ORIEL

500 WATT MERCURY ARC LAMP SUPPLY MODEL 68810

INSTRUCTION MANUAL

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INSTRUCTION MANUAL

Please read these instructions completely before operating this equipment.

If there are any questions or problems regarding the use of this equipment, please contact:

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SECTION I - INTRODUCTION

The Oriel Model 68810 is one of a series of switched-mode arc lamp supplies. Its intended use is to drive 200, 350 or 500 watt Mercury arc lamps, such as Oriel Model 6283 or Model 6286 or Model 6285.

The power converters in these units are switched at a relatively high frequency (20-50 kHz). This technique yields several advantages. The high frequency ripple is easier to filter, the power components (transistor and choke) are smaller and lighter, and efficiency is greatly improved. Also, the high frequency transient response is improved, allowing for externally controlled lamp intensity modulation.

The list of features for these units is extensive, including such items as:

- Operation from 115/230 VAC, 50/60 Hz. With change-over enabled by a rear panel switch.
- Setting of lamp power prior to ignition.
- Output regulation on lamp power (voltage x current).
- Direct power metering, with voltage and current readings available on demand.
- Photofeedback option available.
- Remote metering signals are available at a rear panel connector.
- Option 19" rack mount available.

The packaging of this supply was done with ease of maintenance in mind. With the exception of large power components, all circuitry is located on three easily removable printed circuit cards. All internal calibration potentiometers are located at the left side of the unit, and are readily accessible with the top cover removed.

SECTION II - SPECIFICATIONS

AC Power Input	:	95-130 VAC, 190-260 VAC, 50/60 Hz
DC Power Output	:	600 Watts maximum, 12 Amperes maximum
Light Ripple (50/60 Hz)	:	1.0% RMS Typical
Preadjust Accuracy	:	+/- 2%
Power Meter Accuracy	:	+/- 1%
Stability (after 10 Minute warm-up)	:	+/- 0.2%
Line Regulation	:	+/- 1.0% (over total voltage excursion)
Output Current Limit	:	12 Amperes (+/- 0.5)
Output Voltage	:	Preignition, 120 VDC minimum (unloaded); 90 VDC maximum (loaded)

SECTION III - CONTROLS AND FUNCTIONS

A. Front Panel

Output Pre-adjust Switch	:	Momentary pushbutton switch. When depressed, causes the meter to display lamp power setting prior to ignition.
Meter	:	Has three scales - Watts, Amperes and Volts.
Watts/Volts/Amperes Switch	:	Three position toggle switch, spring-loaded to center position. In the center position, causes the Meter to display lamp power. In the left position, causes the Meter to display lamp voltage. In the right position, causes the Meter to display lamp current.
Output Potentiometer	:	Ten turn potentiometer with friction lock. Sets lamp power.
Lamp Start Switch	:	Momentary pushbutton switch. Used to ignite lamp. Ignition occurs when pressed.
Power Switch	:	Rocker switch. Used to apply power to the unit. Includes a "Power On" indicator lamp and the circuit breaker for the power supply.

B. Rear Panel *Mating connector part numbers given.

J1-Interlock Connector * Cinch/Jones #P302-CCT	:	Two pin connector for interlock cable from the lamp housing.

J2-Remote Connector
* Viking #TKP12-103 : Twelve pin connector providing the following input/output signals:

Pin 1 - Photofeedback Control Input (12 volts max.)
2 - Reference (Buffered Output Control setting) output
3 - Common (ground)
4 - N/C
5 - 117 VAC output
6 - N/C
7 - 117 VAC output
8 - N/C
9 - Remote Meter Power output
10 - Remote Meter Current output
11 - Remote Meter Voltage output
12 - Remote Meter Common output

J3-Accessories AC Outlet : Three pin (grounded) unswitched AC power outlet. Provides AC power at the same line voltage that the unit is plugged into.

J4-AC Input Connector : Three pin (grounded) power input connector. Designed to accept power cords for virtually any country's power system.

J5-Igniter Drive Connector
* Cinch/Jones #P303-CCT : Three pin (grounded) connector providing 100V P/P, 35Hz igniter drive signals for time that the start switch is pressed.

J6-Lamp + Connector
* Amphenol #PL-259 : One pin connector providing positive voltage to the lamp anode.

J7-Lamp - Connector
* Amphenol #PL-259 : One pin connector providing negative voltage to the lamp cathode. This is 1 ohm above ground.

S5 Line Switch, 115/230	:	Two position slide switch. Used to set the internal circuitry to match the applied AC power input voltage. The 115 position covers input voltages between 95 and 130 VAC. The 230 position covers input voltages between 190 and 260 VAC.

SECTION IV - SET-UP AND USE

A. Safety

There are two major areas of concern pertaining to personal safety when using this piece of equipment. The first has to do with the power supply itself, and the second has to do with the lamp powered by this supply.

1. Power Supply

The common, or minus, side of the power supply output is connected through a 1 ohm resistor to earth ground at a single chassis ground point. It is undesirable that the + lamp output connection come in contact with any other ground reference or especially any person. As long as the power supply is turned on, there will be a DC voltage across the lamp output connectors (J6 and J7) in excess of 120 volts when the lamp is not ignited. When the unit is turned off, allow at least three minutes for the internal filter capacitors to discharge. This charge status may be monitored by the front panel Meter.

