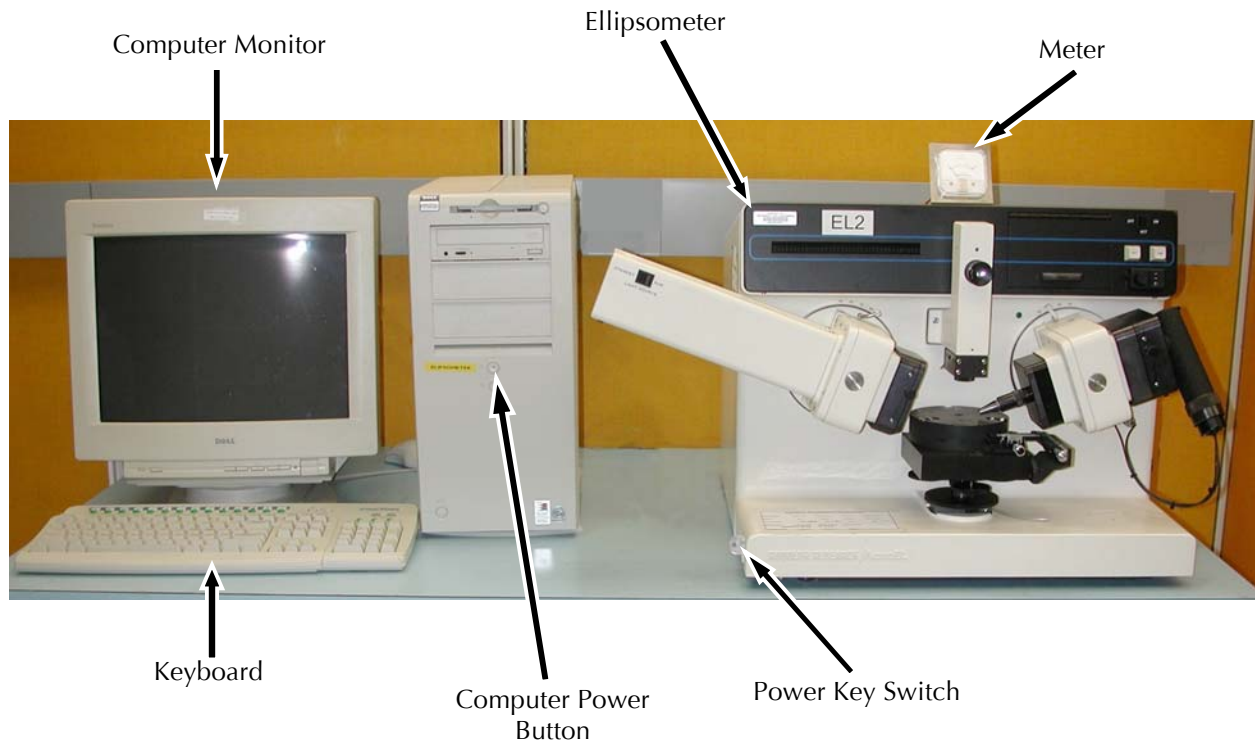
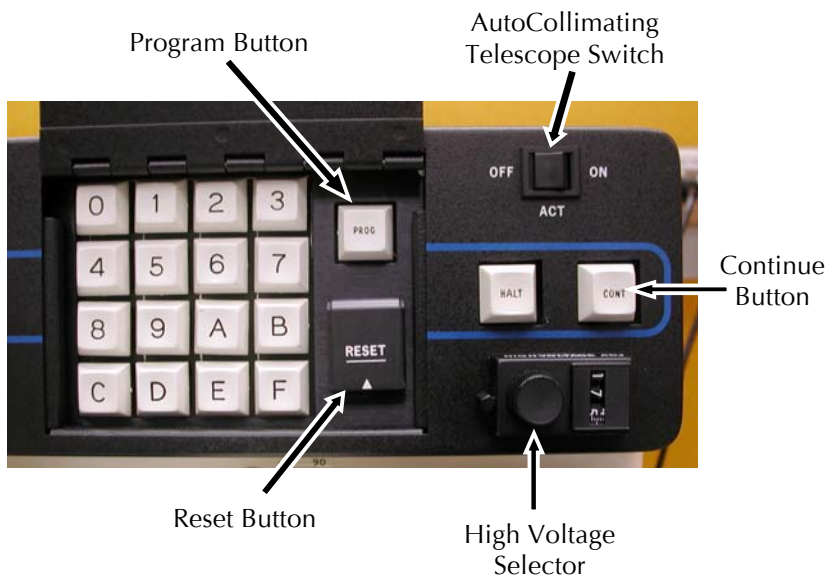
