



**OPERATION MANUAL**  
**Model 200**  
**MASK ALIGNER**  
**TABLE TOP SERIES**

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# 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 notwithstanding. 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 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, and light source. The Constant Intensity Controller is separate from the console.

This tabletop 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**

The alignment module has a sturdy mask frame, which is always in three-point contact with the alignment module casting 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 its 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 pre-loaded 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 Exposure System**

### **The Light Sources**

UV exposure systems available for the 200 Series offer a broad range of exposure areas, intensities, and spectral profiles to match the user's photoresist. 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 light sources provide excellent results for contact or proximity exposure of photoresist.

### **The Regulated, Power-Adjustable Power Supply**

These power supplies hold lamp power to within 1% over power variations as great as  $\pm 15\%$  VAC. The power supply can be adjusted over a limited range of power.

### **The Constant Intensity Controller**

The Constant Intensity Controller (CIC) holds lamp intensity to within  $\pm 2\%$  of the operator set intensity value at the exposure plane and compensates for lamp aging and power variations as great as  $\pm 15\%$  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 alignment module reached the exposure position.

## **Alignment Optics**

A wide variety of alignment optics is available including stereo zoom, compound, 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 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 light source, 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 its 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 manufacturers 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 Figure 1 and the instructions in the Constant Intensity Controller manual.

## **Preparing the Console**

1. Connect all vacuum, air, and nitrogen lines as shown in Figure 2. Turn on the air and nitrogen and adjust your regulator to 60 PSI.
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. The mask frame will not rise if the alignment optics is not in the full rear position and the interlock switch closed. This is to prevent the mask from hitting the optics when raising.
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 Figure 3.

### Installing the Photomask

1. Close the mask frame with the switch at the front of the alignment module.
2. With the chrome side facing down, place the photomask on the mask plate using the alignment pins to properly locate the mask.
3. Turn the **Mask Vac.** ON.
4. Place the mask clamps over the photomask and secure.
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. 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 the **Sub. Vac.** Switch ON.
2. Close the mask frame.
3. Place the Align Optics over the mask by releasing the vacuum hold and moving it forward. Using the small X-Y stage for the final alignment. Then 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 but not touching the mask. (NOTE: Use low magnification for set-up and for locating the alignment structures because low magnification provides the greatest depth of focus and widest field of view.)

5. Turn the **Ball Vac.** switch to UNLOCK and rotate the Z Knob to level the substrate to the mask. Stop when a resistance is felt and the “cogging” of the clutch can be felt. Turn the **Ball Vac.** switch to LOCK.
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 the **Contact Vac.** switch ON. (NOTE: When printing negative resist, contact must be preceded by a nitrogen purge. Purging is done by turning the **N<sub>2</sub> PURGE** ON prior to contact and allowing the nitrogen to displace the air in the vacuum chamber. Turn the **N<sub>2</sub> PURGE** OFF after the **Contact Vac.** is turned ON.)
2. Adjust the **Contact Vac. Adjust** to the desired level.
3. As an alternative for larger substrates, turn the **Sub. Vac.** switches OFF. This will usually improve the contact between the mask and substrate.
4. When you are satisfied with the contact, move the alignment optics to the rear and the alignment module to the "expose" position (far left) 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 automatically 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. Insure that the alignment microscope all the way to the rear.
  - C. Turn the **Sub. Vac.** back ON if turned OFF.
  - D. Turn the **Contact Vac.** OFF.
  - E. Open the mask frames.
  - F. Turn the **Sub. Vac.** 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 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 closed, place as mask on the mask frame and secure it in place with the mask clamp.
3. Place the Align Optics over the mask by releasing the vacuum hold and moving it forward. Using the small X-Y stage for the final alignment.
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 airflow using "chuck level release" valve.
Vacuum chuck vibrates when the chuck release is on.	Excessive air going to vacuum/air bearing cup.	Adjust airflow using "chuck level release" valve.
Short lamp life; lamp explosion	Improper cooling (too much or too little).	Insure that airflow maintains lamp at proper operating temp.

