



BELL & HOWELL SCHOOLS

ASSEMBLY MANUAL 9560-1

5-Inch Triggered-Sweep Oscilloscope

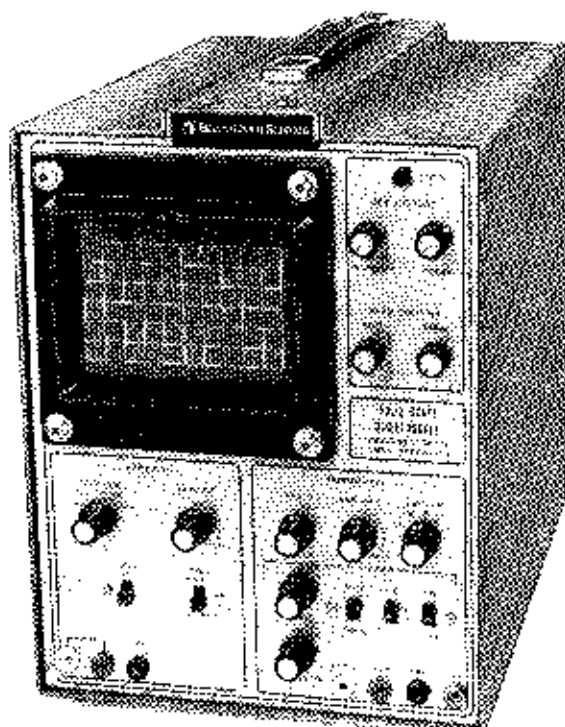
I-595-1636-01

ASSEMBLY MANUAL FOR THE

 **BELL & HOWELL SCHOOLS**

5-INCH TRIGGERED SWEEP
OSCILLOSCOPE

9560-1



Bell & Howell Schools Inc.
4141 Belmont
Chicago, Illinois 60641

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INTRODUCTION

The cathode ray oscilloscope is one of the most versatile instruments available. You can use it to measure AC and DC voltages, frequency, phase relationships, or study the waveforms of complex signals. These capabilities make the oscilloscope valuable for waveform analysis, particularly in audio, television, and transmitter work.

The Bell and Howell Schools, Inc. 5-Inch Triggered-Sweep Oscilloscope is an accurate and dependable instrument which has a wide range of applications. When properly assembled and calibrated, this Oscilloscope can be used to observe or measure all types of electrical and electronic waveforms within its listed specifications, from relatively simple sine and square waves, to complex pulse and composite signals. The basic uses of this instrument are similar to those of other oscilloscopes with comparable sensitivity and frequency response.

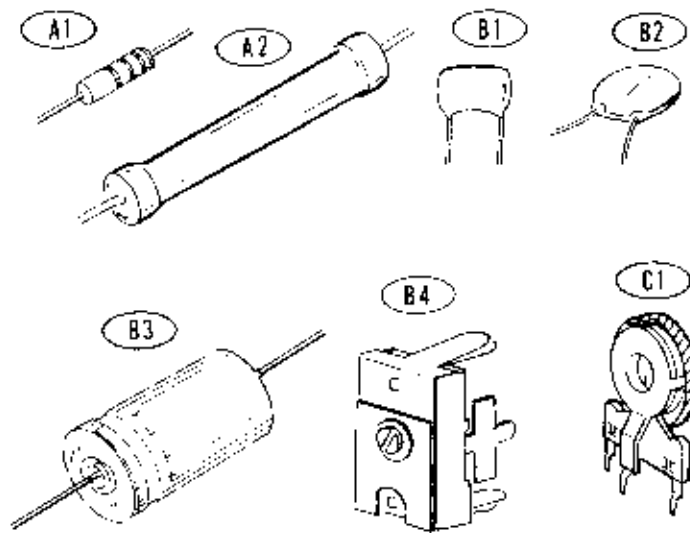
Some of the following professional features that make the Bell and Howell Oscilloscope outstanding are: an accurately calibrated vertical attenuator switch with variable control; triggered horizontal sweep circuits; calibrated time base switch (four decade steps, variable within each step); and provisions for use of external triggering signals or a horizontal deflection signal.

The Oscilloscope uses three printed circuit boards which minimize point-to-point wiring and reduce construction time. The transformer operated, silicon-rectifier power supply can be wired for 110-130 VAC or 220-240 VAC power sources. The primary circuit of the power transformer is fused for protection from overloads.

Other features include: an all-solid-state circuit (except for the CRT), high input sensitivity, modern styling, and versatility. Its rugged construction and ease of operation add to its usefulness and long life.

Your oscilloscope kit is divided into three separate shipments, marked DCS-1, DCS-2, and DCS-3. The Assembly Manuals are labeled 9560-1, 9560-2, and 9560-3; and correspond to the three shipments. After you complete each of the first two Manuals, complete the laboratory exam related to circuit theory and return the exam for grading. A separate Manual (labeled 9560-3, Part II) includes special calibration instructions for the sweep generator as well as some experiments that will familiarize you with oscilloscope operation. The third Assembly Manual (9560-3, Part I) will direct you to the special calibration instructions.

VERTICAL AMPLIFIER CIRCUIT BOARD PARTS PICTORIAL



VERTICAL AMPLIFIER CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #1 and check each part against the following list. Make a check (✓) in the space provided as each part is identified. The key numbers correspond to the numbers in the Parts Pictorial. Do not discard any packing materials until all the parts are accounted for. Pack #1 contains all the parts for the Vertical Amplifier Circuit Board except those parts required from Pack #3, the shipping container.

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION	PRICE Each	KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS, 1/2-Watt					Other Resistors				
NOTE: The following resistor tolerances are 10% unless otherwise noted. 10% is indicated by a fourth color band of silver; 5% is indicated by a fourth gold band.					() A2	5-1-4	2	5600 Ω (5.6 k), 4-watt, wire-wound	.20
() A1	1-83	2	56 Ω, 5% (green-blue black)	.10	CAPACITORS				
() A1	1-3	2	100 Ω (brown-black- brown)	.10	() B1	20-96	1	36 pF mica	.15
() A1	1-4	2	330 Ω (orange-orange- brown)	.10	() B2	21-162	1	180 pF disc	.10
() A1	1-6	2	470 Ω (yellow-violet- brown)	.10	() B2	21-171	1	680 pF disc	.10
() A1	1-9	4	1000 Ω (brown-black-red)	.10	() B2	21-16	1	.01 μF disc	.10
() A1	1-14	1	3300 Ω (orange-orange- red)	.10	() B3	25-54	1	10 μF electrolytic	.20
() A1	1-20	1	10 kΩ (brown-black- orange)	.10	() B3	25-20	1	40 μF electrolytic	.60
() A1	1-35	1	1 MΩ (brown-black- green)	.10	() B3	25-111	1	1000 μF electrolytic	2.35
					() B4	31-49	1	250-1000 pF trimmer	.85
					CONTROLS				
					() C1	10-918	1	500 Ω	.50
					() C1	10-936	1	1000 Ω (1 k)	.35
					() C1	10-904	1	5000 Ω (5 k)	.55

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION	PRICE Each
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DIODES-TRANSISTORS

() D1	56-19	2	VR-9.1 zener diode	1.00
() D1	56-56	2	1N4149 silicon diode	.20

NOTE: Transistors are marked for identification in one of the following four ways.

1. Part number.
2. Transistor type number.
3. Part number and type number.
4. Part number with a transistor type number other than the one listed.

