POWER SUPPLY

MODELS XP-660 / XP-760

Variable Regulated

Model XP-660

Model XP-760

7 56619 00035 0

Instruction Manual

Elenco Electronics, Inc.

 Revised 2000 REV-G 753660

Specifications for Model XP-660 @ 120VAC input

	0-20V Supplies	5V Supply
Input Voltage	110-135VAC 60 Hertz	Same
Output Voltage	0-20VDC Variable	5VDC $\pm$ .1V
Output Current	0-1A over 0-20V range	0-5A
Load Regulation	Less than .1V over 0-20V range	Less than .15V
Line Regulation	Less than .1V 110V to 130V	Less than .15V
Ripple RMS	Less than 5mV	Less than 10mV
Current Protection	.05 to 1A Variable current limiting	Current foldback
Short Protection	.05 to 1A current limit	Current foldback
Output Impedance	.1 ohms	.03 ohms

Specifications for Model XP-760 @ 120VAC input

	0-20V Supplies	5V Supply
Input Voltage	110-135VAC 60 Hertz	Same
Output Voltage	0-20VDC Variable	5VDC $\pm$ .1V
Output Current	0-1A over 0-20V range	0-5A
Load Regulation	Less than .1V over 0-20V range	Less than .15V
Line Regulation	Less than .1V 110V to 130V	Less than .15V
Ripple RMS	Less than 5mV	Less than 10mV
Current Protection	.05 to 1A Variable current limiting	Current foldback
Short Protection	.05 to 1A current limit	Current foldback
Output Impedance	.1 ohms	.03 ohms

Circuit Description

The Elenco XP-660 and XP-760 use the same basic power and regulator circuit. The only difference is in the display function. The XP-660 has two 0-1mA analog meters. These meters convert to a voltmeter by placing a 20kΩ resistor in series or an ampmeter by placing a .39 ohm shunt resistor across the meter.

The Model XP-760 has two 3 1/2 digit LED meters. Voltage is read by connecting the meter to a voltage divider on the power supply output. Current is read by connecting the meter to a shunt resistor in series with the power supply output.

When referring to the schematic diagrams, the circuit components associated with each supply can be identified by its number. The 5V supply begins with 100. The 0-20V Power One Supply begins with 300 numbers and the 0-20V Power Two Supply begins with 200 numbers. The basic circuit of these supplies consist of 1) The power source, 2) The regulator and 3) The readout circuit. These circuits are shown in Figure 1 and will be discussed in detail in the following paragraphs.

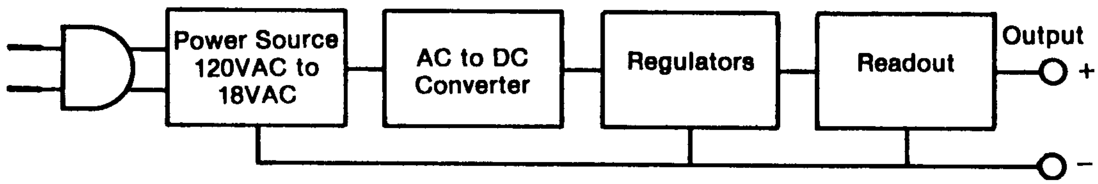


Figure 1 Block Diagram of 0-20V Power Supply

Power Source

The power supply for Models XP-660 and XP-760 consists of a transformer with four isolated step down windings. Connected to each winding is a diode bridge and a filter capacitor. The components on the Power One Supply are diodes D301, D302, D303, D304 and capacitor C304. These components convert the 120VAC input to 25VDC.

0-20V Regulators

Figure 2 shows a simplified circuit of the 0-20V regulator circuit. This circuit consists of a high gain amplifier transistor Q305. The gain of this stage is over 100,000 because of its extremely high load impedance. This load consists of a current source transistor Q301 and its biasing circuit. The effective resistance of this circuit is over 500,000 ohms. Transistor Q302 is a power device that controls the output current. Transistors Q303 and 304 are emitter followers used to prevent loading of the current source. Q301, Q302, Q305 and VR303 form a closed negative feedback loop. If you analyze this loop you will find that when the output voltage goes down due to increase output current, the voltage at the base of transistor Q305 goes negative. This reduces the current in transistor Q305 and thus the collector voltage will increase, returning the output voltage to very near its original value. The high gain is essential to the output voltage. Diode D309 is added to prevent drift with temperature changes and to allow the output voltage to go to zero.