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

## SERIES 200 SPECIFICATIONS

### Alignment Module

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

### Light Source

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 Watts Deep UV: 500, 1000 Watts
Constant Intensity Controller	Maintains intensity to $\pm 2\%$ of operator set value throughout life of the lamp with line voltage variations of $\pm 15\%$ .
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

EM Series  
MEIJI Techno America

Split-field

Zoom Series  
NAVITAR  
- Dual CCTV system  
with 2 @ 9" monitors  
- Single CCTV system  
with 1 @ 12" monitor

**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

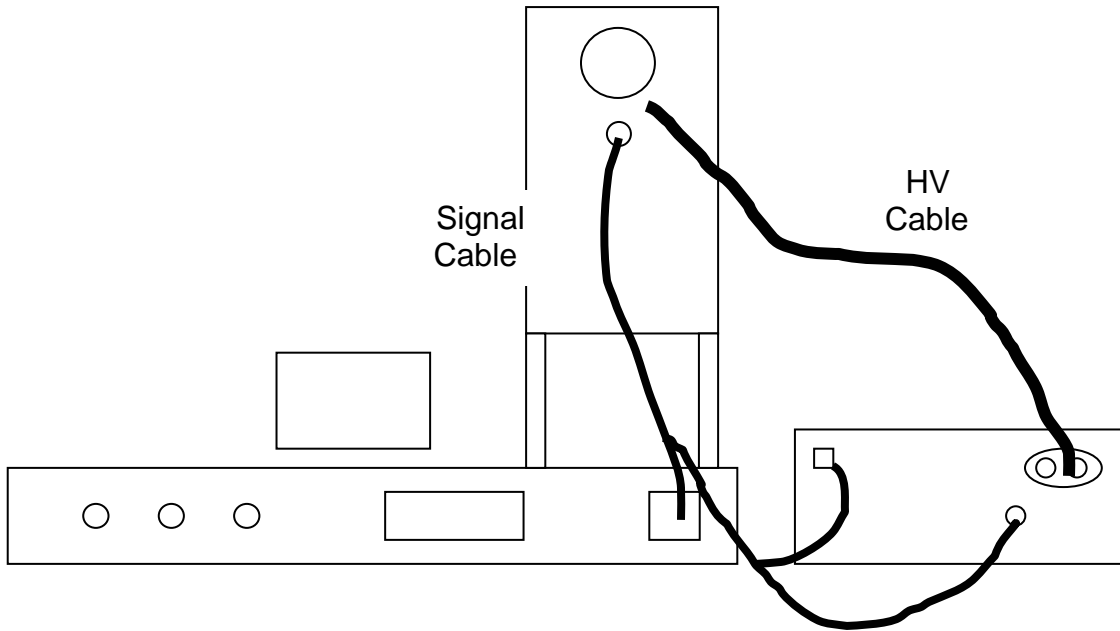
Width: 31" (78.7cm)  
Height: 35" (140cm)  
Depth: 24" (61cm)

Shipping weight

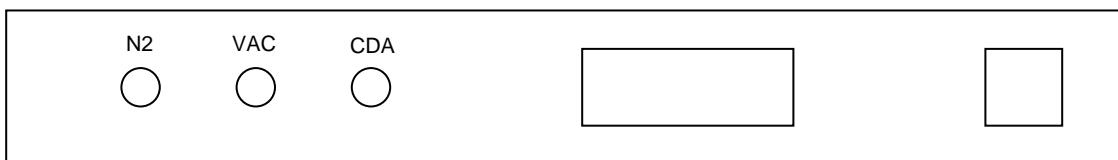
250 lbs. (114Kg)



