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Find the *Opti-Quip 1200* at our website: *Click HERE*

Note: Table of Contents next page.

Thank you for purchasing an Opti-Quip 1500-1200 series power supply.

This manual is for use with the following supplies:

MODEL 1500 POWER SUPPLY

This supply will run any one of six different D.C. arc lamps - both xenon and mercury.

MODEL 1520 POWER SUPPLY

This supply is a variation on the standard 1500 which includes an extra receptacle with connections to power a 110V A.C. lamphouse mounted cooling fan and connections for lamphouse safety interlock. Any attempt to open the lamphouse makes the power supply automatically inoperative.

MODEL 1505 POWER SUPPLY

This supply has connections in its standard receptacle for a lamphouse safety interlock. Any attempt to open a lamphouse or remove a socket from a lamphouse designed with a safety interlock makes the power supply automatically inoperative.

MODEL 1200 POWER SUPPLY

This supply will run three different D.C. arc lamps - 75 watt xenon, 100 watt mercury and 200 watt mercury.

MODEL 1205 POWER SUPPLY

Same modifications as 1505 power supply.

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FEATURES

Introduction:

The Opti-Quip Solid State D.C. Power supplies have been designed to provide the finest illumination available for fluorescence and general microscopy.

Features of the Model 1500-1200 series D.C. Power Supplies

1. The model 1500 will run any one of six differnent arc lamps - 50-100-200 watt D.C. mercury lamps and 75-150-150W/GS (short gap) watt xenon lamps.

2. The 1200 can be used with a 100 watt mercury bulb, 75 watt xenon bulb or a 200 watt mercury bulb.

3. The life of the 200 watt D.C. mercury lamp is double that of the A.C. lamp.

4. The D.C. eliminates bulb flicker and gives more light and life than similar A.C. lamps.

5. The watt meter allows the user to adjust the power supply correctly for the particular bulb in use, and therefore maximize bulb life expectancy.

6. Fast Warm-up. Mercury lamps come up to full power in four minutes; xenon lamps in two minutes.

7. A non-resettable meter logs hours of use. This is helpful in establishing warranted bulb usage.

8. A special regulating circuit insures that ± 10% variations in line voltage result in less than a 1% change in output power.

9. Power supplies are designed to re-ignite hot mercury bulbs in twenty seconds.

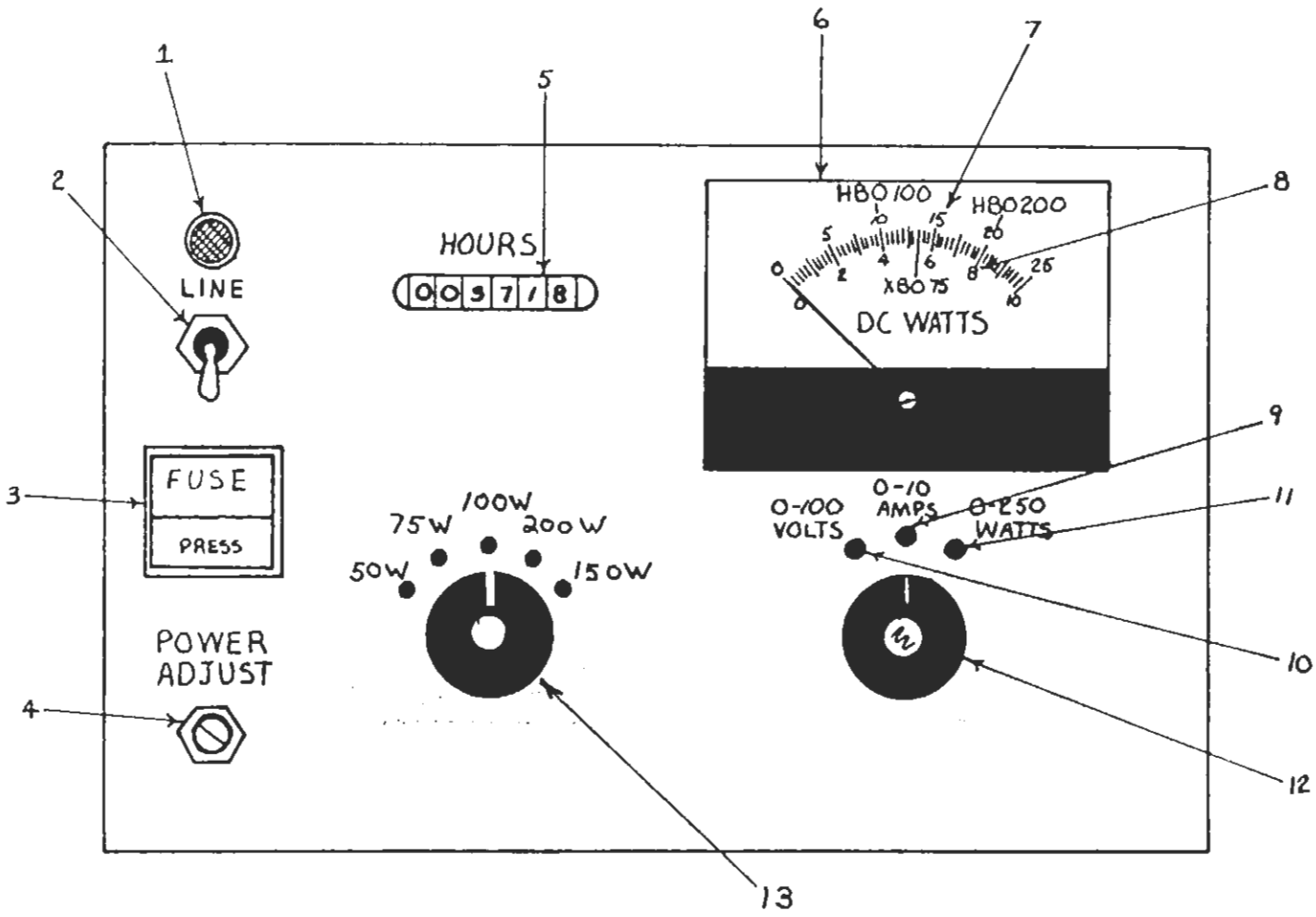
10. Opti-Quip manufactured sockets are compatible with a large number of existing microscope lamphouses.