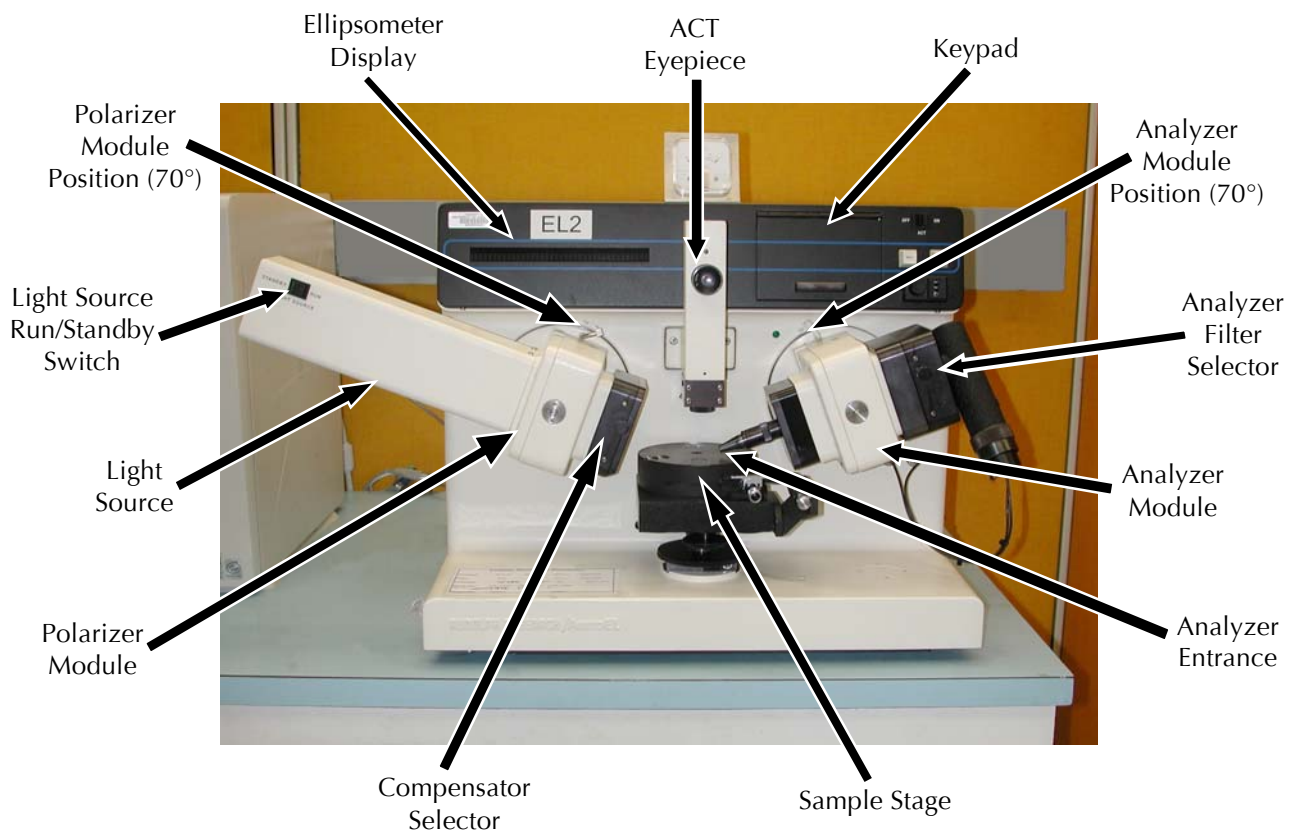


