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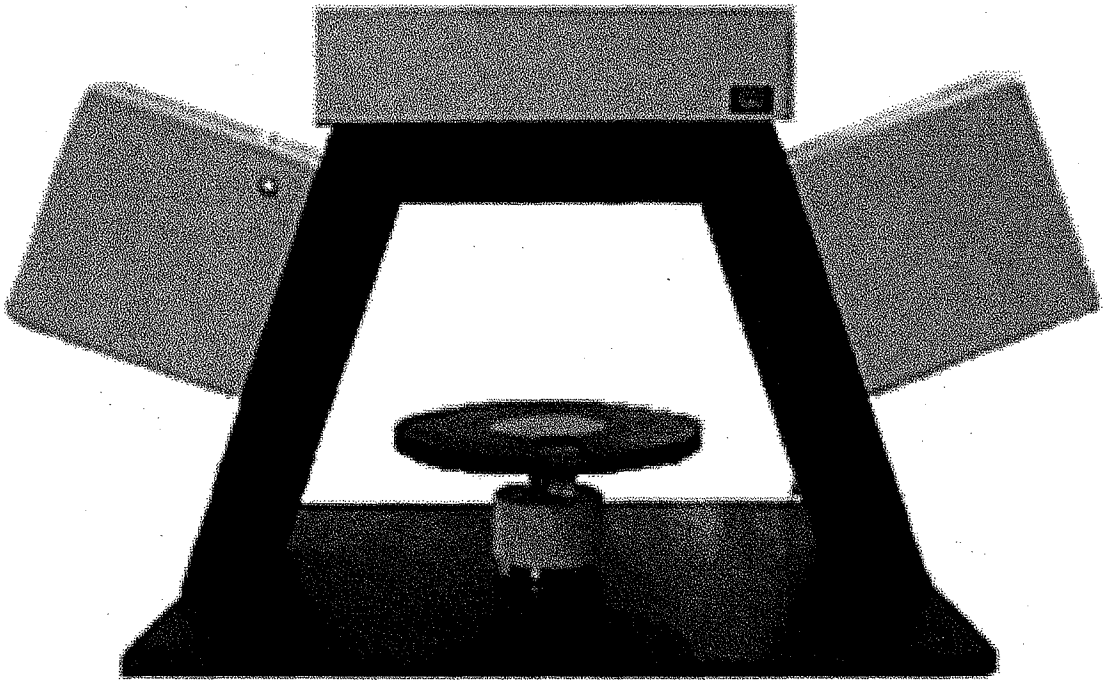
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Find the *Gaertner Scientific LSE* at our website: *Click HERE*

LSE STOKES ELLIPSOMETER
USER MANUAL
7109-C-351-RE1



Gaertner Scientific Corporation

8228 McCormick Blvd., Skokie, Illinois 60076

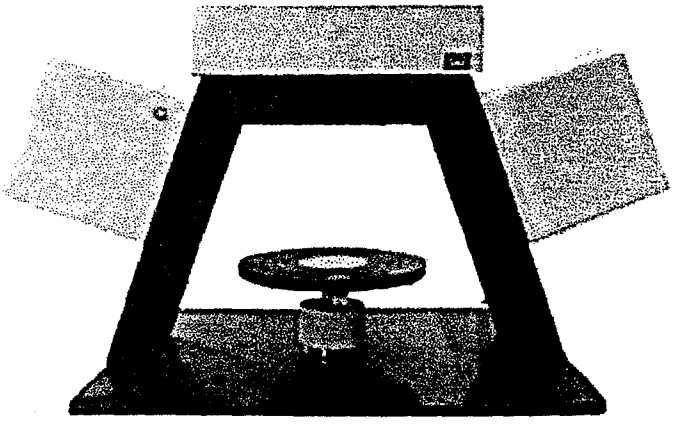
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→ Rusty Kutko
Ranky . . .

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Stokes Ellipsometer LSE



Description

The model LSE Stokes Ellipsometer is a continuation of an entirely new line of ellipsometers based on the revolutionary StokesMeter technology (winner of Photonics Spectra and R&D 100 best new products awards). The units' elegant design offers unprecedented ease of use and instantaneous measurement at a cost much lower than conventional metrology instruments.

This patented ellipsometer uses no moving parts and no modulators to quickly and accurately determine the complete polarization state of the 6328 Å HeNe laser measuring beam at a 70° incidence angle. The space-saving design features a small footprint yet it can accommodate large samples up to 300mm wide. The sample stage is rapidly moved by hand to measure any point on the sample surface. The sample table includes a manual tilt and table height adjustment which is set using an alignment screen on the computer.

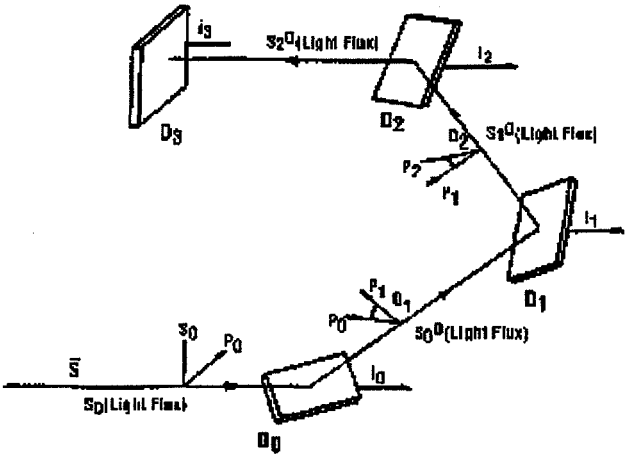
New Windows 95/98 software can measure the top layer film thickness and film refractive index on a substrate or on 1, 2, or 3 known bottom layers. The films can be transparent or absorbing. This durable integration of hardware and software is fast and easy to use.

Extremely precise, stable and low cost the model LSE Stokes Ellipsometer represents an excellent value in a basic ellipsometer.

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Description of Technology

This patented device uses no moving parts and no modulators to quickly and accurately determine the complete polarization state of the measuring beam.



Abstract

A photopolarimeter for the simultaneous measurement of all four Stokes parameters of light. The light beam, the state of polarization of which is to be determined, strikes, at oblique angles of incidence, three photodetector surfaces in succession, each of which is partially spectrally reflecting and each of which generates an electrical signal proportional to the fraction of the radiation it absorbs. A fourth photodetector is substantially totally light absorptive and detects the remainder of the light. The four outputs thus developed form a 4x1 signal vector I which is linearly related, I=AS, to the input Stokes vector S. Consequently, S is obtained by S=A(-1)I. The 4x4 instrument matrix A must be nonsingular, which requires that the planes of incidence for the first three detector surfaces are all different. For a given arrangement of four detectors, A can either be computed or determined by calibration.

The clean, compact StokesMeter replaces a typical rotating analyzer assembly consisting of a drum, prism, encoders, switches, motor and detector and their associated electronics. In addition, the waveplate mechanism on the polarizer arm, is eliminated. This results in a fast, precise, stable no moving parts ellipsometer.

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the alignment laser located in the top module and the StokesMeter detector located in the left module. The yellow LED will turn on indicating possible alignment laser emission. Actual alignment laser emission is controlled by the laser shutter switch.

4. Turn the alignment laser on by gently moving the shutter switch to the right. The measurement point is indicated by the alignment laser beam spot on the table surface. This beam location will be difficult to see on very clean samples so keep the table position as a reference. Do not turn on the separate HeNe power supply without first connecting the male high voltage connector from the left laser module to into the high voltage receptacle of the separate power supply. With the HeNe laser connected, turn the power supply on. Open the mechanical laser shutter located at the HeNe laser exit aperture by rotating the knurled wheel in a downward direction. The reflected beam should be visible against the inside plate on the right side.

5. Place a sample on the table. The sample may be centered using the table rings as a reference. The table itself can be centered with respect to the instrument by observing the alignment laser beam position on the table surface with the sample removed.

6. Run the GEMP measurement software. Refer to the Help Utility found on the GEMP program toolbar for a detailed explanation of this program.

