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OPERATING INSTRUCTIONS

ORIEL MODEL 68700

200 WATT UNIVERSAL ARC LAMP SUPPLY

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 68700 is one of a series of switched-mode arc lamp supplies. Its intended use is to drive any of the following arc lamps:

Model 6251	75W Xe
Model 6353	150W Xe
Model 6354	UV150W Xe
Model 6256	150W Xe
Model 6281	100W Hg
Model 6283	200W Hg
Model 6291	200W Hg (Xe)

The power transformers in these units are switched at a relatively high frequency (20-25 KHz). This technique yields several advantages. The high frequency ripple is easier to filter, the power components (transformer 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 changeover 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.
- Single pulse ignition.
- Photo-feedback option available.
- Remote metering signals are available at a rear panel connector.
- Optional 19" rack mount available.
- Output short circuit protection.

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 easily removable printed circuit cards. All internal calibration potentiometers are located at the right side of the unit, and are readily accessible with the top cover removed.

SECTION II - SPECIFICATION

AC Power Input:	95-130 VAC/4A, 190-260 VAC/2A 50/60 Hz
DC Power Output:	240 Watts maximum; 12 Amperes maximum (Xe), 8 Amperes maximum (Hg)
Light Ripple (50/60 Hz):	0.17% RMS
Preadjust Accuracy:	+/- 2%
Power Meter Accuracy:	+/- 1%
Stability (after 10 minute warm-up):	+/- 0.2%
Line Regulation:	+/- 0.2% (over total voltage excursion)
Output Current Limit:	12 Amperes (+/- 0.5) for Xe and Hg (Xe) 8 Amperes (+/- 0.5) for Hg
Output Voltage:	Pre-ignition, 120 VDC minimum loaded; 90 VDC maximum (Hg) and 45 VDC maximum (Xe and Hg (Xe))

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 upon release.
Lamp Select Switch:	Two position slide switch. Sets the internal circuitry for the supply to drive Xe and Hg (Xe) lamps in the lefthand position, or Hg lamps in the righthand position.
Power Indicator:	Amber neon, indicates the unit is turned on.
Power Switch:	Rocker switch. Used to apply power to the unit.

B. Rear Panel - (*Mating connector part numbers given.)

J1-Remote Connector
*Cinch/Jones #P302-CCT

Two pin connector providing cable from the lamp housing.

J2-Remote Connector
*Viking #TKP12-103

Twelve pin connector providing the following input/outpu signals:

Pin 1 - Photo-feedback control input.
2 - Reference (Buffered Control setting) output.
3 - Common (ground)
4 - N/C
5 - 117 VAC (lo) output.
6 - Boost (External Modulation) input.
7 - 117 VAC (hi) 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) switched AC power outlet. Provides 1 ampere at the same line voltage that 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-Ignitor Drive Connector:
*Cinch/Jones #P303-CCT

Three pin (grounded) connector providing 20 V P/P, 20 Hz ignitor drive signals for several seconds after the LAMP START switch has been released. Pin 3 is chassis ground.

J6-Lamp + Connector:
*Amphenol #PL-259

One pin connector providing positive voltage drive to the lamp anode.

J7-Lamp - Connector: *Amphenol #PL-259	One pin connector providing negative voltage drive to the lamp cathode.
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 slide of the power supply output is connected to earth ground through a 100,000 ohm resistor. This is done to prevent the output from "floating" and thereby building up a high static charge. Even so, it is desirable that neither 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 one minute for the internal filter capacitors to discharge. This charge status may be monitored by the front panel Meter.

It is possible that this power supply may be used with a separate stand-alone ignitor (ORIEL Model 68705) if the lamp housing does not have a built-in ignitor. In that case, an additional danger exists at the output of the ignitor. 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 ultraviolet 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 BUILDUP.

B. INSTALLTION -

Installation of the 68700 is straightforward and should not present any particular problems. 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 INTAKE PORTS AT THE SIDES, AND EXHAUST 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, but no preignition voltage will be generated and no ignition pulses will occur after depressing the LAMP START switch.

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

NOTE: Xenon and Mercury (Xenon) lamps are mounted with the anode (+) up and the cathode (-) down.

Mercury lamps are mounted with the anode (+) <u>down</u> and the cathode (-) <u>up</u>.