() E1	417-83	2	L842 transistor	.75
() E1	417-118	4	2N3393 transistor	.40
() E1	417-201	2	X29A829 transistor	.50
() E2	417-241	2	EL131 JFET	2.55
() E3	417-834	2	MPSU10 (or MBF382) transistor	1.00

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION	PRICE Each
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MISCELLANEOUS

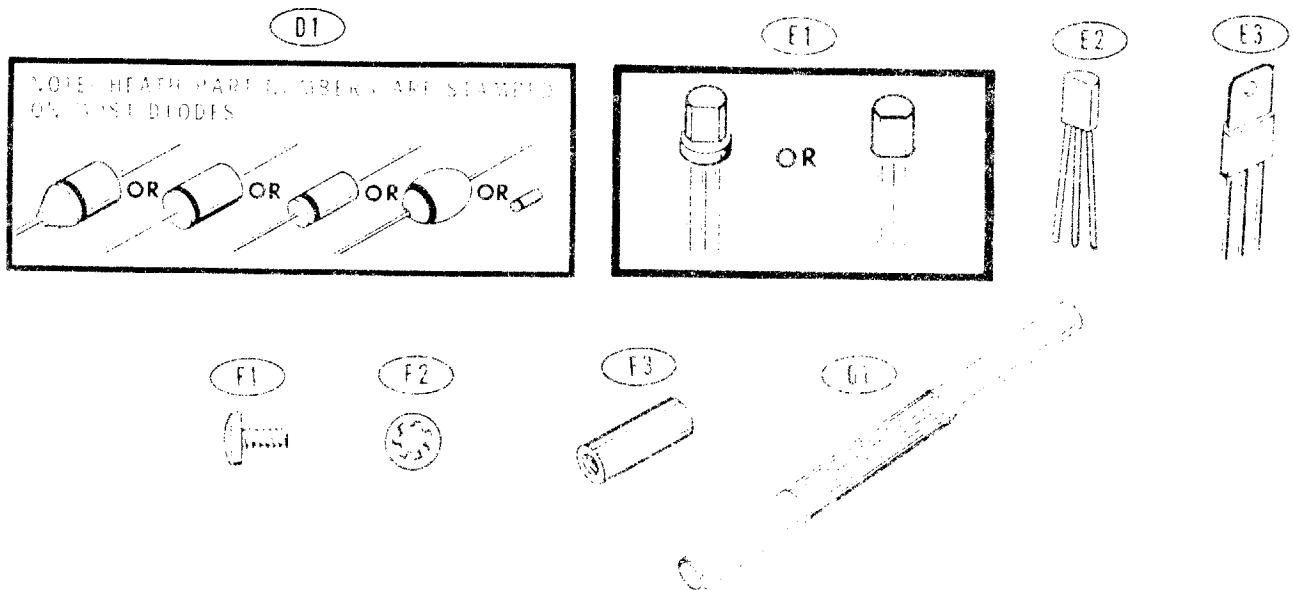
() JF1	250-229	4	6 32 x 1/4" screw	.05
() JF2	254-1	4	#6 lockwasher	.05
() JF3	255-94	4	Tapped spacer	.10

ITEMS FROM PACK #3 (shipping carton)

()	85-1407-1	1	Vertical amplifier circuit board	2.25
()	597-1306	1	Parts Request Form	
() G1	490-5	1	Nut starter	.10
()		1	Assembly Manual (See front cover for part number.)	
()	331-8	1	Solder (Additional 3' rolls of solder, #331-6, may be ordered for 15 cents each.)	

NOTE: See Page 1-5 in this Manual for "Replacement Parts and Price Information."

VERTICAL AMPLIFIER CIRCUIT BOARD PARTS PICTORIAL (Cont'd.)



STEP-BY-STEP ASSEMBLY

START

CONTINUE

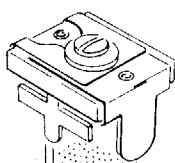
FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN... WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



Position the vertical amplifier circuit board foil-side-up. Then complete each step on the Pictorial.

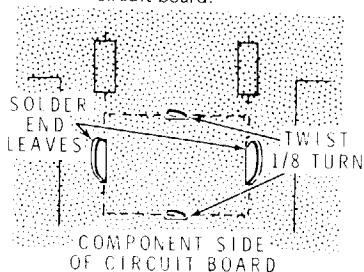
() Install a trimmer capacitor (#31-49) in the following manner.

A. Install the capacitor on the foil side of the circuit board.

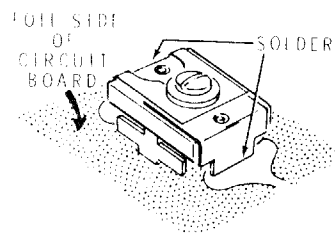


FOIL SIDE OF CIRCUIT BOARD

B. Use pliers to twist the two indicated side lugs (on the component side of the circuit board) slightly. Solder all of the small end leaves together on the component side of the circuit board.



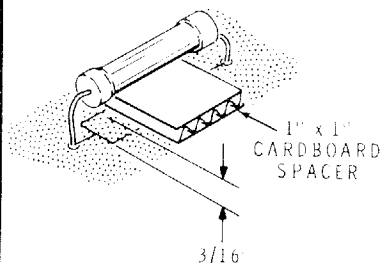
C. Solder the indicated end lugs to the foil on the foil side of the circuit board.



() Turn the vertical amplifier circuit board lettered-side-up. Then complete the following steps.

NOTE: At times, resistors or capacitors will be supplied in various case lengths. Therefore, extra circuit board holes are provided. Use the holes that best accommodate the components you received.

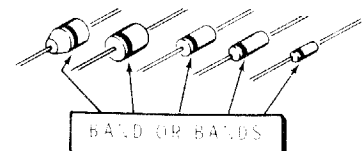
NOTE: When you are instructed to mount a power resistor 3/16" above the circuit board as shown, use a 1" x 1" piece of cardboard (from shipping carton) for a spacer. Solder each resistor as it is installed, cut off the excess lead lengths, and then remove the cardboard spacer.



() 5600 Ω (5.6 k), 4-watt, wire wound resistor. Mount this resistor 3/16" above the circuit board.

() 5600 Ω (5.6 k), 4-watt, wire-wound resistor. Mount this resistor 3/16" above the circuit board.

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BARRAGED END AS SHOWN ON THE CIRCUIT BOARD.



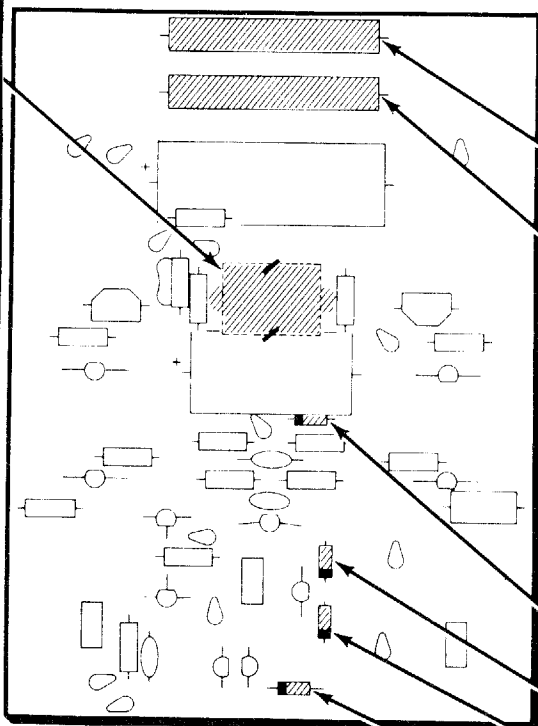
() VR-9.1 zener diode (#56-19) at ZD102.

() 1N4149 diode (#56-56) at D104.

