THEORY OF OPERATION

POWER SUPPLY

FOR 2105A/2108A/2112A PROCESSORS (21MX COMPUTER SERIES)

Part No. 02108-90022

Printed: MAY 1976

NOTE

This document is part of the 21MX Computer Series Engineering Supplement Package and is not available separately.

Contents

Section	Page
General Information	1
Electrical Description	2
General Operation	3
Power Supply Signals	3
PWU	5
$\overline{\text{PON}}$	5
MLOST	5
Lower Board Operation	5
Input Rectifier and Voltage Doubler	7
Internal Supplies and Power Up Sense Circuit	7
Clock and Pre-Regulator Enable	8
Pulse Width Modulator	9
Pre-Regulator Level Shifter	10
Pre-Regulator Power Stage	10
Pre-Regulator Slow Turn-Off	12
High Voltage Crowbar Circuit	13
Pre-Regulator Current Sense	13
Line Voltage Sense	14
Battery Charge and Test Load	14
CPU and Memory Inverters	15
Control Loop Circuit	15

Figures

Title	Page
Power Supply State Transition Diagram	4
Lower Board Block Diagram	6
Lower Board Waveforms	9
Q1 Collector Waveform	11
Q1 Power Consumption	12
T1 Voltage — Current	13

1. GENERAL INFORMATION

The Power Supplies for the 2105/2108 Processors are complex circuits which supply the necessary regulated DC voltages and coordinated logic signals for operation of the CPU, memory and I/O interface cards of the 21MX Computer Series. The required input power is from an input AC power line from 47 to 64 Hz and over a voltage range of 110 ±20% VAC or 220 ±20% VAC. Maximum input voltamperes of the 2108 are approximately 650 and the maximum input voltamperes of the 2105 are approximately 450. The overall efficiency of the power supplies range between 65% and 80%, depending upon loading.

The power supplies operate in four different modes. These are:

1. Operate
2. Line standby
3. Battery standby
4. CPU-MEM Alarm

The computer itself does not distinguish between the line standby mode and the battery standby mode, but these two states are entirely different within the power supply.

In the operate mode, all output voltages are present and current is available up to the full capacity of each output. In the two standby modes, only those voltages necessary to permit the semiconductor memory to retain its contents are present. In CPU-MEM alarm all voltages associated with respective alarm are shut down, requiring a reset to line standby mode for normal operation to resume.

As the two standby names imply, the line standby mode receives input power from the AC line power plug whereas the battery standby mode operates off of power supplied from a 12 volt storage battery.

The optional nickel cadmium battery supplied with the computer, when fully charged, provides standby power for at least two hours. Longer standby periods may be realized by the use of a larger external storage battery of voltage range 10 — 14 VDC and of approximately 3.5 amp hr capacity per 2 hours of desired standby time. It should be noted that the CPU power supply provides a constant current charge of 250 mA to the battery whenever AC line power is present.

The supply output voltage specifications and their current ratings are shown below, with an * indicating those voltages which are present only during the operate mode.

OUTPUT TERMINAL VOLTAGE	2108		2105		MAXIMUM VOLTAGE DEVIATION
	OPERATE CURRENT	STANDBY CURRENT	OPERATE CURRENT	STANDBY CURRENT	
+5 volts (CPU and I/O)	35	*	25	*	±0.25V
-2 volts (CPU and I/O)	5	*	5	*	±0.40V
+12.0V (I/O)	3	*	2	*	±0.5V
-12.0V (I/O)	-3	*	-2	*	±0.5V
+5.0V (mem)	5	5	5	5	±0.25V
+12.5V (mem)	1.8	0.5	.5	.5	±0.5V
-12.5V (mem)	1.8	0.5	.5	.5	±0.5V

*Indicates that this output voltage is 0 during standby mode.

Physically the power supplies consist of two major P.C. board assemblies and five minor P.C. board assemblies.

The two major assemblies contain all circuits necessary for full operation from the AC power line. Three of the minor assemblies contain circuits which in conjunction with the two major assemblies permit standby operation from a 12 volt battery.

The remaining two minor boards serve only to interconnect the two major board assemblies.

Of the two major board assemblies, one contains all circuits associated with the isolated output voltages and control logic. This board has no voltages present greater than +28 VDC. This board (5060-8349 or 5060-8355) is located directly under the top cover of the computer, circuit side up when the supply is installed.

The other major assembly contains circuits associated with the power line input and other circuits where hazardous voltages in excess of 350 VDC are present. This board (5060-8343 or 5060-8354) is inaccessible when the supply is installed in the computer.

Transformers and optical isolators provide isolation in excess of 1500 volts between the supply outputs and the input power line. Practices necessary for UL recognition have been observed.

2. Electrical Description

The operate and line standby modes of operation employ a combination of a high voltage DC switching preregulator, two multi-output DC to DC converters and several series pass regulators.

The battery standby mode of operation employs three independent switching regulators.

All power switching in the regulators and DC to DC converters is performed at a frequency of approximately 20 kHz.

This frequency of operation results in very small size and weight of magnetic components and capacitors and produces no audible noise.

The preregulator and DC to DC converters share a common clock.

The battery powered regulators share a separate clock.

The major energy storage in the supply occurs at the line input capacitors at approximately 300 VDC. Energy storage at this high voltage, prior to the preregulator allows the computer to operate undisturbed despite line dropouts of several cycles and permits the memory to hold up for several hundred milliseconds even without a standby battery installed.

3. GENERAL OPERATION

Referring to the state transition diagram in figure 1, at initial point when all power is off to supply and AC voltage is applied the power supply moves to the line standby state, Memory lost signal will be generated due to the fact that prior to entering line standby no memory supply voltages were present — therefore, contents of memory have been lost. At approximately 70 — 75 volts AC supply will output memory voltages. A reset of power supply logic is performed by the key switch on the front panel of the computer (or via rear panel power control connector) in order to prepare power supply to enter operate state. The key switch is then turned to operate, allowing the power supply to enter the operate state if the input AC line is sufficiently high which is determined by PUUP sense circuitry. In the operate state all CPU voltages are up and in regulation and all CPU timing and control signals generated in the supply are issued. The supply can be returned to the line standby state by turning the key switch to standby position or by removing the AC input voltage. By doing so the CPU is shut down in an orderly manner such that it can be re-enabled with little problem. When returned to line standby by switch, power supply will remain in that state until switched to operate in a power down condition, unit will remain in line standby state long enough to determine if power-fail recovery option has been installed. If the option is not available the power supply will completely power down and initial power up procedure will be followed on powering supply up again.

If power fail system has been installed and battery is sufficiently charged and AC power down, the power supply enters battery standby state where memory voltages are maintained and memory overvoltage and undervoltage sense circuitry remains active. If at any time in battery standby state the battery becomes discharged the power supply will also completely power down and initial power up procedure will be followed. If battery remains charged, on AC power up, if front panel switch is in operate, power supply will enter directly into operate state.

Under the conditions of a CPU or memory overvoltage or overcurrent it enters the appropriate alarm state. In the CPU alarm state, all CPU voltages are shut off while memory voltages remain unaffected. In the memory alarm state all output voltages are shut down. Operate state may be re-entered by turning front panel switch to reset — then back to operate. If, though, the overvoltage or overcurrent still exists the supply will re-enter the alarm state. This condition will continue to exist until the overvoltage or overcurrent condition is removed.

4. POWER SUPPLY SIGNALS

The power supply provides three signals to the CPU for computer operation. These signals are 1) power up (PWU), 2) power on (PON), and 3) "not" memory lost ($\overline{\text{MLOST}}$). The following paragraphs provide a functional description of these signals.

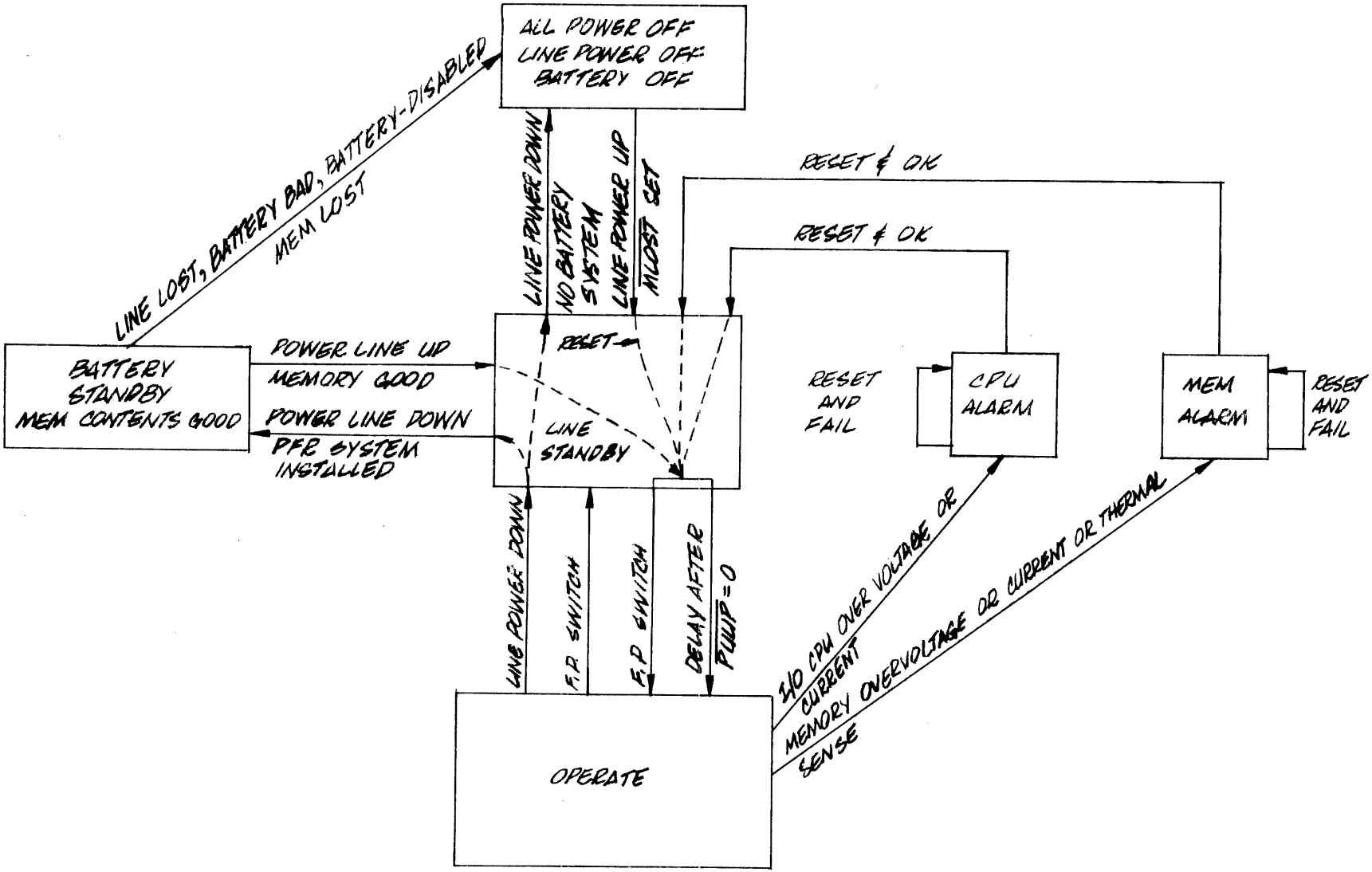


Figure 1. Power Supply State Transition Diagram

4.1 PWU

This signal is high whenever the power supply is in the operate state and the line voltage is within proper tolerances. PWU will go low immediately upon detection of a line voltage failure or alarm condition.

The function of PWU is to initiate a power fail software routine on its falling edge and an auto restart software routine on its rising edge. After PWU switches low for a line voltage failure or by rotating the key-operated switch from OPERATE to STANDBY, all output voltages will remain in regulation for a minimum of 500 μsec to permit execution of the power fail software routine. Upon restoration of power or by rotating the key-operated switch from STANDBY to OPERATE, PWU will go high within approximately one second.

4.2 PON

This signal is similar to PWU except that PON remains high for 500 μsec to 1 msec after PWU switches low. PON switches high simultaneously with PWU. The purpose of PON is to allow the CPU to access memory when the computer operating voltages are within tolerances, and to inhibit the CPU from accessing memory when computer operating voltages are low. Low operating voltages could cause the CPU to write erroneous data into memory.

4.3 $\overline{\text{MLOST}}$

This signal is low whenever there is a possibility that erroneous data may be in memory as a result of memory power supply voltages being out of tolerance, which may occur during initial power up. Automatic restart capability is inhibited whenever $\overline{\text{MLOST}}$ is low. A reset must be performed by the front panel switch or rear panel power control connector to enter the operate state when $\overline{\text{MLOST}}$ is low. Following a reset, rotate key-operated switch from STANDBY to OPERATE. $\overline{\text{MLOST}}$ will remain low for several milliseconds after PON and PWU switch to high. This will indicate to the CPU that a software routine to clear memory of any erroneous data must be performed. The conditions which will cause $\overline{\text{MLOST}}$ to be low are the following:

a. Low line and battery voltages.

b. Memory voltage out of tolerance at any time.

If the power fail recovery system is installed and operating properly, $\overline{\text{MLOST}}$ will remain high through any line voltage losses provided that the battery voltage remains above 10.5 volts. This will ensure valid memory contents and allow the auto restart capability (if enabled) to be performed.

5. LOWER BOARD OPERATION

AC line voltage is directly applied to the input bridge circuitry (see figure 2), which generates the B+ level for the preregulator circuit, and to the internal supply circuitry which generates voltages used by lower board logic. As the AC level increases the 40 kHz clock circuitry becomes enabled. This circuit generates the 20 kHz squarewave for the inverter drive circuitry and the input 20 kHz sawtooth to the pulse width modulator. At approximately 70 to 80 VAC the power up sense circuit is enabled which first generates inverter enable, preregulator enable, and pulse width modulator enable. The pulse width modulator circuit receives the input sawtooth waveform from the clock circuitry and the variable DC from the error amplifier and outputs a 20 kHz pulse train of varying duty cycle which is directly proportional to the DC level from the error amplifier. The output waveform from the pulse width modulator is fed to the preregulator level

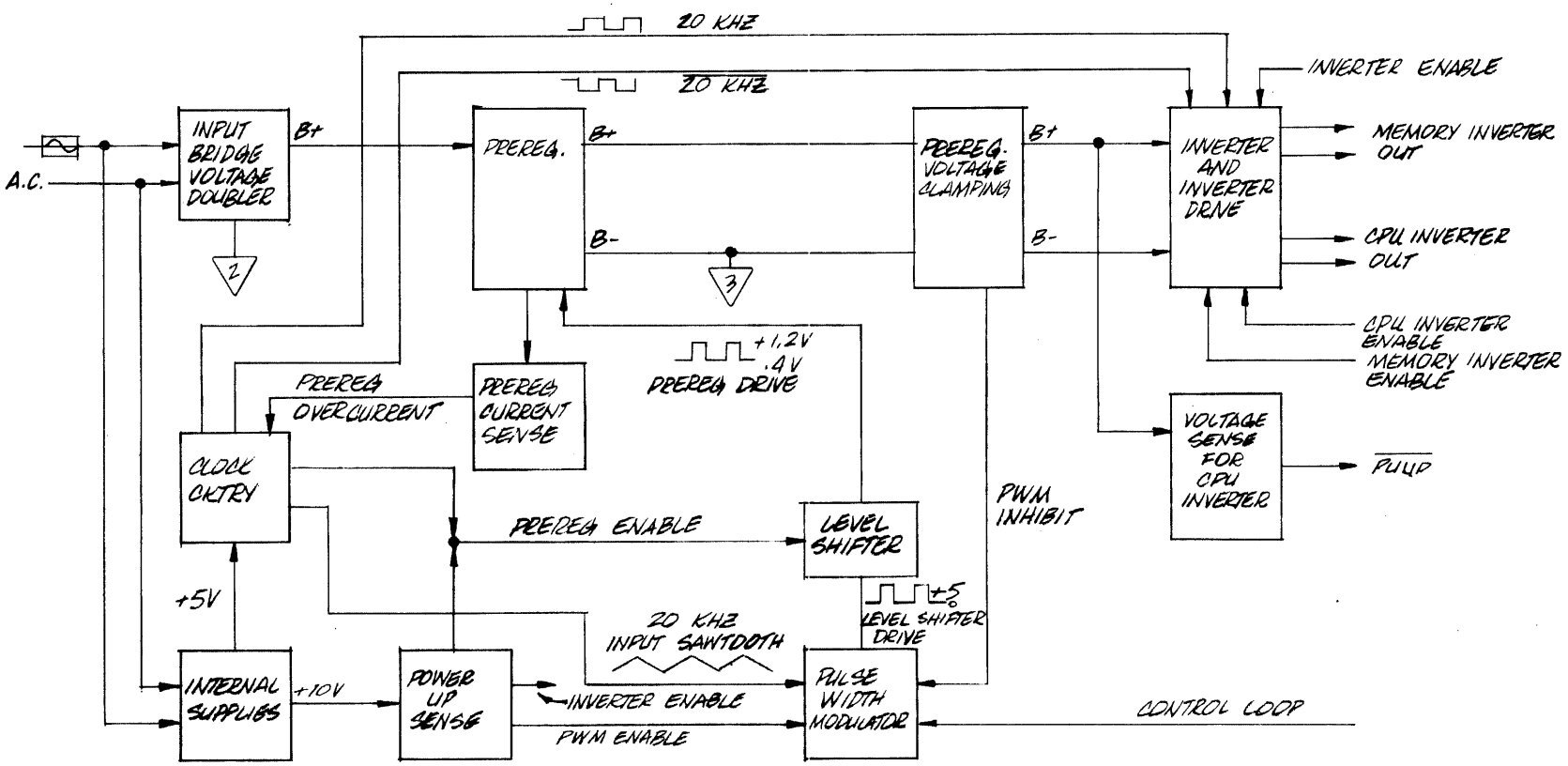


Figure 2. Lower Board Block Diagram

shifter which adjusts the waveform to conform with the biasing in the preregulator. The preregulator receives the waveform from the level shifter and converts it to a varying DC level, labeled B- or common point # 3. This DC level is proportional to the duty cycle of the input waveform so it can be seen that the error amplifier's DC level is transformed into a B- DC level by way of analog to digital and digital to analog conversion. A current sense line is taken from the preregulator and at any time excessive preregulator current is drawn a preregulator overcurrent signal is generated which shuts off the level shifter circuitry and removes the drive signal to the preregulator. B+ is also fed into the high voltage crowbar circuitry which senses if B+ exceeds 400V. If this condition occurs the crowbar circuitry is activated and B+ is shorted to ground which blows the AC input fuse. B+ is also fed to the line voltage sense circuitry. At 88 VAC (or other line voltage set by variable resistor R120) B+ has reached sufficient level to activate the sense circuitry causing $\overline{\text{PUUP}}$ to go low and allowing CPU inverters and CPU output voltages to come up. B+ and B- are finally fed to the inverter and inverter drive circuitry which is designed to generate an inverter output waveform by switching between B+ and B-. These two square waves are applied to the primaries of the CPU and memory power transformers located on the upper power supply PCA. Connected to the memory inverter output is the bootstrap supply circuitry. This circuit aids the internal supplies and bypasses surge limit resistance in the bridge circuitry for more efficient operation of the lower board circuitry.

6. INPUT RECTIFIER AND VOLTAGE DOUBLER

On initial power up, B+ is generated through CR45, CR44, CR41 and CR40 bridge circuit which is in series with R57. R57 acts as surge limit resistor for charging capacitors C1 and C2. Once line voltage has risen sufficiently to enable and maintain the memory inverters, part of the inverter signal is coupled back through T4 to the gates of CR49 and CR50 turning them on. This then creates a bypass circuit around R57, increasing efficiency under load. CR51 and CR48 are inserted in the gate circuitry to prevent reverse biasing. Since the gate signal fed from T4 is 20 kHz, the SCR's are effectively turned on all the time while the memory inverter is enabled.

The B+ level is fed to C1 and C2 which are in series. If the unit is to be operated on 110 VAC a jumper is inserted on the rear panel terminal block, connecting the neutral of the line to the junction of C1 and C2 creating a voltage doubler. In 220V operation the jumper is removed and B+ is derived directly from the bridge circuit.

7. INTERNAL SUPPLIES AND POWER UP SENSE CIRCUIT

Line voltage is applied to 60 Hz transformer T4 and power is taken from the two secondary windings. One winding supplies power to the upper board internal supplies. The other winding is applied to CR30 diode bridge to obtain +10V (Vx) and -10V (V_y). The CR29 bridge acts as a bootstrap supply. Once the memory inverters are enabled power is fed through T4 to the bridge and ±10V in order to compensate for the increased load. The +10V (Vx) supply besides being used directly, also supplies power to the +5V regulator U5 which is used as a supply for all lower board chips. C28 between pins 1 and 3 of U5 is for filtering. C13 has been added to smooth out the voltage fluctuation caused by the interval between when the load on +10V is increased by enabling memory inverters, and when T4 is capable of supplying enough power to compensate for the load increase.

In the power up sense circuit +10 is applied to the emitter of Q14 via diode CR47. At the same time the voltage at the emitter of Q14 is fed to zener CR64 via R123 and is coupled to the base of Q14 by R60. At the point where the emitter is one diode drop above the zener voltage Q14 conducts. U4A is switched on after a slight delay caused by the R77, CR55, C41 and R76 time constant in order to allow +10V to stabilize and C13 to fully charge before enabling the inverters. As U4A is turned on U4B is turned off, allow-

ing inverter enable to go high. At the same time U4C is turned off allowing preregulator enable to go high. U4D is also switched off which, after a delay determined by R63 and C34, allows the pulse width modulator to operate. This is to ensure that the inverters are operating before enabling the preregulator circuitry since preregulator control is dependent on the operation of the inverters.

Two hysteresis loops are incorporated into the power up sense circuitry. One created by R48 to compensate for slight voltage fluctuations during initial power up. The other is created by T4 which supplies the sense circuitry, once the memory power supply is activated, with a voltage which is stable over a wide range of line input voltage.

8. CLOCK AND PRE-REGULATOR ENABLE

The clock circuit consisting of U8B generates a 40 kHz, 90% duty cycle pulse train (see figure 3), that is used to derive all lower board waveforms. +5V lower board is fed to the non-inverting input of U8B by R62 and R71 divider. This causes the output of U8B to go high, which, in turn is fed back by R73. At the same time the output is also fed back to the inverting input of U8B by the R72 — C32 RC network. At the point where the level on the inverting input of U8B exceeds that of the non-inverting input, the output goes low and is held there for a predetermined period by the C32 — R64 network. The output then goes high and the oscillation repeats.

The pulse train is applied to U13A 'D' flip-flop. Both direct set and clear are disabled and the $\overline{Q}$ side is connected to the 'D' input to obtain a divide-by-2 function. The $\overline{Q}$ side is also connected to U12A which in conjunction with the pulse train from the clock circuit generates a 95% duty cycle pulse train at 20 kHz as seen in figure 3. This then drives U13B, which is the preregulator enable flip-flop. Both Q and $\overline{Q}$ sides of U13A are used as the input signals for the inverters as seen in figure 3.

The Q side of U13A is connected to the sawtooth generator for the pulse width modulator. U13B is wired such that as soon as a clock is applied it will set, turning U12B on which generates preregulator enable. The direct reset on U13B is connected to the preregulator current sense. If excessive peak current is drawn by the pre-regulator circuit then the sense line is brought low, disabling operation of the preregulator for the duration of the current 20 kHz cycle. This pre-regulator current limit is independent of the output voltage current sense circuits and serves primarily to protect preregulator transistor Q7 from excessive peak currents during transient conditions.

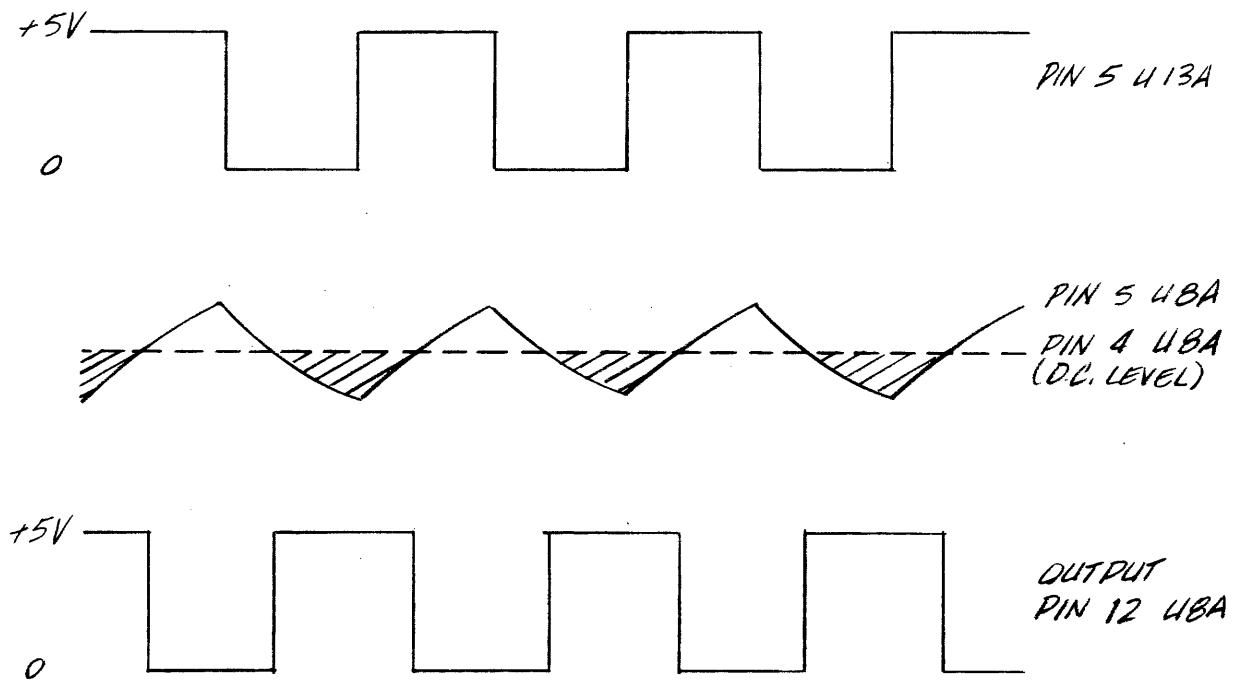


Figure 3. Lower Board Waveforms

9. PULSE WIDTH MODULATOR

The square wave output from U13A is applied to Q11 which generates a sawtooth waveform (see figure 3). This sawtooth waveform is applied to the inverting input of U8A. The non-inverting input is connected to a varying DC level generated by U11. The resulting output waveform at pin 12 is dependent on the DC level with respect to the sawtooth waveform. If the DC level is more negative than any part of the sawtooth, the output is always low. If the DC level is more positive than any part of the sawtooth, the output is always high. When the condition exists as in figure 3 where the DC level is at an intermediate level, a pulse train at pin 12 results. This is caused by the fact that whenever the DC level is more positive than the sawtooth (indicated by slashed lines) the output will be high and when the level is more negative the output will be low. As can be seen, changing the DC level with respect to the sawtooth will alter the times in which the output is high or low, thus allowing the ability to change the duty cycle of 'on' time with respect to pulse period. This is then used as a form of analog to digital converter, creating a drive waveform for the pre-regulator which, in turn acts as a high power digital to analog converter.

Diode CR46 is used by the power up sense circuitry to keep the output of the pulse width modulator at zero duty cycle and the preregulator off during initial power up.

10. PREREGULATOR LEVEL SHIFTER

The signal from the pulse width modulator enters U3 where it is gated by preregulator enable, generated by the power up sense circuitry. The open collector output transistors of U3 begin switching between a floating state and ground. R56 and R54 are used as pullup resistors to the input lines for U3.

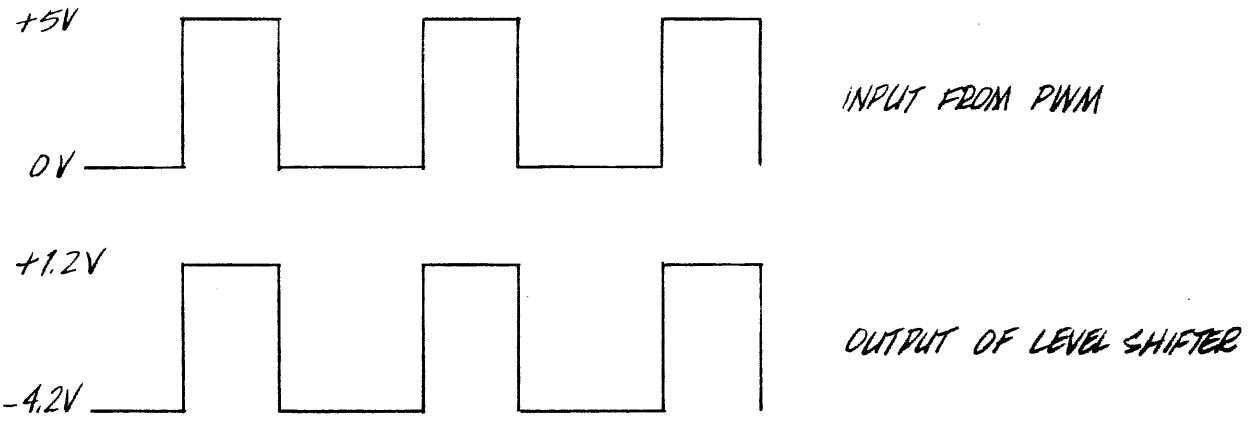
As the PWM input to U3 goes high the upper half of U3 switches Q10 on through R34. Q10 when switched on applies current from 5V through R33 — CR34 to the base of Q2 at E6. Q2 acts as a darlington driver for Q1. At the same instant the lower half of U3 turns Q12 off, which in turn removes the forward bias on Q9 turning it off.

As the pulse train goes low the upper half of U3 switches Q10 off while the lower half switches Q12 on, through R55. This creates a forward bias condition on Q9 which switches a negative current from a -4.22V source created by CR37, through R26 to E6 at the base of Q2 and through CR28 to the base of Q1.

This reverse base current on Q2 and Q1 improves the turn off time of Q1 and Q2 and is followed by reverse base emitter biasing on Q1 and Q2 in approximately 1 μsec as these transistors turn off. CR11 and CR34 serve as an anti-saturation clamp for Q1 and Q2 further improving turnoff time.

CR32 and CR33 together with R26 serve only as a protection circuit to shunt voltage away from other circuits in the event that Q1 fails with a Base-Collector short and open emitter.

As can be seen in diagram below, the resulting waveform at E6 is of the same phase as the input waveform but switches between -4.2V and +1.2V.



11. PREREGULATOR POWER STAGE

The preregulator power stage consists primarily of Q1, L1, CR5, input capacitors C1 and C2 and output capacitors C4, C11 and C12. Q1 and CR5 act as a switch controlled by the variable duty cycle of the pulse width modulator.

When Q1 is in the on state current flows from the + side of input capacitor C1 (B+) through the parallel combination of the output capacitors and the two inverter circuits to - preregulator output at inverter common. From inverter common current flows through inductor L1 and through Q1 back to the negative side of input capacitor C2 at preregulator common.

During this state a voltage appears across L1 which is equal to the difference between the input and output voltages of the preregulator. This voltage and the inductance of L1 determines the rate of change of current in L1:

$$\frac{dI_{L1}}{dt} = \frac{V_{in} - V_{out}}{L1}$$

The period of time during which Q1 is turned on determines the peak current level which builds up in L1 and consequently the level of energy stored in L1 and the average output current into the inverter circuits:

$$I_{p_{L1}} = T_{on} \frac{dI_{L1}}{dt} \quad \text{peak current}$$

$$U_{L1} = \frac{1}{2} L1 \, I^2_{p_{L1}} \quad \text{energy stored}$$

When Q1 turns off, the polarity of the voltage across L1 reverses causing CR5 to become forward biased. Current continues to flow from L1 through CR5 into the output circuit at a decreasing level as the energy stored in L1 is depleted. When the current in L1 drops to zero after a time interval determined by the value of output voltage, the inductance of L1 and the level of current in L1 at turn off of Q1

$$\left(\Delta T = \frac{V_{out}}{L} I_{p_{L1}}\right)$$

the voltage across L1 drops to zero also except for some minor ringing and CR5 is again reverse biased.

During the remaining time of the present switching period the current is supplied to the inverter circuits from the output capacitors alone.

At the beginning of the next cycle of the 20 kHz switching rate this process is repeated. The waveform at the collector of Q1 is shown in figure 4.

The complete preregulator circuit starting at the input current to photo-isolator U11 at pin J2-J on the lower board and ending at output capacitors C4, C11, C12 act as a low loss current-controlled current source translating control current levels at several milliamps and 1.5 volts to output currents of several amps at approximately 150 VDC.

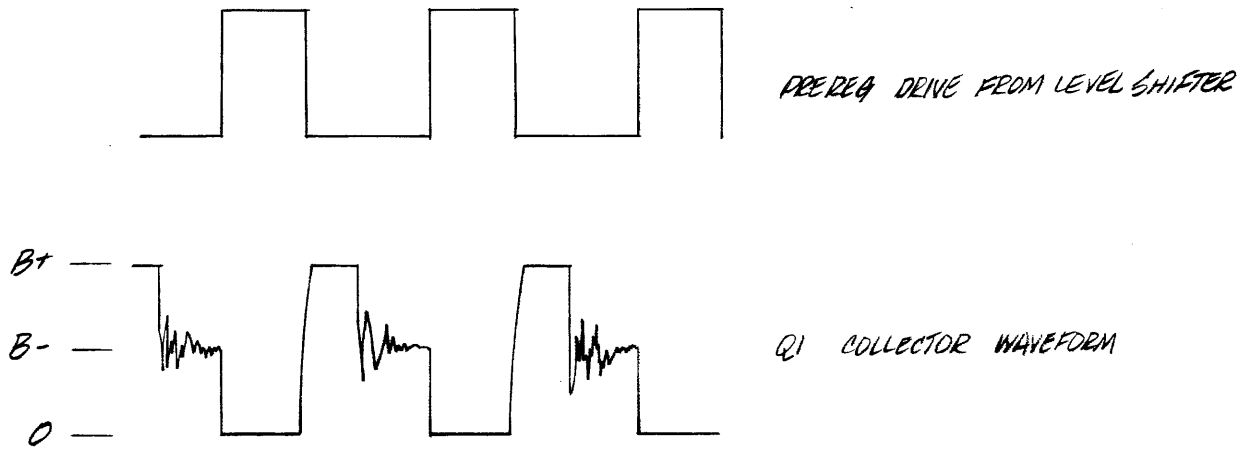


Figure 4. Q1 Collector Waveform

12. PREREGULATOR SLOW TURN-OFF

The requirement for slow turn-off is created by the basic properties of L1 in the preregulator circuit. As can be seen in figure 5, when Q1 is either fully on or fully off, very little power is consumed by it. However, a great deal of power is consumed by Q1 when making the transition from the 'on' state to the 'off' state. This is caused by the fact that as collector voltage is rising from ground to B+, current through Q1 still has the tendency to remain constant, because L1, as an inductor, opposes rapid changes in current through it. A method of minimizing this problem is achieved by creating another path for current to flow other than the transistor. This essentially describes the operation of the slow turn off circuit. The effect desired is created by current flowing through C6 and CR8 to B+. During the time Q1 is on, the side of C6 connected to CR8 is charged to 1/2 B+. As Q1 starts to switch off collector potential rises to 1/2 B+. At this point since the initial potential across C6 was 1/2 B+ and due to the fact that a capacitor opposes rapid changes in potential drop across it, the side of C6 connected to CR8 will have risen to B+ in order to maintain a 1/2 B+ potential drop across C6. At this point CR8 becomes forward biased and as Q1 collector voltage continues to rise current begins to flow through C6 which is trying to maintain its 1/2 B+ potential drop, and CR8 to B+; thus creating the second path for current needed. As can be seen in figure 5 with the

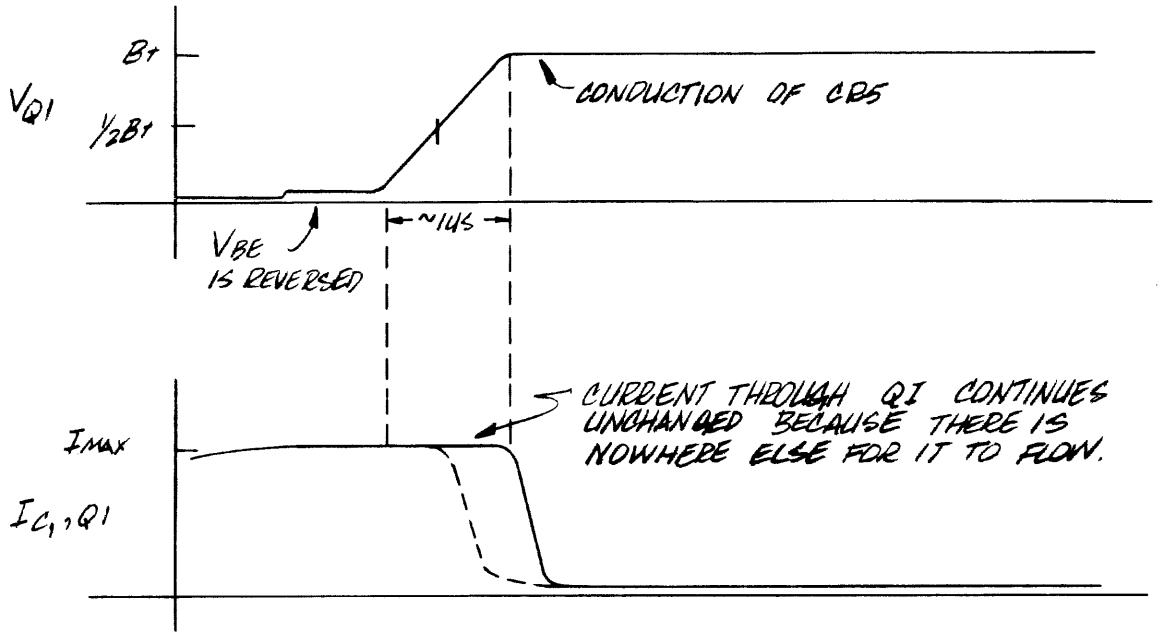


Figure 5. Q1 Power Consumption

dotted line over half of the peak power that would be dissipated in Q1 is diverted to B+. Charging of C6 is achieved in the on time of Q1 by T1 and CR7 connected to the junction of the C1 and C2 voltage doubler which acts as a supply for 1/2B+. As seen in the T1 voltage current graphs in figure 6 at the point where Q1 is about to switch on the voltage at the junction of C6 and CR8 has settled to ~ B+. As Q1 is turned on and collector potential begins to drop below B+ the potential at the junction of C6 and CR8 goes negative with respect to 1/2 B+ and current starts to flow through T1 to charge C6. This creates a back EMF in T1 which approaches -1/2 B+ as collector voltage approaches 0. As the EMF begins to break down to zero, C6 charge current through T1 reaches a maximum. EMF across T1 once again increases to 1/2 B+ until C6 is fully charged and capable of power diversion.

One problem that arises is that due to the periodic charging of C6 the potential at the junction of C1 and C2 will begin to drop, directly affecting the operation of slow turn off. This effect is compensated for by CR9, CR6 and C5. When Q1 is on the junction of CR6 and C5 is charged to ground potential. As Q1 turns off current flows to C5 and CR6 to the junction of C1 and C2 thus acting to return power lost.

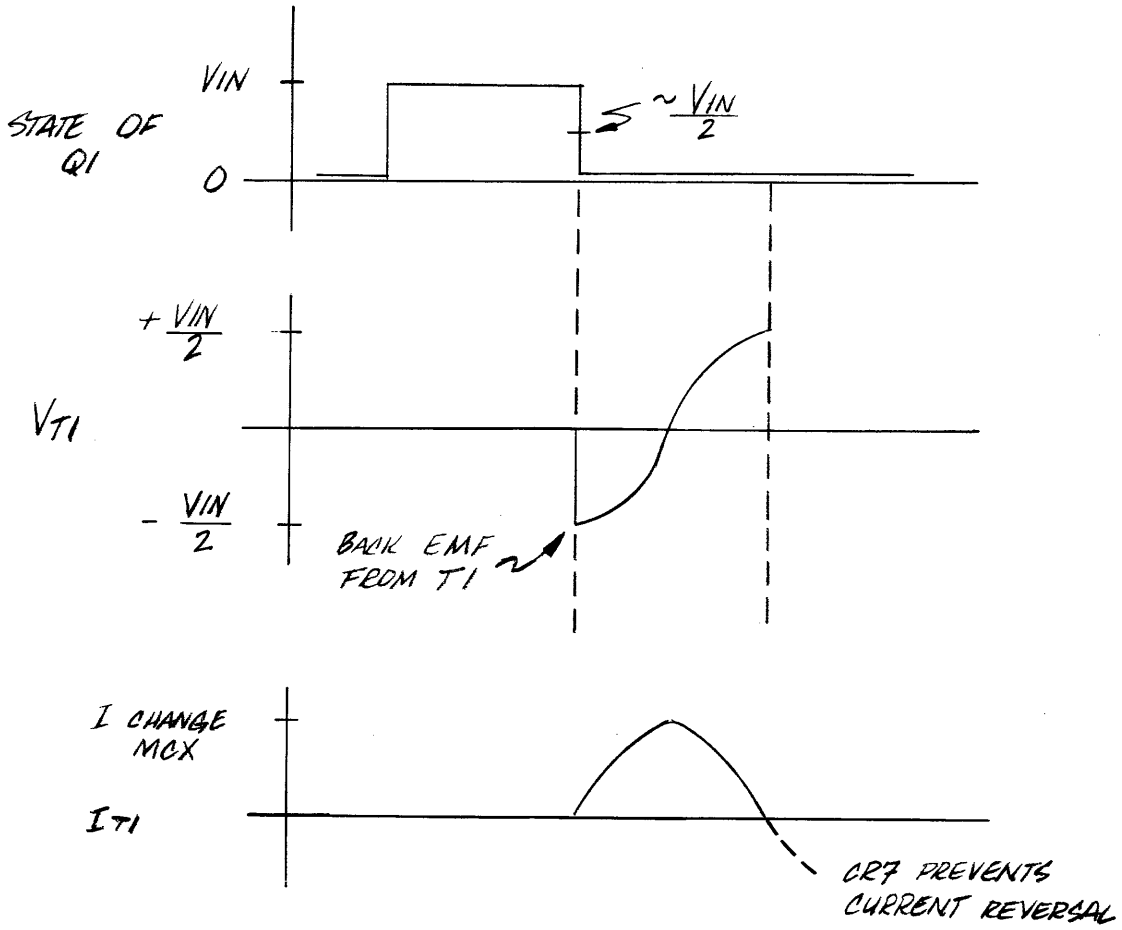


Figure 6. T1 Voltage — Current

13. HIGH VOLTAGE CROWBAR CIRCUIT

The lower board crowbar circuitry protects the power supply from excessive line voltages by shorting the input capacitors and blowing the line fuse whenever B+ exceeds 420V dc. When B+ equals 400V dc, zener diodes CR2 and CR3 begin to conduct, charging C53 through R10. When C53 is charged to approximately 20V dc, diode CR31 fires, discharging C53 into the gate of SCR4, and causing SCR4 to crowbar.

14. PREREGULATOR CURRENT SENSE

Preregulator current flowing through R1 causes a voltage drop. This voltage is passed through R15 and C20 which act as a filter circuit for current spikes. The resulting DC level is applied to Q8 via R16 and R18 divider, turning it on for excessive preregulator currents. Q8 then shorts the current sense line to ground, which clears the preregulator enable flip-flop U13B. The base of Q7 is also connected to the current sense line by R20 and C17 speed-up circuit. When the sense line goes to ground Q7 is turned off and collector voltage goes high. The high level is fed back through C16 and R17 to the base of Q8, keeping it on, and thus creating a hysteresis effect. U13B remains cleared, holding off Q1 until the end of the current 20 kHz cycle of U13A at which time U13B is cleared by a pulse from U12A.

15. LINE VOLTAGE SENSE

B+ generated by the input bridge-doubler circuit is sensed via the R36, R96, R97 and R120 divider network which is connected to a -4.2V potential created by CR55. CR56 acts as a voltage clamp, preventing the PUUP circuit from being enabled if +5V LB is low or missing and also preventing voltage at the junction of R36 — R96 from exceeding the 5V level during normal operation.

Before B+ rises to any significant level, U15A pin 4 is negative with respect to pin 5 and the output at pin 12 is consequently low. The low level at U15A results in a negative voltage appearing at U15B pin 10 via the R86 and R87 divider. This results in a high output from U15B which keeps the LED in photo-isolator U14 off. The output of U14 pin 5 is high due to a pull-up resistor on the upper board.

As B+ level increases the voltage at the junction of R96 and R97 approaches 0V. At the point where this voltage crosses above 0, the output of U15A goes high which in turn causes pin 10 of U15B to go positive, causing the output of U15B to go low. This turns on the LED in U14 causing the output at pin 5 to go low — thus resulting in the $\overline{\text{PUUP}}$ signal.

R93 connects the output of U15A to it's non-inverting input is to create hysteresis, preventing an internal oscillation. The resistor creates a large B+ voltage differential between the point where $\overline{\text{PUUP}}$ is enabled and the point where it is disabled. This is done in order to prevent the condition where the computer has a heavy load and line voltage is applied. On a soft line, line voltage level will drop significantly and if the feed back loop was not large enough to compensate for the fluctuation $\overline{\text{PUUP}}$ would be disabled, and the load would be removed — allowing the line voltage to rise and thus re-enabling $\overline{\text{PUUP}}$. This results in an oscillation condition where the CPU inverters would turn on and off approximately at 1 Hz rate.

C46 is used for slowing the switching of U14, reducing noise. R92 and C47 create a 20 ms delay before $\overline{\text{PUUP}}$ is switched low on power up but introduce no delay when line power is lost.

16. BATTERY CHARGE AND TEST LOAD

+18V rail from the memory inverter transformers is fed into the charge circuitry through R101 to R104 and CR60 which act as the positive supply for operational amplifier U16. +18V rail is also applied to R106 and R109, setting up the bias for Q15 and Q20. R101 acts as the current sense resistor for the 18V rail, limiting the output charge current to 400 mA ±50 mA. The voltage drop across R101 is applied to U16 inputs via divider network R102, R105, R108 and current source transistors Q17 and Q18. The output of U16 is connected via CR58 to the base of Q20. Q20 acts as the driver for Q15 which is the primary current pass transistor. The circuit as can be seen above, has been designed as a constant current source.

In the battery test circuitry the test signal generated on the power fail recovery boards is applied to Q19 via R112. Q19 conducts, applying power through divider R110 and R111 to Q16. Q16 conducts which connects the R91 test load from battery V+ to ground. If the battery voltage should drop below approximately 12 VDC while this load is applied, a sense circuit on the power fail recovery boards will cause the front panel battery light to flash until the battery is sufficiently charged to remain above 12 VDC during a test period.

The battery test is automatically performed for a period of about 6 seconds every six minutes.

17. CPU AND MEMORY INVERTERS

(Only operation of the memory inverters will be explained due to the fact that CPU inverter construction and operation is the same except for two differences: CPU inverters are 180° out of phase with memory inverters to more evenly distribute load on the preregulator, and the existence of T4 bootstrap connected only to memory inverter.)

Memory inverter enable, generated on the upper board, is applied to U10 pin 2 and along with inverter enable causes pin 6 to go low. This low level is used by the two NOR gates or U7 to allow the ÷2 and $\overline{\div 2}$ square waves from the clock circuitry to toggle the output transistors within it. The two outputs of U7 are connected through T2A to +Vx (approximately 10 VDC). C15 is inserted to filter spikes created by T2A. The switching action through T2A primary is induced into the secondaries to be used as base drives for Q5 and Q6. The secondary windings exhibit a degree of mutual coupling in order to compensate for slight differences in switching speed between Q5 and Q6. Due to the coupling, as long as one transistor is on there will be opposition in the secondary winding to a change in state until the transistor has been turned off.

As Q5 and Q6 change states, the output line between the transistors switches from B+ to B- (inverter common). The other output line is biased halfway between B+ and B- and is capacitively isolated to prevent saturation of the inverter output transformer.

18. CONTROL LOOP CIRCUIT

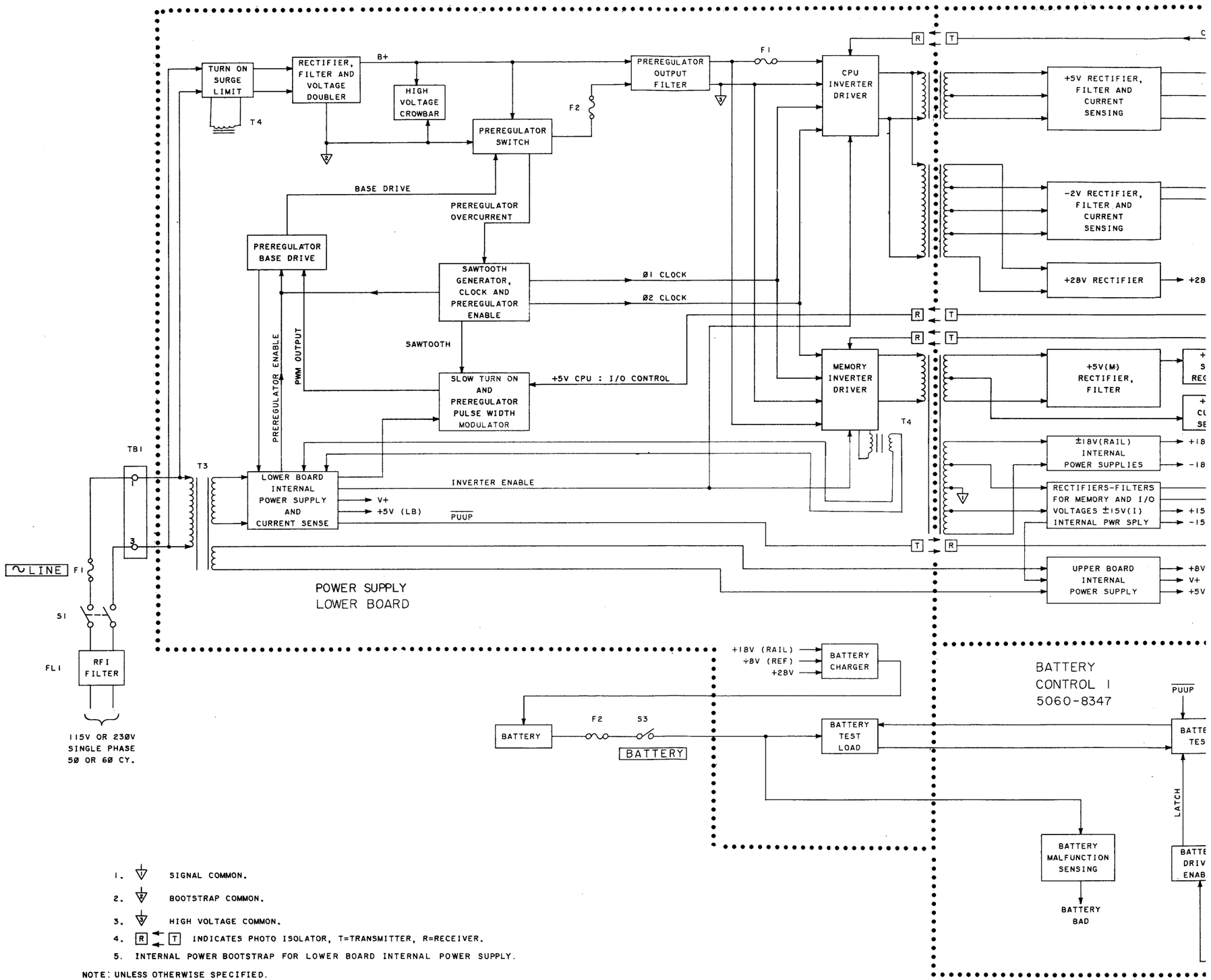
The basic preregulator control loop is designed to operate under two conditions:

1. To maintain constant preregulator control level when CPU inverters are disabled, and
2. To perform basic regulation of 5V when CPU inverters are enabled.

+18V taken from the memory inverter transformer secondary is used as an output sense for preregulator control whenever CPU inverters are not enabled. +18V is applied across R37, R38 divider and the resultant DC level is passed to collector of Q10. If CPU inverter enable is low causing Q10 to be off, the signal passes through CR22 and is applied to pin 2 of U13 via R42. +5V CPU adjust, generated from +8 reference through R116, R115, R119 and CR61 divider is applied to pin 3 of U13. The output of U13 which represents an error signal is fed to Q11 which acts as an output buffer. The output of Q11 is then fed to U11 via R45 and R80 which acts as a current source for the LED in U11. The output of U11 then acts to couple +5V error signal into the pulse width modulator for direct control of preregulator. R43, R44 and C43, coupling the output of U13 to its inverting input, act as a negative feedback loop, decreasing overall gain of unit and preventing oscillation.

At the point when CPU inverters are enabled, the inverter enable signal is coupled through R39 and R40 which turns on Q10 and shuts off the +18V control signal to U13. With CPU inverters up, +5V CPU is coupled to U13 through R36 and CR21 thus shifting preregulator control. C44 is used for maintaining a relatively even transition between control sources during the point after +18V control line is disabled and before +5V rises sufficiently. C45 is inserted primarily for noise reduction on the +5V control adjust line.

During the condition of a memory alarm where there is neither +18V or +5V CPU, U13 turns on fully driving U11 fully on which allows preregulator to turn on fully. At this point the preregulator voltage clamp circuit comes on, limiting preregulator conduction, until the memory alarm is removed.



1. ▽ SIGNAL COMMON.
2. ▽ BOOTSTRAP COMMON.
3. ▽ HIGH VOLTAGE COMMON.
4. R ◄ T INDICATES PHOTO ISOLATOR, T=TRANSMITTER, R=RECEIVER.
5. INTERNAL POWER BOOTSTRAP FOR LOWER BOARD INTERNAL POWER SUPPLY.