Rudolph Ellipsometer EL2 Operating Procedure



Description:

The Rudolph Ellipsometer EL2 is a microprocessor-controlled automatic ellipsometer that measures film thickness. It is capable of performing ellipsometric measurements at a wavelength of 633nm. The instrument computes the DELTA and PSI of single layer thin films while the external computer converts those parameters into measured film thickness and refractive index. Based on the capability of the current computer program, only the thickness and refractive index of homogenous and transparent thin films can be obtained.

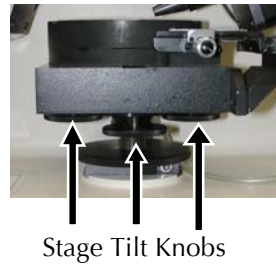
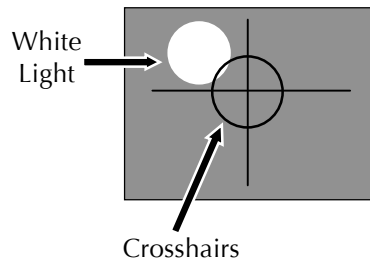


Start Up:

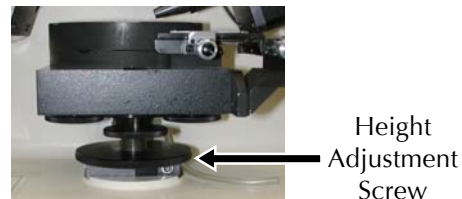
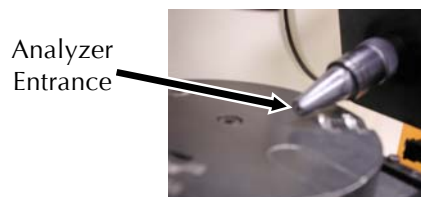
1. Turn power switch key to "ON" position. Within 30 seconds display will read "UP COMP-INSERT SAMPLE-PRESS CONT". Wait at least 15 minutes to permit warm up.
2. Turn on the computer power button.

Initialization:

1. Make sure both the polarizer and analyzer modules are set to 70°. **Note: If the modules are not set to 70°, contact a lab staff for help. Do not try to change the position of the modules by yourself.**
2. Place the standard calibration sample on the sample stage, face up and centered.
3. Turn the AutoCollimating Telescope (ACT) switch to the "ON" position.
4. Look in the ACT Eyepiece and center the white light spot using the three stage tilt knobs. **Note: Make sure the sample or substrate is on the stage or the white light cannot be seen.**



5. Set the Light Source to RUN
6. Check the stage height:
 - a. Dim the room lights; the reflected light entering the analyzer is very faint.
 - b. Place a piece of white paper in front of the analyzer entrance.
 - c. Cover the top half of the opening with the paper; if the light is in a shape of a half circle then the stage height is correct. If the light is not half a circle, then the stage height needs to be adjusted with the height adjustment screw.
 - d. Recheck the ACT white light adjustment. Repeat steps 6A-C as necessary.



7. Set High Voltage to 200 volts
8. Set the Compensator Selector to White
9. Set the Filter Selector to Red.
10. The display screen should read "UP COMP-INSERT SAMPLE-PRESS CONT"
11. Press CONT button
12. The initialization program will begin. Once the initialization is complete, the display screen will read "DOWN COMP-PRESS CONT OR PROG".

Measuring Calibration Sample:

1. Change the Compensator Selector to Red
2. Change the High Voltage to 175 volts
3. Flip open the Keypad door and press the PROG button.
4. Enter in desired program.

Prog #	# of Zones	Rel. Accuracy	Rel. Speed
01	2	High	Slow ~40 seconds
02	1	Low	Fast ~15 seconds
03	2/1	Med	Med ~25 seconds

5. Ellipsometer will then begin to measure the calibration sample.
6. When the measuring is complete, the ellipsometer display will read the DELTA and PSI numbers.

Computer:

Rudolph Research
Double Absorbing Films Calculations
Copyright 1985, 1987

Program filename: STARTUP
Number of Layers: SINGLE
Path for DELTA, PSI: AE > CALC

Ambient	NA = 1.000	KA = 0.000
Upper Film	NU = 1.462	KU = 0.000
Substrate	NS = 3.858	KS = 0.018

TL = 0.0

Output limits Sample ID: PHIO = 70.00
 TU: Yes >> from 0.0 to 1000.0 LAMBDA = 6028.0
 XX: Yes >> from 1.250 to 1.750 Print results: No
 Iterate lim = 0.0010
 Calculate Orders 0 to 2