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

ADDENDUM

This power supply contains an output short circuit protection circuit which acts like an output crowbar. If an output short circuit is detected, the output drive signals will be disabled in less than one millisecond. The protection circuit will latch on, and the only way to reset it is to turn power to the supply off and then back on.

An easy way to tell that the protection circuit has been activated is to press the OUTPUT PRE-ADJUST switch and observe the front panel meter of the power supply. When the protection circuit activates, it drops the pre-adjust setting to a minimal level (approximately the bottom 10% of the meter scale).

If the protection circuit activates, turn off power and check the wiring between the power supply and the arc lamp looking for shorts or miss wires.

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

The AC power cable for the lamp housing should be connected to any convenient AC outlet. If it is desired that AC power is removed from the lamp housing when the power supply is turned off (and if the housing is of the newer design), then the lamp housing may be plugged into J3-ACCESSORIES at the rear of the power supply.

NOTE: In the newer ORIEL lamp housings, which contain a built-in ignitor, it is advisable to connect the AC power to a wall outlet. These units have a thermostatically controlled fan, which will turn off automatically once the temperature inside the lamp housing is low enough.

The Model 68700 may be 19" rack mounted if so desired. A panel kit, Model 68701 is available, and takes just minutes to attach to the power supply.

C. OPERATIONS -

1. For Xenon Lamps

a) With all lamp and power cables in place, set the Lamp Select switch to the lefthand Xe/Hg (Xe) position.

b) Turn on the front panel POWER switch. The POWER indicator should illuminate, and the cooling fan should turn.

c) When the cooling fan is near full speed, the output pre-ignition voltage (100 VDC minimum) will be generated. 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 100 volts is available.

d) Depress the LAMP START switch for several seconds, and release. The lamp should ignite, and the lamp power should regulate at the Pre-adjust Level (+/- 2%). If necessary, adjust the OUTPUT control for the proper output power to the arc lamp.

e) If the lamp does not ignite immediately, repeat the ignition procedure, but not more than 5 times. If the lamp does not ignite after 5 attempts, see paragraph 4 of this section.

2. For Mercury (Xenon) Lamps

a) With all lamp and power cables in place, set the Lamp Select switch to the left hand Xe/Hg (Xe) position.

b) Turn on the front panel POWER switch. The POWER indicator should illuminate, and the cooling fan should turn.

c) When the cooling fan is near full speed, the output pre-ignition voltage (100 VDC minimum) will be generated. Before igniting, depress the OUTPUT PRE-ADJUST button and adjust the OUTPUT control for the desired lamp wattage as indicated on the Meter (in this case, 200 watts). Push the Meter switch to the VOLTS position and verify that a pre-ignition voltage of at least 100 volts is available.

d) Depress the LAMP START switch for several seconds, and release. The lamp should ignite, and lamp current should go immediately to the OVER-CURRENT limit (12 amperes, +/- 1/2), and power should be less than 200 watts.

NOTE: THIS MODEL LAMP (200 WATT Hg (Xe) WILL FREQUENTLY IGNITE OFF OF THE CATHODE. WHEN THIS HAPPENS, LAMP CURRENT DOES NOT REACH THE OVER-CURRENT LIMIT. IF THE LAMP CURRENT DOES NOT REACH THE OVER-CURRENT LIMIT WITHIN 20 SECONDS, TURN THE POWER OFF IMMEDIATELY AND GO THROUGH PARAGRAPH C.2 AGAIN. IF THE ARC LAMP IS ON FOR ANY LENGTH OF TIME WITHOUT THE ARC CENTERED ON THE CATHODE, THE LAMP WILL EXPLODE.

e) Immediately after a proper ignition, the lamp power will be less than the 200 watts selected until the lamp begins to warm up. First the power will climb to the selected 200 watts, and then the lamp current will slowly fall to its final value, which is nominally 9-10 amperes. Since the Output Pre-Adjust is only accurate to +/- 2%, it may be necessary to readjust the OUTPUT control for the proper output power to the arc lamp.

f. If the lamp does not ignite immediately, repeat the ignition procedure, but not more than 5 times. If the lamp does not ignite after 5 attempts, see paragraph 4 of this section.

