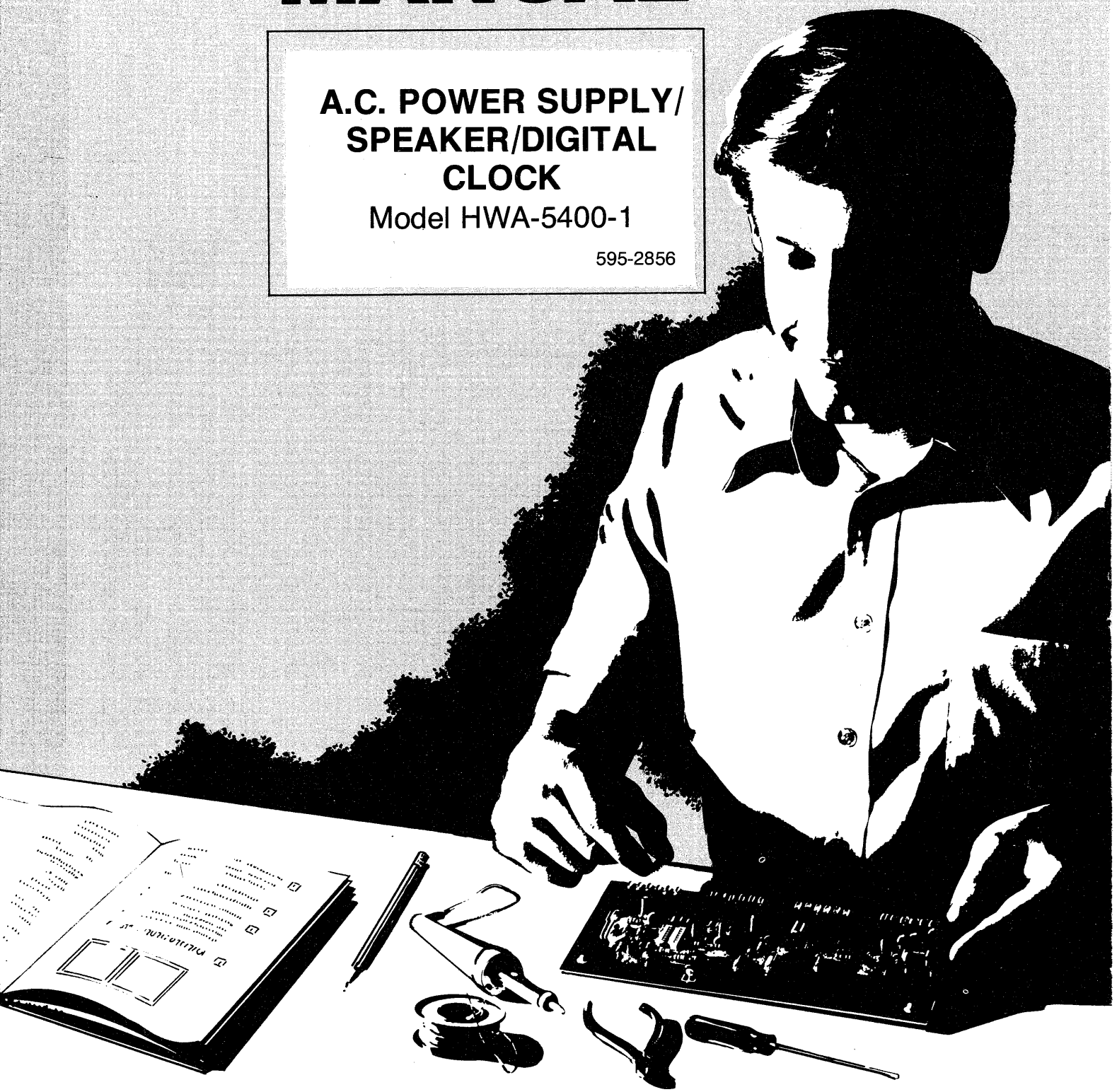
DARWIN KOHN
5-30-85

HEATHKIT® MANUAL

A.C. POWER SUPPLY/ SPEAKER/DIGITAL CLOCK

Model HWA-5400-1

595-2856



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TESTS AND ADJUSTMENTS

During the following tests and adjustments to your kit, if you do not get the desired results, do not proceed with the steps until you have found and corrected any problem. If you are not able to resolve a problem at first, refer to the "In Case of Difficulty" section of this Manual, starting on Page 49.