To protect the regulator from overloads and short circuits, transistor Q306 is added. Whenever the voltage drops across resistor R309 reaches .6V, transistor Q306 will conduct and lower the collector voltage of amplifier Q305. To obtain variable current limiting, transistor Q306 is prebiased via resistor R309 and VR301 (see XP-660 schematic). This will allow the output current limit between .05 and 1 amp. Transistors Q307 and Q308 are added to light the overload LED.

5V Regulator

The circuit of the 5V regulator is shown on the schematic with components beginning with number 100. The heart of the regulator is IC1. This IC contains the same basic circuit as the 0-20V regulator, previously described (see schematic diagram of XP-660). Transistor Q102 is the pass transisitor that controls the output current. Transistor Q101 is used to increase the impedance of the pass transistor. Resistor R104 senses the current and shuts down the IC if the current exceeds 5 amps. The regulator features a current foldback circuit which reduces the current to less than 1 amp when the output is shorted. Resistors R105 and R106 form the current foldback circuit. Resistors R102 and R103 are added to form a stable 3.9V reference voltage for the IC to operate.

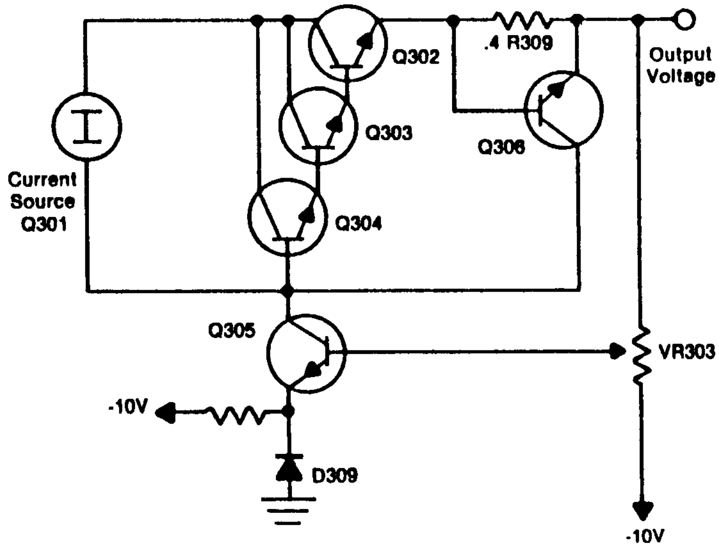


Figure 2 Simplified Regulator Circuit

XP-760 Digital Meters

Meter operation centers around the 7107 integrated circuit (IC). This chip contains a dual slope A/D (analog to digital) converter, display latches, seven segment decoder, and display drivers.

The input of the 7107 IC is fed to an A/D converter. Here the DC voltage is changed to a digital format. The resulting signals are processed in the decoders to light the appropriate LED segments.

Timing for the overall operation of the A/D converter is derived from a 40kHz external oscillator. The IC divides this frequency by four and the resulting clock pulses are used to drive its decade counters. It is then further divided to form three convert-cycle phases. The final readout is clocked at about 2.5 readings per second.

The digitized data is presented to the display as four decoded digits (seven segments) plus polarity. The decimal point position on the display is selected by the Volts/Amps switch.

A/D Converter - Any given measurement cycle performed by the A/D converter can be divided into three consecutive time periods, autozero (AZ), integrate (INTEG) and read. A counter determines the length of the time periods. The integrate period is fixed at 1,000 clock pulses. The read period is a variable time that is proportional to the unknown input voltage. It can vary from zero counts for zero input voltage to 2,000 counts for a full scale input voltage. The autozero period varies from 1,000 to 3,000 counts. For an input voltage less than full scale autozero gets the unused portion of the read period.

During the autozero cycle the accumulated offset voltage errors in the converter are measured and stored as a voltage on the external autozero capacitor. This voltage is used to correct for the offset voltage errors during the read cycle.

During the INTEG cycle the INTEG capacitor is charged up for 1,000 clock pulses (100ms.), see Figure 3. The charging rate is determined by the unknown input voltage. At the end of the integrate cycle the voltage on the capacitor is proportional to the unknown input voltage.

During the read cycle the INTEG capacitor is discharged at a constant rate. The time required for the discharge is therefore proportional to the unknown input voltage. This time is converted to a digital format by counting the number of clock pulses that occur during the discharge.

