Technical Manual

MAINTENANCE
INSTRUCTIONS FOR

PERMACAD POWER PAK AND CHARGER

Honeywell
PHOTOGRAPHIC PRODUCTS DIVISION
P. O. BOX 22083 • DENVER, COLORADO • 80222

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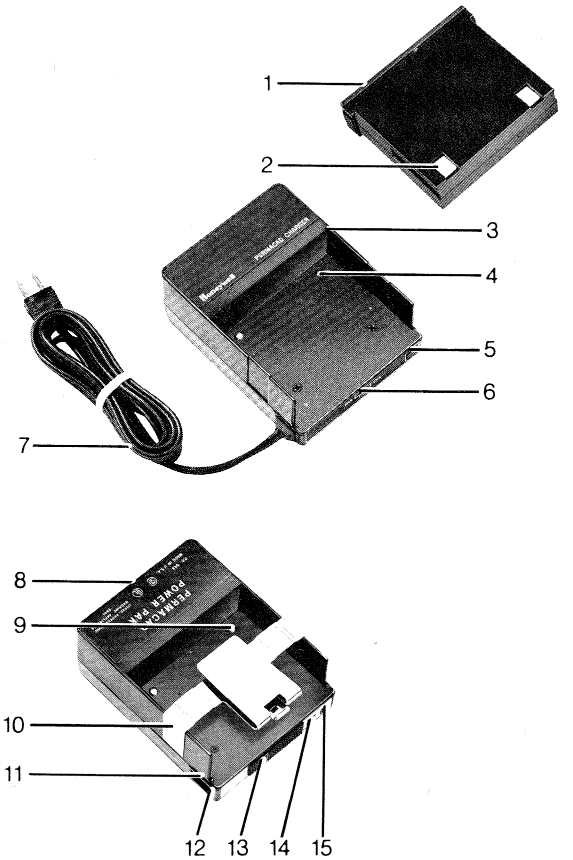

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Figure 1-1. Permacad Power Pak and Charger.

SECTION 1

INTRODUCTION

1-1. SCOPE OF MANUAL.

Your service manual provides maintenance instructions for the Honeywell Permacad Power Pak and Charger. The manual includes information on operational checkout, circuit description, troubleshooting, disassembly, repair, component replacement and recommended test equipment. A list of replaceable parts, exploded view illustrations and schematic diagrams are also provided.

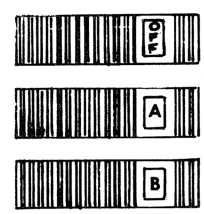
1-2. UNIT DESCRIPTION.

1-3. PERMACAD POWER PAK (See Figure 1-1).

The Permacad Power Pak (8) is a belt or shoulder strap mounted power supply capable of powering the 800 series Strobonars. The 800 series consists of Models 800, 810, 880, 890, 882 and 892. The Power Pak is powered by an interchangeable, rechargeable nickel-cadmium battery cartridge (1). The battery cartridge can be rapid charged in a separate charger unit (3) powered from an AC voltage source.

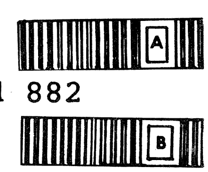
The belt clip (10), battery cartridge contacts (9) and the recess to locate the battery cartridge (1) are located on the front of the Power Pak.

The Ready [R] (red) light (15), the Battery [B] (blue) light (14) and the three position OFF-A-B power switch (13) are located on the top of the Power Pak.



The Ready light [R] indicates the flash head being powered is ready to function. The Battery light [B] indicates the battery cartridge is discharged and should be recharged. The Power Pak will not operate when the Battery light [B] is illuminated.

Position A provides full power (approx. 500 volts) to the Strobonar Models 810, 890 and 892 and half power (approx. 360 volts) to the Model 800, 880 and 882 Strobonars. In position B, full power is provided for the Model 800, 880 and 882 Strobonars.



CAUTION

The Model 810, 890 and 892 Strobonars should NOT be operated with the Power Pak switch in the B position to avoid damaging the Strobonars.

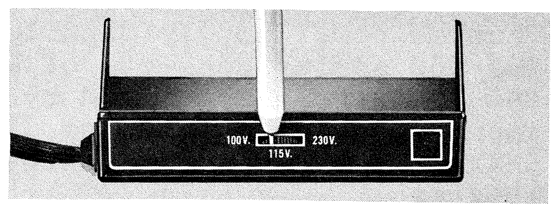
The power cord receptacle is located on the side of the unit. The receptacle is protected by a cover (11) to prevent accidental access to the high voltage connector when the power cord is removed.

1-4. PERMACAD CHARGER (See Figure 1-1).

The Permacad Charger is a separate unit to rapid charge the battery cartridge used with the Permacad Power Pak. The Charger accepts either 100, 120 or 240 nominal AC line voltage at 50-60 Hz depending upon the position of the voltage selector switch (6). The switch is located on the top of the unit along with the red charge light (5) which illuminates when the charger is connected to line voltage.

CAUTION

You must select the proper input voltage by positioning the voltage selector switch (6) to the correct position. Operating the Charger with the switch set to the wrong position will damage the charger.



The battery cartridge contacts (4) and the recess for the battery cartridge are located on the front and the AC power cord (7) is located on the side of the Charger.

1-5. <u>SPECIFICATIONS</u>.

1-6. PERMACAD POWER PAK.

a. Power Source.

8 Sub-C nickel cadmium batteries connected in series in the battery cartridge.

b. Equivalent Battery Source.

10.4 volts ±.1 volt, 125 milliohms impedance.

c. Output Voltage Regulation.

Full power ...... 445 to 500 VDC.
Half power ...... 320 to 360 VDC.

d. Recycle.

(With fully charged batteries at 5th charge cycle at 25°C, ±2°C.)

Full power ...... 3 seconds maximum to full power indication.
Half power ...... 2 seconds maximum to half power indication.

e. Number of Charge Cycles*.

(With fully charged batteries at 25°C, ±2°C at rate of 4 per minute.)

Full power ...... 120 charge cycles.*
Half power ...... 200 charge cycles.*

f. Oscillator Cutoff Calibration Point.

(Operating on battery cartridge or equivalent power source.)

Full power ...... 480 +5, -10 VDC.
Half power ...... 350 +5, -10 VDC.

g. Redundant (Back-up) Oscillator Cutoff.

(With primary oscillator cutoff circuit inoperative.)

Full power ...... 500 - 520 VDC.
Half power ...... 370 - 390 VDC.

h. Power Switch

OFF .... Turns Power Pak off.
A .... Provides full power for Strobonar Models 810, 890 and 892 and half power for Strobonar Models 800, 880 and 882.
B .... Provides full power for Strobonar Models 800, 880 and 882.

i. Ready [R] (red) Light.

Blinks when the Power Pak is supplying 100 percent of regulated power in either switch position A or B.

j. Battery [B] (blue) Light.

Illuminates when the batteries need charging and the Power Pak has turned itself off. The recharge indicator (Battery [B] (blue) light) must not light at 7.6 volts. The oscillator will not operate with an equivalent battery voltage of 6.4 volts and the indicator light must be on.

NOTE

The batteries may discharge beyond the voltage level required to keep the blue [B] light on.

* Charge cycle is defined as charging a capacitor to 70 watt-seconds at full power (445-500 VDC) or to 35 watt-seconds at half power (320-360 VDC). The capacitor leakage current shall not exceed .5 ma.

k. Physical Size.

Power Pak with battery .... 1.9" deep x 4.2" wide x 5.6" high.

Battery only.................................... .... 1.2" deep x 4.2" wide x 3.6" high.

l. Weight.

Power Pak with battery ....31 ounces.

Battery only...........................12 ounces.

1-7. PERMACAD CHARGER.

a. Power Source

90-110 VAC, 50-60 Hz, or
105-129 VAC, 50-60 Hz, or
208-258 VAC, 50-60 Hz.

b. Charger Output.

(With 120 ±1 VAC, 50-60 Hz at 25°C, ±2°C.)

The battery will produce a minimum of 2500 amp-sec when discharged to 1 ±.05 volts per cell at 1 ±.05 amp rate after a 3 hour charge.

NOTE

The charge rate at 50 Hz will be a minimum of 90% of that at 60 Hz.

c. Charge Current Output.

200-300 milliamperes after a 3-hour charge.

d. Charging Periods.

10 hours maximum at ambient temperature of 59°F (15°C) or less.

250 hours maximum at ambient temperature of 59°F (15°C) or higher.

e. Voltage Selector Switch.

Selects 100, 120 or 220 nominal AC voltage depending upon available power source.

f. Indicator Light.

Illuminates when Charger is connected to AC line voltage source.

g. Physical Size.

2.1" deep x 4.7" wide x 5.4" high.

h. Weight.

12 ounces.

1-8. COMPONENT REFERENCE DESIGNATIONS.

To avoid component reference designator duplication, each unit has been assigned a prefix number. A prefix has, therefore, been added to each reference designator as shown below.

UNIT	PREFIX	EXAMPLE
Permacad Power Pak	No Prefix	R1
Permacad Charger	#1 Prefix	1R1
SCR Test Circuit	#2 Prefix	2R1
Resistor R1B Test Circuit	#3 Prefix	3R1
Resistor R13 Test Circuit	#4 Prefix	4R1
Resistor R16 Test Circuit	#5 Prefix	5R1
Resistor R20 Test Circuit	#6 Prefix	6R1

SECTION 2

PRINCIPLES OF OPERATION

2-1. PERMACAD POWER PAK - See Figure 5-5.

The Permacad Power Pak, when coupled with the battery cartridge, provides a power source for the 800 series Strobonars. The three-position switch on the Power Pak either shuts the Power Pak off, or when set to position A, selects full power for the Strobonar Models 810, 890 and 892 and half power for the Models 800, 880 and 882. Placing the switch to position B provides full power for the Model 800, 880 and 882 Strobonars.

CAUTION

> The Model 810, 890 and 892 Strobonars should NOT be operated with the Power Pak switch set to position B to avoid damaging the Strobonar.

The Power Pak circuit can be divided into four basic circuits as shown in Figure 5-5 on page 5-11. The oscillator circuit provides anode voltage for input to the Series 800 Strobonars; the cutoff circuit shuts the oscillator off when the Power Pak has built up to proper output voltage; the battery protection circuit shuts the oscillator off if the battery cartridge output is below specification or if one of the cells has gone into reversal; and the redundant cutoff circuit is a back-up circuit for the primary cutoff circuit to insure against damage to the Power Pak and injury to the user.

PUT Operation - A relatively new electrical component (at least to Honeywell Strobonar circuits), called a PUT, is used in the Oscillator Cutoff Circuit and also in the Battery Protection Circuit in the Power Pak. The initials "PUT" stand for "Programmable Unijunction Transistor". The operation of the PUT is similar to the SCR previously used in Strobonar circuits, except the PUT utilizes an anode gate rather than a cathode gate. The PUT is fired by pulling the gate negative with respect to the anode as compared to an SCR where the gate is pulled positive with respect to the cathode to fire the SCR.

2-2. OSCILLATOR CIRCUIT - See Figure 5-5.

