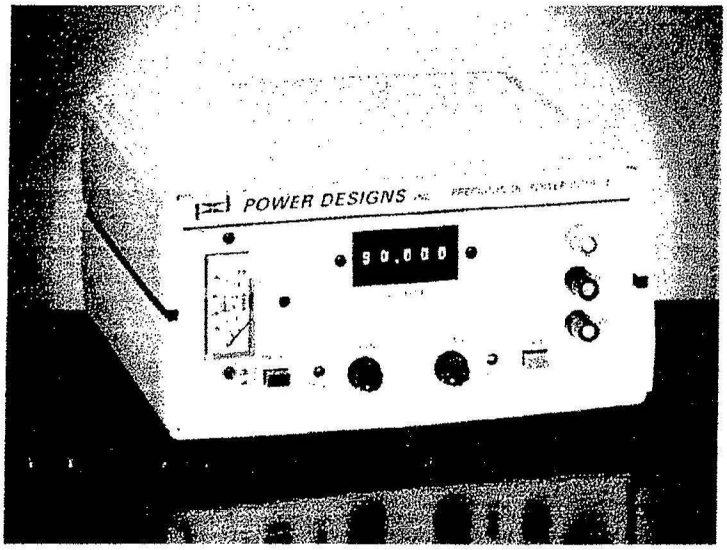
Owner's Manual

2040A
Models 5020A Precision DC Power Source
1001A



Power Designs Inc.
14 Commerce Drive
Danbury, CT 06810
(203) 748-7001

INSTRUCTION MANUAL

SECTION 1
INTRODUCTION

1.1 GENERAL

This manual contains instructions for the installation, operation and maintenance of the Power Designs family of precision calibrated low voltage power sources.

1.2 DESCRIPTION

This regulated power source is designed to provide an extremely accurate and stable D.C. output voltage with less than 100 microvolts of ripple and noise content (PARD). A pushwheel switch on the front panel provides digital presentation of a selected output voltage to five places. A panel mounted potentiometer provides interpolation to a sixth digit. The calibration accuracy for all models is 0.1% of the dial settings.

The output voltage of the supply may be remotely programmed with an external resistance. To maintain accuracy and stability, the external programming resistor must be a precision, low TC type. Rear terminals provide for remote sensing of the output voltage at the load, Calibrated output is available through either front panel binding post terminals or at the rear mounted terminal strip. Metering is provided by means of a dual scale edgewise meter. A function switch selects either voltage or current monitoring.

Current limiting is continuously adjustable over the range of the power supply by means of a front panel mounted control. A "fault" lamp indicates an overload or short circuit condition. The output can be continuously shorted without damage to the supply.

The output terminals of the supply are floating with respect to ground permitting positive or negative polarity. The supply is furnished in a high impact ABS enclosure. A tilting bail assembly is provided for ease of viewing.

1.3 ELECTRICAL SPECIFICATIONS

Input: 105 - 125, 210 - 240 Volts, 47 - 440 Hz. (Input range is internal jumper selectable.)

Output:	Model 2040A	0-10 VDC / 0-4 Amperes 0-20 VDC / 0-2 Amperes
	Model 5020A	0-20 VDC / 0-2 Amperes 0-50 VDC / 0-1 Amperes
	Model 1001A	0-50 VDC / 0-1Amperes 0-100 VDC / 0-.5 Amperes

Regulation: DC voltage change less than 100 microvolts for line and load variations over the operating range measured at the rear terminals.

Ripple and Noise (PARD): 100 microvolts peak to peak maximum when operated at line frequencies between 47 and 63 Hz. to 10 MHz.

Source Impedance: Less than 0.002 ohms at DC, 0.04 ohms at 20KHz, 0.5 ohms at 1MHz.

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 20% to 100% of rated load.

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

Temperature Coefficient: DC output voltage changes lass than 0.001% or 50μvolts, which ever is greater, per degree Celcius over the range O to +4 °C, less than 0.002% or 100 μvolts, whichever is greater, per °C from +45 to +60 °C.

