DELIVERY DATE SEPT 3, 1975

IB-102 Frequency Scaler

ORDER NO 402,536

RC 9-10-75

HEATHKIT®

ASSEMBLY MANUAL

NOTE:
THIS FREQUENCY SCALER IS DESIGNED TO BE USED IN CONJUNCTION WITH THE HEATHKIT IB-1100 FREQUENCY COUNTER

Model IB-102 Frequency Scaler

HEATHKIT®

IB 102
07417

PRICE $2.00

Dear Customer:

The Heathkit electronic product you have purchased is one of the best performing electronic products in the world.

Here's how we aim to keep it that way:

Your Heathkit Warranty

During your first 90 days of ownership, any parts which we find are defective, either in materials or workmanship, will be replaced or repaired free of charge. And we'll pay shipping charges to get those parts to you — anywhere in the world.

If we determine a defective part has caused your Heathkit electronic product to need other repair, through no fault of yours, we will service it free — at the factory, at any retail Heathkit Electronic Center, or through any of our authorized overseas distributors.

This protection is exclusively yours as the original purchaser. Naturally, it doesn't cover damage by use of acid-core solder, incorrect assembly, misuse, fire, flood or acts of God. But, it does insure the performance of your Heathkit electronic product anywhere in the world — for most any other reason.

After-Warranty Service

What happens after warranty? We won't let you down. If your Heathkit electronic product needs repairs or you need a part, just write or call the factory, your nearest retail Heathkit Electronic Center, or any Heath authorized overseas distributor. We maintain an inventory of replacement parts for each Heathkit model at most locations — even for many models that no longer appeàr in our current product line-up. Repair service and technical consultation are available through all locations.

We hope you'll never need our repair or replacement services, but it's nice to know you're protected anyway — and that cheerful help is nearby.

Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

HEATH
Schlumberger

HEATH COMPANY
BENTON HARBOR MICHIGAN 49022
PHONE 616 983-396. TLX 72-9421

March 7, 1974

IMPORTANT NOTICE

Please make the following changes in your Manual before you start to assemble the kit.

Page 3 — Under "Electrolytic."

Change:	25-186	1	.45	1.6 μF
To:	25-197	1	.70	1.0 μF tantalum

Page 5 — Cut out illustration B4 from this Notice and tape it over illustration B4 on the fold-out from this page.

Page 10 — Change the eighteenth step —

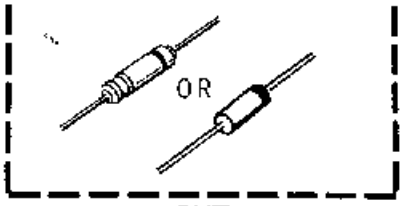
From	1.6 μF electrolytic
To:	1.0 μF tantalum

Page 47 fold-out — On the Schematic diagram, change C2 (just below Q1) from 1.6 μF to 1.0 μF.

Thank you,

HEATH COMPANY

B4

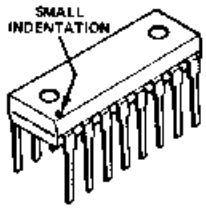


CUT

IB-102/595-1298-05
591-1399

IMPORTANT NOTICE

If your kit has IC's (integrated circuits) in it, and if any of those look like the one shown below, identify the proper end of the IC by the very small indentation.



Save this notice until you have completed your kit.

Thank you,

HEATH COMPANY

591-1409

ORDERED	DESCRIPTION	PRICE	AMOUNT
1	1B-102	79.95	79.95

HEATH COMPANY

BENTON HARBOR, MICHIGAN 49022

BUSINESS OFFICE PHONE: 616-982-3200

ORDER INFORMATION PHONE: 616-982-3411

INVOICE

PRICE OF MERCHANDISE	MICH. SALES TAX	*SHIPPING CHARGE	ALLOWANCE	TOTAL ORDER AMOUNT	REMITTED FOR PREV. ORDER	CASH RECEIVED	CR. —REFUND * —BAL. DUE	CODE NO.
79.95	3.20	1.08		84.23	.00	84.92	.69CR	1

SEE CODE INFORMATION AT LEFT

ENTRY DATE	ORDER NUMBER
SEP 3 75	402,536

CODE NO. CODE INFORMATION

1. Your refund check is enclosed.
2. Your refund check will be mailed separately.
3. We consider this invoice paid although a small balance is shown.
4/5. **Please remit the amount indicated.** Terms 30 days from date of shipment.
   When remitting please include **code number, order number** and **your name and address** exactly as shown on this invoice.
6. Amount collected by carrier for merchandise. (Not including the carrier's charges).

Thank you!

THIS INVOICE IS A COMPLETE STATEMENT OF YOUR TRANSACTION AND THE ONLY ONE YOU WILL RECEIVE

*When insurance fee is remitted, shipments are either postal, or privately insured by Heath Company.

ROCHESTER MI 48063
2

BILLING ADDRESS

A F STAMM
BOX 94
ROCHESTER MI 48063
2

SHIPPING ADDRESS

04

August 1, 1973

HEATHKIT ELECTRONIC CENTERS

ARIZONA

PHOENIX 85017
2727 W. Indian School Rd.
(602) 279-6247
Dick Warner, Mgr.

CALIFORNIA

ANAHEIM 92805
330 E. Ball Rd.
(714) 776-9420
Claud Kell, Mgr.

EL CERRITO 94530
6000 Potrero Ave.
(415) 236-8870
Don Fillmore, Mgr.

LOS ANGELES 90007
2309 So. Flower St.
(213) 749-0261
Tommy Thompson, Mgr.

POMONA 91767
1555 N. Orange Grove Ave.
(714) 623-3543
Bill Lockwood, Mgr.

REDWOOD CITY 94063
2001 Middlefield Rd.
(415) 365-8155
Bob Lord, Mgr.

LA MESA 92041
8363 Center Dr.
(714) 461-0110
Herb Solomon, Mgr.

WOODLAND HILLS 91364
22504 Ventura Blvd.
(213) 883-0531
Don Murray, Mgr.

COLORADO

DENVER 80202
5940 W. 38th Ave.
(303) 422-3408
Don Porter, Mgr.

CONNECTICUT

AVON (Hartford) 06001
395 W. Main St.
(203) 678-0323
Ray Dick, Mgr.

FLORIDA

HIALEAH (Miami) 33012
4705 W. 16th Ave.
(305) 823-2280
Ron Milbrandt, Mgr.

GEORGIA

ATLANTA 30305
5285 Roswell Rd.
(404) 252-4341
Roland Bousquet, Mgr.

ILLINOIS

CHICAGO 60645
3462-66 W. Devon Ave.
(312) 583-3920
Ron Hummell, Mgr.

DOWNERS GROVE 60515
224 Ogden Ave.
(312) 852-1304
Fred Prehn, Mgr.

INDIANA

INDIANAPOLIS 46220
2112 E. 62nd Ave.
(317) 257-4321
Boyd Hagaman, Mgr.

KANSAS

MISSION 66202
5960 Lamar Ave.
(913) 362-4486
Ralph Arnold, Mgr.

MARYLAND

BALTIMORE 21234
1713 E. Joppa Rd.
(301) 661-4446
Bill Schaule, Mgr.

ROCKVILLE 20852
5542 Nicholson Lane
(301) 881-5420
Art (Nick) Nichols, Mgr.

MASSACHUSETTS

WELLESLEY 02181
165 Worcester Ave.
(617) 237-1510
Bob Weintraub, Mgr.

MICHIGAN

DETROIT 48219
18645 W. Eight Mile Rd.
(313) 535-6480
George Pecar, Mgr.

E. DETROIT 48021
18149 E. Eight Mile Rd.
(313) 772-0416
Gerry Bleser, Mgr.

MINNESOTA

HOPKINS 55343
101 Shady Oak Rd.
(612) 938-6371
Bud Jenstad, Mgr.

MISSOURI

ST. LOUIS 63123
9296 Gravois Ave.
(314) 638-5100
Art Folsom, Mgr.

NEW JERSEY

FAIR LAWN 07410
35-07 Broadway (R#4)
(201) 791-6935
Hank Greenberg, Mgr.

NEW YORK

AMHERST (Buffalo) 14226
3476 Sheridan Drive
(716) 835-3090
Ken Palmer, Mgr.

JERICHO L.I. 11753
15 Jericho Turnpike
(516) 334-8181
Al Lyons, Mgr.

NEW YORK 10036
35 W. 45th St.
(212) 765-4590
Rick Miller, Mgr.

ROCHESTER 14626
1384 Long Pond Rd.
(716) 227-4750
Jim O'Brien, Mgr.

OHIO

CLEVELAND 44129
5444 Pearl Rd.
(216) 886-2590
Stan Haase, Mgr.

WOODLAWN 45125
10133 Springfield Pike
(513) 771-8850
Larry Coen, Mgr.

PENNSYLVANIA

PHILADELPHIA 19149
6318 Roosevelt Blvd.
(215) 288-0180
Ted Haldis, Mgr.

PITTSBURGH 15235
3482 Wm. Penn Hwy.
(412) 824-3564
Frank Corbin, Mgr.

RHODE ISLAND

WARWICK (Providence) 02886
558 Greenwich Ave.
(401) 738-5150
Dave Snell, Mgr.

TEXAS

DALLAS 75201
2715 Ross Ave.
(214) 826-4053
Norm Harvey, Mgr.

HOUSTON 77027
3705 Westheimer Rd.
(713) 623-2090
Bill Nico, Mgr.

WASHINGTON

SEATTLE 98121
2221 Third Ave.
(206) 682-2172
Gary Coard, Mgr.

WISCONSIN

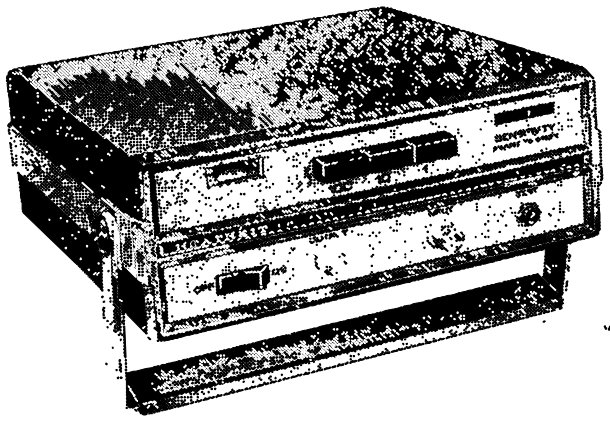
MILWAUKEE 53216
5215 Fond du Lac Ave. W.
(414) 873-8250
Joe Pivo, Mgr.

Assembly
and
Operation
of the

HEATHKIT™

FREQUENCY SCALER

MODEL IB-102



Sept 11, 1975

TABLE OF CONTENTS

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

The Model IB-102 Heathkit Frequency Scaler is used to extend the useful frequency range of a frequency counter. Basically, the Frequency Scaler is a divider which will scale down, by a factor of 10 or 100, any input signal between 2 MHz and 175 MHz. It also has a straight-through mode, making it unnecessary to disconnect the Frequency Scaler from the counter to read the lower frequencies that are within the capabilities of the counter.

Many features make the Frequency Scaler convenient and easy to use. A meter monitors the input level in the divide-by-N mode to indicate if the input level is high enough to provide proper operation. Proper input level can be maintained with the front panel Sensitivity control.

The Frequency Scaler's trim appearance and size make it an ideal companion for the Heathkit Model IB-101 Frequency Counter.

Small and reliable plug-in integrated circuits minimize and simplify maintenance. The regulated power supplies can be operated from either a 110 to 130 or a 220 to 260 volt 50/60 Hz ac power source. The detachable test leads and line cord, along with a three-detent position bail-type handle, make the Scaler easily transportable. The unique bail-type handle can be used to position the Scaler at a desirable viewing angle.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

Check each part against the following parts list. The key numbers correspond to the numbers on the Parts Pictorial (fold-out from Page 5). To order replacement parts, refer to the Price Each column and use the Parts Order form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

KEY No.	PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
RESISTORS				
1/2-Watt				
A1	1-143	1	.10	2.7 Ω (red-violet-gold)
A1	1-41	1	.10	10 Ω (brown-black-black)
A1	1-62	1	.10	51 Ω (green-brown-black)
A1	1-2	1	.10	68 Ω (blue-gray-black)
A1	1-3	2	.10	100 Ω (brown-black-brown)
A1	1-45	2	.10	220 Ω (red-red-brown)
A1	1-42	1	.10	270 Ω (red-violet-brown)
A1	1-4	2	.10	330 Ω (orange-orange-brown)
A1	1-63	1	.10	510 Ω (green-brown-brown)
Resistors (Cont'd.)				
A1	1-7	1	.10	680 Ω (blue-gray-brown)
A1	1-9	1	.10	1000 Ω (brown-black-red)
A1	1-11	1	.10	1500 Ω (brown-green-red)
A1	1-90	1	.10	2000 Ω (red-black-red)
A1	1-13	1	.10	2700 Ω (red-violet-red)
A1	1-14	1	.10	3300 Ω (orange-orange-red)
A1	1-16	2	.10	4700 Ω (yellow-violet-red)
A1	1-20	2	.10	10 kΩ (brown-black-orange)
A1	1-22	1	.10	22 kΩ (red-red-orange)
A1	1-69	1	.10	18 kΩ (brown-gray-orange)
A1	1-35	1	.10	1 MΩ (brown-black-green)

KEY No.	PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
Other Resistor				
A2	3-7-5	1	.15	11Ω, 5-watt
CAPACITORS				
Disc				
B1	21-3	1	.10	10 pF
B1	21-140	5	.10	.001 μF
B1	21-27	1	.10	.005 μF
B1	21-16	4	.10	.01 μF
Electrolytic				
B2	25-200	2	.50	.68 μF tantalum
B3	25-149	2	.50	5 μF
B4	25-~~186~~197	1	~~.85~~ .510	~~10 μF~~ 1.0 MFD TANTALUM
B4	25-211	1	.85	33 μF tantalum
B5	25-98	1	.25	50 μF
B5	25-175	1	.55	250 μF
B5	25-111	1	2.35	1000 μF
B5	25-154	1	1.35	2500 μF
Other Capacitors				
B6	27-85	4	.25	.22 μF Mylar*
B7	26-93	1	1.65	1.5-13 pF trimmer

DIODES-TRANSISTORS-INTEGRATED CIRCUITS

NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways. (The term "type number" refers only to the numbers in a transistor or integrated circuit description. It does not refer to the letters, which could change.)

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

C1	56-75	2	2.25	5.1 V zener diode, 1N5338B
C1	56-71	1	5.00	6.2 V zener diode, 1N825A
C1	56-20	2	.25	Germanium diode, 1N295
C1	57-65	6	.20	Silicon diode, 1N4002
C2	417-118	2	.40	Transistor, 2N3393
C3	417-154	2	1.65	Transistor, 2N2369
C4	417-167	1	1.65	Transistor, UC734
C4	417-258	1	.60	Transistor, TIS87
C5	417-175	1	1.45	Transistor, TA2911
C6	442-2	1	1.15	Integrated circuit, SN4985N
C6	443-1	1	.45	Integrated circuit, SN7400

*DuPont Registered Trademark

KEY No.	PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
Diodes-Transistors-Integrated Circuits (cont'd.)				
C6	443-7	1	1.95	Integrated circuit, SN7490N
C6	443-38	1	5.00	Integrated circuit, MC1023P
C6	443-39	1	5.00	Integrated circuit, MC1034P
C6	443-40	1	3.75	Integrated circuit, MC1013P
C6	443-41	2	5.00	Integrated circuit, MC1027P
CONTROLS-SWITCHES				
D1	10-200	1	.50	2000 Ω control
D2	10-289	1	.30	2000 Ω control
D3	10-285	1	1.45	100 Ω control
D4	60-45	1	.50	SPST rocker switch
D5	64-31	1	1.45	SPST pushbutton switch
D6	64-77	1	2.45	DPDT 3-section pushbutton switch
FUSE BLOCK-TERMINAL STRIPS-CONNECTORS				
E1	422-1	1	.25	Fuse block
E2	431-57	1	.10	2-lug terminal strip
E3	431-10	1	.10	3-lug terminal strip
E4	432-59	2	1.65	BNC connector (with hardware)
E5	432-76	1	.30	Line cord connector
E6	432-144	126	.01	Integrated circuit connector
METAL PARTS				
F1	90-505-1	2	1.65	Cabinet shell (top and bottom)
F2	200-608	1	2.05	Main chassis
F3	200-609	1	.60	Power supply chassis
F4	203-788	1	2.05	Front panel
F5	203-789-1	1	.70	Rear panel
F6	204-1199	1	.10	Meter mounting bracket
F7	204-1201	1	.35	Handle bracket
F8	205-780	2	1.05	Trim plate
F9	211-51	1	1.55	Handle
F10	205-141	2	.10	Tool plate
F11	208-6	1	.15	Capacitor mounting clip
F12	215-44	1	.65	Transistor heat sink
F13	257-15	4	.10	Eyelet
F14	258-106	1	.20	Flat spring

KEY No.	PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
LINE CORD-CABLE-WIRE				
	89-30	1	1.25	Line cord
	134-236	1	4.35	Cable assembly (with BNC connectors on both ends)
	340-11	1	.05/ft	Bare wire
	343-9	1	.10/ft	Coaxial cable
	344-16	1	.05/ft	Red wire
	344-51	1	.05/ft	Brown wire
HARDWARE				
#3 Hardware				
G1	250-49	5	.05	3-48 x 1/4" screw
G2	252-1	5	.05	3-48 nut
G3	254-7	6	.05	#3 lockwasher
#4 Hardware				
H1	250-285	4	.05	4-40 x 1/4" screw
H2	250-273	1	.05	4-40 x 3/8" screw
H3	252-2	1	.05	4-40 nut
H4	254-9	5	.05	#4 lockwasher
#6 Hardware				
J1	250-535	2	.25	6-32 x 1/4" screw
J2	250-89	13	.05	6-32 x 3/8" screw
J3	250-434	12	.05	6-32 x 3/8" flat head screw
J4	250-79	4	.05	6-32 x 1-1/4" screw
J5	252-3	23	.05	6-32 nut
J6	253-27	3	.05	#6 flat washer
J7	254-1	26	.05	#6 lockwasher
J8	255-103	1	.10	6-32 threaded spacer
J9	259-1	1	.05	#6 solder lug

KEY No.	PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
Other Hardware				
K1	254-14	1	.05	1/4" lockwasher
K2	252-7	2	.05	Control nut
K3	253-75	3	.05	3/8" flat washer
K4	259-27	2	.05	3/8" solder lug
K5	266-194	1	.40	Handle detent
MISCELLANEOUS				
L1	45-57	2	.30	10 μH choke
L2	54-272	1	4.05	Power transformer
L3	75-90	1	.10	Fish paper insulator
	85-1131-2	1	3.25	Circuit board
L4	211-52	1	.90	Handle grip
L5	261-29	4	.05	Foot
L6	407-160	1	3.45	Meter
L7	412-31	1	.50	Lamp
L8	421-33	1	.30	1/4 ampere slow-blow fuse
L9	462-224	1	.25	Knob
	390-352	1	.30	Heath label
	390-904	1	.25	Top front panel label
	390-354	1	.25	Bottom front panel label
	391-34	1		Blue and white label
L10	490-5	1	.10	Nut starter
L11	205-778	1	.10	1/8" x 1" alignment blade
	597-308	1		Kit Builders Guide
	597-260	1		Parts Order Form
				Solder (additional 3' rolls of solder can be ordered under part number 331-6 for $.15 each.)
		1	2.00	Manual (See front cover for part number.)

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

ASSEMBLY NOTES

Before starting to assemble this kit, read the Kit Builders Guide for complete information on wiring, soldering, and step-by-step assembly procedures.

NOTE: Because the Frequency Scaler operates at high frequencies, it is important that all wires and component leads be kept short and positioned as shown.

Resistors will be called out by their resistance value in Ω, kΩ, or MΩ, and color code. Use 1/2-watt resistors unless directed otherwise.

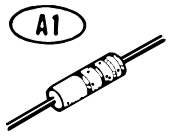
Capacitors will be called out by their capacitance value (in pF or μF) and type (disc, mica, or electrolytic).

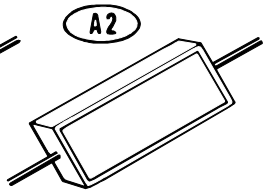
STEP-BY-STEP ASSEMBLY

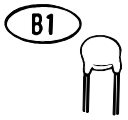
CIRCUIT BOARD

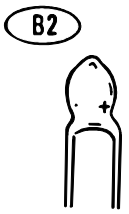
Install the components on the circuit board by following the steps on Pictorials 1 through 8. Position all parts as shown.

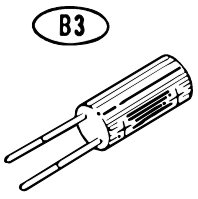
( ) Position the circuit board as shown in the identification drawing at the top of Pictorial 1.

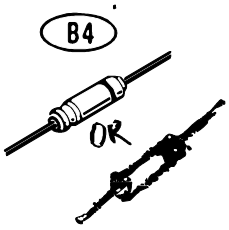


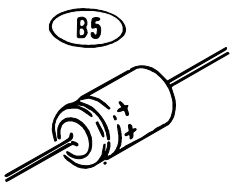


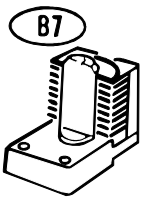




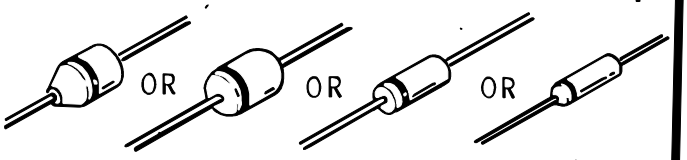


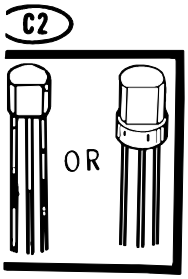


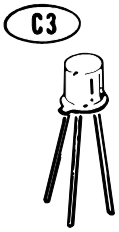


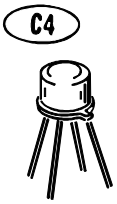


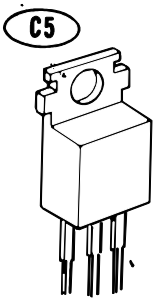
NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.

