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Installation, Operation and Maintenance Manual

Dektak^{3}ST

SURFACE PROFILE MEASURING SYSTEM

P/N 173023
Software Version 2.13

Dektak^{3}ST and Microsoft Windows 3.1

Dektak^{3}ST operates in a graphics environment called Microsoft Windows, created by Microsoft Corporation. An extension of the MS-DOS operating system, Microsoft Windows gives a standard look and feel to Dektak^{3}ST and all other Windows applications.

The Dektak^{3}ST package contains all the software necessary to run Dektak^{3}ST. You can also run Dektak^{3}ST under the full version of Microsoft Windows version 3.1 or higher.

With Microsoft Windows 3.1, you can take advantage of these additional features of the Windows environment:

1. Running multiple applications: You can run several applications under Windows at one time and easily switch between them, creating an integrated work environment.

2. Data exchange between applications: You can transfer data between Dektak^{3}ST and other standard DOS applications, files, directories, and disks, and control all DOS related tasks such as directory or file management and formatting disks.

3. Windows control of the DOS environment: From the Windows environment you can easily access all Windows and non-Windows applications, files, directories, and disks, and control all DOS-related tasks such as directory or file management and formatting disks.

Operating the Dektak^{3}ST under Microsoft Windows 3.1 indicates acceptance of the Microsoft software license agreement.

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Unpacking And Installation

Environmental Considerations

The Dektak^{3}ST is a high precision measuring instrument capable of measuring minute physical surface variations and is very sensitive to the environment in which it is operated. Depending upon the degree of accuracy required, there are two basic modes of operation.

Normal Operating Conditions

The Dektak^{3}ST must be operated in an area free from excessive dust. Vibration levels must be low enough that they cannot be detected by fingertips. The scan head should be covered with the environmental shield to eliminate drafts.

Ambient temperatures should be between 18^{o}C and 24^{o}C (64^{o}F to 75^{o}F).

Reference Operating Conditions

The Dektak^{3}ST has internal vibration isolation. However, for very critical measurements an optional vibration isolation table, designed for use with the Dektak^{3}ST is available. The scanning mechanism is housed within a protective environmental chamber to eliminate drafts. The system must be allowed to stabilize for at least 15 minutes after it is turned on.

Ambient temperatures should be 21^{o}C $\pm$1^{o}C, and should have been held within this range continuously for 8 hours preceding operation of the unit.

For optimum instrument operation, AC line filters are recommended.

Unpacking

The Dektak^{3}ST is shipped in four containers: Four cardboard cartons containing the scan head, computer, monitor, and accessories. The contents of the shipping cartons and the unpacking instructions are provided in the following pages.

NOTE

Save all packing materials, should it be necessary to ship or return the equipment.

Accessories Carton

This carton contains the accessories for the Dektak^{3}ST surface profiler. Items packed within the carton include the operation manual, environmental shield, assembly tools, spare lamp, keyboard, mouse, power supply cover, scan head cover, cables and accessories.

Computer Carton

The computer carton contains the Pentium computer mini-tower. To remove the computer, open the top and bottom flaps of the carton and carefully lift the carton up off the computer mini-tower. Remove the foam inserts and plastic covering and set the computer right-side-up on a sturdy, level surface.

Monitor Carton

The monitor carton contains the 14" Super VGA color monitor. To remove the monitor, open the top and bottom flaps of the carton and carefully lift the carton up off the monitor. Remove the foam inserts and plastic covering and set the monitor right-side-up on a sturdy, level surface.

CAUTION

The computer and monitor are heavy. Attempts made to lift these units out of their cartons without assistance may result in personal injury and/or damage to the equipment. It is recommended that at least two people remove the computer console and monitor from their cartons.

Scan Head Carton

This carton contains the scan head unit and sample stage. The scan head has an extremely sensitive measuring mechanism and should be unpacked and handled with care.

CAUTION

The scan head is heavy (55 lb.) and attempting to lift the unit without assistance may result in personal injury and/or damage to the equipment. It is recommended that at least two people be used to remove the scan head from the carton.

To remove the scan head from the carton, set the carton right-side-up on the floor with both the top and bottom flaps of the carton open. Slide the carton up and off the packed unit. Remove the stage carton, but do not remove the stage from its carton until it is time to install the stage into the scan head. Remove the straps, the foam inserts, and the poly bag from the scan head. Lift the unit and set it right-side-up on a level, sturdy surface. Handholds are provided on either side of the base of the unit to assist in lifting the unit (See Figure1 - 1).

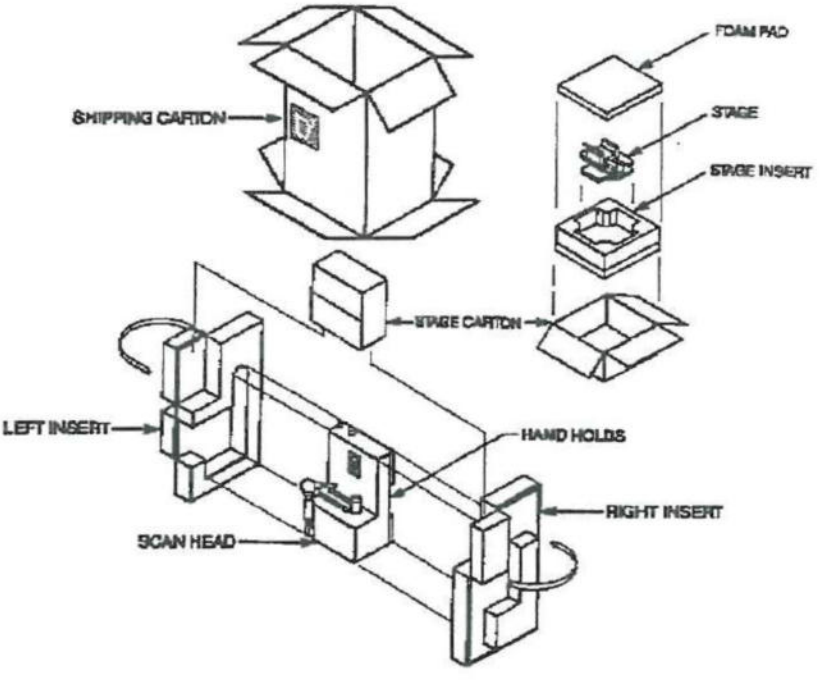


Figure1 - 1 Scan Head Carton

Scan Head Installation

Shock Mounts

The scan head base plate rests on four internal shock mounts. These are locked down during shipping to prevent damage and must be released before operation. To release the shock mounts, unscrew the four captive screws on the underside of the base of the scan head (see Figure1 - 2). This can be accomplished by partially sliding the scan head off the edge of a work bench to expose two of the screws at a time from underneath. Unscrew the captive screws until they are loose, the screws remain attached to the bottom of the scan head. Be sure to support the portion of the scan head hanging off the edge of the work bench. Do not tip or stand the scan head on end to release the captive screws.

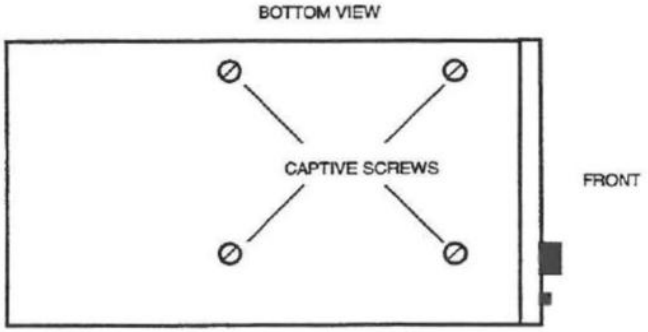


Figure1 - 2 Scan Head Base

Stylus Shipping Paper

A small white piece of paper is inserted above the stylus to limit the vertical travel of the fragile stylus assembly during shipment. To remove the stylus shipping paper, simply grab hold of the end of the paper protruding from the stylus assembly, and gently pull it out, away from the stylus.

CAUTION

The stylus shipping paper must be reinstalled prior to reshipping the unit or damage to the equipment may result.

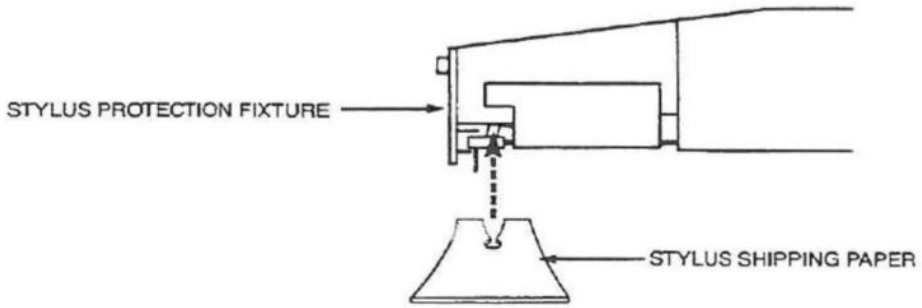


Figure1 - 3 Stylus Shipping Paper Removal

Power Supply/Scan Head Assembly

The power supply is housed within a sheet metal cover, the Dektak^{3}ST name is printed on the front of it. The power supply cover sets on top of the scan head with the power switch facing the rear of the scan head. The assembly procedure is described below.

CAUTION

The front of the power supply cover must be supported while mounting it onto the scan head.

1. Position the power supply cover on the scan head as shown in Figure1 - 4. Be sure that the two "Dzus" fasteners protruding from the base of the power supply cover drop into the two mounting holes located on the top of the scan head. The video cable and scan head power cable should feed through the channel on top of the scan head to avoid being pinched.

2. Using a conventional slotted screwdriver, insert the screwdriver into the access holes on top of the power supply cover and tighten both "Dzus" fasteners approximately one-quarter turn clock-wise to secure the power supply cover onto the scan head.

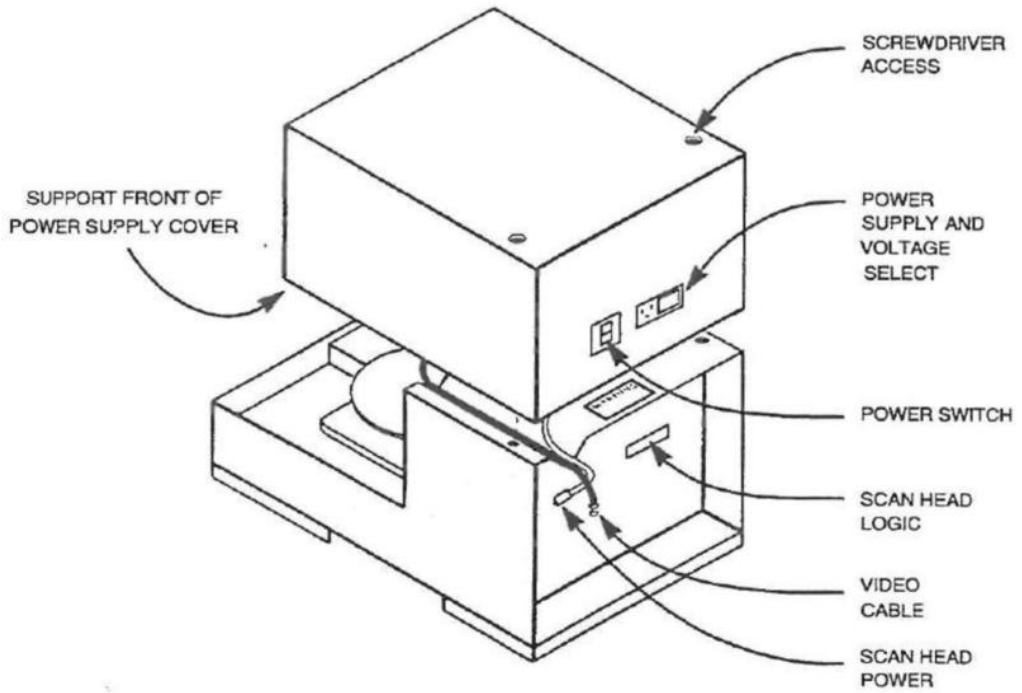


Figure1 - 4 Power Supply Cover/Scan Head Assembly

Power Supply/Voltage Setting

The power supply has been factory set at the appropriate voltage for the original user facility. If the unit is transferred to a facility where the voltage is different, it will be necessary to change the voltage setting. The procedure to verify or change the voltage setting is as follows:

1. Verify that the power is turned off and that all power cables are disconnected from their power source.

2. To change the power supply setting on the computer, locate the voltage select switch on the back of the computer, just above the AC in connector (see Figure1 - 6). Slide the switch to the desired voltage.

3. To change the power supply setting on the scan head, locate the voltage select block on the power supply cover (see Figure1 - 4). Verify the voltage setting, written upside down, through the little window on the fuse holder. Remove the fuse holder a flat blade screw driver. Carefully lift it straight out from the casing to avoid damaging the attached fuses.

4. Remove the voltage select block. Four different voltage supply settings are available. By rotating the block on different sides, choose the desired voltage setting: 100, 120, 220, and 240 (see Figure 1 - 5). Reinsert the voltage supply block with the correct voltage setting displayed upside down. Refasten the fuse holder.

5. Connect the main power cables into a power outlets providing the selected voltage.

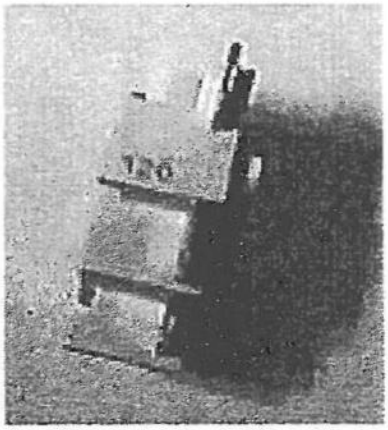


Figure 1 - 5 Main AC Power Voltage Selection

System Configuration/Cable Connections

The Dektak^{3}ST comprised of three main components: 1. The scan head with power supply cover, 2. The monitor, and 3. The computer with keyboard and mouse. These modular components can be arranged in a number of configurations to suit your needs. The monitor can be set on top of the power supply cover to reduce the overall footprint. The scan head can also be set on a vibration platform, separate from the monitor and computer, to isolate it from external vibration. Do not connect or disconnect any cables with the power on. A surge protector can be used to allow all of the components to be powered up simultaneously with the flip of the single master power switch.

Scan Head Cable Connections

The scan head requires a total of four cables. The scan head logic ribbon cable is connected to the back of the scan head and the computer. The video cable is connected to the video camera and is attached to the cable connector labeled "Video O" which is connected to the video and VGA cards on the back of the computer. The scan head power cable runs out from under the power supply cover to the back of the scan head. The power supply power cable is connected to the back of the power supply cover and plugged into an appropriate power outlet or a surge protector.

Monitor Cable Connections

The Super VGA color video monitor is usually placed on top of the Dektak^{3}ST scan head or on the counter beside the system. The adjustable monitor can be swiveled or tilted for operator comfort.

The monitor cable is connected to the monitor port on the back of the computer. The monitor power cable is plugged into a power outlet or into a surge protector.

Computer Cable Connections

Some of the Dektak^{3}ST computer cable connections are described above. The computer power cable is plugged into a power outlet or into a surge protector. The Dektak^{3}ST user interface is operated via mouse and keyboard. The mouse can be placed on any flat smooth surface, a mouse pad is recommended. The keyboard is useful for entering MS-DOS commands. The keyboard is connection is located on the front of the computer and the mouse is connected to the COM 1 port in the back of the computer (see Figure1 - 6).

NOTE

Verify that all cables are properly connected prior to plugging in the system and turning on the power switch.

Cable Connections (Continued)

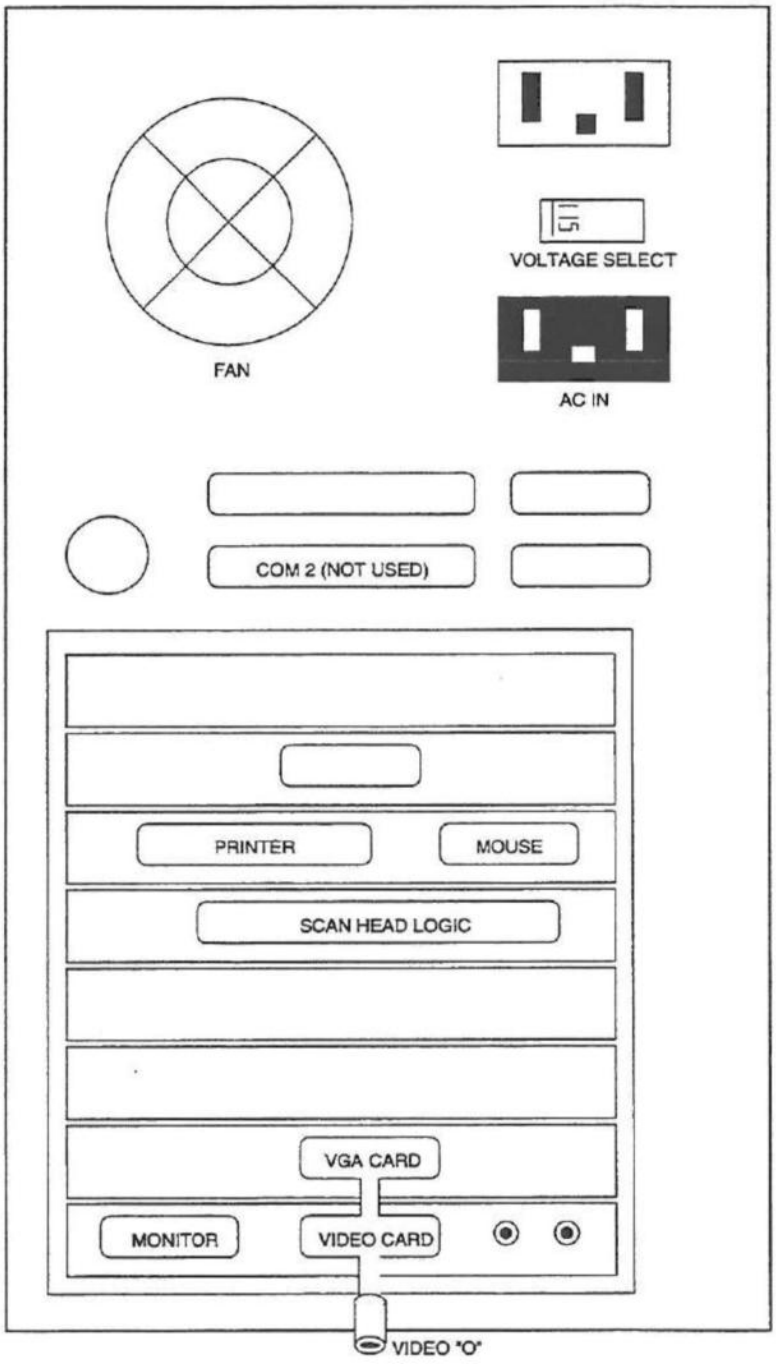


Figure1 - 6 Rear View of Computer Mini-Tower Cable Connections

Preparing Stage For Installation and Stage Cleaning

Remove the stage from the protective shipping carton. Use caution in handling the stage. The surface block and stage pads must be cleaned prior to installation with lint-free and abrasive-free tissues moistened with deionized water or lab grade alcohol.

CAUTION

Do not use other solvents, such as spectrograde acetone, which may attack the adhesives used to mount the Teflon pads. To avoid damage to the Teflon pads, do not allow them to touch any surface other than the surface block.

1. Clean the surface block (sides and top), the Teflon pads, and around the Teflon pads with moistened lint-free tissues. Always wipe new spots with a clean portion of the tissue to avoid transferring contamination to another area. The standard Dektak^{3}ST stage assembly has three Teflon pads which ride on the Scan Head surface block. The motorized stage of the Dektak^{3}ST Auto I version has five Teflon pads on the base of the stage. The left side of the stage has two spring-loaded pads which bear on the side of the surface block. Those on the right are not spring-loaded.

2. Clean the rack loading block with a clean room swab and laboratory grade alcohol. Buff the cleaned surface block and stage pads with a clean lint free cloth. The cloth should move evenly against a properly cleaned surface. DO NOT touch the Teflon pads or the surface block after cleaning; otherwise the procedure must be repeated.

3. Clean the rack and pinion gear with instrument grade "canned air." Hold the can upright and use short bursts to avoid releasing freon.

4. Closely inspect the Teflon pad surfaces. Ensure that no debris is embedded in the pads. Check to see that there is no excess adhesive from the pads adhering to any running surface. Inspect the surface block to ensure that there are no scratches or blemishes in the traverse area.

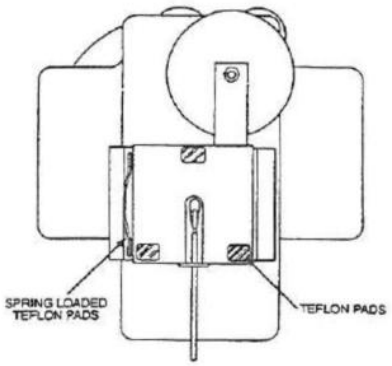


Figure1 - 7 Bottom of Standard Dektak3ST Stage Assembly

Stage Installation

The Dektak^{3}ST has a manually positioned X-Y stage and the Dektak^{3}ST AUTO I has a motorized stage. Installation of both types of stages for the two models are provided below.

CAUTION

Before removing or installing the stage the optics assembly and stylus arm must be fully raised WITH POWER ON by turning the optics height adjustment knob clockwise. Do not move the optics tower without turning on the power first! Doing so will break the optics sensor.

1. Turn power off. Remove the environmental shield. Slide the shield all the way forward until it clears the guide clips on the scan head.

2. Disengage the rack mechanism by inserting a standard 6" screwdriver through the 3/8" diameter hole on the right side of the scan head and into the slotted screw on the rack drive assembly. Turn the screw fully clockwise.

3. Hold the stage in your left hand. The bottom of the stage must be facing the top of the surface block.

4. Insert the rack into the rack loading block, taking care that the rack does not touch the surface block.

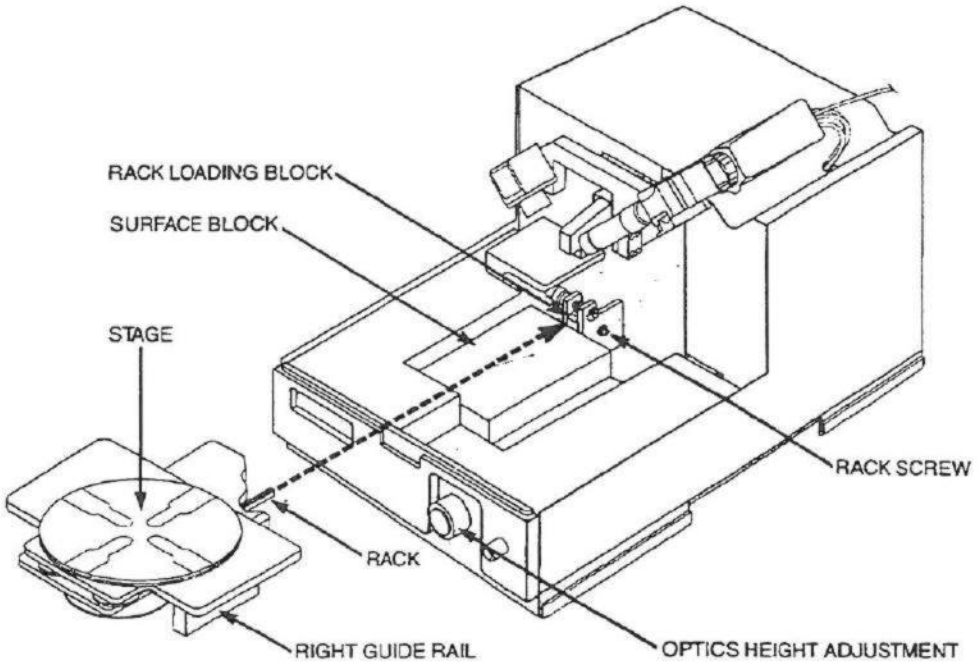


Figure1 - 8 Manual Stage Installation

5. Depress the spring-loaded pads against the side of the surface block and carefully lower the stage into the block.

6. Slide the stage all the way back. Then slide it forward all the way to verify that it is free from any binding or contact through the scan travel.

7. Engage the rack mechanism by inserting the screwdriver into slotted screw on rack drive assembly and turning it fully counterclockwise.

Additional Steps For Auto I Stage Installation

Installation of the Dektak^{3}ST AUTO I motorized sample stage requires additional steps described below.

8. After Auto I stage is installed, the gold colored shipping bracket must be removed from the front of the stage. The bracket is held in place with three (3) 4-40 socket head screws.

CAUTION

Operating the stage with the bracket in place will severely damage the unit

9. The stage cable will have to be connected to the feed through on the vertical bezel of the scan head. Remove the shorting plug from the stage cable after the stage is in position and connect it to the feed through. The shorting plug can be stored in the clamp on the scan head bezel.

CAUTION

The Dektak^{3}ST Auto I shorting plug and stage bracket must be reinstalled on the stage cable and stage prior to re-shipping the unit.

To protect the stage area, install the environmental shield using the guide clips on the scan head. Slide the shield all the way back until it fits snugly.

System Checkout

Once all of the appropriate cable connections have been completed, the Dektak^{3}ST can be powered up to verify that the system is operating properly. The Dektak^{3}ST operating software was loaded onto the hard disk at the factory prior to shipment. A surge protector can be used to allow all of the components to be powered up simultaneously with the flip of the single master power switch.

1. Verify that the power switches on the monitor, computer, and scan head power supply are all in the ON position (see Figure 1-4).

2. If using a surge protector verify that the corresponding switches on the surge protector are also turned on. Turn on the master power switch, located on the front of the surge protector.

3. The software will boot up and the Dektak^{3}ST sign on screen will be displayed on the monitor (see Figure1 - 9).

4. Roll the trackball or mouse to verify that the arrow displayed on the monitor responds to the motion of the pointing device.

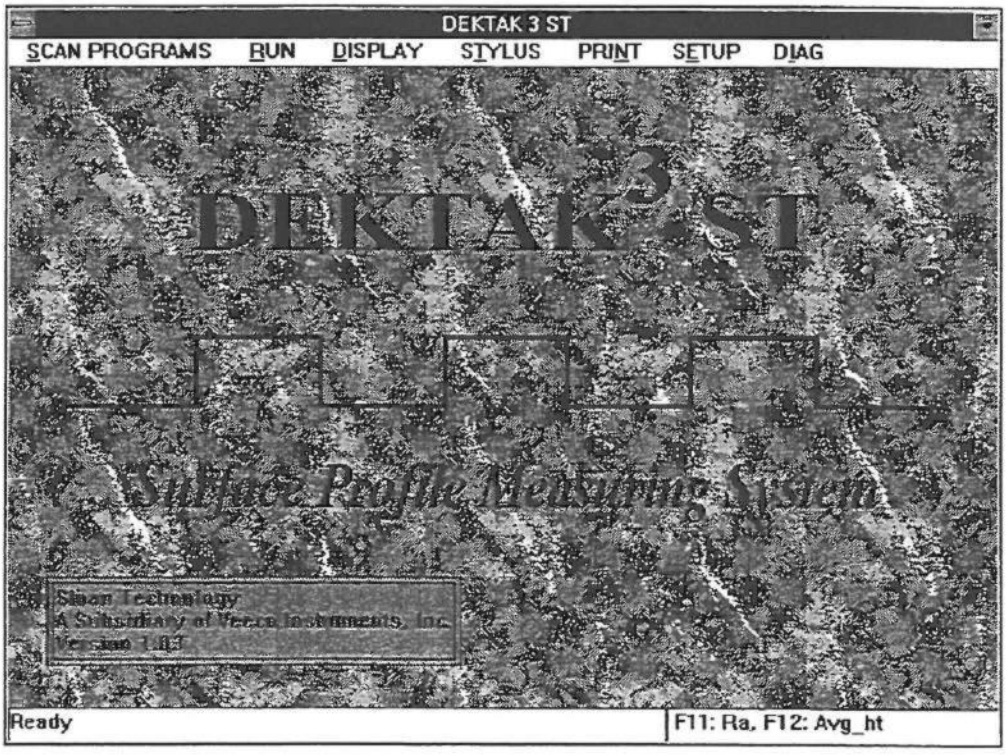


Figure1 - 9 Sign on Message

Section 2

General Information

Introduction

The Dektak^{3}ST is an advanced surface texture measuring system which accurately measures surface texture below submicro-inch and film thickness to 262 microns.

Principle of Operation

Measurements are made electromechanically by moving the sample beneath a diamond-tipped stylus. The high precision stage moves a sample beneath the stylus according to a user-programmed scan length and speed. The stylus is mechanically coupled to the core of an LVDT (Linear Variable Differential Transformer). As the stage moves the sample, the stylus rides over the sample surface. Surface variations cause the stylus to be translated vertically. Electrical signals corresponding to the stylus movement are produced as the core position of the LVDT changes respectively. An analog signal proportional to the position change is produced by the LVDT, which in turn is conditioned and converted to a digital format through a high precision, integrating analog to digital converter. The digitized signals from a single scan are stored in computer memory for display, manipulation, measurement, and print. Stored programs that can be readily changed make the Dektak^{3}ST ideal for both production and laboratory use.

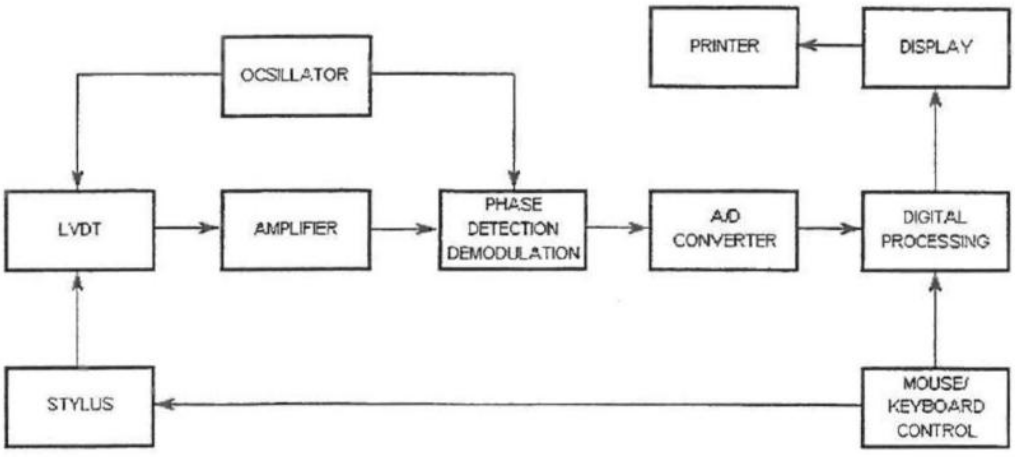


Figure 2 - 1 Block Diagram of Dektak^{3}ST Architecture

Configuration

Computer Console

The Computer Console incorporates a Pentium computer with an internal hard disk drive. It has the capacity to store multiple scans. The 3½" 1.4 MB and 5¼" 1.2 MB high density floppy diskette drives permit unlimited storage capacity. Microsoft Windows provides an easy to learn, easy to use interface with pull-down menus and pop-up windows.

Video Monitor

The Dektak^{3}ST video monitor is a 14 inch high resolution (720x480 pixels), Super VGA color monitor. It displays programs and graphics in full color, along with a color video image of the substrate surface. It can also be used to view the substrate either alone or with the graphics superimposed.

Precision Scan Head

The Dektak^{3}ST precision Scan Head unit contains the mechanical and optical components for sample placement, sample viewing, scanning/measurement and environmental protection. A 2.5 micron radius, diamond tipped stylus permits accurate measurements in a wide range of applications. User programmable stylus force from 1 to 40mg allow profiling on soft or hard surfaces.

Motorized Video Zoom Camera

A 60X to 420X Solid-State video zoom optics system and a variable intensity illuminator permits viewing of the sample in the measurement area. The Dektak^{3}ST Auto I model features motorized remote control adjustments of the video zoom magnification.

Precision Sample Stage

A very high precision sample stage performs the scan and permits X-Y positioning to any location of measurement interest over a 76mmx152mm area (3" x 6"). Theta rotation up to 360 degrees permits access to the entire surface of wafers up to six inches in diameter. Sample positioning is controlled manually on the Dektak^{3}ST. The Dektak3ST Auto I model features motorized X-Y positioning via an integral dual speed joystick.

Stylus Size Considerations

A stylus based surface profiler measures the actual physical surface of sample. In certain applications, stylus size and shape should be taken into consideration.

The radius of the standard diamond stylus is 2.5 microns. The standard stylus meets most all requirements for the majority of applications. Some applications, however, may require either a larger or smaller tip radius.

NOTE

Reducing the stylus tip radius increases the point pressure on the sample and may require the stylus force to be reset. Stylus force may be programmed from 1mg to 40mg.

Four optional styli with radii of sub-micron, 5 microns, 12.5 microns, and 25 microns are available for applications which require very high horizontal resolution or measurement of very soft films.

Also available are chisel-point styli with tips of 0.25 microns x 2.5 microns, 12.5 microns x 100 microns, and 12.5 microns x 200 microns for special applications.

Scan Speed vs. Stylus Force

When using a low stylus force, the stylus may tend to lift off the surface if a large step is encountered at higher scan speeds. In applications where a light stylus force is required, it is recommended that low or medium scan speed be used at the shortest possible scan length.

Stylus Tower Descent Rate

An adjustable stylus tower descent rate gently lowers the stylus onto the sample surface. When in the "Soft Touch" mode, the tower descent speed and the stylus force are reduced to minimize stylus impact damage.

Horizontal Resolution

The horizontal resolution of the Dektak^{3}ST is determined by the scan length and scan speed. There are three default speed ranges: Low, Medium and High. Low speed provides high horizontal resolution with 8,000 data points per scan. At medium or high speed the system requires much less time to complete a scan. The scan length range is from 50 microns to 50 millimeters.

Speed	Resolution
Default Low (50 seconds)	High (8,000 data points per scan)
Default Medium (13 seconds)	Medium (4,000 data points per scan)
Default High (3 to 8 seconds)	Low (2,000 data points per scan)

The following formula may be used to determine the number of data points for any given scan length and speed.

$$\#\ \text{Data Points/Scan} = \frac{\text{Scan Length (in microns)}}{\text{Horizontal Resolution (in microns)}}$$

The horizontal resolution of the Dektak^{3}ST is directly related to the scan length and the number of data points per scan. The number of data points per scan can be adjusted either by altering the scan speed or by altering the scan length. The scan speed parameter controls the amount of time it takes to complete a scan (in seconds) and the scan resolution parameter displays the distance between data points (in microns per sample).

Scan Data Storage Requirements

Scan data can be stored on either the hard disk or on floppy diskettes. The number of data files that can be stored is dependent on the number of data points taken during the scan. It takes five bytes of storage space for each data point plotted. Therefore, a medium speed scan will require approximately 20kB of disk space.

Technical Specifications

Vertical Range:	100Å to 1,310KÅ (0.4 microinch to 2.5 mils)
Vertical Resolution:	1Å/65KÅ, 10Å/655KÅ, 20Å/1,310KÅ
Scan Length Range:	50 microns to 50mm (2 mils to 2 inches)
Scan Speed Ranges:	Low, Medium, High
Scan Time Range:	3 seconds to 50 seconds
Software Leveling:	Two-point programmable or cursor leveling
Stage Leveling:	Manual
Stylus (standard):	Diamond, 2.5 micron radius
Stylus Tracking Force:	Programmable, 10mg to 50mg (0.1 - 0.4 milliNewton)
Maximum Sample Thickness:	45mm (1.5 inches)
Sample Stage Diameter:	165mm (6.5 inches)
Sample Stage Translation: (from center)	X Axis, ±76mm (±3inches) Y Axis, -76mm, (-3 inches)
Sample Stage Rotation:	360° continuous
Maximum Sample Weight:	0.5Kg (1 lb.)
Power Requirements:	100/115/200Vac ±10%, 50-60Hz, 200Vac
Warm-up Time:	15 minutes recommended for maximum stability
Operating Temperature:	21° C, ±3°C (70° F, ±5°F)
Zoom Magnification:	60X to 420X
Camera:	Solid state monochrome video image
Sample Illumination:	Variable intensity white light; IR & UV blocked

Dimensions:

Scan Head	33cmW x 36cmD x 51cmH (13"W x 22"D x 32"H)
Computer	18cmW x 41cmD x 33cmH (7"W x 16"D x 13"H)

OPTIONS/ACCESSORIES

See Appendix A in the back of this manual for a complete list of options and accessories for the Dektak^{3}ST.

Extended Optics	Provides 70X to 400X zoom magnification of sample surface.
Vacuum Chuck	Designed to hold samples up from 100mm to 150mm in diameter. Features include on/off vacuum control switch and all necessary hardware.
Disk Mounting Hubs	Complete set includes hubs for 65mm, 95mm, and 130mm disk sizes.
Vibration Isolation Platform	Specifically designed for the Dektak^{3}ST, isolates the scan head from external vibrations while allowing the computer console to be mounted off of the isolation surface.
Calibration Standards	A broad line of calibration standards are available to calibrate the system for virtually any heights range from 200Å to 100KÅ. Standards may be ordered individually or as a set. All standards are certified traceable to the National Institute of Standards and Technology.
Omni 426 Printer	Centronics-compatible graphic thermal printer. Includes cables and thermal paper.
Styli	A variety of diamond tipped styli are available from submicron radius tip to 25 micron radius tip. Chisel point styli are also available.

Operation Overview

Multi-Scan Program

Multi-Scan Program files permit a number of Scan Routines to be programmed and stored on the hard disk. Several Scan Routines can be inserted into the Multi-Scan Program. Multi-Scan Programs can be stored for various applications in DOS file format on the hard disk or on floppy disks, giving the Dektak^{3}ST virtually unlimited program storage capability.

Scan Routine

The Dektak^{3}ST Scan Routine consists of a number individual parameters which are selected using the mouse. Parameters such as scan length and speed, leveling, and stylus force can all be determined by the user. A total of 200 Scan Routines can be entered into each Automation Program file.

Sample Positioning

The sample is placed on the sample stage and positioned for scanning using the stage translation, rotation, and leveling controls. The standard Dektak^{3}ST allows manual sample positioning. The Dektak3ST Auto I model permits remote control sample positioning via an integral joystick. Two reticules are displayed on the monitor to aid in positioning the stylus and sample. These two cross hairs are generated by the software and are superimposed over the video image of the sample surface.

Scanning

When a scan is run, the stylus is lowered onto the sample surface, and the stage moves the sample as the stylus rides over the surface features.. The video monitor allows the operator to view both the physical scanning of the sample and the plotting of the data simultaneously. At the end of the scan, the stylus automatically retracts and the system is immediately ready for the next scan. The surface features encountered by the stylus are represented as a two dimensional profile which is plotted, scaled, and displayed on the video monitor.

Profile Manipulation and Measurement

An initial profile *may* require software leveling, zero referencing and software magnification to zoom-in on an area of interest. Measurement is a continuous process and is facilitated by simple movements of the Reference and Measurement cursors.

Data Plot Display

The plotting screen displays scan data as well as various parameters from the Scan Routine such as the Scan ID#, scan length, scan speed, and resolution. Also indicated are both the vertical and horizontal distances between the cursor/trace intercepts as well as the distances from the vertical and horizontal "zero" grid lines. If any analytical functions have been chosen, the results from the calculation will also be displayed.

Analytical Functions

The Dektak^{3}ST has a wide range of analytical functions available for analysis of roughness, waviness, step height, and geometrical measurements. Up to 30 analytical functions per scan can be performed.

Boundary Magnification

Following a scan, the operator can modify boundary locations to magnify portions of the trace. These new boundary locations can be stored and recalled at any time.

Printing

When the desired profile is displayed and a permanent record is desired, a printout can be made on almost any Windows compatible printer. A printout of the entire screen image may be requested or just summary of the data only without graphics can be printed. An optional thermal printer is available for fast, full size printouts of the plotted profile and scan data.

Section 3

Optics Adjustment and sample Positioning

Section 3 Overview

This section provides a step-by-step exercise for positioning a 10KA calibration standard, on the Dektak^{3}ST sample stage. This exercise will allow the user to become familiar with the various features of the equipment relating to sample positioning. The skills acquired by performing this exercise can be applied to sample positioning in any application. Items discussed in this section include:

The calibration standard exercise is continued in Sections 4 and 5 of this manual. Section 4 describes single scan operation and Section 5 describes multiple scan operation. By completing the entire exercise, the user will become well acquainted with the basic operation of the Dektak^{3}ST.

Stage Control

The standard Dektak^{3}ST is equipped with a precision sample stage which allows manual sample positioning. The Dektak^{3}ST Auto I model features remote control X-Y sample positioning operated via an integrated joystick. Both operations are described in this section of the manual

Microsoft® Windows 3.11/Windows for Workgroups 3.11 User Interface

The Dektak^{3}ST employs Microsoft® Windows 3.11 as the operating environment. Windows is an extension of the DOS operating system which allows different tasks to be integrated to increase efficiency and ease-of-use.

Windows provides a more practical way of organizing operational tasks of the Dektak^{3}ST into pop-up windows, pull-down menus, and scroll boxes. The operator simply rolls the mouse pointing device and "clicks" on the desired command. Virtually all Window commands are duplicated on the Dektak^{3}ST enhanced keyboard allowing either full Windows control, keyboard control, or a combination of both Windows and keyboard operation.

Mouse Operation

A mouse is a pointing device which is used to choose commands. Using a trackball or mouse is as easy as pointing and clicking.

Although a mouse has multiple buttons, the Dektak^{3}ST uses the left-most button for selecting commands in most applications.

Moving the mouse across a flat surface moves the pointer (the arrow on the screen). To select a command move the tip of the pointer until it rests on the desired command and click the left-most button.

If the mouse runs out of room to move or the arrow is at the edge of the screen, lift the mouse and place it at a different location where you'll have more room. Lifting the mouse does not move the pointer.

The following definitions will be used throughout the rest of this manual:

Pointing device	Mouse.
To point	Move the tip of the pointer until it rests on what you want to point to.
To press	Hold down the left-most button.
To click	Quickly press and release the button.
To drag	Hold down the button while moving the pointing device.
To double click	Click the button twice in rapid succession.

Power On

1. Verify that the Dektak^{3}ST all power cables are connected to an external power source. An optional surge protector is recommended to guard against power surges. With the monitor, computer, and scan head connected to the optional surge protector, the entire system can be powered up with the flip of a single switch on the surge protector.

2. Verify that the monitor, computer, and scan head power supply power switches are all in the ON position (see Figure 1-4). If using the surge protector, turn on all corresponding power switches and turn on the master power switch.

3. The Dektak^{3}ST will initialize and the sign-on screen will be displayed (see Figure 3 - 1).

Figure 3 - 1 Sign on Screen

NOTE

If the Dektak^{3}ST does not power up after following the above procedure, contact Veeco Process Metrology customer service at (805) 963-4431.

Calibration Standard Positioning

1. Open the door to the environmental chamber of the Dektak^{3}ST and position the sample in the center of the stage. The calibration standard should be perpendicular with the side of the machine and oriented on the stage as shown in Figure 3 - 2.

2. Center the calibration standard directly below the stylus near the center rear of the sample stage.

3. Click on the Stylus menu. When the Stylus menu appears, click on STYLUS DOWN. The sample positioning screen will be displayed and the stylus will be lowered toward the calibration standard.

