MODEL 5020

CALIBRATED PRECISION POWER SOURCE

0 - 20 VDC 0 - 2 A 0 - 50 VDC 0 - 1A

PRELIMINARY SPECIFICATIONS

GENERAL DESCRIPTION

The Model 5020 is a calibrated precision power source designed to supply extremely stable DC output with low noise content.

Two dual, concentric decade switches provide digital readout of a selected output voltage between zero and 50 VDC, with a resolution of 10 mv. A ten-turn potentiometer with a decade dial, having a resolution of 10 microvolts, provides readout to six significant figures.

The output voltage of the supply may be remotely programmed with an external resistance without loss of accuracy. Provisions are included for remote sensing of the output voltage at the load.

Compact and light, the Model 5020 is self-contained in a portable housing designed for bench use. Panel adapters are available for assembling one or two units in a standard 19-inch rack.

Each power supply is pre-aged for 100 hours prior to test and shipped with calibration data.

ELECTRICAL SPECIFICATIONS

OUTPUT: 0 to 20 VDC continuously adjustable at 0 to 2 A.
0 to 50 VDC continuously adjustable at 0 to 1 A.
Increased output is available at line voltages above minimum.

INPUT: 105 to 125 volts, 47 to 440 Hz, 100 watts nominal. 210 - 250 volt option available.

REGULATION: DC voltage change less than .001% +100 microvolts for line or load variations over the operating range (without remote sensing, the load regulation is 1.5 μv per milliampere of output current at the front panel terminals).

CALIBRATION ACCURACY: 0.1% + 0.5 mv of set value.

RIPPLE + NOISE: Less than 100 microvolts peak-to-peak when operated at frequencies between 47 - 63 Hz (measured with an oscilloscope with a bandwidth of 10 MHz).

STABILITY: Better than 0.001% + 100 microvolts per 8 hours; better than 1 mv per week (at constant line, load and ambient temperature).

TUCKER MASTER

Do Not Ship

POWER DESIGNS

POWER DESIGNS INC.
1700 SHAMES DRIVE ■ WESTBURY, N.Y. 11590
Tel: 516-333-6200 ■ TWX 510-222-6561

POWER DESIGNS PACIFIC INC.
3381 MIRANDA AVENUE ■ PALO ALTO, CALIF. 94304
Tel: 415-493-6111 ■ TWX 910-373-1251

SOURCE IMPEDANCE: Less than 0.002 ohm at DC; 0.04 ohm at 20 KHz; 0.5 ohm at 1 MHz (measured at the rear terminals).

RECOVERY TIME: Less than 50 microseconds to return to within 20 millivolts of the set voltage, for a step change (1 microsecond rise time) of 80% of rated load (20% minimum load).

TEMPERATURE COEFFICIENT: DC output voltage changes less than 0.001% or 50 microvolts (whichever is greater) per °C over the range 0°C to 45°C, less than 0.002% or 100 microvolts (whichever is greater) per °C from +45°C to +60°C.

CURRENT LIMITING: 0 to 2 A continuously adjustable by a front panel control. Pull-to-Set switch permits easy adjustment without shorting the output terminals. Flashing lamp indicates overload or short circuit.

REMOTE SENSING: Two terminals provided on a rear barrier strip for remote sensing of the voltage at the load.

REMOTE PROGRAMMING: Rear panel barrier strip terminals are provided for remote programming of the output voltage. The ratio of programming resistance to the output voltage is 1,000 ohms per volt. Programming accuracy is better than 0.01% of the programming resistance (including the resistance of the leads).

METERING: Front-panel volt-ammeter permits monitoring output voltage or current with an accuracy of ± 3% of full scale.

CIRCUIT PROTECTION: The AC line and DC load circuits are separately fused.

MECHANICAL SPECIFICATIONS

DIMENSIONS: 8 3/8" x 4 3/4" x 11 9/16".

WEIGHT: 12 pounds.

FINISH: Brushed, satin aluminum panel with lithographed black lettering. Dust cover finished in blue enamel; chassis and bottom plate, gold iridite.

RACK PANEL ADAPTERS: Panel adapters are available for mounting either a single unit or two units side by side.

PRICE: $495.00 *

F.O.B. Westbury, New York

*Price subject to change without notice

INSTRUCTION MANUAL

MODEL 5020 SERIAL _____

POWER DESIGNS INC.
1700 SHAMES DR. WESTBURY, N.Y. 11590
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ADDENDA

POWER SUPPLY

MODEL 5020

The Electrical Parts List and Schematic Diagram have been modified as follows:

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
CHANGE:			
CR7, CR8	Diode, silicon	98095	GI44

MODEL 5020

The Model 5020 is an improved version of the Model 4010. It is interchangeable electrically and mechanically, with increased output voltage and current.

PRECISION DC POWER SOURCE MODEL 4010

SECTION 1
GENERAL DESCRIPTION

1.1. DESCRIPTION

The Model 4010 is a precision DC power source designed to supply an extremely stable 0 to 40 volt, 0 to 1 ampere output. This instrument combines the accuracy of a precision calibrator with the power capability of a general purpose regulated supply.

Two dual, concentric decade switches provide a digital readout of the selected output voltage to within 0.1% +1 millivolt of the selected value. A 10 millivolt range, ten-turn potentiometer provides interplation of the last place. This potentiometer has a resolution of 10 microvolts.

The output voltage of the supply may be remote programmed with the same accuracy, using an external resistance. The supply also includes provisions for remote sensing of the output voltage at the load.

Compact and light, the power source is self-contained in a portable housing designed for bench use. The modular construction of the Model 4010 makes it suitable for rack mounting. Panel adapters are available for mounting one or two units in a standard 19 inch rack having a panel height of 5¼ inches.

A novel bail-handle assembly tilts the front panel for optimum viewing angle and control.

1.2. ELECTRICAL SPECIFICATIONS

OUTPUT: 0 to 40 volts DC, continuously adjustable, 0 to 1 ampere.

INPUT: 105 to 125 volts, 47 to 440 Hz, 90 watts nominal.

REGULATION: DC voltage change less than 0.001% +100 microvolts for line variations of ±10% or load variations of 100% (at sense lead connection points).

RIPPLE AND NOISE: Less than 100 microvolts peak-to-peak measured at 60 Hz.

RESETABILITY: 0.003% or 50 microvolts (whichever is greater) of the original dial setting.

SOURCE IMPEDANCE: Less than 0.5 milliohm at DC, 0.04 ohm at 20 KHz, 0.5 ohm at 1 MHz measured at the rear terminals.

RECOVERY TIME: Less than 30 microseconds to return to within 1 millivolt or 0.005% (whichever is greater) of the set voltage for a step change in rated load (1 microsecond rise time) of 10% to 100%; less than 50 microseconds to return to within 500 microvolts.

