
R76	Resistor,240,2W,5%	598-241
R77	Resistor,13,1W,5%	597-130
R78	Resistor,13,1W,5%	597-130
R79	Resistor,13,1W,5%	597-130
R80	Resistor,12,1W,5%	597-120
R81	Resistor,3.3,1W,5%	597-033
R82	Resistor,5.1,1W,5%	597-051
R83	Resistor,5.1,1/2W,5%	596-051
R88	Resistor,240,2W,5%	598-241
R89	Resistor,240,2W,5%	598-241
R112	Potentiometer,50k,10%, 2W,locking	545-008
R145	Not Used	
R146	Resistor,39k,2W,5%,CC	598-393
S4	Switch,Rotary,5 Pole,2 Pos.	624-008
S5	Switch,Rotary,2 Pole,6 Pos.	624-004
T101	Transformer	10560
TB101	Terminal Board,11 point	484-015
XF101	Fuse Holder	596-001

5-7 Panel-mounted Components

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C1	Cap.,47μF,20V,Tant.	318-001
C2	Cap.,4.7μF,20V	318-002

5-7 Continued

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C3	Cap.,0.5μF,200V,Mylar	320-009
C4	Cap.,0.05μF,200V,Mylar	320-005
C5	Cap.,5000pF,500V	326-004
C6	Cap.,500pF,1kV,Cer.	311-009
C7	Cap.,0.001μF,500V,Poly	326-005
C16	Cap.,0.001μF,500V,Poly	326-005
C17	Cap.,0.01μF,500V,Poly	326-006
C18	Cap.,0.1μF,200V,Mylar	320-007
C19	Cap.,1μF,200V,Mylar	320-001
C20	Cap.,10μF,20V,Tant	318-005
C29	Cap.,0.001μF,500V,Poly	326-005
C30	Cap.,0.01μF,500V,Poly	326-006
C31	Cap.,0.1μF,200V,Mylar	320-007
C32	Cap.,1μF,200V,Mylar	320-001
C33	Cap.,10μF,20V,Tant.	318-005
C49	Cap.,7-100pF,Variable,Cer.	332-003
C50	Cap.,100pF,1kV,Cer.	311-007
C57	Cap.,0.01μF,Cer.	311-012
D1	Diode,1N746A	374-017
I101	Pilot Light	510-008
J1	Connector,BNC	721-013
J2	Connector,BNC	721-013
J3	Connector,BNC	721-013
J4	Connector,BNC	721-013
R1	Resistor,2k,1/2W,5%	596-202
R2	Potentiometer,2.5k,2W,10%	550-009
R25	Resistor,1k,1/2W,5%	596-102
R26	Potentiometer,10k,2W,10%	550-012
R27	Resistor,560,1/2W,5%	596-561
R38	Resistor,1k,1/2W,5%	596-102
R39	Potentiometer,10k,2W,20%	550-012
R43	Resistor,2k,1/2W,5%	596-202
R44	Resistor,10k,1/2W,5%	596-103
R50	Resistor,2k,1/2W,5%	596-202
R128	Potentiometer,100k,2W,10%	550-006
R144	Resistor,100k,1/2W,5%	596-104
S1	Switch,rotary,12 pos.,1 pole	624-040
S2	Switch,rotary,6 pos.,2 pole	624-005
S3	Switch,rotary,6 pos.,2 pole	624-005
S6	Switch,Pushbutton	635-003
S7	Switch,toggle,DPDT	630-006
S101	Switch,toggle,DPDT	630-006

5-8 Hardware

	Power Cord	786-001
	Knob,Large	443-007
	Knob,Medium	443-008
	Knob,Small	443-009
	Fan Blade	493-004
	Motor,fan	570-001

SECTION 6
DRAWINGS

6-1 GENERAL INFORMATION

This section of the manual contains photographs and drawings of the subassemblies and circuits in the E-H Model 132A Pulse Generator. The photographs contain the component circuit designators and show the location of the wiring terminals. On the schematics, physical subassembly boundaries are shown as well as functional element names. The theory of operation is located in Section 3 and the parts list is located in Section 5. Location of specific theory and parts list references is included on the schematic.

Figure 6-1 is an outline dimension drawing of the rack-mount configuration without end-frames. Figures 6-2 through 6-8 are the component location photographs. In general, parts on the R.F. Deck, polarity/attenuator subassembly, and front panel are numbered in consecutive alpha-numeric order commencing with C1. Components located on the power supply chassis and the two regulator boards are numbered in the one-hundreds. Refer to the photographs to determine the location of any specific component.

6-2 SCHEMATIC DIAGRAMS

There are six schematics and one block diagram following the component location photographs. Insofar as possible, the convention of signal-flow from left to right and current-flow from bottom to top are adhered to in the diagrams. Functional circuit groupings shown as individual blocks on the block diagram are shown as shaded green areas on the schematics. Drawing number seven is a master schematic (not a wiring diagram) showing the interconnection of all subassemblies and controls.

Component symbology and nomenclature follow generally-accepted practices. Resistance is given in ohms. Capacitor values less than 1 are in microfarads and more than 1 are in picofarads unless otherwise labeled. Multi-deck rotary switches are shown schematically inline.

Waveforms shown on the schematics were taken under the conditions listed below from a Tektronix Model 541A oscilloscope with an external graticule. A Type L plug-in and