11. The volt meter allows the user to monitor the aging process of the bulb and therefore plan for timely replacement.

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FEATURES

1500 - 1200 Front Panel Organization



1. Pilot Light (lights up when supply is turned on)
2. Power switch (up-on position: down-off)
3. Fuse holder
4. Power adjust
5. Hour meter
6. Watt meter
7. Upper scale (reads watts and indicates correct wattage for mercury lamps)
8. Lower scale (reads amps or volts and indicates correct amps for xenon lamps)
9. Switch position to read "amps"
10. Switch to read "volts"
11. Switch to read "watts"
12. Switch
13. Bulb selector switch (1500 only)

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FEATURES

Terminology:

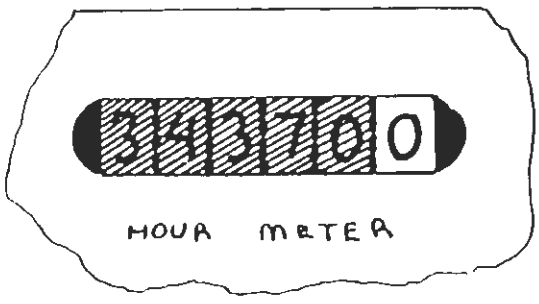
Current	- Amps
Voltage	- Potential
I.C.	- Integrated Circuit
Sola Transformer	- Device used to maintain constant line voltage.
Plasma Streaming	- A magnetic field formed when mercury gas atoms ionize causing a cloud of positively charged atoms to form in a characteristic umbrella shape.
Arcing Over	- Trigger leaking. This may occur when the power supply is triggering.
Arcing	- The misdirected flow of current.
Power Adjust	- Recessed slotted device which is located at the front, lower left panel of the power supply. It can be rotated to the left or right with a screwdriver. In this way the watt or amp readings can be lowered, raised or set precisely on the meter.
Watts	- Power supplied to bulb - arrived at by multiplying volts times amps.

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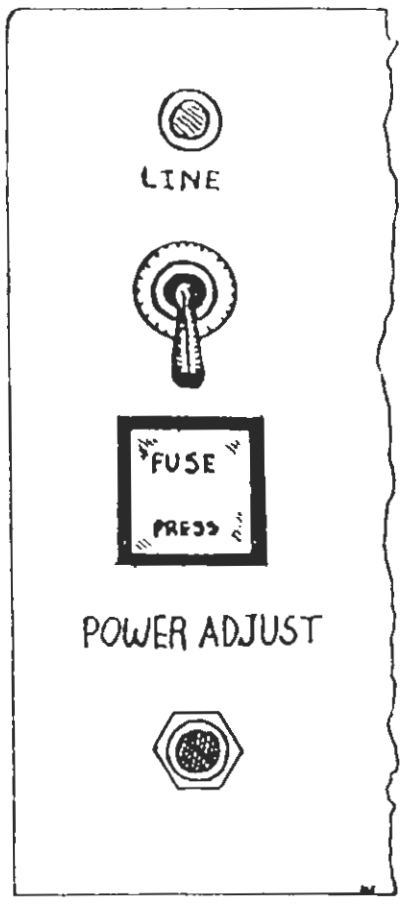
FEATURES

Volt-Amp-Watt Meter: Mercury lamps are rated to be run at constant wattage. The operating voltage increases during the life of the bulb and necessitates a concurrent reduction in operating current. The watt meter integrates these two variables and allows the correct wattage to be set by use of the power adjust (see #4 page 4). As stated in the "High Pressure Xenon Lamp" catalog, "The maximum current for each xenon lamp must never be exceeded as otherwise safety of operation is no longer warranted, and the lamp life will be reduced essentially". If for some reason the watt meter reading doesn't register on the scale of your power supply, you can use the volt and amp meter readings to see what the watt reading would be. (Volts times amps equals watts). Osram also states that "5% either way (lamp running at too high or too low wattage) decreases the life of the bulb". With practice it also is possible to gauge the age of the particular bulb in use, with the aid of the Volt meter - Amp meter - Watt meter. A new 100 watt mercury lamp runs at about 20 volts. As the bulb ages, the arc length grows and the power supply must supply a higher voltage to maintain the arc. While maintaining 100 watts the operating current therefore drops. Older bulbs may go to as much as 26 amps at 38 volts. It is this lengthening of arc that is the real aging process.

Hour Meter: All Opti-Quip Power Supplies are equipped with a non resettable hour meter. This meter is connected for a portion of the testing before shipment. Right digit reads in tenths of an hour. The hour meter is a help to the customer to verify the warranted hours of bulb life. It is of importance to Opti-Quip if repairs become necessary, to have an idea of the total usage the power supply has received.



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Fuse: The power supply main line is fused with a front panel fuse holder. In the event it is necessary to change the fuse, push in and down on the fuse holder to remove it from the supply. Fuse can then be replaced in the holder. Replace only with MTH type fuses (formerly 3AG) 8 amp for model 1500. 5 amp for model 1200.

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INSTALLATION

PLEASE READ THE ENTIRE MANUAL CAREFULLY BEFORE USING THE POWER SUPPLY
This will insure perfect operation of your supply.

Supply Installation: Initial Set-up:

1. Plug the power supply into a 110V grounded outlet.

2. Set the dial below the watt meter to Volts position.

3. Turn on the power switch. Pilot light should come on. If volts register, you know the supply is getting power and will run the burner once it has triggered. (The meter should read 60-75 volts prior to ignition). (If pilot light does not light, check the fuse and replace it if necessary. See "Problems" page 16)

WARNING

Model 1200 uses 5A fuse, Model 1500 uses 8A fuse. Don't use a larger size fuse under any circumstance.

Triggering: Approximately 5 to 15 seconds after turning on the power switch, the just audible sound of "ticking" will be heard. This is a High Voltage trigger which ignites the bulb. TURN OFF THE POWER SWITCH. You are now assured that your power supply is capable of supplying power and should work for you. UNPLUG THE SUPPLY FROM THE OUTLET before installing the bulb in the socket and proceed.

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INSTALLATION

Socket and Bulb Installation:

1. Install the bulb correctly in your socket. Reversed polarity can dramatically shorten the life expectancy of the particular bulb to as little as one or two minutes. The writing on the base of the bulb goes down (fits into the bottom of the socket) on both the mercury and xenon lamps.

   Please note the Model #315 Model #406 Model #614 Model #645 Model #680 lamp sockets are universal sockets. They will accept either the xenon 75 watt bulb or the mercury 100 watt bulb. This is possible because either bulb may be run horizontally. When installing either bulb in these sockets the fat, positive (+) end of the bulb goes into the clamp and is tightened with the allen wrench.