ABILITY: Better than 0.001% +100 microvolts per 8 hours; better than 1 millivolt per week (at constant line, load and ambient temperature after warm-up).

TEMPERATURE COEFFICIENT: DC output voltage change less than 0.001% or 50 microvolts (whichever is greater) per °C over the range of 0° to +45° C; less than 0.002% or 100 microvolts (whichever is greater) per °C from +45° C to +60° C.

CALIBRATION ACCURACY: Better than 0.1% +1 millivolt.

CURRENT LIMITING. 0 to 1 ampere continuously adjustable front panel control.

OUTPUT TERMINALS: Front Panel - Three insulated binding posts for positive output, negative output and chassis ground. Rear Panel - Screw terminals on a molded barrier block for positive output, negative output, chassis ground, remote voltage programming and remote sensing.

REMOTE SENSING. Two terminals are provided on a rear panel barrier block for remote sensing of the voltage at the load.

REMOTE PROGRAMMING: Rear panel barrier block terminals are provided for remote programming of the output voltage. The ratio of the programming resistance to the output voltage is 1000 ohms per volt. The programming accuracy is better than 0.01% of the resistance value, including the resistance of the programming leads.

METERING: Front panel volt-ammeter monitors the output voltage or current with an accuracy of ±2% of full scale. NOTE: This accuracy is considerably less than that of the power source.

CIRCUIT PROTECTION: The AC line and DC load circuits are separately fused. The AC line fuse is accessible at the rear of the unit. The DC load fuse is accessible on the amplifier board.

INDICATOR LAMPS: Oven Lamp - Lights when AC input is applied and oven heater is energized (operates even when AC ON toggle switch is off). Lamp cycles on and off as oven maintains constant temperature environment for critical components. AC ON Lamp - Lights when AC ON switch is switched on.

1.3. MECHANICAL SPECIFICATIONS

DIMENSIONS: 8-3/8" x 4-3/4" x 11-9/16".

WEIGHT: 12 pounds.

FINISH: Brushed anodized aluminum panel with etched black lettering. Dust cover finished in blue enamel; chassis and bottom plate, golden iridite.

RACK PANEL ADAPTERS: Panel adapters are available for mounting either a single unit or two units side by side.

SECTION 2
INSTALLATION AND OPERATION

2.1. INSTALLATION

2.1.1. Laboratory Bench: The Model 4010 is a portable unit designed for bench use. No special processing required. The power source is ready for operation as shipped from the factory.

2.1.2. Rack Mounting: Panel adapters are available for mounting one or two units in a standard 19 inch relay rack. Hardware kits are provided with each panel adapter. The power source is fastened to the front surface of the adapter. If the bumper feet or the tilt handle interfere with the assembly of the equipment to the rack, remove them by disassembling the bottom plate of the power source.

2.2. OPERATION

2.2.1. Be sure that the power source is turned off, shorting links connected between the DC+ and S+, 1 and 2 and S- and DC- rear panel terminals, and the screws holding the links are tight.

2.2.2. Set the CURRENT control fully clockwise.

2.2.3. Connect the AC line cord to a source of 105 to 125 volts, 47 to 440 Hz.

NOTE: The OVEN indicator will light as soon as line voltage is applied to the unit, even when the power source is turned off. The indicator will remain on until the oven reaches operating temperature (approximately 10 minutes). The indicator will cycle on and off as the oven maintains a constant temperature environment.

2.2.4. Paragraphs 2.3 through 2.6 give the connections for remote sensing, series operation, remote programming of the output voltage or current limiting.

2.2.5. Place the AC ON switch in the on position.

2.2.6 Set the output voltage to the desired value, using the front panel dials. Set the 0-10MV control to zero if interpolation between 10 millivolt steps is not desired.

2.2.7. Connect the DC+ and DC- terminals (on the front or rear panel) across the load. If desired, connect the positive or negative output terminals to ground.

2.3. SENSING

The regulator circuit maintains the potential between the sense leads (S+ and S-) at the set output voltage. When these leads are connected to the positive and negative output terminals, the power source is connected for local sensing. When the sense leads are connected to the load, the source is connected for remote sensing. Remote sensing is used when an appreciable voltage drop is anticipated in the leads connecting the positive and negative output terminals to the load. The unit is connected for local sensing when shipped from the factory.

2.3.1. For Remote Sensing:

2.3.1.1. Remove the shorting links from the rear panel DC+ and S+, and DC- and S- terminals.

2.3.1.2. Connect the DC+ and DC- leads to the load.

2.3.1.3. Connect the S+ and S- leads to the positive and negative sides of the load, respectively. Run the sense leads as a tightly twisted, shielded pair. Connect the shield to the G (chassis ground) terminal to minimize output ripple.

2.4. SERIES OPERATION

As many as four Model 4010 units may be connected in series to provide up to 160 volts. Connect the positive DC output terminal of one supply to the negative output terminal of the next, in the same manner as connecting batteries in series. The ground terminals on all units may be left floating or tied together and connected to either the most positive or most negative output terminal.

For optimum voltage regulation, disconnect the shorting links between all S+ and DC+ output terminals except those at the most positive potential. Then connect jumper wires between each S+ terminal and S- terminal on the next more positive power source. The voltage drops in the leads connecting the power sources will be compensated for by the regulator circuits of the individual units. For remote sensing, follow these directions, except connect the most positive and most negative S+ and S- leads across the load.

2.5. REMOTE VOLTAGE PROGRAMMING

The output voltage can be programmed remotely by an external fixed or variable resistance as follows:

2.5.1. Turn off the power source. Set all output voltage controls to zero.

2.5.2. Remove the shorting link between the rear panel terminals 1 and 2.

2.5.3. Select a programming resistance by multiplying the desired output voltage by 1000 (the programming constant is 1000 ohms per volt). A constant current of 1 milliampere will flow through this resistance, and the wattage rating should be chosen to minimize drift due to heating. If low output voltages or precise control are required, the resistance of the programming leads should be included in the calculations of the remote resistance value.

2.5.4. Connect the external programming resistance using twisted shielded wire to minimize stray electrostatic or magnetic pickup. Connect the shield to chassis ground (G terminal) to minimize output ripple.

ION: IF THE REMOTE PROGRAMMING CONNECTIONS ARE OPENED WHILE THE SUPPLY IS OPERATING, THE OUTPUT VOLTAGE WILL RISE SLIGHTLY ABOVE THE SET VALUE. WHEN A SWITCH IS USED TO SELECT RESISTORS FOR OUTPUT VOLTAGE PROGRAMMING, CHOOSE ONE WITH SHORTING TYPE CONTACTS TO AVOID VOLTAGE SPIKES.