Metering: Taut-band front panel volt-ammeter permits monitoring of the output voltage or current with an accuracy of ± 3% of full scale.

Remote Programming: Rear panel barrier strip terminals are provided for remote programming of the output voltage. The ratio of programming resistance to output voltage is 1000Ω / Volt. Programming accuracy is better than 0.01% of the programming including the resistance of the leads.

Calibration Accuracy: 0.1% + 0.5 mv of set value.

Current Limiting: Continuously adjustable by means of a front panel control. A "fault" lamp on the front panel indicates an overload or short circuit condition. Normal operation automatically resumes upon removal of overload condition.

Remote Sensing: Terminals are provided on the rear barrier strip to allow for remote sensing of the output voltage at the load.

Circuit Protection: The AC line and the DC load circuits are both protected by fuses.

Dimensions: 8½w x 4½h x 9¼d

Weight: 10 lbs, 4.55 kgs.

Enclosure: High impact ABS enclosure and rear panel. Front panel is Lexan.

SECTION 2
INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

This instrument is ready for operation as shipped from the factory. After unpacking, inspect for any damage that might have occured in shipping.

2.2 PRELIMINARY PROCEDURES

The power supply is shipped from the factory wired for 115 VAC operation unless otherwise specified at the time of order. If 220 VAC operation is required, refer to the schematic in the appendix of this manual for jumper changes.

2.2.1 Set the AC switch to the OFF position and connect the line cord to an appropriate source of AC power.

2.2.2 Set the decade voltage control switches to the maximum output settings.

2.2.3 Rotate the current control fully colckwise.

2.2.4 Set the Power switch to the ON position.The AC power indicator LED should light.

2.2.5 Set the meter function switch to the volts position. The meter should indicate the output voltage of the power supply. Set the output voltage to the desired level.

2.2.6 Connect the load to either the front or rear output terminals.

2.3 CONSTANT VOLTAGE OPERATION

2.3.1 Voltage Adjustment

(1) Set the voltage control decade switches to zero.

(2) Set the AC switch to the ON position.

(3) Set the meter function switch to the volts position.

(4) Set the decade switches to the desired output level.

2.3.2 Current Limiting

(1) Set the AC switch to the OFF position.

(2) Short circuit the output terminals and turn the AC switch ON. The power LED should turn on.

(3) Set the meter function switch to the AMPS position.

(4) Set the current limit knob so that output current as indicated on meter is at the desired level.

(5) Remove short circuit from output terminals.

2.3.2 Remote Current Limiting

(1) Disconnect the shorting link between RC1 and RC2 (terminals 7 and 8) on the rear barrier block.

(2) Connect the remote programming resistor between RC1 and DC1 (terminals 1 and 8).

(3) The programming constant is approximately 1K ohm for 1 ampere of output current.

2.3.3 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 at the rear termnal block, the power supply is connected for *local sensing*. When the sense leads are connected remotely to the load, the supply is connected for *remote sensing.* Remote sensing is used when an appreciable voltage drop (up to 0.4v) is anticipated in the leads connecting the output terminals to the load. The unit is connected for local sensing as shipped from the factory

For Remote Sensing:

(1) Remove the shorting links from DC+ and S+, and DC- and S- on the rear barrier block.

(2) Connect the DC+ and DC- terminals to the load.

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

(4) Turn the power supply ON. **CAUTION:** If one or both of the remote sensing leads are opened while the supply is operating the output voltage will rise approximately 0.6V above the set point.

2.3.4 Series Operation

As many as four units may be connected in series. 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.

