OPERATION MANUAL

MODEL 200
TABLETOP MASK ALIGNER

OAI

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SECTION 2

COMPONENTS OF THE SERIES 200

Introduction

The OAI Series 200 Mask Alignment and Exposure System can be configured to accommodate a wide variety of substrate sizes, shapes and materials from pieces of substrates up to 6" diameter wafers or even 6"x6" square substrates.

The system can handle masks from 2"x2" to 7"x7". It is capable of resolution of one micron structures with overlay accuracy of 0.2 microns.

The Series 200 consists of a console that holds the alignment module, alignment optics and transport platform, light source and alignment module transport platform. The Constant Intensity Controller is separate from the console.

This table top system may be mounted on pneumatic spring vibration isolators to facilitate alignment of very small structures. (Note: It is possible that there may be vibrations in any given facility which are of period or amplitude beyond the capability of any given vibration isolation system to eliminate. In such a case, the user should contract a vibration survey and obtain vibration isolation designed for the specific environment.)

Unique applications and requirements may be accommodated by means of custom designed components.

The Alignment Module (H200)

The alignment module has a sturdy mask frame which is always in three-point contact with the alignment module casing during exposure to insure that the mask is perpendicular to the axis of illumination. The mask is held in place by a clamping plate which fits over the mask and contacts it around the edge. This Mask Clamp is held by four vacuum cups and can accommodate glass, mylar, and other masking materials.

The mask is mounted on top of the mask frame so that the mask cannot fall onto the substrate or shift from it's proper position if vacuum is lost. Mask rotation is provided to align the array of patterns on the mask with the x-axis of the microscope travel and to allow compensation for mask array rotation error.

The components of the alignment module are mounted on a rigid casting. Micrometer controlled X, Y, Theta and Z are totally independent of each other. The substrate vacuum chuck is mounted on a preloaded bearing assembly to eliminate play in the X-Y plane and it can be quickly removed and replaced by vacuum chucks designed for substrates of different size, shape, or thickness.

The alignment module is mounted to the slide assembly at three points and can be adjusted to level the mask frame to the alignment microscope.

The Alignment Module (J200)

The alignment module has a sturdy mask frame which is always in three-point contact with the alignment module casing during exposure to insure that the mask is perpendicular to the axis of illumination. The mask is held in place by vacuum and is assisted, if necessary by a set of clamps which hold the mask and contacts it around the edge. This Mask Clamp is held by a fastener. Mask Holders can be fabricated to accommodate glass, mylar, and other masking materials.

The mask is mounted on top of the mask frame so that the mask cannot fall onto the substrate or shift from it's proper position if vacuum is lost. Mask rotation is provided to align the array of patterns on the mask with the x-axis of the microscope travel and to allow compensation for mask array rotation error.

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The alignment module is mounted to the slide assembly at three points and can be adjusted to level the mask frame to the alignment microscope.

The Exposure System

The Lightsources

UV exposure systems available for the 200 Series offer a broad range of exposure areas, intensities, and spectral profiles to match the user's photoresists. They range in power from 200 to 2000 watts producing radiation from 220nm to 436nm. Areas from 1" to 6" may be uniformly exposed. These highly collimated lightsources provide excellent results for contact or proximity exposure of photoresist.

The Regulated, Power-adjustable Powersupply

These powersupplies holds lamp power to within 1% over power variations as great as ±15% VAC. The powersupply can be adjusted over a limited range of power.

The Constant Intensity Controller

The Constant Intensity Controller (CIC) holds lamp intensity to within ±2% of the operator set intensity value at the exposure plane and compensates for lamp aging and power variations as great as ±15% VAC. The CIC uses a closed loop feedback control system having two sensors each tuned to a user selected wavelength.

When in the Constant Intensity mode, the CIC monitors one of the two sensors mounted in the light source and adjusts the intensity in response to changes in the lamp's output. The operator selects the wavelength to be monitored by use of a selector switch on the front of the CIC.

Shutter Timer/Field Illumination Control

The shutter timer allows the user to set exposure times in 0.1 second increments from 0.1 seconds to 99.9 seconds and in one second increments from 1 to 999 second increments. It also provides 6 VAC for microscope illumination.

The shutter timer provides power to the shutter solenoid during the exposure interval. The exposure interval can be initiated by pressing the "Expose" button on the shutter timer or remotely by a trigger signal supplied when the light source reached the exposure position.

Alignment Optics

A wide variety of alignment optics are available including stereo, compound, IR, split field microscopes and CCTV systems. This variety allows the user to choose a system which is best suited to his specific needs.

The microscope is moved from its home position to the alignment position by use of the handle on the sliding base located at the far right side of the aligner. The alignment module is moved in the "X" direction and the microscope is moved in the "Y" direction to position alignment structures in the field of view.

Adjustments are provided to level the microscope to the photomask so that it is in focus across the entire photomask.

A fine focus adjustment is provided to insure the sharpest possible image during alignment.

Operating Controls

All operator controls are mounted on the front of the aligner. They are clearly labeled to identify their function.

SECTION 1

INTRODUCTION

Scope of this Manual

This Operation Manual describes installation, calibration, operation, and maintenance of the OAI Series 200 Mask Alignment and exposure system.

Certification

OAI certifies that each Series 200 aligner met or exceeded its technical specifications at the time of shipment. The system is equipped with a Constant Intensity Controller which was calibrated in simulation testing to ensure that the optical sensing loop is properly calibrated with reference to NIST traceable measurement standards. All control and measurement functions were tested to verify proper operation.

Warranty and Assistance

This product is warranted against defects in materials and workmanship for a period of six months or 4000 hours (whichever occurs first) following shipment from the factory provided that installation has been performed or supervised by personnel trained on the Series 200 Mask Alignment and Exposure System. Equipment that in OAI's sole opinion has been misused, abused, incorrectly operated, improperly connected to a power supply, or tampered with shall be denied warranty benefits. Broken factory seals on instruments or power supplies (if the aligner is so equipped) shall be sufficient evidence to void the warranty protection. If the product is found defective within the warranty period mentioned above, OAI shall have the option to replace it or to repair it without charge and shall assume only one-way shipping charges. No other warranty is expressed or implied. No agent or representative has the power to alter or extend OAI's liability as herein stated. Determination of the suitability of the product or its fitness to a particular purpose lies solely with the buyer. In no case shall OAI assume liability for any incidental or consequential damages or expenses. In addition to the remedies herein provided, the buyer may have other rights which vary according to local laws.

Return Policy

1. Notify OAI before returning any product to the factory and obtain a Return Materials Authorization number. No credits, allowances, or adjustments will be made until reported defects have been verified to the satisfaction of OAI.

2. Time spent by OAI in checking equipment that is found to have no defects may be chargeable, warranty status not withstanding. Equipment returned to OAI for warranty service shall be shipped with transportation prepaid by the buyer. OAI will prepay the shipment back to the buyer. OAI reserves the right to refuse collect shipments, or to impose a service charge in addition to all C.O.D. costs.

3. Repairs and calibration services, other than warranty, available at prevailing OAI rates. In such cases the buyer shall pay transportation costs both ways for such services.

Unpacking and Inspection

If the shipping container shows evidence of damage, ask that the carrier's agent be present when the equipment is unpacked. Look for obvious damage, such as scratches, dents, broken faceplates, etc. If the equipment has been damaged, save the shipping and packing materials for the carrier's inspection and contact OAI immediately. OAI will replace products which have been verifiably damaged during shipping without waiting for the carrier's insurance settlement (subject to product availability.)

SECTION 3

INSTALLATION INSTRUCTIONS

NOTE: Before beginning installation, read "unpacking and Inspection" in the introduction.

Alignment Module

The alignment module is installed at the factory so that it is properly aligned to the light source and microscope. It is possible for it to be dislodged during shipment and to require adjustment.

Prior to any adjustment the module must be unpacked.

1. Remove the tie-wrap from the alignment module and lift the mask frame to remove the foam pad from under the mask frame lock and from around the vacuum chuck seat.
2. Remove the foam blocks from between the tips of the X and Y micrometers and the reference surfaces on the X-Y stage.
3. The alignment module is attached to the slide platform by three 1/4-20 mounting bolts. There are two at the back of the module and one at the front. They provide adjustment to level the alignment module in X and Y and can be adjusted from underneath the frame.

Light Source

There is packing material in the lightsource which is placed there to prevent damage to the system. The packing material is placed around both mirrors and on both sides of the lens. Remove it.

1. Install the lamp, with it's heat sink, according to the instructions in the Series 30 Light Source manual.
2. Check to insure that the light source is centered over the alignment module. If it is not, the light source may be moved slightly by loosening the four bolts in the base plate and adjusting the position. The alignment module may also be moved slightly by loosening it's mounting bolts.
3. Insure that the primary mirror has been secured in the 45° position. If it has not been, the heat sensor under the mirror will turn the lamp off.

Installing the microscope

1. Unpack the microscope and assemble it according to the manufacturer's instructions supplied with the microscope. (There is a steel pin attached to the back of the microscope mount. The center of the microscope focus range is determined by the position of this pin and it has been properly installed at the factory.)
2. Insert the pin into the anodized shaft of the transport mechanism and tighten the retaining bolt. (NOTE: The transport mechanism has been secured by tape which prevents movement of the Y stage and by a clamp on the bearing shaft below the front of the transport stage. The clamp has a tag on it instructing the user to remove it before operating the system. Remove the tape and the clamp.)
3. Install eyepieces and objectives as appropriate.

Installing the Constant Intensity Controller

1. Remove the Constant Intensity Controller from its packing.
2. Connect the cables as shown in fig. 2 and the instructions in the Constant Intensity Controller manual.

Preparing the Console

1. Connect all vacuum, air, and nitrogen lines as shown in figure 3. Turn on the air and nitrogen and adjust your regulator to 60 PSI, for Air : 30 psi, for N2
2. The pressure for the Acculign functions (substrate lift and floating the ball seat) have been adjusted at the factory assuming that 60 PSI have been provided. if further adjustment is necessary, the adjustment valves are mounted on the bottom side of the system's base plate.
3. Check the safety and air interlock by raising the mask frame. There should be a brief hiss of air exhausting.
4. Check all electrical connections and plug in the main power line.

SECTION 4

OPERATING INSTRUCTIONS

Controls and Indicators

The controls and indicators are shown and their functions are described in fig. 4.

Installing the Photomask

1. Close the mask frame and turn the mask frame lock on.
2. With the image surface facing down, place the photomask on the mask plate using the alignment pins to properly locate the mask.
3. Place the mask clamps over the photomask and secure.
4. Turn on the mask clamp vacuum.
5. Rotate the mask plate so that the x axis of the mask corresponds the x axis of the microscope's movement. This procedure will greatly facilitate the location of alignment structures on the mask.
6. Turn the mask frame vacuum off and open the mask frame. The substrate may now be placed on the substrate holder assembly (vacuum chuck.)

Placing the substrate on the vacuum chuck and alignment

1. Place the substrate on the vacuum chuck using the alignment pins (if provided) to orient the substrate and turn on the "Substrate Vacuum" switch.
2. Close the mask frame and turn on the "Mask Frame Lock" switch.
3. Press the Align button located to the left of the alignment module and, when it is in position over the mask, focus the microscope on the mask alignment structure.
4. Using the Z motion knob located on the right front-side of the alignment module, raise the substrate (by smoothly rotating the Z Knob) until it is in focus. (NOTE: Use low magnification for set-up and for locating the alignment structures because low magnification provides the greatest depth of focus and field of view.)
5. Turn the "Chuck Release" switch on and rotate the Z Knob to level the substrate to the mask. Stop when a resistance is felt. Release the "Chuck Release" switch. .
6. The gap between the mask and substrate now may be adjusted to a smaller mask to substrate separation which will allow the use of higher magnification optics during alignment.
7. Align the substrate to the mask using the following procedure:
   A. Align the substrate alignment marks to the mask alignment marks in "X".
   B. Align one of the alignment structures in "Y".
   C. Align the other alignment structure by taking up half the alignment error using the "Y" micrometer and half the error using the "X" micrometer.
   D. Repeat as necessary for precise alignment.

Exposing the substrate

1. Turn the contact vacuum adjustment valve counter clockwise and turn on the contact switch. (NOTE: When printing negative resist, contact must be proceeded by a nitrogen purge. Purging is done by turning the purge on prior to contact and allowing the nitrogen to displace the air in the vacuum chamber. Turn the purge off after the contact switch is turned on.
2. Adjust the contact pressure to the desired level.
3. Turn the Substrate vacuum switch off. (This will usually improve the contact between the mask and substrate.)
4. When you are satisfied with the contact, move the alignment module to the "expose" position under the light source. After a delay of approximately one second to allow settling any vibrations which may have been generated by the movement of the alignment module, the shutter timer will open the light source shutter for the time period set on the timer.
5. When the shutter closes;
   A. Move the alignment module to the "Align/Load" position.
   B. Move the alignment microscope all the way to the rear.
   C. Turn the substrate vacuum on.
   D. Turn the contact vacuum off.
   E. Turn the mask frame lock off and open the Mask frame.
   F. Turn the substrate vacuum off and remove the substrate.