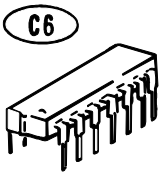


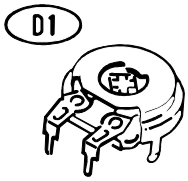


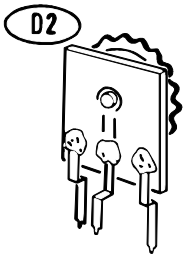


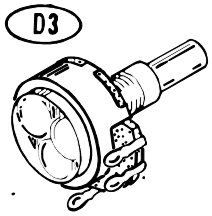


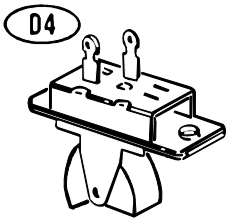


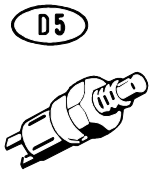


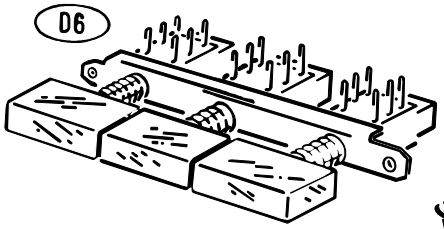


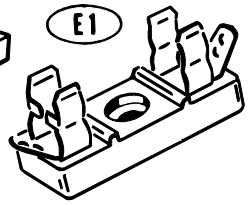


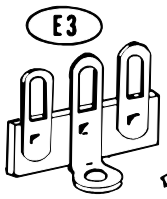


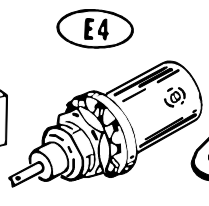


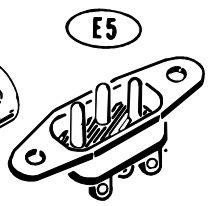


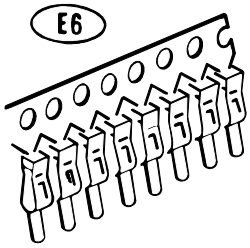


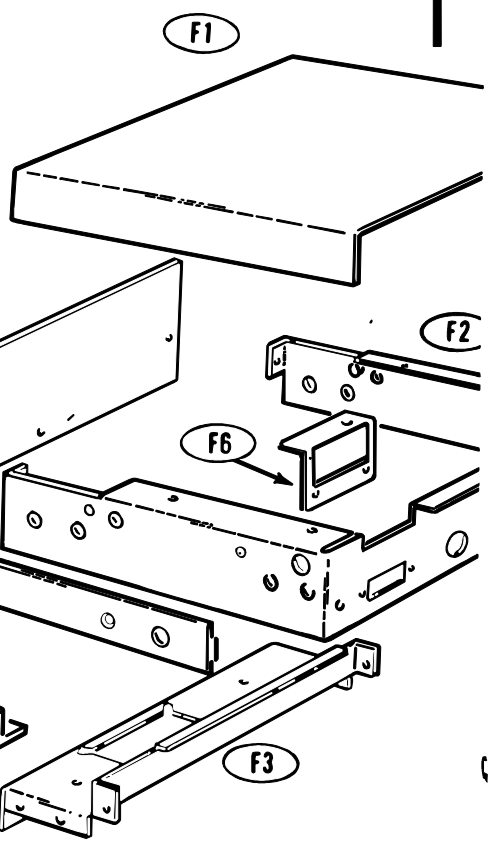




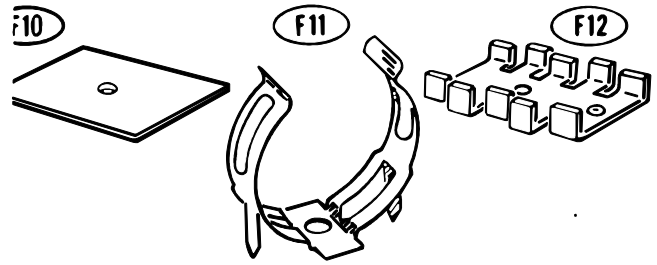


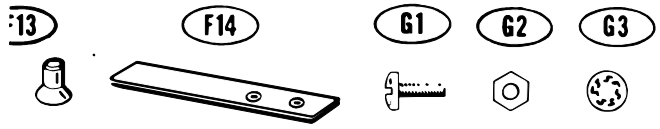


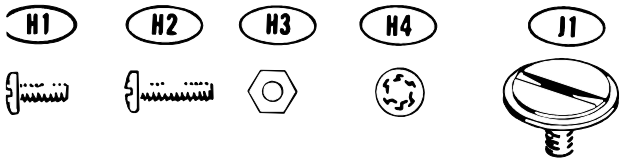


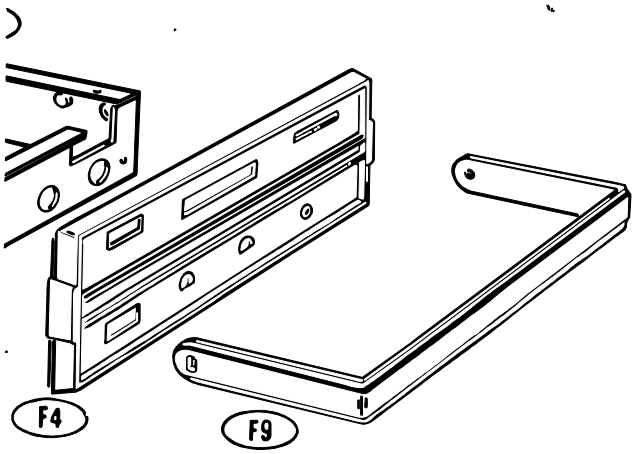


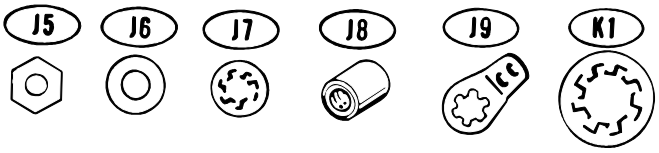
ORIAL

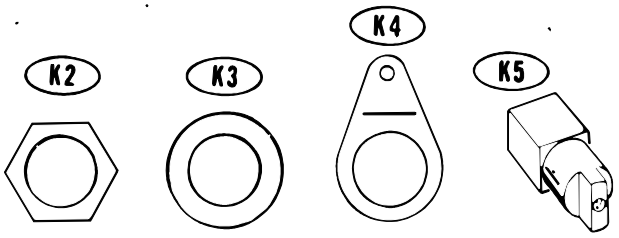


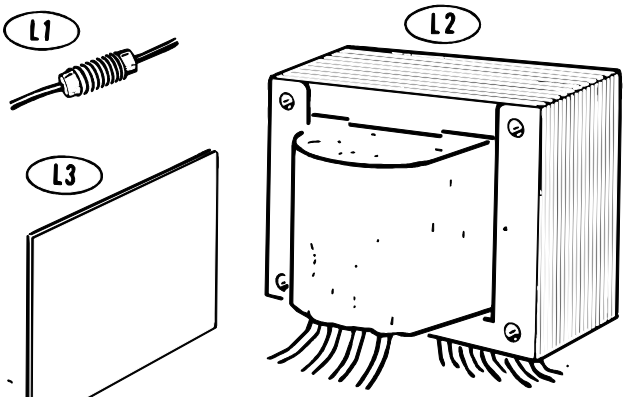


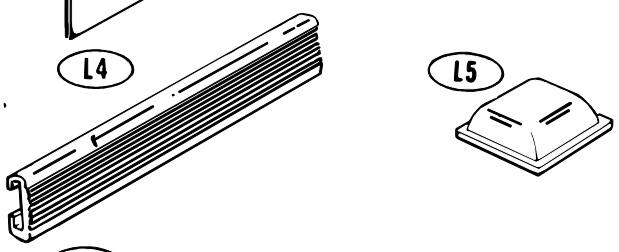


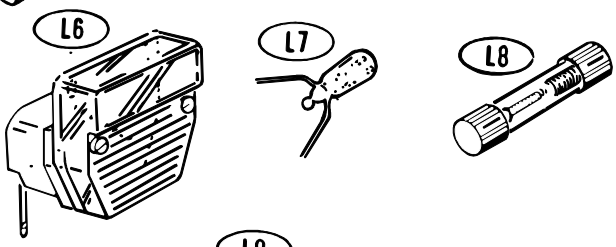


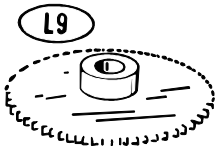


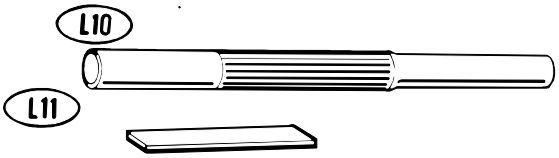












SOLDERING IRON CONSIDERATIONS

Due to the small foil area around the circuit board holes and the small areas between foils, it will be necessary to use the utmost care to prevent solder bridges between adjacent foil areas. Use only a minimum amount of solder, and do not heat components excessively with the soldering iron. Diodes, transistors, etc., can be damaged if they are subjected to excessive amounts of heat. Use no larger than a 25-watt soldering iron with a small tip. Allow it to reach operating temperature, and then apply it only long enough to make a good solder connection.

NOTE: If a small wattage, small-tip soldering iron is not available, proceed as follows: Be sure your soldering iron is cool. Then wrap the large bare wire supplied with this kit tightly around the soldering iron tip as shown in Figure 1. Allow approximately 1/2" of wire to extend beyond the end of the soldering iron. Cut the wire end to a chisel shape as shown.

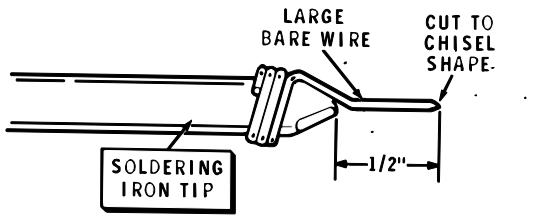
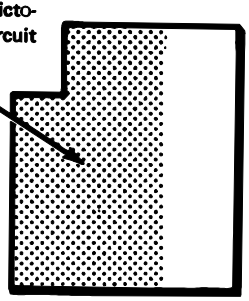


Figure 1

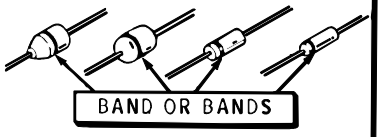
START

The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING



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.



( ) 1N295 germanium diode (#56-20) at D1.

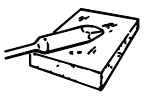
( ) 1N295 germanium diode (#56-20) at D2.

( ) 10 µH choke (#45-57) at L2.

( ) 1 MΩ (brown-black-green).

( ) 10 kΩ (brown-black-orange).

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



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

( ) 68 Ω (blue-gray-black).

( ) 10 Ω (brown-black-black).

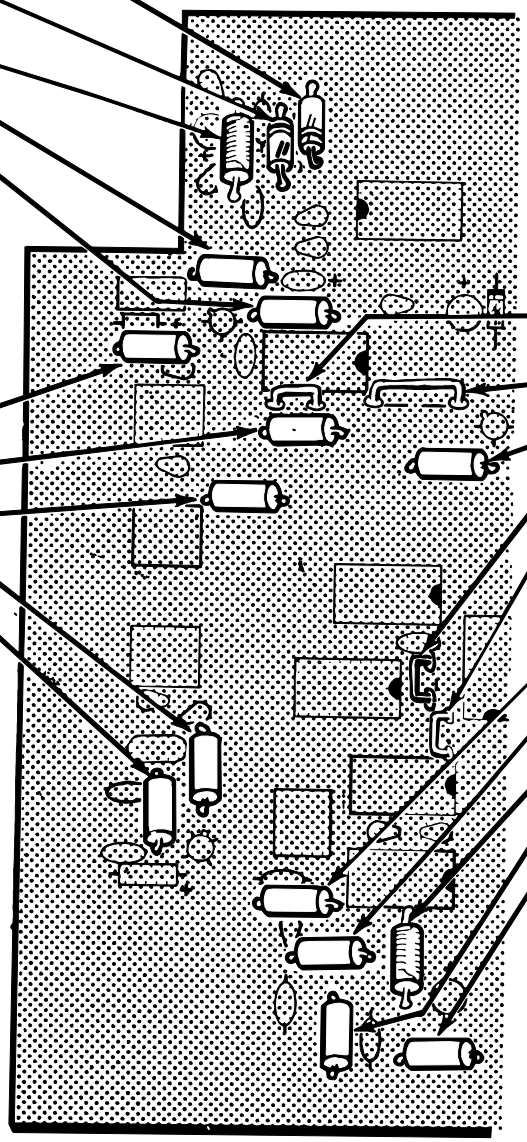
( ) 4700 Ω (yellow-violet-red).

( ) 51 Ω (green-brown-black).

( ) 2000 Ω (red-black-red).

NOTE: In the following step, save four cut-off resistor leads to use as jumper wires later.

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



CONTINUE

( ) Jumper wire. Use a cut-off resistor lead.

( ) Jumper wire.

( ) 680 Ω (blue-gray-brown).

( ) Jumper wire.

( ) Jumper wire.

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

( ) 330 Ω (orange-orange-brown).

( ) 220 Ω (red-red-brown).

( ) 10 µH choke (#45-57) at L1.

( ) 510 Ω (green-brown-brown).

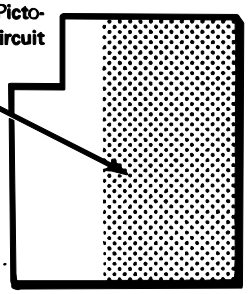
( ) 100 Ω (brown-black-brown).

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

PICTORIAL 1

The steps performed in this Pictorial are in this area of the circuit board.

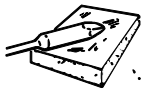
IDENTIFICATION DRAWING



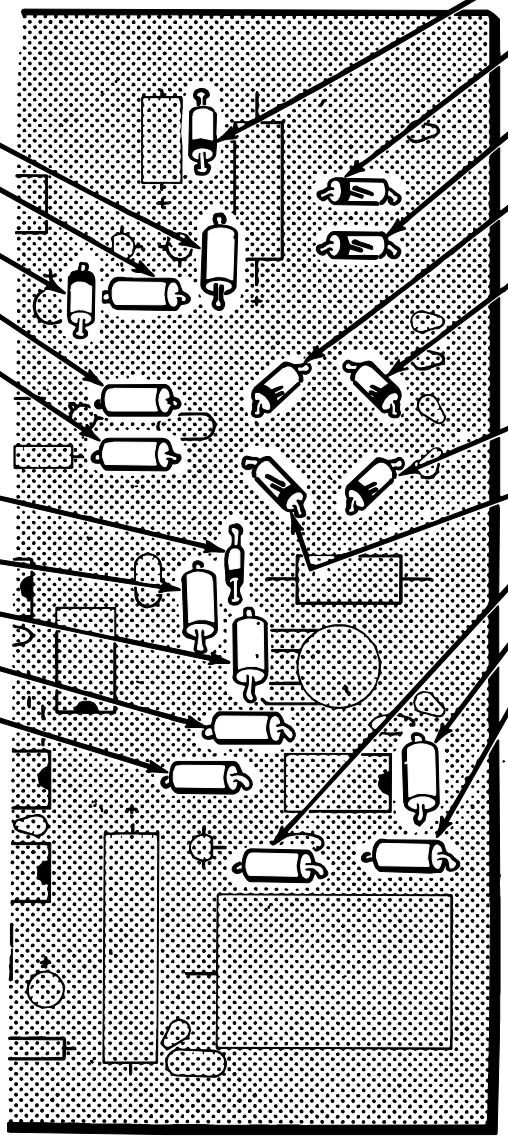
START

- ( ) 100 Ω (brown-black-brown).
- ( ) 2.7 Ω (red-violet-gold).
- ( ) 1N5338B zener diode (#56-75) at ZD2. Note position of banded end.
- ( ) 330 Ω (orange-orange-brown).
- ( ) 3300 Ω (orange-orange-red).
- ( ) Solder all leads to the foil and cut off the excess lead lengths.
- ( ) 1N825A zener diode (#56-71) at ZD3. Note position of banded end.
- ( ) 2700 Ω (red-violet-red).
- ( ) 1000 Ω (brown-black-red).
- ( ) 18 kΩ (brown-gray-orange).
- ( ) 10 kΩ (brown-black-orange).

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



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



CONTINUE

- ( ) 1N5338B zener diode (#56-75) at ZD1. Note position of banded end.
- ( ) 1N4002 silicon diode (#57-65) at D8.
- ( ) 1N4002 silicon diode (#57-65) at D7.
- ( ) 1N4002 silicon diode (#57-65) at D6.
- ( ) 1N4002 silicon diode (#57-65) at D5.
- ( ) Solder all leads to the foil and cut off the excess lead lengths.
- ( ) 1N4002 silicon diode (#57-65) at D3.
- ( ) 1N4002 silicon diode (#57-65) at D4.
- ( ) 4700 Ω (yellow-violet-red).
- ( ) 1500 Ω (brown-green-red).
- ( ) 220 Ω (red-red-brown).
- ( ) Solder all leads to the foil and cut off the excess lead lengths.

PICTORIAL 2

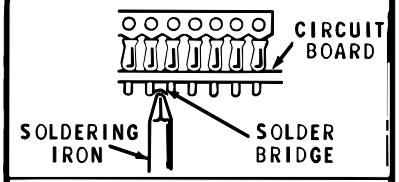
START

See "Soldering Iron Considerations" (fold-out from Page 6).

NOTE: In the following steps, you will be instructed to cut off and install strips of IC (integrated circuit) connectors. But, since all locations do not have consecutive holes, it will be necessary, at times, to remove one or more connectors from a strip before it can be installed. Where this occurs, do not install one connector at a time. Instead, cut off a strip of connectors that is long enough to have a connector for each mounting hole. Then position the strip at the indicated location on the circuit board and remove any connector that does not have a corresponding hole in the circuit board. The individual connectors will break off easily when bent.

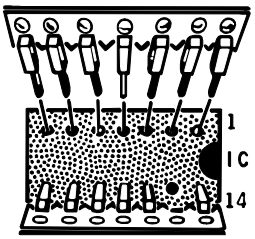
Before soldering the connectors to the foil, be sure each strip is perpendicular to the board and that the connecting band is towards the outline on the board. Solder each connector strip as it is installed.

If a solder bridge occurs between foils, clean the soldering iron tip, and then hold it between the two points that are bridged until the excess solder flows down the tip of the soldering iron.



NOTE: The number of connectors in a strip, as called out in the following steps, will include ALL connectors - including any that have to be removed.

( ) Two seven-connector strips at IC3.

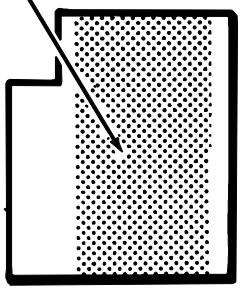


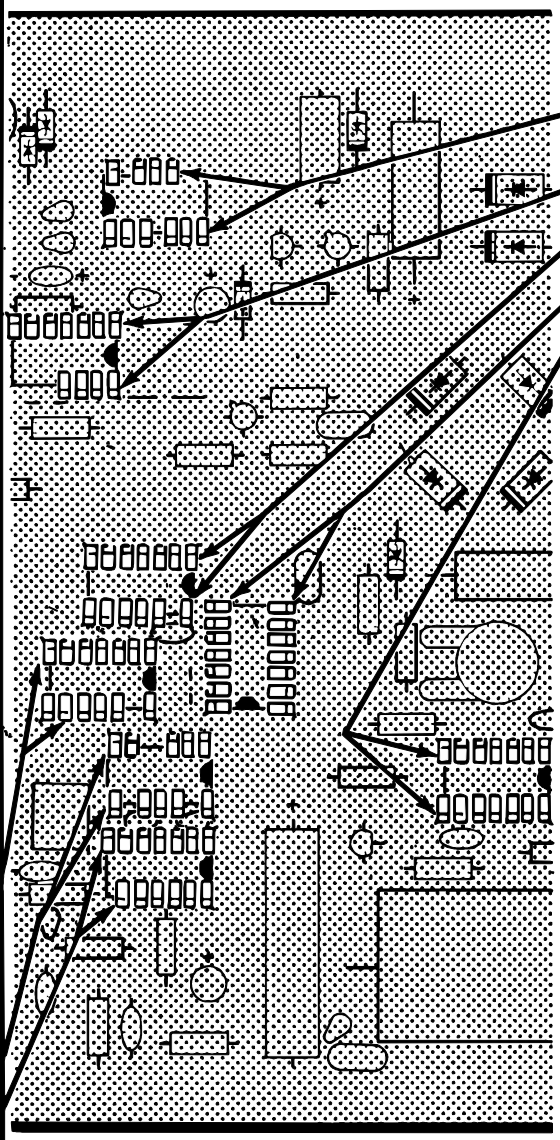
( ) Two seven-connector strips at IC2.

( ) One seven-connector strip and one six-connector strip at IC1.

The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING





SOLDERING IRON TIP

CONTINUE

( ) One five-connector strip and one seven-connector strip at IC7.

( ) One seven-connector strip and one four connector strip at IC6.

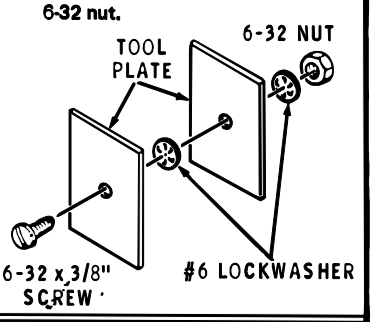
( ) Two seven-connector strips at IC4.

( ) Two seven-connector strips at IC5.

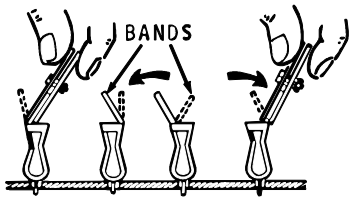
( ) Two seven-connector strips at IC8.

( ) Check to see that all connectors are soldered to the foil and that no solder bridges exist.

( ) Assemble the two tool plates together as shown. Use a 6-32 x 3/8" screw, two #6 lockwashers, and a 6-32 nut.



( ) Remove the connecting bands from the IC connector strips. Do this by first bending the band "inward," then bend it "outward" as shown.

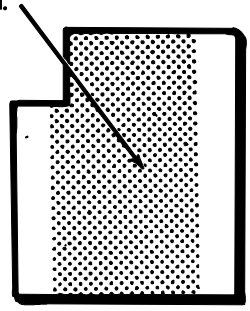


PICTORIAL 3

SOLDERING IRON TIP

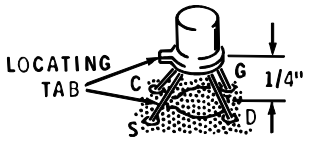
The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

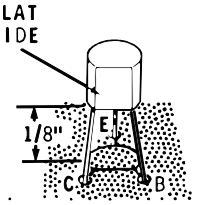


START

( ) **UC734** transistor **(#417-167)** at **Q3**. Position this transistor over its outline on the circuit board and place the **S, C, G,** and **D** leads of the transistor into the corresponding **S, C, G,** and **D** holes of the circuit board. Position the transistor **1/4"** above the circuit board. Solder each lead to the foil and cut off the excess lead lengths.

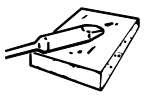


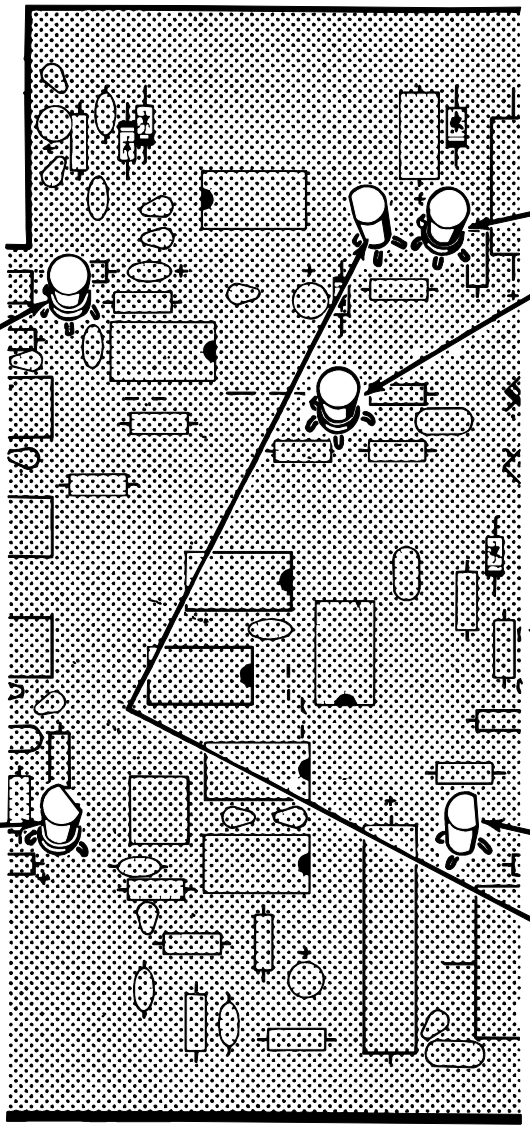
( ) **TIS87** transistor **(#417-258)** at **Q1**. Position the transistor over its outline on the circuit board and place the **C, E,** and **B** leads of the transistor into the corresponding **C, E,** and **B** holes of the circuit board. Position the transistor **1/8"** above the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

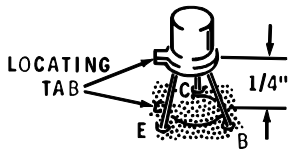
WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.





CONTINUE

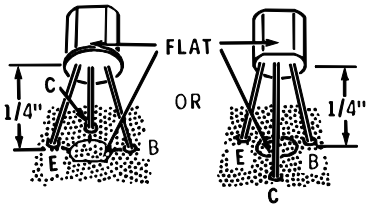
NOTE: When installing the following type of transistor, position it over its outline on the circuit board and place the **C, B,** and **E** leads of the transistor into the corresponding **C, B,** and **E** holes of the circuit board. Position the transistor **1/4"** above the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



( ) **2N2369** transistor **(#417-154)** at **Q7**.

( ) **2N2369** transistor **(#417-154)** at **Q2**.

NOTE: When installing the following type of transistor, position it over its outline on the circuit board and place the **B, C,** and **E** leads of the transistor into the corresponding **B, C,** and **E** holes of the circuit board. Position the transistor **1/4"** above the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



( ) **2N3393** transistor **(#417-118)** at **Q4**.

( ) **2N3393** transistor **(#417-118)** at **Q6**.

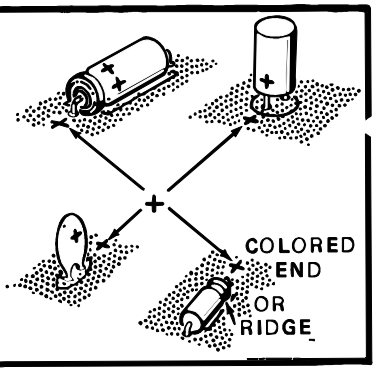
( ) Check to see that all connections are soldered and that the excess lead lengths are cut off.

NOTE: If the large bare wire was wrapped around the tip of your soldering iron, remove it at this time. Use a pair of pliers to avoid being burned.

PICTORIAL 4

START

NOTE: In some of the steps in this Pictorial, you will be instructed to install electrolytic and tantalum capacitors. Always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.



( ) 1000 µF electrolytic.

( ) 50 µF electrolytic.

NOTE: When installing disc capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil. Also the leads of the Mylar capacitors may be coated with a clear film. If any soldering problem is encountered with these capacitors, apply more heat to the leads to melt this film.

( ) .01 µF disc.

( ) 5 µF electrolytic.

( ) .001 µF disc.

( ) 5 µF electrolytic.

( ) .68 µF tantalum.

( ) 33 µF tantalum.

( ) 10 pF disc.

( ) .22 µF Mylar.

( ) .22 µF Mylar.

( ) .001 µF disc.

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

( ) .005 µF disc.

( ) .22 µF Mylar.

( ) .001 µF disc.

( ) .001 µF disc.

( ) ~~1.6 µF electrolytic.~~ 4.0 MF TANT.

( ) .01 µF disc.

( ) .01 µF disc.

( ) .01 µF disc.

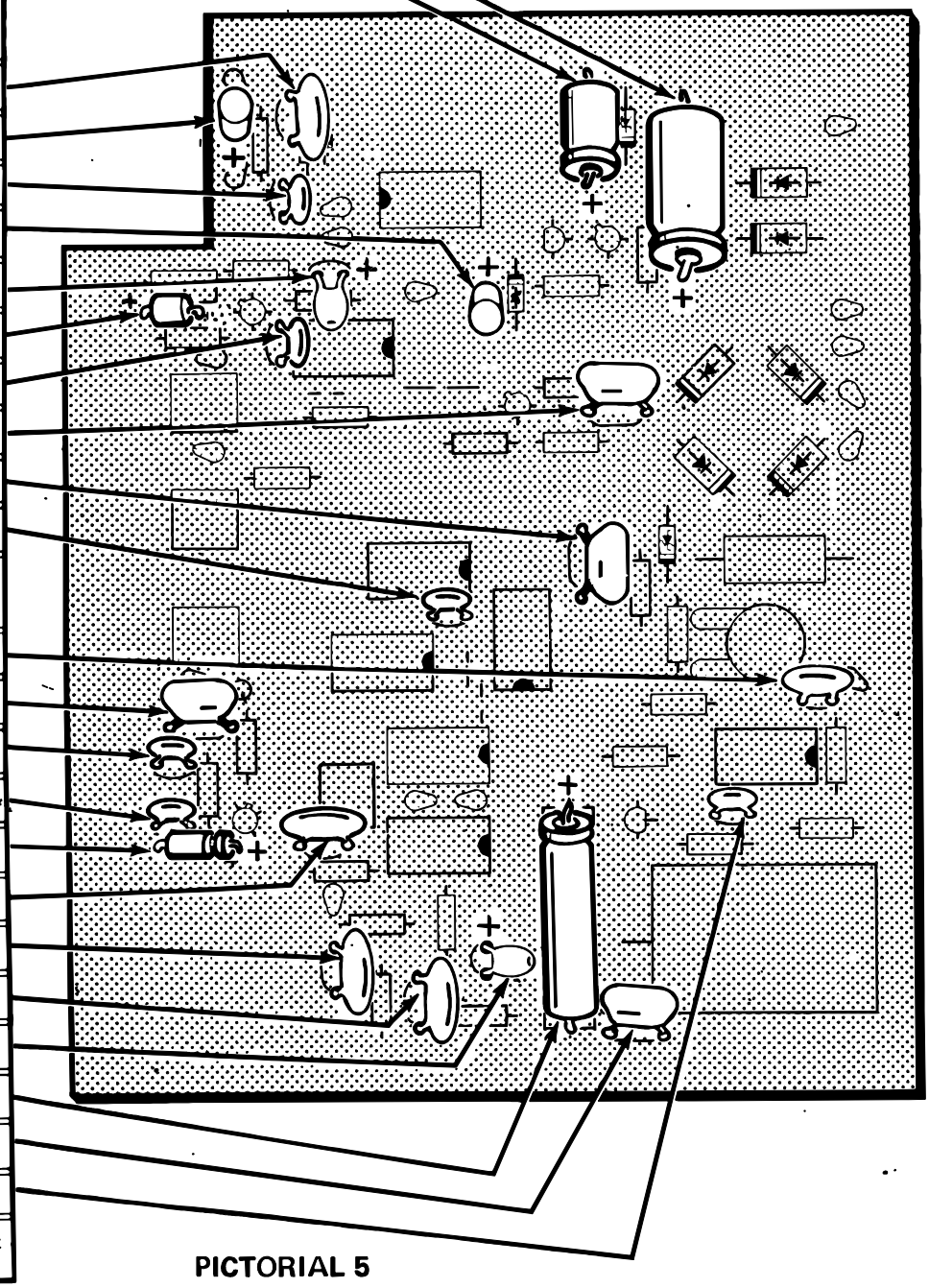
( ) .68 µF tantalum.