7. Enter the Measurement and Calculation window by clicking on the ellipsometer icon on the GEMP program toolbar.

8. Prior to any measurement, the sample table must be adjusted. This is done by clicking on the Sample Alignment button with your mouse to enter the alignment screen. First adjust the tilt by working the sample table tilt knobs until the target cross is centered on the screen (see diagram). Note that tilt should always be adjusted first. Second adjust the height by working the sample table vertical adjustment wheel to obtain maximum power to the detector. This occurs when the longer horizontal bar reaches and is even with the shorter index bar. The shorter index bar indicates the maximum power that has been obtained thus far, while the longer index bar indicates the actual power that is currently entering the aperture. Raise and lower the sample table through the maximum to mark the maximum power position. For a preliminary table height alignment, observe the location of the laser beam at the 1 mm entrance aperture located on the right module inner plate and adjust the sample table height until the measurement laser beam enters the aperture.

9. Return to the GEMP program Measurement and Calculation window. Execute the measurement by clicking the Measure and Calculate button or one of the Shortcut buttons (e.g. Thin Oxide, Thin Nitride). See the Help Utility for further information.

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MODEL LSE STOKES ELLIPSOMETER SPECIFICATIONS

Method of Measurement:	Patented Stokesmeter™ determines the complete beam polarization using no moving parts and no modulators, only 4 stationary silicon detectors so measurements are exact and stable.
Measurement Time:	Practically instantaneous.
Light Source:	6328 A HeNe Laser
Beam Diameter:	1 mm
Alignment:	Tilt and table height on computer alignment screen.
Sample (Wafer) Size:	300 mm wafers easily accommodated
Stage:	Hand positioning with tilt and table height adjustment. 6 inch table standard and 8 inch optional
PC Interface:	LGEMP 4 layer absorbing program runs under Windows 95/98 with a 600 x 800 minimum resolution VGA monitor. Interface card requires an available 16 bit ISA interface slot.
Incidence Angle:	70°
Film Thickness Range:	0-60,000 Angstroms on substrate or on 1,2,3 or 4 known sublayers.
Precision and Repeatability:	± 1 Angstrom over most of the measurement range.
Refractive Index:	± 0.002 over most of the measurement range.
Environment:	20° C (68° F) dry dust free atmosphere
Power:	Supplied thru computer interface card and HeNe laser power supply. 100, 115, 230, volt 50/60 Hz.
CDRH Compliance:	All laser Ellipsometers supplied by Gaertner comply with CDRH requirements 21 CFR 1040 for a Class II laser product emitting less than 1 milliwatt of low power radiation. As with any bright source such as the sun or arc lamp, the operator should not stare directly into the laser beam or into its reflection from highly reflective surfaces.

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INSTALLATION

INSPECTION

Thoroughly inspect the shipping container and the ellipsometer for shipping damage. Verify that the sample table, sample wafer, computer interface card, laser power supply and software were removed from the shipping container together with the ellipsometer.

LOCATION CONSIDERATIONS

The LSE Ellipsometer is designed for use in either a production or laboratory facility under environmentally controlled conditions providing relatively constant room ambient temperature at 20° C (68° F) and a dry, dust-free atmosphere. The ellipsometer requires a clean, solid, level work surface. The LSE Ellipsometer alignment laser and StokesMeter detector is powered by the computer interface card which in turn is powered by the computer. The HeNe measuring laser is powered by its own separate key operated power supply. The line voltage to the equipment should be free of transients having harmonics in the range from audio frequencies to several megahertz. A voltage surge protector is recommended for the system power.

INTERFACE BOARD INSTALLATION

The data acquisition interface board or card is shipped in an anti-static conductive bag. Care must be taken to ensure the board does not come in contact with any static electrical charges. Touch the metal ground of your computer before removing the card from the anti-static bag, and always touch the bag before touching the board. Try to handle the board by the edges, or by the shield boards mounted on the card; avoid touching the gold contacts.

Verify that the computer power is turned off. Remove the computer cover. Remove the metal cover from the back of an empty ISA 16 bit slot in the PC. Make sure you save the screw for the next step. Pick up the card and again touch the metal ground of the computer chassis before allowing the card to directly contact any conductive parts of the computer. Install the card into any available ISA interface slot. Make sure that the card is fully inserted and seated squarely. Screw down the rear connector bracket using the slot cover screw. Replace the computer cover. Attach the ribbon connector to the interface card projecting from the back of the computer and tighten the two screws securing the connector to the card.

GEMP SOFTWARE INSTALLATION

The Gaertner Ellipsometer Measurement Program (GEMP) is for use with Windows 95 or 98. The computer monitor should be VGA with a minimum resolution of 600 x 800 in order to display the software properly. To install the program on your hard drive follow these steps:

1. Insert the Disk #1 containing the GEMP software in your floppy drive
2. From the START menu, select RUN
3. Type A:\SETUP and click OK
4. The software will create a directory \GSC on your hard drive
5. Follow on screen prompts to insert Disk #2
6. After software is installed run the GEMP program by clicking on the program icon
7. Follow on screen prompts
8. Click on the HELP button in the GEMP program toolbar for detailed operating information

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DARK VOLTAGE MEASUREMENT

The ellipsometer sensors have a Dark Voltage which must be set to zero. This is done at the factory as part of the calibration process. However the interaction between the A/D interface card and the computer varies with computer model and manufacturer. Therefore it is important to Re-Establish the Dark Voltage for the unit after installation. This is done by use of the GEMP program as follows:

Choose Main Menu Ellipsometer.
Choose Ellipsometer Menu Diagnostics.
Click on the Measure Dark Votages button.

Note that **It Is Very Important That The Lasers Are ON and that The Sample Table Is Removed**. This allows the system to compensate for internal reflections.

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OPERATING INSTRUCTIONS

DO NOT turn on the power supply WITHOUT A LASER CONNECTED. If you do, turn off the power supply and wait AT LEAST FIVE MINUTES before connecting the laser.

1. Make certain the power switch (front panel) is in the "0" (off) position.
2. Check that the voltage setting on the voltage selector switch (rear panel) matches the input voltage.
3. Insert the line cord into the receptacle (rear panel).
4. Plug the other end of the line cord into an appropriate receptacle.
5. Plug the male high voltage connector from the laser head into the high voltage receptacle (rear panel).

This connection is a TIGHT FIT. To prevent faulty operation, be sure the male connector is FULLY SEATED.

6. To prevent the possibility of electric shock, FULLY TIGHTEN THE HIGH VOLTAGE CONNECTOR RETAINING SCREW (under high voltage receptacle).
7. Turn the power supply on by switching the power switch to "I" (on).

The INDICATOR LIGHT will turn on IMMEDIATELY. There will be A THREE TO SEVEN SECOND SAFETY DELAY before the laser turns on. On lasers equipped with a safety shutter, laser emission WILL NOT BE VISIBLE UNTIL THE SHUTTER IS OPENED.

REMOTE CONNECTOR

WARNING – PREVENTION OF ELECTRIC SHOCK: To maintain the conformance of this unit with the requirements of EN61010-1:1993, the power supply must be SWITCHED OFF AND DISCONNECTED FROM MAINS POWER before removing the remote plug from the socket.

The remote connector is provided as a safety feature to allow REMOTE ACTUATION of the laser power supply. If remote actuation is desired, ensure that the cable and remote switch are RATED FOR THE SPECIFIED POWER SUPPLY INPUT VOLTAGE AND CURRENT. The remote switch WILL ACTUATE THE POWER SUPPLY ONLY WHEN THE MAIN POWER SWITCH IS SWITCHED ON. As supplied, the polarized remote connector plug is WIRED WITH AN INTERNAL JUMPER. If the connector is to be used with a remote external switch, modify the plug as follows:

1. Switch off power and disconnect power supply from mains power.
2. Remove remote connector plug from its socket (rear panel) by pulling straight out.
3. Press out the silver-colored locking pin.
4. Remove plug shell.
5. Remove the shorting wire from the plug terminals.
6. Drill or punch a hole in the flat end of the plug shell.
7. Slide the plug shell onto the remote connector cable.
8. Solder the cable leads to the plug terminals.
9. Insert the connector into its receptacle.