2.3.5 Remote Voltage Programming

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

Turn the power supply OFF. Set the voltage decade switch to zero. Remove the shorting link on the rear barrier between RV1 and RV2 terminals. Select a programming resistance by multiplying the desired output voltage by 1000. A constant current of 1 milliampere will flow through this resistor and the wattage rating should be selected to minimize drift due to heating. Connect the external programming resistor between the RV1 and RV2 terminals on the rear barrier block using twisted or shielded wire. Connect the shield to chassis ground to minimize the output ripple. The programming accuracy is approximately .05% plus the accuracy of the programming resistor. The resistance of the remote programming wires used must be added to the resistor value to determine the total resistance.

SECTION 3
PRINCIPLES OF OPERATION

This precision power supply uses a "Linear Mode" series regulator system in conjunction with our patented ***Uniply®*** design to obtain a highly stable DC output with exceptionally low ripple and noise. This technique consists of placing an electronically controlled variable impedance (series regulator) between an unregulated DC source and the output terminals.

The main secondary winding of T1 (terminals 4, 5 and 6) in conjuction with CR3 and capacitors C3 and C4 produces two unregulated DC power sources that are tied in series. The series regulator transistors are connected between the raw DC supply and the output terminals of the supply.

If the output voltage requirement as determined by the setting of the voltage decade switches is less than the voltage provided by C4, the active series regulator transistors will be Q3 and Q4 with Q1 acting as a driver. If the output voltage requirement is greater than the voltage supplied by C18, CR4 will turn off and the current flow will be through Q2, Q3 and Q4. This reduces dissapation of the pass transistors at a low output voltage setting.

The auxillary winding of transformer T1 (Leads 1,2 and 3) in conjuction with C1 and C2 provide an unregulated bias voltage. The +12 volts that serves as a source of +VCC and as a reference for the current limiter is derived from U1. This is also the source of drive current for the series regulator transistors. A -5VDC voltage is developed across VR1 to provide VCC- for the amplifiers U2 and U3. C2 provides filtering for the -5V source.

The precision reference voltage is supplied by VR2. It is used as the reference source for the voltage regulator U3. The output voltage is compared to the reference voltage through the reference resistors R31 and R32 and the decade switch voltage control assembly. The amplifier tries to maintain zero volts at the summing junction (pin 3) of U3. A constant current of 1 milliampere flows through the feedback resistors (decade switch ass'y.)

The current limit threshold point is set by front panel potentiometer R39 and internal trimpot R20 which is tied to the +12V reference buss. The junction of R2 and R30 are connected to pin 5 of U2. Pin 6 of U2 is connected to the current sensing resistor R18. Pin 6 will become increasingly positive as the load current is increased. When the threshold point is exceeded U2 removes drive current from driver transistor Q6. When Pin 7 of U2 goes low, Q5 turns on causing the fault lamp DS2 to illuminate.

SECTION 4
MAINTENANCE

4.1 GENERAL

This section covers maintenance and calibration procedures. Under normal conditions, no special maintenance is required. If trouble does develop however, the enclosure is easily disassembled to provide access to the printed circuit board and its components.

Regulation and ripple measurements of the output voltage are an excellent indication of the power supply's performance. Special techniques must be employed to properly measure these parameters to avoid measuring voltage drops due to load current. Details of correct measuring procedures are described further along in this section of the manual.

A schematic diagram, a location of components drawing and a detailed electrical parts list are provided in the Appendix of this manual to assist in troubleshooting and repairing the power supply.

4.2 CALIBRATION

All of the internal controls of this instrument have been pre-set prior to shipment from the factory. Recalibration of the supply should be made at one year intervals. Calibration adjustments must be made if the power supply has been subject to a failure that required a component replacement. Calibration control function and location on the printed circuit board can be easily found by referring to the location of components drawing in the Appendix of this manual.

Disassemble the power supply enclosure by removing the screws that hold the plastic bumper feet on the bottom of the unit. Remove the top cover to allow access to the calibration controls. Turn the power supply ON and allow for a 30 minute stabilization period prior to proceeding with the calibration adjustment procedure.

4.2.1 EQUIPMENT REQUIRED

(1) 5 1/2 digit DVM with better than 0.1% accuracy.

