



Lab Manual

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Linewidth Measuring System

(linewidth)

1.0 Title

Linewidth

2.0 Purpose

Linewidth is a Leitz microscope with magnifying power up to 50X and a video camera with a frame grabber interfacing to a PC. Images are captured and analyzed in Caltex Scientifics DMP-1000 analysis software. This tool maybe used for metrology and general imaging.

3.0 Scope

This document describes the basic features of the DMP-1000 software and the associated video capture hardware.

4.0 Applicable Documents

[Revision History](#)

DMP-1000 User's Guide

5.0 Definition & Process Terminology

N/A

6.0 Safety

This tool generally incurs little hazard when used properly, but there are some safety concerns for the user to note.

6.1 Lens Crash

The five objective lenses are each of different length. Do not assume that because one objective lens is a safe distance away from the object under scrutiny, that any of the others will be if they are rotated into position. The objective lenses are rotated mechanically and if they make contact with the object, then either the lens or the object may be damaged. It is recommended that before changing the objective lens, the stage be lowered or moved horizontally to put a safe distance between the lenses and the object.

7.0 Statistical/Process Data

Displayed measurements are in micrometers and degrees.

8.0 Available Process, Gases, Process Notes

8.1 Microscope

Linewidth is available as a general inspection microscope.

8.2 Image Capture

Linewidth is equipped with 3 different cameras:

- 8.2.1 Sony DXC-151A video camera and an Integral Technologies Flashpoint 4XL Lite frame grabber. The camera output is NTSC and this signal is digitized by the frame grabber at 640 x 480 and a color depth of 24 bits.
- 8.2.2 2-megapixel digital camera, captured through USB using basic image capturing software. (This camera can not display a live image in the measurement software. All measurements must be done on a previously captured image.)
- 8.2.3 IR sensitive camera mounted on separate smaller microscope for inspection of post bond alignment accuracy from flipchip-processed substrates. This camera also connects to the Integral Technologies Flashpoint 4XL Lite frame grabber.

8.1 Image Analysis

The DMP-1000 software performs visual inspection and dimensional measurement on images. Filters are available for image enhancement and image stacks maybe combined to make composite images.

9.0 Operating Procedure

9.1 Startup

- 9.1.1 Enable the system on the wand.
- 9.1.2 If necessary, turn on computer.
- 9.1.3 If program is not already running, Start DMP-1000 by double clicking on desktop icon or locate the program in Start Menu>Programs>DMP>DMP1000.
- 9.1.4 Make sure the camera you want to use (Sony DXC-151A or IR Camera) is selected on the video selector box. (The 2 Mega pixel camera does not need to be selected for, as it is connected through USB and not with a video connection.)
- 9.1.5 If using the Sony DXC-151A video camera or the 2 megapixel digital camera, turn on the power to the top side illuminator using the Leitz lamp controller.
- 9.1.6 If using the Sony DXC-151A video camera, turn on the power to the camera by switching on the CMA-D2 camera adaptor.
- 9.1.7 If using the IR camera and smaller microscope, turn on light source on microscope and connect the video camera's power adaptor.

9.2 Focus

- 9.2.1 Locate your structure starting with a low power objective and looking through the microscope eyepieces. The field of view is greater when viewed through the microscope as opposed to using the camera image



- 9.2.2 From the Video menu make sure that Live Image is selected or that **play** is clicked on the toolbar.
- 9.2.3 Adjust the image rotation by turning the knobs on either side of the camera.

9.3 Image Capture

9.3.1 Sony DXC-151A Video amera and IR Camera



- 9.3.1.1 Images may be captured for analysis and processing by selecting Capture from the Video Menu or clicking the **pause** icon located on the tool bar.

9.3.1.2 It is recommended that images are captured before processing them. Some filters will crash the software when the filter is applied to the live image.



9.3.1.3 To return to displaying a live image, select **Live Image** from the Video Menu or click the **play** icon on the tool bar.

9.3.2 2-Megapixel Digital Camera

9.3.2.1 To capture images for measurement from this camera go to FILE>TWAIN and select the first USB option on the list. Remember to select for 1280x1024 before capturing to use the camera to its fullest potential.

9.3.2.2 Focus image on live thumbnail view and then hit the capture button. A larger captured image will then be displayed in the measurement area.

9.3.2.3 For best image results, rotate eye pieces down so that they are horizontal. This will prohibit light from the hepas from entering the eye piece and washing out the image

9.4 Measure Menu

Note: The software displays the measured units in the upper left corner as millimeters even though the measured distances are actually in microns. This is a software limitation and should be ignored.

Before making measurements make sure you have selected the correct measurement calibration for the camera and magnification you are using.