FUSING

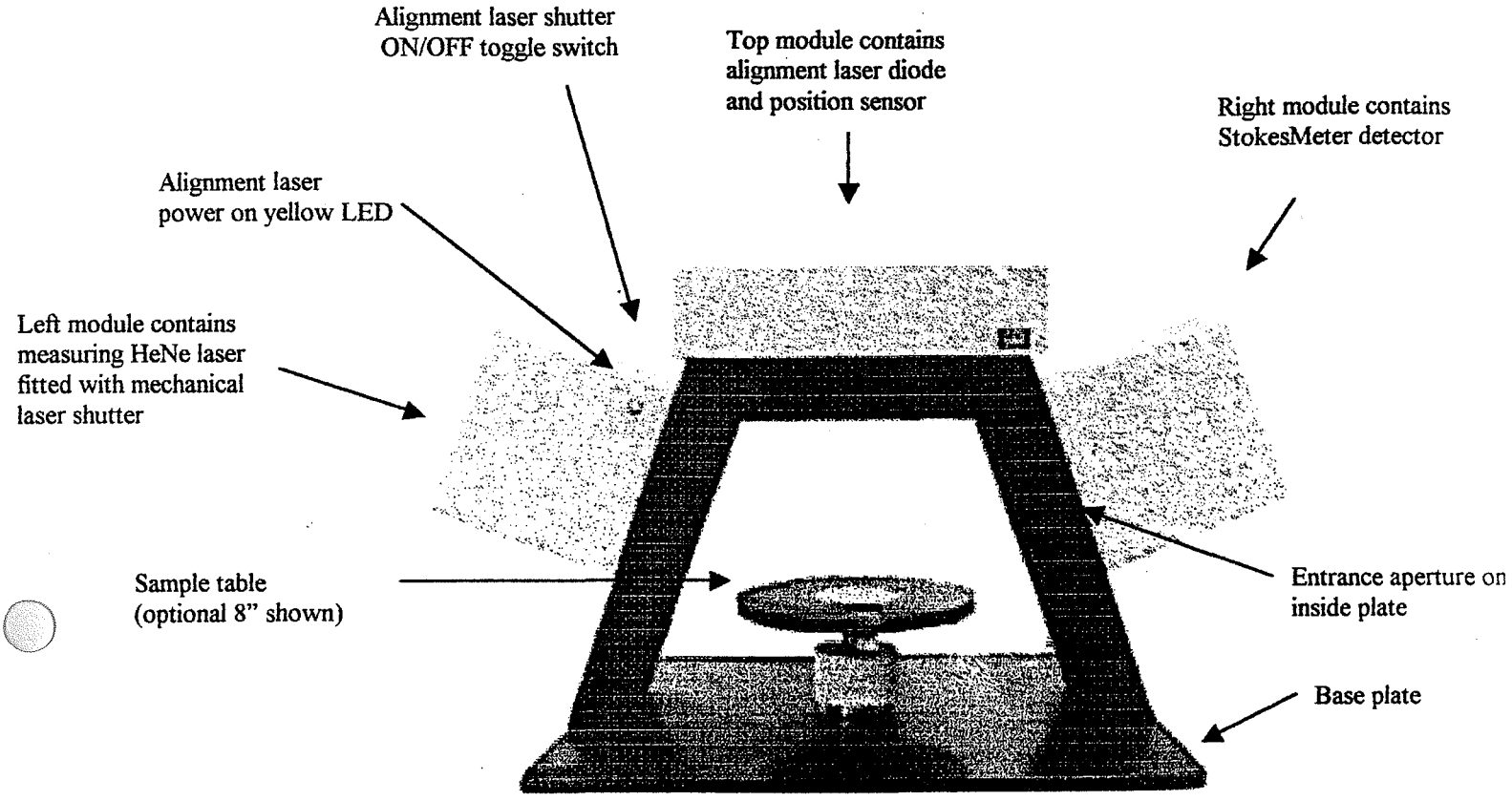
1. The power supply is protected by an INTERNAL, NON-REPLACEABLE FUSE.
2. The fuse is rated 230 VOLTS, 1 ½ AMP, NORMAL ACTING.

IF YOU EXPERIENCE A PROBLEM..... CHECK:

1. that the indicator light is on, indicating presence of line voltage
2. that the laser shutter is open, if provided
3. that the remote plug is firmly inserted in the remote connector receptacle
4. that the remote switch is switched on, if used
5. that the high voltage connector is firmly inserted in the high voltage receptacle
6. that the voltage selector switch is set correctly

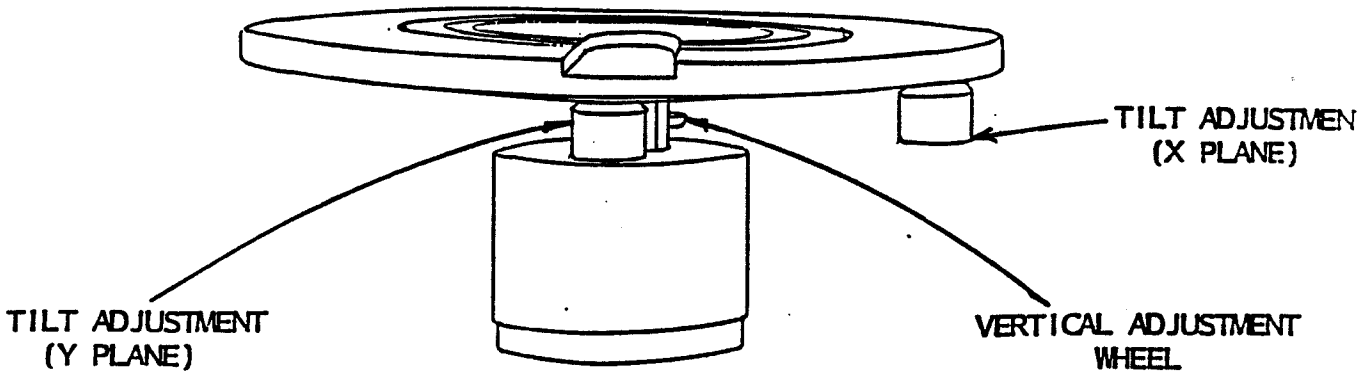
If the power supply is not operated in accordance with these instructions, the function of essential safety features my be impaired. **The laser power supply has no user serviceable parts within and requires no user maintenance.**

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LSE STOKES ELLIPSOMETER

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SAMPLE TABLE

Adjustment of the sample table is done with the aid of the GEMP program by clicking on the Sample Table Adjustment button. A sample table power bar and cross target tilt adjustment screen are displayed on the computer monitor.