3. For Mercury Lamps

a) With all lamp and power cables in place, set the lamp select switch to the righthand Hg position.

b) Turn on the front panel POWER switch. The POWER indicator should illuminate, and the cooling fan should turn.

c) When the cooling fan is near full speed, the output pre-ignition voltage (100 VDC minimum) will be generated. 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 100 volts is available.

d) Depress the LAMP START switch for several seconds, and release. The lamp should ignite, and lamp current should go immediately to the over-current limit of approximately 8 amperes.

e) Immediately after ignition, the lamp power will be less than that selected in step C. As the lamp begins to warm 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 current is typically 5 amperes for Model 6281 (100W Hg) and 3.5 amperes for Model 6283 (200W Hg).

f) If the lamp ignites, but 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.

If the lamp does not ignite immediately, repeat the ignition procedure, but not more than 5 times.

4. If the lamp does not ignite after 5 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 ignitor is in operation.

c) The LAMP START button must be momentarily depressed and then released. If the button is held continously, the lamp will not light.

d) A relay energize/de-energize clicking must always be heard inside the power supply and inside the stand-alone ignitor (if used) when the LAMP START button is released. If this sound is not heard, there is a problem and further investigation is necessary.

SECTION V - CIRCUIT DESCRIPTION

A. Regulator Board (Schematic 68700-3-1101) -

All regulating circuitry is contained on this circuit card. It is located at the right side of the power supply, with its component side facing out. The circuit card is of the plug-in variety with gold plated fingers forming a connector at one end. It is held in place by a plastic bracket which is secured to the chassis by a single machine screw.

1. Output Current

The output current of the power supply is sensed across R3 and R4, two .05 ohm resistors. The voltage developed across R3 is amplified by op-amp A7. Because this is a universal power supply, two different over-current limits are required; one for Mercury lamps (8 amperes), and a higher one for Xenon and Mercury (Xenon) lamps (12 amperes). To achieve the current differential, the over-current voltage at the output of A7 is connected to two zener diodes, CR1 and CR2. The front panel Lamp Select switch connects the circuit at pin 4 of A3 to the appropriate diode, depending on the type of lamp to be powered. R6 is the over-current limit adjustment. The voltage developed across R4 is amplified by op-amp A5, with the resulting DC level used to drive the amp-meter and as an input to multiplier A4. R8 is the amp-meter adjustment.

2. Output Voltage

The output voltage is connected to the circuit card on P1-4. It is dropped across a divider consisting of R15 and R9 (there is an external jumper between P1-5 and P1-N) and then connected to multiplier A4. R18 is the volt-meter adjustment.

3. Output Power

The output power level is developed by multiplier A4. Its output feeds the regulator device (pulse-width modulator) A3, and provides the signal for the watt-meter. R14 is the watt-meter adjustment.

4. Output Control

The power supply output is controlled by A3. It is a push-pull output pulse-width modulator. The reference input from the front panel OUTPUT potentiometer is connected to A3-2, and the output power signal is connected to A3-1. The device will adjust the outputs at pins 11 and 14 within its limits to maintain equality between pins 1 and 2. Two pulse transformers, T1 and T2, couple the drive pulses to the final power FETs.

a) External Modulation -

The regulator A3 generates a stable + 5 VDC reference at pin 16. This is connected to a voltage divider consisting of R35 (3K), R1 (10K OUTPUT potentiometer) and R20 (2K BOOST potentiometer). The wiper of R20 is connected to the rear panel REMOTE connector J2 pin 6.

Depending on the setting of R20 (BOOST) the act of grounding and ungrounding J2-6 will cause the voltage across R1 (OUTPUT) to shift - in turn causing A3 to regulate at a different output power setting.

NOTE: At a power level of 200 watts output. with R20 (BOOST) set to maximum, there should be a power reduction of 20 watts when J2-6 is grounded.

b) Photo Feedback Control -

An optional Photo Feedback Control Unit (ORIEL Model 68715) may be used with this power supply. The control signal from the Photo Feedback Unit connects onto the PC card at P1-X, and is connected to the regulator chip A3 through diode CR12.

B. Power MOS Shelf (Schematic 68700-2-1216) -

The MOS PC Card has two identical drive circuits. Each consists of a pair of Emitter Follower transistors (an NPN and a PNP) which provide low impedance drive into the gate of the power MOS transistor. A series resistor (220 ohms) limits the rise and fall times to control ringing and overshoot on the output wave form.