2. If you have any difficulty inserting the lamp into the socket, it may be that the stamping (lettering) on a bulb is too heavy. To insure getting good contact and making sure that the bulb fits down into the socket, a small file can be used to file down the stamping on the lamp. The lamp is inserted correctly if the stamping (lettering) end is down.

3. Make sure that all connections are clean and tight.

4. Carefully insert the socket into the appropriate lamphouse. Be careful to follow special instructions included with particular socket you wish to use.

5. If the switch under the Watt meter is set to "amps" during ignition and warm up, no reading will be observed until the bulb actually is lit. It will be noted that initially mercury bulbs draw more than their nominally rated current.

	nominal	nominal
HBO 50W/3	2.2 amps	22 volts
HBO 100W/2	5.0 amps	20 volts
HBO 200W/2	3.1-4.2 amps	47-65 volts

This is normal operation. Once bulb has run for 4 or 5 minutes use "How to Adjust" (page 12) to set correct operating wattage. Xenon lamps however, come up to their operation current almost immediately and should not exceed their ratings.

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INSTALLATION

Socket and Bulb installation cont'd:

6. Plug the socket into the power supply.

7. Plug the power supply into the outlet.

8. Review "How to Adjust" instructions (page 12).

To Read Meter

a) To Read Watts The top line of the scale is used to read watts. Set switch to "Watts" position. The top scale reads from 0 to 250. See "How to Adjust" (page 12) for correct reading.

b) To Read Volts The bottom line of the scale is used to read either Volts 0-100 or Amps 0-10. When switch is set to "Volts" position, add 0 to indicated number for correct voltage. For example, a "2" really is 20 volts.

c) To Read Amps Each major division on scale is 1 amp, each small division is 0.2 . For example, the line for "XBO 75" is 5.4 amps (see page 12 "How to Adjust")

Bulb Selector Switch (1500 series only)

See page 4 - "Front Panel Organization" #13
Before operation, set bulb selector switch so setting indicates bulb to be used. The 150 watt position is used both for the standard 150 watt xenon and the short gap 150 watt xenon, only the current ratings differ for these bulbs. Be sure you know which 150 watt bulb you are using. If, inadvertantly, the switch is set for the wrong lamp after start up, simply switch to correct position as soon as noticed. Warning - some missettings will result in no bulb ignition, others could result in drastic bulb life reduction or possible violent failure if left uncorrected.

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INSTALLATION

Hi-Low Trigger Switch

The 1500 series of power supplies has a "Hi" - "Low" switch setting for trigger voltage.

When shipped this switch is in the high position. This setting is appropriate where xenon bulbs primarily are to be used.

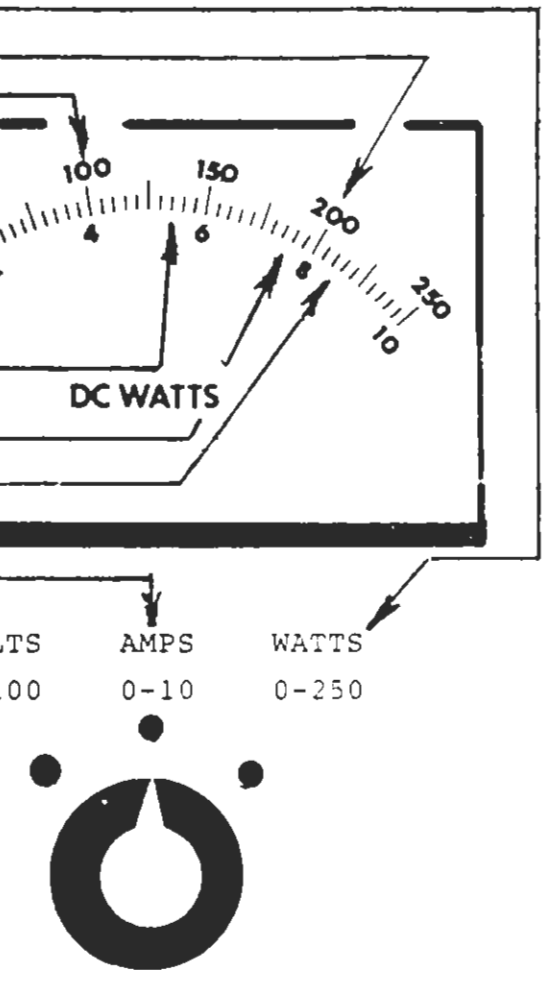
Under certain circumstances where a 50 watt mercury bulb is to be used, this "Hi" setting may result in hard starting. In this case the "Low" setting should be used.

The switch position is shown on the parts layout page. It is on the extreme left side of the board. This may be reached after removing the cover from the 1500 series power supply. Please contact us before changing this switch.

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OPTI-QUIP 1500 - 1200 POWER SUPPLIES

	BULB	RATED TO RUN AT		METER SWITCH POSITION
	200 WATT MERCURY	200 WATTS	-	WATTS
	100 WATT MERCURY	100 WATTS	-	WATTS
*	50 WATT MERCURY	50 WATTS	-	WATTS
	75 WATT XENON	5.4 AMPS	-	AMPS
*	150 WATT XENON	7.5 AMPS	-	AMPS
*	150 WATT XENON SHORT GAP	8.5 AMPS	-	AMPS



NOTE:

Allow mercury bulbs five minutes and xenon bulbs three minutes to warm up. Then use "power adjust" to obtain meter readings, as indicated on this chart.

* BULBS SO MARKED FOR USE WITH 1500 SERIES ONLY

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OPERATION

1. If you haven't already done so read "How to Adjust" instructions. (see page 12)

2. Turn on the Power Switch.

3. The bulb may ignite immediately or may take several seconds to start. This depends on the age of the bulb and whether or not the bulb is hot or cool.

WARNING: IF AT THIS TIME, LOUD "SNAPPING" SOUNDS ARE HEARD FROM THE LAMPHOUSE, TURN OFF THE POWER SUPPLY IMMEDIATELY. THIS INDICATES A PROBLEM WHICH WILL BE DEALT WITH UNDER PROBLEMS AND SERVICING.

If the bulb seems to be going on and off repeatedly before igniting, you may take a screwdriver and raise or lower the power adjust. This will help the bulb to ignite more rapidly. It may be necessary to do this, especially with an older lamp. As the bulb warms up, the current will drop to normal operating range. This should take about 2 or 3 minutes. The bulb has ignited when amps or watts register on the watt meter.