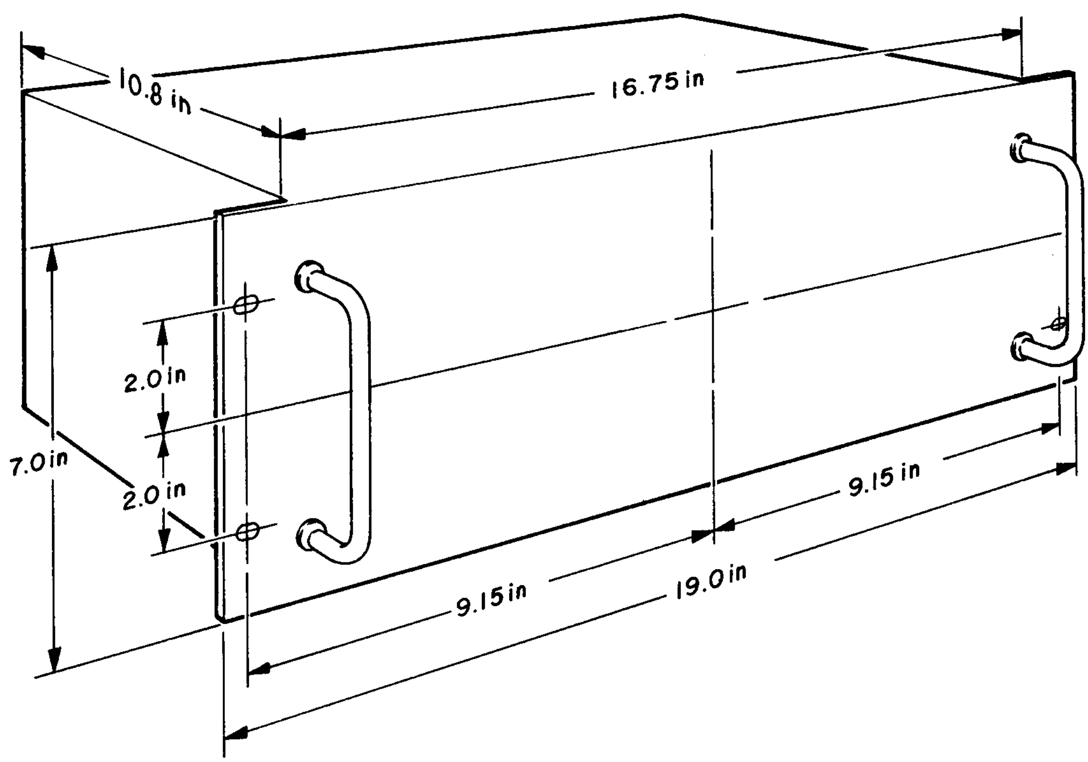


Figure 6-1 Outline Dimensions

6-2 Continued

Model P6028 (x1) probe were used. A Tektronix Model C-12 oscilloscope camera and Polaroid 3000 speed Type 47 film were used for the original photographs. Shutter speed was 1 second and lens opening was f5.6. The photographs were reduced and reversed (black on white) prior to printing.

Vertical sensitivity and sweep speed are shown on each waveform. The scope was externally triggered with the -4 V signal from the Model 132A TRIGGER OUTPUT. The controls on the Model 132A were set up as follows:

FREQUENCY .... 50/500 KC
FINE .... set to produce 400 kHz
DELAY .... 0.1/1 MICRO SEC

6-2 Continued

FINE .... set to produce 1 μs delay
WIDTH .... 0.1/1 MICRO SEC
FINE .... set to produce 1 μs width
RISETIME .... ccw
AMPLITUDE .... ccw
POLARITY .... +
ATTENUATOR 50
PULSE MODE .... SINGLE
POWER .... ON

The PULSE OUTPUT was terminated in a 50Ω resistive load. The probe ground was located as close as practical to the point under observation.