CAUTION

As the stylus tower is being lowered, verify that the calibration standard is positioned below the stylus. To stop the tower down motion, press the ABORT key on the Dektak^{3}ST keyboard.

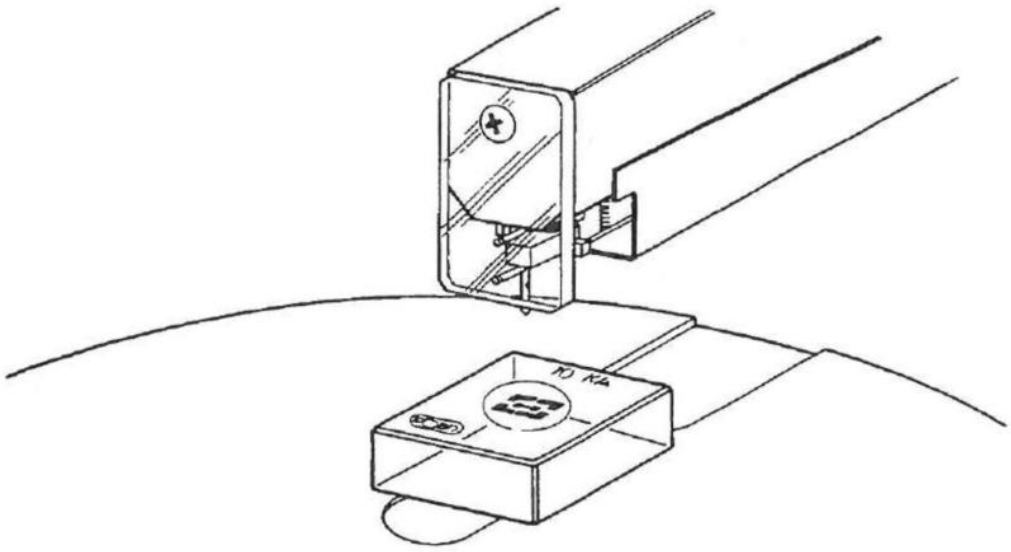


Figure 3 - 2 Calibration Standard Positioning

Sample Viewing

Because fine sample positioning relates to the video image of the sample surface, the video microscope must be properly adjusted for illumination and magnification prior to attempting fine sample positioning.

Once the stylus tower has been lowered, the video image on the monitor should display the stylus resting on the sample surface. The stylus and stylus shadow should meet at the horizontal line of the software reticule (see Figure 3- 3).

If the stylus and calibration standard are not clearly visible, some adjustment to the video image may be required. The procedure for making fine adjustments to the video image is discussed on the following pages.

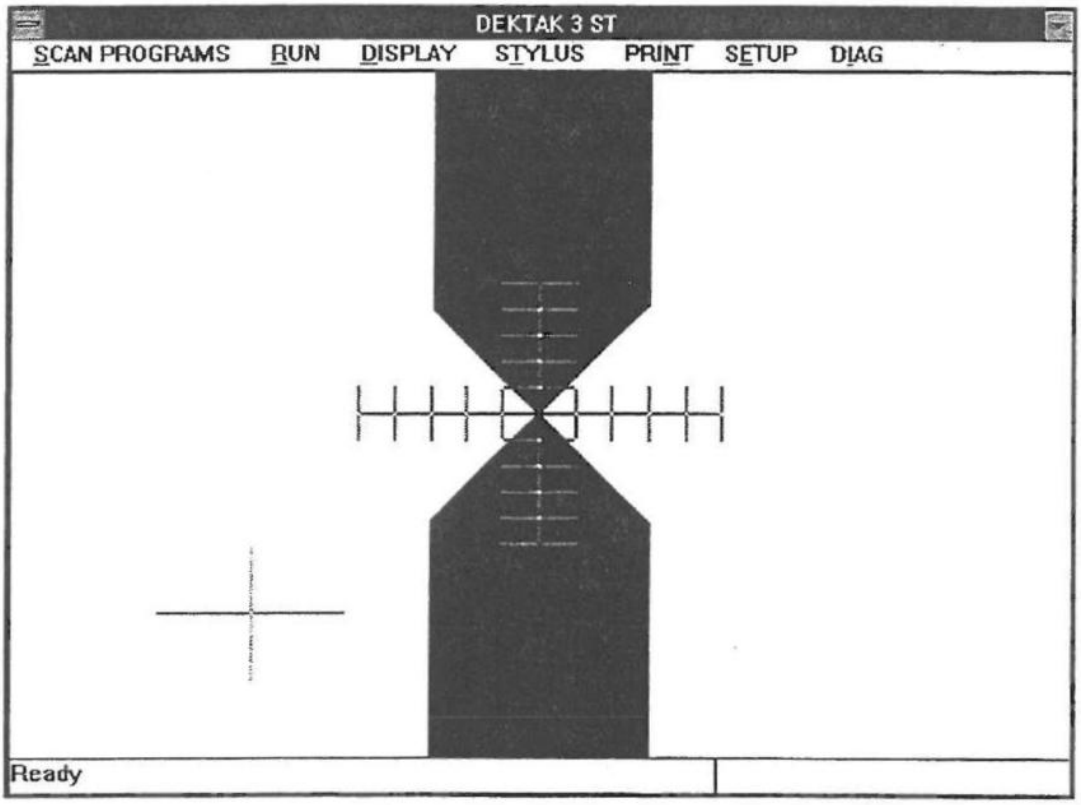


Figure 3- 3 Sample Positioning Screen

Optics Adjustments

The video image displayed on the Dektak^{3}ST monitor can be adjusted to suit various applications by adjusting the focus, illumination, and camera zoom.

Focus Adjustment

Coarse focus adjustments are accomplished by raising and lowering the optics tower using the large black optics height adjustment knob on the front of the scan head (see Figure 3 - 4). Fine focus adjustments can be accomplished by turning the optics focus adjustment on the tip of the camera lens.

Illumination Adjustment

The sample illumination is adjusted by turning the illumination intensity control knob, also located on the front of the scan head (see Figure 3-4).

Camera Zoom Adjustment

The camera zoom adjustment varies depending on the model. On the standard Dektak^{3}ST, the zoom is adjusted manually by turning the barrel of the zoom optics camera lens. On the Dektak^{3}ST Auto I model, the remote control, motorized zoom is adjusted using a push/pull action on the large black optics height adjustment knob. Push in on the knob to zoom in, pull out on the knob to zoom out.

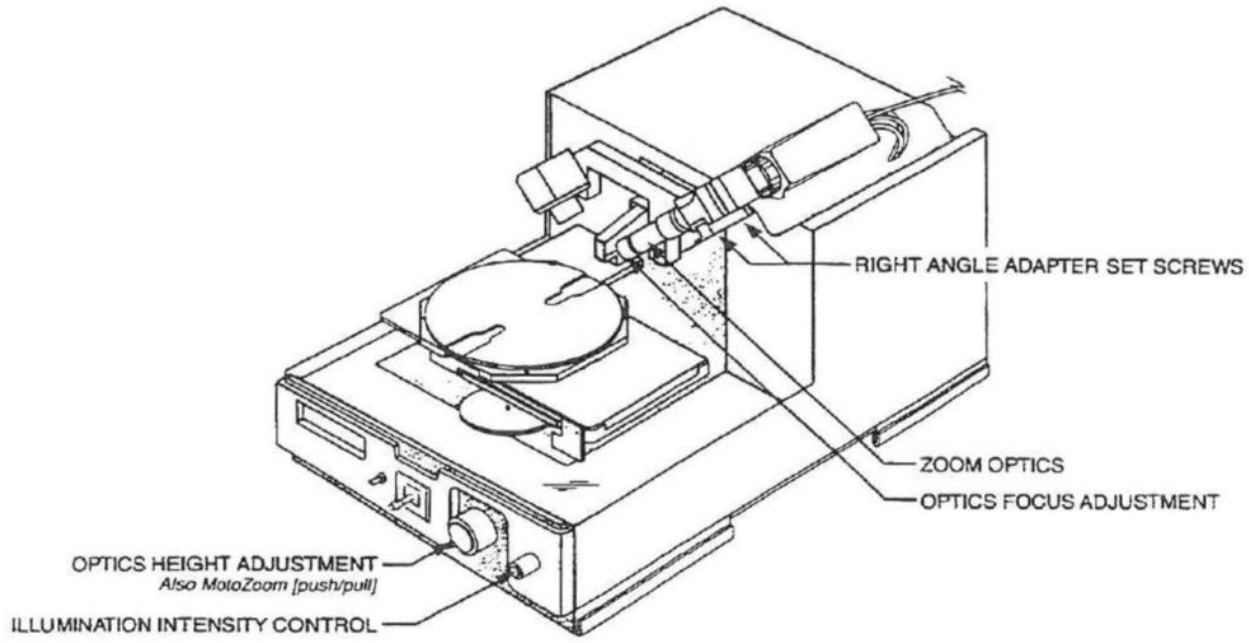


Figure 3 - 4 Optics Adjustment

Stylus Reticule Alignment

The stylus reticule can be aligned to a newly installed stylus, or to allow for tolerances in the stylus head. The stylus reticule indicates where the stylus will touch down on the surface when the stylus is lowered.

1. To align the reticule with the stylus tip click on the Set Up menu from the system menu bar. The set up menu will be displayed.

2. Click on STYLUS RETICULE and two options will appear, ALIGN and RESET. (Clicking on RESET repositions the reticule to the original default location in the center of the screen.) Click on ALIGN to manually reposition the reticule.

3. When ALIGN is selected a dialog box is displayed with instructions to ensure a substrate is located under the stylus. Click on OK to proceed.

4. A cross hair contained within a box will be displayed. Align the cross hair with the stylus tip and double-click.

5. A dialog box will be displayed, click on YES to update the stylus reticule location.

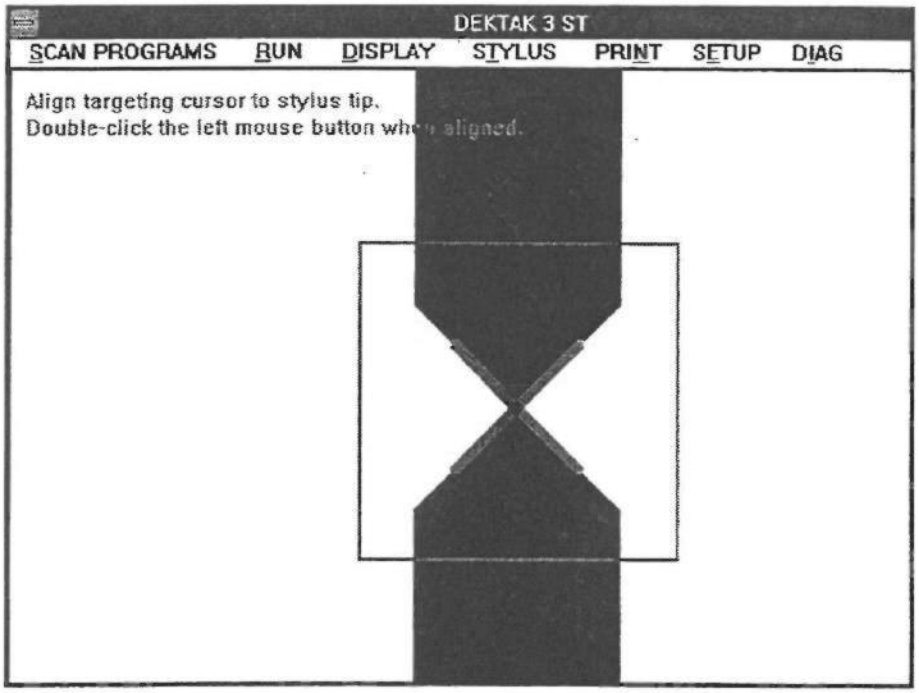


Figure 3 - 5 Stylus Reticule Alignment

Feature Reticule Alignment

The Feature Reticule is the smaller green reticule displayed on the sample positioning screen. The feature reticule can be aligned with a surface feature which is located away from the stylus, to more accurately position the stylus for a scan. The procedure for realigning the Feature Reticule is described below.

1. To reposition the Feature Reticule, roll the pointing device to the desired location on the sample positioning screen. It is best to align the Feature Reticule with an easily recognizable surface feature.

2. Once the cursor is properly aligned with the desired feature, double-click the right button on the mouse.

3. A dialog box will be displayed, click on YES to update the Feature Reticule alignment. The reticule will automatically be repositioned to the new location.

NOTE

The stylus location in relation to the reticule may change slightly when zooming the video camera in or out. In order to maintain proper stylus/reticule alignment, it is recommended that the desired zoom magnification be adjusted prior to aligning the reticule.

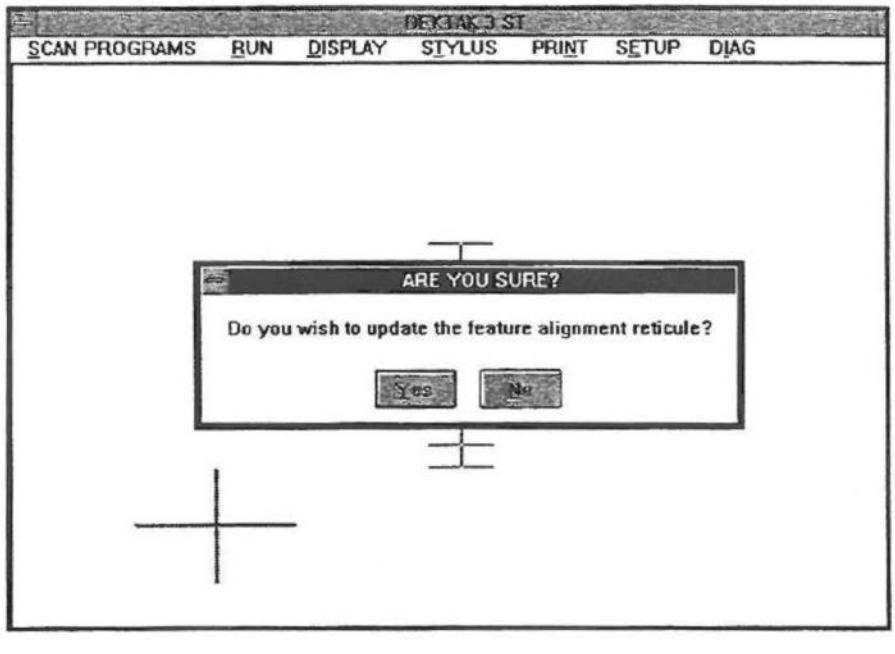


Figure 3 - 6 Feature Alignment Reticule

Lowering/Raising The Stylus

The stylus should be raised whenever repositioning the sample stage. This allows the user to view the sample with the stylus lifted off the surface. It also eliminates the possibility of damage to either the stylus or the sample during stage positioning .

1. To raise the stylus off the sample surface, roll the pointing device to the System Menu Bar and click on the Stylus menu. The STYLUS UP and STYLUS DOWN options raise and lower the stylus mechanism (see Figure 3 - 7).

2. Roll the pointing device down the stylus menu and click on STYLUS UP. The stylus menu will disappear and the stylus will be raised up off the sample surface.

NOTE

If you leave the stylus down while moving the sample and then scan, the data will go out of range before the scan is complete.

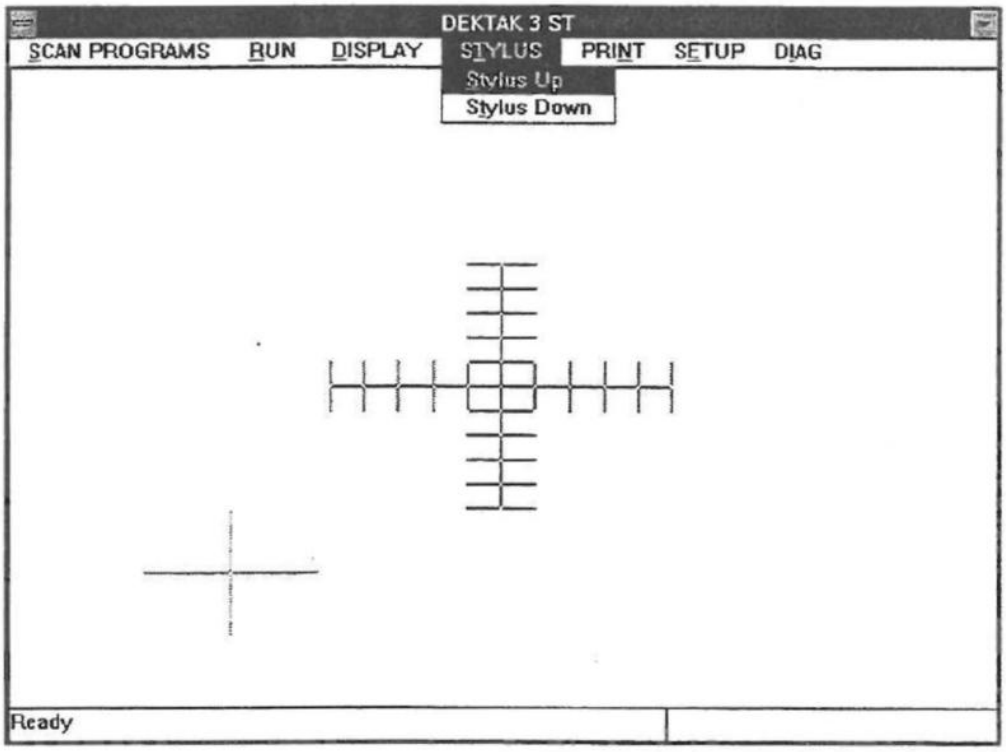


Figure 3 - 7 Stylus Up/Down Menu

Sample Stage Position Adjustments

Once the optics are properly adjusted, the stage can be fine positioned in the X-Y plane and also in the rotated (theta). Sample stage positioning is performed manually on the standard Dektak^{3}ST model and the Dektak^{3}ST Auto I model is equipped with a motorized, remote control stage.

Dektak^{3}ST - Manual Sample Positioning

On the standard Dektak^{3}ST model, sample positioning is accomplished by turning the precision thumbwheels located on the front of the sample stage (see Figure 3 - 8).

The thumbwheel on the left of the stage moves the stage along the X-axis (side-to-side) with a total translation range of six inches. The thumbwheel on the right of the stage translates the stage along the Y-axis (front-to-back) with a translation range of three inches. The stage can be manually rotated 360°. The large thumbwheel at the bottom of the stage is used to manually level the stage.

NOTE

The video camera is mounted at a 90° to the stage. When the stage is translated side-to-side the video image on the monitor will move top-to-bottom. Likewise front-to-back stage translation will be displayed as side-to-side motion on the monitor.

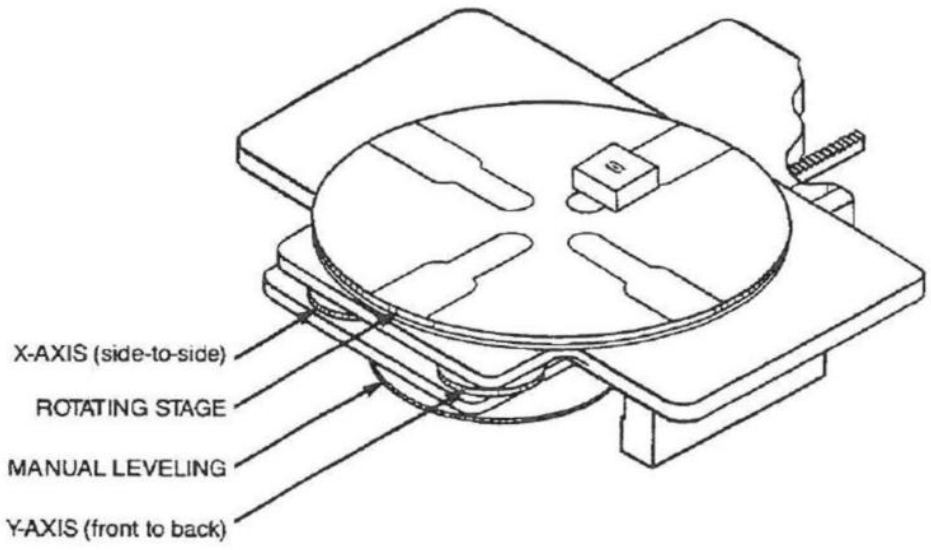


Figure 3 - 8 Dektak^{3}ST Manual Sample Stage

Dektak^{3}ST Auto I - Remote Control Sample Positioning

On the Dektak^{3}ST Auto I model, sample positioning is accomplished via the integrated, dual-speed joystick located on the front of the sample stage (see Figure 3 - 9).

The motion of the joystick corresponds to the video image of the sample surface on the monitor. Because the video camera is mounted at a 90° angle to the stage, it may be confusing to look at the actual sample stage while attempting to operate the joystick. Moving the joystick up and down moves the stage along the X-axis (side-to-side) with a total translation range of six inches. Moving the joystick side-to-side translates the stage along the Y-axis (front-to-back) with a translation range of three inches. The stage can be manually rotated 360°. The large thumbwheel at the bottom of the stage is used to manually level the stage.

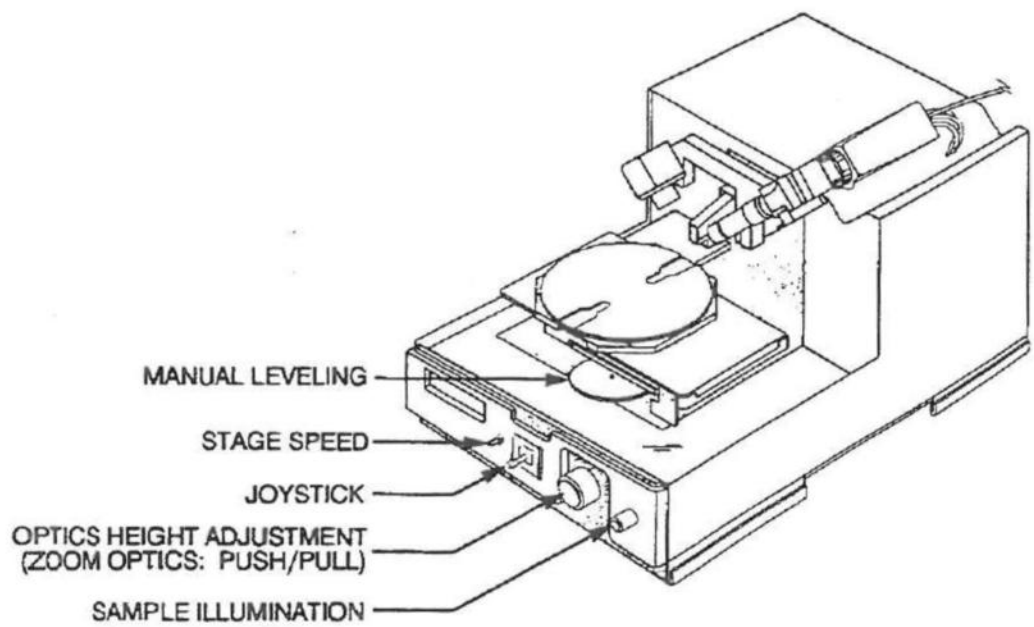


Figure 3 - 9 Dektak3ST Auto I Remote Control Sample Stage

Sample Position At The Beginning Of A Scan

For this exercise, the Veeco Process Metrology 10KA calibration standard will be used to illustrate the proper orientation of the sample in relation to the stylus reticule. The sample stage should be positioned in such a fashion as to match the video image with the image in Figure 3 - 10.

1. The sample should be positioned just to the right of the stylus. During the scan, the sample will move across the screen from right to left below the stationary stylus.

2. Lower the stylus onto the sample surface to verify that the stylus reticule is properly aligned with the reticule.

3. Make and final necessary adjustments to the camera zoom, focus, illumination, stage position, and reticule alignment.

The Dektak^{3}ST is now properly positioned to perform a scan.

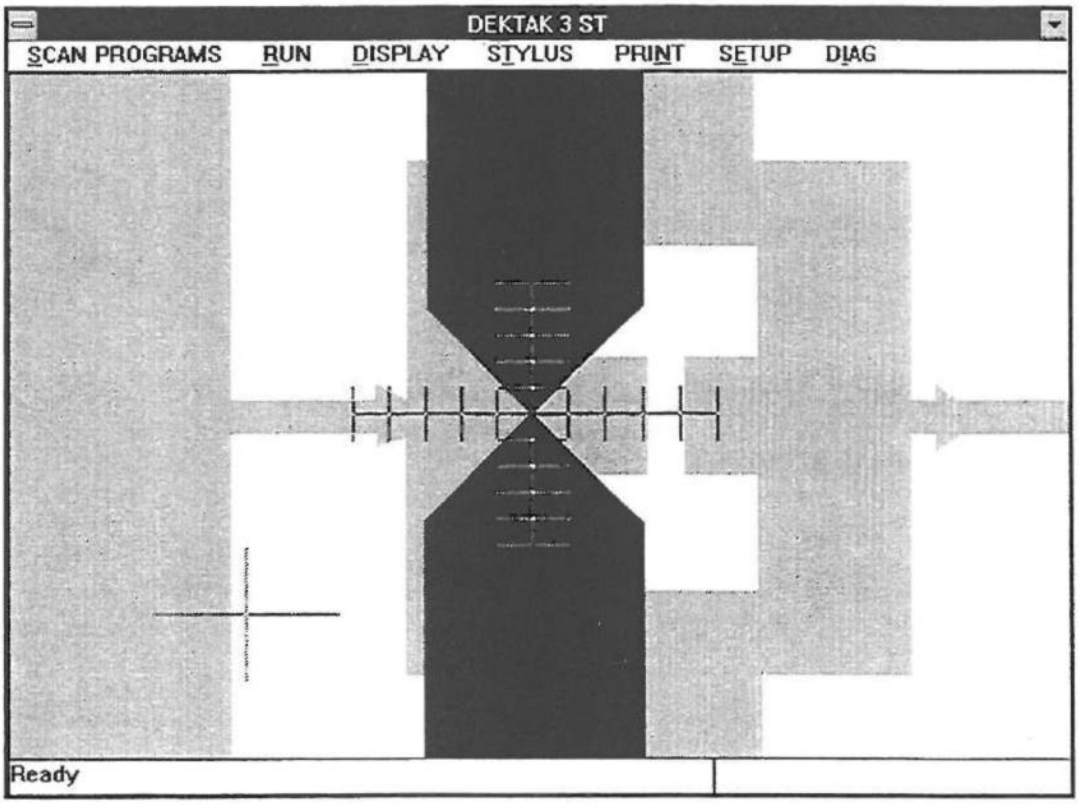


Figure 3 - 10 Proper Sample Position for a Scan

Section 4

Single Scan Operation

Section 4 Overview

This section will provide a step-by-step exercise for performing routine step height measurements on a 10KA calibration with the Dektak^{3}ST. It is a continuation of the exercise begun in Section 3 of this manual. The exercise is designed to teach the user the basic operational skills required to program and run simple scan routines. The items discussed in this section include:

The Dektak^{3}ST is operated via a mouse as well as the keyboard. The user interface screens work in conjunction with the mouse or trackball and the keyboard. The user may want to become familiar with the Dektak^{3}ST user interface by reading section three prior to attempting this exercise.

Creating a Multi-scan Program

Multi-scan programs are files which contain all the necessary information for performing single or multiple scan routine sequences. All scan routines are stored in multi-scan programs, be it a single scan operation or sequence of several scans. The procedure for creating a new automation program is described below.

1. Click-on "SCAN PROGRAMS" from the system menu bar and click-on "Multi-Scan Program" from the Scan Programs menu. The Multi-Scan Program screen will be displayed.

2. Click-on "File" from the screen specific menu bar. The file menu will be displayed (see Figure 4-1).

NOTE

Prior to creating a new multi-scan program, the current multi-scan program must be saved or it will be deleted. Instructions on how to save a multi-scan program are provided at the end of this section.

3. Click-on "New" from the file menu. The current multi-scan program will be deleted and the default scan routine will be entered.

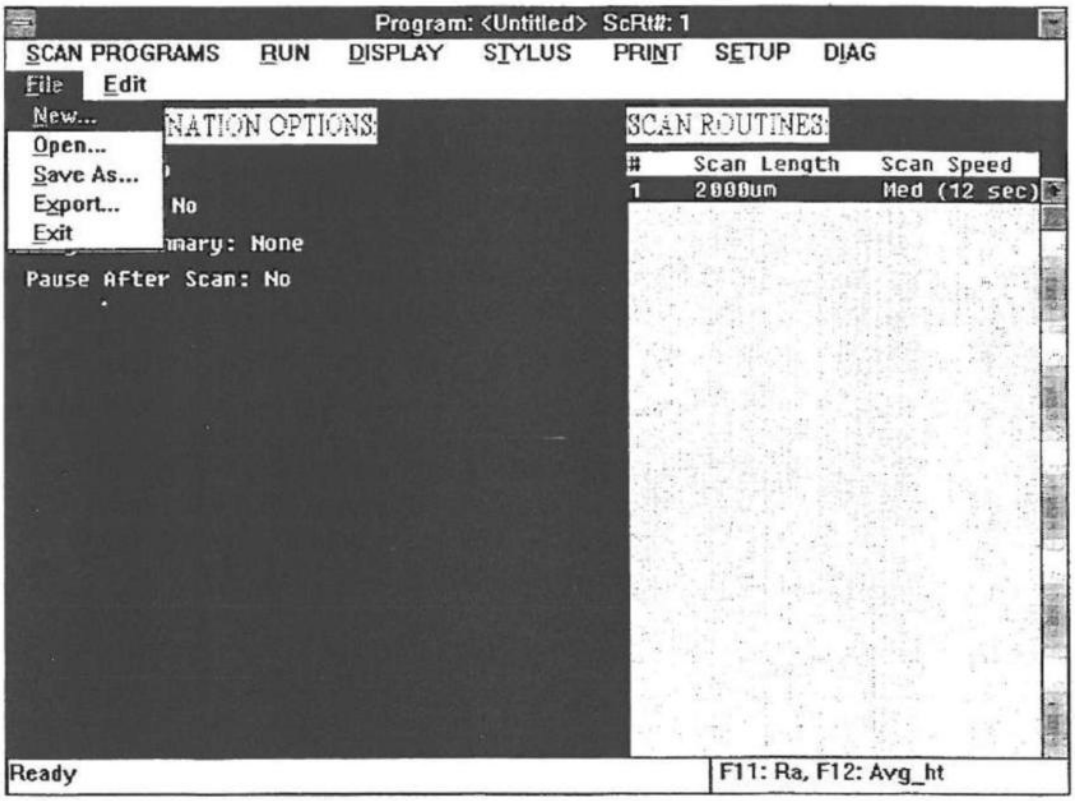


Figure 4-1. Creating A New Multi-Scan Program

Entering the Scan Length

This page describes entering the appropriate scan length for measuring the Sloan 10KA calibration standard. The scan length can be entered from the scan routine screen as described below.

1. Click-on "SCAN PROGRAMS" and click-on "Scan Routine" from the Scan Program Menu. The scan routine screen will be displayed.

2. Click-on the scan length parameter and the scan parameter window will be displayed allowing the various scan routine parameters to be altered.

3. Click-on the scan "LENGTH" box, enter a value of 1000 microns, and click-on "OK". The scan length parameter will be changed to 1000 microns.

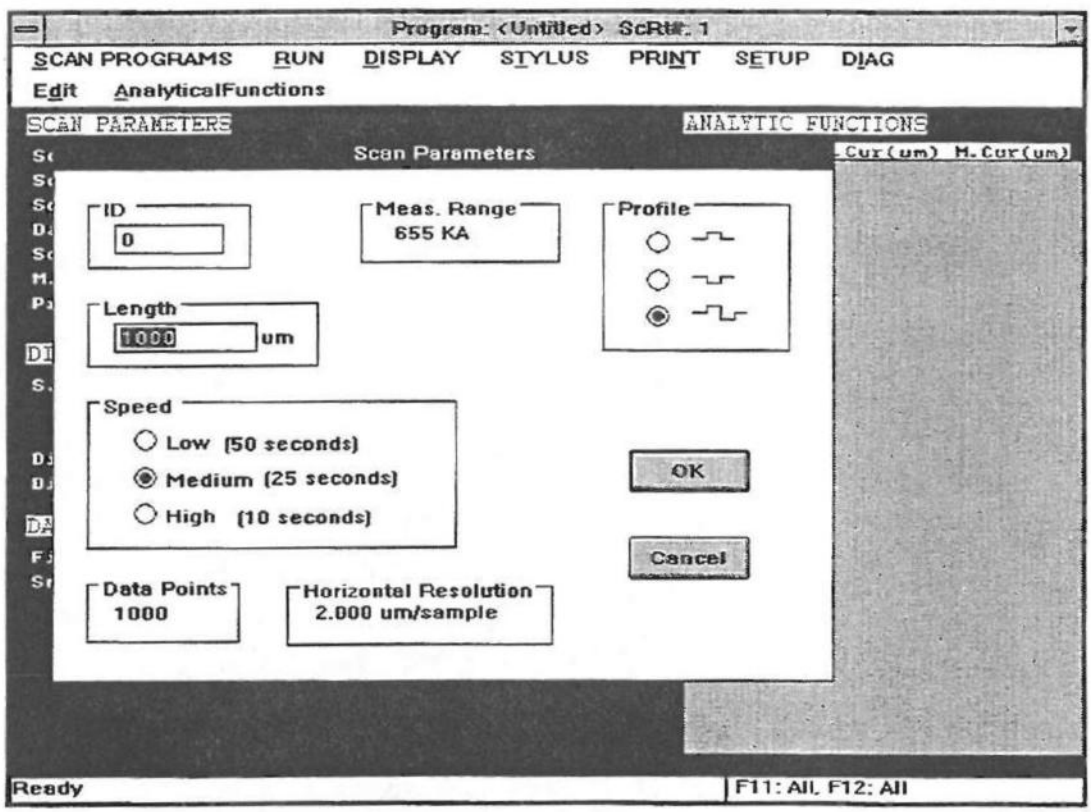


Figure 4-2. Scan Parameter Window

Running A Scan Routine

When running a scan routine, it is often beneficial to view the video image of the stylus and sample with the graphic representation of the surface profile superimposed. To accomplish this, pull-down the Display menu and click on VIDEO AND GRAPHICS.

To run a scan routine, pull-down the Run menu. The RUN SINGLE SCAN command should be used to run the current scan routine. Click on RUN SCAN ROUTINE HERE.

1. The data plot screen will be displayed with the graphic display of the scaled grid superimposed over the video image of the stylus and calibration standard.

2. The stylus will be lowered onto the surface. After a brief pause, the scan will commence. As the calibration standard moves from right to left across the screen, the initial profile trace is plotted on the scaled grid.

3. Once the scan is complete, the stylus will lift off the surface and the stage will return to the X-Y location where the scan originated. The profile is then automatically re-plotted and re-scaled. The image displayed on the monitor should resemble Figure 4 - 1.

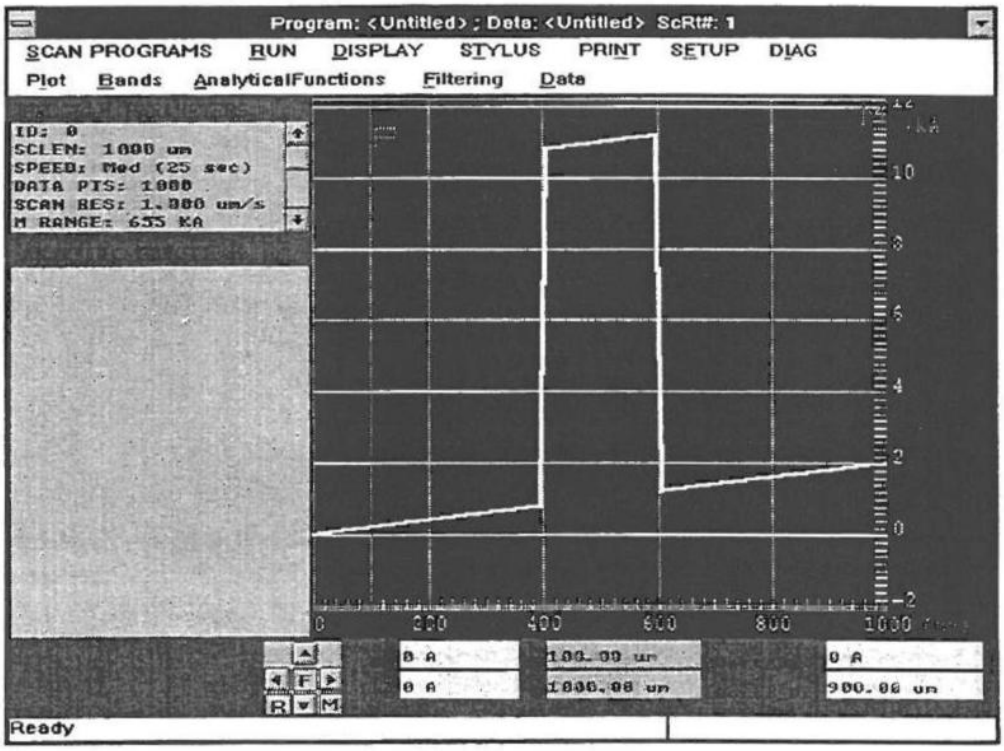


Figure 4 - 1 Calibration Standard Profile

Changing Scan Parameters

This page describes entering the appropriate scan length for measuring the Veeco Process Metrology 10KA calibration standard. The scan length can be entered from the scan routine screen as described below.

1. Click on the Scan Program Menu and choose SCAN ROUTINE. The scan routine screen will be displayed.

2. Click on the scan length parameter and the scan parameter window will be displayed allowing the various scan routine parameters to be altered.

3. Click on the Scan Length box, enter a value of 1000 microns, and click on OK. The scan length parameter will be changed to 1000 microns.

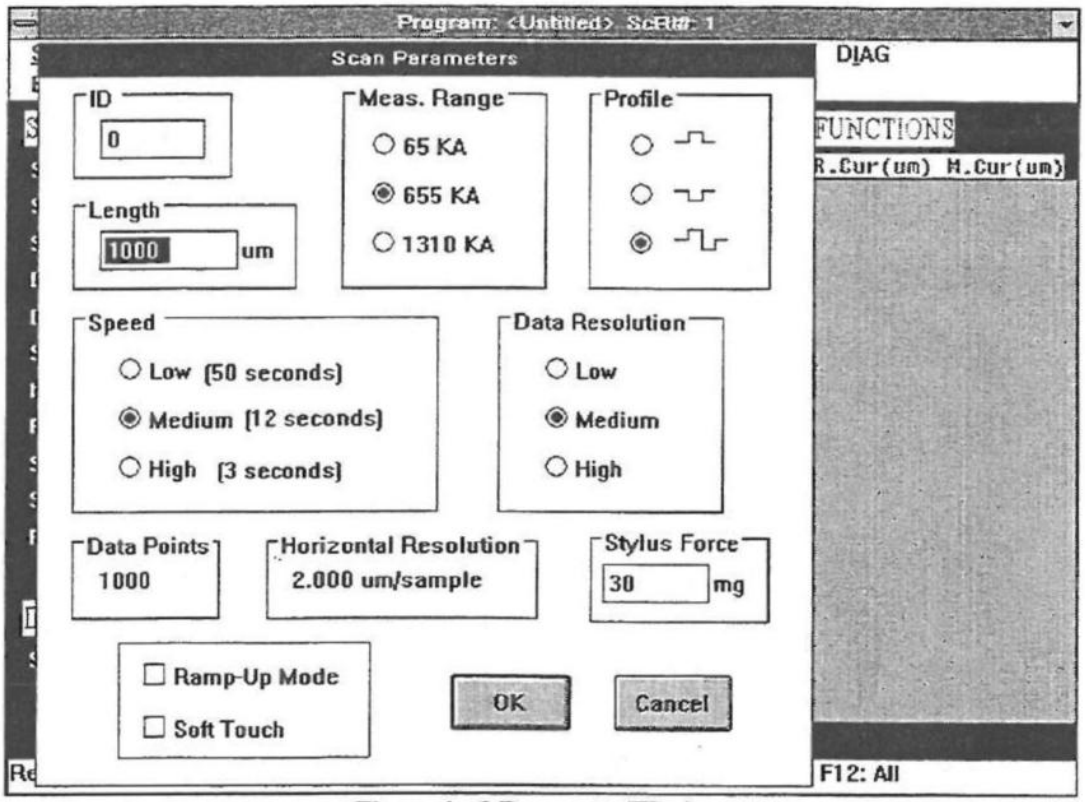


Figure 4 - 2 Parameter Window

Reference/Measurement Cursor Positioning

The reference (R) cursor and measurement (M) cursor are used to define the portion of the profile trace for leveling or performing analytical functions. Cursors can be positioned by using either the mouse method or the numeric entry method. It is recommended that the default cursor band widths be used for leveling and measuring. To activate the default cursor bands click on the Bands menu and choose DEFAULT BANDS (See Figure 4 - 3).

Mouse Cursor Positioning

Special arrow boxes are provided at the bottom of the Data Plot screen for positioning the cursors (see Figure 4 - 3). Click on the R button to reposition the reference cursor and click on the M button to reposition the measurement cursor. Cursors can be repositioned by clicking and holding the left or right arrow button. The cursor will continue to move until the button is released. Clicking-on the center button moves the cursors at high speed. The up and down buttons enlarge and reduce the cursor band widths. The yellow boxes to the right of the cursor positioning arrows indicates the location of the cursors. The top box refers to the R cursor location and the bottom box refers to the M cursor. The number contained in the box indicates the point at which the cursor intercepts the profile trace in relation to the vertical scale.

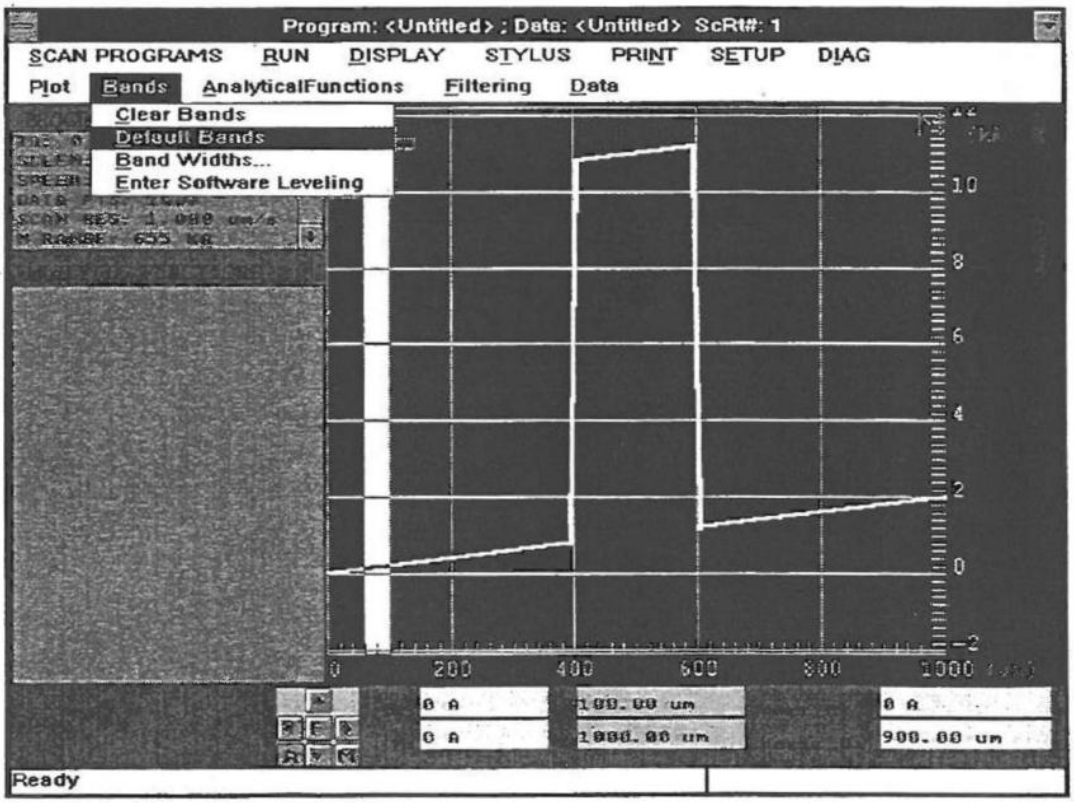


Figure 4 - 3 Setting the Default Cursor Band Widths

Cursor Positioning - Numeric Entry

The blue boxes to the right of the cursor positioning arrows display the cursor position in relation to the horizontal scale. Cursor locations can also be altered by using the Dektak^{3}ST keyboard to numerically enter new cursor positions. For this exercise the R cursor should be set at 100 microns with the M cursor at 900 microns. Keyboard cursor positioning is described below.

