PRICE $2.00

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT

FREQUENCY SCALER
MODEL IB-102

595-1298-02

Assembly

and

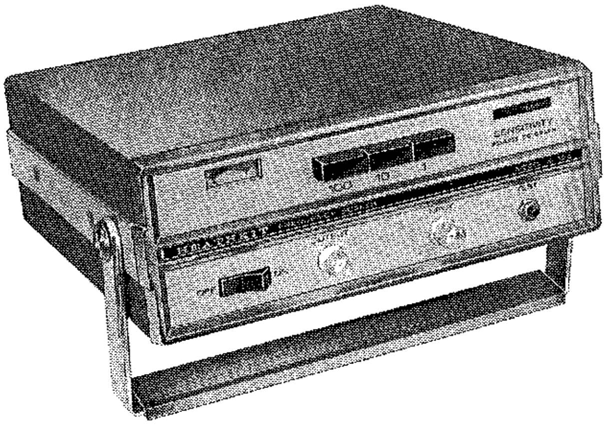
Operation

of the

HEATHKIT

FREQUENCY SCALER

MODEL IB-102



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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

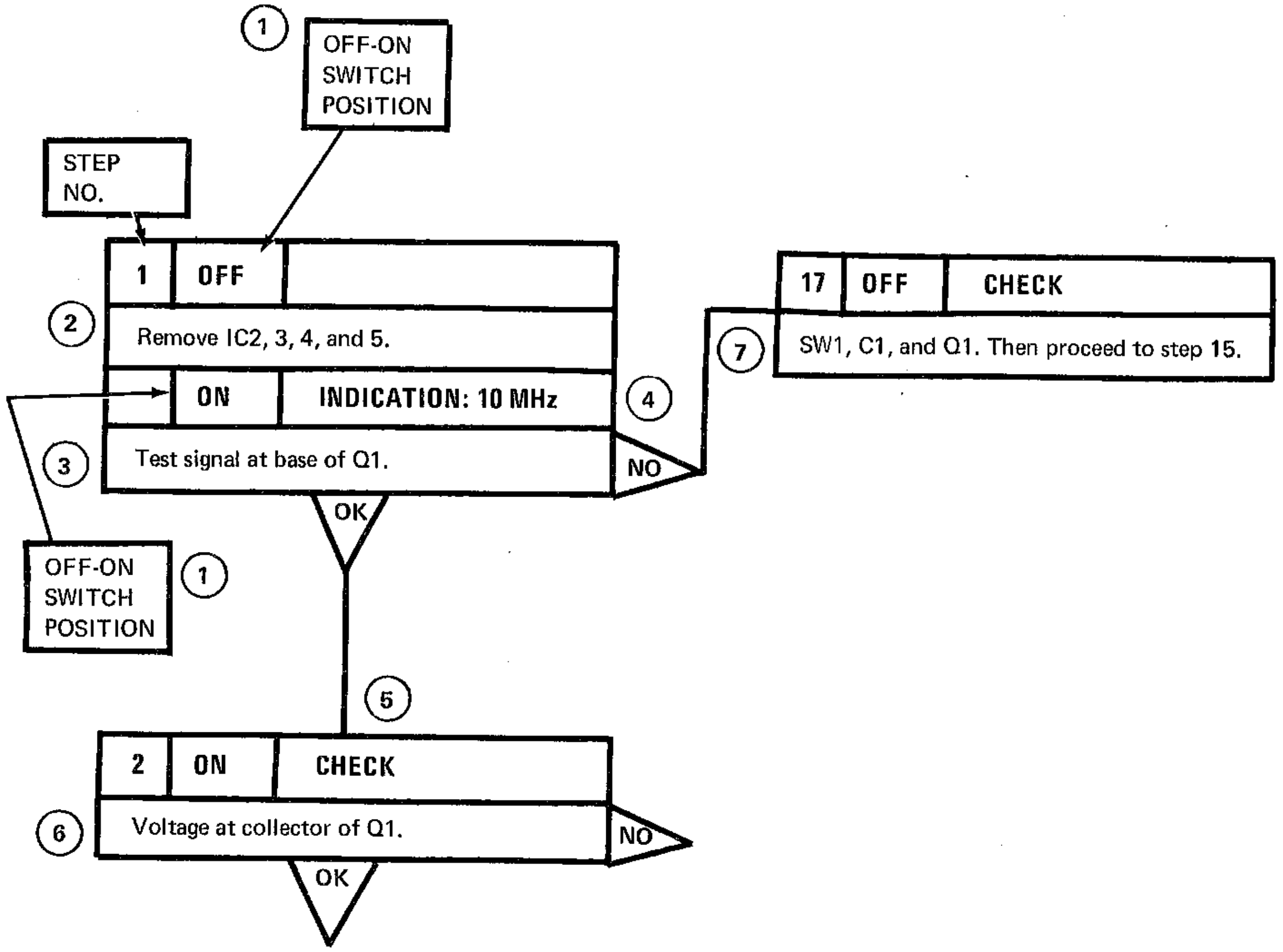
Logic Circuit Tests

If the Frequency Scaler does not divide properly and you have determined that the power supply voltages are correct, it will be necessary to test the logic circuits. This is done by following "Troubleshooting Chart #2," in which you will feed a signal of known frequency into the input of the Frequency Scaler and check the frequency of this signal at various points in the circuit with a frequency counter. In this chart, a step-by-step technique of frequency and voltage tests will enable you to locate the problem area in the circuit. This could be the result of a poor solder connection, the installation of a wrong value part, an incorrectly wired part or, on a rare occasion, a faulty part.

Begin the testing at "Start" on "Troubleshooting Chart #2." As a step is performed you will get an OK or NO result, which steers you to the next step. These steps will quickly bring you to a point where you are instructed to check a particular component. Check the component, for proper installation. Replace the component if it is faulty.

After a repair has been made, check the Frequency Scaler for proper operation, or follow the instructions in the step on the Chart where the fault first showed up. If the kit still does not perform properly, return to "Start" on the Chart and begin the tests again. Possibly there is more than one problem that must be corrected.

Sample Test Chart
(Not to be used for any tests)



USING TROUBLESHOOTING CHART #2

Learn how to use "Troubleshooting Chart #2" properly by referring to the "Sample Test Chart" and reading through the following paragraphs. Do not actually perform the steps. The numbers on the paragraphs are keyed to the circled numbers on the "Sample Test Chart."

1. Turn the Frequency Scaler OFF or ON, as instructed here, with the OFF-ON switch. WARNING: Always turn the Frequency Scaler OFF when removing or installing IC's. When removing or installing any other component, always unplug the line cord of the Frequency Scaler, as line voltage is present at a number of points in the chassis as shown by the boxed-in areas in Figure 3.

2. Follow the instructions given here before you perform the test.

3. This is the test point in the Frequency Scaler from which the signal is taken. NOTE: All "Test signal" measurements are taken with a .01 μF capacitor connected in series with the inner lead of the cable from the frequency counter. The free lead of this capacitor is then touched to the location called out in the step. Remove this capacitor when checking the signal at the Output of the Frequency Scaler and connect the cable directly to the Output connector.

4. This is the frequency that should be read on the frequency counter.

5. This denotes that a check of a voltage or components are to be made.

6. When checking a voltage, as indicated, use the "Voltage Chart" on "Troubleshooting Chart #2." All voltages were taken with a high impedance input voltmeter. Voltages can vary ±20%.

7. These parts should be checked to see that the proper part is installed properly according to the "Step-by-Step Assembly" instructions, that their solder connections are good, and that no solder bridges exist between the foils connected to the part and an adjacent foil. If everything appears alright, the part can be checked electrically. If a part is faulty, it must be replaced with an identical replacement part.

Proceed to "Start" on "Troubleshooting Chart #2" and perform the steps. NOTE: an input signal of 10 MHz is used to make frequency comparison checks. If a different input frequency is used, all other frequencies must be changed accordingly in "Troubleshooting Chart #2." Be sure to take into consideration the limitations of your frequency counter if you select another input frequency.