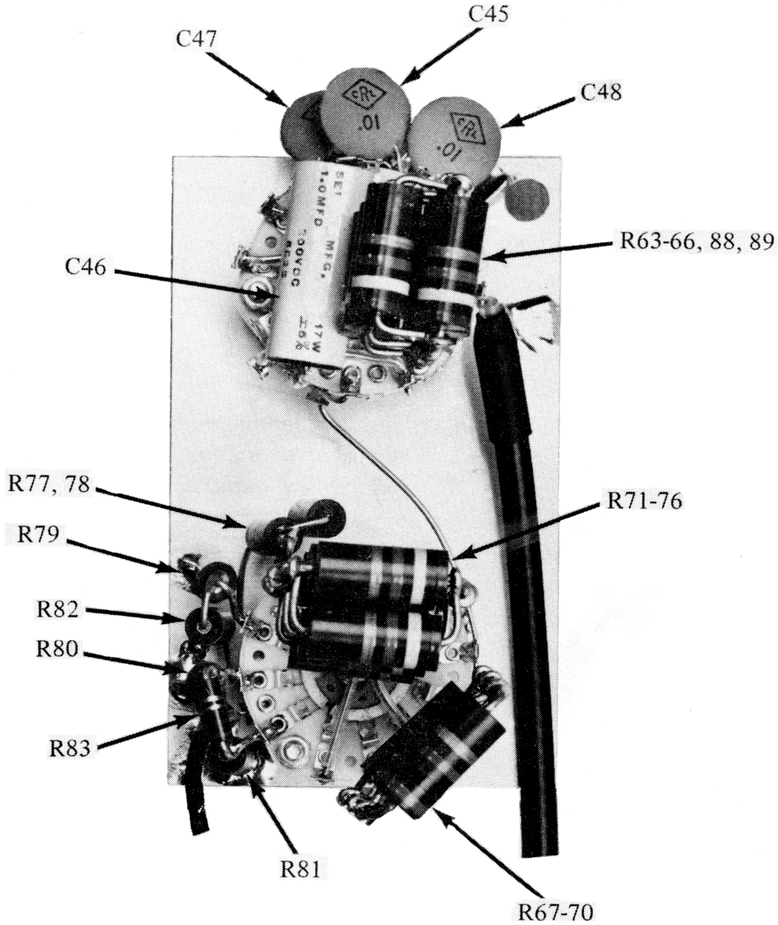


Figure 6-2 Polarity/Attenuator Subassembly

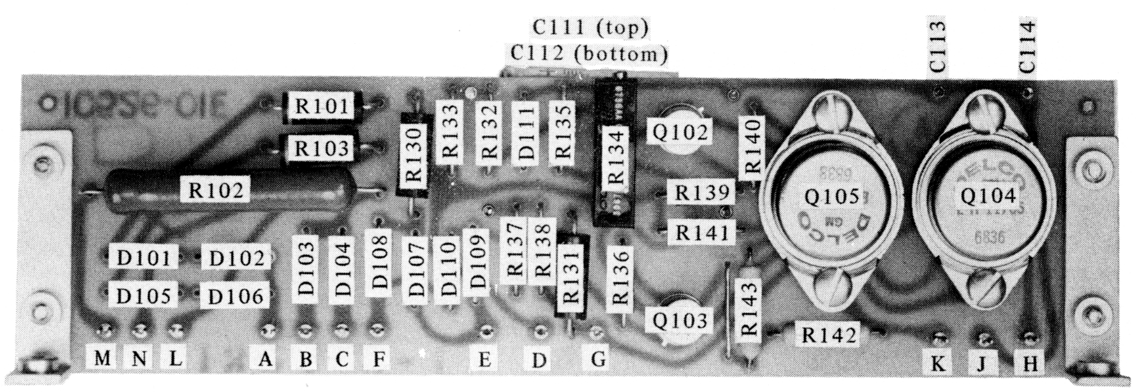


Figure 6-3 Rectifier and Low Voltage Regulator Board

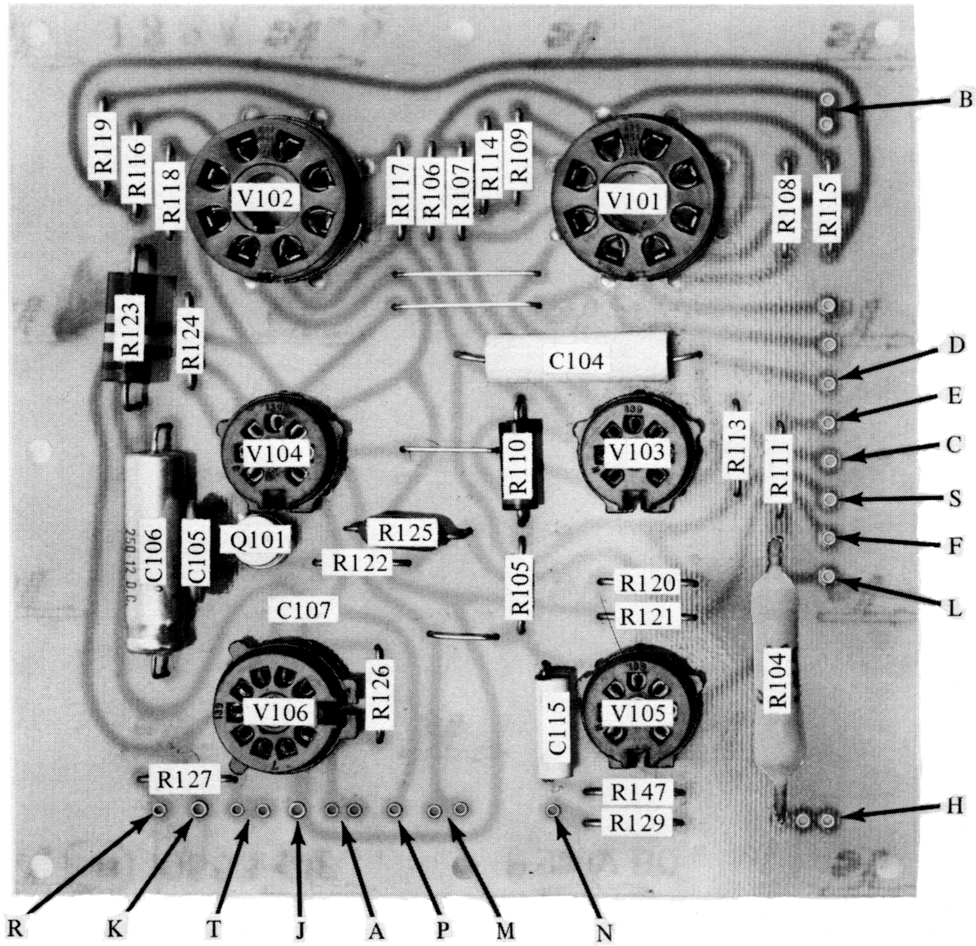