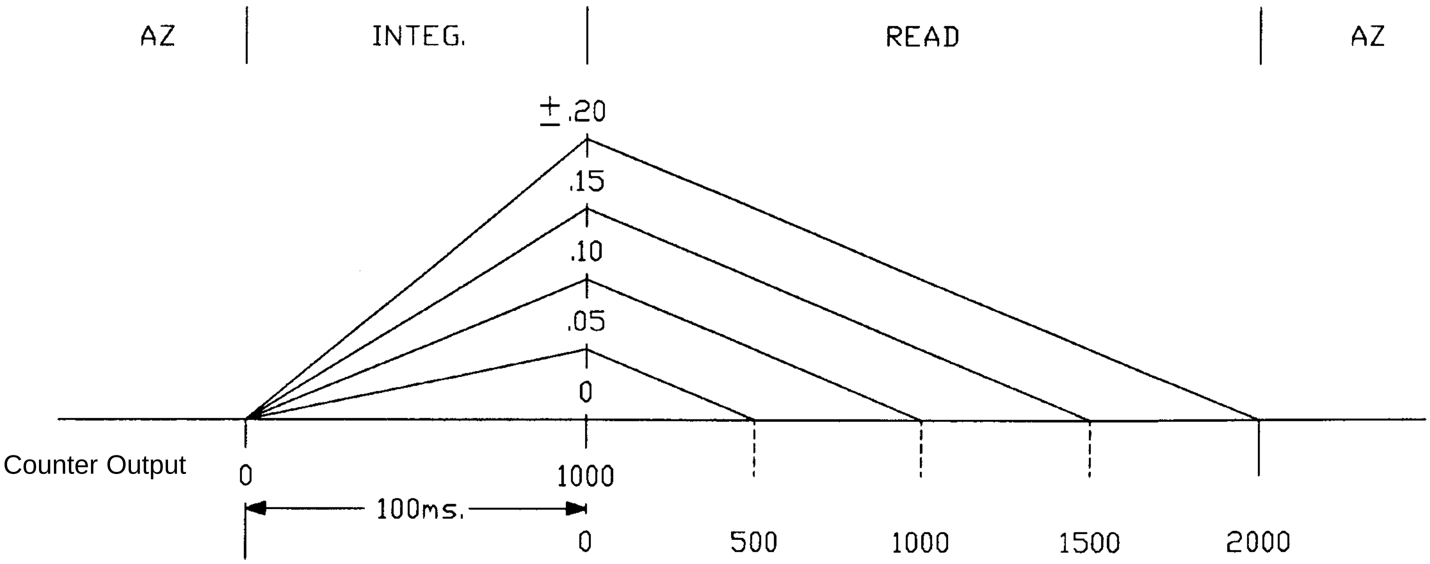


Figure 3 Dual Slope A/D Converter

Operation Instructions

1) Check the voltage rating of the equipment to be powered. Care must be taken not to exceed this rating.

2) Plug the line cord into a 120V 60Hz AC outlet.

3) Adjust the voltage control to the desired voltage. Load variation will have practically no effect on the voltage setting due to the special regulation circuit.

4) Connect the positive lead of your equipment to the red output terminal marked (+) and the negative lead to the black terminal marked (--).

5) Adjust the current limiting control to maximum counter-clockwise position. Switch your equipment on. The overload light will glow if excessive current is drawn. Increase this control until the light goes out and stays out during normal use. Your equipment is now protected from high current surges. An alternate method of adjusting current limiting is to short the output and adjust the current to a desired value. Remove the short. This will now limit the current to your setting.

6) Meters can be switched to read voltage or current.

Elenco Models XP-660 and XP-760 are extremely versatile power supplies. All supplies are completely isolated from each other. This means that they have separate grounds. By tying the ground terminal of one supply to the positive terminal of the other, you can obtain an output of 0-40V @ 1 ampere. Also by stacking the 5V terminal you can increase the output to 45V.

The 0-20V supplies have an adjustable current overload feature, a red LED will light when current limiting is activated. The current limit control adjusts the maximum current the supply will allow before automatically turning down the output voltage. This limit is between 50MA to 1 amp. You can set it to your desired limit by shorting out the output terminal and adjusting the current limit control to the desired current. Remove the short and attach the load. The maximum current drawn will be per your setting.

All three power supplies are protected against external shorts. The 0-20V supplies are protected by the current limiting feature. If the output is shorted the maximum current drawn will depend on the limit control setting. The 5V supply features a current foldback circuit. This circuit will limit the output current to less than 1 amp. When the short is removed, the output voltage will automatically reset to 5V.