( ) 250 µF electrolytic.

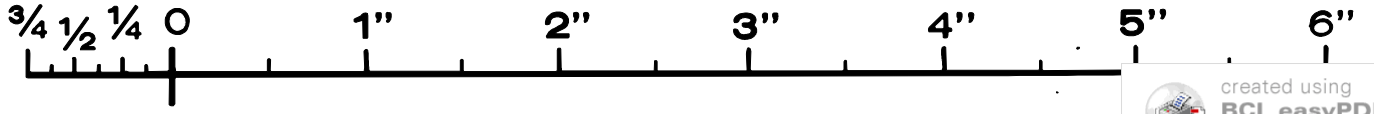
( ) .22 µF Mylar.

( ) .001 µF disc.

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

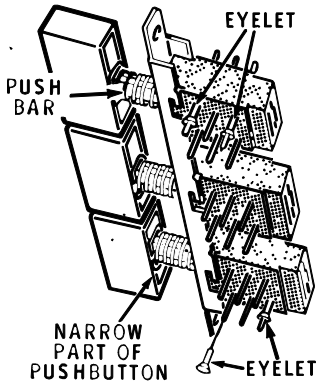


PICTORIAL 5

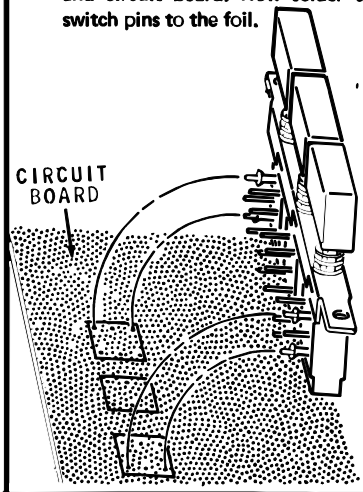


START

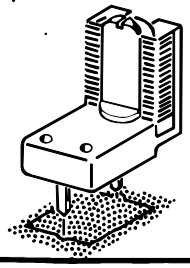
( ) DPDT, 3-section, pushbutton switch. Hold the switch so the narrowest part of the pushbutton, as measured from the push bar of the switch to the outside edge of the pushbutton, is positioned down as shown. Then install an eyelet all the way onto each of the four indicated outside pins of the switch. Pinch the eyelets with a pair of pliers to keep them on the switch pins. These eyelets are to provide proper spacing between the switch and circuit board.



( ) Place the pins of this switch into the holes of the circuit board, pushing the switch tight against the board. The eyelets serve as spacers and must be kept tight against the switch and circuit board. Now solder the switch pins to the foil.

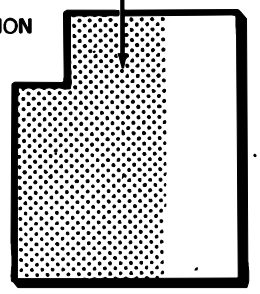


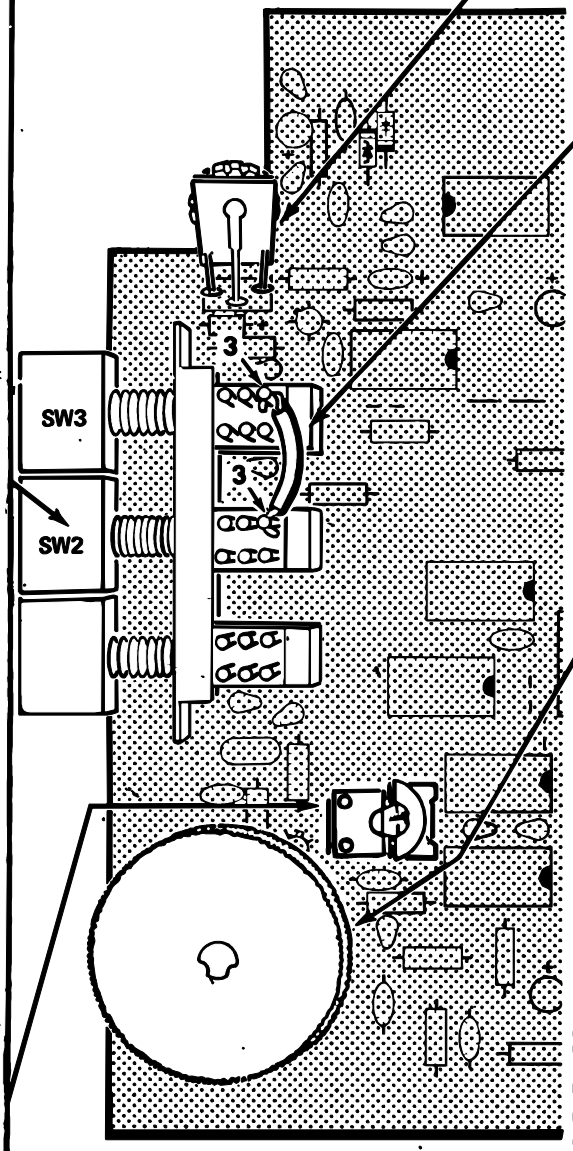
( ) 1.5 pF trimmer capacitor. Solder both pins to the foil.



The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

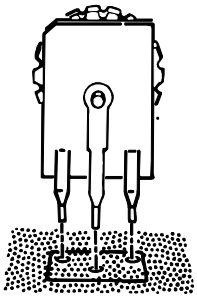




PICTORIAL 6

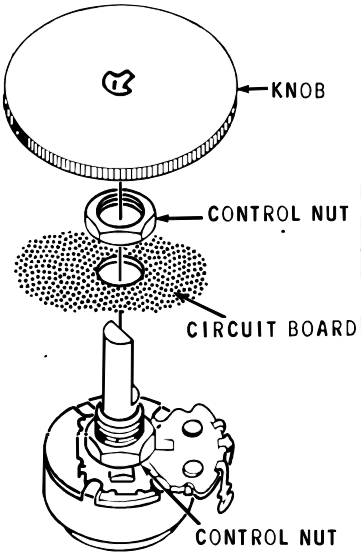
CONTINUE

( ) 2000 Ω control (#10-289). Solder all three pins to the foil.

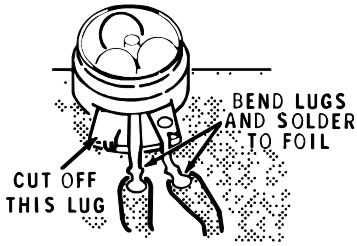


( ) Remove 1/4" of insulation from both ends of a 1-1/2" brown wire. Connect this wire from pin 3 of switch SW3 (S-1) to pin 3 of switch SW2 (S-1).

( ) 100 Ω control (#10-285). Use two control nuts. Then install knob. Turn the first nut all the way down on the threads of the control.

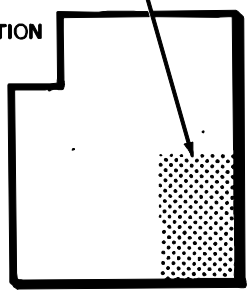


( ) Turn the circuit board over and bend the two indicated control lugs against the indicated foils. Then solder these two control lugs to their foils. Reposition the control if necessary. Cut off the unused lug.



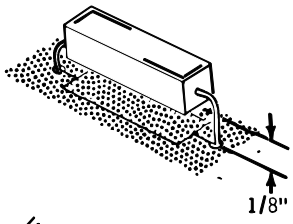
The steps performed in this Pictorial are in this area of the circuit board.

IDENTIFICATION DRAWING

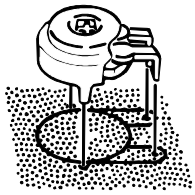


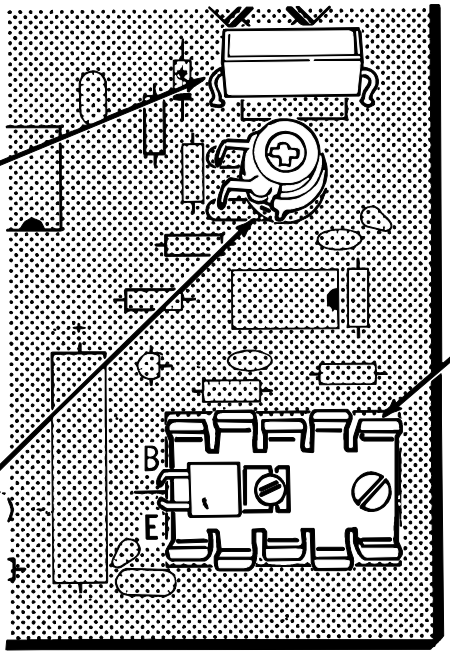
START

( ) 11 Ω, 5-watt resistor. Position the body of the resistor 1/8" above the circuit board. Solder both leads to the foil and cut off the excess lead lengths.



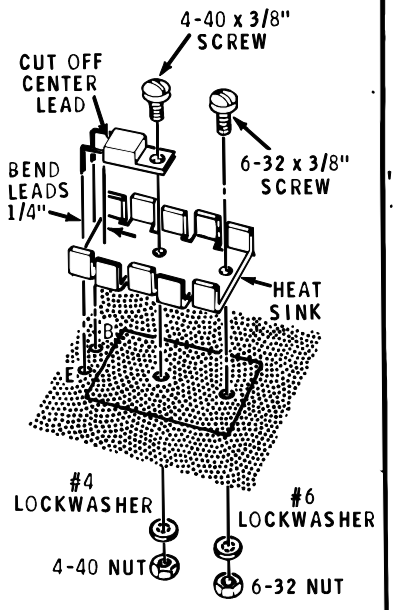
( ) 2000 Ω control (#10-200). Solder all four lugs to the foil.





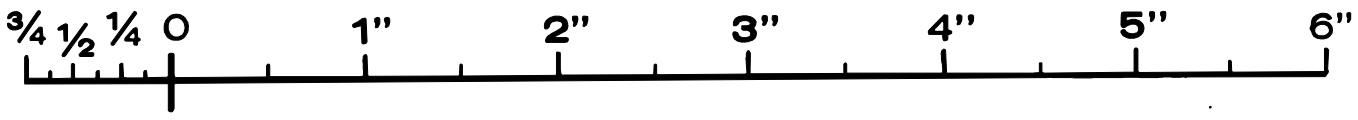
CONTINUE

( ) TA2911 transistor (#417-175) and transistor heat sink at Q5.



( ) Solder both leads to the foil. Be sure the leads do not touch the heat sink.

PICTORIAL 7



START

( ) Remove 1/4" of insulation from both ends of the following lengths of brown wire:

3", 1-1/2", 1-1/2"

Connect one end of each of these wires to the circuit board as follows:

( ) 3" brown wire to hole S (S-1).

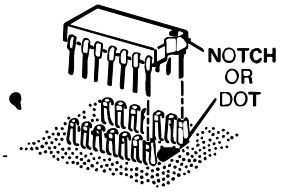
( ) 1-1/2" brown wire to hole R (S-1).

( ) 1-1/2" brown wire to hole P (S-1).

This completes the parts installation on the circuit board except for the IC's. Check to see that all connections are soldered and that no solder bridges exist. There are a number of unused holes which will be used later.

In the following steps, you will be instructed to install the IC's (integrated circuits) into their connectors mounted on the circuit board. Install each of the IC's as follows:

Position the notch or dot end of the IC over the dot screened on the circuit board. Then insert the IC leads into the IC connectors. DO NOT solder the IC to the connectors. DO NOT cut off any unused pins of an IC and be sure they do not touch any other pins or connectors.



NOTE: Should it ever become necessary to remove an IC from its connectors, slide a screwdriver blade under the IC; then gently lift the IC out of the connectors.

( ) IC SN7490N (#443-7) at IC7.

( ) IC SN7400 (#443-1) at IC6.

( ) IC MC1013 (#443-40) at IC4.

( ) IC MC1027 (#443-41) at IC3.

( ) IC MC1027 (#443-41) at IC5.

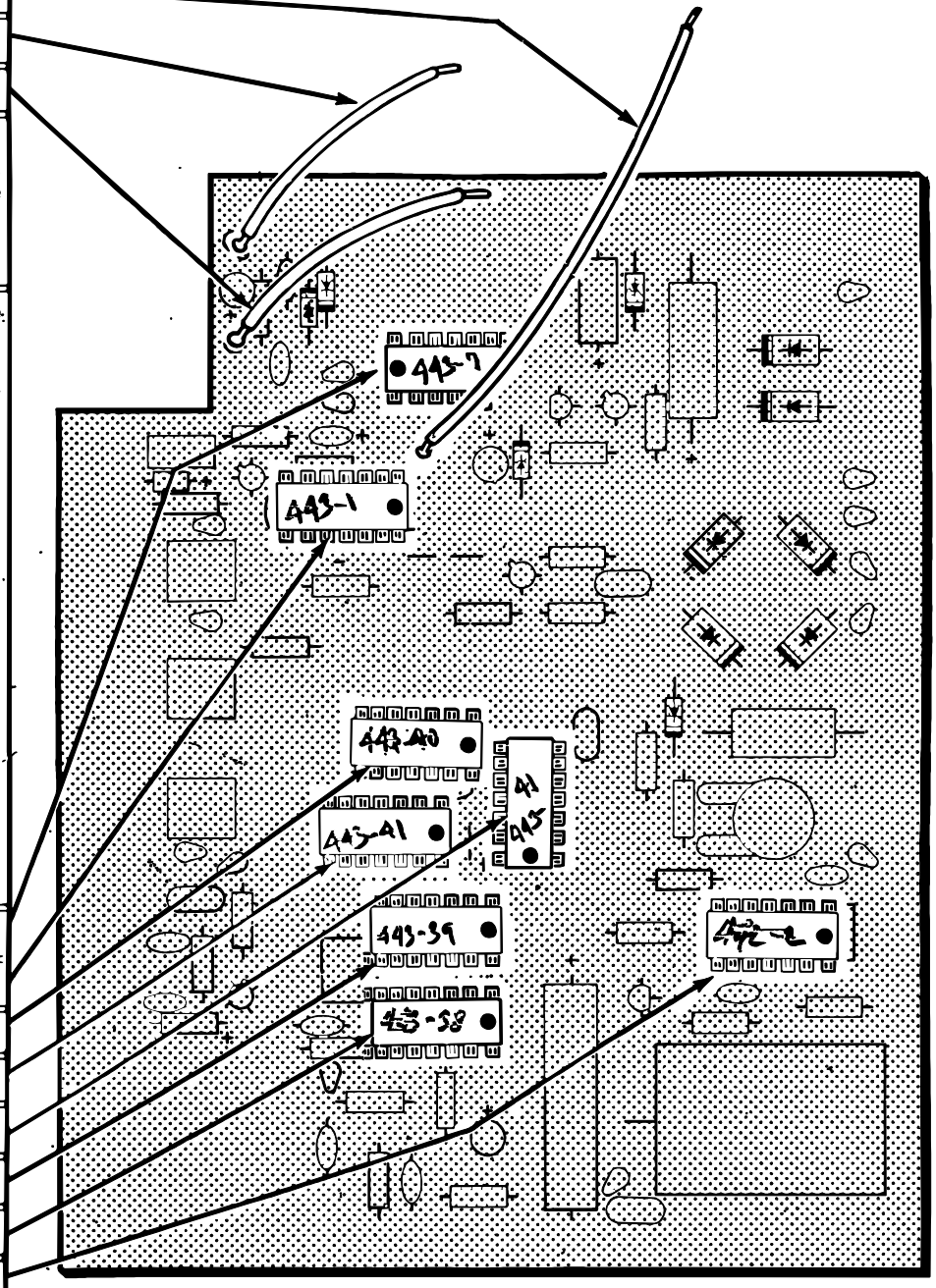
( ) IC MC1034 (#443-39) at IC2.

( ) IC MC1023 (#443-38) at IC1.

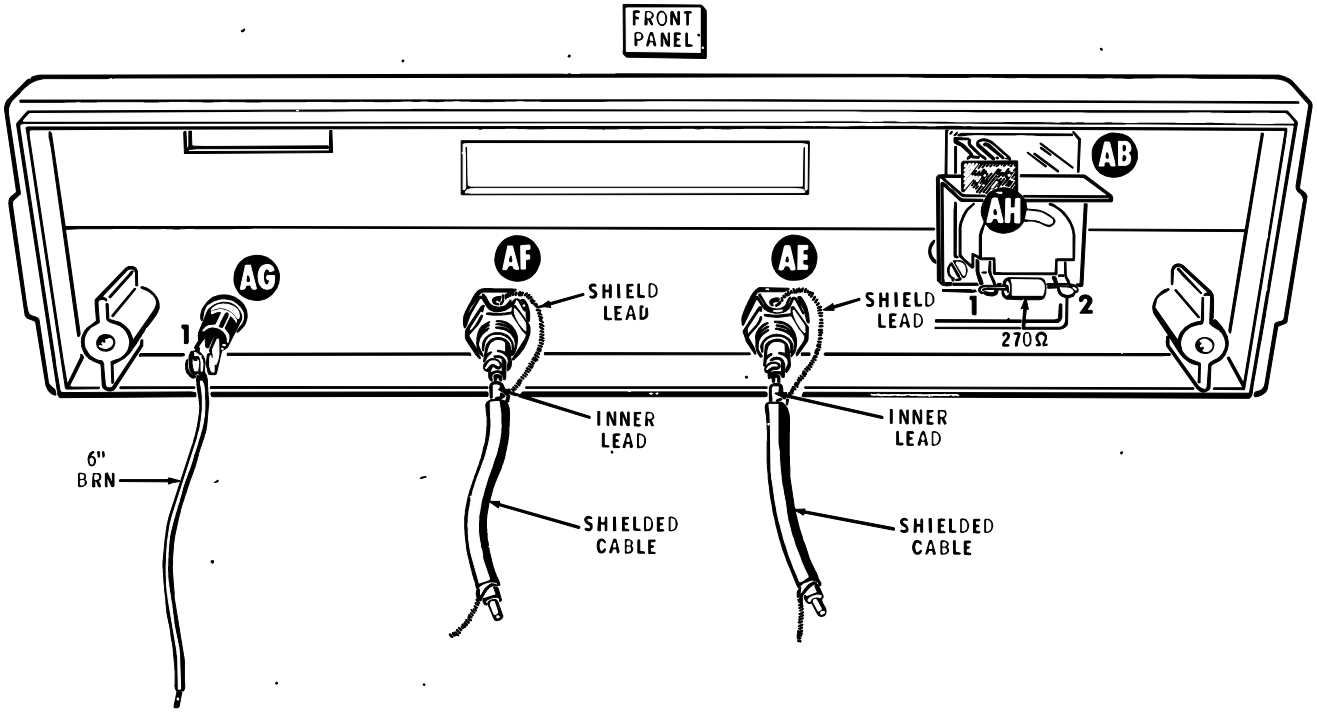
( ) IC SN4985N (#442-2) at IC8.

FINISH

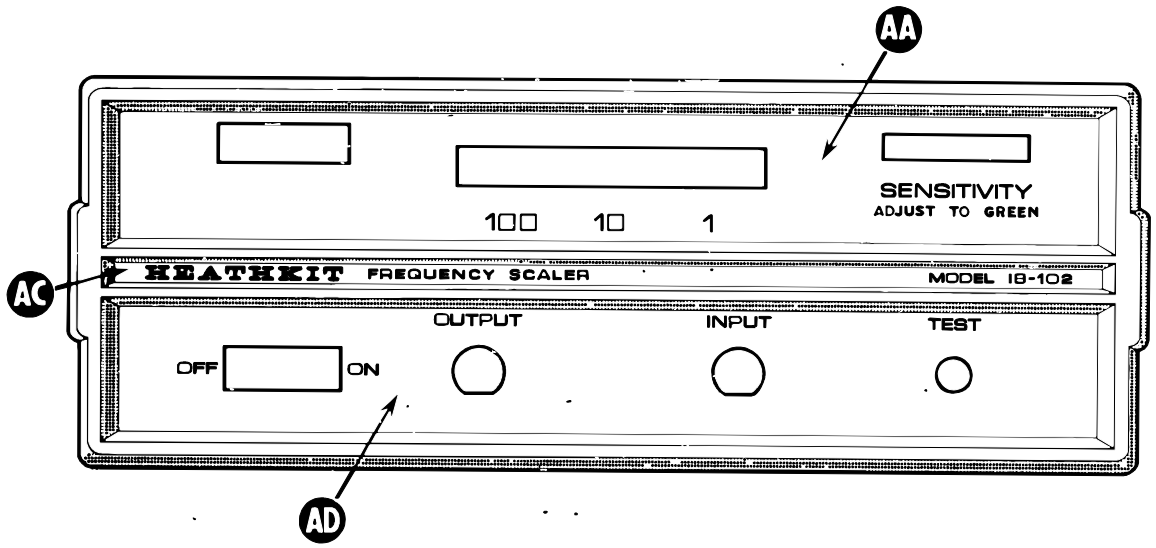
Temporarily set the circuit board aside.



PICTORIAL 8



PICTORIAL 10



PICTORIAL 9

FRONT PANEL ASSEMBLY AND WIRING

Refer to Pictorial 9 for the following steps.

( ) Locate the front panel and position it as shown.

( ) Carefully remove the protective backing from the top front panel label and press the label in place at AA.

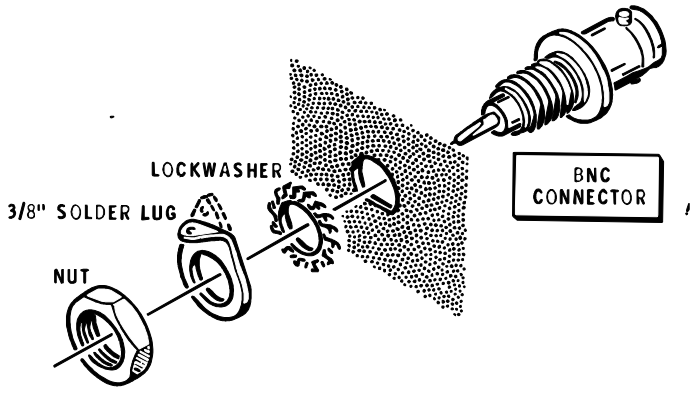
( ) Carefully remove the protective backing from the "Heathkit" label and press it in place at AC.

( ) Carefully remove the protective backing from the bottom front panel label and press it in place at AD.

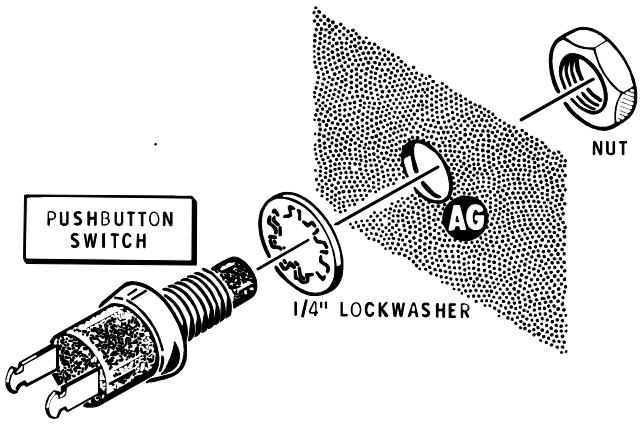
Refer to Pictorial 10 for the following steps.

( ) Refer to Detail 10A and install a BNC connector at AE. Use the nut and lockwasher furnished with the connector and a 3/8" solder lug. Then bend the solder lug as shown.

( ) In the same manner, install a BNC connector at AF.



Detail 10A



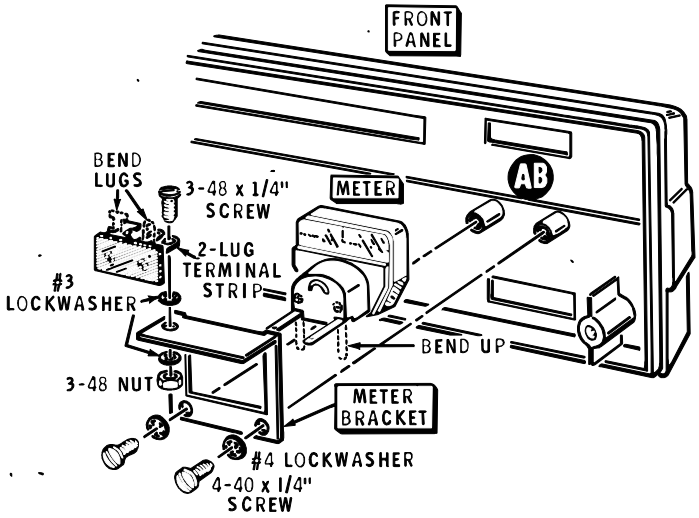
Detail 10B

( ) Refer to Detail 10B and mount the pushbutton switch at AG. Use the nut furnished with the pushbutton switch and a 1/4" lockwasher.

NOTES:

1. Use the plastic nut starter supplied with this kit to hold and start 3-48 and 6-32 nuts on screws. Refer to the "Kit Builders Guide" for further information.

2. The term "hardware" will be used to refer to the screws, nuts, and lockwashers when parts are being mounted in some of the following steps. The phrase "use 3-48 x 1/4" hardware," for example, means to use a 3-48 x 1/4" screw, one or more #3 lockwashers, and a 3-48 nut. Refer to the Detail called out in the step to determine the correct number of lockwashers and the correct way to install the hardware.



