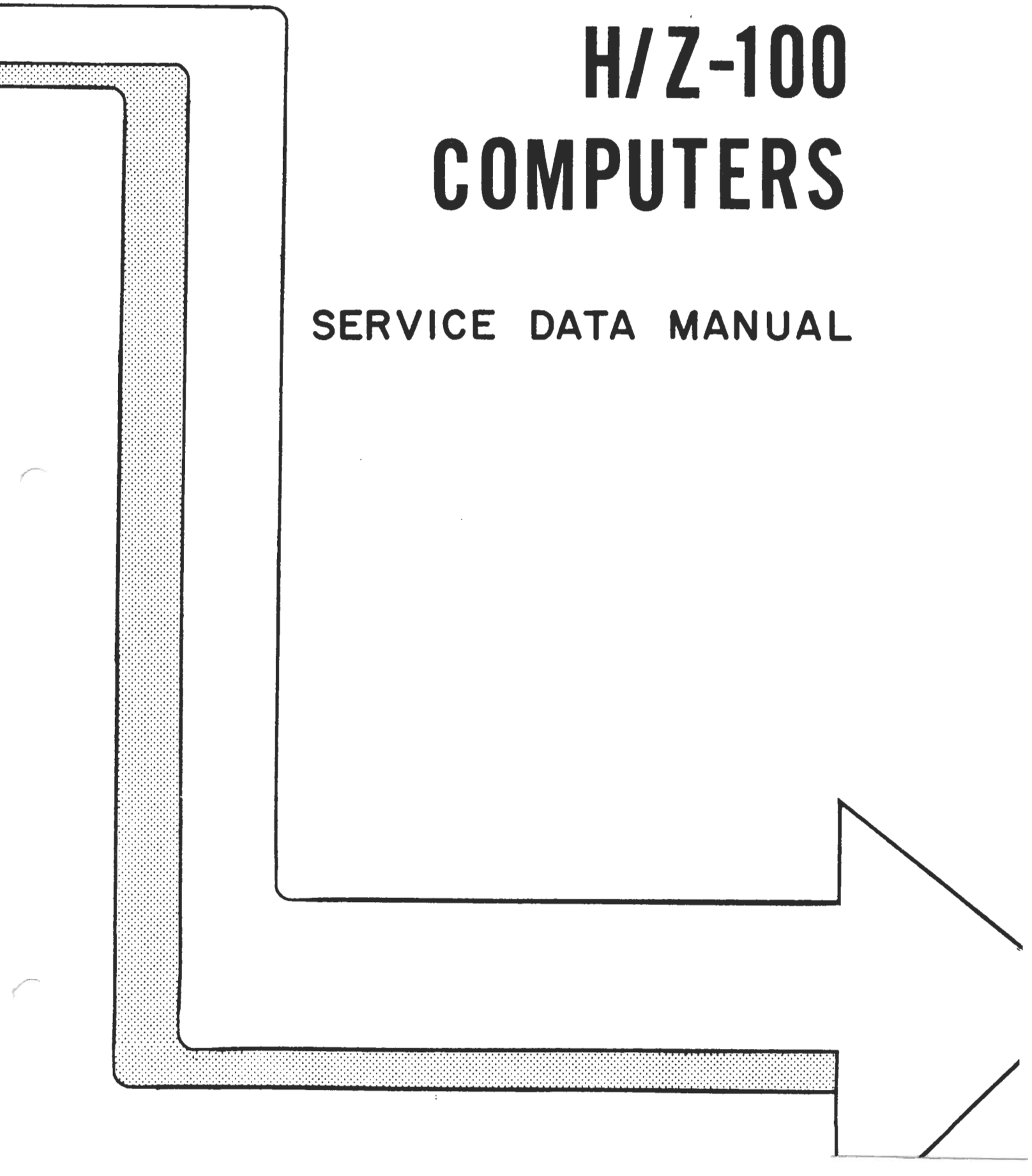
H/Z-100 COMPUTERS

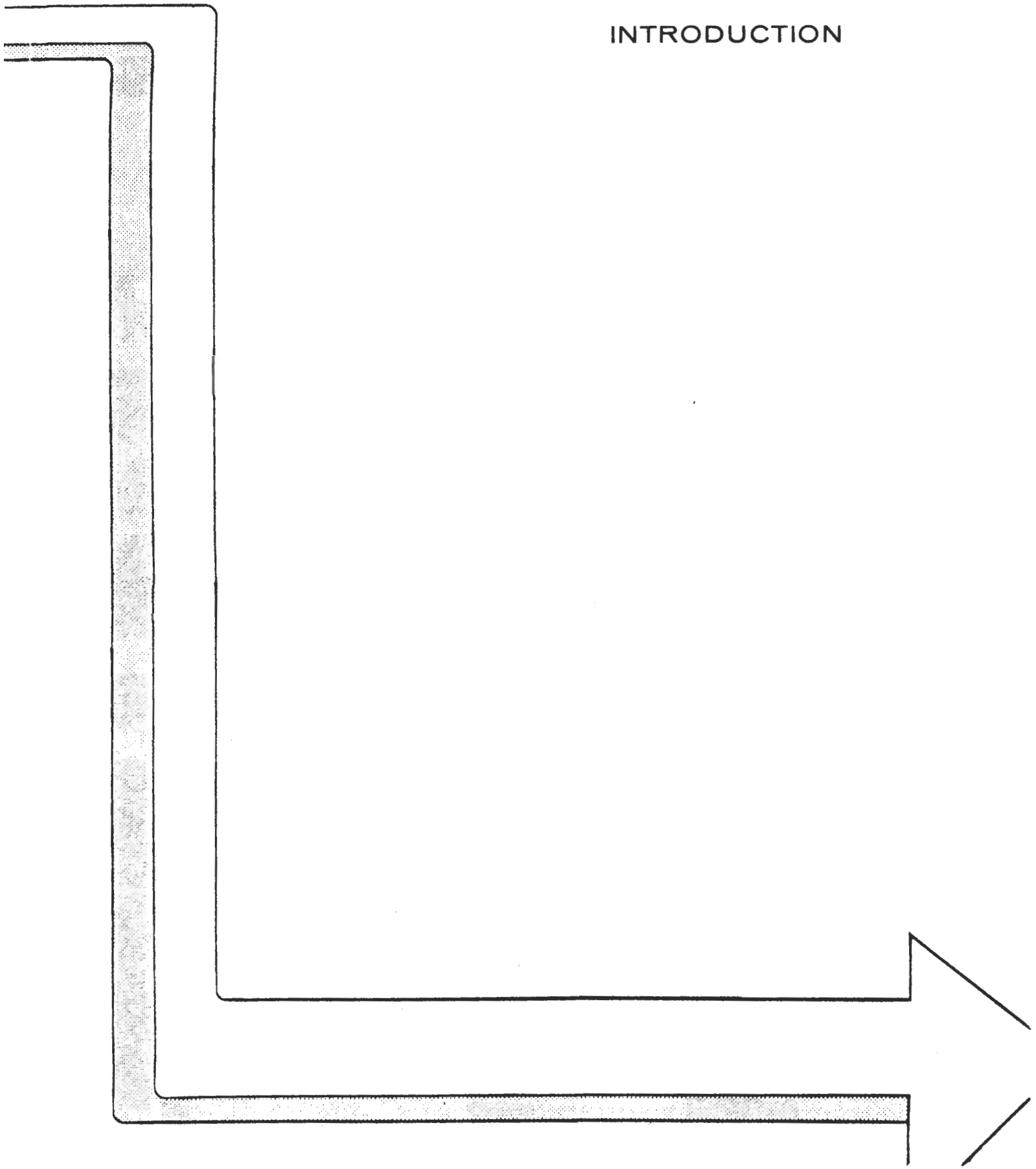
SERVICE DATA MANUAL



Prepared by Heath Company
Service Publications and Training
Benton Harbor, MI 49022

POWER SUPPLY

INTRODUCTION



The power supply provides regulated voltages used by the various components within the H/Z-100. It is located on the left side on the chassis floor. The power supply comes in two external designs, one for the All-in-One and one for the Low Profile. The two power supplies may look different on the outside, but internally they are the same.