Safety Precautions

Certain safety procedures must be observed when this power supply is used with external circuits that are connected to AC power lines. There is always some danger when working with electrical equipment or circuits that operate at hazardous voltages. You should thoroughly familiarize yourself with the equipment before working on it. High voltage may appear at unexpected points in defective equipment.

The Elenco power supplies are equipped with three wire line cords which ground the chassis to power line cord. **DO NOT CUT OFF OR DISABLE THE GROUND PLUG.**

The power supply secondary circuits are isolated from the 120V primary circuit via the power transformer. When working with other equipment, this may not always be the case. Always be familiar with the equipment rating. Keep in mind that defective equipment can have dangerous voltages at unexpected points. **CAUTION:** When removing the cover for fuse replacement, always disconnect the power cord from the AC socket. Service repair should only be done by qualified personnel who are knowledgeable of electrical hazards.

Maintenance and Calibration

The Elenco Models XP-660 and XP-760 have been designed and manufactured to require no routine maintenance. The circuits are protected by design from external shorts or overloads. The following information is provided in the event the supply requires service or re-calibration.

Fixed 5VDC Regulation Calibration

1) Connect an accurate digital meter to the output of the 5V supply.
2) Adjust the variable resistor VR101 to read 5.0 VDC.

Variable 0-20VDC Regulator Calibration

1) Connect an accurate digital meter to the output of the 0-20V supply.
2) Set the voltage pot to maximum position.
3) Adjust the variable resistor VR302 of Power One Supply for 20.0V. Adjust VR203 for Power Two Supply.

Digital Meter Calibration for Model XP-760

1) Note the small pot (R2) on the top of each meter's PC board. This is the GAIN pot which controls the accuracy of the meter.

2) To set the accuracy of the meter you need another very accurate digital meter. Connect this meter to measure the voltage on the output terminals of the supply under adjustment. Set the output to 18VDC. Set the Volts/Amps switch to Volts and adjust the GAIN pot for 18.0 on the XP-760 meter.

3) To set the accuracy of the current measurement connect a suitable load to the output and connect the accurate digital meter to measure the current in the load. Set the Volts/Amps switch to Amps. Set the output current to 0.8 amps. Adjust VR304 (Power One Supply) or VR204 (Power Two Supply) for a reading of 0.8 on the XP-760 meter.

Parts List XP-660

Resistors

Qty	Description		Part #
☐ 2	R105	.14Ω 5% 5W	101405
☐ 2	R213, 313	.39Ω 5% 2W	103911
☐ 2	R210, 310	68Ω 5% 1/4W	126800
☐ 4	R208, 209, 308, 309	200Ω 5% 1/4W	132000
☐ 2	R211, 311	270Ω 5% 1/4W	132700
☐ 4	R202, 203, 302, 303	470Ω 5% 1/4W	134700
☐ 3	R101, 222, 322	1kΩ 5% 1/4W	141000
☐ 4	R206, 214, 306, 314	1.2kΩ 5% 1/4W	141200
☐ 2	R201, 301	1.2kΩ 5% 1/2W	141201
☐ 2	R205, 305	2kΩ 5% 1/4W	142000
☐ 2	R215, 315	3.3kΩ 5% 1/4W	143300
☐ 1	R102	10kΩ 5% 1/4W	151000
☐ 2	R217, R317	20kΩ 1% 1/4W	152030
☐ 3	R103, 204, 304	22kΩ 5% 1/4W	152200
☐ 1	R104	27kΩ 5% 1/4W	152700
☐ 2	R216, 316	100kΩ 5% 1/4W	161000
☐ 2	R218, 318	200Ω Trim Pot LD	191320
☐ 3	VR101, 202, 302	5kΩ Trim Pot SU	191451
☐ 2	VR201, 301	200Ω Pot Panel	192320
☐ 2	R203, 303	5kΩ Pot Panel	192450

Capacitors

Qty	Description		Part #
☐ 3	C104, 206, 306	.001µF Disc	231036
☐ 5	C103,201,202,301,302	100µF Lytic 25V	281045
☐ 2	C205, 305	100µF Lytic 35V	281046
☐ 3	C105, 210, 310	100µF Lytic 25V (axial)	281055
☐ 2	C203, 303	2200µF Lytic 25V	292225
☐ 2	C204, 304	3300µF Lytic 50V	293347
☐ 2	C101, 102	4700µF Lytic 16V	294744