2.6. CURRENT LIMITING

The maximum output may be limited to a value below 1 ampere as follows:

2.6.1. Connect a short across the DC+ and DC- output terminals.

2.6.2. Turn on the power source and set the meter switch to A.

3.6.3. Adjust the CURRENT control until the meter indicates the maximum desired output current. Remove the short.

SECTION 3
PRINCIPLES OF OPERATION

3.1. GENERAL

The Model 4010 is a highly accurate, series regulated, DC voltage source. It comprises a full wave rectifier circuit, a series regulator circuit and a current limiting circuit.

The series regulator circuit is an electronically variable resistance interposed between the unregulated source and the load. The resistance value is controlled by an amplifier which compares the source output voltage with a reference voltage. The amplifier adjusts the series resistance to reduce the error signal to zero.

The reference voltage is generated by an internal auxiliary power source. The error signal resulting from the voltage comparison is amplified and applied through a driver stage to the series transistor to vary its effective resistance.

3.2. FULL WAVE RECTIFIER OPERATION

The full wave rectifier consists of diodes CR13 and CR14. The output is applied through fuse F2 to series regulator transistor Q5, the output filtered by capacitor C8.

3.3. SERIES REGULATOR OPERATION

The series regulator circuit contains the differential amplifier Q3, amplifiers Q9, Q8 and Q7; drivers Q6 and Q1, and series regulator Q5. The voltage reference for the differential amplifier is zener diode CR9. A constant current is maintained through CR9 by transistor Q2 and zener diode CR10. These components are powered by an auxiliary 20 volt supply.

A 1 milliampere current flows from the DC+ through R40 and the output voltage controls to oven terminal pin 3. This current flows through R14 in parallel with R16 and R17 and establishes a voltage at one base of Q3. The common emitter resistor R13 of Q3 returns to the potential of zener diode CR9. The DC- connects to the opposite end of CR9. Therefore, the voltage from the first base of Q3 to DC- is zero. The second base of Q3 is also at zero volts relative to DC- by virtue of R15.

The differential amplifier, its voltage reference and the transistor which maintains a constant current through the voltage reference are located on the oven board assembly. The oven maintains these components in a constant temperature environment to provide highly stable operation.

The input to the differential amplifier is applied from a voltage divider across the supply output. Any change in output voltage changes the bias on the differential amplifier, and consequently changes the collector current on the output half of this stage. This changes the drive on amplifiers Q9, Q8 and Q7. The changed output of Q7 changes

ne drive on Q6 and Q1, and therefore of series regulator Q5. This change in drive on Q5 is in the correct direction to oppose any change in the supply output voltage.

For example, if the output voltage tends to increase, the forward bias on the input stage of the differential amplifier increases. This reduces the collector current of the output half of this stage, reducing the drive of amplifiers Q9, Q8 and Q7. The reduced collector current of Q6 and Q1 reduces the forward bias of series regulator Q5, increasing its effective resistance. The increased resistance of Q5 increases the voltage drop across it, reducing the output voltage.

3.4. CURRENT LIMITING CIRCUIT

The current limiting circuit consists of transistor Q10, the current sensing resistor R26, diodes CR23 and CR17 and their associated components. This stage is powered by the auxiliary 20 volt supply. The current through R26 and the divider consisting of R33, R34 and R35 sets the normal bias on this stage. Potentiometer R33 sets the range of the CURRENT control R35.

When the output load demand exceeds the value set by potentiometer R35, transistor Q10 conducts heavily, turning on diode CR17. With CR17 turned on, Q8, Q7, Q6, Q1 and Q5 are turned off, lowering the output voltage.

Any further increase in load demand further reduces the bias on Q5, further reducing the output voltage. In this manner, the circuit will maintain the load current at the set value for loads down to a short circuit. When the output current demand is reduced, the circuit conditions reverse and the voltage regulating circuits regain control of the output.

APPENDIX

1. INTRODUCTION

This Appendix contains an Electrical Parts List, Schematic Diagram, Parts Location Diagram and equipment Warranty.

2. ELECTRICAL PARTS LIST

All electrical and electronic parts are listed in the sequence of their circuit numbers as shown on the Schematic Diagram. A brief description of each part is given, followed by the code number of the manufacturer and his part number. All manufacturers' code numbers are taken from Cataloging Handbooks H4-1 and H4-2, Federal Supply Code for Manufacturers. These handbooks can be obtained from Federal Agencies or ordered directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.

We recommend that all parts with the code number 98095 be ordered directly from Power Designs, Inc. The commercial equivalents of these parts may have wide parameter tolerances or require special factory inspection or modification before they can be used in the power supply.

All components used in the power supply or supplied as replacements are carefully inspected at the factory. Inspections are performed on a 100% basis or at AQL levels to Military Specification MIL-Q-9858 under which Power Designs, Inc. has been qualified.

All semiconductors are inspected on a 100% basis, not only for operating parameters, but also for critical characteristics related to reliability and predictable life expectancy. Some of these characteristics are observed when the device is taken beyond its normal operating regions. These test techniques have been developed under a "predictable reliability" program in operation at Power Designs, Inc. for the past twelve years. Under this program, quality control procedures are constantly revaluated and updated as advances are made in solid state technology and experience is gained from field history.

Semiconductor manufacturers are continually modifying their products. Complete lines are discontinued to be replaced by devices having improved gain, operating voltage levels and frequency responses. The high gain, closed loop DC amplifiers used in regulator circuits are particularly sensitive to slight changes in these parameters. Commercial or military "equivalent" transistors may affect the performance of the power supply. We can assure compliance with the original specifications if replacement semiconductors are ordered from the Factory.

PRECISION POWER SUPPLY

MODEL 5020

* CALIBRATION DATA

SERIAL NO. 911002

DIAL SETTING	MEASURED VOLTAGE	DIAL SETTING	MEASURED VOLTAGE	DIAL SETTING	MEASURED VOLTAGE	VERNIER DIAL SETTING	VERNIER MEASURED VOLTAGE
						0.000	0.00000
1.000	1.000	0.100	0.1000	0.010	0.01001	0.001	0.00102
2.000	2.000	0.200	0.1999	0.020	0.02000	0.002	0.00203
3.000	3.000	0.300	0.2999	0.030	0.03001	0.003	0.00302
4.000	4.000	0.400	0.3999	0.040	0.04000	0.004	0.00403
5.000	5.000	0.500	0.4999	0.050	0.05000	0.005	0.00502
6.000	6.000	0.600	0.5998	0.060	0.06000	0.006	0.00603
7.000	7.000	0.700	0.6998	0.070	0.07000	0.007	0.00703
8.000	8.001	0.800	0.7998	0.080	0.08000	0.008	0.00803
9.000	9.001	0.900	0.8998	0.090	0.09001	0.009	0.00904
10.000	10.000			0.100	0.09999	0.010	0.01001
20.000	20.000						
30.000	30.000						
40.000	40.000						
50.000	50.001						
60.000							
70.000							
80.000							
90.000							
100.000							

AC INPUT V. 105 - 125

DOCUMENT CONTROL NO. 1945

CALIBRATED BY D.B

DATE 11/29/84

* VOLTAGES MEASURED WITH NO LOAD ON POWER

POWER DESIGNS INC., WESTBURY, NY

All replacement semiconductors are processed and stocked at the factory to insure complete interchangeability with the devices in the original equipment. The original devices are coded with a Power Designs Inc. part number. For example:

MS	1028	A
Semiconductor Manufacturer's Code	Power Designs Inc. Type	Suffix Identifying Special Parameters

When ordering replacements, please identify the device as thoroughly as possible, giving the model and serial number if available.