(2) DC Ammeter, 0-5 Amperes with better than 0.5% accuracy.

(3) Electronic or resistive load.

4.2.2 ZERO VOLTAGE CALIBRATION

(1) Connect the DVM across the output terminals of the supply.

(2) Set the decade push switches for zero volts output. Set the vernier control fully CCW.

(3) Set the AC switch to the ON position.

(4) Set the zero volts adjust trimpot R25 so that the DVM indicates zero volts ±50mv.

4.2.3 MAXIMUM VOLTAGE ADJUSTMENT *(Note: Make this adjustment only after zero calibration adjustment)*

(1) Set the decade switches for the maximum output of the supply under test. (eg: 49.999V for the Model 5020A.)

(2) Set the vernier on front panel full CCW.

(3) Connect the DVM to the output terminals of the supply under test.

(4) Adjust the COARSE CALIBRATE control R32 so that the output voltage of the supply under test agrees with the DECADE SWITCH column of the chart below within ±200 mv.

Model	Decade Switch Setting	Final Eo Tolerance
2040A	19.999	±.001V
5020A	49.999	±.001V
1001A	99.999	±.001V

(5) Adjust the FINE CALIBRATE control R33 so that the output voltage of the supply agrees with the FINAL Eo TOLERANCE column of the chart.

4.2.4 MAXIMUM OUTPUT CURRENT ADJUSTMENT

(1) Connect an external ammeter across the power supply output.

(2) Set thge potput decade switch fo an output greater than 1 volt.

(3) Set the front panel current limit fully clockwise.

(4) Turn the power supply ON and adjust R20 for an output current of 5% above the maximum output rating of the supply.

4.2.5 AMMETER CALIBRATION

(1) With the external ammeter connected as in the preceeding step, adjust the front panel CURRENT LIMIT control so that the external ammeter indicates the current level in the chart below.

Model	Current
2040A	4 Amperes
5020A	2 Amperes
1001A	1 Ampere

(2) Set the meter function switch to the AMPS position.

(3) Adjust trimpot R14 so that the panel meter agrees with the external voltmeter ±3%.

4.2.6 VOLTMETER CALIBRATION

(1) Set the decade switch in accordance with the chart in paragraph 4.2.3.

(2) Adjust trimpot R26 so that the panel meter agrees with the setting of the decade switch ±3%.

4.3 POWER SUPPLY MEASUREMENT TECHNIQUES

Power supply performance measurements require special techniques to insure correct results. The correct location of instrumentation leads is critical, since voltage drops due to contact resistance and load curent flow may lead to misleading results.

Four wire measurement techniques as shown in Figure 1 must be employed to achieve correct results. The connecting leads must be arranged so that one pair carries the load current and a second pair is made to sense the output voltage without the voltage drop error produced by the flow of current through the resistance of the connecting wires.

4.4 TROUBLESHOOTING

When attempting to troubleshoot this unit, make sure that the shorting links between DC+ and S+, DC- and S-, RV1 and RV2 and RC1 and RC2 on the rear barrier block are installed and adequately tightened.

Measure the voltages indicated on the schmetic as a first step when troubleshooting the supply. These voltages should appear when the power supply is turned on and the output voltage is set to the maximum output rating of the supply and the current limit control is set fully clockwise.

4.1.1 No Output

(1) If the Power light does not come on, check that the power supply is connected to a live source of AC power of the proper voltage. Also check that the AC fuse on the rear panel is not open.