NOTES:

1. Do not plug your power supply into a power source until you are directed to do so in a step.

2. You will need a high-impedance input volt-ohmmeter to perform the following tests. It will also be helpful if you have two small test leads with alligator clips.

RESISTANCE CHECKS

( ) Connect the ohmmeter ground (common) lead to any convenient point on the bare chassis. Leave this lead connected in this manner until you are directed to remove it in a step.

( ) Set the ohmmeter to the R × 10 range.

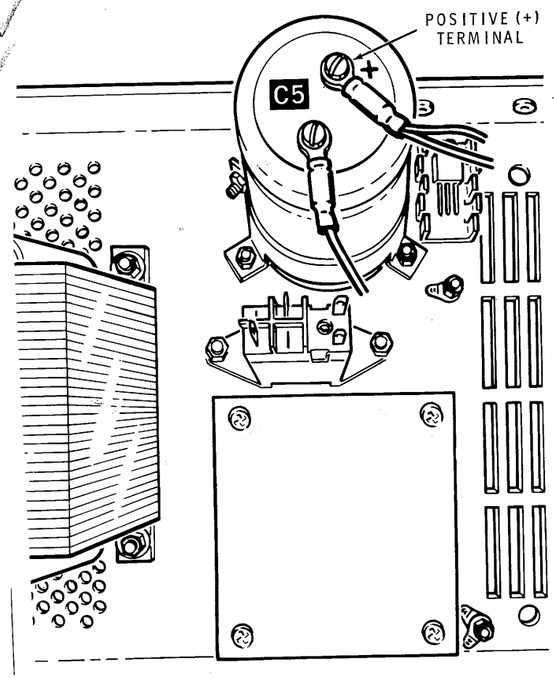
Using the positive ohmmeter probe, check the following points for the indicated reading.

( ) 1. Line cord plug, large round prong — 0 ohms.

( ) 2. Line cord plug, either flat prong (and then the other flat prong) — infinity.

( ) 3. On the end of the flat 4-wire cable, either red wire end — 200 ohms (or greater). NOTE: Allow several seconds for the capacitor to charge.

( ) Measure the positive (+) terminal of capacitor C5 for 200 ohms (or greater). See Pictorial 6-1.



PICTORIAL 6-1

Refer to Pictorials 6-2, 6-3 (Illustration Booklet, Page 13), and 6-4 (Illustration Booklet, Page 14) for the following steps.

CAUTION: Pictorial 6-2 indicates HIGH VOLTAGE AREAS inside the chassis of your power supply. When AC power is applied to your power supply, the voltages in these areas are potentially lethal and could cause severe electrical shock and possible physical damage.

( ) On the display circuit board, set control R204 to the midpoint of its rotation.

( ) On the regulator circuit board, set control R310 to the midpoint of its rotation.

IMPORTANT: In the following steps, do NOT apply power to your kit unless it is resting on an insulated surface. Make sure all the bare wire ends on the rear panel cables are separated, not touching any part of the chassis or in contact with each other.

( ) On the rear panel, remove the 6-wire cable assembly from plug P1.

( ) Plug the line cord into an AC outlet.

( ) Check the clock on the front panel. You should see some indication of time on each of the four digits. The colon should display both upper and lower dots. The left (hours) digit may be blinking.

VOLTAGE CHECKS

( ) Refer to the following chart and, with the positive voltmeter probe, measure the listed test points for the DC voltage indicated. Voltage readings should be within ±20%.

( ) Set your voltmeter to the +15-volt DC range.

TEST POINT	VOLTAGE
P1, pin 1	0 volts
P1, pin 2	+15 volts
P1, pin 3	+5 volts
P1, pins 4, 5, 6	0 volts
Flat 4-wire cable, either red lead	0 volts

( ) Disconnect the line cord from the AC outlet.

( ) Reconnect the cable assembly to rear panel plug P1. Make sure the wires on the end of the cable are kept separated.

REGULATOR ADJUSTMENTS

Refer to Pictorial 6-4 (Illustration Booklet, Page 14) for the following steps.

( ) Connect a jumper wire between the tape-marked shielded cable **shield** lead and the violet 4-wire cable leads, or temporarily tack-solder the lead-ends together.