The power supply of the H/Z-100 series is known as a switching power supply. It has this name because of the circuitry design within it. In this type of power supply, the rectified line voltage is switched on and off at a very high frequency. The resulting square wave is then filtered into a DC voltage. This design results in a power supply that has high efficiency.

The power supply contains many other features. Some of them are:

- 240 watts of available power.
- Internal cooling fan.
- Two position line voltage switch; 115 or 230.
- Detachable line cord.

Primarily, this section will familiarize you with the power supply design and operation. Since the power supply is a sealed unit, it cannot be serviced; however, the information contained in this section will aid you in determining if the power supply is defective.

CIRCUIT DESCRIPTION

BASIC CONVERTER

This supply is an off-line, voltage-fed, half-bridge, switch-mode power supply. This topology first converts the AC power mains to DC. This DC is then chopped to a quasi-square wave. This quasi-square wave is used to drive the primary of an inverter transformer. The secondaries are converted to low voltage DC by using rectifiers and low-pass filters.

EMI FILTER

COMPONENTS

All power entering the power supply passes through an EMI filter. The filter is comprised of C1, C2, C3, C4 and L1.

FUNCTION

The main function of this filter is to reduce conducted emissions emanating from the power supply to a point where it complies with the regulatory agencies.

LINE TRANSIENT SUPPRESSOR

MOV1 is a surge suppressor. Its function is to attenuate high voltage transients from entering the power supply.

POWER MAINS TO DC CONVERSION

COMPONENTS

CR1, RT1, RT2, C5, C6 and R1-R4 form the AC-to-DC conversion circuit.

115 VAC OPERATION

When the 115/230 switch is closed, this circuit is configured in a voltage doubler mode. Each half-power line cycle, C5 and C6 are alternately charged to 1.414 times the rms line voltage. Since the load is across the two capacitors, the voltage is two times the voltage across each capacitor. (Note: The two lower diodes of CR1 are not used in this mode.)

230 VAC OPERATION

When the 115/230 switch is open, the AC-to-DC conversion circuit is configured in a full-wave bridge mode. Now C5 and C6 are charged in series each half cycle. The load "sees" the same DC voltage regardless of the power line voltage selected.

INRUSH LIMITING

Thermistor RT1 and RT2 limit power line inrush when the supply is first turned on.

MAINS DISCHARGE

Resistors R1-R4 discharge C5 and C6 when the supply is turned off (UL requirement).

DC TO QUASI-SQUARE WAVE CONVERSION

OPERATION AND COMPONENTS

Transistors Q1 and Q2 form two active switches that "chop" the DC. They operate 180 degrees out of phase. They are driven through driver/isolation transformer, T1. Diodes CR2, CR3, CR4 and CR5 and C11 and C12 form two turn-off enhancement circuits. When Q1 or Q2 is forward biased, C11 or C12, respectively, charges up to approximately 1.2 volts. When the drive circuit signals either transistor to turn off, it does this by effectively shorting out the primary of transformer T1. Since the secondaries are now effectively shorted, the last charged capacitor is placed across the emitter-base junction of the forward biased transistor. Therefore, at the first instant, the emitter-base junction is reverse biased to approximated 1.2 volts. This supplies not only sufficient IB2, but keeps the transistors reverse biased to prevent false turn on.

CATCH DIODES

Diodes CR6 and CR7 are "catch" diodes that return any inductive energy to the input capacitors, C5 and C6. They also protect Q1 and Q2 from reverse breakdown. R5 and C13 form a "snubber" network. This circuit limits the "ringing" due to leakage inductance in T3 and T4.

BASE DRIVE SCHEME - TRANSFORMER

The base drive scheme is a proportional type. The three-turn winding of T1 has the entire primary current of inverter transformers, T3 and T4, circulating through it. As the output load is increased, so does the amount of base drive to Q1 and Q2. This provides optimum drive under all load conditions.