The replacement part you receive may not have the same part number as that shown on the Electrical Parts List. This can be due to several factors:

a. A different prefix indicates that Power Designs Inc. is using another vendor source. The operating characteristics of the devices are identical.

b. A completely different part number indicates:

(1) The original vendor has discontinued manufacture of the item or can no longer manufacture it to the original specifications.

(2) A better device for use in a particular circuit has been substituted.

(3) Tighter controls for interchangeability have provided greater assurance of reliability with the replacement.

CODE LIST OF MANUFACTURERS FOR MODEL 6150

01121	Allen-Bradley Company	Milwaukee, Wisconsin
71400	Bussman Manufacturing Division	St. Louis, Missouri
75382	Kulka Electric Corporation	Mount Vernon, New York
98095	Power Designs Inc.	Westbury, New York

MODEL 5020

ELECTRICAL PARTS LIST

NOTE: BEFORE REPLACING SEMICONDUCTORS SEE PARAGRAPH 2 OF THIS APPENDIX

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
A1	S5, S6 Switch Assembly (see following parts list)	98095	PS-5020-15
C1	Capacitor, electrolytic, 1 mf, 100 vdc	98095	CE-59-1
C2	Capacitor, plastic film, 0.022 mfd, 200 vdc	98095	CP-A022-2
C3	Capacitor, electrolytic, 1 mf, 100 vdc	98095	CE-59-1
C4	Capacitor, electrolytic, 280 mf, 30 vdc or	98095	CE-281-30
	Capacitor, electrolytic, 300 mf, 40 vdc	98095	CE-301-40
C5	Capacitor, electrolytic, 1 mf, 100 vdc	98095	CE-59-1
C6, C7	Capacitor, tantalytic, 6.8 mf, 35 vdc	98095	CE-6A8-.35
C8	Capacitor, electrolytic, 51 mf, 25 vdc	98095	CEX-51-25
C11	Capacitor, plastic film, 0.1 mf, 200 vdc	98095	CP-17-2
C12	Capacitor, plastic film, 0.0047 mf, 200 vdc	98095	CP-26-2
C13	Capacitor, tantalytic, 6.8 mf, 35 vdc	98095	CE-6A8-.35
C17	Capacitor, plastic film, 0.047 mf, 200 vdc	98095	CP-32-2
C18	Capacitor, tantalytic, 15 mf, 20 vdc	98095	CE-15-20
C19	Capacitor, tantalytic, 33 mf, 10 vdc	98095	CE-33-.10
C20	Capacitor, metal polyester, 4 mf, 150 vdc	98095	CP-4-151
C21	Capacitor, electrolytic, 310 mf, 50 vdc	98095	CE-311-50
C22	Capacitor, tantalytic, 33 mf, 10 vdc	98095	CE-33-.10
C24	Capacitor, tantalytic, 1 mf, 50 vdc	98095	CE-1-500
C25	Capacitor, tantalytic, 6.8 mf, 35 vdc	98095	CE-6A8-.35
C26	Capacitor, plastic film, 0.0022 mf, 200 vdc	98095	CP-A0022-2
C27	Capacitor, plastic film, 0.047 mf, 200 vdc	98095	CP-32-2
C28	Capacitor, plastic film, 0.1 mf, 200 vdc	98095	CP-17-2
C32, C33	Capacitor, electrolytic, 2200 mf, 50 vdc	98095	CE-222-50
C34	Capacitor, electrolytic, 1 mf, 100 vdc	98095	CE-59-1
C35	Capacitor, plastic film, 0.1 mf, 200 vdc	98095	CP-17-2
CR1 thru CR4	Diode, rectifier	98095	FS-88
CR5	Diode, rectifier	98095	GI-44
CR6	Diode, rectifier	98095	FS-88
CR7, CR8	Diode, silicon	98095	GI-44
CR9 thru CR12	Diode, rectifier	98095	FS-88
CR13	Diode, rectifier	98095	GI-44
CR14	Diode, rectifier	98095	SI-5A2
CR15	Diode, rectifier	98095	GI-44

ELECTRICAL PARTS LIST

NOTE: BEFORE REPLACING SEMICONDUCTORS SEE PARAGRAPH 2 OF THIS APPENDIX

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
CR16	Diode, rectifier	98095	FS-88
CR17 thru CR21	Diode, rectifier	98095	SI-5A2
DS1	Indicator Lamp (amber)	98095	PLA-14
DS2	Indicator Lamp (clear)	98095	PLA-15
F1	Fuse, 2A-250 v, Slo-Blo	71400	MDX-2
F2	Fuse, 3A-125 v, Slo-Blo	71400	MDX-3
M1	Meter	98095	MVA-162
Q1	Transistor, silicon, NPN	98095	FS-1700E
Q2	Transistor, silicon, NPN	98095	TI-0421
Q3	Transistor, silicon, NPN	98095	2N2219A
Q5 thru Q7	Transistor, silicon, NPN	98095	FS-1700E
Q8	Transistor, silicon, NPN	98095	MS-1700G
Q9	Transistor, silicon, PNP	98095	FS-1075
Q10	Transistor, silicon, NPN	98095	FS-1700E
Q11	Transistor, silicon, PNP	98095	2N5416
R1	Resistor, precision, metal film, 90.9 kΩ, ± 1%, 1/4 w	98095	RD-9092-1QA
R2	Resistor, precision, metal film, 1 mΩ, ± 1%, 1/4 w	98095	RD-105-1QA
R3	Resistor, precision, metal film, 2.43 kΩ, ± 1%, 1/4 w	98095	RD-2431-1QA
R4, R5	Resistor, precision, metal film, 6.04 kΩ, ± 1%, 1/4 w	98095	RD-6041-1QA
R6	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA
R7	Resistor, precision, metal film, 32.4 kΩ, ± 1%, 1/4 w	98095	RD-3242-1QA
R8	Resistor, wirewound, trimmer, 5 kΩ, ± 10%, 1/2 w	98095	RWT-502-4A
R9	Resistor, precision, metal film, 22.1 kΩ, ± 1%, 1/4 w	98095	RD-2212-1QA
R10	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA
R11	Resistor, composition, 4.7 kΩ, ± 10%, 1/2 w	01121	EB-4721
R13	Resistor, composition, 3.3 kΩ, ± 10%, 1/2 w	01121	EB-3321
R14	Resistor, precision, metal film, 1.58 kΩ, ± 1%, 1/4 w	98095	RD-1581-1QA
R16	Resistor, precision, metal film, 1.4 kΩ, ± 1%, 1/4 w	98095	RD-142-1QA
R17	Resistor, precision, metal film, 1.21 kΩ, ± 1%, 1/4 w	98095	RD-1211-1QA
R18	Resistor, precision, metal film, 15 kΩ, ± 1%, 1/4 w	98095	RD-153-1QA
R19	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA

ELECTRICAL PARTS LIST

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
R20	Resistor, precision, metal film, 909 Ω, ± 1%, 1/4 w	98095	RD-9090-1QA
R21	Resistor, precision, metal film, 280 Ω, ± 1%, 1/4 w	98095	RD-281-1QA
R22	Resistor, wirewound, trimmer, 200 Ω, ± 10%, 1/2 w	98095	RWT-201-4A
R23	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA
R24	Resistor, wirewound, 0.22 Ω, ± 5%, 3 w	98095	RW-F22-3KA
R25	Resistor, precision, metal film, 2.1 kΩ, ± 1%, 1/4 w	98095	RD-212-1QA
R26	Resistor, precision, metal film, 10 kΩ, ± 1%, 1/4 w	98095	RD-103-1QA
R27	Resistor, precision, metal film, 475 Ω, ± 1%, 1/4 w	98095	RD-4750-1QA
R29	Resistor, precision, metal film, 6.04 kΩ, ± 1%, 1/4 w	98095	RD-6041-1QA
R30	Resistor, precision, metal film, 43.2 Ω, ± 1%, 1/4 w	98095	RD-43F2-1QA
R31	Resistor, composition, 10 kΩ, ± 10%, 1/2 w	01121	EB-1031
R32	Resistor, composition, 1 kΩ, ± 10%, 1/2 w	01121	EB-1021
R33	Resistor, composition, 10 kΩ, ± 10%, 1/2 w	01121	EB-1031
R34	Resistor, precision, wirewound, matched component (see page 4)	98095	
R35	Resistor, precision, metal film, 154 kΩ, ± 0.25%, 1/4 w, 25 ppm	98095	RD-1543-11QA
R36	Resistor, composition, 10 kΩ, ± 10%, 1/2 w	01121	EB-1031
R37	Resistor, precision, metal film, 49.9 kΩ, ± 1%, 1/4 w	98095	RD-4992-1QA
R38	Resistor, wirewound, 0.15 Ω, ± 5%, 3 w	98095	RW-F15-3KA
R41	Potentiometer, 1 kΩ, ± 10%, 2 w (part of S4)	98095	B68057-1
R42, R43	Potentiometer, 20 kΩ, ± 5%, 2 w, 10 turn	98095	RWV-203-3C10
R44	Resistor, composition, 100 Ω, ± 10%, 1/2 w	01121	EB-1011
R45	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA
R46, R47	Resistor, wirewound, 0.75 Ω, ± 5%, 3 w	98095	RW-F75-3KA
R48	Resistor, precision, metal film, 100 Ω, ± 1%, 1/4 w	98095	RD-101-1QA
R49	Resistor, composition, 22 kΩ, ± 10%, 1/2 w	01121	EB-2231
R72	Resistor, precision, metal film, 1 kΩ, ± 1%, 1/4 w	98095	RD-102-1QA
R73	Resistor, precision, metal film, 100 Ω, ± 1%, 1/4 w	98095	RD-101-1QA
R74	Resistor, wirewound, 0.5 Ω, ± 5%, 7 w	98095	RW-F5-3RA
R75	Resistor, precision, metal film, 475 kΩ, ± 1%, 1/4 w	98095	RD-4753-1QA
R76	Potentiometer, 10 Ω, + 0%, - 10%, 2 w, 10 turn	98095	RWV-110-3C10L
R77	Resistor, wirewound, trimmer, 5 kΩ, ± 10%, 1/2 w	98095	RWT-502-4A
R78	Resistor, precision, metal film, 121 kΩ, ± 1%, 1/4 w	98095	RD-1213-1QA
R79	Resistor, composition, 33 Ω, ± 10%, 1/2 w	01121	EB3301
R80	Resistor, wirewound, 0.75 Ω, ± 5%, 3 w	98095	RW-F75-3KA

ELECTRICAL PARTS LIST

NOTE: BEFORE REPLACING SEMICONDUCTORS SEE PARAGRAPH 2 OF THIS APPENDIX

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
S1	Toggle, switch - SPST	98095	ST-5
S2	Toggle, switch - DPDT	98095	ST-39
S4	Switch, SPST (part of S4/R41 Assembly)	98095	B68057-1
T1	Transformer	98095	TTM-5020K-1
TB1	Terminal Strip. 8 position	98095	A77046-8
U1	Integrated circuit, operational AMPL, 8 pin	98095	μA-798HC or LM358H
U2	Integrated circuit, operational AMPL, 8 pin	98095	OP-05CP
U3	Integrated circuit, precision reference, matched component (see below)	98095	
VR1	Diode, zener	98095	DZE, F, G
VR2	Diode, zener	98095	3EZ10D5
VR3	Diode, zener	98095	3EZ5.6D5

U3, R34 MATCHED COMPONENTS

When U3 is A65555-1, R34 is 6.87 kΩ, ± 0.1%, 0.3 w, P/N RWA-6871-8SD
When U3 is A65555-2, R34 is 7.09 kΩ, ± 0.1%, 0.3 w, P/N RWA-7091-8SD
When U3 is A65555-3, R34 is 7.32 kΩ, ± 0.1%, 0.3 w, P/N RWA-7321-8SD

CODE LIST OF MANUFACTURERS

01121	Allen-Bradley Company	Milwaukee, Wisconsin
71400	Bussman Manufacturing Division	St. Louis, Missouri
98095	Power Designs Inc.	Westbury, New York