The front panel wattmeter is accurate under load conditions, and should have no offset errors. The specification on accuracy is +/- 1%. Also, the output Pre-Adjust accuracy is +/- 2%.

When the pre-ignition output voltage is present, however, there may be some offset present at the front panel meter. This offset may be either positive or negative. This is caused by the fact that there is a large voltage signal into the power multiplier, and an ever so small (nominally zero) current signal at this time.

It is possible that this power supply may be used with a separate stand-alone igniter (Oriel Model 68705) if the lamp housing does not have a built-in igniter. In that case, an additional danger exists at the output of the igniter. During ignition, one or more high voltage pulses will be generated at a level of 20-30 kV. This output could, under certain conditions, become lethal for any person coming in contact with it.

2. Arc Lamp

Because of the nature of the high pressure arc lamps used with this supply, and because of the high degree of shortwave ultrawave radiation produced, there are several precautions that should be observed while working with these lamps. These precautions are:

a) Read and become thoroughly familiar with any manufacturers information supplied with individual lamps.

b) Do not look at any direct, specular (mirror) or diffuse reflections of the lamp's output beam even for short periods of time without the use of protective glasses or goggles.

c) Wear appropriate goggles or other protective devices when directly observing illuminated lamps.

d) Handle the lamps with extreme care, avoiding fingerprints or other contaminants which could weaken the quartz envelope.

IF OZONE FREE LAMPS ARE NOT USED, BE CERTAIN TO PROVIDE ENOUGH VENTILATION TO PREVENT EXCESSIVE OZONE BUILD-UP.

B. Installation

Installation of the 68810 is straightforward and should not present any particular problem. Before plugging in the power cord, be certain that the 115/230 Line Voltage switch is in the correct position. BE CERTAIN NOT TO BLOCK THE AIR EXHAUST PORTS AT THE SIDES, AND THE AIR INTAKE FAN AT THE REAR OF THE UNIT.

The two-wire safety interlock cable from the lamp housing should be connected to J1 on the rear panel. If the lamp housing does not have a safety interlock cable, a jumper connector must be plugged in at J1 or the power supply will not generate an output.

NOTE: If the interlock system is open, the POWER indicator will illuminate and the fan will be driven, there won't be any open circuit voltage, and no preignition pulses will occur after depressing the LAMP START switch.

If there is an igniter built into the lamp housing, connect the lamp anode (bottom) lead to J6 and the lamp cathode (top) lead to J7 at the rear of the power supply.

If there is a separate stand-alone igniter, the top lamp lead connects to the black connector and the bottom lamp lead connects to the red connector on the igniter. In turn, the top cable from the igniter connects to J6 and the bottom cable from the igniter connects to J7 at the rear of the power supply.

The three-wire cable from the lamp housing (or igniter) connects to J5-IGNITER DRIVE at the rear of the power supply.

The AC power cable for the lamp housing should be connected to any convenient AC outlet or to connector J3 of the power supply.

The Model 68810 may be 19" rack mounted if so desired. Please contact Oriel Corporation for details.

C. Operations

1. With all lamp and power cables in place, turn on the front panel POWER switch. The POWER indicator should illuminate, and the cooling fan should turn.

2. The output pre-ignition voltage (+120V DC minimum) will be available when power is applied. Before igniting, depress the OUTPUT PRE-ADJUST BUTTON and adjust the OUTPUT control for the desired lamp wattage as indicated on the Meter. Push the Meter switch to the VOLTS position and verify that a pre-ignition voltage of at least 120 volts is available.

3. Depress the LAMP START switch for several seconds. The lamp should ignite and lamp power should be well below the Pre-adjust level. The lamp current should be limited at 12 amperes. As the lamp warms up, the voltage and power will rise, but current will remain at the limit until the Pre-adjust level (+/- 2%) is reached. At that point, the power should hold constant and the lamp current should begin to fall at a fairly rapid rate.

   Final lamp currents should be within the range specified by the manufacturer.

   If the lamp does not ignite immediately, repeat the ignition procedure.

If the lamp ignites, but the lamp current does not fall to a reasonable value (or wattage does not climb to the Pre-adjust level), check that there is not too much cooling on the lamp.

4. If the lamp does not ignite after a few attempts, please check the following:

   a) All lamp connections and connectors should be tight and of the correct polarity.

   b) All exposed metal surfaces in electrical contact with either lamp terminal such as support clamps, holders, terminal lugs, etc., should be at least 3/4 of an inch from any grounded metal surface to prevent arcing when the igniter is in operation.

   c) The LAMP START button must be depressed to apply power to the drive circuit.

SECTION V - CIRCUIT DESCRIPTION

A. Overview of the Oriel Model 68810 Arc Lamp Power Supply

The Oriel Model 68810 power supply is a DC-DC converter. It is a step down switching regulator operating at 20 kHz. Please refer to Figure 5.1 for the block diagram of this supply.

The input mains voltage is transformer coupled, rectified to produce pulsating DC, and filtered. The PWM then turns the power switch on and off at a 20 kHz rate. These high frequency pulses of current are filtered to provide a DC output to the arc lamp. Control of power output is done by the regulator board which senses output voltage and current, multiplies them, and then compares the result to a reference voltage. Any deviation is an error, and the control IC will adjust the PW to minimize the error of the output power. The result is a constant power output to the arc lamp.