SECTION 5

Aligning the Microscope to the Alignment Module

1. Insure that the microscope objectives will not hit the mask frame or mask clamp when the microscope moves to the align position.

To check, turn off the air supply and move the microscope by hand toward the mask frame. Adjust the height of the microscope as required according to the microscope installation instructions in section 3. When the height is properly adjusted turn the air back on.

2. With the microscope and light source in the load/unload position and the mask frame locked closed, place as mask on the mask frame and secure it in place with the mask clamp.
3. Move the microscope over the alignment module by pressing the "Align" button located to the left of the alignment module.
4. Focus on one side of the photomask with the highest magnification available and move the microscope to the other side of the mask. If the mask is not in focus use the two rear mounting bolts of the alignment module to bring the mask into focus. Repeat the procedure until the mask remains in focus as the microscope is scanned left and right WITHOUT ADJUSTING THE FOCUS OF THE MICROSCOPE.
5. Move the microscope to the front of the alignment module and focus on the mask. Repeat the same procedure as in 4 above except move the microscope from front to rear and adjust the rear mounting bolts to level the alignment module from front to rear. Be careful to turn both nuts the same amount in order to maintain the left to right leveling.
6. Check leveling again from side to side and make minor adjustments as required.

SECTION 6
TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
Automatic shutter does not open when light source is in exposure position	Trigger magnet not set properly: electrical connections ;defective electrical components	Check electric circuit; reed switch; adjust trigger magnet position.
Vacuum chuck does not float when chuck release is on	Insufficient air going to vacuum/air bearing cup	Adjust air flow using "chuck level release" valve.
Vacuum chuck vibrates when the chuck release is on	Excessive air going to vacuum/air bearing cup	Adjust air flow using "chuck level release" valve.
Short lamp life; lamp explosion	Improper cooling (too much or too little)	Insure that air flow maintains lamp at proper operating temp.

Note: A new lamp should operate in the idle mode at the voltage indicated on its package. The proper operating temperature can be found by installing a new lamp and adjusting the air flow until the listed voltage is indicated by the meter on the front of the Constant Intensity Controller.

SERIES 200 SPECIFICATIONS

Alignment Module

Vacuum Chuck X, Y, travel		±0.47" (12mm)
Vacuum Chuck Z travel		±0.12" (3mm)
Vacuum Chuck rotation		±7°
Substrate size accommodation		pieces to 6"x6"
Micrometer Graduations		or .001mm
Mask size accommodation		2"x2" to 7"x7"
Mask rotation;	Rotating:	±5°
	Pivoting:	±1.5°

Lightsource

Lenses	5" or 7" diameter or 10" truncated (for 6 "x 6" substrates) Schott BK-7 or fused silica.
Power ratings (watts)	Near UV: 200, 350, 500, 1000 Deep UV: 500, 1000
Constant Intensity Controller	Maintains intensity to ±2% of operator set value throughout life of the lamp with line voltage variations of ±15%.
Shutter Timer/ Field Illuminator	Exposure time ranges of 0.1 to 99.9 sec. and 1 to 999 sec. Illuminator voltage control 0-6 VAC, 35 watts maximum.

Alignment Optics

Stereo Microscopes	B&L Stereo Zoom 7 Wild Heerbrugg M5A, M7, M8 Olympus, Nikon,
Metallurgical Microscopes	B&L Microzoom II Olympus, Nikon, Leitz,
Split-field	Zeiss MJM3 and 4 as available Dual CCTV system with 9" monitors

Note: Virtually any microscopes can be mounted to the Series 200 for use as an optical alignment system. OAI will provide any system the customer chooses if it can be properly mounted.

Dimensions

Console	Width: 31" (78.7cm) Height: 35" (140cm) Depth: 24" (61cm)
Shipping weight	250 lbs. (114Kg)

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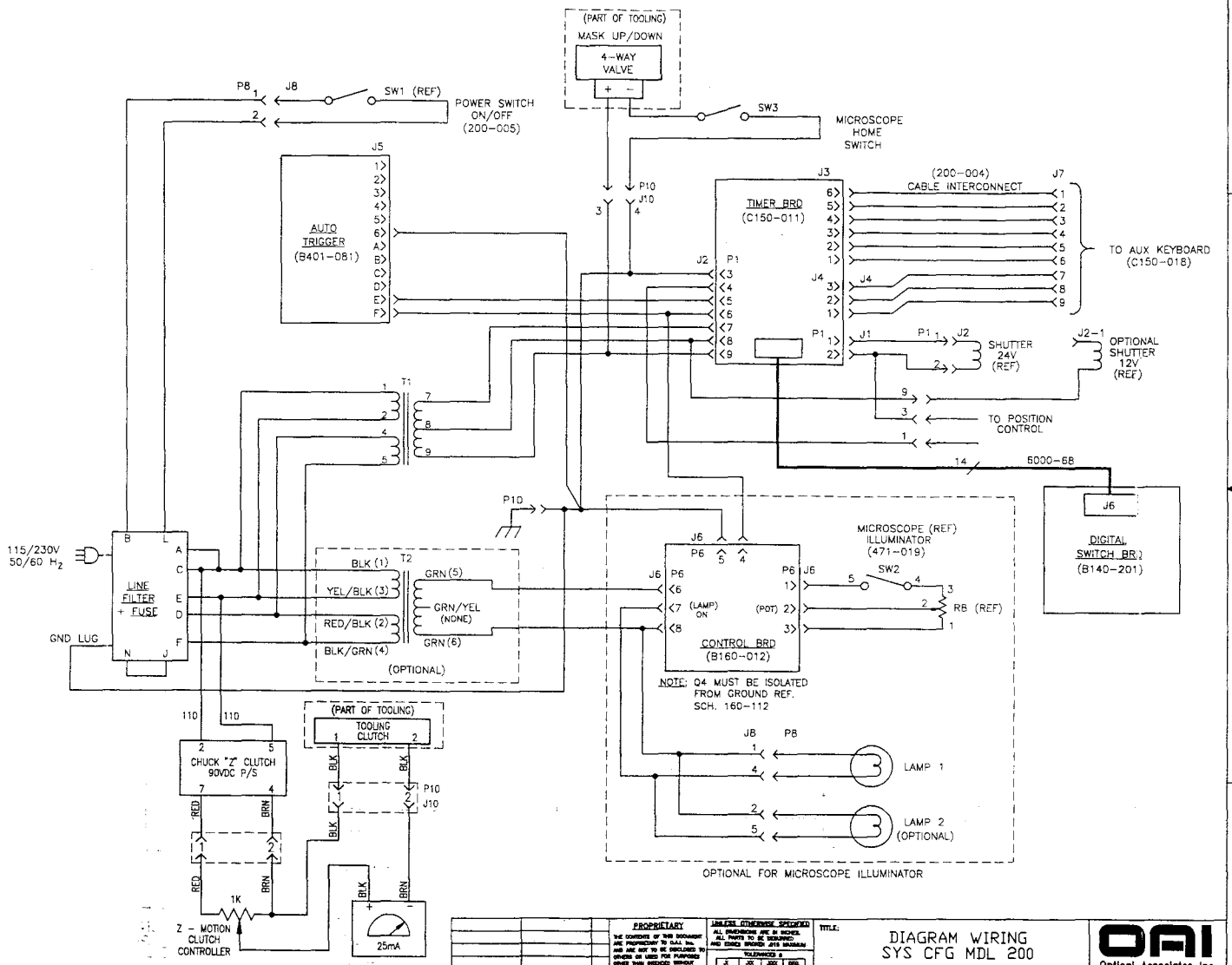

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NOTES: (UNLESS OTHERWISE SPECIFIED)

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UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES.
ALL PARTS TO BE DEBURRED AND EDGES BROKEN .015 MAXIMUM

TOLERANCES ±

X	XX	XXX	ANG.
.030	.010	.005	1/2°

THIRD ANGLE PROJECTION

SCALE: NONE

DO NOT SCALE DRAWING

	DRAWN	CHECKED	ENGINEER
NEXT ASSY. / MODEL / QTY	CTEX		M.MANLEY
APPLICATION	3/30/98		3/30/98

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MATERIAL: NONE

FINISH: NONE

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C 0200-102-01 REV.: A

SHEET: 1 OF 1

REVISIONS					C 0200-101-01 A
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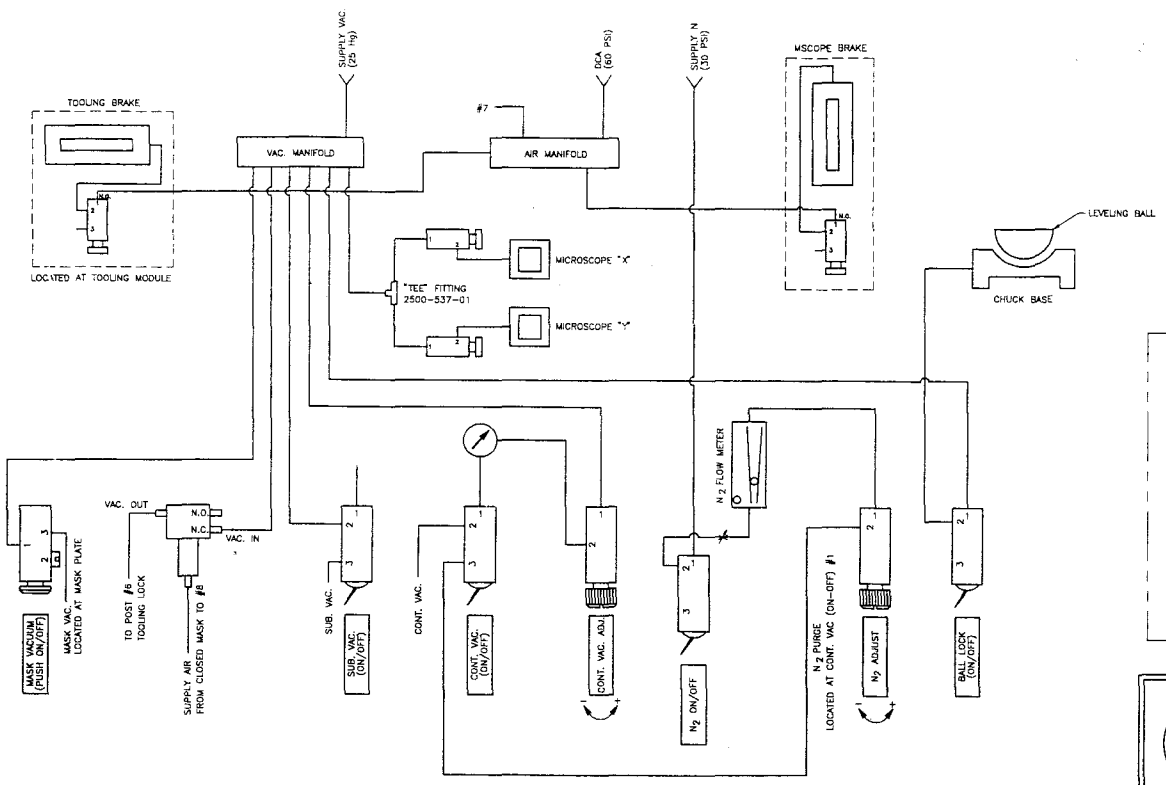
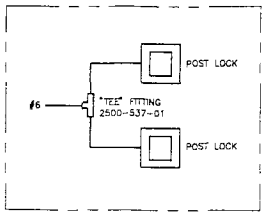
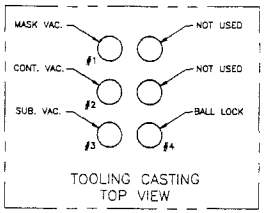
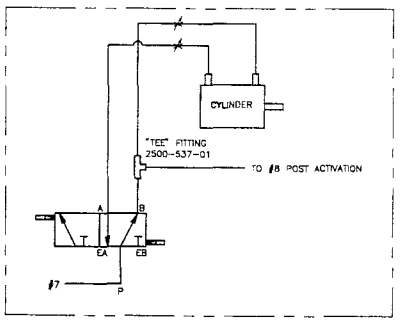
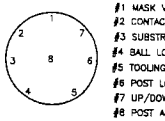






TOOLING CASTING
TOP VIEW





#1 MASK VAC (ø1/8 TUBING)
#2 CONTACT VAC & NITROGEN PURGE (ø1/8 TUBING)
#3 SUBSTRATE VAC (ø1/8 TUBING)
#4 BALL LOCK (ø1/8 TUBING)
#5 TOOLING BRAKE
#6 POST LOCK (ø1/8 TUBING)
#7 UP/DOWN SOLENOID MASK
#8 POST ACTIVATION

TUBING ARRANGEMENT FOR THE TOOLING

1. INTERPRET DRAWING PER MIL-STD-100.

NOTES: (UNLESS OTHERWISE SPECIFIED)

NEXT ASSY.	MODEL	QTY
APPLICATION		

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ALL PARTS TO BE DEBURRED AND EDGES BROKEN .010 MAXIMUM

TOLERANCES ±

.X	.XX	.XXX	ANG.
.030	.010	.005	1/2°

THIRD ANGLE PROJECTION

SCALE: NONE

DO NOT SCALE DRAWING

DRAWN	CHECKED	ENGINEER
CTEX		E PLAMER
3/24/98		3/24/98

TITLE: DIAGRAM PNUEMATIC PIPING & INSTRUMENTATION MDL 200

MATERIAL: NONE

FINISH: NONE

ACAD FILE NAME: M:\ENG\02XX\200\DWGS\101-01A.DWG

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C 0200-101-01 REV.: A

SHEET: 1 OF 1

OPERATION MANUAL

150/160 SHUTTER TIMER

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INTRODUCTION

The Model 150/160 Shutter Timers are intended to operate a solenoid valve, such as the Clippard Model EV-3, operating on 12 volts at 0.1 ampere D.C., or solenoids requiring 24 volts at up to 0.4 amperes. The solenoid coil is energized during the timing interval. The timing interval may be started manually with the pushbutton controls on its panel or remotely by a trigger signal. The Model 150/160 Timers are powered with internal power supplies capable of operation from 90 to 240 volts AC at 50 to 60 Hertz.