TROUBLESHOOTING CHART #2

If the Frequenc
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tests will enab
circuit. This co
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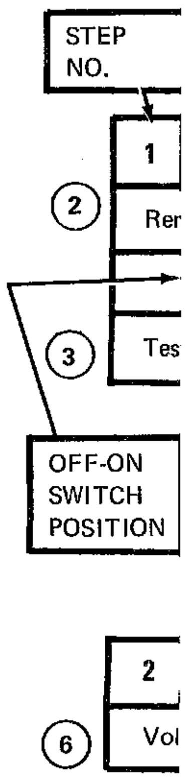
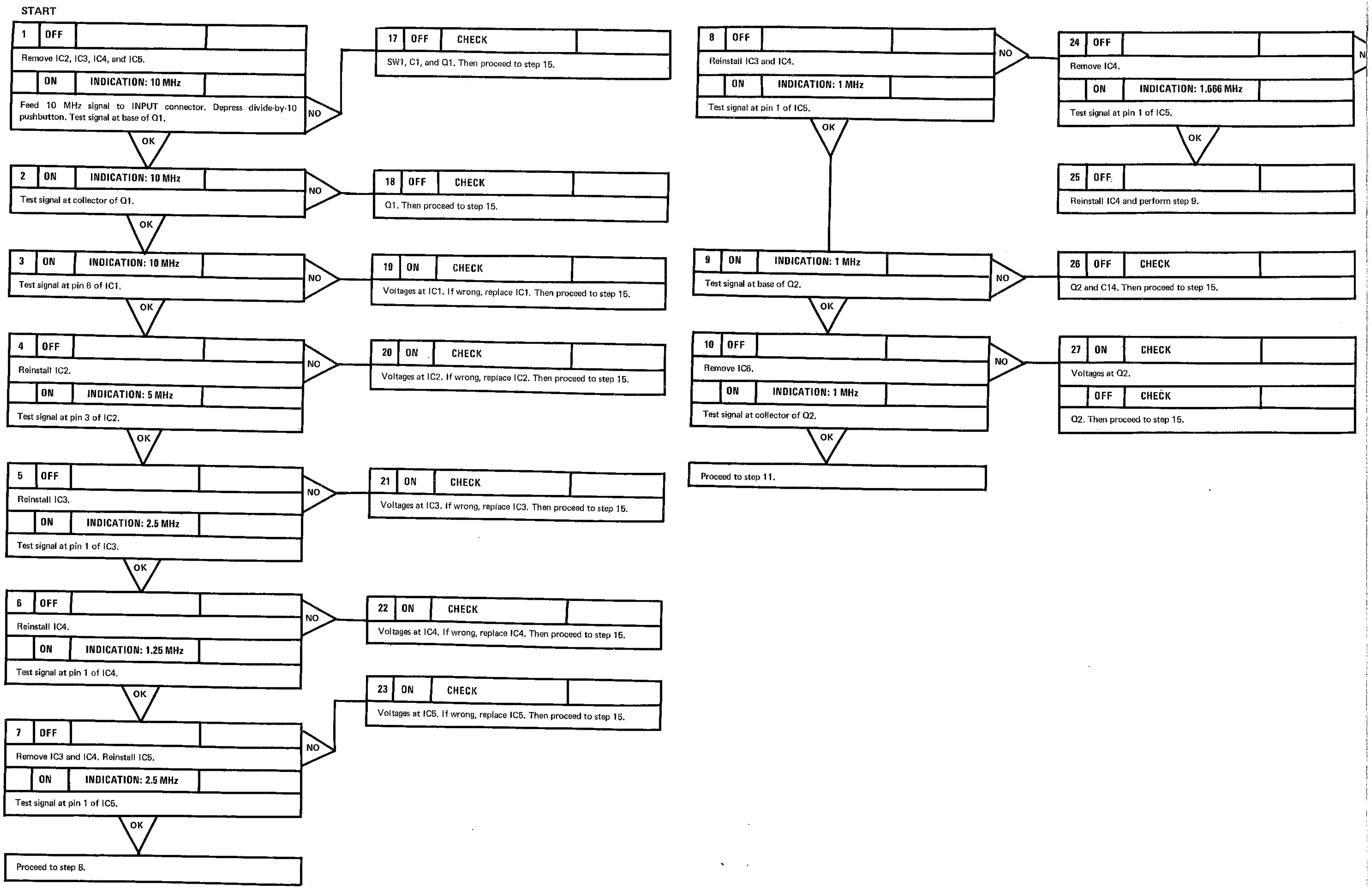




38	OFF		
Interchange IC3 and IC5 in their sockets.			
	ON	INDICATION: 2.5 MHz	
Test signal at pin 1 of IC5.			

NO →

44	OFF		
Replace faulty IC5. Then proceed to step 15.			

OK ↓

39	OFF		
Replace faulty IC3. Then proceed to step 15.			

TROUBLESHOOTING CHART #2 (Cont'd.)

11 | OFF
Reinstall IC6 and remove IC7.
ON | INDICATION: 1 MHz
Test signal at pin 13 of IC6.
NO → 28. OK → 12.

12 | ON | INDICATION: 1 MHz
Test signal at pin 11 of IC6.
NO → 29. OK → 13.

13 | ON | INDICATION: 1 MHz
Test signal at pin 6 of IC6.
NO → 31. OK → 14.

14 | ON | INDICATION: 1 MHz
Test signal at gate (G) of Q3.
NO → 33. OK → 15.

15 | OFF
Reinstall any removed IC's except IC7. Remove IC7 if it is still in its socket.
ON | INDICATION: 1 MHz
Test (direct-coupled) signal at Output.
NO → 34. OK ↓

NOTE: The divide-by-10 function is operating properly. Proceed as follows and check the divide-by-100 function.

16 | OFF
Reinstall IC7 and depress the divide-by-100 pushbutton.
ON | INDICATION: 100 kHz
Test (direct-coupled) signal at Output.
NO → 35. OK ↓

NOTE: The divide-by-100 function is operating properly. Recheck the Adjustments. This completes the tests.

28 | OFF
Replace faulty IC6. Then proceed to step 15.

29 | ON | CHECK
Voltage at pin 12 of IC6 should be 4 V minimum.
NO → 40. OK → 30.

30 | OFF
Perform step 28.

31 | ON | CHECK
Voltage at pin 4 of IC6 should be 4 V minimum.
NO → 41. OK → 32.

32 | OFF
Perform step 28.

33 | OFF | CHECK
Q3 and C17. Then proceed to step 15.

34 | | CHECK
Setting of Zero Adjust control (see adjustments) or Q3. Then repeat step 15.

35 | ON | INDICATION: 500 kHz
Test signal at pin 12 of IC7.
NO → 43. OK → 36.

36 | ON | INDICATION: 100 kHz
Test signal at pin 11 of IC7.
NO → 43. OK → 37.

37 | | CHECK
Setting of Zero Adjust control (see Adjustments), Q3, or IC6. Then repeat step 16.

40 | OFF | CHECK
R14 and pins 5 and 6 of SW2. Then proceed to step 15.

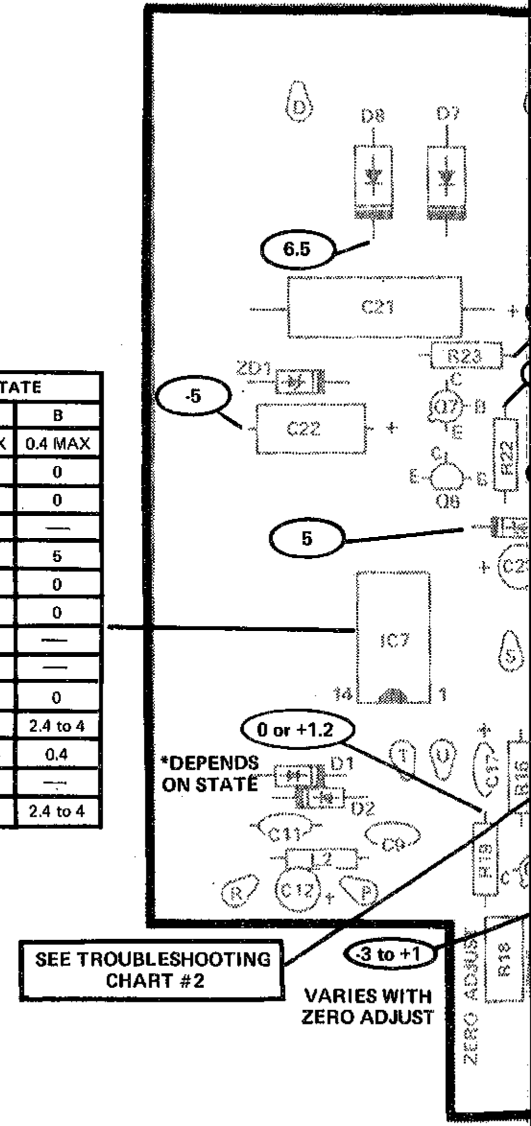
41 | ON | CHECK
Voltage at pin 2 of IC6. Should be 0 V.
NO → 45. OK → 42.

42 | OFF
Perform step 28.

43 | OFF
Replace faulty IC7. Then repeat step 16.

45 | OFF | CHECK
Jumper wire between pin 3 of SW2 and pin 3 of SW3. Then step 15.

PIN No.	STATE A	STATE B
1	0.4 MAX	0.4 MAX
2	0	0
3	0	0
4	—	—
5	5	5
6	0	0
7	0	0
8	—	—
9	—	—
10	0	0
11	0.4	2.4 to 4
12	2.4 to 4	0.4
13	—	—
14	0.4	2.4 to 4



:SHOOTING CHART #2 (Cont'd.)