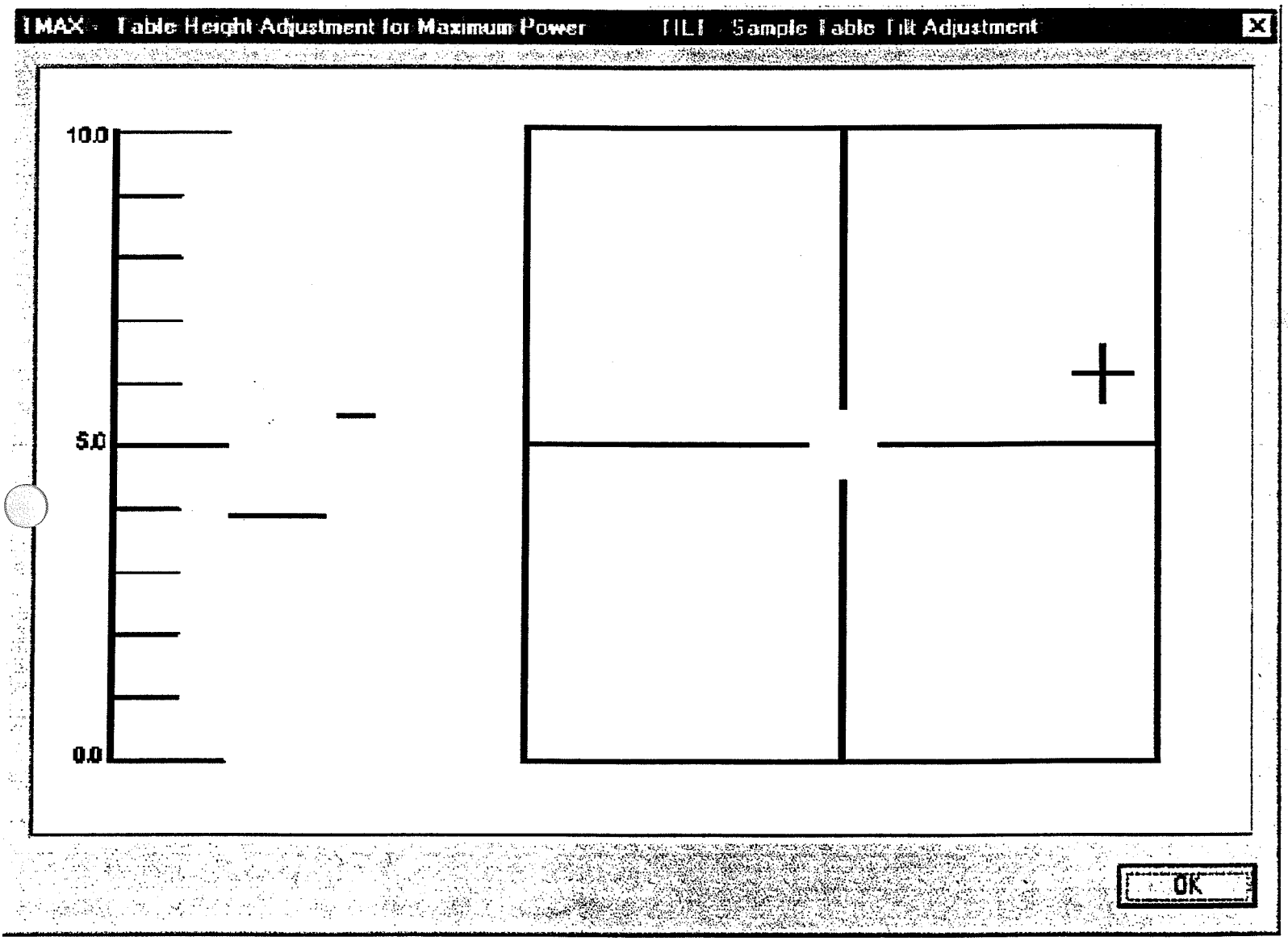
Place the wafer on the table. The table rings serve as a useful reference to help center the wafer. For a preliminary "ballpark" alignment observe the laser beam reflection at the 1 mm entrance aperture located on the right module inner plate. Adjust the table tilt and height until the beam enters the aperture.

USE ONE HAND TO STEADY THE TABLE BASE AND THE OTHER TO WORK THE ADJUSTMENTS

First adjust the sample tilt by turning the tilt adjustment x and y plane knobs under the table until the target cross is centered within the TILT screen. The tilt is always adjusted first.

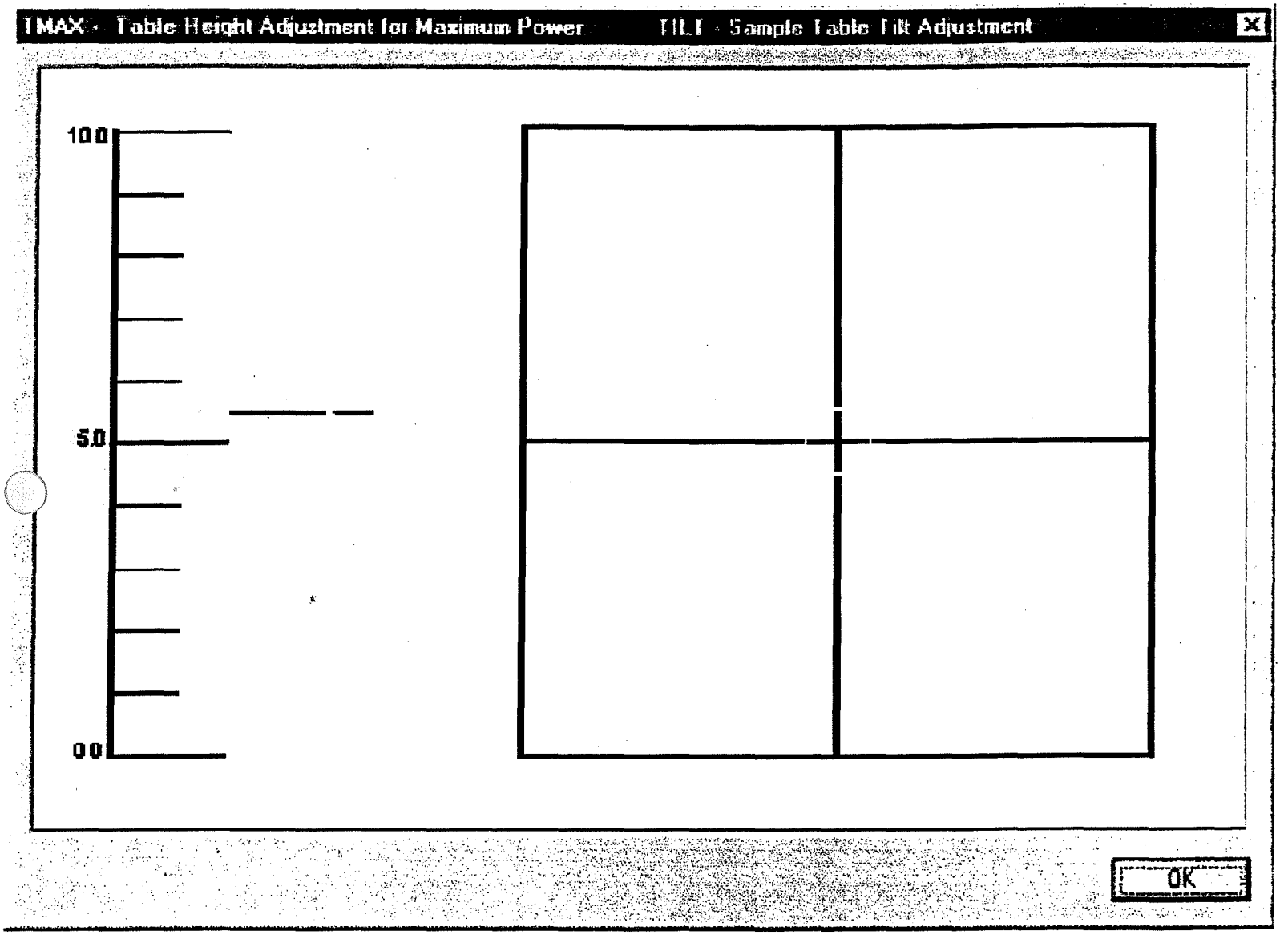
Next adjust the table height by turning the vertical adjustment wheel to raise the power bar and the shorter index bar to their highest position. The maximum position is marked by the shorter index bar when the table passes thru the maximum power position. The table height is correct when the power bar is approximately even with the shorter index bar.

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COMPUTER SCREEN SHOWING SAMPLE TABLE OUT OF AJUSTMENT
Note power bar is not even with maximum power indicator
and cross target is not centered

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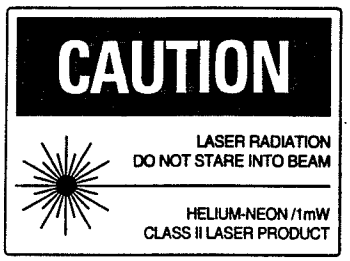


COMPUTER SCREEN SHOWING SAMPLE TABLE IN ADJUSTMENT
Note power bar is even with maximum power indicator
and cross target is centered

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Laser Safety Certification

All laser Ellipsometers supplied by Gaertner comply with CDRH requirements 21CFR 1040 for a class II laser product emitting less than 1 milliwatt of low power radiation. As with any bright source such as the sun or arc lamp, the operator should not stare directly into the laser beam or its reflection from highly reflecting surfaces.
Appropriate Warning Logotypes and Aperature labels alert users and service personnel of the presence of laser radiation during operation. A reproduction of these labels are shown.