The oscillator circuit is basically the same circuit used in the Model 710, 780 and 782 Strobonars with some variation in components and voltage levels.

The transistor-driven stored energy flyback oscillator converts the low dc voltage from the nickel cadmium cells in the battery cartridge (BT1) to high dc voltage which is stored in capacitor C3. C3 provides an AC load for transformer T1 when the oscillator circuit is in the cutoff stage. The polarity of the transformer in the oscillator circuit prevents the secondary from conducting when the magnetic field in the primary is building. When the primary is opened (Q1 off), the magnetic field collapses and current flows in the secondary, charging capacitor C3. The stored energy flyback circuit allows a portion of the magnetic energy to remain in the core of the transformer at the time the succeeding oscillation starts.

The primary current flow circuit consists of BT1, S1A, winding N1 of transformer T1 and transistor Q1. With the Power Pak switch set to A (half power) or to B (full power), Q1 is forward-biased by the base current flowing through N1, R2 and the base-emitter junction of Q1. This is the starting loop causing the oscillator to start running initially.

As the collector of Q1 falls in voltage toward the emitter, current flows through N1 and the emitter-base junction of Q1 to the battery. This is the primary current flow circuit. The current flowing in N1 induces a voltage in winding N3. The voltage is positive at pins 5 and 6 of T1 during the primary current flow cycle.

The forward base drive circuit consists of transformer winding N3, Q1 and CR2. As voltage is induced in N3 from N1, current flows through the base-emitter junction of Q1, through CR2 and back to pin 1 of T1. Pin 5 in the primary winding, pin 6 in the base drive winding and pin 2 in the secondary winding are all positive. At this time, current cannot flow in the secondary circuit to charge C3 because CR4 and CR11 are reverse-biased. Consequently, when current is flowing in the primary circuit (N1), no current is flowing in the secondary. With the base-emitter drive circuit completed through CR2 and as the regenerative feedback of N1 and N3 increases, Q1 saturates.

A shorted or open CR2 will cause the oscillator circuit to be inoperable because of the loss of base drive for transistor Q1.

Assuming there is constant current flowing into the base of Q1, the collector current will increase linearly with time. The collector current, from the time Q1 was turned on, is building flux (or storing energy) in the core of T1. This current (or flux in the core) is becoming increasingly large. For an incremental unit of time, there is an incremental increase in current. This current continues to increase until a point is reached where Q1 base current times the gain of Q1 (βI_b) can no longer supply collector current. At this point, Q1 comes out of saturation because its base drive is insufficient to keep it saturated.

Q1 starts to turn off. The collector voltage starts to rise and the voltage across N1 starts to decrease. The induced voltage across N3 decreases. The collector voltage rises toward the battery positive causing the voltages across the windings to switch, making pins 7, 1 and 4 more positive.

As the voltage on the windings switch, the magnetic field collapses and current flows out of the secondary winding N2. With diodes CR4 and CR11 forward-biased, current flows from pin 4 in the secondary winding to charge capacitor C3. The voltage appearing on C3 is the same value appearing across N2 for any oscillator cycle. Since C3 is charged by the secondary when the magnetic field is collapsing, the current flowing from pin 4 of winding N2 is linearly decreasing.

During the period of time the magnetic field is collapsing and C3 is being charged, the stored energy flyback circuit is operating. The flyback circuit consists of transformer T1 winding N3, R1A, R1B, C1 and CR3. Current flows from pin 1 of N3, through R1A-R1B, C1, CR3 (anode to cathode) and to pin 6 of N3. The voltage across N3 is a constant voltage. Capacitor C1 is charged through R1A-R1B. The charging time constant of C1 and R1A-R1B determines the flyback time constant. R1B is a selected resistor to provide peak collector current for transistor Q1. Refer to paragraph 3-10 for selection of resistor R1B.

Capacitor C10 prevents the oscillator from being in the flyback mode when Q1 is on by slowing down the transition of Q1 from the off state to the on state.

CR3 anode is positive by .7 volt with respect to the cathode. This same voltage is impressed across the emitter-base of Q1 with the emitter being more positive than the base. Q1 is therefore reverse biased and held off.

When C1 is charged to the same voltage across N3, current flow ceases in the flyback circuit. Since there is no longer a voltage drop across CR3, the base of Q1 starts rising from a negative .7 volts due to the current flowing through R2 from pin 7 of N1. Transistor Q1 turns on and the drive cycle is again initiated.

The flyback cycle is accomplished before the magnetic field in the transformer has completely collapsed. Therefore, Q1 is turned on and the drive is initiated <u>before</u> the magnetic flux in the core reaches zero and the stored energy <u>totally</u> expended.

The oscillator circuit is turned off by one of the three remaining circuits; the primary cutoff circuit; the battery protection circuit; or the redundant cutoff circuit by turning on transistor Q2. When Q2 is on and its collector voltage is low, base voltage cannot be generated on Q1. If the base of Q1 is not positive by .7 volts, the oscillator cannot operate.

Diode CR1 protects Q1 during the reverse recovery time of CR4 and CR11. A shorted or open CR1 will cause Q1 to fail. Always check CR1 if Q1 is found to be defective.

Diodes CR4 and CR11 are high-speed, 200 nano-second reverse-recovery diodes. A defective diode(s) CR4 and/or CR11 will cause Q1 and/or CR1 to fail. Two diodes (CR4 and CR11) are required to meet the extremely fast rise and fall times of the oscillator because of the use of the silicon transistor in the oscillator circuit. Very rapid voltage changes are produced on N3 as Q1 is turned on and off.

Resistor R24 provides a discharge path for capacitor C3 when the Power Pak switch is set to the off position.

2-3. OSCILLATOR CUTOFF CIRCUIT - See Figure 5-5.

The oscillator cutoff circuit shuts off the oscillator when the proper anode voltage is reached. Secondary voltage is sensed across a voltage divider and compared to a reference voltage developed across the string of diodes. As the anode voltage increases, the voltage at the junction of the divider exceeds the reference voltage causing the cutoff circuit to activate. Current flows from the load storage capacitor through the cutoff circuit, turning on the Ready [R] light and turning off the oscillator. As the load storage capacitor discharges, the voltage at the junction of the divider drops below the reference voltage causing the cutoff circuit to turn off. With the cutoff circuit inoperative, base voltage is again generated on the oscillator transistor, allowing the oscillator circuit to operate to recharge the load storage capacitor. The cutoff circuit is designed to turn off the oscillator when the anode of CR13 reaches 350 +5, -10 VDC when the Power Pak switch is in either the A or B position.

Refer to paragraph 2-1 for a brief description of the operation of the PUT.

With switch S1 in the A position (half power) diode CR13 is shorted and oscillator cutoff occurs when the anode voltage reaches 350 volts. In the B position (full power) the current path is through CR13. The cathode of CR13 is 130 volts above the anode resulting in an output of 480 volts (350 +130 volts). Full or half power is selected by switching diode CR13 in or out of the circuit by means of switch S1.

Resistor R15 is bias for the three zener diodes CR7, CR8 and CR9. Low current is applied to the diode string to achieve temperature stability. Resistors R10 and R16 act as a voltage divider. With switch S1B in the A position (half power) and the anode voltage at 350 volts, 22 volts is developed at the junction of R10-R16 and applied to the anode of PUT 1 and capacitor C6 is charged.

Resistor R16 is selected to insure anode voltage across capacitor C3 is at 350 +5,-10 VDC with the Power Pak switch in the A position (half power). Refer to paragraph 3-12 to determine the value of R16.

The gate of PUT 1 is at a constant voltage (developed across the diode string) as the anode voltage of PUT 1 rises. PUT 1 fires when the anode voltage exceeds the gate voltage. When PUT 1 fires, capacitor C3 discharges through CR13, R10, PUT 1 anode, diode CR10 to the base of transistor Q3, turning Q3 on. The Ready [R] red light DS1 lights and current flows through the collector-emitter of Q3, diode CR6 to the base of Q2, turning Q2 on, removing base voltage from Q1 and shutting off the oscillator circuit.

Capacitor C6 discharges through R23 to the anode of PUT 1 to provide a pulse of current in addition to the energy supplied by capacitor C3. Since the oscillator is still running when PUT 1 first fires, C6 provides an additional pulse to the base of Q2 to assist in turning off the oscillator.

Summarily, transistor Q2 is on when DS1 is on; whenever Q2 is on, Q1 is off. Therefore, when DS1 is on, Q2 is on, Q1 is off and the oscillator circuit is inoperable.

Capacitor C8 suppresses noise across the gate-anode of PUT 1. Resistor R17 allows PUT 1 to operate with a low maintaining current.

Diode CR10 maintains the cathode of PUT 1 at 10 volts allowing PUT 1 to shut off when the load storage capacitor discharges to 150-200 volt level. With PUT 1 on, CR10 anode is four diode drops above ground (2.5 - 2.8 volts). Without CR10 in the circuit, PUT 1 would turn on and stay on until C3 was nearly discharged.

Resistor R5 absorbs the collector-base leaking current of Q3 and holds Q3 out of conduction until PUT 1 fires. Capacitor C5 is a noise suppressor to eliminate oscillator noise occurring at the base of Q3.

In the case where DS1 should fail, resistor R14 provides collector current for Q3 to insure operation of the cutoff circuit.

2-4. BATTERY PROTECTION CIRCUIT - See Figure 5-5.

The battery protection circuit shuts off the oscillator circuit and prevents high current drain on the battery when one cell of the battery is driven into reversal. The battery voltage is continuously monitored and compared to a reference voltage. When the battery voltage drops below a predetermined level, the PUT fires and current flows through the battery protection circuit. The Battery [B] blue light illuminates and base voltage is removed from the oscillator transistor, thereby shutting off the oscillator circuit.

Refer to paragraph 2-1 for a brief description of the operation of the PUT used in the Battery Protection circuit.

Resistors R9 and R13 act as a divider to sense a drop in battery voltage. R13 is selected to establish a voltage level at the gate of PUT 2. Refer to paragraph 3-11 to determine the value of R13.

With battery BT1 charged to a sufficient voltage level, 7 - 8.5 volts are seen at the junction of the divider R9-R13. If one cell of BT1 goes into reversal, a change of approximately 2 volts is sensed at the gate of PUT 2 dropping the voltage from approximately 8.5 volts to 6.5 volts. Since the anode of PUT 2 is biased at 6.8 volts through diode CR5, the gate of PUT 2 is negative with respect to the anode and PUT 2 turns on.

Battery current flows through R11, PUT 2 anode to cathode, Q4 base turning Q4 on and lighting DS2, the Battery [B] blue light. Q4 emitter current is applied to the base of Q2, turning Q2 on, removing base voltage from Q1 and shutting off the oscillator circuit.

Capacitor C4 is connected across the anode-gate of PUT 2 to prevent noise from turning PUT 2 on when the oscillator circuit is first turned on since battery voltage drops initially when the oscillator circuit is first turned on.

R6 is a current limiting resistor for DS2. R12 establishes a holding voltage for the base of Q4.

2-5. REDUNDANT CUTOFF CIRCUIT - See Figure 5-5.