## MODEL 200 FIGURES



*Figure 1. Electrical Interconnection Diagram*



*Figure 2. Rear Panel Connections*

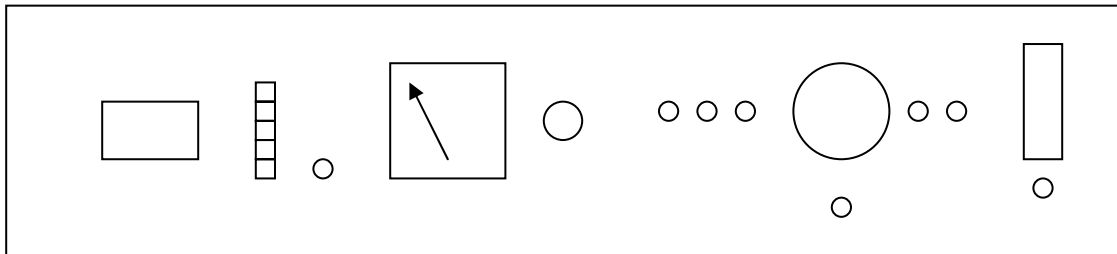


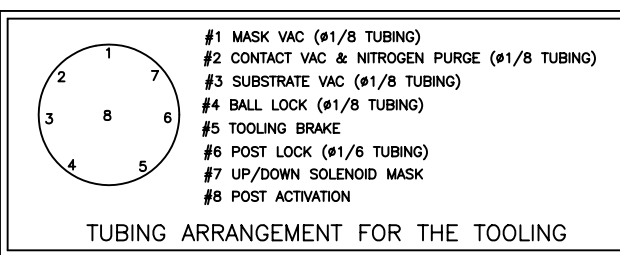
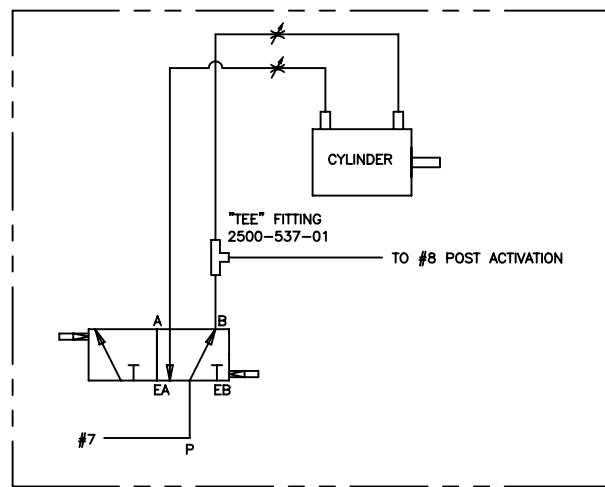
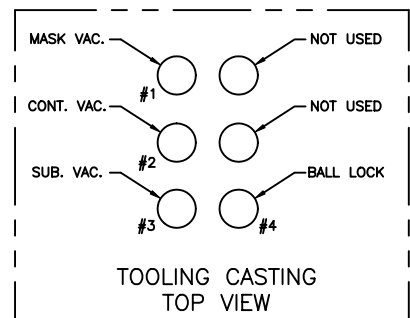
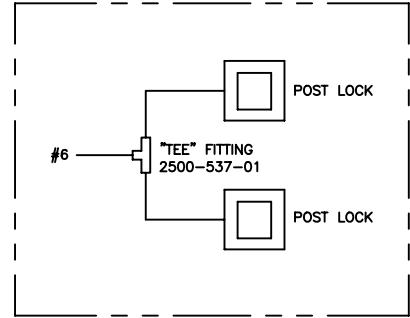
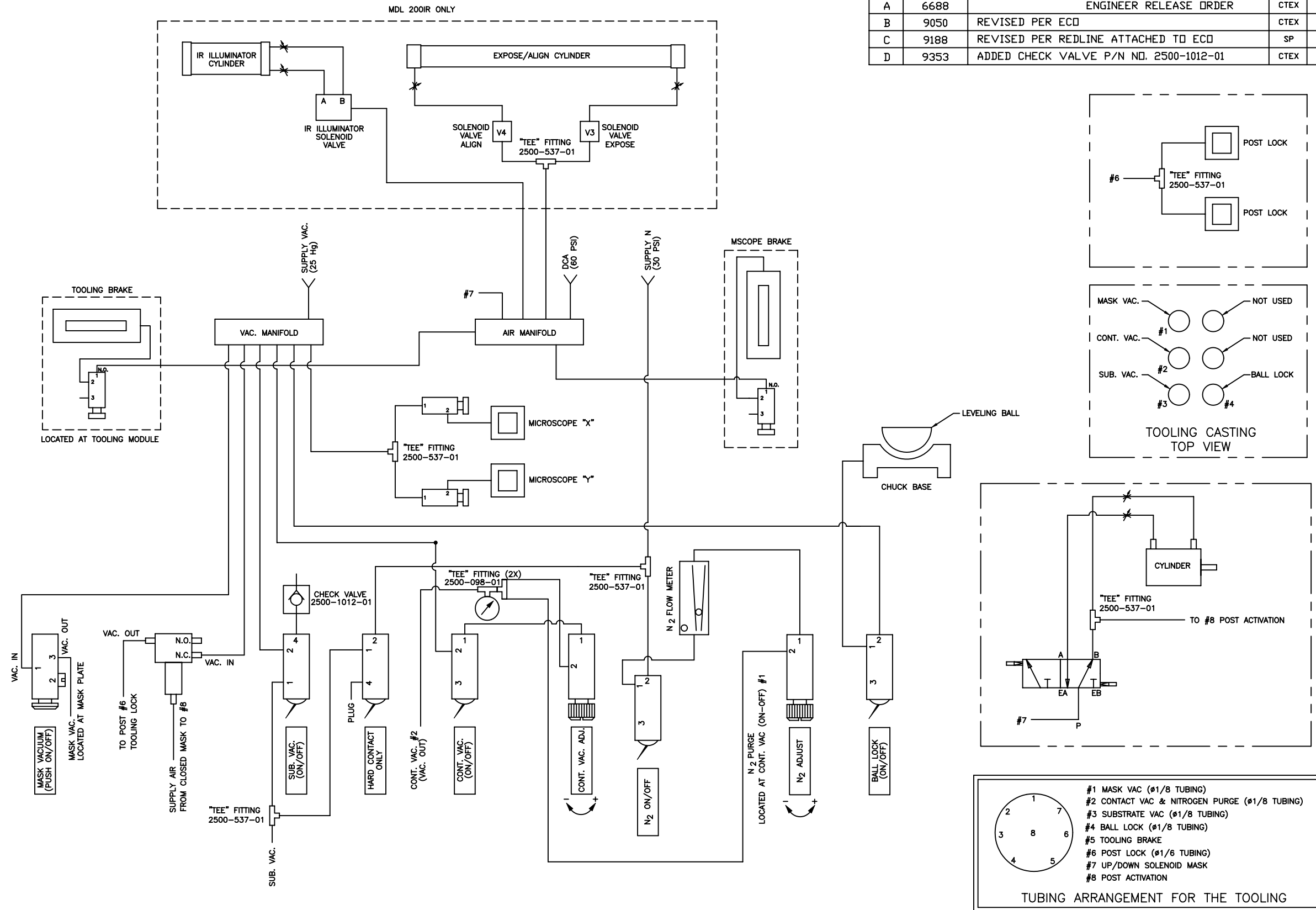
Figure 3. Controls and Indicators