Available Calibrations:

Sony Camera – 2x, 10x, 20x, 50x

IR Camera – IR40x

Digital Camera – USB2x, USB10x, USB20x, USB50x



9.4.1 **Distance** – Measures the distance between two points and returns the magnitude and x-y components.



9.4.2 **Circle** – Calculates the radius based on three points selected by the user on the circle's edge.



9.4.3 **Angle** – Angle is defined as the arc of two lines. You can select three point features or four point features to measure an angle. For a three-point angle, the first point feature and the second point feature are used to construct the first line, and the second point feature and the third point feature are used to construct the second line. To only use three points, click **Finish** after choosing your third point. For a four-point angle, the first point feature and the second point feature are used to construct the first line, and the third point feature and fourth point feature are used to construct the second line.



9.4.4 **Area** – Calculates the area enclosed by the selected points. A minimum of three points is required.



9.4.5 **Linewidth** – Calculates the distance between two lines. Four points are specified with the first two points on one edge and the second two points on another.

9.4.6 **Length** – Calculates the link distances between all points. At least two points are required.



9.4.7 **Measure Box** – A movable, scaleable box template that displays x and y dimensions of the box size. A quick and easy way to measure features when a report is not needed. Best for measurements made orthogonal to the image axes.



9.4.8 **Measure Template** – Moveable, scalable, rotatable, parallel lines that display the x-y components and magnitude of the distance between the lines. A quick way to measure features not orthogonal to the image axes when a report is not needed.

9.5 Miscellaneous Tools



9.5.1 **Edge Detection** – A software algorithm that determines the edge of a structure based on the gray-scale at an edge. The edge is selected in the region of the cross hairs and may have a sub pixel value. This tool is turned on and off at the toolbar allowing you to choose between selecting an edge yourself, or having the software calculate it for you. It is best used when an edge is clearly defined by highly contrasting areas. It is only used when choosing measurement point, not when using the Measurement Box or Measurement Template.

9.5.2 **Histogram** – Produces a gray scale histogram of the image. The thresholds are adjustable and the pixel count for the selected band is returned. This feature can be helpful for edge definition. **It is important that this function is only performed on captured images.**

9.5.3 **V. Profile and H. Profile** – Returns a relative vertical or horizontal cross section of the image along the crosshair axis. Calculated by the relative darkness of pixels along the measured axis. In order to use this tool the crosshairs must be turned on.

9.5.4 **Perfect Focus** – Multiple images at different focus heights are merged together by the software to create images where all depths are in focus. Good for when you want one image with the bottom and tops of trenches or MEMS devices to be in focus at the same time.

9.5.5 **Enhance Menu** -- These tools apply filters to the image to change the image quality, color, and add effects. Be sure to capture the image before applying these filters. Some effects cannot be undone once they have been applied

9.5.6 **Other** – Users have the abilities to overlay and merge saved images on top of captured or live images and/or subtract differences to compare features on different wafers, or different parts of the same wafer.

9.6 Reports & Annotations

9.6.1 **Reports** -- All performed measurements are saved and displayed below the captured image. These can be formatted and exported for use in multiple types of spreadsheets.

9.6.2 **Annotations** – Captured images can have the measurements and names of features placed directly on them. Users have the ability to add notes and drawings on the image also. These can be turned on and off with the **Show Annotation** and **Show Measurement** icons on the toolbar.

9.7 Saving Work

9.7.1 **Images** – Under File>Save Images there are three options

- 9.7.1.1 Image – Saves the raw, captured image seen by the camera.
- 9.7.1.2 Image View – Saves the imaged displayed on screen with all measurement and annotations that are visible.
- 9.7.1.3 Screen – Saves entire screen, anything that is visible on the computer monitor at that time.
- 9.7.2 **Annotations** – Under File>Save Annotations, all annotations added to image are saved separate from image to be possibly placed on other images at a later time.
Note: A directory **DATA** has been set up under the C drive for members to Temporarily save their data. You can also save your data directly onto your memory stick or floppy disk.

9.8 Shutdown

- 9.8.1 Turn off the power to the illuminator
- 9.8.2 Turn off the power to the camera.
- 9.8.3 Return the sample stage to a safe distance below the objective.
- 9.8.4 Leave the DMP-1000 software open.
- 9.8.5 Disable the system on the wand.

10.0 Troubleshooting Guidelines

10.1 Errors with the Video Driver

If the menus appear to be visually corrupted or if there is a live distorted image on the desktop, restart the DMP-1000 software to reinitialize the driver.