The Model 150/160 has two timing ranges, selected by pushbuttons: 100 SEC and 1000 SEC. These provide intervals which range from 0.1 seconds to 99.9 seconds and from 1 second to 999 seconds. After the timer interval has been selected, the shutter opening may be initiated by pressing EXPOSE or by pulling the trigger input (Pin 5 rear connector) to ground (Pin 4 rear connector). This may be a logic signal (TTL, CMOS, etc.) or a contact closure. When the timer interval selected has expired, the shutter for an indeterminate period, press LAMP TEST. Pressing RESET will always close the shutter, either after LAMP TEST or during EXPOSE.

An interconnecting cable (OAI Part No. C150-016) is provided to connect to large OAI lamp housings and shutters which use solenoid valves to control a shutter (24 Volt Solenoid).

THEORY OF OPERATION

The Model 150/160 Shutter Timer provides a timed signal, for a solenoid operated valve, controlled by a digital counter (U8, U9, U10) counting clock pulses provided by an RC oscillator (U2). See the schematic, OAI Drawing No. D150-111. For the Model 160 Timer, also see schematics, OAI Drawing No.'s A160-114 and B160-112. The number of clock pulses counted is selected by a three decade digital switch. The clock circuit provides clock pulses of either a 0.1 second period (100 seconds maximum) or a 1 second period (1000 seconds maximum) depending upon whether the oscillator frequency is fed directly to the counter (U1, U3, S1, S2).

Before timing starts, U6A is set, the signal LOAD is high and the number selected by the digital switch (S6) is loaded into the counter. The timing sequence is begun by pressing S5 or by presenting a trigger signal to Pin 5 of P2. This will reset U6A, setting the signal LOAD low, arming the counter and releasing it from the digital switches. (See the timing diagram, Fig. 1). Simultaneously, LOAD will go high arming U7A, U7B, and present a high to U6B. The following CLOK pulse will start the count down

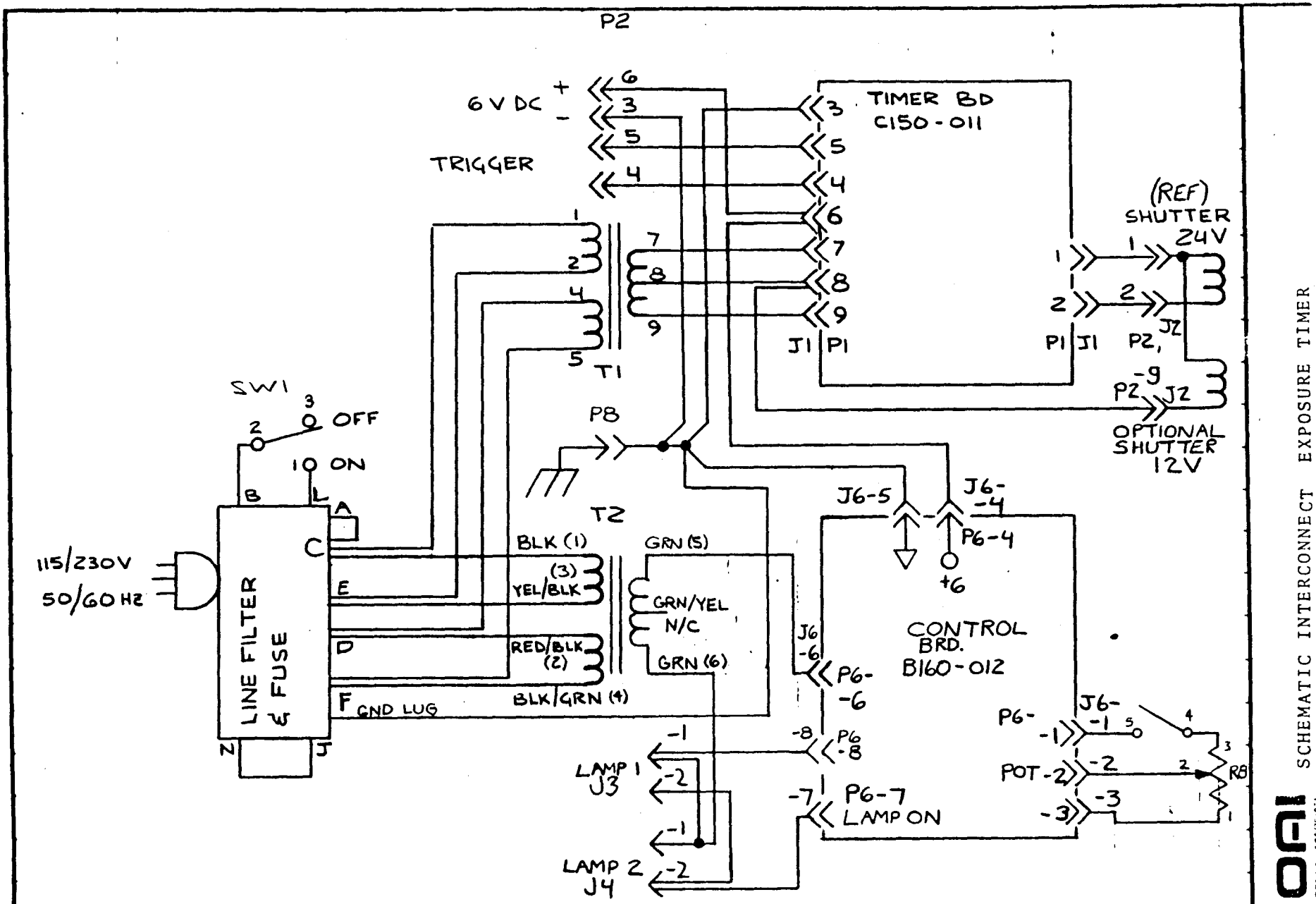
The selection of 100 seconds or 1000 seconds maximum is stored in a latch (U1) which controls the clock gating and the decimal point position as indicated by LED's (DS1, D52). If 100 seconds maximum is desired, the latch opens a gate and the 10 Hertz signal from the clock oscillator (U2) is fed directly to the counter. The trim-pot R6 is used to set this frequency precisely. If 1000 seconds maximum is selected, the signal from U2 is diverted through a divide-by-ten counter where the signal is changed to 1 Hertz before it is fed to the counter. A delay (R1, C1) is provided so that upon power-up, the timing is set for 100 seconds maximum.

The Model 150/160 is powered by an internal power supply providing 12 volts and 24 volts rectified D.C. The 24 volts is used directly to power the solenoid. The clock oscillator and all logic is powered by 6 volts provided by an IC regulator (VR1) which gets its power from the 12 volt supply.

SHUTTER SOLENOID DRIVE

Transistors Q4, Q3, and Q5, provide the current gain required for driving a high current solenoid from the CMOS logic in the timer. 24 volts is provided by the power supply through rectifiers (CR1) and capacitor (C13). While the shutter is off, the capacitor (C13) charges to approximately 40 volts. When transistors Q4, Q3, and Q5, turn on, 40 volts is applied to the

DRAWINGS	NUMBER
Interconnect Schematic	A160-114
Exposure Timer Schematic	D150-111
Exposure Timer PCB Assembly	C150-011
Intensity Control Schematic	B160-112



SCHEMATIC INTERCONNECT EXPOSURE TIMER

REV.	DATE	ECO	REV.	DATE	ECO	REV.	DATE	ECO	REV.	DATE	ECO
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B	12-30-81	1207	E	2/7/83	1526						
C	7-7-82	1300	F	3/23/83	1549						

R. PATEL		
10-5-81	11/5/82	12-6-81

NO. A160-114
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F

OPERATION MANUAL

500W NEAR UV CONSTANT INTENSITY CONTROLLER

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***** IMPORTANT *****

NOTICE: Due to the high voltage required to start mercury arc lamps, the light source power supply starter circuit may create RF noise during the start up cycle that might possibly have an effect on sensitive electronic equipment in the immediate area. Noise may also be created on the power supply AC input line during the start up cycle. To eliminate this potential problem, it is also recommended that the power supply and lamp be started before turning on any sensitive electronics in the immediate area. If this is not possible, it is recommended the power supply and cabling be placed at a distance from any sensitive electronics that has not been adequately shielded .

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OAI Constant Intensity Controller
For 200, 350, and 500 Watt NUV Lamps

Table of Contents

DRAWINGS:

Description:

The OAI Constant Intensity Controller is a solid state line and load regulated power supply designed to operate mercury vapor short arc lamps with negative pressure fill characteristics that allow a breakdown voltage of 1800 volts or less. The supply uses optical feedback to maintain constant intensity control within bounds of the specified wattage range.

The following is a description of the front panel controls:

Power Switch	Turns the power supply on or off.
Start Switch	Momentary contact, provides high voltage to start the lamp.
Meter Select Switch, Intensity / Power	Controls the meter directly above this switch. Switched to the right, meter reads power in Watts. Switched to the left, meter reads intensity in mW/sq. cm.
Meter Select Switch, Current / Voltage	Controls the meter directly above this switch. Switched to the right, meter reads lamp voltage (DCV). Switched to the left, meter reads lamp current in Amps.
Mode Select Switch, Constant Intensity / Constant Power	Selects the operating mode. Switched to the right, system is in constant power mode. Switched to the left, the system is in constant intensity mode.
Sensor Select Switch	Selects which of the two feedback probes in the Lightsource will actually control intensity in "Constant Intensity" Mode, and be displayed on the right-side meter (with the meter select switch in the "Intensity" position).
Intensity "Calibrate"	Two, ten-turn controls (one for each channel) that calibrate the intensity meter.
Intensity "Set"	Two, ten-turn controls (one for each channel) that set the desired intensity for Constant Intensity Mode.
Power Set Control	Ten-turn control that sets the Constant Power wattage level.

There is a two position switch mounted on the circuit card interior to the power supply. The system may be set up for either 200/350 watt or 350/500 watt operation. If the system is set up for 350/500 watt operation; when the switch is in the position towards the rear of the power supply the wattage range limits are 200 and 425 watts. This range is appropriate for a 350 watt lamp. When the switch is in the position towards the front of the power supply the wattage range limits are 350 and 625 watts. This range is appropriate for a 500 watt lamp. The maximum lamp power is either 425 or 625 watts.

If the system has been set up for 200/350 watt operation; when the switch is in the position towards the rear of the card the power supply wattage range limits are 125 and 300 watts. This range is appropriate for 200 watt lamps. When the switch is in the forward position, the wattage range limits are 200 and 425 watts and is appropriate for use with a 350 watt lamp. The maximum lamp power is either 300 or 425 watts.

When the limiting power is achieved an audible alarm will sound. This lets the operator know, when in the constant intensity mode, that the lamp wattage cannot go any higher and therefore the "asked for" intensity (as defined by the intensity set control) is not being achieved.

Specifications:

Mechanical

Length	16.0 in.
Width	10.4 in.
Height	7.0 in.
Weight	44 lbs.