Figure 6-4 High Voltage Regulator Board

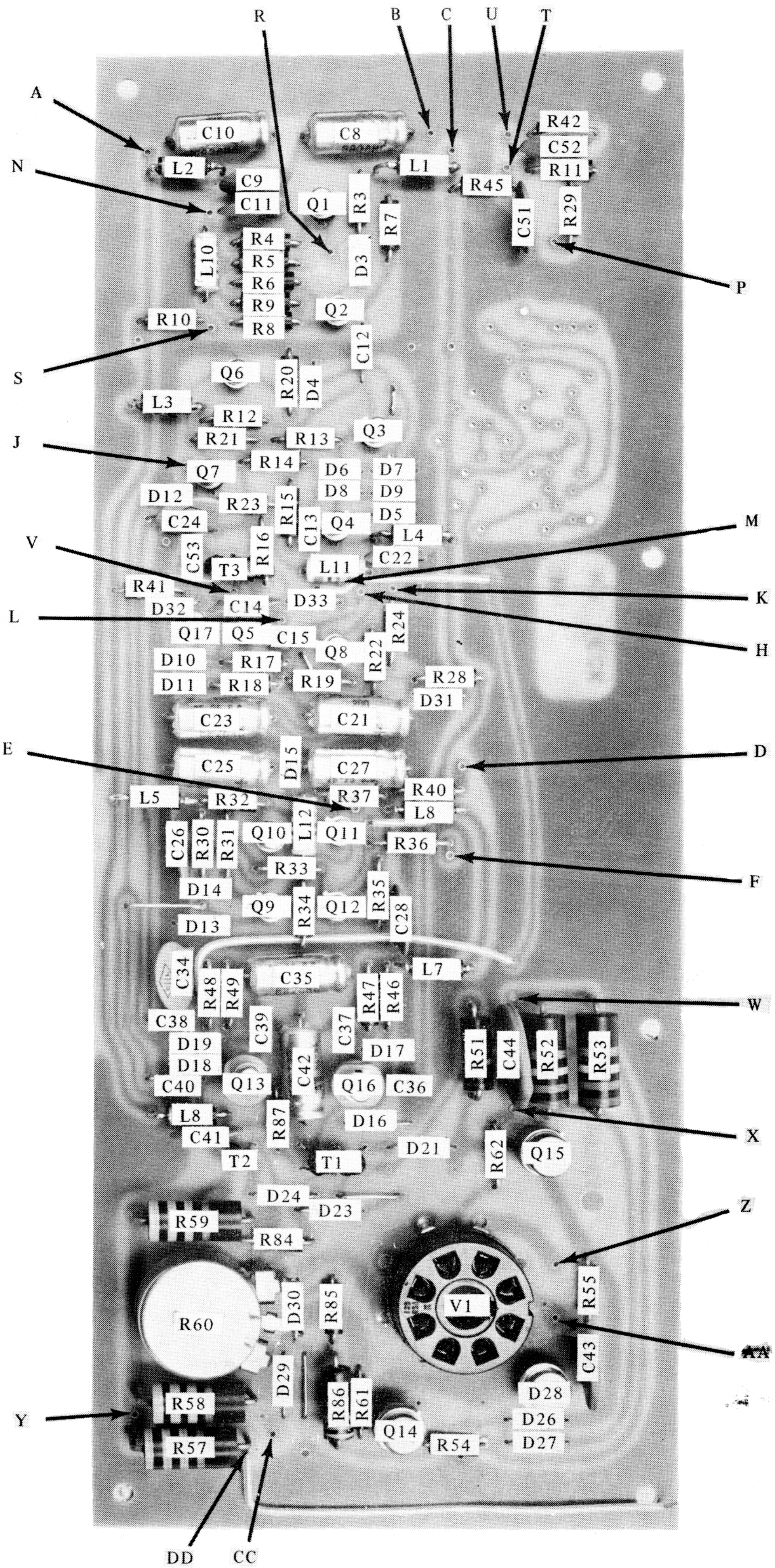


Figure 6-5 RF Deck

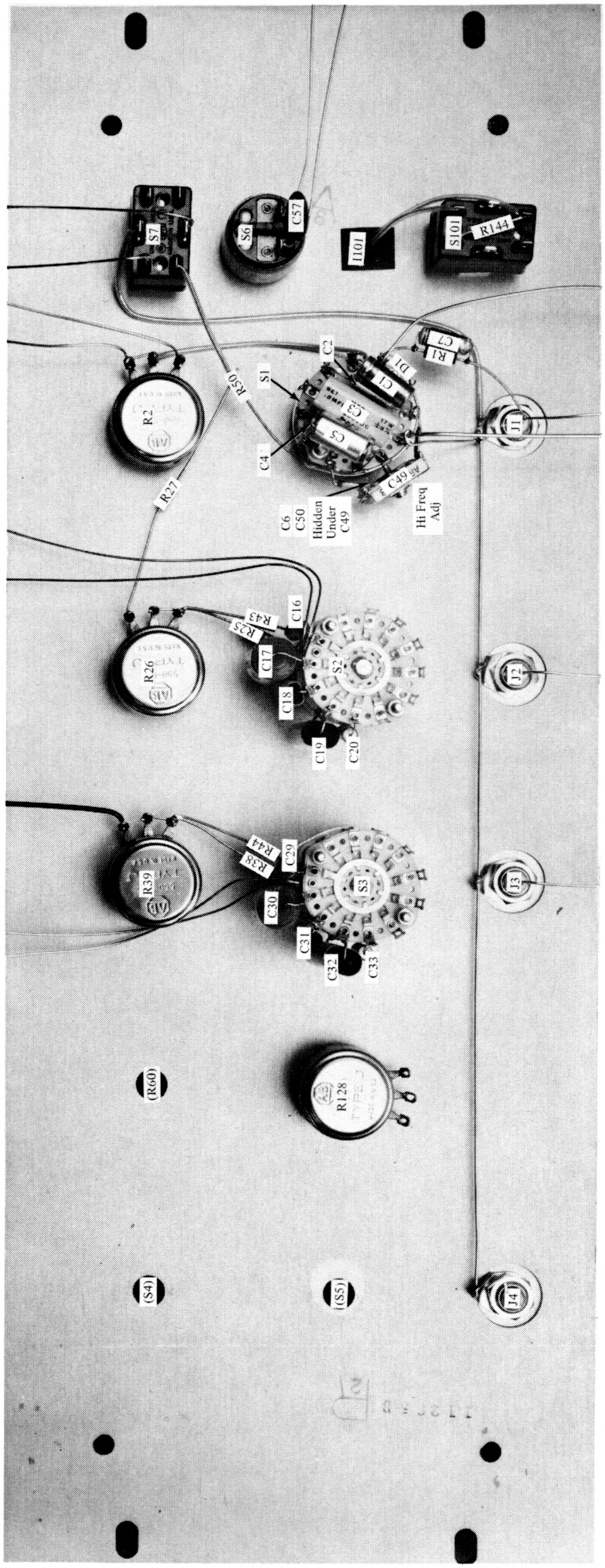


Figure 6-6 Front Panel Subassembly

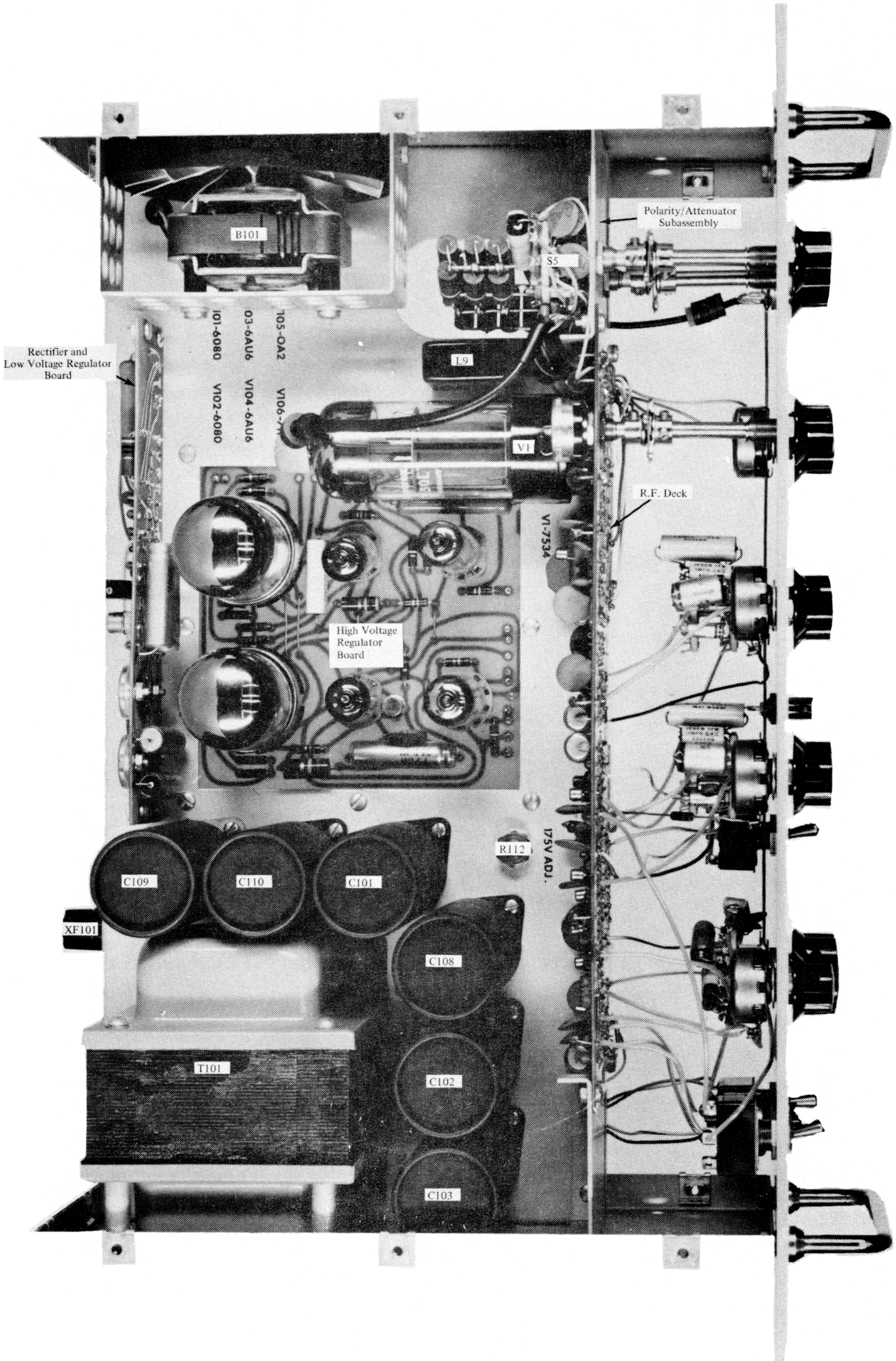


Figure 6-7 Chassis Layout (Top)