4. Operation of D.C. Power Supply with 200 watt mercury lamp.
As the bulb approaches the normal operating temperature it will "stabilize". At this time the arc which normally starts from the tip of one electrode and the side of the other, will jump to a position between the tips of both electrodes. In order for this to happen, the power supply automatically raises the operating voltage while the current is dropping during warm-up. This voltage will continue to rise until the arc stabilizes. If operating correctly, as the voltage rises, the current will drop until the correct wattage is maintained.

PLEASE NOTE: Periodically check operating parameters while lamp is running "watts" for mercury lamps. Current "amps" for xenon lamps. If the reading is slightly off, you can use a screwdriver to turn the power adjust until you obtain the exact reading desired. See "How to Adjust" (page 12)

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OPERATION

Bulb Stabilization:

* * **NOTE:** Plasma Streaming can be confused with flickering (** see page 5 - "Terminology").

An older 200 watt mercury bulb can show its age by failing to stabilize.

A. There are three methods that you can use to determine whether or not your bulb has stabilized.

1. Observe arc through appropriate filters. You can see if the arc is between the two electrodes. **Never look directly at an operating arc bulb.**

2. Watch the watt meter while bulb is warming up toward the 200 watt reading. The needle will drop down very slightly and then go up when the arc has been maintained.

3. Watch the reflection of light, if possible, on a wall or on ceiling. The light will go off and on very quickly when the bulb stabilizes.

The bulb may flicker repeatedly after it stabilizes. In this case, use the power adjust to adjust the watt reading up or down slightly and the flickering should stop. Difficultly with stabilization occurs occasionally with new bulbs, but usually disappears after several hours use. It is exceedingly rare with the 100 watt mercury bulb.

B. If the bulb doesn't stabilize:

1. If it is an old bulb, you may have some difficulty with stabilization. In this case, use the power adust to help the bulb to stabilize.

2. If it is a new bulb, the bulb should run for two hours or so and will stabilize after that. The power adjust may be used in this case also to aid the bulb in stabilizing.

3. If bulb goes out, let it cool for one minute before re-igniting.

4. Bulbs must be run at the correct wattage.

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OPERATION

Bulb Stabilization cont'd from page 14

If the bulb does not stabilize, the power supply will automatically raise the operating voltage and lower the operating current to a point where the arc will no longer be maintained. At this point the bulb will stop working and the power supply will automatically start triggering again. Note the amp (current) reading when the bulb does go off. Restart the bulb. Use the power adjust to assist an old bulb (with high voltage) to get started. The old bulb may go on and off while the supply is triggering. If you replace the bulb and there is no longer an on/off phenomenon, you will know that the bulb was indeed too old.

Bulb Aging: Initial start up ages a bulb faster than continual operation at rated power. Diminuation of light output and lack of stability are indicative of a need for replacement.
The operating voltage of a 100 watt mercury bulb is indicative of the actual aging process. New bulbs start life operating around 20 volts. Once the operating voltage has reached about 38 volts, they should be replaced.

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PROBLEMS AND SERVICING

NOTE: The serial number of the power supply is on the back panel of the supply.
If the occasion should ever arise that your power supply needs servicing and must be returned to Opti-Quip, please note the serial number of your supply and return the socket that you use along with the power supply.

* * IMPORTANT: Power supply must be double boxed and packed with appropriate materials, to prevent shipping damage.

A. If Servicing Becomes Necessary:

1. Turn off the power supply.
2. Leave the supply plugged into the outlet for about five minutes after turning it off. This gives the capacitors a chance to discharge to neutral.
3. Unplug the supply from the outlet.
4. Disconnect the socket from the power supply.

B. Possible Problems:

1. "Arcing Over" (Trigger leaking)

When the supply has been turned on, if a loud noise is heard coming from the lamphouse, the supply should be turned off immediately. This "arcing over" may be caused by:

(a) A defective socket (in this case the "snapping" sound will be heard coming from the lamphouse).

(b) Haphazard socket installation may result in wires being too close to or touching the lamphouse. (Please refer to specific instruction sheets for particular socket) "Arcing over" will occur only when the supply is triggering. If this phenomenon occurs, turn the supply off immediately. If this happens excessively, an I.C. may burn out.

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B. Possible Problems cont'd:

2. Blowing fuses

The length of time it takes for a fuse to fail can be indicative of the reason for failure.

(a) As soon as power switch is turned on - disconnect lamp socket, replace fuse. If problem goes away, look for short circuit between lamphouse and socket. If problem remains, socket and power supply should be returned for repair. If the power supply is new, examine packing material for indications of damage.

(b) If failure occurs after power supply has started to trigger, proceed as in (a). Probable cause is in socket or its installation. Correct as appropriate.

(c) If failure occurs after power supply has ignited bulb and bulb has warmed up, the probable cause is a loose connection. This will cause grossly erroneous readings in the watt meter. A very loose connection will cause arcing with rapid severe heating of adjacent parts. The top connection to bulb is the first place to look. Arcing here will cause metal parts to be blackened or turn dark blue. This over heating will greatly reduce the life of the bulb.

3. Intermittent operation

In a situation where heavy equipment such as a centrifuge or a cooler is connected to the same branch circuit as the power supply, it is possible that the lamp may momentarily go out when this type of equipment is being started. Where observed, the phenomenon may be eliminated by connecting the power supply to a Sola constant voltage transformer - one with a 400-500 watt rating should be used.

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B. Possible Problems cont'd:

4. R.F. - Radio Frequency Interference

Arc lamps emit R.F. during operation. This interference may affect closed circuit television pictures. This is characterized by horizontal interference lines on the video screen. Several things may be done to keep this to a minimum.

(a) Where ever possible use a camera with its electronics in the same case.

(b) Be sure interconnecting cable between camera and monitor is shielded (aluminum foil wrapped around cable is a help).

(c) Re-position power supply and monitor to effect minimum interference.

(d) Attempt to connect power supply to a circuit which is on the other side of the main from the closed circuit system -an electrician in your building will be able to figure this out for you. Development work is progressing in this area.

5. R.F. - During Triggering

Large amounts of R.F. are given off by the high voltage trigger used to ignite arc lamps. This R.F. goes away after the bulb is ignited. To minimize the possible problems in this area, we suggest:

(a) During the initial start up, be sure lamp power supply is first item turned on, only then should auxiliary microscope equipment be turned on.