NOTE: UNLESS OTHERWISE SPECIFIED.

TURN ON SURGE LIMIT
T4
RECTIFIER, FILTER AND VOLTAGE DOUBLER
B+
HIGH VOLTAGE CROWBAR
PREREGULATOR SWITCH
F2
PREREGULATOR OUTPUT FILTER
F1
CPU INVERTER DRIVER
CPU ENABLE
+5V RECTIFIER, FILTER AND CURRENT SENSING
+5V
OVERCURREN
+5V AND -2V OVERVOLTAGE CROWBAR
PUUP
-2V RECTIFIER, FILTER AND CURRENT SENSING
-2V
OVERCURREN
+28V RECTIFIER
+28V
BASE DRIVE
PREREGULATOR OVERCURRENT
PREREGULATOR BASE DRIVE
SAWTOOTH GENERATOR, CLOCK AND PREREGULATOR ENABLE
Ø1 CLOCK
Ø2 CLOCK
SAWTOOTH
PREREGULATOR ENABLE
PWM OUTPUT
SLOW TURN ON AND PREREGULATOR PULSE WIDTH MODULATOR
+5V CPU : I/O CONTROL
MEMORY INVERTER DRIVER
MEMORY ENABLE
+5V(M) RECTIFIER, FILTER
+5V(M) SERIES REGULATOR
+5V(M) CURRENT SENSING
+5V(M) OVERVOLTAGE OVERCURRENT CROWBAR
±18V(RAIL) INTERNAL POWER SUPPLIES
+18V (RAIL)
-18V(RAIL)
RECTIFIERS-FILTERS FOR MEMORY AND I/O VOLTAGES ±15V(I) INTERNAL PWR SPLY
+15V(I)
-15V(I)
±12V CURRENT SENSING
+12V SERIES REGULATOR
-12V SERIES REGULATOR
±12V(M) CURRENT SENSING
+12V(M) SERIES REGULATOR
-12V(M) SERIES REGULATOR
UPPER BOARD INTERNAL POWER SUPPLY
+8V(REF)
V+
+5V(UB)
T4
TB1
T3
LOWER BOARD INTERNAL POWER SUPPLY AND CURRENT SENSE
INVERTER ENABLE
V+
+5V (LB)
PUUP
POWER SUPPLY
LOWER BOARD
LINE
F1
S1
FL1
RFI FILTER
115V OR 230V
SINGLE PHASE
50 OR 60 CY.
+18V (RAIL)
+8V (REF)
+28V
BATTERY CHARGER
BATTERY
F2
S3
BATTERY
BATTERY TEST LOAD
BATTERY CONTROL I
5060-8347
PUUP
BATTERY TEST
FLASH TO FRONT PANEL INDICATOR
LATCH
BATTERY CLOCK
Ø1B
Ø2B
SAWTOOTH
40KHZ
BATTERY MALFUNCTION SENSING
BATTERY BAD
BATTERY DRIVER ENABLE
+V(BT)
±12V(M) BATTERY CURRENT SENSING
VOLTAGE ERROR AMPLIFIER
VOLTAGE ERROR AMPLIFIER
VOLTAGE ERROR AMPLIFIER
PULSE WI MODULAT AND DRIV
PULSE WI MODULAT AND DRIV
PULSE WI MODULAT AND DRIV
BATTER CONTRO 5060-8

1. ▽ SIGNAL COMMON.
2. ▽ BOOTSTRAP COMMON.
3. ▽ HIGH VOLTAGE COMMON.
4. R ← T INDICATES PHOTO ISOLATOR, T=TRANSMITTER, R=RECEIVER.
5. INTERNAL POWER BOOTSTRAP FOR LOWER BOARD INTERNAL POWER SUPPLY.

NOTE: UNLESS OTHERWISE SPECIFIED.

CPU ENABLE

OVERCURRENT +5V

+5V

$\overline{PUUP}$

+5V AND -2V OVERVOLTAGE CROWBAR

-2V

OVERCURRENT -2V

I/O AND CPU OVERVOLTAGE SENSING

OVERVOLTAGE CPU

MEMORY OVERVOLTAGE, UNDERVOLTAGE SENSING

UNDERVOLTAGE (M)

OVERVOLTAGE (M)

+28V

MEMORY ENABLE

+5V(M) SERIES REGULATOR

+5V(M)

+5V(M) OVERVOLTAGE OVERCURRENT CROWBAR

+5V(M) CURRENT SENSING

+18V (RAIL)

-18V(RAIL)

CPU ENABLE

OVERCURRENT +5V(M)

OVERCURRENT ±12V

±12V CURRENT SENSING

+12V SERIES REGULATOR

+12V

±12V OVERVOLTAGE CROWBAR

-12V SERIES REGULATOR

-12V

OVERCURRENT ±12V(M)

+15V(I)

-15V(I)

±12V(M) CURRENT SENSING

+12V(M) SERIES REGULATOR

+12V(M)

±12V(M) OVERVOLTAGE CROWBAR

-12V(M) SERIES REGULATOR

-12V(M)

+8V(REF)

V+

+5V(UB)

STANDBY LOGIC

START BATTERY TEST

PWU

PON

STANDBY

R

ON

PWR UP

BATTERY•$\overline{PUUP}$

RD

MEMORY LOST LOGIC

R

$\overline{M\ LOST}$

$\overline{M\ LOST\ D}$

MGPD LOGIC

CPU ALARM LOGIC

R

CPU ENABLE LOGIC

CPU ENABLE

MEMORY ALARM LOGIC

R

OVERTEMP

RESET

RESET LOGIC

POWER-UP-RESET

MEMORY ENABLE

$\overline{PUUP}$

ØIB

BATTERY TEST

BATTERY CLOCK

Ø2B

SAWTOOTH

40KHZ

FLASH TO FRONT PANEL INDICATOR

LATCH

BATTERY DRIVER ENABLE

+V(BT)

±12V(M) BATTERY CURRENT SENSING

VOLTAGE ERROR AMPLIFIER

VOLTAGE ERROR AMPLIFIER

VOLTAGE ERROR AMPLIFIER

PULSE WIDTH MODULATOR AND DRIVER

PULSE WIDTH MODULATOR AND DRIVER

PULSE WIDTH MODULATOR AND DRIVER

+12V(M) BATTERY OUTPUT

-12V(M) BATTERY OUTPUT

+5V(M) BATTERY OUTPUT

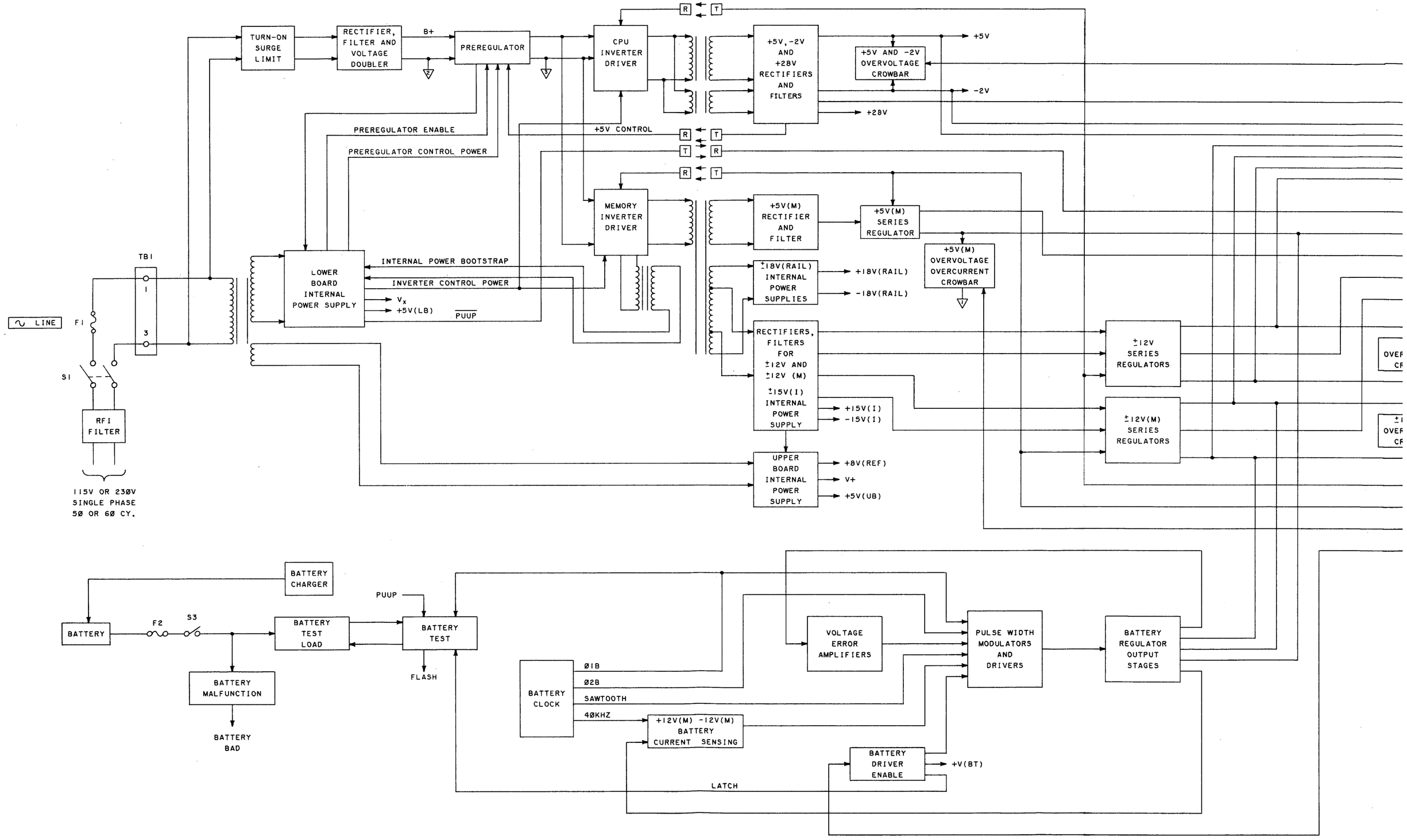
BATTERY CONTROL 2 5060-8353

BATTERY OUTPUT 5060-8346

POWER SUPPLY UPPER BOARD

TITLE	SHEET 1 OF 1
POWER SUPPLY DETAILED BLOCK DIAGRAM 02108-60023-51	
ENGINEER / APPROVED / DATE	

HEWLETT PACKARD CO.
DATA SYSTEMS DEVELOPMENT DIVISION


TURN-ON SURGE LIMIT
RECTIFIER, FILTER AND VOLTAGE DOUBLER
B+
PREREGULATOR
CPU INVERTER DRIVER
+5V, -2V AND +28V RECTIFIERS AND FILTERS
+5V AND -2V OVERVOLTAGE CROWBAR
+5V
-2V
+28V
PREREGULATOR ENABLE
PREREGULATOR CONTROL POWER
+5V CONTROL
MEMORY INVERTER DRIVER
+5V(M) RECTIFIER AND FILTER
+5V(M) SERIES REGULATOR
+5V(M) OVERVOLTAGE OVERCURRENT CROWBAR
TB1
LOWER BOARD INTERNAL POWER SUPPLY
INTERNAL POWER BOOTSTRAP
INVERTER CONTROL POWER
V_x
+5V(LB)
PUUP
±18V(RAIL) INTERNAL POWER SUPPLIES
+18V(RAIL)
-18V(RAIL)
LINE
F1
S1
RFI FILTER
115V OR 230V SINGLE PHASE 50 OR 60 CY.
RECTIFIERS, FILTERS FOR ±12V AND ±12V (M)
±15V(I) INTERNAL POWER SUPPLY
+15V(I)
-15V(I)
±12V SERIES REGULATORS
±12V(M) SERIES REGULATORS
UPPER BOARD INTERNAL POWER SUPPLY
+8V(REF)
V+
+5V(UB)
BATTERY CHARGER
BATTERY
F2
S3
BATTERY TEST LOAD
BATTERY TEST
PUUP
FLASH
BATTERY MALFUNCTION
BATTERY BAD
BATTERY CLOCK
ØIB
Ø2B
SAWTOOTH
40KHZ
+12V(M) -12V(M) BATTERY CURRENT SENSING
VOLTAGE ERROR AMPLIFIERS
PULSE WIDTH MODULATORS AND DRIVERS
BATTERY REGULATOR OUTPUT STAGES
BATTERY DRIVER ENABLE
+V(BT)
LATCH

REV	REFERENCE	SERIES /PREFIX
A	ORIG	NA

R T

+5V,-2V AND +28V RECTIFIERS AND FILTERS

+5V AND -2V OVERVOLTAGE CROWBAR

+5V

-2V

+28V

ROL

R T

T R

R T

+5V(M) RECTIFIER AND FILTER

+5V(M) SERIES REGULATOR

+5V(M) OVERVOLTAGE OVERCURRENT CROWBAR

±18V(RAIL) INTERNAL POWER SUPPLIES

+18V(RAIL)

-18V(RAIL)

RECTIFIERS, FILTERS FOR ±12V AND ±12V (M)

±15V(I) INTERNAL POWER SUPPLY

+15V(I)

-15V(I)

UPPER BOARD INTERNAL POWER SUPPLY

+8V(REF)

V+

+5V(UB)

±12V SERIES REGULATORS

±12V(M) SERIES REGULATORS

OVERVOLTAGE AND UNDERVOLTAGE SENSING

+5V(M)

±12V OVERVOLTAGE CROWBAR

+12V

-12V

±12V(M) OVERVOLTAGE CROWBAR

+12V(M)

-12V(M)

PWP UP

OVERCURRENT +5V AND -2V

OVERVOLTAGE CPU AND I/O

OVERVOLTAGE/UNDERVOLTAGE (M)

STANDBY

OVERTEMP

BATTERY • PUUP

CONTROL AND PROTECTION LOGIC

OVERCURRENT +5V(M)

OVERCURRENT ±12V

OVERCURRENT ±12V(M)

ON RESET

POWER UP RESET

CPU AND I/O CROWBAR TRIGGER

START BATTERY TEST

PWU

PON

M LOST D

MGPD

MEMORY CROWBAR TRIGGER

MEMORY ENABLE

CPU ENABLE

VOLTAGE ERROR AMPLIFIERS

PULSE WIDTH MODULATORS AND DRIVERS

BATTERY REGULATOR OUTPUT STAGES

+12V(M) -12V(M) BATTERY CURRENT SENSING

BATTERY DRIVER ENABLE

+V(BT)

LATCH

4. ▽ SIGNAL COMMON.

3. ▽ BOOTSTRAP COMMON.

2. ▽ HIGH VOLTAGE COMMON.

1. R T INDICATES PHOTO ISOLATOR, T= TRANSMITTER, R= RECEIVER.

NOTE: UNLESS OTHERWISE SPECIFIED,

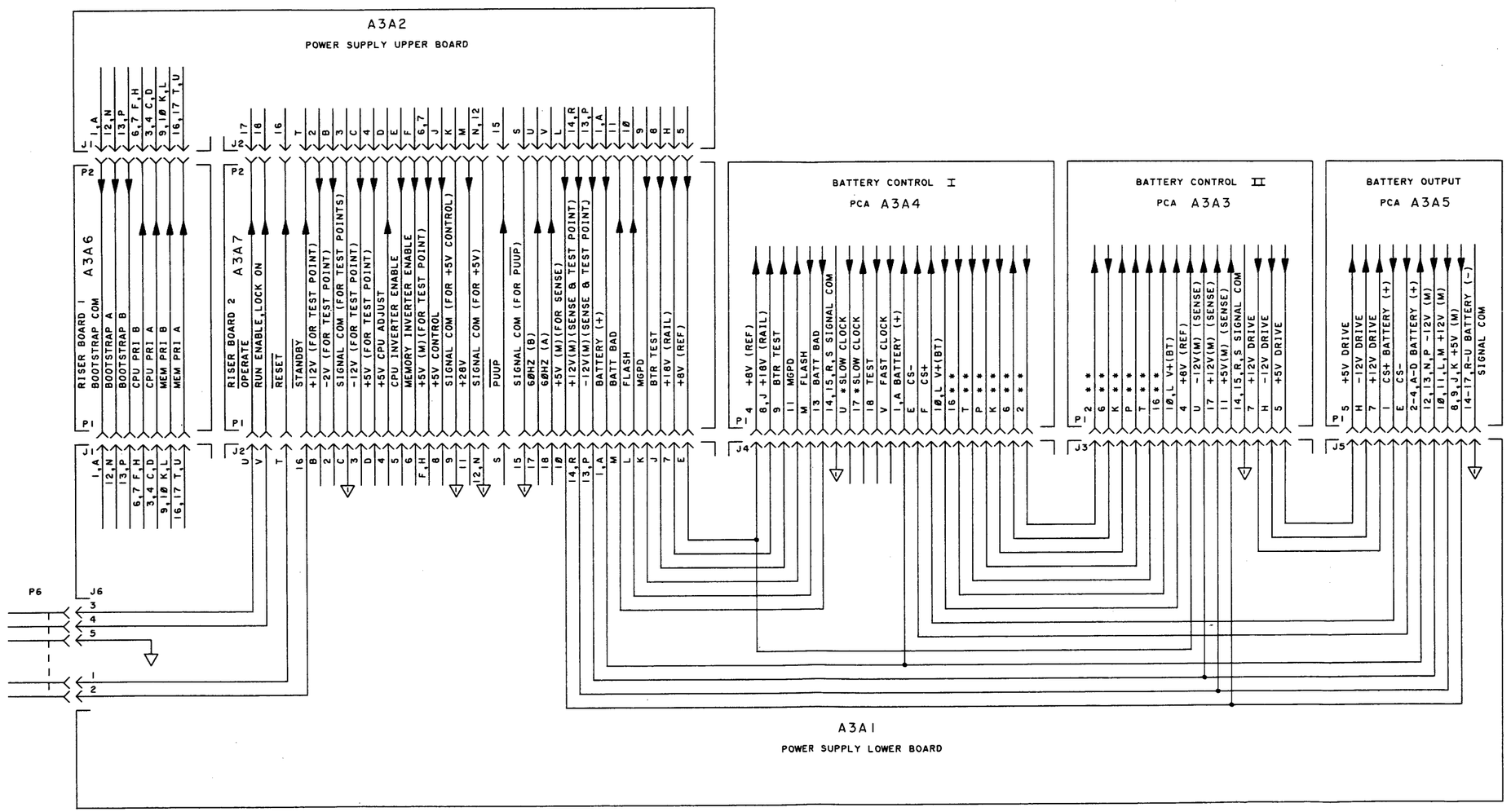
TITLE
POWER SUPPLY OVERALL BLOCK DIAGRAM
02108-60024-51

SHEET 1 OF 1

ENGINEER	APPROVED	DATE

HEWLETT-PACKARD CO.
DATA SYSTEMS DEVELOPMENT DIVISION

REV	REFERENCE	SERIES/PREFIX
A	ORIG	NA



1. PIN CONNECTIONS NOT SHOWN ARE IDENTICAL TO THOSE OPPOSITE.
** THESE CONNECTIONS, AS SHOWN, ARE JUMPER WIRED BETWEEN J3 AND J4 ON PCA A3A1.
* SLOW CLOCK OUTPUT ON PIN U NORMALLY STRAPPED TO INPUT PIN 17.

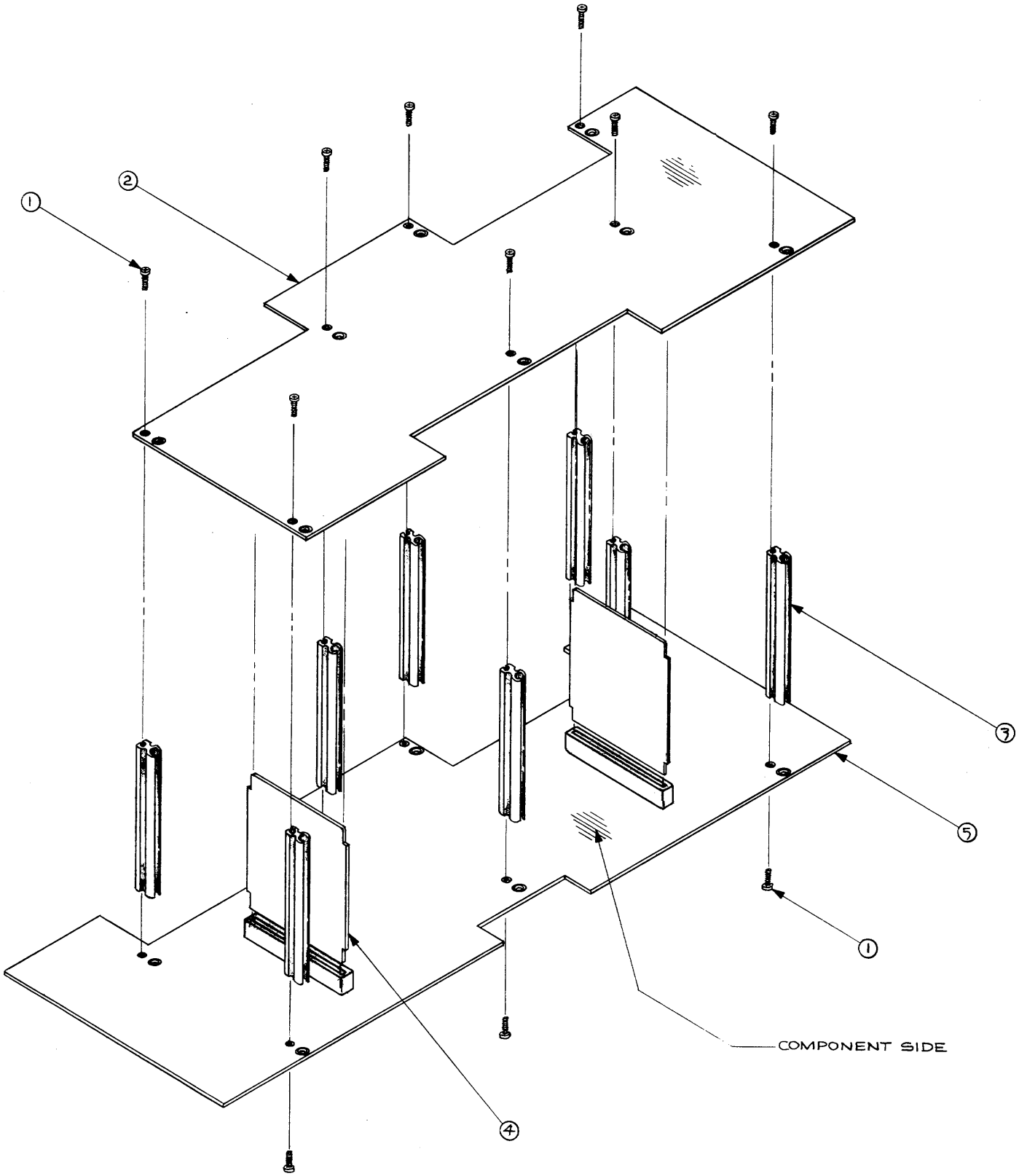
NOTE: UNLESS OTHERWISE SPECIFIED ALL CONNECTIONS TO/FROM J3, J4, AND J5 ARE TRACES ON PCA A3A1.

TITLE
POWER SUPPLY
INTERCONNECTION DIAGRAM
02108-90025

SHEET 1 OF 1

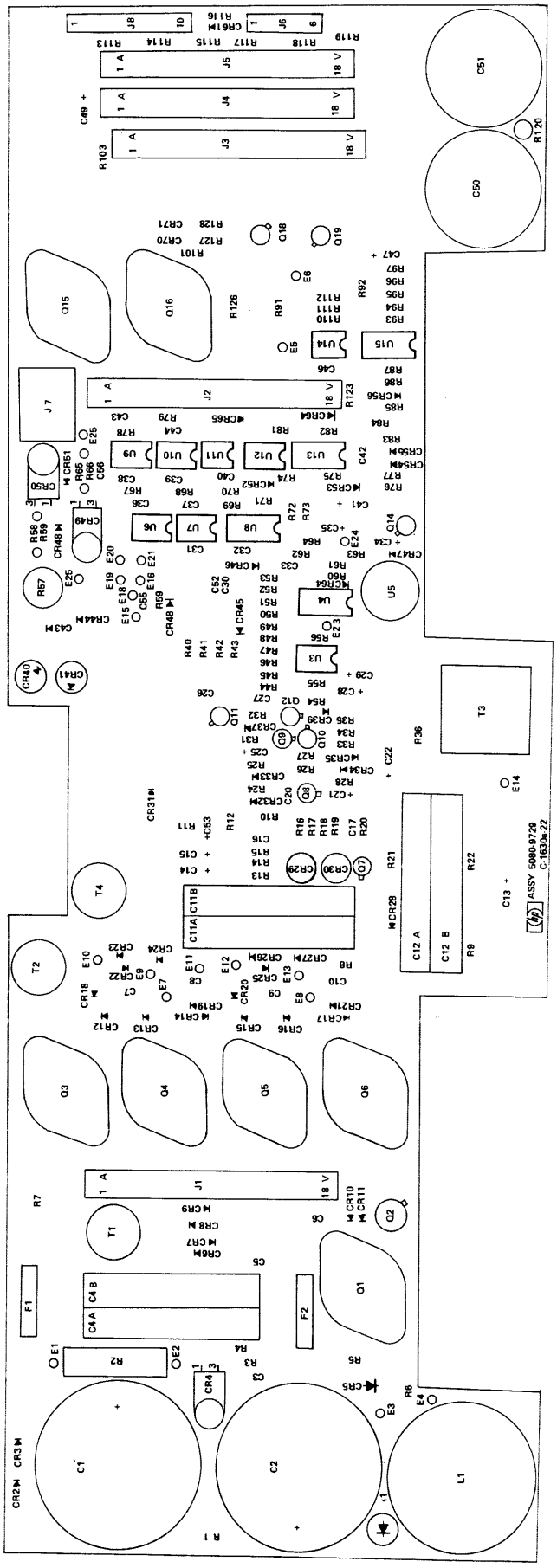
ENGINEER	APPROVED	DATE

HEWLETT PACKARD CO
DATA SYSTEMS DEVELOPMENT DIVISION



			2105-60012	2108-60023
5	1	LOWER P.C. BD. ASSY	5061-1354	5061-1354
4	2	RISER BD.	02105-80003	5080-9744
3	8	STANDOFF	02105-20003	02108-20001
2	1	UPPER P.C. BD. ASSY	5061-1355	5061-1355
1	16	SCREW 6-20 x .625	0624-0062	0624-0062
ITEM	QTY.	MATERAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-PART NO.

2105A/2108A Power Supply Main Assy.



NOTE: Refer to 2105A and 2108A Parts Lists for part no. and part description differences between the 2105A and 2108A assemblies.

2105A/2108A Power Supply Lower Assy
5061-1354

2105A Power Supply Lower Assy Parts List

REF DESIG.	PART DESCRIPTION		
	ASSY-LOWER (see sub-parts list)	5061-1354	1
C12	CAP FXD 2X5 UF	0160-4142	1
C4,11	CAP FXD 5 UF	0160-4186	2
C1,2	CAP 780 UF -10+75%	0180-0432	2
C50,51	CAP 4000 UF 15V	0180-2385	2
R57	RES 5 OHMS 5% 20W	0811-1654	1
L1	XFORMER	9100-2959	1

2108A Power Supply Lower Assy Parts List

	ASSY-LOWER (see sub-parts list	5061-1354	1
C4,11,12	CAP FXD 2X5 UF	0160-4142	3
C1,2	CAP 1150 UF	0180-0431	2
C50,51	CAP 8,000 UF	0180-0463	2
R57	RES 5 OHMS 5% 20W	0811-1654	1
L1	CHOKE	9100-2960	1

5061-1354 Lower Power Supply Subassembly Parts List (Sheet 1 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV 33			7			
3	DIV 63			7			
		CAP 0.1UF		0150-0121		U	9
1	C9,10,31,33,38,39,						
3	42,43,44						
		CAP .001UF 10%		0160-0153		U	2
1	C16,17						
		CAP .47UF-20+80%		0160-0174		U	3
1	C7,8,27						
	C26	CAP .012UF 10%		0160-0301		U	1
		CAP .01UF		0160-2055		U	5
1	C3,36,37,55,56						
	C20	CAP 5000PF		0160-2145		U	1
		CAP 100PF 5%		0160-2204		U	3
1	C40,46,52						
	C32	CAP. 2400PF		0160-2227		U	1
	C5,6	CAP 3000PF		0160-2288		U	2
		CAP 200UF-10+75%		0180-0104		U	3
1	C13,22,49						
		CAP 6.8UF 10%		0180-0116		U	2
1	C14,15						
	C47	CAP 22UF 10%		0180-0228		U	1
		CAP 1UF 10%		0180-0291		U	4
1	C25,28,34,53						
		CAP 6.8UF 20%		0180-1701		U	2
1	C21,29						
	C35	CAP 47UF 10%		0180-1704		U	1
	C41	CAP 68UF 20%		0180-1835		U	1
		PAD-MTG TO5		0340-0164		U	3
		STUD SOLDER		0360-0090		U	17
1	E6-16,18-21,23-25						
	E1-6	TERM STUD FKD		0360-1529		U	6
		SPCR TAP #6X.125		0380-0383		U	17
		CARD GUIDE		0403-0121		U	6

5061-1354 Lower Power Supply Subassembly Parts List (Sheet 2 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	R13,14	RES 2.7 5% .25		0683-0275		U	2
	R33	RES 47 5% .25		0683-4705		U	1
	R32	RES 464 1% .125		0698-0082		U	1
1 3 5	R18,28,34,49,54,56, 62,67,69,71,73,74, 77,81,82,110,112	RES 2.15K 1% .125		0698-0084		U	17
		RES 2.37K 1% .125		0698-3150		U	1
	R119	RES 3.48K 1% .125		0698-3152		U	1
1	R70,86	RES 3.83K 1% .125		0698-3153		U	2
	R52	RES 4.22K 1% .125		0698-3154		U	1
1	R42,43	RES 34.8 1% .50		0698-3395		U	2
1	R40,41	RES 46.4 1% .50		0698-3398		U	2
	R84	RES 215 1% .50		0698-3401		U	1
1	R7,8,9,22,127	RES 14.7K 1% .5W		0698-3414		U	5
	R11	RES 21.5 1% .125		0698-3430		U	1
	R85	RES 147 1% .125		0698-3438		U	1
1 3	R78,79,83,113 114,123	RES 215 1% .125		0698-3441		U	6
	R21	RES 422 1% .125		0698-3447		U	1
	R68	RES 215K 1% .125		0698-3454		U	1
1	R12,63,76	RES 21.5K 1% .125		0757-0199		U	3
	R61	RES 1.78K 1% .125		0757-0278		U	1
1 3 5 7	R10,16,19,24,27,35, 51,58,60,64,66,75, 94-96,103,111,117, 118	RES 1K 1% .125		0757-0280		U	19

5061-1354 Lower Power Supply Subassembly Parts List (Sheet 3 of 5)

ITEM NO.	REFERENCE DESIGNATOR. (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R26	RES 10 1%.125		0757-0346		U	1
	R36	RES 100K 1% .50		0757-0367		U	1
1	R3,15,59,65,92,126,	RES 100 1%.125		0757-0401		U	6
	R55	RES 511 1%.125		0757-0416		U	1
1	R31,45	RES 825 1%.125		0757-0421		U	2
	R97	RES 1.1K 1%.125		0757-0424		U	1
1	R44,128	RES 5.11K 1%.125		0757-0438		U	2
	R93	RES 7.5K 1%.125		0757-0440		U	1
	R20	RES 8.25K 1%.125		0757-0441		U	1
1 3	R17,25,46-48,50,72, 87	RES 10K 1%.125		0757-0442		U	8
	R53	RES 82.5K 1%.125		0757-0463		U	1
	R5	RES 10K 1% .50		0757-0839		U	1
	R101	RES 4.7 5% 2W		0811-1674		U	1
	R91	RES 10 5% 10W PW		0811-1895		U	1
	R1	RES .12 3% 3W		0811-2616		U	1
	R2	RES 2 10%		0811-3108		U	1
	R4,6	RES 15K OHM 3W		0812-0051		U	2
		TBG HS BLK .250D		0890-0312		U	0.25
		HT DIS TO-5		1205-0033		U	1
		HT DIS TO-3		1205-0275		U	7
	J8	CONNECTOR		1251-0674		U	1
	J1-5	CONN PC2X18.156D		1251-2026		U	5
	J6	PIN ASSY		1251-3412		U	1
		CONN UTIL 6PIN M		1251-3819		U	1
		CA TIE 3.6L		1400-0249		U	4

5061-1354 Lower Power Supply Subassembly Parts List (Sheet 4 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	U13	IC SN7474N		1820-0077		U	1
	U5	IC LM309H		1820-0429		U	1
	U3	IC SN75452P		1820-0799		U	1
1	U6,7,12	IC SN75453P		1820-1016		U	3
	U8,15	IC D COMPTR 8K		1826-0175		U	2
1	Q10,12,14,18	XSTR PNP 2N2907A		1853-0281		U	4
	Q2	XSTR 2N3439 TO5		1854-0079		U	1
1	Q7-9,11,19	XSTR 2N2222A TO18		1854-0477		U	5
1	Q15,16	XSTR 2N6055 TO3		1854-0611		U	2
	Q3-6	XSTR 2N6306 TO3		1854-0623		U	4
	Q1	XSTR 2N6308 TO3		1854-0624		U	1
	U4	XISTOR ARRAY		1858-0009		U	1
	CR4	THYRISTOR SCR		1884-0233		U	1
1	CR49,50	THYRISTOR-SCR		1884-0249		U	2
	CR31	THYRISTOR		1884-0258		U	1
1 3	CR35,39,46-48,51-54, 56,61	DIODE SIL		1901-0040		U	11
1 3	CR14,17,21,22,25,26, 34,43,44	DIODE IN4004		1901-0159		U	9
1	CR1,40,41	DIODE 3A 600V		1901-0420		U	3
1	CR32,33,65,70	STABISTOR STB523		1901-0460		U	4
1 3	CR6-13,15,16,18,19, 20,23,24,27,28	DIODE IN4936		1901-1065		U	17
	CR5	RECTIFIER		1901-1087		U	1

5061-1354 Lower Power Supply Subassembly Parts List (Sheet 5 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	CR64	DIODE ZNR 5.11V		1902-0041		U	1
	CR71	DIODE 16.2V		1902-0184		U	1
	CR2,3	DIODE 200V ZENER		1902-0668		U	2
1	CR37,55	DIODE-4.22V		1902-3070		U	2
1	CR29,30	DIODE-FW BRIDGE		1906-0051		U	2
	U9,10	ISOLATOR		1990-0429		U	2
1	U11,14	OPTO ISOLATOR		1990-0537		U	2
	R120	RES VAR 1K		2100-1986		U	1
	R115	RES VAR 1K 10%		2100-3352		U	1
	F1,2	FUSE 2.5A NB		2110-0083		U	2
		FUSE CLIP .250D		2110-0483		U	4
		SCR #4-40X.375L		2200-0143		U	3
		NUT 4-40 W/LK		2260-0009		U	4
		SCR 6-32X.375		2360-0359		U	17
		WSHR #4 SS		3050-0222		U	4
		COMPOUND-THERMAL		6040-0239		U	0.01
		SOLDER-WIRE		8090-0027		U	1
		WIRE 22 WHT		8150-1549		U	0.08
		WIRE 18 BLK		8150-2890		U	1
		WIRE 16 G BARE		8151-0010		U	0.25
	T2	XFORMER		9100-2951		U	1
	T3	XFORMER		9100-2956		U	1
	T1	XFORMER		9100-2966		U	1
	T4	XFORMER-POWER		9100-3803		U	1
		BOARD-ETCHED		5080-9729		W	1
		HEAT SINK		02108-00030		W	3

WARNING: HIGH POTENTIAL POSSIBLE BETWEEN COMMON NODES ▽1 ▽2 AND ▽3 USE ISOLATION TRANSFORMER WHEN TESTING LOWER BOARD.

REV	REFERENCE	SERIES/PREFIX	DWGS AFFECTED
A	ORIG.	1353	ALL
B	22-2087	1415	ALL
C	22-2224	1417	ALL
D	22-2172	1417	ALL
E	22-2466	1503	ALL
F	22-2617	1512	ALL
G	22-2725	1519	ALL
H	22-2825	1532	ALL
I	22-2841	1536	-51
J	22-2933	1542	ALL
K	22-3212	1612	ALL
L	22-3512	1630	-51

DWG	REVISION									
-51	A	B	C	D	E	F	G	H	I	J
-52	A	B	C	D	E	F	G	H	H	J
-51	K	L								
-52	K	K								

RECTIFIER, FILTER, AND VOLTAGE DOUBLER

BATTERY + TO J7-3
BATTERY − TO J7-6

PREREGULATOR BASE DRIVE

HIGH VOLTAGE CROWBAR

PREREGULATOR CURRENT SENSE

PREREGULATOR OUTPUT FILTER

PREREGULATOR ENABLE

CLOCK

SAWTOOTH GENERATOR

LINE VOLTAGE SENSE

PUUP ADJ

PREREGULATOR PULSE WIDTH MODULATOR

INTERNAL POWER SUPPLY +10V BRIDGE AND FILTER

+5V REGULATOR

POWER UP SENSE CKT

SLOW TURN-ON CKT

TO: UPPER BOARD INT. SUPPLY 60HZ (A) J2-V, 60HZ (B) J2-U

INVERTER ENABLE (B14)

+5V CONTROL J2-J

J2-K +5V CONTROL RETURN

J8-8 J2-5 PUUP

(ME) (E15)

1. ▽14 TEST POINT COMMON. ▽18 BATTERY COMMON.
2. ▽2 PREREGULATOR COMMON.
3. ▽3 INVERTER COMMON.

NOTE: UNLESS OTHERWISE SPECIFIED
4. ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICROFARADS
5. CR32,33 ARE STABISTORS.
6. W1,2,4 ARE SHORTED FOR 110V OPERATION.
7. SEE ALSO 2108 PS INTERCONNECTING DIAGRAM.
8. FOR 230V OPERATION, W3 JUMPER ONLY.

02108-90017 Change 1 dated 24 JAN 1978

THIS SCHEMATIC DIAGRAM CONSISTS OF 2 SHEETS, DWG. NOS. 5060-8354-51 AND 5060-8354-52.

POWER SUPPLY LOWER BOARD 5061-1354-51 SHEET 1 of 2

ENGINEER	APPROVED	DATE

HEWLETT PACKARD CO
DATA SYSTEMS DEVELOPMENT DIVISION

REV	REFERENCE
A	ORIG.
B	22-2087
C	22-2224
D	22-2172
E	22-2498
F	22-2817
G	22-2726
H	22-2825
I	22-3212
J	22-2933
K	22-3212

WARNING: HIGH POTENTIAL POSSIBLE BETWEEN COMMON NODES ⑴ ⑵ AND ⑶ USE ISOLATION TRANSFORMER WHEN TESTING LOWER BOARD.

CPU INVERTER ENABLE ← J2-E

MEMORY INVERTER ENABLE ← J2-F

+5V ← J2-4 — R113 215 — J8-5

+5V(M) ← J2-7,6 — R114 215 — J8-6

+12V TEST POINT ← J2-2 — J8-3

+12V(M) ← J2-14,R — R117 1K — J8-9

-2V TEST POINT ← J2-8 — J8-4

-12V TEST POINT ← J2-C — J8-1

-12V(M) ← J2-13,P — R118 1K — J8-10

TEST POINT COMMON ← J2-15,3 — J8-2

RESET ← J6-1 — J2-16

STANDBY ← J6-2 — J2-T

OPERATE ← J6-3 — J2-17

J6-4

LOCK ON ← J6-5 — J2-18

+5V(LB) C38 .1 — +5V(LB) R67 2.15K

R78 215 — U9 — C43 .1 — C36 .01

(F8) INVERTER ENABLE

U6

(D8) ÷2

(E8) ÷2

(G4) V_s

+5V(LB) — C31 .1

C23 1.0

R42 34.8 1W

R13 2.7 — C14 6.8 10%

R43 34.8 1W

T2B

E10 CR18 Q3 CR12

CR22 CR23 C7 .47

E9

E7 CR13 Q4 CR24

CR19 CR14 C8 .47

E11

J1-6,7,F,H CPU PRI B

TO: CPU TRANSFORMER ON UPPER BOARD

J1-3,4,C,D CPU PRI A

CPU INVERTER POWER STAGE

CR1 R8 14.7K R7 14.7K

PREREGULATOR OUTPUT FILTER

C11 5.0 (2105A) 2X5.0 (2108A) — C4 5.0 (2105A) 2X5.0 (2108A) — F1

R22 14.7K — R9 14.7K

B+ (A4)(E5)

MEMORY INVERTER POWER STAGE

C12B 5.0 — C12A 5.0

J1-16,17,T,U MEM PRI A

T2A

R48 46.4 1W — R14 2.7 — C15 6.8 10% — R41 46.4 1W

E12 CR28 CR26 CR25 Q5 CR15 C9 .1 E13

T4 (PRIMARY)

TO: MEMORY TRANSFORMER ON UPPER BOARD

J1-9,18,K,L MEM PRI B

E8 CR16 CR21 CR17 Q6 CR27 C19 .1 E11

INVERTER INPUT FROM PREREGULATOR

C4 = 5UF
C11 = 5UF
C12 = 2X5UF

+5V(LB) C39 .1 — +5V(LB) R24 1K

R79 215 — U10 — C44 .1 — C37 .01

U7

BATTERY CHARGER AND BATTERY TEST LOAD

TEST ← J4-18

Q18 — Q15

CR70 STB

R127 14.7K — R126 — R128 5.11K

16.2V CR71

18V (RAIL) ← J4-B,J / J2-1 — R101 4.7Ω

+8V (REF) ← J2-5 / J3-4 / J4-4

+12V (M) ← J2-14,R — C51 4,000 (2105A) 8,000 (2108A)

-12V (M) ← J2-13,P — C58 4,000 (2105A) 8,000 (2108A)

BATTERY COMMON ← J2-12,N / J7-6 / J5-14

R116 2.37K — CR61 — R115 1K CW — R119 3.48K

280 MA

R112 2.15K — Q19 — R111 1K — Q16 — R118 2.15K

R91 10 10W

C49 288 16V

J3-1,A

J4-1,A V+ BATTERY

J2-1,A V+ BATTERY

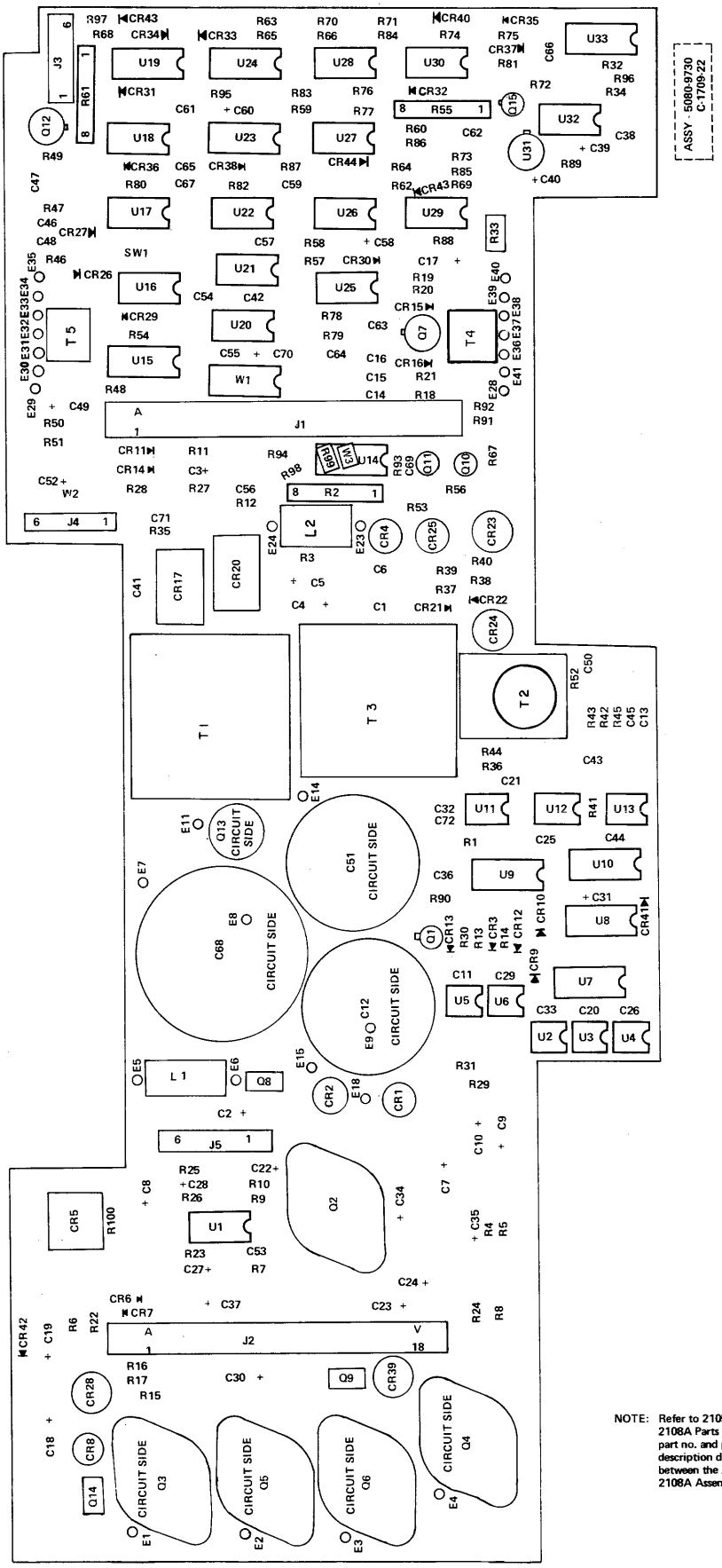
J7-5

R103 1K — J8-7 TP

J2-D +5V CPU ADJUST

THIS SCHEMATIC DIAGRAM CONSISTS OF 2 SHEETS, DWG NOS. 5080-8364-51 AND 5080-8364-52. SEE DWG NO. 5080-8364-51 FOR REVISION STATUS OF ENTIRE DWG SET.