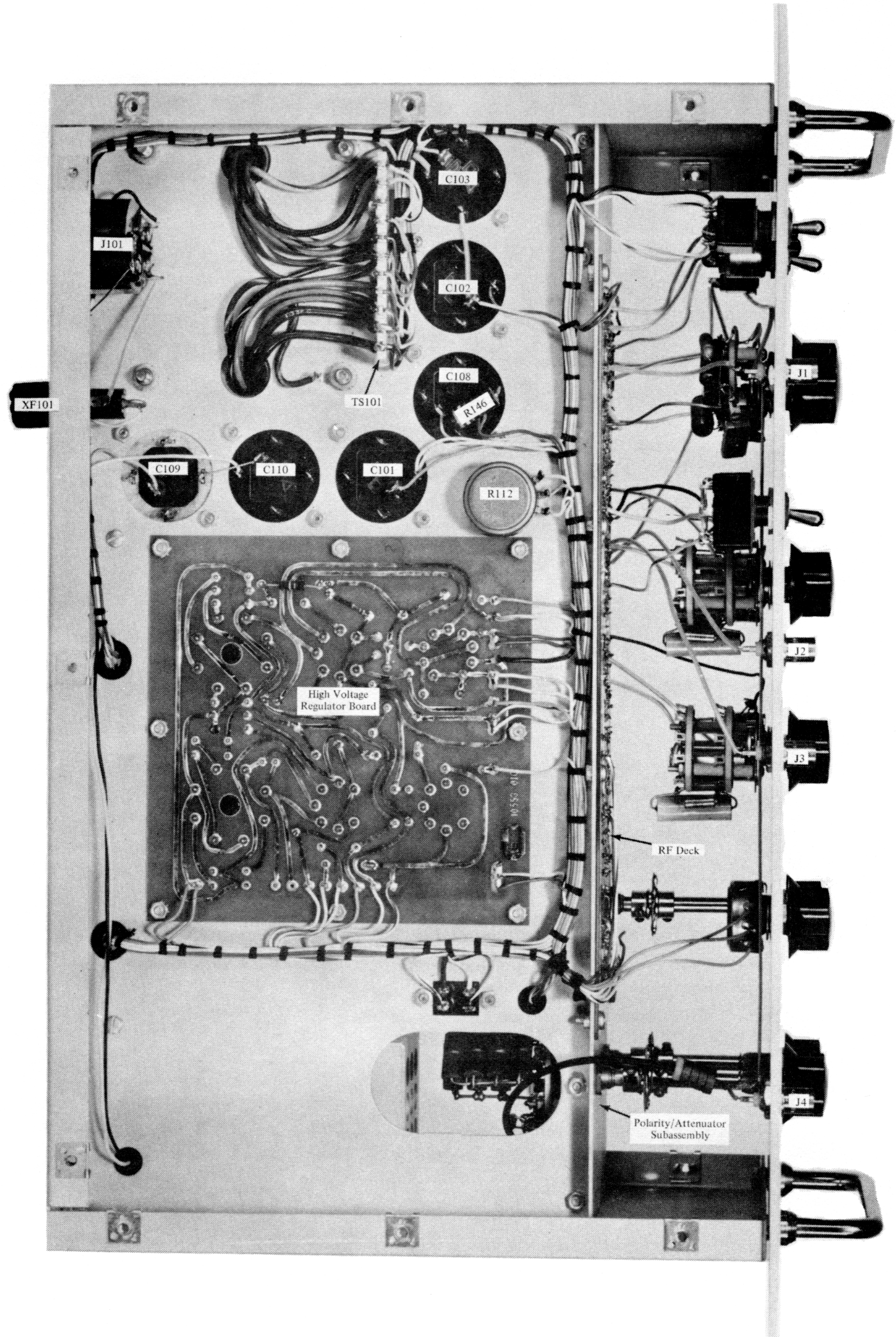
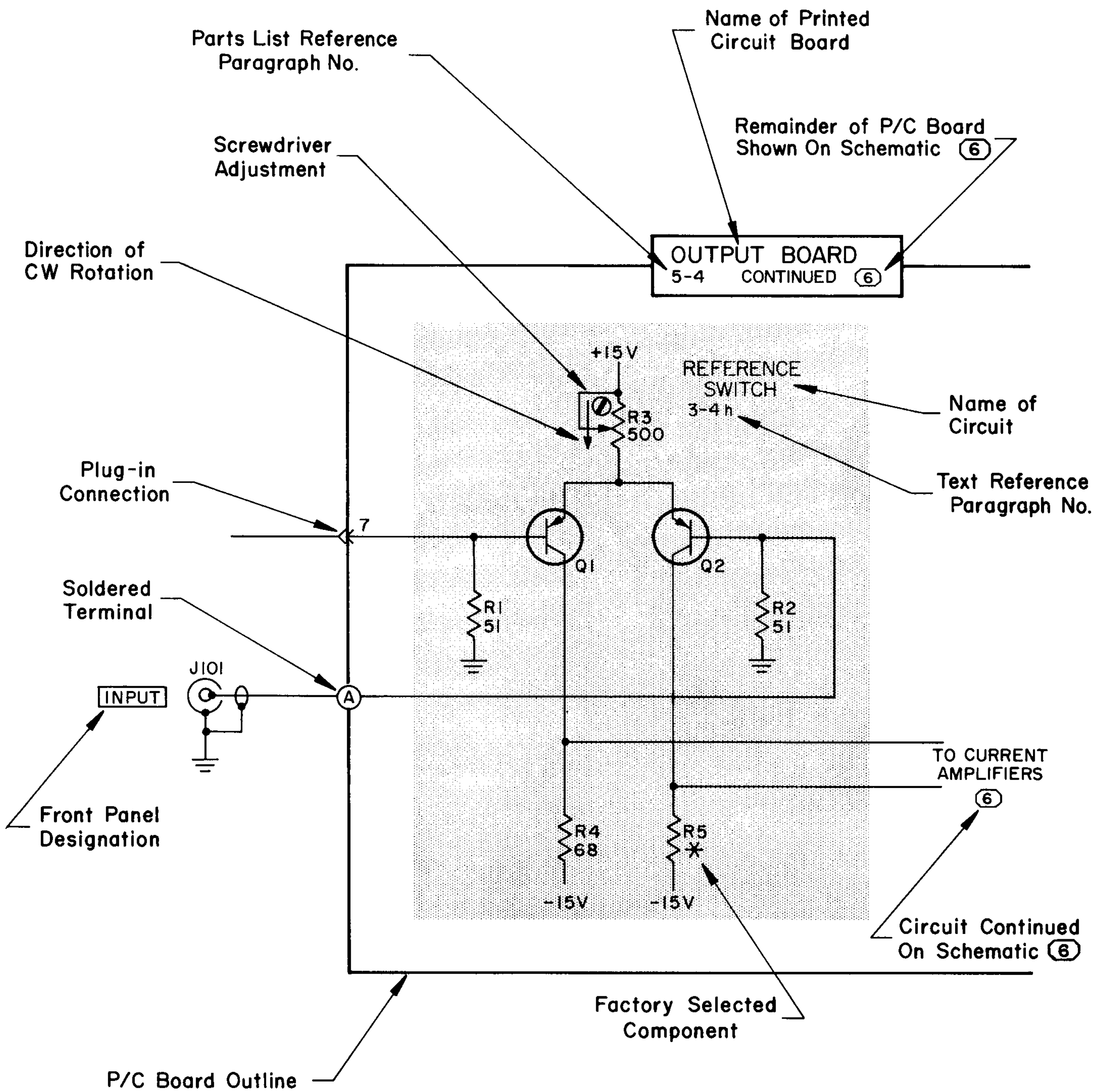
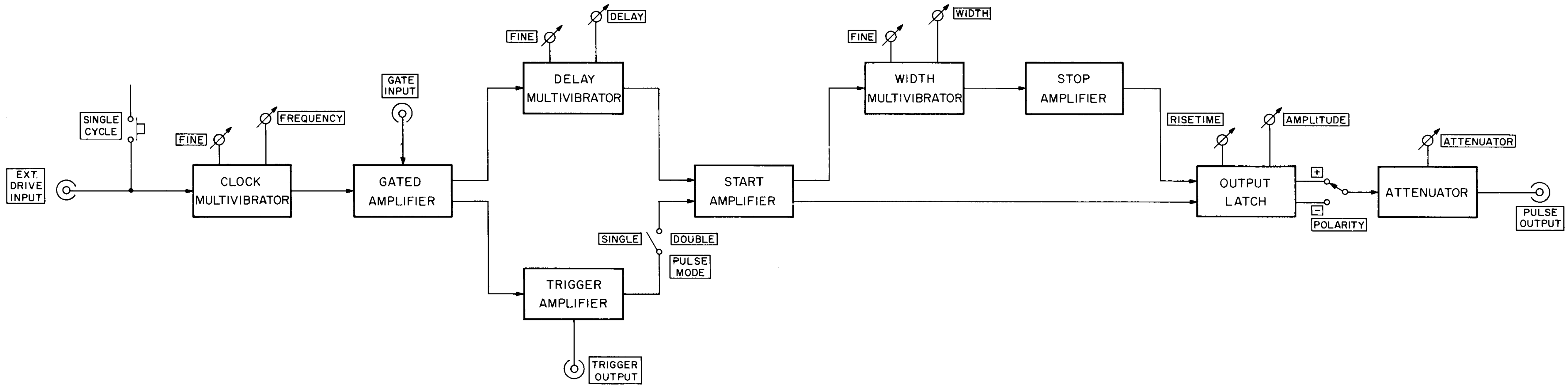