A detailed circuit description is given on the following pages. Please refer to schematic number 68810-4-1001 and Figure 5.2 when reading this section.

B. Mains AC-DC Conversion and Auxiliary Power Supply

The mains voltage is brought in via J304 at the rear panel. The unswitched and unfused accessory socket J303 is connected here as well as to the front panel power/CB switch and then to the 110/220V switch. This switch (S301) places the primary of step-down transformer (T101) in parallel for 110 VAC operation or in series for 220 VAC operation. The cooling fan and connections (D) and (E) are always at 110 VAC operation.

T101 isolates and steps down the input mains so that at nominal line there will be 100 VAC on the secondary. This is rectified and filtered by CR101 and C101 to provide an unregulated source of DC voltage for the main regulator circuit. At nominal line and no load this is at 140 VDC. R101 will safely discharge C101 in five minutes time.

The other secondaries of T101 each go to the three circuit boards to provide power for the regulator PCB, the switch drive PCB, and the igniter drive and output monitor PCB.

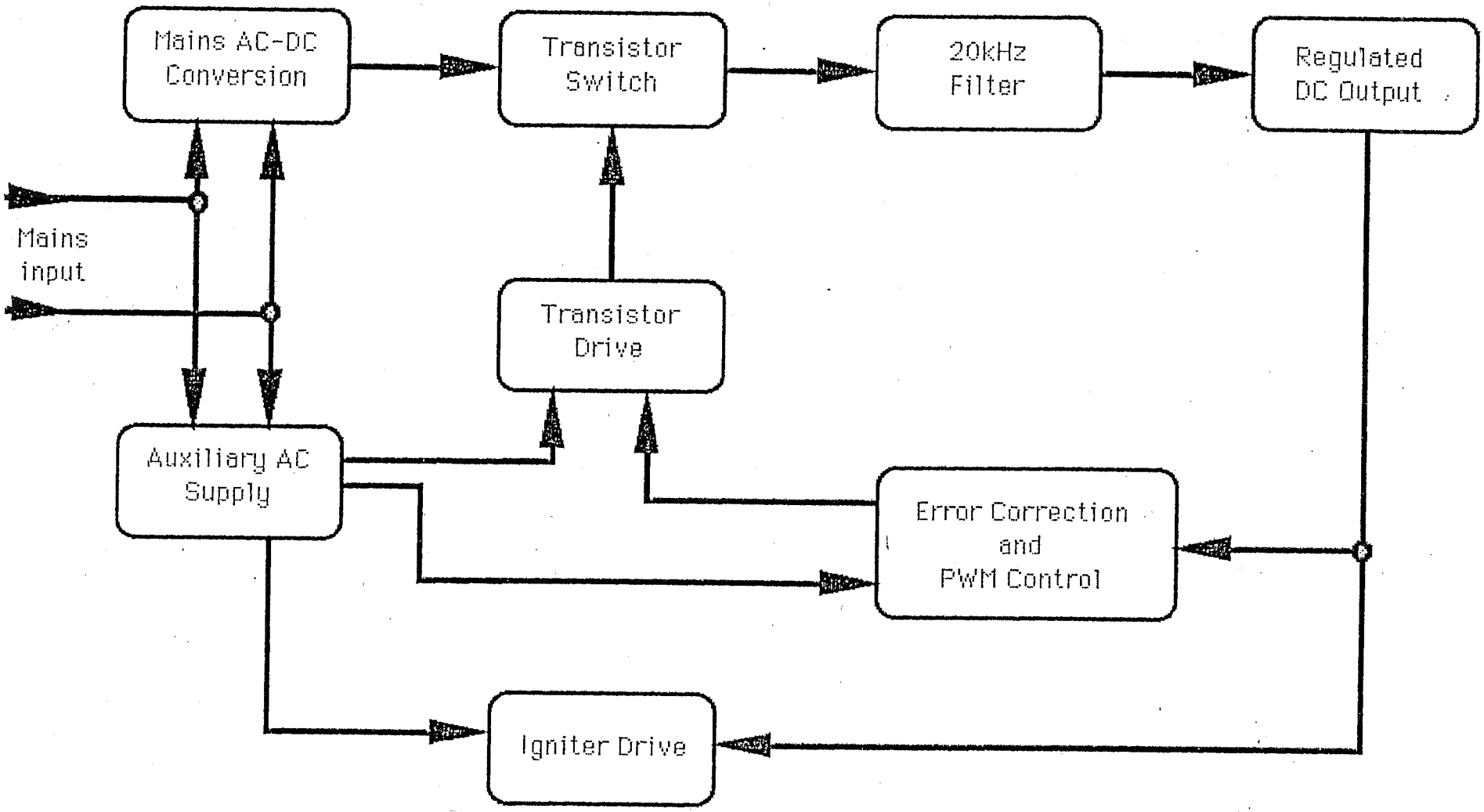


Figure 5.1 Power Supply Block Diagram

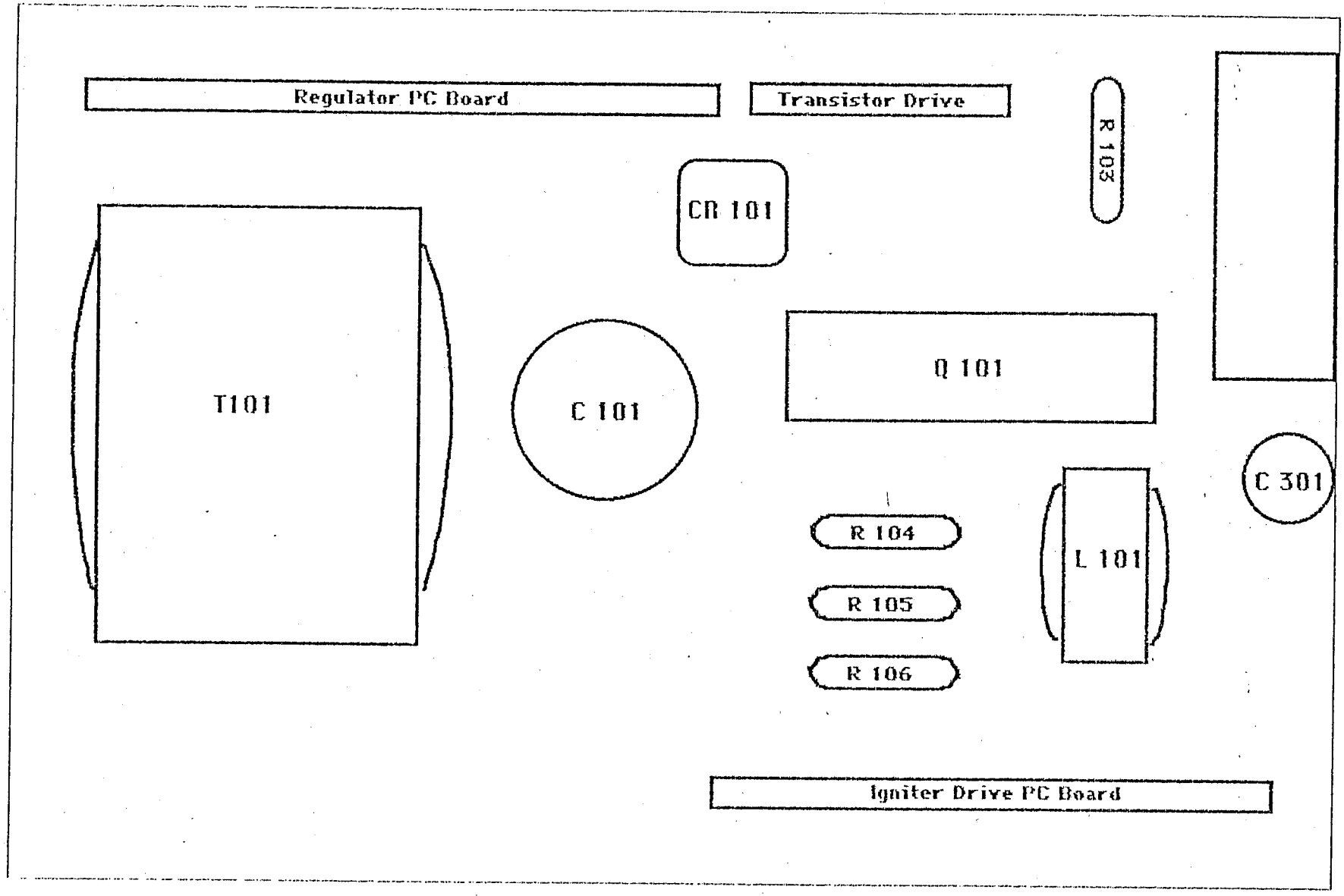


Figure 5.2 Power Supply Chassis Layout

CR6 and C5 provide the unregulated DC voltage for the PWM IC switches. CR7, C3, U1 and CR4, C4, U2 provide the regulated +/- 15VDC for all the ICs on the regulator PCB. The last winding of T101 provides 24V AC power for the igniter drive and output monitoring circuit only when there is an output voltage across the output connectors (J306 and J307).

C. Switching Transistor and Related Drive Circuit

The constant frequency, variable PW output of the regulator IC is transformer coupled to this PCB by T601 and T602. Since there are two pulses per cycle, they are summed by Q603 and Q604 to provide a greater than 50% adjustment of duty cycle. This summed pulse controls Q602 which turns on only when both Q603 and Q604 are off. When Q602 turns on, base drive to Q601 is removed turning Q601 off which in turn shuts the main switching transistor off. A -5V, 1 amp reverse current is also available to assist in the rapid turn off of Q101. When Q602 is off, Q601 turns on and biases Q101 into conduction.

The variable PW controls the on line of Q101 which applies more or less current to the filter circuit thereby changing the average value of the output. During the time that Q101 is off, L101 reverses polarity, and CR102 maintains current flow around the filter loop.

<<<<< C A U T I O N >>>>>

The +18V, +9V and -5V supplies on this PCB are referenced to the emitter of Q101. Do not connect a grounded oscilloscope probe or a grounding wire to this emitter reference. Only a safely isolated scope or meter should be connected here in order to make measurements on this PCB.

D. HF Filtering

The high current, constant frequency, and variable PW pulses are applied to the low pass LC filter combination of L101 and C301. These components average the current pulses to provide a filtered DC output to the load.