Electrical

Input Voltage	100 to 125, or 200 to 250 VAC
Max Input Current	10.6 amps at 100 VAC and 5.3 amps at 200 VAC.
Input Frequency	50/60 Hz.
Starting Voltage	2000 volts
Open Ckt. Voltage	160 volts
Max. Lamp Current	11 amps
Power Ranges	125 to 300 watts for 200 watt lamps 200 to 425 watts for 350 watt lamps 350 to 625 watts for 500 watt lamps

Interface

Lamp Connectors	Amp. #862435-3 (female) #66099-2 (male)
Logic Control Connector	Cinch P304-AB (female) P303-AB (male) (24 volts from pins 4 to 3 commands intensity pulse)
Sensor Connector	Switchcraft A3F
Fan Connector	Cinch P303-AB (female) #P303-CCT (male)

OPERATING INFORMATION:

AC Power:

This Constant Intensity Controller is intended to be operated from a single phase, earth-referenced power source having one current-carrying conductor near earth potential. The unit has a three wire power cord with a three terminal polarized plug for connection to the power source and safety earth. The safety earth terminal of the plug is directly connected to the power supply chassis. For shock protection, insert this plug only in a mating outlet with a safety earth contact.

Operating Temperature:

This Constant Intensity Controller can be operated where the ambient air temperature is between 10 and 35 degrees C. The power supply is cooled by air being drawn in through the rear and exhausted through the side panels. Adequate clearance must be provided on all sides to allow heat to be dissipated from the supply. Blocking or restricting the air flow may result in damage to the power supply.

The Lamp:

This Constant Intensity Controller must be used with a 200 watt, 350 watt or 500 watt mercury vapor lamp with negative pressure inert gas fill having a breakdown voltage of 1800 volts or less.

With normal temperature operating conditions, the lamp will achieve full power in approximately five minutes with voltage and current parameters approximating those specified by the lamp manufacturer. With over-cooling conditions, the mercury in the lamp may not completely vaporize and the lamp will not come up to full power and proper intensity. If a voltage reading is not within a few volts of that specified, check to see that the cooling associated with the lamp housing is working according to specifications. Over-cooling of the lamp will result in severely reduced lamp life.

The following lamp criteria must always be followed:

1) **Always operate the lamp in a vertical position with the anode on the bottom.**

2) **Always operate the lamp with the positive lead connected to the anode terminal.**

3) **The anode and cathode terminals of the lamp must always be isolated from ground and any conductive parts.**

4) **Always use the proper lamp as specified by the light source manufacturer.**

Operating OAI Constant Intensity Controllers:

When the operator is assured that the power supply is properly installed, the correct lamp is in place with a heatsink and the High Voltage lead connected, the unit can be set up with the following step-by-step procedure:

1) Initial front panel settings:

Power Switch	**Off**
Intensity-Power Switch	**Power**
Voltage-Current Switch	**Volts**
Mode Select Switch	**Constant Power**
Sensor Select Switch	**Desired Wavelength**
All Knobs	**Fully CCW**

2) Turn power switch to **ON** position. Voltmeter should indicate 150 to 200 volts.

3) Depress **START** switch momentarily, releasing when the lamp ignites. Within five within five minutes, the power meter should read 125 to 300 watts for a 200 watt system, 200 to 425 watts for a 350 watt system or 350 to 625 watts for a 500 watt system. Adjust the powerset knob for 190 watts for a 200 watt lamp, 275 watts for a 350 watt lamp, or 400 watts for a 500 watt lamp. Rotate the locking ring around the powerset knob to hold the position.

4) Set the Intensity-Power meter select switch to intensity.

5) Open the shutter of the lightsource and, using a calibrated intensity meter, measure the light intensity at the exposure plane.

6) Adjust the Intensity Calibrate knob, for the appropriate channel on the power supply, until the intensity meter indicates the intensity measured in step 5, with the meter.

7) Set the Mode Control Switch to Constant Intensity.

8) Adjust the Intensity Set Control, for the appropriate channel on the power supply, to the desired intensity and check to see that the intensity meter on the power supply tracks the intensity measured at the exposure plane.

This completes the setup procedure. The unit is now ready for production exposures. After the initial setup is accomplished, it is not necessary to go through the setup procedure each time the lightsource is turned on. Simply turn on the power supply with the system shutter closed and the unit will be ready to operate in five minutes.

THEORY OF OPERATION:

The OAI Constant Intensity Controller is a solid state switching regulator designed to start and run either a 350 or 500 watt negative pressure mercury vapor lamp. The power supply uses optical feedback from filtered photodetectors to provide constant light intensity.

Unregulated rectified line voltage (approximately 160 VDC) is regulated down to the lamp voltage by chopping the 160 VDC into a low pass filter which in turn feeds into the lamp. The chopping, or switching is at constant frequency and the duty cycle is changed to affect changes in lamp current.

The power supply employs three feedback loops, two current feedback loops, and one wattage feedback loop. One current loop and the wattage loop are constant frequency pulse width modulated control loops. The other current loop is a hysteresis on-off control loop, sometimes referred to as a "bang-bang" control loop. The purpose of this loop is to provide current limiting during the settling time of the other current loop. The "bang-bang" loop operates only for short periods of time, at the beginning of ignition and sometimes during transients caused by the lamp arc shifting.

Wattage control is achieved by employing an analog multiplier which generates a voltage which is proportional to the instantaneous lamp wattage. The two inputs to the analog multiplier are two voltages proportional to lamp voltage and lamp current respectively. The output of the analog multiplier is a voltage proportional to the product of lamp voltage and lamp current. This voltage is compared to another voltage representing a power command or desired power. A difference between these two voltages causes a change in the switching duty cycle which in turn will increase or decrease the lamp current in the right direction and amount to force the lamp power to the commanded lamp power.

Starting the lamp is accomplished by raising the output voltage of the power supply to a value which is sufficient to ionize the gas between the electrodes of the lamp. A separate high voltage DC (2000 V) unregulated supply provides the necessary voltage to do this. High voltage diodes are used to isolate the starting voltage from the switching regulator.

When the lamp is made conductive by the starting voltage the regulator will conduct current through the lamp. At this point the lamp is cold, the mercury is not yet vaporized, and it represents a low impedance (close to a short circuit). To achieve the commanded power requires a very high current, which is limited, at first, to approximately 15 amps. The "bang-bang" loop does this for about one second, and then the linear current loop limits it to about 11 amps. The unit will operate in the current limit loop at 11 amps, and the lamp power and voltage will increase until the commanded power is achieved. At that point the wattage loop, employing the analog multiplier, will take control. The current will decrease and the voltage will increase, but their product will remain constant. The final value of lamp voltage and current will depend on the individual lamp and the thermal conditions surrounding it.

CIRCUIT DESCRIPTION:

The following is a detailed circuit description with reference to the circuitry and circuit components. This discussion will have a continuous reference to the top schematic, and the control board schematic.

Input Line Circuit:

Referring to the top schematic, the input line voltage is switched by SW1, a one pole breaker switch on the front panel which serves the dual purpose of switching the power supply on and off, and providing over-current protection. The output of SW1 connects to transformer T1 which has two 115 Volt primary windings and five secondary windings. Four of the secondary windings are low power windings which provide various voltages required by the control circuit. The large secondary winding, terminals 9 and 10, provide the raw voltage which is the input to the regulator. The time meter, fan, pilot light and starting transformer, T2, all require 115 VAC which is obtained across terminals 1 and 3 of transformer T1. For 230 Volt operation only the strapping between terminals 2 and 3 is made, and the two primary windings function as a step down autotransformer. The voltage across terminals 1 and 3 remains unchanged and the five secondary voltages remain unchanged.

Series Pass Switching and Filter Circuit:

The full wave bridge rectifier, BR2, always has 115 VAC at its input and its output, across filter capacitor C1, is approximately 160 VDC. The voltage across C1 is unregulated and will vary with line and load variations.

Transistor Q1 is either on fully (saturated) or completely off. When transistor Q1 is on, current will begin to flow from the positive terminal of C1 through the lamp load, through Resistor R2, through inductor L1 (sometimes referred to as the flywheel inductor), and through transistor Q1. The current will not occur instantly, but will start at zero and increase at some rate (amps/sec). This rate will depend on the value of load voltage and the inductance of inductor, L1. Sometime later the current will have reached some level and the transistor, Q1, is turned completely off. The current will decrease and the resulting collapsing field in inductor, L1, will cause the voltage across L1 to change (the voltage on the inductor terminal nearest CR1 will increase). This voltage will grow very rapidly until the diode CR1 (sometimes referred to as the catch diode) forward conducts. Current will circulate, decreasing with time, through the loop defined by diode CR1, the load , and inductor L1. The rate of current decrease will depend on the load voltage and the inductance of L1. If Q1 is again turned on the anode voltage of CR1 will decrease and CR1 will become reverse biased. Current will flow through the loop defined by C1, the load, L1, and Q1. Again the current will increase with time. The load current increases with Q1 on and decreases with Q1 off. If the percentage of "on" time for Q1 is controlled and the frequency of switching is high compared to the growth and decline rate of load current, the load current can be controlled to a substantially constant value.

Starting Circuit:

The primary of the starting transformer, T2, is energized by depressing the momentary start switch SW2. The output of T2, approximately 2000 volts, is rectified by the high voltage bridge, BR1. The output of the bridge appears across the lamp. It is blocked from the regulator by two high voltage diodes, CR2 and CR3. The resistors across the blocking diodes divide the voltage evenly across the diodes.

Control Circuit Supply Voltages:

The control circuit reference and IC rail voltages are regulated to plus and minus 1 volt. The two top secondary windings of transformer T1 (top schematic) provide inputs to bridge rectifiers BR1 and BR2 (card schematic). The bridge outputs go to the 15 volt IC regulators, VR1 and VR2, which provide the regulated voltages as shown on the lower right side of the control board schematic. Note that these voltages are referenced to pin S of the control board, which connects to the lamp cathode and chassis ground. Anytime the ground symbol is used it represents the cathode potential.

First Current Loop (Bang-Bang):

Resistor R2 (top schematic) is a 50 watt current sample resistor mounted on the left rear corner of the power supply. The voltage across this resistor represents lamp current and is input to the control board through pin 4. At this point the voltage is a negative .1 volts per amp. This current signal is an input to the comparator U4-11 through R20 (control board schematic). The other input to the comparator is minus 1.4 volts. This corresponds to 14 amps for the current signal. Resistor R21 provides hysteresis so that the comparator is low when the current is 15 amps and the comparator is high when the current is 13 amps. When in this mode the loop will oscillate between 13 and 15 amps.

Drive Circuit:

The drive circuit starts with R35 (control board schematic) and includes transistors Q1 through Q8, and the resistors and diodes surrounding these transistors. The logic of the drive circuit is as follows: Resistor R35, the lead nearest comparator U4-1, must be high for the main drive transistor to be on, and must be low for the transistor to be off. The circuitry which includes Q3 through Q8 is referenced to the emitter of the main drive transistor. The two bottom windings of transformer T1 (top schematic) provide inputs for bridges BR3 and BR4 (control board schematic). The outputs of these bridges provide plus 8 and minus 5 volts (referenced to the main driver emitter) for the drive circuit.

The output states of U4-1 and U4-2 define the state of Q1 and Q2. Transistor Q2 functions as a logic level shifter from the lamp cathode reference to the lower potential of the main transistor emitter. Transistors Q3 and Q4 provide low level switching gain. Transistors Q6 and Q8 turn the main transistor on by switching plus 8 volts into the base drive resistors (drive card schematic). When U4-1 is low, transistors Q5 and Q7 will be on, which will switch the base of the main drive transistor to minus 5 volts with respect to the emitter. Comparator U4-4 functions as a sequencer. Regardless of the states of U4-1 and U4-2, transistor Q1 (control card schematic) is not allowed to be on for approximately one half second after the power supply is turned on. The time constant of R45, R46, and C6 determines the length of the time delay. Through CR8, Q1 (control card schematic) is turned off immediately upon power down or loss of power. This sequencing keeps the main drive transistor from operating in the linear mode during power down and allows time for all circuit functions to establish their proper control before the main drive transistor is allowed to turn on.

Pulse Width Modulator:

Comparators U4-1 and U4-2 form the pulse width modulator. Comparator U4-3 is a triangle wave oscillator. The wave form on pin 6 of U4-3 is a triangle wave with a period of approximately 60 microseconds. The amplitude is about five volts peak to peak, centered about

ground. The voltage on pin 5 of comparator U4-1 in effect sets the switching threshold of the comparator so that its output duty cycle is proportional to this voltage.

Soft Current Loop:

The current sample signal, minus .1 volts per amp, from pin 4 of the control board, is effectively summed by amplifier U1-A with a reference signal determined by R7. If, during the time the system is in the current limit mode, the lamp current is greater than 11 amps, the output of the U1-A will increase. The output of U2-A will decrease, decreasing the output of U2-B, so that the voltage on pin 5 of U4-1 will decrease. The duty cycle and lamp current will decrease. Likewise the system will make corrections if the current is less than 11 amps.