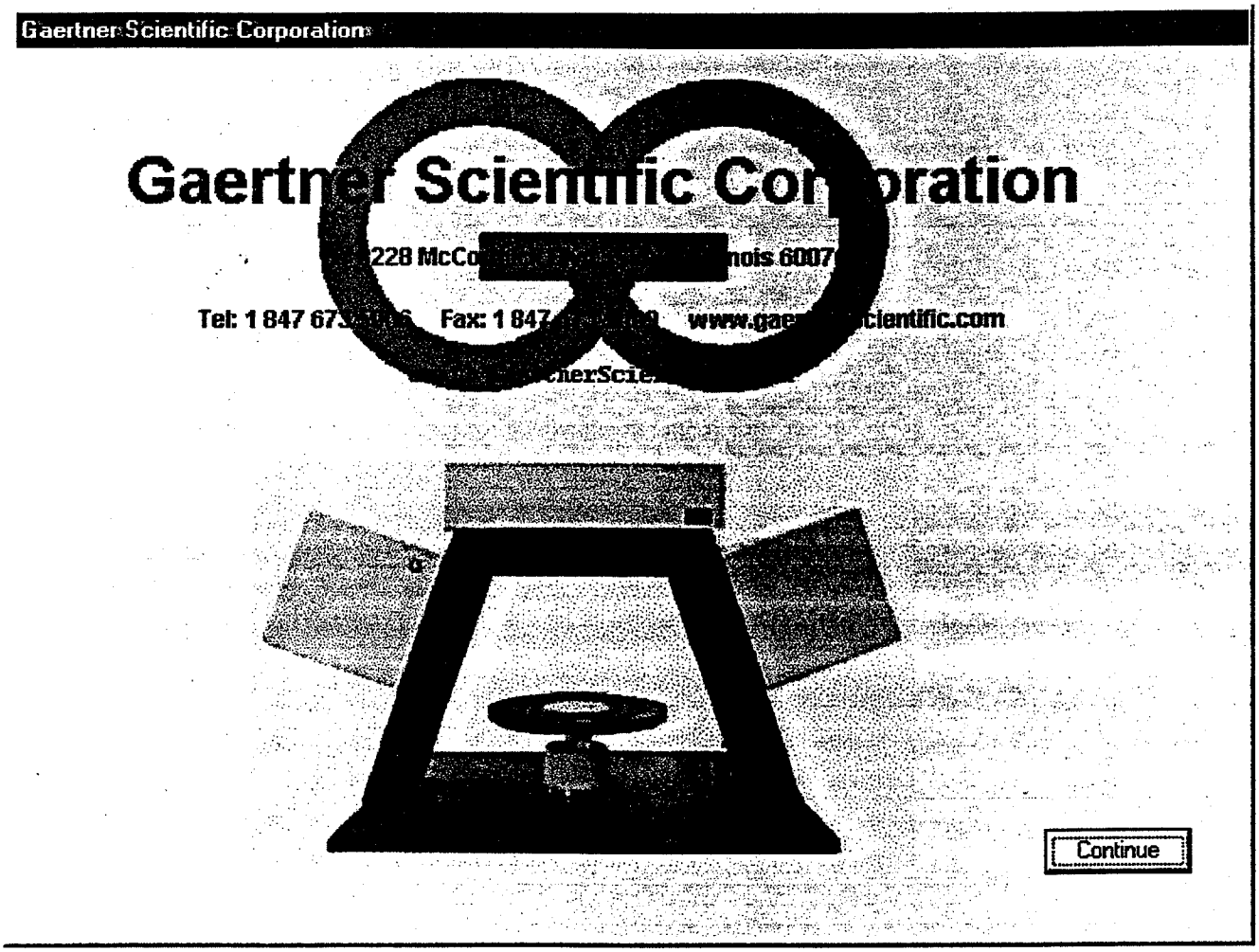


WARRANTY

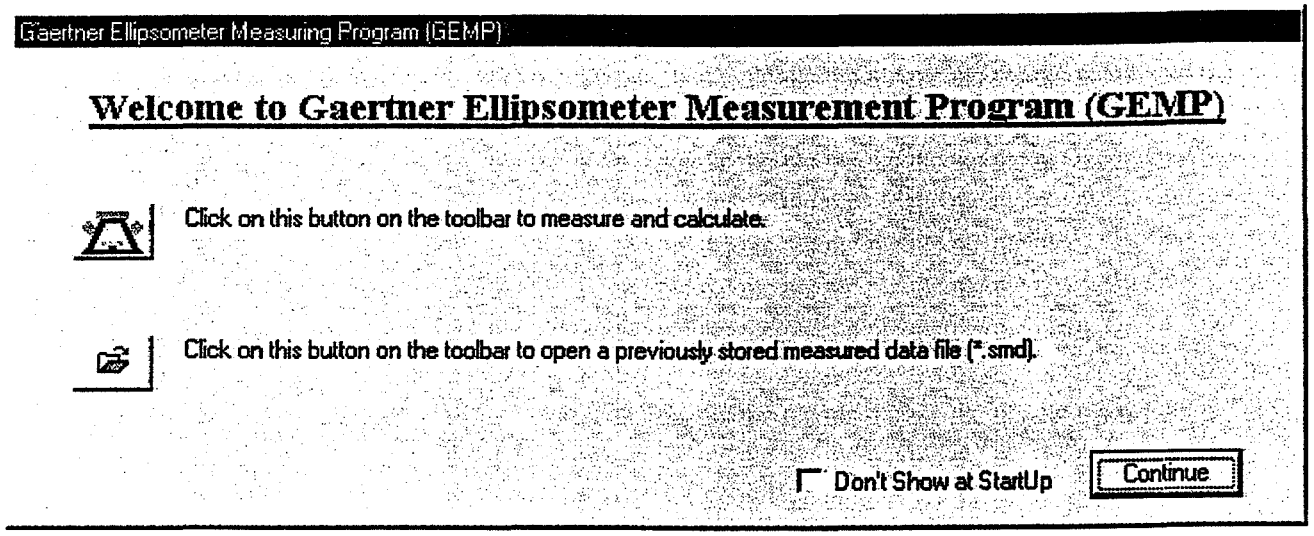
All optical, mechanical and electrical components of Gaertner Ellipsometers, including the lasers are warranted for one year from the date of delivery. Any defects in material or workmanship will be corrected by Gaertner at no cost. Shipping charges, travel and lodging costs incurred by service personnel are not covered by this warranty. Warranty on defects in material and workmanship for any computer, computer monitor and printer supplied with the Ellipsometer is covered by it's respective manufacturer and is passed through onto the user. The computer manufacturer will, at their option, repair or replace equipment that proves defective during the warranty period. Repairs necessitated by the misuse of the equipment, including use of software or interfacing not supplied by Gaertner, are not covered by this warranty. No other warranty is expressed or implied, including, but not limited to, implied warranty of merchantability and suitability for a particular purpose. Gaertner shall not be liable for consequential damages.