(b) Follow all suggestions as in number 4, particularly if a computer is involved.

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SERVICE AT A GLANCE

SYMPTOM	SIGN	CORRECTION AND/OR CAUSE	SEE PAGE*
Loud Noise is heard coming from the lamphouse	"arcing over" (trigger leaking)	defective socket wires too close to or touching lamphouse	16
Supply stops operating for no apparent reason	Blown fuse (no triggering sound heard from supply)	Replace with 5 amp or 8 amp use as appropriate	7
	Bulb hasn't stabilized (supply will be triggering)	Turn off for 5 minutes and restart. Use power adust to encourage lamp to stabilize.	12
	"Brown-out" (triggering will be heard from supply)	Sola transformer	17
	Arcing (blows fuse) (no triggering); running high; can't bring power down	Tighten loose connection	17
Blows fuse	fuse blows right away	Short circuit in lamp housing. Try disconnecting lamp connector on rear panel and try again. If problem persists, it's probably a defective power SCR or diode.	17
	After 45 minutes or so	Loose connection on lamp or short circuit in housing due to thermal expansion.	
Lamp flashes but will not ignite.		Power adjust set too low.	

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SERVICE AT A GLANCE

SYMPTOM	SIGN	CORRECTION AND/OR CAUSE	SEE PAGE*
Pilot light on No open circuit voltage No trigger voltage		Replace IC3 RCA 334	
Bulb doesn't stabilize (Mercury 200 watt)		Bulb may be too old New bulb	14
Arcing	misdirected flow of current	Loose wire; discoloring on nickel plating on bulbs; signs of welding Periodically check watt meter reading to be sure that too much current is not being drawn, and tighten loose wires before damage occurs.	17

* For detailed description

B. Possible Problems cont'd:

6. A Final Note

Many times a conversation with our chief electrical engineer and the help of the following pages, a knowledgeable service person can quickly rectify a seemingly complex problem. Our engineer is available on Tuesday, Wednesday, and Thursday and our telephone number is (914) 928-2254.

C. Technical Assistance

1. Integrated Circuit Description

There are six I.C.'s used in the 1500 and 1200 power supplies which are easy to replace and can sometimes solve minor problems with the supply.

I.C. (1) #LM556 supplies the trigger pulses to the regulating SCR's.

I.C.(2) #LM324 drives I.C. (1), and performs all regulating functions, except for the current sense amplifier, which is in I.C. (3).

I.C.(3) #LM324 section (2) is the current sense amp. Sections (1) and (4) control the Hi voltage trigger, and section (3) prevents an over voltage condition prior to lamp ignition.

I.C. (4) #LM324

comprise the multiplying watt meter circuit

I.C. (6) #LM556

I.C. (5) #4016BCP is an electronic switch thatselects the appropriate signal for the front panel meter.

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C. Technical Assistance cont'd:

2. When Replacing I.C.'s

(a) Before removing the I.C. from the board, please note the polarity on the I.C. Polarity must be correct. Replace the I.C. in the same direction as you find it on the board.

(b) Look for the mark on the I.C. (There may be more than one). This also indicates direction for replacement.

(c) Get the prongs in straight. Do not bend them.