BASE DRIVE SCHEME - ACTIVE COMPONENTS

Transistors Q5 through Q8 form a "push-pull" inverter drive circuit. Transistors Q5 and Q7 provide the turn-on signal to its respective inverter transistor. Transistors Q6 and Q8 provide the turn-off signal to its respective inverter transistor. Diodes CR36 and CR38 allow the current to commutate during turn off. Transistors Q3 and Q4 act as logic inverters between the switching regulator IC1 and the inverter drive circuit.

INTEGRATED SWITCHING REGULATOR - OPERATION

The switching regulator control is IC1. Resistors R28 and C30 determine the clock frequency. The inputs to the error amplifier portion of the control IC are pins 1 and 2. Pin 16 is an internal reference of approximately 5 volts. Approximately 2.5 volts is applied to pin 2 by dividing down the reference through resistors R21, R22, and R23. C29 is a noise-decoupling capacitor. The +5 volt output is divided down to approximately 2.5 volts to be applied to pin 1 through R17 and R18. Pin 9 is the output of the error amplifier. Frequency compensation, for proper roll-off and phase margin, is provided by C26, C43, and R19.

CROSS CONDUCTION PROTECTION

To prevent cross conduction of inverter transistors Q1 and Q2, at any time, a "dead time" limiting circuit is incorporated. R24, R25 and CR26 form this circuit. R24 and R25 form a 2.5 volt voltage divider off the +5 volt internal reference. If the output of the error amplifier ever attempts to slew above this 2.5 volt level, CR26 is forward biased. This clamps the output. The result is the maximum duty ratio attainable is approximately 90%.

SLOW START CIRCUIT

Diodes CR24 and CR25, R20 and C27 form the slow start circuit. This circuit prevents the output from the supply from overshooting on turn-on. The circuit also limits the amount of current the inverter transistors must sustain during turn-on.

At turn-on, C27 is at zero volts. Diode CR25 clamps the output of the error amplifier to one diode drop. Through IC1 logic, this forces Q3, Q4, Q6, and Q8 to conduct. This prevents Q1 or Q2 from switching. Now C27 is charged through R20. This allows the output of the error amplifier to rise. Eventually, IC1 allows a minimal on-time to occur on one of the inverter transistors. A short time later, the other inverter transistor conducts for the same duration. Now, the outputs begin to rise. This process of "walking" up the outputs continues until the inputs of the error amplifier are equal. At this point, the "loop" is closed. Capacitor C27 continues to charge to the internal reference voltage and CR25 is reverse biased. Diode CR24 resets the slow-start capacitor, C27, when the supply is turned off.

OUTPUT STAGES

+5 VOLT OUTPUT

Diode CR9 comprises a full-wave Schottky rectifier that changes a secondary quasi-square wave to a positive polarity square wave for the +5 volt output. L2 and C14 form a low-pass filter to convert the square wave to DC. R6 is a discharge resistor. C21 is a high frequency by-pass capacitor.

+12 VOLT QUASI-REGULATED OUTPUT

Diode CR10 comprises a full-wave rectifier that changes a secondary quasi-square wave to a positive polarity square wave for the +12 volt output. L3 and C17 comprise a low-pass filter to convert the square wave to DC. R76 is a discharge resistor. C22 is a high frequency by-pass capacitor. R56, R57, C39 and C40 are two snubber networks to dampen the ringing due to the leakage inductance of T3.

+8 VOLT OUTPUT

Diode CR8 comprises a full-wave Schottky rectifier that changes a secondary quasi-square wave to a positive polarity square wave for the +8 volt output. L6 and C16 form a low pass filter to convert the square wave to DC. R7 is a discharge resistor. C20 is a high frequency by-pass capacitor.

+16 VOLT OUTPUT

Diodes CR12 and CR14 comprise a full wave rectifier that changes a secondary quasi-square wave to a positive polarity square wave for the +16 volt output. L4 and C18 form a low-pass filter to convert the square wave to DC. R77 is a discharge resistor. C23 is a high frequency by-pass capacitor. The DC fan for the supply is ran off this line through RT3. (This is so the fan will not run faster if the box gets too hot.) This output is also used for "boot strapping" the bias supply through CR33. The purpose of this is twofold. One reason is to maintain the bias voltage once the power to the supply is turned off for output carryover. The second purpose is to allow the use of a small bias transformer, T5, which is used only on start up.