Detail 10C

Refer to Detail 10C for the following steps.

( ) Mount a 2-lug terminal strip at AH on the meter mounting bracket. Use 3-48 x 1/4" hardware. Then bend the lugs of the terminal strip as shown.

( ) Carefully remove the very fine shorting wire from the meter lugs (if there is one). Then bend the meter lugs up as shown.

( ) Mount the meter at AB on the front panel with the meter mounting bracket. Use 4-40 x 1/4" screws and #4 lockwashers.

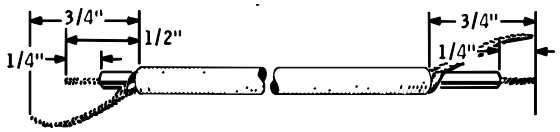
Refer to Pictorial 10 for the following steps.

( ) Prepare a 6" length of brown wire by removing 1/4" of insulation from each end.

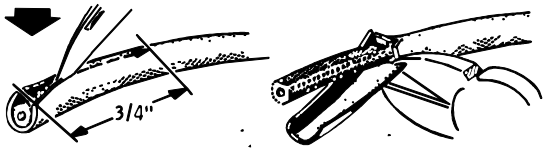
( ) Connect one end of the 6" brown wire to lug 1 of pushbutton switch AG (S-1). Wrap the wire around the lug. The other end of the wire will be connected later.

( ) Refer to Detail 10D and prepare both ends of two 3" shielded cables. Be very careful not to pull the inner lead from the cable.

CUT THE CABLE ACCORDING TO THE DIMENSIONS BELOW. PREPARE EACH END AS SHOWN.

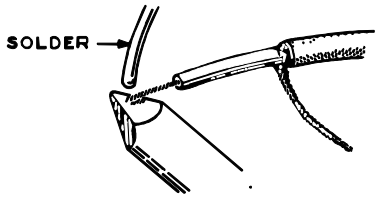


TAKING CARE NOT TO CUT THE OUTER SHIELD OF VERY THIN WIRES, REMOVE THE OUTER INSULATION.



PUSH BACK THE SHIELD. USE A POINTED OBJECT TO SEPARATE THE FINE WIRES OF THE SHIELD AS SHOWN. THEN TWIST THESE FINE WIRES TOGETHER.

REMOVE THE INNER INSULATION AND STRETCH OUT THE SHIELD. APPLY A SMALL AMOUNT OF SOLDER TO THE END OF THE SHIELD AND THE INNER LEAD. USE ONLY ENOUGH HEAT FOR THE SOLDER TO FLOW.



Detail 10D

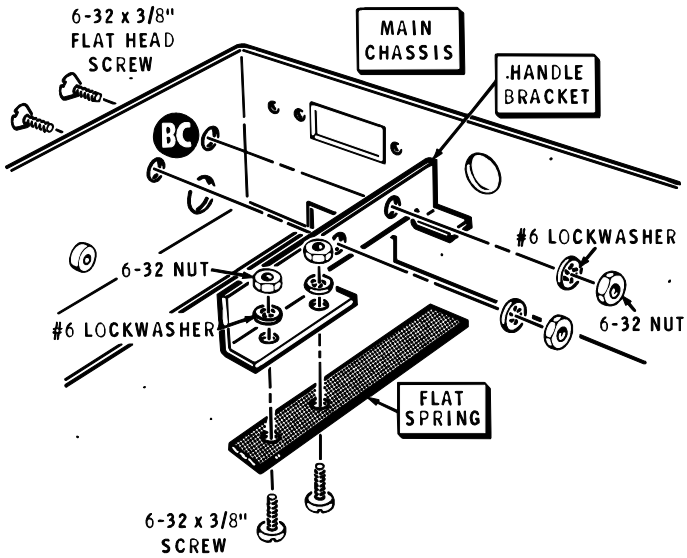
( ) At the end that has the shorter inner lead on one of the 3" shielded cables, connect the inner lead to the center pin of BNC connector AF (S-1) and the shield lead to the solder lug at AF (S-1). The other end of the cable will be connected later.

( ) At the end that has the shorter inner lead on the other 3" shielded cable, connect the inner lead to the center pin of BNC connector AE (S-1) and the shield lead to the solder lug at AE (S-1). The other end of the cable will be connected later.

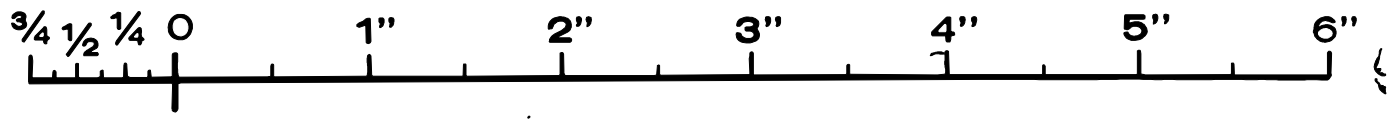
CAUTION: Be very careful when performing the next step, as the lugs of the meter are quite fragile and can be broken easily.

( ) Cut both leads of a 270 Ω (red-violet-brown) resistor to 3/8". Then connect it between lugs 1 (S-1) and 2 (S-1) of meter AB. Position the resistor as shown.

Set the front panel aside temporarily.



Detail 11A



MOUNTING PARTS ON THE CHASSIS

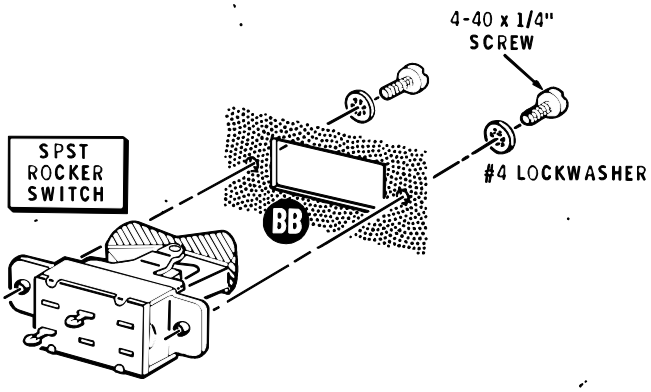
Refer to Pictorial 11 (fold-out from Page 19) for the following steps.

( ) Refer to Detail 11A and mount the flat spring on the handle bracket with 6-32 x 3/8" hardware. Keep the edge of the flat spring parallel to the edge of the handle bracket.

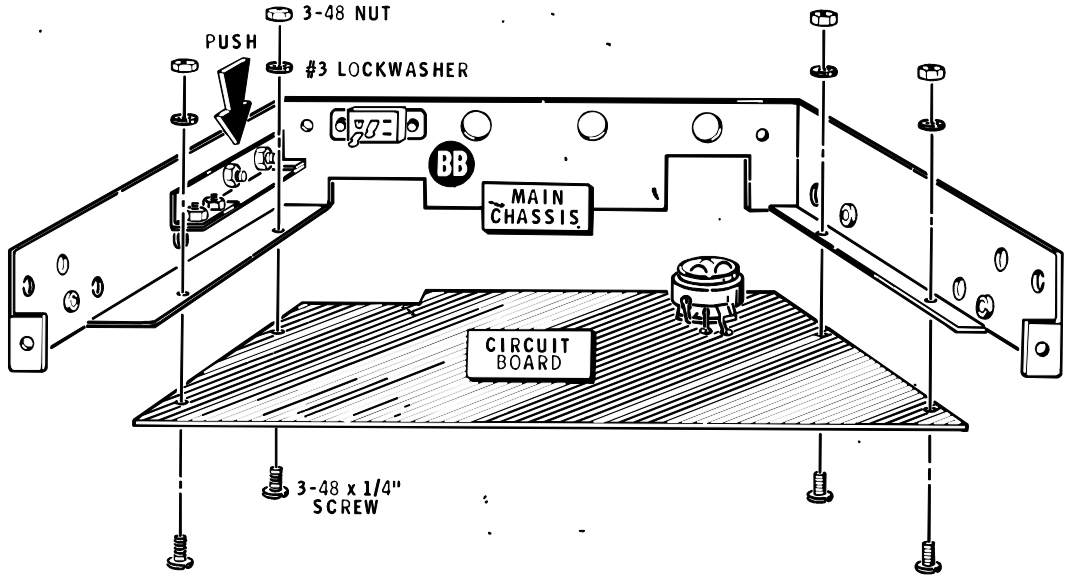
( ) Mount the handle bracket at BC on the main chassis with 6-32 x 3/8" flat head hardware as shown in Detail 11A. Push the bracket as far as possible in the direction of the arrow before tightening the hardware.

( ) Refer to Detail 11B and mount the SPST rocker switch at BB with 4-40 x 1/4" screws and #4 lockwashers. Be sure to position the switch as shown.

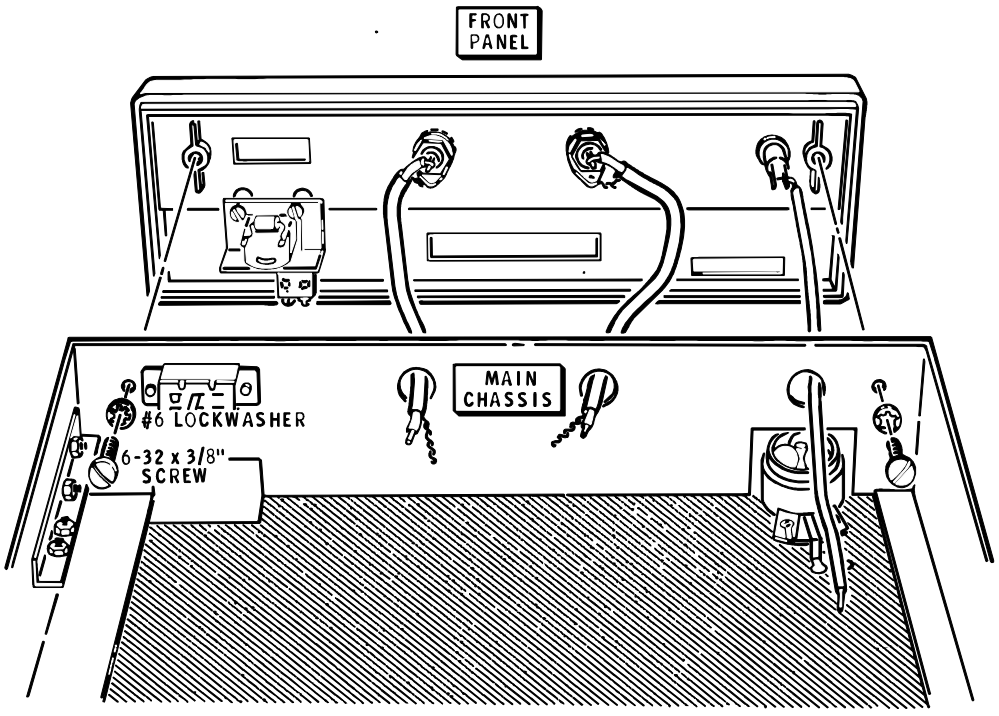
( ) Refer to Detail 11C and mount the circuit board on the main chassis with 3-48 x 1/4" hardware. Be sure not to pinch any wires between the circuit board and chassis. Tighten this hardware only finger tight at this time.



Detail 11B



Detail 11C



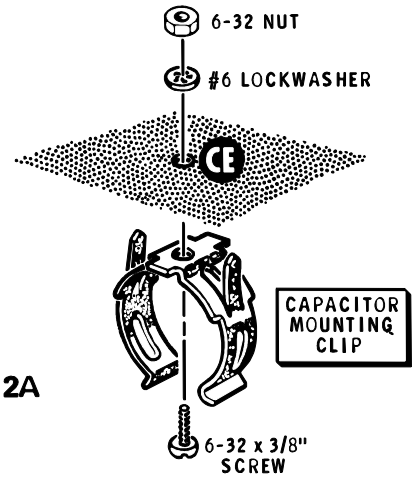
Detail 11D

( ) Refer to Detail 11D and mount the front panel on the main chassis with 6-32 x 3/8" screws and #6 lockwashers. Be sure the wires from the front panel pass through the indicated holes in the main chassis and that the pushbutton knobs, the control knob, and the rocker switch knob fit through the appropriate cut-outs of the main chassis.

Set the chassis assembly aside temporarily.

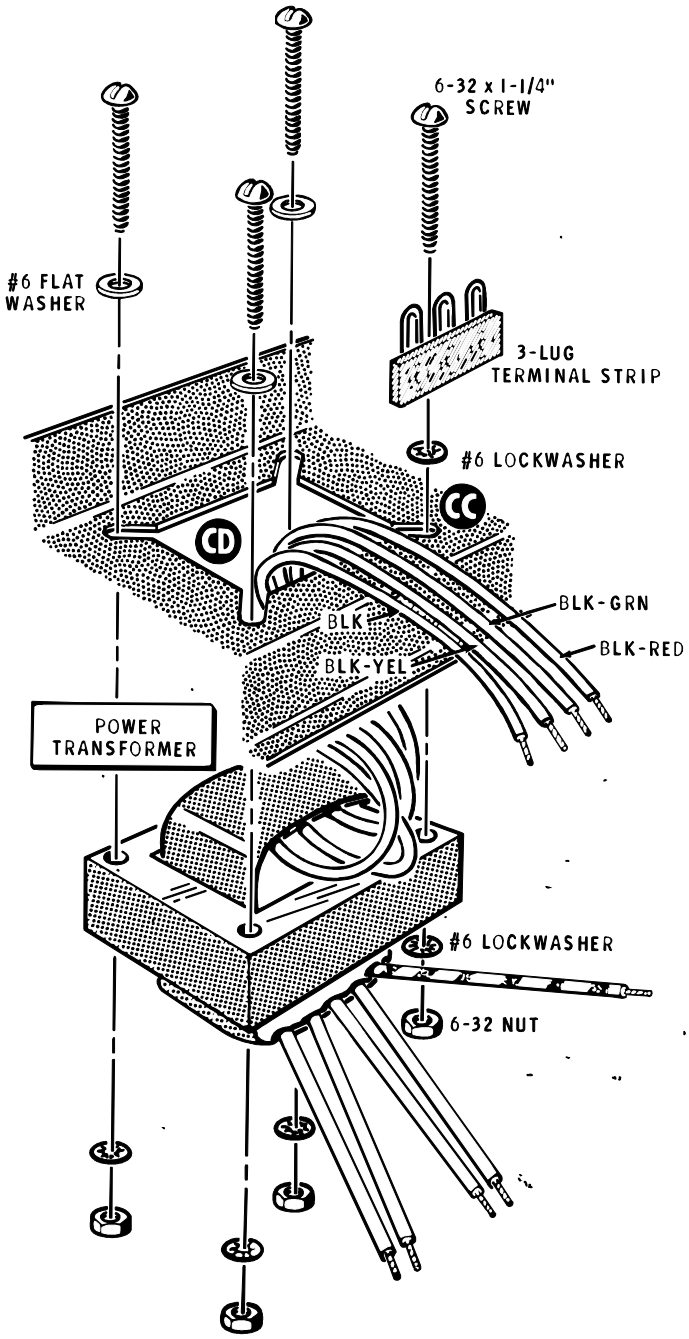
Refer to Pictorial 12 for the following steps.

( ) Refer to Detail 12A and install the capacitor mounting clip at CE with 6-32 x 3/8" hardware on the power supply chassis. Position the capacitor mounting clip as shown.

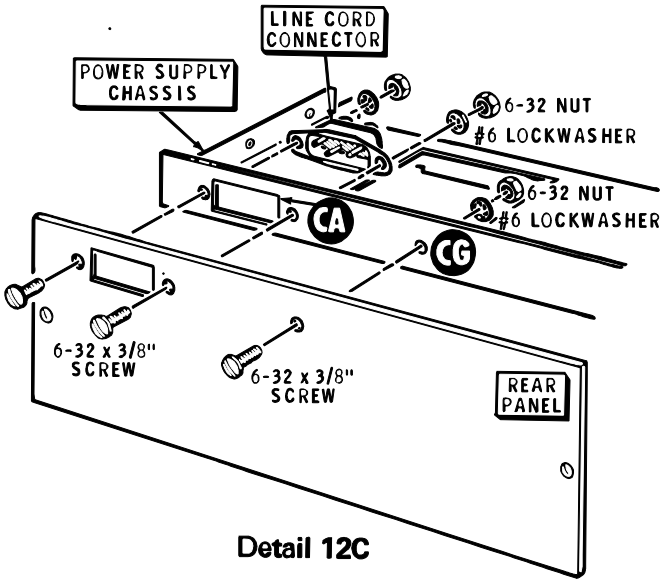


Detail 12A

( ) Refer to Detail 12B and mount the power transformer at CD with a 3-lug terminal strip at CC. Use 6-32 x 1-1/4" hardware with #6 flat washers at the three indicated locations. Pass the indicated color leads through the chassis cut-out as shown.



Detail 12B

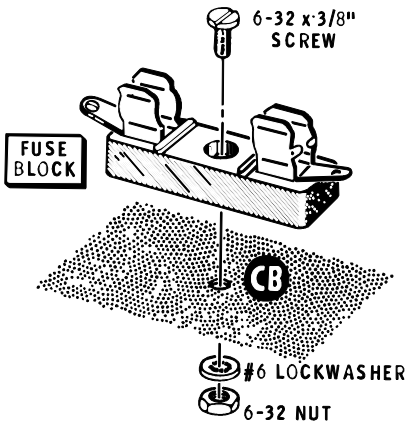


Detail 12C

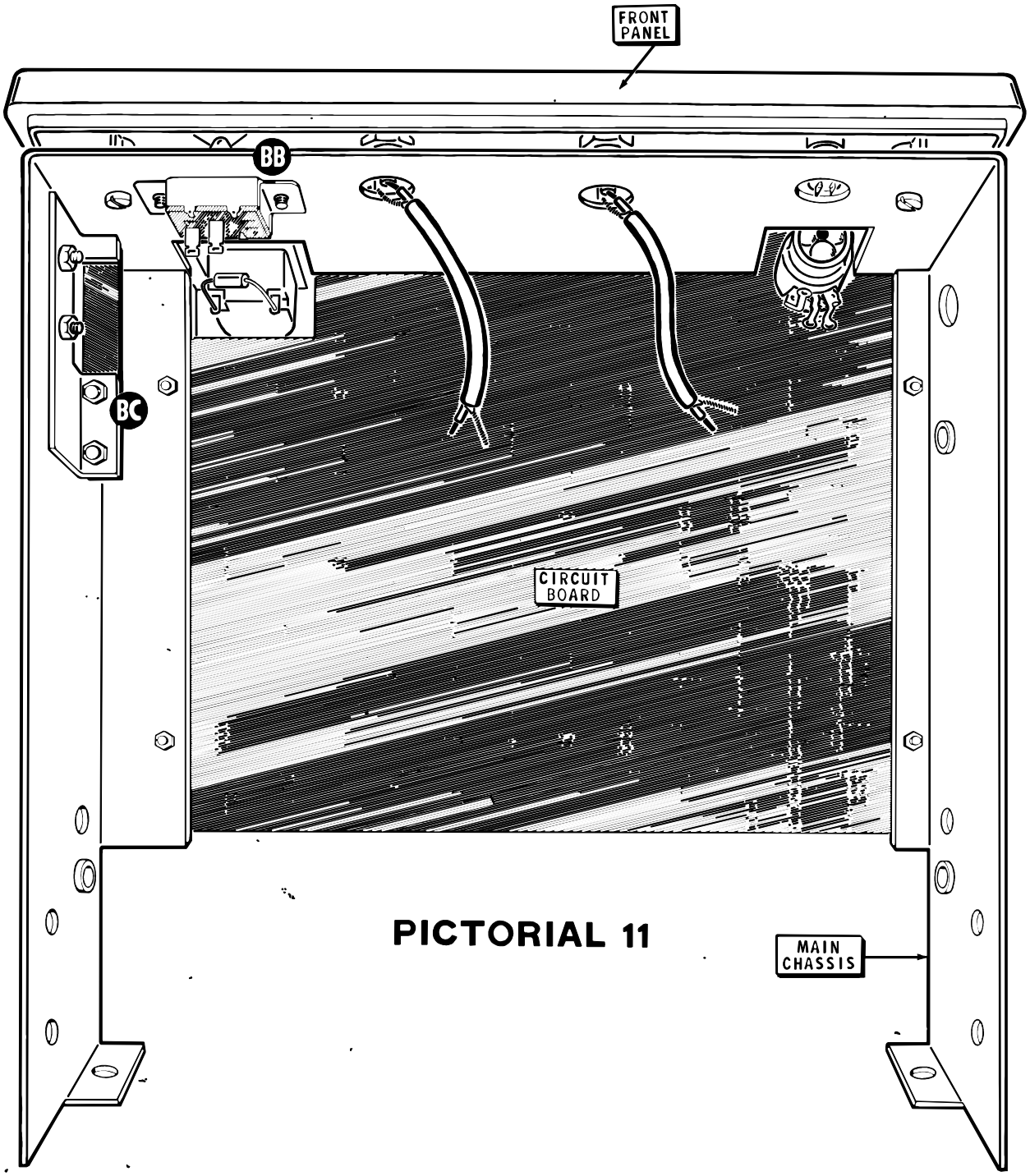
( ) Mount the rear panel on the power supply chassis with 6-32 x 3/8" hardware at CG. Be sure and align the holes at CA in both pieces with each other. See Detail 12C.

( ) Refer to Detail 12C and mount the line cord connector at CA with 6-32 x 3/8" hardware. Position the connector as shown.

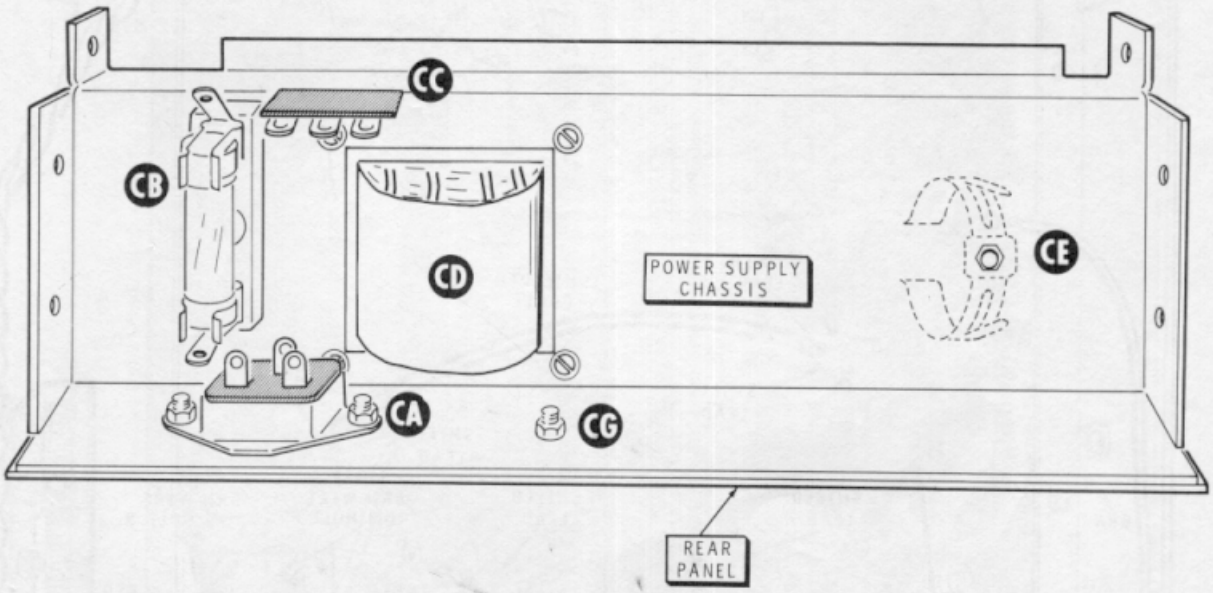
( ) Refer to Detail 12D and mount the fuse block at CB with 6-32 x 3/8" hardware. Do not overtighten the hardware as the fuse block can be broken.