11.0 Figures & Schematics

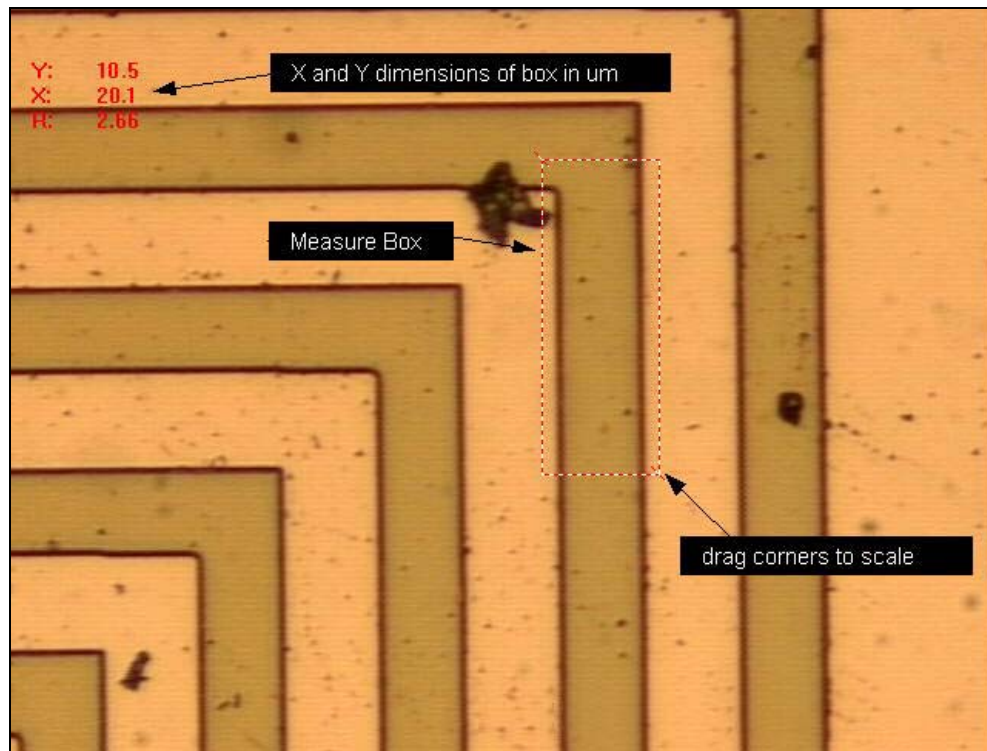


Figure 1 - Measure Box

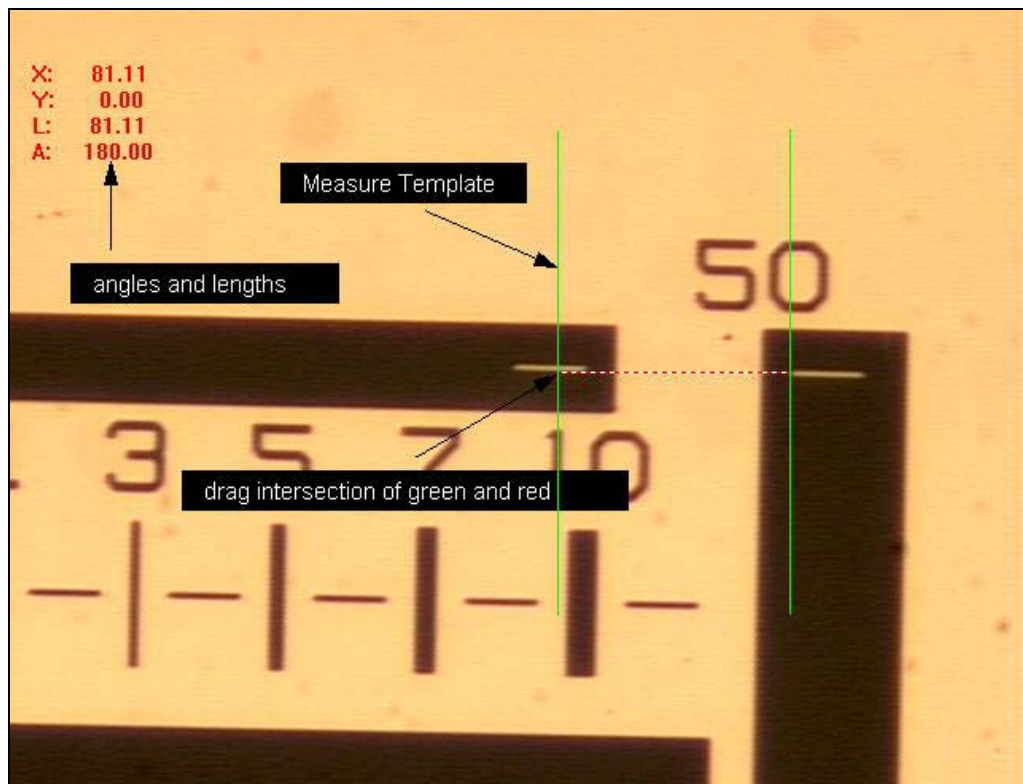


Figure 2 - Measure Template

12.0 Appendix

N/A