TITLE	SHEET 1 of 1
POWER SUPPLY LOWER BOARD 5061-1354-52	
ENGINEER	APPROVED / DATE
HEWLETT-PACKARD CO. DATA SYSTEMS DEVELOPMENT DIVISION	



2105A/2108A Power Supply Upper Assy
5061-1355

2105A Power Supply Upper Assy Parts List

REF DESIG.	PART DESCRIPTION	PART NO.	QUANTITY
	ASSY-UPPER (see sub-parts list)	5061-1355	1
C68	CAP 10,000 UF	0180-0435	1
C51	CAP 8,000 UF, FIXED	0180-0460	1
C12	CAP 5,000 UF	0180-0464	1
J1	CONN PC1X18.156T	1251-2346	1
	JMPR PLUG .3"C-C	1258-0124	3
Q13	THYRISTOR 35 AMPS	1884-0208	1
CR1,2	DIODE RECT SIL	1901-1036	2
CR17,20	DIODE	1901-1062	2
L1	XFORMER-5V CPU	9100-2957	1
L2	CHOKE	9100-1958	1
T1	XFORMER-POWER	9100-3802	1
T2	XFORMER-POWER	9100-3805	1

2108A Power Supply Upper Assy Parts List

REF DESIG.	PART DESCRIPTION	PART NO.	QUANTITY
	ASSY-UPPER (see sub-parts list)	5061-1355	1
C68	CAP 24,000 UF	0180-0461	1
C51	CAP 17,000 UF	0180-0462	1
C12	CAP 10,000 UF	0180-2360	1
J1	CONN PC1X18.156T	1251-2346	1
	JMPR PLUG .3"C-C	1258-0124	3
Q13	THYRISTOR 35 AMPS	1884-0208	1
CR1,2	DIODE RECT SIL	1901-1036	2
CR17,20	DIODE	1901-1062	2
L1	XFORMER-5V CPU	9100-2957	1
L2	CHOKE	9100-2058	1
T1	XFORMER-POWER	9100-3802	1
T2	XFORMER-POWER	9100-3805	1

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 1 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV	33			7		
3	DIV	63			7		
	1C45,66,69	CAP 0.1UF		0150-0121		U	3
	1C60,72	CAP 1.0UF 20%		0160-0127		U	2
	1C54,55	CAP. 2.2UF		0160-0128		U	2
	1C16,48,61	CAP .022UF 10%		0160-0162		U	3
	C59	CAP .033UF 10%		0160-0163		U	1
	1C11,15,20,26,29 3 33,47,57,63,64	CAP .01UF		0160-2055		U	10
	C43	CAP .33UF 20%		0160-2128		U	1
	1C21,25,32,36	CAP 30PF 5%		0160-2199		U	4
	1C38,65,67	CAP 100PF 5%		0160-2204		U	3
	C6	CAP 3000PF		0160-2288		U	1
	C13	CAP 470PF 5%		0160-2940		U	1
	1C14,46,56	CAP 1000PF 10%		0160-3456		U	3
	1C41,44,50	CAP .02UF 20%		0160-3459		U	3
	C1	CAP .05UF-20+80%		0160-3460		U	1
	C2,37	CAP 100UF-10+50%		0180-0094		U	2
	1C4,5,9,10	CAP 4.7UF 10%		0180-0100		U	4
	1C18,23,30,34	CAP 200UF-10+75%		0180-0104		U	4
	C70	CAP 2.2UF 10%		0180-0197		U	1
	C3	CAP 22UF 10%		0180-0228		U	1
	1C39,40	CAP 33UF 10%		0180-0229		U	2

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 2 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1 3	C19,22,24,27,28 31,35,53,58,62	CAP 1UF 10%		0180-0291		U	10
	C42	CAP 6.8UF 20%		0180-1701		U	1
1	C17,49	CAP 22UF 10%		0180-1794		U	2
	C71	CAP 68UF 20%		0180-1835		U	1
	C7,8	CAP 200UF-10+75%		0180-1946		U	2
	C52	CAP 3.3UF 10%		0180-2141		U	1
		PAD-MTG TO5		0340-0164		U	5
1 3	E11,14,15,18,23 24,28-41	STUD SOLDER		0360-0090		U	20
		STUD SOLDER TERM		0360-0474		U	1
1	E5,6,7	TERM STUD FKD		0360-1529		U	3
		SPCR TAP #6X.125		0380-0383		U	14
1	CR1,2,17,20	STANDOFF		0380-0551		U	4
	R89	RES 4.7 5% .25		0683-0475		U	1
1	R94,96	RES FXD 5.6 OHM		0683-0565		U	2
	R54	RES 470 5% .25		0683-4715		U	1
1	R38,44,60,78	RES 2.15K 1%.125		0698-0084		U	4
1	R15,31	RES 1.78K 1% .5		0698-0089		U	2
	R67	RES 2.37K 1%.125		0698-3150		U	1
1 3	R7,9,18,23,25,47,59 63,66,70,73,83	RES 4.64K 1%.125		0698-3155		U	12
	R75	RES 31.6K 1%.125		0698-3160		U	1
1	R65,80,82,97,99	RES 464K 1%.125		0698-3260		U	6

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 3 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R1,35	RES 31.6 1% .50		0698-3394		U	2
	R4,5	RES 14.7 1%.125		0698-3428		U	2
1	R62,84,85	RES 147 1%.125		0698-3438		U	3
	R32	RES 215 1%.125		0698-3441		U	1
	R86	RES 348 1%.125		0698-3445		U	1
	R45	RES 422 1%.125		0698-3447		U	1
	R41	RES 28.7K 1%.125		0698-3449		U	1
1	R10,26	RES 42.2K 1%.125		0698-3450		U	2
	R72	RES 100 1% .50		0757-0198		U	1
	R74	RES 21.5K 1%.125		0757-0199		U	1
1	R21,49	RES 1.21K 1%.125		0757-0274		U	2
1	R34,37	RES 6.19K 1%.125		0757-0290		U	2
1	R50,51,91,92	RES 42.2 1%.125		0757-0316		U	4
	R77	RES 1.33K 1%.125		0757-0317		U	1
1 3	R16,17,19,20,46,48 56,93	RES 100 1%.125		0757-0401		U	8
	R64	RES 511 1%.125		0757-0416		U	1
	R71	RES 681 1%.125		0757-0419		U	1
	R76	RES 750 1%.125		0757-0420		U	1
1 3 5	R11-14,27-30,39 40,53,57,79,88 90,95	RES 10K 1%.125		0757-0442		U	16
	R68	RES 68.1K 1%.125		0757-0461		U	1
1	R43,58,69,81,87	RES 100K 1%.125		0757-0465		U	5
	R52	RES 10 1% .50		0757-0984		U	1

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 4 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R3	RES 51.1 1% .50		0757-1000		U	1
1	R36,42	RES 1.47K 1%.125		0757-1094		U	2
1	R22,24	RES .12 3% 3W		0811-2616		U	2
	R6,8	RES 0.22 OHM WW		0811-3294		U	2
		SLEEVING FLEX.		0890-0064		U	1
		TBG HS BLK .375D		0890-0291		U	0.50
	W1	SOCKET 16 DIP LO		1200-0482		U	1
		HT DIS PL PWR		1205-0219		U	1
		HT DIS TO-3		1205-0275		U	5
	J2	CONN PC2X18.156D		1251-2026		U	1
	J3-5	PIN ASSY		1251-3412		U	3
1	R2,55,61	RES NET 7X4.7K		1810-0125		U	3
	U10	RESISTOR NETWORK		1810-0185		U	1
	U15	RESISTOR NETWORK		1810-0187		U	1
	U14	RESISTOR NETWORK		1810-0188		U	1
	U9	RESISTOR NETWORK		1810-0199		U	1
	U7	NETWORK-RESISTOR		1810-0200		U	1
	U31	IC LM309H		1820-0429		U	1
	U32	IC U6E7723393		1820-0439		U	1
	U23	IC CD4043AY		1820-0941		U	1
	U18	IC CD4023AY		1820-0943		U	1
1	U22,29	IC CD4001AY		1820-0946		U	2
1	U17,26	IC CD4011AE		1820-0949		U	2
	U25	IC CD4012AE		1820-0950		U	1
1	U19,24	IC 4049AE		1820-1145		U	2

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 5 of 7)

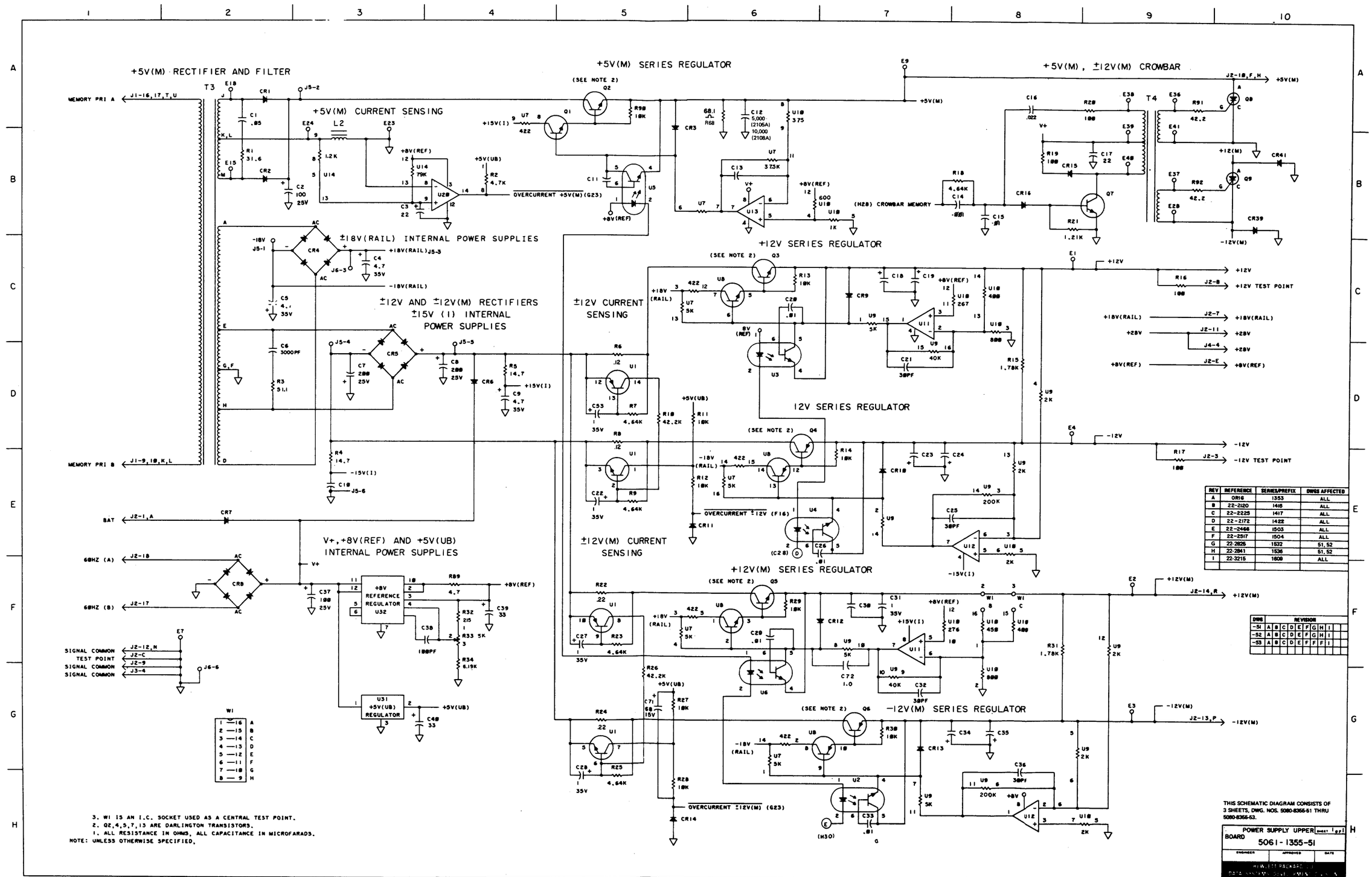
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	U33	IC CD4050AE		1820-1146		U	1
1	U16,20,21	IC QUAD COMPTR		1826-0138		U	3
1	U11-13	IC D OP AMP 20K		1826-0142		U	3
	Q15	XSTR PNP 2N2907A		1853-0281		U	1
	Q4,6	XSTR 2N6053 TO3		1853-0351		U	2
	Q7,12	XSTR 2N3053 TO5		1854-0039		U	2
1	Q1,10,11	XSTR NPN SI PL5		1854-0071		U	3
1	Q2,3,5	XSTR 2N6055 TO3		1854-0611		U	3
1	U1,8,30	XISTOR ARRAY		1858-0008		U	3
1	U27,28	XISTOR ARRAY		1858-0009		U	2
1	Q8,9,14	THYRISTOR-SCR		1884-0240		U	3
1 3 5	C11,14-16,21,22 26,27,30-34 36-38	DIODE SIL		1901-0040		U	16
1 3	CR3,6,7,9,10,12,13 41-44	DIODE IN4004		1901-0159		U	11
1	CR,28,39	DIODE-S1		1901-0415		U	2
	CR40	DIODE SILICONE		1901-0463		U	1
1	CR23,24	DIODE		1901-0676		U	2
	CR29	DIODE 1N823		1902-0033		U	1
	CR35	DIODE 4.64V		1902-3082		U	1
1	CR4,8,24	DIODE-FW BRIDGE		1906-0051		U	3
	CR5	BRIDGE RECTIF		1906-0053		U	1

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 6 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	U2-6	COUPLER-OPTICAL		1990-0403		U	5
	R33	RES 5KOHM 10%		2100-3207		U	1
		LKWSHR 4 HEL		2190-0003		U	4
		LKWSHR 10 INT		2190-0011		U	4
		LKWSHR 1/4 HEL		2190-0032		U	1
		LKWSHR 10 HEL		2190-0034		U	6
		SCR #4-40X.312L		2200-0141		U	4
		NUT 4-40 .250AF		2260-0001		U	4
		NUT 4-40 W/LK		2260-0009		U	1
		SCR #6-32X1.500L		2360-0135		U	1
		SCR #6-32X.500L		2360-0201		U	1
		SCR 6-32X.375		2360-0359		U	12
		NUT 6-32 .312AF		2420-0002		U	1
		SCR 10-32X.375		2680-0099		U	1
		SCR 10-32X.438		2680-0101		U	5
		NUT 1/4-28		2950-0036		U	1
		WSHR #6 SS		3050-0228		U	1
		WSHR #4 SS		3050-0229		U	4
		WSHR .260ID BRS		3050-0234		U	1
		WSHR #10 BRS		3050-0236		U	5
		WSHR #6 FIBER		3050-0247		U	1
		WASHER FLAT		3050-0665		U	1
	S1	SWITCH-THERMAL		3103-0033		U	1
		COMPOUND-THERMAL		6040-0239		U	0.01
	W3	WIRE JUMPERS		8159-0005		U	1
	T4,5	XFORMER-CROWBAR		9100-2953		U	2
	T2	XFORMER-POWER		9100-3804		U	1
		BOARD-ETCHED		5080-9730		W	1

5061-1355 Upper Power Supply Subassembly Parts List (Sheet 7 of 7)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		STRAP-GROUND		02108-00028		W	1



REV	REFERENCE	SERIES/PREFIX	DWGS AFFECTED
A	OR16	1353	ALL
B	22-2120	1418	ALL
C	22-2225	1417	ALL
D	22-2172	1422	ALL
E	22-2466	1503	ALL
F	22-2517	1504	ALL
G	22-2626	1532	51, 52
H	22-2841	1536	51, 52
I	22-3215	1609	ALL

DWG	REVISION
-51	A B C D E F G H I
-52	A B C D E F G H I
-53	A B C D E F F F I

+5V RECTIFIER, FILTER
AND CURRENT SENSING (CPU)

I/O, CPU OVERVOLTAGE SENSING

+5V, -2V, ±12V CROWBAR

-2V RECTIFIER, FILTER
AND CURRENT SENSING

MEMORY
OVERVOLTAGE
UNDERVOLTAGE
SENSING

REV	REFERENCE
A	ORIG
B	22-2120
C	22-2225
D	22-2172
E	22-2466
F	22-2517
G	22-2825
H	22-2841
I	22-3215

THIS SCHEMATIC DIAGRAM CONSISTS OF 3 SHEETS, DWG. NOS. 5080-8365-51 THRU 5080-8365-53. SEE DWG. NO. 5080-8365-51 FOR REVISION STATUS OF ENTIRE DWG. SET.

POWER SUPPLY UPPER BOARD
5060-1355-52

REV	REFERENCE
A	ORIG
B	22-2120
C	22-2225
D	22-2172
E	22-2466
F	22-2517
I	22-3215

PUUP J2-15 — R2 4.7K — +5V(UB) — U29C — CR39 — R58 100K — C58 .1

STANDBY J3-2 — +8V(REF) — CR44 — +5V(UB) R61 4.7K

STANDBY J2-16 — J3-3 — +5V(UB) R61 4.7K

OPERATE J2-U — LOCK ON J2-P — RUN ENABLE J4-5 — +5V(UB) R61 4.7K — CR31

PWR UP J3-5 — CR43 — +5V(CPU)

U18A — U24F — U24B — U22A — U17C — U26A

STANDBY FF U23B — +5V(UB) — R87 100K — C59 .033

U22B — U33F — U19G — U19A — R63 4.64K — U27 — R64 511 — (E6)

+8V(REF) U27 — R62 — J2-5 CPU INVERTER ENABLE

W1 D

V+ — R68 2.1K — U33E — R59 4.64K — U28 — J2-J BATTERY TEST

+5V(UB) — R55 4.7K — R55 4.7K — CR32 — U30 — R67 2.37K — -15V(I)

J4-1 PWU

R65 464K — CR33 — R95 10K — C68 1UF — U33B — U33A — R66 4.64K — U39

+8V(REF) — U38 — R74 21.5K — R75 31.6K — CR35 4.6V — R76 75Ω — R77 1.33K

+5V(MEM) — SEE NOTE1 CR40 — R97 464K — R96 5.6 — Q15 — R72 10Ω — J4-2 PON

R68 68.1K — CR34 — C61 .022 — U33G — R70 4.64K — U28

RESET J2-7 — RESET J3-1 — +5V(UB) R61 4.7K — U19E — U17A — U17E — MEM LOST FF U23C — W1 F — W1 G

R69 100K — C62 10 — U29D — U29A — MEMORY LOST BUFFER FF — U19B — R73 4.64K — U28 — +5V(UB) R55 4.7K — J4-6 MEM LOST — J3-6

(E17) A — R78 2.15K — C63 .01 — +5V(UB) — CPU ALARM U23D — U17B

U22C — +8V(REF) U28 — R83 4.64K — J2-K MGPD

NORMAL OPERATION OF JUMPERS
W1 - CLOSED
W2 - OPEN
W3 - OPEN

OVERTEMPERATURE THERMAL SWITCH — +5V(UB) — SW1 — R88 10K

U24A — U22D — R80 464K — CR36 — C65 100PF

U18C — U24C — CROWBAR CPU (D14)

(H6) OVERCURRENT ±12V(M) — (B5) OVERCURRENT +5V(M) — (F19) C — U25A — R79 10K — MEM ALARM U23A — C64 .01

R81 100K — CR37 — C66 0.1 — W1 A — +5V(UB) — R61 4.7K 6 — CROWBAR INHIBIT — W1 H

U24G — +8V(REF) U27 — R85 14Ω — J2-6 MEMORY INVERTER ENABLE

R82 464K — CR38 — C67 100PF — U18A — U33C — U19F — CROWBAR MEMORY (B7)

R84 147 — U27 — R86 34Ω — E (H7)

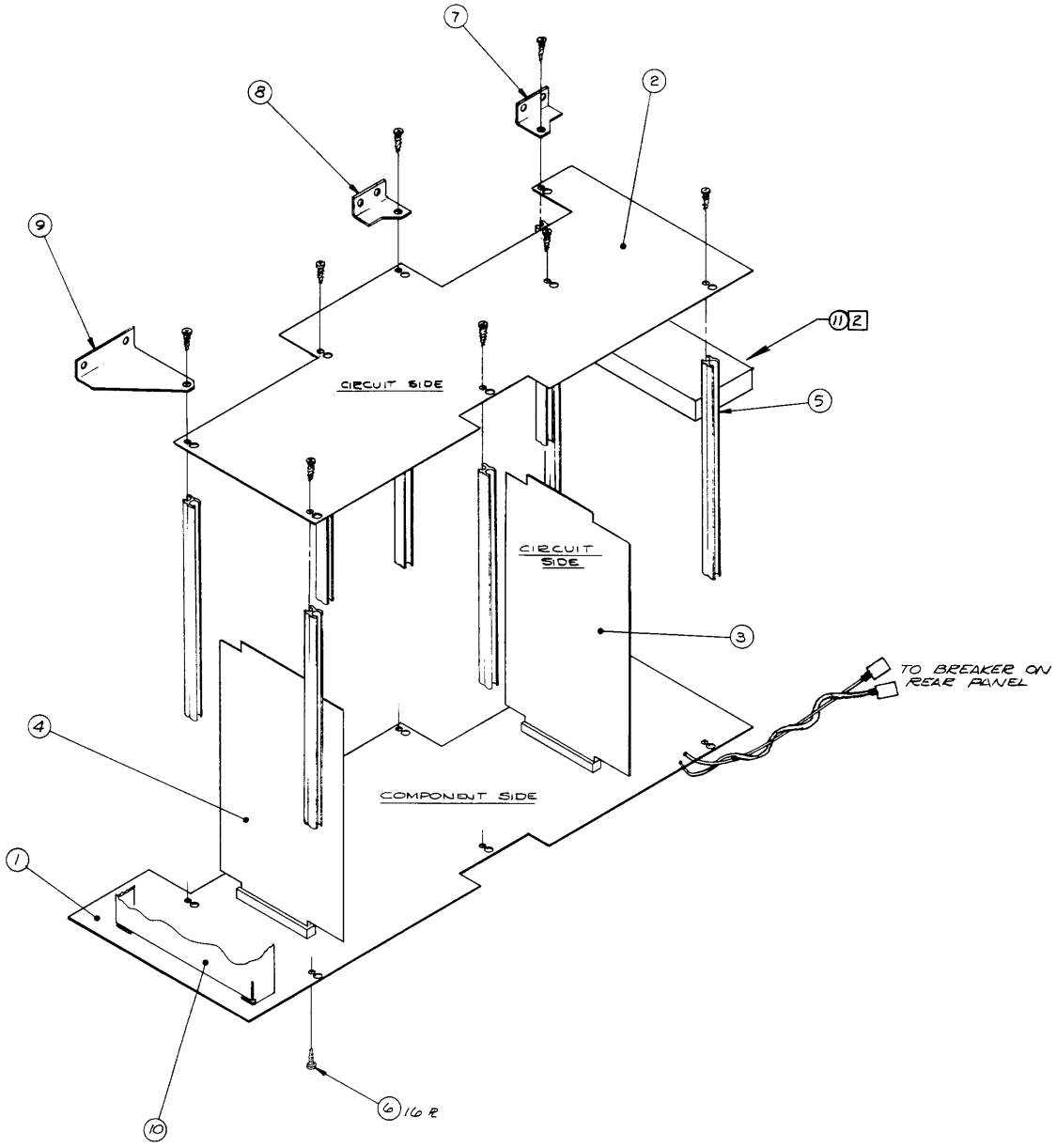
NOTE1: CR40 IS A STABISTOR

THIS SCHEMATIC DIAGRAM CONSISTS OF 3 SHEETS, DWG. NOS. 5080-8355-51 THRU 5080-8355-53. SEE DWG. NO. 5080-8355-51 FOR REVISION STATUS OF ENTIRE DWG. SET.

POWER SUPPLY UPPER BOARD 5060-1355-53 — sheet 1 of 3

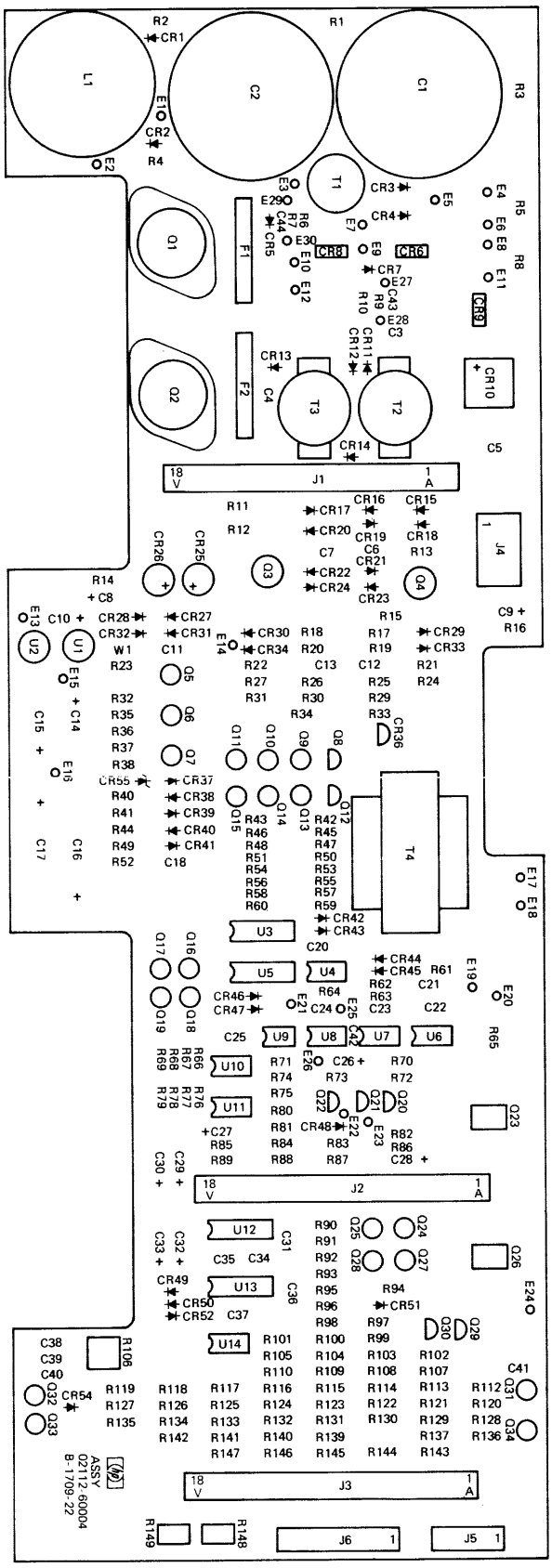
ENGINEER | APPROVED | DATE

HEWLETT PACKARD CO
DATA SYSTEMS DIVISION



ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
11	1	PAD - FOAM	4208-0111
10	1	BRACKET, P.C. BOARD	02112-00008
9	1	TIE BRKT, FRONT	02112-00020
8	1	TIE BRKT, CENTER	02112-00021
7	1	TIE BRKT, REAR	02112-00022
6	16	SCREW #6 20 x .625	0624-0062
5	8	STANDOFF	02112-20001
4	1	RISER BOARD	02112-80007
3	1	RISER BOARD LOADED	02112-60008
2	1	UPPER P.S. BOARD ASS'Y	02112-60005
1	1	LOWER P.S. BOARD ASS'Y	02112-60004

2112A Power Supply Main Assy.
02112-60006



2112A Power Supply Lower Assy.
02112-60004

2112A Power Supply Lower Assembly Parts List (Sheet 1 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV.33			7			
2	DIV.63			7			
	1C11,38	CAP 0.1UF		0150-0121		U	2
	C5,42	CAP .01UF 20%		0150-0123		U	2
	1C21,37	CAP 1.0UF 20%		0160-0127		U	2
	1C36,40	CAP .0022UF 10%		0160-0154		U	2
	1C43,44	CAP .022UF 10%		0160-0162		U	2
	C25	CAP .47UF-20+80%		0160-0174		U	1
	C39	CAP .015UF 10%		0160-0194		U	1
	1C18,20,22-24,34,35	CAP .01UF		0160-2055		U	7
	C31	CAP. 2400PF		0160-2227		U	1
	1C3,4,6,7	CAP 3000PF 5%		0160-2229		U	4
	C41	CAP 470PF 10%		0160-3455		U	1
	1C12,13	CAP 5000PF 10%		0160-3458		U	2
	1C14,15	CAP 100UF 20%		0180-0098		U	2
	1C16,17	CAP 200UF-10+75%		0180-0104		U	2
	1C8,9	CAP 6.8UF 10%		0180-0116		U	2
	C27	CAP 1UF 10%		0180-0291		U	1
	1C26,28	CAP 6.8UF 20%		0180-1701		U	2
	1C10,29,30,32,33,45	CAP 15UF 10%		0180-1746		U	6
		PAD-MTG TO5		0340-0164		U	2
		STUD SOLDER		0360-0090		U	20
		STUD SOLDER TERM		0360-0474		U	9

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		TERM STUD FKD		0360-1529		U	4
		SPCR TAP #6X.125		0380-0383		U	7
	R7,9	RES 56 5% .25		0683-5605		U	2
	1R25,26	RES 464 1%.125 ,61,63,123,64		0698-0082		U	6
	1R40,42 3 113,1 5 145,1	RES 2.15K 1%.125 ,43,75,80, 14,133 05		0698-0084		U	10
	R131	RES 261 1%.125		0698-3132		U	1
	R130	RES 4.22K 1%.125		0698-3154		U	1
	R41	RES 4.64K 1%.125		0698-3155		U	1
	R52	RES 26.1K 1%.125		0698-3159		U	1
	R115	RES 46.4K 1%.125		0698-3162		U	1
	R81	RES 464K 1%.125		0698-3260		U	1
	R146	RES 147 1%.125		0698-3438		U	1
	1R 67,6	RES 215 1%.125 9,77,79		0698-3441		U	4
	1R17,18	RES 422 1%.125 ,38,70,72,73		0698-3447		U	6
	R118	RES 1.21K 1%.125		0757-0274		U	1
	1R134,1	RES 3.16K 1%.125 26		0757-0279		U	2
	1R6,10, 3 91,96 5 103,1	RES 1K 1%.125 21,22,33,49 ,98,100 41,147		0757-0280		U	13
	R116	RES 9.09K 1%.125		0757-0288		U	1
	R110	RES 13.3K 1%.125		0757-0289		U	1
	1R36,109	RES 6.19K 1%.125		0757-0290		U	2
	1R24,27	RES 10 1%.125		0757-0346		U	2

2112A Power Supply Lower Assembly Parts List (Sheet 3 of 6)

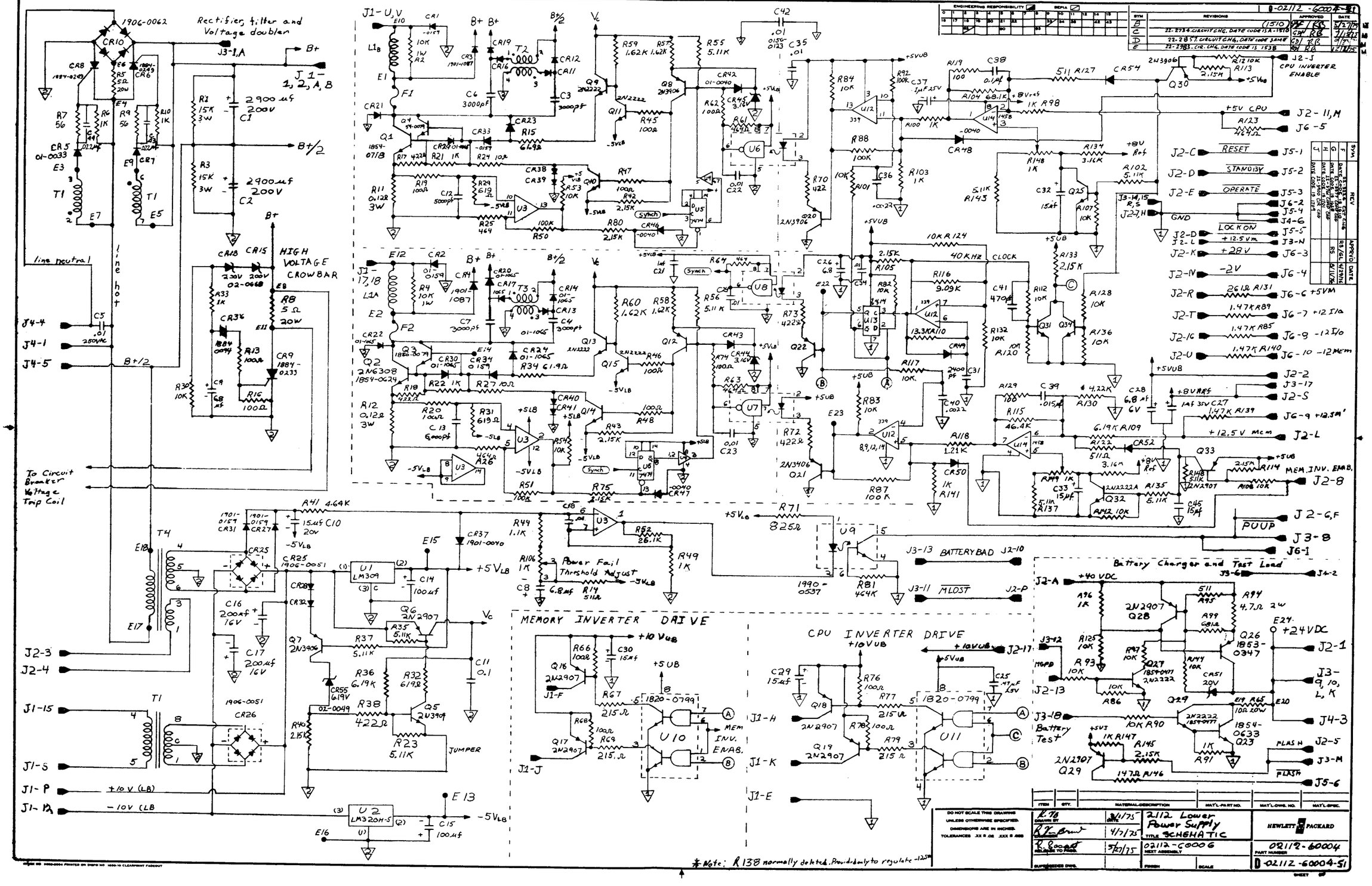
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	1R13,16,19,20, 3 45-48,62,66,68,74 5 76,78,119,129	RES 100 1%.125		0757-0401		U	16
	1R14,95,122,127	RES 511 1%.125		0757-0416		U	4
	1R29,31,32	RES 619 1%.125		0757-0418		U	3
	R99	RES 681 1%.125		0757-0419		U	1
	R71	RES 825 1%.125		0757-0421		U	1
	R44	RES 1.1K 1%.125		0757-0424		U	1
	1R57-60	RES 1.62K 1%.125		0757-0428		U	4
	1R23,35,37,55,56,102, 3 135,137,143,148	RES 5.11K 1%.125		0757-0438		U	10
	1R30,53,54,82-84, 3 86,90,93,97,101,107 5 108,112,117,120, 7 121,124,125,128,132 9 136,142,144	RES 10K 1%.125		0757-0442		U	24
	R104	RES 68.1K 1%.125		0757-0461		U	1
	1R50,51,87,88,92	RES 100K 1%.125		0757-0465		U	5
	R2,4	RES 10K 1% .50		0757-0839		U	2
	1R15,34	RES 61.9 1% .50		0757-1002		U	2
	1R89,85,139,140	RES 1.47K 1%.125		0757-1094		U	4
	R94	RES 4.7 5% 2W		0811-1674		U	1
	1R11,12	RES .12 3% 3W		0811-2616		U	2
	R1,3	RES 15K OHM 3W		0812-0051		U	2
		HT DIS PL PWR		1205-0219		U	3
		HT DIS TO-3		1205-0275		U	2

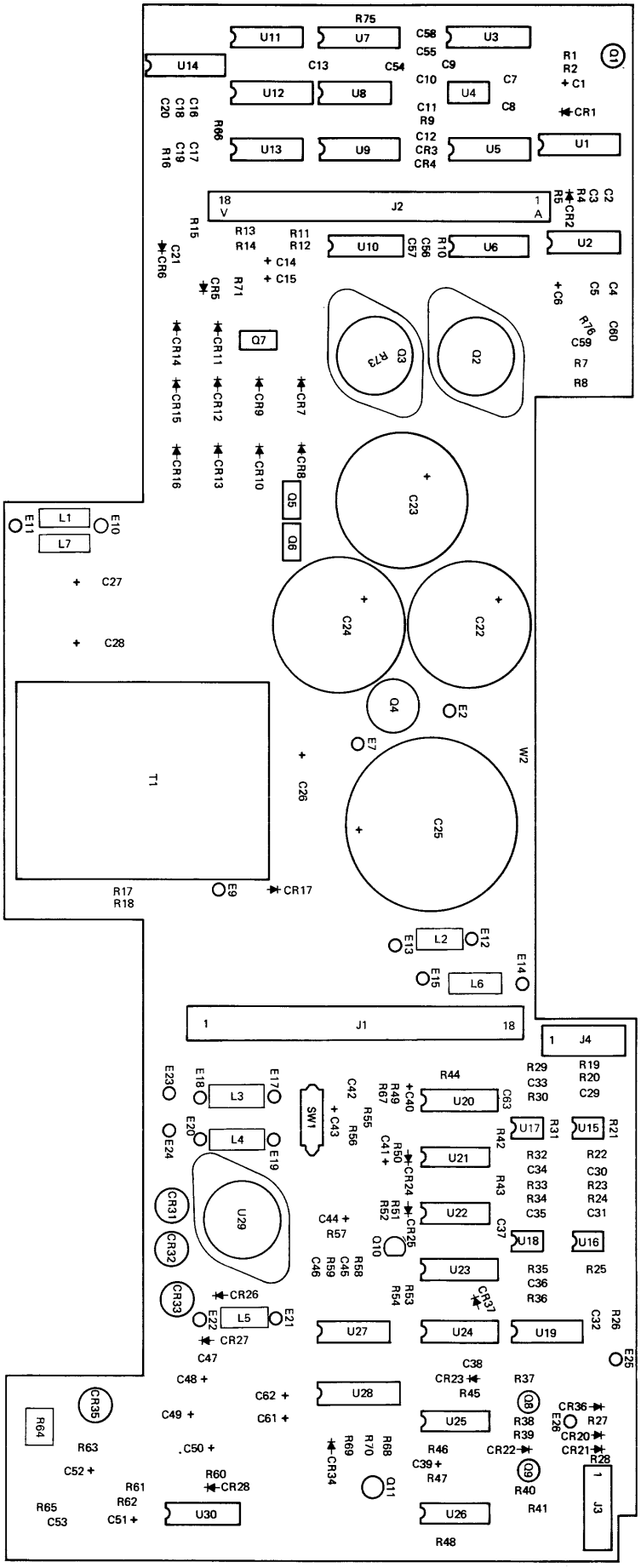
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	U1,2	HEAT SINK TO5		1205-0315		U	2
	J6	CONNECTOR		1251-0674		U	1
1	J1,2,3	CONN PC2X18.156D		1251-2026		U	3
	J5	PIN ASSY		1251-3412		U	1
	J4	CONN UTIL 6PIN M		1251-3819		U	1
	U5,13	IC SN7474N		1820-0077		U	2
	U1	IC LM309H		1820-0429		U	1
1	U4,10,11	IC SN75452P		1820-0799		U	3
	U3,12	IC QUAD COMPTR		1826-0138		U	2
	U14	IC D OP AMP 20K		1826-0142		U	1
	U2	IC V REG -5V		1826-0220		U	1
1	Q8,12,20,21,22,29,30	XSTR 2N3906 PL18		1853-0036		U	7
1	Q 6,7,16-19,33,28	XSTR PNP 2N2907A		1853-0281		U	8
	Q26	XSTR PNPSE DARL		1853-0347		U	1
	Q3,4	XSTR 2N3439 TO5		1854-0079		U	2
1 3	Q5,9,10,11,13,14,15 24,25,27,31,32,34	XSTR 2N2222ATO18		1854-0477		U	13
	Q2	XSTR 2N6308 TO3		1854-0624		U	1
	Q23	XSTR NPN SI DARL		1854-0633		U	1
	Q1	XSTR 2N6251 TO-3		1854-0718		U	1
	CR9	THYRISTOR SCR		1884-0233		U	1
	CR6,8	THYRISTOR-SCR		1884-0249		U	2
	CR36	THYRISTOR		1884-0258		U	1
1	CR5,7,28,32	RECTIFIER SIL		1901-0033		U	4

2112A Power Supply Lower Assembly Parts List (Sheet 5 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1 3	CR37,42,43,46-50 52,54	DIODE SIL		1901-0040		U	10
1	CR34,27,1,2,31,33	DIODE IN4004		1901-0159		U	6
1	CR38-41	STABISTOR STB523		1901-0460		U	4
1 3	CR11-14,17,19-24, 16,29,30	DIODE IN4936		1901-1065		U	14
	CR3,4	RECTIFIER		1901-1087		U	2
	CR55	DIODE 6.19V		1902-0049		U	1
	CR51	DIODE		1902-0556		U	1
1	CR15,18	DIODE 200V ZENER		1902-0668		U	2
1	CR35,44,45	DIODE 3.16V		1902-3036		U	3
1	CR25,26	DIODE-FW BRIDGE		1906-0051		U	2
	CR10	RECTIFIER		1906-0080		U	1
	U6-8	ISOLATOR		1990-0429		U	3
	U9	OPTO ISOLATOR		1990-0537		U	1
	R106	RES VAR 1K		2100-3211		U	1
1	R148,149	RES VAR 1K 10%		2100-3352		U	2
	F1,2	FUSE 2.5A NB		2110-0083		U	2
		FUSE CLIP .290D		2110-0483		U	4
		LKWSHR 6 HEL		2190-0006		U	1
		SCR #4-40X.375L		2200-0143		U	3
		SCR #4-40X.500L		2200-0147		U	2
		NUT 4-40 W/LK		2260-0009		U	5
		SCR #6-32X.750L		2360-0205		U	1
		SCR 6-32X.375		2360-0859		U	7

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		NUT 6-32 .312AF		2420-0002		U	1
		WSHR #10		3050-0006		U	1
		WSHR #4 SS		3050-0222		U	10
		WSHR #6 SS		3050-0227		U	2
		COMPOUND-THERMAL		6040-0239		U	0.01
	W1	WIRE JUMPERS		8159-0005		U	1
	T4	TRANSFORMER		9100-0665		U	1
	T2,3	XFORMER		9100-2966		U	2
	T1	XFORMER-POWER		9100-3803		U	1
		BOARD-ETCHED		5080-9755		W	1
		HEAT SINK		02108-00030		M	3


Rectifier, filter and Voltage doubler
1906-0062
CR10
2900 uf 200V C1
2900uf 200V C2
HIGH VOLTAGE CROWBAR
line neutral
line hot
To Circuit Breaker Voltage Trip Coil
J3-1,A
J1-1, 2, A, B
J4-4
J4-1
J4-5
J1-15
J1-S
J1-P
+10 V (LB)
J1-N
-10V (LB
J2-3
J2-4
J1- U, V
J1-17,18
T1
T4
CR25 1906-0051
CR26
U1 LM309
U2 LM320H-5
+5VLB
-5VLB
Vc
Power Fail Threshold Adjust
MEMORY INVERTER DRIVE
CPU INVERTER DRIVE
+10VUB
+5VUB
U10
U11
MEM INV. ENAB.
J1-F
J1-H
J1-J
J1-K
J1-E
J2-17
U12
U13
U14
9.09K
13.3KA1/0
40KHz CLOCK
J2-C RESET
J2-D STANDBY
J2-E OPERATE
GND
LOCK ON
+12.5 Vm
+28V
-2V
2612 R131
1.47K R89
1.47K R85
1.47K R140
+12.5V Mem
+5V CPU
J2-11, M
J6-5
J2-J CPU INVERTER ENABLE
J2-2
J3-17
J2-S
J6-9 +12.5M'
J2-L
J2-8
MEM. INV. ENAB.
J2-6, F
POUP
J3-8
J6-1
BATTERY BAD
MLOST
Battery Charger and Test Load
+40 VDC
+24VDC
J2-1
J3-9, 10, L, K
J4-3
J2-5
J3-M
J5-6
FLASH
J3-18 Battery Test
J2-13
J3-12
J3-14, 15 R, S
J2-7, H
J5-1
J5-2
J5-3
J6-2
J5-4
J4-6
J5-5
J3-N
J6-3
J6-4
J6-6 +5VM
J6-7 +12 I/O
J6-8 -12 I/O
J6-10 -12MEM
J4-2
Synch
Q1 thru Q33
R1 thru R145
C1 thru C45
CR1 thru CR57
* Note: R138 normally deleted. Provided only to regulate -12.5V
Rectifier, filter and Voltage doubler
HIGH VOLTAGE CROWBAR
Battery Charger and Test Load
MEMORY INVERTER DRIVE
CPU INVERTER DRIVE
2112 Lower Power Supply SCHEMATIC
02112-60006
02112-60004
0-02112-60004-5
HEWLETT PACKARD



ASSY 02112-60005
A - 1709 - 22

2112A Power Supply Upper Assy.
02112-60005

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV.33			7			
2	DIV.63			7			
		CAP 0.1UF		0150-0121		U	9
1	C4,29,33,35,45,46						
3	56,57,63						
		CAP 1.0UF 20%		0160-0127		U	4
1	C3,5,38,59						
		CAP. 2.2UF		0160-0128		U	4
1	C2,16,18,20						
	C42	CAP .022UF 10%		0160-0162		U	2
		CAP .01UF		0160-2055		U	13
1	C7,8,10-13,17,19						
3	37,54,55,58,60						
	C53	CAP 1000PF 10%		0160-3456		U	1
	C21	CAP .02UF 20%		0160-3459		U	1
		CAP .0001UF		0160-3466		U	4
1	C30,31,34,36						
	C32	CAP .027UF 10%		0170-0066		U	1
	C47	CAP 47UF 10%		0180-0097		U	1
	C48	CAP 4.7UF 10%		0180-0100		U	1
	C50	CAP 200UF-10+75%		0180-0104		U	1
		CAP 6.8UF 10%		0180-0116		U	3
1	C1,61,62						
	C52	CAP 50UF -10+75%		0180-0141		U	1
		CAP 33UF 10%		0180-0229		U	3
1	C40,43,51						
		CAP 1UF 10%		0180-0291		U	4
1	C6,9,39,41						
	C49	CAP 5UF -10+75%		0180-0301		U	1
		CAP 440UF-10+75%		0180-0595		U	3
1	C26-28						
	C15	CAP 47UF 10%		0180-1704		U	1
	C44	CAP .1UF 10%		0180-1743		U	1
	C14	CAP 15UF 10%		0180-1746		U	1

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		STUD SOLDER		0360-0090		U	5
		STUD SOLDER TERM		0360-0474		U	3
		TERM STUD FKD		0360-1529		U	12
		SPCR TAP #6X.125		0380-0383		U	11
		STANDOFF		0380-0689		U	2
1	R17,18	RES 2.7 5% .25		0683-0275		U	2
	R61	RES 4.7 5% .25		0683-0475		U	1
	R40	RES FXD 5.6 OHM		0683-0565		U	1
1	R9,16,43	RES 1000 5% .25		0683-1025		U	3
1	R4,29,53,58,59,63	RES 10K 5% .25		0683-1035		U	6
	R52	RES 1200 5% .25		0683-1225		U	1
1	R21,31	RES 150 5% .25		0683-1515		U	2
	R48	RES 22K 5% .25		0683-2235		U	1
	R60	RES 390 5% .25		0683-3915		U	1
1 3 5	R5,10-12,19 28,37,38,42 47,49-56	RES 4700 5% .25		0683-4725		U	12
1	R22,24,32,35	RES 47K 5% .25		0683-4735		U	4
1	R23,25,33,36	RES 560 5% .25		0683-5615		U	4
1	R39,51	RES 680 5% .25		0683-6815		U	2
1	R20,34	RES 464 1%.125		0698-0082		U	2
1	R66,67	RES 14.7K 1%.125		0698-3156		U	2
	R45	RES 464K 1%.125		0698-3260		U	1

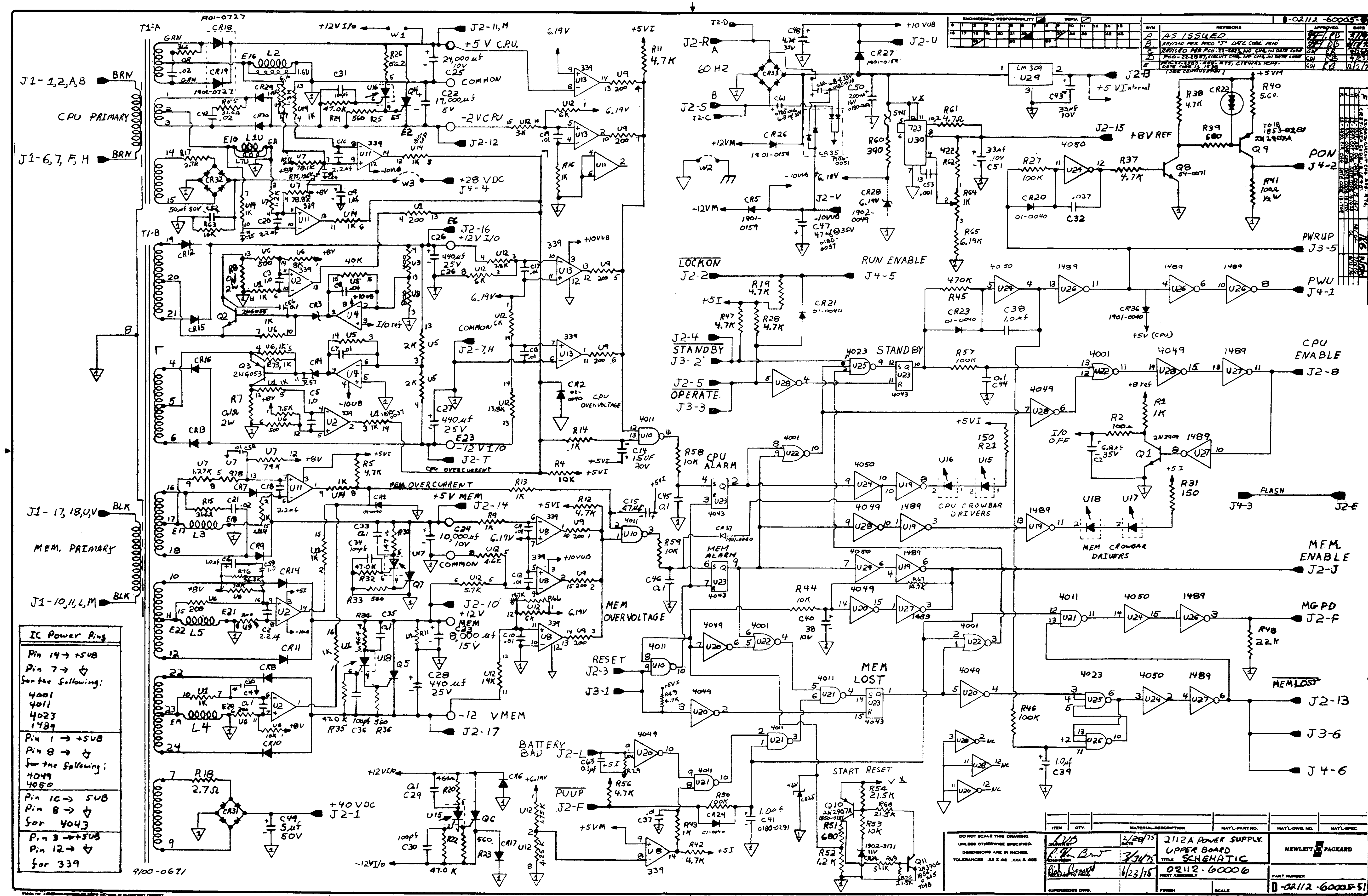
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	R15,55	RES 31.6 1% .5Q		0698-3394		U	2
	R30	RES 147 1%.125		0698-3438		U	1
	R62	RES 422 1%.125		0698-3447		U	1
	R75	RES 196K 1%.125		0698-3453		U	1
	R41	RES 100 1% .50		0757-0198		U	1
1	R54,68,70	RES 21.5K 1%.125		0757-0199		U	3
1	R1,13,14,73	RES 1K 1%.125		0757-0280		U	4
	R65	RES 6.19K 1%.125		0757-0290		U	1
	R2	RES 100 1%.125		0757-0401		U	1
	R71	RES 619 1%.125		0757-0418		U	1
	R44	RES 10K 1%.125		0757-0442		U	1
	R69	RES 51.1K 1%.125		0757-0458		U	1
	R76	RES 56.2K 1%.125		0757-0459		U	1
1	R27,46,50,57	RES 100K 1%.125		0757-0465		U	4
	R26	RES 56.2 1% .75		0757-1001		U	1
	R7,8	RES 0.15Ω2W PW		0811-3290		U	2
		TBG #20 TFE NAT		0890-0212		U	0.33
		HT DIS TO-3		1205-0275		U	2
	J2	CONN PC2X18.156Q		1251-2026		U	1
	J3,4	PIN ASSY		1251-3412		U	2
	U1,14	RES NET 8X1K DIP		1810-0037		U	2
	U9	RES NET 8X200DIP		1810-0124		U	1
	U3	RESISTOR NETWORK		1810-0185		U	1
	U12	RESISTOR NETWORK		1810-0187		U	1
	U7	RESISTOR NETWORK		1810-0188		U	1
	U5	RESISTOR NETWORK		1810-0199		U	1

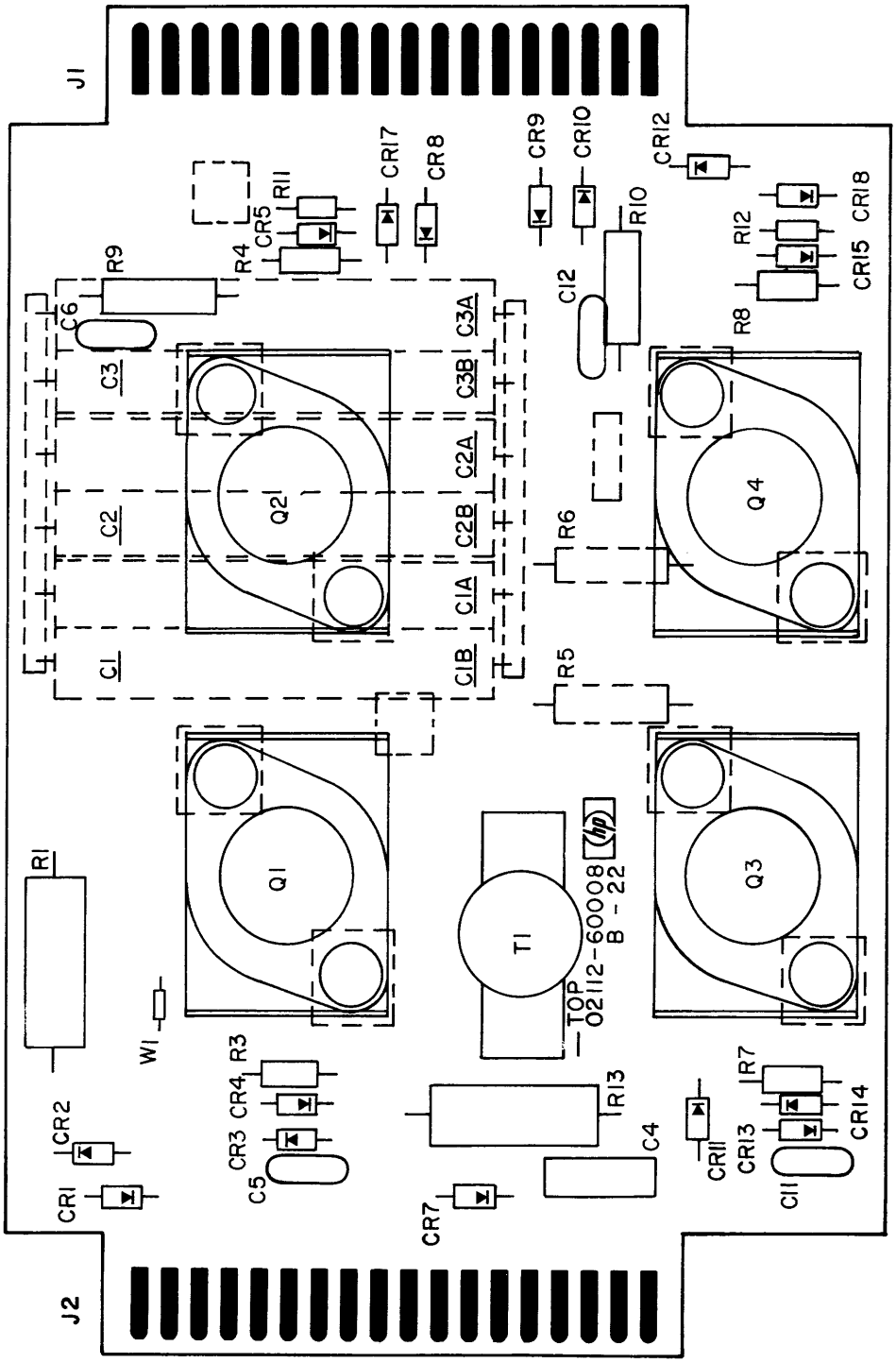
2112A Power Supply Upper Assembly Parts List (Sheet 4 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	U6	NETWORK-RESISTOR		1810-0222		U	1
	U29	IC LM309K		1820-0430		U	1
	U30	IC U6E7723303		1820-0439		U	1
	U23	IC CD4043AY		1820-0941		U	1
	U25	IC CD4023AY		1820-0943		U	1
	U22	IC CD4001AY		1820-0946		U	1
1	U10,21	IC CD4011AE		1820-0949		U	2
1	U19,26,27	IC MC1489AL		1820-0990		U	3
1	U20,28	IC 4049AE		1820-1145		U	2
	U24	IC CD4050AE		1820-1146		U	1
1	U2,8,11,13	IC QUAD COMPTR		1826-0138		U	4
	U4	IC D OP AMP 20K		1826-0142		U	1
	Q9,10	XSTR PNP 2N2907A		1853-0281		U	2
	Q3	XSTR 2N6053 TO3		1853-0351		U	1
	Q1,8	XSTR NPN SI PLS		1854-0071		U	2
	Q11	XSTR 2N3904 PLS		1854-0215		U	1
	Q2	XSTR 2N6055 TO3		1854-0611		U	1
1	Q5,6,7	THYRISTOR-SCR		1884-0240		U	3
1 3	CR1,2,20,21,23,24 C36,37	DIODE SIL		1901-0040		U	8
1	CR5,6,17,26,27	DIODE IN4004		1901-0159		U	5
	CR22	STABISTOR STB523		1901-0460		U	1
1	CR7,9	DIODE		1901-0676		U	2
1	CR8,10-16	DIODE		1901-1086		U	8

2112A Power Supply Upper Assembly Parts List (Sheet 5 of 5)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	CR3,4,	DIODE 6.19V 28		1902-0069		U	3
	CR25	DIODE 6.64V		1902-3082		U	1
	CR34	DIODE 80 11V		1902-3171		U	1
1	CR31-33	DIODE-FW BRIDGE 35		1906-0051		U	4
1	U15-18	ISOLATOR OPTO		1990-0431		U	4
	R64	RES VAR 1K		2100-3211		U	1
		SCR 6-32X.375		2360-0359		U	6
		NUT 6-32 W/LK		2420-0001		U	1
		WSHR #6 BRS		3050-0100		U	1
	Sw1	SWITCH-THERMAL		3103-0033		U	1
		COMPOUND-THERMAL		6040-0239		U	0.0010
		WIRE 30AWG WHT		8150-3426		U	0.25
		WIRE 22GA BARE		8151-0013		U	0.30
	W2	WIRE JUMPERS		8159-0005		U	1
		BOARD-ETCHED		5080-9756		W	1
		GROUND STRAP		02112-00004		W	1
		GROUND STRAP		02112-00005		W	1


2112A POWER SUPPLY
UPPER BOARD
SCHEMATIC
02112-60006
D-02112-60005-51
HEWLETT PACKARD
DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005
2/28/75
3/31/75
6/23/75
SHEET 1 OF 1
REVISIONS
A AS ISSUED
B REVISED PER PPCO "J" DATE CODE 1510
C REVISED PER PCO-22-2823, NO CHG. IN DATE CODE
D PCO-22-2857, CIRCUIT CHG. NO CHG. IN DATE CODE
E PCO-22-2983-ADD R75, C15 WAS 15µf. DATE CODE IS 1538 (SEE CONTINUATION)
IC Power Pins
Pin 14 → +5VB
Pin 7 → ⏚
for the following:
4001
4011
4023
1489
Pin 1 → +5VB
Pin 8 → ⏚
for the following:
4049
4050
Pin 16 → 5VB
Pin 8 → ⏚
for 4043
Pin 3 → +5VB
Pin 12 → ⏚
for 339
9100-0671
CPU PRIMARY
MEM. PRIMARY
J1-1,2,A,B
J1-6,7,F,H
J1-17,18,U,V
J1-10,11,L,M
+5 V C.P.U.
-2 VCPU
+28 VDC J4-4
+12V I/O
-12 V I/O
+5V MEM
+12 V MEM
-12 VMEM
+40 VDC J2-1
CPU OVERVOLTAGE
CPU OVERCURRENT
MEM OVERCURRENT
MEM OVERVOLTAGE
60 HZ
LOCKON J2-2
RUN ENABLE J4-5
STANDBY J2-4 J3-2
OPERATE J2-5 J3-3
CPU ALARM
MEM ALARM
RESET J2-3 J3-1
BATTERY BAD J2-L
PUUP J2-F
MEM LOST
START RESET
+8V REF J2-15
+5 VInternal J2-B
PON J4-2
PWRUP J3-5
PWU J4-1
CPU ENABLE J2-8
I/O OFF
CPU CROWBAR DRIVERS
MEM CROWBAR DRIVERS
FLASH J4-3 J2-E
MEM. ENABLE J2-J
MGPD J2-F
MEMLOST J2-13 J3-6 J4-6



2112A
Riser Board Assy
02112-60008

2112A Riser Board Assembly Parts List (Sheet 1 of 2)

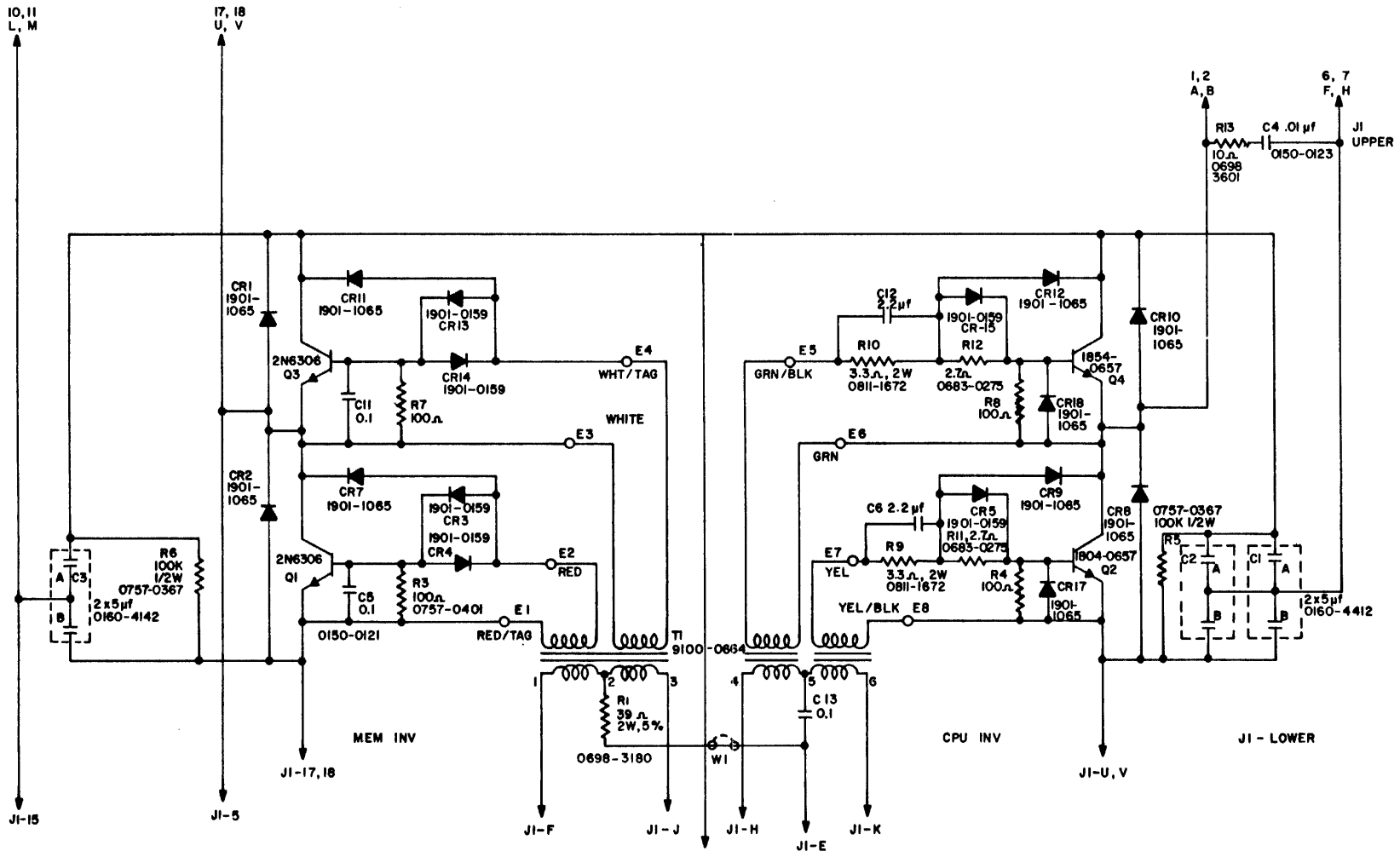
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV.33			7			
2	DIV.63			7			
	C5,11	CAP 0.1UF		0150-0121		U	2
	C4	CAP .01UF 20%		0150-0123		U	1
	C6,12	CAP. 2.2UF		0160-0128		U	2
	C1-3	CAP FXD 2X5UF		0160-4142		U	3
	E1-8	STUD SOLDER TERM		0360-0294		U	8
	E9	STUD SOLDER TERM		0360-0474		U	1
	E10	STUD SOLDER TERM		0360-1047		U	1
		EYELET BRASS		0361-0534		U	1
		SPCR TAP #6X.125		0380-0305		U	8
		STANDOFF		0380-0886		U	2
1	R11,12	RES 2.7 5% .25		0683-0275		U	2
	R13	RES 10 5% 2W		0698-3601		U	1
	R1	RES 39 5% 2W		0698-3613		U	1
	R5,6	RES 100K 1% .50		0757-0367		U	2
1	R3,4,7,8	RES 100 1%.125		0757-0401		U	4
	R9,10	RES 3.3 5% 2W		0811-1672		U	2
		TBG HS BLK .750D		0890-0301		U	0.0001
		HT DIS TO-3		1205-0275		U	4
	Q1,3	XSTR 2N6306 TO3		1854-0623		U	2
	Q2,4	XSTR NPN SI		1854-0657		U	2
1	CR3,4,13,14	DIODE IN4004		1901-0159		U	4
1 3	CR1,2,5,7-12,15,17,18	DIODE IN4936		1901-1065		U	12
		SCR #4-40X.312L		2200-0141		U	2
		SCR #6-32X.375L		2360-0117		U	8

2112A Riser Board Assembly Parts List (Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		COMPOUND-THERMAL		6040-0239		U	0.01
		WIRE JUMPERS		8159-0005		U	1
		INSULATOR RISER		02112-00024		W	1
		BOARD-ETCHED		02112-80008		W	1

C-0 - 60008-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	RB	3-15-73
B	CHANGED WIRE COLOR CALLOUT (DATE CODE 1510) PPCO,'F'	RB	5-14-75
C	PCO-22-27794. PILOT RING MODS. DATE CODE IS A:1510	RB	7-15-75



ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L PART NO	MAT'L DWG NO	MAT'L SPEC.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY	R Van Bent	2/4/75
ENGINEER	R Van Bent	2/4/75
RELEASE TO PROD	Richard Bassett	5/28/75
SUPERSEDES DWG.		