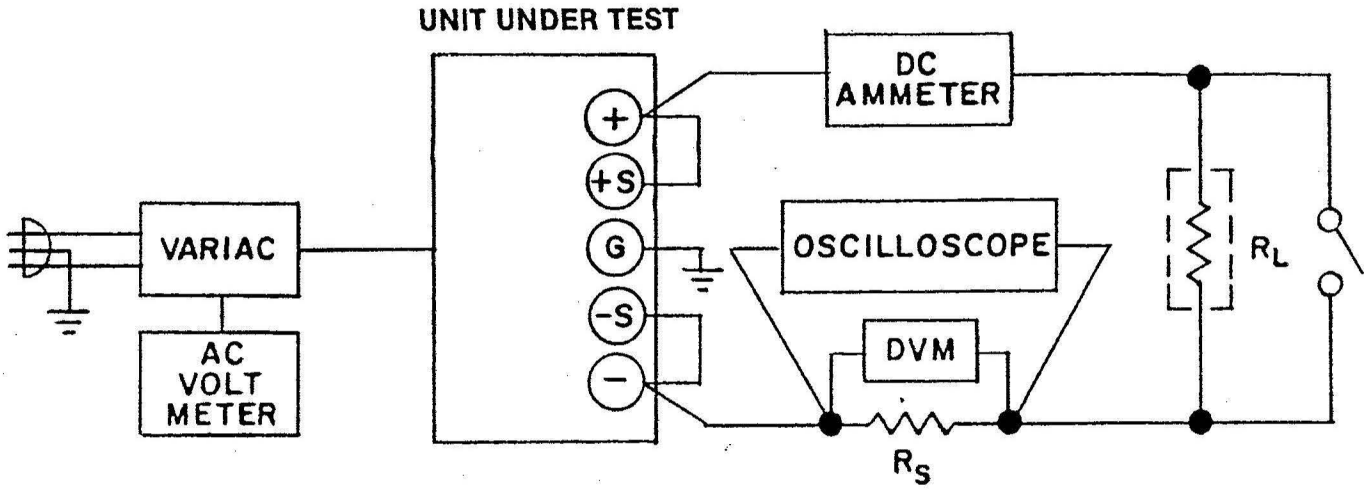
(2) Check that the DC fuse located on the printed circuit board is not open.

4.4.2 High Unregulated Output

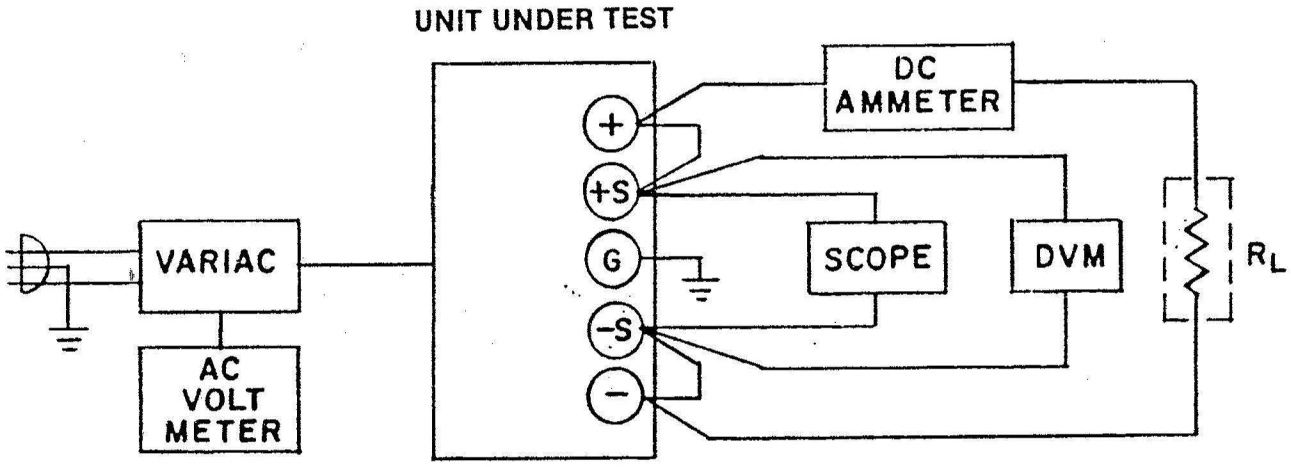
(1) Shorted series regulator transistor or shorted driver transistor.

(2) Open sensing links (DC+ to DC-) on the rear barrier block.