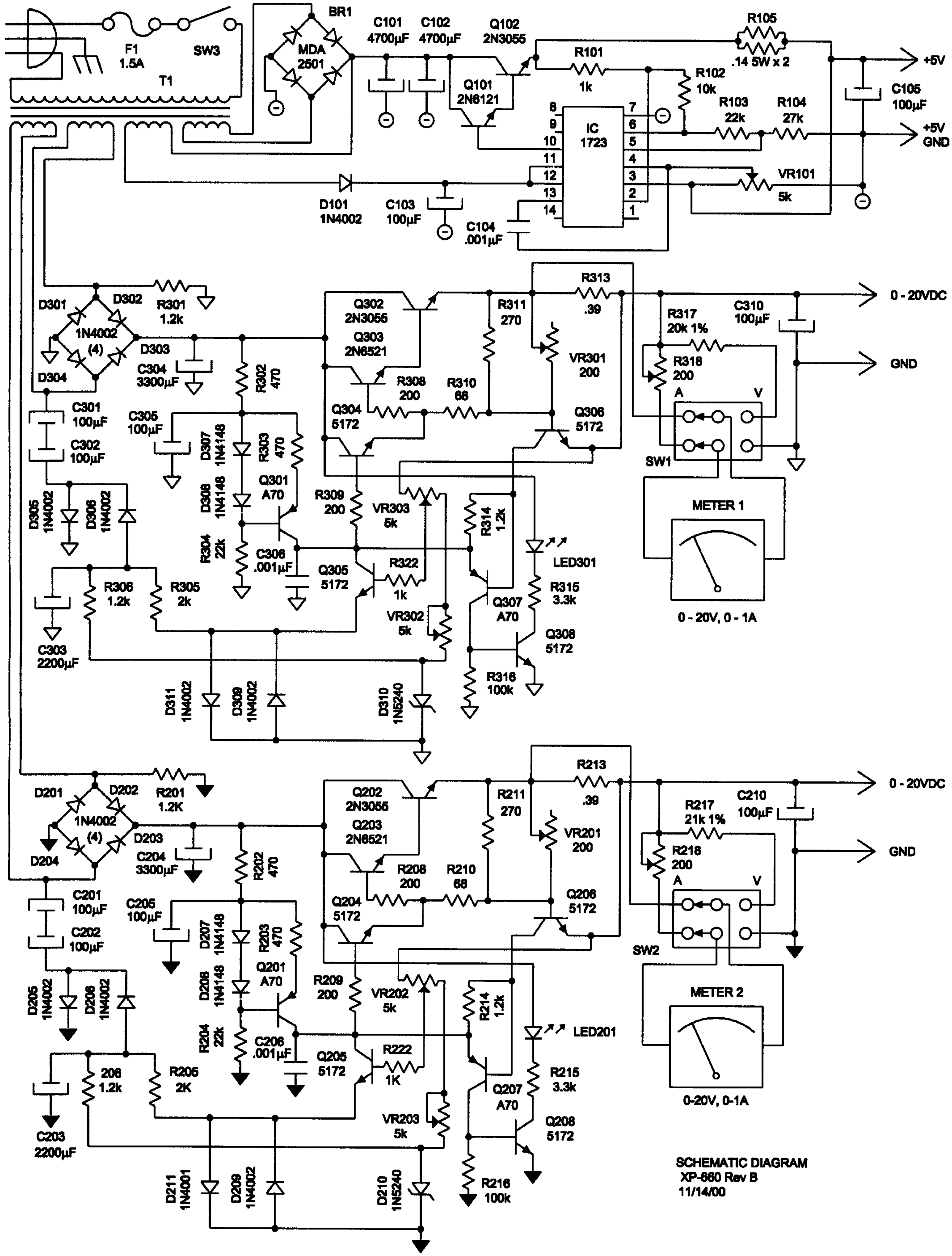
Semiconductors

Qty	Description		Part #
☐ 1	BR1	Diode bridge 6A	310148
☐ 2	D211, 311	Diode 1N4001	314001
☐ 15	D101, 201-206, 209, D301-306, 309	Diode 1N4002	314002
☐ 4	D207, 208, 307, 308	Diode 1N4148	314148
☐ 2	D210, 310	Diode Zener 1N5240 10V	315240
☐ 4	Q201, 207, 301, 307	Transistor MPSA70	320070
☐ 1	Q101	Transistor TIP120	320120
☐ 3	Q102, 202, 302	Transistor 2N3055	323055
☐ 8	Q204-206, 208, Q304-306, 308	Transistor MPS5172	325172
☐ 2	Q203, 303	Transistor MPS6521	326521
☐ 1	IC	IC MC1723	331723
☐ 2	LED201, 301	LED Red	350001