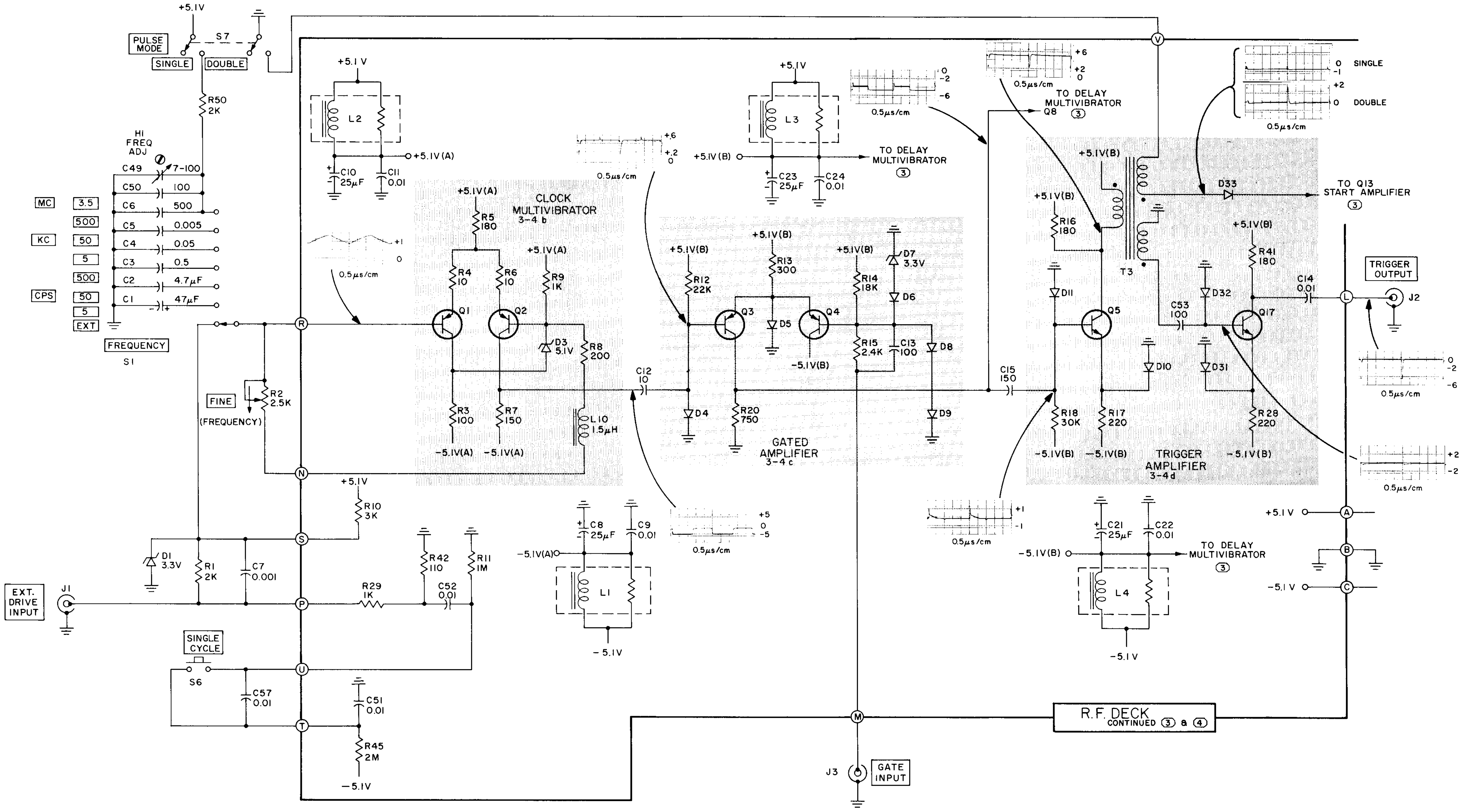
Figure 6-8 Chassis Layout (Bottom)