SWITCH/ADJUSTMENT	FUNCTION
Seconds	Exposure time in seconds or tenths of seconds.
Expose	Can be used to expose at time set on timer.
Reset	Causes the shutter to close immediately.
1000 Sec	Sets timer for 0-1000 seconds in 1 second intervals.
100 Sec	Sets timer for 0-100 seconds in 0.1 second intervals.
Lamp Test	Opens shutter with no timer. Use Reset to close shutter.
Timer	Power ON/OFF for the timer and system.
Chuck "Z" Adjust	Clutch current for z-axis.
Mask Vac.	Mask vacuum ON/OFF.
Ball Vac.	Ball vacuum ON/OFF.
Sub. Vac.	Substrate vacuum ON/OFF.
Contact Vac. Adjust	Contact vacuum adjustment.
Contact Vac.	Contact vacuum ON/OFF.
N2 Purge	Nitrogen purge ON/OFF.
N2 Flow Adjust	Nitrogen flow adjust.
Mask Frame	Switch is on front of alignment module and causes the mask frame to raise or lower.

## SECTION 7: DRAWINGS/SCHEMATICS

<u>PART NUMBER:</u>	<u>DESCRIPTION:</u>	<u>REV</u>	<u>PGS</u>
0200-101-01	DIAG PNEU PIPING & INSTRUMEN MDL 200	D	1
0200-102-01	DIAG WIRING SYS CFG MDL 200	L	1

REVISIONS				C	D
REV.	ECO No.	DESCRIPTION	INCORP. BY	ENGINEER APPROVAL	DATE
A	6688	ENGINEER RELEASE ORDER	CTEX	EP	3/24/98
B	9050	REVISED PER ECO	CTEX	EP	3/29/05
C	9188	REVISED PER REDLINE ATTACHED TO ECO	SP	EP	9/29/05
D	9353	ADDED CHECK VALVE P/N NO. 2500-1012-01	CTEX	EP	4/21/06