( ) Temporarily tack-solder the 75-ohm, 5-watt, wire-wound resistor between either black and either red flat 4-wire cable lead.

( ) Temporarily tack-solder the 4-wire cable assembly red lead to either red flat 4-wire cable lead.

( ) Plug the line cord into an AC outlet. The relay should click on, and power transformer T1 may hum for a few seconds.

( ) Using the positive voltmeter probe, measure for +13.8 volts DC on either red **flat** 4-wire cable lead. On the regulator circuit board, adjust control R310 for a voltmeter reading of +13.8 volts.

( ) Unplug the line cord from the AC outlet.

NOTE: In the following step, be careful when you handle the 75-ohm resistor; it may have become very warm during the preceding steps.

( ) Remove the remaining jumper wire or unsolder any temporarily-tacked connection. Remove the 75-ohm wire-wound resistor from the flat-wire cable leads. Be sure to keep all the wire and cable ends separated.

( ) Disconnect the voltmeter leads and set the meter aside.

CLOCK TESTS AND ADJUSTMENTS

Check and set the clock in the following steps.

( ) Plug the line cord into an AC outlet.

( ) With a suitable thin tool, depress and hold FAST SET pushbutton switch SW202. Allow the clock to cycle entirely through the 12-hour or the 24-hour format, depending on the way you wired the display circuit board. Check to make sure all numeral segments come on. When you have completed the cycle, stop.

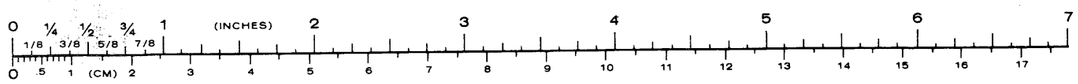
( ) Readjust the clock time to approximately 10 minutes prior to your present time.

( ) Using the same thin tool, depress SLOW SET pushbutton switch SW201 and adjust the clock to display the present time.

( ) Adjust display circuit board control R204 for the desired brightness of the clock digits.

( ) Unplug the line cord from the AC outlet.

This completes the "Tests and Adjustments." Proceed to "Final Assembly."



FINAL ASSEMBLY

Refer to Pictorial 7-1 (Illustration Booklet, Page 15) for the following steps.

( ) Refer to Part A of Detail 7-1A (Illustration Booklet, Page 15) and install a foot on the cabinet bottom at AN with 6-32 × 1/2" hardware and a #6 flat washer.

( ) In the same manner, install another foot on the cabinet bottom at AP.

NOTE: Perform only one of the next two steps. If you wish your Power Supply to rest in a horizontal attitude on your bench, perform the next step. If you wish to have the front of your Power Supply tilted upward slightly, skip the next step and follow the directions in the second step.

( ) In the same manner as in the preceding two steps, install feet on the cabinet bottom at AR and AS. NOTE: You may discard the two 6-32 × 1-1/4" screws and the tapered spacers.

( ) Refer to Part B of Detail 7-1A and place a #6 flat washer on a 6-32 × 1-1/4" screw, followed by a foot and a tapered spacer. Secure the foot and spacer to the cabinet bottom at AR with a #6 lockwasher and a 6-32 nut.

( ) In the same manner, install a foot and a tapered spacer on the cabinet bottom at AS.

( ) Remove the backing from your "Heathkit" label and carefully position the label into the indicated recess on the front panel escutcheon as shown in the Pictorial.

( ) Remove the paper backing from the blue and white label and press the label in place on the inside of the chassis vertical flange as shown in the inset drawing on Pictorial 7-1. NOTE: Be sure to refer to the Model and Series numbers on the blue and white label in any correspondence you have with the Heath Company about your kit.

IMPORTANT: If you are going to use this Power Supply with other than the Heathkit Model HW-5400 Transceiver, read the information under "Other Transceivers" on the next page before you proceed.

( ) Position the chassis assembly of your Power Supply into the cabinet bottom as shown in the Pictorial. Be sure to line up the holes in the side of the cabinet bottom with those in the two rear brackets and those in the front side flanges.

( ) Position the cabinet top down onto the flanges of the cabinet bottom. After you align the side holes, secure the two cabinet components to the chassis at AT, AV, AX, and AY with four 6-32 × 3/8" black screws.

This completes the Step-by-Step Assembly of your Power Supply kit.