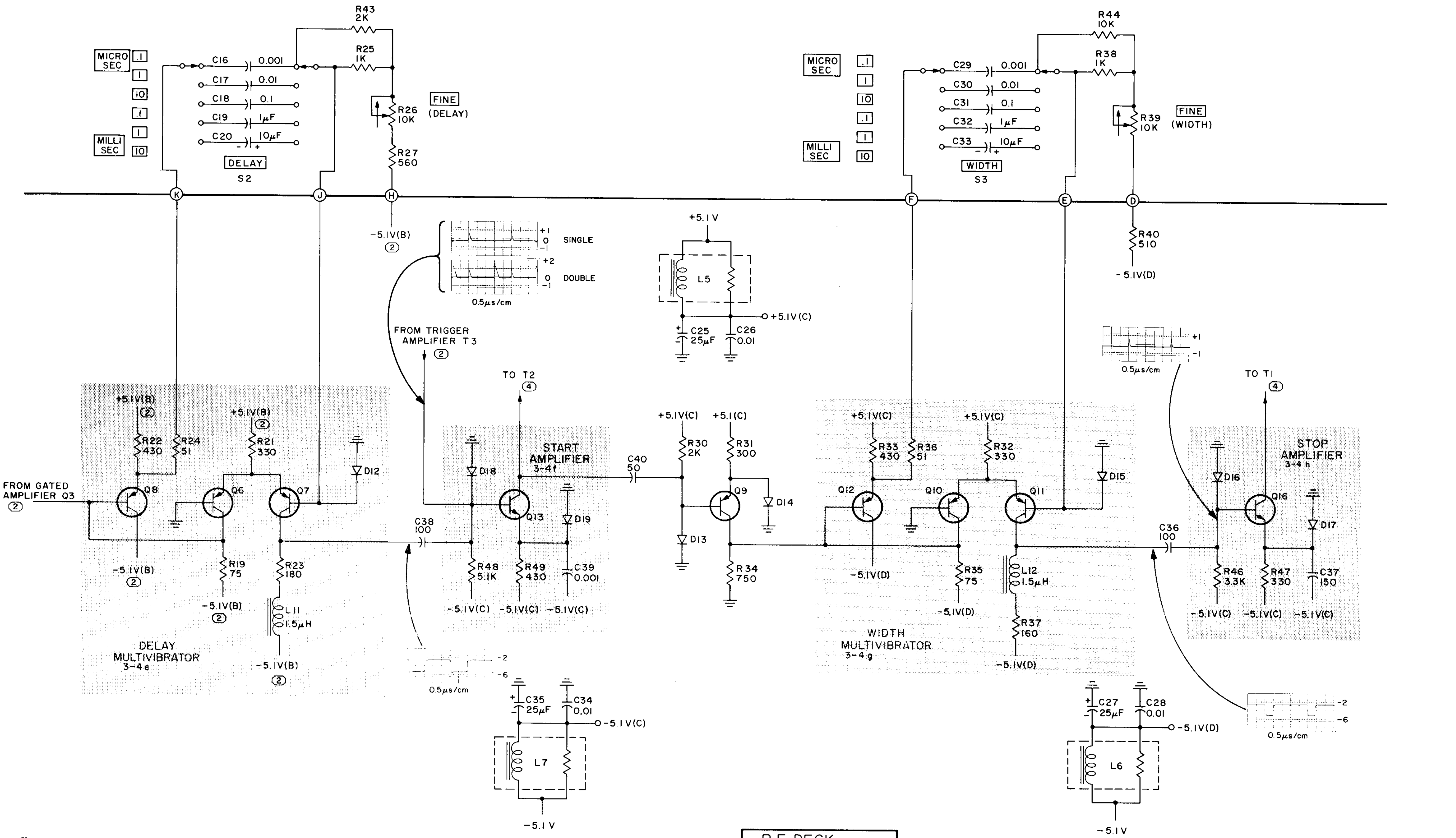
EXPLANATION OF SCHEMATIC NOTATIONS



BLOCK DIAGRAM 1
(A) 132 A

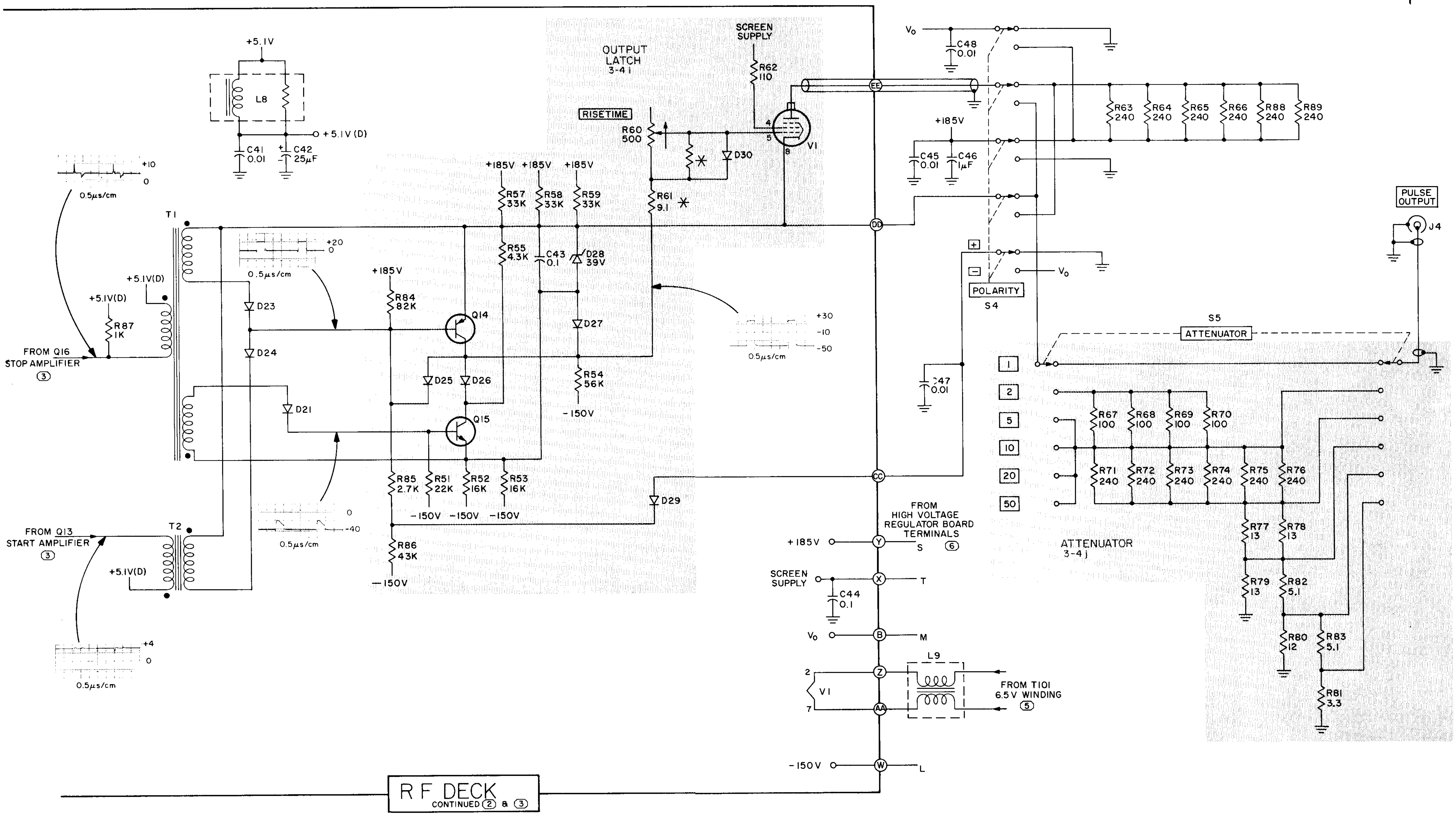


CLOCK AND TRIGGER (2)
(A) 132 A



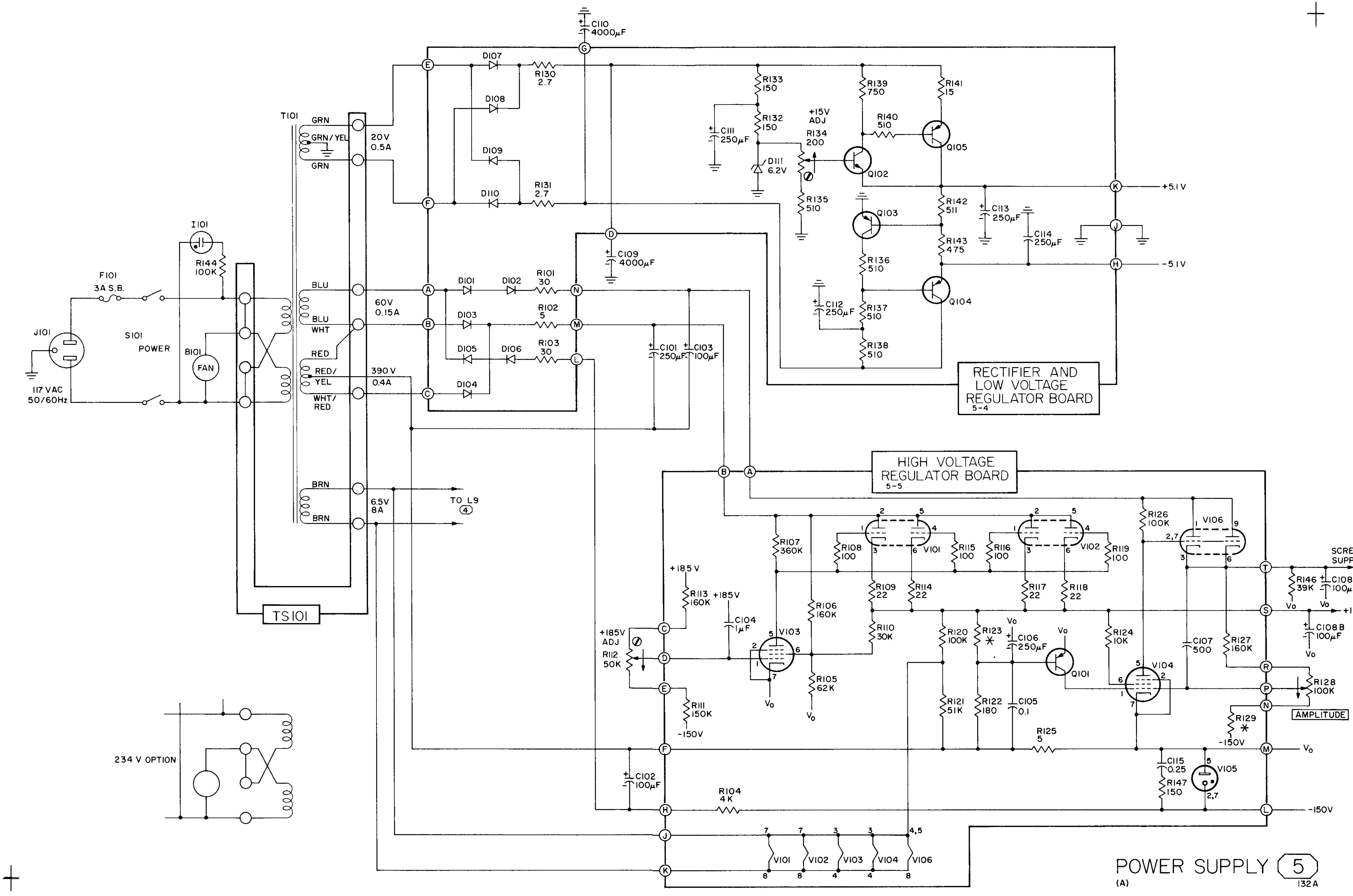