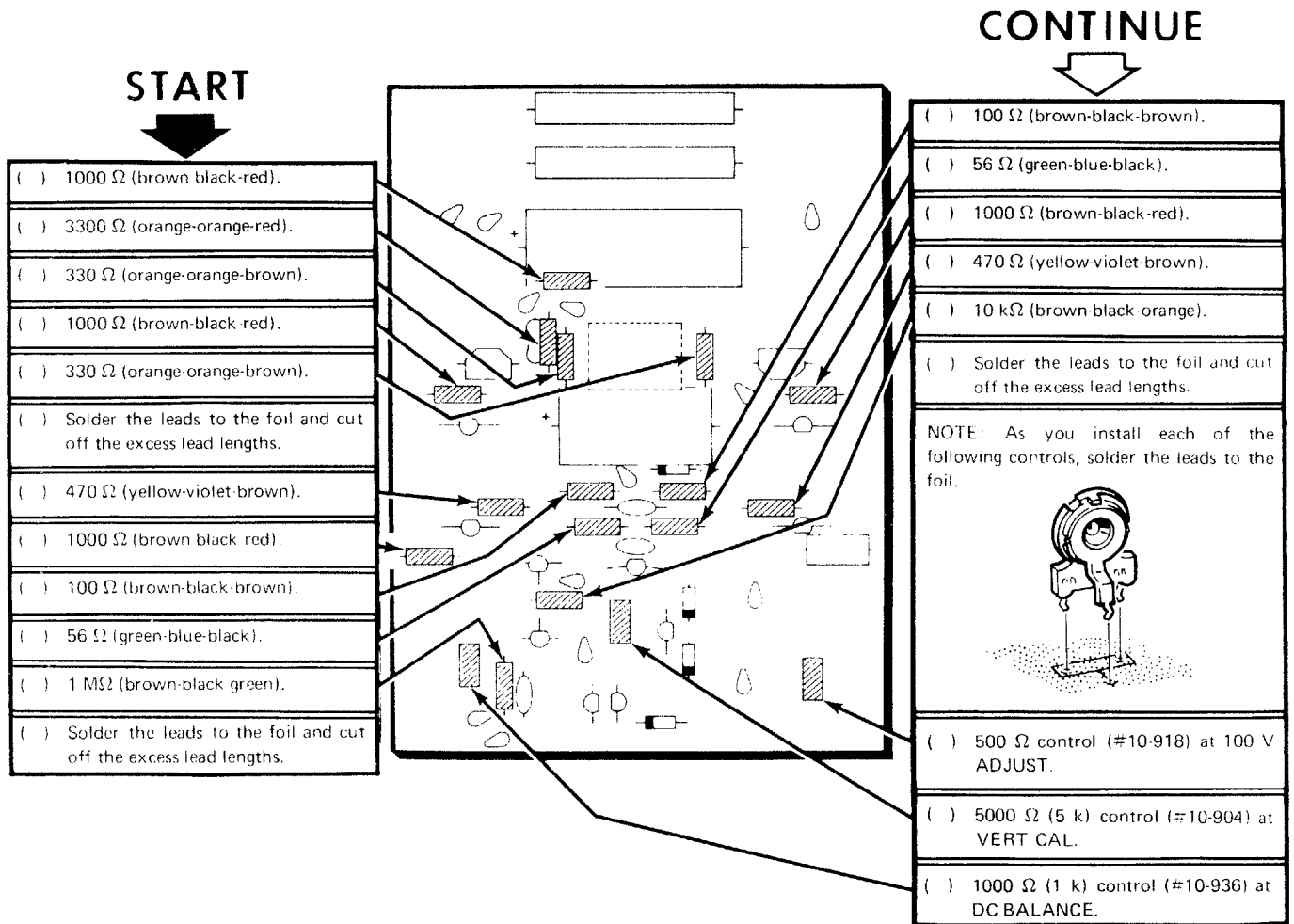
() 1N4149 diode (#56-56) at D103.

() VR-9.1 zener diode (#56-19) at ZD101.

() Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-1

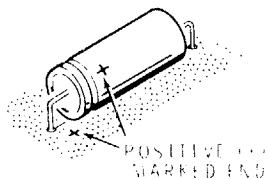


PICTORIAL 1-2

START

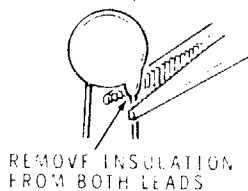


NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.



- () 40 μ F electrolytic.
- () 10 μ F electrolytic.
- () 1000 μ F electrolytic.
- () 36 pF mica.

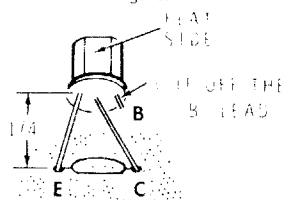
NOTE: Before you install disc capacitors, use long-nose pliers to remove the excess insulation from the capacitor leads.



- () 180 pF disc.
- () 680 pF disc.
- () .01 μ F disc.

() Solder the leads to the foil and cut off the excess lead lengths.

NOTE: Install the next two transistors in the following manner: Cut off the "B" lead and then insert the other two leads into their correct holes in the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



- () 2N3393 transistor (#417-118) at D101.
- () 2N3393 transistor (#417-118) at D102.

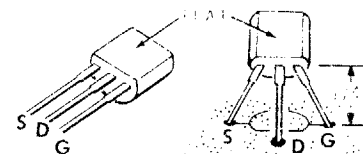
CONTINUE



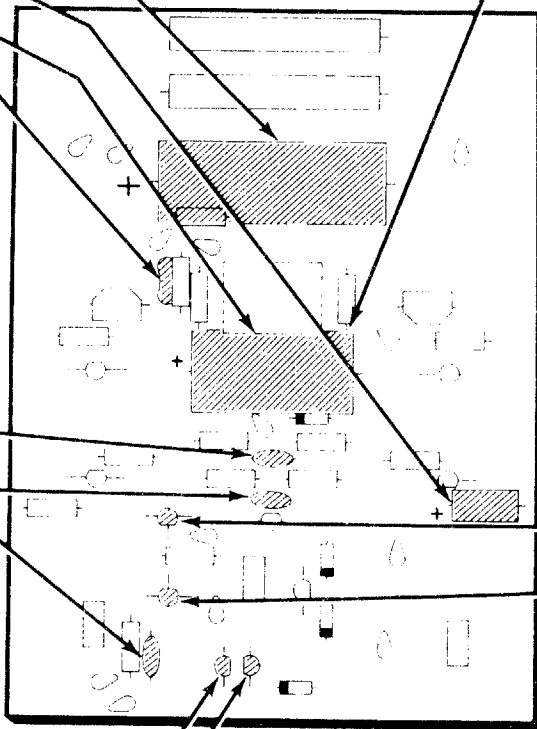
CAUTION: Be sure this resistor lead does not touch the 1000 μ F electrolytic capacitor case.

NOTE: In the following steps, install each of the transistors as follows:

1. Refer to the illustration below, and identify the S, D, and G leads of the transistor.
2. Insert the transistor leads into the corresponding S, D, and G holes in the circuit board.
3. Position the transistor 1/4" above the circuit board.
4. Turn the circuit board over, solder the leads to the foil, and cut off the excess lead lengths.



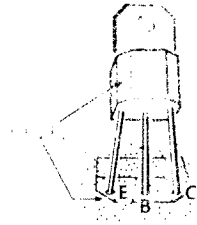
- () EL131 transistor (#417-241) at Q103.
- () EL131 transistor (#417-241) at Q101.



PICTORIAL 1-3

START

NOTE: Install the next two transistors as shown. Match the pins on the transistor with the level outline on the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

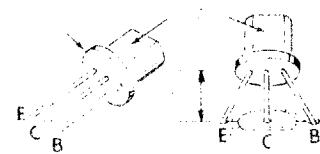


() MPSU10 (or MBF382) transistor (#417-834) at Q111

() MPSU10 (or MBF382) transistor (#417-834) at Q109

NOTE: In the following six steps, install each of the transistors as follows:

1. Refer to the illustration below, and identify the E, C, and B pins of the transistor. The transistor supplied with your kit may not have a letter 'A' shown.
2. Insert the transistor leads into the corresponding E, C, and B holes in the circuit board.
3. Position the transistor 1/4" above the circuit board.
4. Turn the circuit board over, solder the leads to the foil, and cut off the excess lead lengths.



() L842 transistor (#417-833) at Q105

() X29A829 transistor (#417-201) at Q107

() 2N3393 transistor (#417-118) at Q104

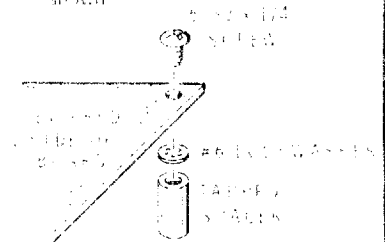
() 2N3393 transistor (#417-118) at Q102

CONTINUE

() X29A829 transistor (#417-201) at Q108.

() L842 transistor (#417-833) at Q106.

() Note the locations marked ⊕ at each corner of the circuit board. Mount a tapped spacer at each of these four locations with a #6 lockwasher and a 6-32 x 1/4" screw. Place the lockwasher between the circuit board and the spacer as shown.