INSTALLATION AND OPERATION

NOTE: If you have purchased the HWA-5400-1 Power Supply for use with the Heathkit HW-5400 Transceiver, refer to the [redacted] Manual for that kit and prepare the Power Supply cable ends as directed. Use the parts supplied with the Transceiver to perform those steps. After you have completed the cable preparation, return to this point and continue with the following steps.

OPTION

HW-5400 POWER SUPPLY INSTALLATION

Refer to Pictorial 8-1 (Illustration Booklet, Page 16) for the following steps.

( ) Plug the 4-wire flat cable into the rear of the Transceiver.

( ) Plug the 4-wire cable assembly into the rear of the Transceiver.

( ) Plug the Power Supply into an AC outlet.

( ) With a toothpick or other small flat tool, adjust the clock to the time desired.

NOTE: Your Power Supply is now completely operational and will be turned on and off appropriately by your Transceiver.

IN CASE OF DIFFICULTY

The first part of this section of the Manual, titled "Visual Checks," tells you what to do about any difficulties that occur right after your unit is assembled.

If the "Visual Checks" fail to clear up the problems, or if difficulties occur after your unit has been in use for some time, refer to the "Troubleshooting Chart."

NOTE: Refer to the "Circuit Board X-Ray Views" for the physical location of parts.

VISUAL CHECKS

1. Recheck the wiring. Trace e lead with a colored pencil on the Pictorial as you check it. 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 service do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" instructions on Pages 6 and 18.

3. Closely examine each circuit board foil in a good light to see that no solder bridges exist between adjacent connections. Remove any solder bridges by holding a clean, hot soldering iron tip between the two points that are bridged until the excess solder flows down onto the tip. Compare your foil pattern with the "Circuit Board X-Ray Views."

4. Check to be sure each transistor is in the proper location (correct part number and/or type number). Make sure each transistor lead is connected to the proper point.

5. Check to be sure the correct diode is installed at each diode location. Make sure each diode band is positioned above the diode band printed on the circuit board.

6. Check each capacitor value. Make sure that a capacitor of the correct value is installed at each capacitor location. Check electrolytic capacitors to be sure their positive (+) and negative (−) leads are at the correct positions.

7. Check each resistor value carefully. 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 2200 Ω (red-red-red) resistor where a 220 Ω (red-red-brn) resistor should have been installed.

8. Be sure all the wires and leads connected to the circuit boards have been trimmed as close as possible to the circuit board foils.

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

If you still have not located the trouble after the "Visual Checks" are completed, and if a voltmeter is available, check the voltage readings at the locations indicated on the Schematic Diagram. Read the "Precau-

tions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high-input impedance voltmeter. Regulated voltages should not vary more than 5% from those indicated on the Schematic. Other voltages may vary as much as ± 20%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. The Warranty is located inside the front cover.

PRECAUTIONS FOR TROUBLESHOOTING

WARNING: When power is applied to the kit, the full AC line voltage is present in some areas of your kit (see Pictorial 6-2 on Illustration Booklet, Page 13). Be careful to avoid electrical shock when you perform checks with the power on.

If you have a high-input impedance voltmeter and wish to make voltage measurements, the voltages are shown on the Schematic Diagram. Make sure you observe the following precautions when you make tests with the power on.

1. Be sure you do not short any connections to chassis ground. If the probe should slip, for example, and short out a bias or a voltage supply to ground, it is almost certain to damage one or more transistors and/or diodes.

2. Do not attempt to remove any components from the kit when the power is turned on.

TROUBLESHOOTING CHART

The following chart lists conditions and possible causes of some troubles you might encounter. If a particular part is mentioned (C106 for example) as a possible cause, check that part and other components connected to it to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
Less than 200 Ω reading from line cord flat prong to gnd., or C5 (+) lug to chassis.	1. Solder bridge on AC circuit board. 2. Transistors Q301, Q302 shorted to heat sink, or no insulators installed. 3. Bridge rectifier BR1 incorrectly wired. 4. Solder bridge on regulator circuit board.
Incorrect DC voltages or no indication.	1. Fuses F101, F102 open or not installed. 2. Transformer T1 primary wiring jumpers not installed.
No 15-volts DC, or On/Off function.	1. Capacitor C106. 2. Diodes D101-D104 incorrectly installed.
Memory circuit 0 or 15-volts DC (should be 5.1-volts).	Zener diode D105.
Cannot adjust 13.8 DC output voltage; remains 17-volts DC.	1. 13.8-volt sensor line not connected to DC output. 2. Plug P1 incorrectly wired (check both ends, plugs AND sockets). 3. Diode D303. 4. Transistor Q301.
DC output reads 25-volts; will not adjust.	1. Solder bridge on regulator circuit board. 2. Transistors Q1 and Q303.
DC output at zero.	20-ampere fuse F1.
Clock completely inoperative.	1. Display tube V201. 2. Control R204. 3. Transistor Q201. 4. Wiring to display circuit board. 5. Solder bridge(s) on display board.
Clock numeral or colon segments not illuminated.	Check display tube pin connections (see Page 60) and reheat and solder as necessary.
Clock digits illuminated but produce invalid times (e.g. 18:88), or time not advancing.	1. IC U201. 2. Capacitor C201 3. Solder bridge on U201, pin 35.