1. Click on the upper blue box indicating the R cursor horizontal position. A flashing prompt will appear in the box.

2. Key-in 100 on the Dektak^{3}ST keyboard and press enter. The R cursor will be repositioned at 100 microns.

3. Click on the lower blue box indicating the M cursor horizontal position. A flashing red prompt will appear in the box.

4. Key-in 900 and press enter. The M cursor will be repositioned at 900 microns.

The yellow box in the labeled Vert D: displays the vertical difference between the points at which the R and M cursors intercept the profile trace. The box below it labeled Horiz D: provides the horizontal distance between the cursors.

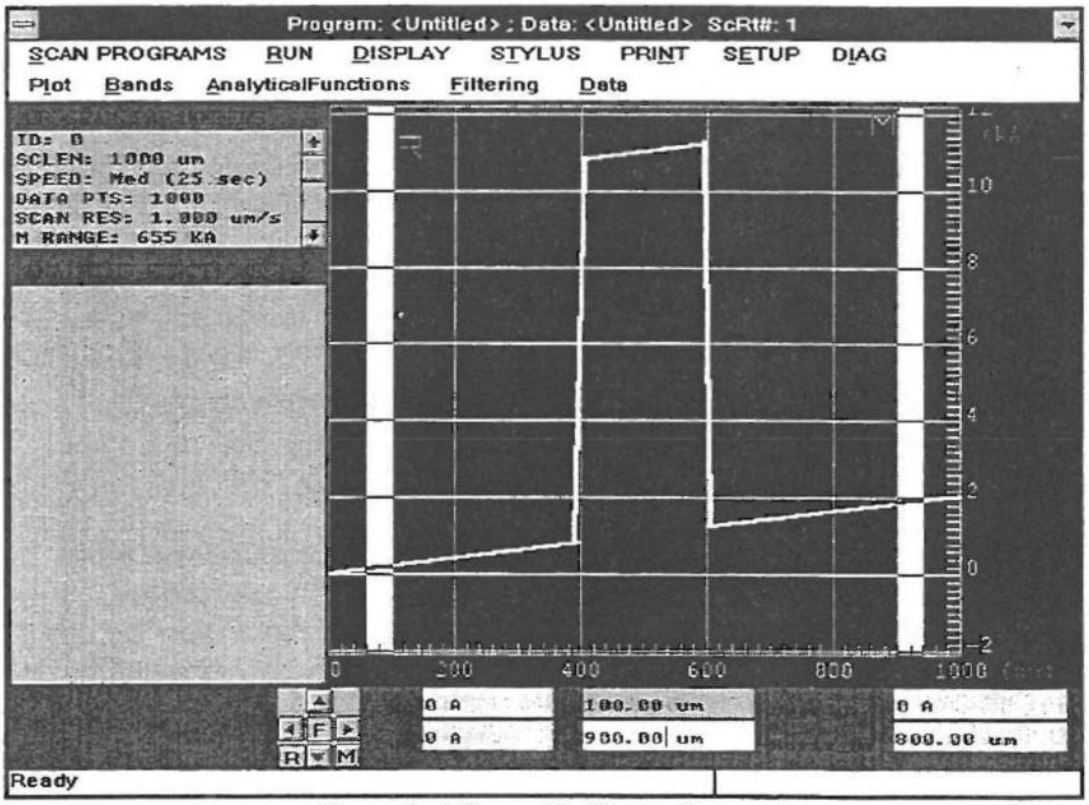


Figure 4 - 4 Cursor Positioning Entry

Stage Leveling

Manual coarse leveling is an important aspect of the Dektak^{3}ST operation. The closest possible manual leveling will ensure the best instrument performance. The manual leveling thumbwheel, located below the front of the stage (see Figure 3-7), levels the stage about a pivot axis directly centered below the stylus. This allows for sample surfaces not parallel to the reference surface block to be leveled (perpendicular to the stylus). The procedure for manually leveling the stage is describe below.

1. Stage leveling can be performed while a scan is in progress to view the affect of leveling on the profile trace in real time. To run a new scan, click on the Run menu and choose RUN SINGLE SCAN.

2. As the stage is moving and a trace is being generated on the screen, turn the leveling thumbwheel until the profile trace is tracking in a horizontal line. Clockwise rotation raises the trace and counterclockwise will lower the trace.

3. Click on RUN SINGLE SCAN again from the Run menu. The profile must appear totally within the graphic boundaries to achieve the minimum acceptable manual leveling. If not, repeat the manual leveling procedure above.

NOTE

For maximum performance of this instrument, it is very important to position the sample surface to within ±0.01° of level.

To verify that the maximum possible level has been obtained, the cursors should be placed to intersect the horizontal trace base line, similar to Figure 4 - 5.

The slope analytical function can be used to determine to what degree the stage is out of level. The slope of the trace between the cursors will be displayed in degrees. This angle indicates the amount that the trace is out of level. If the angle is greater than ±0.01° , repeat the above steps to obtain minimum possible slope/maximum possible level.

NOTE

If the trace is extremely out of level, change the measurement range to the maximum range of 1,310KA. Level the trace as described above and change to the intermediate range and repeat the procedure until leveled.

Software Leveling

Even after the stage has been manually leveled, ensuing scans may show the profile trace slightly out of level. Software leveling allows the system to quickly level the profile trace, without actually having to completely level the stage. The stage must be software leveled in order to obtain accurate step height measurements or accurate readings from analytical functions. Software leveling sets the reference and measurement cursors at zero to establish reference for measurements.

1. To software level a trace, position the R and M cursors along the baseline of the step as described on the previous page for auto leveling (see Figure 4 - 5).

2. Roll the pointing device to the screen specific menu bar and click on the PLOT menu.

3. Choose LEVEL. The profile trace will be re-plotted and leveled with the R and M cursor intercepts at zero.

Software leveling can also be programmed into the scan routine to automatically level the trace at the conclusion of the scan.

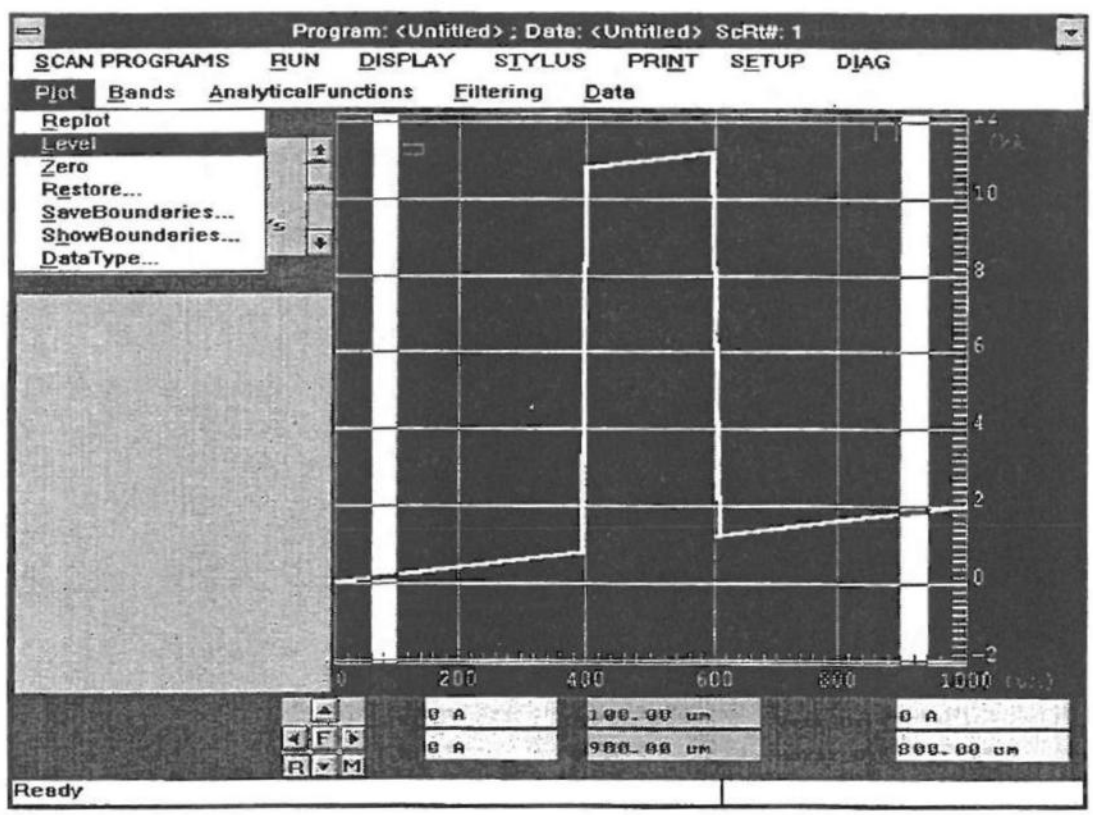


Figure 4 - 5 Cursor Positioning for Leveling

Setting the Zero Point

Any point on the profile trace may be selected as the zero point. The zero point is the point of reference from which all measurements are taken. Software leveling sets both the R and M cursor intercepts at Zero. When the Zero function is activated, it sets the zero point only at the R cursor intercept. This is important when measuring step heights with the M cursor is positioned at the top of the step. For optimum results, the zero point should be set as close to the base of the step, prior to step height measurements.

1. Position the reference or R cursor at the desired zero location, just to the left of the base of the step as shown in the figure below.

2. Click on the Plot menu.

3. Choose ZERO from the Plot menu. The profile trace will automatically be re-plotted and the zero point will be established at the R cursor intercept (see Figure 4 - 6).

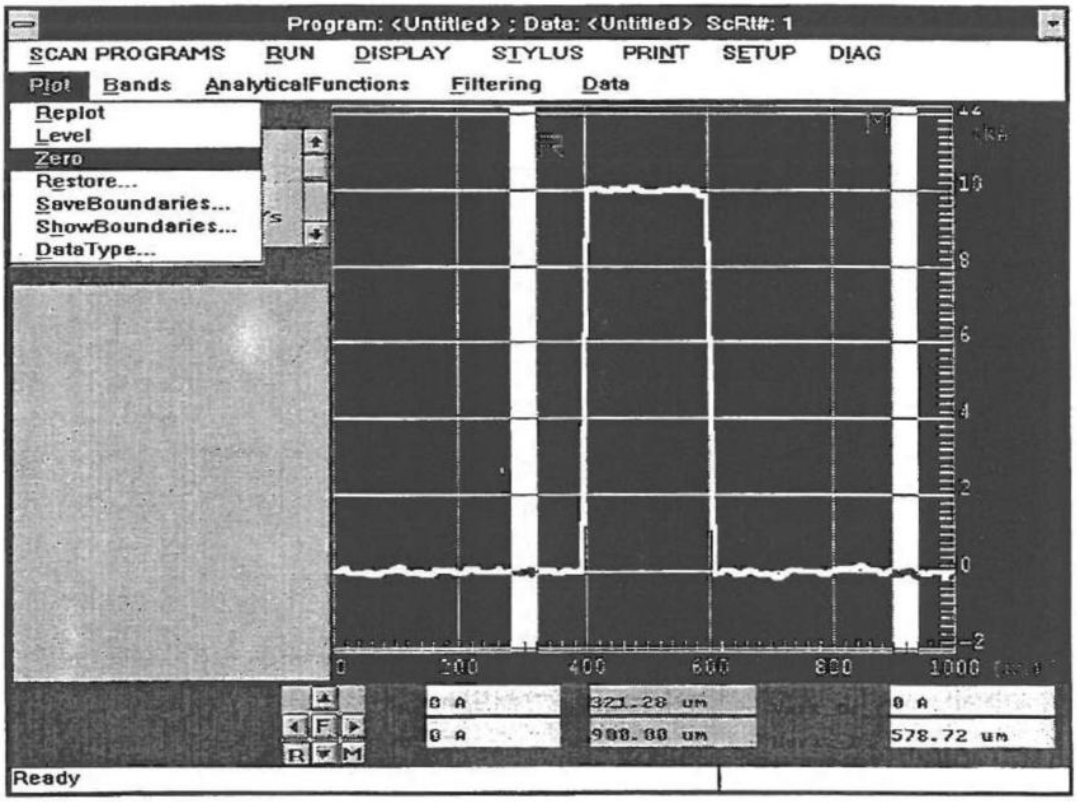


Figure 4 - 6 Setting the Zero Point

Making a Step Height Measurement

Once the scan routine has been run and the profile is properly leveled and zeroed, an accurate step height measurement of the calibration standard can be obtained.

1. Roll the pointing device down to the lower/left of the screen. Click on and hold the box containing the small left arrow for the M cursor. The M cursor will slowly move to the left.

2. Position the M cursor at the top of the step height at a point free of excess roughness or noise (see Figure 4 - 7). The R cursor should remain along the baseline at the zero point at the left of the step.

3. Once the cursors are positioned as shown in Figure 4 - 7, the value of the step height will be displayed in the lower/right of the screen in the box labeled Vert. D:. The vertical difference between the R cursor intercept and M cursor intercept is expressed in angstroms.

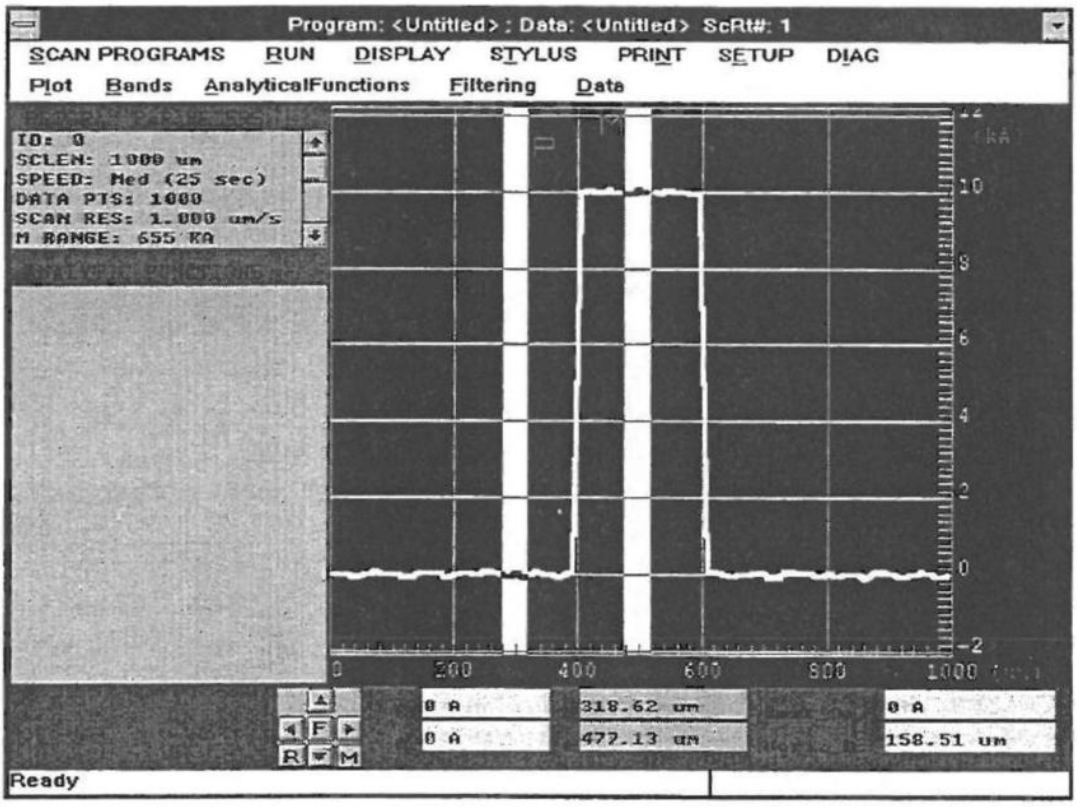


Figure 4 - 7 Step Height Measurement

Entering an Analytical Function

The Dektak3ST is equipped with many useful analytical functions. Multiple analytical functions can be performed on a single scan. For the purpose of this exercise, the Delta average step height analytical function will be demonstrated.

1. To calculate the Delta average step height function, click on Analytical Functions from the menu bar and click on COMPUTE.(see Figure 4 - 8).

2. Analytical functions are calculated using the R and M cursors. The cursor positions shown in Figure 4 - 7 are correct for the Delta average step height calculation, with the R cursor at the base of the step and the M cursor at the top of the step. To activate the Delta average step height function, click on the box labeled ASH from the Height selections.

3. Click on the Measure and Program radio button located at the bottom of the Analytical Functions dialogue box to enter the ASH function into the current scan routine. Click on the Compute button and the average step height will be calculated with the result displayed in the area to the left of the data plot screen. The ASH function will also be entered into the scan routine to be automatically performed when the current scan routine is run again.

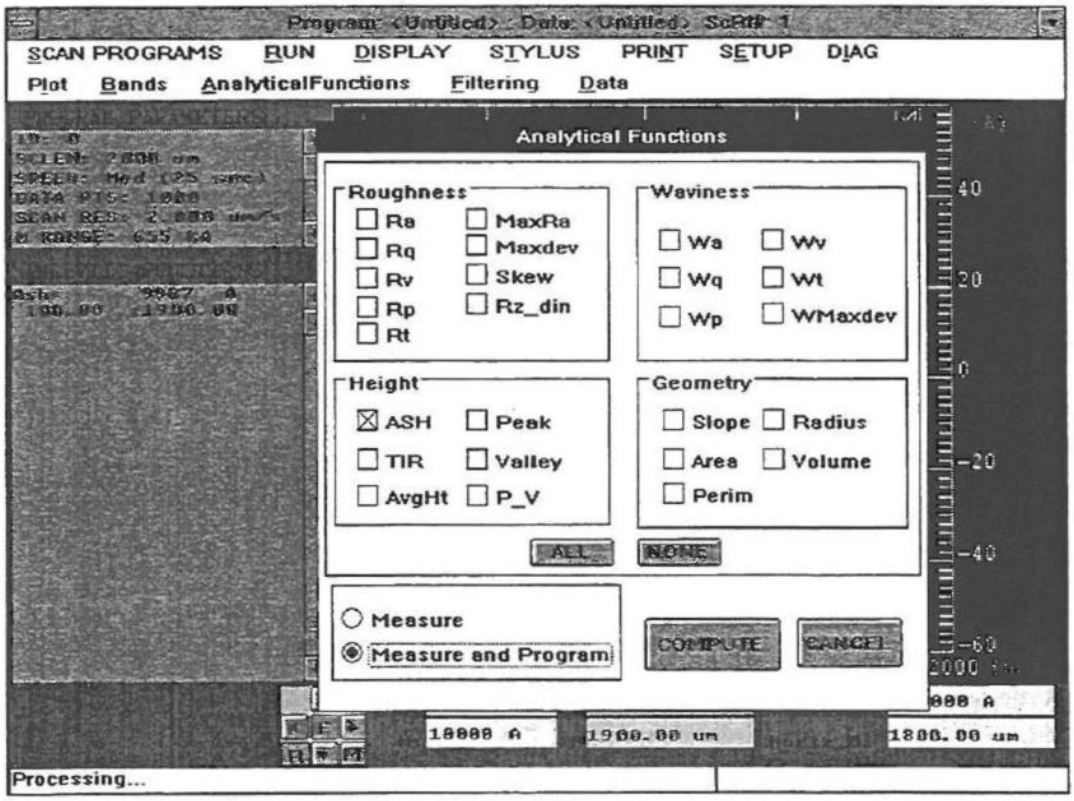


Figure 4 - 8 Analytical Functions

Plot Magnification

Once a scan has been run and the profile trace is plotted, a portion of the data plot display can be isolated and magnified for more detailed analysis of the profile trace.

1. To magnify an area of interest, roll the pointing device to the data plot grid. The location of the pointing device on the grid will be displayed as a light green cross hair. Roll the cross hair to the corner of the area of the data plot screen that is to be magnified and click on that location.

2. The green cross hair will now be displayed as a small red box. Drag the pointing device away from the first corner at a diagonal to expand the box. Once the box has turned green, it contains enough data to allow the trace to be re-plotted. When the desired boundaries are set, click on the mouse or trackball button a second time. For this exercise the boundaries should look similar to those shown in Figure 4 - 9.

3. Roll the pointing device to the menu bar and click on the Plot menu. Then choose REPLOT. The system will automatically re-plot the profile trace with the new boundaries.

4. To redisplay the original profile trace, pull-down the Plot menu once again and click on REPLOT a second time.

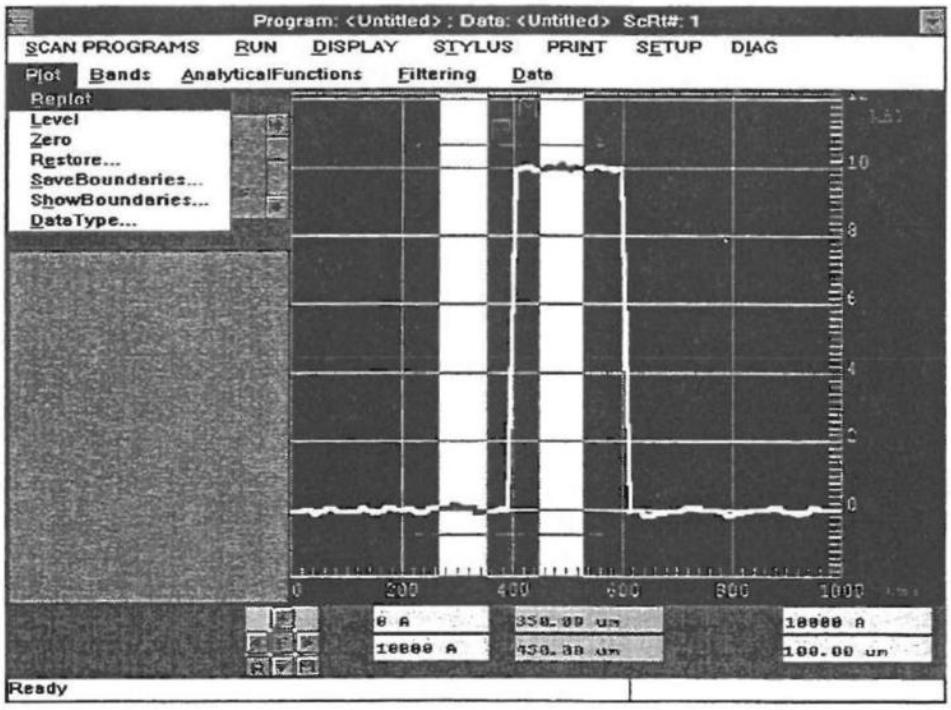


Figure 4 - 9 Plot Magnification

Saving Boundaries

To save the new set of boundaries, roll the pointing device to the screen specific menu bar and click on the Plot menu.

1. Choose SAVE BOUNDARIES. A dialog box will pop-up requesting an identification number under which to save the boundaries (see Figure 4 - 10). Any number between 1 and 9 may be used.

2. Use the numeric keypad to key-in ID number for the plot boundaries. For this exercise select Number 1. Once the number has been entered click on OK. The dialog box will disappear and the current boundaries will be saved in memory under ID number 1. If previous boundaries had already been saved under ID number 1, the new boundaries will replace the old.

3. To show the saved boundaries, click on the Plot menu and choose SHOW BOUNDARIES. All boundaries currently saved in memory will be displayed on the Data Plot Screen along with the ID number.

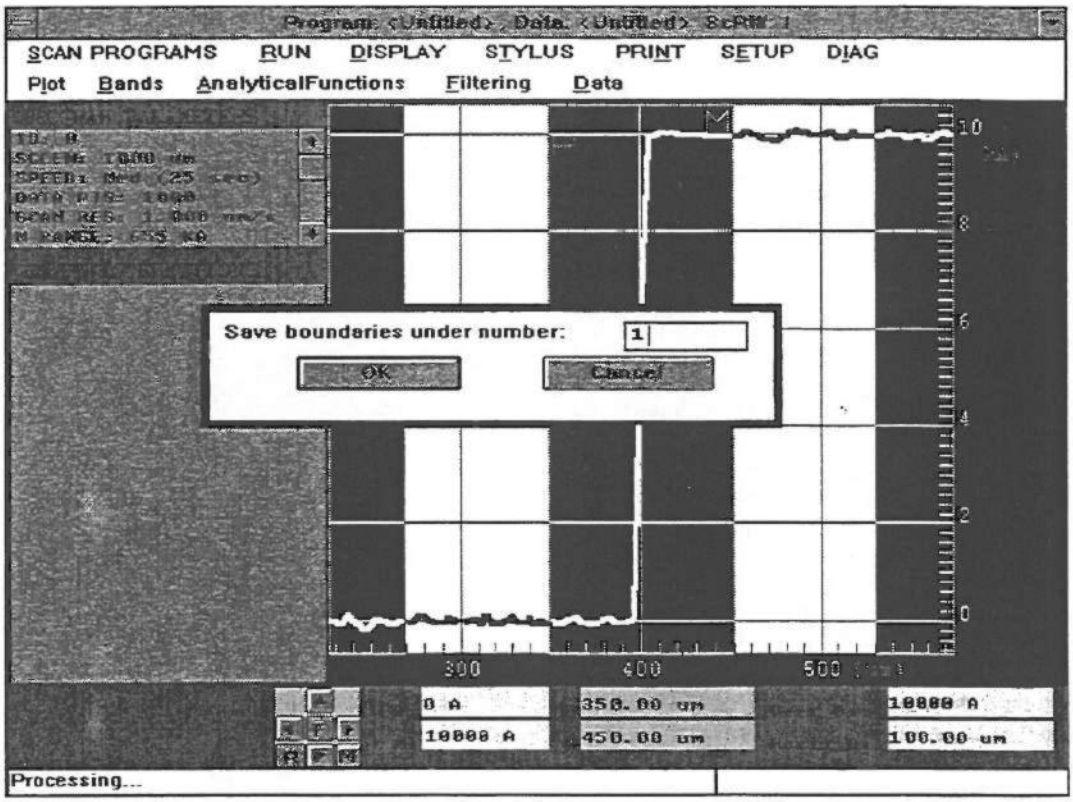


Figure 4 - 10 Saving Boundaries

Restoring Saved Boundaries

The restore function allows the profile trace displayed on the data plot screen to be re-plotted using a set of boundaries saved in memory.

1. Click on the Plot menu.

2. Click on RESTORE. A dialog box will be displayed requesting the ID number under which the desired boundaries to be restored were saved (see Figure 4 - 11).

3. Key-in the ID number "1" and click on OK. The current scan trace will then be re-plotted using the saved boundaries.

4. The original profile trace may also be restored by following the above procedure for restoring a saved boundary and entering restore boundaries under number "0". The original trace will be restored.

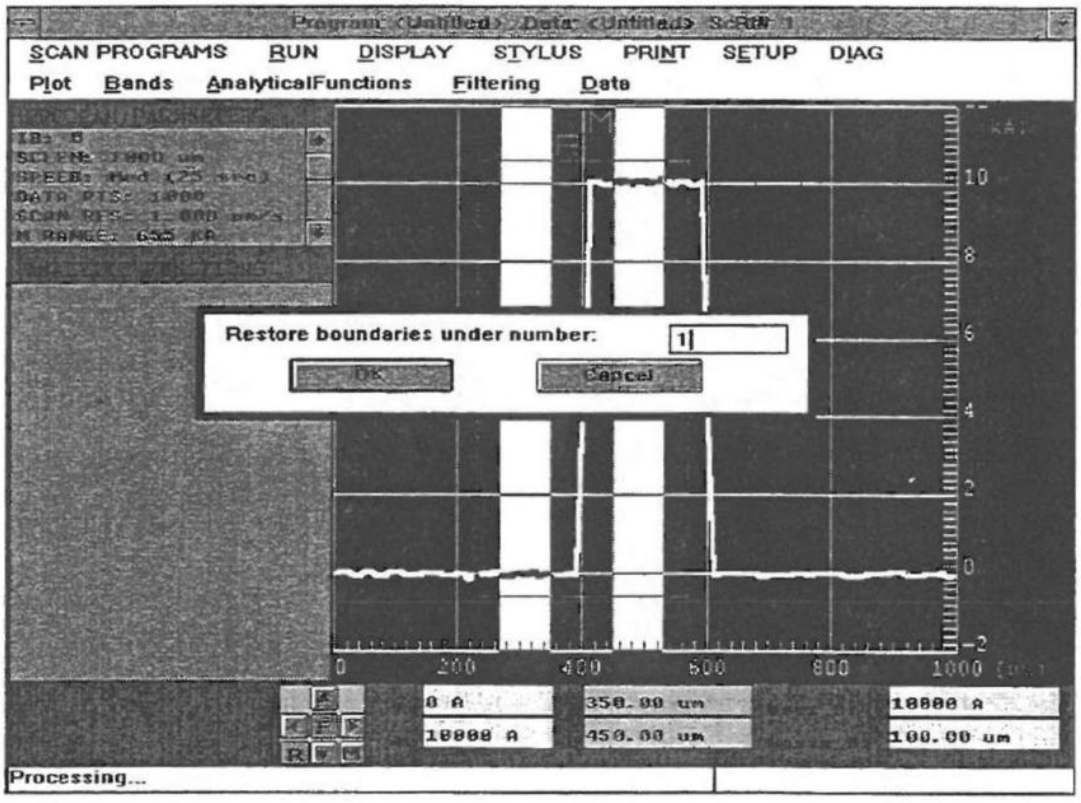


Figure 4 - 11 Restoring Saved Boundaries

Printout

A printout may be requested on the optional Dektak^{3}ST thermal printer or on most any Windows compatible raster printer. A printout can be obtained of the plotted profile with a summary of the scan data, a summary of the scan data only, the scan routine form, and the Multi-Scan form, Multi-Scan summary, or when using a Windows compatible printer the entire active screen can be printed.

For example, to request a printout of the scan plot and summary, click on the Print menu and choose PLOT AND SUMMARY (see Figure 4 - 12). A printout will be produced of the scan data and profile.

NOTE

The printer port is assigned in the SET-UP menu. Two options are provided for either the optional Dektak^{3}ST Omni 426 thermal printer or for using Windows compatible printers. The drivers for the Windows compatible printers must be installed prior to use.

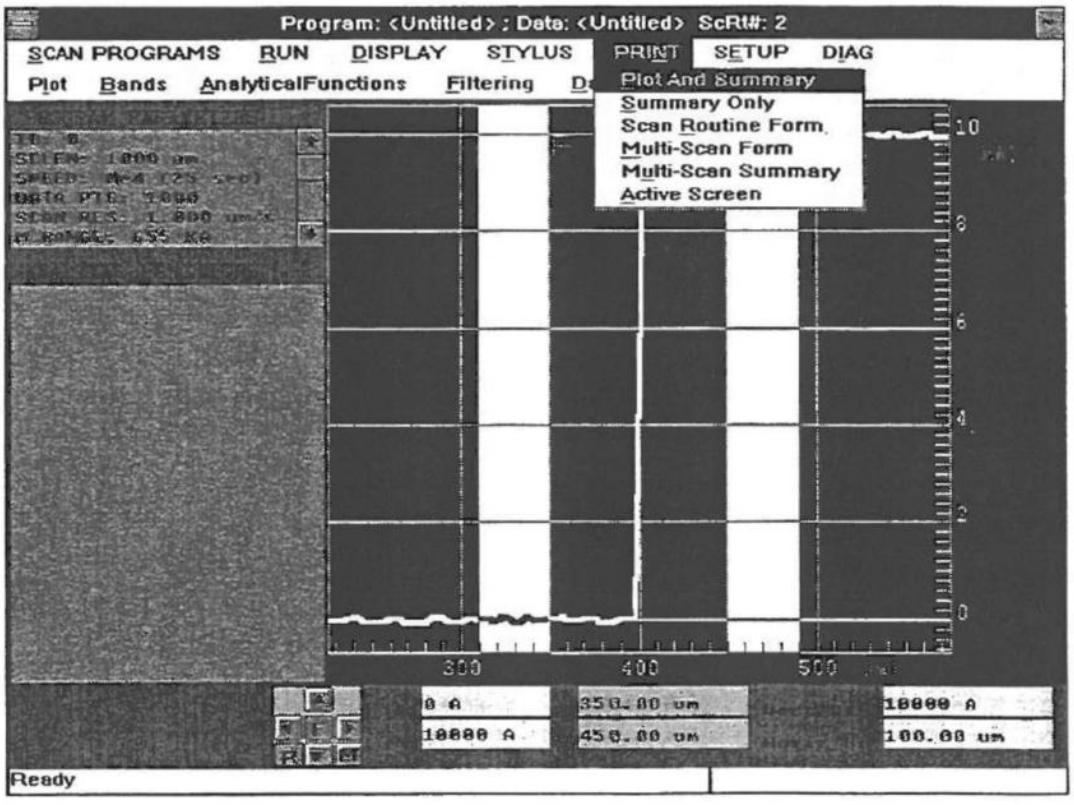


Figure 4 - 12 Print Menu

Saving A Multi-Scan Program

A multi-scan program can be stored on theDEKTAK^{3ST} hard disk or on a diskette. The multi-scan program can then be opened at a later time to be rerun or altered. For the purpose of this exercise, follow the procedure described below to save the automation program created in this section onto the hard drive.

1. Click-on "SCAN PROGRAMS" and click-on "Multi-Scan Program" from the scan programs menu. The multi-scan program screen will be displayed.

2. Click-on "File" from the multi-scan program screen menu bar. The file menu will be displayed.

3. Click-on "Save" from the File Menu. A pop-up window is displayed requesting file name under which the multi-scan program is to be saved (see Figure 4-14).

4. A filename up to eight characters long may be entered. For this exercise key-in the file name "exercise" and click-on "OK." The window will disappear and the multi-scan program is now saved on the hard disk under file name "exercise".

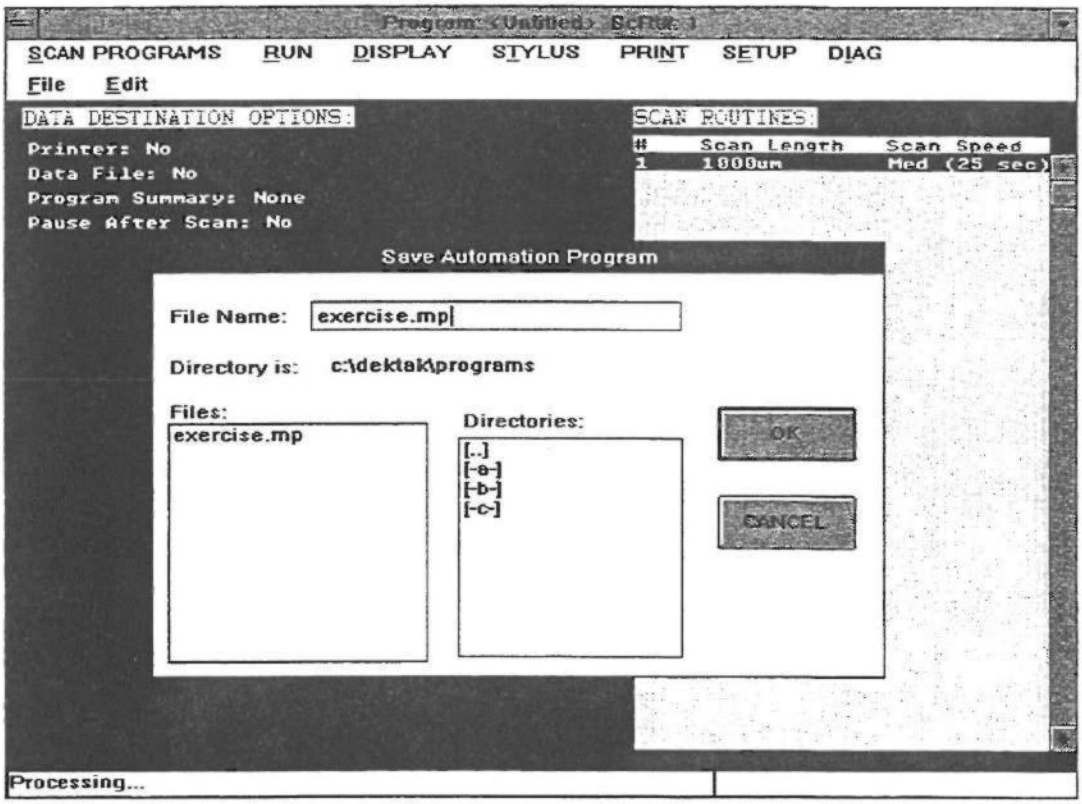


Figure 4-14. Multi-Scan Program File Name

Section 5

Multi-Scan Operation

Multi-Scan Program Exercise

This section is a continuation of the exercise from Sections 3 and 4 using the Veeco Process Metrology 10KA calibration standard. By building on the experience gained in creating and performing a single scan operation, the Dektak^{3}ST can be used to produce complex Multi-Scan sequences. Items discussed in this chapter include:

Multi-Scan Program Description

The Multi-Scan Program is the basis for all operations performed on the Dektak^{3}ST. Multi-Scan programs can be stored in DOS file format on the hard disk or on floppy diskettes, giving the Dektak^{3}ST virtually unlimited program storage capability. A basic knowledge of MS-DOS commands will be very helpful in understanding and creating Multi-Scan programs. For more information, see the Microsoft MS-DOS operating system user's guide and user's reference.

The Multi-Scan programs screen displays the current scan routine along with data destination options. This screen allows the Dektak^{3}ST to be programmed for performing Multi-Scan operations at various locations on a sample.

The Screen Specific menu bar located just above the Multi-Scan program screen contains a File menu and Edit menu. These menus are described in the following pages.

Creating a Multi-Scan Program

Multi-Scan programs are files which contain all the necessary information for performing single or multiple scan routine sequences. All scan routines are stored in Multi-Scan programs, be it a single scan operation or sequence of several scans. The procedure for creating a new automation program is described below.

NOTE

Prior to creating a new Multi-Scan program, the current Multi-Scan program must be saved or it will be deleted. Instructions on how to save a Multi-Scan program are provided on page 53.

1. Click on the Scan Programs menu from the system menu bar and choose MULTI-SCAN PROGRAM. The Multi-Scan Program screen will be displayed.

2. Click on the File menu from the screen specific menu bar. The file menu will be displayed (see Figure 5 - 1).

3. Choose NEW from the file menu. The current Multi-Scan program will be deleted and the default scan routine will be entered as Scan Routine #1.

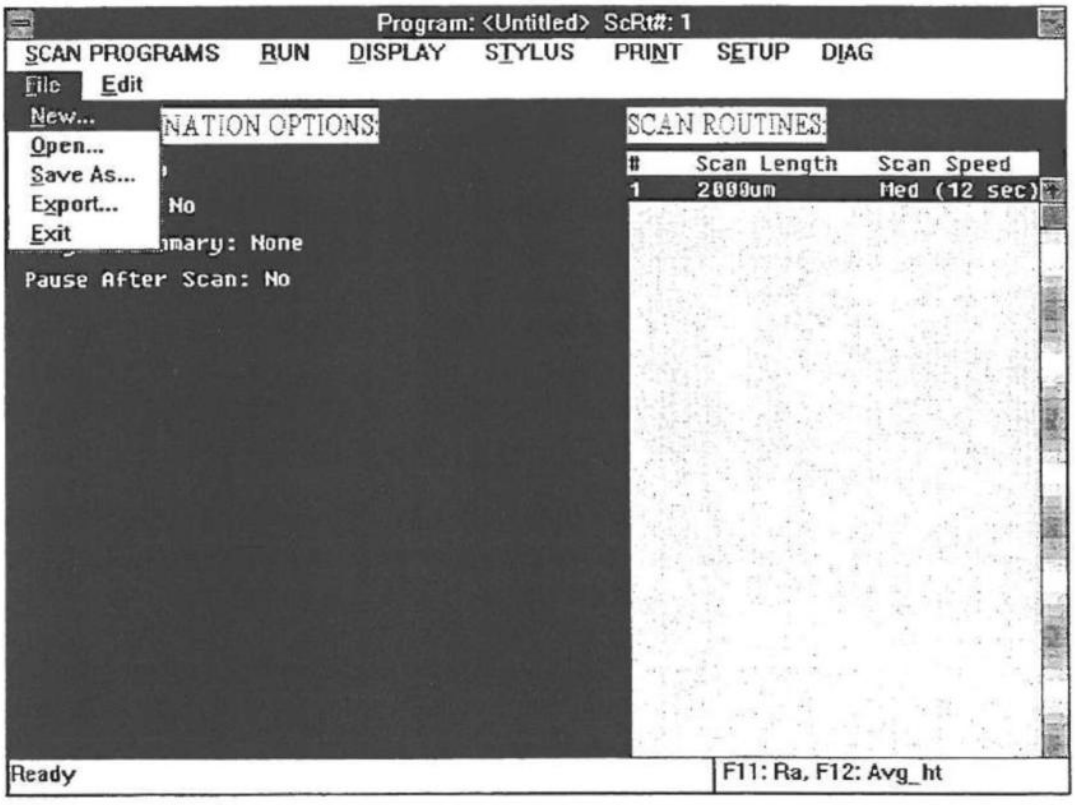


Figure 5 - 1 Creating A New Multi-Scan Program

Saving a Multi-Scan Program

A Multi-Scan program can be stored on the Dektak^{3}ST hard disk or on a diskette. The Multi-Scan program can then be opened at a later time to be rerun or altered. Follow the procedure described below to save the automation program created in this section.

1. Click on Scan Programs and click on MULTI-SCAN PROGRAM from the Scan Programs menu.

2. Click on the File menu from the Multi-Scan program screen menu bar.

3. Click on SAVE AS from the File menu. A pop-up window is displayed requesting file name under which the Multi-Scan program is to be saved (see Figure 5 - 2).

CAUTION

The File Name box defaults to drive a:/. If there is no disk in drive a or if drive c is not selected, the program will not be saved and there is no warning message.

4. A filename up to eight characters long may be entered. For this exercise key-in the file name "exercise" and click on OK. The window will disappear and the Multi-Scan program is now saved on the hard disk under file name "exercise".