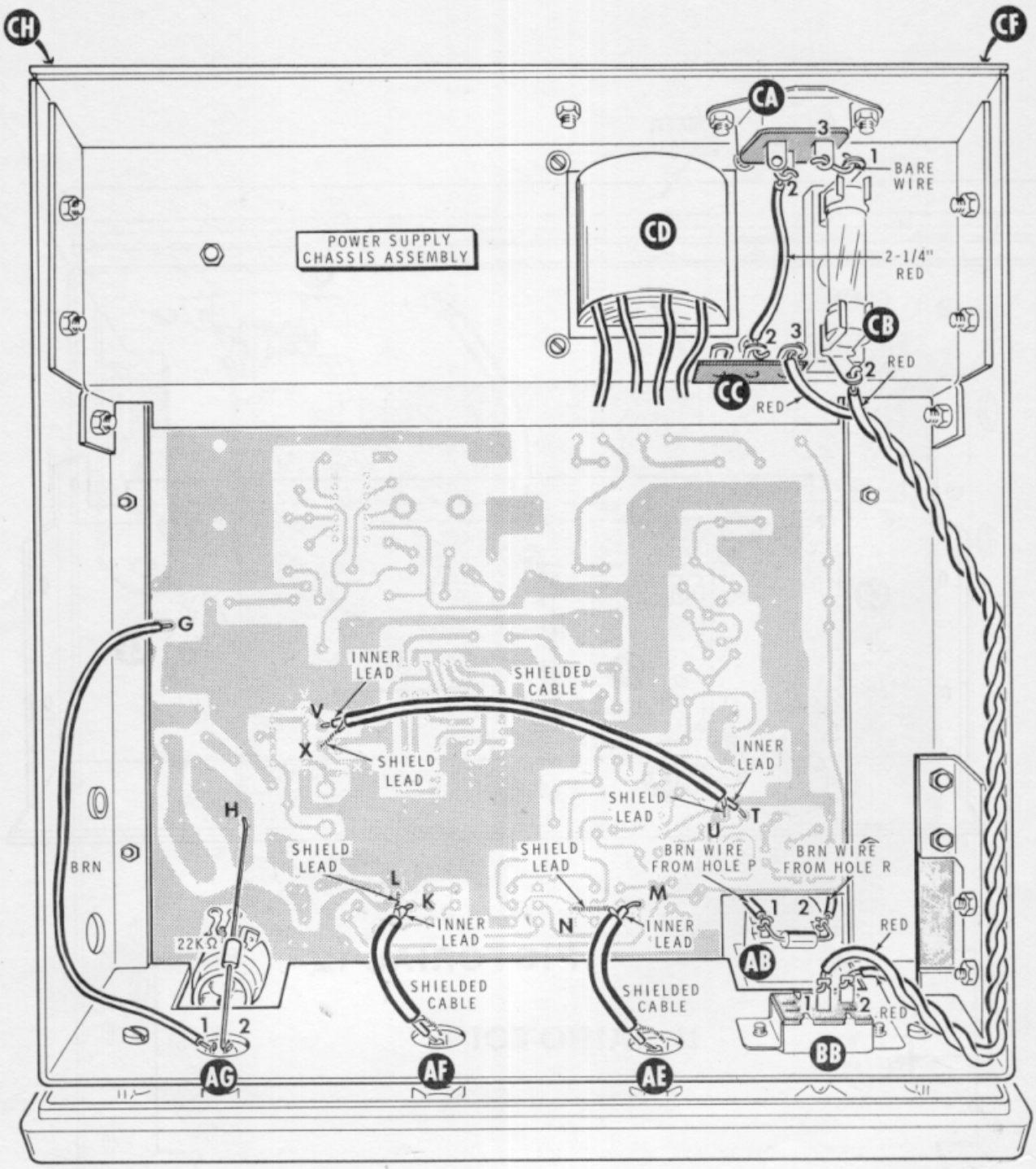
Detail 12D



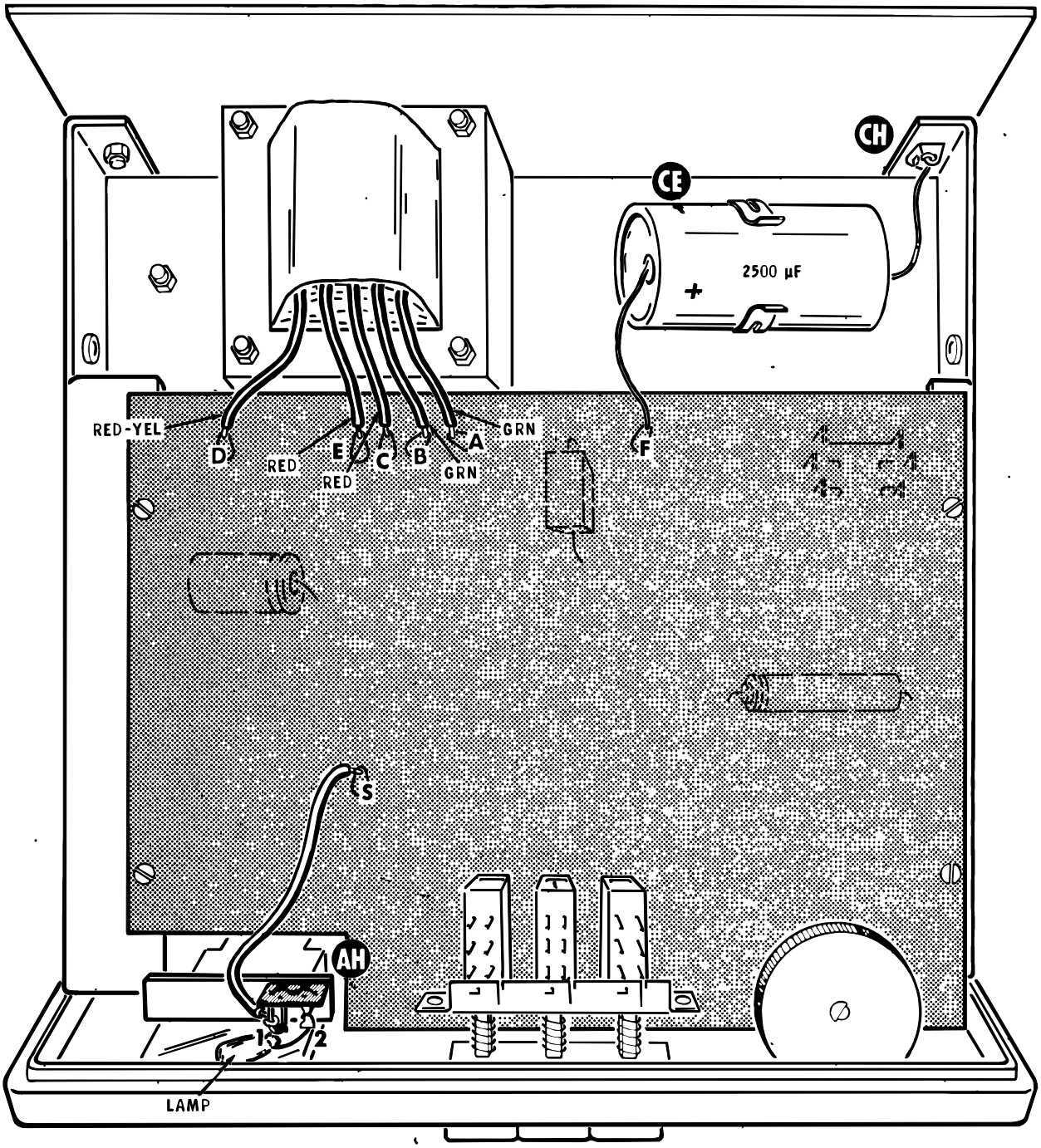
PICTORIAL 11



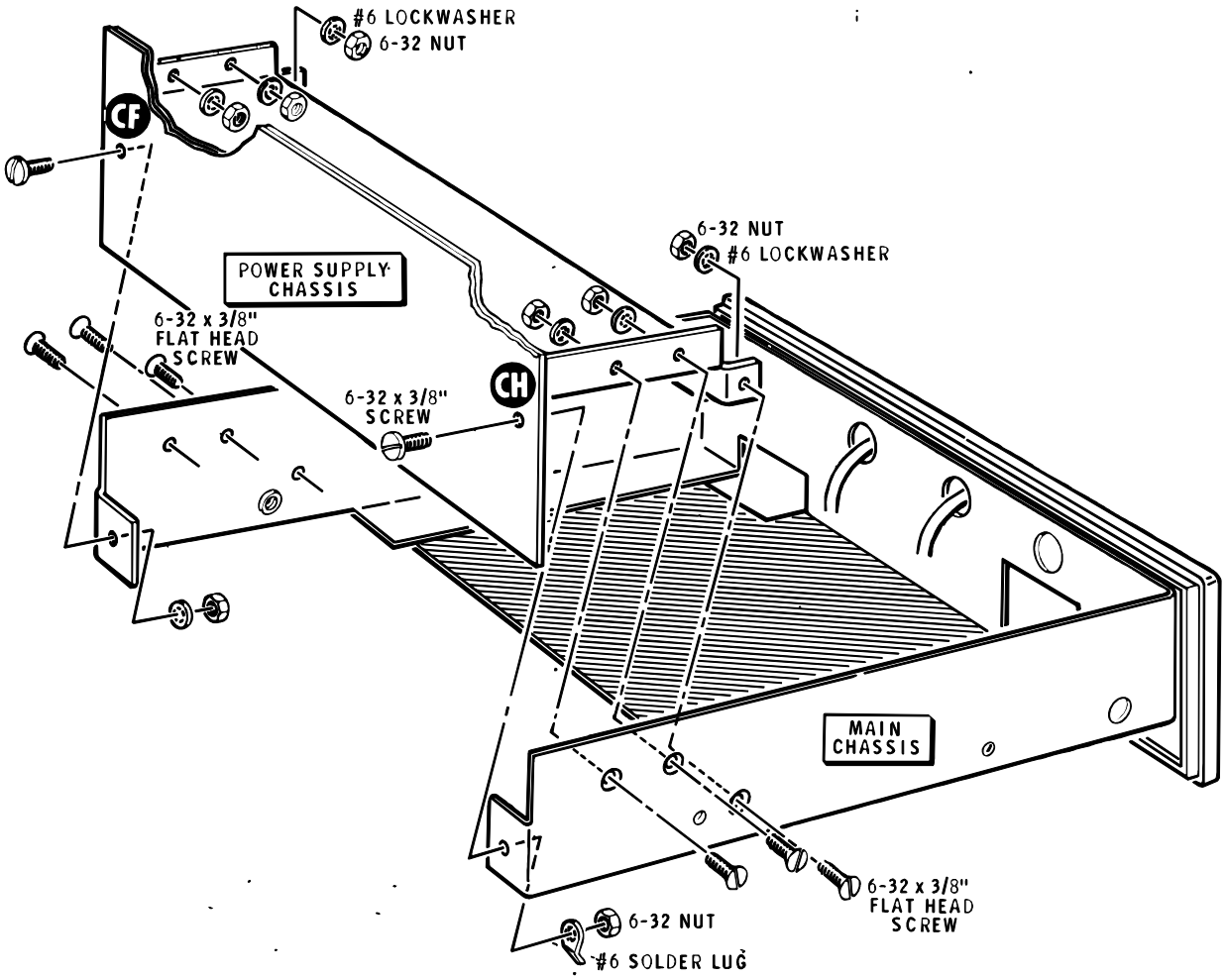
PICTORIAL 12



PICTORIAL 13



PICTORIAL 14



Detail 13A

WIRING CHASSIS BOTTOM

Refer to Pictorial 13 for the following steps.

( ) Refer to Detail 13A and mount the power supply chassis to the main chassis with 6-32 x 3/8" hardware at CH and CF with a #6 solder lug at CH. Be sure no leads are pinched between the chassis and circuit board.

( ) Install 6-32 x 3/8" flat head hardware at the six indicated locations in the main chassis and power supply chassis.

( ) Now tighten the hardware mounting the circuit board to the chassis.

NOTE: When installing wires into the holes from the foil side of the circuit board, as in some of the following steps, leave the insulation 1/8" above the circuit board. If the insulation is pushed tight against the foil, it is impossible to get a good solder connection to the wire and foil.

( ) Connect the free end of the brown wire coming from lug 1 of pushbutton switch AG into hole G in the circuit board (S-1). Position the wire as shown.

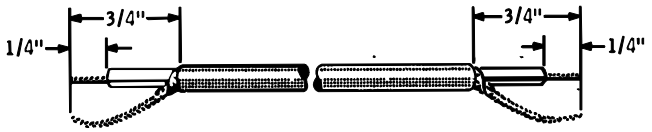
( ) Cut both leads of a 22 kΩ (red-red-orange) resistor to 1". Connect this resistor from lug 2 of pushbutton switch AG (S-1) into hole H in the circuit board (S-1).

( ) Connect the free end of the shielded cable coming from BNC connector AF to the circuit board as follows: Inner lead into hole K (S-1) and the shield lead into hole L (S-1). Be sure none of the fine wires touch any other foil on the circuit board.

( ) Connect the free end of the shielded cable coming from BNC connector AE to the circuit board as follows: Inner lead into hole M (S-1) and the shield lead into hole N (S-1).

( ) Connect the brown wire coming from hole P (in the lettered side of the circuit board) to lug 1 of the meter AB and solder the connection. A resistor is already soldered to the lug.

( ) Connect the brown wire coming from hole R (in the lettered side of the circuit board) to lug 2 of the meter AB and solder the connection. A resistor is already soldered to the lug.



Detail 13B

( ) Refer to Detail 13B and prepare the ends of a 5-1/2" length of shielded cable.

( ) Connect either end of this shielded cable to the circuit board as follows: Inner lead into hole V (S-1) and the shield lead into hole X (S-1).

( ) Connect the other end of this shielded cable to the circuit board as follows: Inner lead into hole T (S-1) and the shield lead into hole U (S-1).

( ) Prepare the ends of two 7-1/2" red wires as follows:

1. Remove 1/4" of insulation from each end of both wires.
2. Twist together the fine wires at each end of each wire.
3. Melt a small amount of solder on the bare wire ends.

( ) Position one end of each of these two wires even and twist the wires together to form a twisted pair.

( ) At either end of this twisted pair of wires, connect either wire to lug 1 (S-1) and the other wire to lug 2 (S-1) of rocker switch BB. Be sure the bare wire ends do not touch the metal frame of the switch.

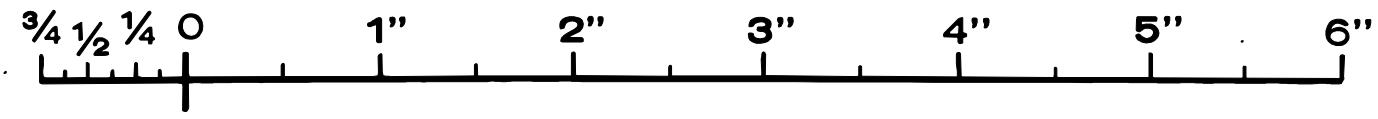
( ) Position the twisted pair of wires as shown. At the other end, connect either wire to lug 2 of fuse block CB (S-1) and the other wire to lug 3 of terminal strip CC (NS).

( ) Prepare the end of a 2-1/4" red wire.

( ) Connect this red wire from lug 2 of line cord connector CA (S-1) to lug 2 of terminal strip CC (S-1).

( ) Connect a bare 1/2" wire (remove all the insulation from a length of brown hookup wire) from lug 3 of line cord connector CA (S-1) to lug 1 of fuse block CB (S-1). Bend lug 1 of the fuse block up as shown.

CAUTION: Be sure all wires connect to the fuse block, line cord connector, terminal strip CC, and are at least 1/8" away from the chassis or other metal parts.



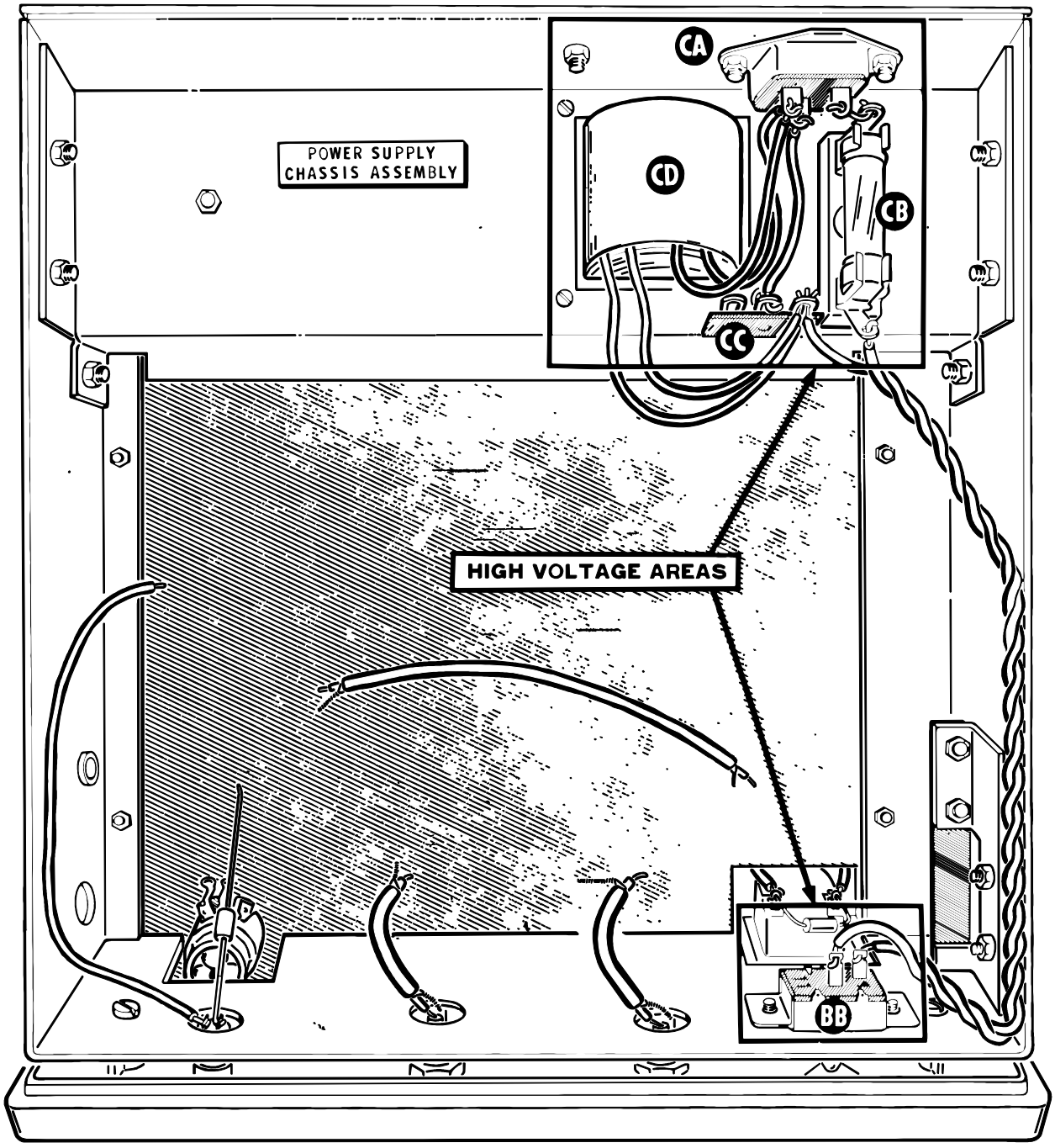


Figure 3

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 Vac line voltage and the other for 240 Vac line voltage. In the U.S.A. 120 Vac is most often used, while in other countries 240 Vac is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 Vac Wiring

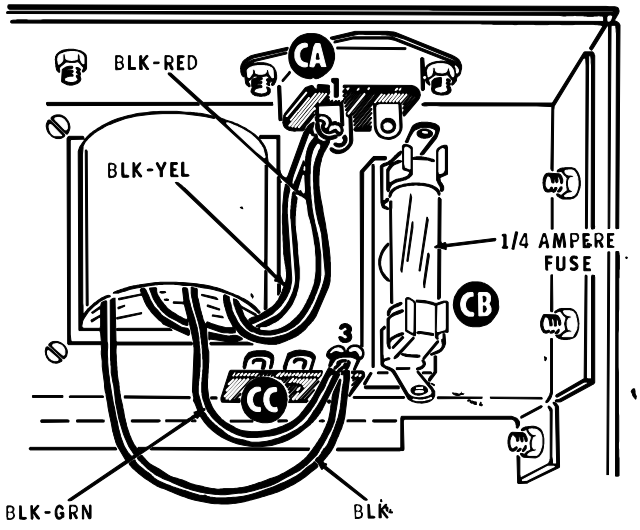
Refer to Detail 13C for the following steps.

Connect the power transformer leads as follows:

( ) Black-red and black-yellow leads to lug 1 of line cord connector CA (S-2).

( ) Black and black-green leads to lug 3 of terminal strip CC (S-3).

( ) Install the 1/4 ampere fuse in fuse block CB.



Detail 13C

This completes the 120 Vac wiring. Proceed to "Wiring Chassis Top."

240 Vac Wiring

Refer to Detail 13D for the following steps.

Connect the power transformer leads as follows:

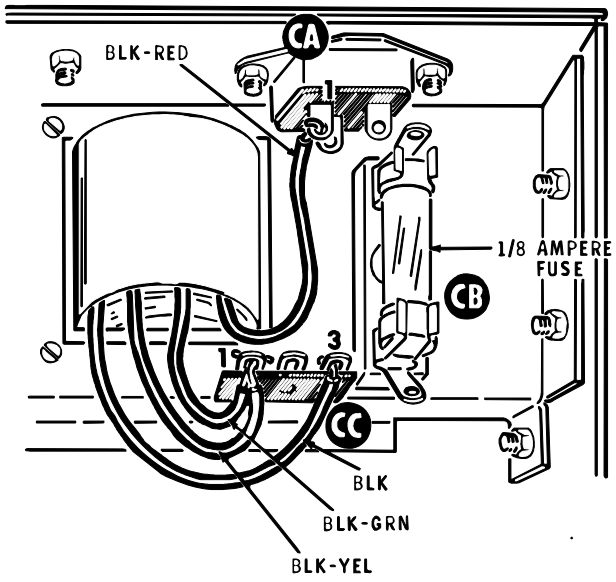
( ) Black-red lead to lug 1 of line cord connector CA (S-1).

( ) Black-green and black-yellow leads to lug 1 of terminal strip CC (S-2).

( ) Black lead to lug 3 of terminal strip CC (S-2).

( ) Install a 1/8 ampere slow-blow fuse (not furnished with the kit) in fuse block CB.

This completes the 240 Vac wiring. Proceed to "Wiring Chassis Top."



Detail 13D

WIRING CHASSIS TOP

Refer to Pictorial 14 (fold-out from Page 20) for the following steps.

( ) Connect the free end of the brown wire coming from hole S in the circuit board to lug 1 of terminal strip AH (NS).

( ) Connect the lamp between lugs 1 (S-2) and 2 (S-1) of terminal strip AH. Position the end of the lamp so it is centered behind the meter. Be sure the leads do not touch each other.

( ) Install the 2500 µF electrolytic capacitor in the capacitor mounting clip at CE. Position the positive (+) end as shown.

( ) Connect the positive (+) lead of this capacitor into hole F of the circuit board (S-1) and the other lead to solder lug CH (S-1). Be sure the positive (+) lead does not touch the metal chassis. Cut off its excess lead lengths.

Connect the leads of the power transformer to the circuit board as follows:

( ) First green into hole A (S-1).

( ) Second green into hole B (S-1).

( ) First red into hole C (S-1).

( ) Second red into hole E (S-1).

( ) Red-yellow to hole D (S-1).

This completes the wiring of the kit. Check to see that all connections are soldered and no solder bridges exist between foils on the circuit board. Shake out any wire clippings or solder splashes. Be sure all excess lead lengths are cut off.

ADJUSTMENTS

Equipment Required:

- A frequency counter that meets the output requirements of the Frequency Scaler (see Specifications on Page 39).
- A signal source capable of producing a signal between 2 and 175 MHz, with an output level between 100 mV and 3 V rms if available.
- A voltmeter capable of measuring 5.25 Vdc, if one is available.

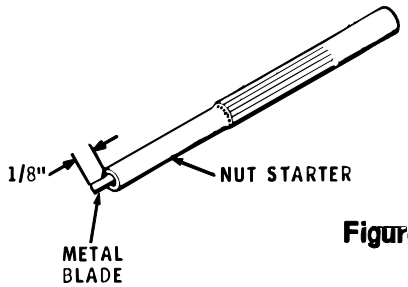


Figure 1A

( ) Locate the 1/8" x 1" metal strip. This is the alignment tool tip. With a pair of pliers, insert the tip into the small end of the nut starter so that it extends 1/8" from the end of the starter as shown in Figure 1A. Use this tool for all calibration adjustments.

Refer to Figure 2 (fold-out from Page 25) for the following step.

Make the following preset adjustments. Where necessary, use the alignment tool prepared above.

( ) OFF-ON – to OFF.

( ) SUPPLY ADJUST – 1/4 turn counterclockwise from its full clockwise position.

( ) BANDWIDTH ADJUST – plates fully closed.

( ) ZERO ADJUST – center of rotation.

( ) 10 division pushbutton – pushed in.

( ) SENSITIVITY – fully clockwise. NOTE: This is a 10 turn control. A slight increase in friction will occur when the control reaches an end limit.

NOTE: If the Frequency Scaler does not perform as described in the following steps, immediately unplug its line cord and refer to the "In Case of Difficulty" section on Page 29.

WARNING: Line voltage is present in the Frequency Scaler as shown by the boxed-in areas in Figure 3 (fold-out from Page 22), when the line cord is plugged into an ac outlet.

NOTE: Do not connect an external signal source (if available) to the INPUT of the Scaler until instructed to do so in a step.

( ) Plug the line cord into the line cord connector on the Frequency Scaler.

( ) Plug the line cord of the Frequency Scaler into an ac outlet of the proper voltage (120 or 240 Vac, depending upon how you wired the power transformer).

( ) Press the OFF-ON switch to ON. The lamp behind the meter should light and the meter might deflect up scale to the right (or read full scale).

( ) If a voltmeter is available, set the SUPPLY ADJUST control so that the voltage at pin 14 of IC1 reads +5.25 Vdc. Then disconnect the voltmeter leads. CAUTION: Do not allow the voltmeter probe to short adjacent pins of an IC together when making the adjustment, as the IC could be permanently damaged.

NOTE: The SENSITIVITY control, to be adjusted in the next step, functions as a peaking adjustment. It is necessary to turn its knob counterclockwise to obtain the highest meter indication. This indicates maximum sensitivity.

( ) Adjust the SENSITIVITY control for a maximum indication on the meter.

( ) Connect the frequency counter to the OUTPUT connection of the Frequency Scaler. Set the frequency counter for 1 to 100 ms gate time or 1 kHz, whichever is appropriate for your counter.

This Note and step only apply if the Scaler is connected to a dc coupled counter.

NOTE: The Frequency Scaler should be adjusted to the counter with which it is to be used. Connecting the Scaler to another dc coupled counter having different input characteristics may require readjustment of the ZERO ADJUST control.

The ZERO ADJUST control, when turned, will cause the frequency counter to start and then stop counting. Observe the small portion of the control's range where this occurs as you adjust the control in the next step. The final setting of the ZERO ADJUST control should be in the center of this small range. Note that the reading on the frequency counter will be unstable.

( ) Set the ZERO ADJUST control as just described.

The adjustment of the BANDWIDTH ADJUST is to provide maximum sensitivity of the Scaler.

( ) Turn the BANDWIDTH ADJUST clockwise until the counter just stops counting. You should now have a minimum indication on the meter of the Frequency Scaler. See the inset drawing in Figure 2.

( ) Rotate the SENSITIVITY control back-and-forth to see if the counter will again start to count. If it does, repeak the SENSITIVITY control, and then readjust the BANDWIDTH ADJUST until the counter stops counting.

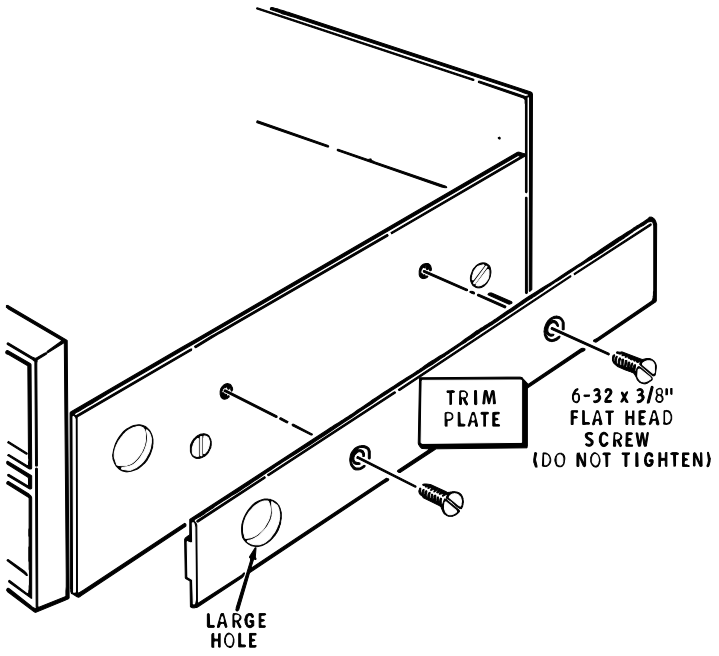
( ) Repeat the above step as many times as necessary. When further adjustment of the SENSITIVITY control will no longer start the counter counting, the adjustment is completed. Do not turn the BANDWIDTH ADJUST any further clockwise than necessary. Otherwise input sensitivity will be lost.