The MOS transistors alternately (push-pull) turn on (and then off) each half of the primary of the main power transformer.

C. Ignitor Drive Card (Schematic 68700-1-1311) -

The 20 volt secondary winding of the main power transformer is connected to pins 2 and 6 of the drive card. Prior to lamp igniton, the output of the main power transformer is effectively a full square wave. The front panel LAMP START switch is connected across pins 5 and 7, connecting C1 (+) to K1 relay coil. When the switch is pushed, C1 (+) is momentarily connected to R1, and is charged to +20 VDC through R1 and CR1. When the switch is relased, C1 discharges through the K1 relay coil, energizing K1 for several seconds. The contacts of K1 connect the 20V square wave through bridge rectifier CR2 to K2 relay coil. The contacts of K2 connect the 20V square wave out to pin 1 of J5 to the ignitor circuit.

D. Overview and Main Chassis (Schematic 68700-3-1001) -

Main AC power is switched on through double-pole circuit breaker CB1 and applied to ACCESSORIES outlet J3 and filter FL1. The purpose of the filter is to keep the high frequency switching transients from modulating the AC power line.

The output of FL1 is connected to the cooling fan, the regulator PC card, and bridge rectifier CR1. There is a thermistor, R5, in series with CR1, which limits the initial inrush current to charge the filter capacitors (C1 and C2) when power is first applied.

When line voltage is nominally 117 VAC, and switch S5 is in the 110 position, CR1 is used as a full wave rectifier (2 diodes), and one side of the AC line is connected to the junction of filter capacitors C1 and C2. When line voltage is nominally 220 VAC, and switch S5 is in the 220 position, CR1 is used as a full wave bridge rectifier (4 diodes).

SECTION VI - CALIBRATION PROCEDURE

Calibration by the user should not be necessary under normal circumstances. The only time it may be necessary is if the Regulated PC Card (68700-3-1100) or front panel Meter have been replaced.

A. Required Test Equipment

- 25 Amperes Ammeter
- 100 Volt Voltmeter
- 20 ohm, 500 watt Resistor
- 2 ohm, 500 watt Resistor
- 1 ohm, 500 watt Resistor