The redundant cutoff circuit shuts off the oscillator circuit in the event the primary cutoff circuit, described in paragraph 2-3, malfunctions and fails to shut it off. The SCR in the redundant circuit turns on and stays on when the anode voltage reaches a value slightly higher than that required to activate the primary cutoff circuit. Base current is applied to the back-up transistor in the redundant cutoff circuit, removing base voltage from the oscillator transistor, thereby shutting off the oscillator circuit.

Capacitor C3 voltage is sensed through diode CR13. If the primary cutoff circuit malfunctions and the anode of CR13 builds up to 380 ±10 volts, an excess of 200 volts is sensed at the junction of R19-R20.

With 200 volts at the junction of R19-R20, current flows through CR14 to the gate of SCR1, turning the SCR on. With the anode of SCR1 connected to battery voltage, SCR1 stays on applying current to the base of Q5. Q5 is a back-up transistor for Q2 and performs the same function as Q2.

With current applied to the base of Q5, Q5 turns on removing base voltage from Q1 and shutting off the oscillator circuit.

The value of resistor R20 is selected to produce 200 volts at the junction of the divider R19-R20 when the anode voltage reaches 375 ±5 volts. Refer to paragraph 3-13 to determine the value of R20.

Capacitor C9 prevents the redundant cutoff circuit from shutting off the oscillator when the Power Pak switch is changed from the OFF position to position A or from position A to position B. For a short period of time when the switch is being moved, it only touches one switch contact during its travel. CR13 is not being shorted during this short period of time and the anode voltage tends to go to 500 volts instantaneously. If the anode voltage reaches 450-500 volts before the switch is fully in position, an excess of 200 volts would appear across the divider R19-R20 causing the redundant cutoff circuit to activate. With C4 across the gate-cathode, the gate signal must be present for a specified duration of time before SCR1 turns on.

R22 biases the gate-cathode voltage of SCR1. R21 is the current limiting resistor for the base of Q5.

2-6. PERMACAD CHARGER - See Figure 5-6.

The charge circuit contains switch 1S1, transformer 1T1, diode 1CR1, charge light 1DS1 and resistor 1R1. The voltage selector switch 1S1 selects the input-line voltage available. Transformer 1T1 is wound so the source impedance is the same in any switch position and to insure the voltage across the secondary is the same with either of the voltage inputs.

Half-wave rectifier 1CR1 comprises the charging circuit for the 8 Sub-C nickel cadmium cells in the battery cartridge. Approximately 3 hours are required to fully charge a set of batteries. The charge light illuminates when the charger is connected to line voltage and the battery cartridge is properly connected to the Charger.

Transformer 1T1 steps the line voltage down across the secondary. Assuming an input of 120 VAC, 50-60 Hz, when pin C of 1T1 is positive, pin A is positive (pins D and B are negative) and current flows through 1CR1, the battery cartridge and back to pin B of 1T1 to charge the batteries.

On the next half cycle when pins D and B of 1T1 are positive (pins C and A are negative) current is blocked through 1CR1 and the batteries. Thus, half-wave rectification is accomplished to charge the batteries.

Resistor R3 is a voltage limiter for the charger indicator light 1DS1.

SECTION 3

CHECKOUT AND TROUBLESHOOTING

3-1. GENERAL.

When you are checking out or adjusting the Permacad Power Pak, you should insure that all electrical connections are good; the load storage capacitor has been formed; and the batteries are fully charged.

WARNING

> When you are repairing the unit, discharge capacitor C3 through a 100 ohm, 2 watt resistor to insure that the unit is safe to work on.

3-2. OPERATIONAL CHECKOUT.

3-3. TEST EQUIPMENT.

You will find the following test equipment is required for operational check of the Power Pak and Charger.

Volt-Ohm Meter - Triplett Model 630-NA or equivalent.

DC Power Supply - Variable dc voltage to 380 volts, Honeywell Model 230 Power Panel or equivalent.

3-4. CAPACITOR C3 FORMING.

Before performing any operational checkout, you should form the capacitor C3 for at least one hour at anode voltage. Flash the unit a few times to accelerate forming.

3-5. CAPACITOR C3 LEAKAGE CHECK.

Form the capacitor before checking for leakage. Disconnect one end of C3 from the circuit. Using a dc power supply, form the capacitor for one hour at 360 volts with a 1K ohm, 1% resistor in series with the capacitor. With 360 volts across C3, connect a voltmeter in parallel with the 1K ohm resistor. Measure the leakage current of C3 by reading the voltage across the 1K ohm resistor. If you find the leakage current exceeds 1 ma (1 volt across the 1K ohm resistor), replace C3.

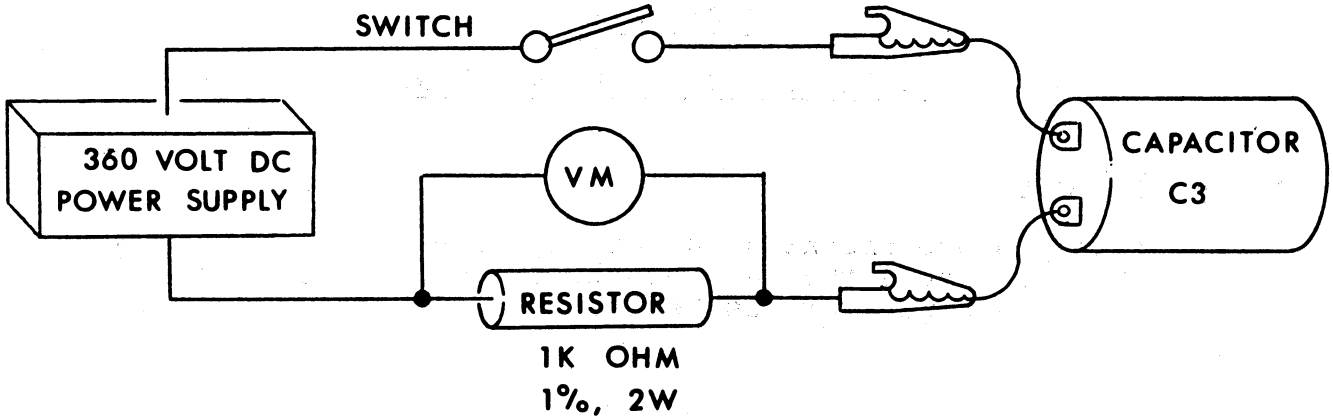


Figure 3-1. Capacitor C3 Leakage Test.

3-6. RECYCLE.

With the batteries fully charged, the recycle time to full power indication shall be 3 seconds maximum and 2 seconds maximum to half power indication.

3-7. ANODE VOLTAGE.

With the unit operating on fully charged batteries or on an equivalent battery source of 10.4 ±.1 VDC, 125 milliohms, the anode voltage should be 480 +5, -10 volts at full power and at half power should be 350 +5, -10 volts.

3-8. BATTERY CHARGING.

After a 3 hour charge at 25°C, ±2°C and 120 ±1 VAC, 50-60 Hz, the battery shall produce a minimum of 2500 amp-seconds when discharged to 1 ±.05 volts per cell at 1 ±.05 amp rate.

3-9. BATTERY CONDITIONING.

The batteries should be conditioned for the following reasons: if the unit is new, if the unit has not been used for more than one (1) month, if the unit has been stored at a temperature of 95°F (35°C) or above, or if the unit has been deeply discharged.

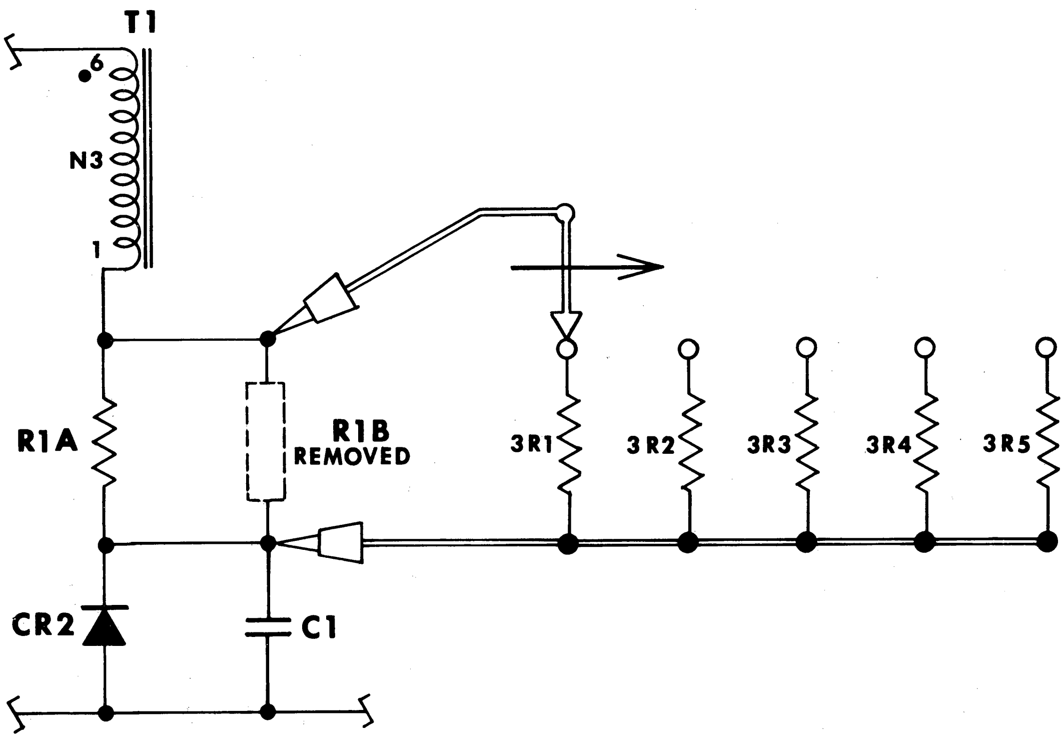
To condition the batteries, charge for 4 hours at 120 ±1 VAC, 50-60 Hz and then discharge at 1 ±.05 amp until the terminal voltage equals 1 ±.05 volts per cell. Then charge again for 3 hours.

3-10. RESISTOR R1B SELECTION.

Resistor R1B requires selection and replacement if it fails or if the recycle time needs to be adjusted. Remove resistor R1B from the circuit and connect the Resistor Selector Circuit as shown in Figure 3-2.

Select the highest resistor value in the Selector Circuit. Set the Power Pak switch to the A position. Advance through the test resistors until the recycle time is between 3 to 4 seconds. Be sure you start with the highest resistor value first.

If you have not built the Resistor Selector Circuit, simply replace R1B with the resistor values listed in Figure 3-2, starting with the highest value first.



RESISTOR	VALUE (1W, 5%)	PART NO.
3R1	270 ohms	H73004070-549
3R2	150	-543
3R3	82	-537
3R4	47	-531
3R5	30	-526

Figure 3-2. Resistor R1B Selector Circuit.