2112 POWER SUPPLY SCHEMATIC/RISER

TITLE

NEXT ASSEMBLY

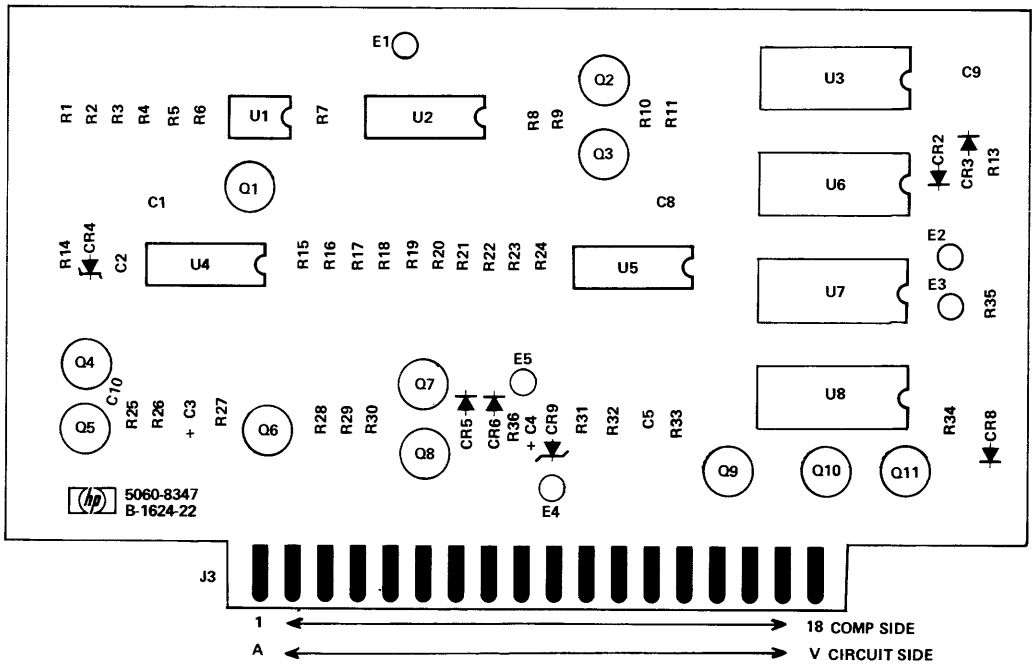
FINISH | SCALE

HEWLETT PACKARD

PART NUMBER C-02112-60008-51

SHEET OF

STOCK NO 9280-0083 PRINTED ON DIEPO NO 1030 10 CLEARPRINT FADEOUT



Battery Control I Assy
5060-8347

Battery Control I Assembly Parts List (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
3	DIV	33		7			
5	DIV	63		7			
	C8	CAP 1.0UF 20%		0160-0127		U	1
	C5	CAP 1000PF 5%		0160-0938		U	1
	C2,10	CAP .01UF		0160-2055		U	2
	C9	CAP 47PF 5%		0160-2307		U	1
	C1	CAP 560PF 5%		0160-3535		U	1
	C3	CAP 2.2UF 10%		0180-0197		U	1
	C4	CAP 22UF 10%		0180-0228		U	1
	E1-3	STUD SOLDER TERM		0360-0294		U	3
	E4,5	STUD SOLDER TERM		0360-0474		U	2
	R27	RES 2.15K 1%.125		0698-0084		U	1
1	R1,2,16-18,21,	RES 4.22K 1%.125		0698-3154		U	8
3	22,25						
	R7	RES 23.7K 1%.125		0698-3158		U	1
	R36	RES 316 1% .50		0698-3402		U	1
	R6	RES 42.2K 1%.125		0698-3450		U	1
	R33	RES 21.5K 1%.125		0757-0199		U	1
	R24	RES 5.62K 1%.125		0757-0200		U	1
	R32	RES 9.09K 1%.125		0757-0288		U	1
	R14	RES 825 1%.125		0757-0421		U	1
1	R19,26	RES 5.11K 1%.125		0757-0438		U	2
	R28	RES 8.25K 1%.125		0757-0441		U	1
1	R3-5,10,11,15,	RES 10K 1%.125		0757-0442		U	8
3	20,29						
1	R9,31,34	RES 51.1K 1%.125		0757-0458		U	3
1	R8,13,23,35	RES 100K 1%.125		0757-0465		U	4

Battery Control I Assembly Parts List (Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R30	RES 1.47K 1%.125		0757-1094		U	1
	U1	IC LM301AN		1820-0477		U	1
	U6,7	IC CD4020AY		1820-0935		U	2
	U3,8	IC CD4027AD		1820-0938		U	2
	U2	IC CD4011AE		1820-0949		U	1
	U4,5	IC D COMPTR 8K		1826-0175		U	2
	Q2,9	XSTR 2N3906 PL18		1853-0036		U	2
	Q6	XSTR PNP 2N2907A		1853-0281		U	1
1	Q1,3-5,7,8,10,11	XSTR 2N3904 PL5		1854-0215		U	8
	CR5,6	RECTIFIER SIL		1901-0033		U	2
1	CR2,3,8	DIODE SIL		1901-0040		U	3
	CR9	DIODE-ZENER 13V		1902-0555		U	1
	CR4	DIODE 4.64V		1902-3082		U	1
		BOARD-ETCHED		5080-9738		W	1

REV	REFERENCE	SERIES /PREFIX
A	ORIG.	1553
B	22-2088	1415
C	22-2237	1417
D	22-2286	1445
E	ERRATA	NO CHANGE
F	22-3253	1616
G	22-3340	1624

40KHZ CLOCK

BATTERY DRIVER ENABLE

BATTERY TEST

BATTERY MALFUNCTION

±12V CURRENT SENSING

2. SLOW CLOCK OUTPUT ON PIN 11 NORMALLY STRAPPED TO INPUT PIN 17.
1. ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICROFARADS.

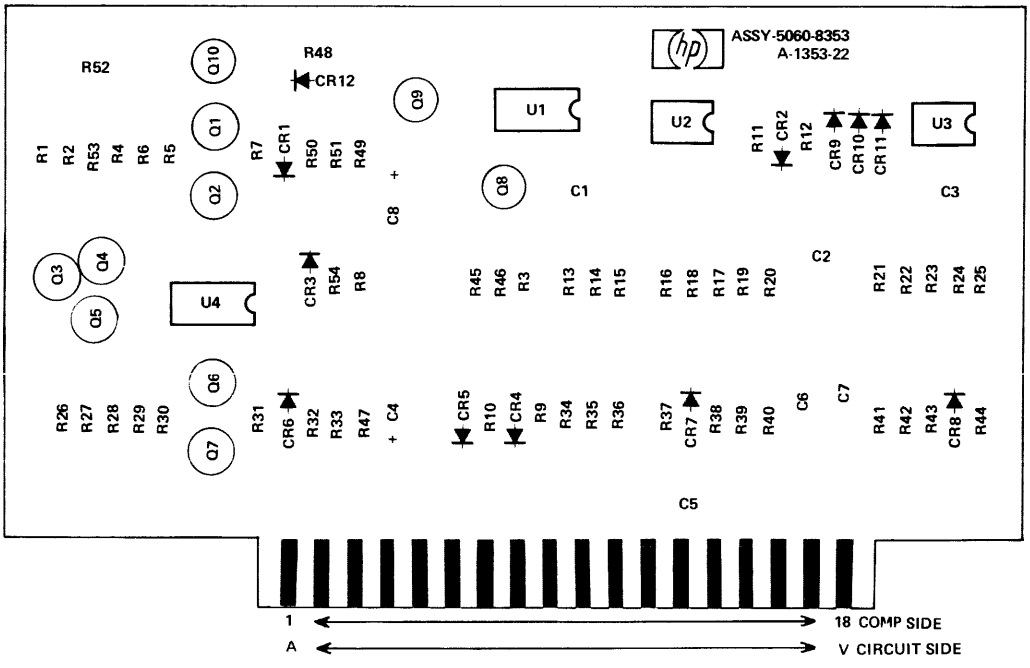
NOTE: UNLESS OTHERWISE SPECIFIED,

TITLE
BATTERY CONTROL I
5060-8347-51

SHEET 1 OF 1

ENGINEER | APPROVED | DATE

HEWLETT PACKARD CO
DATA SYSTEMS DIVISION LOVELAND, COLORADO



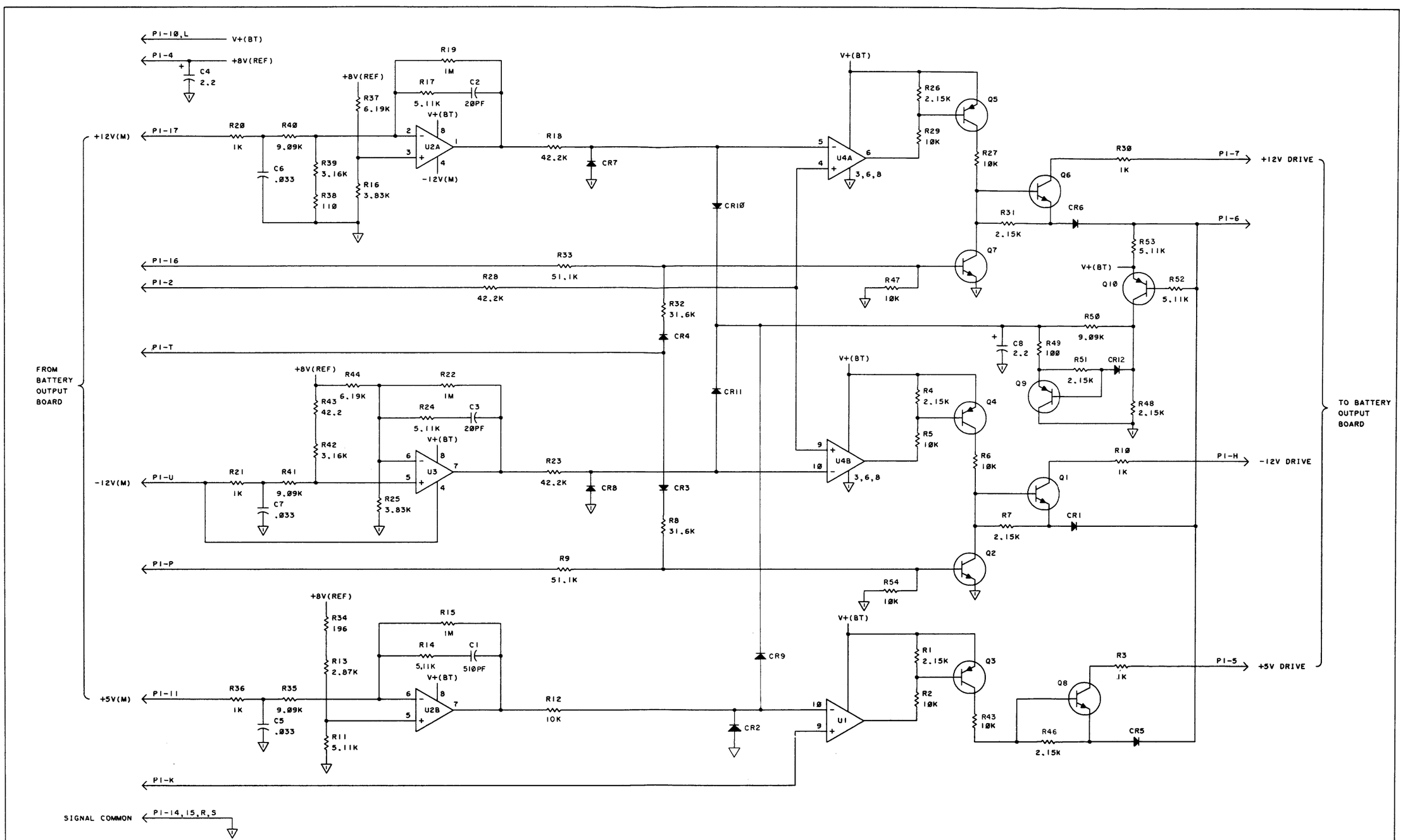
Battery Control II Assy.
5060-8353

Battery Control II Assembly Parts List (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
3	DIV 33			7			
5	DIV 63			7			
	C5-7	CAP .033UF 10%		0160-0163		U	3
	C2,3	CAP 20PF 5%		0160-2198		U	2
	C1	CAP 510PF 10%		0160-3534		U	1
	C4,8	CAP 2.2UF 10%		0180-0197		U	2
1	R15,19,22	RES 1M 5% .25		0683-1055		U	3
1 3	R1,4,7,26,31 46,48,51	RES 2.15K 1%.125		0698-0084		U	8
	R13	RES 2.87K 1%.125		0698-3151		U	1
1	R16,25	RES 3.83K 1%.125		0698-3153		U	2
	R8,32	RES 31.6K 1%.125		0698-3160		U	2
	R34	RES 196 1%.125		0698-3440		U	1
1	R18,23,28	RES 42.2K 1%.125		0698-3450		U	3
1	R39,42	RES 3.16K 1%.125		0757-0279		U	2
1 3	R3,10,20,21 30,36	RES 1K 1%.125		0757-0280		U	6
1	R35,40,41,50	RES 9.09K 1%.125		0757-0288		U	4
1	R37,44	RES 6.19K 1%.125		0757-0290		U	2
	R43	RES 42.2 1%.125		0757-0316		U	1
	R49	RES 100 1%.125		0757-0401		U	1
	R38	RES 110 1%.125		0757-0402		U	1
1 3	R11,14,17,24 52,53	RES 5.11K 1%.125		0757-0438		U	6
1 3	R2,5,6,12,27,29, 45,47,54	RES 10K 1%.125		0757-0442		U	9

Battery Control II Assembly Parts List (Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R9,33	RES 51.1K 1%.125		0757-0458		U	2
	U2,3	IC MC1458 P1		1826-0139		U	2
	U1,4	IC D COMPTR 8K		1826-0175		U	2
	Q3-5,9,10	XSTR 2N3906 PL18		1853-0036		U	5
	Q1,2,6-8	XSTR 2N3904 PL5		1854-0215		U	5
	CR1-12	DIODE SIL		1901-0040		U	12
		BOARD-ETCHED		5080-9742		W	1



1. ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICROFARADS.

NOTE: UNLESS OTHERWISE SPECIFIED.

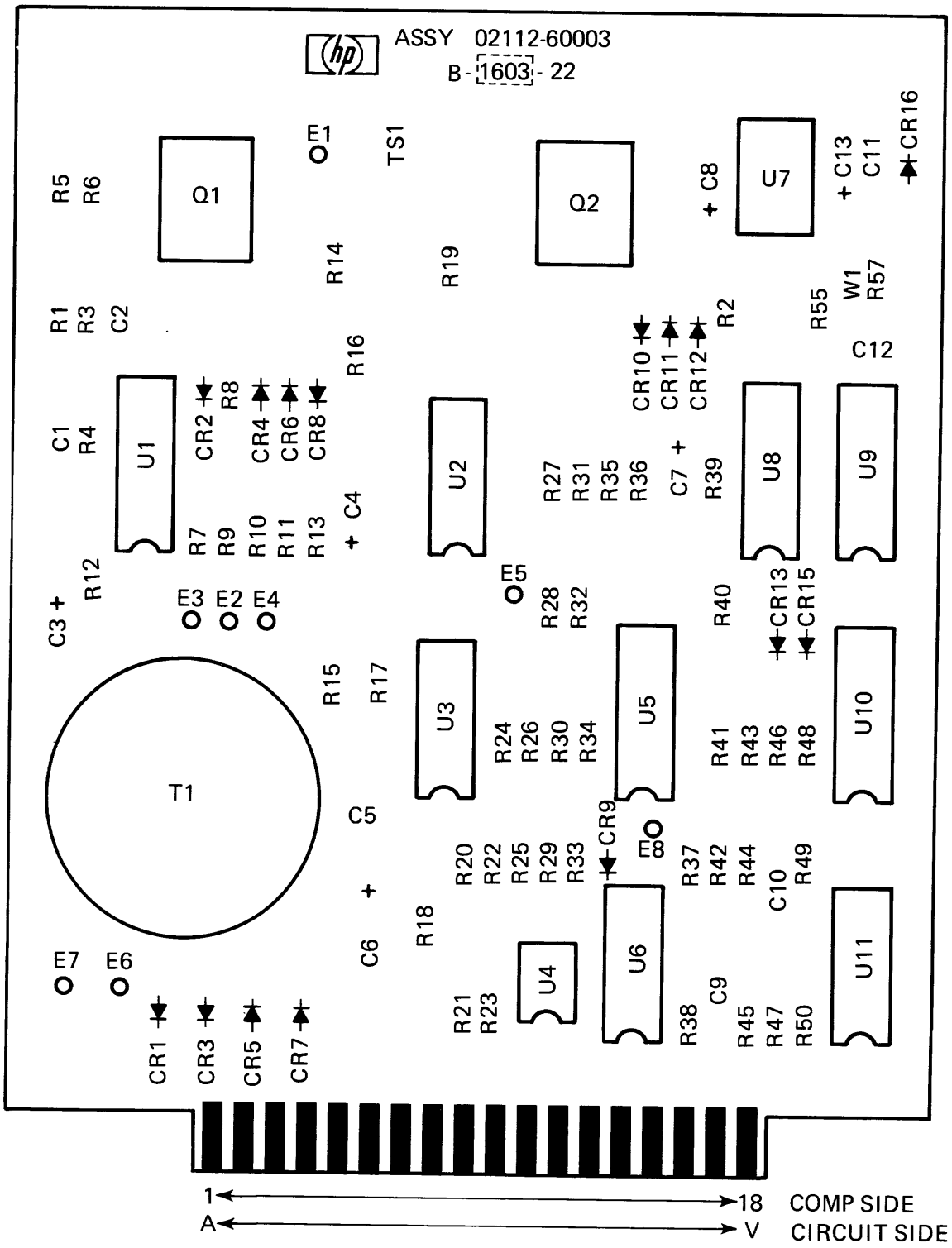
REV	REFERENCE	SERIES/PREFIX
A	ORIG.	1353
B	ERRATA	NO CHANGE

TITLE: BATTERY CONTROL II
5060-8353-51

SHEET 1 OF 1

ENGINEER | APPROVED | DATE

HEWLETT PACKARD CO
DATA SYSTEMS DEVELOPMENT DIVISION



Battery Inverter Assembly
02112-60003

Battery Control Inverter Assembly Parts List (Sheet 1 of 3)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV.33			7			
2	DIV.63			7			
3	DIV 50			7			
		CAP 0.1UF		0150-0121		U	2
1	C10,11						
	C9	CAP 1.0UF 20%		0160-0127		U	1
	C12	CAP 47PF 5%		0160-2307		U	1
	C1,2	CAP 1000PF 10%		0160-3456		U	2
	C5	CAP 820PF 5%		0160-3539		U	1
	C6	CAP 50UF -10+75%		0180-0141		U	1
	C3	CAP 2.2UF 10%		0180-0197		U	1
	C8,13	CAP 1UF 10%		0180-0291		U	2
	C4,7	CAP 15UF 10%		0180-1746		U	2
	E1-8	STUD SOLDER TERM		0360-0294		U	8
	R12	RES 10K 5% .25		0683-1035		U	1
		RES 2.15K 1%.125		0698-0084		U	5
1	R2,3,23,28,31						
		RES 4.22K 1%.125		0698-3154		U	6
1	R38,44-47,49						
		RES 4.64K 1%.125		0698-3155		U	2
1	R11,39						
	R57	RES 14.7K 1%.125		0698-3156		U	1
	R22	RES 23.7K 1%.125		0698-3158		U	1
	R20	RES 147 1%.125		0698-3438		U	1
		RES 215 1%.125		0698-3441		U	2
1	R13,36						
	R4	RES 21.5K 1%.125		0757-0199		U	1
		RES 1K 1%.125		0757-0280		U	5
1	R5,26,32,34,35						
	R37	RES 6.19K 1%.125		0757-0290		U	1
		RES 100 1%.125		0757-0401		U	3
1	R6,16,27						

Battery Control Inverter Assembly Parts List (Sheet 2 of 3)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
	R14,19	RES 511 1%.125		0757-0416		U	2
	R10,24,30	RES 5.11K 1%.125		0757-0438		U	3
	R42	RES 6.81K 1%.125		0757-0439		U	1
	R1	RES 8.25K 1%.125		0757-0441		U	1
	R7-9,25,29,33,41-43	RES 10K 1%.125		0757-0442		U	8
	R40	RES 51.1K 1%.125		0757-0458		U	1
	R48,50,55	RES 100K 1%.125		0757-0465		U	3
	R15,17	RES 10 1% .50		0757-0984		U	2
	R21	RES 1.47K 1%.125		0757-1094		U	1
	R18	RES .12 5%2WPW		0811-3291		U	1
		HT DIS PL PWR		1205-0284		U	2
	U4	IC LM301AN		1820-0477		U	1
	U8,9	IC CD4020AY		1820-0935		U	2
	U5,10	IC CD4027AD		1820-0938		U	2
	U6	IC CD4011AE		1820-0949		U	1
	U7	IC V REG 12V		1826-0099		U	1
	U11	IC D COMPTR 8K		1826-0175		U	1
	Q1,2	XSTR NPN X58		1854-0552		U	2
	U3	XISTOR ARRAY		1858-0008		U	1
	U2	XISTOR ARRAY		1858-0009		U	1
	U1	XSTR ARRAY 5 NPN		1858-0021		U	1
	CR9,13,15,16	DIODE SIL		1901-0040		U	4
	CR1,3-8,10-12	DIODE IN4936		1901-1065		U	10
	CR2	DIODE ZNR 5.11V		1902-0041		U	1

Battery Control Inverter Assembly Parts List (Sheet 3 of 3)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		LKWSHR 6 HEL		2190-0851		U	6
		SCR #6-32X.312L		2360-0195		U	1
		SCR #6-32X.375L		2360-0197		U	2
		SCR #6-32X.500L		2360-0201		U	2
		NUT 6-32 .312AF		2420-0002		U	6
		NUT 6-32 .250AF		2420-0003		U	6
		WSHR #6 SS		3050-0228		U	12
	TS1	SWITCH-THERMAL		3103-0033		U	1
		COMPOUND-THERMAL		6040-0239		U	0.01
	W1	WIRE JUMPERS		8159-0005		U	1
		TRANSFORMER-PWR		9100-0666		U	1
		BOARD-ETCHED		02112-80003		W	1

D-02112-60003-5A

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED A-1510-22	[illegible]	3-11-75
B	DELETED R54 PPC A (1299-A) R.57. C3 WAS .01 22-2775. DELETED R51, ADD. R3,	[illegible]	5/21/75
C	A-1548 22-3065. C8 WAS .1, DATE CODE IS	GDJ RB	8/6/76
D	A-1603 22-3078 R3 WAS 1K, DATE CODE IS	GDJ RB	11/24/76
E	A-1603 22-3411, NEW PCA, DATE CODE IS	GDJ RB	11/24/76
F	A-1603	GD/ SB	10/12/78

ENGINEERING RESPONSIBILITY / REPLACEMENT

THERMAL OUTPUT, MOUNT AS CLOSE TO HEATSINK AS POSSIBLE

70°C SW TS1

40 KHZ E8

SLOW CLOCK

+24 V BATT. 18,L,9,K

+8V REF. 17

MGPD 12

EXT+12V 6

COM. 14,15,R,S

+12 VDC REG. TO CKTS. ON BD.

BATT BAD 13

TEST 18

FLASH M

FAST CLK U

SLOW CLK

3622 POT CORE T1 -24 V

TO H.V. RAIL

54-0552's ARE MOUNTED ON HEATSINKS.

1858-0008
1858-0009

NOTE: [U2] TRANSISTOR ARRAY IS A 1858-0009 WITH HEATSINKS
[U3] TRANSISTOR ARRAY IS A 1858-0008
[U1] TRANSISTOR ARRAY IS A 1858-0021
ALL DIODES NOT LABELED ARE 1901-1065

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY	C. Koepman	3-6-75
ENGINEER	[illegible]	3/11/75
RELEASE TO PROD.	[illegible]	5/21/75
SUPERSEDES DWG.		

BATT. INV. SCHEMATIC

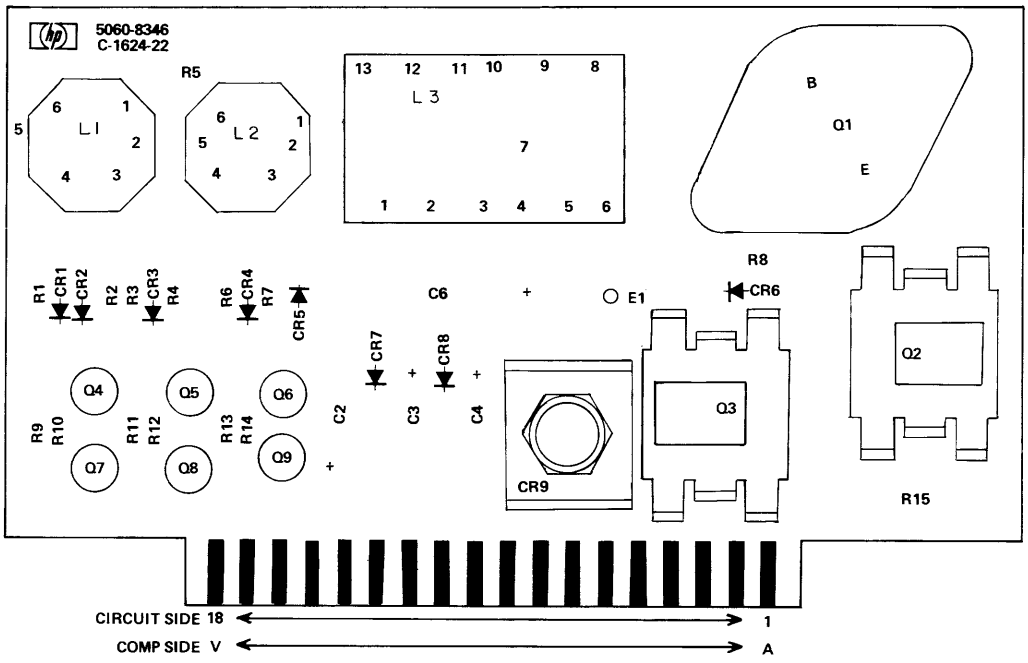
HEWLETT PACKARD

NEXT ASSEMBLY	PART NUMBER
12991A	12963A
FINISH ~	SCALE ~

D-02112-60003-5A

SHEET 1 OF 1

STOCK NO. 5060-0004 PRINTED ON SEPIA NO. 1000-10 CLEARPRINT FADEOUT



Battery Output Assy
5060-8346

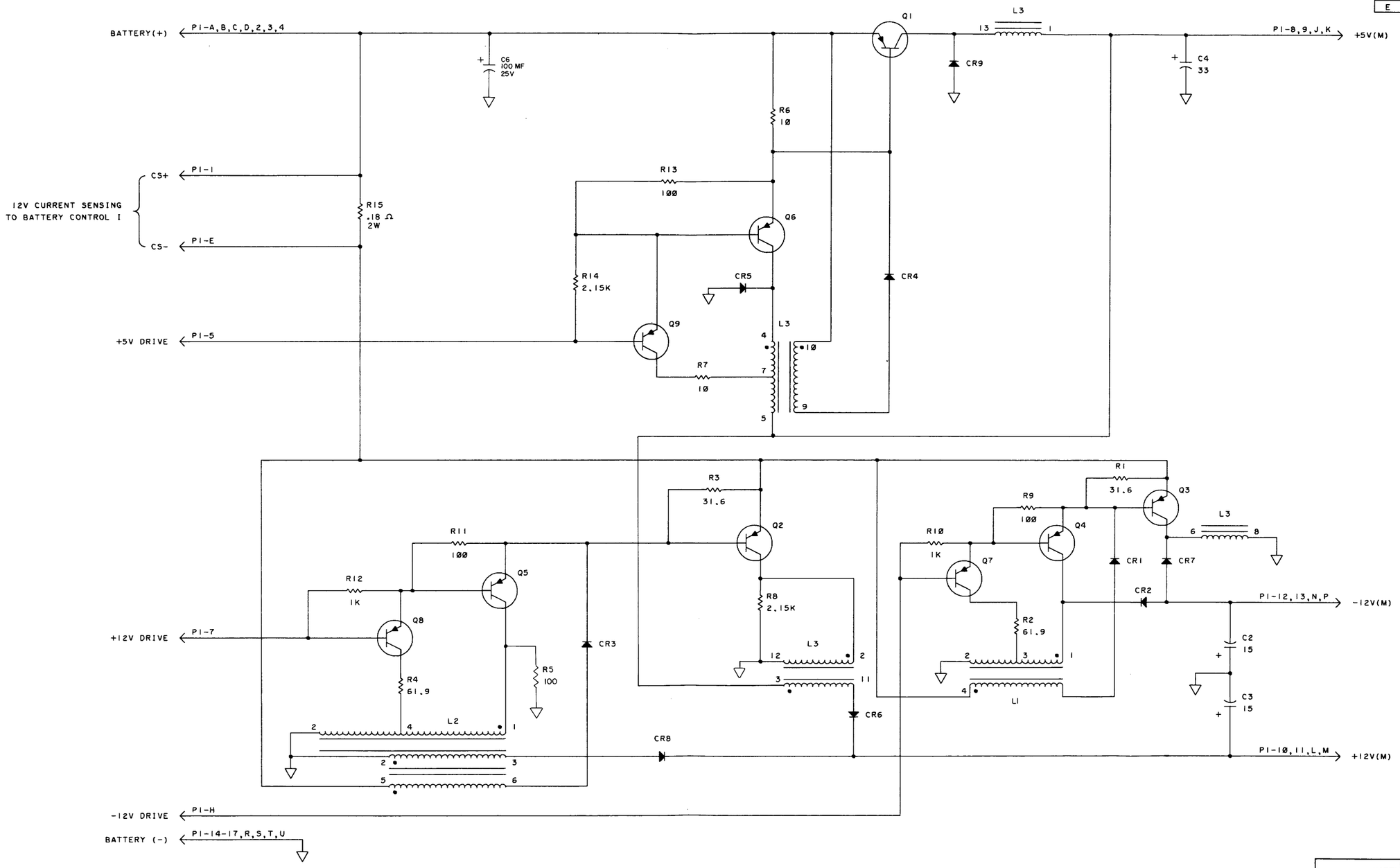
Battery Control Output Assembly Parts List (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
1	DIV	50		7			
3	DIV	33		7			
5	DIV	63		7			
	C6	CAP 100UF-10+50%		0180-0094		U	1
	C4	CAP 33UF 10%		0180-0229		U	1
	C2,3	CAP 15UF 10%		0180-1746		U	2
		STUD SOLDER TERM		0360-0294		U	1
		SPCR TAP #6X.125		0380-0305		U	2
	R8,14	RES 2.15K 1%.125		0698-0084		U	2
	R1,3	RES 31.6 1%.125		0757-0180		U	2
	R5	RES 100 1% .50		0757-0198		U	1
	R2,4	RES 61.9 1%.125		0757-0276		U	2
1	R10,12	RES 1K 1%.125		0757-0280		U	2
	R6,7	RES 10 1%.125		0757-0346		U	2
1	R9,11,13	RES 100 1%.125		0757-0401		U	3
	R15	RES 0.18 OHM WW		0811-3293		U	1
		SLEEVING FLEX.		0890-0064		U	0.25
		HT DIS PL PWR		1205-0219		U	2
		HT DIS TO-3		1205-0275		U	1
1	Q7,8,9	XSTR 2N3906 PL18		1853-0036		U	3
	Q2,3	XSTR 2N5194 X58		1853-0212		U	2
	Q6	XSTR 2N4236 TO5		1853-0213		U	1
	Q4,5	XSTR PNP 2N2907A		1853-0281		U	2
	Q1	XSTR 2N4398 TO3		1853-0310		U	1
	CR6,7	DIODE-RECTIFIER		1901-0699		U	2
	CR9	DIODE		1901-1062		U	1
1	CR1-5,8	DIODE IN4936		1901-1065		U	6

Battery Control Output Assembly Parts List (Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		LKWSHR 10 HEL		2190-0034		U	1
		LKWSHR 6 HEL		2190-0851		U	1
		SCR #6-40X.500L		2200-0147		U	2
		NUT 6-40 W/LK		2260-0009		U	2
		SCR #6-32X.437L		2360-0199		U	2
		NUT 10-32 .375AF		2740-0002		U	1
		WSHR #4 SS		3050-0229		U	4
		WSHR #10 BRS		3050-0236		U	1
		COMPOUND-THERMAL		6040-0239		U	0.0012
		WIRE 22 GRN		8150-0011		U	2
	L2	CHOKE		9100-2962		U	1
	L1	CHOKE		9100-2963		U	1
	L3	CHOKE		9100-2964		U	1
		BOARD-ETCHED		5080-9737		W	1
		HEAT SINK		02108-00024		W	1

REV	REFERENCE	SERIES/PREFIX
A	ORIG.	1353
B	ERRATA	NO CHANGE
C	22-2386	1445
D	ERRATA	NO CHANGE
E	22-3312	1624



1. ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICROFARADS.

NOTE: UNLESS OTHERWISE SPECIFIED.

TITLE
BATTERY OUTPUT
5060-8346-51

SHEET 1 OF 1

ENGINEER	APPROVED	DATE

HEWLETT-PACKARD CO
DATA SYSTEMS DEVELOPMENT DIVISION

POWER SUPPLY

5061-1356

FOR HP 21MX "B" MODEL COMPUTERS

Printed: DEC 1977

NOTE

This document is part of the 21MX E-Series Engineering and Reference Documentation and is not available separately.

Table of Contents

Title	Page
1. INTRODUCTION	1-1
2. REFERENCE INFORMATION	2-1
2-1. Binary Signal Levels	2-1
2-2. Schematic Reading	2-2
2-3. Signal Names	2-2
2-4. Cross References	2-2
3. THEORY OF OPERATION	3-1
3-1. Introduction	3-1
3-2. Primary Input Power Circuits (sheets 1,8)	3-1
3-3. Preregulator A3A1 and Inverter A3A2 Boards (sh 2,3)	3-4
3-4. Inverter Stage	3-9
3-5. Control Board A3A5 (sheet 5)	3-11
3-6. Inverter Board A3A2 (sheet 3)	3-12
3-7. Preregulator Drive Circuitry	3-13
3-8. Jumper Board A3A4 (sheet 4)	3-17
3-9. Power Fail Recovery System (PFRS)	3-17
3-10. Battery Charger Board A3A3 (sheet 6)	3-17
3-11. Battery Backup Board A3A4 (sheet 7)	3-18
3-12. Battery/Status Asembly (sheet 9)	3-19
4. PROTECTION CIRCUITS	4-1
4-1. CPU and I/O Overcurrent Circuits	4-1
4-2. Memory Overcurrent Circuits	4-2
4-3. Overvoltage Protection Circuits	4-3
4-4. Overtemperature Protection Circuits	4-4
5. POWER FAILURE/AUTO RESTART CIRCUITS	5-1
5-1. Power Up Sequence	5-1
5-2. Power Down Sequence	5-2
5-3. Interconnection of the Power Supplies	5-3
APPENDIX A Power Supply Troubleshooting	A-1

1 INTRODUCTION

This document is the Theory of Operation for the 5061-1356 Power Supply and describes the operation of the various circuits and their interconnection in the power supply. The description is conducted on a functional level using block level diagrams and references to the schematic diagrams. Understanding the theory of operation is essential for performing detailed troubleshooting and repair of the power supply. A power supply Troubleshooting Flowchart and parts location diagrams are included at the rear of this section in Appendix A. A complete understanding of the following publications is very helpful in understanding this theory:

a. HP 21MX E-Series Computer HP2109B and HP2113B Operating and Reference Manual (Part No. 02109-90014).

b. HP 21MX E-Series Computer HP2109B and HP2113B Installation and Service Manual (Part No. 02109-90015).

2 REFERENCE INFORMATION

The 5061-1356 Power Supply is covered on nine sheets of schematics and nine sheets of assembly drawings. The drawings and schematics are listed in table 2-1. The electronic design is illustrated in the schematics and the assembly drawings show the component locations. The Parts Lists are provided at the rear of this section with the Assembly Drawings and Schematic Diagrams.

Table 2-1. Assembly Drawing and Schematic Numbers.

Sheet No.	Reference Designator	Drawing No.	Title
1	A3	B-5061-1350-1	Rear Panel Assembly Drawing
		D-5061-1356-1	Power Supply Assembly Drawing
		02109-90024	Line (Mains) Power Distribution Schematic Diagram
2	A3A1	C-5061-1347-1	Pre-regulator Board Assy Dwg
		C-5061-1347-51	Pre-regulator Board Schematic
3	A3A2	D-5061-1344-1	Inverter Board Assembly Drawing
		C-5061-1344-51	Inverter Board Schematic
4	A3A4	C-5061-1351-1	Jumper Board Assembly Drawing
		B-5061-1351-51	Jumper Board Schematic
5	A3A5	D 5061-1345-2	Control Board Assembly Drawing
		C-5061-1345-51	Control Board Schematic
6	*A3A3	C-5061-1348-1	Battery Charger Board Assy Dwg
		C-5061-1348-51	Battery Charger Board Schematic
7	*A3A4	C-5061-1349-1	Battery Backup Board Assy Dwg
		C-5061-1349-51	Battery Backup Board Schematic
8	A3A6	F-5061-1371-1	Mother Board Assembly Drawing
		C-5061-1371-2	Mother Board Heatsink Assy Dwg
		C-5061-1371-51	Mother Board Assembly Schematic
9	----	02109-90024	Battery/Status Assembly Wiring Diagram
		B-12944-90004 -51	Battery/Status Assy Schematic
* p/o optional PFRS (Power Fail Recovery System)			

2-1. Binary Signal Levels

Most of the logic used in the power supply is implemented with standard or Schottky TTL devices. High logic levels are approximately +2.5 to +4.5 Vdc. Low logic levels are approximately 0.0 to +0.8 Vdc. The actual values measured will vary due to the type of device,the load, and the condition of the device. When using positive logic, a high is "true" and a low is "false".

2-2. Schematic Reading

Logic symbols are drawn to aid in understanding the logical functions being represented. A circle or bubble at an input or output indicates an active low logic level. A circle or bubble on the clock input of a flip-flop indicates that a negative-going edge of the clock signal is used to clock the flip-flop.

2-3. Signal Names

Signal names are alphanumeric identifiers selected to aid in the understanding of the signal function. Not all signals are labeled, but all signals running between schematic sheets are labeled. Any signal mnemonic may have a bar over it to indicate that the signal is active low. For example, the $\overline{\text{ABC}}$ signal is low only when the ABC button is pressed. When the ABC button is not pressed, the $\overline{\text{ABC}}$ signal is high. A signal in the computer is considered "true" when it is high, whether or not its label includes a bar.

2-4. Cross References

There are many signals that run from sheet to sheet in the schematics. Signals leaving one sheet travel to other sheets are coded with the sheet number(s) adjacent to the signal name. For example, a signal leaving sheet 1 for sheet 7 would be coded as follows: ABC (7). A signal coming from sheet 7 to sheet 1 would be coded as follows: (7) DEF. If the signal is going to several sheets from sheet 1, it would be coded as follows: XYZ (3,4,5,7). If the signal is coming from several sheets to sheet 1, it would be coded as follows: (7,8) WXY.

3. THEORY OF OPERATION

3-1. Introduction

The overall power supply can be functionally separated into three individual units:

a. An ac to dc supply that converts the line (mains) voltage into a +325 Vdc bus;
b. A dc to dc supply that converts the +325 Vdc bus into +5V and -2V (CPU), +12V,-12V,and +30V (I/O), and 18Vac; and
c. A ac to dc supply that converts the 18Vac into +5VM,+12.5VM, and -12VM.

The overall functional block diagram of the power supply is shown in figure 3-1. The two configurations for the power supply are shown in figures 3-2 and 3-3. Figure 3-2 illustrates a power supply with the optional Power Fail Recovery System (PFRS). It should be noted that the CPU and the I/O voltages are developed from the +325 Vdc bus via the Preregulator and Inverter circuits. The 18 Vac bus is also developed from the +325 Vdc bus via the Inverter and Preregulator circuits. This 18 Vac bus is converted into a +18 Vdc by the Battery Charger Board A3A3. The Battery Backup board A3A4 and the Battery Charger board A3A3 develop the memory voltages from either the +18 Vdc or from the external battery (+14 Vdc). If the +18 Vdc is lost, the +14 Vdc battery will maintain the memory voltages. The Battery Charger board A3A3 charges the battery while the ac power is applied.

Figure 3-3 represents a power supply without a power fail recovery system. In this mode the Jumper board A3A4 performs the function of developing the memory voltages directly from the CPU voltages. The +5VM is tied directly to the +5V (CPU). The -12VM is tied directly to the -12V (I/O). The 18 Vac bus is rectified into +18 Vdc and regulated via a series pass regulator to +12.5 VdcM.

3-2.Primary Input Power Circuits

For the following paragraphs schematics of the Line (Mains) Power Distribution (sheet 1) and the Mother Board A6 (sheet 8) are required.

The line (mains) power, either 115 Vac or 230 Vac, is applied to the power supply through the Line Filter FL1 to remove line induced noise,etc and to prevent noise from leaving the power supply and going out on the ac lines (mains). The Circuit Breaker CB1 also acts as the ~ POWER OFF/ON switch. Terminal Block TB1 is used to configure the power supply for operation from either 115 Vac or 230 Vac line power. The configuration of the power supply consists of moving jumper wires on TB1 and making the appropriate connections on CB1. This sets the fans, the bias transformer, and the power supply input for operation with

the proper voltage. Since it is desirable to develop the same bus voltage (B+) at 115 Vac and at 230 Vac, a voltage doubler circuit on the Mother board A3A6 is employed for 115 Vac operation. Therefore, the dc input voltage to the Inverter and Preregulator circuits is twice the peak of the ac input waveform.

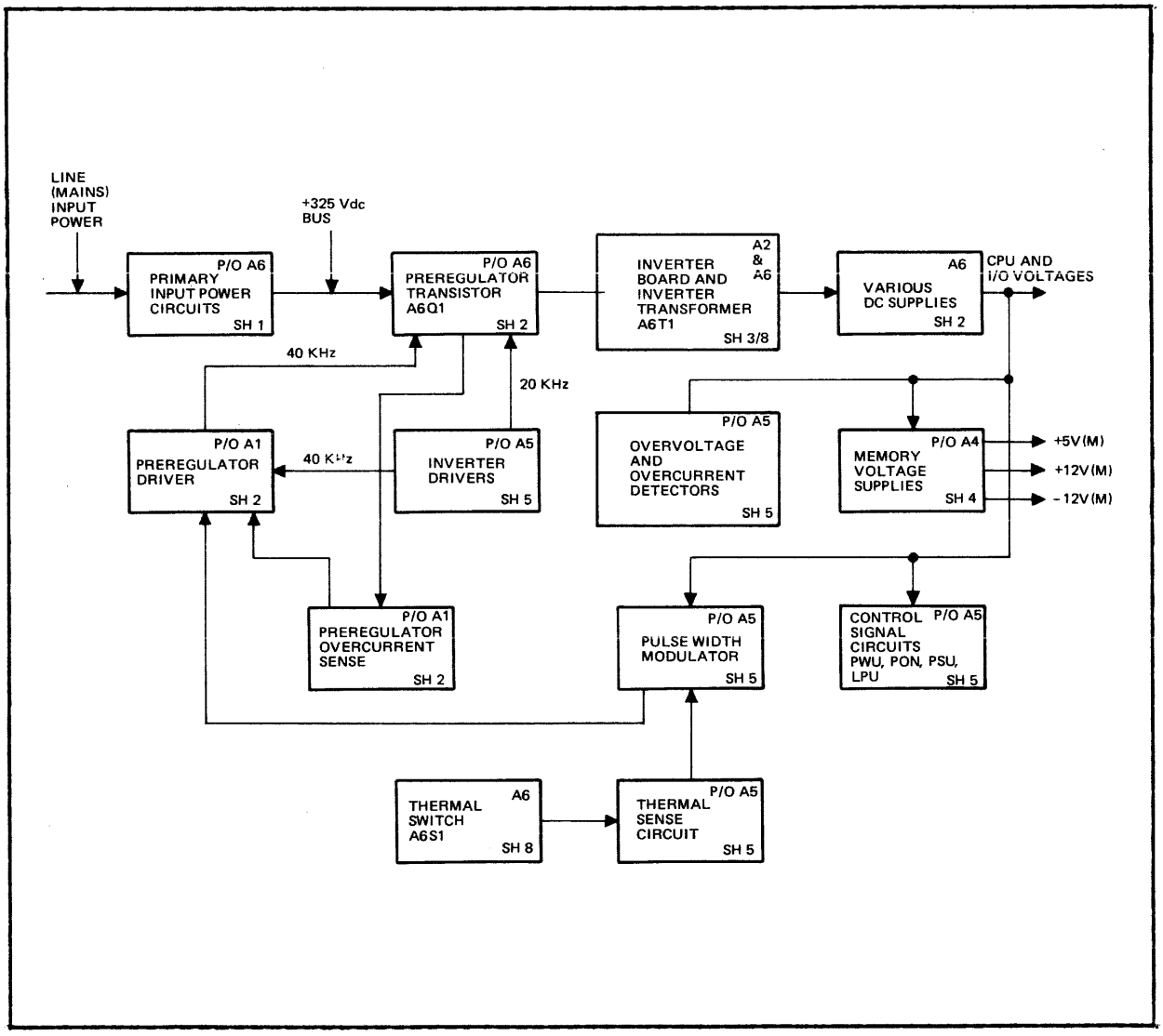


Figure 3-1. Power Supply Overall Block Diagram.

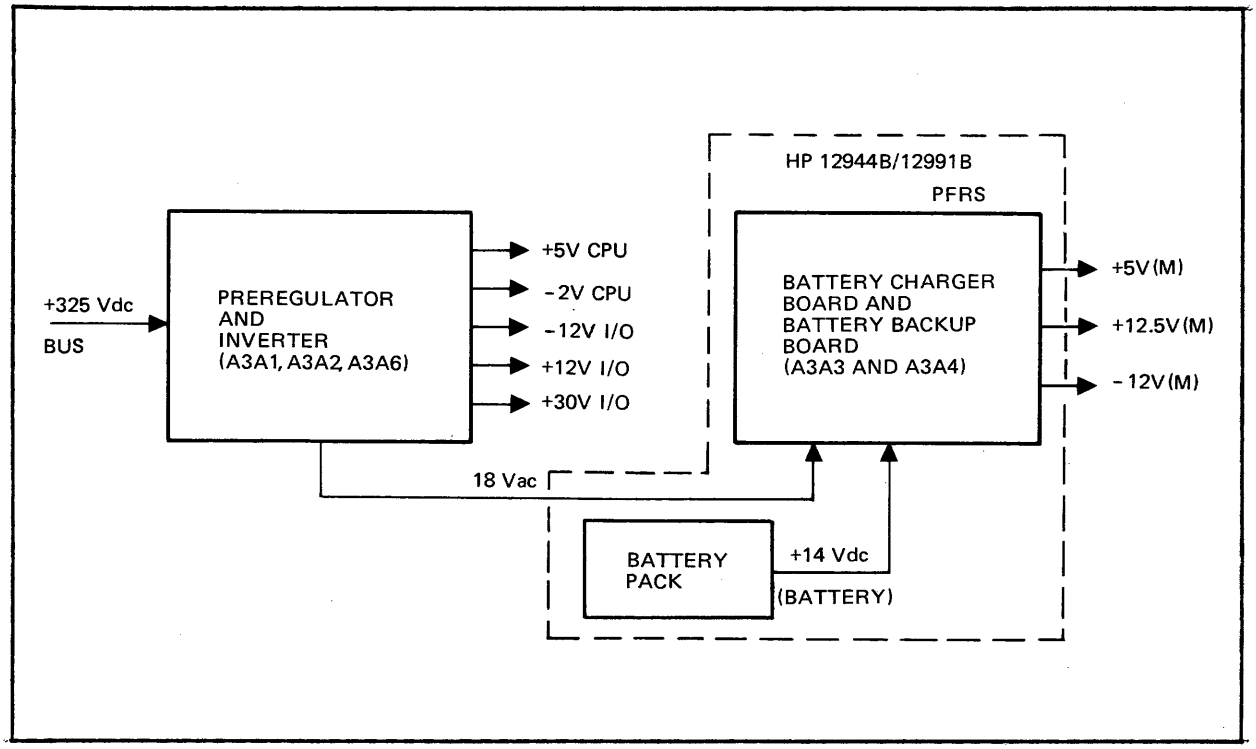


Figure 3-2. Power Supply with Optional PFRS.