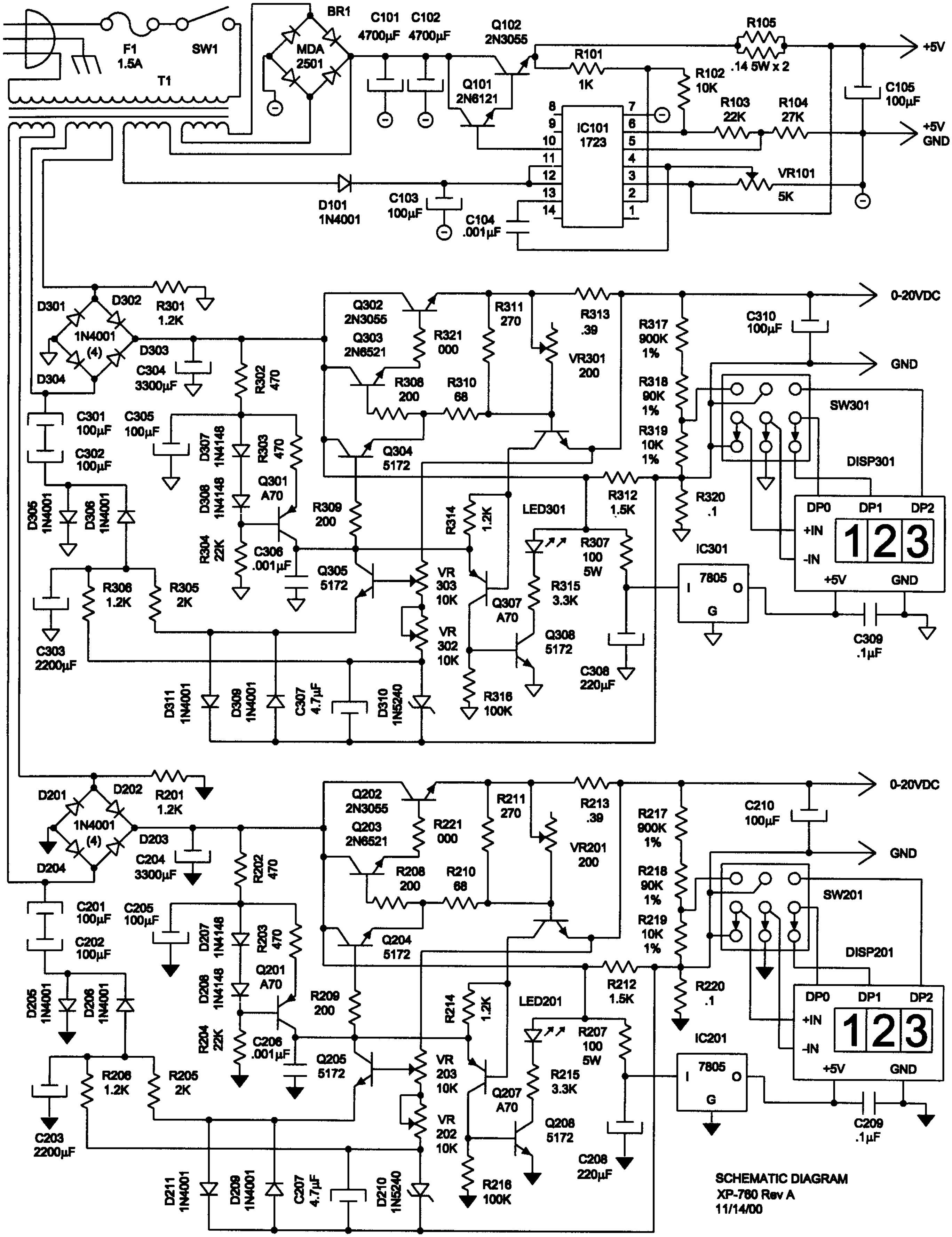
Miscellaneous

Qty	Description	Part #
☐ 1	Transformer	440660
☐ 1	PC Board	512010
☐ 1	Fuse 1.5A Slow Blow	520150
☐ 2	Switch slide DPDT	541111
☐ 1	Switch Illuminated	541204
☐ 2	Volt/Amp Meter	571020
☐ 1	Cover	611060
☐ 1	Chassis	611660
☐ 1	Heatsink 1 TO-3	615001
☐ 2	Heatsink Ham Rod	615100
☐ 4	Knob	622009
☐ 1	Bushing Strain 3 wire	624003
☐ 3	Binding Post Black	625031
☐ 7	Binding Post Hex Nut	625031HN
☐ 7	Binding Post Lockwasher	625031LW
☐ 3	Binding Post Red	625032
☐ 1	Binding Post Green	625033
☐ 4	PCB Stand-off 4-40	625002
☐ 2	LED Lens	626014
☐ 6	Cable Ties	628982
☐ 1	Rivet .122	632211
☐ 1	Screw 6-32 x 1/2”	641665
☐ 4	Screw 8-32 x 3/8”	641840
☐ 4	Screw 6 x 3/8” Truss, AB	642652
☐ 8	Screw 6 x 3/8” AB	642660
☐ 1	Nut 6-32 Small	644601
☐ 4	Nut 8-32	644800
☐ 4	Nut 7mm	644101
☐ 4	Washer 8mm	645101
☐ 6	Washer 1/8”	645600
☐ 11	Lockwasher 5/16”	646101
☐ 1	Lockwasher #6	646600
☐ 5	Lockwasher #8 Ext.	646828
☐ 2	Lug ground	661001
☐ 4	Lug Solder #8	661002
☐ 1	Fuse Holder Lower Body	663005LB
☐ 1	Fuse Holder Nut	663005N
☐ 1	Fuse Holder Upper Body	663005UB
☐ 1	Fuse Holder Washer	663005W
☐ 1	IC Socket 14-Pin	664014

Schematic Diagram XP-660



Schematic Diagram XP-760



Parts List XP-760

Qty	Description		Part #
	Resistors		
☐ 2	R105	.14Ω 5% 5W	101405
☐ 2	R213, 313	.39Ω 5% 2W	103911
☐ 2	R210, 310	68Ω 5% 1/4W	126800
☐ 2	R207, 307	100Ω 5% 7W	131017
☐ 4	R208, 209, 308, 309	200Ω 5% 1/4W	132000
☐ 2	R211, 311	270Ω 5% 1/4W	132700