( ) If available, connect a signal source (between 2 MHz and 175 MHz) to the INPUT of the Frequency Scaler. A correct frequency reading should be obtained on the frequency counter.

( ) Depress the divide-by-100 pushbutton. The frequency counter should now read at the new division ratio. A slight peaking of the SENSITIVITY control may be necessary.

This completes the Adjustments. Disconnect all the equipment and the line cord from the Frequency Scaler. Then proceed to "Final Assembly."

FINAL ASSEMBLY

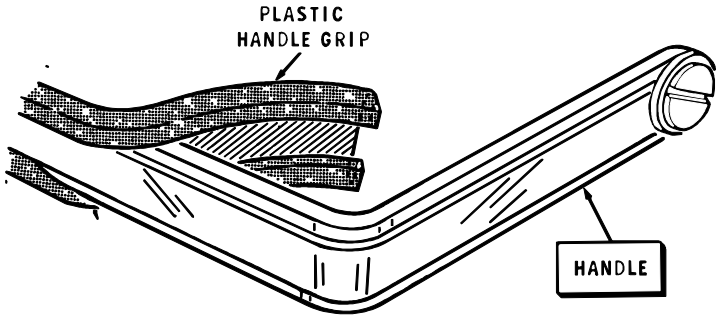


Detail 15A

Refer to Pictorial 15 (fold-out from Page 27) for the following steps.

( ) Refer to Detail 15A and loosely mount a trim plate on each side of the main chassis with 6-32 x 3/8" flat head screws. Align the large hole in each trim plate with the large hole in the main chassis.

( ) Refer to Detail 15B and install the handle grip on the handle.



Detail 15B

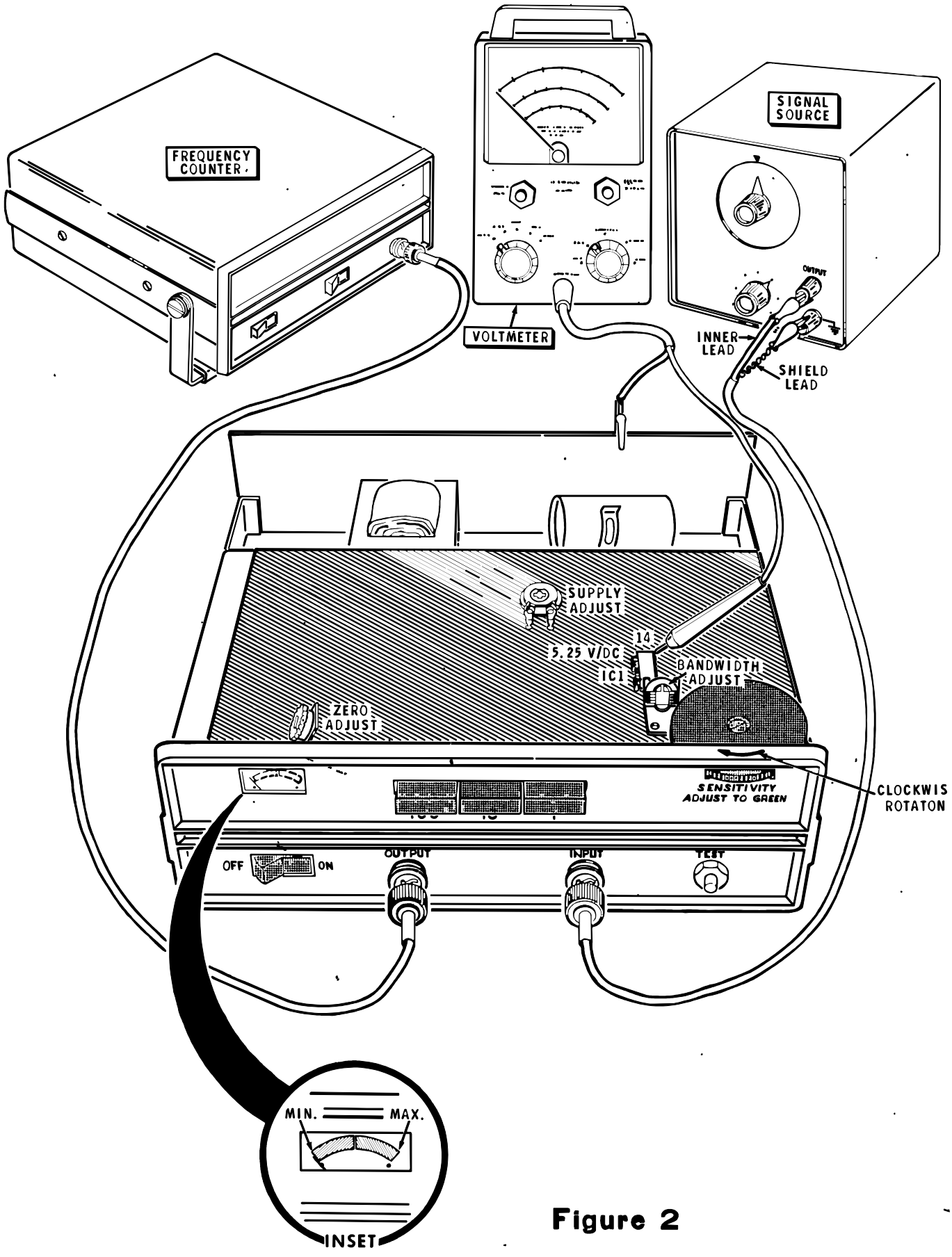
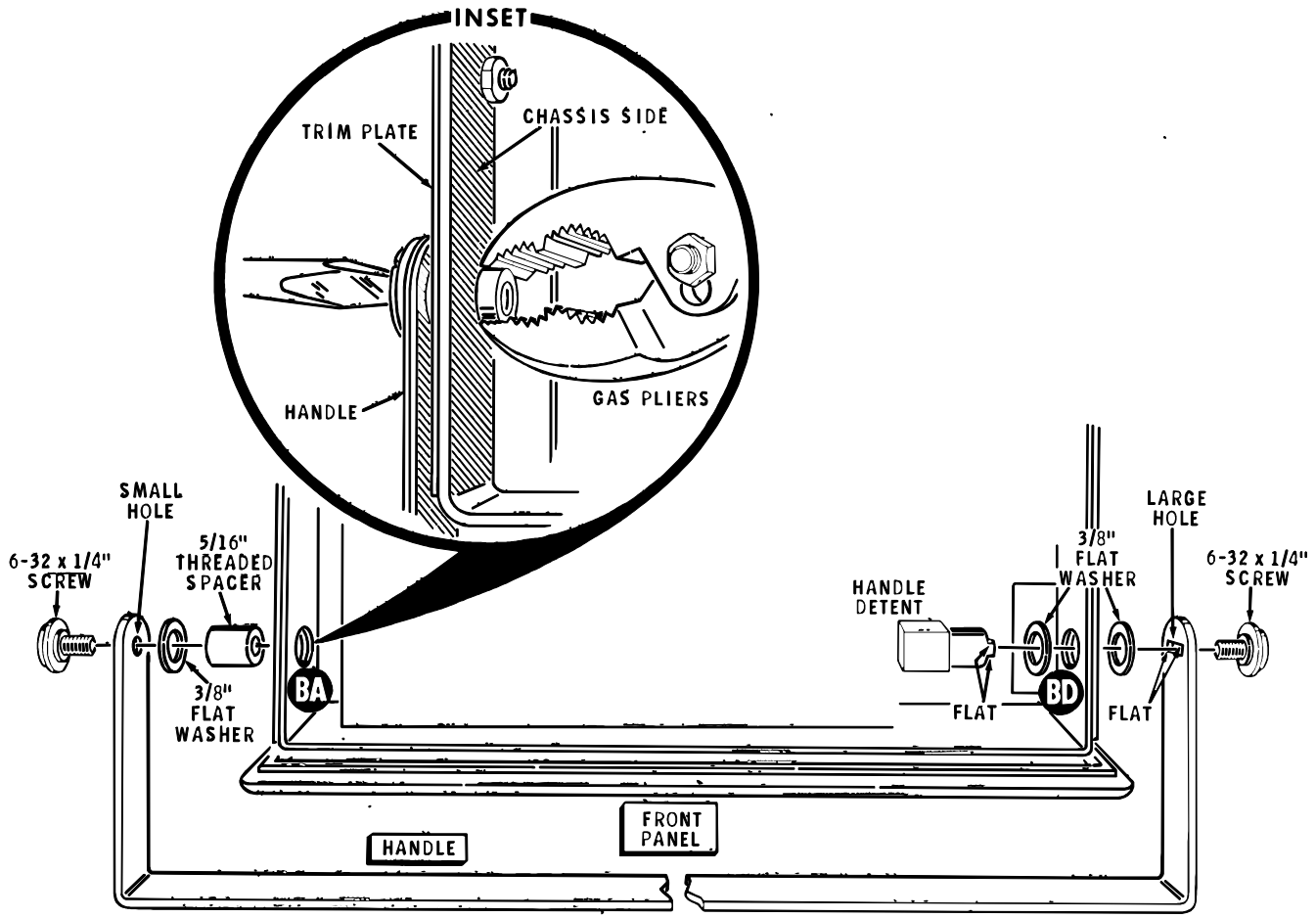


Figure 2



Detail 15C

Refer to Detail 15C for the following steps.

( ) Position the handle so the end with the round hole is aligned with hole BA in the trim plate and the chassis side.

( ) At BA, install the 6-32 threaded spacer with a 3/8" flat washer and a 6-32 x 1/4" screw. See the inset drawing in Detail 15C. Use gas pliers to keep the threaded spacer from turning.

( ) Install the handle detent at BD with two 3/8" flat washers and a 6-32 x 1/4" screw. Be sure the flat on the handle detent is aligned with the slotted hole in the handle. NOTE: One of the flat washers must be positioned between the inside of the chassis and the flat spring before the handle detent can be inserted into hole BD.

Refer to Pictorial 15 for the following steps.

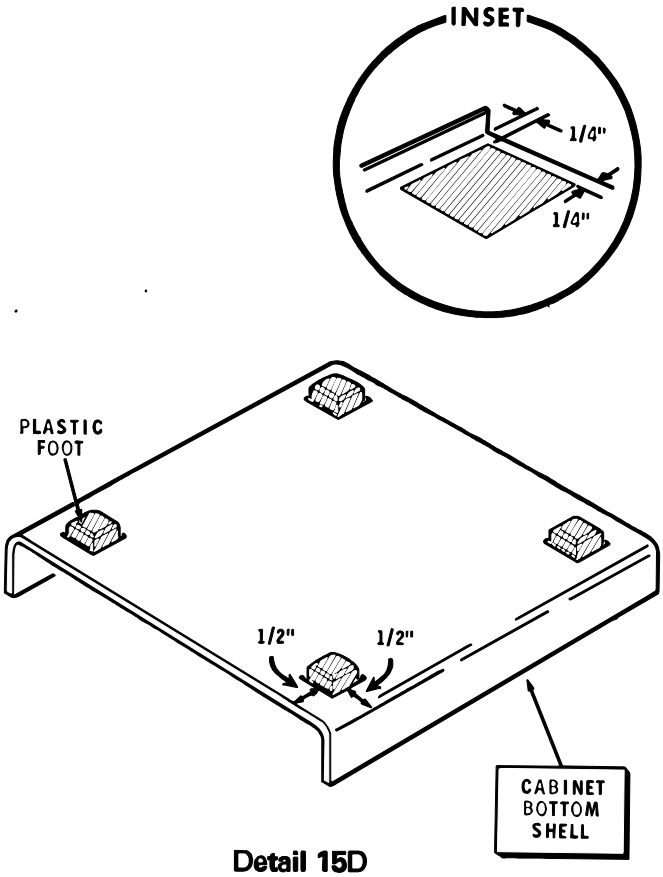
( ) Refer to Detail 15D, remove the protective backing from the four feet, and install them on either cabinet shell. This is now the cabinet bottom shell.

( ) Remove the protective backing from the fish paper insulator. Press this insulator in place on the inside of the cabinet bottom shell according to the dimensions in the inset drawing in Detail 15D.

( ) Position the chassis onto the bottom cabinet shell, and position the other cabinet shell onto the top of the chassis. Be sure the fish paper insulator is positioned under the power transformer. The side edges of each cabinet shell must fit between the chassis and trim plates.

( ) Tighten the screws in both trim plates to hold the cabinet shells in place.

NOTE: The blue and white label that will be installed in the next step, shows the model number and production series

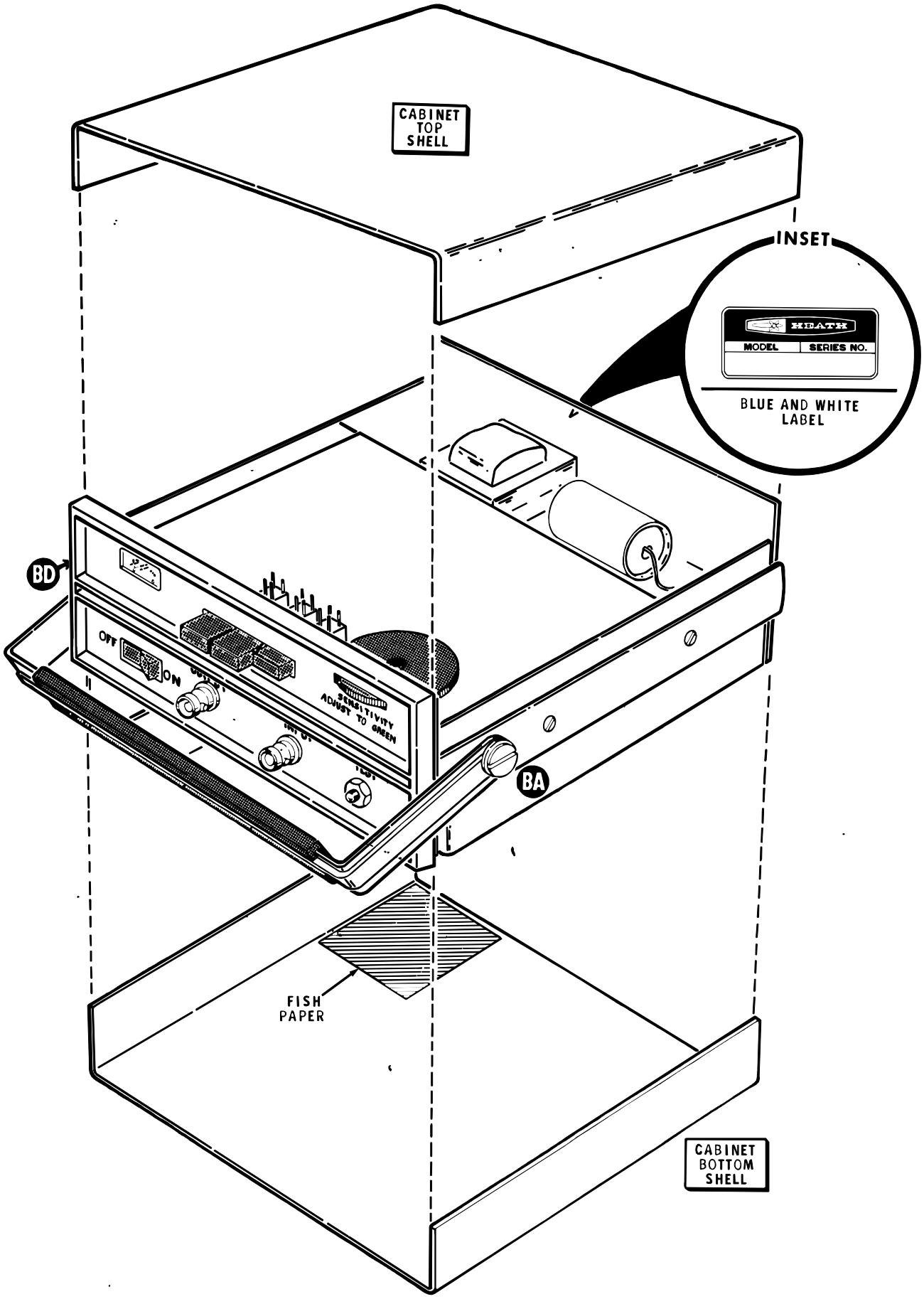


Detail 15D

number of your kit. Refer to these numbers in any communications with the Heath Company. This assures you that you will receive the most complete and up-to-date information in return.

( ) Carefully peel the backing paper from the blue and white identification label. Press the label onto the rear panel as shown in the inset drawing on Pictorial 15.

This completes the Final Assembly. Proceed to the "Operation" section on Page 28.



PICTORIAL 15

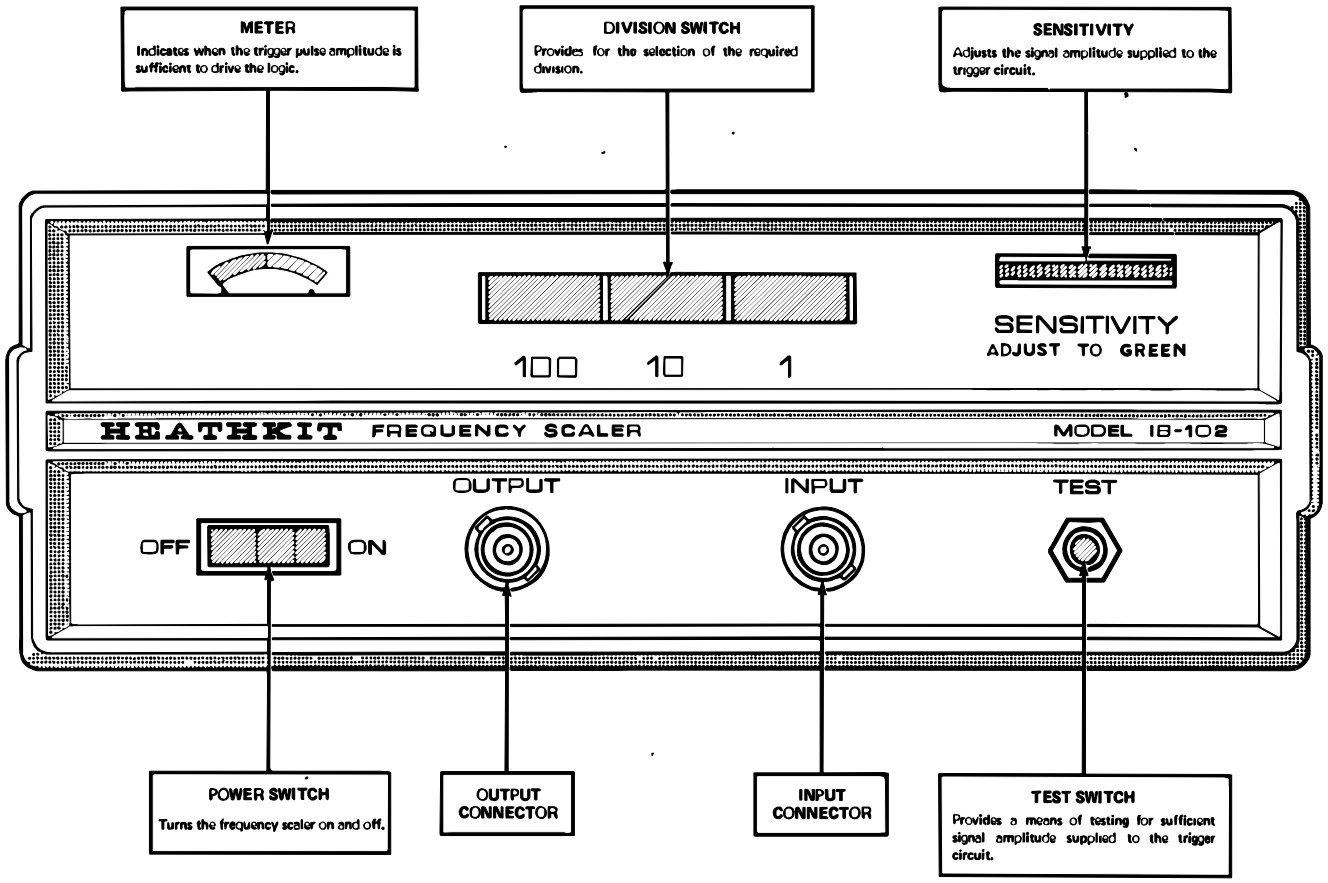


Figure 4

OPERATION

Figure 4 gives a brief description of each front panel function.

DIVISION RATIO

This Frequency Scaler can be used to divide by any one of three ratios: 1, 10, or 100. The ratio that you use will depend on the capability of the counter being used with the Frequency Scaler. Use the divide-by-1 pushbutton to read any frequency that falls within the range of the counter itself.

As an example, if the counter being used has a 2 MHz maximum input frequency limit and the frequency to be measured is 14,000 kHz, the Frequency Scaler can be operated in either of the following ways:

1. Divide by 100. This would result in an indication of 140 kHz on the counter (reading in kHz). 14 MHz ÷ 100 = .14 MHz or 140 kHz.

2. Divide by 10. The counter would then indicate 1400 kHz (still within the range of the counter). 14 MHz ÷ 10 = 1.4 MHz or 1400 kHz.

If, however, the input signal to the Scaler were 22 MHz, only the divide by 100 could be used. Otherwise the signal would be beyond the capability of the counter. 22 ÷ 10 = 2.2 MHz or 22 ÷ 100 = .22 MHz.

SIGNAL LEVEL

The SENSITIVITY control should be adjusted for a peak indication on the meter, with the meter pointer in its green area, to assure proper results. Even on very low input levels, a careful adjustment of the SENSITIVITY control will allow accurate measurements.

If a coaxial cable or other transmission line is used between the Frequency Scaler and the Frequency Counter, it is possible that the Counter will read two or more times the correct frequency if the cable is not terminated in its characteristic impedance – that is, 50 Ω, 75 Ω, 93 Ω, 300 Ω, etc.

To be sure of operation on each frequency scale, hold the TEST switch in and adjust the SENSITIVITY control until you obtain a stable reading on the meter. If you cannot obtain a stable reading, the amplitude of the input signal is too low. This will show up on the meter as a reading between the red and green locations or lower into the red area.

When the input level is high enough to properly trigger the circuit, the reading on the counter will not be affected when you press the TEST switch or slightly change the setting of the SENSITIVITY control. If the reading on the counter is affected by either of these actions, readjust the SENSITIVITY control for a higher peak on the meter.

NOTE: If the Frequency Scaler is adjusted to be used with one particular counter, and then used with a different counter, it may be necessary to repeat the "Adjustments" to obtain proper operation due to different input characteristics of some counters.

IN CASE OF DIFFICULTY

This section of the Manual is divided into five parts. "Visual Tests," "Precautions for Troubleshooting," "Power Supply and Meter Tests," "Logic Circuit Tests," and "Checking Transistors." Begin your search for any trouble that occurs after assembly by carefully following the checks listed in the "Visual Test" section.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide." Refer also to "Customer Service" information on the inside rear cover of this manual if it becomes necessary to return your kit for factory repair.

Refer to the "Circuit Board X-Ray View" on Page 47 and the "Chassis Photos" on Page 44 for the physical location of parts on the circuit board and chassis.

VISUAL TESTS

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the "Soldering" section of the "Kit Builders Guide."

3. Check to be sure all transistors are in their proper locations. Make sure each lead is connected to the proper point.

4. Check to be sure that all of the IC pins are properly installed in their connectors and not bent out or under the IC. Also be sure the IC's are installed in their correct positions.

5. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial diagrams. It would be easy, for example, to install a 10 Ω (brown-black-black) resistor where a 100 Ω (brown-black-brown) resistor should have been installed.

6. Check each electrolytic and tantalum capacitor to make sure the positive-marked end is positioned properly. Check each diode to be sure the banded end is positioned properly.

7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

8. A review of the Circuit Description may also help you determine where the trouble is.

If the trouble is still not located after the visual tests are completed, and a voltmeter is available, check voltage readings against those shown on the "Voltage Chart" (on Page 46). Read the "Precautions for Troubleshooting" before making any measurements. NOTE: All voltage readings were taken with a high impedance voltmeter. Voltages may vary as much as ±20%.

PRECAUTIONS FOR TROUBLESHOOTING

1. Be cautious when testing IC and transistor circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than tubes.

2. Be sure you do not short any terminals to ground when making voltage measurements. If the probe should slip, for example, and short out a bias or supply point, it is very likely to cause damage to one or more IC's, transistors, or diodes.

Power Supply and Meter Tests

The following chart lists some conditions and possible causes of malfunctions in the power transformer wiring, the circuits of the power supplies, and the meter. If a particular part or parts are mentioned (transistor Q5 or resistor R23, for example) as a possible cause, check these parts to be sure they are correctly installed or wired correctly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

TROUBLESHOOTING CHART #1

CONDITION	POSSIBLE CAUSE
A. Pilot lamp does not light.	1. Line cord not plugged in. 2. Fuse. 3. Pilot lamp. 4. Transistor Q6 or Q7. 5. Diodes D7, D8, ZD1, or ZD2. 6. Resistor R22 or R23. 7. Capacitors C21, C22, or C23.
B. No +5 voltage source.	1. See condition A, causes 4, 5, 6, and 7.
C. The +5 voltage source too high or too low.	1. Zener diode ZD1 or ZD2.
D No -5 voltage source.	1. See condition A, causes 4, 5, 6, and 7.
E. The -5 voltage source too high or too low.	1. Zener diode ZD1 or ZD2.
F. No +5.2 voltage source	1. Diodes D3, D4, D5, and D6. 2. Transistors Q4, Q5, and associated parts. 3. IC8 and associated parts.
G. The +5.2 voltage source too high or too low.	1. Improper setting of Supply Adjust control R31. 2. Zener diode ZD3.
H. Meter does not deflect.	1. Shielded cable from holes Y and X to holes T and U. 2. Diode D1 or D2. 3. Resistors R9. 4. Capacitors C9, C11, or C12. 5. Meter. 6. Insufficient input signal.