1. INTERPRET DRAWING PER MIL-STD-100.  
NOTES: (UNLESS OTHERWISE SPECIFIED)

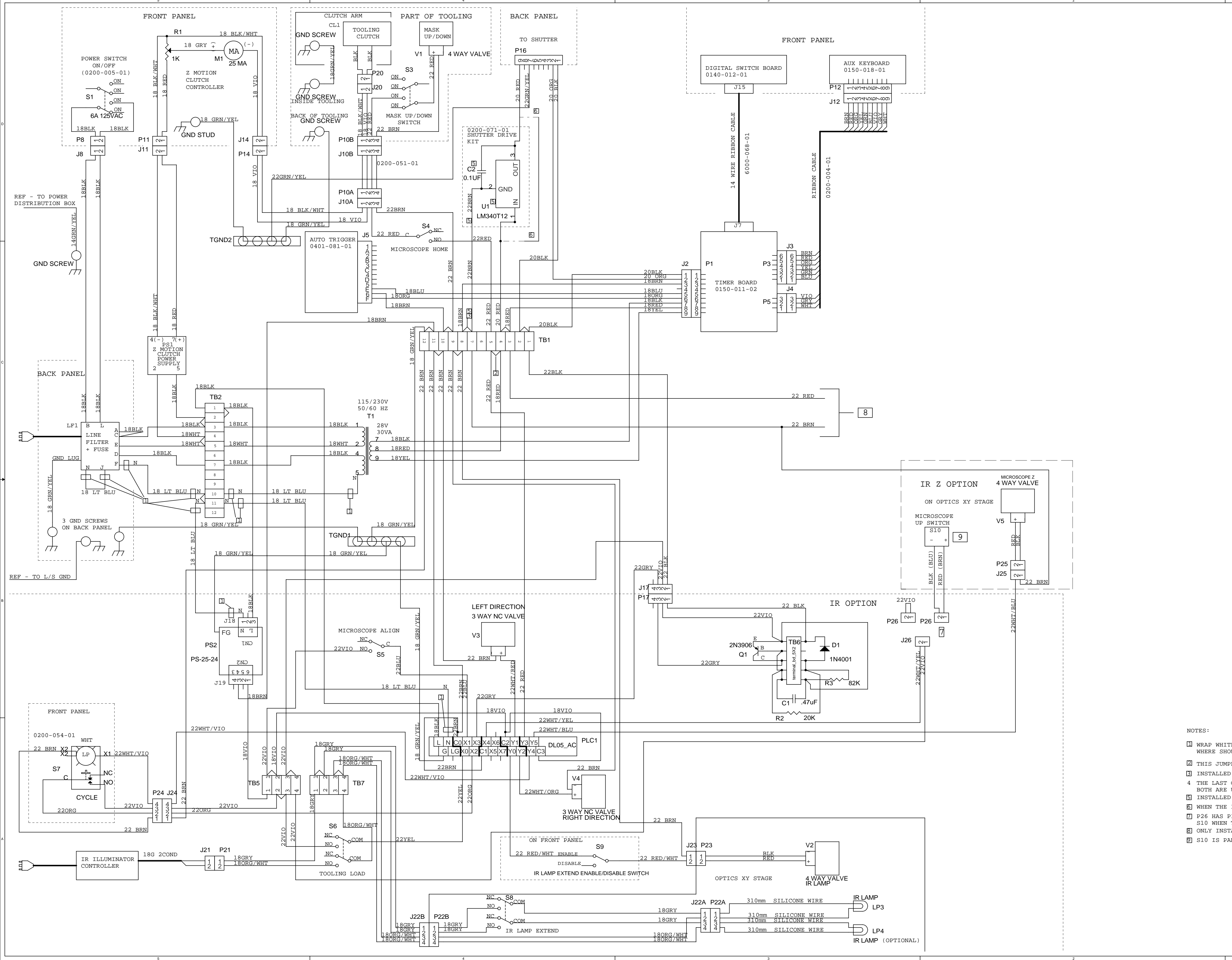
<p><b>PROPRIETARY</b> THE CONTENTS OF THIS DOCUMENT ARE PROPRIETARY TO OAI, INC. AND ARE NOT TO BE DISCLOSED TO OTHERS OR USED FOR PURPOSES OTHER THAN INTENDED WITHOUT THE WRITTEN APPROVAL OF OAI.</p>		<p><b>UNLESS OTHERWISE SPECIFIED</b> ALL DIMENSIONS ARE IN INCHES. ALL PARTS TO BE DEBURRED AND EDGES BROKEN .015 MAXIMUM</p>									
<p>TOLERANCES ±</p> <table border="1"> <tr> <td>.X</td> <td>.XX</td> <td>.XXX</td> <td>DEG.</td> </tr> <tr> <td>.030</td> <td>.010</td> <td>.005</td> <td>1/2°</td> </tr> </table>		.X	.XX	.XXX	DEG.	.030	.010	.005	1/2°	<p>SCALE: NONE DO NOT SCALE DRAWING</p>	
.X	.XX	.XXX	DEG.								
.030	.010	.005	1/2°								
<p>THIRD ANGLE PROJECTION</p>	<p>DRAWN</p> <p>CTEX</p>	<p>CHECKED</p> <p>E PALMER</p>	<p>ENGINEER</p> <p>3/24/98</p>								
<p>NEXT ASSY.</p>	<p>MODEL</p>	<p>APP</p>	<p>APPLICATION</p> <p>3/24/98</p>								