40	OFF	CHECK	
R14 and pins 5 and 6 of SW2. Then proceed to step 15.			

45	OFF	CHECK	
Jumper wire between pin 3 of SW2 and pin 3 of SW3. Then proceed to step 15.			

NO

NO

41	ON	CHECK	
Voltage at pin 2 of IC6. Should be 0 V.			

NO

OK

42	OFF		
Perform step 28.			

) or Q3. Then repeat

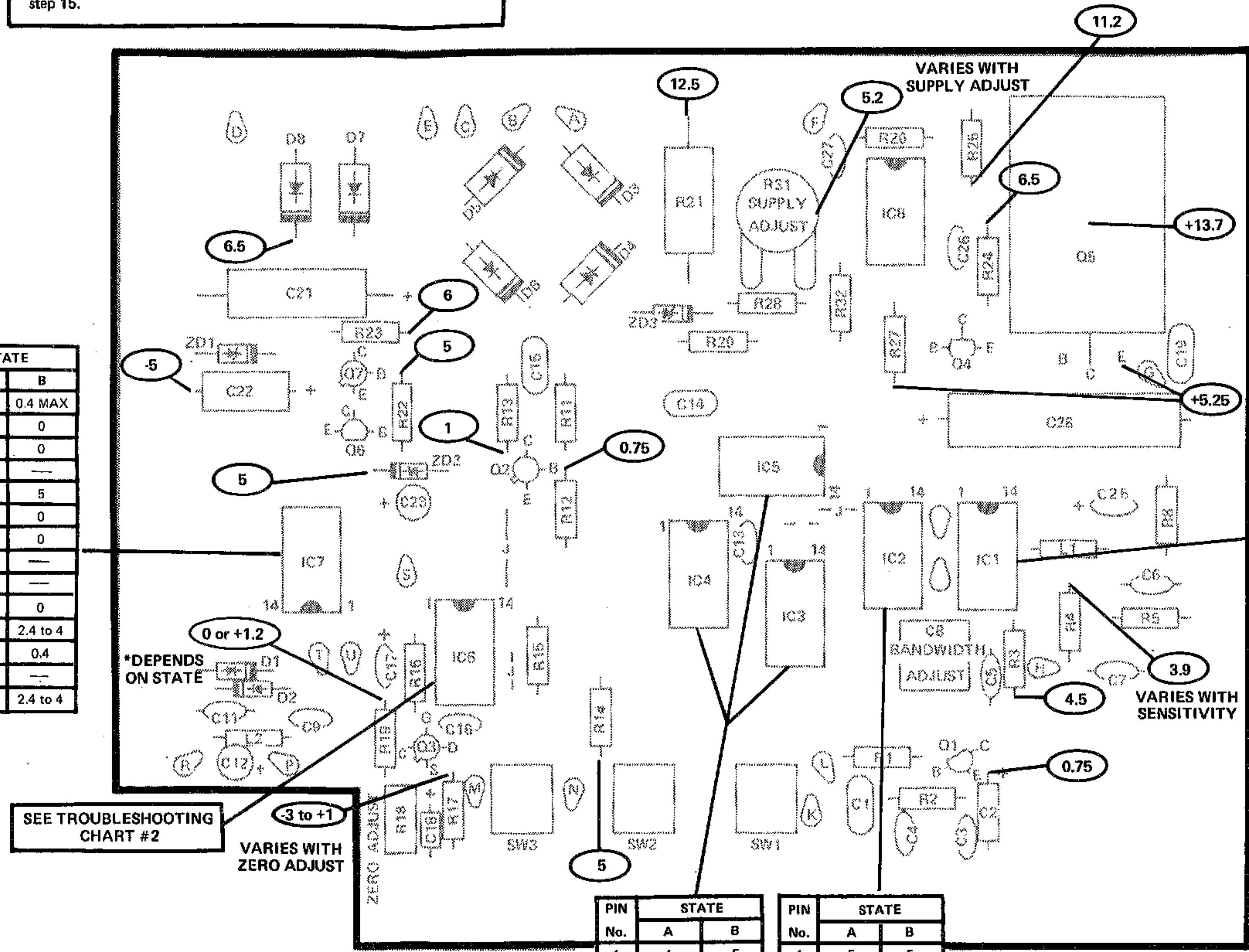
NO

NO

43	OFF		
Replace faulty IC7. Then repeat step 16.			

s), Q3, or IC6. Then

PIN No.	STATE A	STATE B
1	0.4 MAX	0.4 MAX
2	0	0
3	0	0
4	—	—
5	5	5
6	0	0
7	0	0
8	—	—
9	—	—
10	0	0
11	0.4	2.4 to 4
12	2.4 to 4	0.4
13	—	—
14	0.4	2.4 to 4



PIN No.	STATE A	STATE B
1	4	5
2	4	5
3	4	5
4	4	5
5	4	5
6	5	4
7	0	0
8	5	4
9	3.5	4.5
10	3.5	4.5
11	3.5	4.5
12	3.5	4.5
13	4	5
14	4	5

PIN No.	STATE A	STATE B
1	4	5
2	0	0
3	4-5	4-5
4	0	0
5	4-5	4-5
6	4-5	4-5
7	0	0
8	0	0
9	0	0
10	0	0
11	4-5	4-5
12	0	0
13	5	4
14	5	5

PIN No.	STATE A	STATE B
1	5	5
2	5	4
3	4	5
4	—	—
5	—	—
6	0	0
7	0	0
8	4-5	4-5
9	—	—
10	4	5
11	4	5
12	5	4
13	—	—
14	5	5

VOLTAGE CHART
(VIEWED FROM SCREEN SIDE)

NOTES:

1. All voltages are dc and taken with a high impedance voltmeter from the point indicated to chassis ground. Voltages may vary ±20%.
2.* IC voltages have an A and B state of logic.
   - A. Sensitivity control adjusted to 3.5 V at pin 9 of IC1.
   - B. Sensitivity control adjusted to 4.5 V at pin 9 of IC1.

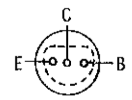
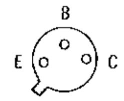
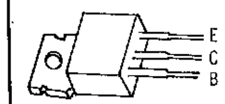
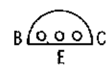
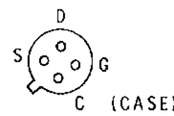
NOTE: 4-5 means this voltage can be either 4 volts or 5 volts.

CHECKOUT CHART

Meter Range: x 1000

NOTE: If the meter reading indicates that a transistor is faulty, recheck the reading before replacing the transistor.

*NOTE: The meter readings can vary ±20%.

TYPE	HEATH PART NO.	BASE DIAGRAM	CONNECT METER + LEAD TO TRANSISTOR LEAD:	CONNECT METER – LEAD TO TRANSISTOR LEAD:	METER READING * RANGE X 1000
2N3393	417-118		B B E E C	C E C B B	8500 9000 INF INF INF
2N2369	417-154		B B E E C	C E C B B	9500 8000 INF INF INF
TA2911	417-175		B B E E C	C E C B B	5000 5000 INF INF INF
TIS87	417-258		B B E E C	C E C B B	10,000 10,000 10,000 INF INF
UC734	417-167		S D G S D G	D S S G G D	2500 2500 10,000 INF INF 10,000

FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) Or, if you wish, you can deliver your kit to a nearby Heathkit Electronic Center. These centers are listed in your Heathkit catalog.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heathkit Electronic Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heathkit Electronic Center, please ship it to the factory at Benton Harbor, Michigan and observe the following shipping instructions:

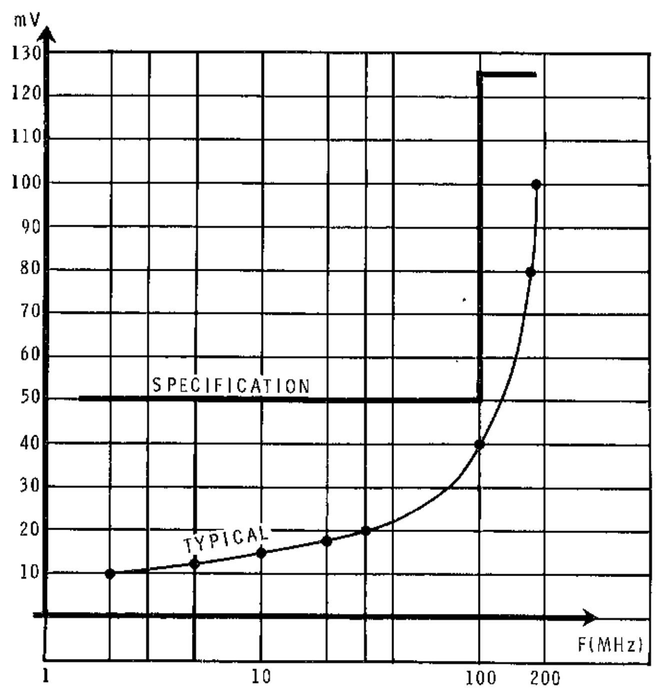
Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packaging, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan 49022.

Check the equipment to see that all parts and screws are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



SENSITIVITY VERSUS FREQUENCY CHART

SPECIFICATIONS

Frequency Range	2 MHz to 175 MHz.
Resolution (Counter with 1 ms time base)	Divide by 10 = 10 kHz. Divide by 100 = 100 kHz.
(Counter with 1 s time base)	Divide by 10 = 10 Hz. Divide by 100 = 100 Hz.
Meter	Green area indicates adequate signal level.

INPUT

Sensitivity*	50 mV: 2 MHz to 100 MHz. 125 mV: 100 MHz to 175 MHz.
Impedance	Divide by 1: Same as frequency counter. Divide by 10 and 100: 50 Ω.
Amplitude (maximum)	3 V rms, in ÷ 10 and ÷ 100 and 600 V rms, in ÷ 1.

OUTPUT

Amplitude (minimum)	1 V across 1 MΩ and 20 pF load.
Rise Time	20 ns.
Fall Time	10 ns.
Offset From Ground	Adjustable from zero to ±500 mV.

GENERAL

Power Requirements	110 - 130 or 220 - 260 Vac, 50/60 Hz, 5 watts.
Ambient Temperature Range	Storage: -55 degrees C to 80 degrees C. Operation: 10 degrees C to 40 degrees C.
Dimensions	8-1/4" wide x 3-3/8" high x 9" deep. (Dimensions do not include handle.)
Weight	7 lbs.

*See Sensitivity-Versus-Frequency Chart on Page 38.

CIRCUIT DESCRIPTION

Refer to the Block Diagram (Page 41) and the Schematic Diagram (fold-out from Page 47) while you read this "Circuit Description."

GENERAL

Input transistor Q1 isolates the input from trigger circuit IC1 and amplifies the input signal. IC1 consists of two OR gates that shape the signal into pulses and change the reference level of these pulses from ground to a positive level. The divide-by-2 circuit, IC2, and the divide-by-5 circuits, IC3, IC4, and IC5, work together to divide the total number of input pulses by ten. These divided pulses are then fed to level translator Q2 where their positive level is changed back to the near-zero or ground reference required for the following circuits. From the collector of Q2, the pulses are applied to the gating circuits of IC6 and the divide-by-10 circuit IC7.

The divide-by-10 and the divide-by-100 switches turn on the proper gates in IC6. When the divide-by-10 switch is depressed, the pulses from Q2 are applied through the gating circuits of IC6, buffer transistor Q3, to the Output terminals. When the divide-by-100 switch is depressed, the pulses from Q2 are first divided by ten in IC7, and then applied through Q3 to the Output terminals.

NOTE: Portions of some of the IC's in this Scaler are not used or required.