For example, 115 Vac developes a bus voltage of :

(115 Vrms) X (1.414) X (2) = +325 Vdc.

The 230 Vac operation does not employ a voltage doubler circuit. Therefore, its bus voltage is simply equal to the peak of the input waveform. For example, 230 Vac develops a bus voltage of :

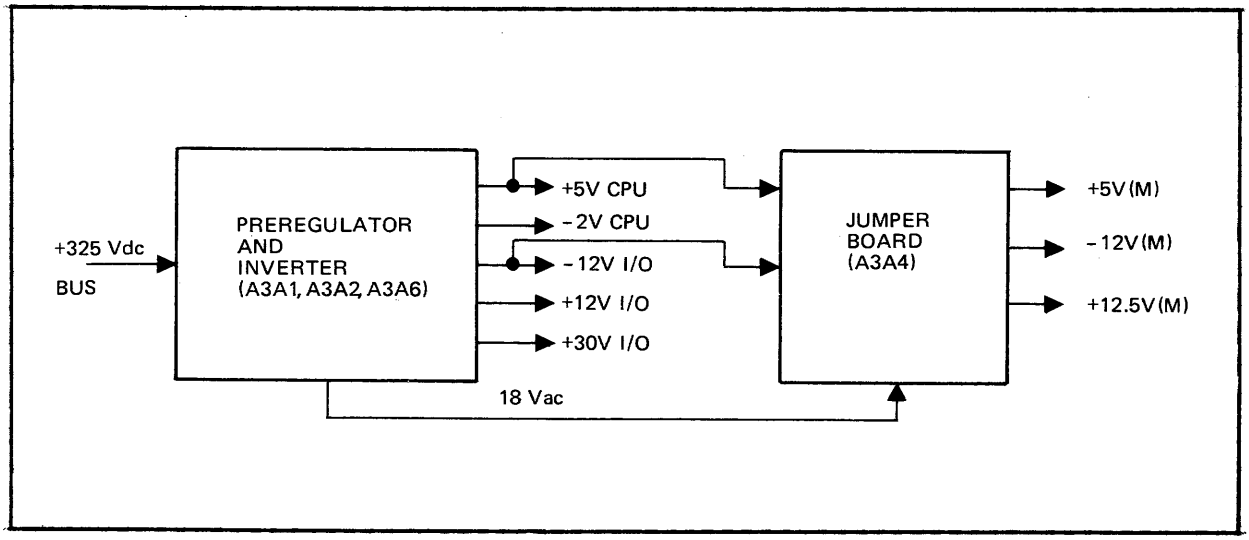


Figure 3-3. Power Supply without PFRS.

(230 Vac) X (1.414) = +325 Vdc.
It should be noted that the ac input waveform MUST BE a sinusoidal waveform for these formulas to be accurate.

To operate the power supply from 115 Vac, the C/T terminal must be connected to the N (neutral) terminal. This forms a voltage doubler circuit comprised of capacitors C12 and C13 and the diode bridge CR15. To change from 115 Vac operation to 230 Vac operation, the C/T terminal must be left unconnected. This allows capacitors C12 and C13 and the diode bridge CR15 to function strictly as a rectifier and filtering circuit.

On initial power turn on, the input capacitors C12 and C13 are discharged and thermistors R5 and R6 are cold. The cold resistance of the thermistors is approximately 2.5 ohms each. Since the input capacitors charge through this resistance, thus limiting the input surge current. After a few cycles of the input power, the input current heats up the thermistors allowing their resistance to decrease. Therefore, the capacitors are allowed to charge through a much lower resistance. Since the resistance of the thermistors decreases as the input current increases, the losses across the thermistors at low line decrease to aid regulation.

The cooling time constant required for the thermistors to go from their hot (low resistance) to their cold (high resistance) is equal to the time required to discharge the input capacitors C12 and C13. This ensures that if the ac input power is lost the thermistors will cool down at the same rate that the capacitors C12 and C13 are discharging.

3-3. Preregulator A3A1 and Inverter A3A2 Boards (sh 2,3).

The Preregulator Board A1 (sheet 2), the Inverter Board A2 (sheet 3), and the Mother Board A6 (sheet 8) schematics are required for understanding this section.

The purpose of the Preregulator and the Inverter Boards is to apply a square wave to the primary of A6T1 (sheet 8). Neglecting all circuit losses, the amplitude across the primary of A6T1 should remain constant under all load conditions on the secondary of A6T1. If the primary voltage remains constant, the +5V (CPU) supply from the secondary of A6T1 is also constant. The +5V(CPU) supply is the sensed output. The -2Vdc supply has a shunt regulator consisting of a two-junction stabistor A6CR25 and a power transitor A6Q4. This regulator holds the -2Vdc supply to approximately -2.1 to -2.2Vdc. The regulator for the +12.5Vdc and -12.5Vdc supplies are located on the heatsink attached to the Mother board. A6Q2 and A6CR20 control the -12.5Vdc supply and A6Q3 controls the +12.5Vdc supply. The 18Vac bus is also derived from the secondary of A6T1.

To control the voltage across the primary of A6T1, the preregulator transistor A6Q1 controls the amount of current going through the primary of A6T1 (see figure 3-4). Figure 3-5 is a simplified diagram of figure 3-4 when transistors A2Q1 and A2Q4 and A6Q1 are conducting. When A6Q1 starts to conduct, the impedance in series with A6Q1 is infinite due to the inductance of A6L1 and the current is zero. At a finite time later, the dc resistance of the primary of A6T1 and the inductor A6L1 reaches a minimum value and are the only impedance in series with A6Q1. Therefore, the current through A6Q1 is maximum at this time. Using these two facts, the current through A6L1 and the primary of A6T1 is a function of the inductance of A6L1 and the primary of A6T1 added together, the value of B+, and the length of time that A6Q1 conducts. Since the inductance of A6L1 and the primary of A6T1 is constant and B+ is held constant, the only variable factor that controls the current through the primary of A6T1 is the length of time that A6Q1 is allowed to conduct. Figure 3-10A represents the base drive to A6Q1. The frequency of this waveform is 40 kHz. The "on time" of A6Q1 is directly proportional to the duty cycle of this waveform.

The power supply monitors the +5V (CPU) output and determines the duty cycle from its value. Also, if the value of B+ is changed, it will effect the on time of A6Q1. If the load on the secondary of A6T1 is increased, the the duty cycle will increase. This is due to the decrease in the impedance on the secondary of A6T1 being reflected back to the primary of A6T1. Since the impedance is less on the primary, the current through the primary of A6T1 must increase to maintain a constant voltage across the primary. To do this the on time of A6Q1 must increase. If the load is decreased on the +5V (CPU), the duty cycle will decrease. This is due to the impedance increasing on the secondary of A6T1. Therefore, the reflected impedance at the primary of A6T1 will increase and reduce the current through the primary of A6T1. Inorder to decrease the current through the primary, the on time for A6Q1 will have to decrease.

Since the preregulator transistor A6Q1 is turned on and off at a 40 kHz rate, the signal at the primary of A6T1 has a 40 kHz ripple. The current waveform through the primary of A6T1 is shown in figure 3-10D. At times T1 and T3 the current through the primary of A6T1 is going through A6Q1. This may be noted in figures 3-5 and 3-8. At times T2 and T4 the current is supplied by the collapsing field of A6L1 and the continuing current flow through the commutating diode A6CR16. This action is shown in figures 3-6 and 3-9. Since A6Q1 and A6L1 work together to maintain a constant current through the primary of A6T1, the ripple is held to a minimum and the current through A6L1 can be considered dc current. The purpose of the Inverter Board A2 is to change the

direction of this dc current flow through the primary of A6T1. Figures 3-4 and 3-7 illustrate this action (note the polarity dots). The dc current through A6L1 becomes the ac current of A6T1.

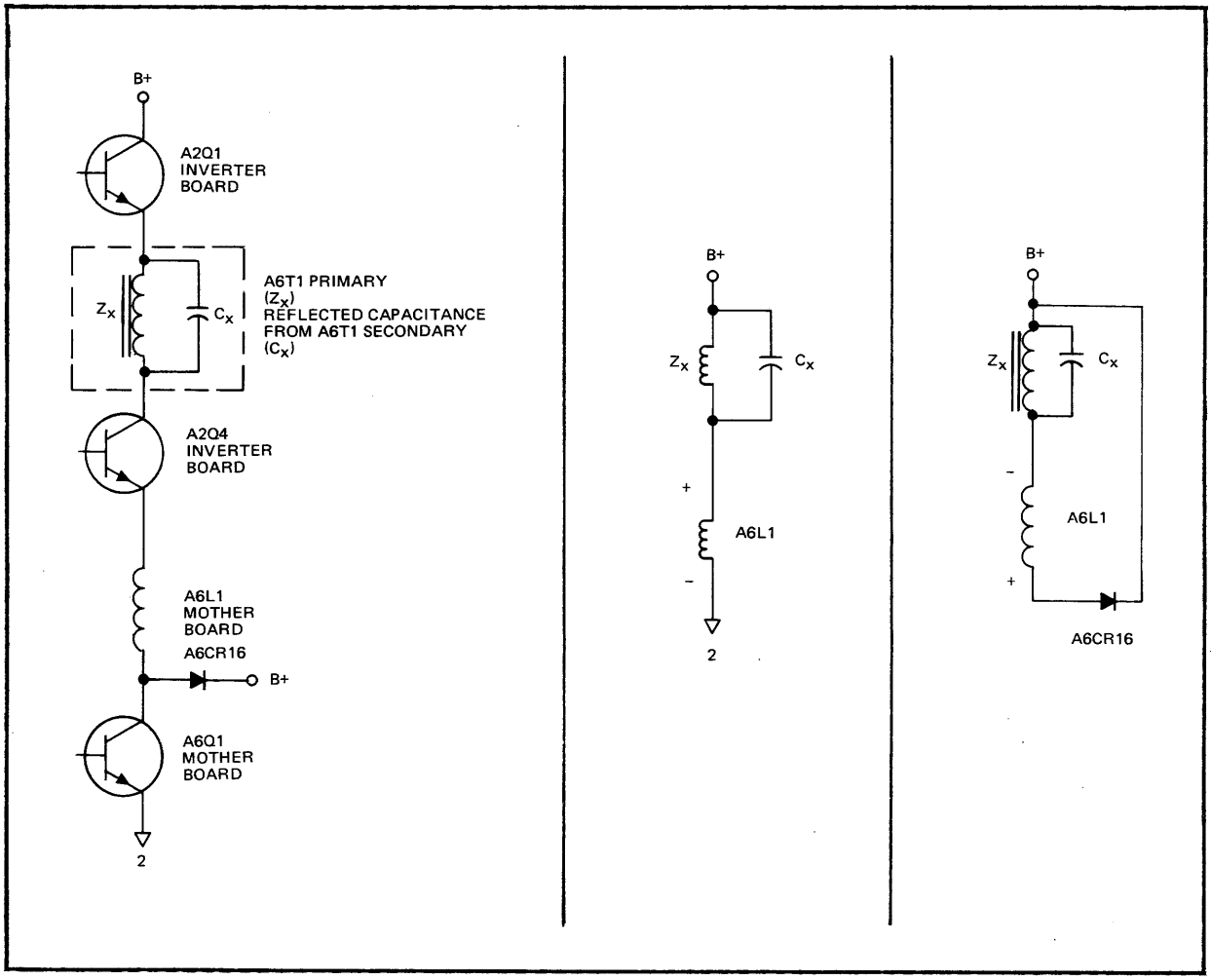
The remainder of this section covers the interaction of the Inverter and the Preregulator Boards at four time intervals (see figure 3-10). It also covers the Inverter and the Preregulator Boards in detail (duty cycle control).

a. Time T1 (see figure 3-10).
The preregulator transistor A6Q1 is conducting at this time and the inverter transistors A2Q1 and A2Q4 are conducting. Figure 3-4 shows the components involved and figure 3-5 is a simplified version of figure 3-4. From figure 3-5 it is shown that A6Q1 is building up a field around A6L1, with the polarity of the voltage drop as indicated. Zx represents the reflected impedance of the secondary of A6T1 to the primary of A6T1. The preregulator current is determined by the on time of A6Q1 and must be sufficient to develop the required voltage at the secondary of A6T1 for an output of +5V (rectified).

b. Time T2 (see figure 3-10).
At this time A6Q1 turns off and A2Q1 and A2Q4 are still conducting. The field of A6L1 begins to collapse and the voltage drop across A6L1 is indicated in figure 3-6. A6L1 tends to maintain the current constant through the primary of A6T1 during this time interval. It should be noted that during this time interval the field of A6L1 is never allowed to collapse fully before T3 occurs. The induced voltage across A6L1 due to the collapsing field is enough to cause the + end of A6L1 to go to B+ plus the forward drop of A6CR16, thus developing the current path from A6L1 through A6CR16 through the primary of A6T1 back to A6L1.

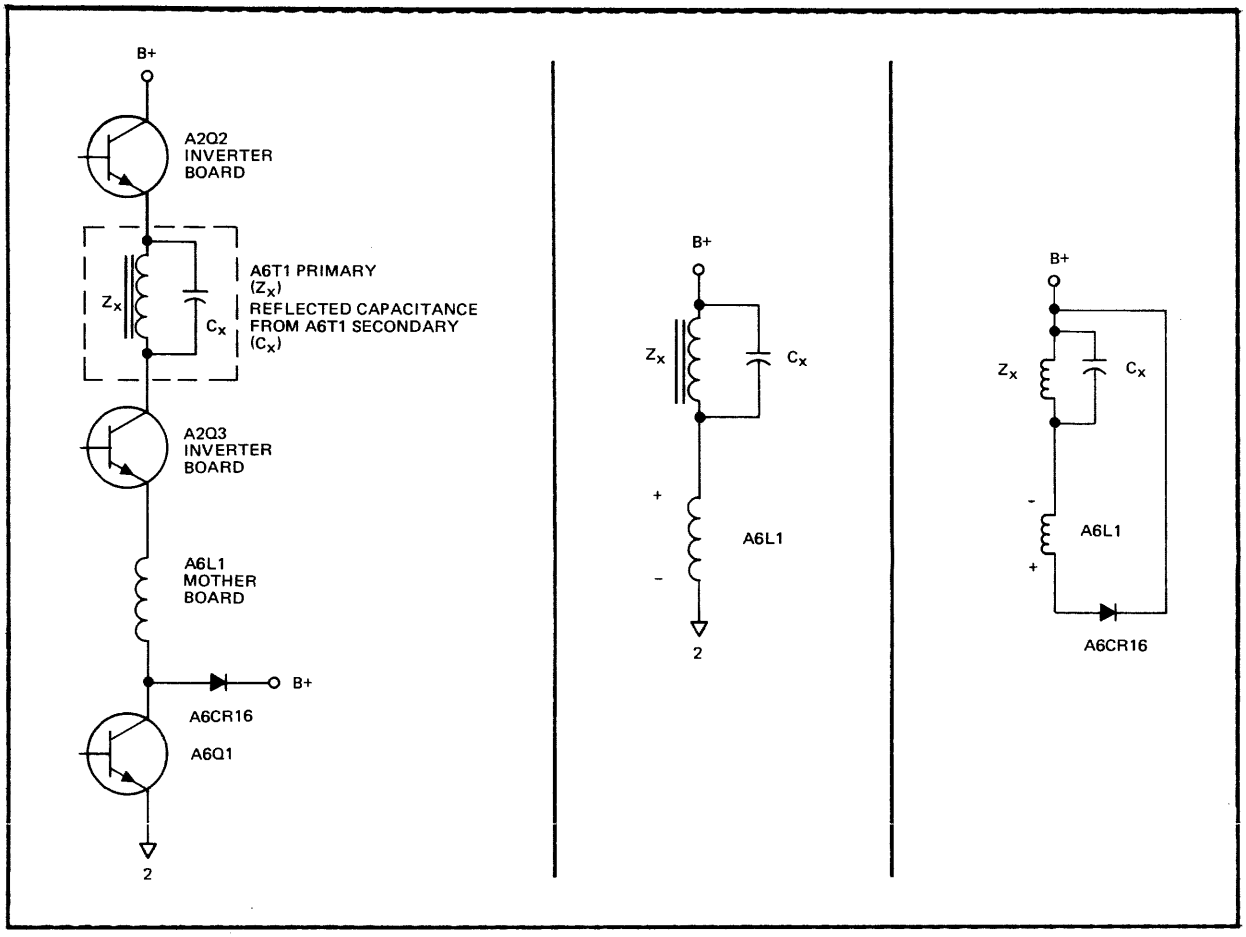
c. Time T3 (see figure 3-10).
At this time A6Q1 is conducting. The inverter transistors A2Q1 and A2Q4 are turned off but A2Q2 and A2Q3 are now conducting. Figure 3-7 shows the components involved. Figure 3-8 is a simplified version of figure 3-7. It should It should be noted that the voltage drop across the primary of A6T1 is reversed as indicated by the polarity dot. Therefore, the current through the primary of A6T1 is reversed at this time. A6Q1 builds up the field of A6L1 and developes the desired voltage across Zx. Cx represents the reflected capacitance from the secondary of A6T1. This capacitance is necessary to prevent ringing or high voltage spikes.

d. Time T4 (see figure 3-10).
Figure 3-9 is a simplified diagram showing the components involved during T4. During this time period the field of A6L1 begins to collapse as A6Q1 turns off inducing the



Figures 3-4,3-5, and 3-6.

indicated voltage drop across A6L1. The voltage at the + end of A6L1 reaches a value of B+ plus the forward voltage drop of A6CR16. This forward biases A6CR16 and allows the current through Zx to remain constant. The current path is from the + end of A6L1 through A6CR16 and Zx, then back to the - end of A6L1. Inverter transistors A2Q2 and A2Q4 are still conducting during this period. It should be noted that if the commutating diode A6CR16 were not in the circuit, the voltage at the + end of A6L1 would go much higher than B+ plus the forward drop of A6CR16. A6CR16 is also fundamental in provideing a current path for A6L1 as it tries to maintain current in the loop of A6L1, A6CR16, and Zx when A6Q1 is off.



Figures 3-7, 3-8, and 3-9.

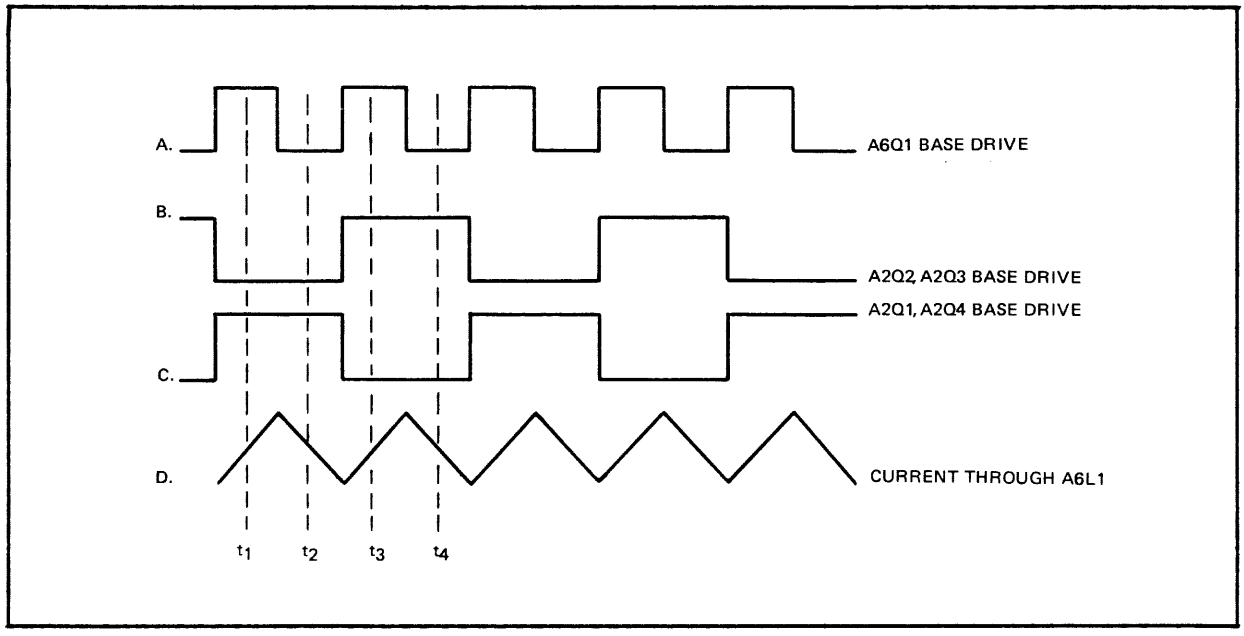


Figure 3-10. Timing Waveforms.

3-4. Inverter Stage

The inverter transistors are arranged in an "H" configuration (see figure 3-11) and are driven at a 20 kHz rate. As shown in figure 3-1 the inverter transistors are driven by the 20 kHz output from the Control Board A5 (sheet 5) and are synchronized with the Preregulator Board A1 (sheet 2). The inverter transistors are driven by the inverter driver transformer A2T1 at a constant 50% duty cycle. Due to the fact that the inverter transistors are in series with A6L1, there is no need for "dead time". "Dead time" refers to the amount of time that both pairs of inverter transistors are not conducting. Since it takes longer to turn off the inverter transistor pair than to turn them on, due to storge time of the transistors. An RC time delay network is usually incorporated to delay the turn on time. This delay is used to make sure that both pairs of transistors are not conducting at the same time. This results in "dead time" because the RC turn on delay is longer than the turn off time. Since A6L1 is in series with the inverter transistors, it acts to limit current during the time that both pairs of transistors are conducting.

The inverter transformer A6T1 reflects the inductance of A6L1 from its primary to its secondary to produce the required inductance for filtering in the secondary. A6T1 also reflects the required capacitance from its secondary to its primary to produce filtering in the primary. Resistor A6R14 and capacitor A6C17 form a snubber network to shape the load so that the primary of A6T1 looks resistive.

The remainder of this section discusses the inverter drive at the component level. The schematic for the Control Board A5 (sheet 5) will be needed along with previously listed schematics.

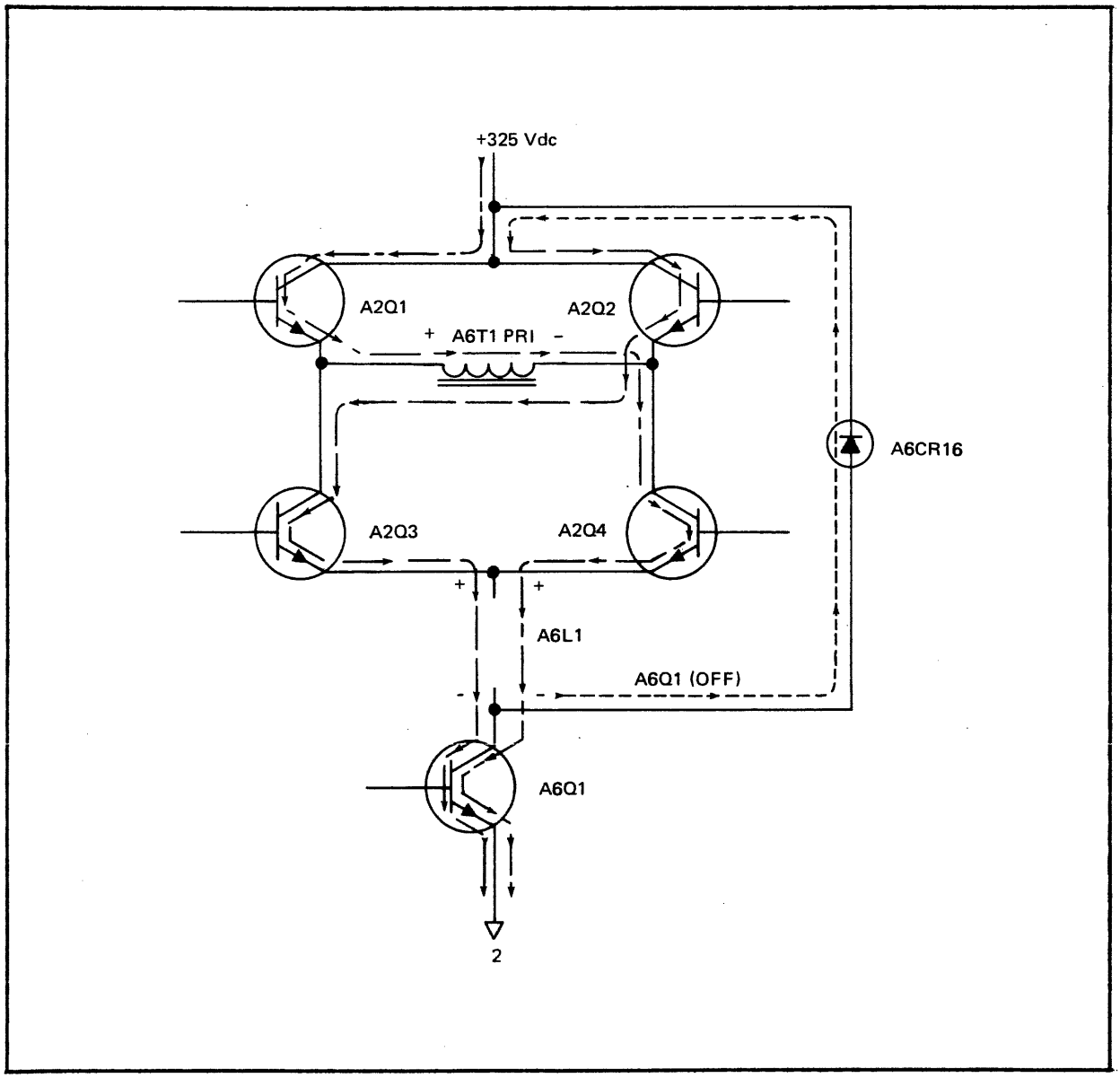


Figure 3-11. H Configuration of the Inverter Transistors.

3-5. Control Board A3A5 (sheet 5)

The comparator (U1A) and associated components form a 40 kHz oscillator. The square wave output of U1A-2 is integrated by R3 and C2. This integrated waveform (a triangle waveform) is applied U1B-6. A dc level is applied to U1B-7. The interaction of this dc level and the integrated waveform produces a square wave at the output pin 1 of U1B. This square wave output is buffered by Q4 and drives the clock input of the negative-edged triggered J-K flip-flop U2,a 74S112. The configuration of U2A and U2B is shown in figure 3-12. Since U2B is held in a constant reset state, the Q output (U2-7) is high at all times. The high at U2-7 holds the J and K inputs of U2A pins 3 and 4 high. Thus the outputs of U2A pins 5 and 6 will toggle (change state) for each clock input. This divides the clock input frequency by 2 (40 kHz/2 = 20 kHz). The two outputs of U2A are 180 degrees out of phase and have a 50% duty cycle. The output at U2-5 drives Q9 which pulls the primary of A2T1A (pin 6) to ground. A2T1A (pin 4) returns to the Control Board through J2-S and is tied to the +8V through R48. The output at U2-6 drives Q8 which pulls the primary of A2T1B (pin 3) to ground. A2T1B pin 1 returns to the Control Board through J2-P and is tied to the +8V through R49. During one half of the 20 kHz cycle Q9 is conducting and Q8 is cut off. When Q9 is conducting, it drives off the inverter transistors A2Q1 ands A2Q4. When Q9 is conducting, Q8 and the inductive flyback of the primary of A2T1B turn on A2Q2 and A2Q3. On the other half cycle Q9 turns off allowing the inductive flyback of the primary of A2T1A to turn on A2Q1 and A2Q4. At this time Q8 is driving off A2Q2 and A2Q3. Since the inductive flyback turns the inverter transistors on, and Q8 and Q9 turn off the inverter transistors. Therefore,the turn on energy is less than the turn off energy. At this frequency of operation the flyback action has just enough energy to keep an inverter pair turned on for a half cycle. This removes the need for anti-saturation diodes because the transistors are falling out of saturatiion at the end of their on time. They are about to fall out of saturation just in time to be driven off.

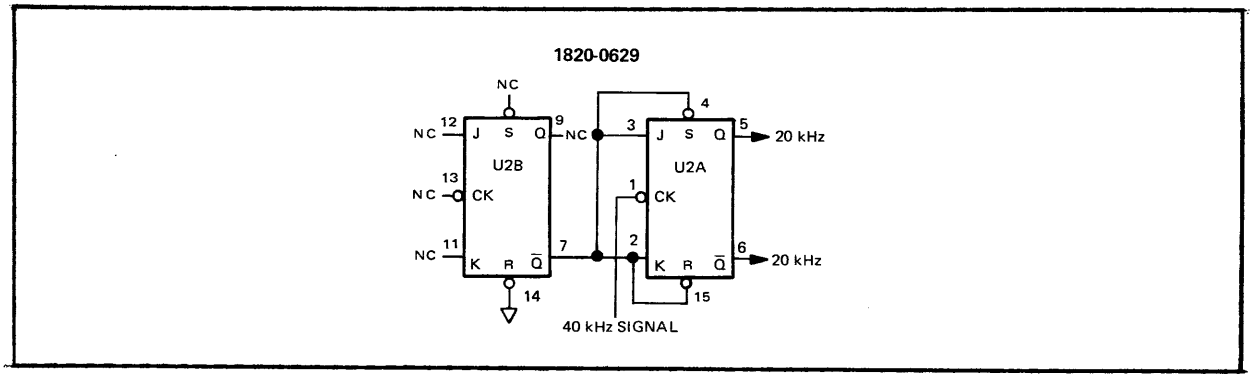


Figure 3-12. Divider Circuit.

3-6. Inverter Board A3A2 (sheet 3)

Current sharing resistors A2R2,A2R3,A2R5, and A2R8 prevent one transistor in an inverter pair from passing all the current. When one transistor has a lower Vbe than the other transistor the impedance of the one ohm resistor is enough added impedance to ensure that one secondary of A2T1 has enough reflected impedance into the other secondary to develop the required voltage to turn on both inverter transistors. If the resistors were not used, the base-emitter junction of the transistor with the lower Vbe, would be the only impedance reflected back to the other secondary. The result would be one transistor stealing the base drive from the other transistor of the pair.

3-7. Preregulator Drive Circuitry

The purpose of the preregulator drive circuitry is to monitor the +5V (CPU) and determine a corresponding duty cycle for the preregulator transistor A6Q1. The preregulator drive circuitry consists of an error amplifier(A5U3), a pulse width modulator(A5U1C), and circuitry to develop enough drive current to turn on and off A6Q1. The following schematics are required for the remainder of this discussion: Control Board A5 (sheet 5), Preregulator Board A1 (sheet 2), and Mother Board A6 (sheet 8).

The error amplifier is A5U3 on the Control Board. It is a 723 type voltage regulator and is shown in figure 3-13. Pin 6 is the output of an internal voltage reference amplifier and has a constant 7V output. This voltage is divided down to approximately +5 volts and is applied to pin 5, the non-inverting input of an internal operational amplifier. Pin 4 is the inverting input to the same amplifier and has the +5V (CPU) applied to it. The output of this internal operational amplifier drives an emitter follower stage. The collector of the emitter follower stage is tied to pin 11 and the emitter is tied to pin 10. If the +5V (CPU) output increases, the output of the internal operational amplifier decreases. This decreases the voltage on the emitter (pin 10) of the internal emitter follower stage. This also decreases the voltage at A5U1-9, the pulse width modulator. In conclusion the error amplifier A5U3 acts as an inverting amplifier producing an output that is directly proportional to the differential between the +5V CPU) and the internal voltage reference at A5U3-6.

The pulse width modulator (A5U1C) takes the output of the error amplifier A5U3 and compares it with an integrated waveform (triangle waveform) from the 40 kHz clock (U1-4). The dc level of the error amplifier intersects with the integrated waveform to produce an appropriate duty cycle (typically 50%) square wave at A5U1-14 under normal operating conditions. Varying the dc level changes the level of intersection with the integrated waveform, thus changing the duty cycle. The triangle waveform is applied to A5U1-8. The dc output of the error amplifier is applied to A5U1-9. A5U1-14 produces the corresponding duty cycle output. Figures 3-14 through 3-16 illustrate this action.

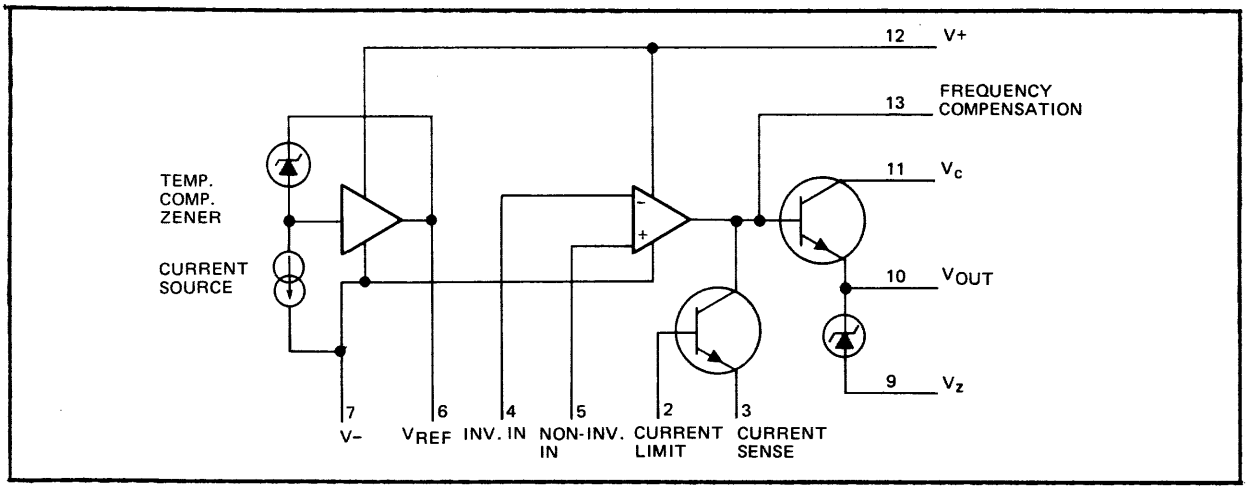
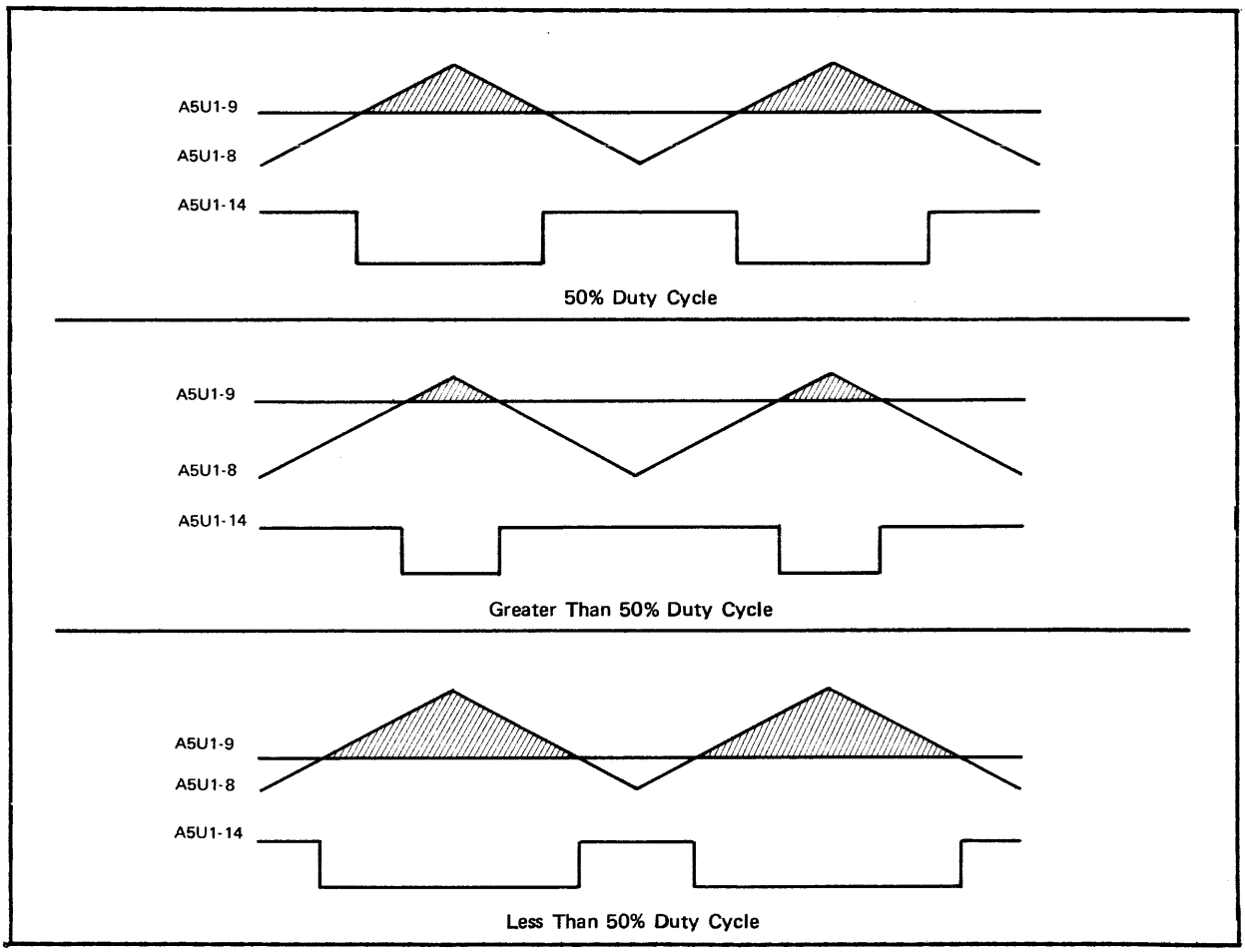


Figure 3-13. Typical 723 Voltage Regulator Functional Block Diagram



Figures 3-14 through 3-16.

Combining the operation of the pulse width modulator and the error amplifier produces the following conclusion : The interaction between the +5V (CPU) and the duty cycle is inversely proportional, i.e. if the +5V (CPU) output level decreases, the duty cycle goes up. It should be noted that the duty cycle can be determined either at A5U1-14 or at the base of A6Q1 because both of these signals are in phase. As a proof a detailed description of the A6Q1 base drive will now be discussed.

When A5U1-14 is high, A5Q5 turns on pulling A1U2-3 to ground (GND). A1U2-2 returns via A1R9 to +5V (L) on the Mother Board. This turns on U2, an OPTO-isolator, causing A1U2-6 to be pulled low to REF GND (A1U2-5). Note the change in references. REF GND is the reference for the preregulator drive and GND is the reference for the Control Board. The action of the OPTO isolator allows this shift in references. The configuration for U1 and U2 are shown in figure 3-17.

WARNING

DO NOT CONNECT REF COMMON 2 TO GND 1 AS THERE IS APPROXIMATELY 150 VOLTS DIFFERENCE.

CAUTION

Any measurements using REF COMMON must be made using test instruments with a floating input.

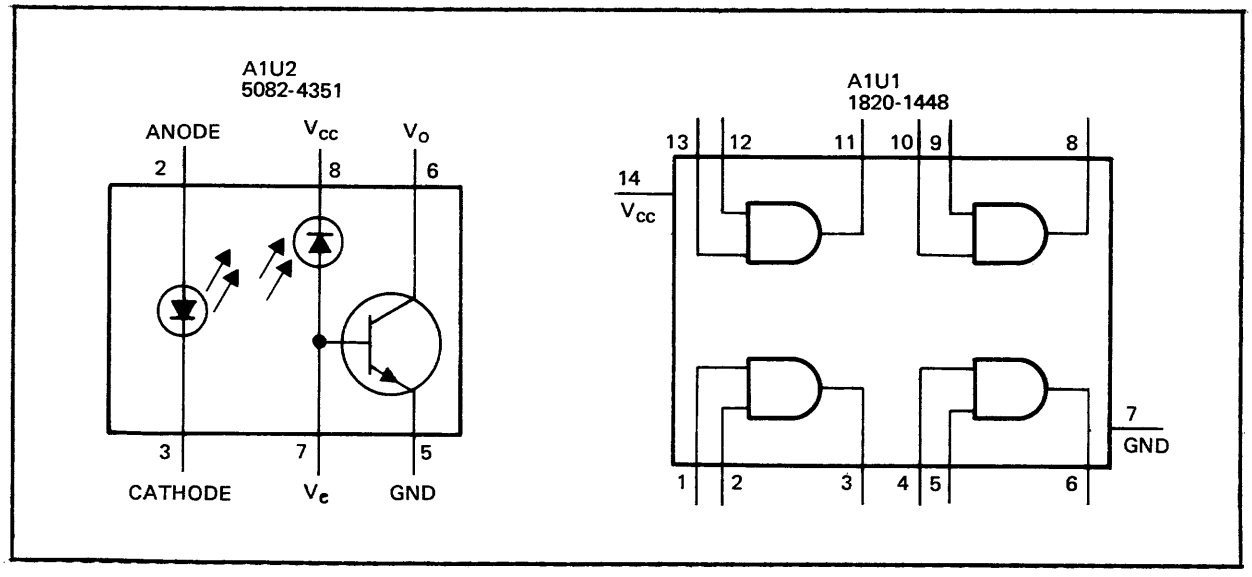


Figure 3-17. A1U1 and A1U2 Configurations.

Table 3-1 shows the conditions that exist for the two states of A5U1-14.

Table 3-1. Preregulator Drive Conditions

A5U1-14	HIGH	LOW
A1U2-6	LOW	HIGH
A1U1-1	LOW	HIGH
A1U1-3	LOW	HIGH
A1Q7	OFF	ON
A1Q8	OFF	ON
A1Q9	ON	OFF
A1U1-10	HIGH	LOW
A1U1-8	HIGH	LOW
A1Q5	ON	OFF
A1Q6	ON	OFF
A1Q3	OFF	ON
A6Q1	ON	OFF

3-8. Jumper Board A3A4 (sheet 4)

The Jumper Board A3A4 developes the memory voltages directly from the CPU voltages. J4-F,6 the +5V M is tied directly to the +5V CPU at J4-9,10. The -12V CPU at J4-12 ties directly to the -12VM. The 18 Vac bus from the secondary of A6T1 is applied to J4-L,N. Diodes A4CR4 and A4CR5 and capacitor A6C9 (mounted on the Mother Board A3A6) rectify and filter the 18 Vac into +18 Vdc. A4U2, a 723 type voltage regulator, and A4Q1 form a series pass regulator for the +12.5VM. A4U2 provides voltage regulation and current protection. Overvoltage protection is provided by the circuit composed of A6CR3,A6CR4,A6R4,A6C7, and A6C8 mounted on the Mother Board A3A6. A4R12 adjusts the +12.5VM output at J4-P,13.

3-9. Power Fail Recovery System (PFRS)

The optional Power Fail Recovery System (HP 12944B for the HP2108B /2109B or the HP 12991B for the HP2112B/2113B) consists of one Battery Charger Board (A3A3), one Battery Backup Board (A3A4), and the appropriate Battery/Status Assembly. A Battery Load Simulator Plug must be connected to the BAT.INPUT connector A3J2 on the rear of the Power Supply,if the Battery cable is not connected. The Battery Charger Board (A3A3) and the Battery Backup Board (A3A4) convert the 18 Vac bus into the various memory voltages. This section will discuss the operation of the Battery Backup and Charger Boards under two conditions:

a. Line power down with a good battery; and
b. Line power up.

3-10. Battery Charger Board A3A3 (sheet 6)

Figure 3-18 is a simplified diagram of the switching network used to switch from +18 Vdc to the +14 Vdc battery. When line power is up, the inverter and preregulator stages supply +18 Vdc to point X. This voltage is regulated to a suitable charge voltage (determined by the temperature sense resistor in the battery pack) via a series pass regulator on the Battrery Charger Board and forward biases A3CR5 to charge the battery. A4CR10 is forward biased and goes to point Y which feeds the Battery Backup Board which inturn developes the memory voltages. At this point A3CR4 is reversed biased. When the line power goes down, the Inverter and Preregulator stages cut off and the +18 Vdc goes to zero volts. The battery then forward biases A3CR4 as point Y is approximately +13.7 Vdc. This voltage powers the Battery Backup Board A3A4 until the battery discharges down to +12.5 Vdc (80% discharged). Diodes A3CR5 and A4CR10 are reverse biased when the battery is supplying the memory voltages.

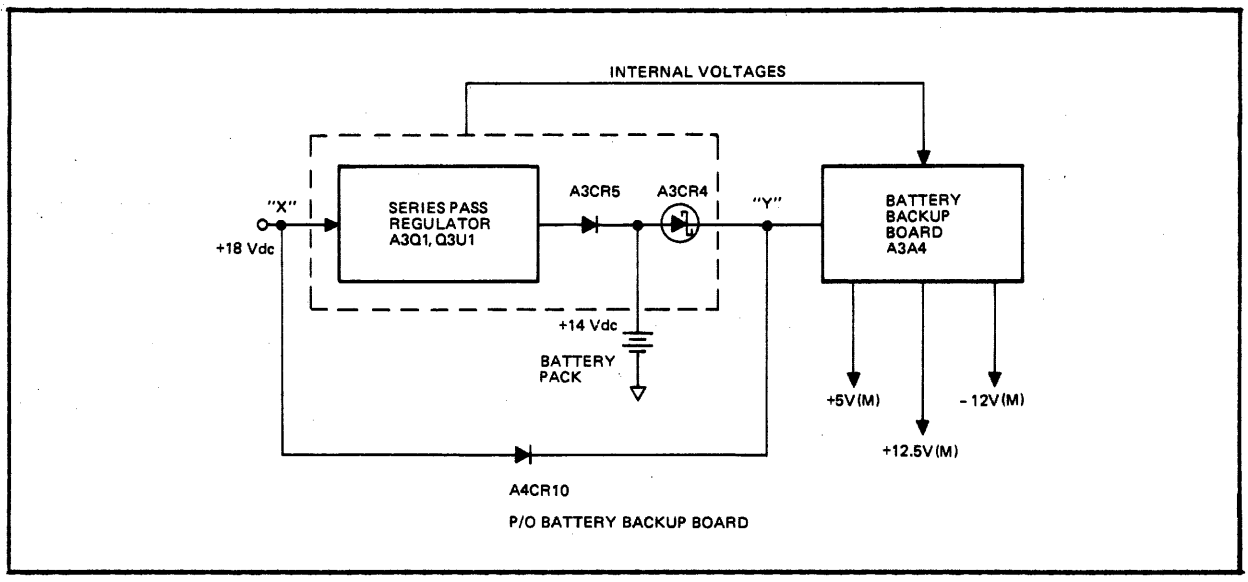


Figure 3-18. Power Fail Recovery System (PFRS) Simplified Block Diagram

3-11. Battery Backup Board A3A4 (sheet 7)

The Battery Backup Board A3A4 operation is described in the following paragraphs. The input to the Battery Backup Board is a dc voltage at J4-D,4. Transistor A4Q5, transformer A4T1, and capacitor A6C10 form the major components for the switching supply (buck switching regulator) that produces the +5V and the -12VM outputs.

A4U2,a 723 type voltage regulator, operates as an error amplifier. A4U3A and its associated components form a 20 kHz oscillator. The output of A4U3A (pin 2) is applied to the inverting input of A4U3B (pin 6) through A4R29 and the output of A4U2 (pin 10) is applied to the non-inverting input (pin 7) of A4U3B. A4U3B forms a pulse width modulator circuit so that the output pulses at A4U3-1 vary in width inversely as the level of the +5VM output. That As the +5VM decreases, the pulse width increases in width, when the +5VM increases, the pulse width decreases in width. The reason for this is apparent from the following circuit description.

A4U3-1 drives A4Q8 which in turn drives A4Q7 and A4Q5. As A4U3-1 goes high, A4Q5 and A4Q7 are turned on by A4Q8. When A4Q7 turns on, it effectively places the voltage across primary of A4T1 across A4Q5's base-emitter junction, thus supplying more drive current than A4Q8 could supply by itself. This drive current supplied by A4Q7 is limited by A4R25 and A4Q6. If the base drive for A4Q5 is too high, A4R25 developes enough voltage to turn on A4Q6, which diverts some of the base current from A4Q7, thus decreasing the base current to A4Q5.The action of A4Q6 and A4R25 provides a constant drive to A4Q5 regardless of the voltage

at J4-D,4.

The -12VM output is developed by the secondary winding of A4T1. The +12.5VM output is developed by a series pass regulator consisting of A4Q2,A4Q3, and A4U1A and B. A4Q3 is the series pass transistor. A4U1A is an error amplifier with A4Q2 providing drive for A4Q3. A4U1-3 is an adjustable reference that determines the output voltage of the series pass regulator. If the voltage output A4U1-2 decreases, this causes A4U1-1 to increase, which increases the conduction of A4Q2. This increases the base drive to A4Q3, which in turn increases the output voltage back to the correct level.

3-12. Battery/Status Assembly (sheet 9)

The Battery/Status Assembly operation is described in the following paragraphs. The description will be given only for the HP 12991B because the only difference between the HP12991B and the HP12944B is that the HP12944B contains only one battery pack.

The two parallel battery packs,BT1 and BT2, provide +14Vdc to the BAT.INPUT connector A3J2 through the Battery switch S1,and through the 6A fuse, F1. Diode CR1 provides protection against reverse voltage being applied to the power supply.

The operation of the Temperature Sense thermistor RT1 is described in Section 4, paragraph 4-4.

When the Battery Switch S1 is in the OFF position, the +14Vdc supplied by the external or internal batteries is removed from the power supply. When the Battery Switch S1 is in the EXT (external) position, the internal batteries are disconnected and an external dc supply is connected to the terminal block TB1. Diode CR1 and fuse F1 still provide their protection. The Battery Status Board A1 (5061-1352) and R1, a 3 ohm 50 watt resistor form a circuit to test the condition of the batteries, external or internal.

CAUTION

Do not push the Battery Test switch A1S1 while the computer is in the RUN mode, if switch S1 is not in the INT (internal) position, the computer will halt.

When the Battery Test switch A1S1 is pressed, the LED A1CR3 will light and remain lit as long as A1S1 is held in the TEST position, if the batteries are fully charged. If the batteries have a low charge, the LED A1CR3 may or may not light and extinguish even though the Battery Test switch is still in the TEST position. Refer to the Troubleshooting Flowchart in Appendix A for further information on this problem.

4. PROTECTION CIRCUITS

The Overcurrent, Overvoltage ,and Overtemperature Protection Circuits are located on seveal different board assemblies in the power supply. The description of the circuits will be broken into four parts:

a. The CPU and I/O overcurrent circuits;
b. The Memory overcurrent circuits;
c. The overvoltge circuits; and
d. The overtemperature circuits.

The schematics for the Mother Board (sheet 8), the Preregulator Board (sheet 2), the Control Board (sheet 5), the Battery Backup Board (sheet 7),and the Battery/Status Assembly (sheet 9) are needed for this section.

4-1. CPU and I/O Overcurrent Circuits

The overcurrent sense resistors for the -2V (CPU),-12V (I/O), and +12V (I/O) are located on the Mother Board A3A6. When the voltage drop across A6R3 exceeds 0.7V due to an overcurrent condition, this will turn on A5Q13. This action turns on A5Q2 which is part of the a differential amplifier consisting of A5Q1 and A5Q2. The collector of A5Q2 supplies base drive to A5Q3 , which results in A5Q3 turning on and pulling the cathodes of A5CR6 and A5CR7 to ground. A5CR7 and A5R34 pull the base of A5Q2 to ground and latch A5Q2 on even after the overcurrent condition is removed. A5CR6 pulls the non-inverting input (A5U1-9) of the pulse width modulator A5U1 to +0.7V causing the duty cycle to be reduced. This action removes the CPU and I/O voltages.

When the -12V (I/O) supply draws excessive current, the voltage drop across A6R2 exceeds 0.7V causing A5Q12 to conduct. This causes A5Q2 to turn on. The same chain of events that occured for the -2V (CPU) overcurrent will follow for the -12V (I/O) when it draws excessive current.

When the +12V (I/O) supply draws excessive current,A6R7 developes a voltage drop greater than 0.7V causing A5Q15 to conduct. When A5Q15 conducts, there is approximately +12V on its collector. This puts a positive level on A5U4-11 and causes the output A5U4-13 to swing positive. A5R39 provides positive feedback to latch A5U4's output high.This action turns on A5Q14 which pulls A5U1-9 ,the non-inverting input, low causing the duty cycle to be reduced. This action removes all the CPU and I/O voltages.