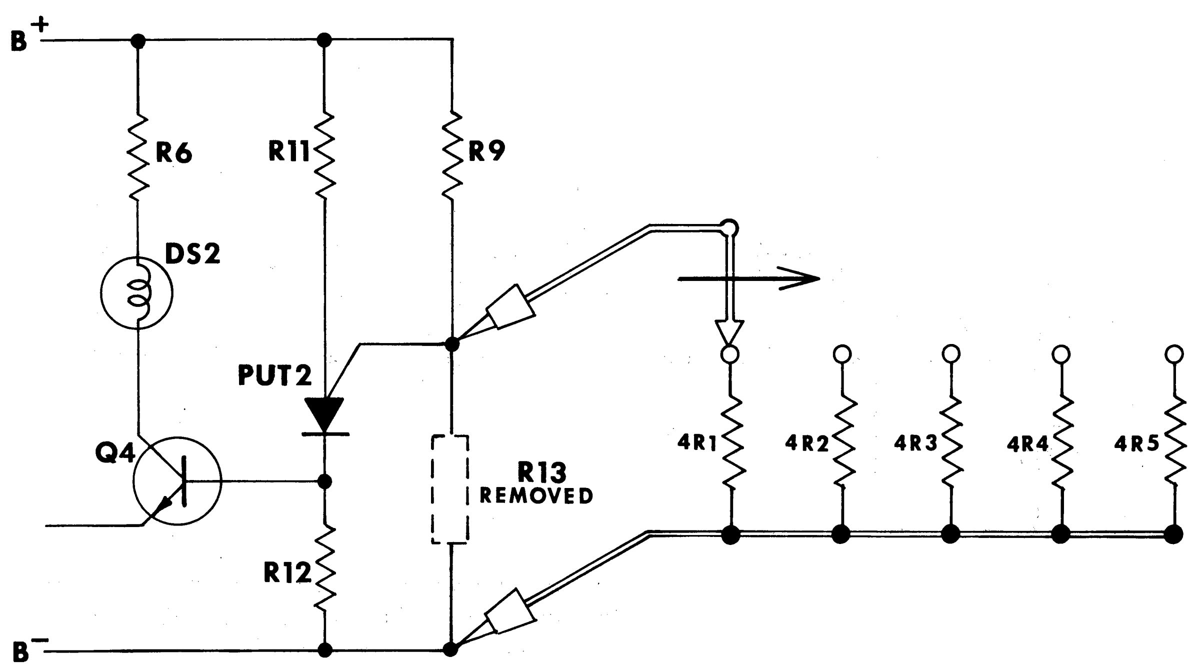
3-11. RESISTOR R13 SELECTION.

Resistor R13 requires selection and replacement if it fails or to insure DS2 illuminates when the power source is below 7.2 volts. Remove resistor R13 from the circuit and connect the Resistor Selector Circuit as shown in Figure 3-3.

Disable the oscillator circuit by shorting the collector-emitter of Q2. Select the highest resistor value in the selector circuit. Apply 7.2 volts across B+ and B-. Advance through the test resistors decreasing the value of R13 until DS2 illuminates.

Increase the power source across B+ and B- to 7.6 volts. Turn the Power Pak switch off and then back on. Check to see DS2 did NOT come on. Be sure you start with the highest resistor value first.

If you have not built the Resistor Selector Circuit, simply replace R13 with the resistor values listed in Figure 3-3, starting with the highest value first.



RESISTOR	VALUE (¼W, 1%)	PART NO.
4R1	18.7K	H73003356-427
4R2	14.3	-416
4R3	11.8	-408
4R4	9.31	-394
4R5	6.98	-382

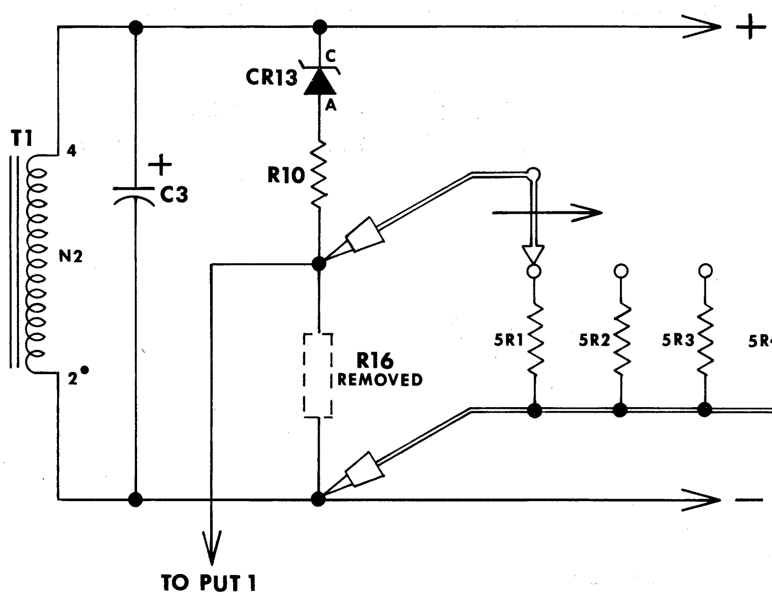
Figure 3-3. Resistor R13 Selector Circuit.

3-12. RESISTOR R16 SELECTION.

Resistor R16 requires selection and replacement if it fails or if the anode voltage is NOT between 345-355 volts with the oscillator circuit running properly and the Power Pak switch in the A position. Remove resistor R16 from the circuit and connect the Resistor Selector Circuit as shown in Figure 3-4.

Select the highest resistor value in the selector circuit. Set the Power Pak switch to the A position. Advance through the test resistors until the anode voltage reaches 345-355 volts. Be sure you start with the highest resistor value first.

If you have not built the Resistor Selector Circuit, simply replace R16 with the resistor values listed in Figure 3-4, starting with the highest value first.



RESISTOR	VALUE (¼W, 1%)	PART NO.
5R1	115K	H73003356-507
5R2	113	-506
5R3	110	-505
5R4	107	-504
5R5	105	-503
5R6	102	-502
5R7	100	-501
5R8	97.6	-496
5R9	95.3	-495
5R10	93.1	-494

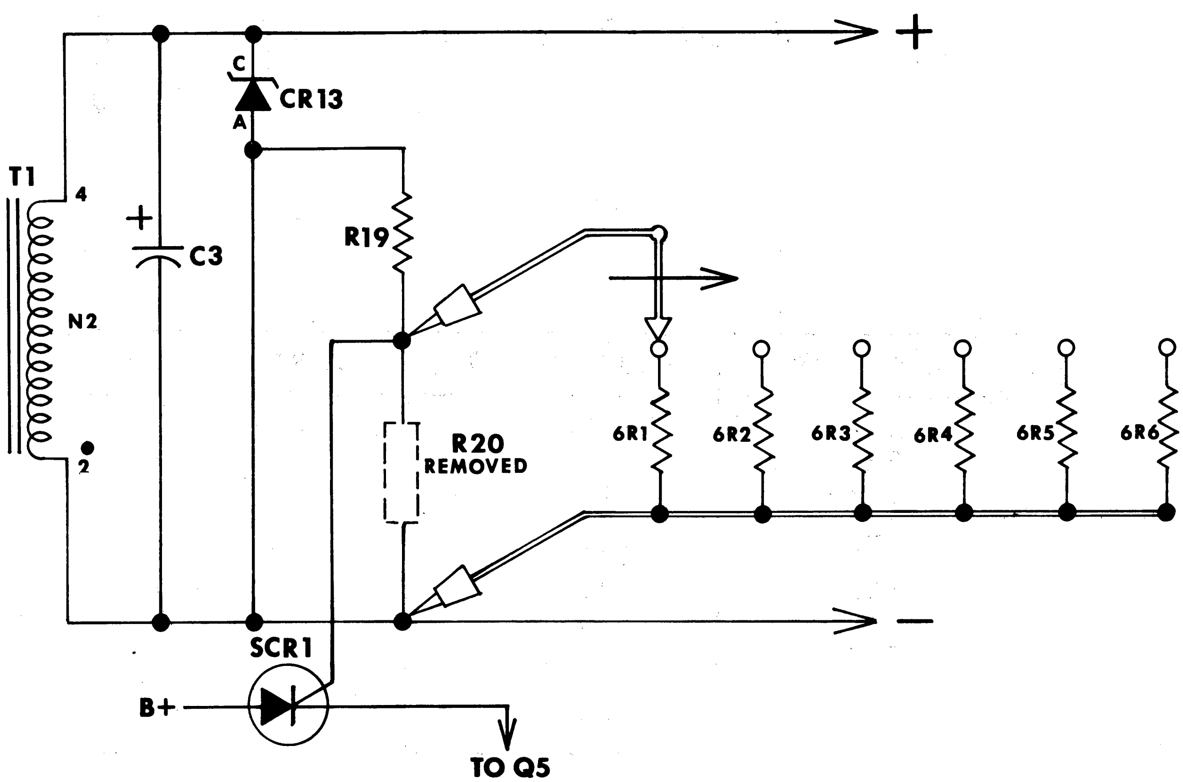
Figure 3-4. Resistor R16 Selector Circuit.

3-13. RESISTOR R20 SELECTION.

Resistor R20 requires selection and replacement if it fails or to insure the redundant cutoff circuit fires when the anode voltage across C3 reaches 375-385 volts with the Power Pak switch in the A (half power) position. Remove resistor R20 from the circuit and connect the Resistor Selector Circuit as shown in Figure 3-5. Select the highest resistor value in the selector circuit.

Disable the main cutoff circuit by shorting the base-emitter of Q2. Set the Power Pak switch to A (half-power). The oscillator circuit will fire and the anode voltage will build to fire the redundant cutoff circuit. Check the anode voltage at the time the SCR fires. Select the various resistors in the Resistor Selector Circuit, decreasing the value with each selection until the SCR turns on when the anode votlage across C3 reaches 375-385 volts. Be sure to set the Power Pak switch to off and then turn it back to A between each resistor value selection. Be sure you start with the highest resistor value first.

If you have not built the Resistor Selector Circuit, simply replace R20 with the resistor values listed in Figure 3-5, starting with the highest value first.



RESISTOR	VALUE(¼W, 1%)	PART NO.
6R1	280K	H73003356-544
6R2	261	-541
6R3	237	-537
6R4	221	-534
6R5	205	-531
6R6	187	-527

Figure 3-5. Resistor R20 Selector Circuit.

3-14. TROUBLESHOOTING.

For assistance in troubleshooting the Permacad Power Pak and Charger, you should refer to the circuit description in Section 2, the troubleshooting data charts in Section 3-22 and to the schematic diagrams in Section 5.

3-15. TECHNIQUES.

Before starting a detailed checkout of the circuit, you should first look for obvious things: broken wires, broken or discolored components, or evidence of physical damage. Faults such as arcing and burned-out resistors or transformers can often be detected by sight, smell or sound. Most faults can be located by voltage, current and resistance measurements. Check electrical connections at connectors.

Isolate the section of the circuit responsible for the fault. You will find that an operational check will demonstrate what the circuit is doing or what it is NOT doing. Observe the actions of switches and indicators to isolate the fault.

After you have isolated the defective section of the circuit, isolate the component responsible for the malfunction. Consider which components, if faulty, could cause the voltages or currents to be as you find them. Refer to the schematic diagram located in Section 5.

3-16. COMPONENT CHECKS.