INPUT CIRCUIT

Input amplifier transistor Q1 offers a 50 Ω input impedance to the applied signal. This stage also provides isolation between the input and the trigger circuit that follows.

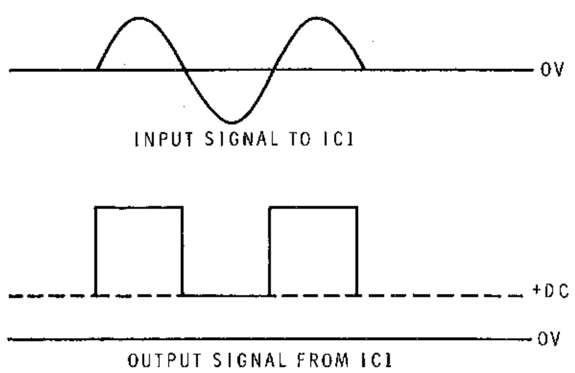


Figure 5

TRIGGER CIRCUIT

Trigger circuit IC1 consists of two OR gates that are connected to provide two functions: They use a positive and negative limiting action to shape the input signal into square-wave pulses that are suitable for driving the logic circuits that follow, and they shift the reference level of these pulses to a positive dc that provides correct bias to the following circuits. Figure 5 shows the relationship between the input signal and the output pulses of these two gates.

Sensitivity control R7, which is connected in a voltage divider with R5 and R8, provides bias to the first gate. This control is adjusted for optimum output at high frequencies.

Pressing the Test switch places a small amount of power supply ripple across resistor R5 to provide a test signal to the two OR gates. This test signal is then added to the input signal. If the addition of this small (approximately 5 mv) test signal causes the OR gates to trigger irregularly (unstable triggering), either the input signal is too weak or the Sensitivity control requires adjustment. Trimmer capacitor C8 provides a small amount of negative feedback to the first OR gate to improve the bandwidth.

DIVIDE-BY-2

Divide-by-2 circuit IC2 contains a D-type repeater flip-flop that changes states only when a positive-going pulse (the leading edge of a square wave) is applied to input C2. Figure 6 shows the relationship between the input and output pulses of IC2. Notice that two complete pulses are required to produce one pulse in the output, hence, the number of input pulses is divided by two.

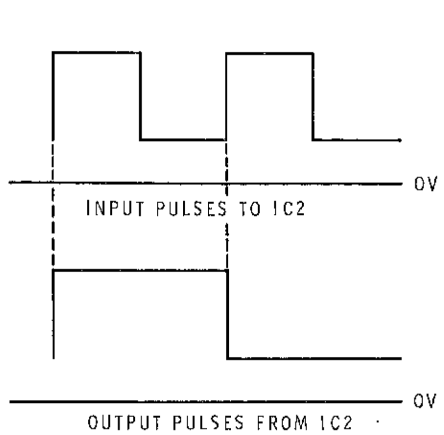
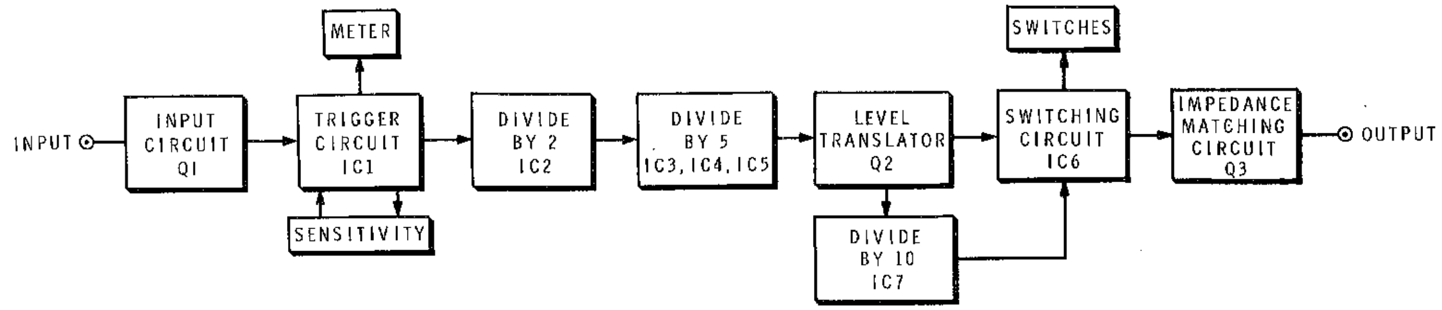


Figure 6



BLOCK DIAGRAM

DIVIDE-BY-5

IC3, IC4, and IC5 make up the divide-by-5 circuit. Each of these three integrated circuits contains a single J-K flip-flop. Various feedback connections are made between these IC's to provide only one pulse out to the level translator for every five pulses received from the divide-by-2 circuit.

The combined effect of the divide-by-2 and the divide-by-5 circuits will be to divide the number of pulses supplied from the trigger circuit by 10. For example: For every 100 pulses received from the trigger circuit, the divide-by-2 circuit provides only 50 pulses to the divide-by-5 circuit. For every 50 pulses received from the divide-by-2 circuit, the divide-by-5 circuits provide only 10 pulses to the level translator.

LEVEL TRANSLATOR

Level translator transistor Q2 amplifies the pulses received from the divide-by-5 circuit and shifts the reference level of these pulses to the near-zero or ground reference required by the following circuits. These pulses are connected to pin 13 of IC6 and pin 14 of IC7.

GATING CIRCUIT

Gating circuit IC6 uses three of the four NAND gates contained within its module. These three gates are controlled by two of the pushbutton switches located on the front panel of the Scaler. The selection of the divide-by-1 function routes the input signal straight through the switches to the Output of the Scaler. The selection of the divide-by-10 function connects a +5 volts through SW2 to pin 12 of the first gate. Since the two input levels to the first gate are the same (+), the gate is opened, allowing inverted (-) pulses to be applied to pin 5 of the second gate. At the same time a (+) level is applied to pin 4, opening the second gate and allowing the divided-by-10 pulses to be routed from pin 6, through buffer Q3, to the Output.

Selection of the divide-by-100 function closes the first gate of IC6. A +5 volts is applied through SW3 to pin 2 of the third gate, opening this gate to pulses received from pin 11 of decade counter IC7. Inverted (-) pulses are then fed from pin 3 of the third gate to pin 4 of the second gate. At the same time a +5 volts is applied to pin 5, opening the second gate and allowing the divided-by-100 pulses to be routed from pin 6, through buffer Q3, to the Output.

DIVIDE-BY-10

Divide-by-10 circuit IC7 is a decade counter. This circuit uses one gate and four J-K flip-flops connected in such a way as to divide by 10. This process of further dividing the received pulses by ten has the overall effect of dividing by 100. For example: For every 100 pulses received from the trigger circuit, ten pulses are routed to the divide-by-10 circuit. Then, for every 10 pulses received by this circuit, only 1 pulse is routed through the gating circuit and buffer transistor Q3 to the Output, hence, the number of pulses from the trigger circuit is divided by 100.

BUFFER

Buffer transistor Q3 is a field-effect transistor with an input impedance large enough to keep the IC's from being loaded by the output. The output impedance of Q3 is small enough to provide a matched impedance with the coaxial cable connected to the output circuit.

METER

The meter obtains its signal from the trigger circuit. Since the trigger circuit already limits the amplitude of its output signal to IC2 (the process used to shape the input signal into a square wave), this feature is also used to prevent possible pegging of the meter needle. The coaxial cable used to connect the meter with the trigger circuit exhibits an internal capacitance at high frequencies. This internal capacitance is effectively neutralized by the coil etched on the circuit board foil. Diodes D1 and D2 detect the amplitude level of the signal received from the trigger circuit. This amplitude level is then filtered and applied to the meter to present a visual indication of adequate signal strength for proper operation of the circuits.

POWER SUPPLY

Dual-primary transformer T1 can be wired to operate from either 120 Vac or 240 Vac. Two secondary output windings furnish the ac voltage for the +5.25-volt, +5-volt, and -5-volt power supplies.

+5.25-Volt Power Supply

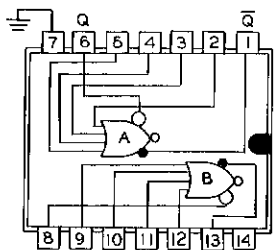
Diodes D3, D4, D5, and D6 form a rectifier bridge network for the +5.25 voltage. The rectified output voltage from this bridge is filtered by R21 and C24, and then applied to the collectors of pass transistors Q4 and Q5.

Transistor Q5 acts as a variable resistor to keep the +5.25 voltage constant by continuously comparing it to a reference voltage furnished to Q4 by operational amplifier IC8. IC8 measures any difference between the reference voltage obtained from the wiper of Supply Adjust control R31 and the actual output voltage at the emitter of Q5. Any difference between the reference voltage and the actual output voltage is amplified and used to control Q4, which drives Q5 to keep the +5.25-volt supply constant.

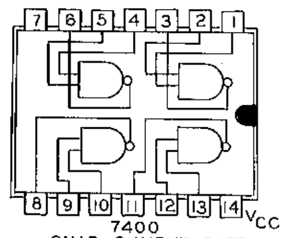
+5-and -5-Volt Power Supply

The +5-volt and the -5-volt sources are obtained from a separate power supply to keep them from being affected by stray signals. Stray signals, if carried within the voltage source, could cause the logic circuits to trigger at random and produce errors in the output.

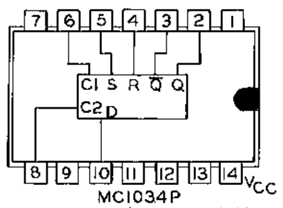
Diodes D7 and D8 form a full-wave rectifier for the +5-volt and the -5-volt regulator. Constant-current amplifier transistors Q6 and Q7 maintain a constant current to zener diodes ZD1 and ZD2, the +5-volt and -5-volt loads. Any increase in dc voltage into the regulator would result in an increase in current through R22. This would increase the forward bias on Q6 and result in more current through R23. An increase in current through R23 would decrease the forward bias on Q7 and result in less current through R22, thus returning Q6 to normal.