3. The Schematics - see successive four pages.

4. A Physical Parts Layout - see page 27.

5. A Parts List - see pages 28-31.

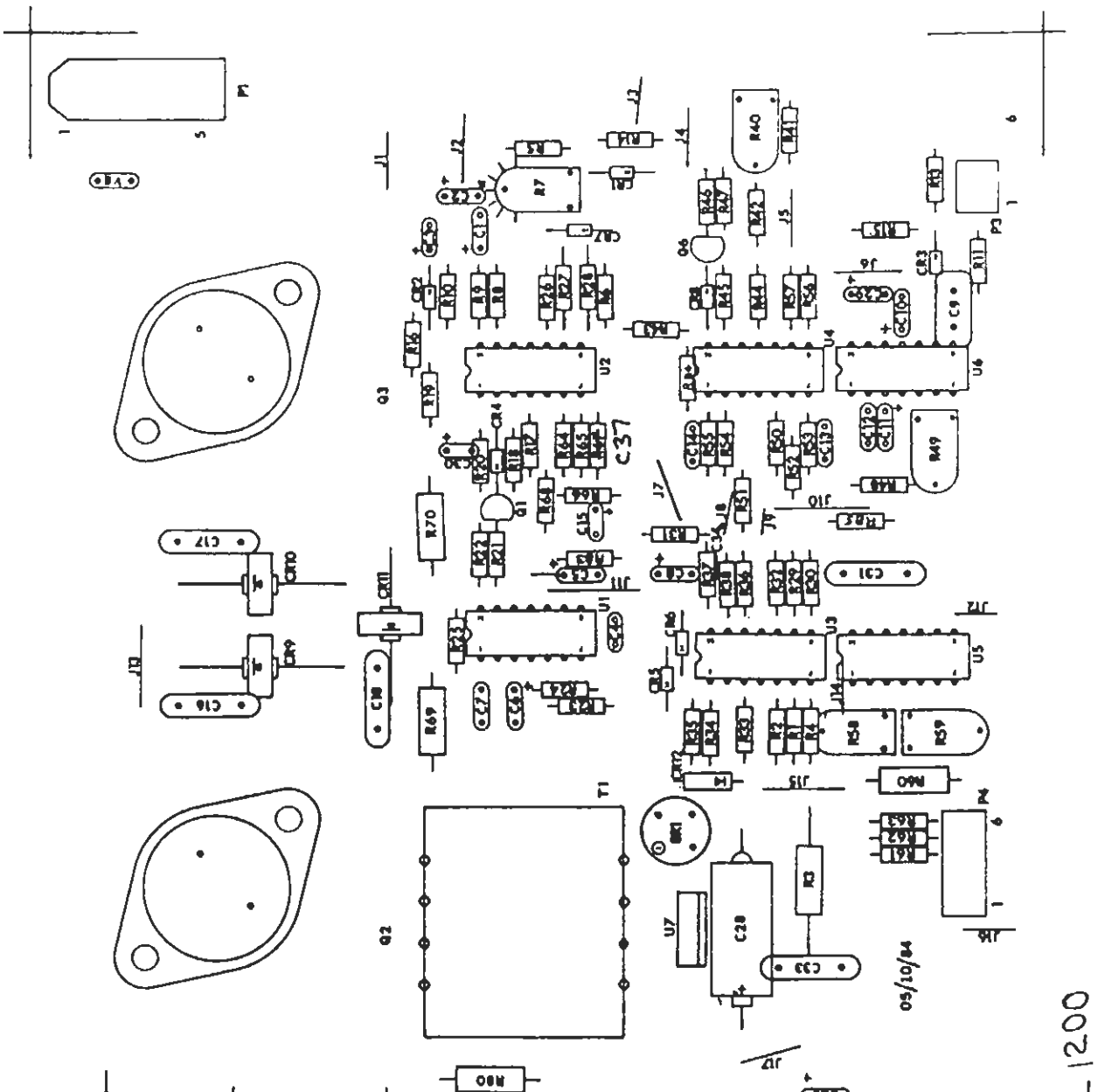
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REFERENCE	1200	1500	1520	1205	
R 1	10K	10K	10K	10K	1/4W 1%
R 2	10K	10K	10K	10K	1/4W 1%
R 3	.01	.01	.01	.01	3W 5%
R 4	1Meg	1Meg	1Meg	1Meg	1/4W 1%
R 5	10K			10K	1/4W 5%
R 6	10K			10K	1/4W 5%
R 7	50K			50K	TrimPot
R 8	30K	30K	30K	30K	1/4W 5%
R 9	10K	10K	10K	10K	1/4W 5%
R10	470K	470K	470K	470K	1/4W 5%
R11	150K	JUMPER	JUMPER	JUMPER	1/4W 5%
R12	100K	100K	100K	100K	POWER ADJ
R13	82K	JUMPER	JUMPER	JUMPER	1/4W 5%
R14	10K	10K	10K	10K	1/4W 5%
R15	2K	1K	1K	2K	1/4W 5%
R16	2.7Meg	2.7Meg	2.7Meg	2.7Meg	1/4W 5%
R17	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R18	10Meg	10Meg	10Meg	10Meg	1/4W 5%
R19	9.1Meg	9.1Meg	9.1Meg	9.1Meg	1/4W 5%
R20	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R21	100K	100K	100K	100K	1/4W 5%
R22	30K	30K	30K	30K	1/4W 5%
R23	10K	10K	10K	10K	1/4W 5%
R24	1K	1K	1K	1K	1/4W 5%
R25	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R26	2K	2K	2K	2K	1/4W 5%
R27	33.2K	33.2K	33.2K	33.2K	1/4W 1%
R28	3.01K	3.01K	3.01K	3.01K	1/4W 1%
R29	510K	510K	510K	510K	1/4W 5%
R30	10Meg	10Meg	10Meg	10Meg	1/4W 5%
R31	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R32	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R33	15K	15K	15K	15K	1/4W 5%
R34	100K	100K	100K	100K	1/4W 5%
R35	1K	1K	1K	1K	1/4W 5%
R36	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R37	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R38	180K	100K	100K	180K	1/4W 5%
R39	3.3K	3.3K	3.3K	3.3K	1/4W 5%
R40	5K	5K	5K		TrimPot
R41	30K	30K	30K		1/4W 5%
R42	270K	270K	270K		1/4W 5%
R43	1Meg	1Meg	1Meg		1/4W 5%
R44	1Meg	1Meg	1Meg		1/4W 5%
R45	330K	330K	330K		1/4W 5%
R46	100K	100K	100K		1/4W 5%
R47	1.5K	1.5K	1.5K		1/4W 5%
R48	20K	20K	20K		1/4W 5%
R49	50K	50K	50K		TrimPot

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REFERENCE	1200	1500	1520	1205	
R50	2Meg	2Meg	2Meg		1/4W 5%
R51	1Meg	1Meg	1Meg		1/4W 5%
R52	604K	604K	604K		1/4W 1%
R53	604K	604K	604K		1/4W 1%
R54	604K	604K	604K		1/4W 1%
R55	604K	604K	604K		1/4W 1%
R56	47K	47K	47K		1/4W 5%
R57	15K	15K	15K		1/4W 5%
R58	5K	5K	5K		TrimPot
R59	5K	5K	5K		TrimPot
R60	6.8K	6.8K	6.8K		1/4W 1%
R61	15K	15K	15K		1/4W 5%
R62	15K	15K	15K		1/4W 5%
R63	15K	15K	15K		1/4W 5%
R64	10K	10K	10K	10K	1/4W 5%
R65	510K	510K	510K	510K	1/4W 5%
R66	100K	100K	100K	100K	1/4W 5%
R67	NOT USED				
R68	10K	10K	10K	10K	1/4W 5%
R68	10K	10K	10K	10K	1/4W 5%
R69	330 Ohm	330 Ohm	330 Ohm	330 Ohm	1/2W 5%
R70	330 Ohm	330 Ohm	330 Ohm	330 Ohm	1/2W 5%
R71	4.7K	4.7K	4.7K		2 W 10%
R72	0.5 Ohm	0.5 Ohm	O.5 Ohm		50W 10%
R73	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R74	1Meg	1Meg	1Meg	1Meg	1/4W 5%
R75	4.3K	4.3K	4.3K	4.3K	1/4W 5%
R76	33 Ohm	33 Ohm	33 Ohm	33 Ohm	1/4W 5%
R77	4.3K	4.3K	4.3K	4.3K	1/4W 5%
R78	15K	15K	15K	15K	1/2W 10%
R79	15K	15K	15K	15K	1/2W 10%
R80	100 Ohm	100 Ohm	100 Ohm	100 Ohm	1/2W 10%
R81	10K	10K	10K	10K	2 W 10%
R82	10K	10K	10K	10K	2 W 10%
R83	3Meg	3Meg	3Meg	3Meg	1/4W 5%
R84	6.8K	6.8K	6.8K		1/4W 5%
R85	4.7K	4.7K	4.7K		1/4W 5%
R107		1K	1K		1/4W 5%