A1

S5 and S6 Switch Assembly

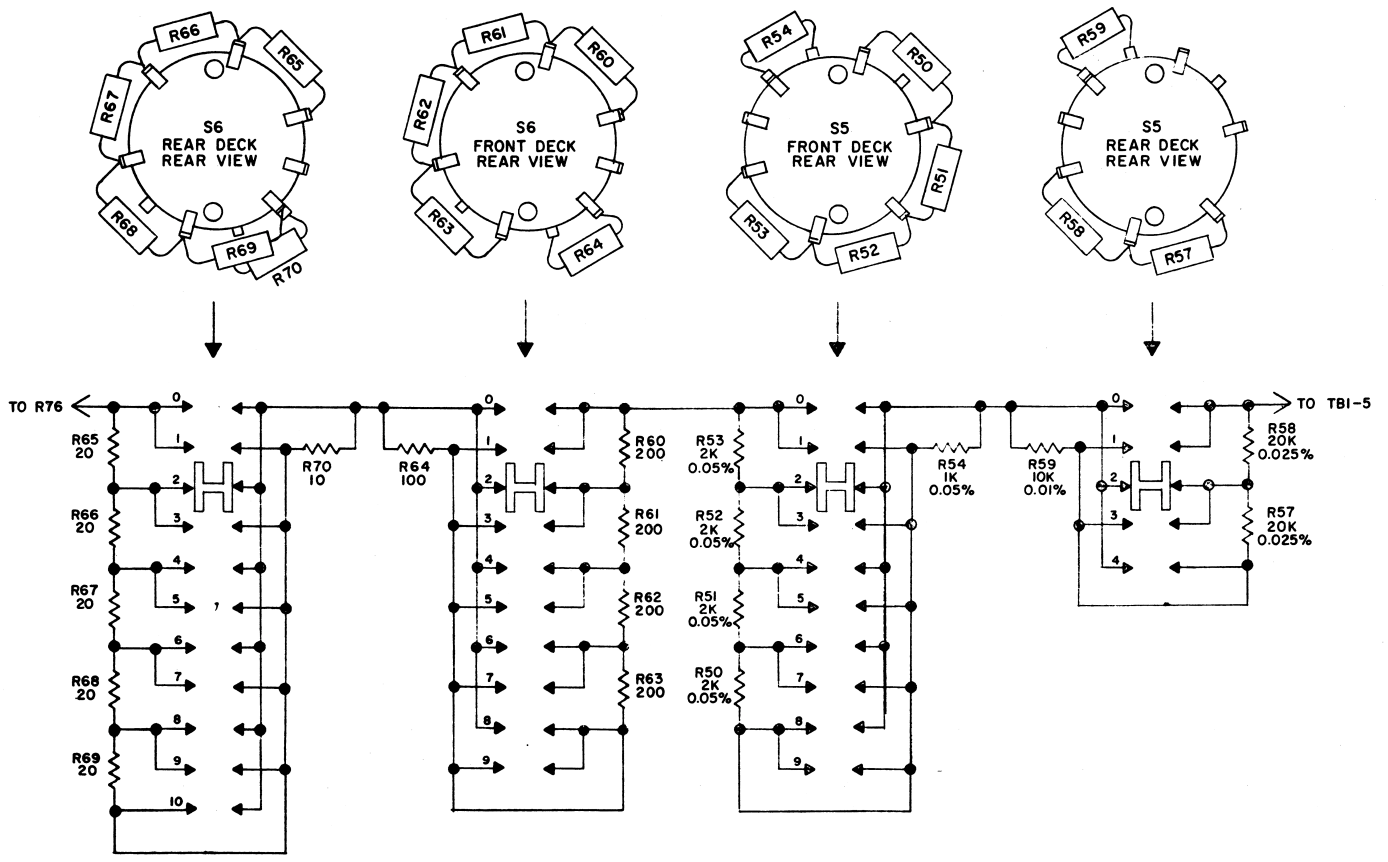
P/N PS-5020-15

ELECTRICAL PARTS LIST

CIRCUIT NUMBER	DESCRIPTION	MFR CODE NUMBER	PART NUMBER
A11	S5 Switch Assembly (consisting of):	98095	PS-5020-13
S5	Switch, Rotary	98095	C78002-3
R50 thru R53	Resistor, precision, wirewound, 2 kΩ, ± 0.05%, 0.3 w	98095	RWA-202-12SD
R54	Resistor, precision, wirewound, 1 kΩ, ± 0.05%, 0.3 w	98095	RWA-102-12SD
R57, R58	Resistor, precision, wirewound, 20 kΩ, ± 0.025%, 0.3 w	98095	RWA-203-14SD
R59	Resistor, precision, wirewound, 10 kΩ, ± 0.01%, 0.3 w	98095	RWA-103-13SD
A12	S6 Switch Assembly (consisting of):	98095	PS-5020-14
S6	Switch, Rotary	98095	C78002-2
R60 thru R63	Resistor, precision, wirewound, 200 Ω, ± 0.1%, 0.3 w	98095	RWA-201-8SD
R64	Resistor, precision, wirewound, 100 Ω, ± 0.1%, 0.3 w	98095	RWA-101-8SD
R65 thru R69	Resistor, precision, wirewound, 20 Ω, ± 0.1%, 0.3 w	98095	RWA-200-8SD
R70	Resistor, precision, wirewound, 10 Ω, ± 0.1%, 0.3 w	98095	RWA-100-8SD

CODE LIST OF MANUFACTURERS

98095	Power Designs Inc.	Westbury, New York



NOTE:

1. VOLTAGE CONTROL WIRING FOR MODEL 5020.
2. ALL SWITCH ROTORS ARE MAKE-BEFORE-BREAK.
3. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 0.1%, 0.3W.