It should be noted here that there is not any current sense resistor in the secondary of A6T1 to sense an overcurent condition in the +5V (CPU) supply.In order to decrease the voltage loss across a sense resistor for the +5V (CPU) supply. this resistor is placed in the primary circuit of

the inverter transformer A6T1. Therefore, an overcurrent condition in the secondary on the +5V (CPU) is reflected back to the primary, causing an overcurrent shutdown to occur. This type of overcurrent condition is referred to as a preregulator overcurrent, even though it is the +5V (CPU) causing the overcurrent condition. It is important to note that anything drawing too much ccurrent through A6Q1 will cause a preregulator overcurrent condition to occur. Examples of this are shorted inverter transistors or any short in the primary or the secondary of A6T1 that can draw enough current through A6Q1 to be considered an overcurrent condition.

A1L1 and A1C3 filter the 20 kHz voltage across A6R13 into a negative dc voltage with respect to REF GND 2. When the voltage across A1C3 reaches a level of -1.4 Vdc, an overcurrent condition exists in the preregulator circuit. The voltage across A1C3 forward biases A1CR1 and turns on A1Q1. A1Q1 turns on A1Q2 causing A1Q2's collector to be approximately -5V. A1CR3 and A1CR4 are three junction stabsistors, each with a voltage drop of about 2.1V. The -5V on the collector of A1Q2 forward biases A1CR2,A1CR3, and A1CR4. A1CR2 and A1R5 latch A1Q1 and A1Q2 on. A1CR3 and A1CR4 pull A1U2-7 low causing A1U2's internal transistor ot turn off and allowing A1U2-6 to go high. Table 3-1 in Section 3 Preregulator Drive, shows that if the opto isolator (A1U2) is off, a condition similar to the internal transistor being off, the preregulator transistor A6Q1 is also off. This action rem,opves all the CPU and I/O voltages.

Under all overcurrent conditions for the -2V (CPU), +5V (CPU), -12V (I/O), and +12V (I/O) the memory voltages remain unchanged if a power fail recovery system is being used. If a power fail recovery system is not used, the memory voltages will go down on any of the described overcurrent conditions.

4-2. Memory Overcurrent Circuits

The +5VM supply does not have an overcurrent shutdown circuit but it incorporates a current limit circuit. Some of the internal components of A4U2 are shown in the dashed lines of figure 4-1. As the curren through A4R20 reaches a value high enough to turn on Qx, which decreases the base drive tc Qy, which in turn decreses the voltage drop across A4R23. The decrease in the voltage across A4R23 decreases the duty cycle output of the pulse width modulator A4U3B, thus decreasing the output voltage +5VM. If the load is too high, the voltage across A4R20 keeps Qx turned on, limiting the output current until the overcurrent condition is removed.

The +12.5VM supply incorporates an overcurrent shutdown circuit. A4U1B monitors the voltage across A4R5. When the current through A4R5 is large enough to be considered an overcurrent condition, the output A4U1-7 turns on A4CR12. Since A4CR12 is an SCR, it remains conducting until the bias voltages are removed from the board. A4CR12 turns off A4Q2, which turns off A4Q3. This action removes the +12.5VM.

If the +5VM current limits or if the +12.5VM latches, the CPU and I/O voltages remain at their respective levels. The +30V (I/O) and -12VM do not have any overcurrent protection.

4-3. Overvoltage Protection Circuits

Since the action of all the overvoltage protection circuits is the same only the +5V (CPU) overvoltage protection circuit will be explained here.

When the output level of the +5V (CPU) reaches the value to cause A6CR9, a 6.19 volt zener, to conduct plus 0.7V to turn on A6CR18, the +5V (CPU) output is tied to ground by the SCR,A6CR18. This action produces an overcurrent condition and shuts down the supply just as if an

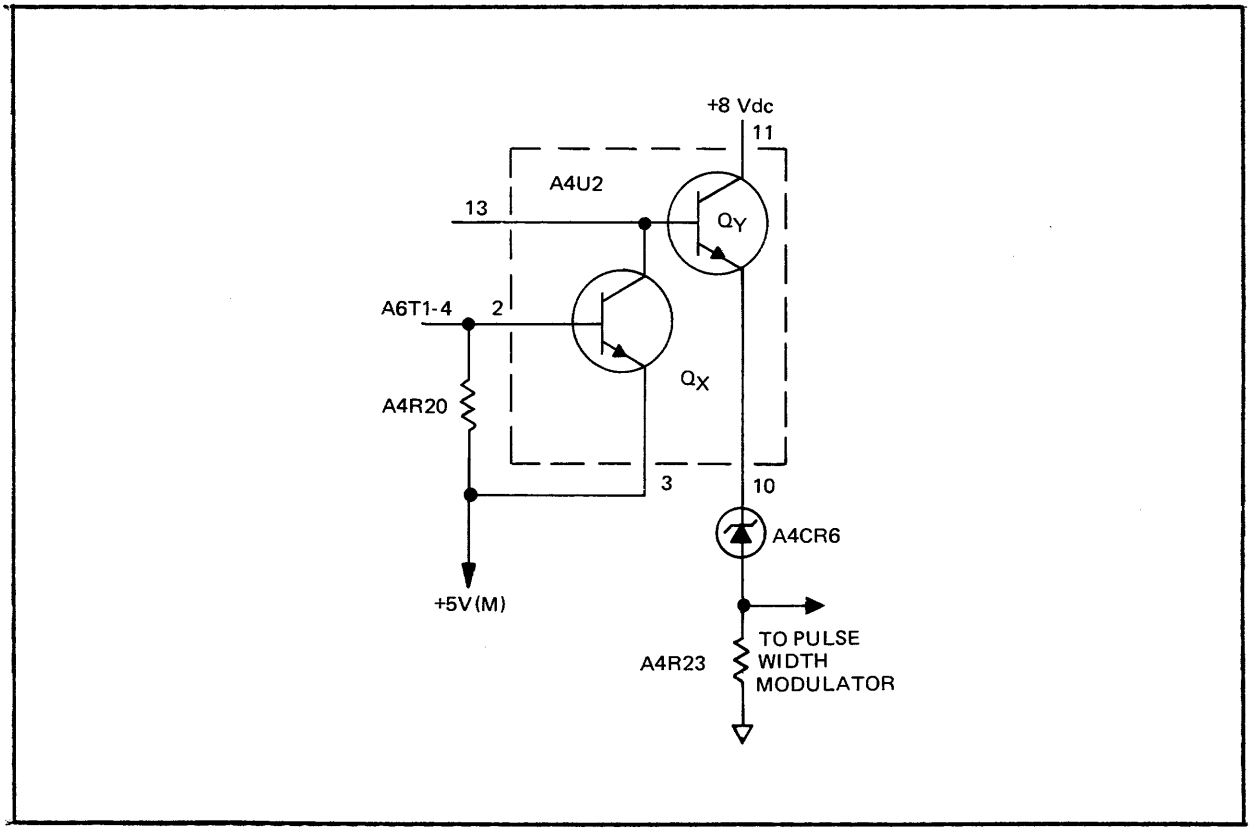


Figure 4-1. Partial Schematic of the Voltage Regulator A4U2

overcurrent condition had occured.

All voltages that have overvoltage protection convert an overvoltage condition into an overcurrent condition by shorting the output voltage to ground.

The +30V (I/O), -2V (CPU), and -12VM supplies do not have overvoltge protection circuits.

4-4. Overtemperature Protection Circuits

There are two overtemperature protection circuits, one consists of the Thermal Switch A6S1 on the Mother Board and the other one consists of the Temperature Sense Themistor RT1 in the Battery/Status Assembly part of the optional Power Fail Recovery System (PFRS).

a. Thermal Switch (A6S1) Circuit

When the Thermal Switch A6S1 opens due to an over temperature condition,the ground is removed from the base of A5Q11. This allows the base-emitter junction of A5Q11 to be forward biased causing A5Q11 to conduct. This action applies a ground to A5U3-5 (non-inverting input) causing A5U3-10 (output) to go to zero. The comparator's output A5U1-14 is forced to zero, reducing the pulse width and the duty cycle to zero. Thus shutting down the power supply. When the temperature returns to normal, the thermal switch A6S1 closes and the base of A5Q11 is returned to ground cutting off A5Q11. The ground is removed from A5U3-5 when A5Q11 cuts off and the power supply returns to normal operation. Capacitor A5C16 on the base of A5Q11 acts as a noise filter.

b. Temperature Sense Thermistor (RT1) Circuit

The Temperature Sense Thermistor RT1, normally 815 ohms, is mounted in the battery pack BT1 or BT2. If the battery pack overheats due to high ambient temperature, a heavy current drain, or overcharging, the thermistor RT1 increases in resistance. This increase in resistance causes A3A3U1-2 on the Battery Charger board to go more positive causing A3A3U1-6 to go negative and cutoff A3A3Q8 and A3A3Q1. A3A3Q1 is the pass transistor supplying the battery charge current. This will allow the battteries to return to their normal operating temperature. When the thermistor RT1 returns to its normal resistance, A3A3U1-2 returns to its normal value and A3A3U1-6 goes positive turning on A3A3Q8 and A3A3Q1.

5. POWER FAILURE / AUTO RESTART CIRCUITS

The following definitions of signals are fundamental to the understanding of this section.

PWU (Power UP) : This signal indicates that the ac line (mains) input voltage is at a level that will provide enough input energy to the power supply for it to supply all of the outputs at their maximum ratings. This signal "communicates" with the CPU.

PON (Power On) : This signal indicates that all the dc output voltages are operating . This signal "communicates" with the CPU.

LPU (Line Power UP) : This is an OR tied signal that indicates the same things as the PWU signal. This is the basic signal for communicating from power supply to power supply, whereas the PWU signal communciates to the CPU.

PSU (Power Supply Up) : This is an OR tied signal that indicates the same thing as the PON signal. This signal communciates from power supply to power supply.

$\overline{\text{MLOST}}$ (Memory Lost) : This signal indicates that the memory voltages are lost and not capable of sustaining the memory, therefore memory is lost. This signal communicates with the CPU.

$\overline{\text{MLO}}$ (Memory Lost OR) : This is an OR tied signal that indicates the same thing as the $\overline{\text{MLOST}}$ signal. This signal communciates from power supply to power supply.

5-1. Power Up Sequence

The signals and timing involved during a power up sequence are shown in figure 5-1. In a power up sequence the timing between PWU and PON is unimportant. PON should go high as soon as possible after all of the dc voltages are valid. When PON goes high, the CPU checks the status of the $\overline{\text{MLOST}}$ signal. If $\overline{\text{MLOST}}$ is high this means that the memory was not lost during a power down sequence, therefore, the CPU will not perform a clear memory routine. If $\overline{\text{MLOST}}$ is low, the CPU will perform a clear memory routine. It is very important that $\overline{\text{MLOST}}$ stay low for at least 50 us after PON goes high on a power up sequence (where memory was lost) so that the CPU has time to check the status of the $\overline{\text{MLOST}}$ signal. If $\overline{\text{MLOST}}$ went high as soon as PON went high, a clear memory routine could not be initiated. The components that produce the 50 us delay for the $\overline{\text{MLOST}}$ signal are A3C7

and A3R23 on the Battery Charger Board. On a power up sequence with low battery voltage (below +12.5V), initially the +16.45V bus is low (below +12.5V). When the ac line (mains) power is applied the +16.45V bus goes high. The inverting input of A3U2A (pin 4) is at a lower voltage level than the non-inverting input of A3U2A (pin 5). Therefore, the output of A3U2A (pin 2) is high. As A3C2 charges through A3R5 raising the voltage level at A3U2-4 to a value where A3U2-2 goes low. This action turns on A3Q5,A3Q7, and A3Q6. A3Q6 is a three terminal voltage regulator that supplies the internal bias voltages to the Battery Backup Board. Shortly after the bias voltages are applied to the Battery Backup Board, the +5VM is applied to J3-F and becomes valid. A3C7 and A3R23 provide a delay at A3U2-7. Therefore, as A3U2-7 goes high, A3Q9 turns off causing A3Q10 to conduct, thus causing MLOST and MLO to go high.

If a valid battery voltage had been present at the +16.45V bus, A3U2-2 would have remained low and the MLOST and MLO signals would have remained high. The circuitry for the PON and PWU is found on the Control Board A3A5.

A5U4B monitors the voltage of the bias transformer T2 point "Y". A5R2 is adjusted so that A5U4-1 goes high when the ac line (mains) input voltage reaches 88 Vac. It may be noted that the voltage at point "Y" depends on the value of the ac line (mains) input voltage. When the line (mains) reaches 88 Vac, A5U4-1 goes high and turns on A5Q7. This action pulls LPU and PWU high. When PWU goes high, A5U4-14 goes high, and as soon as the +5V (CPU) tied to A5R19 at point "X" and the +5VM tied to A5R42 at J5-7 go high, then A5U4-2 goes high. This turns on A5Q17,A5Q18, and A5Q19, thus pulling both PON and PSU high.

5-2. Power Down Sequence

The signals and timing involved for a power down sequence are shown in figure 5-1. As can be seen from the figure, MLOST is a "don't care" condition on a power down sequence. When the ac line (mains) input voltage is less than 88 Vac, that is, not high enough to maintain the power supply operation, A5U4-1 goes low. This pulls LPU and PWU low. The low PWU signal initializes a power fail routine and the CPU interrupts its operation to perform this routine. At this time it is important to notice that PWU is low and PON is high. This means that the ac line (mains) input is invalid but that the dc voltages are still valid. As PWU goes low, A5U4-14 goes low. This pulls A5U4-5 low via a time delay developed by A5C12 and A5R22. This time delay is approximately 500 us and delays A5U4-2 from going low, causing PON and PSU to go low. The time delay of 500 us from PWU going low until PON goes low is long enough for the CPU to perform a power fail routine. The power fail

routine is halted when PON goes low because about 50 us after PON goes low, the dc voltages are considered to be invalid. The reason the dc voltages can stay up as long as they do is because of the energy stored in the input capacitors, A6C12 and A6C13.

5-3. Interconnections of The Power Supplies

When several power supplies are connected together, the LPU,PSU, and $\overline{\text{MLO}}$ are all OR tied from power supply to power supply. Therefore, if any one of the signals goes low, it pulls the same signal low on all the power supplies (i.e., when LPU goes low on one power supply, it pulls LPU low on all the power supplies). When any of these signals go low, they in turn cause the signals in the supply that communicates with the CPU (PWU,PON, and $\overline{\text{MLOST}}$) to go low.

An example would be two supplies tied together and one supply lost ac line (mains) input power. If the supply that lost the ac line (mains) power was in an extender (memory

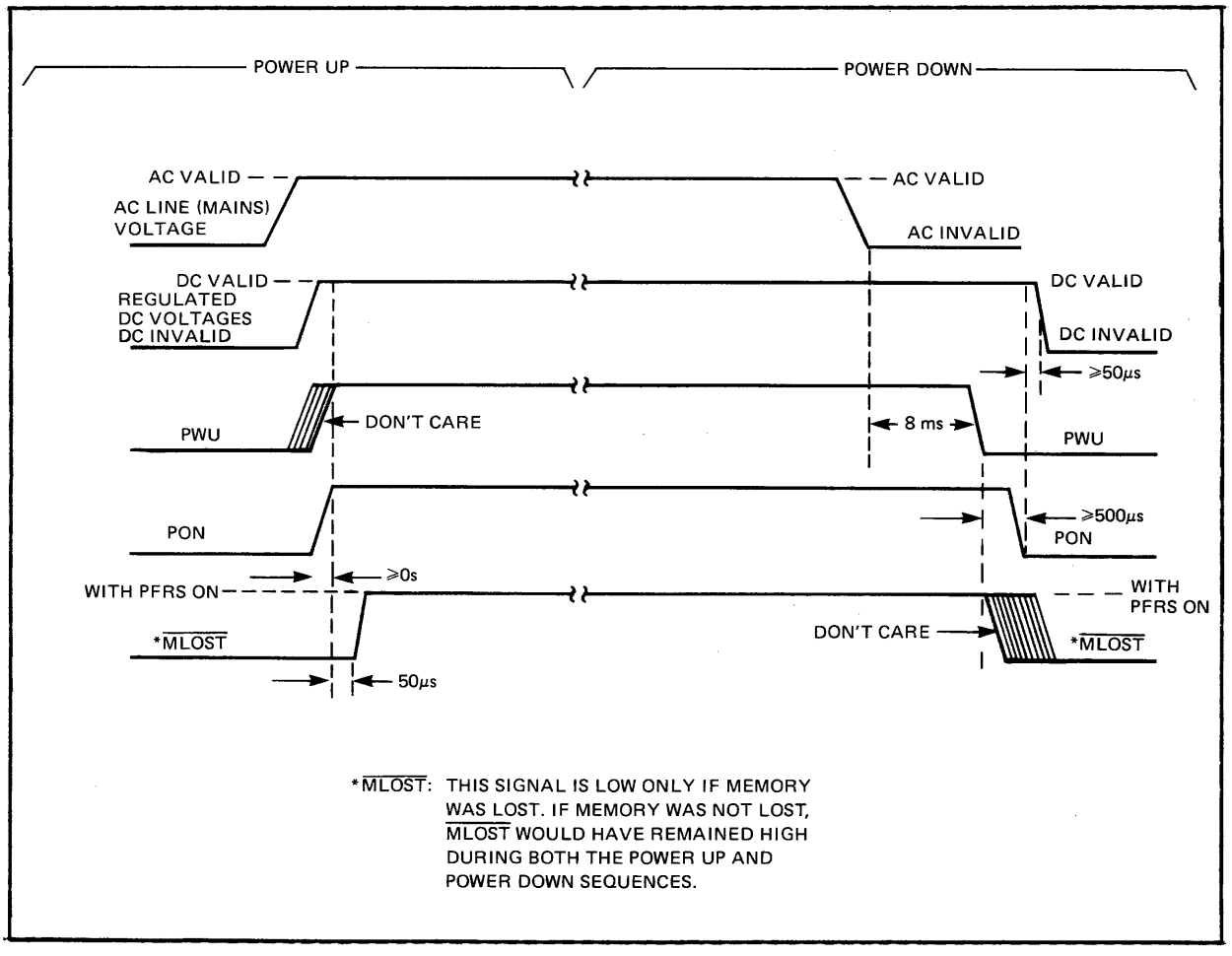


Figure 5-1. Signals and Timing Diagram for Power Up and Power Down Sequences

or I/O), it would pull PWU low on the other supply that communicates with the CPU via LPU. This action would cause a power fail routine to be initiated.

For simplification figure 5-2 shows the connections between a CPU power supply, a memory extender power supply, and an I/O extender power supply.

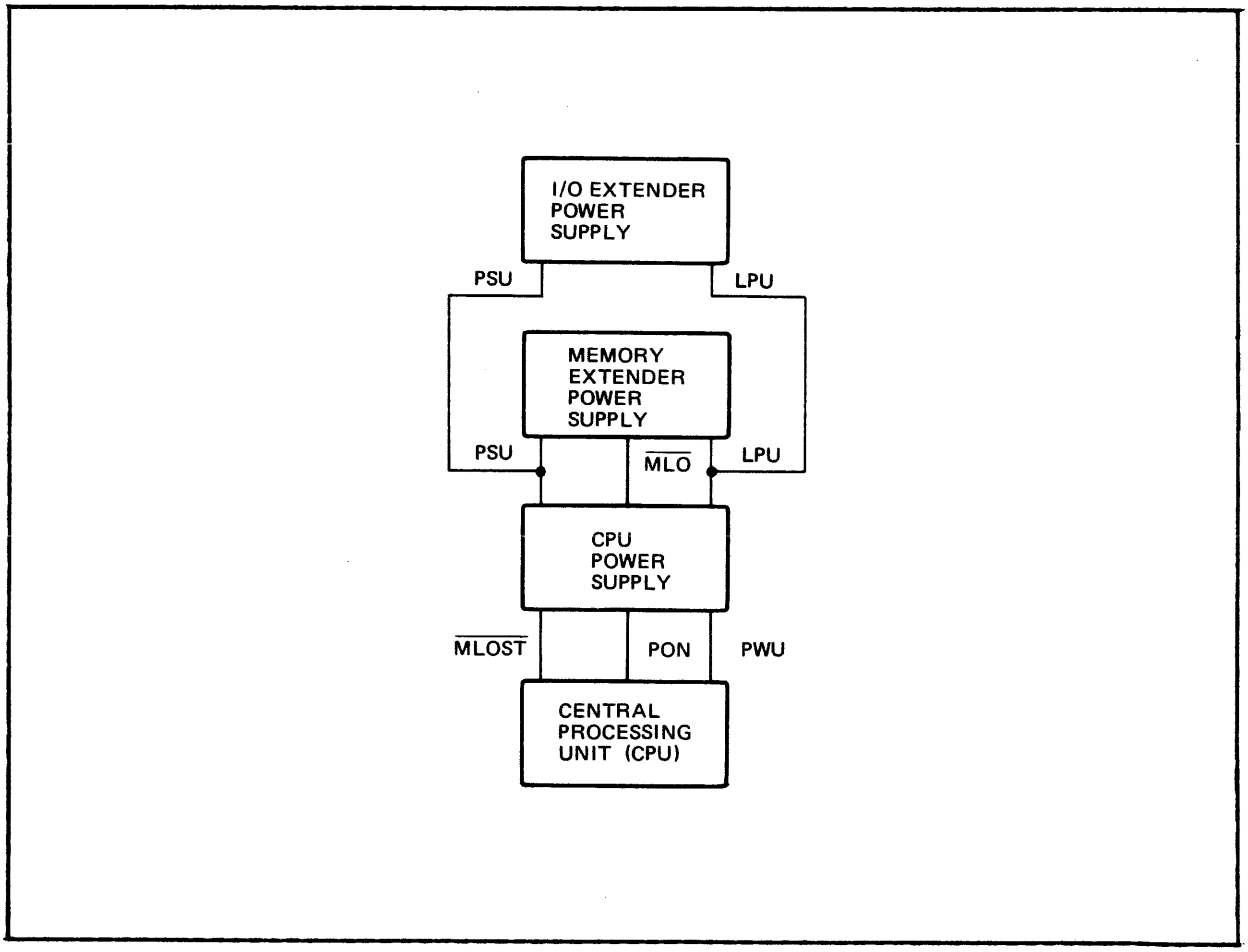


Figure 5-2. Interconnection of Power Supplies.

APPENDIX A

Power Supply Troubleshooting

This section contains the Power Supply Troubleshooting Flowchart and a Parts Location Diagram. The Troubleshooting Flowchart may be used in level by performing in sequence the procedure presented in figure A-1 (sheets 1 and 2). The Parts Location Diagram is used in locating the test points and adjustment locations. When a malfunction is encountered, replace the first suspect assembly(s) and/or components as required and repeat that portion of the procedure where the malfunction occurred. (See the Installation and Service Manual for removal and replacement procedures). If the malfunction persists, reinstall the original subassembly(s), and replace the next suspect subassembly, and repeat the procedure. After the malfunction is cleared, contact the nearest Hewlett-Packard Sales and Service Office for instructions regarding shipment of the defective subassembly or subassemblies.

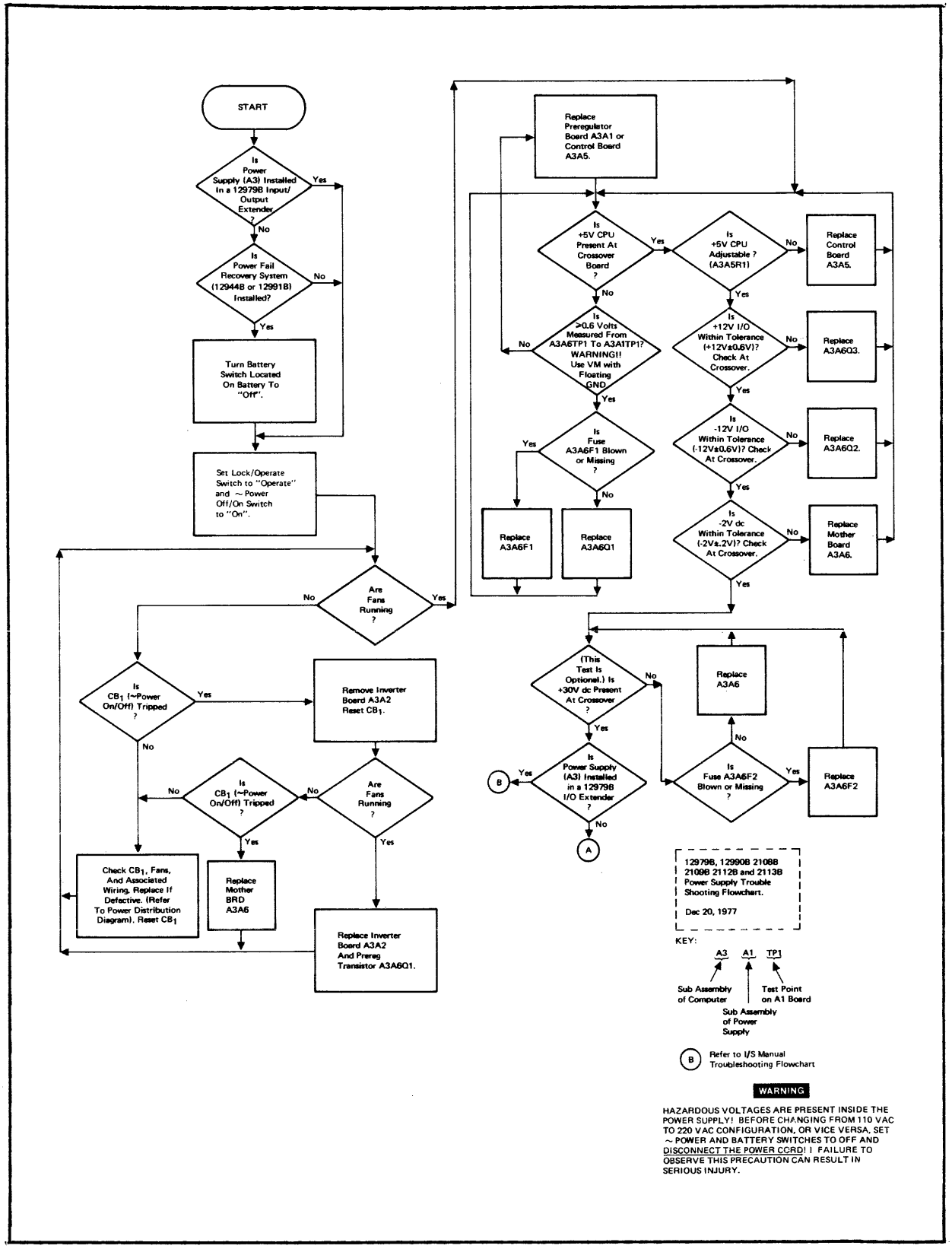


Figure A-1. Power Supply Troubleshooting Flowchart (Sheet 1 of 2)

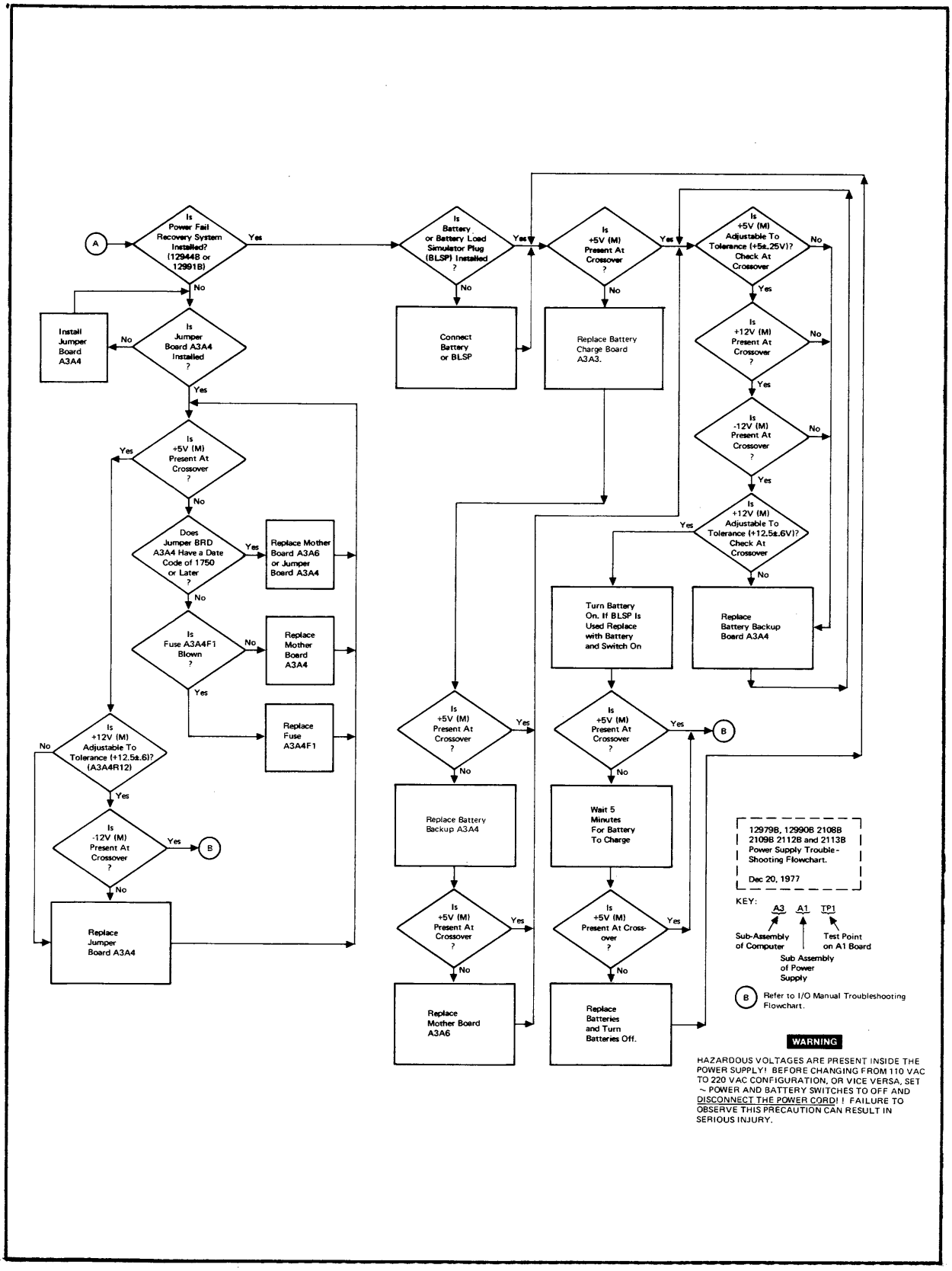
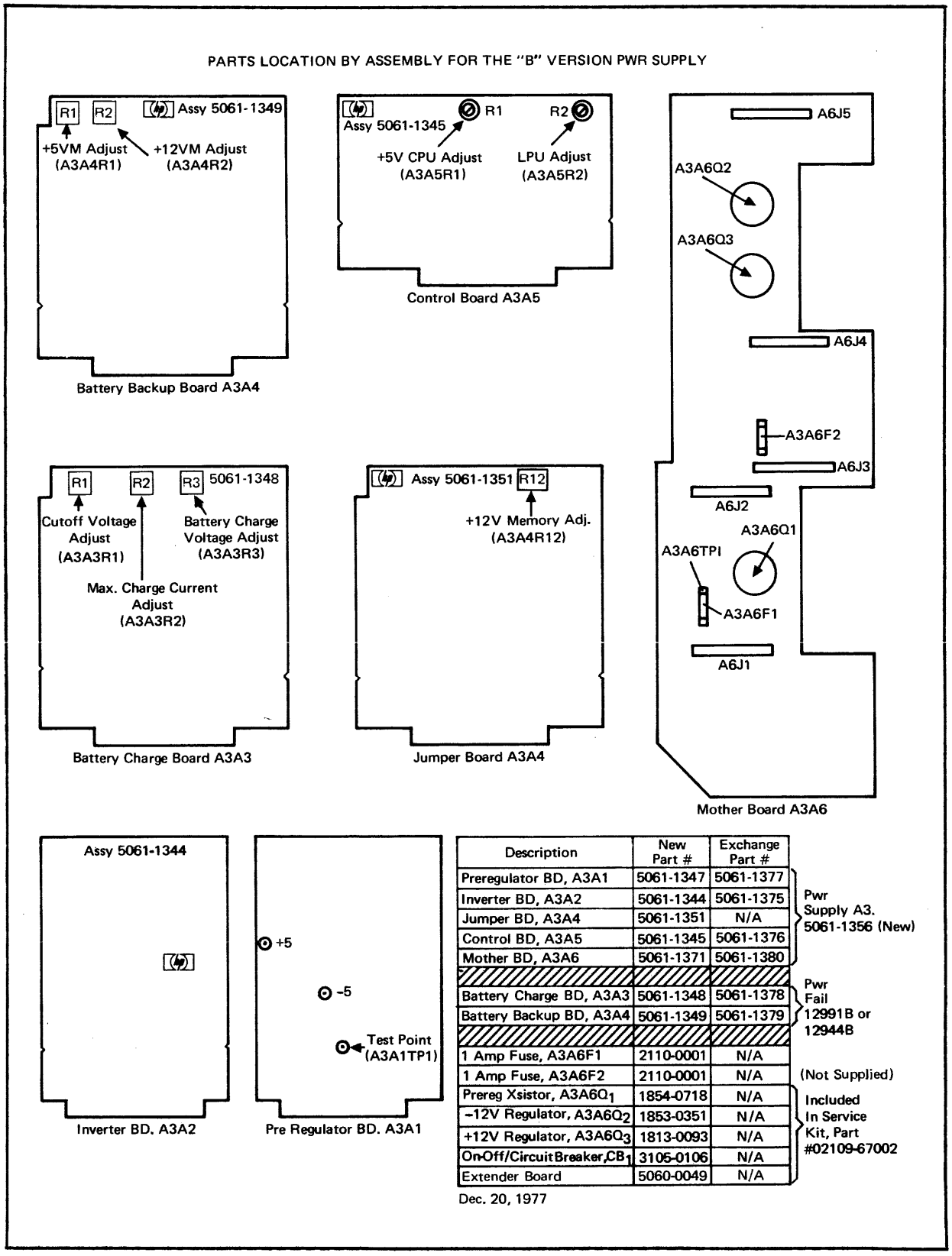


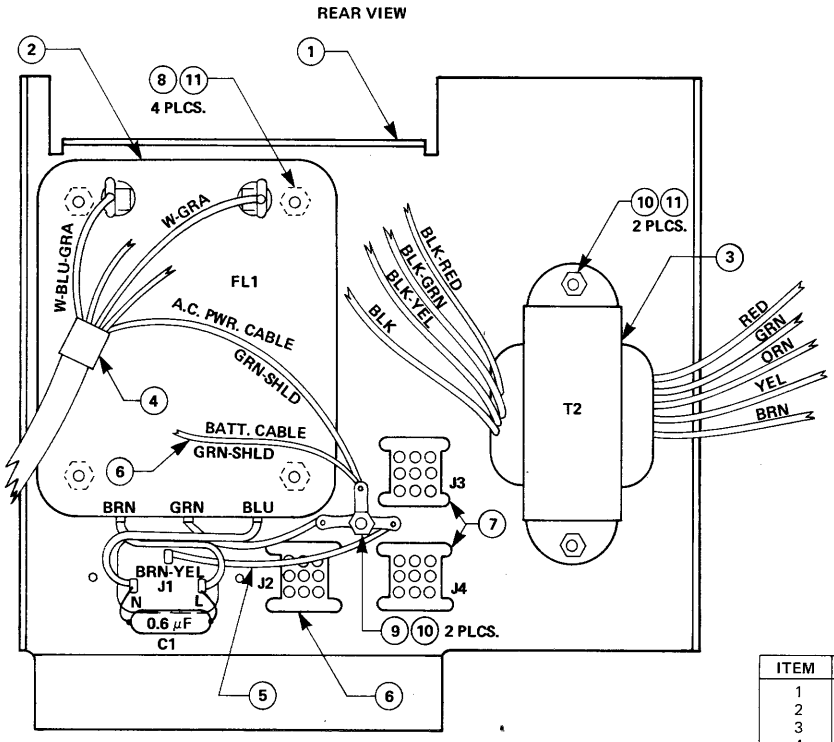
Figure A-1. Power Supply Troubleshooting Flowchart (Sheet 2 of 2)

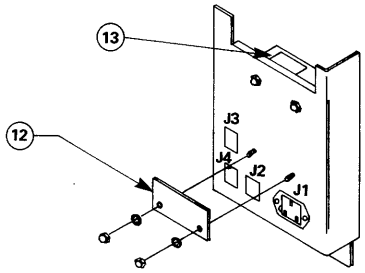


Description	New Part #	Exchange Part #	
Preregulator BD, A3A1	5061-1347	5061-1377	Pwr Supply A3. 5061-1356 (New)
Inverter BD, A3A2	5061-1344	5061-1375	
Jumper BD, A3A4	5061-1351	N/A	
Control BD, A3A5	5061-1345	5061-1376	
Mother BD, A3A6	5061-1371	5061-1380	
			Pwr Fail 12991B or 12944B
Battery Charge BD, A3A3	5061-1348	5061-1378	
Battery Backup BD, A3A4	5061-1349	5061-1379	
1 Amp Fuse, A3A6F1	2110-0001	N/A	(Not Supplied)
1 Amp Fuse, A3A6F2	2110-0001	N/A	
Prereg Xsistor, A3A6Q_1	1854-0718	N/A	Included In Service Kit, Part #02109-67002
-12V Regulator, A3A6Q_2	1853-0351	N/A	
+12V Regulator, A3A6Q_3	1813-0093	N/A	
On-Off/Circuit Breaker, CB_1	3105-0106	N/A	
Extender Board	5060-0049	N/A	

Dec. 20, 1977

Figure A-2. Parts Location Diagram.





ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	BACK PANEL	5000-8091
2	1	FILTER	9135-0045
3	1	TRANSFORMER,BIAS	9100-3949
4	1	CABLE ASSY AC PWR	5061-1358
5	1	WIRE – 18 GRN/YEL	8150-2919
6	1	BATT. CABLE ASSY.	5061-1357
7	1	CABLE ASSY. CONTROL	5061-1360
8	4	ACORN NUTS	0510-0110
9	2	LUG SOLDER	0360-0268
10	5	NUT HEX NO. 6	2420-0003
11	6	LOCKWASHER SPLIT NO. 6	2150-0851
12	1	INFO TAG	5001-2632
13	1	LABEL-WARNING	7120-4626
14	1	CAP 0.6 μF	0160-4413

2109B/2113B Power Supply Rear Panel Assembly
5061-1350

2109B/2113B Power Supply Rear Panel Assembly Parts List 5061-1350

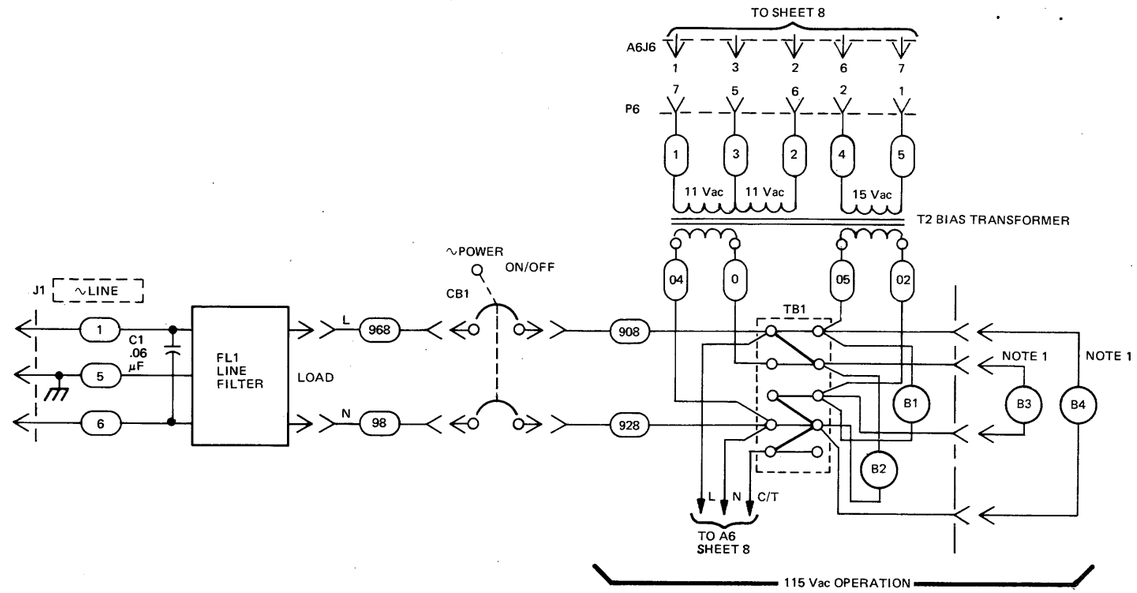
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01							
03							
		CAPACITOR-FIXED		0160-4413		U	1
01	C1						
		LUG SOLDER #6LKG		0360-0268		U	2
		LUG CRP16-14RT6		0362-0328		U	4
		NUT-CAP		0510-0110		U	4
		CONTACT FEMALE		1251-3411		U	5
		CONN POST 7POS F		1251-4358		U	1
		CA TIE 3.6L		1400-0249		U	5
		LKWSHR 6 HEL		2190-0851		U	6
		NUT 6-32 .250AF		2420-0003		U	5
		LABEL-WARNING		7120-4626		U	1
		LABEL-AL COLOR		7120-5480		L	1
		WIRE 18 GRN-YEL		8150-2919		U	0.25
		TRANSFORMER		9100-3949		U	1
		FILTER-LINE		9135-0045		U	1
		PANEL-REAR LCPS		5000-8091		W	1
		INFO TAG		5001-2632		W	1
		ASSY-CABLE BATT		5061-1357		G	1
		ASSY-CABLE AC		5061-1358		G	1
		ASSY-CBL CONTROL		5061-1360		G	1

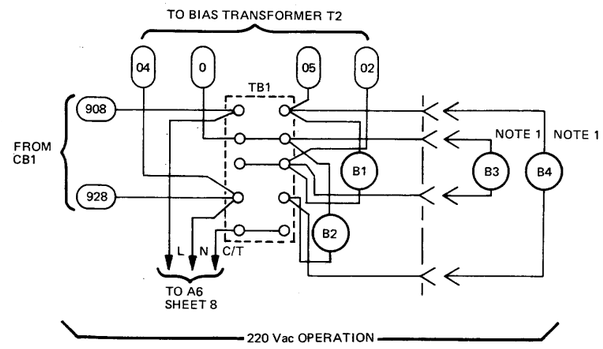
ENGINEERING RESPONSIBILITY															
0	1	2	3	4		6		8	9		11	12	14	15	
16	17		19		21	22	23	25	29	30	32	33	38	43	
45	46	61	63												

SEPIA

B - 02109-90024 -

SYM	REVISIONS	APPROVED	DATE





WARNING

HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE POWER SUPPLY! BEFORE CHANGING FROM 110 VAC TO 220 VAC CONFIGURATION, OR VICE VERSA, SET ∼ POWER AND BATTERY SWITCHES TO OFF AND DISCONNECT THE POWER CORD! ! FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS INJURY.

NOTES:

1. FANS B3 AND B 4 ARE REQUIRED ONLY FOR THE HP 2113B.
2. ENCLOSED WIRE COLOR CODE (◯). CODE USED IS THE SAME AS THE RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES THE BASE COLOR, SECOND NUMBER IDENTIFIES THE WIDE STRIPE, AND THE THIRD NUMBER IDENTIFIES THE NARROW STRIPE, e.g., (947) DENOTES WHITE BASE, YELLOW WIDE STRIPE, AND VIOLET NARROW STRIPE.

Sheet 1 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

TOLERANCES .XX ± .02 .XXX ± .005

SEE CORP. STD. 608

DRAWN BY | DATE

ENGINEER

RELEASE TO PROD.

SUPERSEDES DWG.

TITLE: LINE (MAINS) POWER DISTRIBUTION SCHEMATIC

NEXT ASSEMBLY

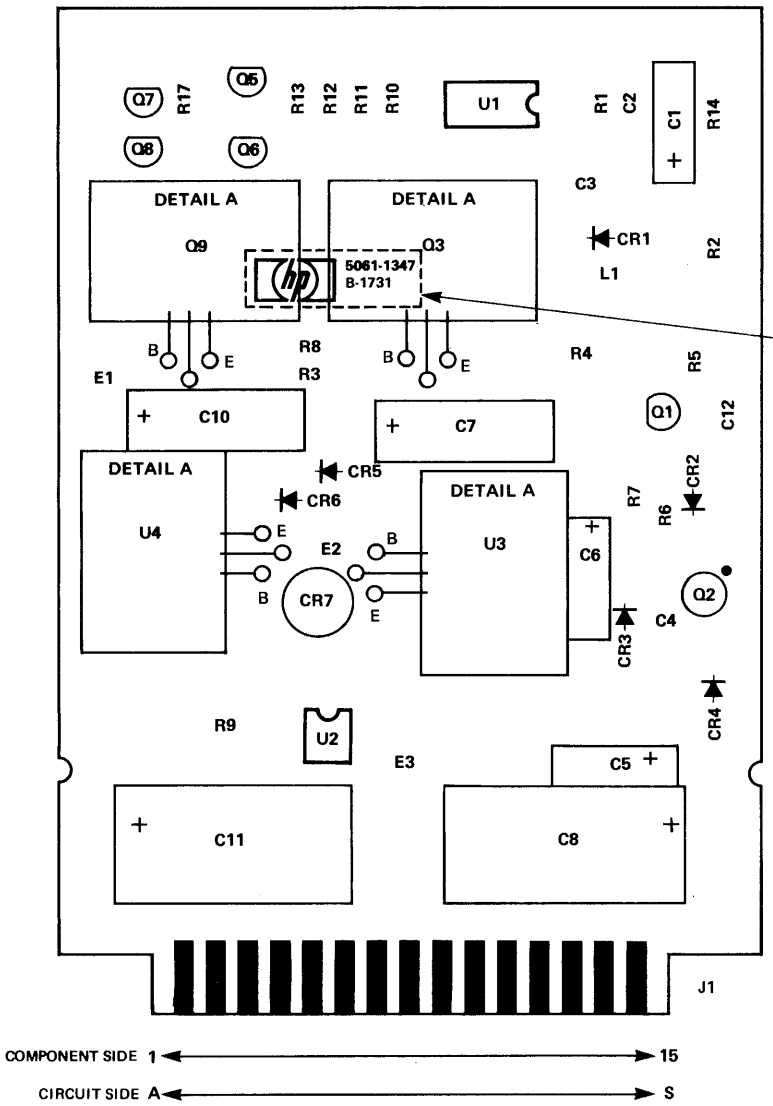
FINISH | SCALE

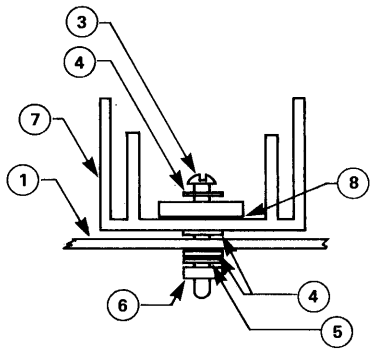
HEWLETT hp PACKARD

PART NUMBER 5061-1356

B - 02109-90024 -

SHEET OF





DETAIL A

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	PC BOARD, ETCHED	5080-9799
2	3	TERMINAL, E1-E3	0360-0294
3	4	SCREW, 4-40 X 3/8	2200-0143
4	12	WASHER FLAT 4-40	3050-0229
5	4	WASHER, SPLIT LOCK	2190-0108
6	4	NUT, 4-40	2260-0001
7	4	HEAT SINK	1205-0219
8	1	THERMAL COMP.	6040-0239

A1 Pre-regulator Assembly
5061-1347

A1 Pre-regulator Assembly Parts List 5061-1347 (Sheet 1 of 3)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01							
03							
00	C2,12	CAP 0.1UF		0150-0121		U	2
01	C4	CAP .01UF		0160-2055		U	1
01	C3	CAP 2.2UF 20%		0160-3901		U	1
01	C1,5,6	C-F 56UF 6VDC		0180-0548		U	3
00	C7,10	CAP 120UF 10%		0180-2145		U	2
00	C8	C-F 1500UF 16V		0180-2500		U	1
00	C11	CAP 1000UF 16V		0180-2732		U	1
00	E1-3	STUD SOLDER TERM		0360-0294		U	3
		ADHESIVE		0470-0409		U	0.01
01	R12	RES 2.15K 1%.125		0698-0084		U	1
00	R2	RES 23.7K 1%.125		0698-3158		U	1
01	R13,17	RES 316 1%.125		0698-3444		U	2
00	R7	RES 3.16K 1%.125		0757-0279		U	1
01	R3,8,14	RES 100 1%.125		0757-0401		U	3
00	R9	RES 110 1%.125		0757-0402		U	1
00	R5,6	RES 511 1%.125		0757-0416		U	2
01	R10,11	RES 619 1%.125		0757-0418		U	2
		RES 1.62K 1%.125		0757-0428		U	1

PART NO CONT

A1 Pre-regulator Assembly Parts List 5061-1347 (Sheet 2 of 3)

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PART NO CONT		0757-0428			
00	R1						
		RES 5.6 5% 2W		0811-1675		U	1
00	R4						
		HT DIS PL PWR		1205-0219		U	4
		IC SN74S 09 N		1820-1448		U	1
00	U1						
		IC RGLTR +5V		1826-0144		U	1
00	U4						
		IC LINEAR 5V		1826-0294		U	1
00	U3						
		XSTR 2N4403 TO92		1853-0271		U	3
01	Q1,5,7						
		XSTR 2N4401 TO92		1854-0467		U	2
00	Q6,8						
		XSTR 2N2222ATO18		1854-0477		U	1
00	Q2						
		XSTR MJE4923		1854-0683		U	2
00	Q3,9						
		DIODE IN2071		1901-0029		U	1
00	CR1						
		DIODE SIL		1901-0040		U	1
01	CR2						
		STABISTOR STB523		1901-0460		U	2
01	CR3,4						
		DIODE IN4936		1901-1065		U	1
00	CR5						
		DIODE IN5817		1901-1080		U	1
00	CR6						
		DIODE-FW BRIDGE		1906-0051		U	1
00	CR7						
		OPTO ISOLATOR		1990-0444		U	1
00	U2						
		LKWSHR 4 HEL		2190-0108		U	4
		SCR #4-40X.375L		2200-0143		U	4
		NUT 4-40 .250AF		2260-0001		U	4

A1 Pre-regulator Assembly Parts List 5061-1347 (Sheet 3 of 3)

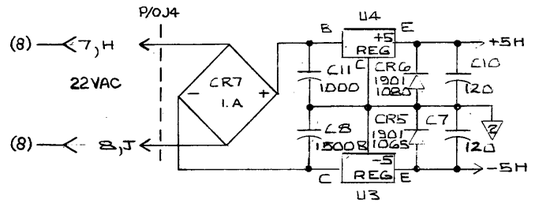
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP OPTION	LOC	QUANTITY PER
		WSHR #4 SS		3050-0229		U	12
		COMPOUND-THERMAL		6040-0239		U	0.01
		LABEL-AL COLOR		7120-5480		L	1
00L1		COIL-FXD 68UH		9100-1633		U	1
		BOARD-ETCHED		5080-9799		W	1

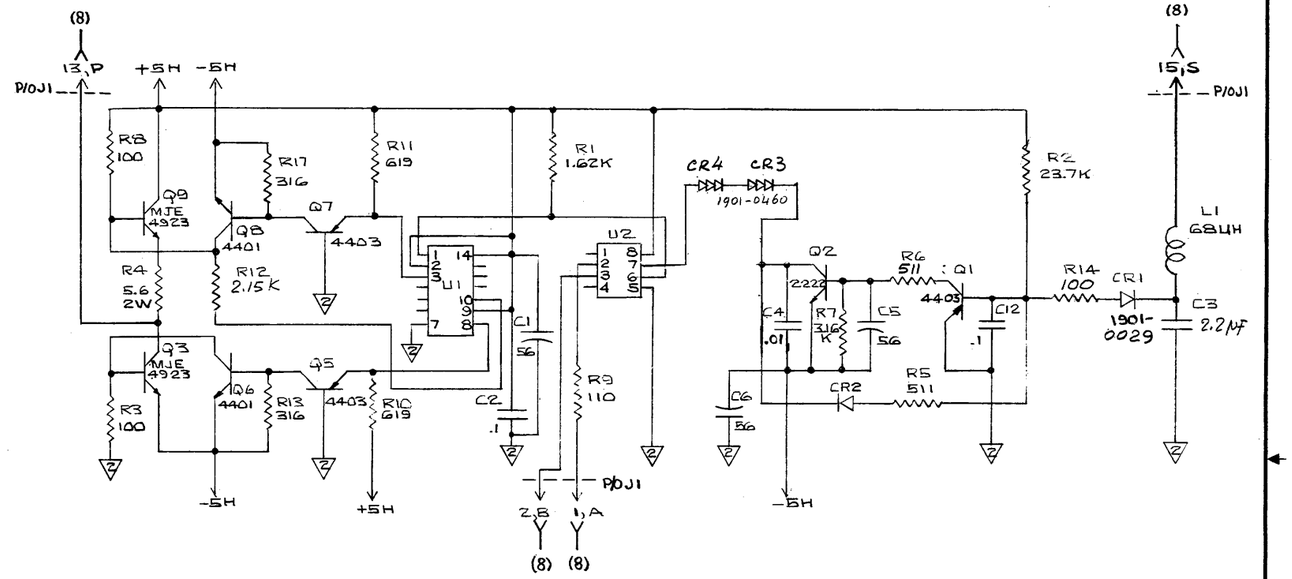
ENGINEERING RESPONSIBILITY ◪ SEPIA ◪

0	1	2	3	4	5	6	7	8	9	10	11	12	14	15
16	17	18	19	20	21	22			33	34	38		42	43
		63			90			93						

1 C-5061-1347-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED (1646)		12-6-76
B	C4 WAS .001, R14 WAS 511, CR1 WAS 1901-0040 PER PRCR A 4CH'S		3-17-77
C	CHANGED C4 FROM .47 TO .01 PER ECO-22-4197		5/20/77
D	ECO-22-4197, R6 WAS 511Ω, CR4 WAS 1901-1080. DATE CODE IS 1726	GD/	8-15-77
E	ECO-22-4260, C3 WAS 1 MF, R6 WAS 2.15K, CR3 WAS SILICON DIODE, CR4 WAS 1902-3048, R12 WAS 4.64K. DATE CODE IS 1731	GD/	





SEE WARNING
REF COMMON
PINS 9,K

ALL RESISTORS IN OHMS
EXCEPT R

ALL CAPACITORS IN MICROFARADS

+5H AND -5H REFERENCED TO REF COMMON ▽2

WARNING

HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE POWER SUPPLY! BEFORE CHANGING FROM 110 VAC TO 220 VAC CONFIGURATION, OR VICE VERSA, SET ~ POWER AND BATTERY SWITCHES TO OFF AND DISCONNECT THE POWER CORD! ! FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS INJURY.