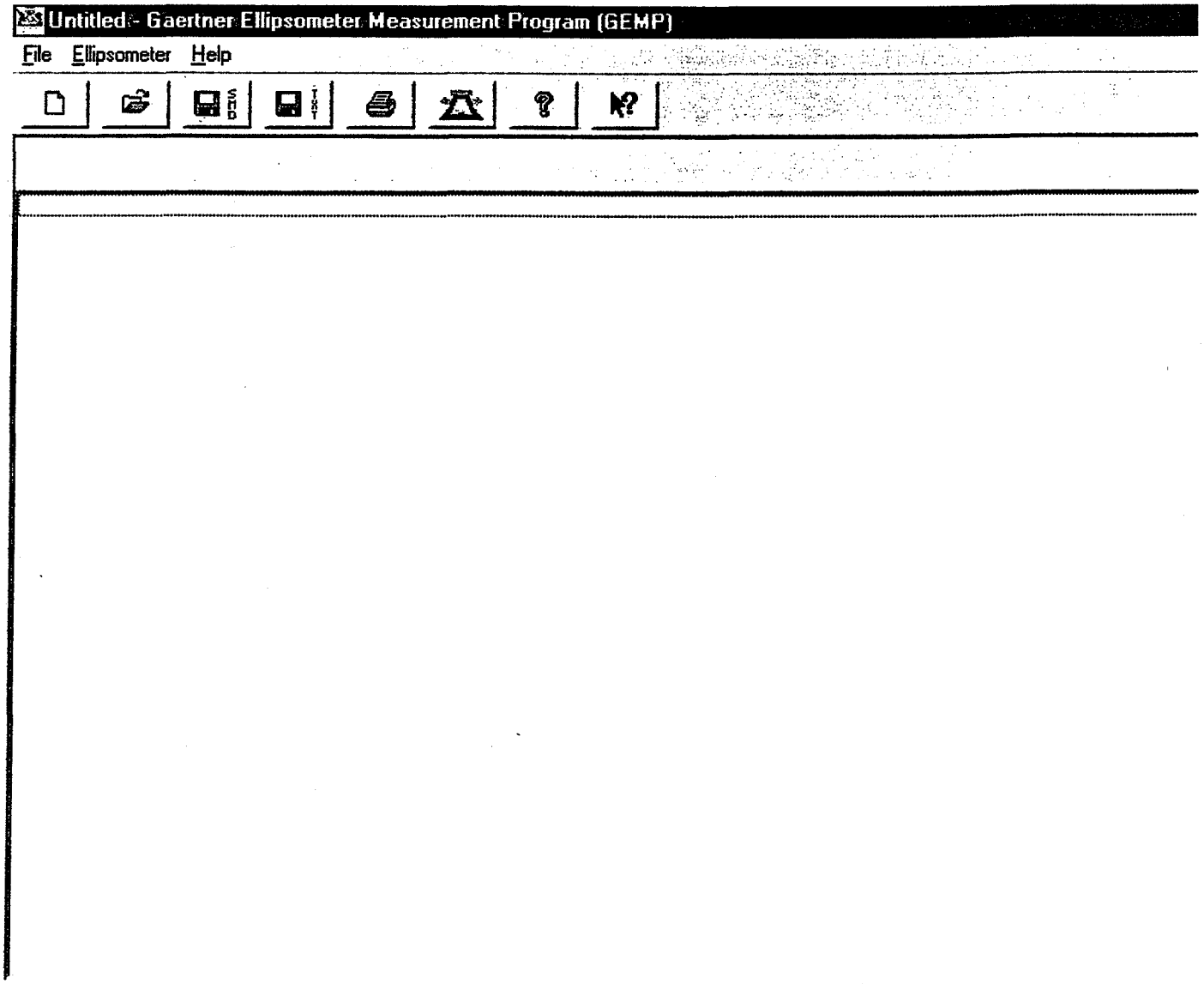
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Following is a printout of the Gaertner Ellipsometer Measurement Program (GEMP) help utility screens which are accessible from within the program

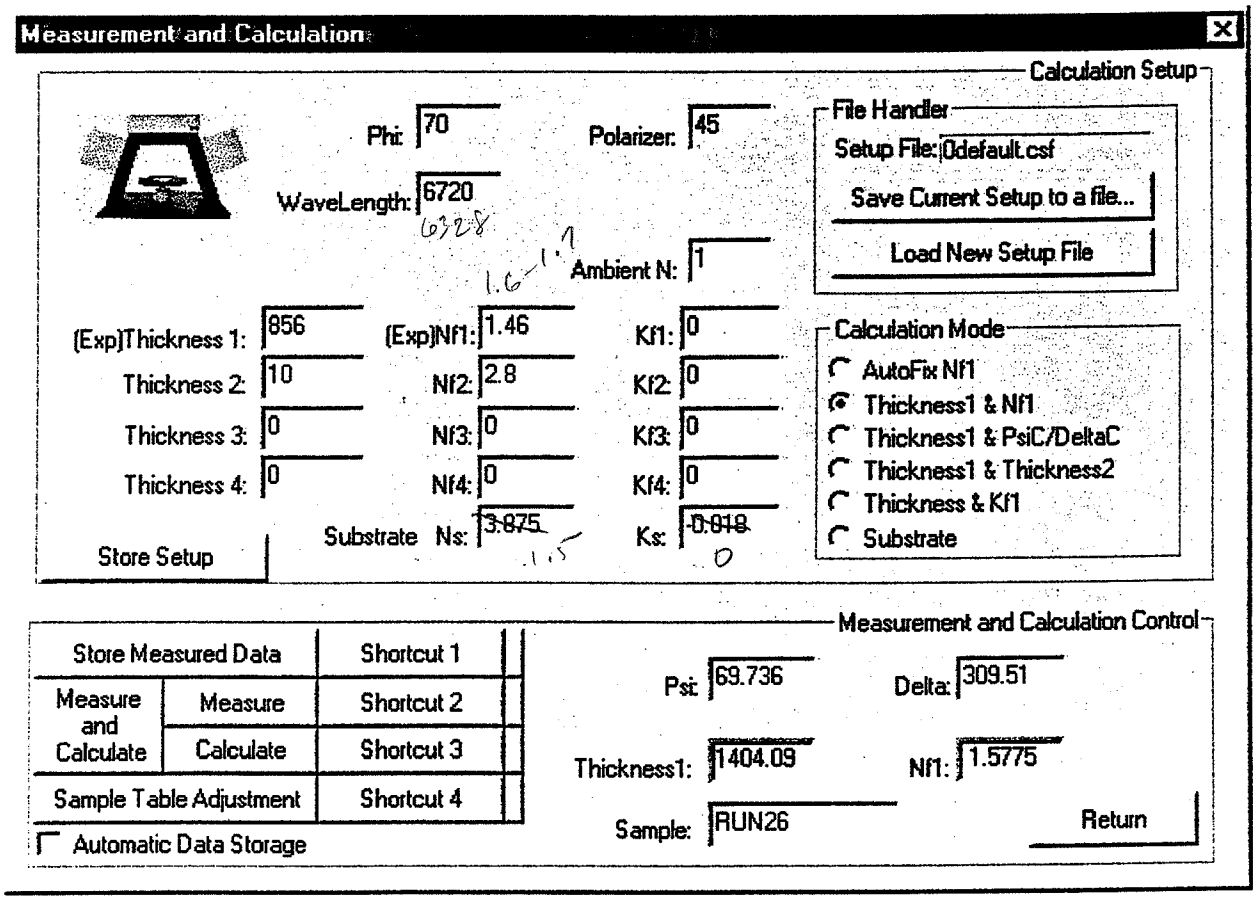


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period of photoresist ≈ 2700 Å

Got refractive index of PR @ 6328 Å wavelength

Got absorption rate " "

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Gaertner Ellipsometer - Help Main page

For new users...

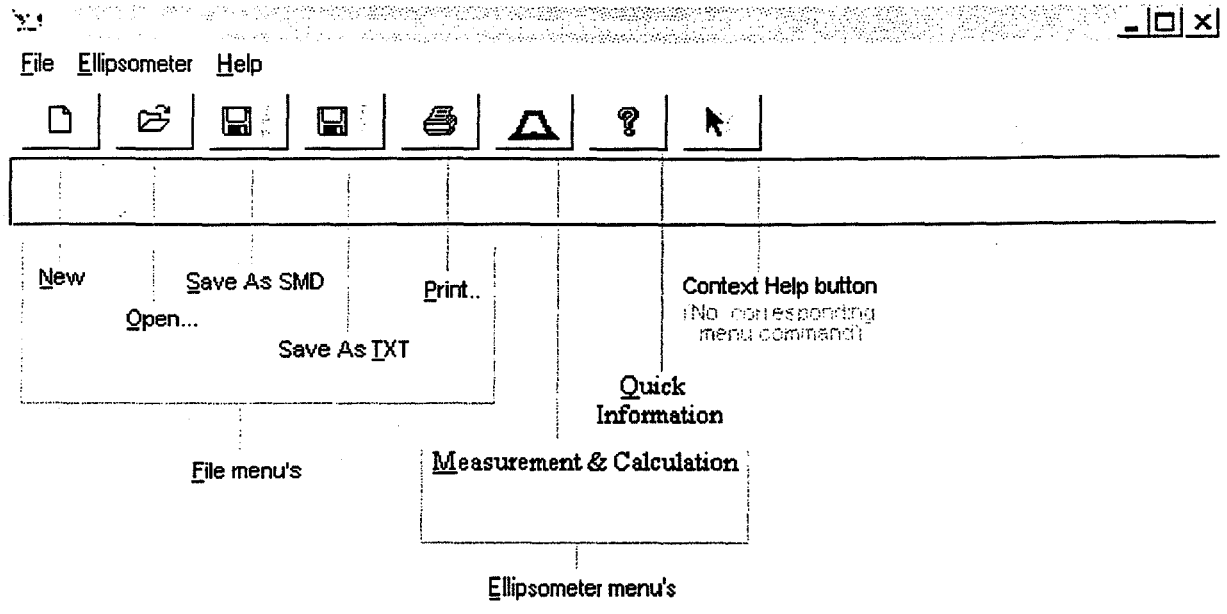
Quick Information
Step By Step Tutorial for Measurement & Calculation

Menu Commands

File menu's commands
Ellipsometer menu's commands
Help menu's commands

Toolbar buttons

Except for the Context Help button, toolbar buttons have corresponding menu commands as shown below. See the corresponding menu help topic for the a detailed description.