SYM.	DESCRIPTION	APPD.	DATE
A	RELEASED		

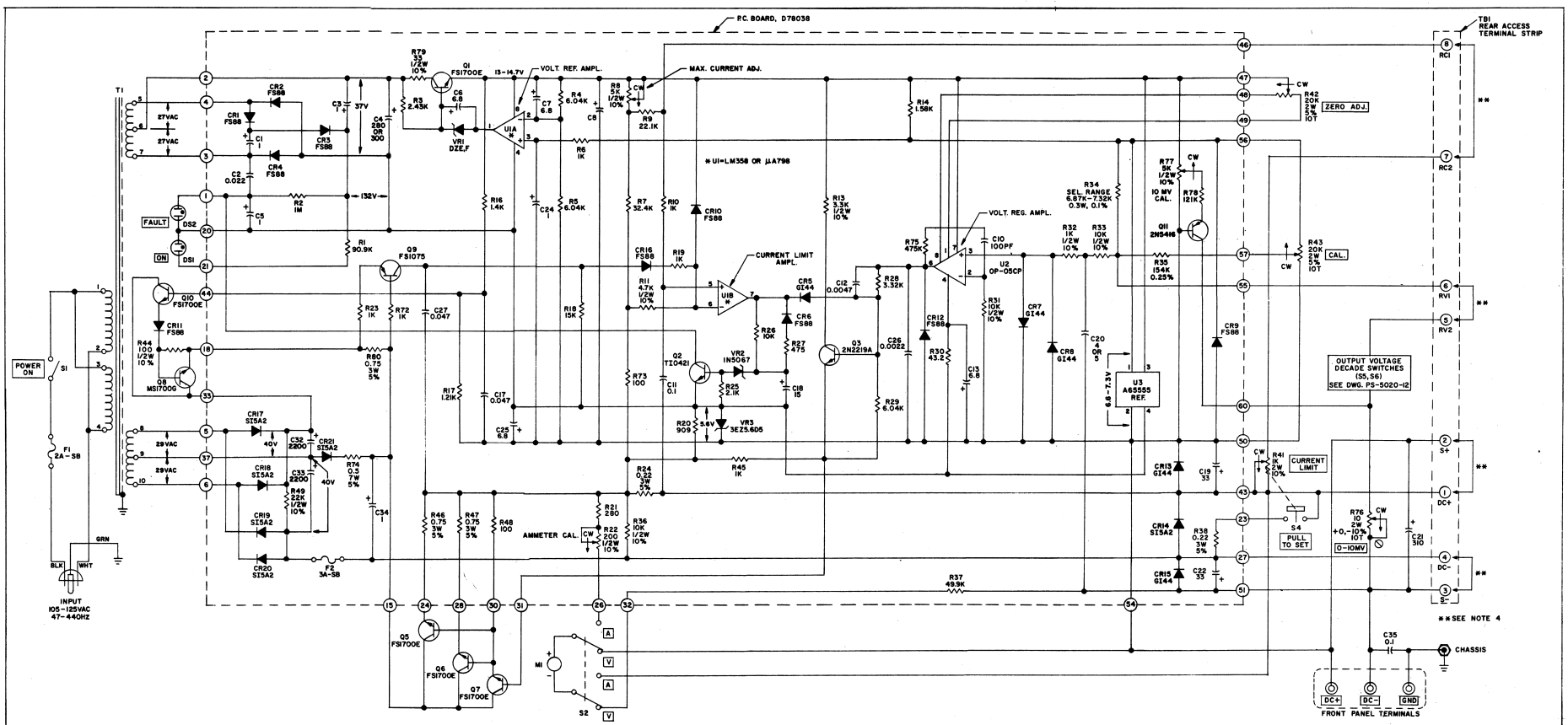
REVISIONS

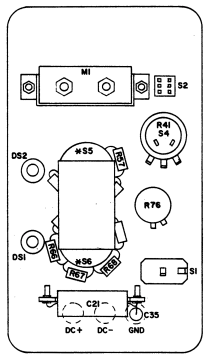
DRAWING NO. PS-5020-12 REV. A

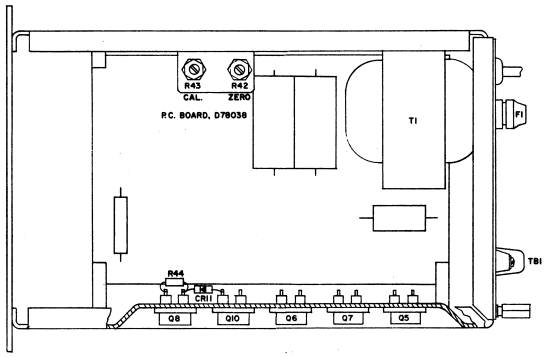
TITLE S5 & S6 SWITCH SCHEMATIC

DRAWN	CHECKED	APPROVED
HC		
DATE 3/9/79	DATE	DATE 3/9/79

Power Designs inc.
NEW YORK







LOCATION OF COMPONENTS

NOTES:

1. **UNLESS OTHERWISE SPECIFIED:**
   ALL RESISTORS ARE IN OHMS, 1/4W, 1%.
   ALL CAPACITORS ARE IN MICROFARADS.
   ALL VOLTAGES REFERENCE TO COMMON.
2. ALL FRONT PANEL CONTROL FUNCTIONS AND INDICATORS ARE SHOWN IN RECTANGLES. ALL OTHER CONTROLS ARE ON THE P.C. BOARD.
3. NUMERALS IN CIRCLES THAT ARE CONNECTED BY DASH LINES INDICATE P.C. BOARD TERMINAL NUMBERS.
4. SHORTING LINKS ARE SHOWN FOR NORMAL OPERATION.

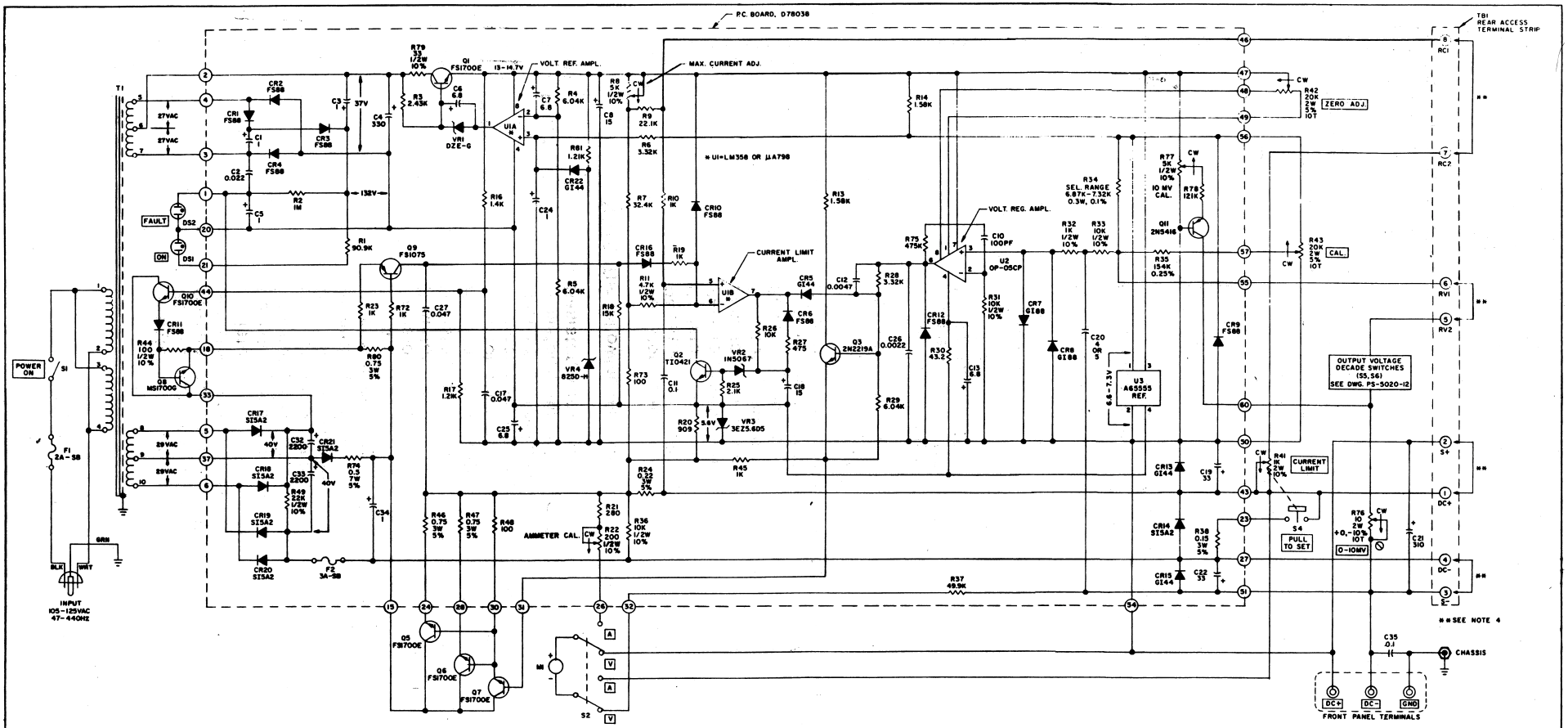
SYM.	REVISIONS DESCRIPTION	APPR.	DATE
D	REVISED, ECN 3192	VJ	3/9/79
C	REVISED, ECN 3101		
B	REVISED, ECN 3073		
A	RELEASED		