WARNING

DO NOT CONNECT REF COMMON ▽2 TO GROUND (GND ▽1) AS THERE IS APPROXIMATELY 150 VOLTS DIFFERENCE!

CAUTION

ANY MEASUREMENTS USING REF COMMON ▽2 MUST BE MADE USING TEST INSTRUMENTS WITH A FLOATING INPUT.

Sheet 2 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES. TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY	J DIXON	DATE 5-6-76
ENGINEER	K. Check	10/26/76
RELEASED TO PROD		5-23-77
SUPERSEDES DWG.		

TITLE: PRE. REGULATOR BD. POWER SUPPLY A3A1

NEXT ASSEMBLY: 5061-1356

FINISH — SCALE —

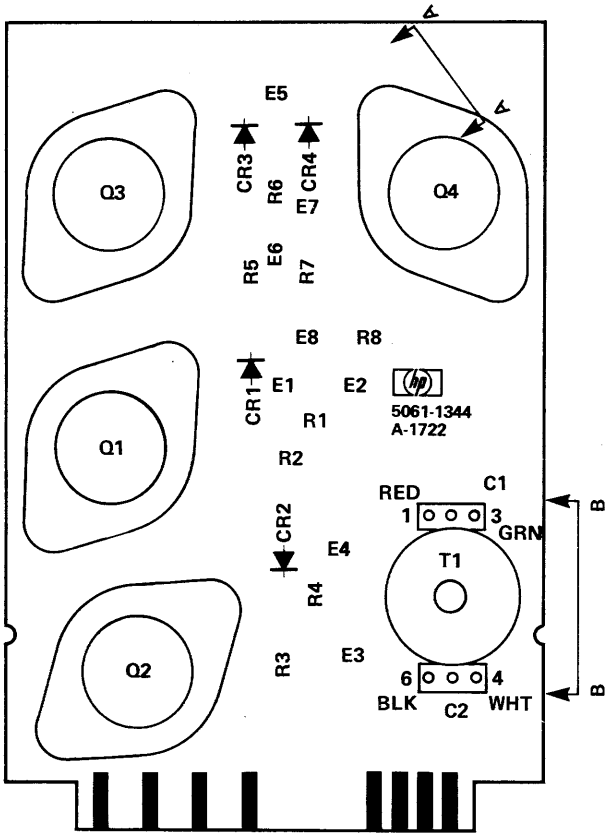
HEWLETT PACKARD

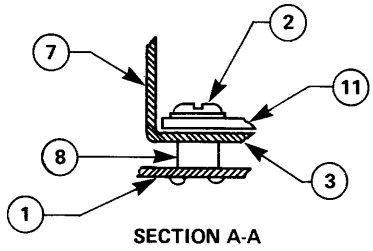
PART NUMBER: 5061-1347

C-5061-1347-51

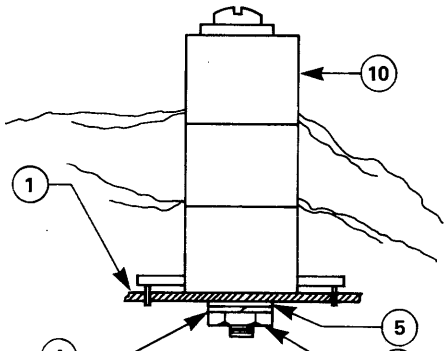
SHEET OF

STOCK NO. 9280-0003 PRINTED ON DIEPO NO. 1020-10 CLEARPRINT FADEOUT





SECTION A-A



SECTION B-B

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	P.C. BOARD, ETCHED	5080-9796
2	8	SCREW 6-32 X 3/8 WITH LK	2360-0119
3	1	COMPOUND-THERMAL	6040-0239
4	1	LOCK WASHER # 4	2190-0003
5	1	FLAT WASHER # 4	3050-0222
6	1	NUT 4-40	2260-0001
7	4	HEAT SINK TO-3	1205-0312
8	8	STAND OFF	0380-0745
9	8	TERMINAL E1-E8	0360-0294
10	1	XFORMER	9100-2951
11	4	XSTR (TO-3)	1854-0772

WIRE LIST		
RED	(LONG)	E7
RED	(SHORT)	E8
GREEN	(LONG)	E1
GREEN	(SHORT)	E2
WHITE	(LONG)	E6
WHITE	(SHORT)	E5
BLACK	(LONG)	E3
BLACK	(SHORT)	E4

A2 Inverter Assembly
5061-1344

A2 Inverter Assembly Parts List 5061-1344

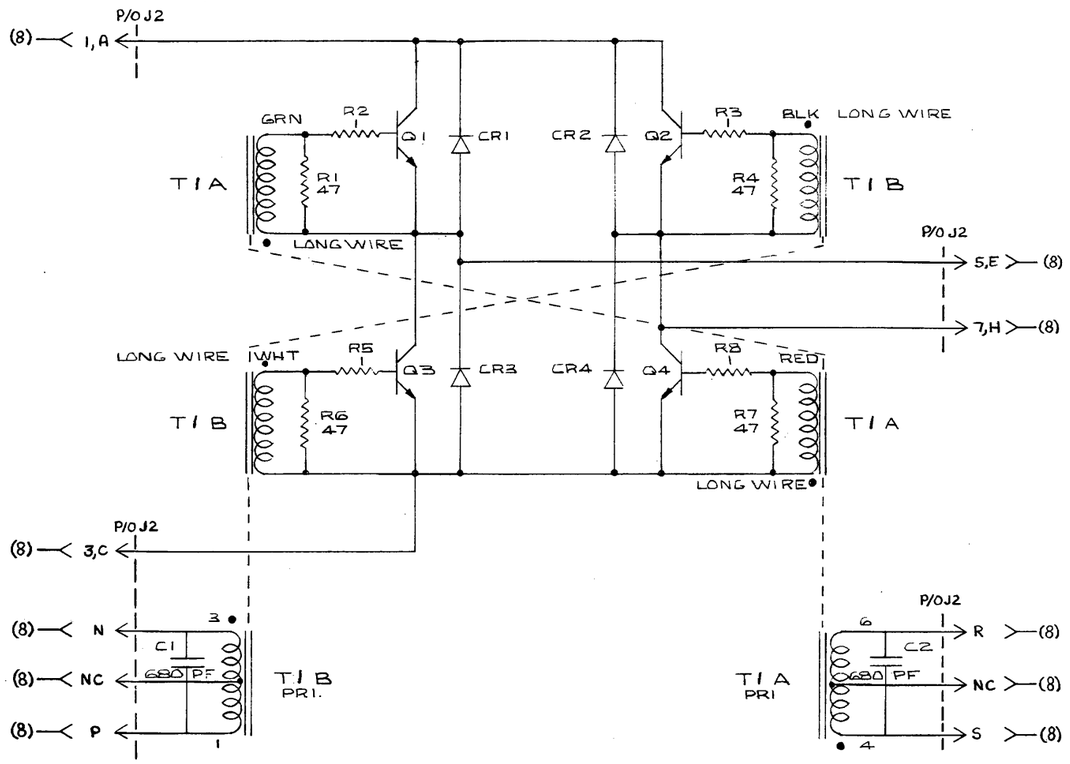
ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP OPTION	LOC	QUANTITY PER
01							
03							
		CAP 680PF 10%		0160-3573		U	2
00	C1,2						
		STUD SOLDER TERM		0360-0294		U	8
00	E1-8						
		SPCR TAP #6X.187		0380-0745		U	8
00	E9-16						
		RES 47 5% .25		0683-4705		U	4
01	R1,4,6,7						
		RES 1 10% .40W		0811-3438		U	4
01	R2,3,5,8						
		HEAT SINK		1205-0312		U	4
		XSTR TO3		1854-0772		U	4
01	Q1-4						
		DIODE IN4936		1901-1065		U	4
00	CR1-4						
		LKWSHR 4 HEL		2190-0003		U	1
		NUT 4-40 .250AF		2260-0001		U	1
		SCR #6-32X.437L		2360-0119		U	8
		WSHR #4 SS		3050-0222		U	1
		COMPOUND-THERMAL		6040-0239		U	0.01
		LABEL-AL COLOR		7120-5480		L	1
		XFORMER		9100-2951		U	1
00	T1						
		BOARD-ETCHED		5080-9796		W	1

ENGINEERING RESPONSIBILITY	SEPIA

0	1	2	3	4	5	6	7	8	9	10	11	12	14	15
16	17	18	19	20	21	22			33	34	38		42	43
		63			90			93						

C-5061-1344-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	RB	10/30/76
B	5959-32-4188-914,3,4 WERE 1854-0657- DATE CODE IS 1722.	RD	7-6-77

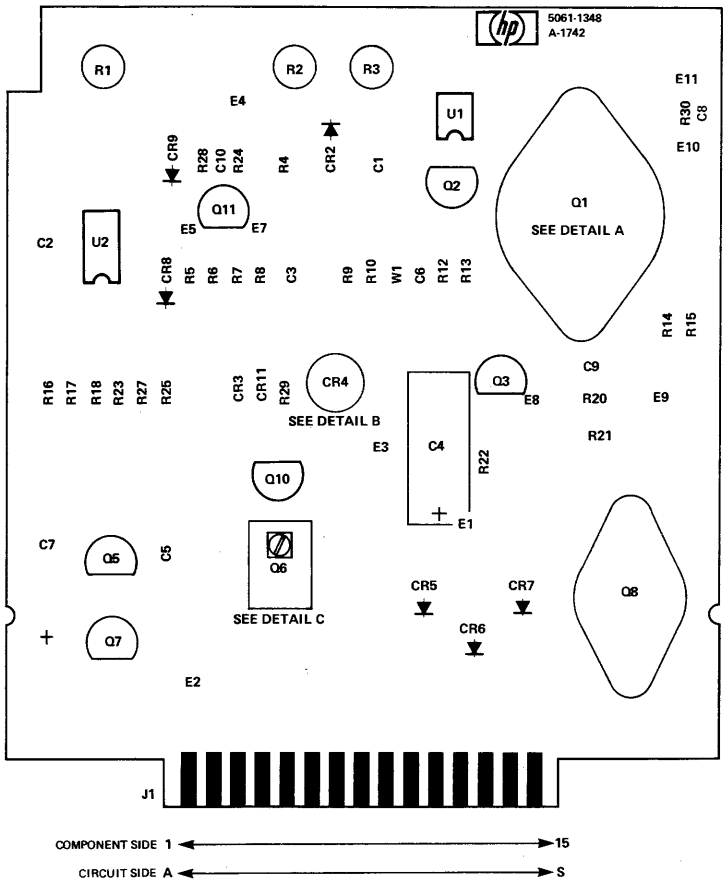


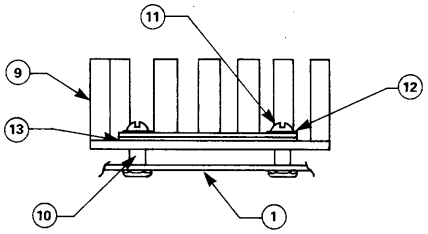
Sheet 3 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

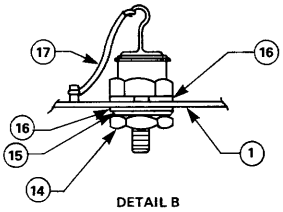
DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY J. DIXON	DATE 5-5-76	TITLE INVERTER BD. POWER SUPPLY A3A2	HEWLETT PACKARD
ENGINEER K. Check	10/26/76		
RELEASE TO PROD.	5-23-77	NEXT ASSEMBLY 5061-1356	PART NUMBER 5061-1344
SUPERSEDES DWG.		FINISH SCALE	C-5061-1344-51

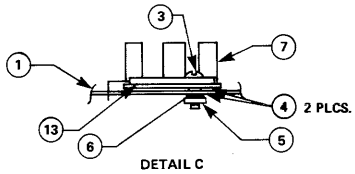




DETAIL A



DETAIL B



DETAIL C

ITEM	QTY.	MATERIAL DESCRIPTION	MAT'L-PART NO.
1	1	P.C. BOARD, ETCHED	5080-9800
2	3	TERMINAL, E1-3	0360-0294
3	2	#4-40 X 3/8 SCREW	2200-0143
4	2	#4-40 WASHER, FLAT	3050-0229
5	1	#4-40 NUT	2260-0001
6	1	#4-40 WASHER, LOCK	2190-0003
7	1	HEAT SINK	1205-0219
8			
9	1	HEAT SINK	1205-0289
10	4	SPACER	0380-0305
11	2	SCREW	2360-0199
12	4	WASHER, LOCK	2190-0851
13	1	THERMAL COMPOUND	6040-0239
14	1	NUT	2740-0002
15	1	WASHER, LOCK	2190-0034
16	2	WASHER, FLAT	3050-0236
17	1	WIRE 18 GA. YEL	8150-0577
18	2	SCREW	2360-0195
19	1	JUMPER W1	8159-0005
20	8	STUD SOLD. TERM. E4-E11	0360-0474
21	1	EYELET	0361-1076

A3 Battery Charger (PFRS) Assembly
5061-1348

A3 Battery Charger (PFRS) Assembly Parts List 5061-1348 (Sheet 1 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01							
03							
		CAP 0.1UF		0150-0121		U	1
01	C10						
		CAP .01UF		0160-2055		U	1
00	C1						
		CAPACITOR .01MF		0160-3451		U	2
01	C8,9						
		CAP 100UF 20%		0180-0098		U	1
01	C4						
		CAP 6.8UF 10%		0180-0116		U	1
00	C2						
		CAP 1UF 10%		0180-0291		U	3
01	C3,5,6						
		CAP 330UF 10%		0180-1714		U	1
00	C7						
		STUD SOLDER TERM		0360-0294		U	3
00	E1-3						
		STUD SOLDER TERM		0360-0474		U	8
01	E4-11						
		EYELET		0361-1076		U	1
		SPCR TAP #6X.125		0380-0305		U	4
		RES 470K 5% .25		0683-4745		U	1
00	R6						
		RES 2.15K 1%.125		0698-0084		U	1
00	R24						
		RES 2.61K 1%.125		0698-0085		U	1
00	R25						
		RES 3.83K 1%.125		0698-3153		U	1
00	R10						
		RES 23.7K 1%.125		0698-3158		U	1
00	R27						
		RES 26.1K 1%.125		0698-3159		U	1
00	R18						
		RES 46.4K 1%.125		0698-3162		U	2
00	R7,16						

A3 Battery Charger (PFRS) Assembly Parts List 5061-1348 (Sheet 2 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
00	R20	RES 348 1% .50		0698-3403		U	1
00	R29	RES 287 1%.125		0698-3443		U	1
00	R5	RES 261K 1%.125		0698-3455		U	1
01	R8	RES 287K 1%.125		0698-3456		U	1
00	R28	RES 1.21K 1%.125		0757-0274		U	1
00	R12	RES 3.16K 1%.125		0757-0279		U	1
00	R15	RES 1K 1%.125		0757-0280		U	1
00	R4,23	RES 1.33K 1%.125		0757-0317		U	2
00	R14	RES 100 1%.125		0757-0401		U	1
01	R13,22	RES 511 1%.125		0757-0416		U	2
00	R9	RES 750 1%.125		0757-0420		U	1
01	R17	RES 10K 1%.125		0757-0442		U	1
01	R30	RES 11K 1%.125		0757-0443		U	1
00	R21	RES .27 5% 2W		0811-1659		U	1
		HT DIS PL PWR		1205-0219		U	1
		HT DIS TO-3		1205-0289		U	1
00	Q6	IC 7808C		1826-0146		U	1
00	U2	I.C. MC 3302		1826-0174		U	1
00	U1	IC UA 741C		1826-0271		U	1

A3 Battery Charger (PFRS) Assembly Parts List 5061-1348 (Sheet 3 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01	Q3,5,11	XSTR 2N4403 TO92		1853-0271		U	3
00	Q1	XSTR 2N4398 TO3		1853-0421		U	1
00	Q8	XSTR 2N3766 TO66		1854-0259		U	1
01	Q2,7,10	XSTR 2N4401 TO92		1854-0467		U	3
01	CR8,11	DIODE SIL		1901-0040		U	2
00	CR4	DIODE		1901-1062		U	1
01	CR5-7	DIODE		1901-1086		U	3
00	CR3	DIODE		1902-0064		U	1
00	CR2	D10-ZNR 1N827		1902-0680		U	1
00	CR9	DIODE 2.37V 5%		1902-3002		U	1
00	R2	RES 5KOHM 10%		2100-3207		U	1
00	R3	RES VAR 500 OHM		2100-3351		U	1
01	R1	RES 50KOHM 10%		2100-3354		U	1
		LKWSHR 4 MEL		2190-0003		U	1
		LKWSHR 10 MEL		2190-0034		U	1
		LKWSHR 6 MEL		2190-0851		U	4
		SCR #4-40X.375L		2200-0143		U	2
		NUT 4-40 .250AF		2260-0001		U	1
		SCR #6-32X.312L		2360-0195		U	2
		SCR #6-32X.437L		2360-0199		U	2
		NUT 10-32 .375AF		2740-0002		U	1

A3 Battery Charger (PFRS) Assembly Parts List 5061-1348 (Sheet 4 of 4)

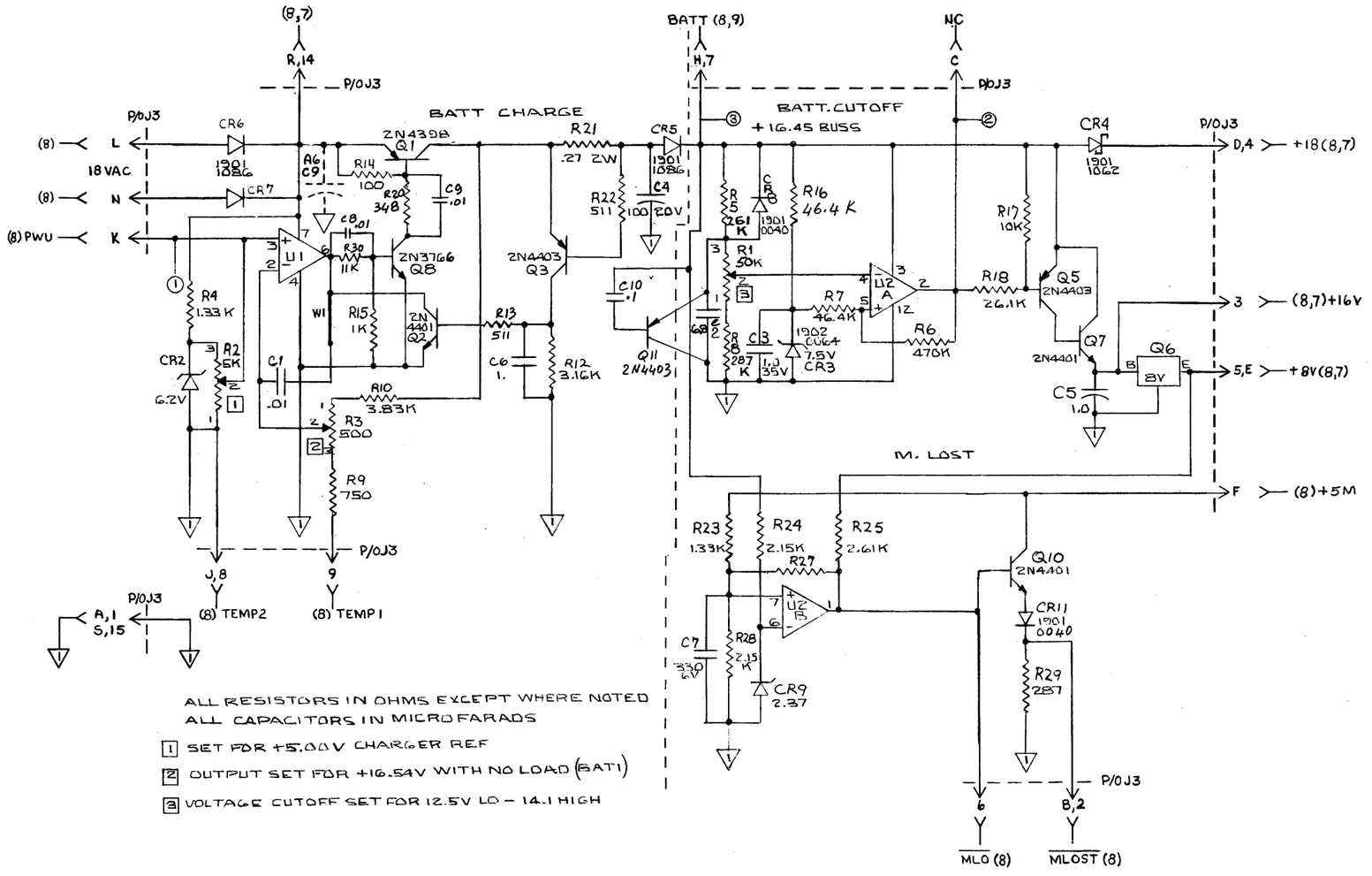
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		WSHR #4 SS		3050-0229		U	2
		WSHR #10 BRS		3050-0236		U	2
		COMPOUND-THERMAL		6040-0239		U	0.05
		LABEL-AL COLOR		7120-5480		L	1
		WIRE 18 YEL		8150-0577		U	0.15
		BOARD-ETCHED		5080-9800		W	1

ENGINEERING RESPONSIBILITY ◪ SEPIA ◪

0	1	2	3	4	5	6	7	8	9	10	11	12	14	15
16	17	18	19	20	21	22			33	34	38		42	43
		63			90			93						

C-5061-1348-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	RB	10/30/76
B	PCO-22-4318. CIRCUIT CHG. DATECODE 1742	CmA	10/9/77
C	PCO-22-4350 - ADD. C8, C9, C10, R11, R11 AND R30. DELETED CR1 & R11. DATE CODE IS 1742		11.14.77



ALL RESISTORS IN OHMS EXCEPT WHERE NOTED
ALL CAPACITORS IN MICROFARADS

[1] SET FOR +5.00V CHARGER REF

[2] OUTPUT SET FOR +16.54V WITH NO LOAD (BAT1)

[3] VOLTAGE CUTOFF SET FOR 12.5V LO – 14.1 HIGH

Sheet 6 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

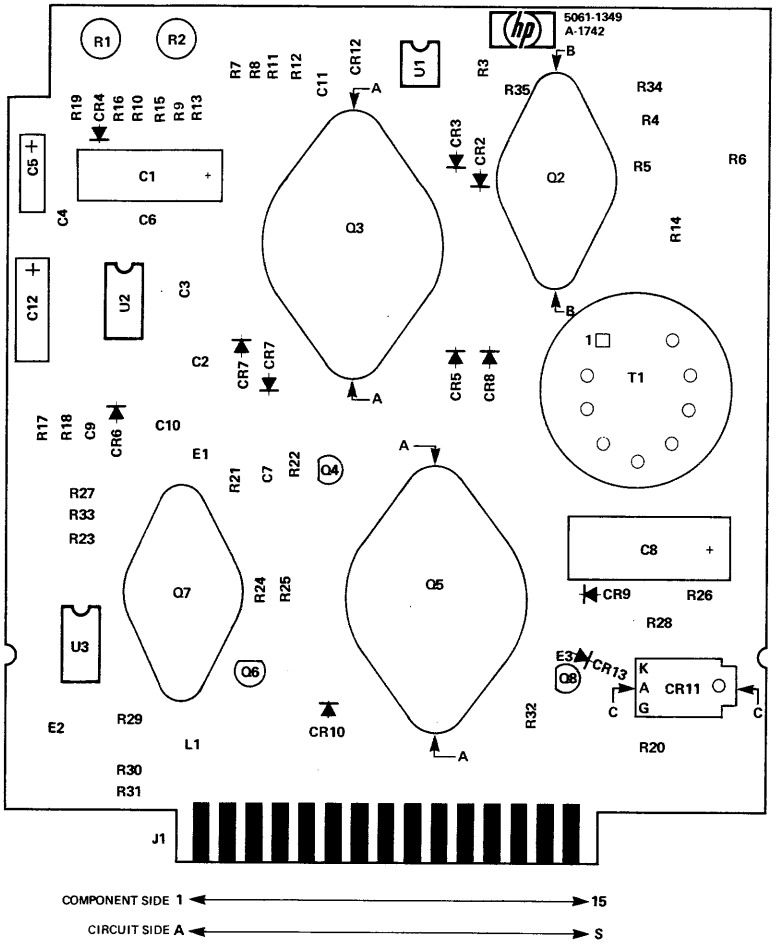
DRAWN BY J. DIXON	DATE 5-13-76	BATTERY CHARGER BOARD (PFRS) A3A3
ENGINEER	DATE 10/29/76	TITLE
RELEASE TO PROD.	DATE 5-23-77	12944B 12991B
SUPERSEDES DWG.		NEXT ASSEMBLY
		FINISH — SCALE —

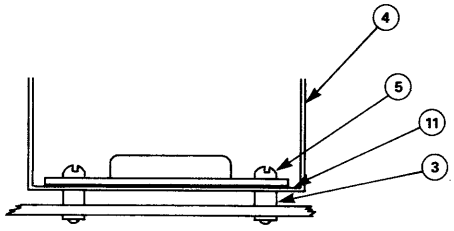
HEWLETT PACKARD

5061-1348
PART NUMBER
C-5061-1348-51

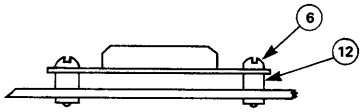
SHEET 1 OF 1

STOCK NO. 9280-0003 PRINTED ON DIEPO NO. 1020-10 CLEARPRINT FADEOUT

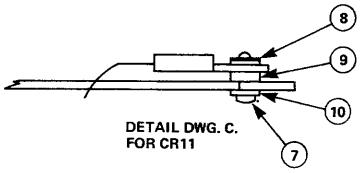




DETAIL DWG. A
FOR Q3, 5



DETAIL DWG. B.
FOR Q2, 7



DETAIL DWG. C.
FOR CR11

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	BOARD, ETCHED	5081-2301
2	2	TERMINAL E1, 2	0360-0124
3	4	SPACER	0380-0305
4	2	HEATSINK	1205-0289
5	4	SCREW 6-32 X .438	2360-0119
6	4	SCREW 4-40 X .312	2200-0105
7	1	SCREW	2200-0143
8	1	NUT	2260-0009
9	1	WASHER-FLAT	3050-0229
10	1	WASHER-FIBER	3050-0080
11	1	THERMAL-COMP	6040-0239
12	4	SPACER	0380-0886
13	1	EYELET	0361-1076
14	1	WIRE	8150-3426
15	1	TERMINAL E3	0360-0474

A4 Battery Backup Assembly
5061-1349

A4 Battery Backup Assembly Parts List 5061-1349 (Sheet 1 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01							
03							
		CAP .0022UF 10%		0160-0154		U	1
	00C7						
		CAP .1UF 20% 50V		0160-0576		U	3
	01C4,9,11						
		CAP 100PF 5%		0160-2204		U	1
	00C3						
		CAP 1500PF 5%		0160-2222		U	1
	00C10						
		CAP 5000PF 10%		0160-3458		U	1
	00C6						
		CAP .05UF-20+80%		0160-3460		U	1
	00C2						
		CAP 100UF 20%		0180-0098		U	2
	00C1,8						
		CAP 1UF 10%		0180-0291		U	1
	00C5						
		CAP 39UF 10%		0180-0393		U	1
	00C12						
		STUD SOLDER TERM		0360-0124		U	2
	00E1,2						
		STUD SOLDER TERM		0360-0474		U	1
	01E3						
		EYELET		0361-1076		U	1
		SPCR TAP #6X.125		0380-0385		U	4
		STANDOFF		0380-0886		U	4
		RES 2.7 5% .25		0683-0275		U	1
	00R25						
		RES 2.15K 1%.125		0698-0084		U	1
	00R16						
		RES 2.61K 1%.125		0698-0085		U	1
	00R9						
		RES 3.83K 1%.125		0698-3153		U	1
	00R10						
		RES 4.64K 1%.125		0698-3155		U	1
				PART NO CONT			

A4 Battery Backup Assembly Parts List 5061-1349 (Sheet 2 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX.	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PART NO CONT		0698-3155			
00	R19						
		RES 14.7K 1%.125		0698-3156		U	1
00	R12						
		RES 19.6K 1%.125		0698-3157		U	1
00	R7						
		RES 22 5% 2W		0698-3609		U	1
00	R28						
		RES 120 5% 2W		0698-3622		U	1
00	R6						
		RES 1K 1%.125		0757-0280		U	3
00	R4,34						
01	3						
		RES 42.2 1%.125		0757-0316		U	1
00	R26						
		RES 100 1%.125		0757-0401		U	2
01	R14,24						
		RES 511 1%.125		0757-0416		U	2
01	R22,32						
		RES 5.11K 1%.125		0757-0438		U	1
00	R33						
		RES 10K 1%.125		0757-0442		U	8
01	R8,17,18,21,23,27						
03	30,31						
		RES 20K 1%.125		0757-0449		U	1
00	R29						
		RES 51.1K 1%.125		0757-0458		U	1
00	R13						
		RES 100K 1%.125		0757-0465		U	1
00	R35						
		RES 1.47K 1%.125		0757-1094		U	2
00	R15,11						
		RES .05 10% 3W		0811-1826		U	1
00	R5						
		RES .1 3% 5W		0811-2490		U	1
00	R20						
		HT DIS TO-3		1205-0289		U	2

A4 Battery Backup Assembly Parts List 5061-1349 (Sheet 3 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
00	U2	IC V REG		1826-0049		U	1
00	U1	IC MC1458 P1		1826-0139		U	1
00	U3	I.C. MC 3302		1826-0174		U	1
00	Q7	XSTR 2N3740 TO66		1853-0052		U	1
00	Q4,6	XSTR 2N4403 TO92		1853-0271		U	2
00	Q3,5	XSTR 2N4398 TO3		1853-0421		U	2
00	Q2	XSTR 2N3766 TO66		1854-0259		U	1
00	Q8	XSTR 2N4401 TO92		1854-0467		U	1
00	CR12	SCR 2N5062		1884-0232		U	1
00	CR11	THYRISTOR SCR		1884-0233		U	1
01	CR1,3,4,7	RECTIFIER SIL		1901-0033		U	4
01	CR13	DIODE SIL		1901-0040		U	1
00	CR5	DIODE IN4936		1901-1065		U	1
00	CR10	DIODE		1901-1086		U	1
00	CR8	RECTIFIER		1901-1087		U	1
00	CR9	DIODE 6.19V		1902-0049		U	1
00	CR6	DIODE 3.83V		1902-3059		U	1
00	CR2	DIODE 4.64V		1902-3082		U	1
		RES VAR 500 OHM		2100-3351 PART NO CONT		U	1

A4 Battery Backup Assembly Parts List 5061-1349 (Sheet 4 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PART NO CONT		2100-3351			
00	R2						
		RES VAR 1K 10%		2100-3352		U	1
00	R1						
		SCR 4-40X.312		2200-0105		U	4
		SCR #4-40X.375L		2200-0143		U	1
		NUT 4-40 W/LK		2260-0009		U	1
		SCR #6-32X.437L		2360-0119		U	4
		WSHR #5		3050-0080		U	1
		WSHR #4 SS		3050-0229		U	1
		COMPOUND-THERMAL		6040-0239		U	0.05
		LABEL-AL COLOR		7120-5480		L	1
		WIRE 30AWG WHT		8150-3426		U	0.10
		XFORMER-PULSE		9100-0669		U	1
00	T1						
		COIL CHK 3300UH		9100-1665		U	1
00	L1						
		BOARD-ETCHED		5081-2301		W	1

ENGINEERING RESPONSIBILITY / SEPIA

0	1	2	3	4	5	6	7	8	9	10	11	12	14	15
16	17	18	19	20	21	22			33	34	38		42	43
		63			90			93						

C-5061-1349-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	JMF/RB	12/8/76
B	PCO-77-4350 ADD. CR13 - DATE CODES 1742	JMF/RB	11-14-77

(8,6) R,14 — P/OJ4 — CR10 1901-1086 — P/OJ4 — (8,6)+18V → D, 4

-12 VM (8) — P/OJ4 — CR5 1801 1065 — C8 100 20V

Q5 2N4398 — R24 100 — CR7 1901-0033 — R22 511 — CR8 1901-1087 — T1 (8 7 2 3 4) — R20 1 5W

R21 10K — C7 .0022 — 2N4403 Q4 — R25 2.7 kW — Q7 2N3740 — L1 3.3 MH — 2N4403 Q6

A6C11 3600 25V

AG C10 5600 4F 6.3V — CR9 6.19V — CR11 1884 0233 — R26 42.2 — R28 22 2W

P/OJ4 → F,6 → +5M(8,5,6)

+8V 20KHZ OSC.

P/OJ4 (8,7) → E

R27 10K — R30 10K — C9 .1 — R31 10K — U3 A — R17 10K — R29 20K — C10 1500 PF

CR6 1902 3053 — R33 5.11K — U3 B — Q8 2N4401 — R23 10K

+8V — VREF +16V — R32 511 — 39 PF — R16 2.51K — C3 100 PF — C4 .1 — 1824-0049 U2 — R18 10K — C6 .005 — CR4 1901-0033

CR13 1901-0040 — R1 1.1K — R19 4.64K — C5 1. 35V

TP (2) P/OJ4 — 5 NC — +12.5V REG

(6) +16V — 3,C P/OJ4

V REF — R9 2.61K — R7 19.6K — C2 .05 — R13 51.1K — +12.5V SET — R2 500 — R10 3.83K — R8 10K — U1 A

CR12 1884 3232E — CR2 1N6230 — C11 .1 — R11 1.47K — R12 14.7K — R4 1K

TP (1) — +18V — R14 100 — Q3 2N4398 — R6 100 5W — Q2 2N3766 — CR3 1901 0033 — R5 .05 2W — 1K R3 — R35 100K — CR1 1901-0033 — +8V

P/OJ4 P,13 → +12.5VM(8)

U1 B — A6C7 1000 16V — 14.7V A6 CR3 — A6 CR4 1884 0233 — R34 42.2 — A6C8 .01 — C1 100 25V

NOTES:
1. ALL RESISTORS IN OHMS EXCEPT WHERE SHOWN
2. ALL CAPACITORS IN MICROFARADS EXCEPT WHERE SHOWN

Sheet 7 of 9

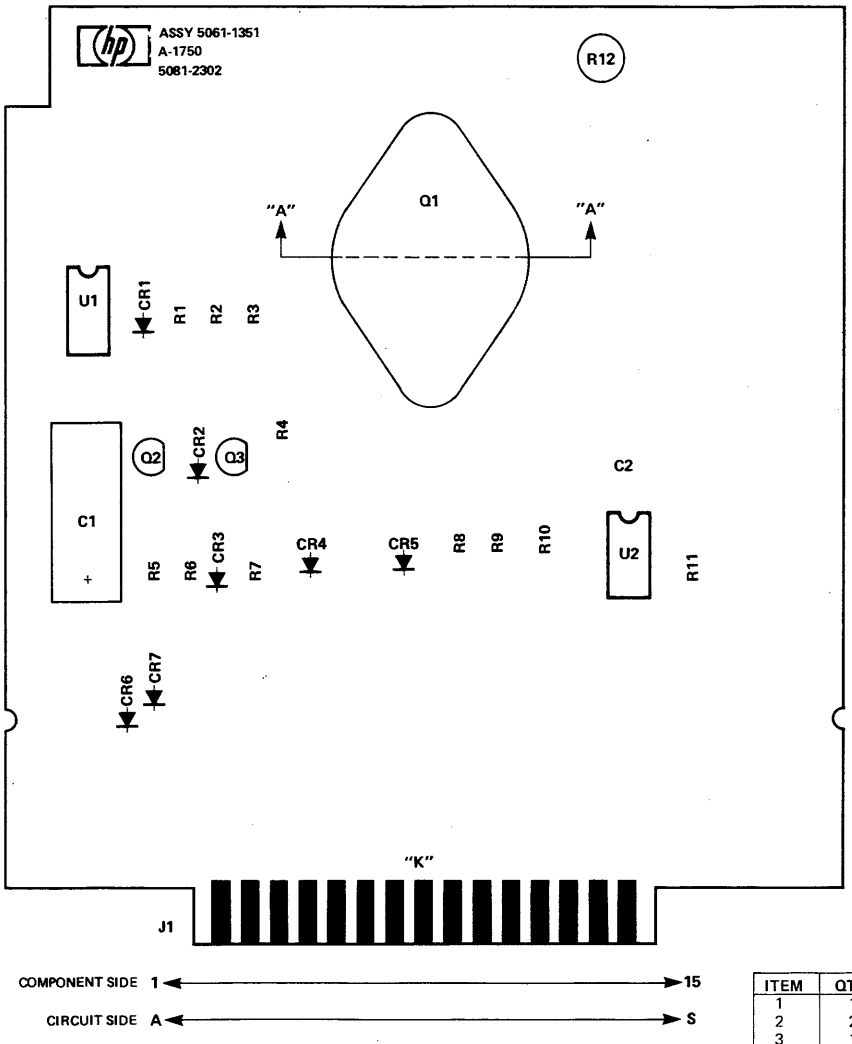
ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

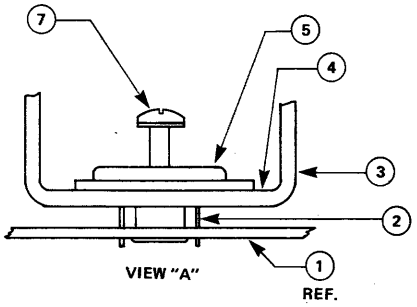
DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY J. DIXON	5-24-76 DATE	BATTERY BACKUP BOARD A3A4 PFRS — TITLE
ENGINEER K. Check	1-5-77	HEWLETT PACKARD
RELEASED TO PROD. Dan Dupa	5-23-77	12944B, 12991B NEXT ASSEMBLY
SUPERSEDES DWG.		FINISH — SCALE —
		5061-1349 PART NUMBER
		C-5061-1349-51

STOCK NO. 8280-0003 PRINTED ON DIEPO NO. 1020-10 CLEARPRINT FADEOUT

SHEET OF





ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	P.C. BOARD – ETCHED	5081-2302
2	2	SPACER 6-32 X .125	0380-0342
3	1	HEAT SINK TO-3	1205-0289
4	1	THERMAL COMPOUND	6040-0239
5	1	TRANSISTOR Q1	1853-0421
6		NOT USED	
7	2	SCREW 6-32 X .375	2360-0359

A4 Jumper Board Assembly
5061-1351

A4 Jumper Board Assembly Parts List 5061-1351 (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01		)					
03		)					
		CAP 100PF 5%		0160-2204		U	1
00	C2						
		CAP 330UF 10%		0180-1714		U	1
00	C1						
		EYELET		0361-1076		U	2
		SPCR TAP #6X.125		0380-0342		U	2
		RES 2.15K 1%.125		0698-0084		U	3
01	R1,2,5						
		RES 3.83K 1%.125		0698-3153		U	1
00	R9						
		RES 287 1%.125		0698-3443		U	1
00	R7						
		RES 61.9 1%.125		0757-0276		U	1
00	R11						
		RES 1.33K 1%.125		0757-0317		U	1
00	R6						
		RES 5.11K 1%.125		0757-0438		U	2
00	R3,8						
		RES 10K 1%.125		0757-0442		U	1
00	R4						
		RES .27 5% 2W		0811-1659		U	1
00	R10						
		HT DIS TO-3		1205-0289		U	1
		IC V REG		1826-0049		U	1
00	U2						
		I.C. MC 3302		1826-0174		U	1
00	U1						
		XSTR 2N4403 TO92		1853-0271		U	1
00	Q2						
		XSTR 2N4398 TO3		1853-0421		U	1
00	Q1						
		XSTR 2N4401 TO92		1854-0467		U	1
00	Q3						
		DIODE SIL		1901-0040		U	3

PART NO CONT

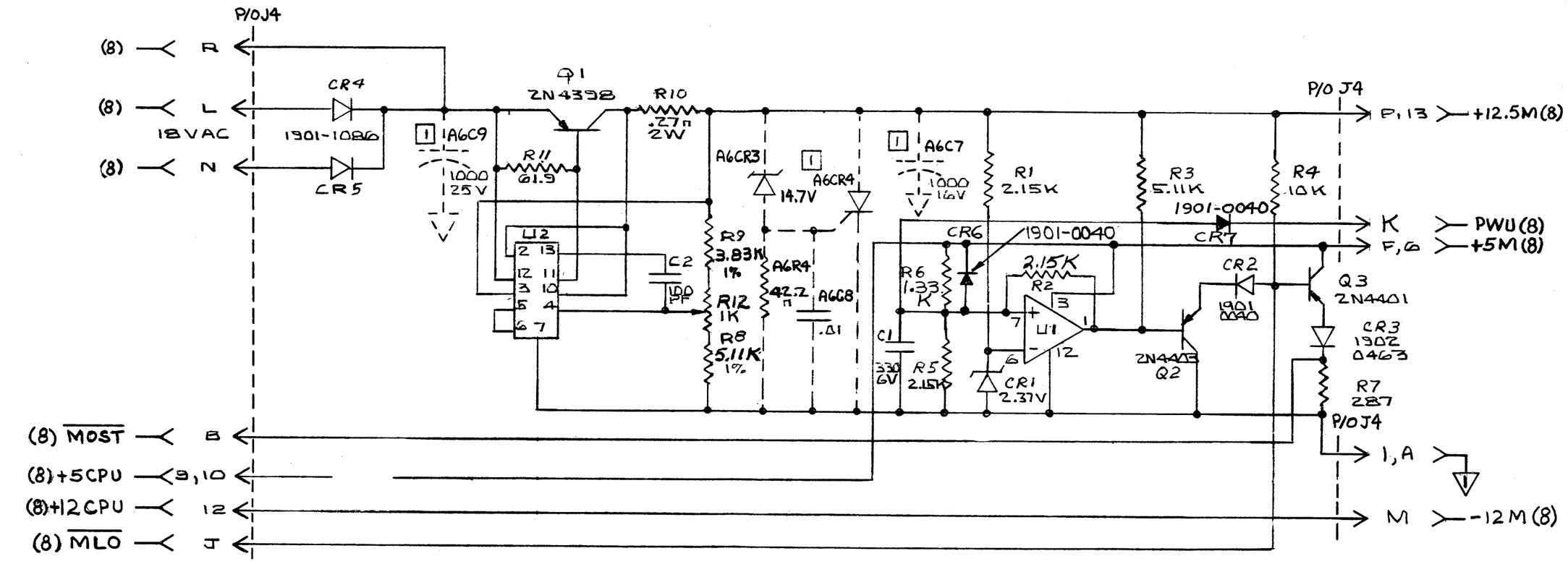
A4 Jumper Board Assembly Parts List 5061-1351 (Sheet 2 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01	CR2,6,7	PART NO CONT		1901-0040			
00	CR3	DIODE SILICONE		1901-0463		U	1
00	CR4,5	DIODE		1901-1086		U	2
00	CR1	DIODE 2.37V 5%		1902-3002		U	1
00	R12	RES VAR 1K 10%		2100-3352		U	1
00	F1	FUSE 6A NB		2110-0056		U	1
		FUSE CLIP .250D		2110-0269		U	2
		SCR 6-32X.375		2360-0359		U	2
		COMPOUND-THERMAL		6040-0239		U	0.01
		LABEL-AL COLOR		7120-5480		L	1
		WIRE 30AWG WHT		8150-3426		U	0.25
		BOARD-ETCHED		5081-2302		W	1

ENGINEERING RESPONSIBILITY															SEPIA
0	1	2	3	4	5	6	7	8	9	10	11	12	14	15	
16	17	18	19	20	21	22			33	34	38		42	43	
		63			90			93							

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	[illegible]	10/30/76
B	CHANGED R2 From 23.7K TO 2.15K PRCR C	[illegible]	5/20/77

B-5061-1351-51



NOTES:

[1] COMPONENTS IN BROKEN LINE ARE LOCATED ON MOTHER BD.

Sheet 4 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY J.DIXON	DATE 5-28-76	
ENGINEER K. Check	5-14-76	
RELEASE TO PROD. Doug Dyke	5-23-77	
SUPERSEDES DWG.		

TITLE: JUMPER BOARD POWER SUPPLY A3A4

5061-1356 NEXT ASSEMBLY

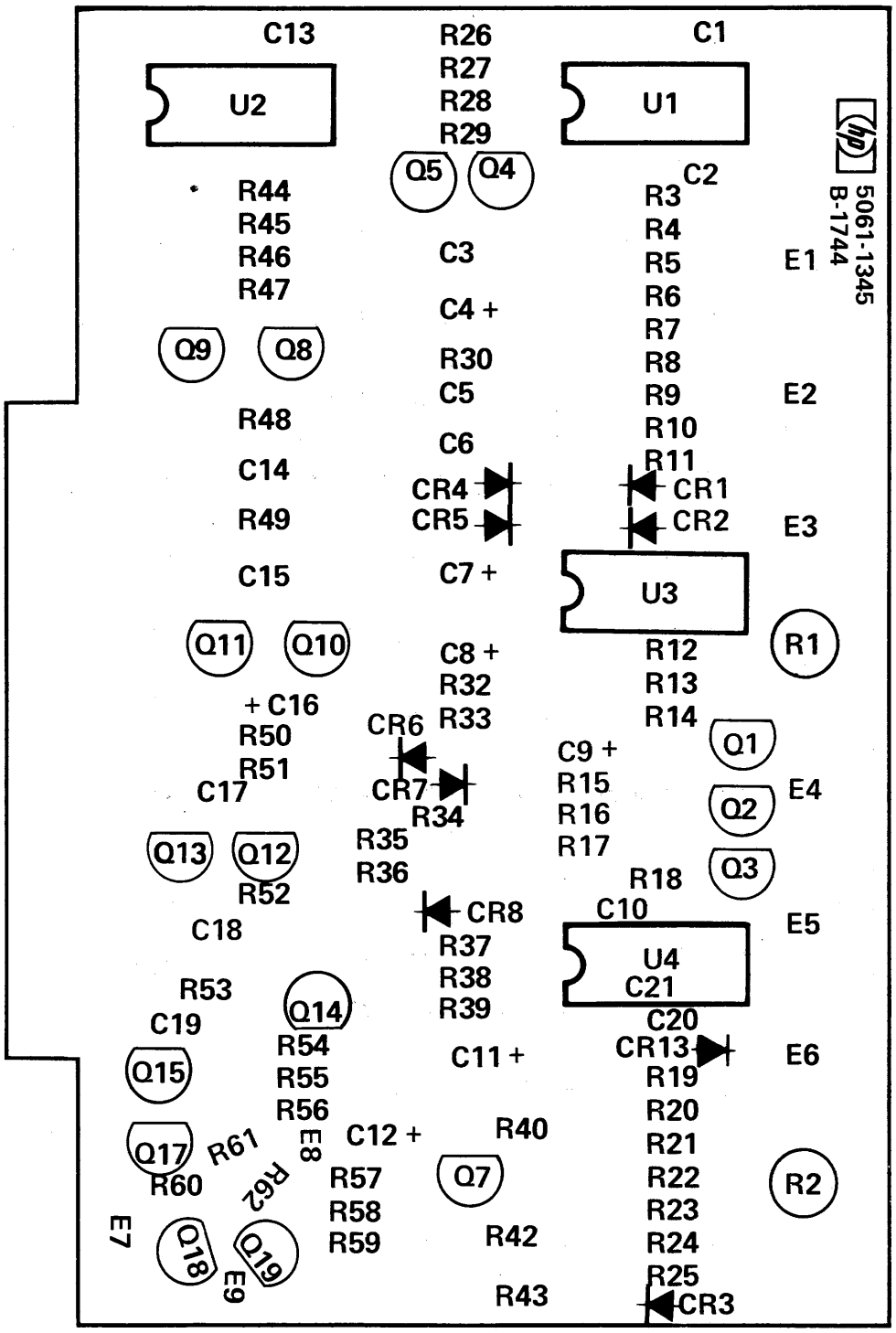
FINISH ~~FINISH~~ SCALE ~~SCALE~~

HEWLETT hp PACKARD

PART NUMBER 5061-1351

B-5061-1351-51

SHEET 1 OF 1



A5 Control Board Assembly
5061-1345

A5 Control Board Assembly Parts List 5061-1345 (Sheet 1 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	L O C	QUANTITY PER
01 03							
01	C1,5,10,13	CAP 0.1UF		0150-0121		U	4
01	C14,15	CAP .47UF-20+80%		0160-0174		U	2
01	C6	CAP .047UF 20%		0160-0575		U	1
01	C17-21	CAP .01UF		0160-2055		U	5
00	C2	CAP 2000PF 5%		0160-2225		U	1
01	C7	CAP 4.7UF 35WVDC		0180-0100		U	1
01	C9,11,16	CAP 2.2UF 10%		0180-0197		U	3
00	C8	CAP .68UF 10%		0180-0373		U	1
00	C3	C-F 56UF 6VDC		0180-0548		U	1
00	C12	CAP 6.8UF 20%		0180-1701		U	1
00	C4	CAP 120UF 10%		0180-2145		U	1
00	E1-6	STUD SOLDER TERM		0360-0294		U	6
01	E7-9	STUD SOLDER TERM		0360-0474		U	3
		EYELET		0361-1076		U	5
00	R60	RES 220 5% .25		0683-2215		U	1
00	R40	RES 47 5% .25		0683-4705		U	1
01	R4-7,9,30,37,54	RES 2.15K 1%.125		0698-0084		U	8
		RES 2.61K 1%.125		0698-0085		U	2
				PART NO CONT			

A5 Control Board Assembly Parts List 5061-1345 (Sheet 2 of 4)

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PART NO CONT		0698-0085			
01	R23,59						
		RES 2.37K 1%.125		0698-3150		U	1
01	R20						
		RES 2.87K 1%.125		0698-3151		U	1
00	R8						
		RES 3.83K 1%.125		0698-3153		U	2
01	R15,36						
		RES 4.22K 1%.125		0698-3154		U	1
01	R24						
		RES 4.64K 1%.125		0698-3155		U	2
01	R12,35						
		RES 14.7K 1%.125		0698-3156		U	2
01	R21,58						
		RES 26.1K 1%.125		0698-3159		U	1
00	R56						
		RES 14.7 1% .5W		0698-3388		U	2
01	R48,49						
		RES 383 1%.125		0698-3446		U	2
01	R44,46						
		RES 46.4 1%.125		0698-4037		U	2
01	R45,47						
		RES 1.21K 1%.125		0757-0274		U	1
00	R57						
		RES 1.78K 1%.125		0757-0278		U	2
01	R17,19						
		RES 3.16K 1%.125		0757-0279		U	1
00	R32						
		RES 1K 1%.125		0757-0280		U	10
01	R10,11,22,25,26,						
03	28,33,50,61,62						
		RES 1.33K 1%.125		0757-0317		U	1
00	R42						
		RES 75 1%.125		0757-0398		U	1
00	R27						
		RES 100 1%.125		0757-0401		U	1
00	R29						

A5 Control Board Assembly Parts List 5061-1345 (Sheet 3 of 4)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01	R34,51-53	RES 511 1%.125		0757-0416		U	4
00	R43	RES 562 1%.125		0757-0417		U	1
01	R14,18,55	RES 5.11K 1%.125		0757-0438		U	3
00	R3	RES 7.5K 1%.125		0757-0440		U	1
00	R39	RES 10K 1%.125		0757-0442		U	1
00	R16	RES 11K 1%.125		0757-0443		U	1
01	R13,38	RES 1.47K 1%.125		0757-1094		U	2
00	U2	IC SN74S112N		1820-0629		U	1
00	U3	IC V REG		1826-0049		U	1
00	U1,4	IC QUAD COMPTR		1826-0138		U	2
01	Q1,2,15,18,19	XSTR 2N4403 TO92		1853-0271		U	5
01	Q3-5,7-14,17	XSTR 2N4401 TO92		1854-0467		U	12
01	CR3-5,7,13	DIODE SIL		1901-0040		U	5
01	CR8,35	DIODE SILICONE		1901-0463		U	1
00	CR6	DIODE SILICON		1901-0539		U	1
00	CR1	DIODE ZNR 5.11V		1902-0041		U	1
00	CR2	DIODE 2.61V		1902-0126		U	1
00	R1,2	RES VAR 1K		2100-1986		U	2
		LABEL-AL COLOR		7120-5480		L	1

A5 Control Board Assembly Parts List 5061-1345 (Sheet 4 of 4)