Wattage Control Loop:

The integrated circuit, U3, on the control board is an analog multiplier. The output, pin 4, is proportional to the product of the two inputs, pins 1 and 6. Pin 6 is fed from the amplifier U1-A, whose input is the current sample signal. The lamp voltage sample is taken from the positive terminal of Capacitor C1, (top schematic). Diodes CR3 and CR4 on the control card compensate for the drop across the two blocking diodes, CR2 and CR3 (top schematic). The variable voltage divider in the voltage sample circuit defined by R16, R19, and trimpot P5 (control card schematic), is used to calibrate the analog multiplier. The output of the analog multiplier is fed into the summing junction of amplifier U2-A, where it is compared to the wattage command, which comes from U7-B. The resulting signal controls the duty cycle of the main transistor if the system is not in a current limit mode.

Optical Control Circuit:

The external sensors (at any given time only one sensor is used depending on the position of the sensor select switch on the front panel) produce a current proportional signal which is converted to a proportional voltage signal by amplifier U5. The gain of this amplifier is set by the appropriate intensity calibrate control on the front panel of the power supply. The intensity reference signal is generated by the appropriate intensity set control on the front panel of the power supply. The two signals, intensity and intensity reference, are compared at amplifier U6-B on the control board. The output of this amplifier is the wattage command for the regulator. This signal is limited to approximately 4.25 volts by the limit circuit, U7-A and U7-B, and then goes to the regulator circuit. The maximum power corresponding to this limit is 625 watts. If this limit is reached, comparator U9 activates an audible alarm.

The mode of the power supply, constant intensity or constant power (idle) mode, is determined by an external logic input, usually coordinated with the shutter of the lightsource using the power supply. The mode signal controls the optical coupler, OC1, which determines the state of comparators U8-2, U8-3, and U8-4. The comparators choose the source of the wattage command input, either the front panel power set control or the signal generated by U6-B from the sensor signal and the intensity reference signal.

TROUBLE SHOOTING PROCEDURE:

In the event of malfunction, the following procedure can be used as an aid to troubleshooting. Before starting the detailed troubleshooting procedure, check for the most obvious malfunctions such as:

AC Power Connection
Line Voltage
Interface Connections
Lamp Conditions
Full Lamp Cooldown (before restart)

Sometimes power supply failures result in burnt or visibly damaged components. Any such components should be replaced, however it must not be assumed that the power supply is repaired because these visibly damaged components are replaced. It is possible that other components are defective and attempting to operate the power supply could result in additional damage. The full procedure should be followed before attempting to operate the power supply with a lamp. Most of the failures in the field are due to failures of the main switching transistor and its associated drive circuitry. This is addressed in step five of the procedure and most of the defective power supplies will be repaired from step five. However, the other suggested tests should be made before the power supply is tested with a lamp.

1) With a scope referenced to ground of the power supply chassis, check the plus and minus 15 volt references; minus 15 at the negative terminal of C9, located at the center of the control board, and plus 15 at the bottom lead of R34, located near the center of the control board near trimpot P1. These voltages should be within one volt of 15 volts and should be free from ripple. Replace BR1, BR2, VR1, and VR2 as required.

2) Check the oscillator output with the scope probe on the right hand lead of capacitor C5. The waveform should be triangular with a period of 60 microseconds and a peak to peak amplitude of 5 volts centered about ground, Replace comparator U4 if necessary.

3) Put the scope probe on the junction of R92, R93, and C16, located near the center rear of the control card. With the mode select switch in the constant power position, turn the power set control clockwise, the voltage on the scope should increase and limit to approximately three volts. When this voltage limits the audible alarm should sound. Replace U6 or U8 as required.

4) Before proceeding, make sure that the scope is not grounded either at the frame or at the power plug. **The scope must be isolated!** Reference the scope to the emitter of the main drive transistor Q1, MJ10004. This can easily be done at the negative terminal of C1 (top schematic) the 640 microfarad capacitor mounted near the front panel of the power supply next to the largest transformer. The voltage on the positive lead of C12 on the control board should be approximately eight VDC. The voltage on the negative lead of C13 on the control board should be approximately minus five volts. Replace bridge rectifiers BR3 and or BR4 as necessary.

5) With the power supply power cord plugged into an outlet and the lamp leads disconnected, turn the power supply on while looking at the voltmeter on the front panel of the power supply. The volt meter should immediately indicate approximately 100 volts and then should jump to about 160 volts in about one half second. If the voltage immediately goes to 160 volts when the power supply is turned on, the main drive transistor, Q1 (top schematic) is shorted. This transistor is mounted on the large heatsink at the rear of the power supply. Any time this transistor is defective it is likely that the base drive circuitry for the transistor is also damaged. Therefore, whenever Q1 (main drive transistor, MJ10004) is replaced, replace the following components on the control card: Q3, Q4, Q5, Q6, Q7, Q8, and CR9, CR10 and, CR11. Also check capacitor C3 on the drive card. This can be accomplished by unsoldering one lead of the capacitor and looking for a transient indication on an ohmmeter set to it's highest impedance range. If defective, this capacitor should be replaced with a .03 microfarad, 300 volt, extended foil capacitor. These components represent a small expense compared to the main drive transistor and should always be replaced when the main drive transistor is replaced. If, when turning the power supply on, the voltage rises very slowly (3 to 4 seconds) or not at all, check F1 (top schematic), the 30 amp fuse located between transformer T2 and the drive card; replace if defective. If the voltage still rises slowly or not at all, the main drive transistor is open. Replace the transistor along with the components listed above.

6) If the circuit breaker consistently breaks when attempting to turn the power supply on without attempting to start a lamp, then either BR1 (the bridge rectifier mounted on the large heat sink at the rear of the supply nearest the power cord) or C1 (the 2400 microfarad capacitor on the right side of the supply) is shorted. Replace as necessary.

7) If the power supply operates in the constant power mode, but does not operate properly in the constant intensity mode, most likely the problem is with the optical sensors or the sensor input circuitry. With the power supply operating a lamp in the constant power mode and with the system shutter open, there should be an indicated intensity on the front panel intensity meter. The intensity indication should increase smoothly as the intensity calibrate control is rotated clockwise. The intensity indication should also increase smoothly as the lamp power is increased. If this does not happen, check to insure that the sensor is installed properly. If the problem still persists, change U9 and U10 on the control board. If U9 is changed, trimpot P8 must be readjusted. Unplug the sensor and, with the intensity calibrate control fully clockwise, adjust P8 for a null on the front panel intensity meter.

OPERATION MANUAL

MODEL 306

UV POWERMETER

OAI 1425 McCandless Drive Milpitas, CA. 95035

Phone 408/263-4944 • FAX 408/263-6389 • 800/843-8259

OPERATION MANUAL

FOR

MODEL 306

UV POWERMETER

WARNING

The high intensity energy produced by employing mercury arc lamps can cause eye damage. Personnel with this equipment should wear eye protection with suitable filtration to block ultraviolet and infrared radiation. OAI will not be responsible for injuries arising from incorrect or unprotected work with these systems. They should not be adjusted or serviced by personnel lacking specific training on them.

OAI

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11/93

CONTENT

SECTION 1

INTRODUCTION

Unpacking and Inspection

If the shipping carton containing your Powermeter shows evidence of damage, ask that the carrier's agent be present when the instrument is unpacked. Look for obvious damage, like scratches or dents. If the Powermeter has been damaged in transit, save the shipping and packing materials for the carrier's inspection; then contact OAI immediately. OAI will repair or replace products suffering from verified shipping damage without awaiting the carrier's insurance settlement (subject to product availability).

Warranty

This product is warranted against defects in materials and workmanship for a period of six months from the date of shipment. OAI will, at its option, repair or replace without charge, products which prove defective within the limits expressed herein. Equipment damaged in transit, abused, misused, operated on incorrect power sources, or on which the factory seals have been broken (evidencing unauthorized intrusion), shall be excluded from warranty coverage. No other warranty is expressed or implied and no agent or representative has the power to alter or to extend OAI's liability as stated herein. Determination of the suitability of the product or fitness to a particular purpose, lies solely with the Buyer. OAI assumes no liability for any incidental or consequential damages or expense.

Return Policy

Products should not be returned without first notifying OAI, so that the shipment can be expected, avoiding possible misunderstanding or loss. Written advisement as to the action desired and a description of symptoms to be corrected should accompany the product being returned, along with a covering purchase order, if not under warranty. No credits, allowance or replacements shall be made until alleged defects are established to OAI's satisfaction. Time spent by OAI to check out equipment that is found to have no fault may be chargeable. A product returned to OAI for warranty service must be shipped with transportation costs prepaid by the Buyer. OAI will prepay the shipment back to the Buyer after warranty service. OAI reserves the right to refuse collect shipments or to impose a service charge, in addition to C.O.D. costs, if electing to handle a collect shipment. Non-warranty repairs and calibration services are available at prevailing OAI rates, and the Buyer shall pay the transportation costs both ways.

SECTION 2

GENERAL DESCRIPTION

The Model 306 Portable UV Powermeter is a high-performance instrument for measure of power density in mW/cm^2. It is extremely useful for both intensity and uniformity measurements on exposure equipment or related systems. The Model 306 is accurate, rugged, lightweight, solid state and battery operated. Calibration is traceable to the NIST. The specifications are listed in Table 2-1. The full-scale intensity range of the Model 306 is 0.1 through 1999 mW/cm^2 with a digital Liquid Crystal Display. The 306 will range automatically between scales as required.

Optical probes are an integral part of the Model 306 and contain a filtered detector system. The detector itself is a silicon device, selected for long-term stability and freedom from hysteresis effects. Filters are either absorptive in the near UV region or dielectric in the deep UV region and are computer designed to shape responses accurately. Probes are available in several near-UV and deep-UV response configurations as shown in Figure 2-1.

Each Model 306 UV Powermeter is calibrated as a unit. Single channel meters require only one calibration. Dual channel meters require calibration of each wavelength independently.

In Figure 2-1, the spectral output distribution of the mercury arc lamp emission is shown by the Gray area. Relative strengths of spectral peaks are shown with relation to each other. Superimposed are response curves of Standard OAI Sensors (probes). These are designed to closely match the responses of various UV-sensitive materials to portions of the mercury emission curve.

The Model 306 can be used in three ways:

1) Normal; the display shows the intensity of the light striking the probe.

2) Peak Hold; the display shows the maximum intensity during an exposure.

3) Hold; the display holds the reading at the time the "hold" switch is activated.

These functions are selected with the switch on the right of the front panel.

In addition to autoranging between full scales, the 306 has an automatic autozero. The autozero functions by placing the mode switch in the "NORM" position.

Optional DC Output: An optional output connector will provide a DC output of 0-2 volts corresponding to a 0-2000 mw Display reading. This output signal can be used with a chart recorder, etc. with a minimum impedance of 10KΩ.

TABLE 2-1. SPECIFICATIONS

POWER METER

Calibration Accuracy		Within ±3% (OAI Standards)*
Linearity		Within 1% over the full range
Electronics		Solid-state
Power		One 9-volt transistor-radio type batteries (NEDA No. 1604 or 1604A)
Dimensions	cm (in)	7.5 wide x 15 high x 4 deep (3.0 x 6 x 1.5)
Weight		10 oz (300g)

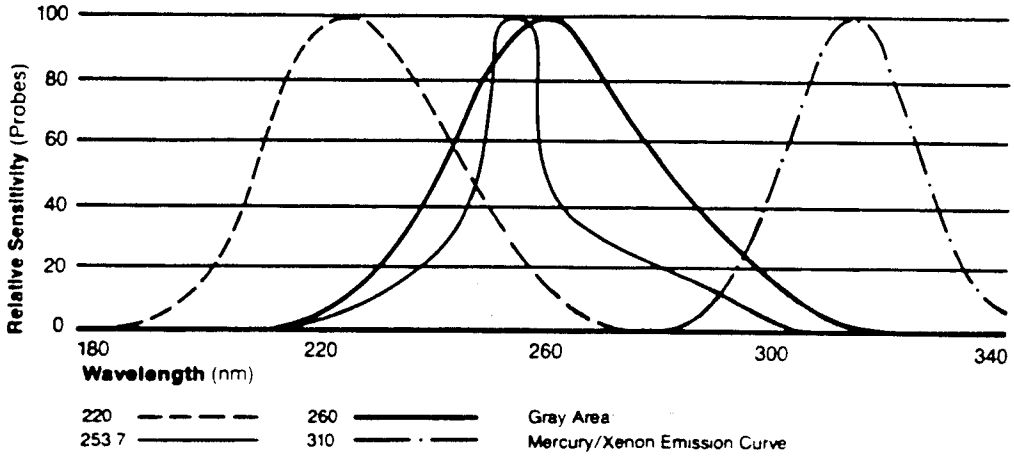
*Traceable to NBS

PROBES

Responses (Also see Figure 2-1)		Choice of OAI standard responses Deep UV (nm): 220, 253.7, 260, 310 Near UV (nm): 365, 380, 400, 420, 436, 540
Sensor Material		Silicon, UV-enhanced
Filter		Absorptive in the near UV; dielectric in the deep UV
Probe Dimensions	(cm) (in)	4.45 diameter x 1.6 thick with 1.37 meter cable (1.75 diameter x 0.63 thick with 4.5 foot cable)
Weight		113.4 grams (4 oz.), approximately

Specifications subject to change without notice or obligation.