Another use of the +16 volt output is the power source for the +12 volt regulated output. The operation of this regulator is described in the +8 Volt Output section.

+12 VOLT REGULATOR OPERATION

The +12 volt linear regulator is made up of discrete transistors Q9 thru Q11. The +5 volt output, used as a reference, is applied to the emitter of Q9. Since, at the first instant, the +12 regulated output is zero, Q9 is off. R54 pulls the base of Q11 high. Since Q10 and Q11 are in a Darlington configuration, both Q10 and Q11 are turned on. The +12 regulated output begins to rise until Q9 becomes forward biased through voltage divider R50 and R51. At this point, the circuit is in equilibrium. The dynamic resistance of Q10 drops the +16 volt line to the +12 volt regulated output potential.

-16 VOLT OUTPUT

Diodes CR11 and CR13 form a full-wave rectifier that changes a secondary quasi-square wave to a negative polarity square wave for the -16 volt output. L5 and C19 form a low pass filter to convert the square wave to DC. R10 through R13 are discharge resistors as well as a minimum load to ensure that the filter inductor remains critical at all times. R58, R59, C41, and C42 are two snubber networks used to dampen the "ringing" due to the leakage inductance of T4.

PROTECTION CIRCUITS

CURRENT LIMIT PROTECTION

Transformer T2 is a current-sense transformer that monitors primary current. R14 provides a load for the transformer. This converts current to a voltage. Full-wave bridge, CR15 through CR18, converts this quasi-square wave voltage to a positive polarity square wave. R15 is adjusted to extract the amount of voltage that would constitute an overcurrent condition. R16 and C25 is a low-pass filter and time delay. The time delay prevents false shutdowns for momentary transients. CR19 resets C25 every time primary current falls to zero. During dead time, CR30 is an isolation diode, since the remainder of this circuit is shared with the overvoltage protection circuit. If the voltage of C25 is of sufficient amplitude to exceed the 5-volt reference on the inverting input of comparator IC2C, the output will go high. This forward biases CR30 and CR29; the thyristor, CR29, will latch into conduction pulling its cathode high. This will also pull pin 10 of IC1 high. A high on pin 10 will inhibit all switching action and the outputs will fall to zero. To recover from this condition, the AC power must be removed from the power supply, the overcurrent condition corrected, and the power returned to the power supply.