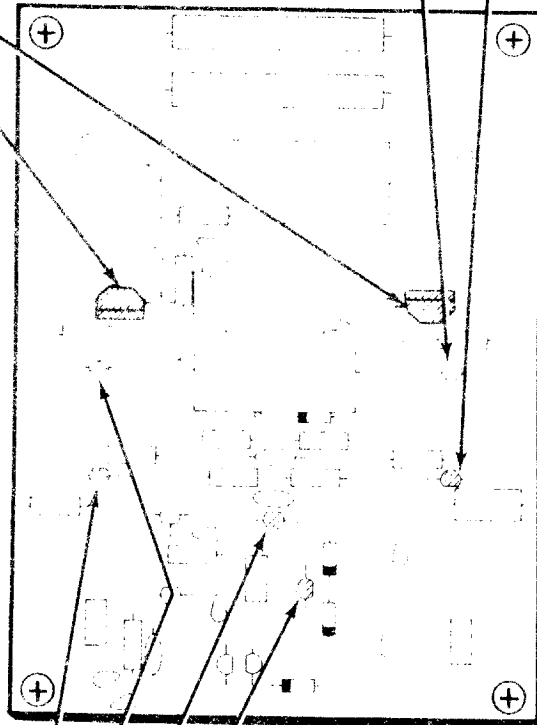


CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions:

- () Unsoldered connections
- () "Cold" solder connections
- () Solder bridges between foil patterns
- () Protruding leads which could touch together
- () Transistors for the proper type and installation
- () Electrolytic capacitors for the correct position of the positive end
- () Leads for the correct position of the banded end.

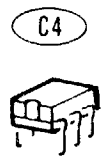
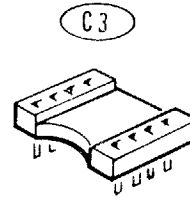
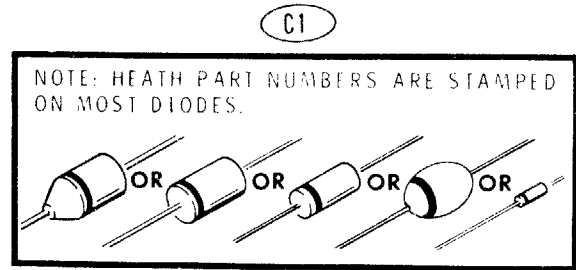
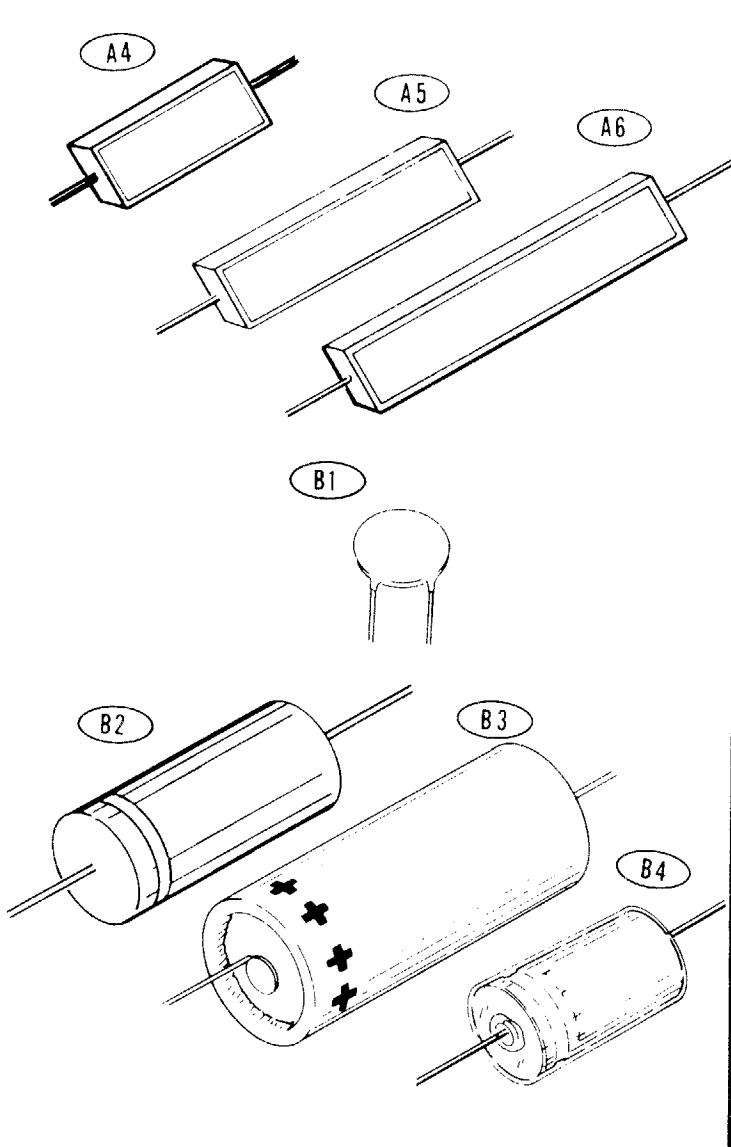
NOTE: At this point, there should be no remaining components. If any parts remain, carefully recheck your work to see if a step may have been overlooked.



PICTORIAL 1-4

POWER SUPPLY CIRCUIT BOARD

PARTS PICTORIAL (Cont'd.)



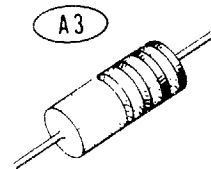
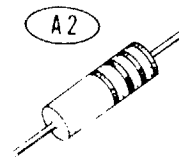
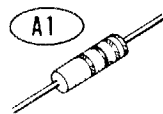
POWER SUPPLY CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #2 and check each part against the following list. Make a check (✓) in the space provided as each part is identified. The key numbers correspond to the numbers in the Parts Pictorial. Do not discard any packing materials until all the parts are accounted for. Pack #2 contains all the parts for the Power Supply Circuit Board except those parts required from Pack #3, the shipping container.

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS				
1/2-Watt, 10%				
() A1	1-9	1	1000 Ω (brown-black red)	.10
() A1	1-93	1	1800 Ω (brown-gray-red)	.10
() A1	1-24	1	33 kΩ (orange-orange orange)	.10
() A1	1-29	2	220 kΩ (red-red-yellow)	.10
1-Watt, 10%				
() A2	1-19-1	1	220 Ω (red-red-brown)	.10
() A2	1-32-1	3	470 kΩ (yellow violet yellow)	.10
2-Watt, 10%				
() A3	1-13-2	2	220 Ω (red-red-brown)	.10
() A3	1-30-2	1	270 Ω (red violet brown)	.10
() A3	1-16-2	1	330 Ω (orange orange-brown)	.10

PARTS PICTORIAL



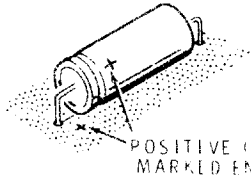
KEY PART		PARTS Per Kit	DESCRIPTION	PRICE Each	KEY PART		DESCRIPTION	PRICE Each	
No.	No.				No.	No.			
Resistors (cont'd.)					DIODES				
Other Resistors					()C1	56-19	1	VR-9.1 zener	1.00
()A4	3-41-5	1	140 Ω , 5-watt, wire-wound	.15	()C1	56-55	1	VR-36A zener	1.00
()A4	3-19-5	1	330 Ω , 5-watt, wire-wound	.15	()C1	56-68	1	ZVR-68 zener	1.50
()A5	3-15-7	1	1000 Ω (1 k Ω), 7-watt wire-wound	.15	()C1	57-27	8	1N2071 silicon	.50
()A5	3-2-7	1	3750 Ω , 7-watt, wire-wound	.20	()C1	57-52	2	5D20 silicon	1.20
()A6	3-7-10	1	10 k Ω , 10-watt, wire-wound	.25	TRANSISTORS-INTEGRATED CIRCUIT				
CAPACITORS					()C2	417-834	2	MPSU10 (or MBF382) transistor	1.00
()B1	21-116	2	.005 μ F, 3 kV, disc	.35	MISCELLANEOUS				
()B2	23-62	3	.1 μ F, 1600 V, tubular	.75	()C3	434-233	1	IC socket	.15
()B3	25-43	1	70 μ F electrolytic	1.15	()	346-1	6"	Sleeving	.05/ft
()B4	25-121	1	500 μ F electrolytic	1.30	ITEMS FROM PACK #3 (shipping carton)				
					()	85-1409-1	1	Power supply circuit board.	
					()C4	443-631	1	TIL115 integrated circuit	2.90

NOTE: See Page 1-5 in this Manual for "Replacement Parts and Price Information."