E. Error Feedback and PWM Control

PWM is performed on the regulator card. The output voltage is sensed directly by divider R27, R33 and R33a, and the load current is sensed through current sense resistor R103 which is amplified by U3. These scaled voltage and current outputs are applied to U5 for multiplication. The output is a representation of output power, and is compared with a reference set by front panel pot R201 at U7. Any deviation from the reference is amplified within U7 and modulates the PW of the output transistors of U7. This modulated signal is transformer coupled to the transistor drive board.

The current sense signal is also amplified by U4 which then limits the maximum output current (normally set to 10 amps) by controlling the maximum PW out of U7. As a secondary protection, the output of U4 also controls Q6 which will reduce output power by decreasing the reference level when Q6 is biased into conduction.

A tertiary overcurrent protection shuts the regulator IC if a short circuit condition exists. Resistive divider R1 and R2 bias Q2 on when a voltage exists across the output of the power supply. At the same time, a portion of the amplified output of the current sense amplifier (U3) exists at the ten volt zener (CR1). When a short circuit condition exists there will not be any voltage therefore Q2 turns off. Also, the output of U3 will be at maximum (less than 14 volts), and the zener will break down and conduct current to the gate of the SCR (Q3). Once a gate signal is present Q3 conducts and latches thereby removing bias from Q4 which turns off. With Q2 off, the shutdown control at pin 10 of U7 goes to a high level and shuts off the outputs of the regulator IC. The only way of restarting the power supply is to shut the main power switch (CB201), and then turn it on again.

The interlock circuitry performs the same way via CR13 and R13. If no interlock is present pin 10 of U7 is at a high level. When the interlock is connected at J301, CR13 is reverse biased and pin 10 of U7 is at a low state which turns on the output of the regulator IC.

IC U6 buffers the internal reference so that it can be applied to the power meter for a preset adjustment or for use by an external accessory via J302.

F. Igniter Drive and Output Monitor Circuit

The igniter drive PCB contains circuitry to generate the 25kHz square wave required by the igniter. It is a self oscillating inverter which starts when relay K401 energizes at an open circuit voltage of 95 volts or more. Relay contact K401-1 is closed, and the start switch is pressed to apply 24 VAC to rectifier CR401. The filtered output is used by R402 to slightly bias Q401 into conduction.

Q401 goes into conduction more and more until T401 saturates. At saturation, Q401's collector current increases at the limit set by the beta of the transistor and input voltage. This limits collector current to one ampere. Since di/dt is removed from T401, Q401 shuts off due to lack of base drive. The flyback voltage is of the correct polarity to bias Q402 into conduction, and the action repeats but of opposite polarity. The result will be a two to one unregulated step up on T401's secondary. This is nominally a 100V P-P square wave @ 30kHz. This square wave is connected to the igniter via J401 on the rear panel.

The additional sense circuit consisting of an op-amp (U401), divider resistors, and Q403 monitor the output voltage for the low voltage condition which is normal operation during the starting cycle of the mercury arc lamp. Therefore, the comparator turns on Q403 with no load applied across the output.

With Q403 on, relay K401 is energized and places R413, a 15 ohm 2 watt resistor, in series with the output filter to limit the maximum discharge current. Once the lamp is lit, the operating voltage will be less than the open circuit voltage and the comparator turns off Q403. R413 will be bypassed during normal lamp operation so that the output ripple is standard.

The low voltage startup condition also forces a much lower duty cycle than can be provided by the regulator IC during lamp startup. Therefore, the parallel combination of R104, R105, and R106 is effectively in series with the negative output connector (J307).

When the lamp is in its warmup phase this equivalent resistance of one ohm remains in the circuit. The power supply is providing power to the lamp and to the ballast resistor, and a minimum duty cycle of 10% is maintained to prevent damage to the main switching transistor (Q101) and to the flyback diode (CR102).

SECTION VI - CALIBRATION PROCEDURE

Calibration of the power supply should be performed by qualified personnel. It should be performed if the regulator PC board (68810-3-1400) is replaced. Please refer to Figure 6.1 for the adjustment potentiometer layout.

A. Required Test Equipment

- 25 Ampere Ammeter
- 200 Volt Voltmeter
- 10 ohm, 500 watt power resistor
- 2 ohm, 500 watt power resistor

B. Initial Conditions

Before applying any AC power to the power supply, set the below listed controls to the specified settings.

NOTE: The PC card mounted potentiometers are 20 turns or more, end to end.