No attempt is made in the troubleshooting data to describe how to test or check a particular part. The method of checking and testing is left up to you. However, we would like to remind you of the following points:

a. Turn off power and discharge C3 before making resistance measurements.

b. Set ohmmeter to the lowest range when checking continuity.

c. Set ohmmeter to the highest range when checking high resistance.

d. Capacitors which are shorted can be found by resistance measurements.

e. Check the large electrolytic capacitor (C3) for leakage current. Refer to paragraph 3-5.

f. A capacitor which is suspected of being open can be checked by substituting a good capacitor and seeing if this makes the unit operational.

3-17. SCR TEST CIRCUIT (See Figure 3-6).

To check out the SCR, remove it from the circuit and either substitute a good SCR or set up the test circuit as shown in Figure 3-6. Select the proper meter (2M1 or 2M2) by determining the range of the SCR to be tested. Position switch 2S3 to select the proper meter.

Insert the suspected SCR in the test circuit, close switch 2S2 and adjust potentiometer 2R3 for 0 current on the meter. With switch 2S2 closed, hold switch 2S1 closed and adjust potentiometer 2R3 until the meter reverses and moves in a negative direction. The readings on the SCR's should be as follows:

SCR1 -- 20 ua maximum

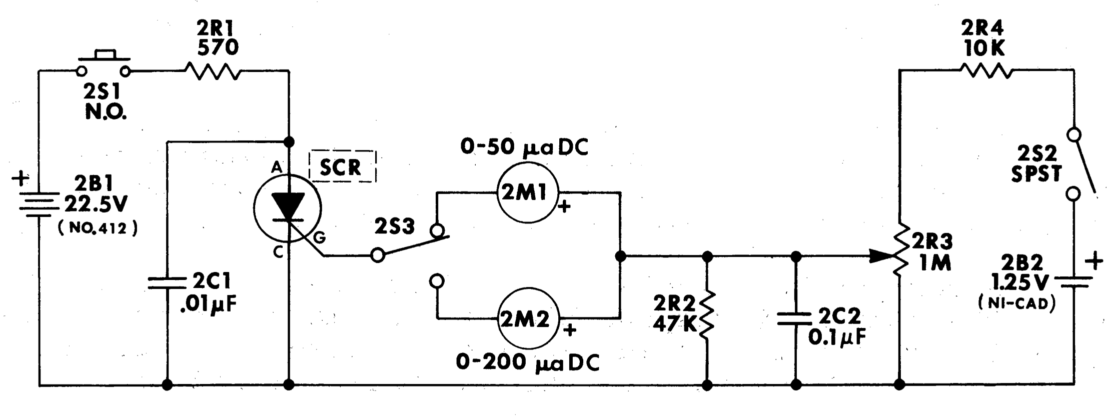


Figure 3-6. SCR Test Circuit.

3-18. SEMICONDUCTOR CHECK.

An ohmmeter will detect catastrophic defects in the transistors or diodes. First determine the polarity of the ohmmeter with a voltmeter or diode. In each pair of resistance readings, the high resistance reading should be at least 10 times the low resistance reading. Use the same ohmmeter range for both readings in each pair.

3-19. PNP TRANSISTOR.

a. Base to emitter, positive lead to base - high resistance. Base to emitter, positive lead to emitter - low resistance.

b. Base to collector, positive lead to base - high resistance. Base to collector, positive lead to collector - low resistance.

3-20. NPN TRANSISTOR

a. Base to emitter, positive lead to base - low resistance. Base to emitter, positive lead to emitter - high resistance.

b. Base to collector, positive lead to base - low resistance. Base to collector, positive lead to collector - high resistance.

3-21. DIODE.

a. Resistance across a good diode with the positive lead to the anode is low.

b. Resistance across a good diode with the positive lead to the cathode is high.

3-22. TROUBLESHOOTING DATA.

3-23. PERMACAD POWER PAK.

TROUBLE: No Oscillator Operation (cut-off circuits not activated).

ACTION	INDICATION	REMARKS
a. Check battery cartridge output.	Good	Go to step b.
	Bad	Charge or replace battery cartridge.
b. Check battery cartridge making good contact with Power Pak.	Good	Go to step c.
	Bad	Repair contact defects.
c. Check diode CR2.	Good	Go to step d.
	Bad	Replace CR2.

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Continued from preceeding page.

TROUBLE: No Oscillator Operation (Cutoff circuits not activated).

ACTION	INDICATION	REMARKS
d. Check diodes CR4 and CR11 in secondary.	Good	Go to step e.
	Bad	Replace CR4 and/or CR11. Check Q1/CR1.
e. Check CR1 and Q1.	Good	Go to step f.
	Bad	Replace CR1 and Q1. Check CR4 and CR11.
f. Check C3.	Good	Go to step g.
	Bad	Replace C3.
g. Check fuse clad - refer to Figure 5-2.	Good	Check switch S1.
	Bad	Repair defect. Replace with fuse wire.

TROUBLE: Low Anode Voltage.

ACTION	INDICATION	REMARKS
a. Check for discharged battery cartridge.	Good	Go to step b.
	Bad	Recharge or replace battery cartridge.
b. Check value selection of R16.	Good	Go to step c.
	Bad	Replace R16 with proper value. See para. 3-12.
c. Check C3 leakage. See para. 3-5.	Good	Go to step d.
	Bad	Replace C3.
d. Check anode voltage with switch in B (full power) position.	480 volts	Go to step e.
	350 volts	Check CR13 for short.

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TROUBLE: Low Anode Voltage.

ACTION	INDICATION	REMARKS
e. Check for oscillator cut-off circuit inoperative due to low battery voltage.	Good	Check Redundant Cut-off Circuit.
	Bad	Recharge or replace batteries.

TROUBLE: Oscillator Cut-Off Circuit Inoperative.

ACTION	INDICATION	REMARKS
a. Check anode voltage at CR13 anode.	350 ±5 volts or below.	Check Low Anode Voltage troubleshooting data.
	350 ±5 volts or above.	Go to step b.
b. Check value selection of R16.	Good	Go to step c.
	Bad	Replace R16 with proper value. See para. 3-12.
c. Check for reference voltage at cathode of CR7.	21-22 volts	Go to step e.
	Less than 21-22 volts.	Go to step d.
d. Check CR7, CR8 and CR9 for short or open.	Good	Check R17.
	Bad	Replace CR7, CR8 or CR9.
e. Check CR10.	Good	Go to step f.
	Bad	Replace CR10.
f. Check PUT 1.	Good	Go to step g.
	Bad	Replace PUT 1.
g. Check Q2 and/or Q3.	Good	Check all associated circuitry.
	Bad	Replace Q2 and/or Q3.

TROUBLE: Ready [R] Red Light DS1 Does Not Light - cutoff circuit operates properly.

ACTION	INDICATION	REMARKS
a. Check DS1.	Good	Go to step b.
	Bad	Replace DS1.
b. Check R3.	Good	Go to step c.
	Bad	Replace R3.
c. Check for 2.5V at cathode of Q3.	Good	Check Q3.
	Bad	Check associated circuitry.

TROUBLE: Battery Protection Circuit Inoperative - cutoff circuit operates properly.

ACTION	INDICATION	REMARKS
a. Check value selection of R13.	Good	Go to step b.
	Bad	Replace R13 with proper value. See para. 3-11.
b. Check for reference voltage of 6.8 volts at anode of PUT 2.	Good	Go to step c.
	Bad	Check CR5.
c. Check PUT 2.	Good	Go to step d.
	Bad	Replace PUT 2.
d. Check R11.	Good	Go to step e.
	Bad	Replace R11.
e. Check Q4.	Good	Go to step f.
	Bad	Replace Q4.
f. Check R6 and/or DS2 for open.	Good	Go to step g.
	Bad	Replace R6 and/or DS2.
g. Check Q2 and CR6 if cut-off circuit is inoperative.	Good	Check all associated circuitry.
	Bad	Replace Q2 and/or CR6.

TROUBLE: Battery Protection Circuit Shuts Power Pak OFF Each Time Oscillator Is Turned On - battery voltage within acceptable limits.		
ACTION	INDICATION	REMARKS
a. Check C4.	Good	Check all associated circuitry.
	Bad	Replace C4.

TROUBLE: Battery [B] Blue Light DS2 Does Not Light.		
ACTION	INDICATION	REMARKS
a. Check DS2.	Good	Go to step b.
	Bad	Replace DS2.
b. Check R6.	Good	Go to step c.
	Bad	Replace R6.
c. Check for 10V at collector of Q4.	Good	Check Q4.
	Bad	Check all associated circuitry.

TROUBLE: Redundant Cut-Off Circuit Inoperative.		
ACTION	INDICATION	REMARKS
a. Check R19.	Good	Go to step b.
	Bad	Replace R19.
b. Check CR14.	Good	Go to step c.
	Bad	Replace CR14.
c. Check SCR1.	Good	Go to step d.
	Bad	Replace SCR1.

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TROUBLE: Redundant Cut-Off Circuit Inoperative.		
ACTION	INDICATION	REMARKS
d. Check R21.	Good	Go to step e.
	Bad	Replace R21.
e. Check Q5.	Good	Check all associated circuitry.
	Bad	Replace Q5.

TROUBLE: Redundant Cut-Off Circuit Shuts Power Pak Off Each Time Oscillator Circuit Is Turned On - anode voltage within acceptable limits.		
ACTION	INDICATION	REMARKS
a. Check C9.	Good	Check all associated circuitry.
	Bad	Replace C9.

3-24. PERMACAD CHARGER.

TROUBLE: Charger Circuit Inoperative.

ACTION	INDICATION	REMARKS
a. Check to make sure switch 1S1 is in proper position for voltage available.	Good	Go to step b.
	Bad	Place 1S1 in proper position. Check 1T1.
b. Check contact between battery cartridge and charger.	Good	Go to step c.
	Bad	Repair defects.
c. Check 1S1.	Good	Go to step d.
	Bad	Replace 1S1.
d. Check 1T1.	Good	Go to step e.
	Bad	Replace 1T1.
e. Check 1CR1.	Good	Go to step f.
	Bad	Replace 1CR1.
f. Check 1DS1 and 1R1.	Good	Check associated circuitry.
	Bad	Replace 1DS1/1R1.

SECTION 4

MAINTENANCE

4-1. GENERAL.

This section contains procedures for disassembly, cleaning, electrical component removal and reassembly of the Permacad Power Pak and Charger.

You should disassemble the units to the extent necessary for operational checkout, troubleshooting and repair. Reassembly is the reverse of disassembly. Special reassembly instructions are included where required.

4-2. TOOLS.

It is not necessary for you to have special tools or fixtures to perform maintenance or to replace any parts or components on the Power Pak or Charger. Ordinary screwdrivers, diagonal cutters, long nose pliers, a soldering iron and other common hand tools are adequate to perform all repair and replacement procedures.

4-3. DISASSEMBLY.

4-4. PERMACAD POWER PAK.

a. Remove the top decal (1).

b. Remove the two screws (2) under the top decal and the two screws (4) in the battery cartridge recess.

c. Remove the rear case half (5) and the belt clip (3).

d. The circuit board assembly (6), switch cover (9), HV door (10) and spring (11) are accessible at this point of disassembly and can be removed from the front case half (12) as required.

NOTE

Replace the top decal (1) if damaged.