START



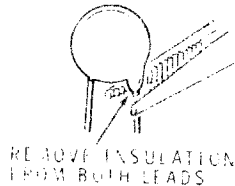
NOTE: When you install an electrolytic capacitor, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.



() 70 μ F electrolytic.

() 500 μ F electrolytic.

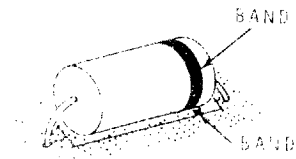
IMPORTANT NOTE: Before installing disc capacitors in this kit use long-nose pliers to remove the excess insulation from the capacitor leads.



() .005 μ F disc. Position this capacitor 1/8" above the circuit board and solder the leads to the foil.

() .005 μ F disc

NOTE: When you install the following three capacitors, always match the banded end of each capacitor with the band mark on the circuit board.

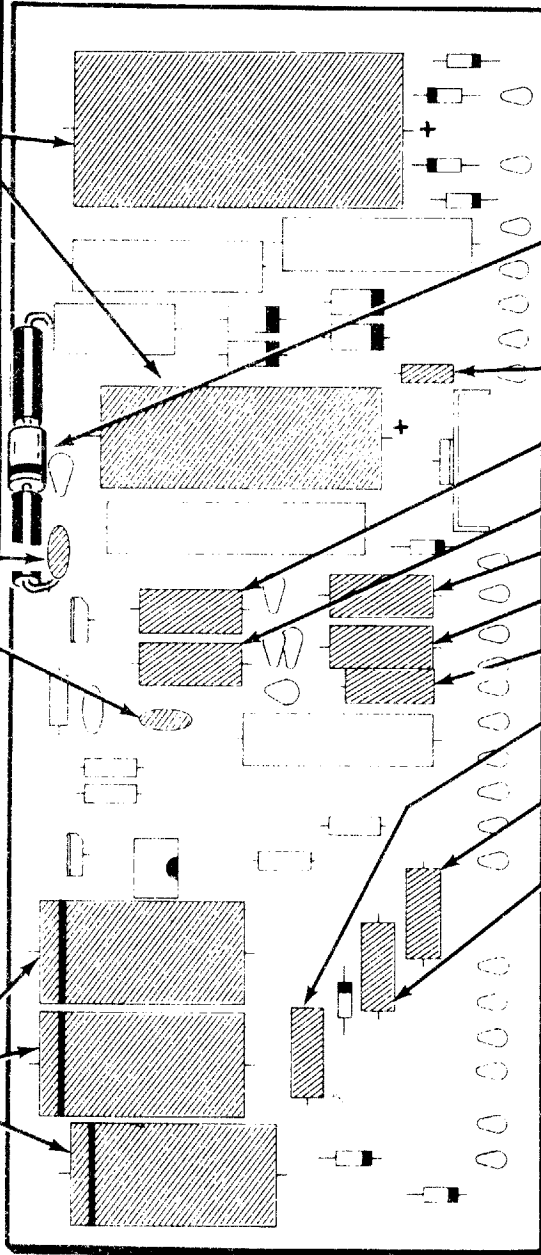


() 1 μ F, 1600 V (1.6 kV) capacitor.

() 1 μ F, 1600 V (1.6 kV) capacitor.

() 1 μ F, 1600 V (1.6 kV) capacitor

() Solder the leads to the foil and cut off the excess lead lengths.



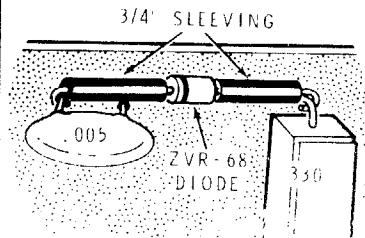
CONTINUE



() Cut two 3/4" lengths of sleeving. Place a length of sleeving on each lead of a ZVR-68 diode (#56-68).

() Connect the banded end of the ZVR-68 diode to the indicated lead of the .005 μ F capacitor as shown (S-1).

() Connect the other end of this diode to the indicated lead of the 330 Ω , 5-watt resistor as shown (S-1).



() 1800 Ω (brown-gray red).

() 330 Ω , 2-watt (orange orange brown).

() 220 Ω , 2-watt (red red brown).

() 270 Ω , 2-watt (red-violet brown).

() 220 Ω , 2-watt (red-red brown).

() 220 Ω , 1-watt (red-red brown).

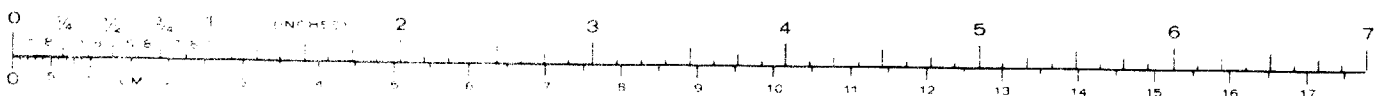
() 470 k Ω , 1-watt (yellow-violet yellow).

() 470 k Ω , 1-watt (yellow violet yellow).

() 470 k Ω , 1-watt (yellow-violet yellow).

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-2



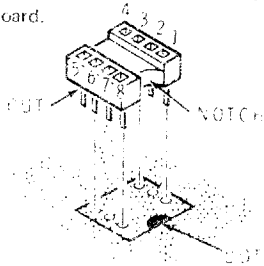
START



NOTE: Read the following information carefully before you install the IC (integrated circuit) socket in the following step.

() Mount the IC socket as follows.

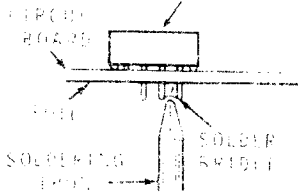
1. Cut and remove pins 4 and 5 from the IC socket as shown.
2. Match the notch at the end of the IC socket to the dot on the circuit board.



3. Insert the IC socket pins into their respective holes in the circuit board.
4. Push the IC socket firmly against the circuit board.

5. Solder the pins to the foil at each IC socket as installed. **NOTE:** It is easier to solder the pins to the foil if you use a small tin soldering iron.

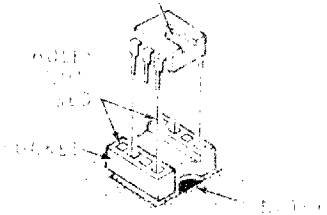
6. If a solder bridge occurs, clean the soldering iron tip and place it between the two points that are bridged until the excess solder flows down the wire. **IC SOCKET**



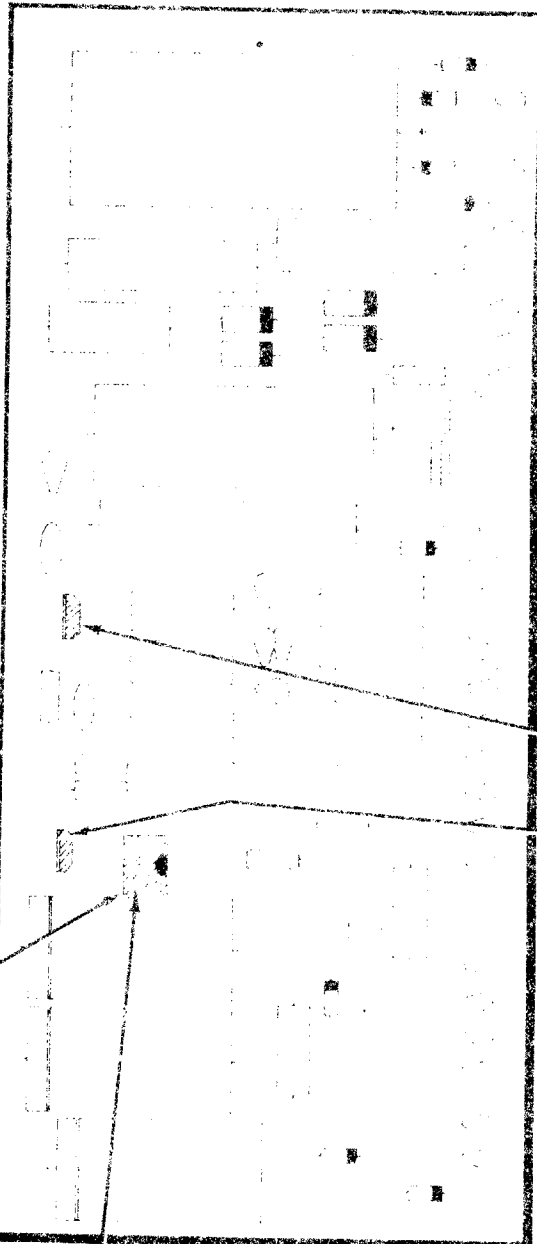
NOTE: In the following step, you must install a 6-pin IC in the 8-pin socket. Do not use the two socket holes nearest the edge of the circuit board.