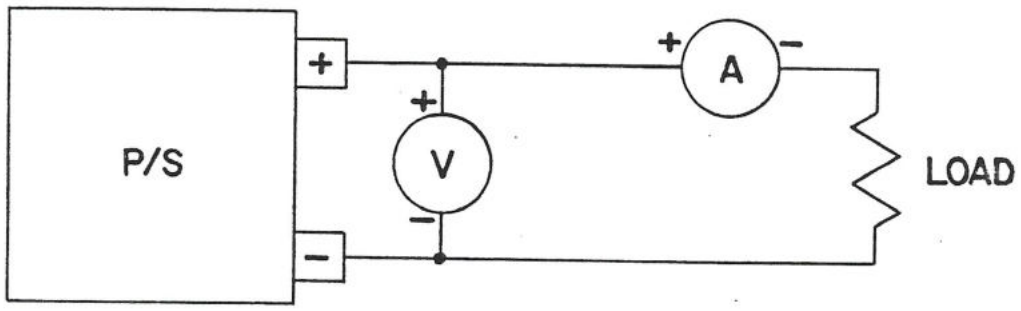
B. Initial Conditions

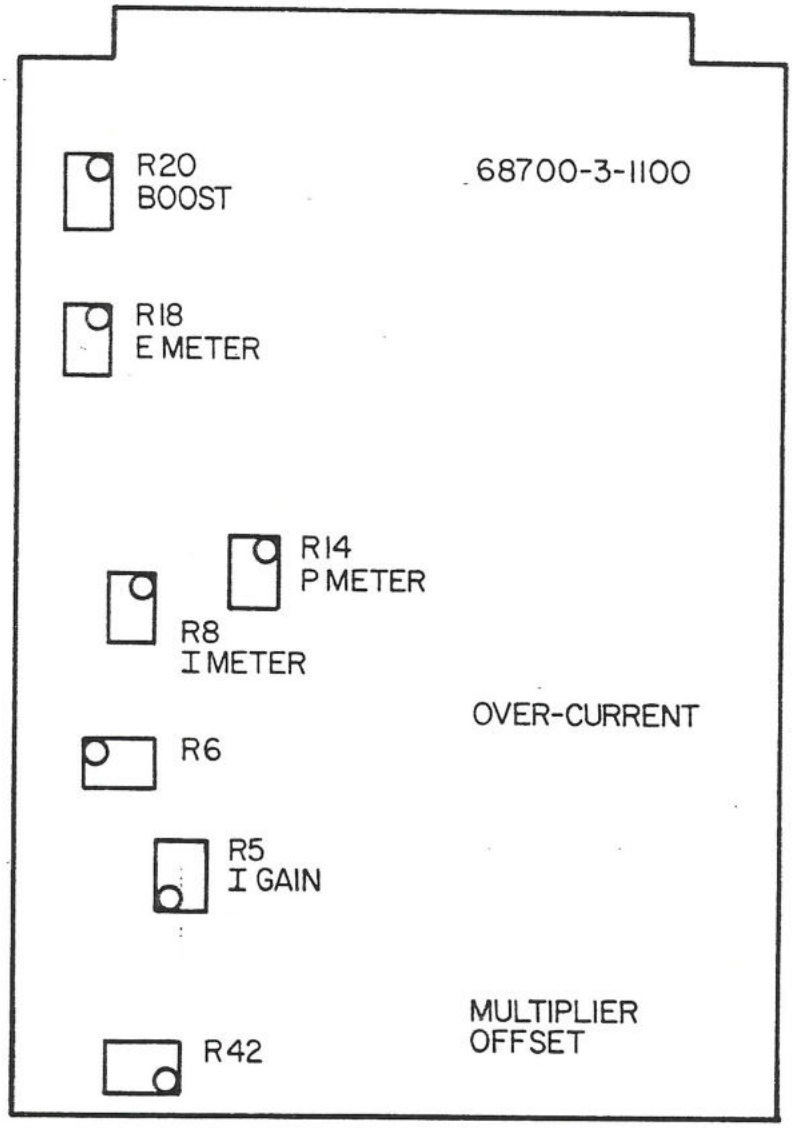
Prior to applying power to the unit, set the below listed controls to the specified settings. IF A CONTROL IS NOT LISTED, LEAVE IT ALONE.

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

NO.	NAME	LOCATION	SETTING
R1	Output	Front Panel	Full CW
R5	I Gain	Regulator Card	Full CW
R6	Over-current	Regulator Card	Full CW
R8	I Meter	Regulator Card	Full CCW
R14	P Meter	Regulator Card	Full CCW
R18	E Meter	Regulator Card	Full CCW
R20	Boost	Regulator Card	Full CW
S4	Lamp Select	Front Panel	Lefthand (Xe) Position

Connect the Ammeter, Voltmeter and 2 ohm load resistor to the power supply output terminals as shown. Unplug the shorting connector into J1 INTERLOCK at the rear panel.




R20
BOOST
68700-3-1100
R18
E METER
R14
P METER
R8
I METER
OVER-CURRENT
R6
R5
I GAIN
MULTIPLIER
OFFSET
R42

C. Preliminary Settings

Apply power to the unit. The fan should start to turn immediately, and the power indicator should illuminate.

1) Press (and hold in) the OUTPUT PRE-ADJUST switch. Adjust R14 (P METER) for a full scale reading of 240 watts. Adjust the OUTPUT control for a PRE-ADJUST reading of 100 watts. Release the OUTPUT PRE-ADJUST switch.

2) Plug a shorting connector into J1 INTERLOCK at the rear panel. There should immediately be an output, and the front panel Meter should indicate 100 watts (+/- 2%).

3) While observing the external test meters, adjust R5 (I GAIN) for a true output of 100 watts.

4) Turn the OUTPUT control full CW, and the output should go up to 240 watts. The output current should be approximately 10.7 amperes.

5) Adjust R6 (OVER-CURRENT) for an output current of 10 amperes.

D. Over-Current Adjustment

1) Turn off power to the unit, and replace the 2 ohm load resistor with the 1 ohm load resistor.

2) Apply power to the unit. Output current should be limited to approximately 10 amperes.

3) Adjust R6 (OVER-CURRENT) for an output current of 12 amperes.

E. Final Settings, Xenon/Mercury (Xenon)

1) Turn off power, and remove the shorting connector at J1 INTERLOCK Replace the 1 ohm load resistor with the 2 ohm load resistor.