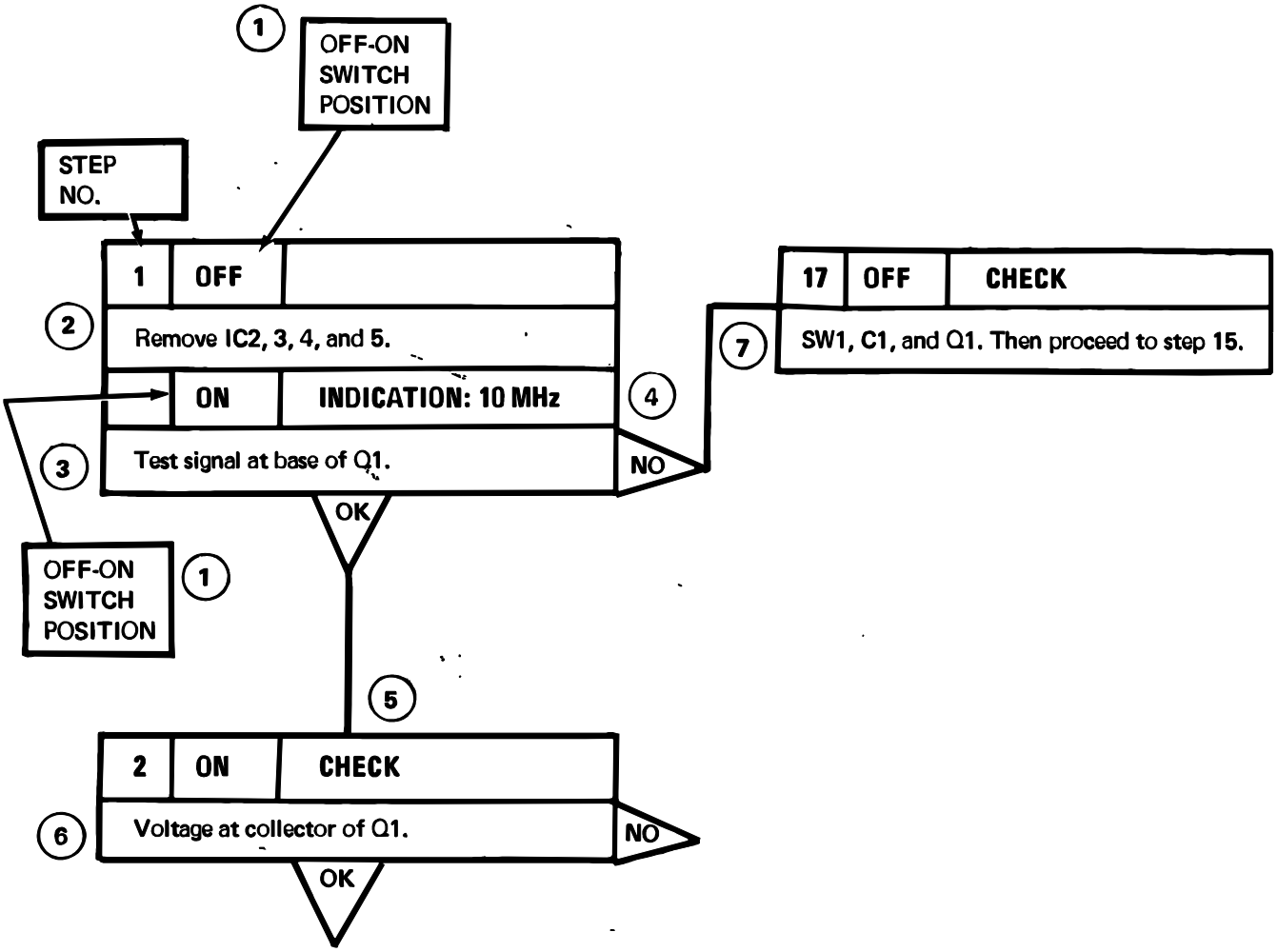
Logic Circuit Tests

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.

START

1	OFF		
Remove IC2, IC3, IC4, and IC5.			
	ON	INDICATION: 10 MHz	
Feed 10 MHz signal to INPUT connector. Depress divide-by-10 pushbutton. Test signal at base of Q1.			

NO → 17 OFF CHECK | | SW1, C1, and Q1. Then proceed to step 15.

OK

2	ON	INDICATION: 10 MHz	
Test signal at collector of Q1.			

NO → 18 OFF CHECK | | Q1. Then proceed to step 15.

OK

3	ON	INDICATION: 10 MHz	
Test signal at pin 6 of IC1.			

NO → 19 ON CHECK | | Voltages at IC1. If wrong, replace IC1. Then proceed to step 15.

OK

4	OFF		
Reinstall IC2.			
	ON	INDICATION: 5 MHz	
Test signal at pin 3 of IC2.			

NO → 20 ON CHECK | | Voltages at IC2. If wrong, replace IC2. Then proceed to step 15.

OK

5	OFF		
Reinstall IC3.			
	ON	INDICATION: 2.5 MHz	
Test signal at pin 1 of IC3.			

NO → 21 ON CHECK | | Voltages at IC3. If wrong, replace IC3. Then proceed to step 15.

OK

6	OFF		
Reinstall IC4.			
	ON	INDICATION: 1.25 MHz	
Test signal at pin 1 of IC4.			

NO → 22 ON CHECK | | Voltages at IC4. If wrong, replace IC4. Then proceed to step 15.

OK

7	OFF		
Remove IC3 and IC4. Reinstall IC5.			
	ON	INDICATION: 2.5 MHz	
Test signal at pin 1 of IC5.			

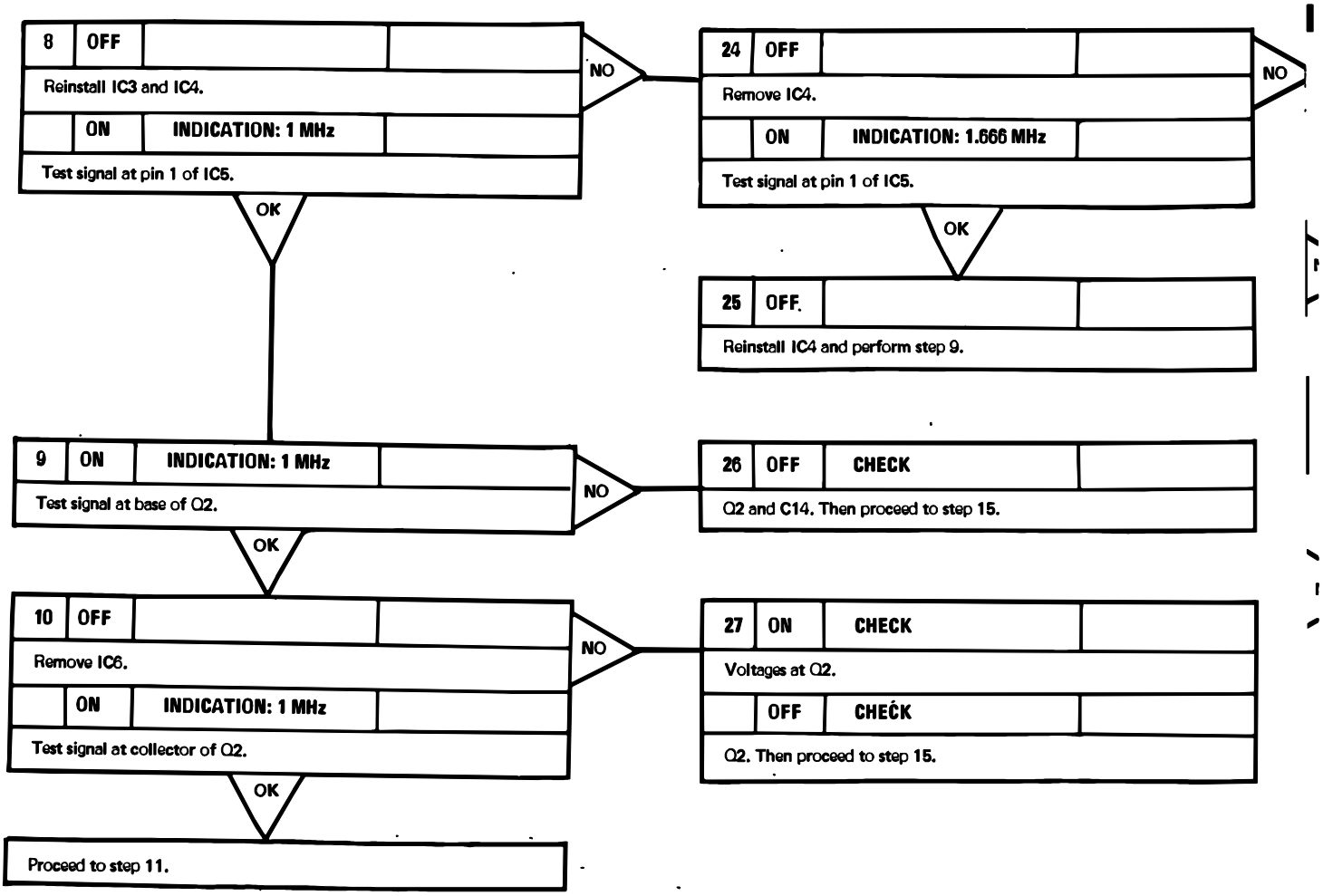
NO → 23 ON CHECK | | Voltages at IC5. If wrong, replace IC5. Then proceed to step 15.

OK

Proceed to step 8.

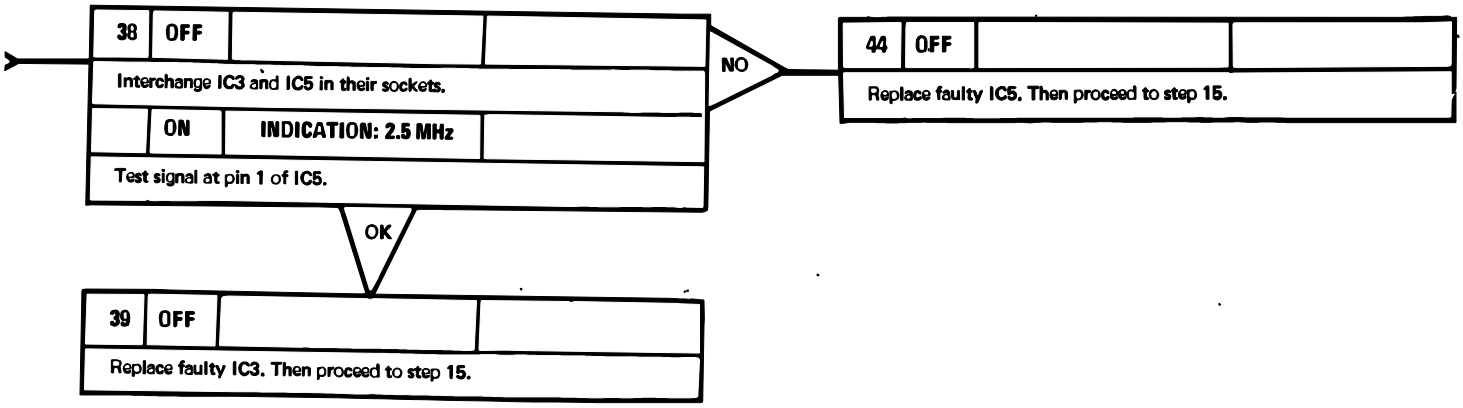
LINE UP WITH PAGE 33b

TROUBLESHOOTING CHART #2



LINE UP WITH PAGE 33a

LINE UP WITH PAGE 34



LINE UP WITH PAGE 33b

TROUBLESHOOTI

11	OFF		
Reinstall IC6 and remove IC7.			
	ON	INDICATION: 1 MHz	
Test signal at pin 13 of IC6.			

NO → 28 OFF
Replace faulty IC6. Then proceed to step 15.

OK

12	ON	INDICATION: 1 MHz	
Test signal at pin 11 of IC6.			

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

OK → 30 OFF
Perform step 28.

OK

13	ON	INDICATION: 1 MHz	
Test signal at pin 6 of IC6.			

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

OK → 32 OFF
Perform step 28.

OK

14	ON	INDICATION: 1 MHz	
Test signal at gate (G) of Q3.			

NO → 33 OFF CHECK
Q3 and C17. Then proceed to step 15.

OK

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

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 ON INDICATION: 500 kHz
Test signal at pin 12 of IC7.

OK → 36 ON INDICATION: 100 kHz
Test signal at pin 11 of IC7.

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

OK

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

OTING CHART #2 (Cont'd.)

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

NO

45	OFF	CHECK	
Jumper wire between pin 3 of SW2 and pin 3 of SV step 15.			

NO

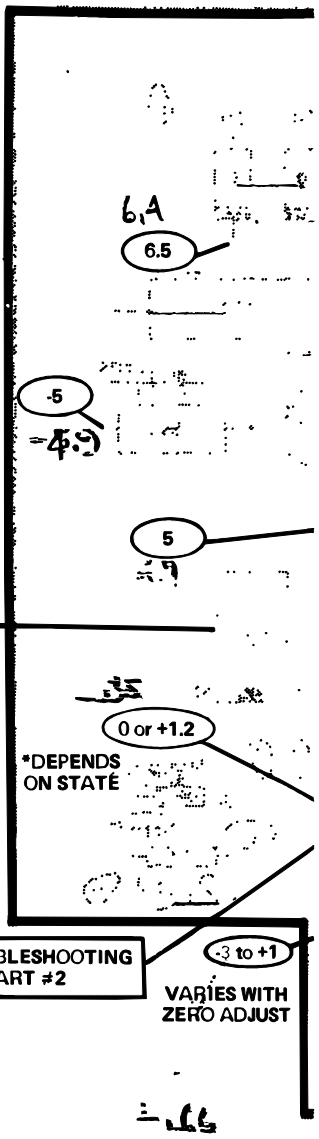
41	ON	CHECK	
Voltage at pin 2 of IC6. Should be 0 V.			

NO

OK

42	OFF		
Perform step 28.			

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



repeat

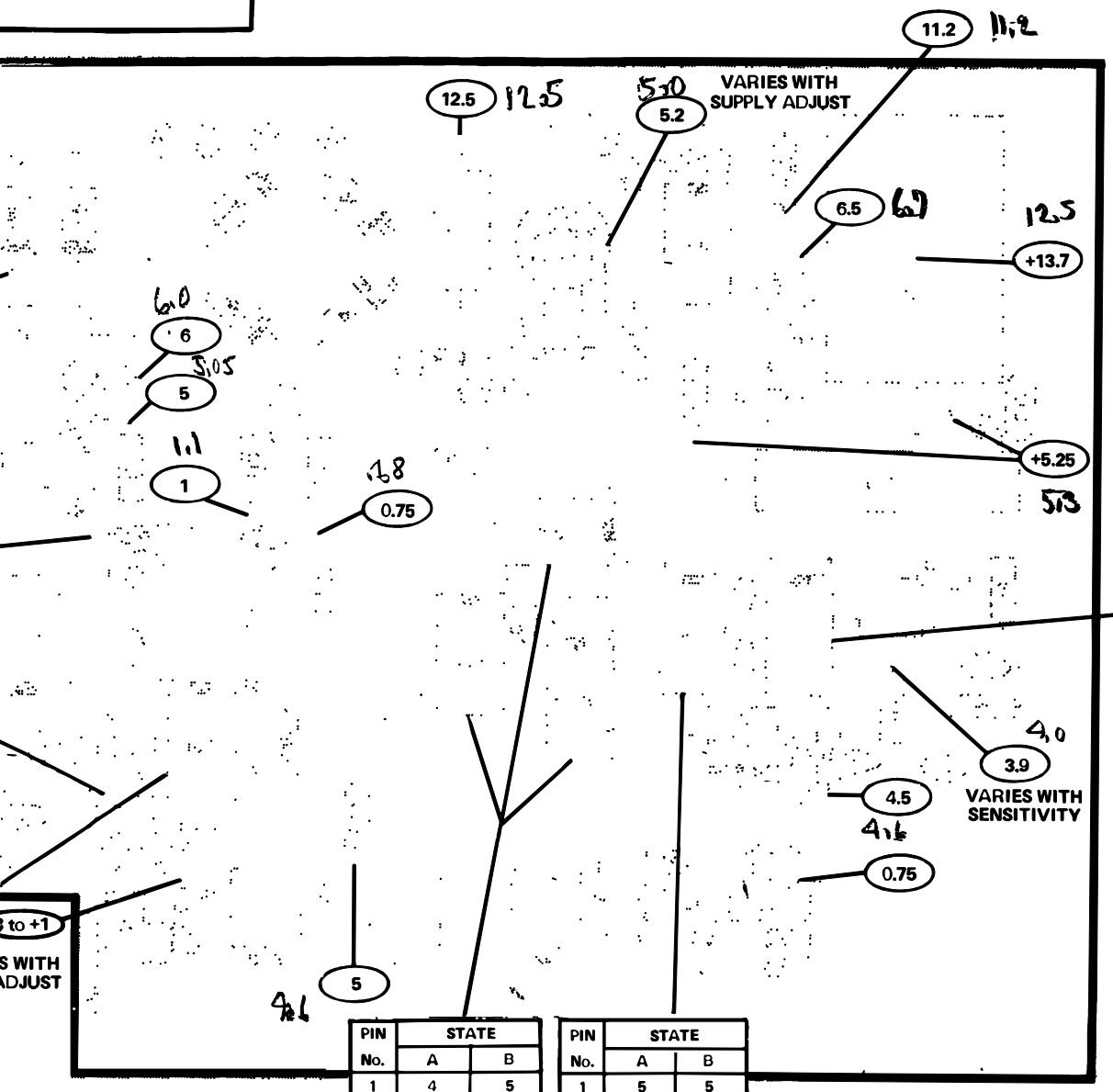
NO

43	OFF		
Replace faulty IC7. Then repeat step 16.			

NO

. Then

d pin 3 of SW3. Then proceed to



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.

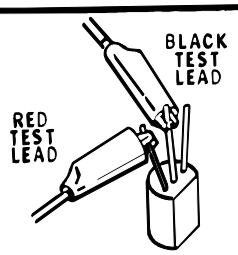
Checking Transistors

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the ohmmeter battery is connected to the positive (red) test lead, and the negative battery terminal is connected to the negative (black) test lead. In some ohmmeters, this wiring is reversed and erroneous readings will be obtained when making the following measurements. Try reversing the ohmmeter test leads if the measurements do not check correctly the first time.

Transistors may be checked as follows:

1. Remove the transistor from the circuit board.
2. Set the ohmmeter range switch to RX1000.
3. Connect the ohmmeter leads to the transistor leads as shown in the example below.

EXAMPLE

Connect the red test lead to one lead as directed in the Checkout Chart.	
Connect the black test lead to another lead, as directed in the Checkout Chart.	

NOTE: The base diagrams are viewed from the bottom of the transistor.

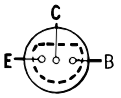
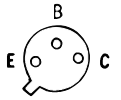
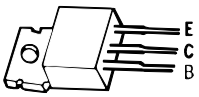
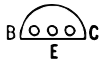
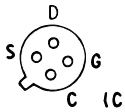
TRANSISTOR	FET
B = BASE	G = GATE
C = COLLECTOR	S = SOURCE
E = EMITTER	D = DRAIN
	C = CASE

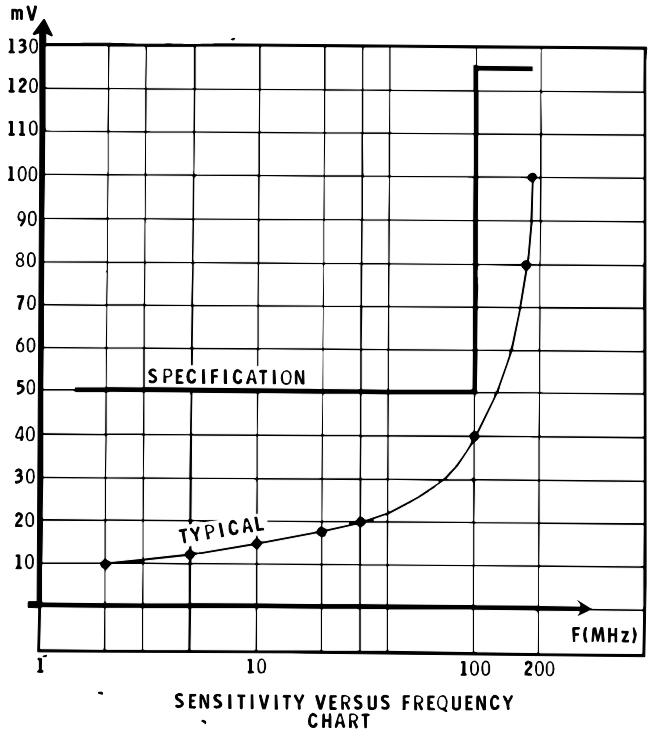
CHECKOUT CHART

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



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.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

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.

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.

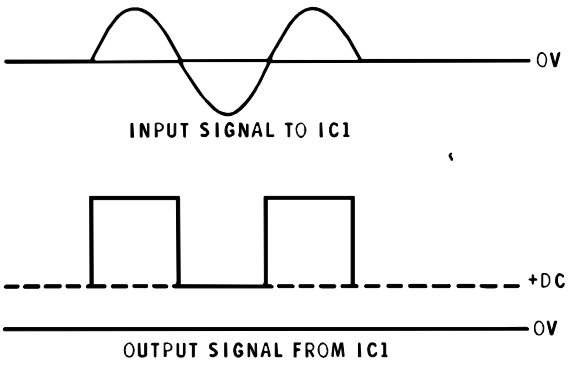


Figure 5

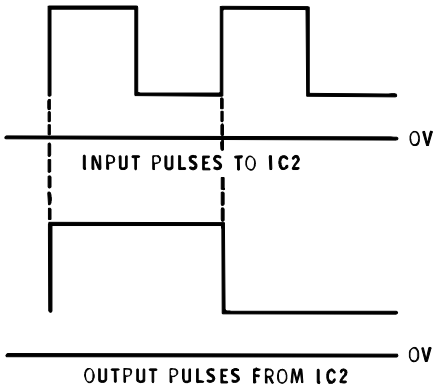
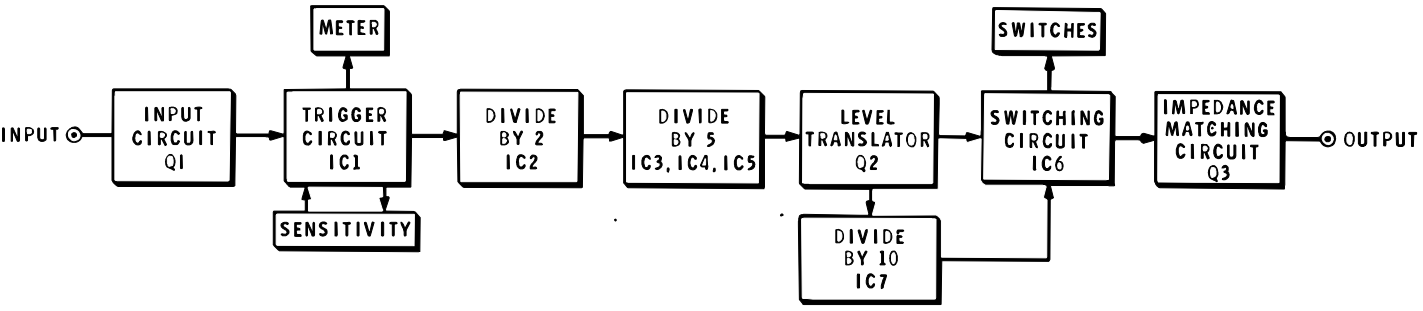


Figure 6



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.

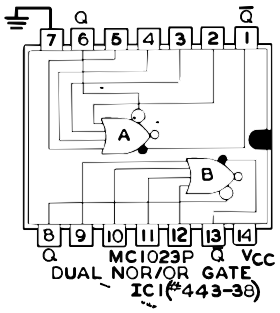
Transistor Q5 acts as a variable resistor to keep the +5.25 voltage constant by continuously comparing it to a reference voltage furnished to Q4 by operational amplifier IC8. IC8 measures any difference between the reference voltage obtained from the wiper of Supply Adjust control R31 and the actual 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.

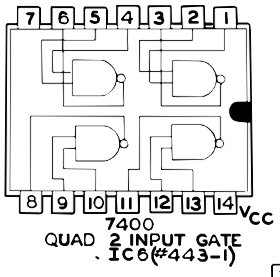
+5-and -5-Volt Power Supply

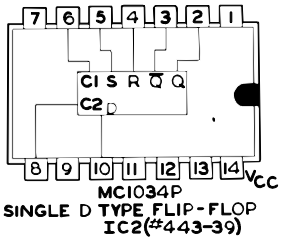
The +5-volt and the -5-volt sources are obtained from a separate power supply to keep them from being affected by stray signals. Stray signals, if carried within the voltage source, could cause the logic circuits to trigger at random and produce errors in the output.

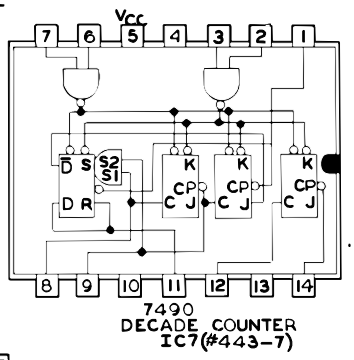
Diodes D7 and D8 form a full-wave rectifier for the +5-volt and the -5-volt regulator. Constant-current amplifier transistors Q6 and Q7 maintain a constant current to zener diodes ZD1 and ZD2, the +5-volt and -5-volt loads. Any increase in dc voltage into the regulator would result in an increase in 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.