Before applying downward pressure to the IC, make sure each IC pin is centered in its proper socket opening. Handle the IC with care as its pins are very easily bent.

IC SOCKET
 (4417-834) or (4417-834)



- () Integrated Circuit (IC) (#4436711) at IC201



CONTINUE

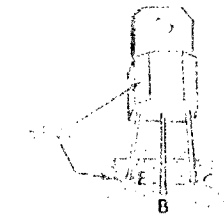


1. Refer to the illustration below and identify the E, B, and C leads of the transistor.

2. Bend the base (B) lead of two MPS110 transistors (#417-834) as shown.

3. Insert the transistor leads into the corresponding E, B, and C holes in the circuit board.

4. Turn the circuit board over; solder the leads to the foil and cut off any excessive lengths.



- () MPS110 (or MBE 362) transistor (#417-834) at Q202

- () MPS110 (or MBE 362) transistor (#417-834) at Q202

CIRCUIT BOARD CHECKOUT

This completes the assembly of your Bell and Howell DC51 subunit. Carefully inspect the power supply circuit board for the following conditions:

- () Unsoldered connections.
- () Solder bridges between wires.
- () Bent pins which could touch together.
- () Transistors for correct type and installation.
- () Electrolytic capacitor for correct proper position of the positive (+) and (-).
- () Diodes for the correct position of the banded end.

Save the unused sleeving and solder for later use. Transistor Q201 will be installed later. Set the circuit boards aside; they will be called for during the assembly portion of Manual 3500 3, Part 1. Proceed to the "Circuit Description" on the following page; they complete the examination on Page 1-23 as instructed.

PICTORIAL 2 3

CIRCUIT DESCRIPTION

A complete Circuit Description of your Oscilloscope is contained in Book Three, Assembly Manual 9560-3, Part 1. The partial Circuit Description, which follows, applies only to those portions of your kit that you have completed in the first Assembly Manual, 9560-1.

VERTICAL AMPLIFIER

From the attenuator circuit, a portion of the input signal is coupled through resistor R101 and capacitor C101 to the gate of transistor Q101. Resistor R101 protects Q101 from being damaged in case a high potential is applied to the vertical Input connector while the Volts/Cm switch is in one of its lower ranges. Diodes D101 and D102 are transistors connected to provide a zener action. These diodes limit the input signal to approximately ± 9 volts, to further protect Q101 from excess gate voltage. Capacitor C101 improves high frequency response by forming a high frequency path around R101.

Transistor Q101 is a field effect transistor (FET) connected as a source follower. This type of transistor provides the high impedance input necessary to prevent loading the circuit under test.

Transistor Q102 is a constant current source for input transistor Q101. Diodes D103 and D104 each provide a .6 volt drop (total 1.2 volts) and hold the base of Q102 at a constant voltage. Since the circuit of transistor Q102 is basically an emitter follower (common-collector), and the emitter voltage is dependent upon the base voltage, the emitter voltage will also remain constant. This constant emitter voltage is across DC Balance control R102; therefore, the current through R102 is constant. Control R102 is adjusted so the source voltage of Q101 is zero when an input signal is not present.

A signal applied to the gate of Q101 will cause only voltage changes at the source because the current through Q101 is constant. These voltage variations are applied across vertical Variable control R409, and a portion of this signal is applied to the gate of source follower Q103.

Transistor Q104 forms a constant current source for transistors Q105 and Q106. Since the emitter of each transistor is connected to this constant current source, the current source serves as a common emitter resistance and sets the operating point for the following stages.

The output from source follower transistor Q103 is amplified by Q105. A portion of the signal applied to the base of Q105 appears at its emitter. Because transistors Q105 and Q106 have a common emitter resistance, the signal present at the Q105 emitter is effectively coupled to the emitter of Q106.

Transistor Q106 functions as a common base amplifier whose base is held constant by the Vert. position control, R403. This control positions the trace by applying a DC voltage to the base of transistor Q106 and causes a DC unbalance in the vertical amplifier. When the collector output voltage of Q105 decreases, its emitter voltage will increase. An increased emitter voltage at Q106 reduces its forward bias and increases its collector output voltage. The signal at the collector of transistor Q106 is 180 degrees

out of phase with the signal at the collector of Q105 and forms a "push-pull" type of amplifier required to drive the CRT deflection plates. Capacitor C103 is an emitter bypass capacitor to boost the gain at high frequencies. Emitter resistors R108 and R109 establish the DC gain of the vertical amplifier.

Driver transistors Q107 and Q108 are common emitter amplifiers. In addition to providing gain, they also isolate transistors Q105 and Q106 from the output stages.

Output amplifiers Q109 and Q111 again amplify the differential signal and drive the vertical plates of the CRT

POWER SUPPLY

Line voltage is connected through the slow-blow fuse and the power switch on the Intensity control to the primary windings of the power transformer. The dual-primary transformer windings may be connected in parallel for 120-volt operation or in series for 240-volt operation.

The high-voltage secondary winding of the power transformer is connected to the voltage doubler circuit consisting of D201, D202, C204, and C205. Resistor R208 and capacitor C203 filter this negative high voltage which is coupled through resistor R412 to the grid of the CRT. The intensity and focusing voltages are also supplied to the CRT from the voltage divider network consisting of resistors R206, R207, R209, Intensity control R403, and Focus control R411. A separate 6.3 volt winding supplies the CRT filament voltage.

A secondary winding supplies 1 volt peak-to-peak to the 1VP-P input and to the Input switch on the front panel.

The low voltage secondary winding is connected to full-wave rectifier diodes D203, D204, D205, and D206. Zener diode ZD204 and resistor R217 maintain a constant voltage to the base of pass transistor Q201. (Figure 1-1 shows a simplified schematic of this power supply.) The output from the series pass transistor is a regulated 31 volts. By connecting equal loads from each side of the supply to ground, shown as RL1 through RL6, six separate DC output voltages are obtained. These are: +8 volts (vert), +9 volts (horiz), +5 volts (sweep), -5 volts (sweep), -9 volts (vert), and -9 volts (horiz).

Deflection potentials are obtained from another secondary winding connected to full-wave bridge rectifier diodes D207, D208, D209, and D211. An unregulated 180 volts DC is obtained through resistor R219, and an unregulated 150 volts DC is obtained through resistor R221

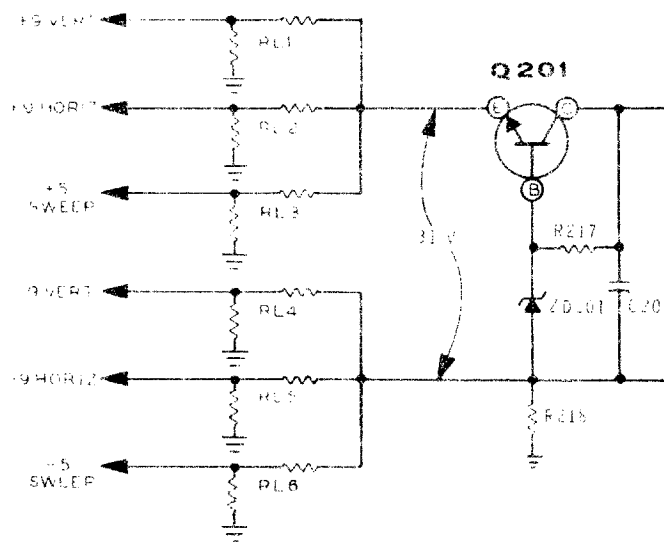


Figure 1-1

QUESTIONS

IMPORTANT — These instructions **MUST** be accurately followed to avoid loss, or errors in grading.