4-5. PERMACAD CHARGER.

a. Remove the nameplate (1).

b. Remove the two screws (2) under the nameplate and the two screws (3) in the battery cartridge recess.

c. Remove the rear case half (4).

d. The circuit board assembly (5) and switch cover (6) are accessible at this point of disassembly and can be removed from the lower case half (8) as required.

NOTE

Replace the nameplate (1) if damaged.

4-6. REASSEMBLY.

You should reassemble the unit by reversing the disassembly procedures and by following the precautions and assembly procedures listed.

a. Insure that all leads are properly dressed and are not shorted to other leads or components.

b. Check that the power switch on the Power Pak and the voltage selector switch on the Charger operate properly.

c. Check that the HV door and spring on the Power Pak are properly assembled.

d. Check that the circuit board assemblies are properly seated in the case halves before reassembling the units.

e. Check that the light lenses are properly positioned before reassembling the two case halves.

4-7. CLEANING.

Wipe the large surfaces with a clean, dry, lint-free cloth. Use low pressure compressed air to blow dust from hard-to-reach areas. When using compressed air, always direct the first blast of air at the floor to remove moisture from the air line.

4-8. ELECTRICAL COMPONENT REMOVAL.

When removing or replacing electrical components, you should observe the following precautions:

a. When applying heat, you should use a heat sink to avoid damaging the components or circuit board due to heat conduction of the component leads.

b. You should apply heat sparingly to the component lead to be removed and lift the lead clear of the junction.

c. You should insure that component replacement and lead dressing of new components be the same as for the original.

SECTION 5

PARTS LISTS AND DIAGRAMS

5-1. GENERAL.

This section includes a listing of all replaceable parts, exploded views of all assemblies and schematics for the Permacad Power Pak and Charger. The following explains the column headings as used in the parts lists:

INDEX REF - Lists the reference (or callout) number of each part as shown in the illustrations.
SCHEM REF - Lists the schematic reference designator of electrical parts.
HONEYWELL PART NO. - Lists the number by which an item may be ordered.
DESCRIPTION - Lists the part name and specifications required for identification.
QTY/UNIT - Lists the total quantity of each item used in the unit or assembly.

5-2. SCHEMATIC REFERENCE PREFIXES.

Prefix numbers have been added to the schematic reference designators to avoid designator duplication. Each unit has been assigned a prefix number, as shown in the chart.

UNIT	PREFIX	EXAMPLE
Permacad Power Pak	No Prefix	R1
Permacad Charger	#1 Prefix	1R1
SCR Test Circuit	#2 Prefix	2R1
Resistor R1B Test Circuit	#3 Prefix	3R1
Resistor R13 Test Circuit	#4 Prefix	4R1
Resistor R16 Test Circuit	#5 Prefix	5R1
Resistor R20 Test Circuit	#6 Prefix	6R1

5-3. ORDERING INFORMATION.

When ordering spare or replacement parts, specify the unit model number, item description, Honeywell part number and quantity required.

Order parts from: Honeywell
Photographic Products Division
P.O. Box 22083
Denver, Colorado 80222

REF		HONEYWELL PART NO.	DESCRIPTION	QTY
INDEX	SCHEM			
		Not Supplied	Permacad Power Pak Assy	1
1		H73003333 001	Top Decal	1
2		H73003544 324	Screw	2
3		H73003342 001	Belt Clip	1
4		H73003544 310	Screw	2
5		H73003345 002	Rear Case Half	1
6		H73003367 001	Circuit Board Assembly (See Figure 5-2)	1
7		H73003326 001	Lens, Blue	1
8		H73003327 001	Lens, Red	1
9		H73003334 001	Switch Cover	1
10		H73003328 001	HV Door	1
11		H73003319 008	Extension Spring	1
12		H73003344 001	Front Case Half	1
13		H73003392 004	Rear Decal	1

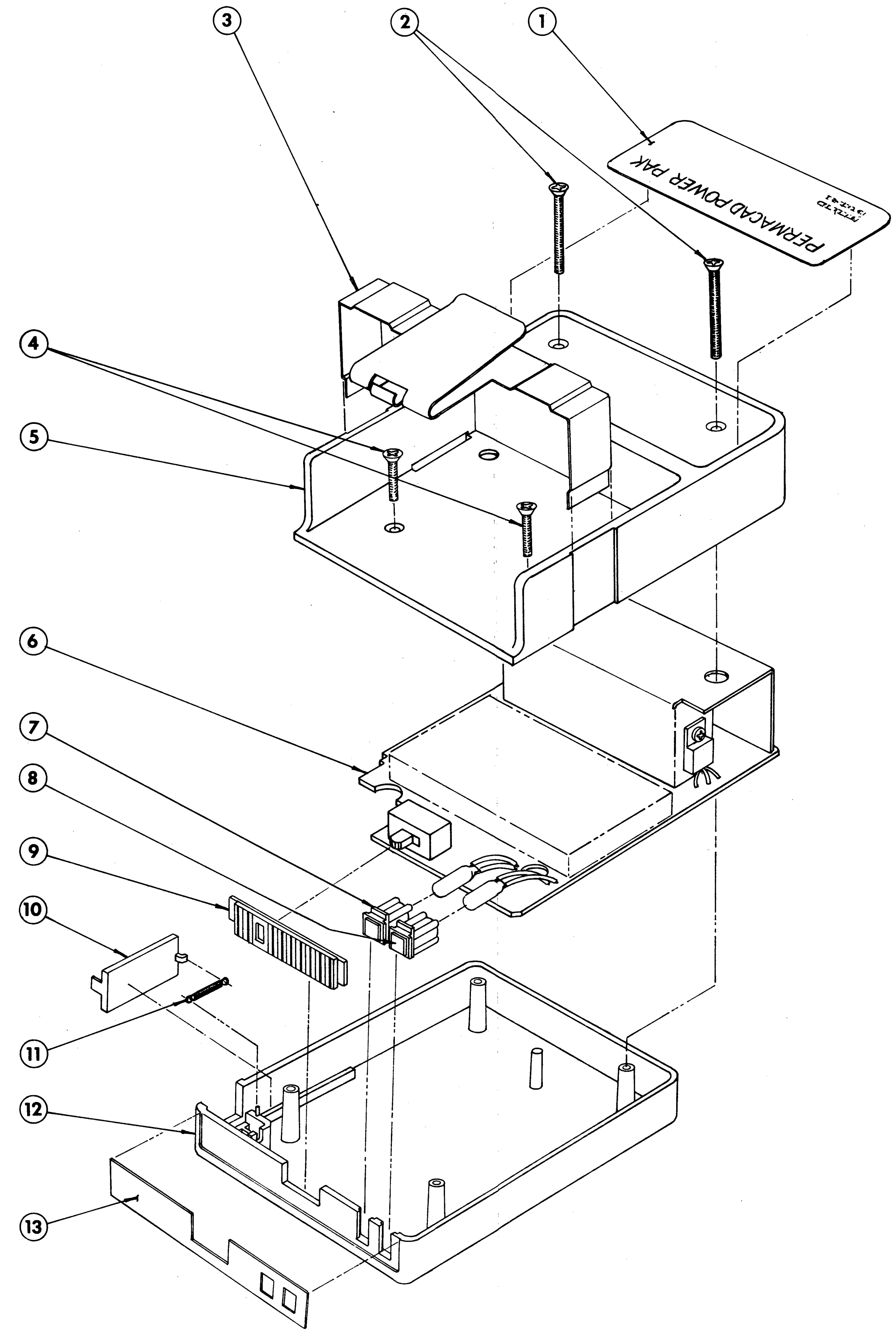


Figure 5-1.
Exploded View -
Permacad Power Pak

REF		HONEYWELL PART NO.	DESCRIPTION	QTY
INDEX	SCHEM			
		Not Supplied	Permacad Power Pak Circuit Board Assembly	1
1		H73003468 001	Circuit Board	1
2		H73003343 001	Heat Sink	1
3	T1	H73003366 004	Transformer, Power	1
4	CR1	H73003381 001	Diode, Zener, 47V	1
5	R2	H16758183 828	Resistor, 470 ohm, ½W, 10%	1
6		H73002938 001	Heat Sink Compound	A/R
7		H73001251 304	Screw	1
8	Q1	H73003317 002	Transistor, Power, NPN	1
9	CR2	H73001970 001	Diode, 50V	1
10	R1A	H16750078 014	Resistor, 30 ohm, 2W, 5%	1
11	C10	H73003664 113	Capacitor, .1 uf, 250V	1
12	R1B	H73004070 △2	Resistor △2 1W, 5%	1
13	Q5	H73003382 001	Transistor	1
14	CR5	H73000056 001	Diode, 6.8V, Zener	1
15	R11	H16758183 829	Resistor, 560 ohm, ½W, 10%	1
16		H73003557 001	Spring	2
17		H16100456 001	Eyelet	2
18	PUT 2	H73003316 001	Programmable Unijunction Transistor, Silicon	1
19	CR3	H73001970 001	Diode, 50V	1
20	R12	H16758183 832	Resistor, 1K, ½W, 10%	1
21	Q2	H73003382 001	Transistor, Silicon, NPN	1
22	CR6	H73003522 002	Diode, 75V	1
23	R3	H16758183 816	Resistor, 47 ohm, ½W, 10%	1
24	CR8	H73000204 001	Diode, Zener, 7.3V	1
25	CR7	H73000204 001	Diode, Zener, 7.3V	1
26	Q3	H73001889 002	Transistor, Darlington, NPN	1
27	Q4	H73003222 001	Transistor, Signal, NPN	1
28	R21	H16758183 822	Resistor, 150 ohm, ½W, 10%	1
29	R22	H16758183 582	Resistor, 22K, ½W, 10%	1
30	R14	H16758183 820	Resistor, 100 ohm, ½W, 10%	1
31		H16750977 438	Sleeving	4
32	DS1	H73003265 004	Lamp, Incandescent	1
33	DS2	H73003265 004	Lamp, Incandescent	1
34	R6	H16758183 523	Resistor, 82 ohm, ½W, 10%	1

REF INDEX	REF SCHEM	HONEYWELL PART NO.	DESCRIPTION	QTY
35	C9	H73003202 013	Capacitor, 1 uf, 35V	1
36	S1	H73002908 001	Switch, 3PDT	1
37		H73002919 001	Switch Spacer	1
38		H73003923 001	Contact Assy, Male	1
39		H73003923 002	Contact Assy, Female	1
40	R24	H16758183 615	Resistor, 510K, ½W, 10%	1
41	CR13	H73003531 354	Diode, Zener, 130V	1
42	R19	H73003356 530	Resistor, 200K, ¼W, 1%	1
43	CR14	H73003531 261	Diode, Zener, 200V	1
44	R20	H73003356 △3	Resistor △3 ¼W, 1%	1
45	SCR1	H73002511 007	Rectifier, 20 ua, 60V	1
46	R10	H73003517 618	Resistor, 1.5 M, ½W, 1%	1
47	R16	H73003356 △4	Resistor △4 ¼W, 1%	1
48	C8	H73002426 008	Capacitor, 2200 pf, 50V	1
49	R15	H16758183 654	Resistor, 22M, ½W, 5%	1
50	PUT 1	H73003316 002	Programmable Unijunction Transistor,Silicon	1
51	R17	H16758183 869	Resistor, 1M, ½W, 10%	1
52	CR10	H73000204 001	Diode, Zener, 7.3V	1
53	R23	H16758183 614	Resistor, 470K, ½W, 10%	1
54	C6	H73001150 032	Capacitor, .01 uf, 500V	1
55	C5	H73002426 016	Capacitor, 820 pf, 50V	1
56	R5	H16758183 864	Resistor, 390K, ½W, 10%	1
57	CR9	H73000204 001	Diode, Zener, 7.3V	1
58	C4	H73003202 013	Capacitor, 1 uf, 35V	1
59	R9	H73003356 347	Resistor, 3.01K, ¼W, 1%	1
60	R13	H73003356 △5	Resistor △5 ¼W, 1%	1
61	C1	H73003664 113	Capacitor,.1 uf, 250V	1
62	CR4	H73002061 002	Diode, 600V	1
63	C3	H73003602 001	Capacitor, 10 uf, 500V	1
64	CR11	H73002061 002	Diode, 600V	1

NOTES:

△1 Apply heat sink compound to transistor Q1 surface facing heat sink.
△2 Refer to paragraph 3-10 for selection of resistor R1B.
△3 Refer to paragraph 3-11 for selection of resistor R13.
△4 Refer to paragraph 3-12 for selection of resistor R16.
△5 Refer to paragraph 3-13 for selection of resistor R20.