(3) Open links between RV1 and RV2 on the rear barrier blocks.



CONSTANT CURRENT MEASUREMENTS



CONSTANT VOLTAGE MEASUREMENTS

FIGURE 1

4.4.3 High Ripple and Noise

(1) Power supply is oscillating. This can be caused by long sensing leads or sensing leads that are not tightly twisted or shielded. If high frequency oscillation occurs when remote sensing, place a 20μf capacitor across the supply where the sensing leads are connected to the load.

(2) Remote voltage programming feaure is used and noise is picked up by the programming leads. Use tightly twisted or shielded wire for remote voltage programming connections.

4.4.4 Poor Regulation

(1) Poor regulation is frequenty the result of improper measurement techniques. Use a four wire measurement procedure as described in 4.3 to measure the supply's performance.

(2) High frequency oscillation is a common cause of poor regulation. Check that all connections on the rear barrier block are securely tightened. A defective output capacitor may cause the supply to oscillate.

SECTION 5
APPENDIX

5.1 GENERAL

This section contains the schematic diagram, a location of components drawing and an electrical parts list. All parts are listed in the sequence of their circuit designation numbers as shown on the schematic diagram.

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-9858A under which Power Designs Inc. has been qualified.

All semiconductors are specified not only for their normal operating parameters, but also for critical characteristics related to reliability and predictable life expectancy. Some of these characteristics are observed only 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. since 1975. Under this program, quality control procedures are constantly revalued 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 sometimes 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.

All replacement semiconductor devices are processed and stocked at the factory to insure complete interchangeability with the devices in the original equipment. When ordering replacement parts please identify the device as throughly as possible, giving the model and serial number if available.

ELECTRICAL PARTS LIST

MAIN CIRCUIT BOARD

REF. DES.	DESCRIPTION	PART NO.
B1	FAN, 12VDC, 39CFM	3110KL04WB40
C1	CAPACITOR, ELECTROLYTIC, 1000uF, 25V	
C2	CAPACITOR, ELECTROLYTIC, 330uF, 25V	
C3, C4*	CAPACITOR, ELECTROLYTIC, 1500uF, 80V	
C3,C4**	CAPACITOR, ELECTROLYTIC, 33,000uF, 25V	
C3,C4***	CAPACITOR, ELECTROLYTIC, 6800uF, 50V	
C5,C8	CAPACITOR, CERAMIC, 100pF, 100V	
C6	CAPACITOR, PLASTIC FILM, 0.0047, 100V	
C7	CAPACITOR, PLASTIC FILM, 0.0022, 100V	
C9	CAPACITOR, METAL FILM, 3.9uF,100V	
C10, C11	CAPACITOR, TANTALYTIC, 33uF,10V	
C13*	CAPACITOR, ELECTROLYTIC, 330uF, 50V	
C13**	CAPACITOR, ELECTROLYTIC, 330uF, 50V	
C13***	CAPACITOR, ELECTROLYTIC, 330uF, 100V	
C14	CAPACITOR, CERAMIC DISK, 0.1uF, 600V	
C15	CAPACITOR, CERAMIC DISK, 0.02, 600V	
CR1	RECTIFIER, BRIDGE, 1A, 200V	RS-103
CR3	RECTIFIER, BRIDGE, 6A, 200V	BR62
CR4	DIODE	GI504
CR5 - CR7	DIODE	1N4004
CR8 - CR14	DIODE	1N4936
DS1	LED, SUPERBRITE, GREEN	
DS2	LED, SUPERBRITE, RED	
F1	FUSE, SLO-BLO, 2A/250V,5MM	
F2*	FUSE, FAST ACTING, 2A/250V, 5MM	
F2**	FUSE, FAST ACTING, 5A/250V, 5MM	
F2***	FUSE, FAST ACTING, 3A/250V, 5MM	
J1	HEADER, 0.156 SPACING, 9 POSITION	3160-8-109-1
J2	HEADER, 0.156 SPACING, 3 POSITION	3160-8-103-1
J3,J5,J7	HEADER, 0.100 SPACING, 2 POSITION	1100-26-102-1
J4	HEADER, 0.156 SPACING, 5 POSITION	3160-8-105-1
M1*	METER, ANALOG, 0 -100V, 0 - 1A	MVA-187
M1**	METER, ANALOG, 0 -20V, 0 - 4A	MVA-188
M1***	METER, ANALOG, 0 -50V, 0 - 2A	MVA-185