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REFERENCE	1200	1500	1520	1205	
C 1	10ufd	10ufd	10ufd	10ufd	16V Tant.
C 2	10ufd	10ufd	10ufd	10ufd	16V Tant.
C 3	4.7ufd	4.7ufd	4.7ufd	4.7ufd	16V Tant.
C 4	.0047ufd	.0047ufd	.0047ufd	.0047ufd	100V Mylar
C 5	0.1ufd	0.1ufd	0.1ufd	0.1ufd	16V Tant.
C 6	0.1ufd	0.1ufd	0.1ufd	0.1ufd	16V Tant.
C 7	.001ufd	.001ufd	.001ufd	.001ufd	100V Mylar
C 8	4.7ufd	4.7ufd	4.7	4.7	16V Tant.
C 9	.47ufd	.47ufd	.47ufd		100V Mylar
C10	0.1ufd	0.1ufd	0.1ufd		16V Tant.
C11	0.1ufd	0.1ufd	0.1ufd		16V Tant.
C12	.022ufd	.022ufd	.022ufd		100V Mylar
C13	.047ufd	.047ufd	.047ufd		100V Mylar
C14	.047ufd	.047ufd	.047ufd		100V Mylar
C15	0.1ufd				16V Tant.
C16	.01ufd	.01ufd	.01ufd	.01ufd	1KV Ceram.
C17	.01ufd	.01ufd	.01ufd	.01ufd	1KV Ceram.
C18	.01ufd	.01ufd	.01ufd	.01ufd	1KV Ceram.
C19	17Kufd	17Kufd	17Kufd		75V Elect.
C20	0.1ufd	0.1ufd	0.1ufd	0.1ufd	600V Mylar
C21	5ufd	5ufd	5ufd	5ufd	150V Elect.
C22	Jumper	5ufd	5ufd	Jumper	150V Elect.
C23	15ufd	15ufd	15ufd	15ufd	16V Tant.
C24	4ufd	4ufd	4ufd	4ufd	350V Elect
C25	4ufd	4ufd	4ufd	4ufd	350V Elect.
C26	.22ufd	.22ufd	.22ufd	.22ufd	600V Polypro.
C27	.22ufd	.22ufd	.22ufd	.22ufd	600V Polypro.
C28	250ufd	250ufd	250ufd	250ufd	25V Elect.
C29	4.7ufd	4.7ufd	4.7ufd		16V Tant.
C30	4.7ufd	4.7ufd	4.7ufd	4.7ufd	16V Tant.
C31	0.1ufd	0.1ufd	0.1ufd		50V Ceram.
C32	0.1ufd	0.1ufd	0.1ufd	0.1ufd	100V Mylar
C33	0.1ufd	0.1ufd	0.1ufd	0.1ufd	50V Ceram.
C34	15ufd	15ufd	15ufd	15ufd	16V Tant.
C35	.22ufd	.22ufd	.22ufd	.22ufd	600V Polypro.
C36	.22ufd	.22ufd	.22ufd	.22ufd	600V Polypro.
C37	10ufd	10ufd	10ufd	10ufd	16V Tant.
C38	.01ufd	.01ufd	.01ufd	.01ufd	50V Mylar

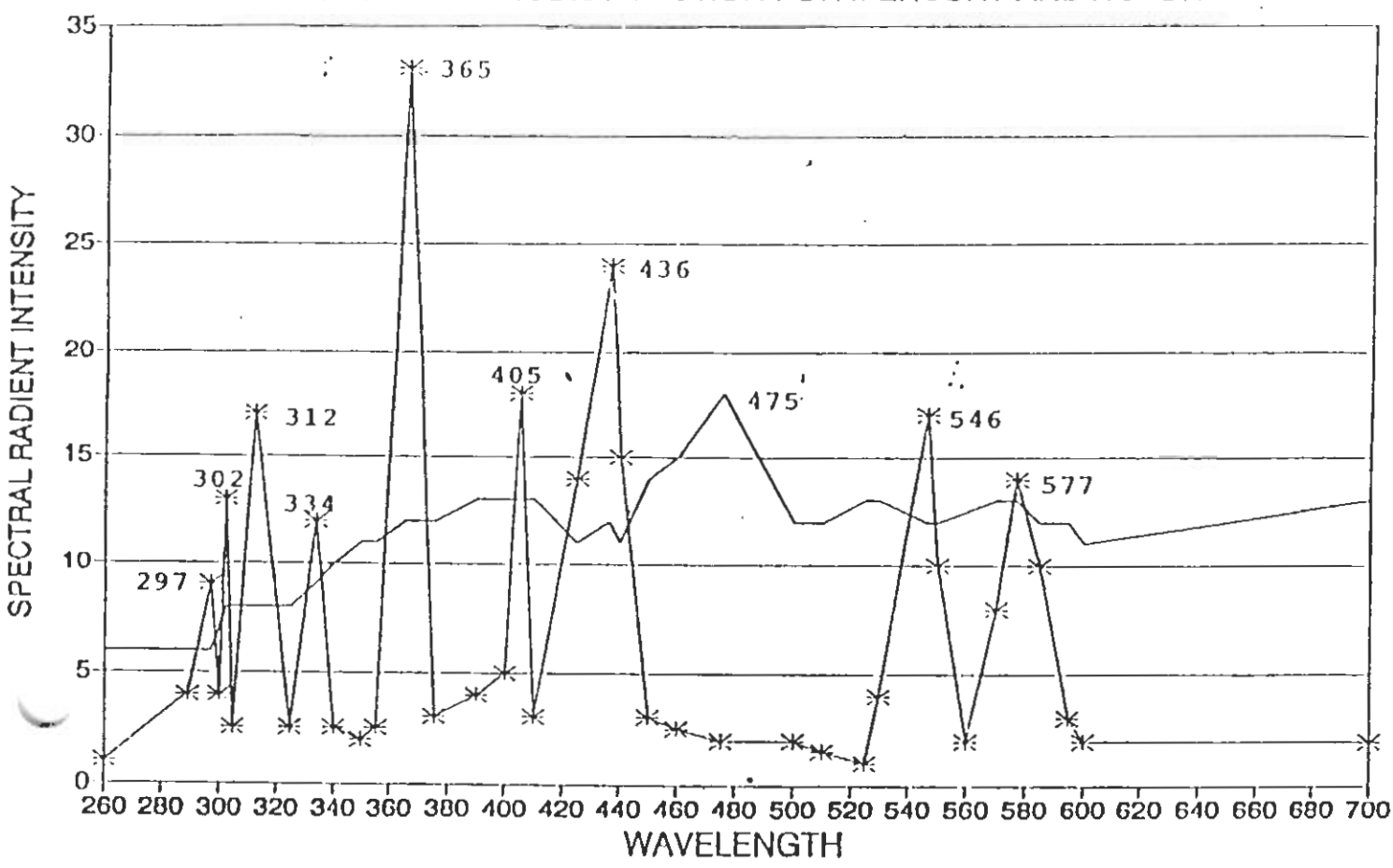
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REFERENCE	1200	1500	1520	1205	
IC 1	556	556	556	556	
IC 2	324	324	324	324	
IC 3	324	324	324	324	
IC 4	324	324	324		
IC 5	4066	4066	4066		
IC 6	556	556	556		
IC 7	7815	7815	7815	7815	
OC 1	4N26	4N26	4N26	4N26	
CR 1	1N914	1N914	1N914	1N914	
CR 2	1N914	1N914	1N914	1N914	
CR 3	1N4736A	1N4736A	1N4736A	1N4736A	6.8Volt Zener
CR 4	1N4733A	1N4733A	1N4733A	1N4733A	5Volt Zener
CR 5	1N914	1N914	1N914	1N914	
CR 6	1N914	1N914	1N914	1N914	
CR 7	1N914	1N914	1N914	1N914	
CR 8	1N4733A	1N4733A	1N4733A		
CR 9	MR752	1/4 BR358	1/4 BR358		Mounted on
CR10	MR752	1/4 BR358	1/4 BR358		Chassis (BR358)
CR11	MR752	MR752	MR752	MR752	
CR12	1N4007	1N4007	1N4007	1N4007	
CR13	1N4007	1N4007	1N4007	1N4007	
CR14	1N4007	1N4007	1N4007	1N4007	
CR15		1N4007	1N4007		
CR16	1N4007	1N4007	1N4007	1N4007	
CR17	1N4007	1N4007	1N4007	1N4007	
CR18	1N4745A	1N4745A	1N4745A	1N4745A	15V Zener
CR19	1N4007	1N4007	1N4007	1N4007	
BR 1	CSCB40S	CSCB40S	CSCB40S	CSCB40S	400V @ 1.5A
V 1	V130LA1	V130LA1	V130LA1	V130LA1	
V 2	V130LA1	V130LA1	V130LA1	V130LA1	
Q 1	2N5087	2N5087	2N5087	2N5087	
Q 2	2N3669	2N3669	2N3669	2N3669	RCA
Q 3	2N3669	2N3669	2N3669	2N3669	RCA
Q 4	MPU131	MPU131	MPU131	MPU131	
Q 5	S2600M	S2600M	S2600M	S2600M	RCA
Q 6	2N5087	2N5087	2N5087		
T 1	ST-3-16	ST-3-16	ST-3-16	ST-3-16	
T 2	TX107	TX107	TX107		
L 1	CH-4	CH-6	CH-6		
L 2	LN103	LN103	LN103	LN103	
M 1	0-1Ma	0-1Ma	0-1Ma		