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Help menu commands

The Help menu offers the following commands, which provide the user assistance with this application:

Help Topics	Offers the user a Help System to find topics on which the user can get help.
Quick Information	Offers the user a Quick Information dialog box.
About	Displays the version number of this application.

Click here to go to Help Main Page

Help menu's Quick Information command or button  **on the toolbar**

Use this command to display the Quick Information Dialog Box. This gives a quick and short explanation of what the main features of this program are.

Keyboard shortcut

Keys: Press Q

Click here to go to Help Main Page

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Measurement & Calculation command or  button on toolbar.

The Measurement & Calculation command or button pops up the Measurement & Calculation Dialog Box over the application window.

Through this dialog box, the user can:

set instrument parameters,
set film parameters,
save the current active parameters setting into a CSF (Calculation Setup File) file,
load a parameters setting from an existing CSF file,
save the measured data and current setup to a SMD (Store Measured Data) file or a TXT (Text) file
open a saved SMD file to the application's document area by loading, or
get the Psi & Delta and two solutions and put them into the application's document area.

Instrument Parameter fields:

Polarizer, Wavelength, Phi and Ambient N

Film Parameter fields:

Thickness1, Thickness2, Thickness3, Thickness4,
Nf1, Nf2, Nf3, Nf4,
Kf1, Kf2, Kf3, Kf4, and
Ns, Ks, and Calculation Mode

Store Setup button:

Stores the current active measured data on the application screen's document area. (Since the application window is behind the Measurement & Calculation Dialog Box, the user may need to move the Measurement & Calculation Dialog Box by dragging it to see part of the application window's document area.)

Calculation Mode button:

AutoFix Nf1,
Thickness1 & Nf1,
Thickness1 & PsiC/DeltaC,
Thickness1 & Thickness2,
Thickness & Kf1, and
Substrate

Save Current Setup to a file button:

Opens the Save As dialog box in which the user can type in the file name to save current parameters setting. If the user doesn't type the file extension, *.CSF will be appended to the file name the user has typed in. For example, if the user typed ***test1*** in the File name: field, the file name will be ***test1.csf*** . Since this file is a normal text file, the user can use any text editing program to see the contents.

Load New Setup File button:

Opens the Open dialog box which displays all the *.CSF files if there are. The user can select an existing file and click the Open button, then the file's parameters will be loaded and displayed in the Measurement & Calculation Dialog Box.

Note: Whenever the user saves, the current setting to, or loads, from a CSF file, the Parameter File field at the top-right corner of Measurement & Calculation Dialog Box will show the associated CSF file. However, if the user changes any of the parameters, the changes will **not** update the associated file until the user saves the changed settings to the file.:

Sample Table Adjustment button:

Adjust Sample Table Prior to Measurement via an alignment graphic screen. Prior to any measurement, the sample table must be adjusted. First adjust the tilt by working the sample table tilt screws until the target cross is centered on the screen. Note that tilt should always be adjusted first. Second adjust the height by working the sample table height screw to obtain a maximum power to the detector. This occurs when the longer horizontal bar reaches and is even with the shorter index bar. The shorter index bar indicates the maximum power that has been obtained thus far, the longer index bar indicates the actual power that is currently entering the aperture. Raise and lower the sample table through the maximum to establish the maximum power position. For a preliminary table height alignment, observe the location of the laser beam in relation to the 1mm entrance aperture located on the

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right module inner plate and adjust the sample table height until the measurement laser beam enters the aperture.

Measure button:
Measures the Psi and Delta through the Ellipsometer and displays them.

Calculate button:
Calculates the 2 solutions with the current parameters setting using the Psi & Delta and displays the result.

Measure and Calculate button:
Measures the Psi and Delta through the Ellipsometer and displays them and does the calculation in the current Calculation Mode and parameter setting using the Psi & Delta and displays the result. If the Automatic Storing Data field is set (or checked), the Psi & Delta, and the calculation result will be put into the application window's document area.

Store Measured Data button:
Stores the current Psi & Delta and the two solutions(if there are calculated solutions) into the application window's document area.

Note: If the Automatic Storing Data field is set (or checked), this button is not available until the Automatic Storing Data field is cleared (or unchecked).

Automatic Data Storage checkbox:
Automatically stores the Psi- Delta and the calculation results into the application window's document area.

Measurement and Calculation Control field:
User can enter the Sample name, Psi, and Delta values into edit fields. Solutions 1 and Solutions 2 are entered into Thickness1 and Auto edit fields respectively.

Shortcut buttons:
User may attach a Calculation Setup File to each shortcut button. This is done by the use of the small button to the right of each shortcut. The new name of the Calculation Setup File will be displayed on the button.

Return button:
Closes the Measurement & Calculation Dialog Box and returns to the main window document area.

Keyboard shortcut

Keys: Press M

Click here to go to Help Main Page

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Ellipsometer menu commands

The File menu offers the following commands:

Measurement & Calculation	Use for single point measurement and calculation.

Click here to go to Help Main Page

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Step By Step Tutorial for Measurement & Calculation

1. Check the hardware connection between the Ellipsometer instrument and the computer. Turn on the computer's switch.
2. Run the application.
3. Open the Measure & Calculate box (Measurement & Calculation Dialog Box) by either the Ellipsometer menu's Measure & Calculate command or the Measure & Calculate button  on tool bar.
   >> The Measurement & Calculation Dialog Box will pop up over the application window with the 0default.csf file's setting. The 0default.csf file is used when the user opens the Measurement & Calculation Dialog Box for the first time in each session of the application,

4. Type a string (up to 80 characters) for the Sample field, change some parameters: for example, 4000 for the Thickness1, 1.458 for Nf1, 0.001 for Kf1, etc. Click the Save Current Setup to a file button.
   >>The Save As dialog box will pop up. Type *test1* into the File name: field and click the Save button, then the current setting will be saved into the file *test1.csf*, and the file name will be displayed in the Setup File field of the Measurement & Calculation Dialog Box.

5. To make it easier on the user, four shortcut buttons have been added. The user may attach a Calculate Setup File(CSF) to each shortcut button. This is done by the use of the small button to the right of each shortcut button. The name of the Calculate Setup File will be displayed on the shortcut button.
   >>When a shortcut button is clicked, three actions occur:
   a.) Setup parameters are set to those of the setup file linked to the shortcut button.
   b.) The ellipsometric parameters Psi and Delta are measured.
   c.) A solution is calculated based on the thin film model defined by the setup file.

   Note: When the user first enters the Measurement & Calculation Dialog Box, the shortcut buttons will have the default settings.

6. Click the Store Setup button.
   >>The current active setup will be displayed on the application screen's document area. (Since the application window is behind the Measurement & Calculation Dialog Box, the user may need to move the Measurement & Calculation Dialog Box by dragging it to see part of the application window's document area.)