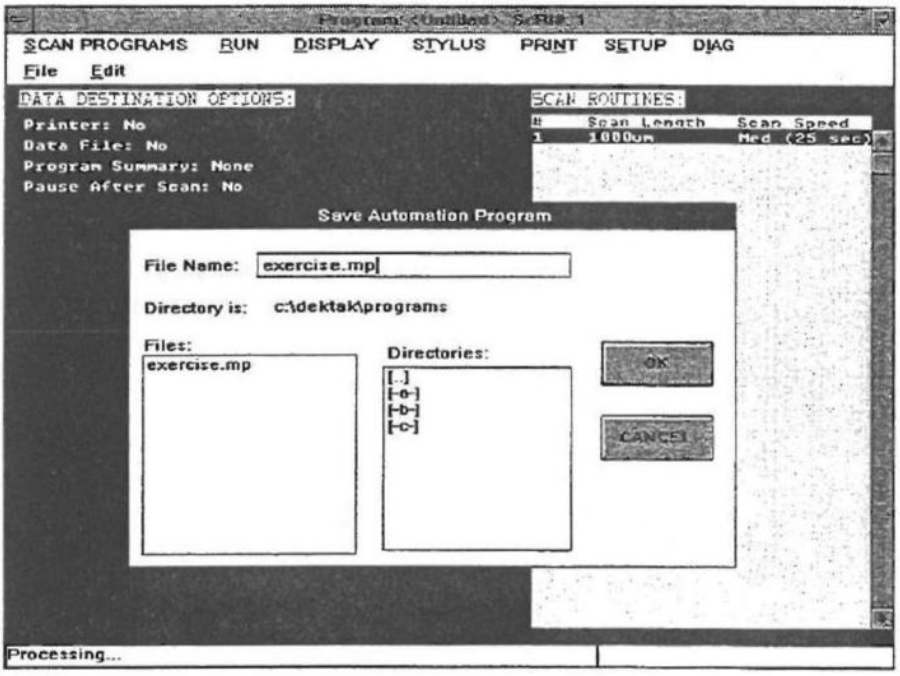


Figure 5 - 2 Multi-Scan Program File Name

Opening a Saved Multi-Scan Program

For the purpose of this exercise, the Multi-Scan program saved on page 53 will be used to demonstrate how to set up a multiple scan routine program.

1. Click on the Scan Programs menu and choose MULTI-SCAN PROGRAM. The Multi-Scan program screen will be displayed.

2. Click on the File menu and choose OPEN. A pop-up window will be displayed containing a directory listing of the saved Multi-Scan program file names (see Figure 5 - 3)

3. The directory listing should include the filename "exercise.mp" referring to the Multi- Scan program saved previously. The ".mp" following the file name is the file name extension identifying the file name as that of a Multi-Scan program. Click on the filename "exercise.mp". The file name will be highlighted and displayed in the box at the top of the window. Click on OK. The window will disappear and the "exercise" Multi-Scan program will be opened.

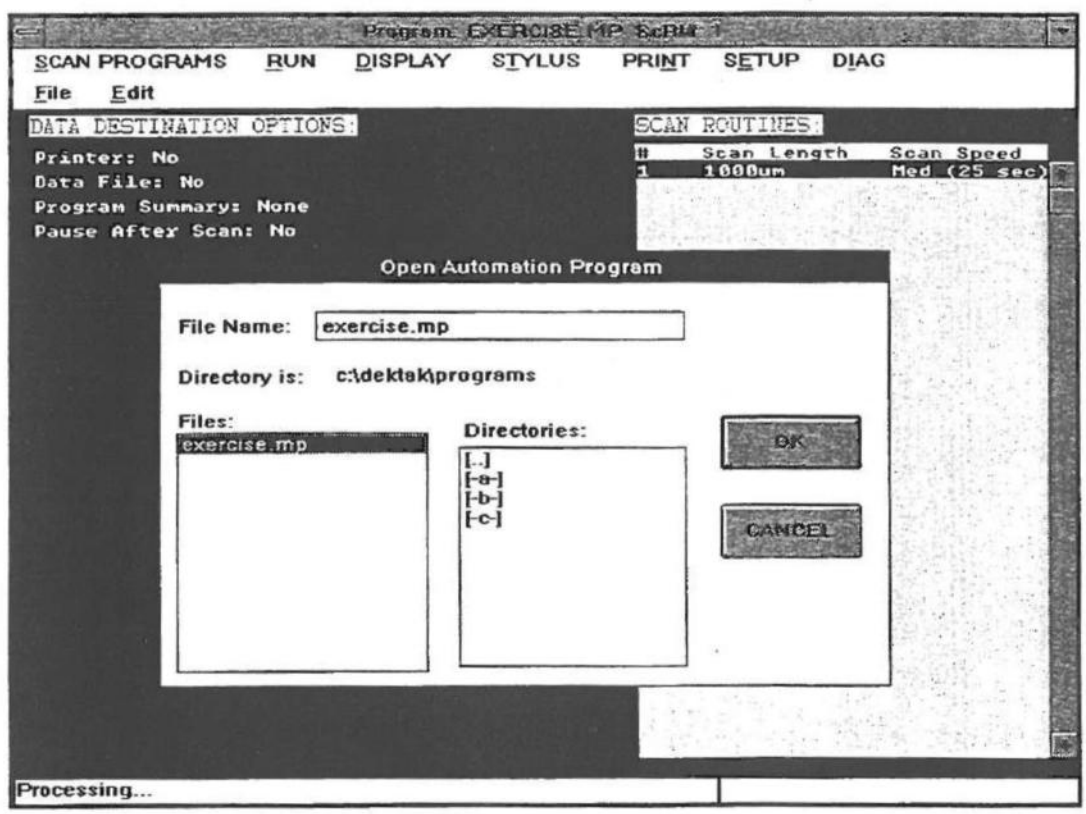


Figure 5 - 3 Multi-Scan Program Directory Listing

Copying A Multi-Scan Program

The procedure below describes how to copy the current Scan Routine to create a Multi-Scan program containing multiple scan routines. A Multi-Scan program can contain up to 200 scan routines, however, for the purpose of this exercise, a Multi-Scan program will be created containing three scan routines.

1. Click on the Edit menu from the Multi-Scan program screen menu bar and choose COPY TO RANGE.... A pop-up window will be displayed requesting the copy to range (see Figure 5 - 4)

2. A flashing cursor will appear in the box labeled COPY CURRENT SCAN ROUTINE TO SCAN ROUTINE #. Type in number "2" in the upper box.

3. Click on the box below labeled THROUGH SCAN ROUTINE #. The flashing cursor will appear in the second box. Type in number "3".

4. Click on OK. The window will disappear and the current Scan Routine 1 will be copied to Scan Routines 2 and 3 where the scan routines are listed on the right half of the Multi-Scan programs screen. Scan routine 2 is now the current scan routine.

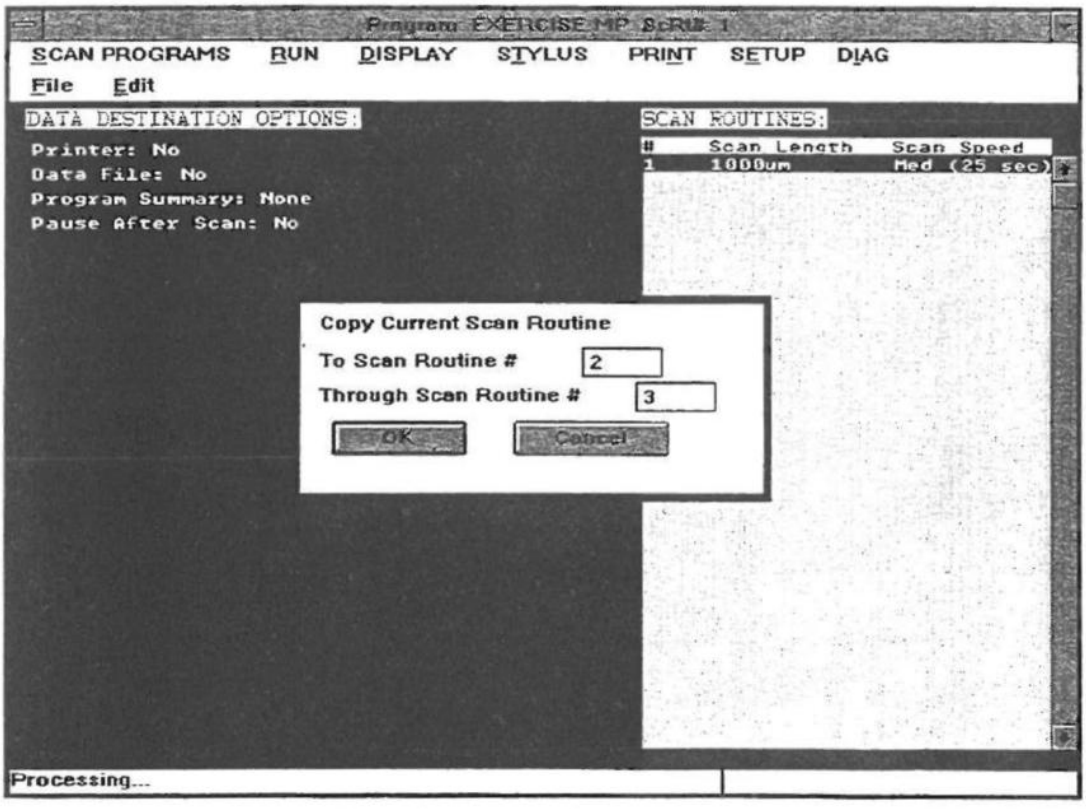


Figure 5 - 4 Copy to Range Window

Global Edit Mode

The individual scan parameters within each scan routine of a Multi-can program can be changed at any time. For the purpose of this exercise, the Global Edit Mode will be used to alter the parameters within all the scan routines of the Multi-Scan program simultaneously.

1. Double-click on scan routine #1 in the list on the right of the Multi-Scan program screen. The Scan Routines screen will be displayed. Click on the Scan Programs menu and choose GLOBAL EDIT MODE. When the global edit mode is activated the status line at the bottom of the screen will indicate that the global edit mode is on.

2. Click on the scan parameter labeled S Leveling. The Display Parameters window will be displayed allowing adjustment of the cursor band widths. Click on OK to enter the default band width.

3. Click on the M cursor parameter box and enter the new location at "900" microns for software leveling. Click on OK. The software leveling parameters will automatically be edited for all the scan routines within the Multi-Scan program.

NOTE

For this to work the scan length must be greater than the M position.

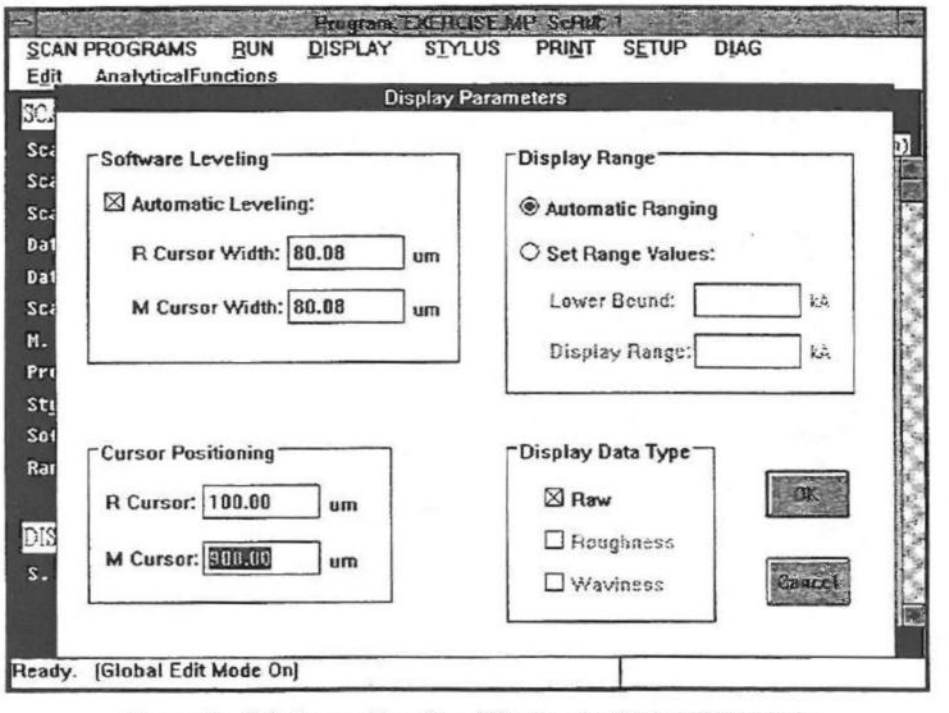


Figure 5 - 5 Software Leveling Window in Global Edit Mode

Running a Multi-Scan Program

The Multi-Scan program created on the previous pages can be run as a repetitive scan over the same portion of the sample in sequence. Always verify that a sample is position below the stylus prior to running a scan. Press the abort key (in the upper right corner of the keyboard) to abort the Multi-Scan sequence at any time during the operation.

1. Click on the Run menu from the system menu bar and choose RUN PROGRAM. The Multi-Scan program will run scan routine #1 first.

2. The data plot screen will be displayed superimposed over the video image of the sample as the stylus is lowered onto the sample.

3. After a brief pause, the scan will commence. As the sample moves right to left across the screen, the initial profile is plotted on the scale grid.

4. Once the scan is complete, the profile will be re-plotted, automatically leveled, and the ASH analytical function will be calculated and displayed.

5. The stage will return to the original location, and scan routines #2 and #3 will scan over the same portion of the sample.

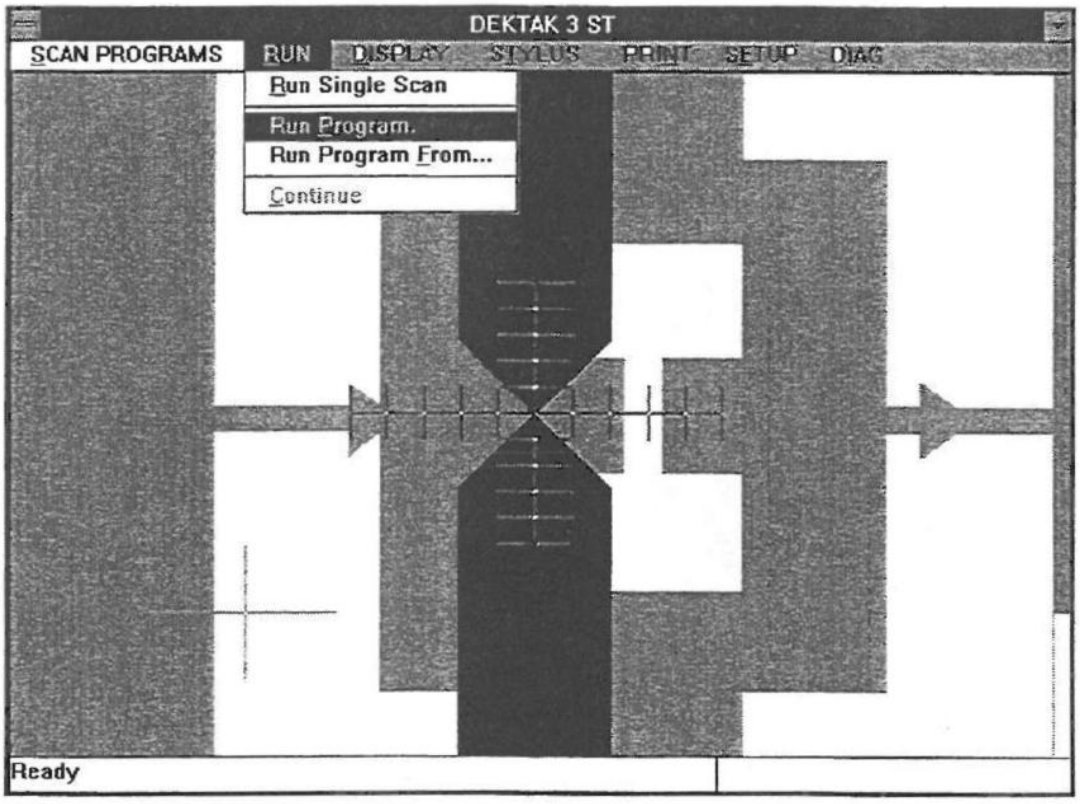


Figure 5 - 6 Run Program

Data Destination Options

Data destination options can be entered into the Multi-Scan program to automatically perform a selected function at the conclusion of each scan routine. Four data destination options are available on the Dektak^{3}ST:

- **Printer**
- **Data File**
- **Program Summary**
- **Pause After Scan**

The procedure to program these options for the purpose of this exercise is described on the following pages.

Printer

If No Printout is selected, a printout will not be produced. If Print Plot And Summary is selected, the plotted profile trace along with the profile data will be produced after each scan routine is completed, as part of this Multi-Scan program. If Print Summary Only is selected, a printout will be produced of a summary of the scan data only.

1. Click on the Scan Programs menu and choose MULTI-SCAN PROGRAMS. The Data Destination Options window will appear (see Figure 5 - 7).

2. For this exercise, click on Print Plot And Summary and click on OK.

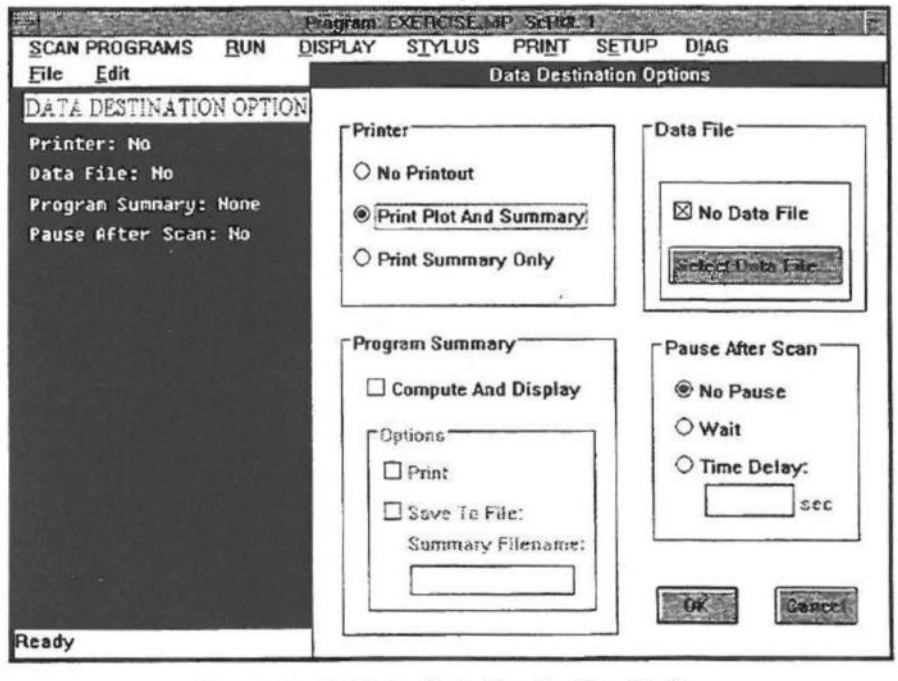


Figure 5 - 7 Printer Data Destination Option

Data File

The data file option permits the data plot screen from the previous scan routine to be filed to either the Dektak^{3}ST hard disk or to the A drive for back-up on a diskette. The plotted profile can then be retrieved (see page 60) at a later date for further analysis. Two data file options are available:

- **No Data File**
- **Select Data File**

1. Click on Select Data File button from the data file option in the Data Destination Options dialog box. A window will be displayed containing a directory listing of the data plot screen saved previously (see Figure 5 - 8).

2. Unless otherwise specified, data will automatically be loaded to the default Data subdirectory in the Dektak directory on the C drive. Click on the box labeled File Name: and drag the cursor across the *.* to highlight it.

3. A file name may be up to seven characters long. Type in the filename "exercise" and click on OK. When the current Multi-Scan program is run, the data plot screens produced from the scan routines will be filed under the name of exercise.

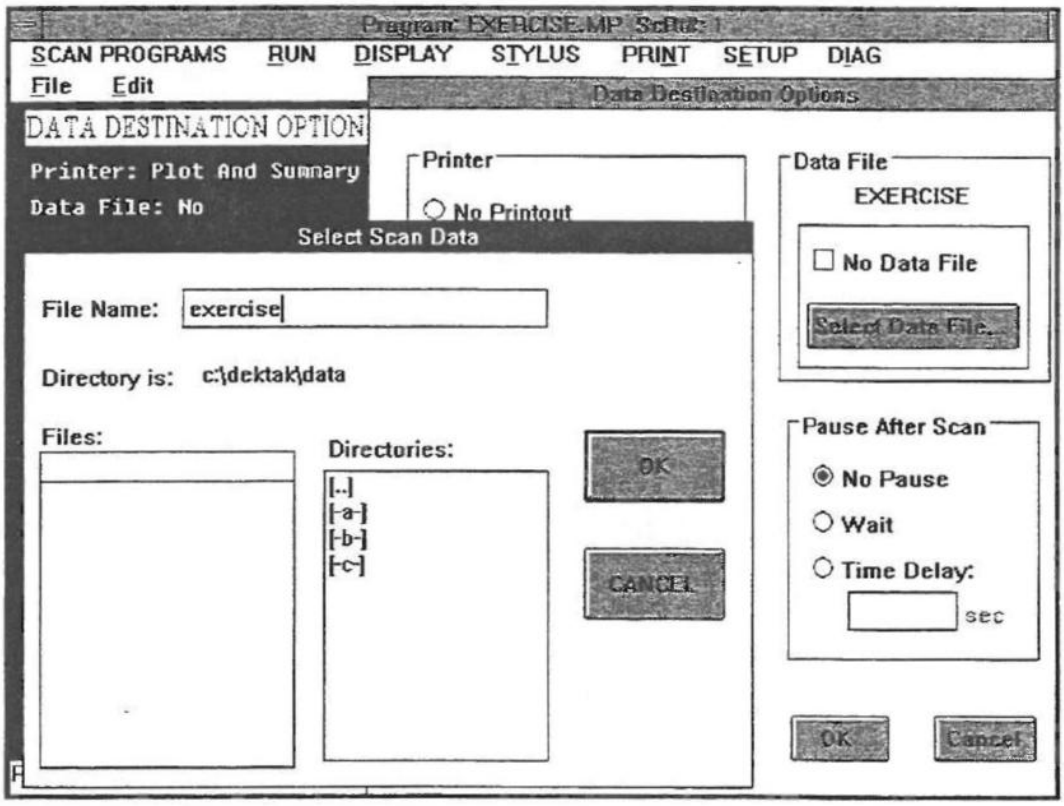


Figure 5 - 8 The Data File Directory

Retrieving Data Plot Screens

For the purpose of this exercise, the current Multi-Scan program will be run and then the data plot screens will be retrieved.

1. Click on the Run menu and choose RUN PROGRAM. The Multi-Scan program will be run and the data plot screens will be filed.

2. At the conclusion of the Multi-Scan program, the data plot screens can be retrieved by clicking on the Data located above the data plot screen.

3. Click on Select Data File from the Data menu. A directory listing will be displayed of the saved data plot screens. The data plot screen from scan routines 1, 2, and 3 are filed under the names of: exercise.001, exercise.002 and exercise.003 respectively (see Figure 5 - 9)

4. To redisplay the Data Plot Screen from Scan Routine #1, click on exercise.1 and click on OK. The Data Plot screen from Scan Routine #1 will be re-plotted and redisplayed.

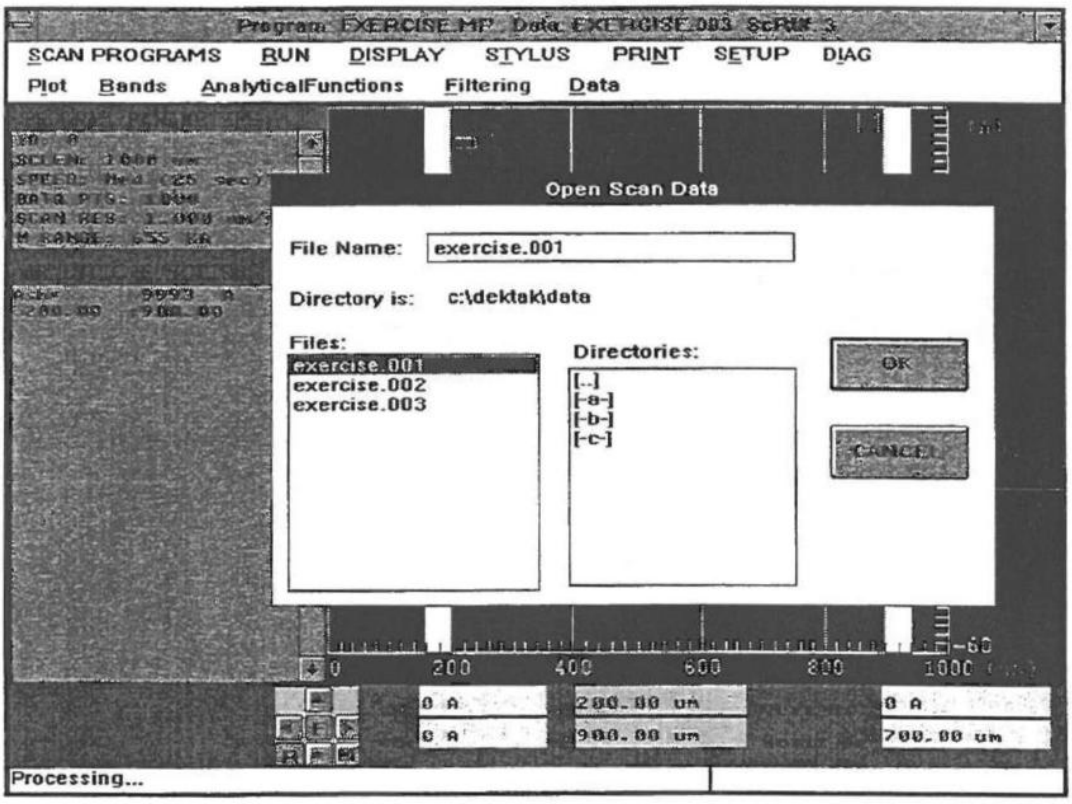


Figure 5 - 9 Load Data File Directory

Program Summary

The Program Summary data destination option provides a summary and listing of the analytical function results for a Multi-Scan program. All scan routines within the Multi-Scan program must have identical scan routine parameters.

1. Return to the Multi-Scan program screen. Click on the line labeled Program Summary and the Data Destination Options window will be displayed (see Figure 5 - 10).

2. Click on the box labeled Compute and Display to compute and display the program summary screen at the conclusion of the Multi-Scan program.

3. Click on the Print option to produce a printout of the program summary.

4. Click on the box labeled Save to File and click on the box labeled Summary File Name to Type in the filename "exercise" **(by convention these file names should be given an .aps file extension).** Click on OK.

5. Click on the Run menu and choose RUN PROGRAM. The current Multi-Scan program run and the Multi-Scan program summary will be computed, displayed, printed, and saved to file.

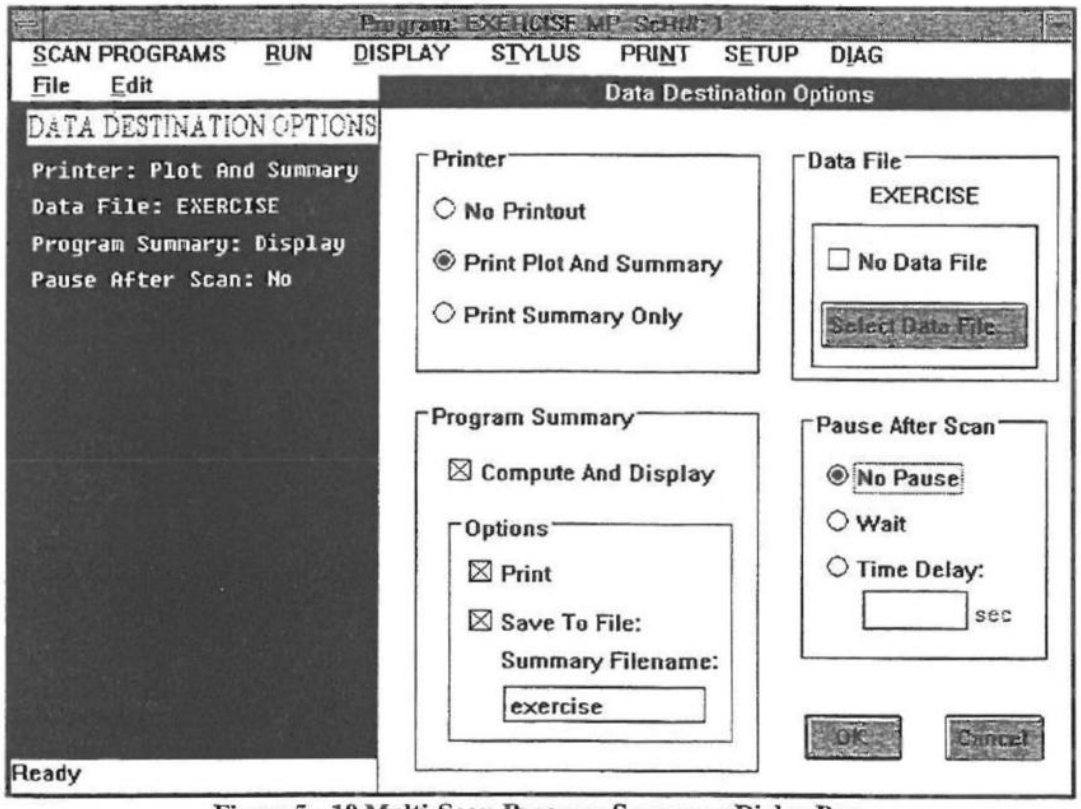


Figure 5 - 10 Multi-Scan Program Summary Dialog Box

Program Summary Screen

The Program Summary Screen (see Figure 5 - 11) provides data on the just concluded Multi-Scan program. The items highlighted in yellow include: The Multi-Scan program filename, number of scan routines, sample ID, Multi-Scan program start time and date. The items highlighted in green display the locations of the reference and measurement cursors for each analytical function. The items highlighted in blue provide the mean, standard deviation, minimum, maximum, and range of the analytical function from all the scan routines. The items highlighted in red provide the individual analytical function results for each scan routine.

1. To save an Multi-Scan program Summary to file from the APS screen, click on the File menu and choose SAVE. Enter the desired filename with the .aps file extension and click on OK.

2. To redisplay an Multi-Scan program Summary saved to file, click on the File menu. from the APS screen menu bar and click on LOAD. A listing of the files saved under the .aps file extension will be displayed. Click on the desired filename and click on OK.

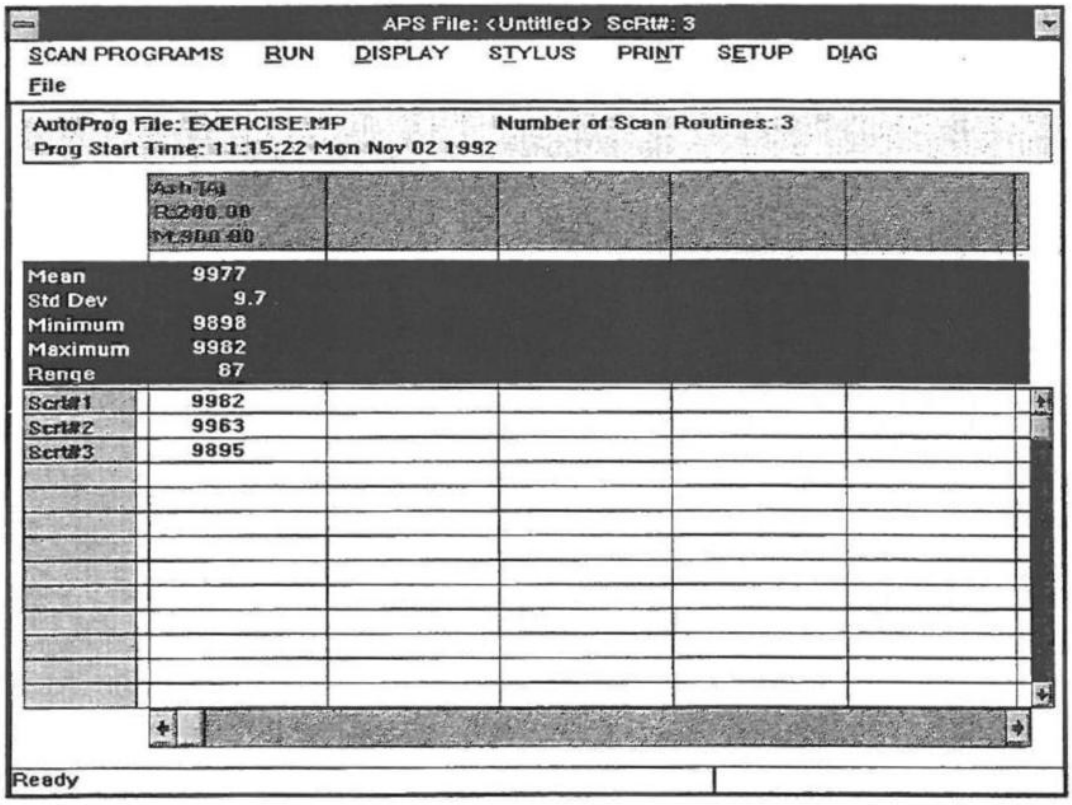


Figure 5 - 11 Multi-Scan Program Summary Screen

Pause After Scan

The Pause After Scan (in the Data Destination Option window - see Figure 5 - 12) allows a pause or a time delay to be entered between each scan routine to permit the operator time to reposition the sample or visually inspect and record scan data. Three pause after scan options are available:

- No Pause
- Wait,
- Time Delay

When No Pause is selected, all scan routines within the Multi-Scan program will be run one right after another. When Wait is selected, the system will stop after each scan routine. It will wait until the operator clicks-on CONTINUE from the Run menu before continuing to the next scan routine. The Delay Time selection permits a time delay to be entered between scans (the maximum delay is 600 seconds). For this exercise, Wait will be selected.

1. Click on Wait and click on OK.

2. Click on the Run menu and choose RUN PROGRAM. Scan routine #1 will run and the system will wait for the operator to click on continue at conclusion of the scan.

3. Reposition the sample during the pause and click on the Run menu and choose CONTINUE. The Dektak^{3}ST will perform scan routine #2 and wait. Reposition the sample again and click on CONTINUE to run scan routine #3.

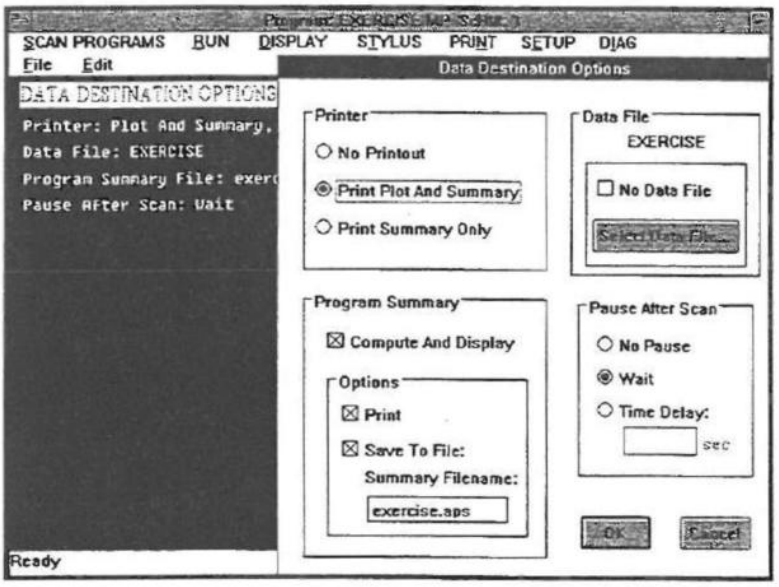


Figure 5 - 12 Pause After Scan

Replacing an Existing Multi-Scan Program

By participating in the exercise described in this section, many changes and alterations have been made to the Multi-Scan program entitled "exercise". The procedure for re-saving an existing Multi-Scan program with the new changes is described below.

1. Return to the Multi-Scan programs screen and click on the File menu.

2. Click on SAVE AS from the File menu. A pop-up window will request Save File Name As: C:\DEKTAK\PROGRAMS\EXERCISE.MP. This window also allows the file to be saved by a different file name, or to be saved to a different directory.

3. Click on OK to save the file to the current directory path. A second pop-up window will be displayed with a warning asking if it is OK to replace the existing "exercise.mp".

4. Click on Yes. Both windows will disappear and the new Multi-Scan program "exercise" will replace the existing program (see Figure 5 - 13).

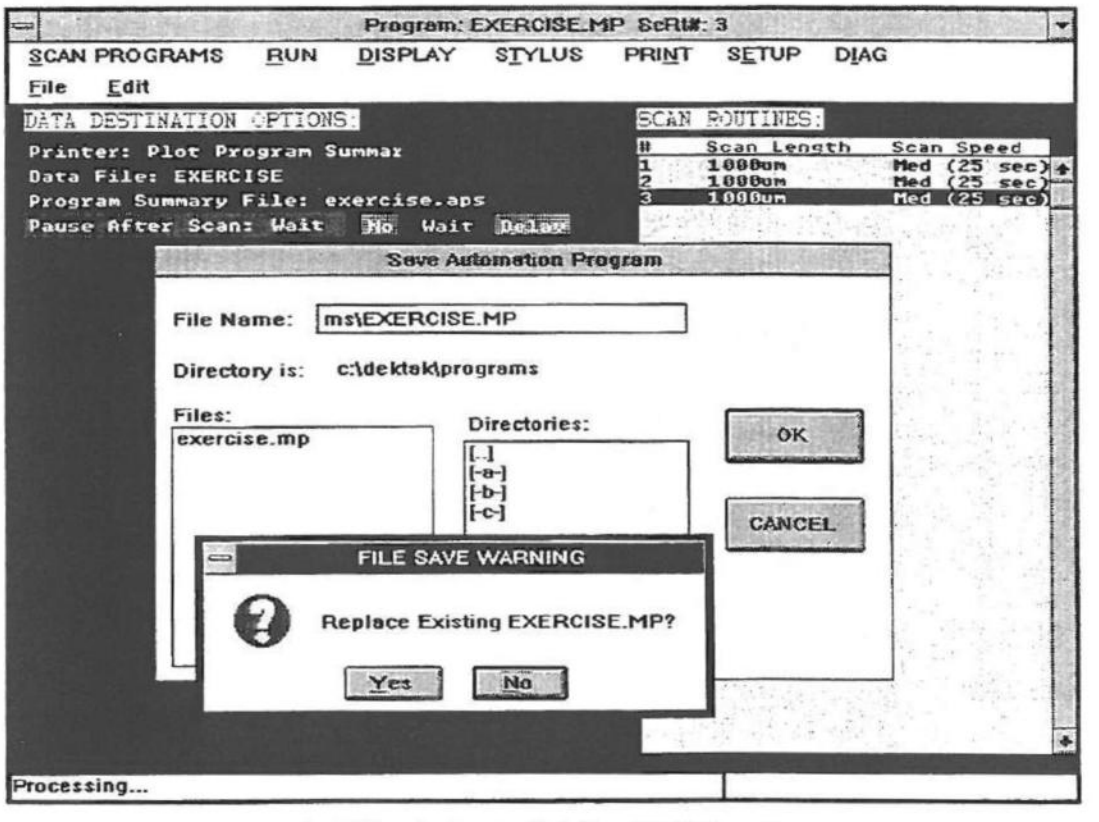


Figure 5 - 13 Replacing an Existing Multi-Scan Program

Section 6

Analytical Functions

Section Overview

This section provides a description of the analytical functions included as part of the standard Dektak^{3}ST software. These special functions allow the user to perform complex analytical computations on the profile data quickly and easily. Multiple analytical functions can be entered into a scan routine to automatically calculate surface texture parameters on like samples. The operator can also perform analytical functions at the conclusion of a scan by selecting the desired parameters one-by-one.

By using these functions to analyze the profile data, valuable information can be obtained for controlling and monitoring the production process. To assist the operator, analytical functions are grouped by applications: roughness, waviness, step height, and geometry parameters. The items included in this section are listed below.

Analytical Functions Description

The Dektak^{3}ST is equipped with 26 different analytical functions for measuring surface texture. The following pages provide the abbreviation for each function as it appears on the screen, along with a brief description of the parameter.

If extensive surface texture analysis is planned, it is recommended that the ANSI B46.1 specification on surface texture be studied. A copy of this specification can be obtained from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

Roughness Parameters

When calculating roughness parameters, the R and M cursors are used to define the assessment area of the profile trace. For the best results, the stage should be leveled and the scan trace should be software leveled prior to calculating any analytical function.

Max Dev Maximum Deviation: Calculates the furthest data point above or below the mean line.

Max Ra Maximum Ra: Identifies that portion of the assessment length which has the highest Ra. The assessment length, defined by the cursors, is divided into nineteen overlapping segments. Each segment is equal to one-tenth of the assessment length distance. The Ra is calculated for each segment. The R cursor will be positioned in the center of the segment with the highest Ra. Only one MRa is allowed to be programmed into a scan program.

Ra Arithmetic Average Roughness: Formerly known as AA and CLA. Ra is the universally recognized, and most used, international parameter of roughness. It is the arithmetic average deviation from the mean line.

Rp Maximum Peak: The maximum height or the highest peak of the profile roughness above the mean line, within the assessment length.

Rq Root-mean-square (RMS): Determines the root-mean-square value of roughness corresponding to Ra.

Rt Maximum Peak to Valley: The sum total of the Maximum Peak and Maximum Valley measurements of roughness within the assessment length (Rt = Rp + Rv).

Rv Maximum Valley: The lowest point, or the maximum depth of the profile roughness below the mean line, within the assessment length.

Rz din Ten Point Height Average: The average height difference between the five highest peaks and the five lowest valleys in accordance with DIN 4768/1 specification published by the Deutsche Institut fuer Normung c.v.

Skew Skewness: The symmetry of the profile about the mean line. It will distinguish between asymmetrical profiles of the same Ra or Rq.

Waviness Parameters

When calculating waviness parameters, the R and M cursors are used to define the assessment area of the profile trace. For the best results, the stage should be leveled and the scan trace should be software leveled prior to calculating any analytical function.

Wa Arithmetic Average of Waviness: The average deviation of waviness from the mean line (corresponds to Ra).

Wmaxdev Maximum Deviation of Waviness: Measures the distance of the furthest data point above or below the mean line from the waviness profile (corresponds to Maximum Deviation of roughness).

Wp Maximum Peak of Waviness: Measures the maximum height of the highest peak of the waviness profile, above the mean line (corresponds to Rp).

Wq Root-Mean-Square of Waviness: Determines the root-mean-square (RMS) value of waviness (corresponds to Wa).

Wt Maximum Peak to Valley of Waviness: The sum total of the maximum peak and maximum valley measurements of waviness (Wt=Wp+Wv).

Wv Maximum Valley of Waviness: The lowest point, or the maximum depth of the waviness profile below the mean line (corresponds to Rv).

NOTE

Waviness and roughness parameters are calculated on raw profile data unless the cut-off filters have been activated.

Step Height Parameters

When calculating step height parameters, the R and M cursors are used to define the assessment area of the profile trace. The stage should be leveled and the scan trace should be software leveled prior to calculating any analytical function.