MC1023P DUAL NOR/OR GATE IC1(#443-38)

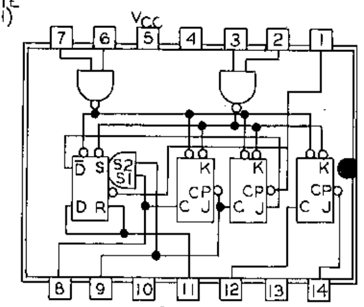


7400 QUAD 2 INPUT GATE IC6(#443-1)

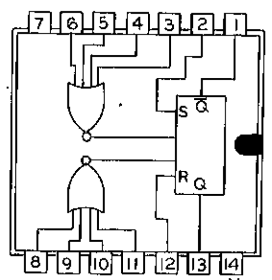


MC1034P SINGLE D TYPE FLIP-FLOP IC2(#443-39)

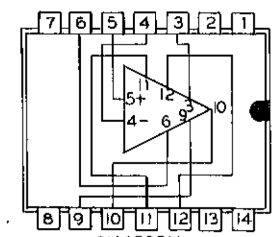
INTEGRATED CIRCUITS



7490 DECADE COUNTER IC7(#443-7)

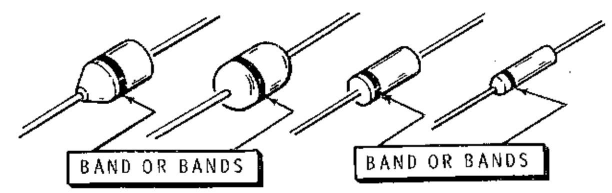
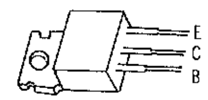
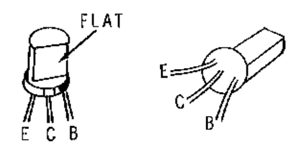
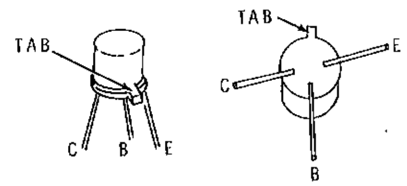
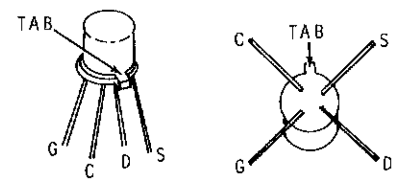
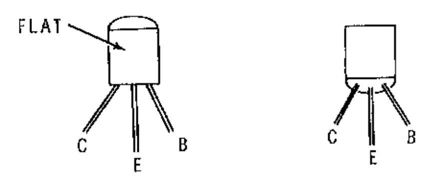


MC1027P AND 1013P SINGLE J-K FLIP-FLOP IC3, AND IC5(#443-41) IC4(#443-40)

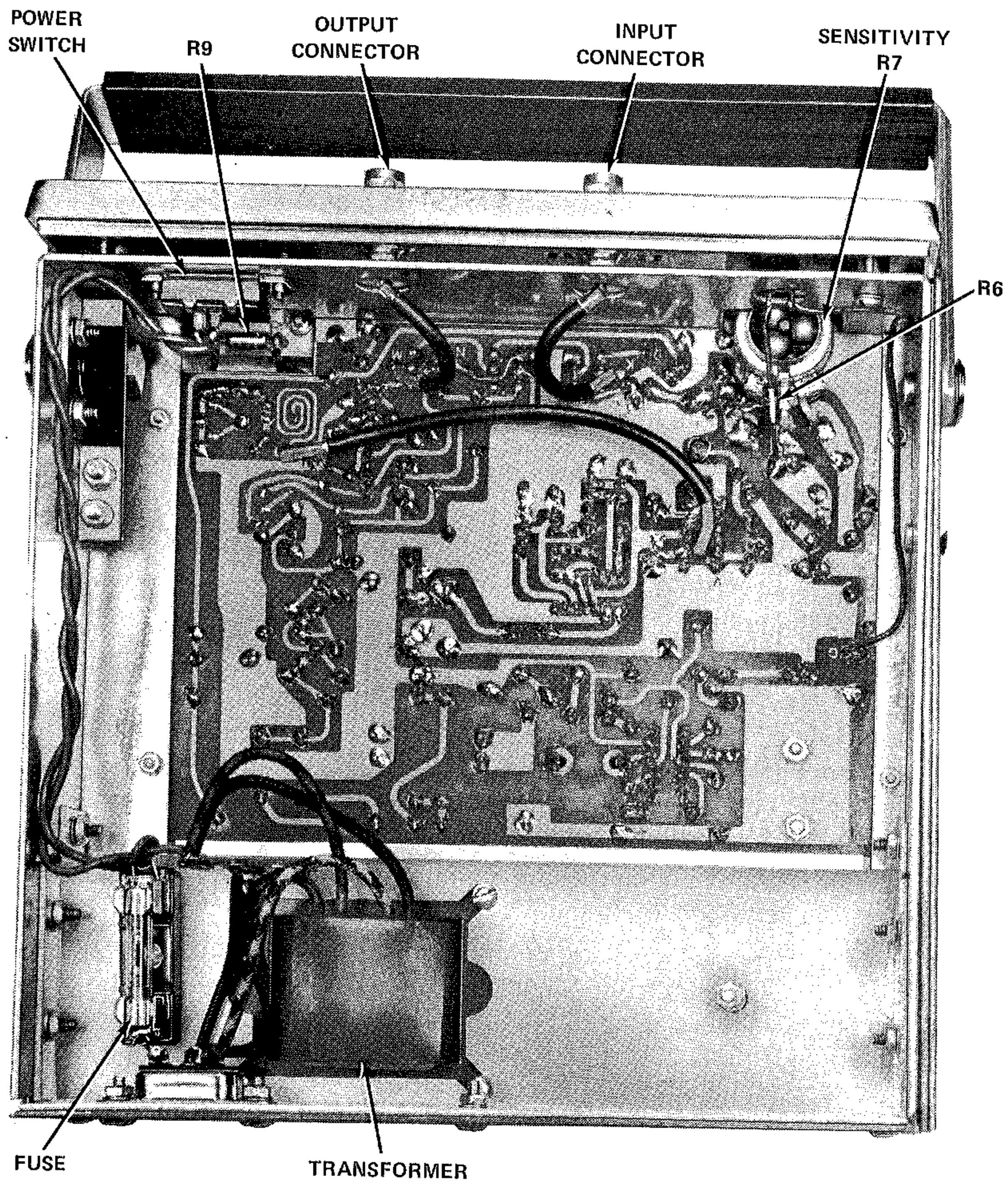


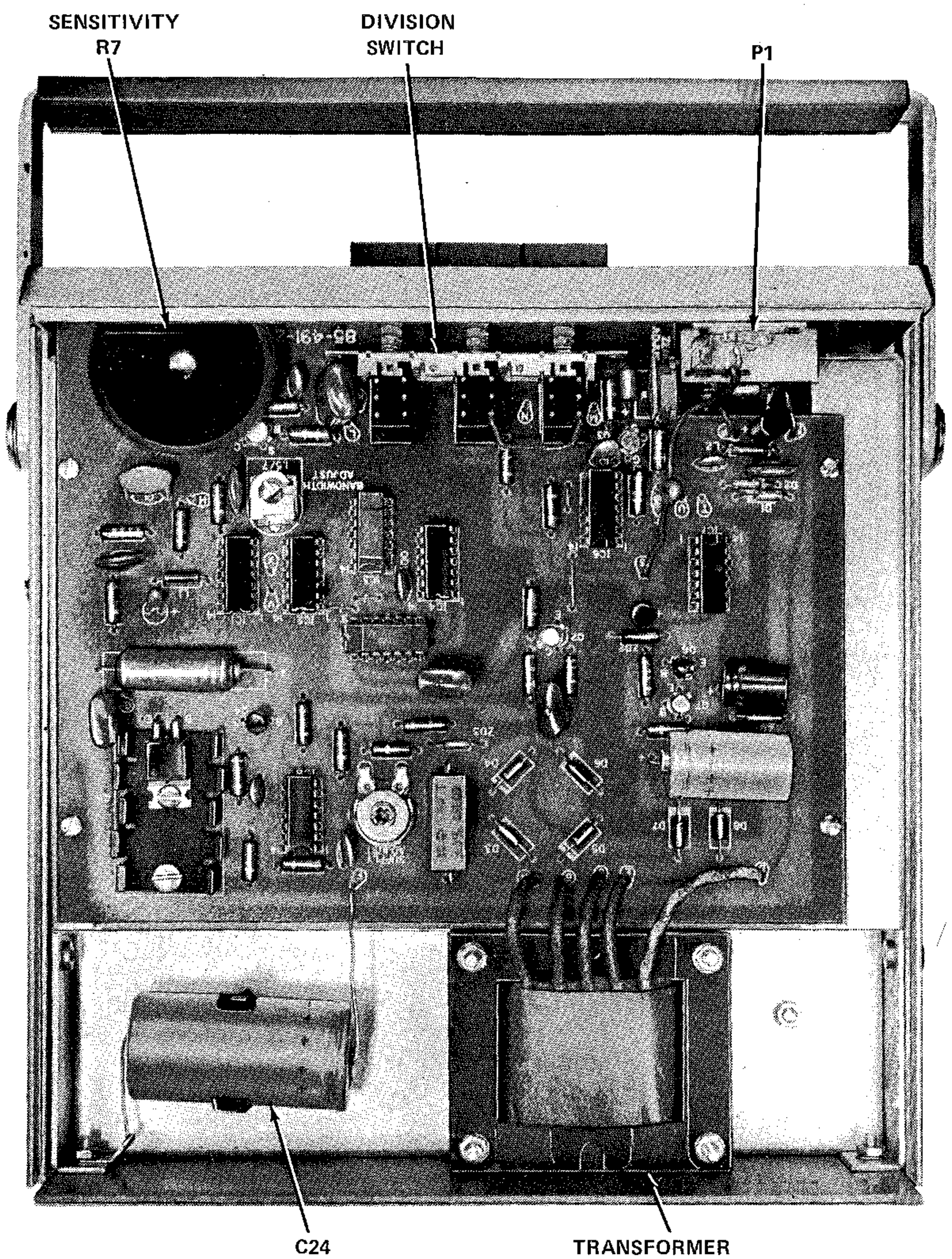
SN4985N OPERATIONAL AMPLIFIER IC8(#442-2)