Deep UV Probe Responses



Near UV Probe Responses

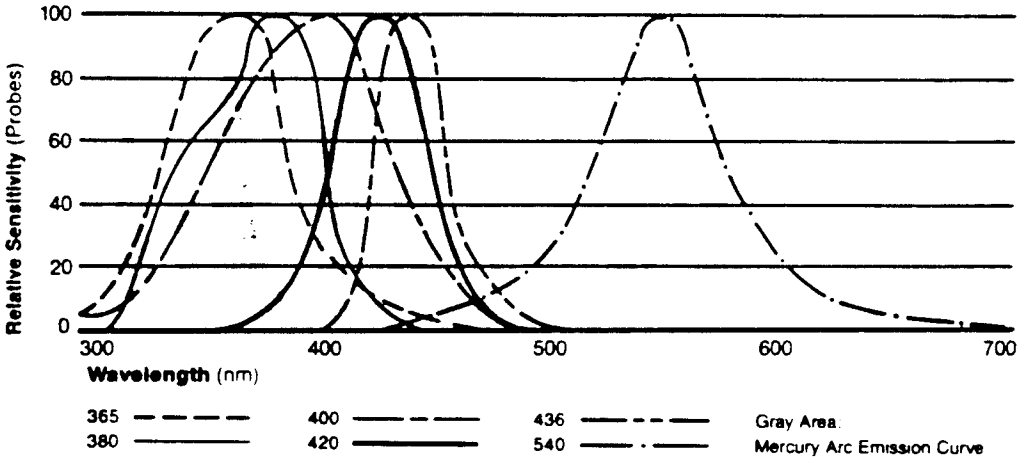


Figure 2-1. Model 306 UV Powermeter Probes - Spectral Response Curves

SECTION 3

OPERATING INSTRUCTIONS

Battery Life

Battery life is approximately 80 hours of normal, intermittent use. It is important that the instrument be turned off each time it is not in use, greatly preserving battery life.

The low battery indicator will show in the display when it is time to replace the battery. Refer to Section 4 for replacement instructions.

Operation of Model 306 (Figure 3-1.)

a) The meter is turned "On" using the switch on the left of the front panel.

Note

It is recommended that ambient light be at least one or two decades of sensitivity less than the source under test so that changing room light conditions will not affect measurements.

b) Place the probe on the exposure plane or similar location where energy density is to be measured

c) Use the switch on the right of the front panel to choose the type of measurement:

Norm: For real-time measurement.

Peak Hold: For holding the maximum intensity during an exposure

Hold: To hold a reading at the time the "Hold" switch is activated.

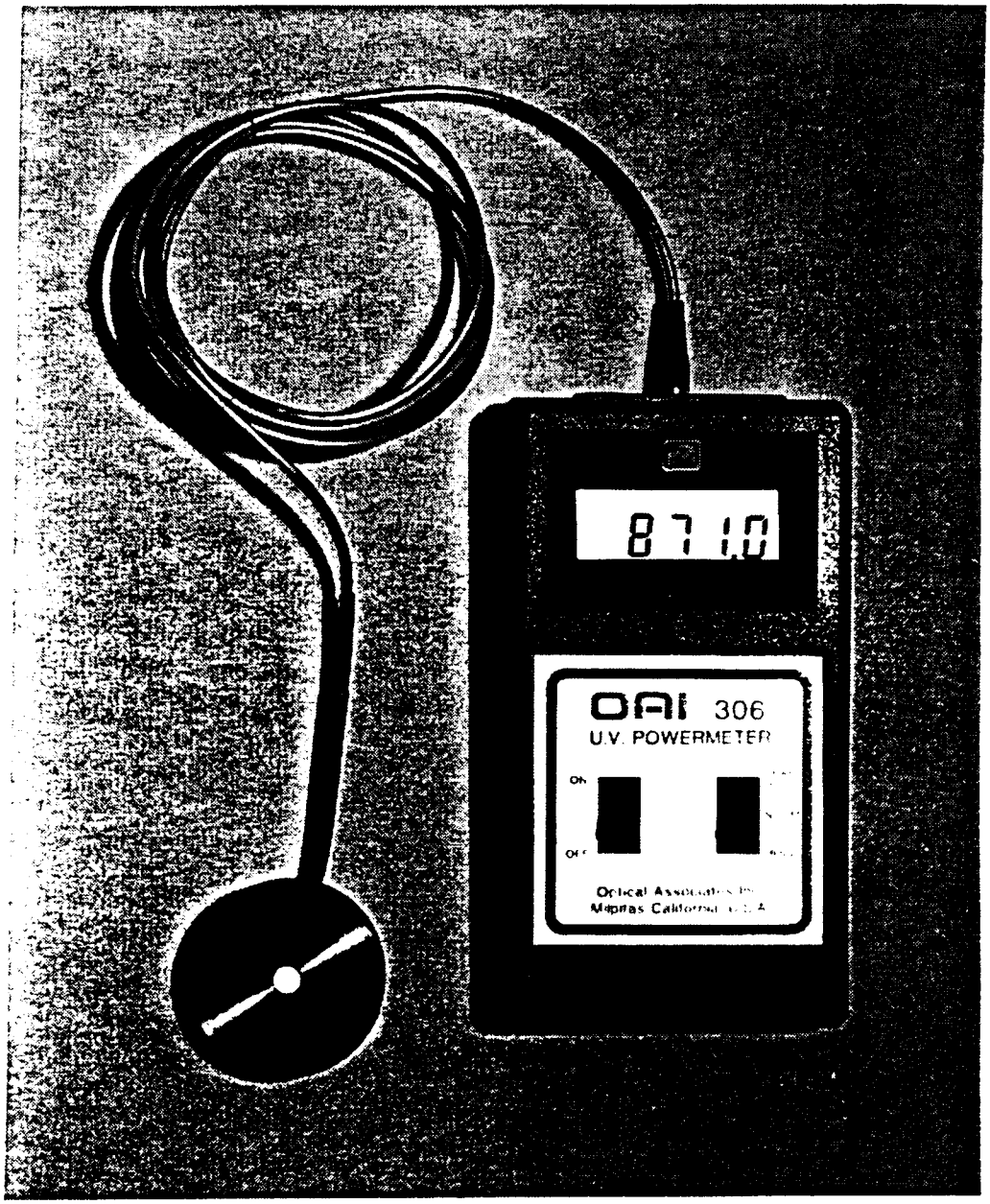


Figure 3-1. Model 306 UV Powermeter

SECTION 4

SERVICING

Battery Replacement

1. Slide the coverplate down. Lift the battery out of the compartment and unsnap the connector.
2. Reverse these steps to install a new battery.

Calibration Requirements

Model 306 Electronics

Recalibration is recommended semi-annually to assure continued linearity and accuracy of quoted specifications.

Optical Probes

The filter/detector (probe) system has been calibrated to standards traceable to the National Institute of Standards and Technology (NIST). The filters are highly stable, absorptive or di-electric designs which do not vary with age. The sensor itself is a silicon photodiode, also ultra-stable, with less than one percent variation in a typical year of use. Recalibration is suggested every six months, however, to assure performance within quoted specifications.

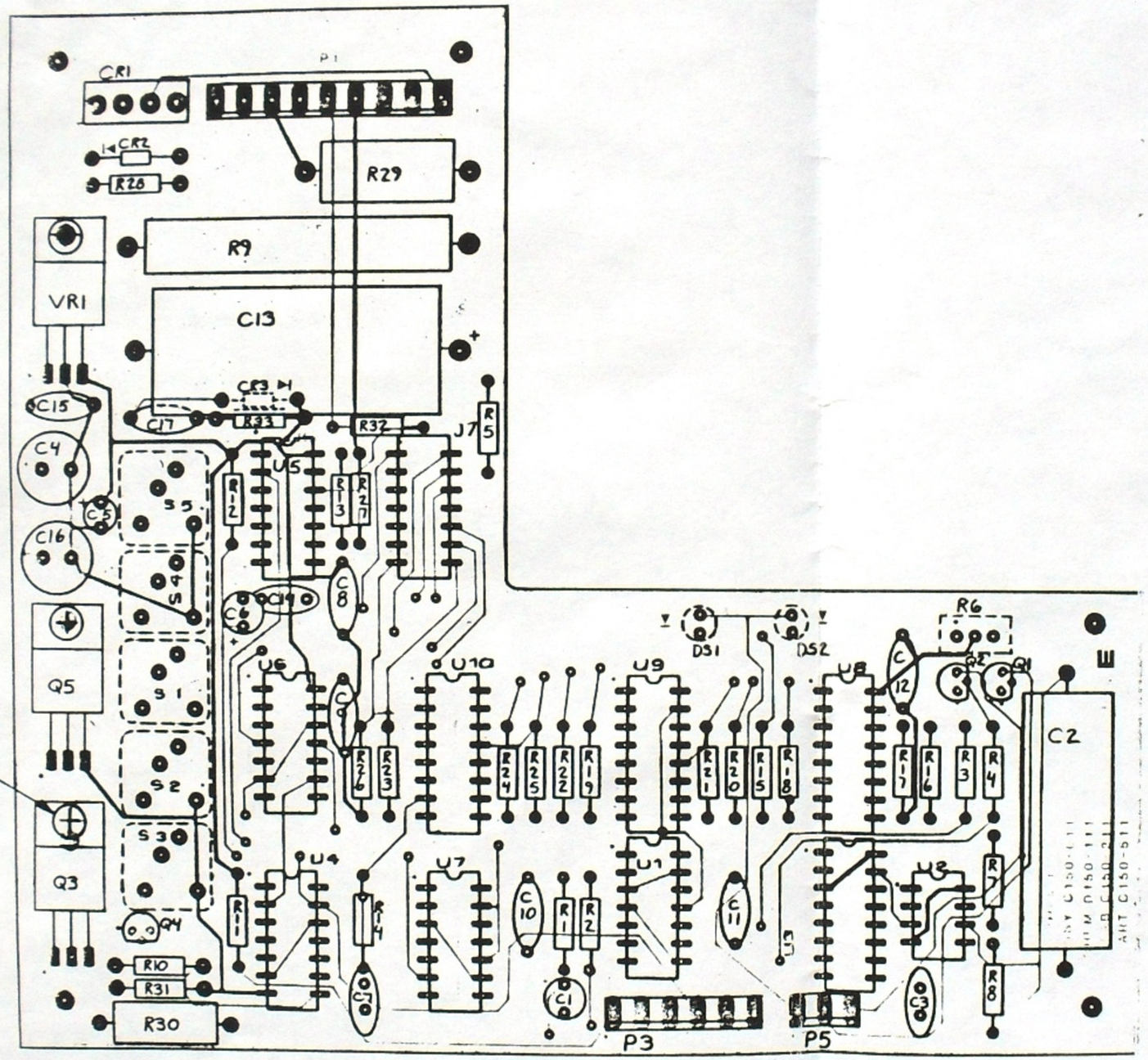
Note

Recalibration services are available at OAI. It is advisable to contact OAI in advance, before submitting instruments for recalibration services.

Maintenance Notes

No field service is recommended. Any service which requires opening of the case before or after expiration of the warranty should be avoided. Please contact OAI for service.

J	ECO # 21104	7-21-88	WEB
H	REVISED PER ECO 2680	7-17-87	



NOTES: 1. FOR -02 VERSION, DO NOT USE SWITCHES 1 THRU 5, OR DIODES 1 AND 2 ON THIS PC BRD. THEY APPEAR ON 150-018.

-01, USED ON 150-014, 160-014

-02, USED ON 470-013

470-013	500
160-014	160

EXCEPT AS NOTED
TOLERANCE: X = ___ XX = ___ XXX = ___ DEGREES = ___
DEBURR AND BREAK EDGES
SCALE: 2:1

DRAWN	CHECKED	ENGINEER
EC	Dave L.	Dave L.