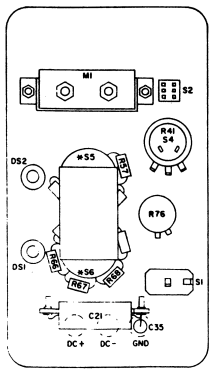
DRAWING NO. PS-5020-1 REV. D

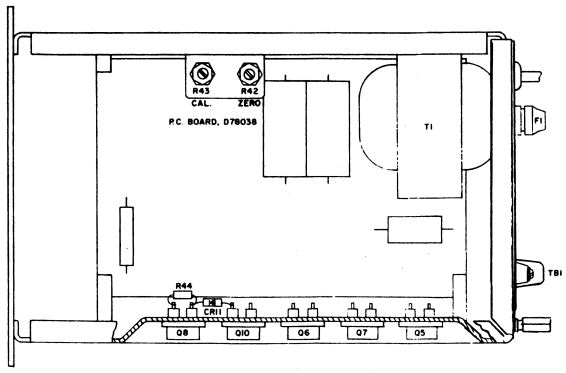
TITLE SCHEMATIC, MODEL 5020

DRAWN HC DATE 3/7/79 | CHECKED DATE | APPROVED DATE

Power Designs Inc.
NEW YORK







LOCATION OF COMPONENTS

NOTES:

1. **UNLESS OTHERWISE SPECIFIED:**
   ALL RESISTORS ARE IN OHMS, 1/4W, 1%.
   ALL CAPACITORS ARE IN MICROFARADS.
   ALL VOLTAGES REFERENCE TO COMMON.
2. ALL FRONT PANEL CONTROL FUNCTIONS AND INDICATORS ARE SHOWN IN RECTANGLES. ALL OTHER CONTROLS ARE ON THE P.C. BOARD.
3. NUMERALS IN CIRCLES THAT ARE CONNECTED BY DASH LINES INDICATE P.C. BOARD TERMINAL NUMBERS.
4. SHORTING LINKS ARE SHOWN FOR NORMAL OPERATION.

REV	DESCRIPTION	APPD	DATE
G	REVISED, ECN 3325		
F	REVISED, ECN 3286 & 3295		
E	REVISED, ECN 3261 & 3282		
D	REVISED, ECN 3192		
C	REVISED, ECN 3101		
B	REVISED, ECN 3073		
A1	RELEASED		

REVISIONS

DRAWING NO. PS-5020-1 REV. G

TITLE SCHEMATIC, MODEL 5020

DRAWN	CHECKED	APPROVED
NC		
DATE 1/27/79	DATE	DATE

Power Designs Inc. NEW YORK

PRECISION POWER SUPPLY

MODEL 5020

* CALIBRATION DATA

SERIAL NO. 202051

DIAL SETTING	MEASURED VOLTAGE	DIAL SETTING	MEASURED VOLTAGE	DIAL SETTING	MEASURED VOLTAGE	VERNIER DIAL SETTING	MEASURED VOLTAGE
						0.000	00000
1.000	1.000	0.100	0.1000	0.010	0.01001	0.001	0.00101
2.000	2.000	0.200	0.2000	0.020	0.02001	0.002	0.00203
3.000	3.000	0.300	0.3000	0.030	0.03001	0.003	0.00302
4.000	4.000	0.400	0.4000	0.040	0.04001	0.004	0.00403
5.000	5.000	0.500	0.5000	0.050	0.05001	0.005	0.00502
6.000	6.000	0.600	0.6000	0.060	0.06001	0.006	0.00602
7.000	7.000	0.700	0.7001	0.070	0.07002	0.007	0.00703
8.000	8.000	0.800	0.8000	0.080	0.08002	0.008	0.00803
9.000	9.000	0.900	0.9000	0.090	0.09002	0.009	0.00905
10.000	10.000			0.100	0.10002	0.010	0.01001
20.000	20.000						
30.000	29.999						
40.000	40.000						
50.000	50.000						
60.000							
70.000							
80.000							
90.000							
100.000							

AC INPUT V. 105-125 V

DOCUMENT CONTROL NO. 1945

CALIBRATED BY HR

DATE 12/6/82

* VOLTAGES MEASURED WITH NO LOAD ON POWER

POWER DESIGNS INC., WESTBURY, NY

GUARANTEE

POWER DESIGNS INC., guarantees to the original purchaser, each instrument sold by us, or our authorized agents, and all the parts thereof, to be free from defects in material or workmanship under normal use and service within the specified ratings and operating conditions.

Its obligation under this guarantee is hereby limited to the repair or replacement of any instrument, or part thereof, which is returned to us by the original owner within one year after date of shipment, and which shall prove, after our examination, to be thus defective.

This guarantee does not include the cost of transportation charges to and from the factory and/or the cost of packaging or crating of instruments for return to the factory, unless such instrument is returned within thirty (30) days from the date of original shipment as shown on the packing list or shipping documents.

The repair or replacement of an instrument, or any part thereof, does not void or extend the original guarantee.

POWER DESIGNS INC., reserves the right to discontinue any instrument without notice, or to make modifications in design at any time, without incurring any obligation to make these modifications in instruments previously sold.

POWER DESIGNS INC.
Westbury, L.I., New York

All Power Designs power sources are inspected mechanically at least three times during manufacture. They are electrically tested for compliance with published specifications at least twice and "burned-in" on an aging rack for 50 hours under full load prior to final electrical test.

If a power supply is not in perfect working condition upon receipt, please contact the factory within five days.

In the event of transportation damage, the purchaser must contact the factory for instruction as to procedure and approval of return.

POWER DESIGNS
POWER DESIGNS INC.
1700 SHAMES DRIVE ■ WESTBURY, N.Y. 11590
Tel: 516-333-6200 ■ TWX 510-222-6561