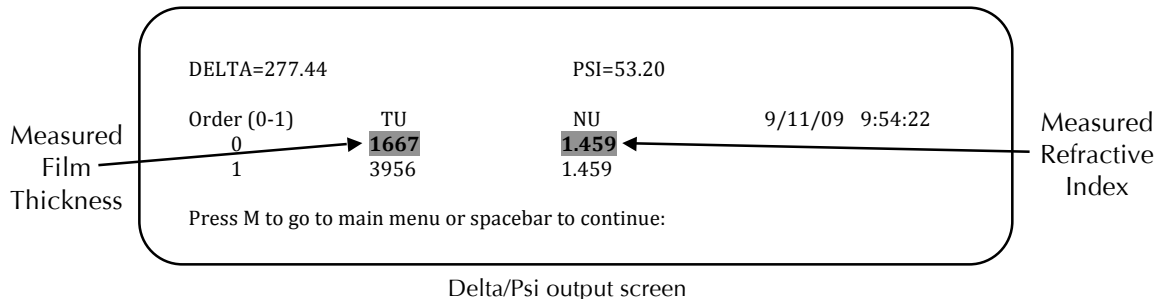
Name of the program file associated with these specifications

Commands <sp> <bs> <Tab> Tag Modify Set/printer Help Go Quit Areset Rest

Computer Default Input Screen

1. Change the following fields (Spacebar or Enter to move; M to modify)
 - a. Program Filename: **633NM**
 - b. Number of Layers: **SINGLE**
 - c. Path for DELTA, PSI: **KB>CALC** (Once you enter KB>C, it will enter the rest for you).
 - d. Upper Film NU: **1.462**- Refractive Index of film
 - e. Substrate NS: **3.858**- Refractive Index of Silicon substrate
 - f. Substrate KS: **0.018**- Imaginary part of Silicon substrate refractive index.

2. Once those parameters have been entered, move back to the Upper Film NU field and press I (I= iterate)
3. Press G to go.
4. A new screen will open asking you to enter the DELTA that was measured and displayed on the ellipsometer screen. Type in the DELTA number and press enter.
5. It will then ask you for the measured PSI. Type in the PSI and press enter.
6. You should then get a measured thickness of the calibration thin film. The measured thickness should be $1127\text{\AA} \pm 3$.



Performing a Sample Measurement:

1. Remove the calibration sample and place it back in the holder. Place the wafer to be measured on the wafer stage, face up and centered.
2. Check the alignment in the ACT Eyepiece. If the light is not centered, use the stage tilts to bring it back to center.
3. Check the stage height and adjust if necessary.
4. Press M to go to the menu.
5. Set up the computer with your sample parameters.
 - a. Program Filename: **633NM**
 - b. Number of Layers: **SINGLE**
 - a. Path for DELTA, PSI: **KB>CALC**
Note: Once you enter KB>C, the computer will enter the rest for you
 - c. Upper Film NU: Refractive Index of your film
 - d. Substrate NS: Refractive Index of your substrate
 - e. Substrate KS: Imaginary part of substrate refractive index.
6. The Ellipsometer display should read: COMMUNICATION ERROR-PRESS CONT.
 - a. Pressing CONT once will display last DELTA and PSI readings.
 - b. Pressing CONT twice will begin a new measurement.
7. If beginning a new measurement in the same area, press CONT twice.
8. If beginning a new measurement in a different area of the sample:
 - a. Carefully move the sample to the area to be measured.
 - b. Check the alignment in the ACT Eyepiece, center if needed.
 - c. Press CONT twice to begin new measurement.
 - d. Repeat DELTA and PSI data input to obtain film thickness measurement.

Shutdown:

1. Carefully remove sample.
2. Turn the ACT switch to OFF
3. Turn the Light Source to Standby
4. Turn the power switch key to the OFF position.
5. Turn off the computer by pressing the power button on the computer tower.

APPENDIX A

ADDITIONAL FEATURES:

1. RESET Button- Provides a hardware and software reset. If depressed the EL2 must be re-initialized. This function is normally not used unless a problem is encountered or re-initialization is required.
2. HALT- when depressed the EL2 will interrupt the current operating mode and prompt: HALTED-PRESS CONT OR RESET.
3. METER- Displays analyzer signal output. If no voltage reading on meter when acquiring a measurement, then either there is no sample on the stage or there is a problem with the ellipsometer.