ASH Delta Average Step Height: Used to obtain a step height measurement in applications where roughness or noise is present on the profile trace. It computes the difference between two average height measurements (see Figure 6 - 1).

AVG HT Average Height: Calculates the average height of a step, with respect to the zero line, using the R and M cursors to define the area of measurement.

PEAK Maximum Peak: Calculates the maximum height above the baseline, as determined by the cursor/trace intercepts.

PV Maximum Peak to Valley: Calculates the vertical distance between the maximum peak and maximum valley.

TIR Total Indicated Reading: Calculates the vertical distance between the highest and lowest data points between the cursors.

VALLEY Maximum Valley: Calculates the maximum depth below the baseline, determined by the cursor/trace intercepts.

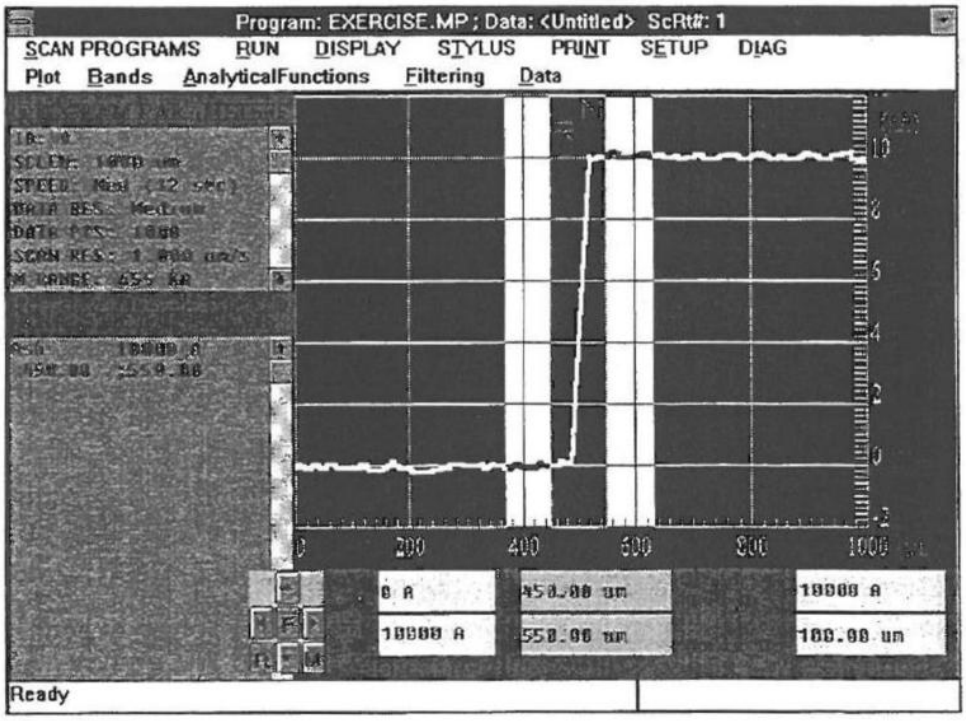


Figure 6 - 1 Average Step Height Cursor Locations

Geometry Parameters

When calculating step height parameters, the R and M cursors are used to define the assessment area of the profile trace. The stage should be leveled and the scan trace should be software leveled prior to calculating any analytical function.

Area Area-Under-The-Curve: Computes the area of a profile between the R and M cursors with respect to the horizontal zero grid line. The profile **must be leveled** for accurate results. If the profile is above the zero line, area is expressed as a positive value in square microns. If the profile is below the zero line, the result will be a negative value.

Perim Perimeter: Calculates the outside perimeter of a profile between the R and M cursors. A horizontal reference line is created using the R and M cursor intercepts. The profile must be leveled for accurate results.

Radius Radius: A least-squares-arc is fitted to the data points and the radius is calculated from the equation of a circle. The algorithm does not distinguish between concave and convex shapes. To maximize the accuracy of the results, the following factors must be considered: (1) the sample shape must approximate a sector of a circle: (2) the stylus tip must traverse the apex of the sample if it is a sphere. Using the largest radius stylus possible will help minimize the error; (3) Repeatability errors may dominate the measurement if the chord rise is less than 100Å for scans longer than 1mm.

Slope Slope: Calculates the arc tangent of the ratio of the vertical distance to the horizontal distance between the R and M cursor/trace intercepts. The result is expressed in degrees. Slope is useful only for relatively shallow slopes. If the stylus radius is too large or the step too steep, the stylus will contact the upper edge of the step before the lower edge and the slope measurement will be inaccurate.

Volume Volume: The integration-by-shells technique is used to find the volume of a solid. This is accomplished by rotating the lamina delineated by the scan trace and a line segment connecting the cursor intercepts through 180 degrees about a vertical axis which is located half way between the cursors.

Analytical Function Exercise

This exercise will demonstrate how to perform an average roughness measurement at the conclusion of a scan. For the purpose of this exercise, the optically flat glass of the calibration standard provided with the system can be used. The calibration standard should be positioned so that a 2mm scan will traverse across the glass portion of the standard without encountering a step (see Figure 6 - 2).

1. Click on the Scan Programs menu and choose MULTI-SCAN PROGRAM. The Multi-Scan program screen will be displayed.

2. Click on the File Menu from the menu bar, and choose NEW. The default scan routine will be entered into the current Multi-Scan program.

3. With the stage positioned as shown in Figure 6 - 2, click on the Run menu and choose RUN SINGLE SCAN. The current Scan Routine will be run.

4. Once the scan routine has been run with the profile plotted, the trace must be leveled. Click on PLOT and click on LEVEL from the menu. The trace will be re-plotted and leveled.

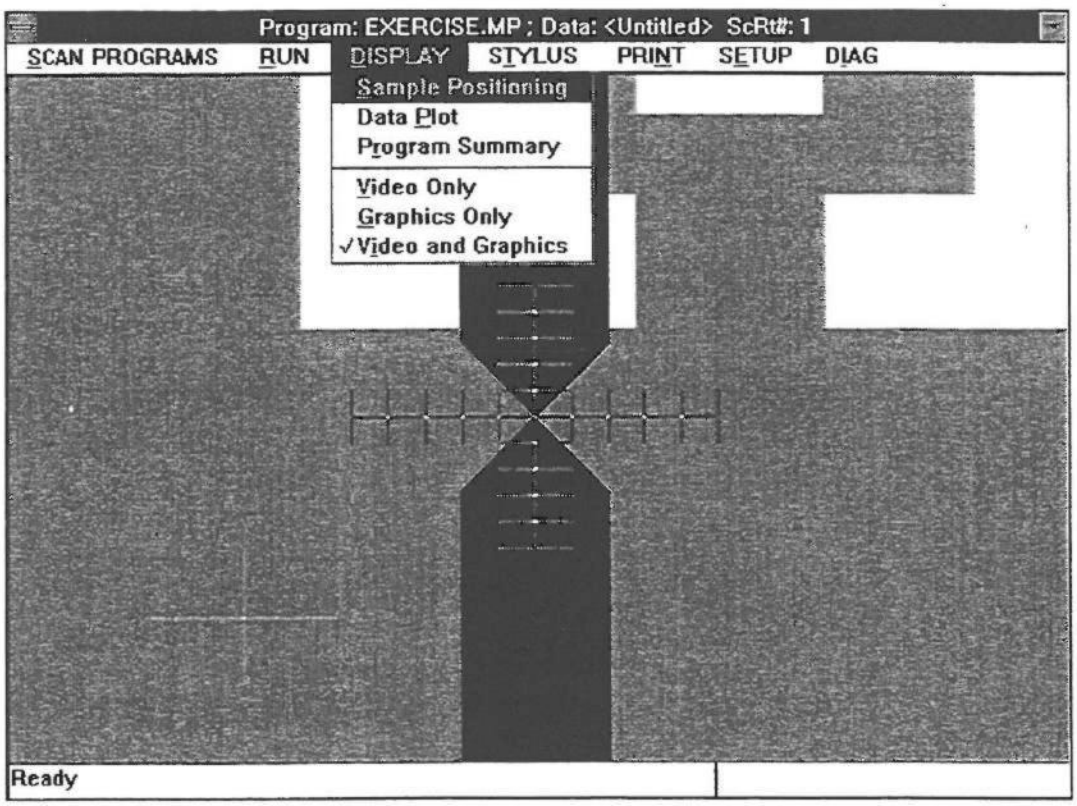


Figure 6 - 2 Calibration Standard Positioning for a Roughness Measurement

Average Roughness Measurement

Once the scan is run and the profile trace is leveled, an analytical function may be performed from the Data Plot screen. The procedure for executing the Average Roughness (Ra) analytical function on the raw profile data is described below. The cursors can be relocated if desired, but for this exercise, the default cursor setting of 100 and 1900 microns should be appropriate for a 2mm scan.

1. Click on the Analytical Functions menu and choose COMPUTE. The Analytical Functions Menu will be displayed (See Figure 6 - 3).

2. The Analytical Functions Menu contains selections for setting roughness, waviness, heights, and geometry parameters. The roughness functions menu lists nine different parameters, click on RA.

3. Click on the Measure button provided at the bottom of the analytical functions window (selecting MEASURE AND PROGRAM automatically enters the analytical function into the Scan Routine program).

4. Click on COMPUTE and the average roughness will be calculated. The result from the RA function will be displayed in the area of the left of the Data Plot screen.

Note

The an asterisk appears next to the Ra, this indicates that the analytical function was calculated on the raw, unfiltered data.

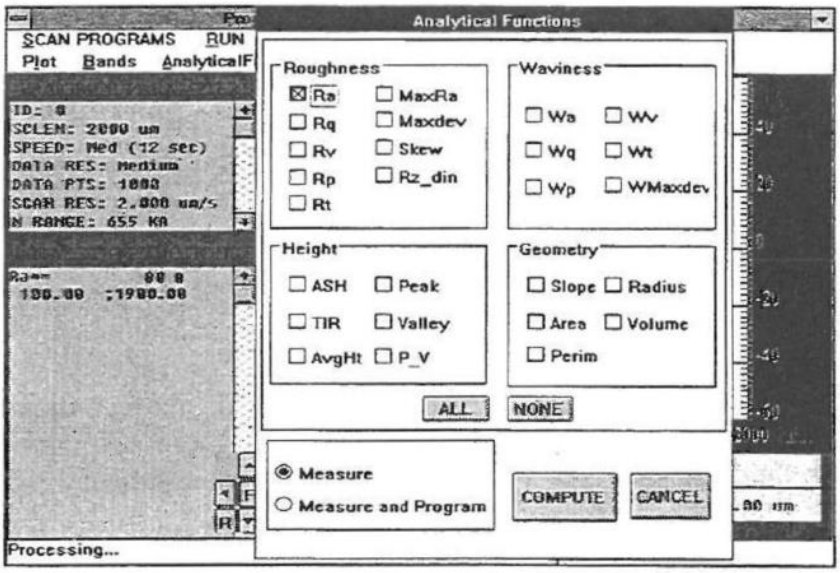


Figure 6 - 3 Roughness Functins Window

Determining The Cutoff Wavelength

The Dektak^{3}ST is equipped with short pass and long pass digital filters for filtering out high and low frequency signals. In effect, the cutoff frequencies defines the intended difference between roughness and waviness. The filters are designed in accordance with the ANSI B46.1 specification on surface texture. The wavelengths are user selectable from 1 to 20,000 microns.

The appropriate cutoff wavelength will vary from application to application. However, it is recommended that the scan length be at least 5-10 times longer than the cut-off wavelength. The cutoff value will not be accepted if fewer than 8 data points are available per cutoff wavelength. The scan Resolution parameter displayed on the Scan Routine Screen provides the number of microns per sample for a given scan length and speed. The minimum acceptable cut-off wavelength must be at least eight times longer than the value listed as the scan resolution. This can be otherwise defined as: microns per sample x 8 = minimum acceptable cut-off wavelength.

For example, the default scan routine used for the purpose of this exercise has a scan length of 2000 microns, a scan speed of medium, and a scan resolution of 0.513 microns per sample. Multiplying 0.513 by 8 equals 4.10, so the minimum acceptable cut-off wavelength is 5 microns. The scan length must be at least 5 times greater than the cut-off wavelength. Dividing the 2000 micron scan length by 5 equals 400. Therefore, a cut-off value must be selected between 5 and 400 microns.

Three separate cut-off filters are provided for selecting the wavelength by pass frequency. The three filters are described below.

Short (High) Pass Filter

This filter is used for calculating roughness data. It filters out low frequency waviness signals and allows high frequency roughness data to pass through. Generally, a good rule of thumb for selecting the short pass cutoff filter value is to divide the scan length by 100 and enter that value.

Long (Low) Pass Filters

This filter is used for calculating waviness data. It filters out high frequency roughness signals and allows low frequency waviness data to pass through. Typically, the long pass filter value is about 10 times shorter than the scan length.

Band Pass Filter

When the band pass filter is selected, both the short pass and long pass filters will be enabled to calculate the roughness data. It creates a band which filters out high frequency signals above the band and low frequency signals below the band.

Activating The Cutoff Filters

To obtain accurate roughness measurements, it is recommended that the short pass filter be activated. The procedure for activating the short pass and long pass filters is described below.

1. Click on the Filtering menu from the Data Plot Screen menu bar, and choose CUTOFF FILTERS. A dialog box will be displayed for setting the roughness and waviness filters (see Figure 6 - 4).

2. Click on the box labeled Short Pass Filter Cutoff and enter a cutoff value of 20.

3. Click on the box labeled Long Pass Filter Cutoff and enter a cutoff value of 200.

4. Click on OK and the profile trace will be re-plotted with three separate scan traces: The white trace represents the raw profile data, the yellow trace represents the roughness profile as determined with the short pass filter, and the red trace represents the waviness profile as determined by the long pass filter.

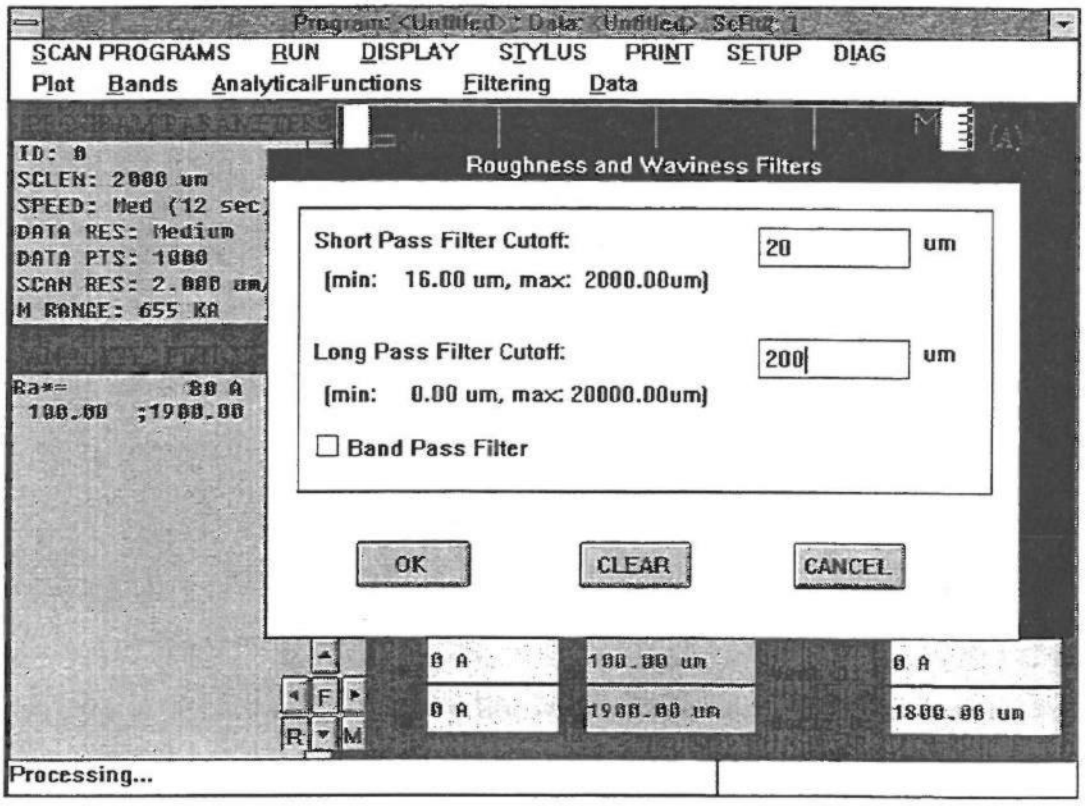


Figure 6 - 4 Roughness and Waviness Filter Dialog Box

Data Type Selection

The operator may select the type of data to be displayed on the data plot screen. The raw, roughness, and waviness profile data can be displayed either individually or simultaneously. The procedure for selecting the data type is described below.

1. Click on the Plot menu from the Data Plot Screen menu bar.

2. Click on DATA TYPE from the Plot menu. A window will be displayed permitting the selection of raw, roughness, or waviness data type display. All three selections should be activated as indicated by an X in their respective boxes (see Figure 6 - 5)

3. Click on the box labeled Waviness to delete the X from the box. (The box acts as a toggle to switch the data type on and off.)

4. Click on OK. The Data Plot screen will be re-plotted with the roughness (yellow) and raw (white) profiles displayed and the waviness (red) profile deleted.

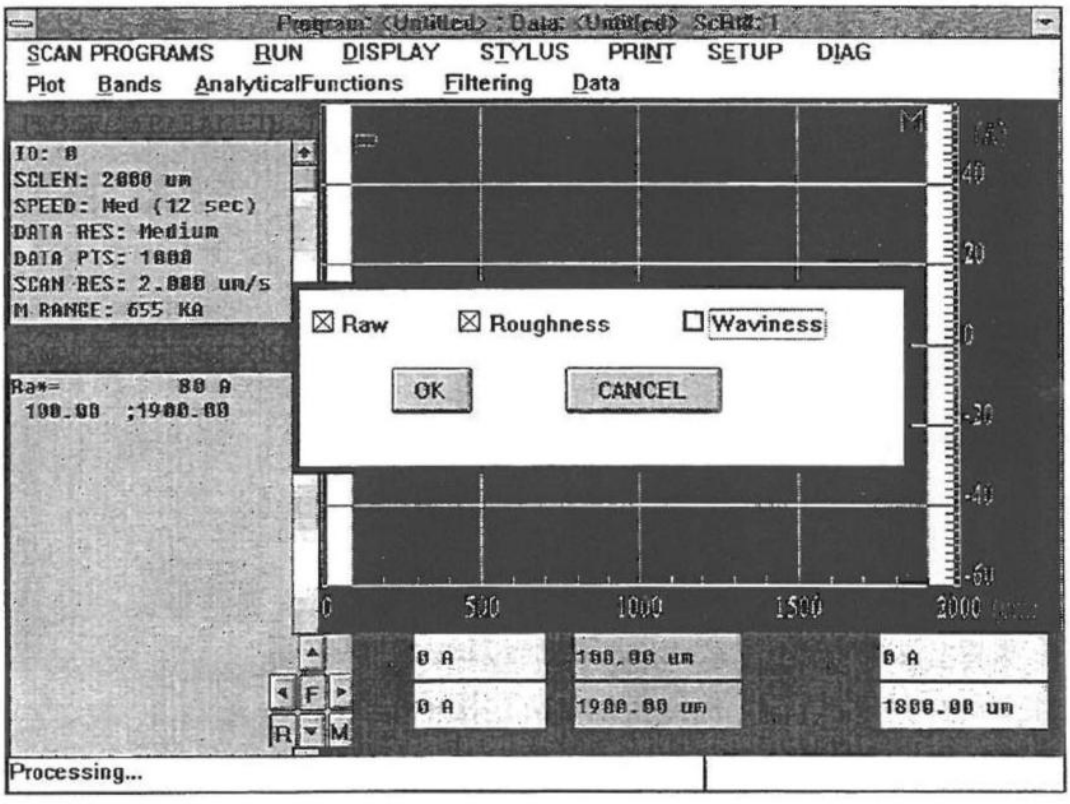


Figure 6 - 5 Data Type Window

Measuring And Entering Analytical Functions

Once the short pass roughness filter is activated, perform the average roughness analytical function a second time. Analytical functions can be entered into the current scan routine from the Data Plot Screen to be automatically calculated whenever the current scan routine is performed. The procedure for measuring the Ra function and entering it into the scan routine is described below.

1. Click on the Analytical Functions menu from the Data Plot Screen menu bar and choose Compute.

2. Click on RA from the roughness functions menu. An X will appear in the RA parameter box when activated. Click on the Measure and Program button at the bottom of the analytical functions window (see Figure 6 - 6).

3. Click on COMPUTE. The analytical functions menu will disappear and the average roughness will be measured and entered into the current scan routine. The result from the Ra function will be displayed in the area to the left of the data plot screen. Note the different results from the first Ra calculated on the unfiltered raw profile data and the second Ra calculated on the filtered roughness data.

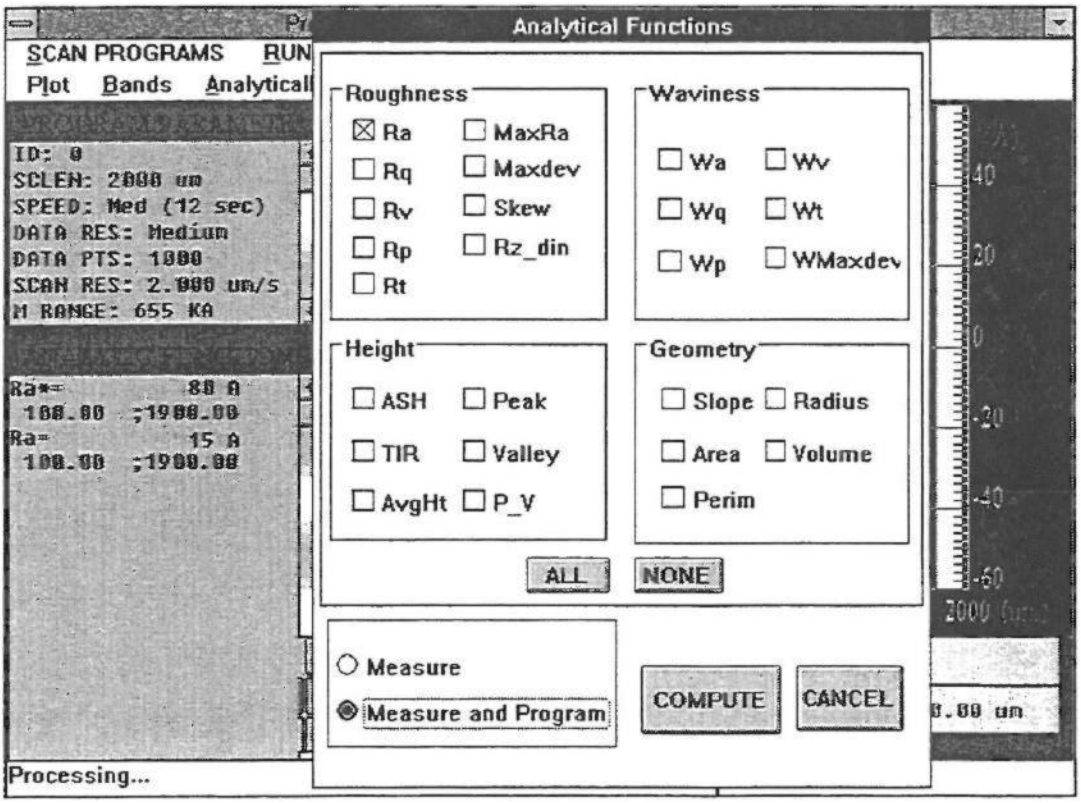


Figure 6 - 6 Analytical Functions/Data Plot Screen Entry

Entering Analytical Functions Into A Scan Routine

Multiple analytical functions can be entered into the Scan Routine screen, to be automatically calculated at the conclusion of the scan. The procedure for entering analytical functions into the scan routine is described below.

1. Click on the Scan Programs menu from the system menu bar, and choose SCAN ROUTINES from the scan programs menu.

2. Click on the Analytical Functions menu from the scan routine screen menu bar, and choose APPEND. The Analytical Functions menu window will be displayed.

3. Click on WA from the Waviness Functions menu. WA will be highlighted.

4. The cursors can be set at different locations for each individual analytical function. To adjust the cursor positioning, click on the box for the R cursor, delete the current value, and key-in 0. Then click on the box for the M cursor, delete the current value, and key-in 2000.

5. Click on OK. The WA function will be entered into the area on the right of the Scan Routines screen labeled Analytic Functions (see Figure 6 - 7).

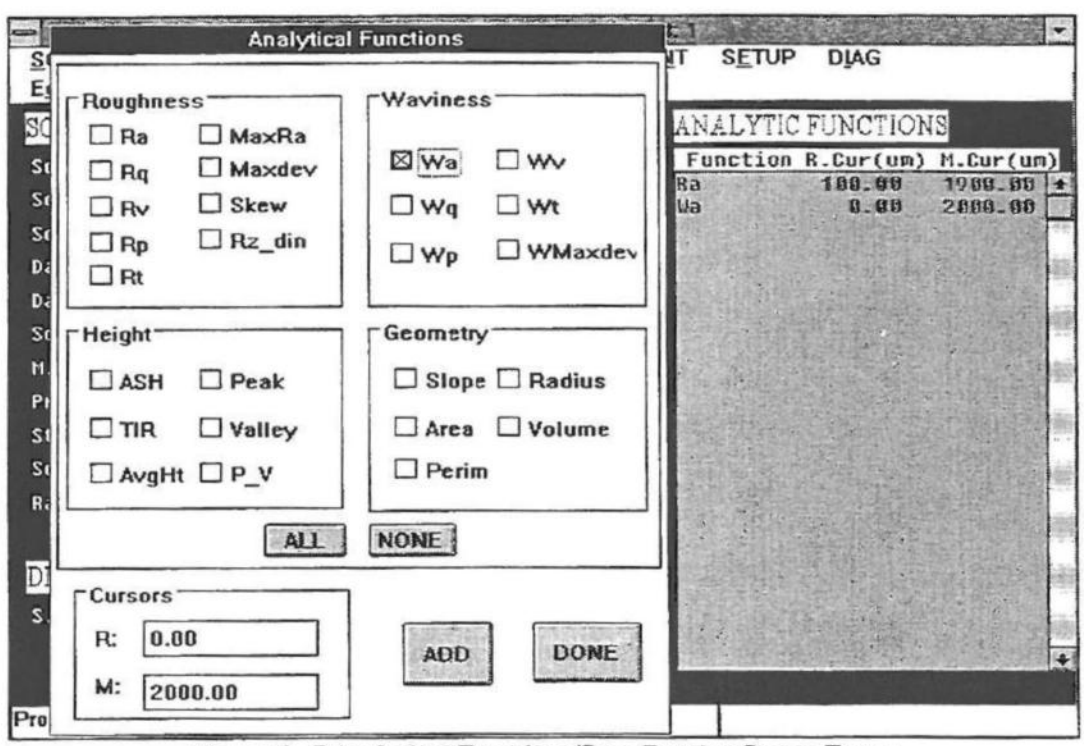


Figure 6 - 7 Analytical Functions/Scan Routine Screen Entry

Entering Filter Cutoffs Into A Scan Routine

The short pass and long pass filters can be entered into the scan routine to automatically be activated for calculating roughness and waviness analytical functions. The procedure for entering filter cutoffs into a scan routine is described below.

1. Click on the data processing parameter labeled Filter Cutoffs from the Scan Routine Screen. The data processing parameters window displayed (see Figure 6 - 8)

2. Click on the box labeled Short Pass Filter Cutoff and Type in a cutoff value of "20 microns" for calculating roughness.

3. Click on the box labeled Long Pass Filter Cutoff and type in a cutoff value of "200 microns" for calculating waviness.

4. Click on OK and the dialog box will disappear and the cutoff values will be entered into the scan routine.

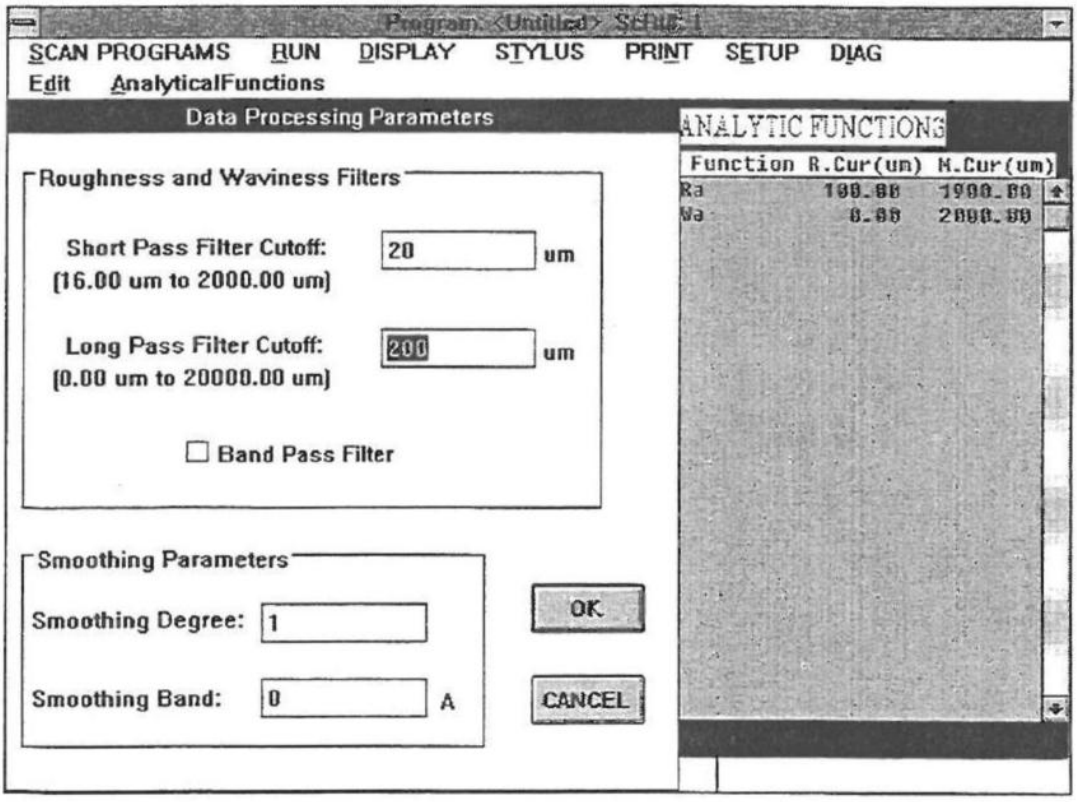


Figure 6 - 8 Filter Cutoffs Parameter

Entering Data Type into a Scan Routine

The type of profile data to be displayed at the conclusion of a scan can also be predetermined by entering the selected data types into the scan routine. The procedure for entering the data type into a scan routine is described below.

1. Click on the Display Data Type parameter from the Scan Routine Screen. The display parameters window provides three display data type options: raw, roughness, and waviness (see Figure 6 - 9).

2. When the default Scan Routine is used, the raw profile data is entered as the Display Data Type parameter. For the purpose of this exercise all three data types will be displayed. Click on the boxes labeled Roughness and Waviness to enter all three data types into the scan routine.

NOTE

The roughness data type cannot be selected unless the short pass filter is first activated. Likewise, the waviness data type cannot be selected unless the long pass filter is activated.

Once the analytical functions, cutoff filters, and display data types have been entered into the current scan routine, they will automatically be executed whenever the current scan routine is run.

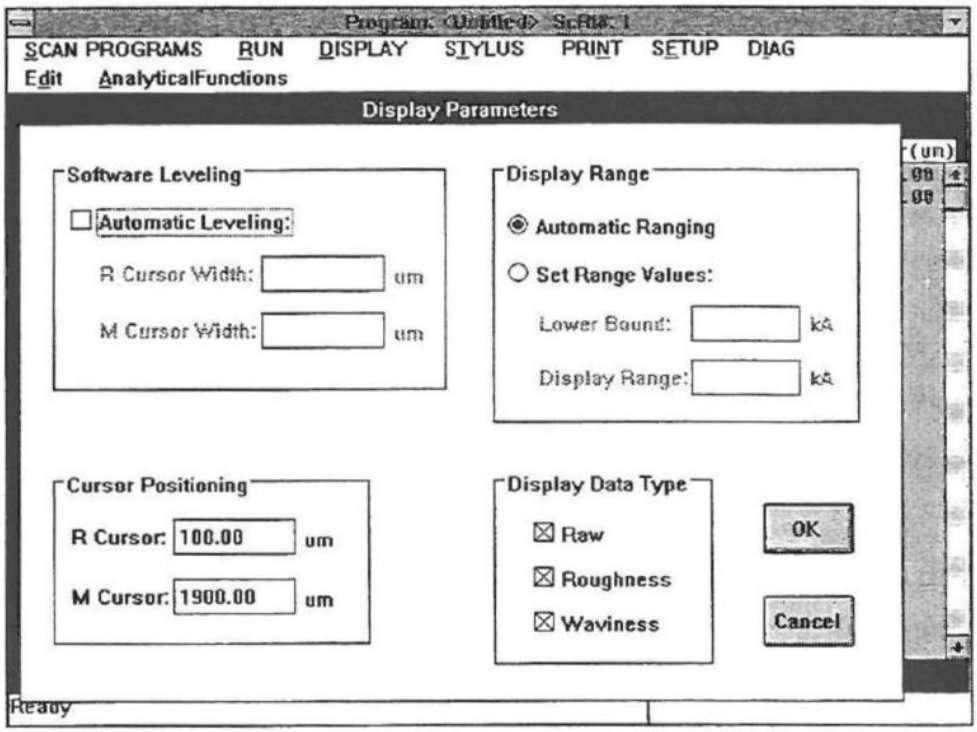


Figure 6 - 9 Display Data Type Parameter

Deleting Analytical Functions from a Scan Routine

When the scan routine screen is displayed and an analytical function is entered, the delete function can be accessed from the analytical functions menu. The procedure for deleting an analytical function from the scan routine is described below.

1. Roll the pointing device to the right hand portion of the scan routines screen where the entered analytical functions are listed. Click on the desired analytical function to be deleted. For the purpose of this exercise, click on WA. The function to be deleted will be highlighted.

2. Click on the Analytical Functions menu from the scan routine screen menu bar and choose DELETE. The delete analytical functions window will be displayed allowing a number of analytical functions or all the functions to be deleted.

3. Click on Delete 1 Item(s) and click on OK from the delete analytical functions window. The highlighted analytical function will be deleted from the scan routine.

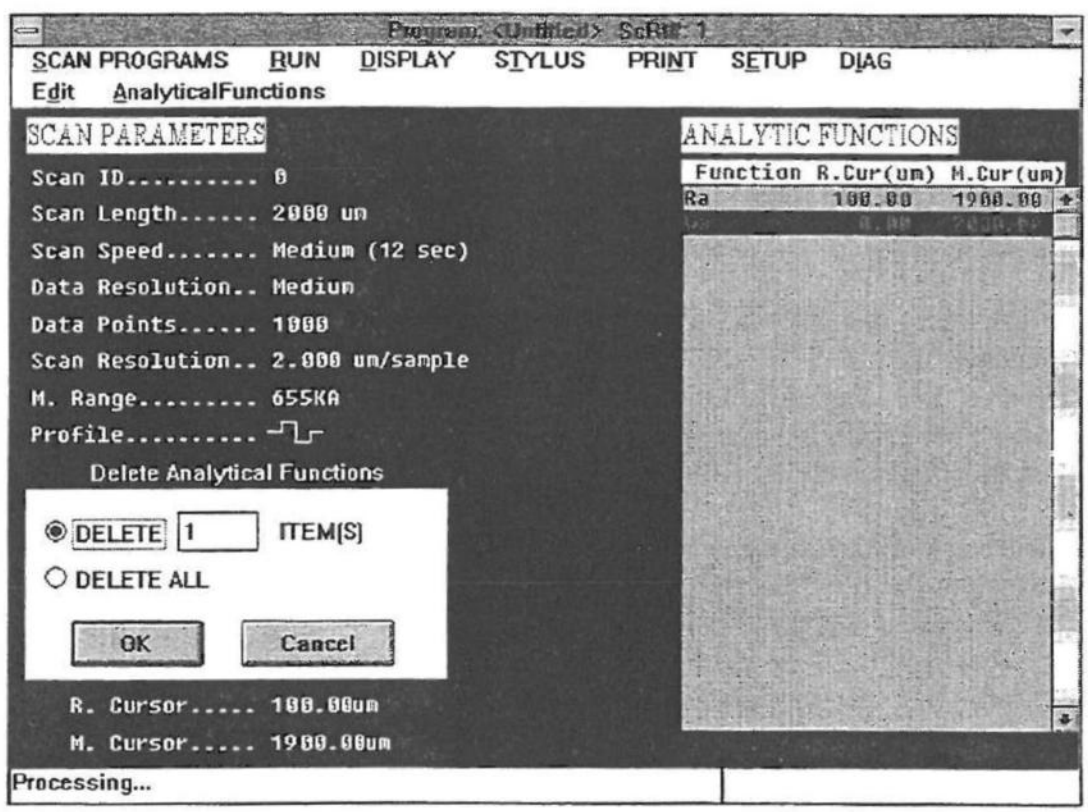


Figure 6 - 10 Deleting Analytical Functions

Description of the Smoothing Function

Whenever the smoothing function is activated, the roughness, waviness, or raw profiles will be calculated using the smoothed data. The smoothing function is used to reduce high frequency, low amplitude noise on a trace. Some applications involve films deposited over rough substrates. This substrate roughness "transfers" to the film surface, which can make measurements difficult or questionable.

The Dektak^{3}ST offers three degrees of smoothing. The higher the degree, the more smoothing will be realized.

Degree 1: 5-point smoothing
Degree 2: 11-point smoothing
Degree 3: 23-point smoothing

After the degree of smoothing is selected, a prompt asks for the value of the vertical distance between the maximum peak to valley roughness.

Determine the maximum peak to valley distance of the high frequency low amplitude noise, and then enter this or a greater value (the TIR analytical function can easily be used to determine the noise band to be entered).

The smoothing function smoothes all data within the specified noise band by examining each data point in turn and comparing it with the previous and following points.

If Degree 1 is selected, five consecutive data points are used in the smoothing calculation and if they lie within the specified noise band, a running calculation is started. A first-order curve is fitted to all consecutive points lying within the noise band. As new points are examined, the routine calculates the new value of each point by looking at the four closest points that lie within the band.

When the algorithm encounters a point that lies outside the band, the calculation is interrupted. The new point is left "as is" and becomes a center point of a new noise band. If the next five points are within the new band, the calculation is restarted. If subsequent points lie outside the band, they will be plotted "as is," and each becomes a new reference point. This technique is desirable to straight filtering as the slope of the profile is maintained.

The smoothing function may be used in one of two ways. In applications where rough samples will be run on a regular basis, smoothing may be entered into the Scan Routine. In this way, the smoothing function will be performed on each scan profile automatically. The smoothing function may also be selected after a scan has been completed. Both methods for smoothing will be discussed on the following pages.

Activating the Smoothing Function

Smoothing may be performed on profile data at the conclusion of a scan. The procedure for smoothing a profile from the data plot screen is described below.

1. Click on the Display menu from the system menu bar, and choose DATA PLOT. The Data Plot Screen will be displayed with the profile data re-plotted.

2. Click on the Analytical Functions menu from the data plot screen menu bar, and choose TIR from the analytical functions menu. The total indicated reading peak to valley distance will be calculated and displayed.

3. Click on the Filtering menu from the data plot screen menu bar, and choose SMOOTHING from the filtering menu. A dialog box will be displayed for entering smoothing parameters (see Figure 6 - 11).

4. Three degrees of smoothing are available. For the purpose of this exercise, enter "2" into the box labeled Smoothing degree.

5. Click on the box labeled Smoothing Band and enter a value equal to or greater than the value displayed as the TIR result. Click on OK and the raw profile data will be smoothed and re-plotted.

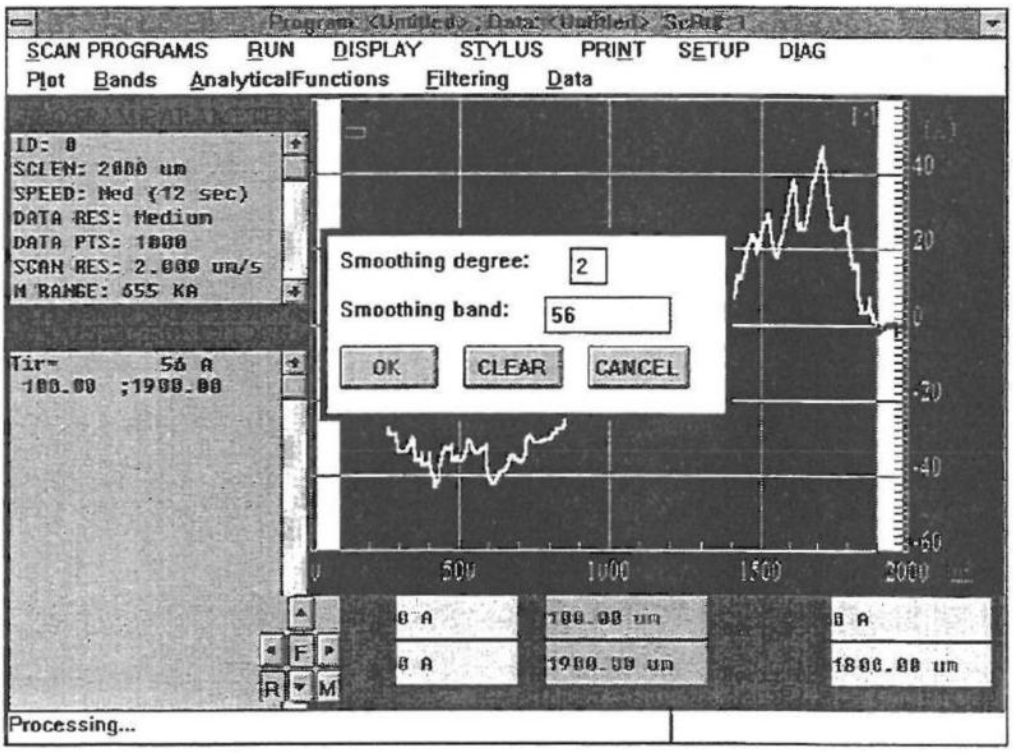


Figure 6 - 11 Smoothing Dialogue Box

Entering Smoothing into a Scan Routine

Smoothing may be entered into the current scan routine to automatically be executed at the conclusion of the scan. The procedure for entering smoothing into the scan routine is described below.

1. Click on the Scan Programs menu from the system menu bar, and choose SCAN ROUTINES.

2. Click on the Smoothing parameter at the bottom of the Scan Routines screen and the data processing parameters window will be displayed permitting the smoothing parameter to be entered. Three degrees of smoothing are available. Enter the desired degree either 1, 2, or 3.

3. The smoothing band value can be determined by performing the Total Indicated Reading (TIR) analytical function on the scan to be smoothed. Enter a value equal to or greater than the TIR value. The smoothing function will now automatically smooth the profile data whenever the current scan routine is executed. To clear smoothing, enter a smoothing band value of "0".