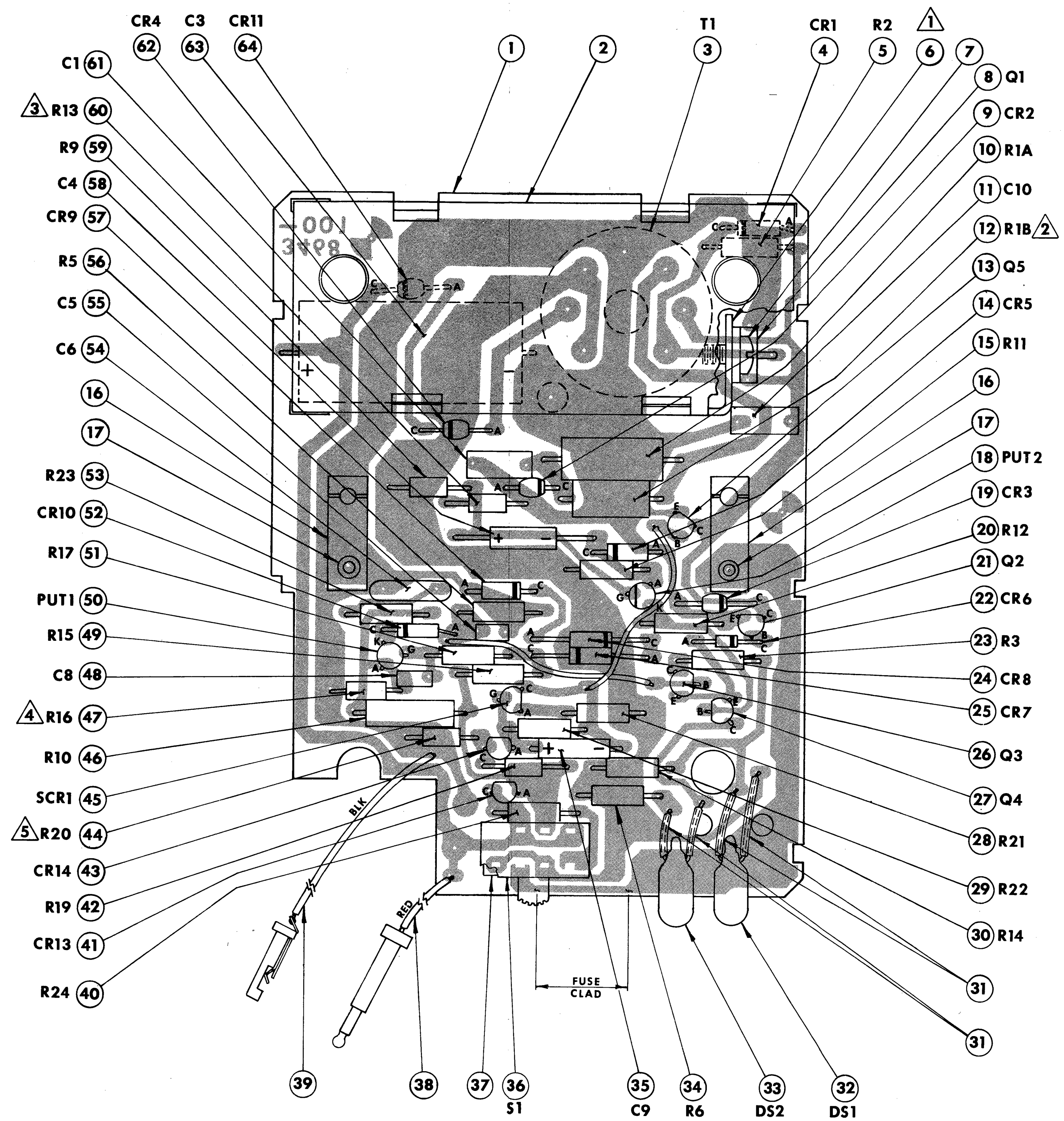


Figure 5-2.
Circuit Board Assembly - Power Pak

REF		HONEYWELL	DESCRIPTION	QTY
INDEX	SCHEM	PART NO.		
		Not Supplied	Permacad Charger Assy	1
1		H73003391 001	Nameplate	1
2		H73003544 324	Screw	2
3		H73003544 310	Screw	2
4		H73003345 002	Rear Case Half	1
5		H73003368 001	Circuit Board Assembly (See Figure 5-4)	1
6		H73003471 001	Switch Cover	1
7		H73003378 001	Lens, Red	1
8		H73003344 005	Lower Case Half	1
9		H73003390 001	Front Decal	1

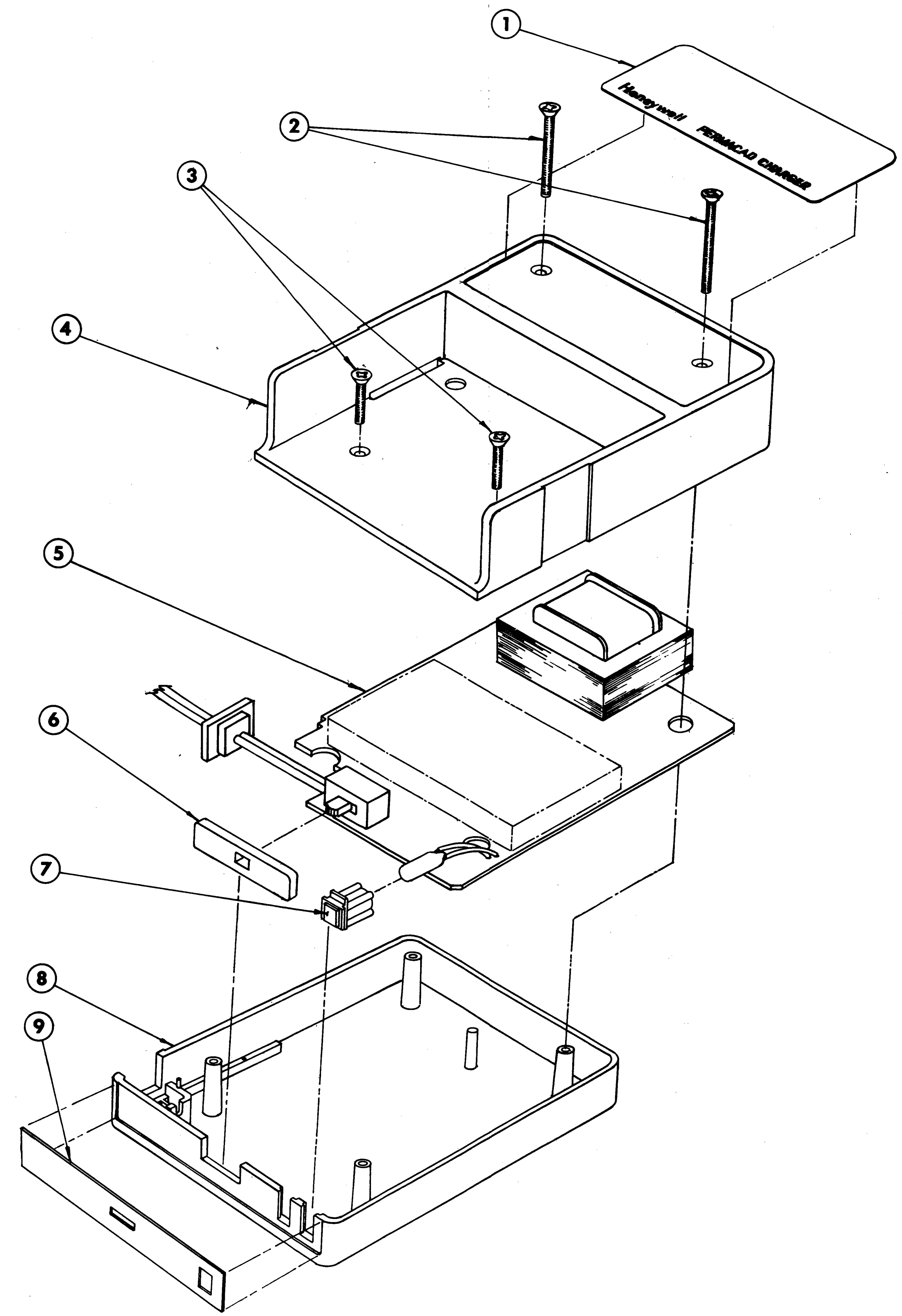


Figure 5-3.
Exploded View -
Permacad Charger

REF INDEX	REF SCHEM	HONEYWELL PART NO.	DESCRIPTION	QTY
		Not Supplied	Permacad Charger Circuit Board Assembly	1
1		H73003468 002	Circuit Board	1
2	2T1	H73003393 002	Transformer	1
3	2R1	H73000948 144	Resistor, 6.2 ohm, 2W	1
4		H16100456 001	Eyelet, .085 Dia.	2
5		H73003557 001	Spring	1
6	2CR1	H73001970 001	Diode, 50V	1
7		H16750977 142	Sleeving	2
8	2DS1	H73003265 003	Incandescent Lamp	1
9		H73002919 001	Switch Spacer	1
10	2S1	H73002908 001	Switch, 3PDT	1
11		H73003389 001	Cord, AC	1