* USED ON MODEL 1001A
** USED ON MODEL 2040A
*** USED ON MODEL 5020A

ELECTRICAL PARTS LIST

MAIN CIRCUIT BOARD

REF. DES.	DESCRIPTION	PART NO.
P1	CONECTOR, IDC, 0.156 SPACING, 9 POSITION	3360-109-422
P2	CONECTOR, IDC, 0.156 SPACING, 3 POSITION	3360-103-418
P3,P5,P7	CONECTOR, IDC, 0.100 SPACING, 2 POSITION	1300-102-422
P4	CONECTOR, IDC, 0.156 SPACING, 5 POSITION	3360-105-422
Q1 - Q4	TRANSISTOR, NPN	TIP35
Q5	TRANSISTOR, PNP	2N4401
Q6	TRANSISTOR, NPN	2N4403
Q7	TRANSISTOR, PNP	2N6520
R1	RESISTOR, METAL FILM, 2.74K OHM, 1%,1/4W	
R2	RESISTOR, WIREWOUND, 0.1 OHM, 10%,3W	
R3	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R4	RESISTOR, METAL FILM, 47.5K 0HM ,1%, 1/4W	
R5*	RESISTOR, METAL FILM, 475 0HM ,1%, 1/4W	
R5**	RESISTOR, METAL FILM, 2.1K OHM, 1%, 1/4W	
R5***	RESISTOR, METAL FILM, 1.13 K OHM, 1%, 1/4W	
R6	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R7	RESISTOR, METAL FILM, 27.4 0HM ,1%, 1/4W	
R8	RESISTOR, WIREWOUND, 0.2 OHM, 10%, 3W	
R9	RESISTOR, METAL FILM, 27.4 0HM ,1%, 1/4W	
R10, R11	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R12	RESISTOR, METAL FILM, 4.99K 0HM ,1%, 1/4W	
R13*	RESISTOR, METAL FILM, 845 0HM ,1%, 1/4W	
R13**	RESISTOR, METAL FILM, 649 0HM ,1%, 1/4W	
R13***	RESISTOR, METAL FILM, 223 0HM ,1%, 1/4W	
R14	RESISTOR, CERMET TRIMMER, 200 OHM, 10%, 1/2W	3386F-1-201
R15	RESISTOR, METAL FILM, 475K 0HM ,1%, 1/4W	
R16	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R17	RESISTOR, COMPOSITION, 10K OHM, 5%, 1/2W	
R18*	RESISTOR, WIREWOUND, 1 OHM, 10% 3W	
R18**	RESISTOR, WIREWOUND, 0.2 OHM, 10%, 3W	
R18***	RESISTOR, WIREWOUND, 0.2 OHM, 10%, 3W	
R19*	RESISTOR, METAL FILM, 66.5K 0HM ,1%, 1/4W	
R19**	RESISTOR, METAL FILM, 66.5K 0HM ,1%, 1/4W	
R19***	RESISTOR, METAL FILM, 174K 0HM ,1%, 1/4W	