TITLE: ASSY. TIMER BD. EXPOSURE TIMER
MATERIAL:
FINISH:

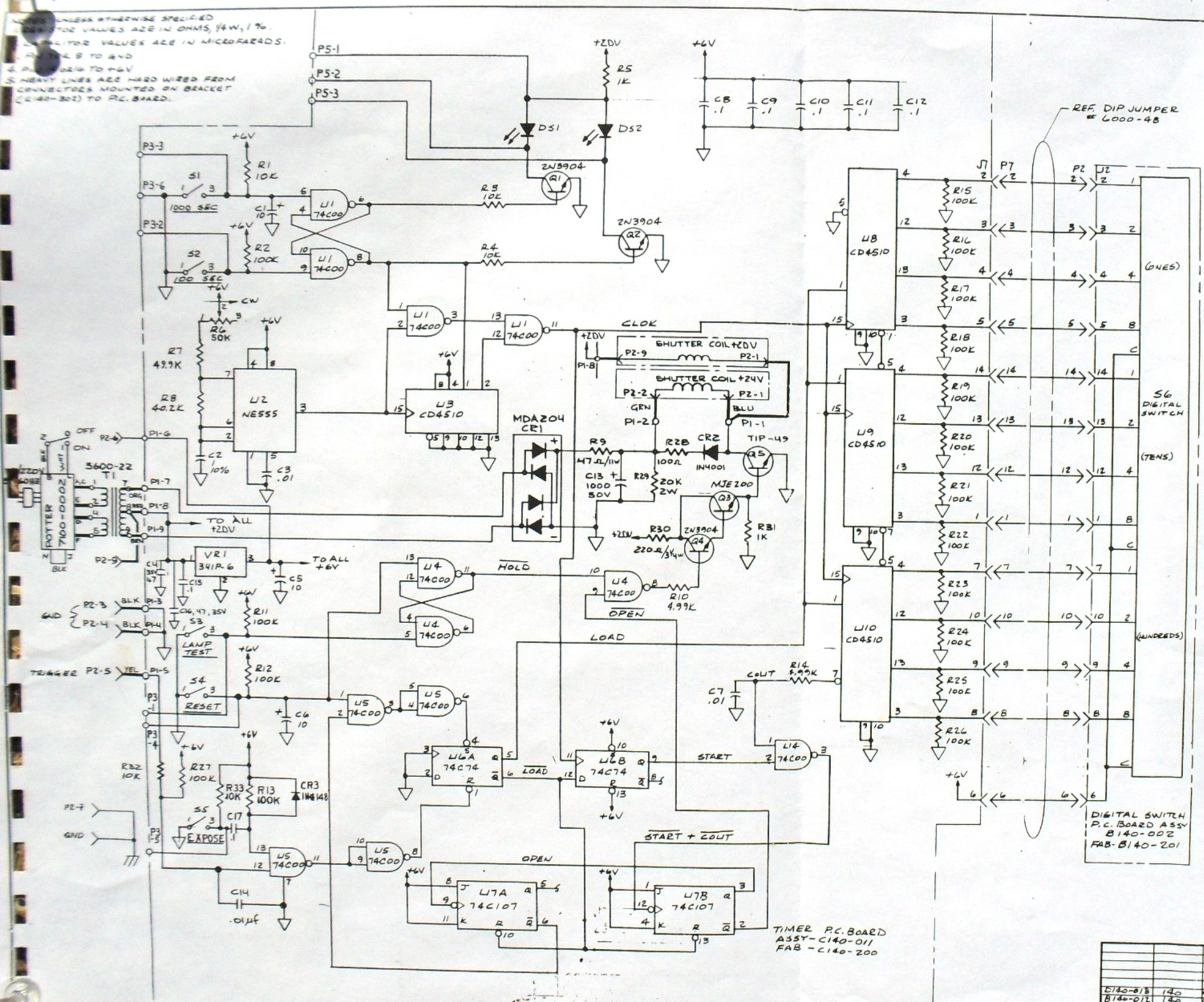
OAI Optical Associates Inc.

C150-011 REV. H

UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, ¼W, 1%.
CAPACITOR VALUES ARE IN MICROFARADS.
ALL GND TO GND
ALL +6V TO +6V
HEAVY LINES ARE HARD WIRED FROM CONNECTORS MOUNTED ON BRACKET (C140-302) TO P.C. BOARD.

REV.	REVISIONS DESCRIPTION	BY	CHECKED	ENG.	DATE
A	RELEASE TO PRODUCTION / ECO 1124			BS	7/80
B	ECO 1197, 1207, 1208	RP			10/80
C	REVISE PER ECO # 1293				11/80
D	REVISE PER ECO # 1489, 1500, 1526				7/82
E	ECO 2007				12/82
F	ECO#2073				6-7-84
		EAB			3-7-84

D 150- 111 E



FIRST	LAST	DELETED
C1	C17	
CR1	CR3	
DS1	DS2	
E1	E8	
J1	J4	
P1	P2	
Q1	Q5	
R1	R33	
S1	S6	
U1	U10	
VR1	VR1	

C140-813	140				
B140-012	140				
RELEASED					

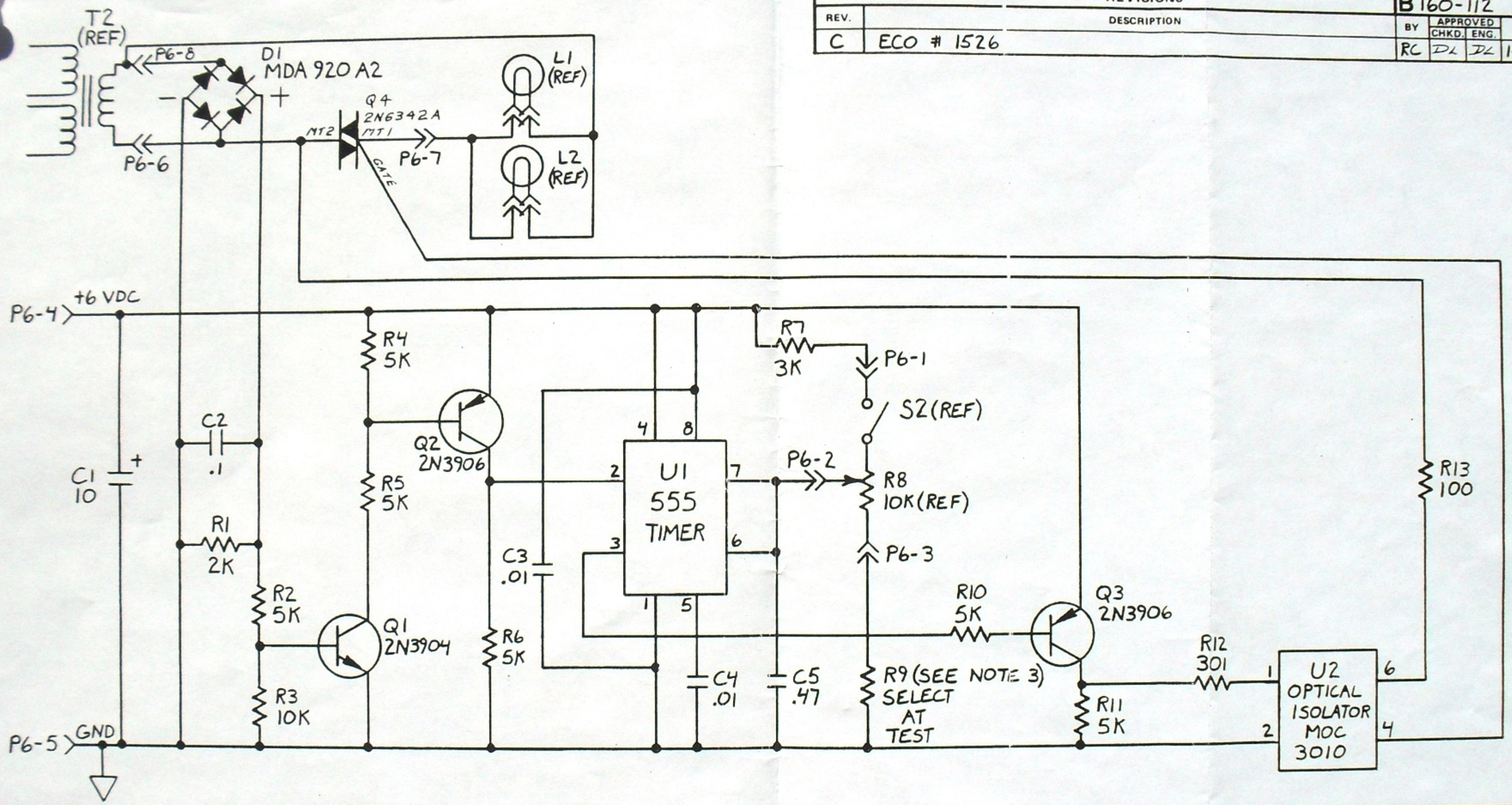
EXCEPT AS NOTED
TOLERANCES
2 DEC ± .005
3 DEC ± .010
1 DEC ± .030
ANGLES ± 1°
DRAWN AND BREAK EDGES
SCALE: FULL
SURFACE FINISHED INDICATED BY RMS STANDARDS AS GENERAL MACHINING

TITLE: SCHEMATIC, EXPOSURE TIMER, MODEL 150
MATERIAL:
DRAWN | CHECKED | ENGINEER | APPROVED

optical associates inc.

D 150- 111 F

REVISIONS						B 160-112	C
REV.	DESCRIPTION	BY	APPROVED CHKD.	APPROVED ENG.	DATE		
C	ECO # 1526	RC	DL	DL	1-26-83		



NOTES:

1. ALL RESISTOR ARE IN OHMS.
2. ALL CAPACITORS ARE IN MICROFARADS.
3. VALUE OF R9 IS SELECTED AT TEST, AT A RANGE OF 50KΩ TO 1MEG OHM.

NEXT ASSY.	MODEL	QTY
APPLICATION	160	

ISSUE	BY	DATE

EXCEPT AS NOTED

TOLERANCES
3 DEC. ±.005
2 DEC. ±.010
1 DEC. ±.030
ANGLES ±½°

DEBURR AND BREAK EDGES

SCALE: FULL

SURFACE FINISHED INDICATED BY RMS STANDARDS 63 √
GENERAL MACHINING

RELEASED
ENGINEERING CONTROL

TITLE: INTENSITY CONTROL SCHEMATIC

MATERIAL:

DRAWN	CHECKED	ENGINEER	APPROVED
RC	Dave L.	Dave L.	Dave L.
1-26-83	2-14-83	2-14-83	2-14-83

optical associates inc.