Identification Chart

COMPONENT	HEATH PART NUMBER	MAY BE REPAIRED WITH	IDENTIFICATION DRAWING
D1, D2	56-20	1N295	NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. ALWAYS POSITION THIS END AS SHOWN IN THE PICTORIAL. 
D3, D4, D5, D6, D7, D8.	57-65	1N4002	
ZD1, ZD2	56-75	1N5338B 5.1 VOLT, 240mA ZENER	
ZD3	56-71	1N825A 6.2 VOLT, 7.5mA ZENER	
Q5	417-175	TA2911	
Q4, Q6	417-118	2N3393	
Q2, Q7	417-154	2N2369	
Q3	417-167	UC734	
Q1	417-258	TIS87	

CHASSIS PHOTOGRAPHS





VOLTAGE CHART

NOTES:

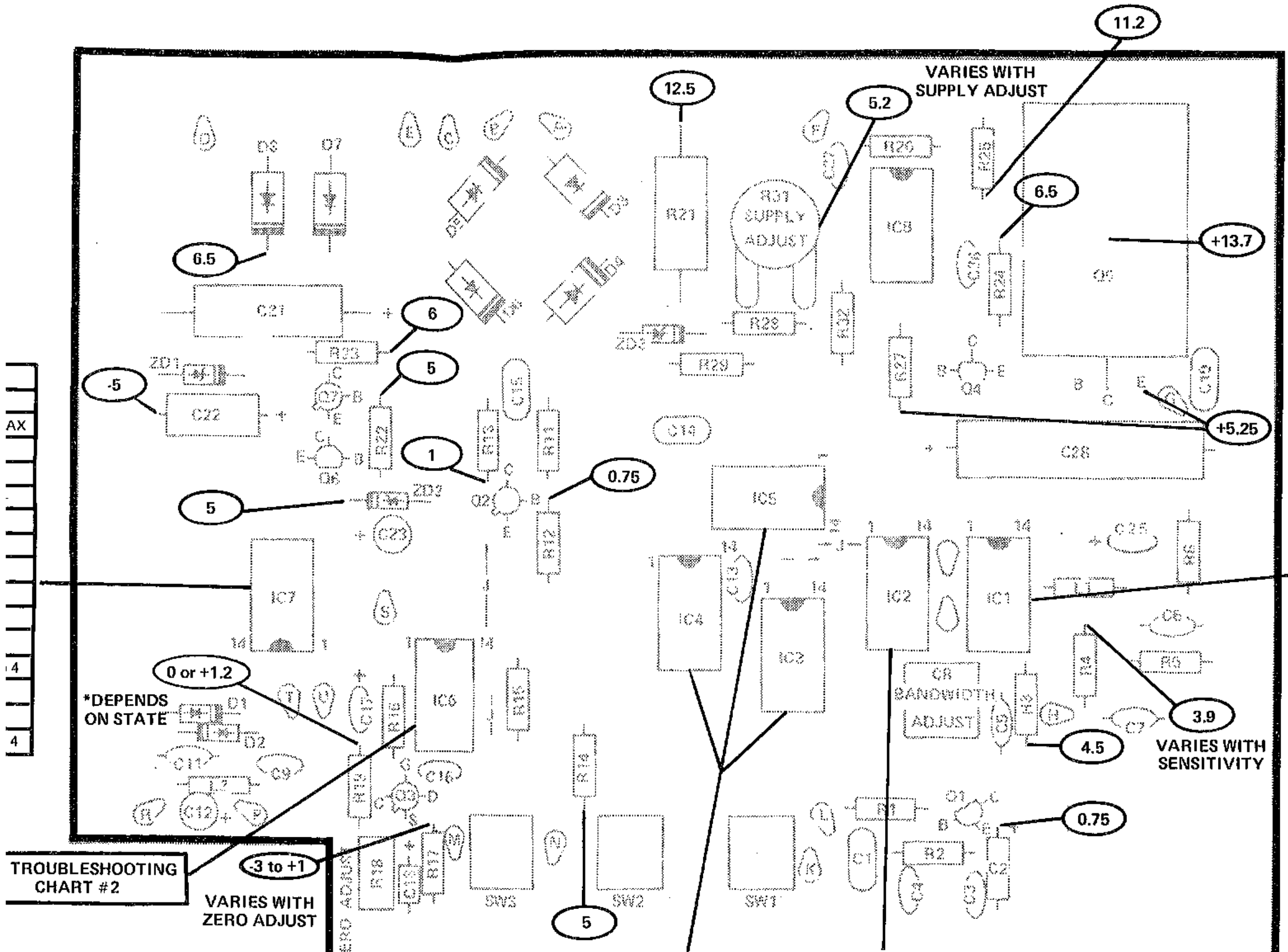
1. All voltages are dc and taken with a high impedance voltmeter from the point indicated to chassis ground. Voltages may vary ±20%.

2.* IC voltages have an A and B state of logic.

   A. Sensitivity control adjusted to 3.5 V at pin 9 of IC1.

   B. Sensitivity control adjusted to 4.5 V at pin 9 of IC1.

NOTE: 4-5 means this voltage can be either 4 volts or 5 volts.



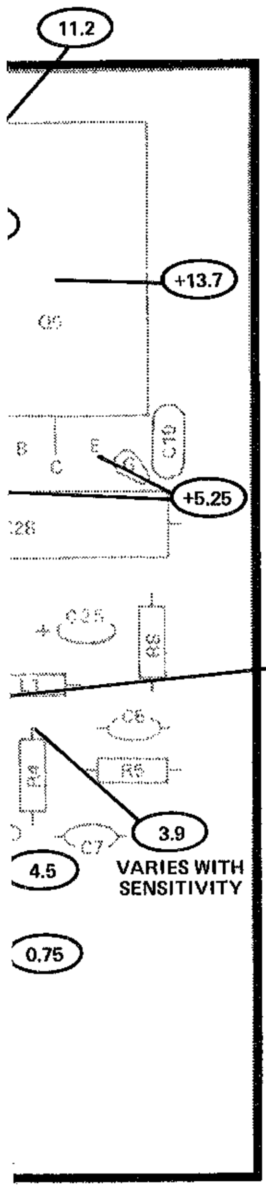
PIN No.	STATE A	STATE B
1	4	5
2	4	5
3	4	5
4	4	5
5	4	5
6	5	4
7	0	0
8	5	4
9	3.5	4.5
10	3.5	4.5
11	3.5	4.5
12	3.5	4.5
13	4	5
14	4	5

PIN No.	STATE A	STATE B
1	4	5
2	0	0
3	4-5	4-5
4	0	0
5	4-5	4-5
6	4-5	4-5
7	0	0
8	0	0
9	0	0
10	0	0
11	4-5	4-5
12	0	0
13	5	4
14	5	5

PIN No.	STATE A	STATE B
1	5	5
2	5	4
3	4	5
4	—	—
5	—	—
6	0	0
7	0	0
8	4-5	4-5
9	—	—
10	4	5
11	4	5
12	5	4
13	—	—
14	5	5

VOLTAGE CHART
(VIEWED FROM SCREEN SIDE)

VOLTAGE CHART



PIN No.	STATE A	STATE B
1	4	5
2	4	5
3	4	5
4	4	5
5	4	5
6	5	4
7	0	0
8	5	4
9	3.5	4.5
10	3.5	4.5
11	3.5	4.5
12	3.5	4.5
13	4	5
14	4	5

NOTES:

1. All voltages are dc and taken with a high impedance voltmeter from the point indicated to chassis ground. Voltages may vary ±20%.

2.* IC voltages have an A and B state of logic.

   A. Sensitivity control adjusted to 3.5 V at pin 9 of IC1.

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NOTE: 4-5 means this voltage can be either 4 volts or 5 volts.