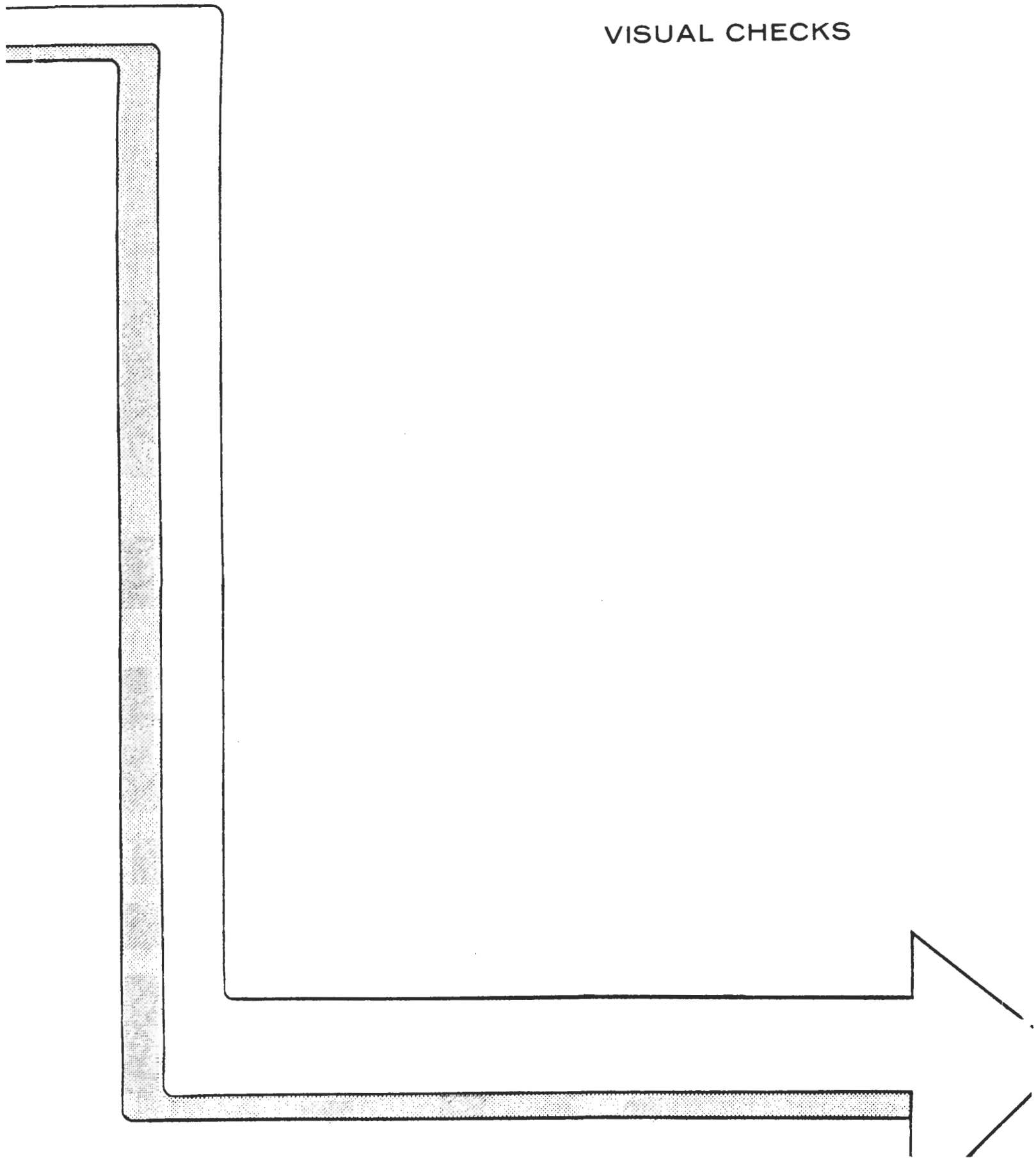
OVERVOLTAGE PROTECTION

IC2A is the overvoltage comparator. A 2.5 volt reference is applied to the inverting input of the comparator. The +5 volt output is applied to the non-inverting input of the comparator. The +5 volt output is applied to the non-inverting input of the comparator through voltage divider R39 and R40. If the +5 volt output exceeds approximately 6.2 volts, the output of the comparator will go high, forward biasing CR32. This will, similar to an overcurrent, forward bias CR29. CR29 will latch and pull pin 10 of IC1 high. Once again, all outputs will fall to zero. The supply will not restart until the overvoltage condition has been corrected and the power line recycled.