* USED ON MODEL 1001A
** USED ON MODEL 2040A
*** USED ON MODEL 5020A

ELECTRICAL PARTS LIST

MAIN CIRCUIT BOARD

REF. DES.	DESCRIPTION	PART NO.
R20	RESISTOR, CERMET TRIMMER, 100K OHM, 10%, 1/2W	3386F-1-104
R21	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R22	RESISTOR, METAL FILM, 4.99K 0HM ,1%, 1/4W	
R23*	RESISTOR, METAL FILM, 97.6K 0HM ,1%, 1/4W	
R23**	RESISTOR, METAL FILM, 17.4K 0HM ,1%, 1/4W	
R23***	RESISTOR, METAL FILM, 47.5K 0HM ,1%, 1/4W	
R24	RESISTOR, METAL FILM, 845 0HM ,1%, 1/4W	
R25	RESISTOR, CERMET TRIMMER, 20K OHM, 10%, 1/2W	3296W-1-203
R26	RESISTOR, CERMET TRIMMER, 5K OHM, 10%, 1/2W	3386F-1-502
R27	RESISTOR, METAL FILM, 10K 0HM ,1%, 1/4W	
R28	RESISTOR, METAL FILM, 154K 0HM ,1%, 1/4W	
R29	RESISTOR, METAL FILM, 10K 0HM ,1%, 1/4W	
R30	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R31	RESISTOR, PRECISION, 6.87K 0HM, 0.1%, 1/8W	
R32	RESISTOR, CERMET TRIMMER, 1K OHM, 10%, 1/2W	3386F-1-102
R33	RESISTOR, CERMET TRIMMER, 20K OHM, 10%, 1/2W	3296W-1-203
R35	RESISTOR, METAL FILM, 2.26K 0HM ,1%, 1/4W	
R36	RESISTOR, METAL FILM, 1.05K 0HM ,1%, 1/4W	
R37	RESISTOR, CERMET TRIMMER, 10K OHM, 20%, 1/4W	
R38	RESISTOR, WIREWOUND, 0.2 OHM, 10%, 3W	
R39	RESISTOR, CERMET TRIMMER, 10K OHM, 20%, 1/4W	3310C-1-103
S1	SWITCH, PUSHBUTTON, DPDT, 7A/125V	P227EEX
S2	SWITCH, PUSHBUTTON, DPDT, 0.5A/125V	TA2UEE-C-AG-PN-TAC-BL
T1	TRANSFORMER	TTM-5020A-6
TB1	TERMINAL BLOCK	102209.01.000
U1	I.C., VOLTAGE REGULATOR, 12V	LM340AT-12
U2	I.C., DUAL OPERATIONAL AMPLIFIER	LM358AN
U3	I.C., OPERATIONAL AMPLIFIER	OP-05CP
VR1	DIODE, ZENER	1N4734A
VR2	DIODE, PRECISION REFERENCE	LM329DZ

* USED ON MODEL 1001A
** USED ON MODEL 2040A
*** USED ON MODEL 5020A

ELECTRICAL PARTS LIST

DECADE SWITCH ASSEMBLY

REF. DES.	DESCRIPTION	PART NO.
R40 - R48	RESISTOR, WIREWOUND, 1 OHM, 0.1%, 0.4W	
R49 - R57	RESISTOR, LOW T.C. METAL FILM , 10 OHM, 0.1%, 1/8W	
R58 - R66	RESISTOR, LOW T.C. METAL FILM 100 OHM, 0.1%, 1/8W	
R67 - R75	RESISTOR, LOW T.C. METAL FILM 1K OHM, 0.1%, 1/8W	
R76**	RESISTOR, LOW T.C. METAL FILM 10K OHM, 0.1%, 1/8W	
R76 - R79***	RESISTOR, LOW T.C. METAL FILM 10K OHM, 0.1%, 1/8W	
R76 - 84*	RESISTOR, LOW T.C. METAL FILM 10K OHM, 0.1%, 1/8W	
S3	DECADE, SWITCH	
	ENCODING SWITCH, 5 PC.	DP421CPNN-00
	END PLATE, 2PC	20DP100-01N
	SPACER, WITH DECIMAL POINT	20DP100-03N
	PEG STOP, 5 - 6 PC.	20A1050-000

* USED ON MODEL 1001A
** USED ON MODEL 2040A
*** USED ON MODEL 5020A