SPECIFICATIONS

Line Voltage	120/240 VAC, 50/60 Hz.
Output Voltage	13.8 VDC at rated load.
Protection	DC Output: 20-ampere fuse. AC Primary: 7-ampere slow-blow fuse for 120 VAC primary, 4-ampere slow-blow fuse for 240 VAC primary.
Output Current	As required by the Transceiver up to 18 (20 peak) amperes during transmit.
DC Output Regulation	7% from receiver load to transmit load at 120 VAC primary; 4% additional if the AC changes from 110 to 130 VAC or 220 to 260 VAC.
Ripple	50 mV or less at rated load.
Duty Cycle	18 amperes, 50%, 5 min. ON, 5 min. OFF.
Speaker	4 ohms impedance, 300-3000 Hz frequency response, 2 watts peak power.
Clock	Display: 4-place vacuum-tube fluorescent, 12/24-hour format. Accuracy: Line frequency synchronized.
Size (excluding feet)	8-1/2″ W. × 14″ L. × 4-3/8″ H. (21.6 × 35.6 × 11.1 cm).
Net Weight	26 lbs. (57.3 kg).

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

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (Illustration Booklet, Page 17) as you read the following Circuit Description.

A different number series has been assigned to the circuit components mounted on each of the circuit boards and on the chassis. These series numbers are referred to in various sections of this Manual to help you identify the components and to determine their locations. These component numbers are grouped as follows:

1- 99	Parts mounted on the chassis.
101-199	Parts mounted on the AC circuit board.
201-299	Parts mounted on the display circuit board.
301-399	Parts mounted on the regulator circuit board.

PRIMARY CIRCUITS

When the line cord of your Power Supply is connected to an AC power source, the clock transformer primary circuit is energized. This circuit is on at all times, while another primary circuit is controlled by the On-Off switch of the Transceiver. The primary circuits of both transformers include jumper-wiring to accommodate either 120- or 240-VAC and 50/60 Hz power inputs.

SECONDARY CIRCUITS

AC power to transformer T101 is routed through fuse F101. This circuit is on at all times to provide the necessary power for the On-Off, Memory, and Clock circuits. From the secondary of T101, the voltage is routed across a full-wave bridge rectifier consisting of diodes D101 through D104. From the rectifier, the voltage is filtered by capacitors C105 and C106. The voltage is applied to the clock circuits on the display circuit board, to On-Off relay K1, and to the memory circuits in the Transceiver, when connected. Coil L101, capacitor C107, resistor R103, and zener diode D105 provide additional filtering for the memory circuit 5.1-volt supply.

When the Transceiver is turned on, a grounding path for relay K1 is provided directly from interconnecting cable connector P1 pins 1 and 2. K1 then energizes and closes its contacts to provide an AC path to the primary winding of transformer T1 through fuse F102. Also in the primary circuit of the transformer are varistors R101 and R102, which protect the transformer from transient spikes and bypass capacitors C102, C103, and C104. The output of transformer T1 is rectified by bridge rectifier BR1, filtered by capacitor C5, and then routed to the circuits which regulate the 13.8-volt output.

OUTPUT CIRCUITS

The bases of transistors Q301 and Q302 are controlled by the action of transistors Q1 and Q303 in the following manner: A 13.8-volt sensor line monitors the output DC voltage and routes the sampled voltage across a voltage divider consisting of resistors R309 and R311 and control R310. Control R310 sets the base bias voltage for Q303, while zener diode D303 sets the emitter reference voltage. When Q303 conducts, it establishes the base bias on transistor Q1 which, in turn, controls the voltage on the bases of transistors Q301 and Q302. Resistors R307 and R308 limit the current through the bases of Q301 and Q302 to inhibit any excess current surges through either transistor. Resistors R303 through R306 in the emitter circuits of these transistors aid in equalizing the current.