No.	Name	Location	Setting
R201	Output Adjust	Front Panel	Full CW
R17	E meter adjust	Regulator Card	Full CW
R22	I limit adjust	Regulator Card	Full CW
R25	I meter adjust	Regulator Card	Full CW
R28	I gain adjust	Regulator Card	Full CW
R36	Multiplier offset	Regulator Card	Full CW
R48	P meter adjust	Regulator Card	Full CW

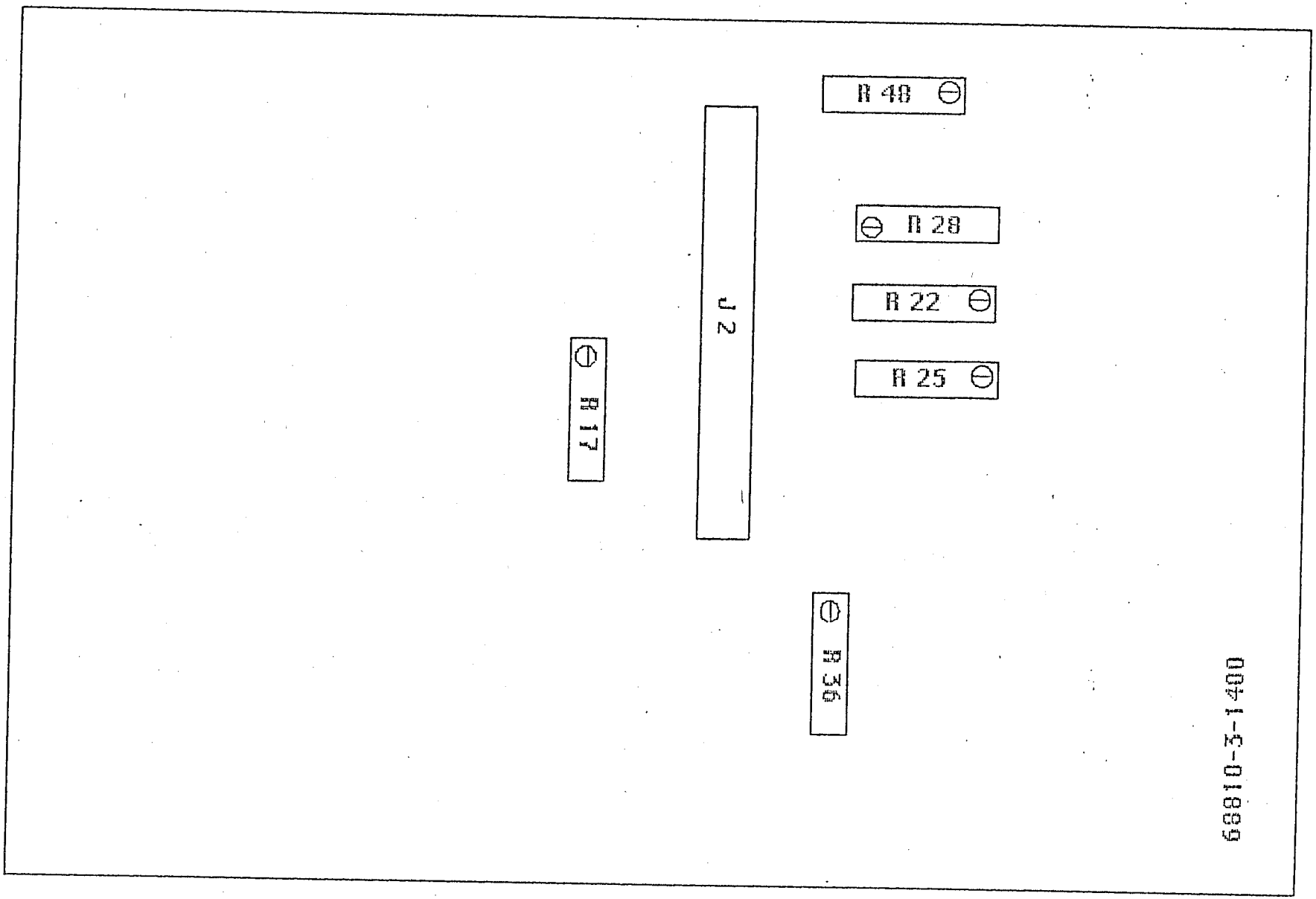


Figure 6.1 PWM Control PC Board Potentiometer Layout

C. Open Circuit Test

These tests will insure that the proper voltages and preliminary settings will be correct.

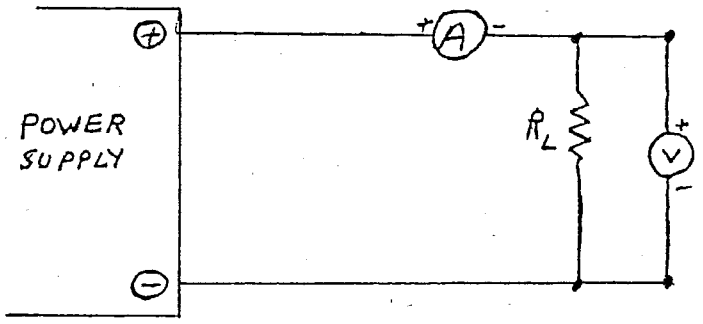
1. Remove the interlock plug from J301 at the rear panel, plug the unit into the mains source (be sure that S301, the input line voltage switch, is in the correct position for your mains voltage), and place the power switch on. The internal lamp in the power switch should turn on, and the fan should be operating. There should not be any output voltage present.

2. Adjust R36 (Multiplier Offset) so that the power meter shows zero (0) power. Press and hold in the Output Pre-Adjust switch, and adjust R48 (P meter) for a full scale reading of 600 watts. Adjust the Output Adjust (R201) potentiometer for a reading of 300 watts. Release the Output Pre-Adjust switch.

3. Install the interlock plug into J301, there should be an output voltage of 140 volts DC or more. If necessary trim R36 to display 0 output power. Shut the power supply off.