Indicate your answer on this sheet by filling in the box for the most correct answer to each question.

When all questions have been answered, place the answer card in the proper position to line up the boxes on the card with the boxes on the sheet.

Next, copy the complete lesson code into the space provided on the card, and fill in the answer boxes to correspond with those previously filled in on this sheet.

Before mailing, be certain your correct student number, name and address appear on the card.

LESSON CODE
9560-1

1. In what position of the vertical attenuator switch is the input signal applied directly to the vertical amplifier

A	<input type="checkbox"/>
B	<input checked="" type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

 (A) 1.3, (B) .03, (C) 3, (D) 30.

2. Transistors D101 and D102 in the vertical amplifier circuit are connected as

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input checked="" type="checkbox"/>

 (A) emitter followers, (B) common emitter amplifiers, (C) common base amplifiers (D) zener diodes.

3. Q104 operates as a

A	<input checked="" type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

 (A) constant current source, (B) common emitter amplifier source, (C) common emitter amplifier, (D) common base amplifier.

4. To provide dc balance of the Q101 stage, R102 is adjusted for

A	<input checked="" type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

 (A) zero Q101 source voltage, (B) a slightly positive Q101 source voltage, (C) a slightly negative Q101 source voltage, (D) maximum Q101 source voltage.

5. When the voltage at the base of Q201 in the power supply circuit increases,

A	<input checked="" type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

 (A) the emitter voltage decreases, (B) the emitter voltage remains constant, (C) the emitter voltage increases, (D) the collector voltage decreases.

6.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

7.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

8.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

9.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

10.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

THIS EXAM CONTAINS ONLY FIVE QUESTIONS

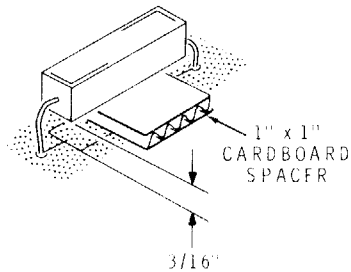
STEP-BY-STEP ASSEMBLY

START 

Position the power supply circuit board as shown. Then proceed with the following steps.

Resistors are 1/2-watt unless otherwise stated.

NOTE: Mount the following five resistors above the circuit board as shown. Use a 1" x 1" piece of 3/16" cardboard (from shipping carton), for a spacer. Solder each resistor as it is installed, cut off the excess lead lengths, and then remove the cardboard spacer.



() 1000 Ω, (1 k), 7-watt, wire-wound.

() 330 Ω, 5-watt, wire-wound.

() 3750 Ω, 7-watt, wire-wound.

() 10 kΩ, 10-watt, wire-wound.

() 140 Ω, 5-watt, wire-wound. Save a cutoff lead for the next step.

(-) Wire. Use the cutoff lead from the previous step. Ignore the "220" and the resistor outline at this location.

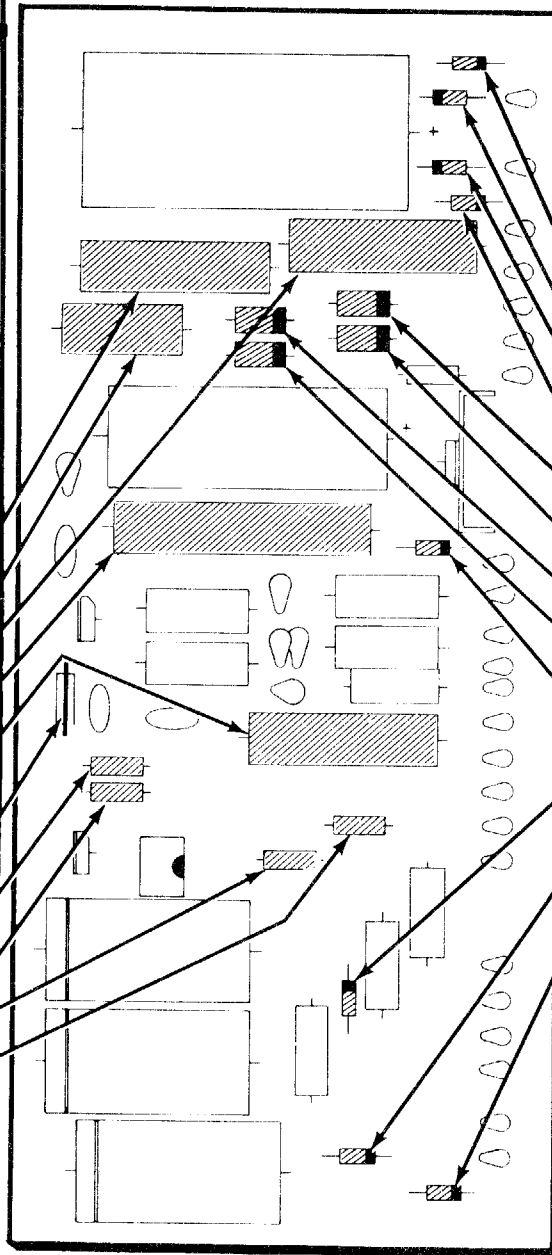
() 220 kΩ (red-red-yellow).

() 220 kΩ (red-red-yellow).

() 33 kΩ (orange-orange-orange).

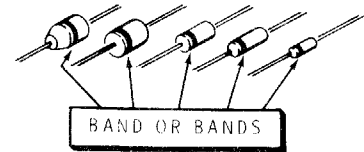
() 1000 Ω (brown-black-red).

() Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE 

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



() Locate eight 1N2071 silicon diodes (#57-27). They will be installed in the following steps.

() 1N2071 diode at D207.

() 1N2071 diode at D208.

() 1N2071 diode at D209.

() 1N2071 diode at D211.

() 1N2071 diode at D206.

() 1N2071 diode at D204.

() 1N2071 diode at D205.

() 1N2071 diode at D203.

() VR-36A zener diode (#56-55) at ZD201.

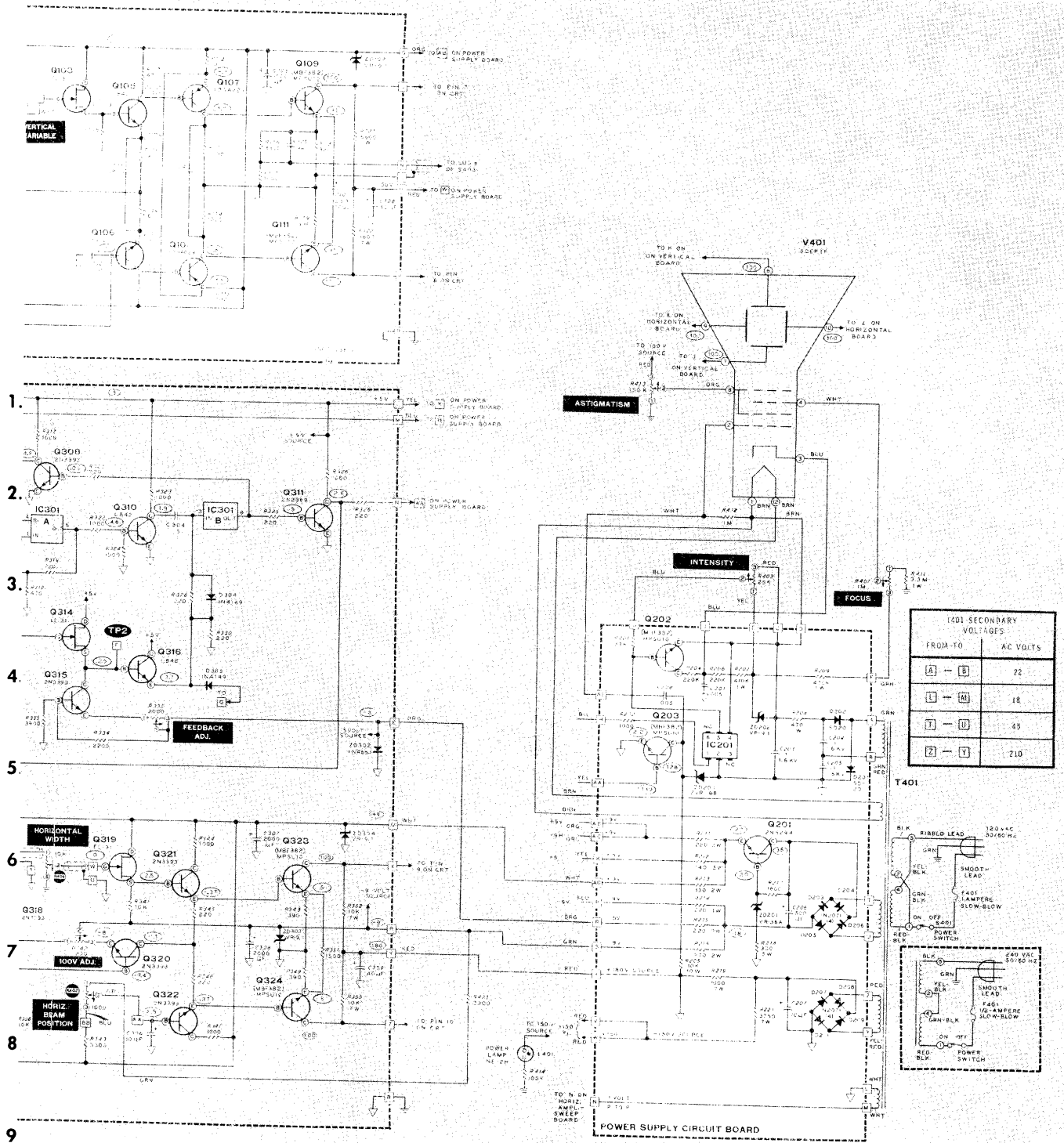
() VR-9.1 zener diode (#56-19) at ZD202.