At the output of the power supply, capacitors C308 and C309, with resistor R313, provide DC filtering.

The collector voltages for Q1 and Q303 are provided through the circuits of rectifiers D301 and D302, and are filtered by capacitors C301 through C305. Resistor R301 with capacitor C306 help to establish the reference voltage on the base of Q1. This full-wave supply is used to provide more efficient ripple control on the output 13.8-volt DC supply.

CLOCK CIRCUITS

In the fluorescent display circuit of V201, transistor Q201, resistor R201, and control R204 provide brightness control by regulating the filament-to-grid voltage differential.

The line frequency pulse is routed to the clock portion of integrated circuit U201 through resistor R205. The timekeeping functions of U201 are controlled by jumper wires to produce either 12- or 24-hour operation on either 50 or 60 Hz input, depending on which jumpers you install.

Integrated circuit U201 provides all of the timekeeping and encoding operations to drive display tube V201 directly. Diodes D201 and D202 are used for isolation of the segments in the tens-of-hours digit in V201.

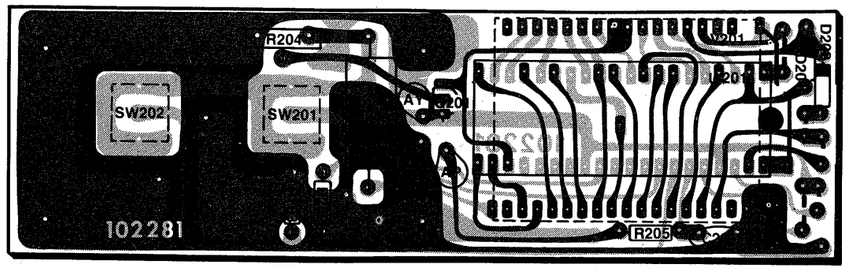
CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

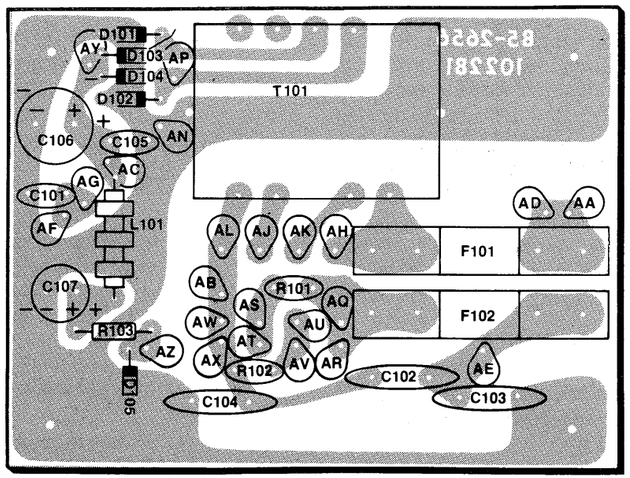
A. Find the circuit component number (R111, C101, etc.) on the "X-Ray View."

B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

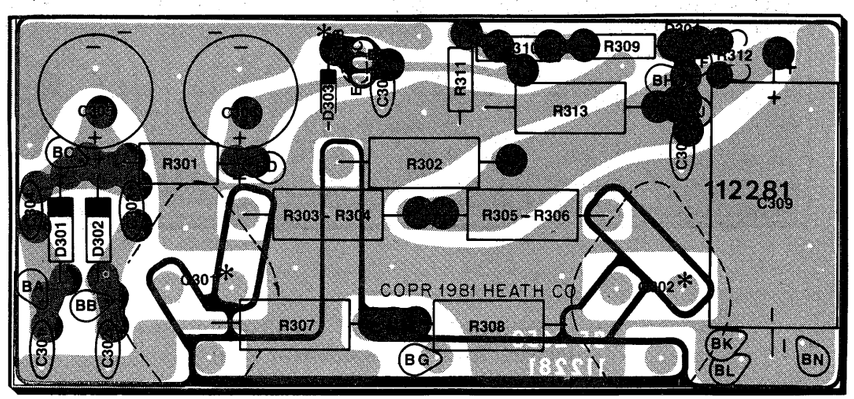
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