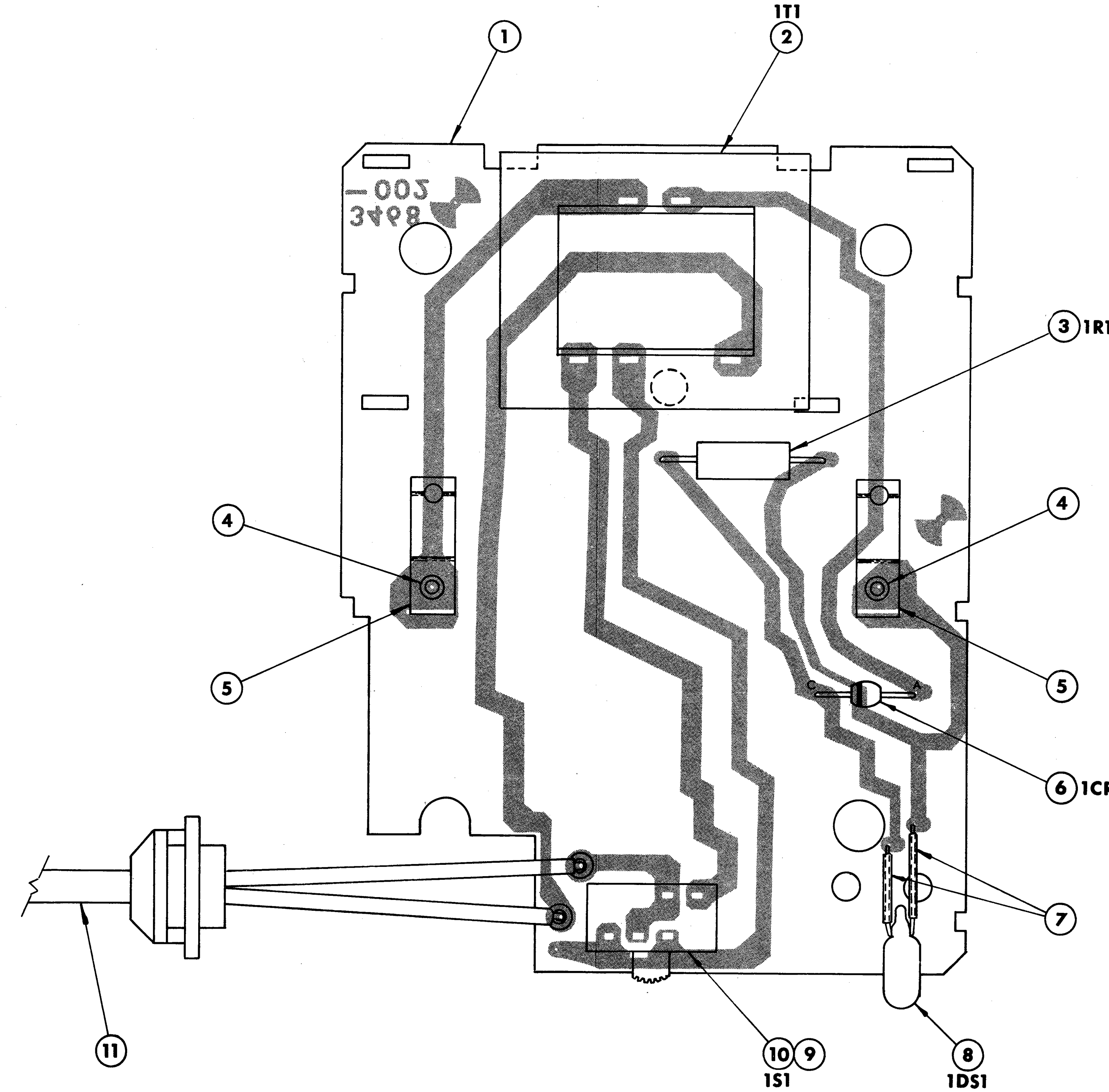
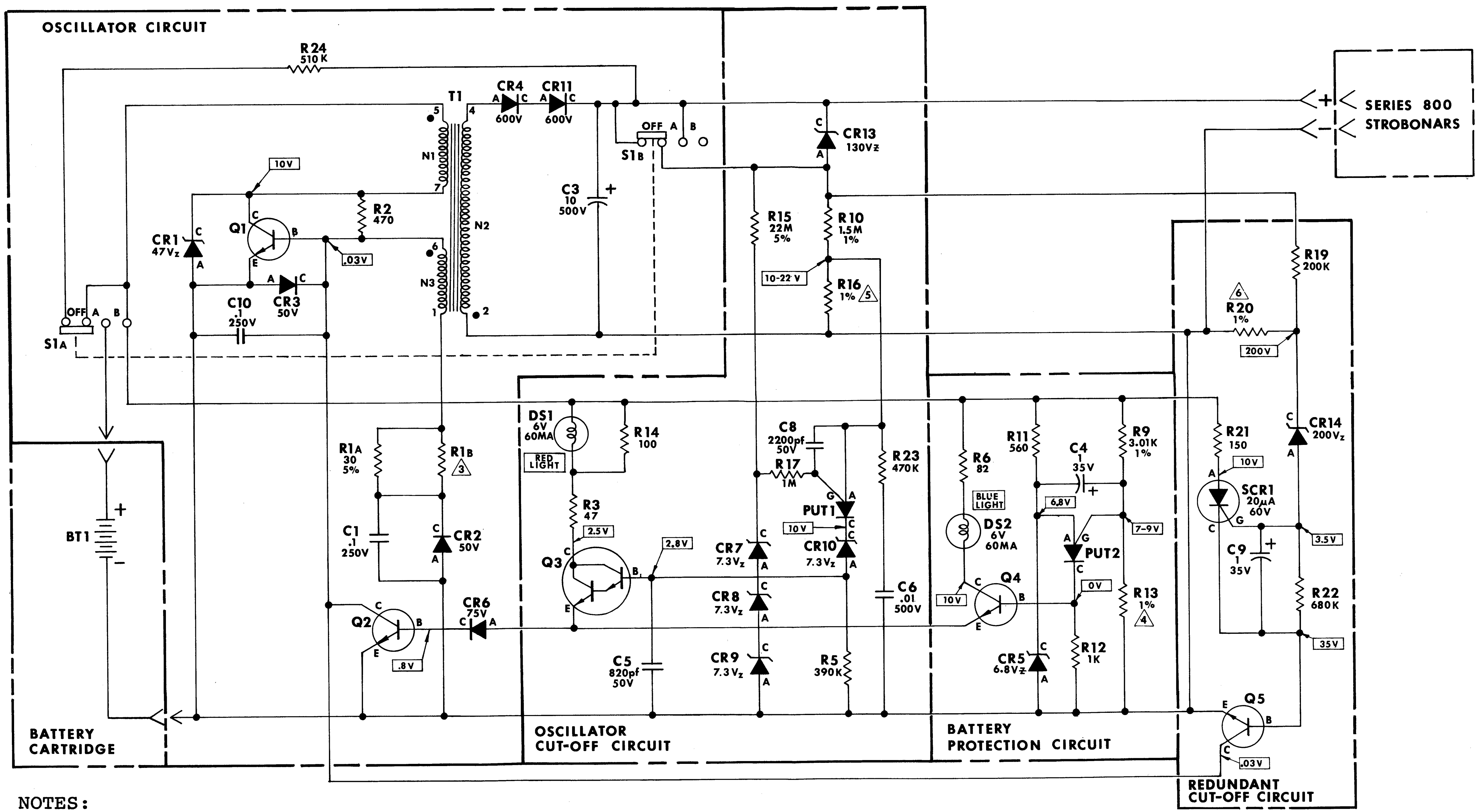


Figure 5-4.
Circuit Board Assembly - Charger



NOTES:

1. All resistance values in ohm, ¼W, 10%.
2. All capacitance values in microfarads.
3. Refer to paragraph 3-10 for selection of resistor R1B.
4. Refer to paragraph 3-11 for selection of resistor R13.
5. Refer to paragraph 3-12 for selection of resistor R16.
6. Refer to paragraph 3-13 for selection of resistor R20.
7. Test voltages taken with oscillator at cutoff with switch S1 in the A (half-power) position.

Figure 5-5.
Schematic Diagram -
Power Pak

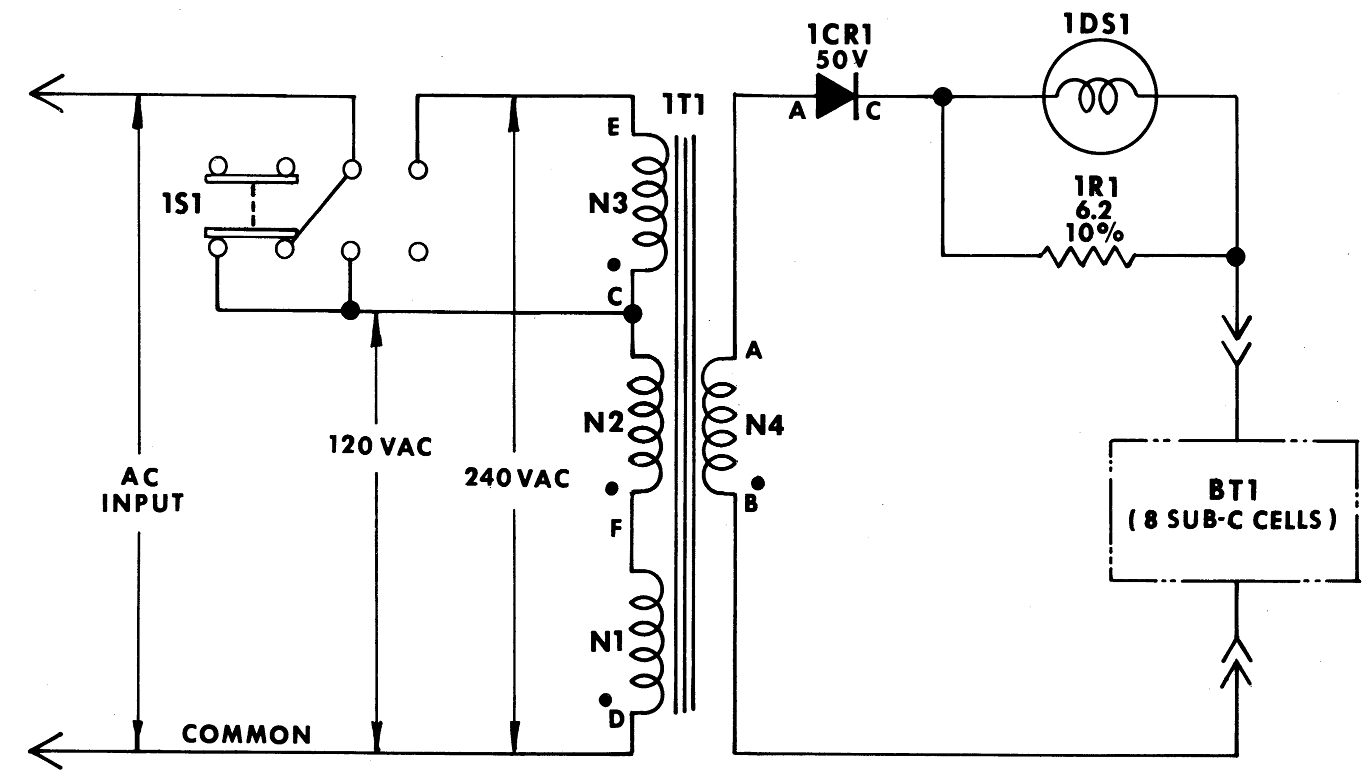


Figure 5-6.
Schematic Diagram -
Charger