☐ 4	R202, 203, 302, 303	470Ω 5% 1/4W	134700
☐ 2	R219, 319	910Ω 5% 1/4W	139100
☐ 3	R101, 222, 322	1kΩ 5% 1/4W	141000
☐ 4	R206, 214, 306, 314	1.2kΩ 5% 1/4W	141200
☐ 2	R201, 301	1.2kΩ 5% 1/2W	141201
☐ 2	R307, 312	1.5kΩ 5% 2W	141503
☐ 2	R205, 305	2kΩ 5% 1/4W	142000
☐ 2	R215, 315	3.3kΩ 5% 1/4W	143300
☐ 1	R102	10kΩ 5% 1/4W	151000
☐ 3	R103, 204, 304	22kΩ 5% 1/4W	152200
☐ 1	R104	27kΩ 5% 1/4W	152700
☐ 2	R216, 316	100kΩ 5% 1/4W	161000
☐ 2	R217, 317	1MΩ 5% 1/4W	171000
☐ 2	VR201, 301	200Ω Pot LD	191320
☐ 1	VR101	5kΩ Pot SU	191451
☐ 2	VR302, 303	10kΩ Pot SU	191516
☐ 2	VR204, 304	200Ω Pot Panel	192320
☐ 2	VR202, 203	10kΩ Pot Panel	192511
☐ 2	R220, 320	.01Ω Shunt Wire	897120
	Capacitors		
☐ 3	C104, 206, 306	Disc .001µF Z5V	231036
☐ 2	C209, 309	Disc .1µF	251010
☐ 2	C207, 307	Lytic 4.7µF 50V Radial	264747
☐ 7	C103, 201, 202, 205 C301, 302, 305	Lytic 100µF 25V	281045
☐ 3	C105, 210, 310	Lytic 100µF 25V Axial	281055
☐ 2	C208, 308	Lytic 220µF 25V	282245
☐ 2	C203, 303	Lytic 2200µF 25V	292225
☐ 2	C204, 304	Lytic 3300µF 50V	293347
☐ 2	C101, 102	Lytic 4700µF 16V	294744
	Semiconductors		
☐ 1	BR1	Diode bridge 6A	310148
☐ 17	D201-206, 209, 211 D301-306, 309, 311	Diode 1N4001	314001
☐ 4	D207, 208, 307, 308	Diode 1N4148	314148
☐ 2	D210, 310	Diode Zener 1N5240 10V	315240
☐ 4	D201, 207, 301, 307	Transistor MPSA70	320070
☐ 3	Q102, 202, 302	Transistor 2N3055	323055
☐ 8	Q204, 206, 208, Q304-306, 308	Transistor MPS5172	325172
☐ 1	Q101	Trans. 6121/1061	326121
☐ 2	Q203, 303	Trans. MPS6521	326521