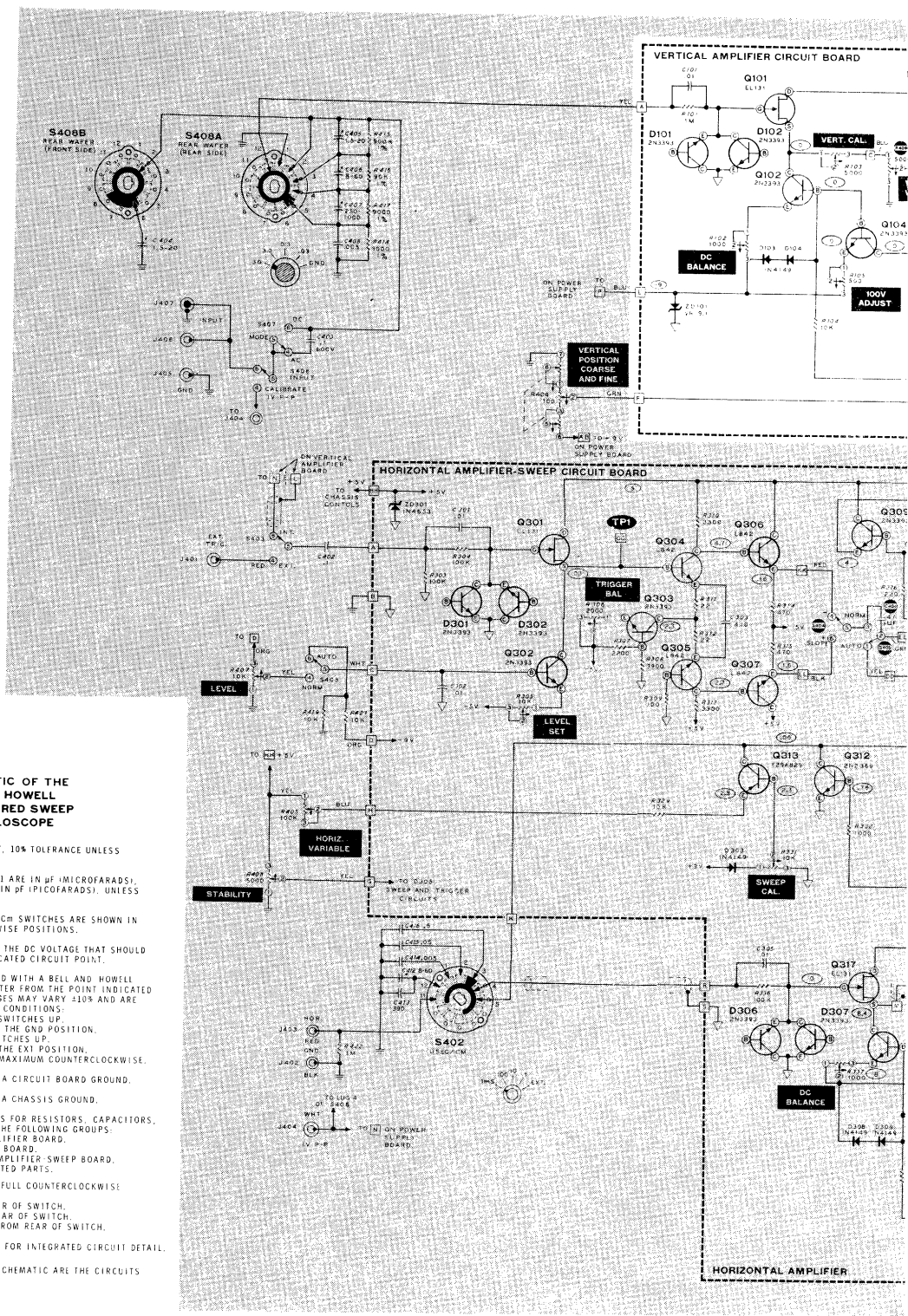
() 5D20 silicon diode (#57-52) at D202.

() 5D20 silicon diode (#57-52) at D201.

() Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 2-1





SCHEMATIC OF THE BELL & HOWELL 5" TRIGGERED SWEEP OSCILLOSCOPE

- NOTES:
- ALL RESISTORS ARE 1/2 WATT, 10% TOLERANCE UNLESS OTHERWISE NOTED.
 - ALL CAPACITORS LESS THAN 1 ARE IN pF (PICOFARADS), ALL OTHER CAPACITORS ARE IN pF (PICOFARADS), UNLESS OTHERWISE NOTED.
 - THE VOLTS/cm AND THE μ SEC/cm SWITCHES ARE SHOWN IN THEIR FULLY COUNTERCLOCKWISE POSITIONS.
 - THIS SYMBOL INDICATES THE DC VOLTAGE THAT SHOULD BE PRESENT AT THE INDICATED CIRCUIT POINT.
 - ALL VOLTAGES WERE MEASURED WITH A BELL AND HOWELL DIGITAL MULTIMETER VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY $\pm 10\%$ AND ARE TAKEN UNDER THE FOLLOWING CONDITIONS:
 - ALL SWEEP TRIGGER SWITCHES UP.
 - VOLTS/cm SWITCH IN THE GND POSITION.
 - MODE AND INPUT SWITCHES UP.
 - μ SEC/cm SWITCH IN THE EX1 POSITION.
 - STABILITY CONTROL MAXIMUM COUNTERCLOCKWISE.
 - THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
 - THIS SYMBOL INDICATES A CHASSIS GROUND.
 - LETTER-NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS:
 - 100-199 VERTICAL AMPLIFIER BOARD.
 - 200-299 POWER SUPPLY BOARD.
 - 300-399 HORIZONTAL AMPLIFIER SWEEP BOARD.
 - 400-499 CHASSIS MOUNTED PARTS.
 - ROTARY SWITCHES SHOWN IN FULL COUNTERCLOCKWISE POSITIONS.
 - S402 WAFER VIEWED FROM REAR OF SWITCH.
 - S408A WAFER VIEWED FROM REAR OF SWITCH.
 - S408B WAFER X-RAY VIEWED FROM REAR OF SWITCH.
 - SEE PAGE 3-79 OF THE MANUAL FOR INTEGRATED CIRCUIT DETAIL.
 - UNSHADED PORTIONS OF THE SCHEMATIC ARE THE CIRCUITS ASSEMBLED IN THIS MANUAL.