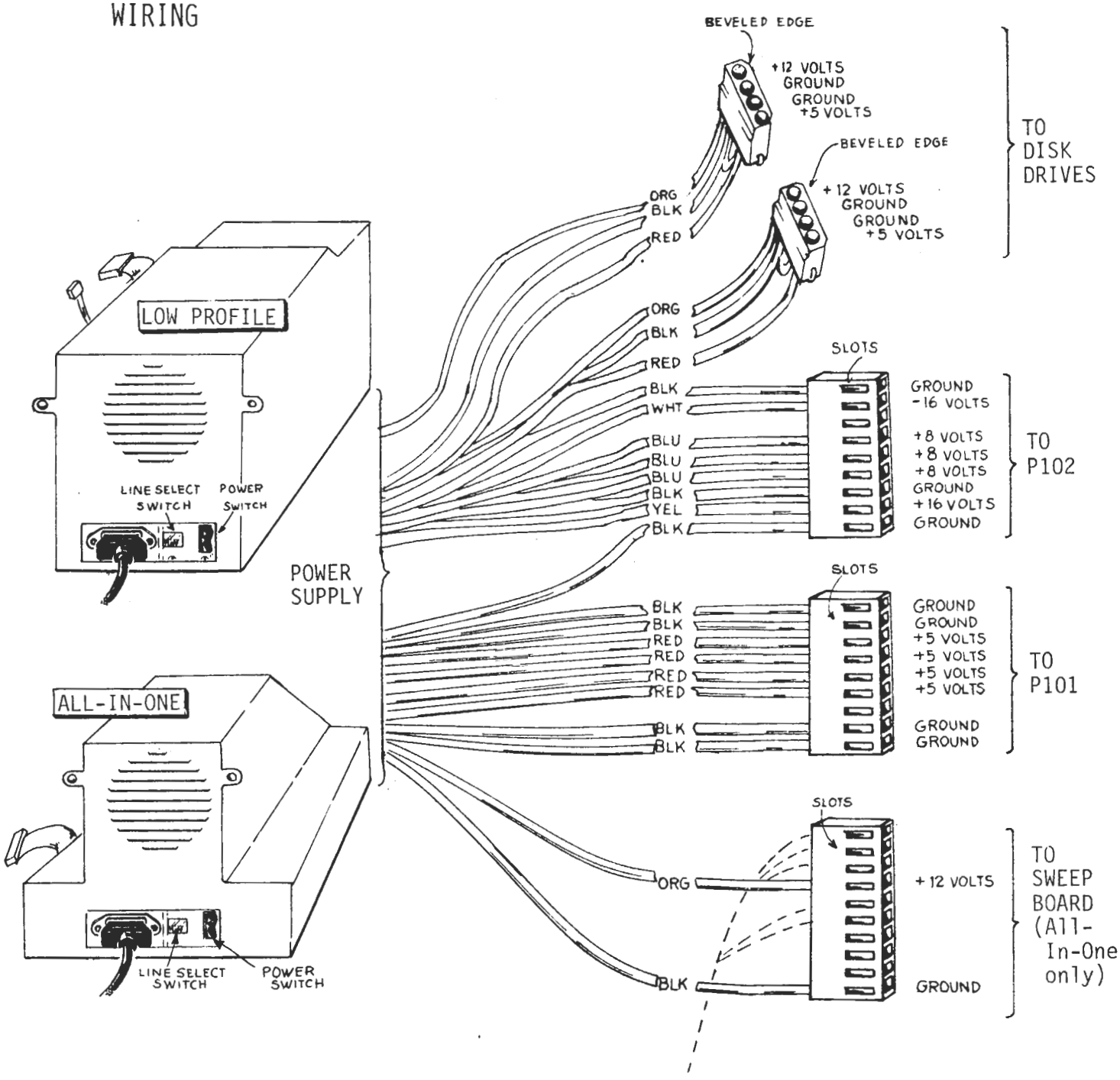
+12 VOLT REGULATOR OVERCURRENT PROTECTION

IC2B is used as an overcurrent comparator on the +12 volt regulated output. If the voltage on the output side of R45 drops too low because of an excessive current drain, the output of IC2B will go high, forward biasing CR31. This will, similar to an overcurrent, forward bias CR29. CR29 will then latch and pull pin 10 of IC1 high. Once again all outputs will fall to zero. The supply will not restart until the overcurrent condition has been corrected and the power line recycled. This condition on the +12 volt regulated output could destroy Q10 without activating the primary overcurrent circuit.