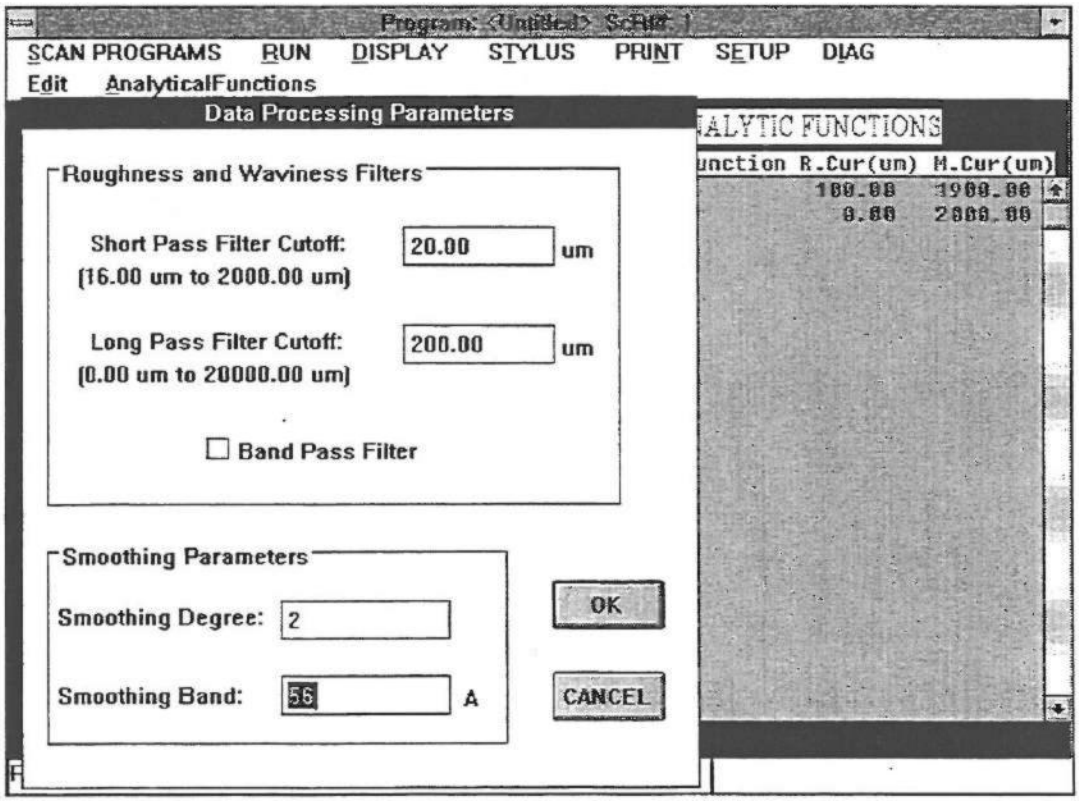


Figure 6 - 12 Smoothing Parameter

Section 7

System Menu Descriptions

Section 7 Overview

This section provides a brief description of the various menus and menu selections available in the Dektak^{3}ST software. This section is included to provide additional information on the various menu items which may or may not have been discussed in the previous sections of this manual. Items discussed in this section include:

The Dektak^{3}ST uses Microsoft Windows as the user interface. Microsoft Windows is an extension of the DOS operating systems. Whenever the Dektak^{3}ST file is accessed, the Dektak^{3}ST screen is displayed (see Figure 7 - 1). Continually displayed at the top of the Dektak^{3}ST screen is the system menu bar. The various menus included in the system menu bar are described in the following pages. Individual screens such as the Multi-Scan programs screen and the scan routines screen, have a second, screen specific, menu bar in addition to the system menu bar. These additional menus will also be described later in this section.

System Menu

The Dektak^{3}ST user interface consists of a variety of screens. The system menu box, status line and system menu bar are continually displayed at the top of each screen.

System Menu Box

The small box in the upper left corner of the screen displays a pop-up window when clicked on (See Figure 7 - 1). The window permits the user to exit the Dektak^{3}ST software and enter MS-DOS commands.

Current File

The current file is displayed at the top/center of the screen. It displays the current Multi-Scan program file name, scan ID number, and scan routine number.

Status Line

A status line is visible at all times, located at the bottom of the screen. It constantly displays screen specific status information.

System Menu Bar

The system menu bar provides access to the different types of operations available. A description of the contents of each menu are provided in the following pages of this section.

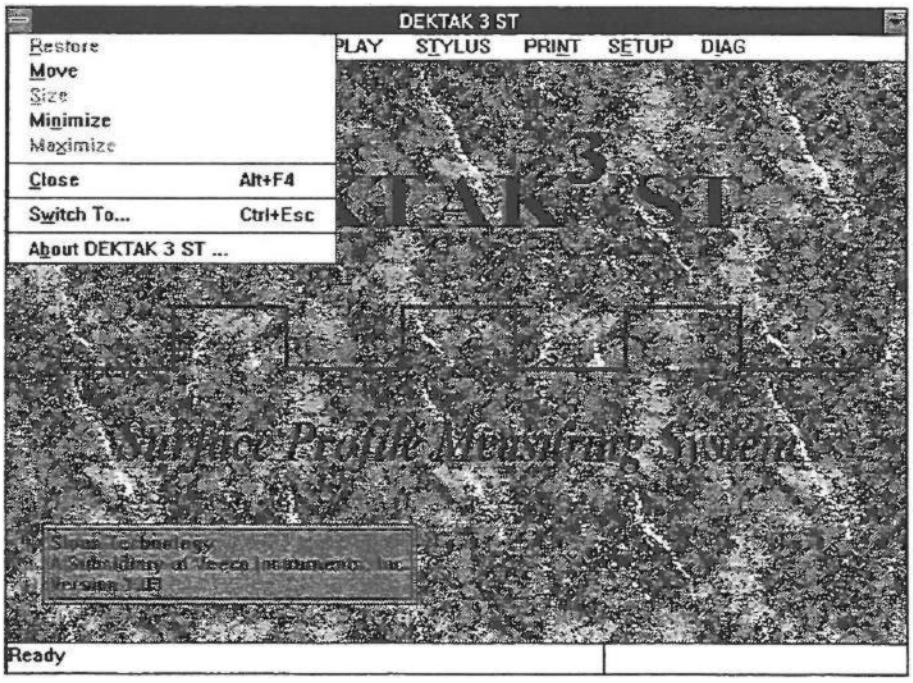


Figure 7 - 1 System Menu Box

Scan Programs Menu

The Scan Programs Menu permits access to the Multi-Scan programs screen, the scan routines screen, and the global edit mode. To access the Scan Programs Menu, click on SCAN PROGRAMS (see Figure 7 - 2).

Multi-Scan Program

When Multi-Scan Program is clicked-on, the Multi-Scan program screen is displayed (see Figure 7 - 8). The Multi-Scan program screen permits the programming of up to 200 scan routine operations. The Multi-Scan program is the basis for all operations of the Dektak^{3}ST. All Scan Routine parameters are contained within Multi-Scan program files.

Scan Routines

When Scan Routines is clicked-on, the Scan Routine program screen is displayed (see Figure 7 - 9). The Scan Routines screen is used to enter scan parameters such as scan length, stylus force, and analytical functions.

Global Edit Mode

Clicking-on the Global Edit Mode item in the scan programs menu acts as a toggle to go in and out of the global edit mode. When activated, this mode transfers the editing of the parameters of a single scan routine to all the scan routines within a Multi-Scan program.

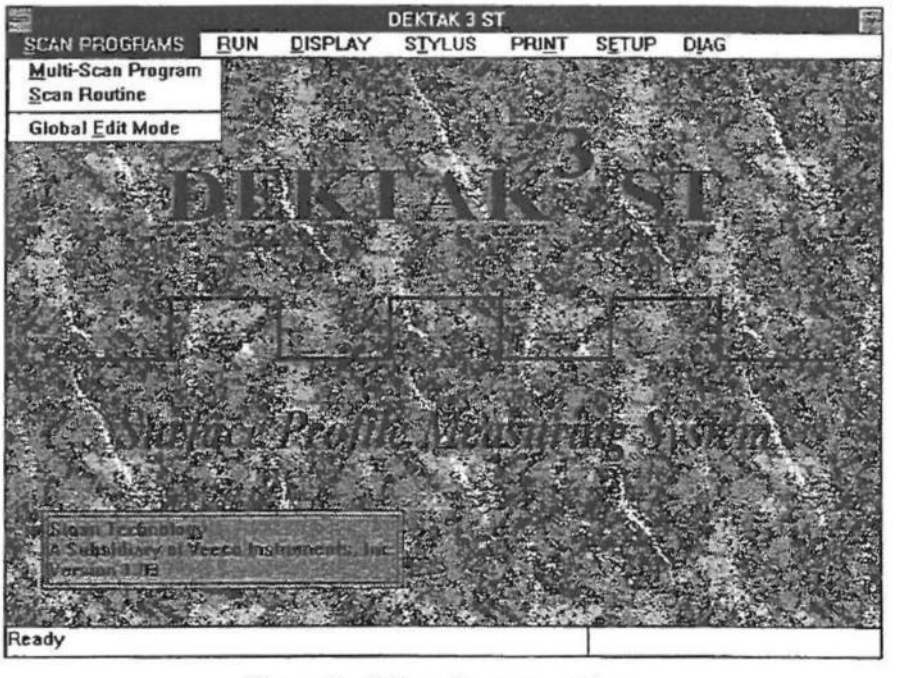


Figure 7 - 2 Scan Programs Menu

Run Menu

This pull-down menu is used to run a single scan routine or a Multi-Scan program. To access the Run Menu, click on RUN (see Figure 7 - 3).

Run Single Scan

When Run Single Scan is clicked-on, the scan head runs a scan according to the predetermined parameters of the current scan routine.

Run Program

When Run Program is clicked-on, all of the Scan Routines in the current Multi-Scan program are run, beginning with Scan Routine #1.

Run Program From

When Run Program From is clicked-on, the current Multi-Scan program is run beginning at the selected scan routine and through to the end of the Multi-Scan program.

Continue

This command is used to continue the current Multi-Scan program when the wait between scan routine function has been activated.

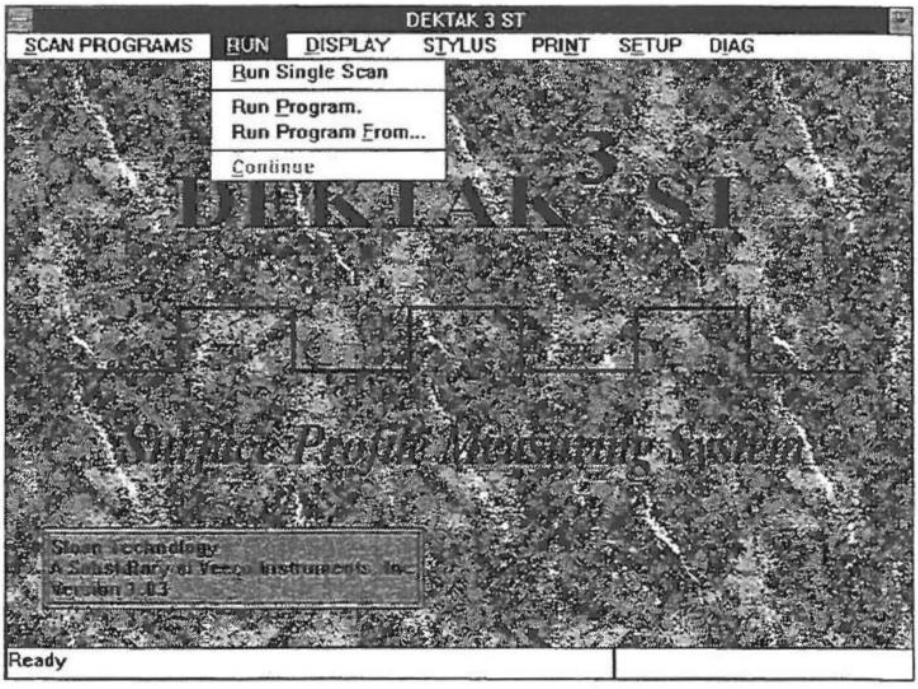


Figure 7 - 3 Run Menu

Display Menu

This pull-down menu is used for displaying various graphic and video screens. To access the Display Menu, click on DISPLAY (see Figure 7 - 4).

Sample Positioning

Displays the sample positioning screen.

Data Plot

Displays the graphic data plot screen. A scan routine must be run first.

Program Summary

Displays the program summary screen when enabled in the Multi-Scan program.

Video Only

Displays the video image of the sample surface from the video microscope.

Graphics Only

Displays the graphic screen only on the monitor, without the video image.

Video and Graphics

Displays the graphic screen superimposed over the video image.

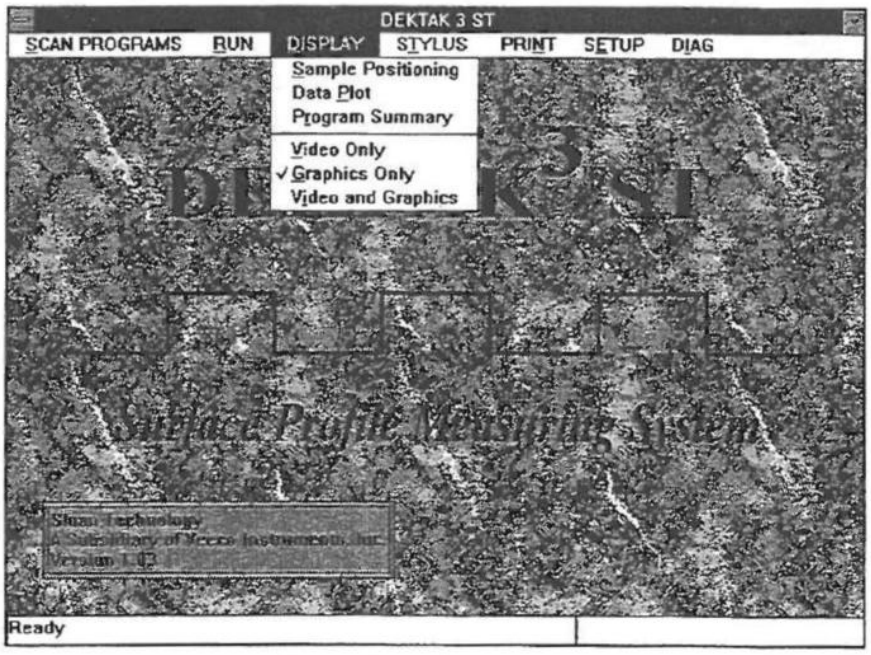


Figure 7 - 4 Display Menu

Stylus Menu

This pull-down menu is used to raise and lower the stylus and stylus tower. To access the Stylus Menu, click on STYLUS. The stylus menu will be displayed (see Figure 7 - 5).

Stylus Up

When Stylus Up is clicked-on, the system raises the stylus off the surface of substrate without raising the stylus tower. This provides an unobstructed view of the sample surface to the user and allows positioning of the stage, without contact between the stylus and sample.

Stylus Down

When Stylus Down is clicked-on, the stylus will be lowered onto the sample surface. The stylus is should be raised off the sample surface whenever the sample stage is repositioned.

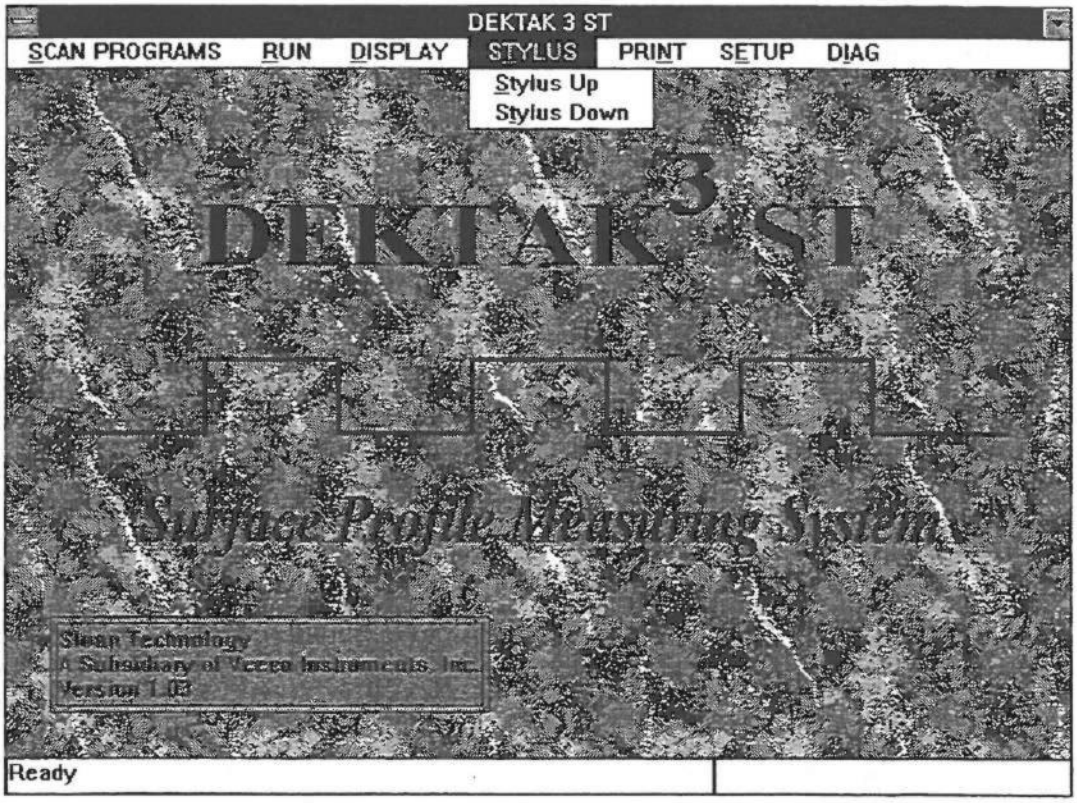


Figure 7 - 5 Stylus Menu

Print Menu

Plot And Summary

Prints out of the plotted profile trace along with the scan data summary.

Summary Only

Prints a summary of the scan data only.

Scan Routine Form

Prints the scan parameters and analytical functions of the current scan routine.

Multi-Scan Form

Prints the file name, data destination options, and scan routines entered into the current Multi-Scan program.

Multi-Scan Summary

Prints the Multi-Scan program summary. The program summary must be enabled and the Multi-Scan program run prior to attempting a printout.

Active Screen

Prints the entire graphic display image off the monitor screen to a raster-type, Windows compatible printer. See the Windows manual for a list of printers.

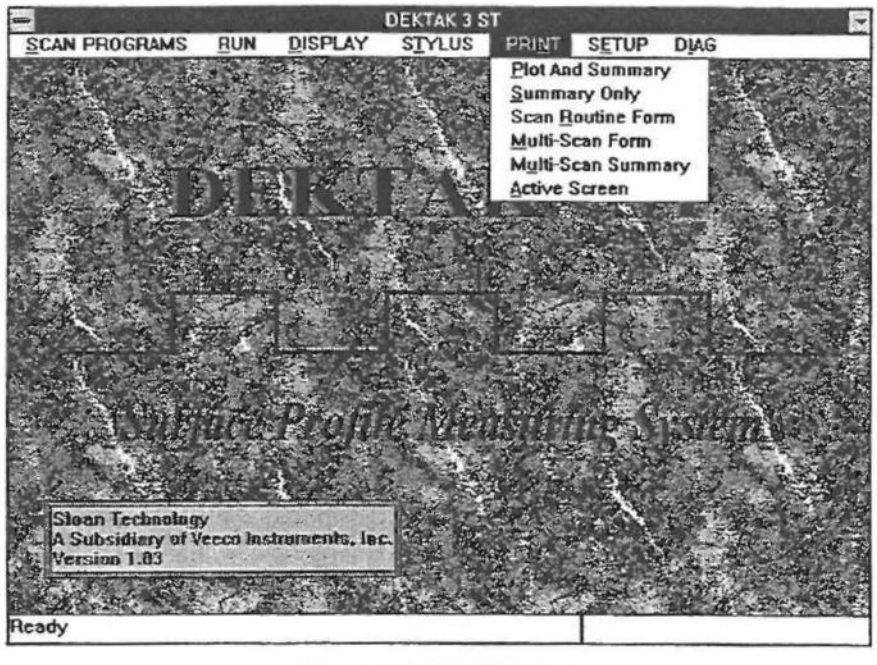


Figure 7 - 6 Print Menu

Set-Up Menu

This pull-down menu is used for setting up the printer, selection of sample templates, or for setting the vertical calibration (see Figure 7 - 7).

Vertical Calibration

Displays a dialog box for setting and clearing the vertical calibration of the Dektak3ST (see Section 10 of this manual).

Stylus Reticule

Permits the stylus reticule position to be adjusted.

Assign Printer Port

Allows the print signal to be transferred to the optional OmniPrint 426 thermal printer port or to an active Windows compatible printer.

Set Working Directories

Displays a dialog box which allows the working directories to be reset.

Assign Analytical Function To Keystroke

Allows analytical functions to be assigned to the F11 and F12 function keys.

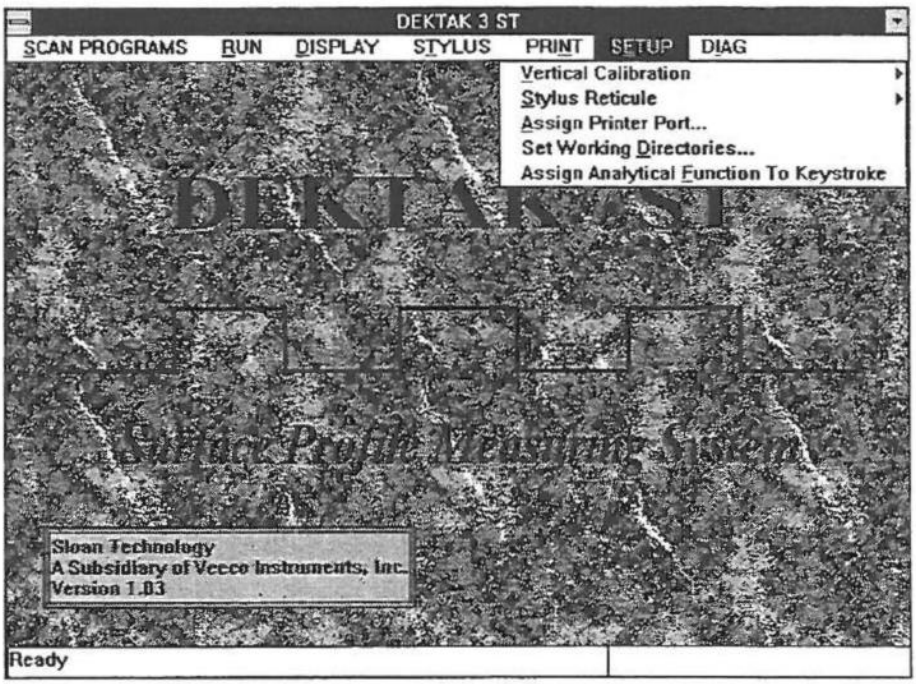


Figure 7 - 7 Set-Up Menu

Multi-Scan Programs Menu Selections

When the Multi-Scan program screen is displayed, additional menu selections are provided below the system menu bar (see Figure 7 - 8). These menus are briefly described below. A detailed description is provided in Section 5 of this manual.

File Menu

The File menu contains five selections: New opens the default Multi-Scan program file. Open displays a directory file of the saved Multi-Scan program files. Save As permits the current Multi-Scan program to be saved. Export allows Multi-Scan program to be saved in an ASCII format. Exit displays the Dektak^{3}ST sign-on message.

Edit Menu

The Edit menu (see Figure 7 - 8) also contains five selections: Insert Default Scan Rt establishes the current scan routine as the default scan routine. Delete Scan Rt deletes the current scan routine from the Multi-Scan program. Delete ScRt Range allows a range of scan routines to be deleted. Copy To allows the current scan routine to be copied to a requested scan routine number. Copy To Range allows the current scan routine to be copied to a range of scan routine numbers.

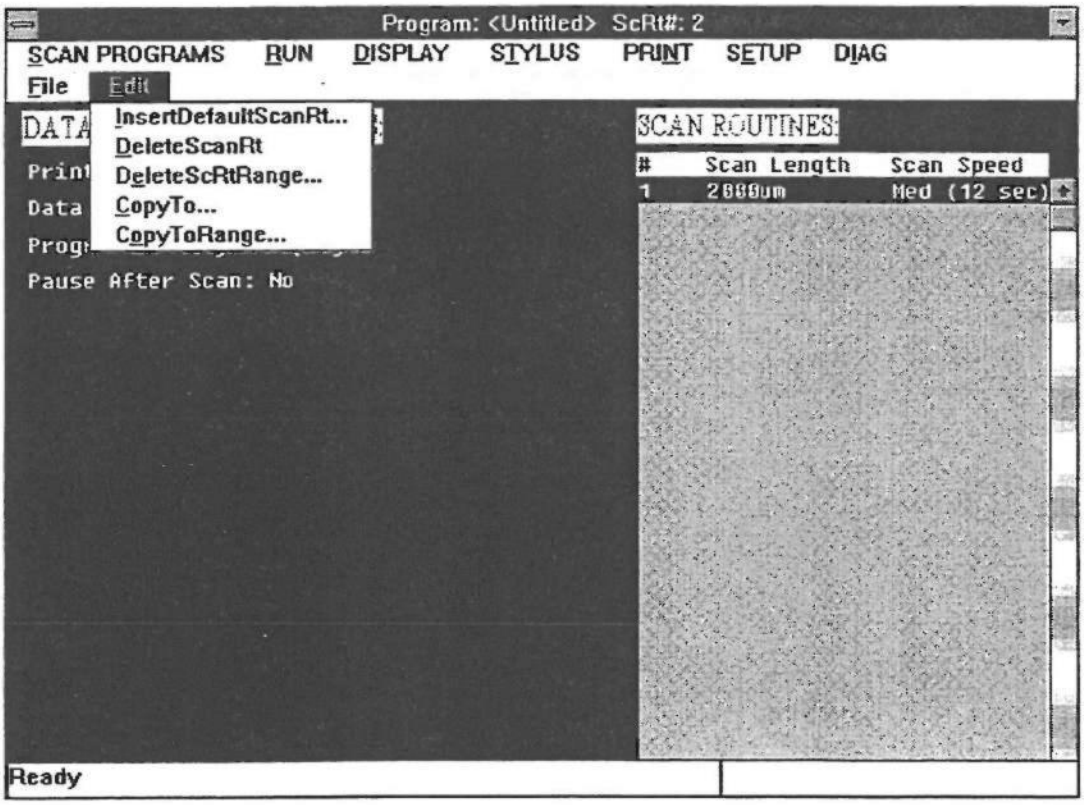


Figure 7 - 8 Multi-Scan Program Menu

Scan Routine Menu Selections

The scan routines screen is displays additional menu selections below the main menu bar (see Figure 7 - 9). These menus are briefly described below.

Edit Menu

The Edit Menu permits editing of individual scan routines within a multiscan program, by providing three menu options: Next, Previous, and Go To. Selecting Next displays the next scan routine in sequence of the current Multi-Scan program. Selecting Previous displays the previous scan routine of the current Multi-Scan program. The Go To function allows a selected scan routine to be displayed.

Analytical Functions Menu

The Analytic Functions Menu provides two menu options to append and delete the analytical functions within the scan routine. The analytic functions menu and its use is described in detail in Section 6 of this manual.

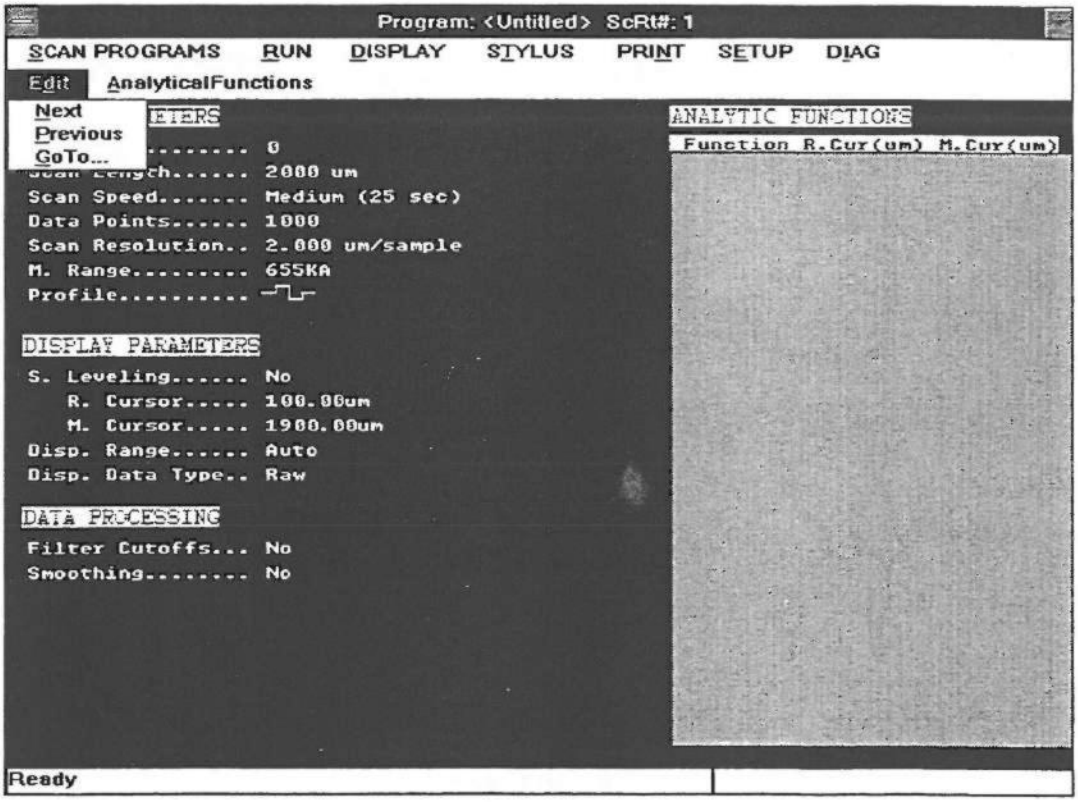


Figure 7 - 9 Scan Routine Menus

Section 8

Scan Routine Parameter Descriptions

Section 8 Overview

This section describes the various scan parameters and display parameters of the Scan Routine Screen (see Figure8 - 1). Up to 200 different Scan Routines can be entered into a single Multi-Scan program File. Each Scan Routine within an Multi-Scan program contains all the necessary parameters for performing a specified scan. These individual parameters are user selectable, providing extraordinary flexibility to adopt the Dektak3ST for a wide range of applications. The Scan Routine parameters discussed in this section include:

Scan Parameters Window

The scan routine screen (see Figure8 - 1) lists all the parameters of a specified scan routine. The parameters specific to the scan itself are listed under the heading Scan Parameters. Clicking-on any one of these parameters displays the scan parameters window (see Figure8 - 2). The procedure for setting the various scan parameters is described below.

Scan ID

This parameter permits a seven digit scan identification number or filename to be assigned. To enter the Scan ID, click on the scan ID parameter box and key-in the desired filename or number using the keyboard and press the enter key.

Scan Length

The maximum scan length allowed is 50,000 microns (50mm). To set the scan length, click on the Length parameter box enter the desired scan length using the Dektak^{3}ST numeric keypad, and press the enter key.

Scan Speed

The scan speed is directly related to the horizontal resolution and the number of data points per scan. Three default scan speed settings are available: Low speed (50 seconds), medium (12 seconds), and high speed (3 seconds) per scan.

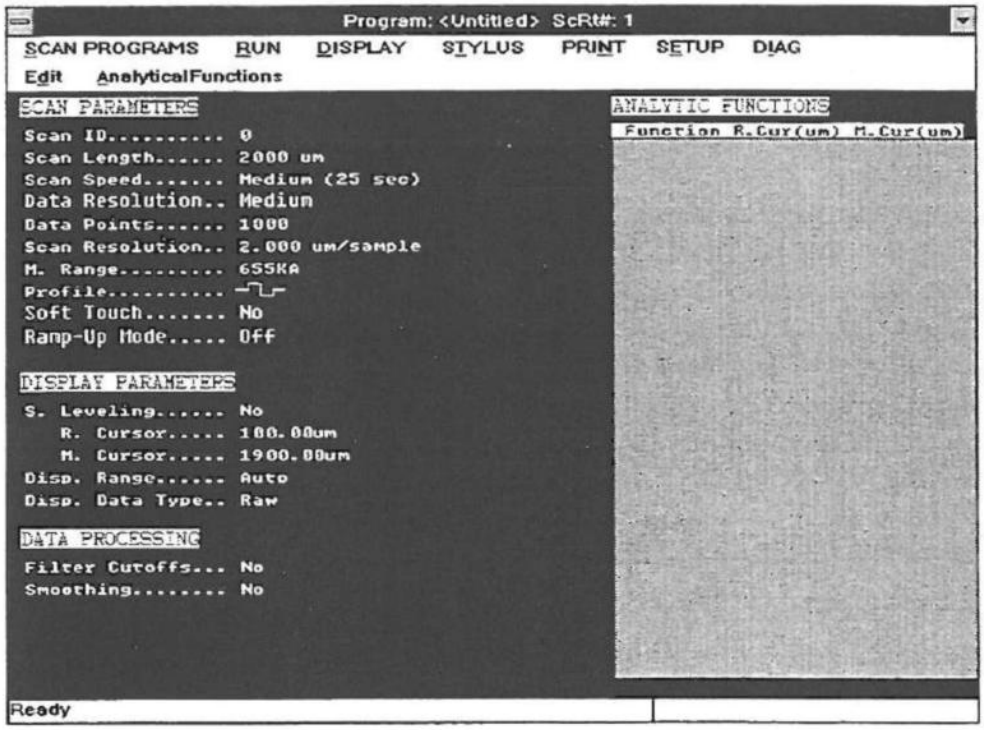


Figure8 - 1 Scan Routine Screen

Data Resolution

The data resolution parameter allows the horizontal resolution for the scan length and scan speed to be entered into the scan routine. The data resolution parameter provides three options: low, medium, and high. Adjusting the data resolution parameter adjusts the number of data points per scan and horizontal resolution (microns per sample), respectively.

Data Points

The data points parameter displays the number of data points per scan. The number of data points can only be adjusted by altering the data resolution or scan speed. The higher the number of data points the better the horizontal resolution. The Dektak^{3}ST has a maximum of 8,000 data points per scan (with the scan speed set at low and the data resolution set at high.

Scan Resolution

The scan resolution parameter is expressed in microns per sample. Therefore, the lower the number of microns per sample, the better the horizontal resolution. The Horizontal Resolution box in the scan parameters window displays the resolution (um/sample) for the scan length, speed, and data resolution of the current scan routine. Adjusting the scan length or speed or data resolution alters the horizontal resolution accordingly.

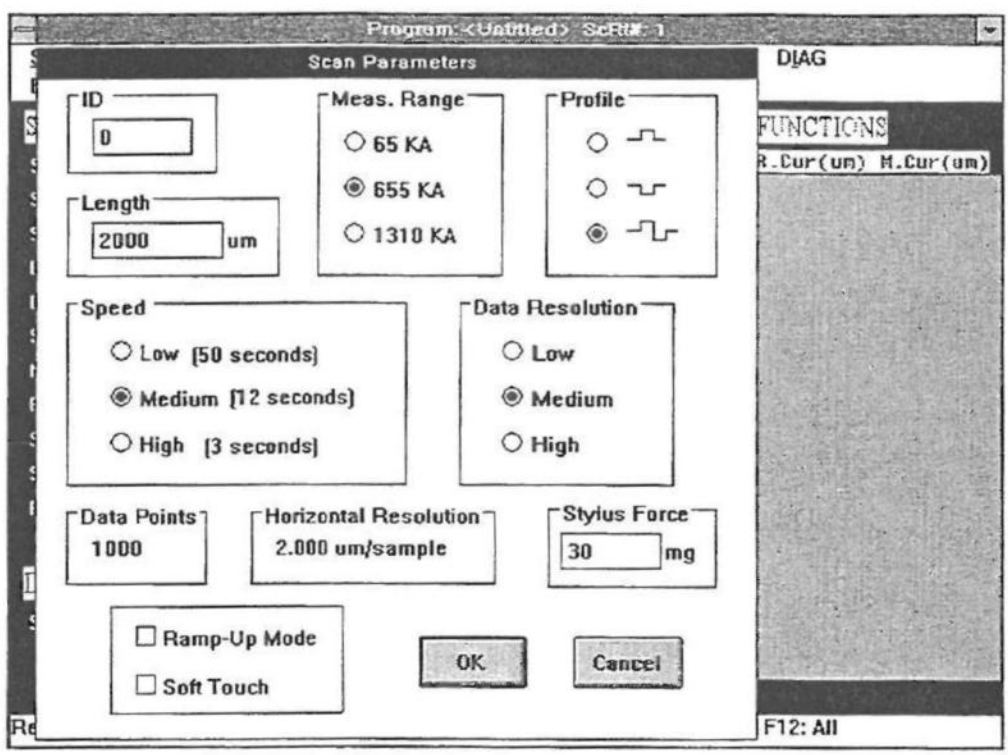


Figure8 - 2 Scan Parameters Window

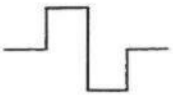
Measurement Range

The available vertical resolution depends upon the measurement range selected. When measuring extremely fine geometry's, the 65KA range provides a vertical bit resolution of 1A. For general applications, the 10A vertical resolution of the 655KA range is usually adequate. When measuring thick films or very rough or curved samples, the 1,310KA range with 20A resolution should be selected. The scan parameters window displays three measurement range selections: 65KA, 655KA and 1,310KA. Click on the desired measurement range to enter the selection.

Profile

The profile setting scales the measurement range according to the profile selected. Three different profiles are available for a variety of sample surface characteristics.

(Valleys) Provides 90% of the measurement range below the zero horizontal grid line. Used primarily for measuring etched depths.



(Hills and Valleys) Provides 50% of the measurement range above the zero horizontal grid line and 50% below. Used in most applications, especially if the surface characteristics of the sample are not well known, or if the sample is out of level.

(Hills) Provides 90% of the measurement range above the horizontal grid line. Used primarily for measuring step heights.

To set the profile, click on the selected profile and it will be entered into the scan routine program.

Stylus Force

The stylus force may be adjusted to compensate for various surface characteristics. When measuring soft material, a low stylus pressure should be used. When measuring hard samples with relatively large step heights, a high stylus force can be used to keep the stylus from lifting off the sample surface. The stylus force range is 1mg to 50mg.

When the scan parameters window is displayed, a new stylus force can be entered. To set the stylus force, click on the box labeled Stylus Force. Using the Dektak^{3}ST numeric keypad, key-in the desired stylus force in milligrams and press the enter key or click on OK.

Soft Touch

The tower speed determines at what velocity the stylus tower is lowered onto the sample surface. When measuring soft surfaces, the soft touch feature should be selected to eliminate stylus impact damage to the sample. Because the soft touch feature lowers the stylus tower at a slower speed, throughput may be effected. If throughput is important, a high tower speed can be selected when measuring hard surfaces. To activate the soft touch feature, click on the box labeled Soft Touch and click on OK (see Figure8 - 3).

Ramp-Up Mode

The Ramp-Up is a precision homing routine that requires a slightly longer return-after-scan time than the normal mode. The advantage of this mode is that the data taking starts immediately when the stage begins to travel allowing very small features to be positioned with extreme precision and accuracy with respect to the stylus/data start position.

The Ramp-Up Mode can be selected at Low speed with scan lengths of 500 microns or less. Ramp-Up Mode can be selected at Medium speed with scan lengths of 1,000 microns or less. Ramp-Up Mode can be selected at High speed with scan lengths of 2,000 microns or less.

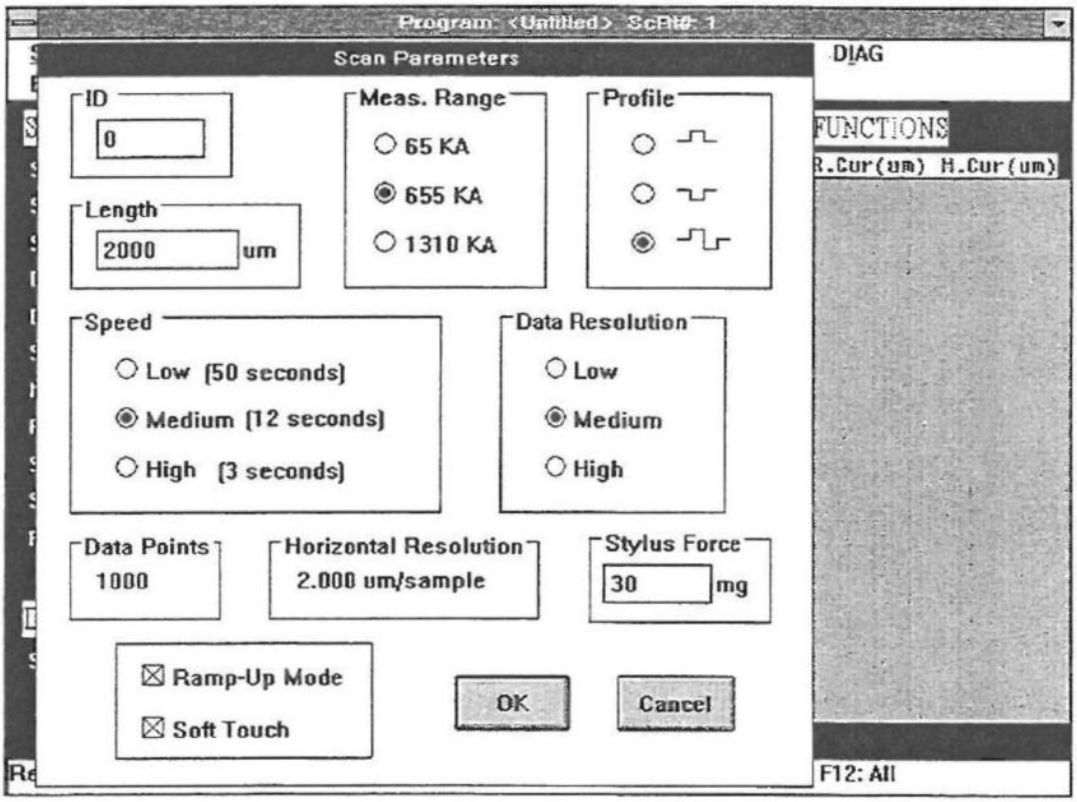


Figure8 - 3 Soft Touch and Ramp-Up Modes

Display Parameters

The Scan Routines screen contains additional parameters under the heading Display Parameters which allow automatic manipulation of the graphic display of the profile trace. Clicking-on any of the display parameters listed on the scan routine screen opens the Display Parameters Window (see Figure 8 - 4).

Software Leveling

The Dektak^{3}ST can be programmed to automatically software level the profile trace at the conclusion of a scan in relation to the cursor/trace intercepts. In order to obtain accurate step height readings and analytical calculations, the trace must be software leveled. Software leveling can be programmed into the scan routine. Cursor band widths can also be entered to perform 4-cursor delta leveling.

To enter software leveling, click on the box labeled Automatic Leveling in the display parameters window. When automatic leveling is selected, two additional boxes will be activated. These boxes permit the cursor band widths to be adjusted and entered into the software leveling parameter. If no bands are required, enter 0, and the default fine line cursors will be used to level the trace. If the desired cursor widths are known, they can be entered into the scan routine. The first box represents the width of the reference cursor and the second box is for setting the measurement cursor width.