DISPLAY CIRCUIT BOARD
(shown from the component side)



AC CIRCUIT BOARD
(shown from the component side)

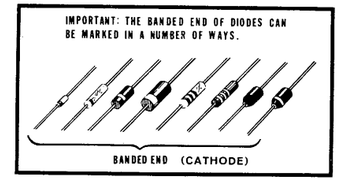
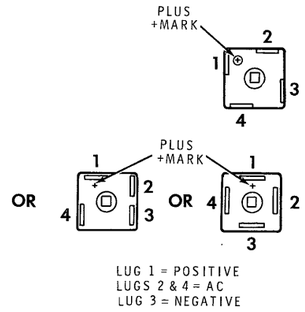


REGULATOR CIRCUIT BOARD
(shown from the component side)

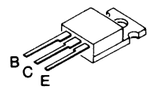
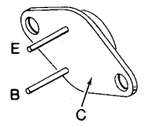
*Components mounted on the back of circuit board.

SEMICONDUCTOR IDENTIFICATION CHART

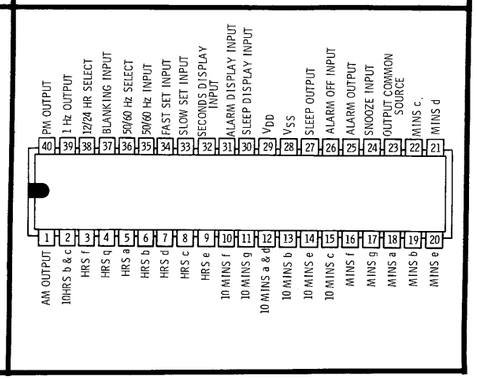
DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D105, D303	56-16	1N5231B	
D201, D202, D304	56-56	1N4149	
D301, D302	57-42	3A1	
D101 thru D104	57-65	1N4002	
BR1	57-88	MDA990	

TRANSISTORS

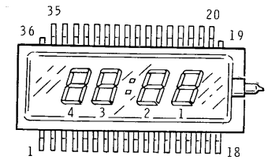
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	417-203	TA7311	
Q301, Q302	417-254	MJ802	
Q201, Q303	417-801	MPSA20	

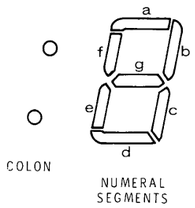
CLOCK DISPLAY, INTEGRATED CIRCUIT

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U201	443-848	EA5316	

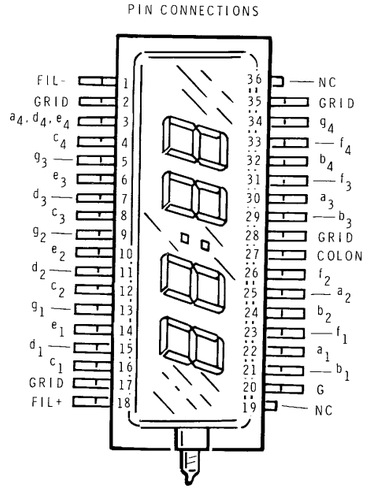
READOUT TUBE V201

Heath #411-836,
Manufacturer's Number FUTABA 4BT-04





PIN CONNECTIONS



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TLX 72-9421

IMPORTANT NOTICE

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

Page 8 — Left column, under "Electronic Parts."

Change:	A7	401-107	1	Speaker
To:	A7	401-167	1	Speaker

Page 26 — Tape the new Page 26, supplied with this Notice, over Page 26 in your Manual.

Page 27 — Right column. Add the following note to the fourth step.

NOTE: This hole may not be marked.

Page 36 — Tape the new Page 36, supplied with this Notice, over Page 36 in your Manual.

Page 37 — Tape the new Page 37, supplied with this Notice, over Page 37 in your Manual.

Page 45 — Tape the new Page 45, supplied with this Notice, over Page 45 in your Manual.

Page 48 — Left column, third line of the note.

Change: ....refer to the Assembly Manual for that....
To: ....refer to the Operation Manual for that....

ILLUSTRATION BOOKLET

Page 14 — Tape the new Pictorial 6-4, supplied with this Notice, over Pictorial 6-4 in your Illustration Booklet.

Thank you,

HEATH COMPANY