D. Load Test at 10 Ohms

1. Connect the power supply, the meters and the load resistor as shown, before beginning this test.



2. Turn on the power supply which should display 300 watts immediately after turn on.

3. Observe the external test meters and adjust R28 (I gain) for a true output of 300 watts.

4. Set the output to 500 watts with the front panel Output Adjust control. Adjust R28 (I gain) for a true output of 500 watts.

5. Set the output to 200 watts and trim R36 -MULTIPLIER ZERO- to output and display 200 watts. Continue to adjust the output alternating between 200 and 500 watts, trimming R36 for 200 watts and R28 for 500 watts till the actual output is within 2% of the displayed output.

6. Set the output voltage to 60 volts and adjust R17 (E meter) so that the front panel meter reads 60 volts when the volts-power-amps switch is in the volts position.

7. Set the output current to 7 amps and adjust R25 (I meter) so that the front panel meter reads 7 amps when the volts-power-amps switch is in the amps position.

8. Set the output power to maximum and adjust R22 (I limit) so that the output power is reduced by 1 watt.

9. Turn the power supply off, and replace the 10 ohm resistor with the 2 ohm resistor. Turn the power back on, and adjust R22 (I limit) for a maximum output current of 12A amperes. At loads of less than one ohm impedance the short circuit protection circuit disables the output. If this occurs turn the power supply off and then on again to reset the circuit.

SECTION VII - TROUBLESHOOTING

A careful reading of the circuit description should be done before attempting any repairs or adjustments. The information given in this section is based on prototype and reliability testing, and is general in nature. Troubleshooting should be performed by qualified electronic service personnel. Careful use of test equipment or tools must be done especially when testing the high power section or the switching transistor drive PCB.

< < < < < W A R N I N G > > > > >

Potentially lethal voltages exist in the power supply when power is applied, and for a few minutes after power is removed. Extreme care should be taken when working within or near the power supply whenever the cover is removed.

If a problem exists with the power supply a visual inspection of all components and wiring should be made. Inspect for the obviously damaged or broken components before proceeding with the power on testing of the power supply. Below are some items to check and their expected signals. For most of the troubleshooting, an oscilloscope is a necessary piece of test equipment. Please exercise caution when testing the transistor drive board because this board is not referenced to ground. It is referenced to the emitter of Q101, and is therefore floating at the DC supply voltage.

A. Low Voltage Auxiliary Supplies

Measurement Point referenced to ground	Expected Signal	Probable Problem
U7-15	+18VDC	CR6
U7-16	+5VDC	U7
U6-4	-15VDC	U2
U6-7	+15VDC	U1
For the next three measurements, use an isolated oscilloscope if that is the instrument being used. Use J1-2 as reference.		
R602-Positive side	+18V	R602,Q601,CR601, CR605,Q602
Q602 - C	+9V	Q601,Q602,CR601, CR605
Q604 - E	-5V	Q602,CR605,CR602, Q604,Q603

If any or all of the above voltages are missing, check the auxiliary power supplies transformer for the proper AC voltages.

B. The following flowchart, Figure VII-1, will serve as a starting point for the repair of the power supply. Please observe all cautions previously mentioned. A qualified electronics person should perform the troubleshooting and repair.

If the lamp does not start, the igniter drive and the igniter should be checked for proper operation. Please refer to the related documentation for the circuit descriptions and diagrams.