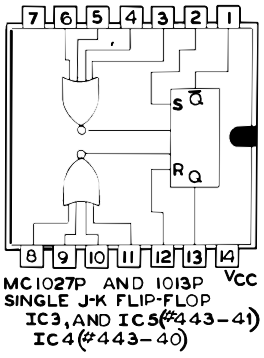
INTEGRATED CIRCUITS

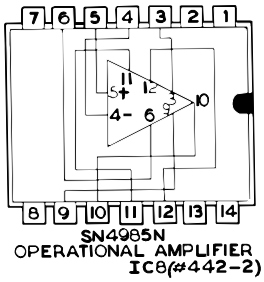




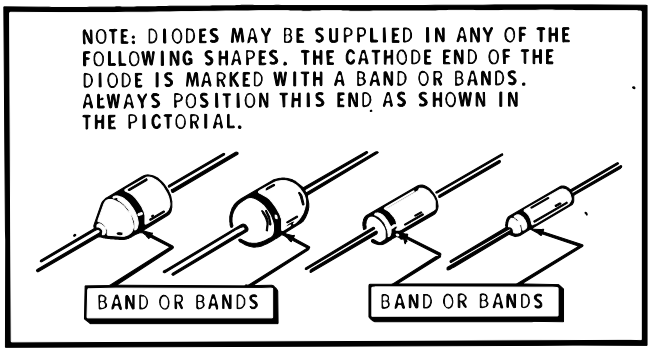
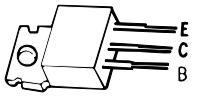
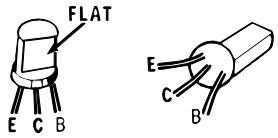
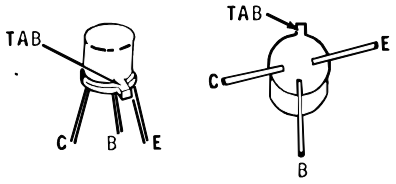
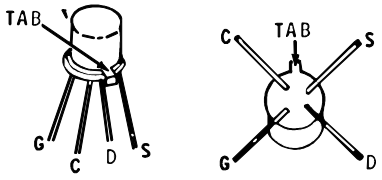
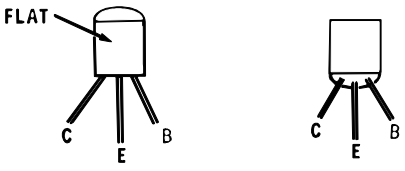




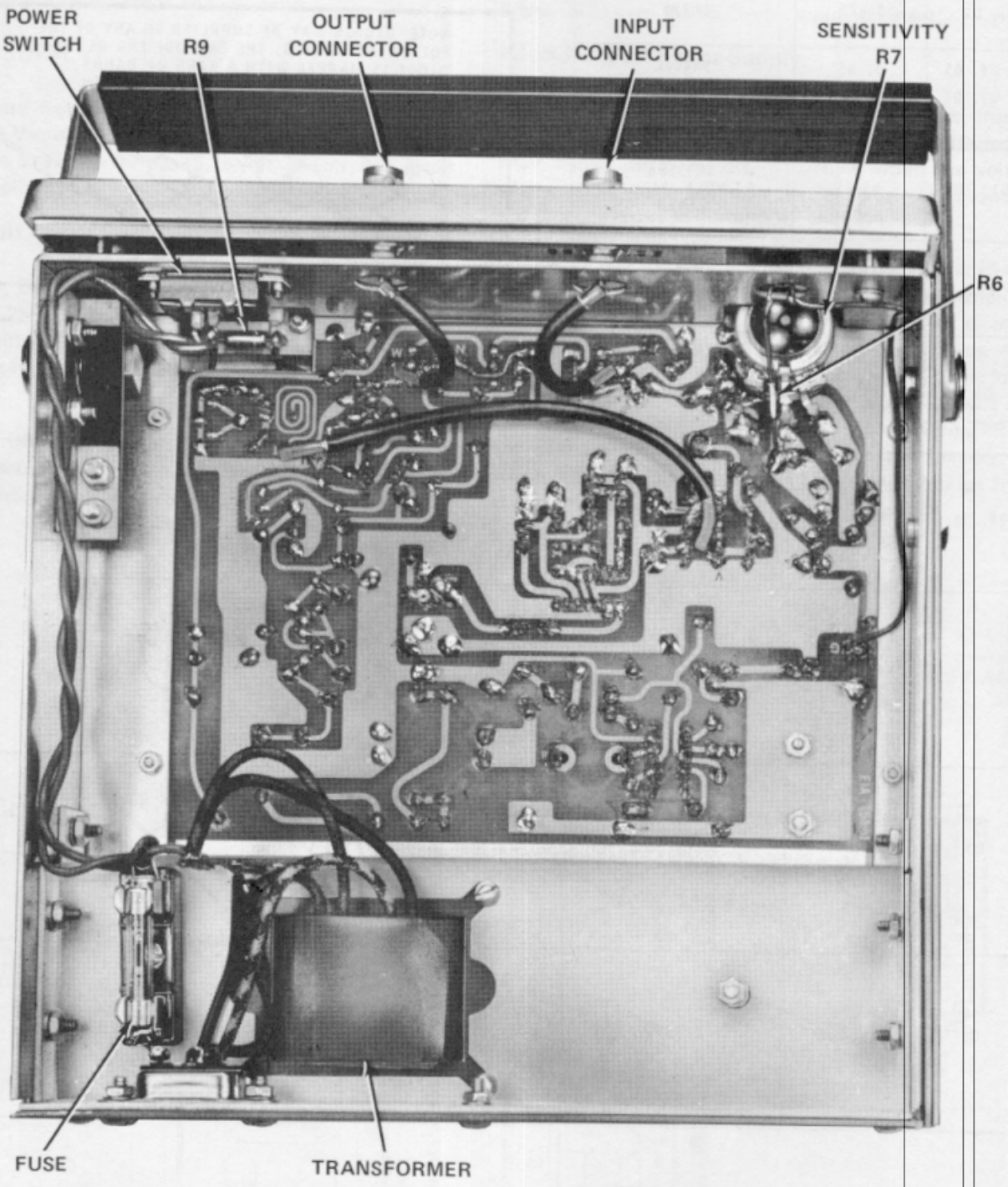


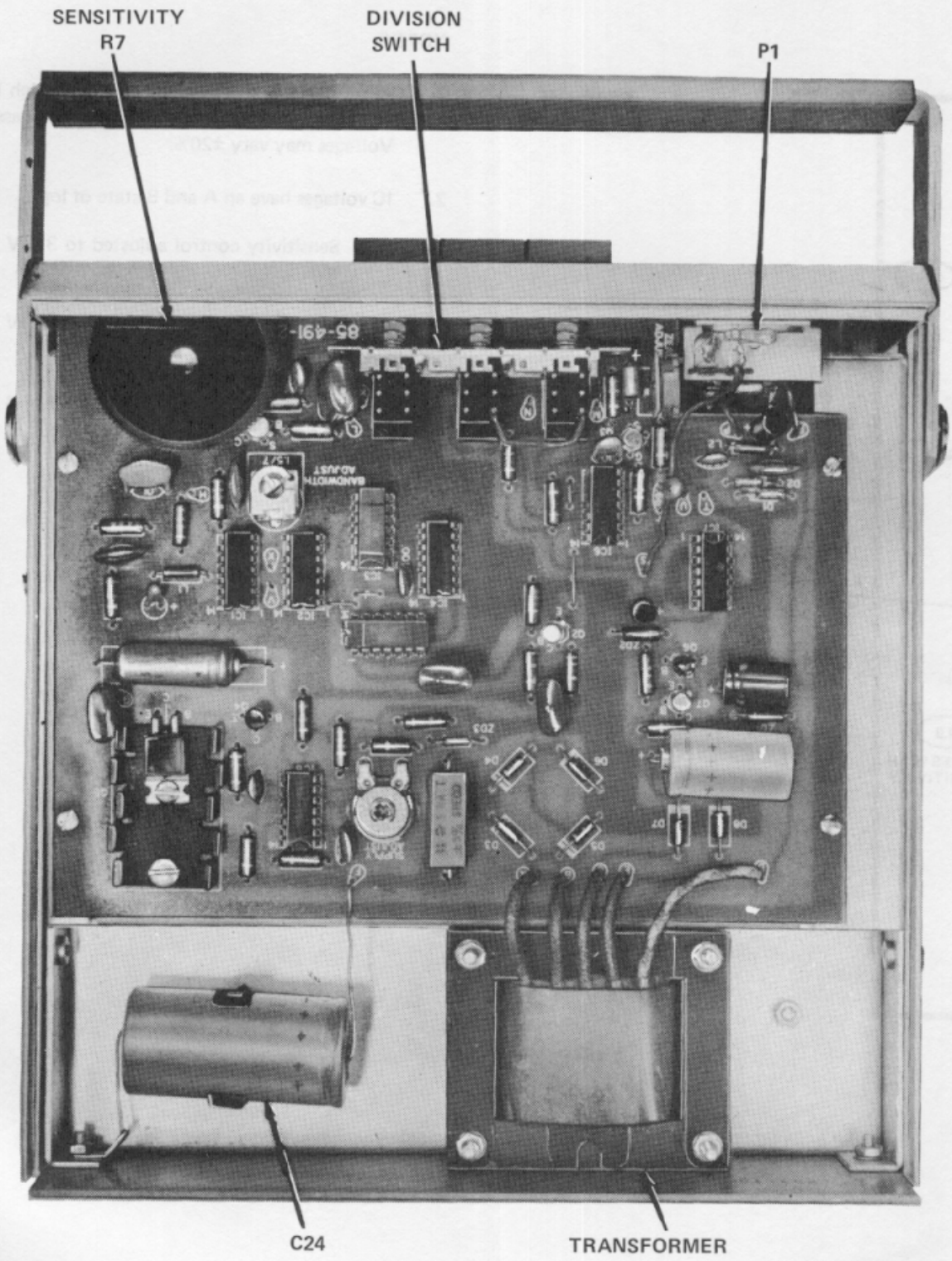


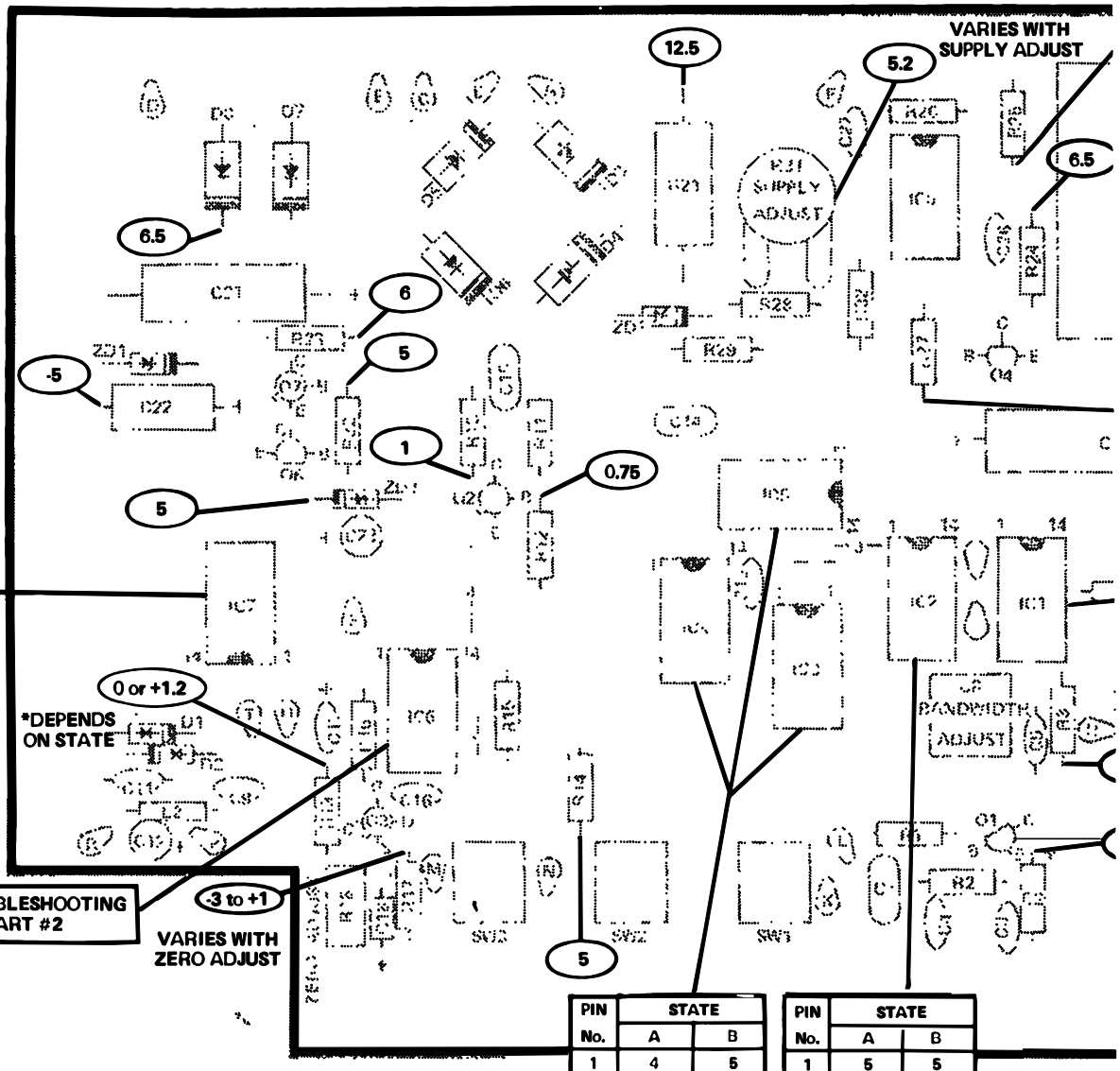
Identification Chart

COMPONENT	HEATH PART NUMBER	MAY BE REPAIRED WITH	IDENTIFICATION DRAWING
D1, D2	56-20	1N295	
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




SENSITIVITY
R7
DIVISION
SWITCH
P1
C24
TRANSFORMER



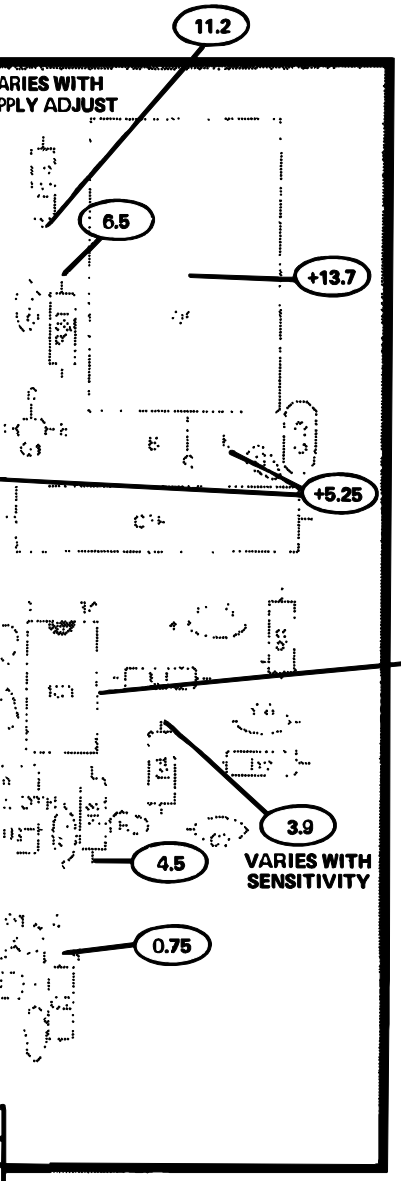
PIN No.	STATE A	STATE B
1	0.4 MAX	0.4 MAX
2	0	0
3	0	0
4	—	—
5	5	5
6	0	0
7	0	0
8	—	—
9	—	—
10	0	0
11	0.4	2.4 to 4
12	2.4 to 4	0.4
13	—	—
14	0.4	2.4 to 4

PIN No.	STATE A	STATE B
1	4	5
2	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	STATE	
No.	A	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.

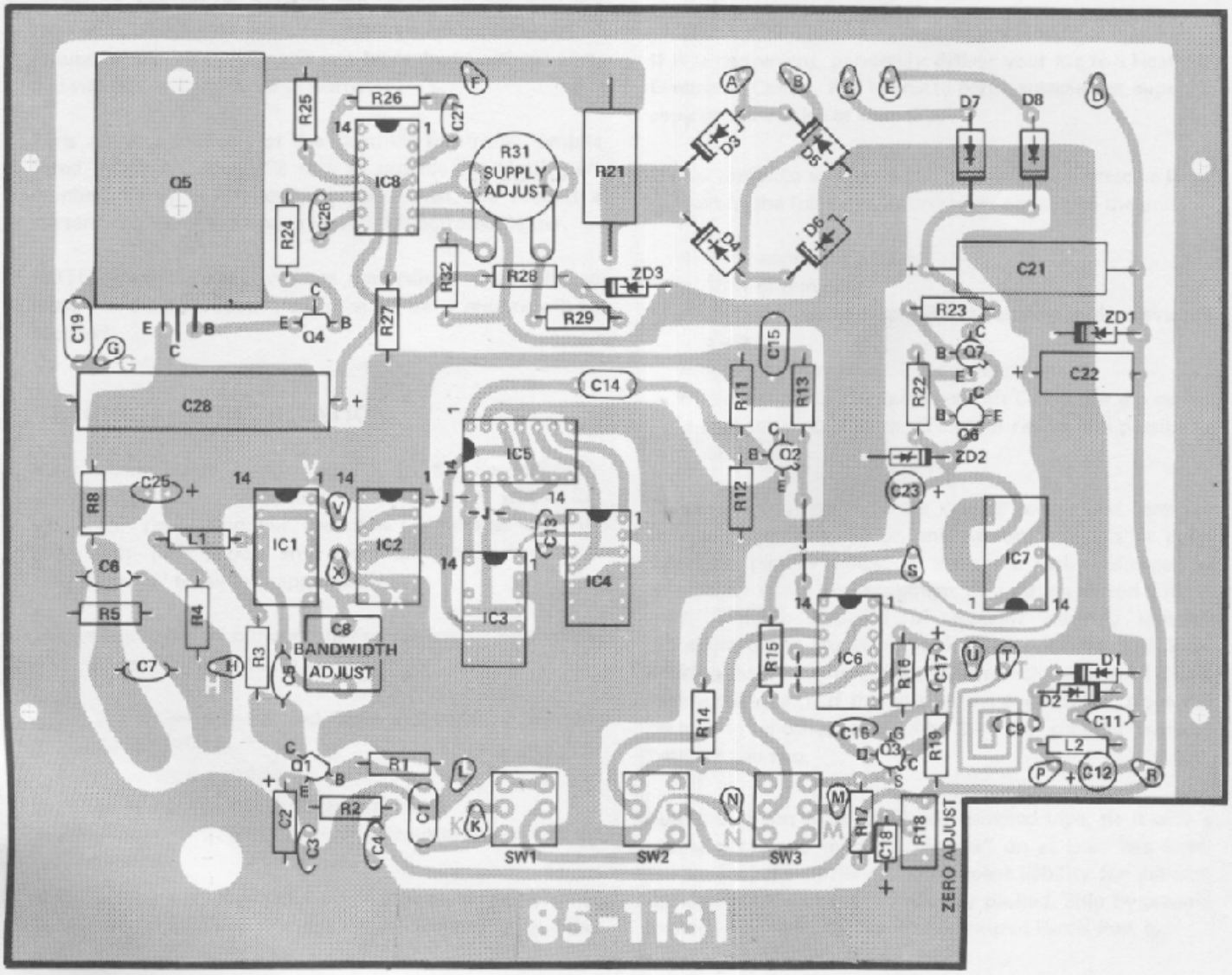
   B. Sensitivity control adjusted to 4.5 V at pin 9 of IC1.

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

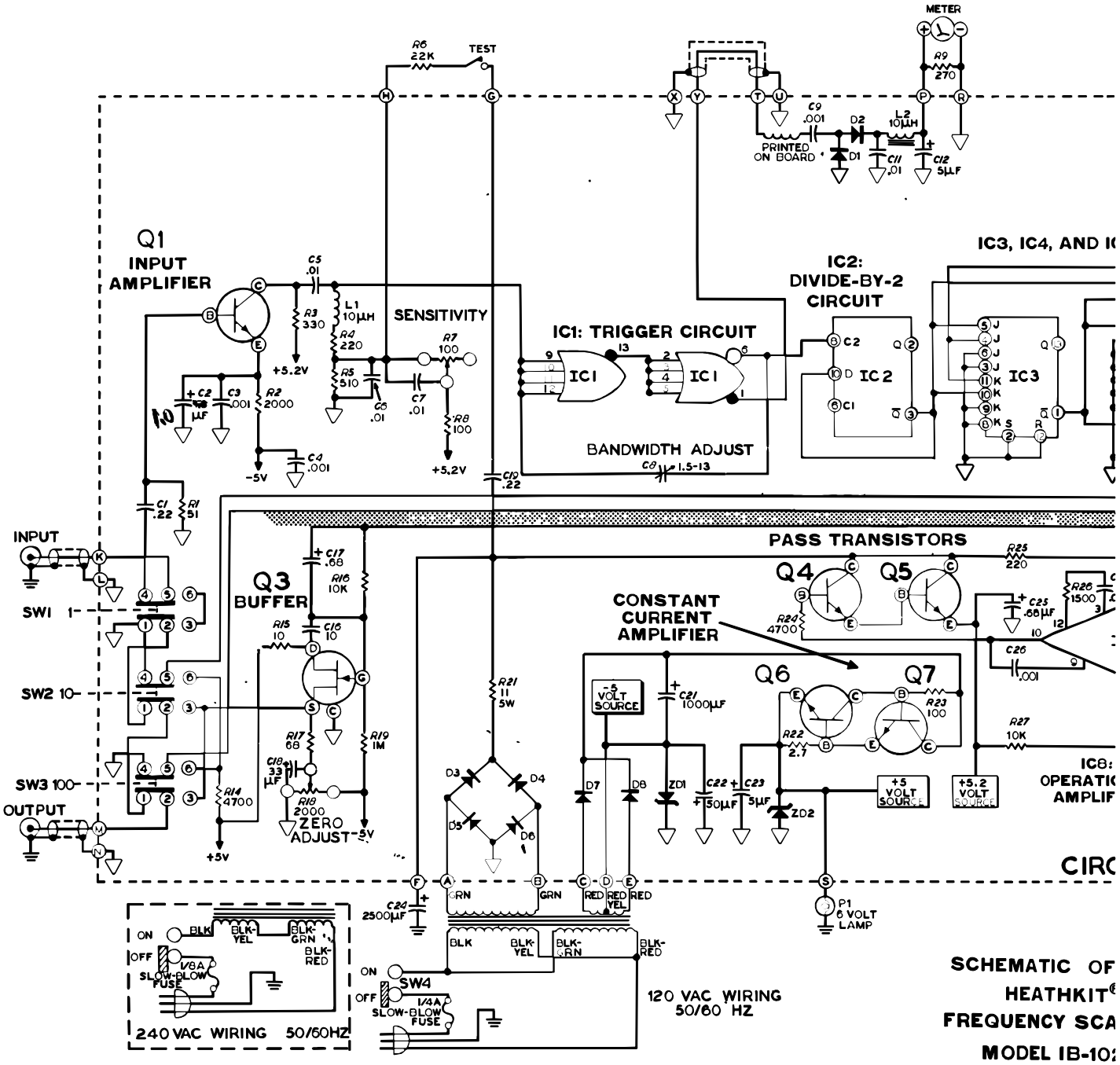
CIRCUIT BOARD X-RAY VIEW

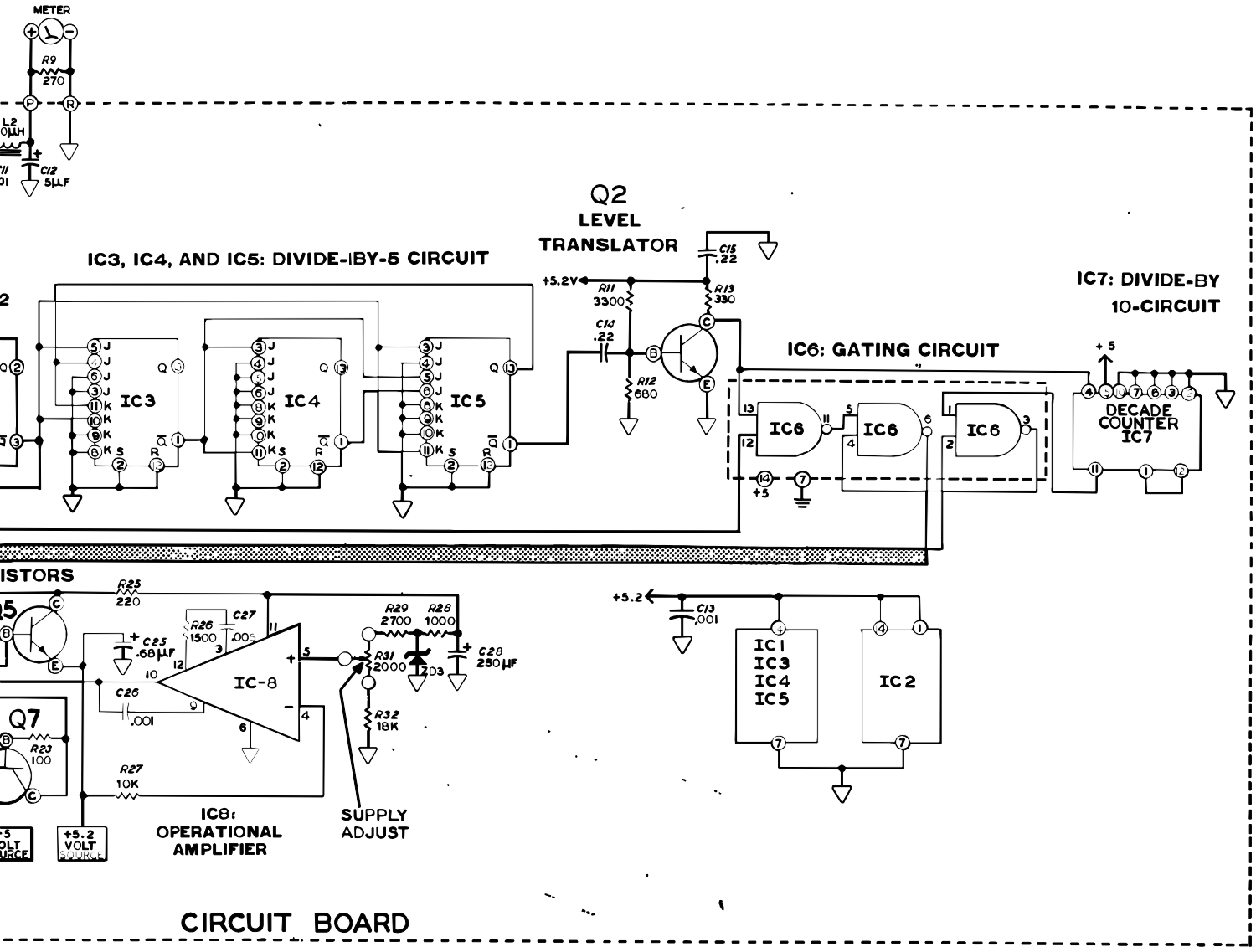
NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed as follows:

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

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.

CUSTOMER SERVICE

REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- **Part number** and **description** as shown in the **Parts List.**
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

Please do not return parts to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

TECHNICAL CONSULTATION

Need help with your kit? . . . . Self-Service? . . . . Construction? . . . . Operation? . . . . Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek. . .please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit C.O.D. for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.