Qty	Description		Part #
	Semiconductors (Con't)		
☐ 1	IC101	MC1723	331723
☐ 2	IC201, 301	MC7805CT	337805
☐ 2	LED201, 301	LED Red	350001
	Miscellaneous		
☐ 2	LED Display		355614MI
☐ 1	Transformer		440660
☐ 1	PC Board		512010
☐ 1	Fuse 1.5A Slow Blow		520150
☐ 2	Switch 3PDT		541047
☐ 1	Switch Illuminated		541204
☐ 1	Cover		611060
☐ 1	Heat Sink 5V		615001S
☐ 2	Heat Sink Clip On		615005
☐ 2	Heat Sink 20V		615100F
☐ 4	Knob Push On		622009
☐ 1	Bushing		624003
☐ 4	PCB Stand Off		625002
☐ 3	Binding Post Black		625031
☐ 7	Binding Post Lockwasher		625031LW
☐ 7	Binding Post Hex Nut		625031HN
☐ 3	Binding Post Red		625032
☐ 1	Binding Post Green		625033
☐ 2	LED Lens Red		626014
☐ 5	Cable Tie		628982
☐ 7	Rivet .122		632211
☐ 1	Screw 6-32 x 1/2”		641665
☐ 4	Screw 8-32 x 3/8”		641840
☐ 4	Screw 6 x 3/8” Truss, AB		642652
☐ 8	Screw 6 x 3/8”		642660
☐ 4	Nut Hex 7mm		644101
☐ 1	Nut 6-32		644600
☐ 1	Nut 6-32 Small		644601
☐ 4	Nut 8-32		644800
☐ 3	Washer Flat #8		645008
☐ 4	Flat Washer Pot 8 x 14mm		645101
☐ 4	Washer Fiber #4		645404
☐ 7	Flat Washer 1/4” OD		645600
☐ 1	Lockwasher #6		646600
☐ 5	Lockwasher #8 Ext.		646828
☐ 4	Lockwasher Pot 3/8”		646900
☐ 2	Lug Ground		661001
☐ 1	Lug Solder		661002
☐ 4	Feet		662001
☐ 1	Fuse Holder Lower Body		663005LB
☐ 1	Fuse Holder Nut		663005N
☐ 1	Fuse Holder Upper Body		663005UB
☐ 1	Fuse Holder Washer		663005W
☐ 1	IC Socket 14-Pin		664014
☐ 1	Line Cord 3 Wire		862105

WARRANTY POLICY

All of our instruments have been tested and conform to our rigid requirements on performance and durability, they are guaranteed to be free of defects in workmanship, materials and construction for a period of 2 years. If this product should fail in normal use within the first 3 months from the date of purchase, Elenco will repair or replace the unit at no cost. For the remainder of the warranty period, a nominal service charge is required to cover shipping and handling. Elenco will either repair or at its sole option, replace any part except for fuses, probes, lamps, batteries and other optional materials which are defective in either workmanship or material under normal and proper use.

This warranty does not cover equipment which has been tampered with in any way, or damage caused by accident, negligence, alteration, misapplication or unassembled products. This product must be returned transportation prepaid, properly packed and insured and must include proof of purchase. This warranty applies only to the original purchaser. **NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED. ELENCO IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.** Please contact Elenco for further instructions before returning your instrument.

Direct all warranty inquiries to:

Elenco Electronics, Inc. • Service Department

150 West Carpenter Avenue, Wheeling, IL 60090 • Phone: (847) 541-3800

Elenco Electronics, Inc.
150 W. Carpenter Avenue
Wheeling, IL 60090
(847) 541-3800
Fax: (847) 520-0085
http://www.elenco.com
e-mail: elenco@elenco.com