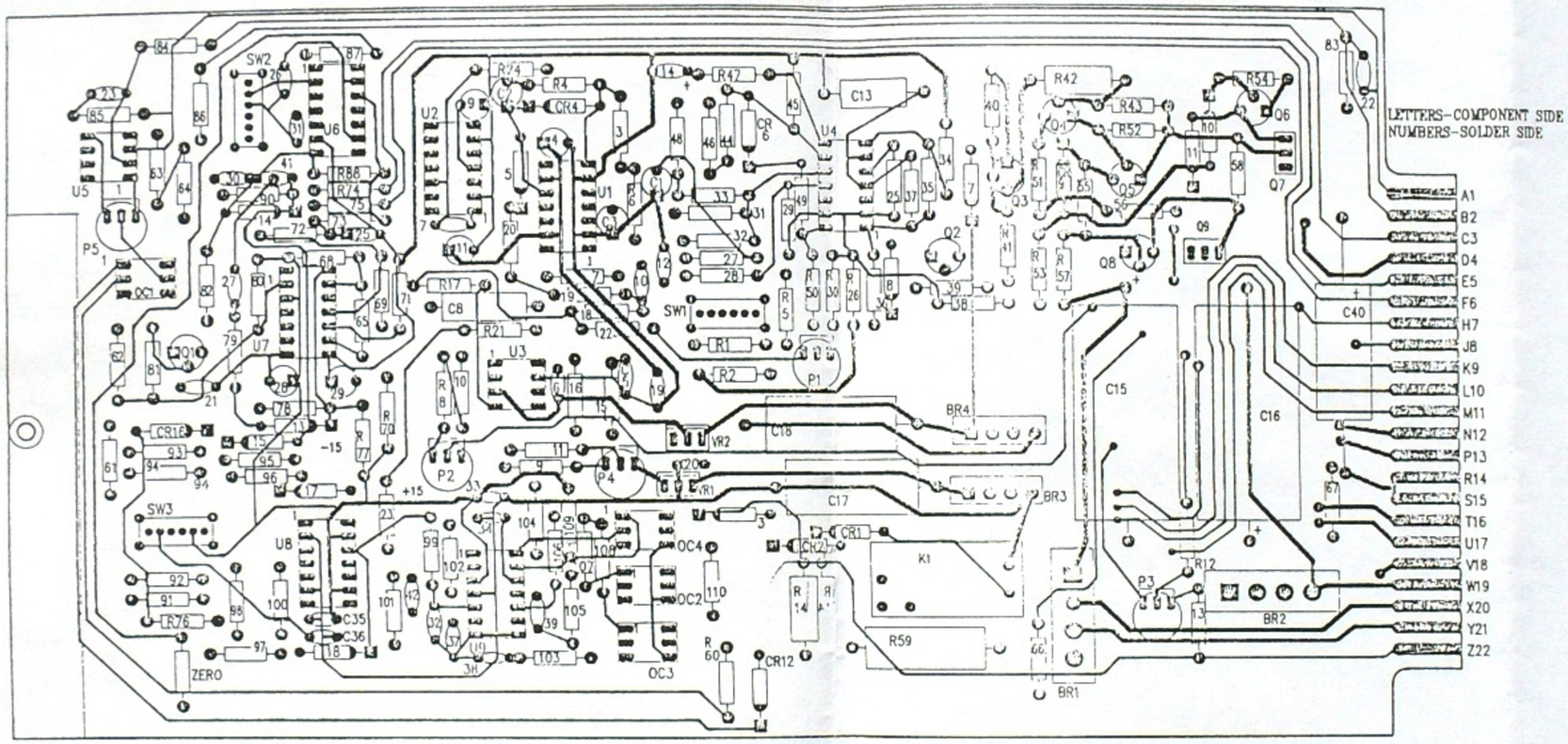
Santa Clara, California
(408) 988-6900

B 160-112 REV. C

SHEET 1 OF 1

NO R89
NO C24

COMPONENT SIDE



R1	R26 10K	R51 5.1K	R76 5.1K	R101 10K	C11	C36	CR16 4148	U8 747	K1 DC-24
R2	R27 240 Ω	R52 1.5K	R77 10K	R102 10K	C12 .1u MON	C37 .1 u MON	CR17 4148	U9 339	
R3 4.7K	R28 240 Ω	R53 2K	R78 750K	R103 10K	C13 .0015 u	C38 .1 u MON	CR18 4148		
R4 15K	R29 220K	R54 10K	R79 1.0K	R104 10K	C14 3.3 uDT	C39 .1 u MON			VR1 7815
R5 5.1 Ω	R30 10K	R55 1K	R80 20K	R105 1K	C15 4700u	C40 220 u			VR2 7815
R6 1K	R31	R56 5.1K	R81 30K	106 30K	C16 4700u	C41 .01 u MON		Q1 45	
R7	R32	R57 2K	R82 6.2K	R107 6.2K	C17 220u	C42		Q2 43	
R8	R33	R58 5.1K	R83 15K	R108 6.2K	C18 220u		P1 5K	Q3 5416	OC1 MCT274
R9 5.1K	R34 20K	R59 1K 5W	R84 100K	R109 6.2K	C19 .1 u MON		P2 5K	Q4 43	OC2 MCT274
R10	R35 100K	R60 1.2K	R85 5.1K	R110 10K	C20 .1u MON		P3 5K	Q5 43	OC3 MCT274
R11 75K	R36 5.1K	R61 1.5K	R86 10K		C21 .47 u MON	CR1	P4 5K	Q6 43	OC4 MCT274
R12 1.5K	R37 62K	R62 1.5K	R87 10K		C22 .01 u MON	CR2	P5 50K	Q7 6111	
R13 110K	R38 75K	R63 47K	R88 10K		C23 .1 u MON	CR3		Q8 45	
R14 30K 1W	R39 10K	R64 10K	R89		C24	CR4 4148		Q9 6288	
R15	R40 1.2K	R65 10K	R90 10K		C25 3.3 u DT	CR5 4148			
R16	R41 22K	R66 10K	R91	C1 .47 MON	C26	CR6 4148			
R17	R42 30K 1W	R67 100 Ω	R92	C2 3.3 uDT	C27 .1u	CR7 4148			
R18 10K	R43 5.1K	R68 20K	R93	C3 3.3 uDT	C28	CR8 5241			
R19 10K	R44 10K	R69 2.2M	R94	C4 3.3 uDT	C29	CR9 4148	U1 747	BR1 MDA970	
R20 20K	R45 5.1K	R70 47K	R95 2.4K	C5 470 p	C30 .1 U MON	CR10 4148	U2 747	BR2 MDA970	
R21 10K	R46 200K	R71 3.3K	R96 10K 1%	C6 .1 u MON	C31	CR11 4148	U3 4200	BR3 MDA200	
R22	R47 36K	R72 10K	R97 10K 1%	C7 .0022u MON	C32 1 u DT	CR12 4148	U4 339	BR4 MDA200	
R23 20K	R48 200K	R73 5.1K	R98 10K 1%	C8 .33 u	C33	CR13 4148	U5 355		
R24 240 Ω	R49 120K	R74 15K	R99 200K	C9 3.3 uDT	C34	CR14 5241	U6 747		
R25 470K	R50 10K	R75 15K	R100 10K 1%	C10 .015u MON	C35	CR15 4148	U7 339		

CONVERTER MODEL

	HA5C2	HA10C2	500C2DUV
R1	68K	110K	110K
R2	68K	110K	110K
R7	10K	16K	16K
R8	18K	13K	13K
R10	39K	47K	39K
R15	150K	200K	150K
R16	150K	200K	150K
R17	18K	36K	47K
R22	3.9K	5.1K	5.1K
R31	12K	20K	12K
R32	12K	20K	12K
R33	1.2K	1.2K	680 Ω
R91		24K	24K
R92		24K	24K
R93		20K	16K
R94		20K	16K
CR1	4004	4004	0 Ω
CR2	4004	4004	0 Ω
CR3	4004	4004	0 Ω

POWER SCALING FOR HA5C2

POWER RANGE	200–350 125 TO 300	200–350 200 TO 300	350–500 200 TO 300	350–500 350 TO 625
R91	36K		24K	
R92	51K		36K	
R93	33K		16K	
R94	56K		33K	

Notes

Drawn By RAH

Date 5/92

RADIATION POWER SYSTEMS, INC.

Title HA5C2, HA10C2, 500C2DUV CONTROL CARD ASSEMBLY

Revision

Assembly File 7022-111

Size D

Sheet

Drawing No.

CONVERTER MODEL

	HA5C2	HA10C2	500C20UV
R1	68K	110K	110K
R2	68K	110K	110K
R7	10K	10K	16K
R8	18K	13K	13K
R10	39K	47K	39K
R15	150K	200K	150K
R16	150K	200K	150K
R17	18K	36K	47K
R22	3.9K	5.1K	5.1K
R31	12K	20K	12K
R32	12K	20K	12K
R33	1.2K	1.2K	680 Ω
R91		24K	24K
R92		24K	24K
R93		20K	16K
R94		20K	16K
CR1	4004	4004	0 Ω
CR2	4004	4004	0 Ω
CR3	4004	4004	0 Ω

POWER SCALING FOR HA5C2

	200–350		350–500	
POWER RANGE	125 TO 300	200 TO 300	200 TO 300	350 TO 625
R91	36K		24K	
R92	51K		36K	
R93	33K		16K	
R94	56K		33K	

POWER IN J
LOGIC CONTROL IN + M
LOGIC CONTROL IN − H
MODE SELECT V
INTENSITY METER 7
CAL RETURN 17
SET A E
SET B F
CAL POT C
SENSOR INPUT B
SENSOR RETURN A
WATTMETER 5
500 OR 750 FS
CURRENT SAMPLE 4
CURRENT METER H
20 AMP FS
D
V LAMP IN 22
V LAMP METER 8

REMOVE R65 FOR LOGIC INPUT CONTROL

SHUTTER OPEN 10
POWER LIMIT 9
LAMP READY 6
STATUS COMMON K
SONALERT J
R DRIVE J
B DRIVE D
8 AC X Y
+8 2
DRIVE COMMON 18 19 V
−5 W
4 AC 20 21
+24 16
22 AC U T
+15 1
GROUND 14 15 R S
−15 N
22AC P

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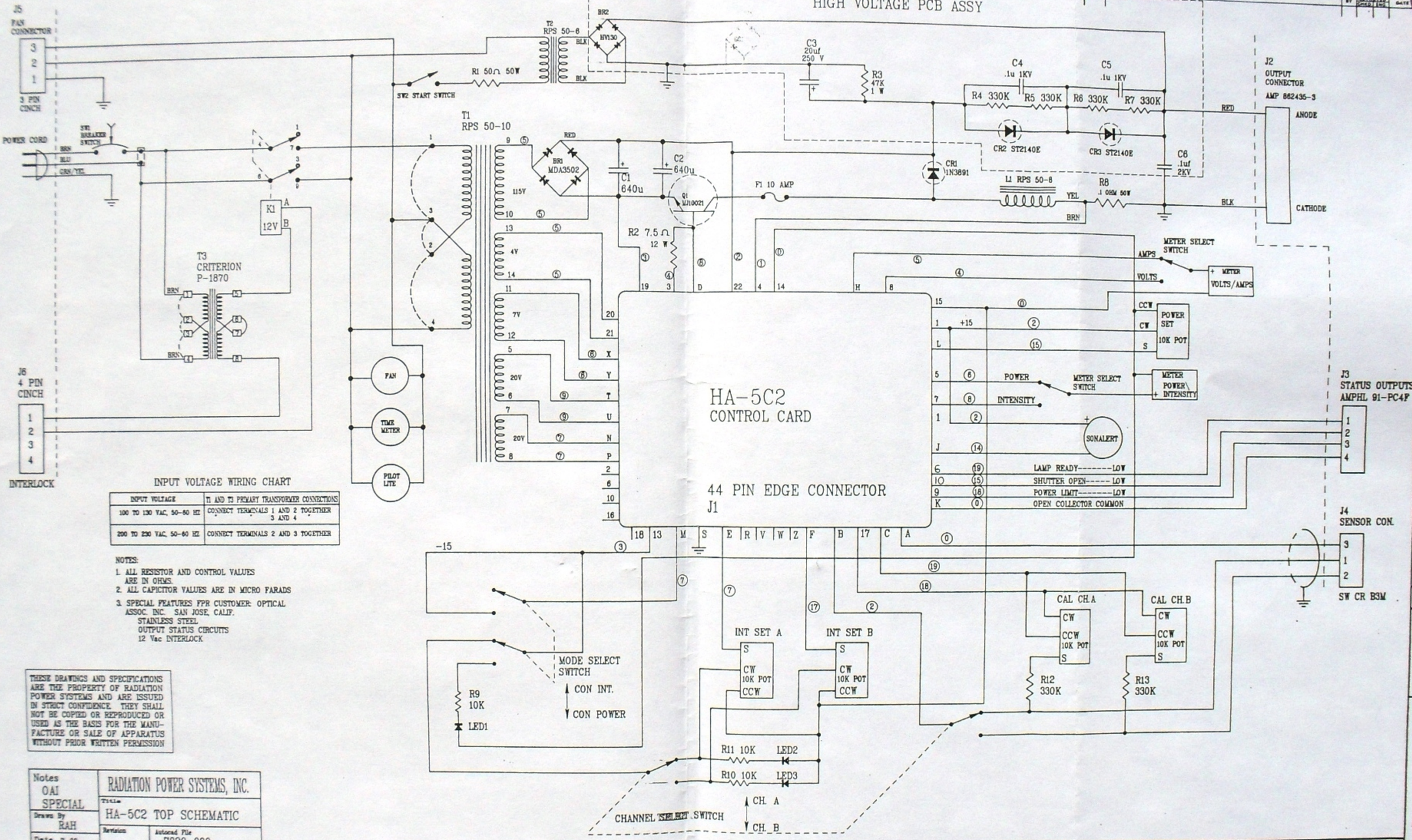
Notes

RADIATION POWER SYSTEMS, INC.

Title: HA5C2, HA10C2, 500C2DUV CONTROL CARD SCHEMATIC

Drawn By: RAH
Date: 9\91
Revision:
Internal File: 7022-110
Size: D
Sheet: 1 OF 1
Drawing No.



INPUT VOLTAGE WIRING CHART

INPUT VOLTAGE	T1 AND T3 PRIMARY TRANSFORMER CONNECTIONS
100 TO 130 VAC, 50-60 HZ	CONNECT TERMINALS 1 AND 2 TOGETHER 3 AND 4
200 TO 230 VAC, 50-60 HZ	CONNECT TERMINALS 2 AND 3 TOGETHER

NOTES:

1. ALL RESISTOR AND CONTROL VALUES ARE IN OHMS.
2. ALL CAPICITOR VALUES ARE IN MICRO FARADS
3. SPECIAL FEATURES FPR CUSTOMER: OPTICAL ASSOC. INC. SAN JOSE, CALIF.
   - STAINLESS STEEL
   - OUTPUT STATUS CIRCUITS
   - 12 Vac INTERLOCK

Notes	RADIATION POWER SYSTEMS, INC.
OAI SPECIAL	Title: HA-5C2 TOP SCHEMATIC
Drawn By: RAH	Revision / Autocad File: 7020-000
Date: 7-90	Size: D / Sheet / Drawing No.

EXCEPT AS NOTED	TITLE:	optical associates inc.		
RELEASED	MATERIAL:	Milpitas, California (408) 263-4944		
ENGINEERING CONTROL	DRAWN	CHECKED	ENGINEER	APPROVED
NEXT ASSY. / MODEL / APPLICATION				D