2) Double check the zero setting on the front panel Meter. The zero adjust screw is just inside the hole in the front panel below the meter face.

3) Apply power to the unit. There should be no output, and the front panel Meter should indicate zero watts. Adjust R41 (MULTIPLIER OFFSET) on the Regulator Card for a 0 watts reading.

4) Plug the shorting connector in at J1 INTERLOCK. The output should jump to approximately 240 watts. Turn the OUTPUT control for a reading of 200 watts, as measured on the external test meters.

5) Adjust R14 (P METER) for a front panel Meter reading of 200 watts.

6) Adjust the OUTPUT control for an output current of 10 amperes as measured on the external test AMMETER.

7) Adjust R8 (I METER) for a front panel Meter reading of 10 amperes.

8) Adjust the OUTPUT control for an output voltage of 20 volts as measured on the external voltmeter.

9) Adjust R18 (E METER) for a front panel Meter reading of 20 volts.

F. Final Settings, Mercury

1) Turn off power to the unit. Set front panel Lamp Select switch to the right hand Hg position.

2) Apply power to the unit. After a short delay (fan interlock function) there should be an output, and current should be limited to between 7.5 and 8.0 amperes.

   - If the output current is less than 7.5 amperes, adjust R6 (Over-current) for an output current of 7.5 amperes.
   - If the output current is more than 8 amperes, adjust R6 (Over-current) for an output current of 8.0 amperes.

3) Turn off power to the unit. Replace the 2 ohm load resistor with the 20 ohm load resistor.

4) Apply power to the unit. After a short delay (fan interlock function) there should be an output of 200 watts.

5) Adjust the OUTPUT control for an output voltage of 60 volts as measured on the external voltmeter.

6) Adjust R18 (E METER) for a front panel Meter reading of 60 volts.

SECTION VII - TROUBLESHOOTING

Repairs or internal adjustments to this equipment should only be attempted by an experienced electronic technician. Improper use of test equipment or tools can easily damage components within the unit or compound existing problems.

WARNING: POTENTIALLY LETHAL VOLTAGE LEVELS EXIST WITHIN THIS UNIT WHEN POWER IS APPLIED - MANY MINUTES AFTER POWER HAS BEEN REMOVED. EXTREME CARE SHOULD BE TAKEN WHEN WORKING IN OR NEAR THIS UNIT WHENEVER THE COVER IS NOT IN PLACE.

If trouble is encountered, the top cover should be removed and a visual inspection made for shorts, broken wires, and obviously damaged or broken components.

If nothing obvious is visible, below are some items to check and expected signals, etc. For most of the troubleshooting, an oscilloscope will be a necessary piece of test equipment. For testing purposes, a convenient ground reference for most of the control circuitry is the metal tab on the Regulator VR1 mid-way along the bottom edge of the Regulator PC Card.

A. Low Voltage Power Supply

With a VOM, check for the presence of the following DC voltages on the Regulator Board.

Measurement Point	Expected Signal	Probable Problem if Wrong
A3-15	+15VDC or +18VDC	VR1, CR16
A3-16	+5VDC	A3
A1-4	-15VDC	A6
A1-7	+15VDC	A2

If all of the above are missing - check for bad T3.

B. Switching Drive - *Use an isolated oscilloscope!

1) On the Regulator Card, look for square-wave drive signals at A3-12 and A3-13. If they are missing, look for an open interlock circuit or a bad A3.

2) On the Regulator Card look for 12V P/P square-wave drive signals across the diodes: CR7, CR9, CR10, CR11. If they are missing, look for a bad diode or a bad transformer T1 or T2.

3) At the MOS driver card on the shelf, look for high voltage square-waves across 1-3 and 4-6. If they are missing, look for bad buffer transistors or bad MOS transistors.

4) At the input to the choke L1, look for a +DC level. and/or positive square-wave signals. If they are missing, look for a bad power transformer T1, or bad rectifiers CR2 thru CR5.

C. Improper Regulation

In the event that there is output drive, but improper regulation is occurring, look for the following:

1) If the unit will not output sufficient power, check for a bad A3, bad A7, or miss-adjusted R6 (OVER-CURRENT).

2) If the power level is drifting, or 50/60 Hz ripple is excessive, check for a bad A3.

3) If power readings are off, but the voltmeter and ammeter readings are good, check for a bad A4.

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