TITLE:	DIAG PNEU PIPING & INSTRUMEN MDL 200
MATERIAL:	N/A
FINISH:	
ACAD FILE NAME:	101-01D.DWG

**OAI**  
Optical Associates Inc.  
San Jose, Calif. 95134  
(408)232-0600

C	0200-101-01	REV.:	D
SHEET: 1 OF 1			

REV.	ECO NO.	DESCRIPTION	INCOMP. BY	ENGINEER APPROVAL	DATE
A	6692	PRODUCTION RELEASE	CTEX		1/6/99
B	8006	REVISED PER ECO	TW		5/3/01
C	7959	REVISED PER ECO	SGOH		8/23/01
D	8603	ADD IR OPTION	MM	MM	2/3/03
E	8904	ADD S8, J22B, P22B	MM	MM	7/28/04
F	8940	ADD J23, P23, & S9	MM	MM	10/07/04
G	9257	MAKE REDLINE CHANGES	MM	MM	02/01/06
H	9304	ADD Z OPTION NOTE	MM	MM	03/13/06
I	9675	PS AC PIN WAS 2 IS 3	MZ	MZ	5/9/07
J	10341	ADD 0200-071-01	MM	MM	5/14/09
K	10349	ADD GND WIRE TO P16	MM	MM	6/2/09
L	10438	ADD IR Z OPTION	MM	MM	10/19/09



- NOTES:
- 1 WRAP WHITE ELECTRICAL TAPE (OR) WHT SHRINK TUBING ON WIRE APPROXIMATELY WHERE SHOWN.
  - 2 THIS JUMPER IS REMOVED WHEN THE IR OPTION IS ADDED TO THE MACHINE.
  - 3 INSTALLED WITH THE MICROSCOPE Z OPTION (0420-0002-XX).
  - 4 THE LAST CONNECTORS USED ARE P26 & J26 & THE LAST VALVE USED IS V5, WHICH BOTH ARE USED ON THE MICROSCOPE Z OPTION (0420-0002-XX).
  - 5 INSTALLED WITH THE LVDC SHUTTER DRIVE KIT (0200-071-01).
  - 6 WHEN THE 12V SHUTTER DRIVER KIT ISN'T INSTALLED, THIS WIRE RUNS FROM P16-9 TO TB1-4.
  - 7 P26 HAS PIN 1 & PIN 2 SHORTED WHEN THERE IS NO IR Z OPTION INSTALLED. P26 IS WIRED TO S10 WHEN THE IR Z OPTION IS INSTALLED.
  - 8 ONLY INSTALLED WITH THE MICROSCOPE Z OPTION (0420-0002-01 OR 0420-0002-02).
  - 9 S10 IS PART OF CYLINDER 4900-101-01.

OAI	
DIAGRAM WIRING SYS CFG MDL 200	
Size D	CAGE Code (Cage Code)
DWG NO 0200-102-01	Rev L
Scale	Sheet 1 of 1

Wednesday, October 14, 2009