VISUAL CHECKS



WIRING


BEVELED EDGE
+12 VOLTS
GROUND
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BEVELED EDGE
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TO DISK DRIVES
ORG
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SLOTS
GROUND
-16 VOLTS
+8 VOLTS
+8 VOLTS
+8 VOLTS
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+16 VOLTS
GROUND
TO P102
LOW PROFILE
LINE SELECT SWITCH
POWER SWITCH
POWER SUPPLY
ALL-IN-ONE
LINE SELECT SWITCH
POWER SWITCH
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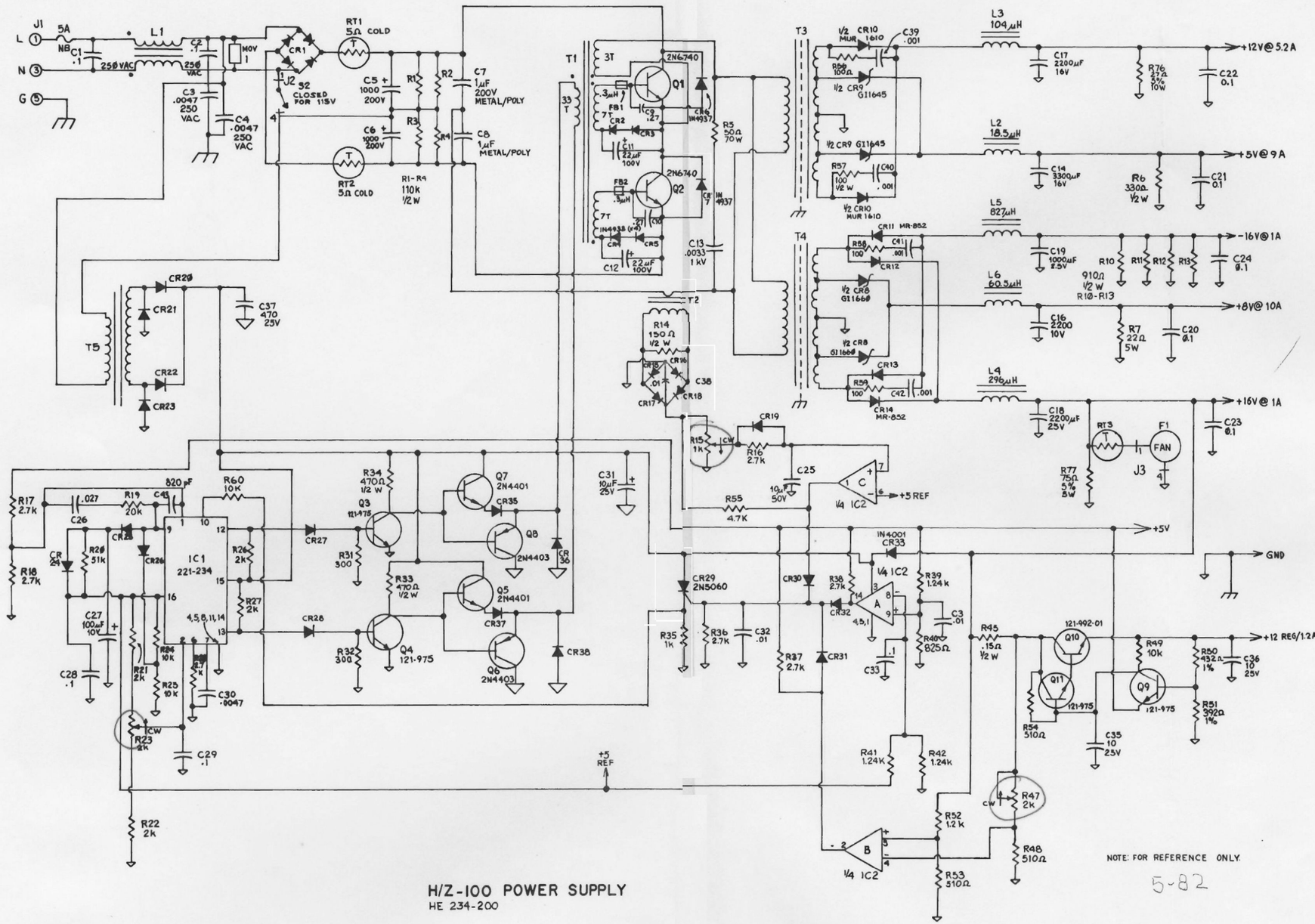
GROUND
TO P101
ORG
BLK
SLOTS
+12 VOLTS
GROUND
TO SWEEP BOARD (All-In-One only)



R23- Adj, all but +12v for video

R15 - current limiting

R47 - +12v for CRT over cur. Adj.

H/Z-100 POWER SUPPLY
HE 234-200

NOTE: FOR REFERENCE ONLY.

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