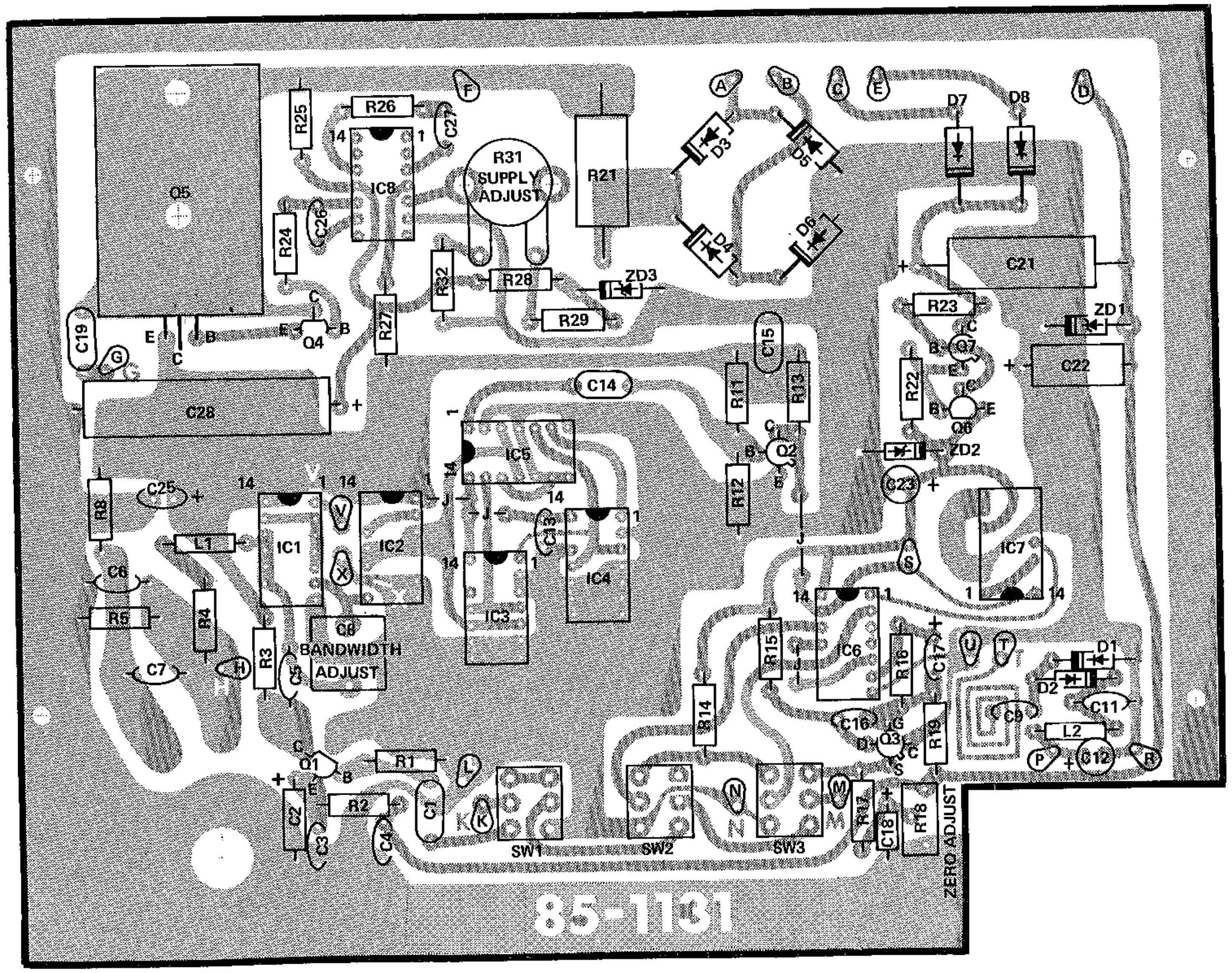
CIRCUIT BOARD X-RAY VIEW

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

1. Note the identification number of the part (R-number, C-number, etc.).

2. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part (for example: 22 kΩ, .05 μF, or 2N2712) will also appear near the part.

3. Look up this Description in the Parts List.



(VIEWED FROM FOIL SIDE)

CIRCUIT BOARD X-RAY VIEW

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

1. Note the identification number of the part (R-number, C-number, etc.).

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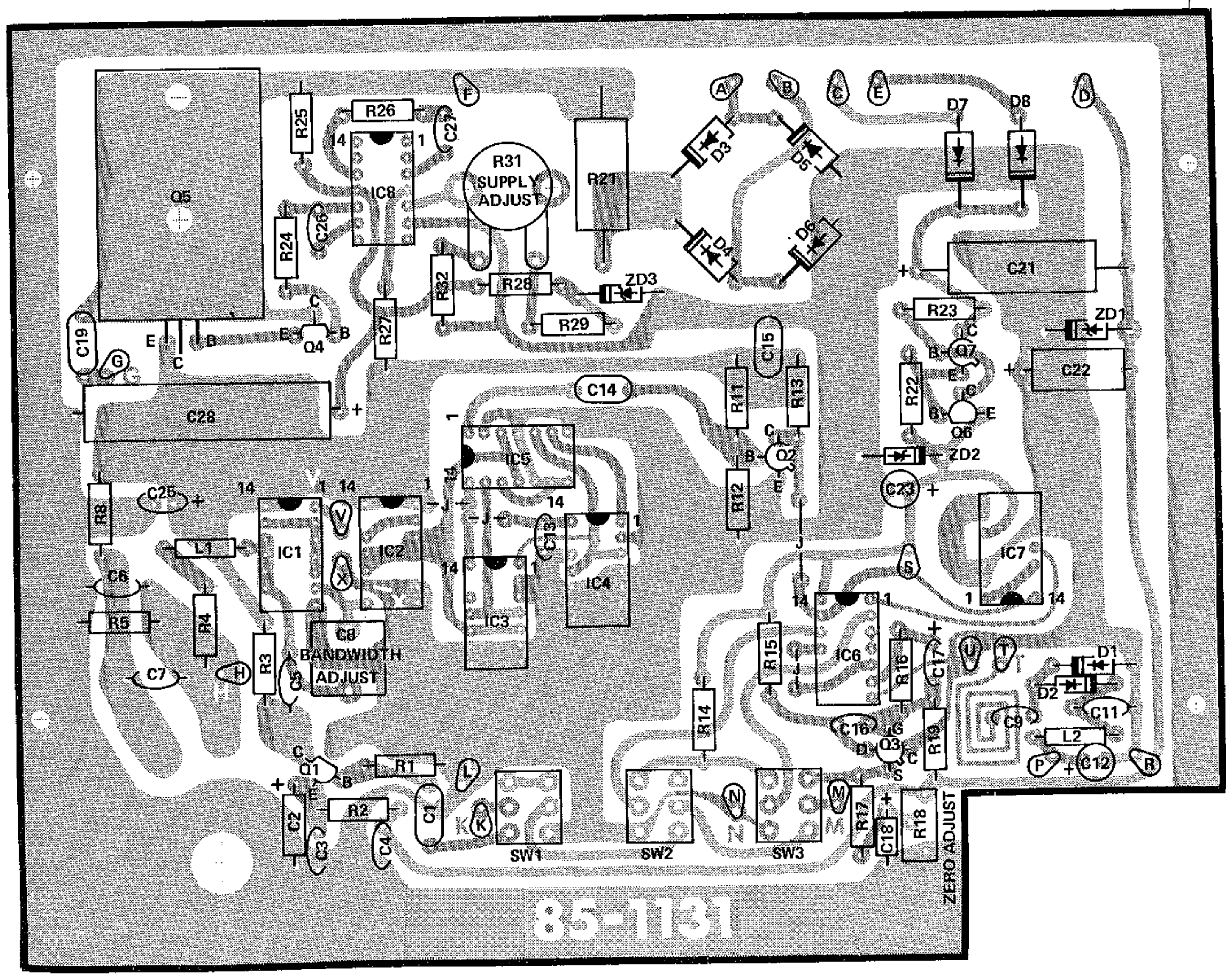
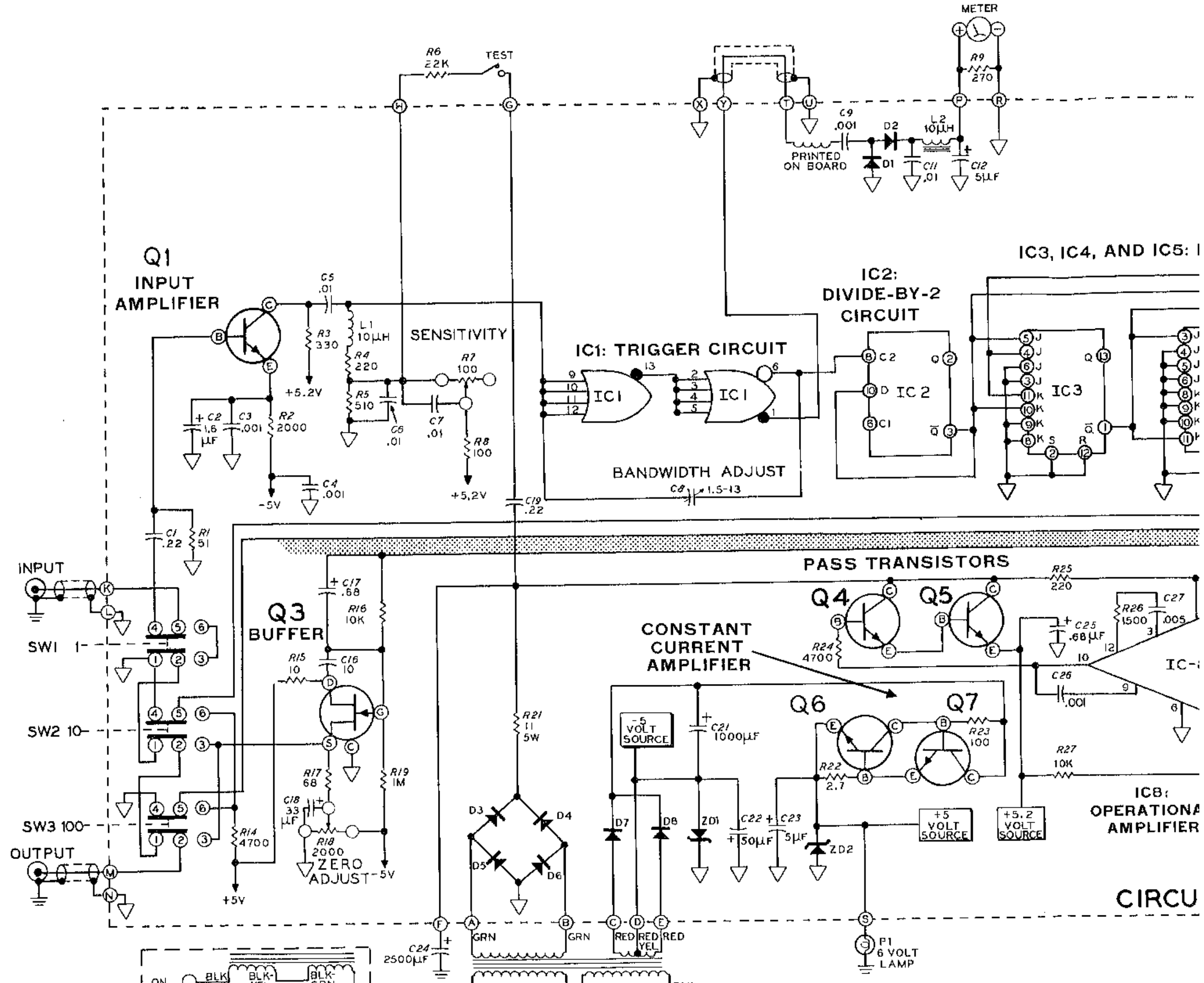