R F DECK
CONTINUED (2) & (4)

DELAY AND WIDTH (3)
(A)
132 A



OUTPUT (4)

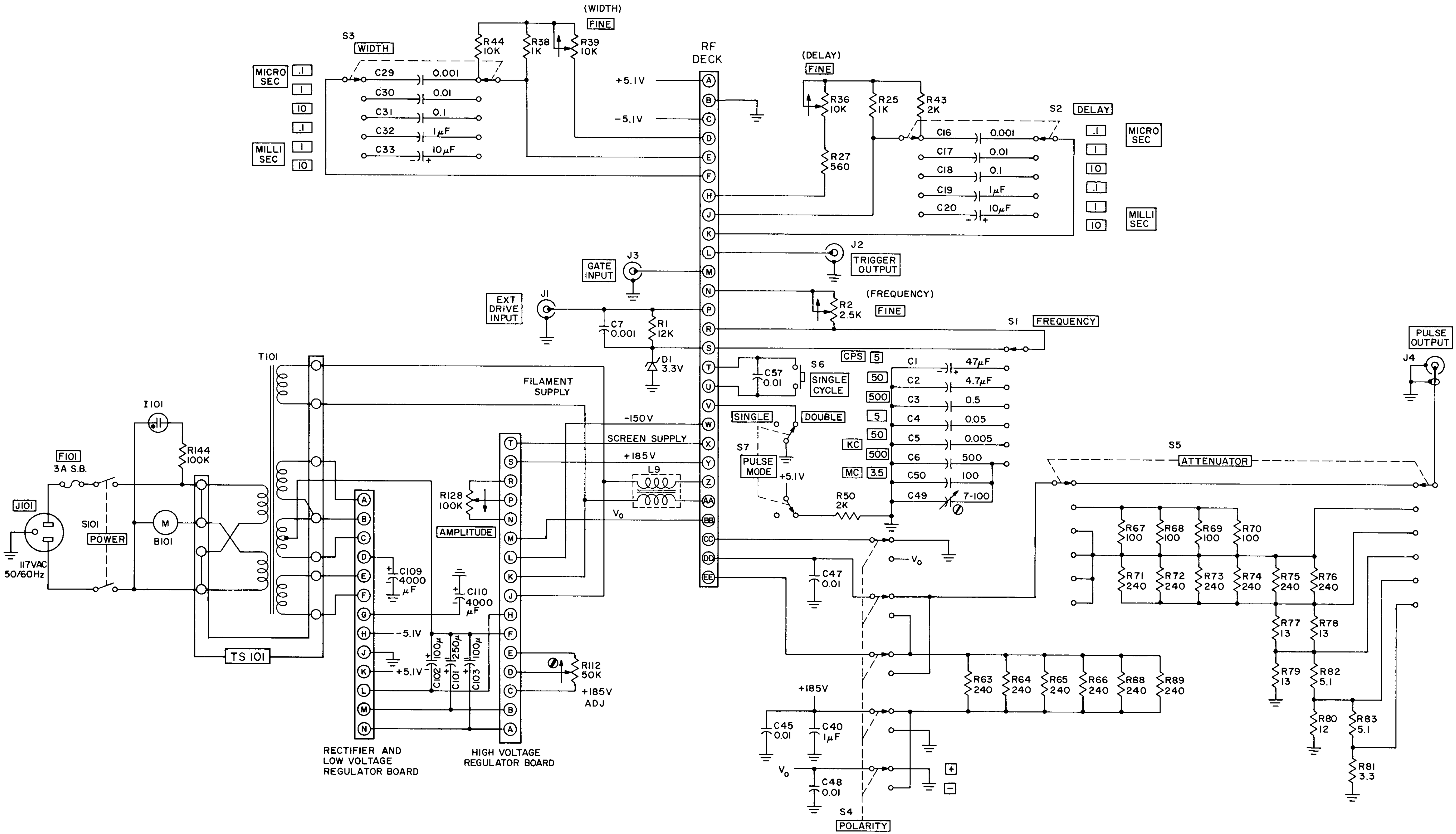
(A) 132 A



POWER SUPPLY 5

(A)

132A



MASTER SCHEMATIC (A) 6

132 A