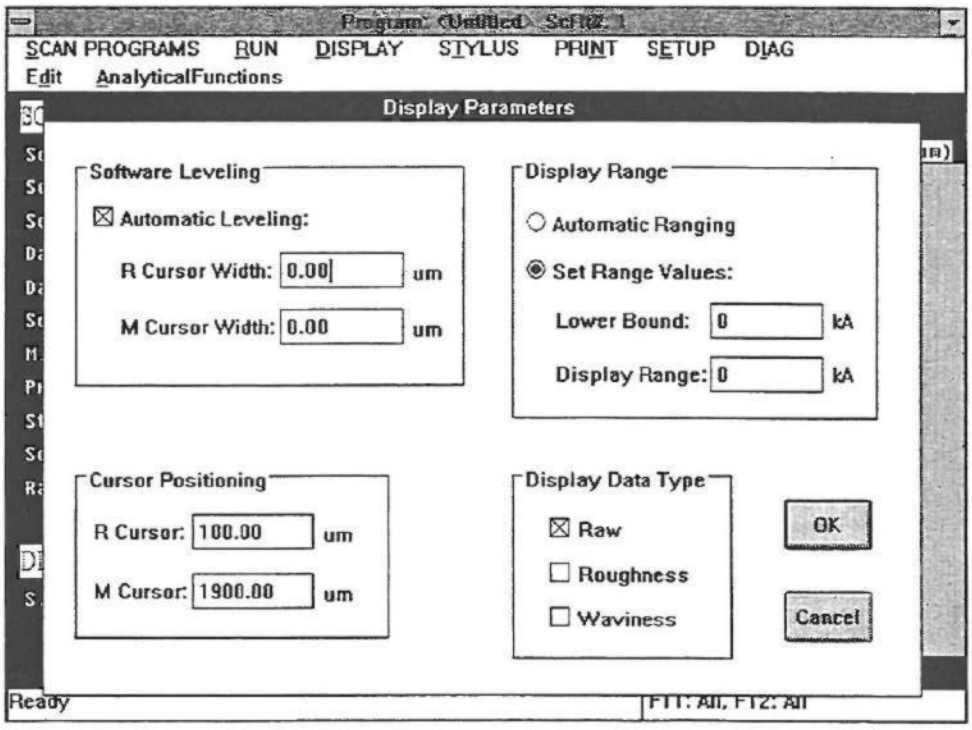


Figure 8 - 4 Display Parameters Window

Band Width Setting

Cursor band widths can also be entered from the Data Plot screen. Delta averaging technique is used to provide a roughness average reading of the section of the profile trace within the bands. The profile trace will then be automatically leveled according to the two average readings.

When setting the cursor band widths and cursor locations, it is often helpful to first run a sample scan of the scan routine to be leveled. Once the scan has been completed and the unleveled trace is displayed, position the cursors at two points on the trace that run along the same horizontal plane.

To set the cursor width click on the Bands menu from the Data Plot screen menu bar. Click on Set Bands and a window will be displayed permitting the cursor band widths to be adjusted (see Figure 8 - 5). Once the desired band widths are set, click on OK.

To enter the new band widths into the software leveling parameter of the Scan Routine screen, pull down the Bands menu again and click on Enter Software Leveling. The selected band width value will automatically be entered into the software leveling parameter.

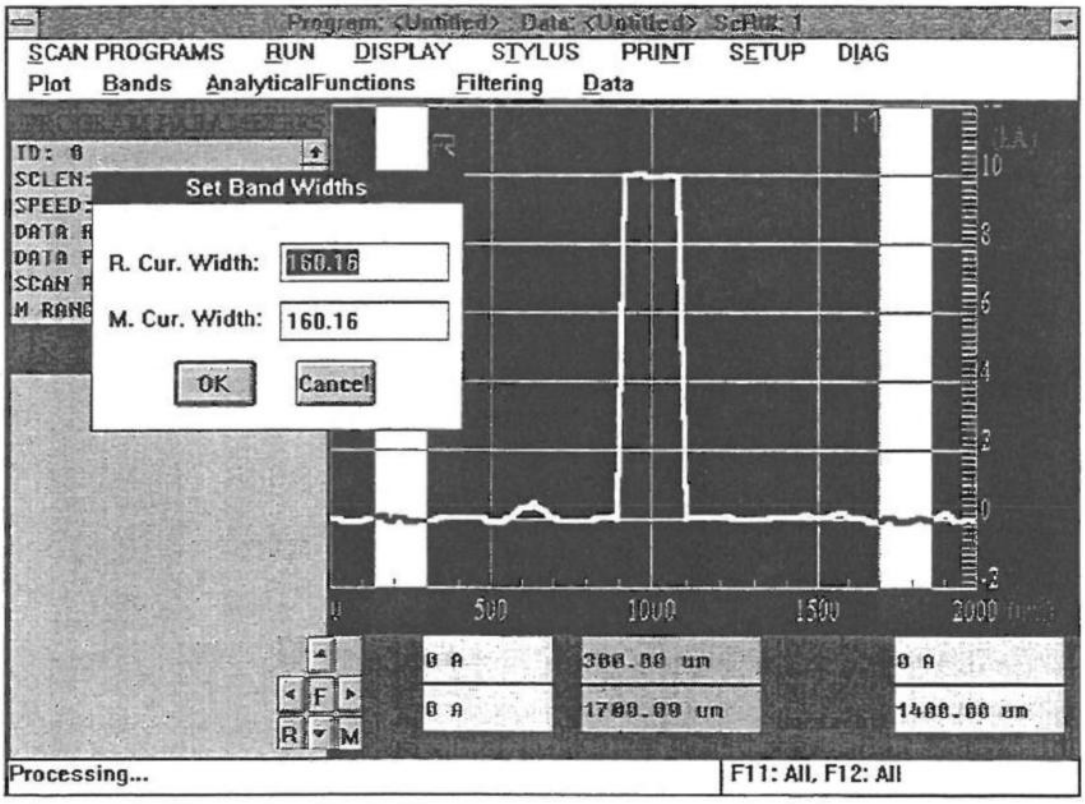


Figure 8 - 5. Software Leveling Band Width

Reference/Measurement Cursors

The R. Cursor and M. Cursor parameters permit the reference and measurement cursor locations in relation to the horizontal scale of the Data Plot screen to be entered into a scan routine. Once entered, whenever the scan routine is executed, the cursors will automatically be positioned to the programmed locations. The cursor settings are used to automatically software level the profile trace. If the desired cursor settings are known, they can be numerically entered directly into the Scan Routine screen, when the display parameters window is displayed (see Figure 8 - 4). This can be accomplished by simply clicking-on the boxes labeled R. Cursor or M. Cursor, and entering the desired cursor location.

Cursor locations can also be entered into the current scan routine from the Data Plot screen. To set the cursor locations for leveling, it is recommended that a sample scan be run of the feature to be measured. Once the scan is complete, position the reference cursor at a location along the reference plane (i.e., the base of a step or the lip of an etched depth). To accurately level the trace, the measurement cursor should be positioned away from the reference cursor, yet along the same horizontal plane. If the cursors cannot be positioned to intercept the scan trace at a point free of excess roughness or noise, the cursor bands should be used to accommodate for the roughness. Once the cursors have been properly positioned, click on Band from the Data Plot screen menu bar. Click on Enter Software Leveling from the Bands menu (see Figure 8 - 6). The new cursor locations will be entered into the scan routine.

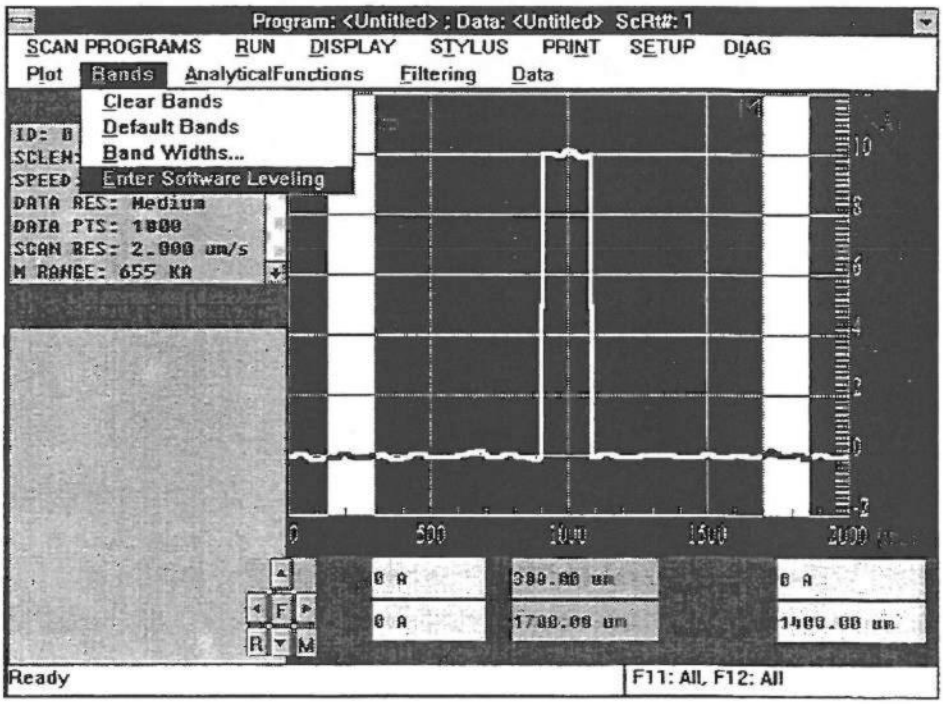


Figure 8 - 6. Cursor Parameters

Display Range

The Auto Ranging feature automatically scales and ranges the profile trace to fill 80% of the data plot display. However, in some applications where repetitive or like scans are being compared, it may be advantageous to preset the graphic scale by numeric entry.

To set the display range, click on the box labeled Set Range Values (see Figure 8 - 7). When set range values is activated two additional boxes for entering the lower boundary of the graphic scale and the display range are also activated. Enter the desired setting for the lower boundary in the first box. Enter the desired setting for the display range in the second box and click on OK.

Display Data Type

This parameter permits raw profile data as well as the roughness and waviness profile to be displayed. The raw profile and roughness or waviness profiles can be displayed individually or simultaneously, to easily correlate the profiles. A detailed description of the function and use of the Display Data Type parameter is provided in Section 6 of this manual.

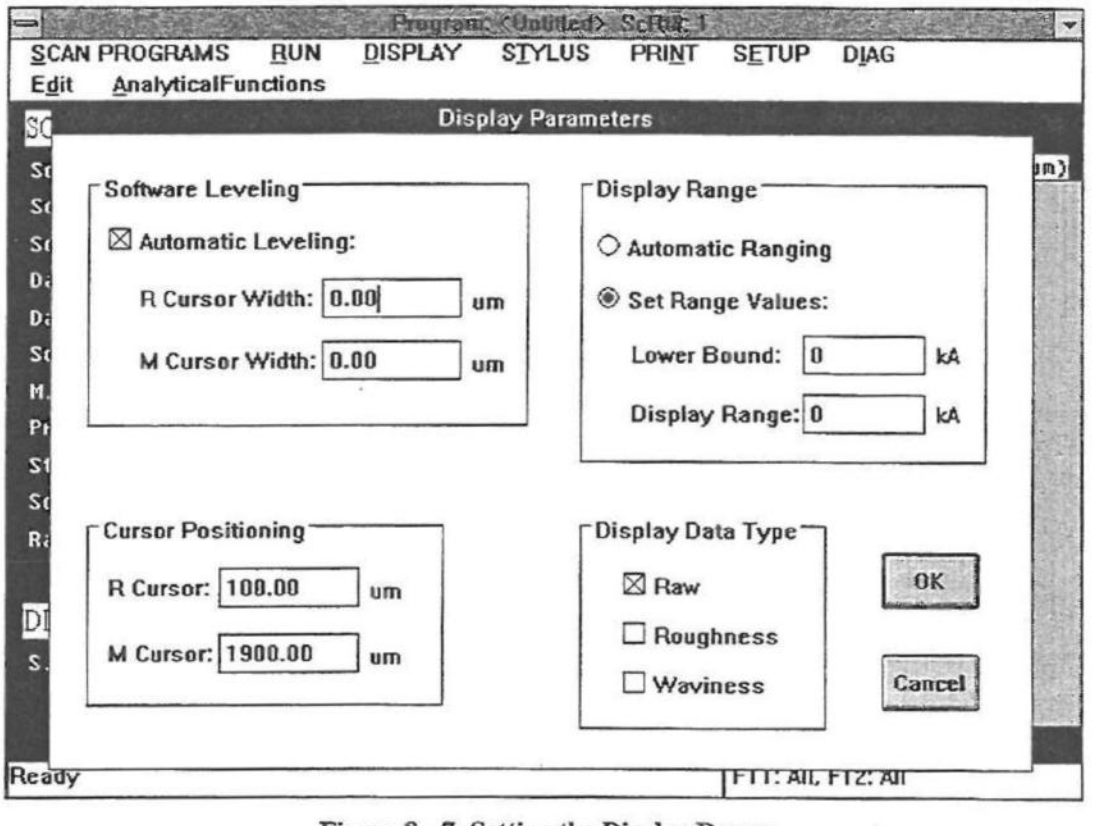


Figure 8 - 7. Setting the Display Range

Data Processing

The Dektak^{3}ST provides parameters for processing profile data for specific applications. Within the field of the Scan Routines screen are two parameters listed under the heading Data Processing. Clicking-on either parameter will display the data processing parameters window (see Figure 8 - 8). These parameters permit filter cutoffs and smoothing filters to be activated. Their use and function is described in detail in Section 6 of this manual.

Filter Cutoffs

Roughness and waviness filter cutoffs can be entered from the Scan Routine screen or the Data Plot screen. This parameter permits user selected cutoff values to be entered into the current Scan Routine. A short pass filter is available for calculating roughness analytical functions. A long pass filter is available for calculating roughness analytical functions.

Smoothing

The smoothing parameter permits a smoothing filter to be activated. When the smoothing function is used, raw, roughness and waviness profiles are calculated using the smoothed data. Three degrees of smoothing are available. The higher the degree, the more smoothing will be realized.

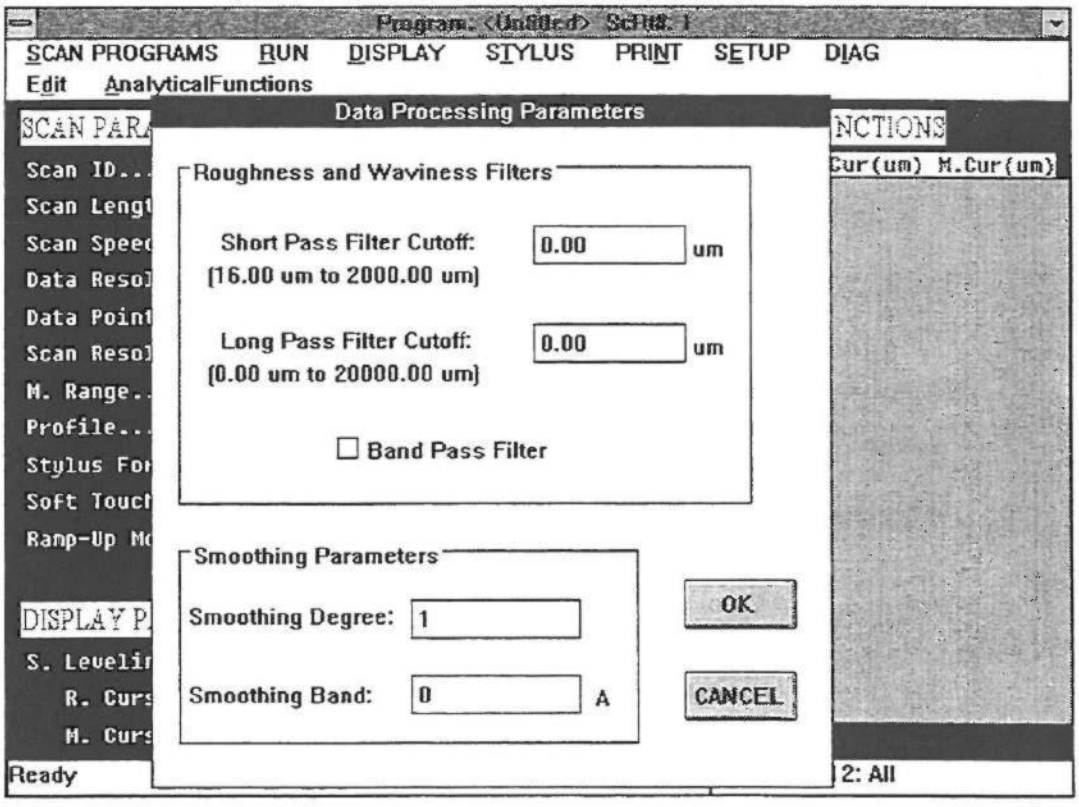


Figure 8 - 8. Data Processing Parameters Window

Section 9

Keyboard Description

Keyboard Functions

Key	*Function*
ESC (red)	(ABORT) Interrupts a scan or Multi-Scan program in progress. Also used to stop the stylus tower motion.
F1	(HELP) Reserved for future help screen.
F2	(VIDEO) Controls three video display modes: video only, graphics only, or video/graphics overlay.
F3 (yellow)	(STYLUS UP/DOWN) Raises and lowers the stylus tower.
F4 (green)	(RUN) Initiates the current scan routine.
F5	(PROGRAM) Displays the current scan routine screen.
F6	(R CURSOR) Selects the R cursor to be move by arrow keys.
F7	(M CURSOR) Selects the M cursor to be move by arrow keys.
F8	(LEVEL) Software levels a trace according to the R and M cursor/trace intercepts.
F9	(REPLOT) Will re-plot the trace according to the boundaries settings. Also redisplays the original boundaries.
F10 (blue)	(PRINT) Prints the scan data and plotted profile trace.
⇒	(RIGHT ARROW) Moves the selected cursor from left to right. Pressing Ctrl + ⇒ moves the cursor in fine increments.
⇐	(LEFT ARROW) Moves the selected cursor from right to left. Pressing Ctrl + ⇐ moves the cursor in fine increments.

Assigning Analytical Functions To Keystrokes

The Dektak3ST analytical functions can be assigned to the F11 and F12 function keys. This is useful if certain analytical functions are used frequently. The procedure for assigning an analytical function to a keystroke is described below.

1. Click on "SET-UP" and click on "Assign Analytical Function To Keystroke" from the set-up menu a dialogue box will be displayed (see Figure9 - 1).

2. The dialog box allows an analytical function to be assigned to either the F11 or F12 function key. Clicking-on the F11 or F12 box pulls down a menu listing of the available analytical functions. The menu may be scrolled down to view additional selection by clicking-on the down arrow key.

3. Click on the desired analytical function and it will be entered into the function key box. Click on "OK" to assign the selected analytical function to the keystroke. The keystroke assignments will be displayed in the lower right of the screen.

4. When a scan has been run and the profile is displayed on the data plot screen, the selected analytical functions can be run with the F11 and F12 keys.

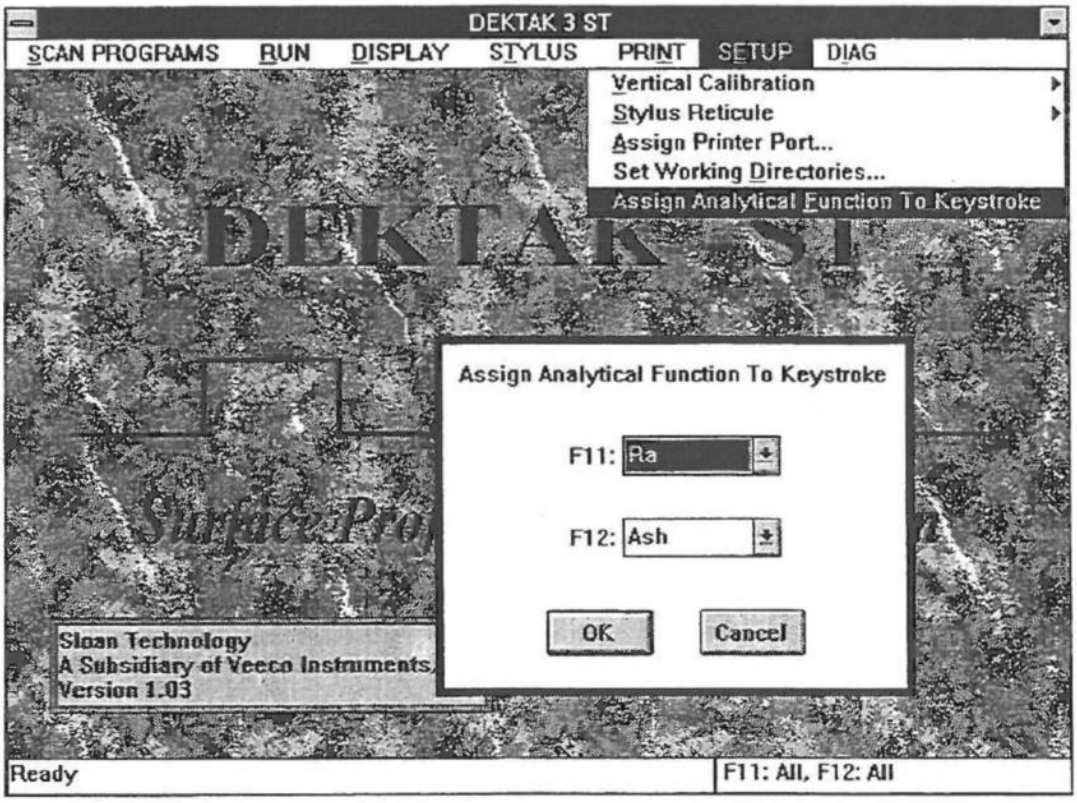


Figure9 - 1 Assign Analytical Function To Keystroke

Section 10

Maintenance And Warranty

Section 10 Overview

Items discussed in this section include:

Care and Handling

Like any precision instrument, the Dektak^{3}ST requires care in handling and operation. The recommendations below should be followed.

1. Allow the Dektak^{3}ST to warm up for approximately 15 minutes prior to use to stabilize the electronics.

2. Always position the sample so that the stylus is the only part of the stylus arm that touches the sample.

3. Never connect or disconnect any cables when power is on.

4. Do not lower the stylus tower without the stage assembly in place.

5. Do not move a sample during a scan.

6. Avoid vibration and shock during measurements. (A common source of this is an operator or observer touching or bumping a surface close to the instrument or the instrument itself during a scan.)

7. Always raise stylus tower and optics assembly to the full up position when the system is not in use, even when power is left on.

Cleaning the Stage

The key to prevent the quality of scans from deteriorating due to contamination is to clean the stage regularly. First the stage must be removed. Use caution in handling the stage. The surface block and stage pads must be cleaned with lint-free and abrasive-free tissues moistened with deionized water or lab grade alcohol.

To Remove the Stage

1. Raise the Stylus by clicking on STYLUS UP in the Stylus menu.

2. Raise the optics completely by using the optics height adjustment knob located on the front of the scan head.

3. Disengage the rack mechanism by inserting a standard 6" screwdriver through the 3/8" diameter hole on the right side of the scan head and into the slotted screw on the rack drive assembly. Turn the screw fully clockwise.

4. Carefully slide the stage towards you (the front of the machine).

To Clean the Stage

CAUTION

Do not use other solvents, such as spectrograde acetone, which may attack the adhesives used to mount the Teflon pads. To avoid damage to the Teflon pads, do not allow them to touch any surface other than the surface block.

1. Clean the surface block (sides and top), the Teflon pads, and around the Teflon pads with moistened lint-free tissues. Always wipe new spots with a clean portion of the tissue to avoid transferring contamination to another area. The standard Dektak^{3}ST stage assembly has three Teflon pads which ride on the Scan Head surface block. The motorized stage of the Dektak^{3}ST Auto I version has five Teflon pads on the base of the stage. The left side of the stage has two spring-loaded pads which bear on the side of the surface block. Those on the right are not spring-loaded.

2. Clean the rack loading block with a clean room swab and laboratory grade alcohol. Buff the cleaned surface block and stage pads with a clean lint free

cloth. The cloth should move evenly against a properly cleaned surface. DO NOT touch the Teflon pads or the surface block after cleaning; otherwise the procedure must be repeated.

3. Clean the rack and pinion gear with instrument grade "canned air." Hold the can upright and use short bursts to avoid releasing freon.

4. Closely inspect the Teflon pad surfaces. Ensure that no debris is embedded in the pads. Check to see that there is no excess adhesive from the pads adhering to any running surface. Inspect the surface block to ensure that there are no scratches or blemishes in the traverse area.

Vertical Calibration

The Dektak^{3}ST should be software calibrated regularly (at least once a month) to ensure vertical measurement accuracy. The exercise below uses the Veeco Process Metrology 10KA calibration standard. Additional calibration standards are also available to calibrate the instrument for a wide variety of applications.

Vertical Calibration Help Window

The Dektak^{3}ST provides user instructions for setting the vertical calibration. This window can be displayed from any screen but the Data Plot screen. The procedure to display the Vertical Calibration Help window is described below.

1. Click on SET-UP from the system menu bar located at the top of either the sign-on message, Automation Program, or Scan Routines screens. The set-up menu will be displayed (see Figure 10 - 1).

2. Click on Vertical Calibration from the set-up menu and click on Set. The vertical calibration help window will be displayed.

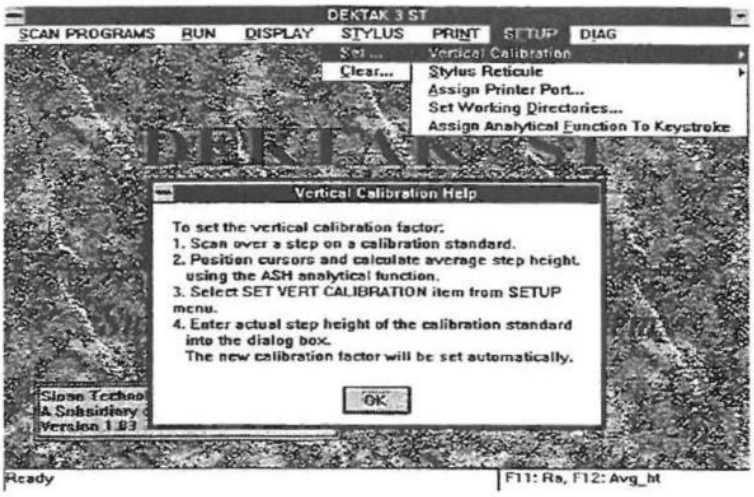


Figure 10 - 1 Vertical Calibration Set-Up

Scanning a Calibration Standard

To set the vertical calibration, a scan must first be run using a calibration standard and the average step height function must be calculated on the scan data. The detailed instructions for sample positioning, and running a scan are provided in Section 3 and 4 of this manual. For the purpose of discussion, the calibration procedure described below will use the 10KA calibration standard supplied with the Dektak^{3}ST.

1. Open a new Multi-Scan program and enter a scan length of 500 microns into the scan routine.

2. Position the calibration standard to run a 500 micron scan over the center of the dog bone shaped step of the 10KA calibration standard.

3. Click on Run Single Scan from the Run menu. The 500 micron scan will be run and the profile will be plotted.

4. Level the stage, as described in Section 4 of this manual.

5. Click on Run Single Scan a second time, and software level the trace as described in Section 4. The resulting profile should resemble Figure 10 - 2 below.

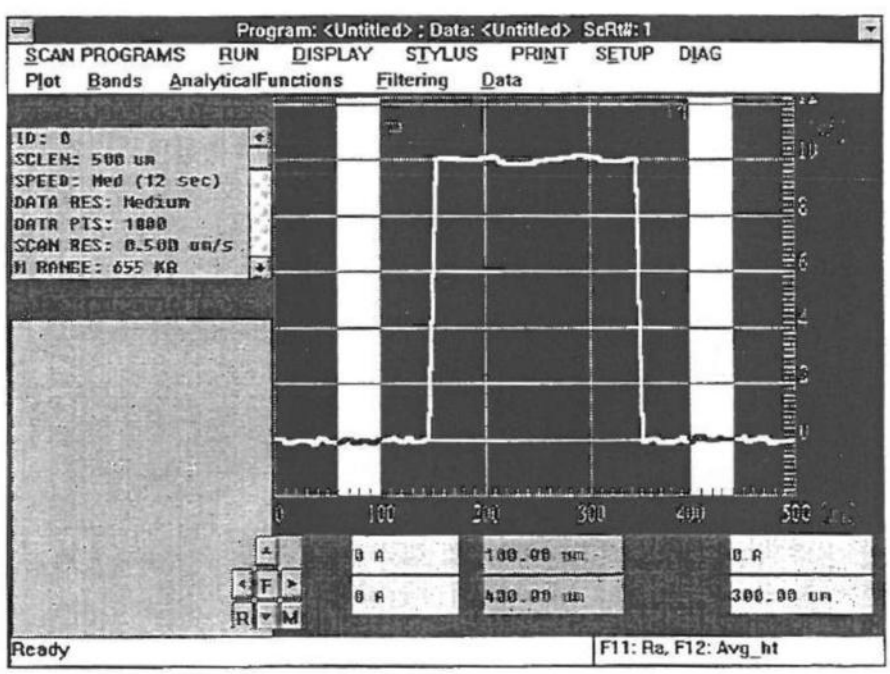


Figure 10 - 2 Calibration Standard Step Height

Calculating Average Step Height

It is recommended that the cursor band widths be set at approximately 100 microns for calculating the average step height analytical function. The cursor bands can also be used for software leveling the trace. A detailed description of the procedure for setting the width of the bands is provided in Section 8 of this manual.

1. To set the cursor bands, click on Default Bands from the bands menu and enter band widths of 100 microns for each cursor.

2. With the reference cursor positioned along the base of the step, reposition the measurement cursor to the center of the step (see Figure 10 - 3).

3. Click on Analytical Functions and click on ASH to activate the average step height parameter and click on COMPUTE. The average step height will be calculated and the result will be displayed to the left of the Data Plot screen.

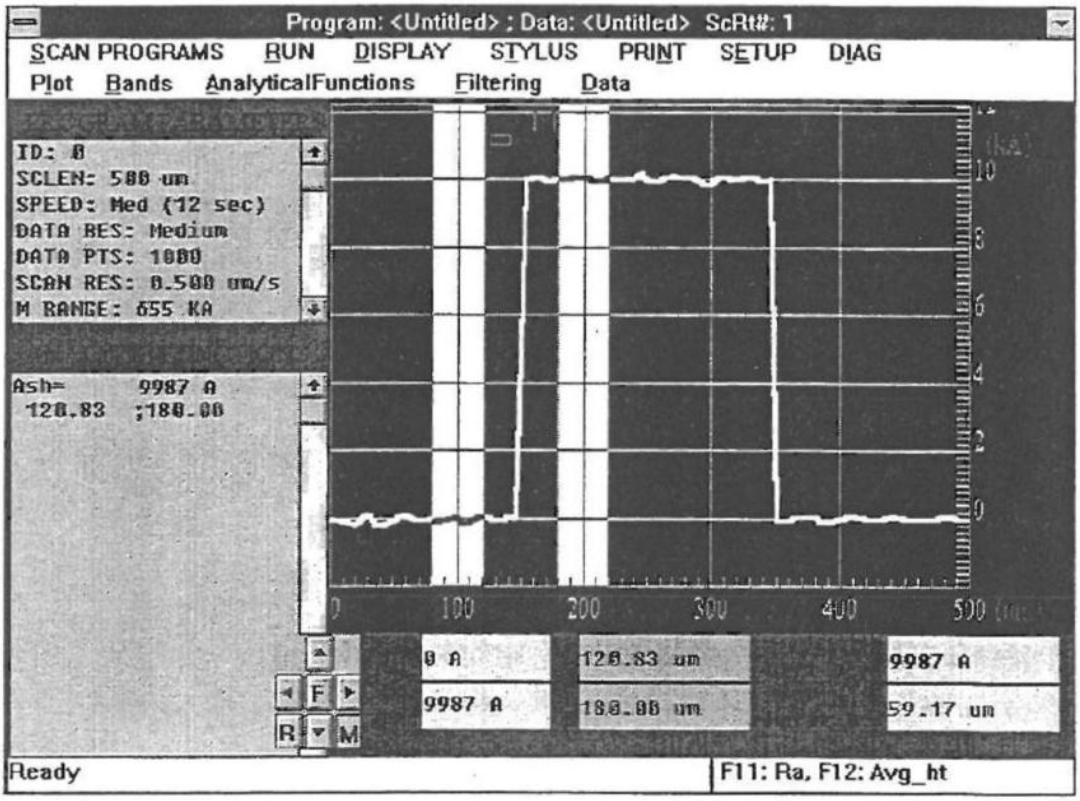


Figure 10 - 3 Calculating Average Step Height

Setting the Vertical Calibration

Once the average step height has been calculated, the vertical calibration can be set from the data plot screen.

1. Click on SET-UP from the system menu bar and click on Vertical Calibration from the set-up menu. A dialog box will be displayed permitting the vertical calibration to be set (see Figure 10 - 4).

2. The dialog box displays the measurement range of the current Scan Routine. The Set Options selections permit the vertical calibration to either be set for the current measurement range, or for all three ranges: 65KA, 655KA and 1,310 KA. For the purpose of this exercise, click on Set for All Ranges.

3. The Measured Step Height value is actually the average step height value calculated on the just concluded scan. In the box labeled Actual Step Height, enter the certified step height value printed on the certificate of calibration and on the case provided with the 10KA calibration standard.

4. Click on OK to set the vertical calibration. When the scan routine is rerun and the average step height function is once again calculated, the ASH result should equal that of certified value.

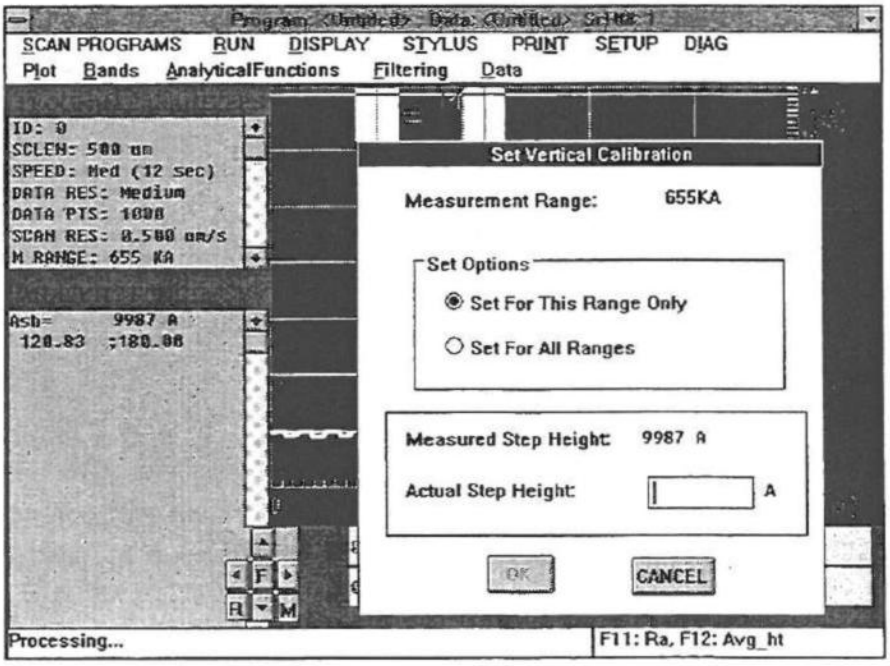


Figure 10 - 4 Set Vertical Calibration Dialog Box

Clearing Vertical Calibration

Whenever the vertical calibration is set, the old values are automatically cleared and replaced by the new parameters. However, in some cases, it may be desirable to clear individual ranges or all ranges. This procedure is described below.

1. Click on Vertical Calibration from the set-up menu and click on Clear, the clear vertical calibration dialog box will be displayed (see Figure 10 - 5).

2. The dialog box permits the vertical calibration to be cleared from the various display ranges either individually or from all the ranges. Click on the range or ranges to be cleared and click on CLEAR and click on OK. The vertical calibration will be cleared from the selected range or ranges.

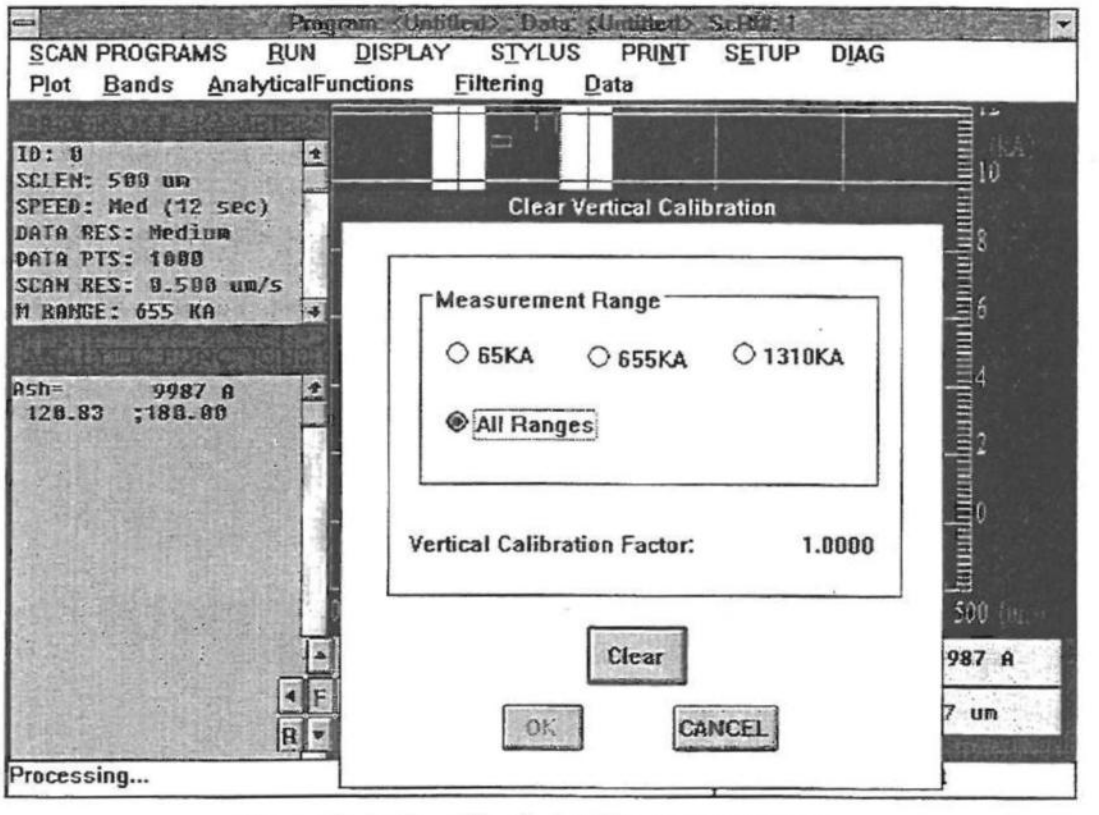


Figure 10 - 5 Clear Vertical Calibration Dialog Box

Changing the Time and Date

The Dektak^{3}ST computer has an internal clock which keeps the time and date. Resetting the clock is accomplished in the MS-DOS executive window. The procedure for setting the time and date is described below.

1. Click on the System Menu Box located in the uppermost left corner of the Dektak^{3}ST screen. Click on Switch To... from the system menu. The MS-DOS task list window is displayed.

2. Double click on the Program Manager. If the Windows main menu is not displayed, double click on the Main icon.

3. Double click on the Control Panel icon from the main menu, the control panel will be displayed (see Figure 10 - 6). Double click on the Date/Time icon. A window will be displayed for changing the date and time.

4. To change the time or date, click on the item to be changed (for example, minutes). The item will be highlighted and arrows will be displayed to increase or decrease the number. Once the desired time and date is set, click on OK and click on the control panel menu box and click on Close.

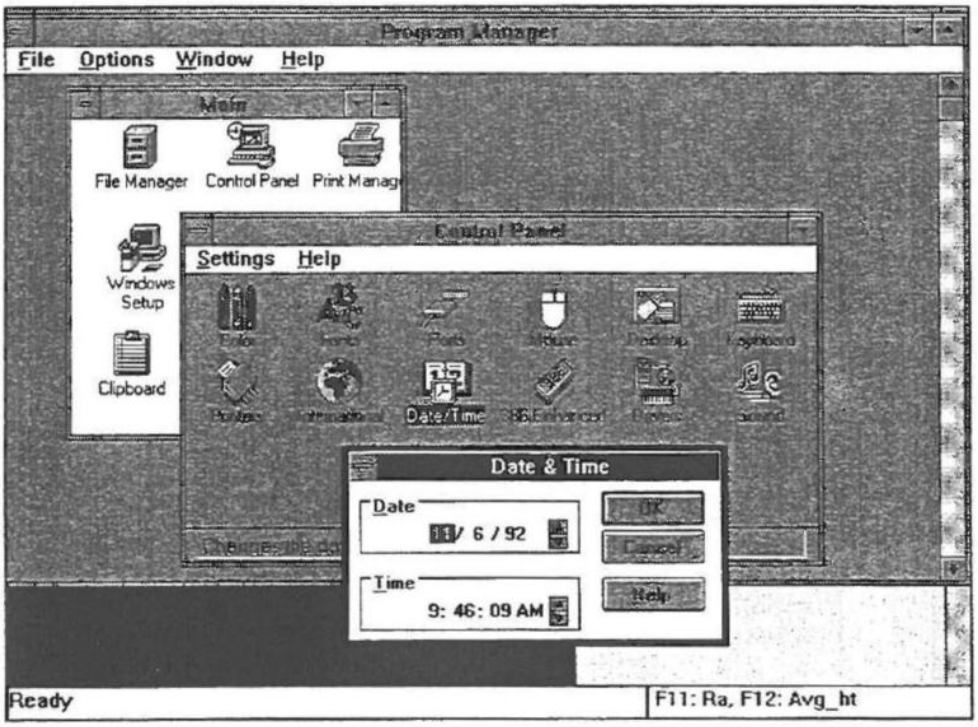


Figure 10 - 6 Time and Date Control Panel

Formatting a Data Disk

Dektak^{3}ST Multi-Scan programs and scan data files can be stored on external floppy disks rather than on the hard disk drive. The 5¼ inch floppy disk drive on the Dektak^{3}ST computer is the A drive. The Dektak^{3}ST B drive is the 3½ inch diskette drive. Before a diskette can be used, it must be formatted. The procedure for formatting a 3½ inch diskette in the Dektak^{3}ST B drive is described below.

1. Click on the System Menu Box located in the uppermost left corner of the Dektak^{3}ST screen. Click on Switch To... from the system menu. The MS-DOS task list window is displayed.

2. Double click on the Program Manager. If the Windows main menu is not displayed, double click on the Main icon.

3. Double click on the File Manager icon from the main menu, the file manager will be displayed. Click on Disk from the file manager menu bar and click on Format Disk. Enter the B drive as the assigned disk drive. Insert a new 3½ inch diskette into drive B and click on OK. The diskette inserted into drive D will be formatted.

CAUTION

Formatting a disk erases any data that currently exists on the disk.

Deleting Files

Multi-Scan program files and scan data files can be deleted from the hard disk from the Windows file manager.

1. Click on the System Menu Box located in the uppermost left corner of the Dektak^{3}ST screen. Click on Switch To... from the system menu. The MS-DOS task list window is displayed.