(VIEWED FROM FOIL SIDE)



SCHEMATIC OF THE
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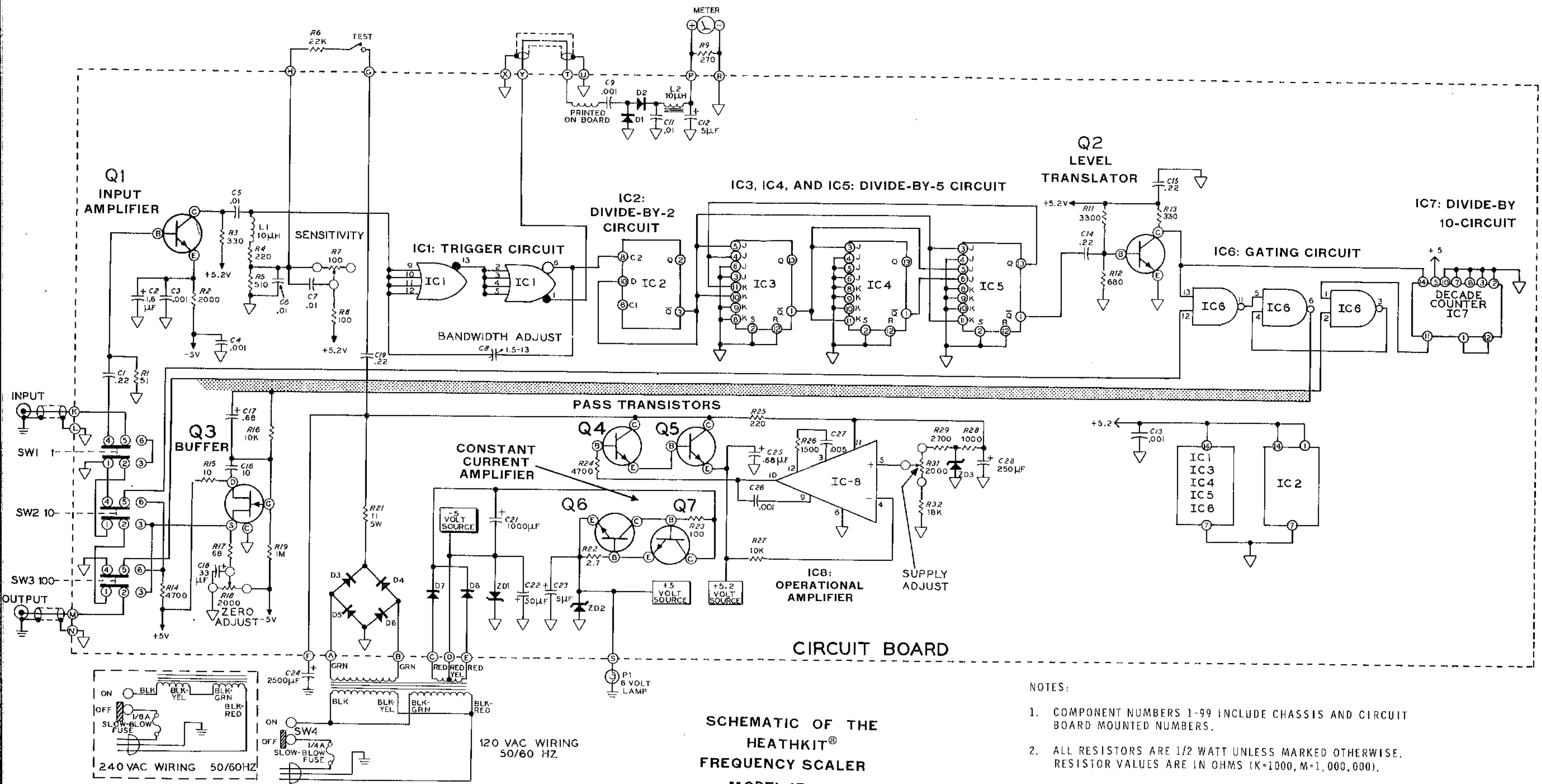
MODEL IB-102



SCHEMATIC OF THE HEATHKIT® FREQUENCY SCALER MODEL IB-102

NOTES:

1. COMPONENT NUMBERS 1-99 INCLUDE CHASSIS AND CIRCUIT BOARD MOUNTED NUMBERS.
2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1000, M=1,000,000).
3. ALL CAPACITOR VALUES LESS THAN 1 ARE IN µF. VALUES OF 1 AND ABOVE ARE IN PF UNLESS MARKED OTHERWISE.
4. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
5. ⏚ THIS SYMBOL INDICATES A CHASSIS GROUND.

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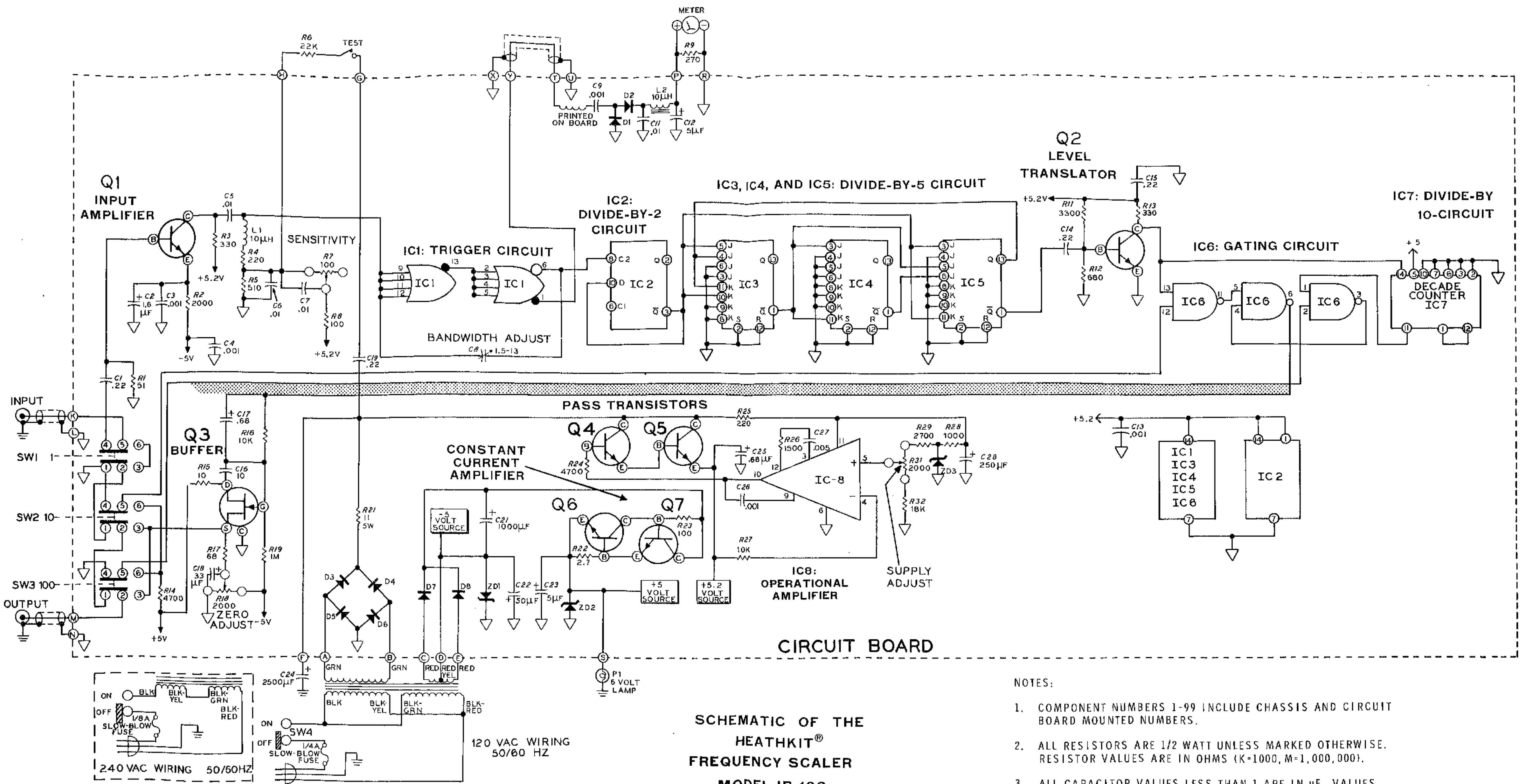

SCHEMATIC OF THE HEATHKIT® FREQUENCY SCALER MODEL IB-102

NOTES:

1. COMPONENT NUMBERS 1-99 INCLUDE CHASSIS AND CIRCUIT BOARD MOUNTED NUMBERS.
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4. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
5. ⏚ THIS SYMBOL INDICATES A CHASSIS GROUND.

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