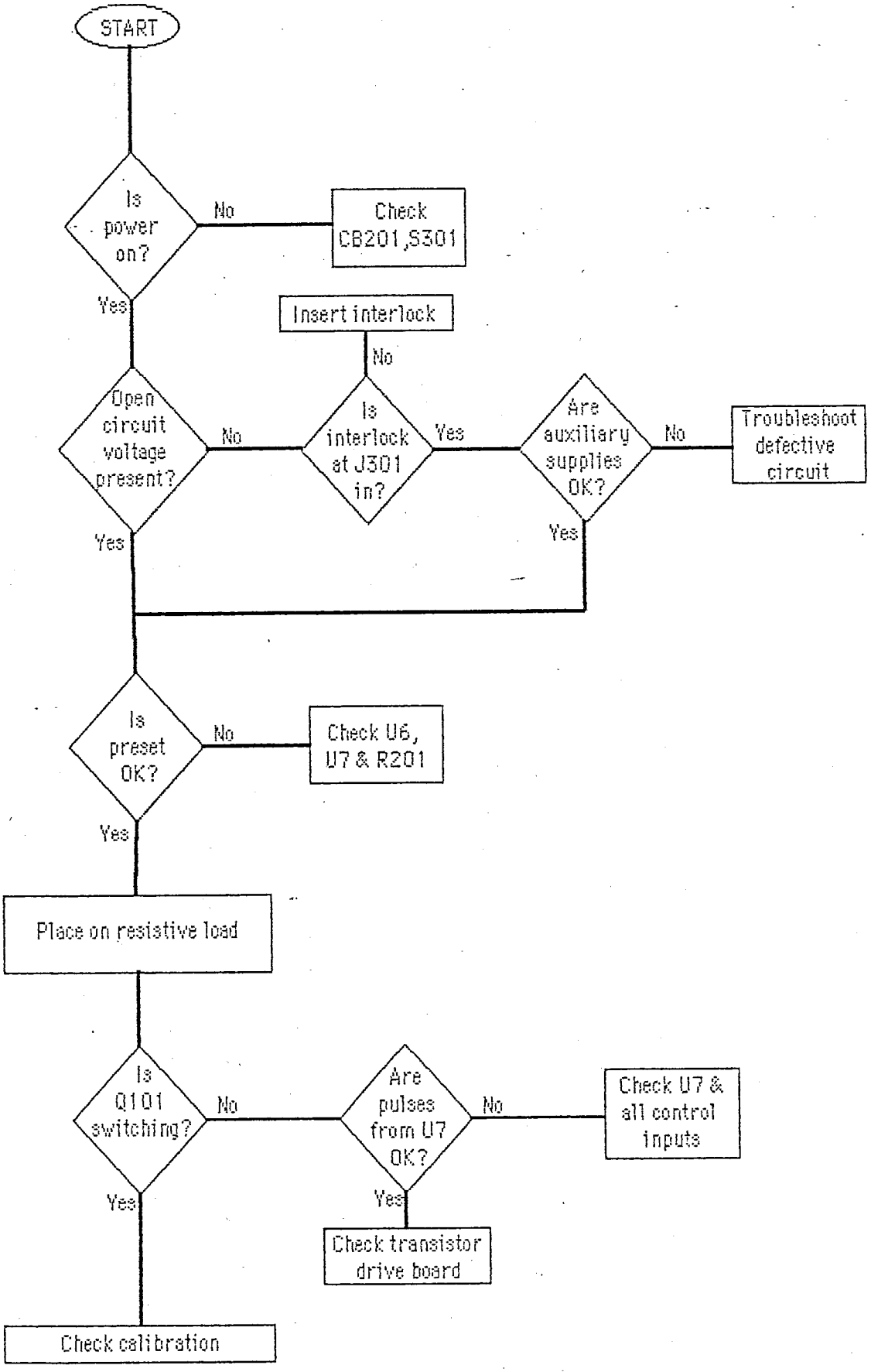


Figure 7.1 Troubleshooting Flowchart

SECTION VIII - WARRANTY

Oriel Corporation warrants that all goods listed in this acknowledgement (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in materials and workmanship. In cases of defects in materials and/or workmanship, such defects must become apparent within the following period:

a. All covered products, except spare parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to buyer.

b. Spare parts: ninety (90) days after delivery of goods to buyer.

The extent of Oriel Corporation's liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Oriel Corporation shall provide all materials to accomplish the repaired adjustment, repair or replacement. Oriel Corporation shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the Buyer ONLY on condition that the defective goods are returned freight prepaid to an Oriel Corporation designated facility. Oriel Corporation shall provide labor for field adjustment, repair and/or replacement at prevailing rates for such field service.

Oriel Corporation shall be relieved of all obligations and liability under this warranty if:

1. The goods are operated with any accessory, equipment or part not specifically approved or manufactured or specified by Oriel Corporation unless buyer furnishes reasonable evidence that such installations were not a cause of the defect, provided that this provision shall not apply to any accessory, equipment or part, the use of which does not affect the safety of the machine.

2. The goods are not operated or maintained in accordance with Oriel's instructions and specifications.

3. The goods have been repaired, altered or modified by other than Oriel authorized personnel.

4. Buyer does not return the defective goods, freight prepaid, to Oriel repair facility within the applicable warranty period.

WARRANTY (continued)

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS OR MERCHANTIBILITY, AND BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTEES, CONDITIONS OR LIABILITIES, EXPRESS OR IMPLIED ARISING BY LAW OR OTHERWISE AND WHETHER OR NOT OCCASIONED BY ORIEL'S NEGLIGENCE. This warranty shall not be extended, altered or varied except by a written instrument signed by both parties; provided, that in the event the provision relieving Oriel from liability for its negligence should for any reason be held ineffective the remainder of the paragraph shall remain in full force and effect.

CONSEQUENTIAL DAMAGES -

Oriel Corporation shall not be responsible for consequential damages as a result of misfunctions or malfunctions of the goods listed on this acknowledgement. Oriel's total responsibility shall be limited to repairing or replacing the misfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE -

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Oriel, shall assume full responsibility for any and all damage while in their care, custody and control. Should damage occur unrelated to the proper and warranted use and performance of the goods, recipient of goods accepts full responsibility for restoring the goods to their conditions upon original delivery, and for assuming all costs and charges.

SECTION IX - RETURNS

Before returning equipment to Oriel for repair, please call the Customer Service Department. The phone number is (203) 377-8282. You will be given a Return Material Authorization number (RMA). To save time, have the Purchase Order number used to purchase the equipment available before calling Oriel. Having this number will insure that your equipment will be properly processed and greatly shorten the time required for the repair. Equipment returned without a Return Material Authorization (RMA) may be rejected by the Oriel Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Customers will be notified of repairs not covered by warranty along with a cost for the repair, before the work is started.

SECTION X - DRAWINGS

The following drawings are supplied with this manual:

A. Schematics

68810-4-1001 Power Supply

B. Drawings

68810-3-1400 Control Board
68810-3-1600 Igniter Drive PC
68810-2-1500 Transistor Drive PC

C. Parts Lists

Available upon request.