2. Double click on the Program Manager. If the Windows main menu is not displayed, double click on the Main icon.

3. Double click on the File Manager icon from the main menu, the file manager will be displayed. Click on the file to be deleted, the selected file will be highlighted.

4. Click on File from the menu bar, and click on Delete from the File Menu. A dialog box will display the file to be deleted. Click on OK to delete the file.

Stylus Replacement

All Dektak^{3}ST styli have the same shank size. They differ only in the radius of the diamond tip. The procedure to replace a stylus is described below.

CAUTION

Do not remove the stylus protection fixture when replacing a stylus. If it is removed, the vertical range of the LVDT will be misaligned and it will require service.

1. Click on the Stylus and click on STYLUS UP to raise the stylus. Raise the optics tower all the way up.

2. Turn off all power to the Dektak^{3}ST.

3. Remove the environmental shield.

4. Place a piece of lint-free tissue on the sample stage to catch the stylus that is already in place.

5. The stylus retaining screws are located on either side of the stylus assembly, just above the stylus. Locate the stylus retaining screw above the colored dot on the stylus and use a .035 Allen wrench to loosen the stylus retaining screw. One and one-half turns should be sufficient.

6. If the stylus does not drop free, loosen the opposing set screw ¼ turn.

7. Remove the replacement stylus from shipping capsule. Use a pair of tweezers to install the replacement stylus in the stylus arm. The flat on the stylus shank should be facing the stylus retaining screw. Gently push the stylus up until the top of the stylus shank is flush with the top of the stylus holder. Retighten stylus retaining screw.

CAUTION

Gently tighten the stylus retaining screw. The threads are very fine, so use extra care not to over-tighten.

8. Turn on the Dektak^{3}ST and check stylus position relative to stylus reticule.

Aligning Video Image of Stylus with Software Reticule

All Dektak^{3}ST zoom optics assembly has been adjusted at the factory for parafocal length and focus, it should not require additional adjustment. However, if the video image of the stylus on the monitor has shifted significantly so that the stylus cannot be aligned with the software reticule, adjustment to the optics may be necessary.

CAUTION

Please consult with Veeco Field Service prior to attempting adjustments in regards to the optics parafocal length, focus, mirror angle , or stylus position on the video monitor.

1. With power on, position a calibration standard or other sample under the stylus.

2. From the Sample Positioning Window, click on the Stylus and click on STYLUS DOWN to lower the stylus. Adjust the optics height adjustment knob until the stylus and shadow meet at the approximate center of the monitor.

3. Remove the environmental shield.

4. Adjust the focus with the stylus down by rotating the optics focus adjustment ring at the end of the camera lens. Because the camera is at a 45° to the surface, the entire image will not be in focus from the top to the bottom of the monitor. Adjust the focus until the tip of the stylus is located within the area of focus at maximum magnification.

5. Zoom in and out to check the stylus position relative to the software reticule. If the position of the stylus moves significantly along the horizontal axis of the reticule or if the stylus is so far off center that reticule cannot be realigned with video image of the stylus, adjustment to the optics may be necessary.

6. To adjust the position of the stylus image along the horizontal axis of the software reticule, use a 9/16" hex driver to loosen the two right angle adapter set screws (see Figure 3-4).

7. Slide the camera in or out to move the position of the stylus image to the left or right on the software reticule. Retighten set screws verify that stylus position does not shift when zooming in and out. Repeat step 6 and 7 as necessary.

8. If the stylus position remains constant when zooming in and out but is still not located in the center of the monitor, the four set screws on the front of the optics assembly can then be used to position the stylus in the center of the screen.

Illuminator Lamp Replacement

CAUTION

Do <u>not</u> touch lamp while power is on. The bulb is extremely hot.

1. Click on STYLUS and click on Stylus Up to raise the stylus to the full up position. Raise the optics tower to the full up position.

2. Turn off the Dektak^{3}ST.

3. Remove the screw attaching the cover plate to side of the illuminator and remove the cover plate.

4. Pull the lamp straight out.

5. Place a new bulb in the socket and check the reference dimension. For optimum illumination, set the bulb filament parallel to the filter (see Figure 10 - 7). If the new lamp does not light, check the lamp wire connection at the rear of the optics bridge.

6. Replace the illuminator cover plate.

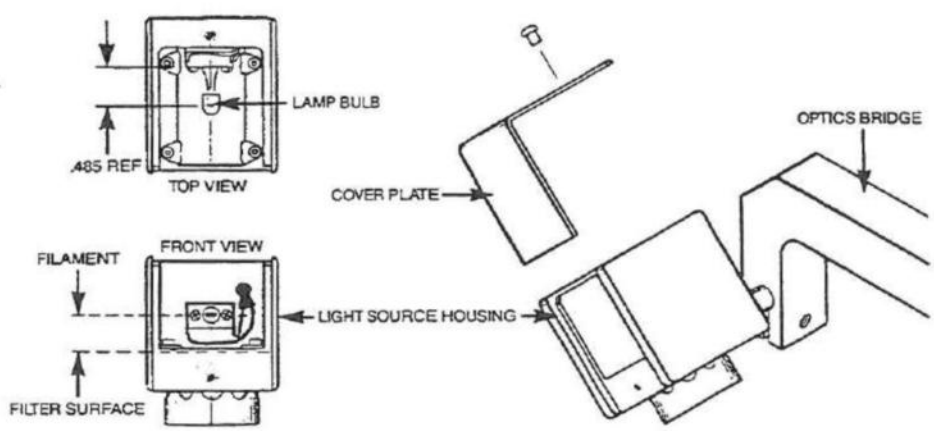


Figure 10 - 7 Illuminator Lamp Replacement

Error Messages

The table below lists the error messages associated with Dektak^{3}ST software and hardware error conditions. Please call Veeco Process Metrology field service for further assistance should any of these error messages be displayed.

Message	Operation	Error Condition
home x axis position error	scan	faulty home or end sensor; faulty scan motor or tachometer; disconnected SHI:J3, SHI:J4
Tower: won't go up	start up	faulty tower motor or tachometer; disconnected SHI:J5
Not Enough Disk Space For Printing	print	hard disk full
dek3.dll Dynamic Link Library Not Found	start up	s/w not properly loaded
Did not get Pointer to dek3 hardware functions	start up	s/w not properly loaded
Not Enough Memory Available For Printing	print	faulty RAM in computer; incorrect CMOS setup; s/w not loaded properly
Timeout waiting for AD PORT C BIT 4 to SET	scan	faulty tower motor or tachometer; disconnected SHI:J5
Timeout waiting for AD PORT C BIT 5 to SET	scan	stylus stuck up
Timeout waiting for AD Conversion	scan	scan head not connected; faulty SHI; faulty DIB
Timeout while Coarse Nulling Tower	scan	faulty top sensor; disconnected SHI:J6
Timeout while moving forward to clear home sensor during stage homing		
Timeout while moving to rampup position during stage homing		
Timeout while moving to home sensor during stage homing		

AC = Anti-Crash Board
SCB = Signal Conditioning Board
SHI = Scan Head Board

Service Contracts

To maximize equipment uptime and avoid major repairs, Veeco Process Metrology offers customized service contracts to meet customer needs. These contracts can be used to extend the one-year factory warranty. Service contracts include routine maintenance to keep the equipment up to factory spec.

For more information, call Veeco Process Metrology and ask about service contracts:

Santa Barbara, CA: (805) 963-4431

Major Repairs

WARNING

The computer console and/or Video Monitor should NEVER be opened when connected to the primary power source. Major service should only be performed by qualified, factory trained, Veeco Process Metrology Service Engineers.

The Dektak^{3}ST cannot be readily repaired after major component failures without the assistance of specialized test equipment and software routines. In the event of equipment failure, please call the Veeco Process Metrology Service Center for assistance.

Before calling the Veeco Service Center, check the following:

1. Reboot the Dektak^{3}ST by first turning the system off, and then turning the power back on.

2. Are all cables properly connected and free of obvious damage?

3. Is the power cord connected properly?

4. Is the sample illumination properly adjusted?

5. Does the stylus tower move up and down when Stylus Up or Stylus Down is clicked-on?

Warranty

All new catalog-listed standard equipment sold and/or manufactured under Veeco Process Metrology's labels, is warranted by Veeco Process Metrology to be free of defects in material and workmanship if properly operated and maintained. This warranty covers the cost of necessary parts and labor (including, where applicable, field service labor and field service engineer transportation) during the warranty period.

The warranty period is one (1) year.

Warranty period takes effect upon date of shipment. Except as excluded below, these warranties extend to parts which are manufactured by persons other than Veeco Process Metrology which are components of standard catalog items. Purchased equipment incorporated into any item supplied by Veeco Process Metrology will be covered by manufacturer's warranty.

Expendable items, including but not limited to styli, lamps, and fuses, are specifically excluded from the foregoing warranties and are not warranted. All used Equipment is sold on an "as is, where is" basis without warranty, express or implied.

Equipment made or modified to Purchaser's specifications on special order shall carry the above warranties with respect to material and workmanship, but shall be specifically excluded from any other warranties, express or implied, including those related to performance specifications, and any special components shall only carry the original manufacturer's warranties.

Warranty Claims

Veeco Process Metrology's obligation under these warranties is limited to repairing or replacing at Veeco Process Metrology's option defective non-expendable parts. Veeco Process Metrology's obligation shall not extend to defects that do not impair service. No claim will be allowed for any defect unless Veeco Process Metrology has received notice of the defect within thirty days following its discovery by Purchaser.

Claims for Shipment Damage

No claim will be allowed for Equipment damaged in shipment sold under standard terms of F.O.B. Factory. Within thirty days of Purchaser's receipt of Equipment, Veeco Process Metrology must receive notice of any defect which Purchaser could have discovered by prompt inspection of Equipment. In any event, Veeco Process Metrology shall have the option of inspection at Purchaser's premises or at Veeco Process Metrology 's plant, before allowing or rejecting the claim.

Warranty Eligibility

To be eligible for the above warranties, Purchaser must perform preventive maintenance in accordance with the schedule set forth in the Operation and Maintenance Manual provided. Veeco Process Metrology assumes no liability under the above warranties for Equipment or system failures resulting from improper operation, improper preventative maintenance, abuse or modifications of the equipment or system from the original configuration.

NOTE

This warranty is in lieu of all other warranties, expressed or implied and constitutes fulfillment of all of Veeco Process Metrology's liabilities to the purchaser. Veeco Process Metrology does not warrant that the system can be used for any particular purpose other than that covered by the applicable specifications. Veeco Process Metrology assumes no liability in any event, for consequential damages, for anticipated or lost profits, incidental damages or loss of time or other losses incurred by the purchaser or any third party in connection with systems covered by this warranty or otherwise.

Service

Field Service is available nationwide. Service and installations are performed by factory trained Veeco service engineers.

Contact Veeco Process Metrology and ask for field service.

Veeco Process Metrology
602 East Montecito Street
Santa Barbara, CA 93103
Phone: (805) 963-4431
Fax: (805) 965-0522

APPENDIX A

Options, Accessories And Replacement Parts

Options

Item	*Description*	*Part No.*
Omni 426 Printer	Centronics-compatible graphics thermal printer. Includes one roll of paper	173804 (115V) 173805 (220V)
Omni Printer Paper	OmniPrint 426 Model.	085542
Clean Room Paper	All Omni Models.	085556
Extended Optics	70X to 400X.	508360
Vacuum Chuck	Designed to hold 100mm-150mm wafers. Features include continuous 360° rotation, removable wafer flat alignment pins, and on/off vacuum control switch and all necessary hardware.	154008
Disk Mounting Hubs	Complete set includes hubs for 65mm, 95mm, and 130mm disk sizes.	172935
Vibration Isolation Platform	This active table isolates the scan head from external vibrations. Table measures 20"Lx24"Wx3"H. Passive design does not require continuous air supply.	085620
MotoZoom	Permits remote control of the 35-200x zoom optics on the standard model of the Dektak^{3}ST.	154009
Clean Room Manual	Printed on clean room paper with ultra-low particulate, extractable, and sodium levels. Bond in moisture-proof polyethylene binder	173009

Accessories

Item	*Description*		*Part No.*
Styli	Color Code	Size	
	Black	25 micron radius	139307
	Red	12.5 micron radius	139117
	Orange	5 micron radius	139308
	Gray	2.5 micron radius	139309
	Green	Sub-micron radius	139331
	Blue	12.5x100 micron radius	154075
	Yellow	12.5x200 micron radius	154076
Calibration Standards Set	Five Calibration Standards. Veeco Process Metrology certified nominal 200A and 500A, and NBS traceable nominal 1KA, 5KA, and 50KA measurements. May be used with all Stylus Profilers. Includes a Certificate of Calibration and hardwood case.		138375
Individual Calibration Standards	Nominal 200A measurement		138365
	Nominal 500A measurement		138366
	Nominal 1KA measurement		138367
	Nominal 5KA measurement		138368
	Nominal 10KA measurement		138369
	Nominal 50KA measurement		138370
	Nominal 100KA measurement		138371
Factory Recertification of Veeco Process Metrology Calibration Standard(s) available.			
VLSI Calibration Standards	Nominal 180A measurement		085350
	Nominal 440A measurement		085351
	Nominal 880A measurement		085352
	Nominal 4500A measurement		085353
	Nominal 9400A measurement		085354
VLSI Roughness Standards	90A (0.354um)		085370
	220A (0.866um)		085371
	440A (1.732um)		085372
	2250A (8.858um)		085373
	4700A (18.504um)		085374
	Complete set (90A, 220A, 440A, 2250A, 4700A)		085360
Sample Illuminator Lamp	Replacement Bulb		140229

APPENDIX B

Dektak^{3}ST Thermal Printer Option

The optional OmniPrint 426 thermal printer produces full size printouts (over 4" wide) in less than 17 seconds. The OmniPrint 426 provides a valuable graphic record of measurement and program data. The printer is a compact unit (10"W x 8"D x 3"H0 that can be installed on top of the scan head, on the computer, or on the counter away from the scan head.

Printer Selection

1. Click on SETUP from the Dektak^{3}ST menu bar and click on ASSIGN PRINTER PORT. A window will be displayed allowing the printer port to be set.

2. Two options are available: OmniPrint 426 and Active Window Printer. Click on the OmniPrint 426 and then click on OK.

The Active Window Printer selection allows the Dektak^{3}ST to be used with any Windows compatible printer installed on the Dektak^{3}ST computer.

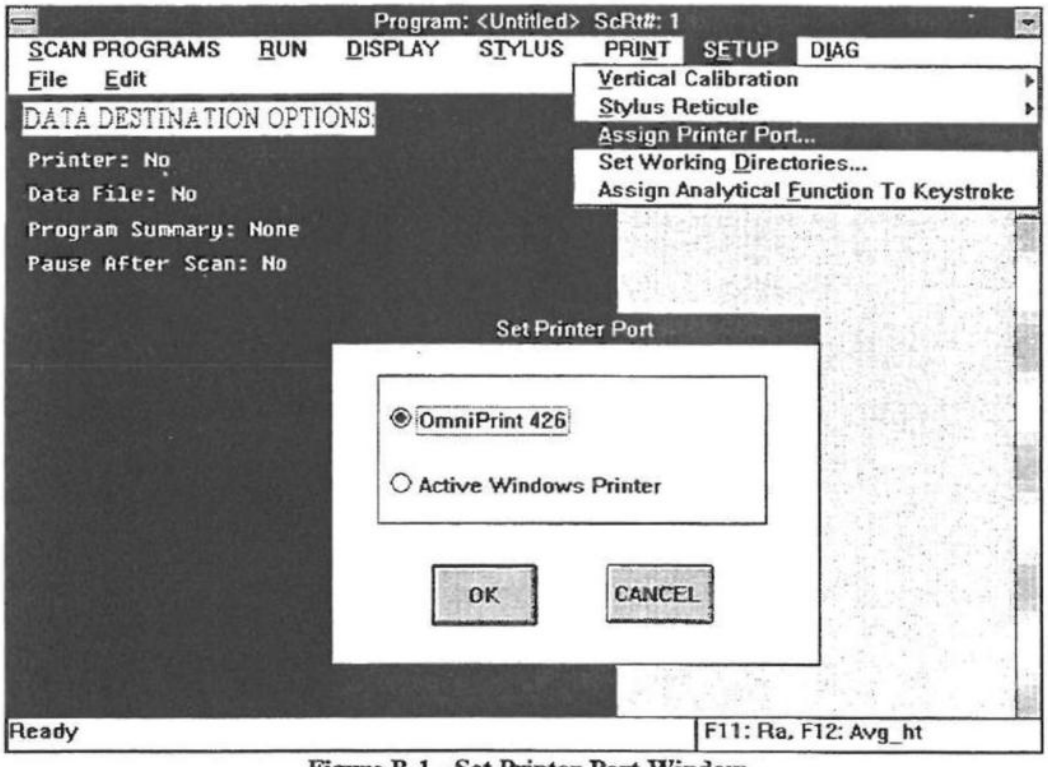


Figure B-1 - Set Printer Port Window

Printer Installation

1. Connect the printer ribbon cable to the OmniPrint 426 printer and to the back of the Dektak^{3}ST computer in the printer port shown in Figure 1-6 of this manual.

2. Plug in the printer power cable in the back of the printer and into the surge protector.

Loading Printer Paper

Before loading paper into the printer, the end of the paper must be cut squarely without any jagged edges.

1. Turn off the surge protector power switch. Turn off printer.

2. Pull the Printer Head lever forward to lift the head.

3. Open the paper roll cover. Place the printer paper in the curve of the gray roller. The paper should be rolling off the bottom of the paper roll.

4. Roll the roller with one hand and push the paper under the roller at the same time. The edge of the paper should appear on the top side of the gray roller.

5. Pull the Printer Head lever back to the paper feed position.

6. Turn on the surge protector power switch. Press and hold the Paper Feed button and turn on the printer.

The printer should begin with a self test mode. The paper should feed out smoothly. Any adjustments of the paper position can be made by moving the Printer Head lever forward and moving the paper.

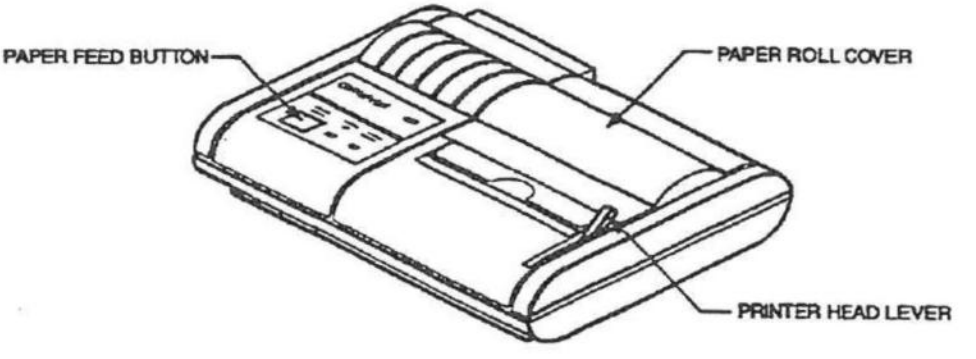


Figure B-2 - Loading Printer Paper

Print Menu Selections

The print menu provides a variety of print options for the OmniPrint 426 printer. These various selections are described in detail in section 7 of this manual. The only selection from the print menu not available with the OmniPrint 426 is the ACTIVE SCREEN option. This selection provides a printout of the entire image of the current active screen. The active screen selection is available to most Windows compatible printer.

To create a printout on the OmniPrint 426 click on PRINT from the Dektak^{3}ST menu bar and click on any of the print selections that are not grayed-out. The selections are grayed-out if the required scan activities are not performed prior to required a printout. For example, a scan must first be performed before the Plot and Summary or Summary Only selections can be accessed. Likewise a Multi-Scan summary report must first be created in order to select the Multi-Scan Summary option.

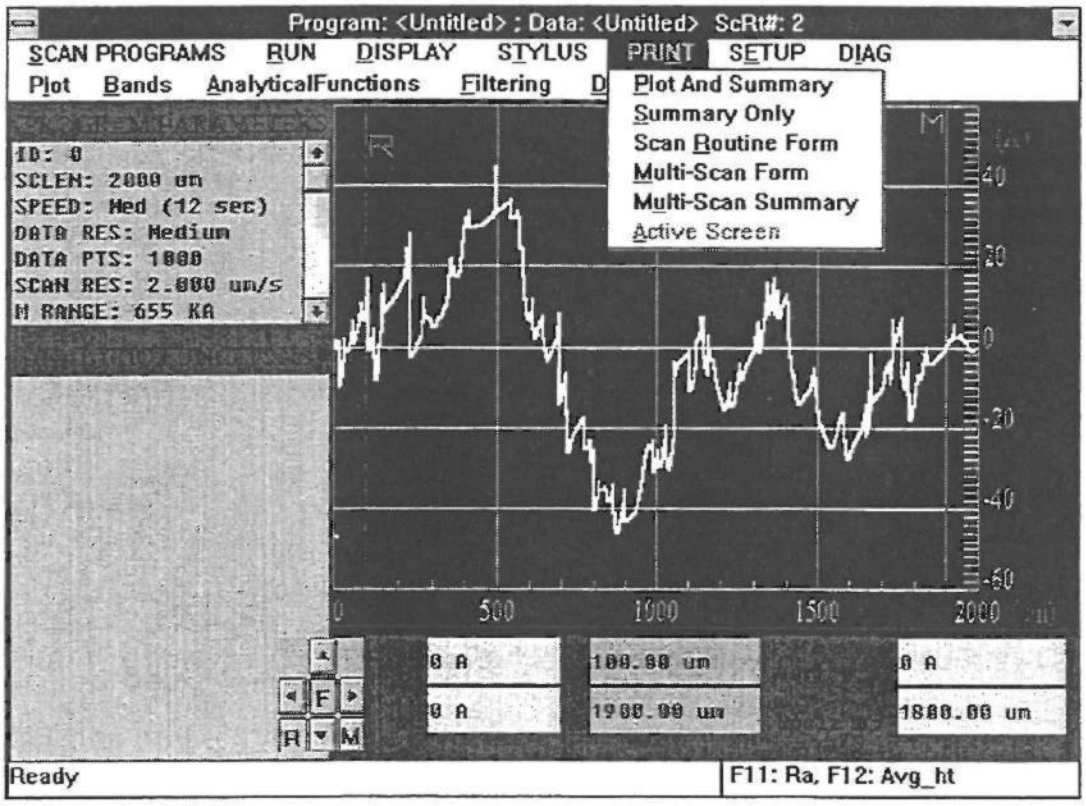


Figure B-1 Print Menu Selections

APPENDIX C

Dektak^{3}ST Auto I Vacuum Chuck Option

The vacuum chuck option is available only for the Dektak3ST AUTO I remote control sample stage. The vacuum chuck secures a sample up to six inches in diameter firmly to the stage. The vacuum chuck includes:

- Adjustable alignment pins allowing consistent positioning from one sample to the next
- degree continuous rotation
- Recessed slots for tweezers or vacuum wand.
- Quick disconnect fittings for stage removal.

Installing the Vacuum Chuck

NOTE

All Dektak3ST AUTO I stage installation procedures must be completed prior to installing the vacuum chuck.

1. Raise the stylus by clicking on STYLUS UP from the Stylus menu.

2. Raise the optics to the full up position using the optics height adjustment knob located on the front of the scan head.

3. Once the stylus and optics have been raised completely turn the power off (see Figure 1-4).

4. Remove the scan head environmental shield and the power supply cover using a long handled standard screw driver to release dzus lock through the access holes on the top.

5. Remove the stage. This procedure is described in detail on page 105.

6. Use a 3/32' driver to remove the four socket head screws securing the horizontal bezel (see Figure C-1). Carefully remove the bezel.

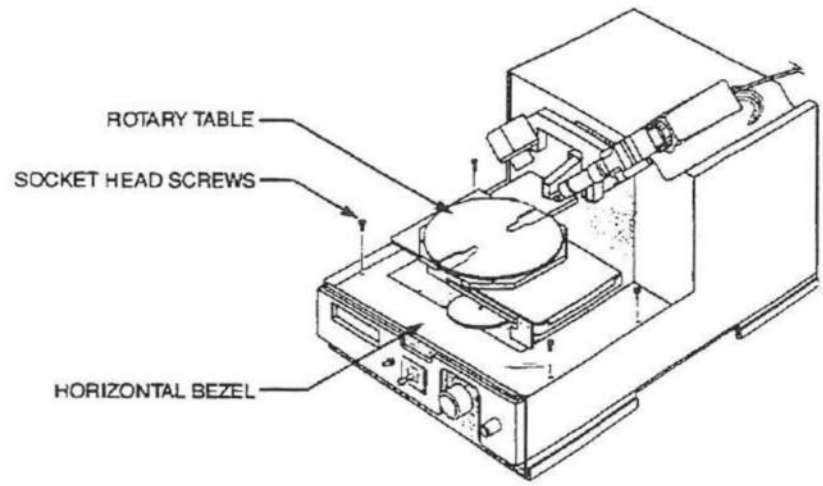


Figure C-1 - Horizontal Bezel and Rotary Table

7. Using a 5/64" driver, remove the four socket head screws on the old rotary table and remove the rotary table from the stage.

Installing the new vacuum chuck

8. Attach the clip to the top of the slide table approximately 2.5" from the front edge. The tube should be flush with the side edge of the slide table when installed in the clip (see Figure C-2).

9. The vacuum hose on the stage should have a 9" service loop between the vacuum chuck and the clip. **The loop must not be so long that it hangs up on the front of the slide table.**

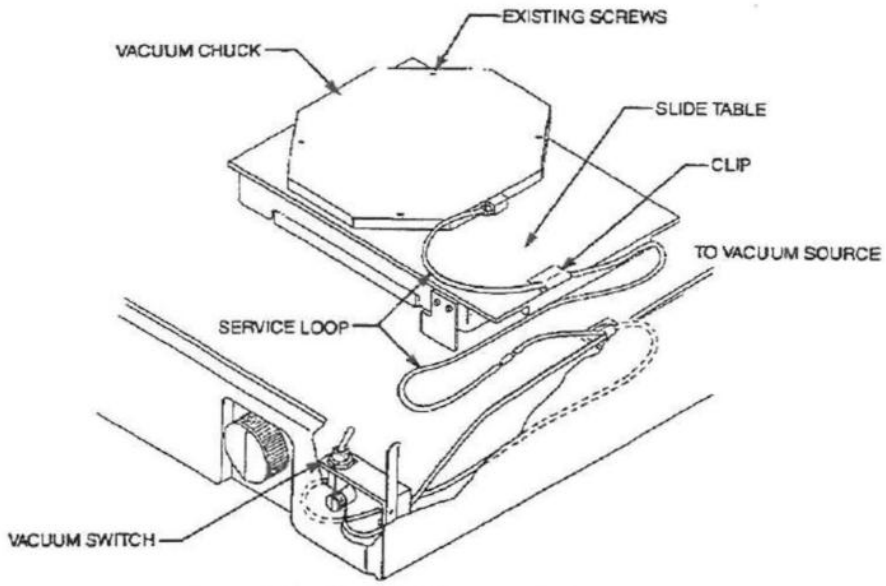


Figure C-2 - AUTO I Stage and Tube Routing

10. Run the vacuum line from the back of the right vertical bezel to the vacuum switch. Make sure to use the cable clamp provided. It will ensure the hose doesn't interfere with the stage movement.

NOTE

The vacuum hose to the switch should have a 12" service loop between the clip on the slide table and the right vertical bezel. Open the cable clamp and feed the hose through the clamp so that the hose will loop over the top of the clamp when the switch is put into position.

11. Run the vacuum hose to the source through the contrast cable clamp and follow the cable routing under the vertical bezel and out the back of the Scan Head through the cutout in the lower right corner of the rear panel.

NOTE

The vacuum hose must be routed so that the hose does not interfere with the stage cable in any way. The hose should be routed under the contrast cable through the cable clamp, but must not be restricted so to impede stage movement.

12. Use the 3/32" driver to remove the two 4-40 x ¼" socket head screws from the environmental shield retainer mounted inside the right front of the scan head. (See Figure C-3)

13. Line up the mounting holes on the vacuum switch bracket with the mounting holes in the environmental shield retainer and secure with the screws. Reinstall the washers as required.

14. After completing the hose routing, installing the stage, engaging the rack mechanism turn on the power.

15. Run two or three scans to check that the hose does not interfere with the stage cable or stage movement.

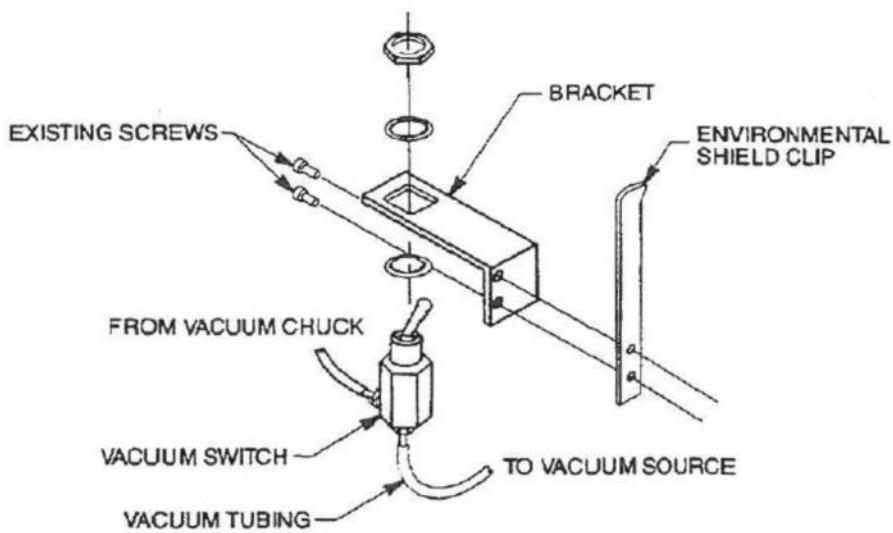


Figure C-3 - Vacuum Switch Assembly

Appendix D

Stress Measurement Option

Description Of Stress

The stress algorithm creates a *stress curve*, made up of stress values for every data point on the scan trace. If a pre-stress scan data file was saved, then the calculation proceeds (on all the scan data points) as follows:

1. The pre-stress scan data is loaded and smoothed using a running average with a window size of 1/10 the scan length.

2. The smoothed data is further smoothed using a piece wise third order polynomial interpolation technique.

3. The curvature trace is derived from the first and second derivatives of the smoothed data trace.

4. Steps 1-3 are then applied to the post stress scan data, producing a curvature trace for the post stress scan data.

5. The stress curve is then computed from the curvature traces.

6. The maximum and average compressive and tensile stresses are calculated from the stress curve, and displayed in the Stress Results dialog box. Only those values of the stress curve between the cursors are considered.

Stress Reference

Prior to calculating stress, a reference must be established. Stress can either be calculated using a straight line as the reference, or by producing a preliminary reference scan on the sample prior to processing. In order to accurately measure stress, the reference scan and the scan produced after thin film deposition, must have identical scan parameters, including cursor locations (stress is computed on the data between the reference and measurement cursors). For this reason, it is recommended that the scan parameters used to produce the original reference scan be saved in an Automation Program file to be used after deposition.

Once the reference scan is produced, it must be saved in a data file. The data file is then used as the reference for comparison and stress calculation.

Identifying Substrate Characteristics

To program stress, first, position the R and M cursors to enclose that part of the scan trace over which to collect stress statistics. If a reference scan is being used to compute stress, then the same scan parameters used to produce the reference scan must be used to produce the scan on the substrate after deposition. Whether the default straight line reference or a reference scan is being used to calculate stress, the substrate must also be scanned after thin film deposition. Once the scan has been produced on the substrate after deposition, the characteristics of the substrate being measured for stress must be entered into the stress calculation.

1. Run the scan on substrate after deposition. The scan will be plotted.

2. Click-on "Analysis" from the Data Plot screen menu bar.

3. Click-on "Compute Stress" from the Analysis Menu. The stress dialog box will be displayed (see Figure C-2).

4. The "Thin Film Substrate" portion of the stress dialog box displays the material, orientation, and elasticity of the thin film substrate. Several options are stored in memory to compute stress in a variety of applications. To view the preprogrammed thin film substrate selections click-on "Options." The Options menu will be displayed (see Figure C-1).

5. Click-on the thin film substrate to be measured for stress and click-on "OK."

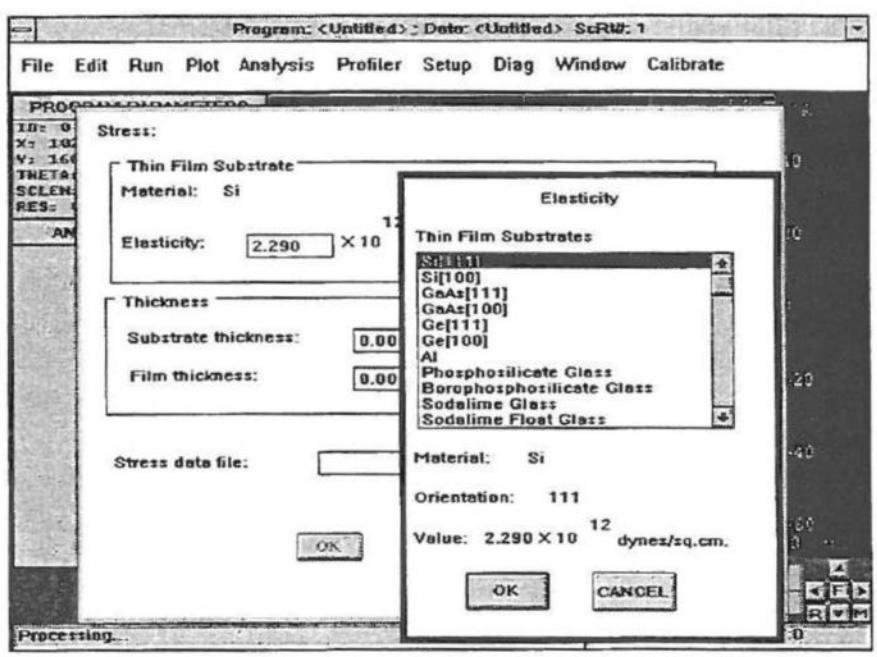


Figure D- 1 Stress Options Menu

Entering Stress Parameters

Once the substrate material and orientation has been identified, the other stress parameters can be entered.

1. If the elasticity of the substrate is known to be different than the value displayed in the box labeled "Elasticity," click on the box and enter the correct value.

2. Click-on the box labeled "Substrate Thickness" and enter that value in microns.

3. Click-on the box labeled "Film Thickness" and enter that value in microns.

4. If the stress is to be measured against the default straight line reference click-on "OK" and the stress result will be displayed.

5. If the stress is to be measured against a reference scan produced earlier and saved in a data file, click-on the box labeled "Stress Data File." Enter the file name under which the reference scan profile data was saved and click-on "OK." Stress will be computed and the stress result window will be displayed (see Figure C-3).

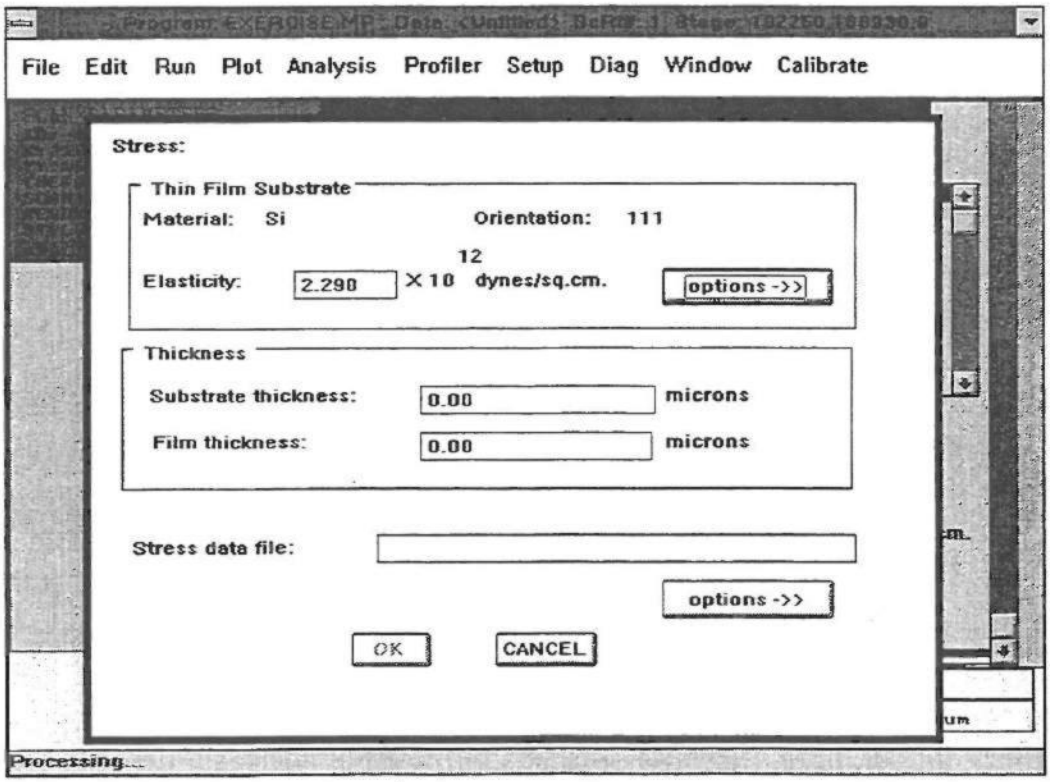


Figure D- 2 Stress Measurement Dialog Box

Stress Results

The statistical results are displayed in the Stress Results dialog box. These results can be viewed at any time after stress has been computed by selecting the Analysis menu from the Data Plot window and selecting "Stress Results" item.

A print out of stress results can be obtained by either selecting the PRINT button from the Stress Results dialog box or as part of the Scan Data Summary print out.

Upon the completion of the stress computation, the stress and smoothed scan data traces are shown. Whenever a stress curve is displayed, the vertical scale changes from Angstroms to Dynes/cm2. The following types of stress plots can be selected from the Stress Curves dialog box obtained from the Plot Menu in the Data Plot screen by selecting the "Stress Curves" menu item:

- *Pre stress scan data, curve fit, and stress.*
  Scan data curve plotted in white, curve fit in cyan, stress curve in green.

- *Post stress scan data, curve fit and stress.*
  Scan data curve plotted in white, curve fit in cyan, stress curve in green.

- *Pre and Post stress curves, and stress difference curve.*
  Post stress scan data curve in white, pre stress curve in cyan, post stress curve in green, and stress difference curve in orange.

- *Remove all stress curves.*
  Removes all stress and curve fit curves, and restores the vertical scale to Angstroms.

Constraints And Limitations

- The stage should be hardware leveled, and in the same leveled position for both the pre and post stress scans.

- Both pre and post stress scans must have the same number of data points. Don't abort either scan before completion.

- The algorithm will work best on a flat wafers. Surface features will throw off the curve fitting algorithm, and produce invalid maximum stress values.

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Dektak³ Series Specifications

Performance Specifications

Sample Stage Diameter	D3	= 127mm (5")
	D3ST/Auto I	= 165mm (6.5")
Scan Length Range	D3	= 50μm to 30mm
	D3ST/Auto I	= 50μm to 50mm
X-Y Stage Translation	D3	= 20mm x 80mm
	D3ST/Auto I	= 76mm x 152mm
X-Y Sample Positioning	D3/D3ST	= Manual
	Auto I	= Motorized
Theta Sample Positioning	All models	= 360° manual
Vertical Data Resolution	D3	= 5Å maximum
	D3ST/Auto I	= 1Å maximum
Vertical Range	D3	= 65.5μm maximum
	D3ST/Auto I	= 131μm maximum
Step Height Repeatability	10Å, 1 sigma typical	
Data Points Per Scan	D3	= 2,000 maximum
	D3ST/Auto I	= 8,000 maximum
Sample Viewing (color camera)	D3	= 90x (60-420x option)
	D3ST/Auto I	= 60-420x
Zoom Optics Adjustment	D3/D3ST	= Manual zoom
	Auto I	= Motorized zoom
Stylus Tip Radius	D3	= 12.5μm standard
	D3ST/Auto I	= 2.5μm standard
Stylus Force Range	D3	= 10-50 mg.
	D3ST/Auto I	= 1-40 mg.
Stylus Force Adjustment	D3	= Manual
	D3ST/Auto I	= Programmable

Standard Analytical Software

Roughness Parameters	Ra, Rq, Rp, Rv, Rt, Rz, Tp, Max. Ra, Max. Dev., Skew
Waviness Parameters	Wa, Wq, Wp, Wv, Wt, Max. Dev.
Step height Parameters	Avg. Step Ht., Avg. Ht., Max. Peak, Max. Valley, Max. Ht., Peak to Valley
Geometry Parameters	Area, Slope, Volume, Radius, Perimeter

Programmable Cutoff Filter Conforms to ANSI B46.1

Measurement Applications

- Semiconductors: step heights, etched depths, and stress
- Data Storage: thin film head step heights and disk dub-off
- Optics: lens curvature and optical coating thickness
- Hybrid Circuits: thick films and substrate roughness
- Industrial: high precision chemical etching, plating and polishing

System Configuration

Microprocessor	Intel® Celeron, 333MHz			
Software Environment	Microsoft® Windows 98			
Interface Method	Mouse/keyboard			
Monitor	14" Super VGA standard			
Power Requirements	115/220 Vac, 50/60Hz, 5 Amps			
Dimensions (w/computer)	Depth	Width	Height	
D3	61.9cm (24")	66cm (26")	53.3cm (21")	
D3ST/Auto I	93.9cm (37")	43.2cm (17")	81.3cm (32")	
Shipping Weight	D3 = 57 kg. (125 lbs.)			
	D3ST/Auto I = 79 kg. (175 lbs.)			

Optional Features

Network Card	Enables scan data to be exported and printed via a network
B&W Thermal Printer	Prints profile and scan data
Stress Measurement Software	Calculates tensile/compressive stress of wafers
Optional Styli	Sub-micron to 25μm radius tips
Calibration Standards	200Å to 100KÅ step heights NIST traceable standards
Vibration Isolation Table	Isolates scan head from external noise
Extended Optics	120-790x magnification
Vacuum Chuck	For D3ST/Auto I stage
CE Certification	Includes CE documentation

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Veeco

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www: hrdektak.com

QUOTATION / ESTIMATE

To: HVVI
10235 S. 51st Suite 100
Phoenix, AZ 85044

Quotation No.: HRC08051

Date: July 2, 2008

Phone: 480-776-3800 Fax:
Attn: Son Tran

Quotation Valid 30 Days From Above Date
Reference:

We thank you for the opportunity to quote on the product(s) and or Services listed below.

Item	Qty.	P/N	Description	Unit Price	Total Price
1	1	139309	Stylus 2.5 Micron, Grey Dot.	$700.00	$700.00
2	1	139117	Stylus 12.5 Micron, Red Dot.	$500.00	$500.00
3	1	139334	Stylus Sub One Micron, Green Dot.	$1500.00	$1500.00

Delivery estimated at weeks ARO **On hand**

F.O.B. Point: Santa Barbara, CA Terms: Net 30 Days
Credit cards Accepted, 15% Charge Over 30 Day Net Pay.

Signature: Hank Calles