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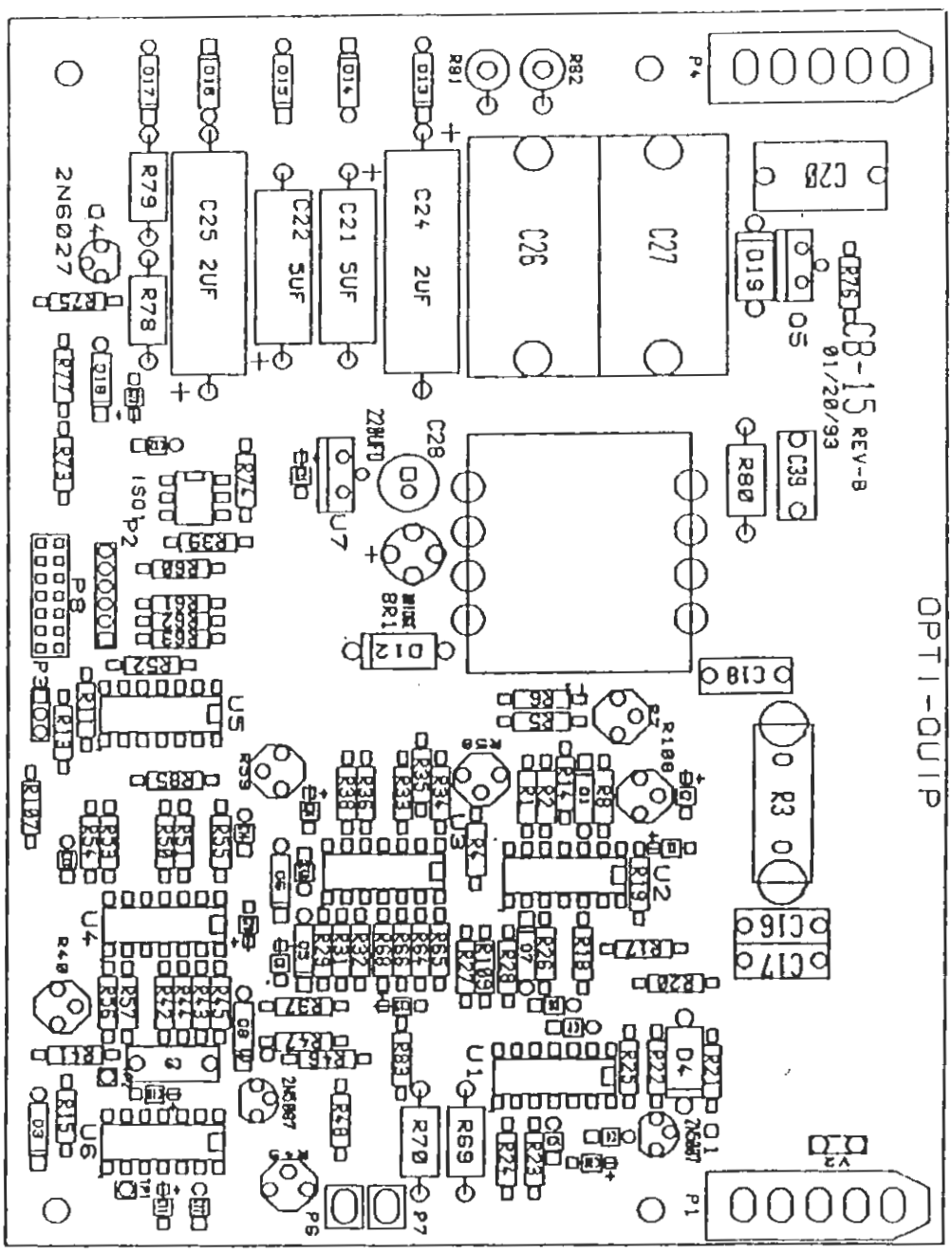
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