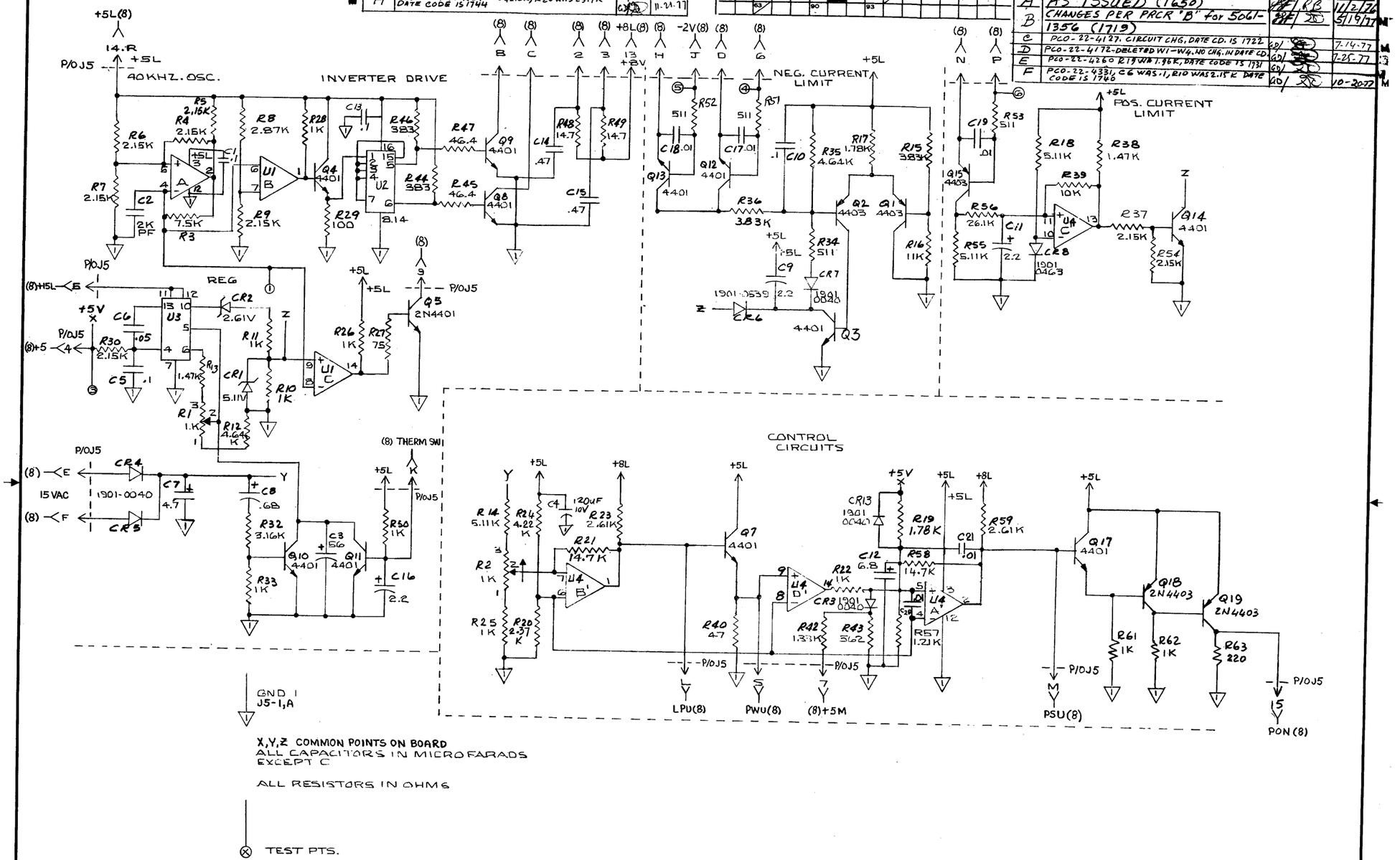
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		BOARD-ETCHED		5080-9797		W	1

REVISIONS			
G	PCO-22-4350 - ADD. C21, R61, R62, Q18 & Q19 - DATE CODE IS 1742	CD	11-14-77
H	PCO-22-4376 - R24 WAS 42.2K; R20 WAS 23.7K DATE CODE IS 1744	CD	11-21-77

ENGINEERING RESPONSIBILITY — SEPIA

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED (1650)		11/2/76
B	CHANGES PER PRCR "B" for 5061-1356 (1719)		5/19/77
C	PCO-22-4127. CIRCUIT CHG, DATE CD. IS 1722	CD	7-14-77
D	PCO-22-4172-DELETED W1-W4, NO CHG. IN DATE CD.	CD	7-25-77
E	PCO-22-4260 R19 WAS 1.96K, DATE CODE IS 1731	CD	
F	PCO-22-4331, C6 WAS .1, R10 WAS 2.15K DATE CODE IS 1740	CD	10-2077

C-5061-1345-51



ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

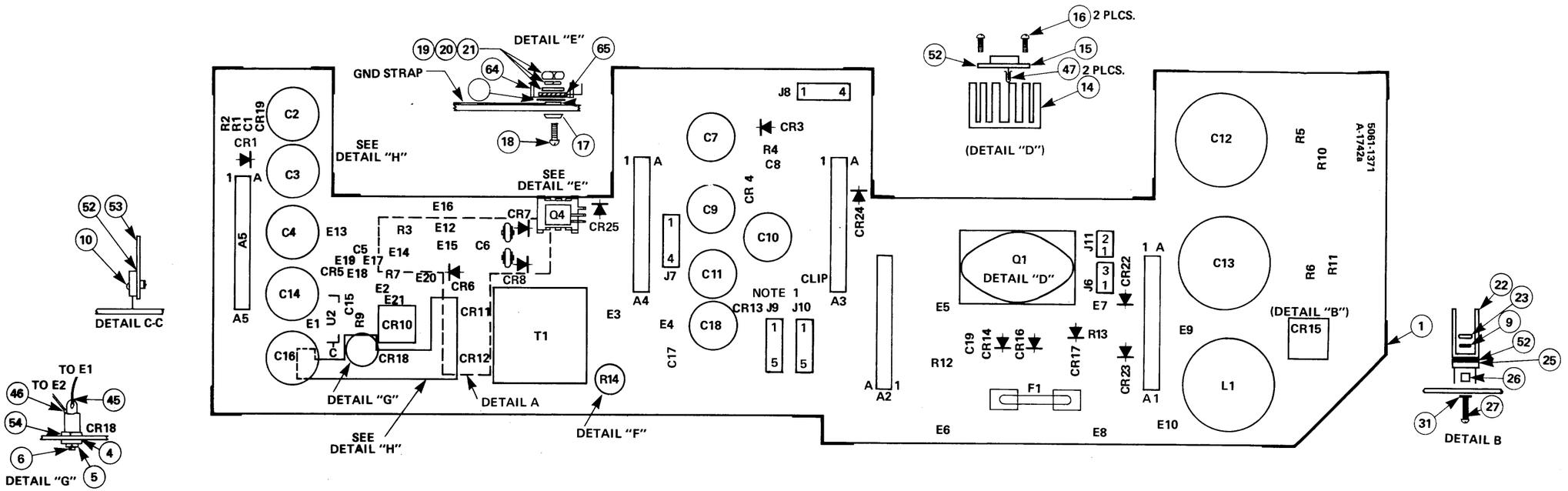
Sheet 5 of 9

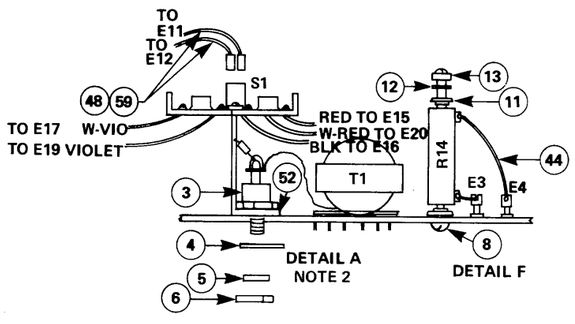
DO NOT SCALE THIS DRAWING
UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

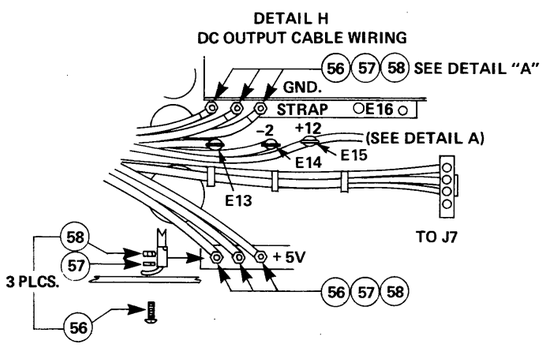
DRAWN BY J. DIXON	DATE 5-23-76	CONTROL BOARD POWER SUPPLY A3A5	HEWLETT PACKARD
ENGINEER K. Creek	11-5-76	TITLE	
RELEASE TO PROD.	6-3-77	NEXT ASSEMBLY 5061-1356	PART NUMBER 5061-1345
SUPERSEDES DWG.		FINISH — SCALE —	C-5061-1345-51

STOCK NO. 9280-0003 PRINTED ON DIEPO NO. 1020-10 CLEARPRINT FADEOUT

SHEET 1 OF 1





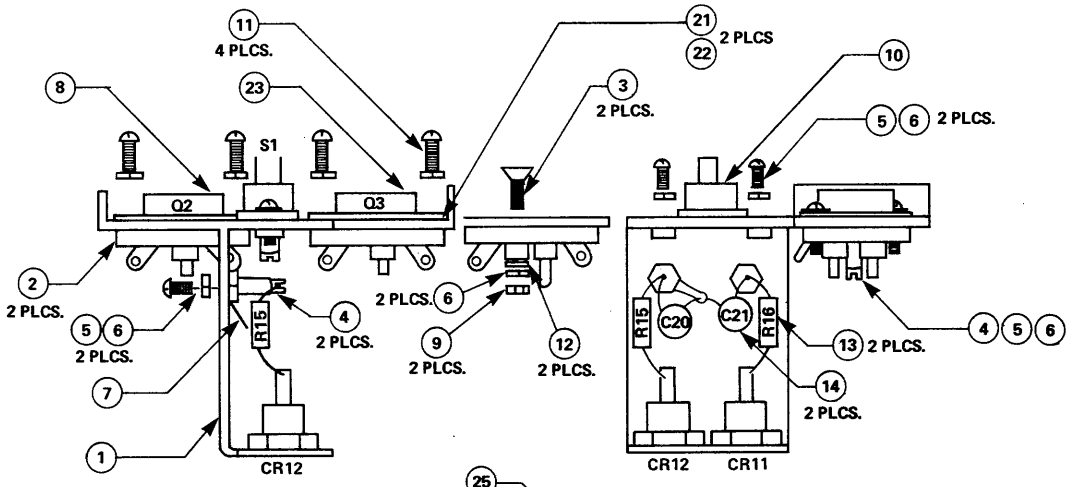


NOTES:
1. F2 NOT SUPPLIED (REFER TO INSTALLATION MANUAL.
2. SEE 5061-1371 ASSEMBLY FOR ADDITIONAL DETAIL.

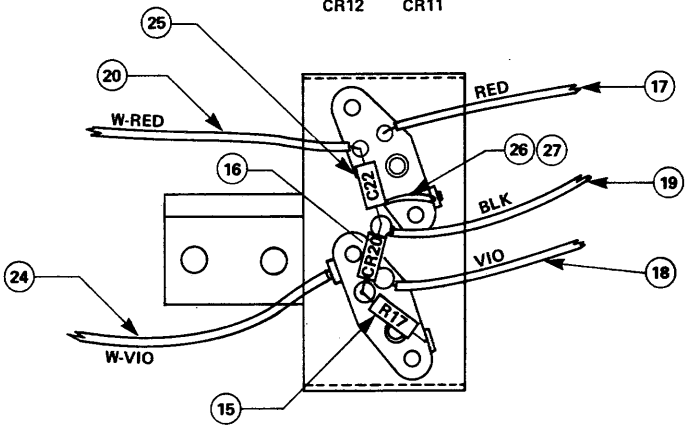
ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
35	1	NUT HEX # 10	2740-0002
36	3	LUG FASTON	0360-1685
37	3	RIVET	0361-1032
38	2	SPACER	0380-0383
39	5	TERMINAL	0360-0390
40	1	TERMINAL	0360-1167
41	18	EYELETS	0361-0252
42	4	FUSE CLIP	2110-0269
43	12	TERMINAL	0360-1529
44	3½"	WIRE BLUE 18GA	8150-2893
45	2500	WIRE YEL 18GA	8150-0577
46	2"	WIRE GRN 22 GA	8150-1545
47	2	CONNECTOR, PIN TYPE	1251-2913
48	2	LUG-FASTON	0362-0480
49	0.75'	WIRE 30 GA	8150-3426
50	0.33'	WIRE 22 GA	8151-0013
51	0.33'	SLEEVING	0890-0212
52	.010Z	THERMAL COMPOUND	6040-0239
53	1	HEAT SINK	5001-2617
54	1	SPACER	3050-0234
55	1	LKWSHR # 10 INT	2190-0011
56	6	SCREW 6-32 X .375	2360-0197
57	6	SPLIT LOCK # 6	2190-0851
58	6	NUT # 6	2420-0003
59	.95'	WIRE 22 GA. BLUE	8150-1546
60	1	GND STRAP	5001-2622
61	1	+5V STRAP	5001-2621
62	1	ASSY-WIRING	5061-1362
63	3	TERMINAL E17, 19, 20	0360-1869
64	1	HEAT SINK	1205-0219
65	1	TRANSISTOR	1854-0768
66	1	DIODE CR 25	1901-0463
67	6"	WIRE-WHT/VIOL	8150-2650
68	4"	WIRE-BLK	8150-2890

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	BOARD P.C.	5080-9798
2	4	PAD-FOAM	4208-0171
3	2	DIODE	1901-0727
4	3	WASHER FIBRE	3050-0665
5	3	LOCK WASHER SPLIT	2190-0032
6	3	NUT HEX	2950-0036
7	10	SCREW 4-40	2200-0143
8	1	SCREW 6-32 X 2.500	2360-0221
9	12	LOCK WASHER SPLIT 4	2190-0003
10	2	SCREW 4-40 X .250	2200-0139
11	2	EXTRUDED WASHER	3050-0006
12	1	WASHER, FLAT	3050-0100
13	1	NUT, HEX	2420-0001
14	1	HEAT SINK	1205-0312
15	1	TRANSISTOR	1854-0718
16	2	SCREW	2360-0117
17	1	WSHR	3050-0239
18	1	SCREW 6-32 X .625 LG	2360-0203
19	1	WASHER FLAT	3050-0228
20	1	WASHER LOCK SPLIT	2190-0851
21	1	NUT HEX 6-32	2420-0003
22	2	HEAT SINK	5001-2808
23	2	NUT HEX	2260-0001
24	2	EYELET	0361-1076
25	1	BRIDGE DIODE	1906-0080
26	2	SPACER NYLON	0380-0996
27	2	SCREW 4-40 X .750	2200-0151
28	10	CARD HOLDERS	5040-0170
29	11	SCREW 4-40 X .250	2200-0139
30	11	LOCK WASHER SPLIT # 4	2190-0003
31	2	WASHER-LOCK	2190-0078
32	4	SCREW 10-32 X .375	2680-0099
33	4	LOCK WASHER SPLIT # 10	2190-0034
34	5	WASHER FLAT # 10	3050-0236

A6 Mother Board Assembly
5061-1371-1



ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.
1	1	HEAT SINK	5001-2616
2	2	SOCKET XSISTOR	1200-0452
3	2	SCREW 4-40 X .500 FH	2200-0169
4	3	STANDOFF	0360-0279
5	5	SCREW 4-40 X .250	2200-0103
6	2	LOCKWASHER SPLIT 4	2190-0108
7	1	LUG SOLDER	0360-0272
8	1	TRANSISTOR	1853-0351
9	2	NUT HEX NO. 4	2260-0002
10	1	THERMO SWITCH	3103-0051
11	4	SCREW 6-32 X .500	2360-0123
12	2	WASHER-FLAT	3050-0229
13	2	RESISTOR 100 V2W	0757-0198
14	2	CAP .01	0160-2055
15	1	RESISTOR 150 1/4 W	0683-1515
16	1	DIODE ZENER 13.3V	1902-3193
17	3.25"	WIRE RED 18GA	8150-2891
18	3.25"	WIRE VIO 18GA	8150-2894
19	3.00"	WIRE BLK 18GA	8150-2890
20	3.25"	WIRE W-R 18	8150-2649
21	2	INSULATOR	1200-0043
22	.01TB	THERMAL COMPOUND	6040-0239
23	1	VOLTAGE REGULATOR	1813-0093
24	3.25"	WIRE W-VIO 18	8150-2650
25	1	CAP. 100 μF	0180-2840
26	0.15'	WIRE-BUSS 18 GA.	8151-0011
27	0.07'	SLEEVING	0890-0064



BOTTOM VIEW WIRING

A6 Mother Board Assembly
5061-1371-2

A6 Mother Board Assembly Parts List 5061-1371 (Sheet 1 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01 03							
01	C20,21	CAP .01UF-20+80%		0150-0093		U	2
01	C17,19	CAP .01UF 20%		0150-0123		U	2
01	C1,6,8,15	CAP .01UF		0160-2055		U	4
01	C12,13	CAP 1150UF		0180-0431		U	2
00	C5	CAP 120UF 10%		0180-2145		U	1
00	C2	CAP 10KUF 6.3V		0180-2652		U	1
00	C18	CAP 750UF 40V		0180-2653		U	1
00	C10	CAP 5600UF 6.3V		0180-2654		U	1
00	C7,9	CAP 1000UF 25V		0180-2656		U	2
00	C4	CAP 8200UF 16V		0180-2657		U	1
00	C11,14	CAP 3600UF 25V		0180-2658		U	2
00	C16	CAP 18KUF 6.3V		0180-2659		U	1
01	C22	CAPACITOR-FIXED		0180-2840		U	1
01	C3	CAPACITOR-FIXED		0180-2882		U	1
01	E2,11,12,17-21	STUD SOLDER		0360-0090		U	5
		TERM-SOLDER LUG		0360-0272		U	1
		STUD SOLDER TERM		0360-0279		U	3
00	E1	TERM DBL-TUR		0360-1167		U	1

A6 Mother Board Assembly Parts List 5061-1371 (Sheet 2 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01	E3-10,13-16	TERM STUD FKD		0360-1529		U	12
		LUG SOLDER #5		0360-1685		U	3
01	E17,19,20	TERMINAL-STUD		0360-1869		U	3
		EYLT RLD FLG		0361-0252		U	18
		EYLT .121DX.200		0361-1032		U	3
		EYELET		0361-1076		U	2
		LUG CRP26-24.19F		0362-0480		U	2
		SPCR TAP #6X.125		0380-0383		U	2
		SPACER #4X.125		0380-0996		U	2
01	R17	RES 240 5% .25		0683-2415		U	1
01	R15,16	RES 100 1% .50		0757-0198		U	2
01	R1,4,8,9	RES 42.2 1%.125		0757-0316		U	4
01	R10,11	RES 22K 5% 2W MO		0764-0045		U	2
00	R7	RES .125 OHM		0811-1846		U	1
00	R12	RES 5K 5% 10W PW		0811-1914		U	1
00	R3	RES .07 5% 5W PW		0811-3174		U	1
00	R13	RES .25 5% 10W		0811-3176		U	1
00	R2	RES 0.18 OHM WW		0811-3293		U	1
00	R14	RES 50 5% 20W PW		0819-0022		U	1
00	R5,6	THERMISTOR		0837-0130		U	2
		SLEEVING FLEX.		0890-0064		U	0.07

A6 Mother Board Assembly Parts List 5061-1371 (Sheet 3 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		TBG #20 TFE NAT		0890-0212		U	0.33
		INSL-XSTR TO3 AL		1200-0043		U	2
		SOCKET TO-3		1200-0452		U	2
		HT DIS PL PWR		1205-0219		U	1
		HEAT SINK		1205-0312		U	1
00	J1-5	CONN PC2X15.156D		1251-2035		U	5
		CONNECTOR; SGL		1251-2913		U	2
00	J9,10	CONN MALE 5 POST		1251-3825		U	2
00	J7,8	CONN UTIL 4PIN M		1251-3837		U	2
00	J11	CONN POST 2POS M		1251-4245		U	1
00	J6	CONN POST 3POS M		1251-4246		U	1
00	Q3	VOLTAGE REGLTR		1813-0093		U	1
00	U1	IC RGLTR +5V		1826-0144		U	1
00	U2	IC 7808C		1826-0146		U	1
00	Q2	XSTR 2N6053 TO3		1853-0351		U	1
00	Q1	XSTR 2N6251 TO-3		1854-0718		U	1
		XSTR NPN SI		1854-0768		U	1
00	CR18	THYRISTOR 35AMPS		1884-0208		U	1
01	CR2,4,19	THYRISTOR SCR		1884-0233		U	3
01	CR25	DIODE SILICONE		1901-0463		U	1
		RECTIFIER		1901-0727		U	2
				PART NO CONT			

A6 Mother Board Assembly Parts List 5061-1371 (Sheet 4 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PART NO CONT		1901-0727			
01	CR11,12	DIODE IN4936		1901-1065		U	2
01	CR14,22	DIODE		1901-1086		U	2
00	CR7,8	RECTIFIER		1901-1087		U	2
01	CR16,17	DIODE 6.19V		1902-0049		U	1
00	CR9	DIODE		1902-0554		U	1
01	CR23	DIODE 3.16V		1902-3036		U	1
00	CR24	DIO-ZNR 13.3V 2%		1902-3194		U	1
01	CR20	DIODE 14.7V		1902-3203		U	3
01	CR1,3,6	DIODE-FW BRIDGE		1906-0051		U	2
01	CR5,13	RECTIFIER		1906-0079		U	1
00	CR10	RECTIFIER		1906-0080		U	1
00	CR15	FUSE 1A NB		2110-0001		U	1
00	F1	FUSE CLIP .250D		2110-0269		U	4
		LKWSHR 4 MEL		2190-0003		U	10
03				2190-0003		U	2
		LKWSHR 6 MEL		2190-0006		U	1
		LKWSHR 10 INT		2190-0011		U	1
		LKWSHR 1/4 MEL		2190-0032		U	3
		LKWSHR 10 MEL		2190-0034		U	4
		LKWSHR 4 MEL		2190-0078		U	2

A6 Mother Board Assembly Parts List 5061-1371 (Sheet 5 of 6)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		LKWSHR 4 HEL		2190-0108		U	2
		LKWSHR 6 HEL		2190-0851		U	7
		SCR 4-40X.25		2200-0103		U	5
		SCR #4-40X.250L		2200-0139		U	12
		SCR 4-40X.75		2200-0151		U	2
		SCR #4-40X.500L		2200-0169		U	2
		NUT 4-40 .250AF		2260-0001		U	2
		NUT		2260-0002		U	2
		SCR #6-32X.375L		2360-0117		U	2
		SCR #6-32X.625L		2360-0123		U	4
		SCR #6-32X.375L		2360-0197		U	6
		SCR #6-32X.625L		2360-0203		U	1
		SCR #6-32X2.5L		2360-0221		U	1
		NUT 6-32 W/LK		2420-0001		U	1
		NUT 6-32 .250AF		2420-0003		U	7
		SCR 10-32X.375		2680-0099		U	4
		NUT 10-32 .375AF		2740-0002		U	1
		NUT 1/4-28		2950-0036		U	3
		WSHR #10		3050-0006		U	2
		WSHR #6 BRS		3050-0100		U	1
		WSHR #6 SS		3050-0228		U	1
		WSHR #4 SS		3050-0229		U	2
		WSHR .260ID BRS		3050-0234		U	1
		WSHR #10 BRS		3050-0236		U	5
		WSHR #8 FIBER		3050-0239		U	1
		WASHER FLAT		3050-0665		U	3
		SWITCH THERMAL		3103-0051		U	1
		FOAM-PLASTIC		4208-0171		U	4

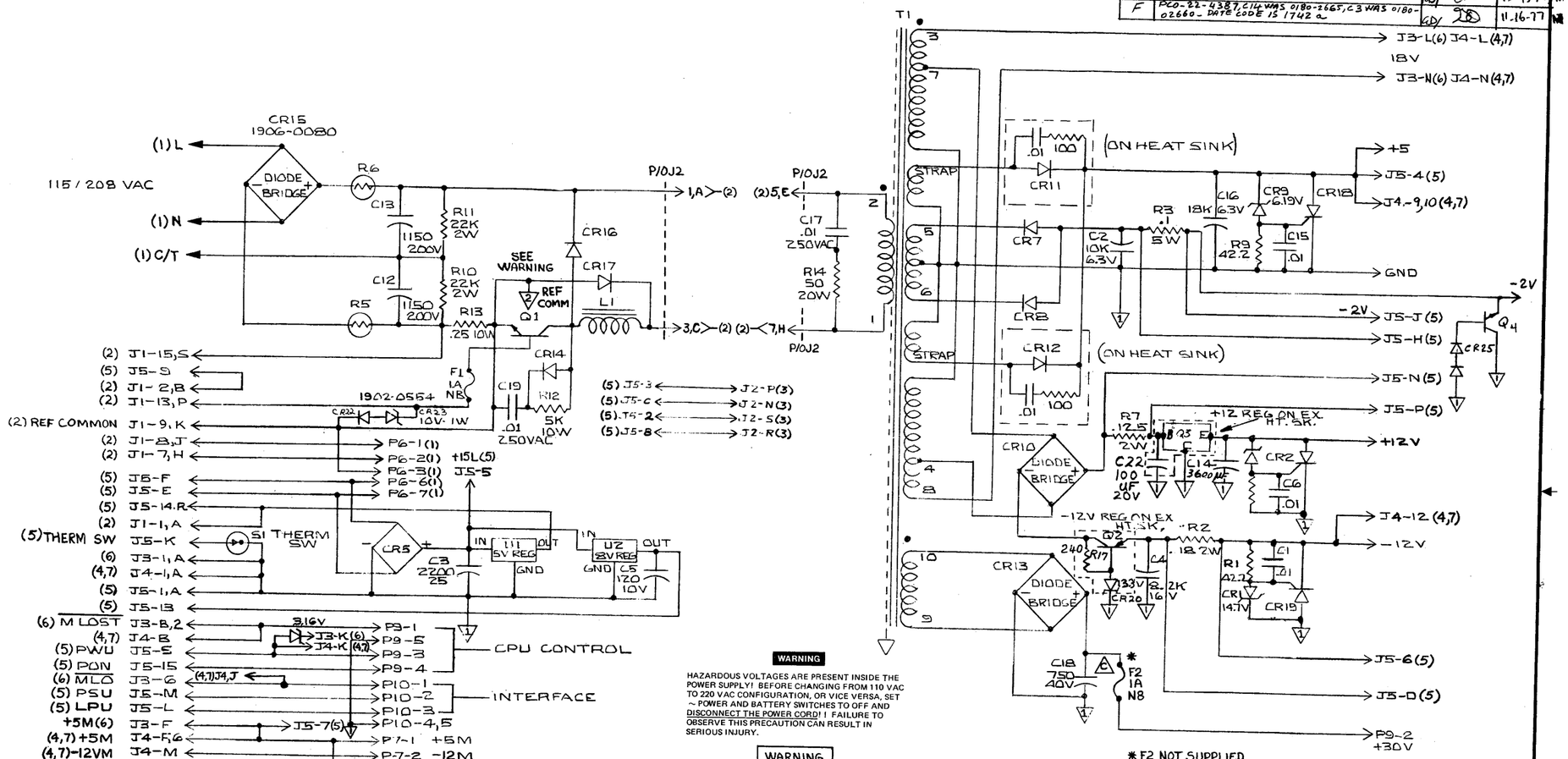
A6 Mother Board Assembly Parts List 5061-1371 (Sheet 6 of 6)

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		COMPOUND-THERMAL		6040-0239		U	0.01
03				6040-0239		U	0.01
		LABEL-AL COLOR		7120-5480		L	1
		WIRE 18 YEL		8150-0577		U	0.22
		WIRE 22 GRN		8150-1545		U	0.17
		WIRE 22 BLU		8150-1546		U	0.95
		WIRE 18 WHT-RED		8150-2649		U	0.28
		WIRE 18 WHT-VIO		8150-2650		U	0.83
		WIRE 18 BLK		8150-2890		U	0.58
		WIRE 18 RED		8150-2891		U	0.28
		WIRE 18 BLU		8150-2893		U	0.25
		WIRE 18 VIO		8150-2894		U	0.28
		WIRE 30AWG WHT		8150-3426		U	0.75
		WIRE 18 AWG BARE		8151-0011		U	0.15
		WIRE 22GA BARE		8151-0013		U	0.33
		CHOKE		9100-3947		U	1
		TRANSFORMER		9100-3950		U	1
		HEAT SINK		5001-2616		W	1
		HEAT SINK		5001-2617		W	1
		+5V STRAP		5001-2621		W	1
		GROUND STRAP		5001-2622		W	1
		HEAT SINK		5001-2808		W	2
		GUIDE-PC		5040-0170		W	10
		ASSY-CBL DC OUT		5061-1362		G	1
		BOARD-ETCHED		5080-9798		W	1

C-5061-1371-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED		1-4-77
B	CORRECTED CR20 POLARITY PER A LCPS		3-22-77
C	PCO-22-4277. DELETED FUSE F2. DATE CODE IS 1732; C22 WAS 0180-0098	GD	9-8-77
D	PCO-22-4298. ADD. Q4 AND CR25. DATE CODE IS 1735	GD	
E	PCO-22-4317 R17 WAS 150 Ω, CR20 WAS 1902-3193, DATE CODE IS 1740.	GD	10-13-77
F	PCO-22-4387, C14 WAS 0180-2665, C3 WAS 0180-02660. DATE CODE IS 1742 a	GD	11-16-77

ENGINEERING RESPONSIBILITY / SEPIA



WARNING

HAZARDOUS VOLTAGES ARE PRESENT INSIDE THE POWER SUPPLY! BEFORE CHANGING FROM 110 VAC TO 220 VAC CONFIGURATION, OR VICE VERSA, SET ~ POWER AND BATTERY SWITCHES TO OFF AND DISCONNECT THE POWER CORD! ! FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS INJURY.

WARNING

DO NOT CONNECT REF COMMON ② TO GROUND (GND ⏚) AS THERE IS APPROXIMATELY 150V DIFFERENCE!

CAUTION

ANY MEASUREMENTS USING REF COMMON ② MUST BE MADE USING TEST INSTRUMENTS WITH FLOATING INPUT.

Sheet 8 of 9

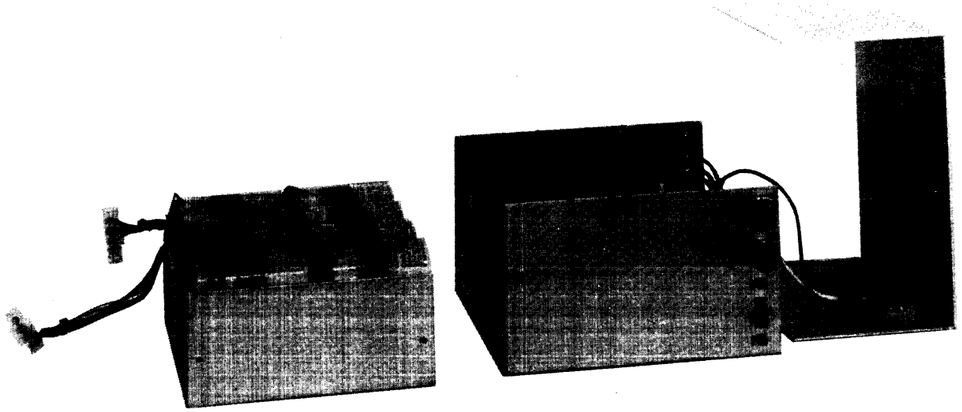
ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES. TOLERANCES .XX ± .02 .XXX ± .005

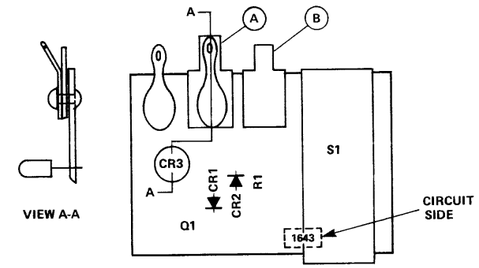
DRAWN BY	J. DIXON	4-13-76	MOTHER BD. SCHEMATIC. A3A6
ENGINEER	K. CHECK	1-17-77	HEWLETT PACKARD
RELEASED TO PROD.		5-23-77	5061-1356 NEXT ASSEMBLY
SUPERSEDES DWG.			5061-1371 PART NUMBER
			FINISH — SCALE — C-5061-1371-51

SHEET OF

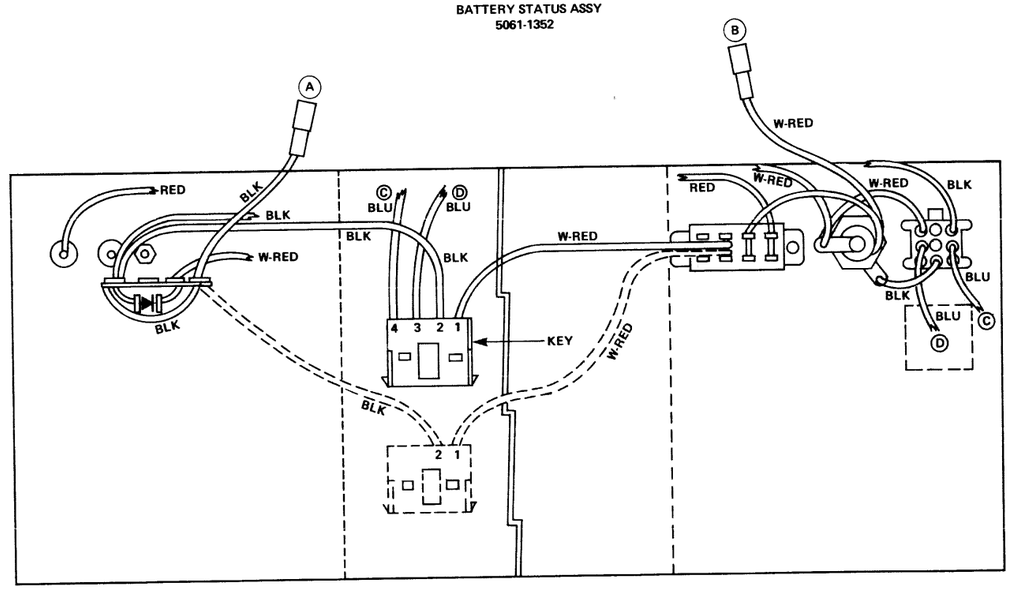
STOCK NO. 9280-0003 PRINTED ON DIEPO NO. 1020-10 CLEARPRINT FADEOUT



*The 12944B Battery Status Assembly supplied with single battery set.



BATTERY STATUS ASSY
5061-1352



NOTE:
MATERIAL IN BROKEN LINES USED IN 12991-60001 ONLY.
BATTERY BOX WIRING

12944B/12991B Battery Status Assembly*
5950-3728

12944B Battery Status Assembly Parts List (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
01							
03							
		BARRIER BLOCK		0360-0643		U	1
		TERM-SOLDER LUG		0360-1158		U	1
		STRIP TERM 5		0360-1590		U	1
		RES 3 1% 50W		0811-2966		U	1
		BATTERY ASSY		0950-1596		U	1
		WASHER NEOPRENE		1400-0090		U	1
		DIODE		1901-1086		U	1
		FUSE 6A NB		2110-0056		U	1
		CAP-FUSEHOLDER		2110-0465		U	1
		FUSEHOLDER-BODY		2110-0470		U	1
		LKWSHR 4 MEL		2190-0003		U	6
		LKWSHR 1/2 INT		2190-0068		U	1
		LKWSHR 6 MEL		2190-0851		U	10
		SCR #4-40X.250L		2200-0139		U	2
		SCR #4-40X.375L		2200-0143		U	2
		NUT		2260-0002		U	2
		SCR #6-32X.250L		2360-0193		U	10
		SCR #6-32X.625L		2360-0203		U	2
		NUT 6-32 .250AF		2620-0003		U	2
		NUT 1/2-28		2950-0054		U	1
		SW SLIDE DP3T PC		3101-2151		U	1
		FOAM-PLASTIC		4208-0173		U	1
		LABEL-INFO		7120-4368		U	1
		WIRE 18 BLK		8150-2890		U	0.62
		WIRE 18 RED		8150-2891		U	0.25
		WIRE 18 AWG BARE		8151-0011		U	0.15

12944B Battery Status Assembly Parts List (Sheet 2 of 2)

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP. OPTION	LOC	QUANTITY PER
		PAD-FOAM		9220-2070		C	1
		BOX-BATTERY		5000-8095		W	1
		COVER-BATTERY		5000-8096		W	1
		HOLD DWN BATTERY		5000-8097		W	1
		ASSY-LCPS STATUS		5061-1352		K	1
		ASSY-BAT. CBL		12944-60005		G	1

12991B Battery Status Assembly Parts List (Sheet 1 of 2)

ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP OPTION	LOC	QUANTITY PER
01							
03							
		BARRIER BLOCK		0360-0643		U	1
		TERM-SOLDER LUG		0360-1158		U	1
		STRIP TERM 5		0360-1590		U	1
		PES 3 1% 50W		0811-2966		U	1
		BATTERY ASSY		0950-1596		U	2
		CONN UTIL 4PIN		1251-4623		U	1
		CONTACT-CONN		1251-4747		U	2
		WASHER NEOPRENE		1400-0090		U	1
		DIODE		1901-1086		U	1
		FUSE 6A NB		2110-0056		U	1
		CAP-FUSEHOLDER		2110-0465		U	1
		FUSEHOLDER-BODY		2110-0470		U	1
		LKWSHR 4 HEL		2190-0003		U	6
		LKWSHR 1/2 INT		2190-0068		U	1
		LKWSHR 6 HEL		2190-0851		U	10
		SCR #4-40X.250L		2200-0139		U	2
		SCR #4-40X.375L		2200-0143		U	2
		NUT		2260-0002		U	2
		SCR #6-32X.250L		2360-0193		U	10
		SCR #6-32X.625L		2360-0203		U	2
		NUT 6-32 .250AF		2420-0003		U	2
		NUT 1/2-28		2950-0054		U	1
		SW SLIDE OP3T PC		3101-2151		U	1
		FOAM-PLASTIC		4208-0173		U	1
		LABEL-INFO		7120-4368		U	1
		WIRE 18 WHT-RED		8150-2649		U	0.50

12991B Battery Status Assembly Parts List (Sheet 2 of 2)

ITEM NO	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP OPTION	LOC	QUANTITY PER
		WIRE 18 BLK		8150-2890		U	1.12
		WIRE 18 RED		8150-2891		U	0.25
		WIRE 18 AWG BARE		8151-0011		U	0.15
		PAD-FOAM		9220-2070		C	2
		ASSY-LCPS STATUS		5061-1352		A	1
		ASSY-BAT. CBL		12944-60005		G	1
		HOLD DWN BATTERY		12991-00001		W	1
		COVER-DOUBLE		12991-00002		W	1
		BOX-BATTERY		12991-00003		W	1

Battery Status Subassembly Parts List 5061-1352

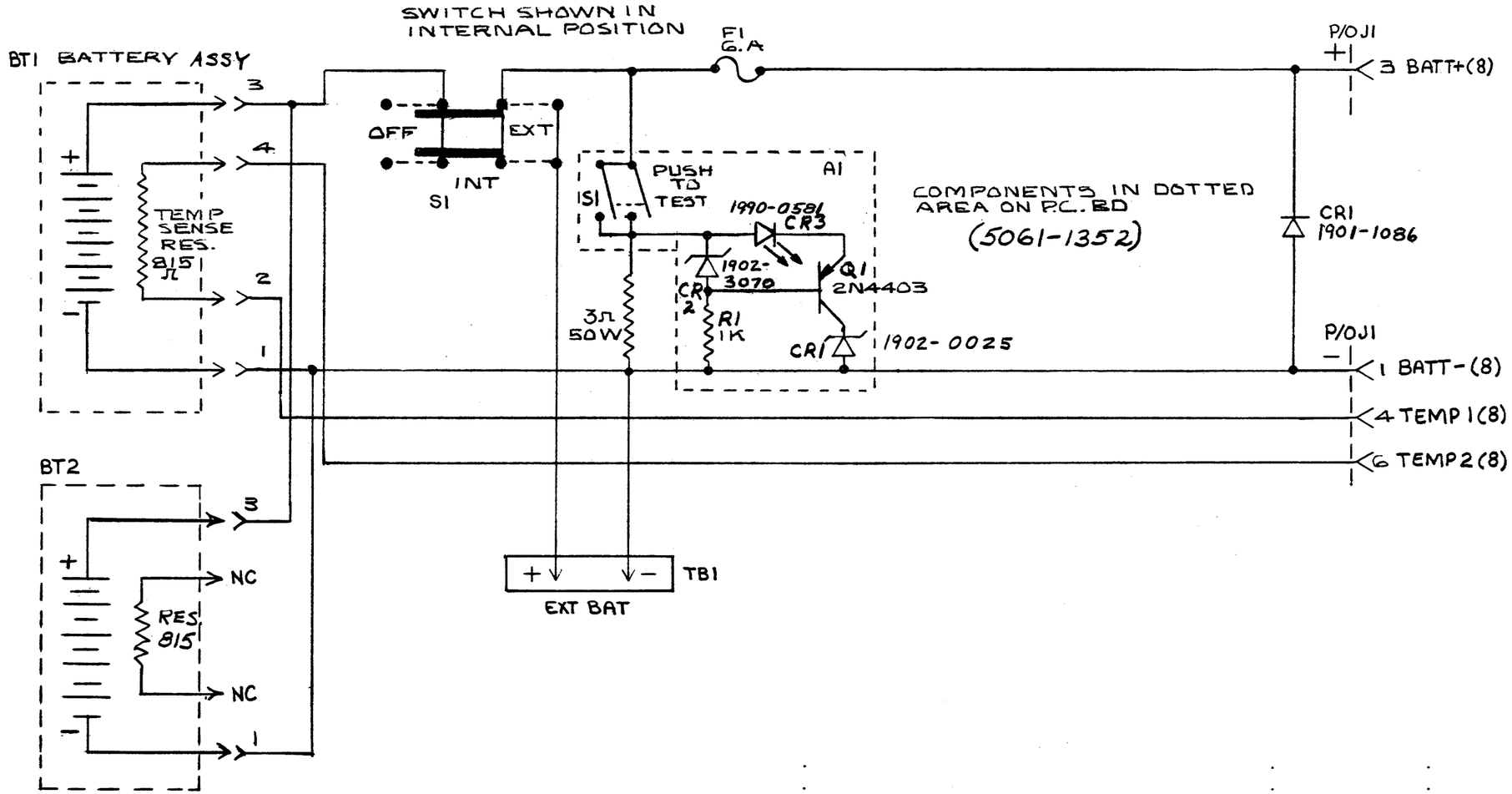
ITEM NO.	REFERENCE DESIGNATOR (FIRST SIX)	PART DESCRIPTION	PARENT OPTION	PART NUMBER	COMP OPTION	LOC	QUANTITY PER
01							
03							
		TERM-SOLDER LUG		0360-0272		U	2
		TERM-BARR BLOCK		0360-1824		U	2
		EYLT .121DX.200		0361-1032		U	3
00	R1	RES 1K 1%.125		0757-0280		U	1
00	Q1	XSTR 2N4403 TO92		1853-0271		U	1
00	CR1	DIODE 10V ZEN		1902-0025		U	1
00	CR2	DIODE-4.22V		1902-3070		U	1
00	CR3	LED-V SEN		1990-0581		U	1
00	S1	SW SLIDE MOM		3101-2153		U	1
		LABEL-AL COLOR		7120-5480		L	1
		BOARD-ETCHED		5081-2303		W	1

ENGINEERING RESPONSIBILITY															
0	1	2	3	4		6		8	9		11	12	14	15	
16	17		19		21	22	23	25	29	30	32	33	38	43	
45	46	61	63												

SEPIA

B-12944-90004-51

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	JJF / RR	10/29/76
B	PCO-22-4230 - BATTERY ASSY. WAS 12944-60004	GD / [illegible]	8/24/77



Sheet 9 of 9

ITEM	QTY.	MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY J. DIXON — DATE 6-7-76
ENGINEER K. Check — 10/29/76
RELEASE TO PROD. [signature] — 5-23-77
SUPERSEDES DWG.

TITLE: BATTERY/STATUS SCHEMATIC (PFRS)
NEXT ASSEMBLY 12944B / 12991B / 13303J
FINISH — SCALE

HEWLETT PACKARD

PART NUMBER 5061-1352, 12944-60001, 12991-60001

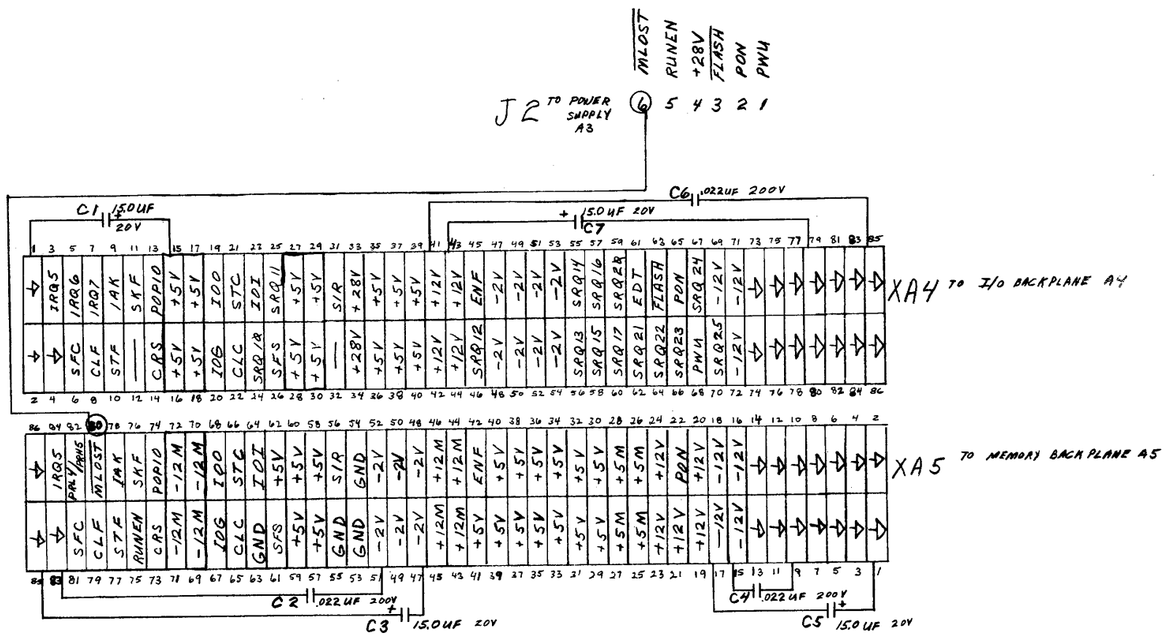
B-12944-90004-51

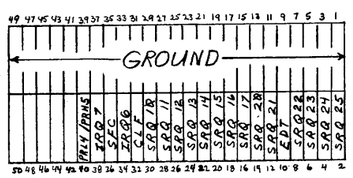
SHEET 1 OF 1

Crossover Board Assy
5060-8345

ENGINEERING RESPONSIBILITY	SEPIA

STH	REVISIONS	APPROVED	DATE
A	AS ISSUED SERIES 1353	KR/RB	2/24/76
B	32-2147, REM R1, SERIES 1415	KR/RB	3/22/76





NOTE:
1. ALL CAPACITORS ARE ±10%

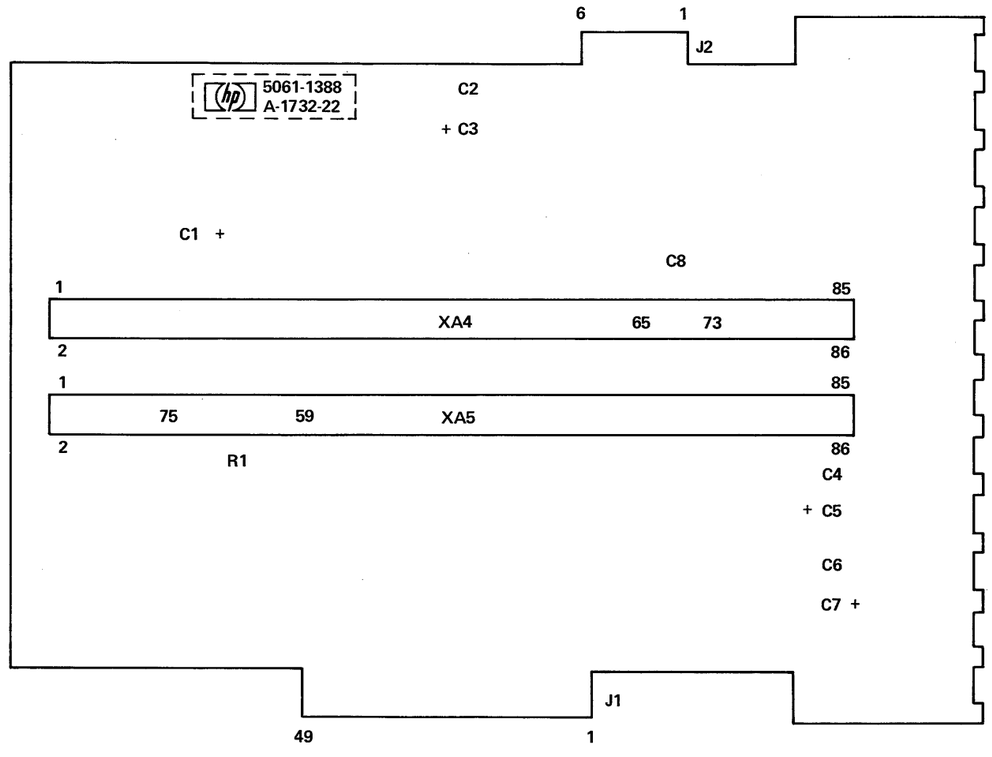
ITEM	QTY.	MATERIAL DESCRIPTION	MAT'L PART NO.	MAT'L DWG. NO.	MAT'L SPEC.

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.
TOLERANCES .XX ± .02 .XXX ± .005

DRAWN BY: WALT LEHNERT 11/21/74
ENGINEER: WALT LEHNERT 2/12/74
RELEASE TO MFGR: 3/22/76
SUPERSEDES DWG.

CROSS-OVER PCA
TITLE: SCHEMATIC
NEXT ASSEMBLY
FINISH SCALE

HEWLETT PACKARD
PART NUMBER D-5060-8345-S1
SHEET 1 OF 1



2109B/13B Crossover Board Assembly
5061-1388

ENGINEERING RESPONSIBILITY	SEPIA

SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED		5-12-77
B	PCO-22-4231-ADD-K-1(1K) DATE CODE 1817Z	GDJ	9-9-77

D-5061-1388-51

TO POWER SUPPLY A3

J2 TO POWER SUPPLY A3

A6J2 — MLOST (6), RUNEN (5), +30V (4), NC (3), PON (2), PWU (1)

C1 15.0UF,20V

C6 .022UF, 200V

C7 + 15.0UF 20V

C8 .01 UF

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85
⇩	IRQ5	IRQ6	IRQ7	IAK	SKF	POPIO	+5V	+5V	IOG	STC	IOI	SRQ11	+5V	+5V	SIR	+30V	+5V	+5V	+5V	+12V	+12V	ENF	-2V	-2V	-2V	-2V	SRQ14	SRQ15	SRQ16	SRQ20	EDT	SRQ22	PON	SRQ24	-12V	-12V	⇩	⇩	⇩	⇩	⇩	⇩	⇩
⇩	SFC	CLF	STF	———	CRS	+5V	+5V	IOG	CLC	SRQ10	SFS	+5V	+5V	+5V	———	+5V	+5V	+5V	+12V	+12V	SRQ12	-2V	-2V	-2V	-2V	SRQ 3	SRQ15	SRQ17	SRQ21	———	SRQ23	PWU	SRQ25	-12V	⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86

A6XA4 TO I/O BACKPLANE A4

86	84	82	80	78	76	74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2
⇩	IRQ5	PRI4/PRI5	M LOST	IAK	SKF	POPIO	-12M	-12M	IOG	STC	IOI	+5V	+5V	GND	SIR	GND	-2V	-2V	-2V	+12M	+12M	ENF	+5V	+5V	+5V	+5V	+5V	+5V	+5M	+5M	+5M	+12V	PON	+12V	-12V	-12V	⇩	⇩	⇩	⇩	⇩	⇩	⇩
⇩	SFC	CLF	STF	RUNEN	CRS	-12M	-12M	IOG	CLC	GND	SFS	+5V	+5V	GND	GND	-2V	-2V	-2V	-2V	+12M	+12M	+5V	+5V	+5V	+5V	+5V	+5V	+5V	+5M	+5M	+5M	+12V	+12V	+12V	-12V	-12V	⇩	⇩	⇩	⇩	⇩	⇩	⇩

A6XA5 TO MEMORY BACKPLANE A5

85	83	81	79	77	75	73	71	69	67	65	63	61	59	57	55	53	51	49	47	45	43	41	39	37	35	33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1

C2 .022UF,200V

C3 + 15.0UF,20V

R1 1K

C4 .022UF,200V

C5 15.0UF, 20V

49	47	45	43	41	39	37	35	33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1
⇩	⇩	⇩	⇩	PHL4/PRI5	IRQ7	SFC	IRQ6	CLF	SRQ12	SRQ11	SRQ13	SRQ14	SRQ15	SRQ16	SRQ17	SRQ20	SRQ21	EDT	SRQ22	SRQ23	SRQ24	SRQ25	⇩	⇩
GROUND																								

50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2

A6J1 (TO DCPC PCA J1)

NOTE:
1. ALL CAPACITORS ARE ±10%

ITEM	QTY.	MATERIAL DESCRIPTION	MAT'L PART NO.	MAT'L DWG. NO	MAT'L SPEC.

DO NOT SCALE THIS DRAWING	L. GUERRERO 5-18-77 DRAWN BY / DATE	CROSS-OVER PCA SCHEMATIC A6	HEWLETT PACKARD
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.	ENGINEER 5-18-77		
TOLERANCES .XX ± .02 .XXX ± .005	RELEASED TO PROD. 5-18-77	NEXT ASSEMBLY	PART NUMBER D-5061-1388-51
SEE CORP. STD. 608	SUPERSEDES DWG.	FINISH — SCALE	SHEET 1 OF 1