7. At the bottom-left side of the Measurement & Calculation Dialog Box, click the Sample Table Adjustment button.
   >>The Sample Table Adjustment Screen will appear. Prior to any measurement, the sample table must be adjusted. First adjust the tilt by working the sample table tilt screws until the target cross is centered on the screen. Note that tilt should always be adjusted first. Second adjust the height by working the sample table height screw to obtain a maximum signal to the detector. This occurs when the longer horizontal bar reaches and is even with the shorter index bar. The shorter index bar indicates the maximum power that is currently entering the aperture. Raise and lower the sample table through the maximum to establish the maximum power position. For a preliminary table height alignment, observe the location of the laser beam in relation to the 1mm entrance aperture located on the right module inner plate and adjust the sample table height until the measurement laser beam enters the aperture.

8. Click the Measure button.
   >>It will measure the Psi and Delta from the instrument and display it on the screen.

9. Click the Calculate button.
   >>It will do the calculation in the current Calculation Mode with the current parameters settings and display the result to the screen.

10. Click the Store Measured Data button
    >>The current Psi-Delta and two solutions (Thickness1 and Auto [the 1st and 2nd solutions respectively]) will be displayed on the application window's document area.

11. Now, click the Measure and Calculate button.
    >>Steps 8 and 9 will be performed right after each other.

    Just like step 10, the user can store this result by clicking the Store Measured Data button. If the user wants to keep storing the result of every Psi-Delta Calculation, check the box next to the Automatic Data Storage. For practice, click the Measure and Calculate button several times after the Automatic Data Storage has been set (or checked).

12. Close the Measurement & Calculation Dialog Box by clicking the Return button.

13. On the application window, the user can save the contents in the document area into an external file by the Save SMD button  on the toolbar or the File menu's Save command.
    For practice, click the Save SMD button on the toolbar and type *test1* in the File name: field of the Save As dialog box and click the Save button. The document will be saved as *test1.smd* file.

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If the user wants to save the contents in the document area into a TEXT file, click the Save As TXT button  on the toolbar or the File menu's Save As TXT command. For this text file, the user can use any text editing program to open and modify it.

14. Now create a new document by clicking the New button  on the toolbar or File menu's New command.
The document area will be cleared with new a blank document.

15. Open the Measurement & Calculation Dialog Box again (see step 3)
>> This time, the Measurement & Calculation Dialog Box will pop up over the application window with the test1.csf file's settings, which the user has used recently, rather than the 0default.csf.
The user may try to change the parameters and save it as a different parameter file as many times as the user wants (see step 4).

16. Click the Load New Setup File button.
>>The Open dialog box will pop up and display all the CSF files. Select a file and click the Open button. Then the Measurement & Calculation Dialog Box will be re-displayed with the parameter settings of the file the user has selected.

17. Now close the Measurement & Calculation Dialog Box and exit the application.
>>If the current document area has been changed but it has not been saved yet, the user will be prompted to save it or not. Then the application will close the-application window.

To see detailed descriptions about menu commands and buttons, go through the Menu Commands on the Help Main Page

Click here to go to Help Main Page

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File menu commands

The File menu offers the following commands:

New	Creates a new document.
Open	Opens an existing document.
Save	Saves an opened document using the same file name.
Save As	Saves an opened document to a specified file name.
Save AsTXT	Saves an opened document to a Text format file (with .TXT extension).
Print	Prints a document.
Print Preview	Displays the document on the screen as it would appear printed.
Print Setup	Selects a printer and printer connection.
1 2 3 or 4	Selects one of the Most Recently Used files to open if there were.
Exit	Exits Gaertner Ellipsometer Measurement.

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. GEMP Calculation Mode

The GEMP software acquires data from the ellipsometer and calculates the ellipsometer values of Psi and Del for the measured sample. The Calculation Mode in the software offers 6 choices for converting the results of the Psi & Del measurement into a user-constructed model of the sample. The user simply clicks on the desired Calculation Mode with the computer's mouse pointer and then clicks the Calculate button after individual entries of film Thickness, film refractive index Nf and absorption Kf are entered into the sample model fields. The individual values in the setup or construction of the sample model can be repeatedly changed and recalculated until a best-fit solution for the sample is found.

Although the GEMP software permits up to 4 layers with 14 individual values to be entered into the setup fields for modeling of the sample only the 1 or 2 top unknown values can be calculated since only 2 values (Psi and Delta) are returned from the measurement. The number of unknowns can never be greater than the number known. Usually the unknowns are the top film Thickness1 and the film refractive index Nf1 with all of the other bottom 12 values entered as known parameters or fixed values. The calculated Thickness value is dependent on the accuracy of the entered known fixed values and will reflect any error in these values.

- AutoFix Nf1 - Calculates Top Film Thickness 1 and automatically measures the film refractive index Nf1 if it is in a good measurement range. If the index value is weak and unstable then it automatically defaults to the entered value and is fixed. The index value is important because it's value is used to calculate the optical path or film thickness. An example would be 500 A SiO2 film layer on a Silicon wafer measuring Psi 21.37 and Delta 98.713. The software would calculate a film refractive index of 1.458 and Thickness 1 of 456.50 A. Since SiO2 is completely transparent at the measured wavelength of 6328 A the absorption Kf1 is zero. This same SiO2 oxide film if etched down to 100 A would measure a Psi of 11.25 and Delta of 151.778. In this thickness range the refractive index measurement is unstable so this calculation mode permits the software to fix the index at its entered default value of 1.46 and calculate the thickness. A similar fixing of index would occur if this oxide were within a few hundred angstroms of the period value of 2800 A. Again the index measurement is unstable in this thickness range (within about 25% of zero thickness or period value). Conversely the best thickness range for index measurement is mid period 1400 A for SiO2. and 900 A for Nitrides which have a period value of 1800 A.

- Thickness1 & Nf1 –Always returns a measured film refractive index Nf1 no matter how unstable and incorrect. Since the calculation of top film Thickness 1 is dependent on this index value it will also be incorrect. This measurement mode is used to find an approximate value of film refractive index and thickness.

- Thickness1 & PsiC/DeltaC –Always uses the entered value of film refractive index Nf1 to calculate the Top Film Thickness 1. In addition the software also

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calculates one of the measured values of PsiC or DeltaC. The agreement between the measured Psi or Delta and the calculated values of PsiC or DeltaC gives an indication of the correctness of the value of index and other values in the model of the sample. This mode will give the best repeatability in thickness and if the index value is correct then this mode also gives the best and most stable film thickness measurement. This mode can be used to measure very thin films down to 1A as well as near period films.

- Thickness1 & Thickness2 –Calculates the top film Thickness1 and the film Thickness2. All other values are fixed in this calculation. An example would be a 600A Nitride layer Thickness1on 400A of Oxide Thickness2 on a Silicon substrate. In this mode the Thickness2 behaves much like the index and becomes unstable and difficult to measure in thinner ranges of thickness.

- Thickness1 & Kf1 –Calculates the top film Thickness 1 and the top film absorption Kf1. An example would be a polysilicon film with a approximate Thickness1 of 4000A a known index value Nf1 of 4.0 and an absorption Kf1 of about 0.3 over a 1000A known oxide layer on a Silicon wafer. In this example the oxide layer Thickness 2 and refractive index must be accurately known. The polysilicon must be known to within 800A since its high film index gives it a period value of only 800A. In most cases the absorption Kf1of the polysilicon is more volatile not as well known as the real refractive index Nf1. Since the Nf1 is more stable, the Nf1 is fixed and the absorption Kf1 is measured.

- Substrate –Calculates the real Ns and imaginary part of the refractive index Ks of a bare substrate. Although the measurement itself is simple the results are more complicated because most substrates including silicon form a thin native oxide layer on the surface of the substrate when exposed to air. This offsets the calculated values. In addition, microscopic surface roughness introduces polarization errors that influence the Ks value. For uniformity and simplicity well known published "book" values are generally used in place of individual user measured values. A good substrate will be flat, stable, have a smooth highly reflective surface with a different index than the film layer being measured. If the substrate is transparent like glass or fused silica then care must be taken so that the light reflected from the bottom surface does not enter the ellipsometer. A transparent substrate can be thicker than 6mm, or have it's bottom surface roughened to scatter the light or placed in optical contact with a thicker layer to absorb the unwanted bottom reflection. A 10mm thick polished fused silica plate is an example of a good substrate.

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