Dektak 3030 Operation Summary

Basic Operation

This quick guide is intended to provide instruction for performing simple, single scan operations. For more specific information on repetitive measurement operations and other applications, refer to the operation manual.

1 Sample Loading and Viewing

1. Turn power on.
2. Load the sample onto the sample stage with the area to be measured centered below the stylus.
3. Press the stylus up/down key △▽. Stylus will lower onto sample surface. (If using an AUTO II, the stage will automatically home when the instrument has just been turned on.)
4. Press the **FCTN** key and the number **5** key to display the software reticle.
5. Press the **VID** key until the software reticle and video image appear simultaneously.
6. Adjust the optics height knob (large black knob on the front of the system) until the stylus tip rests along the horizontal axis of the software reticle.
7. Adjust the sample surface illumination (small black knob) and the contrast (thumbwheel below the video monitor) as necessary.
8. Press the stylus up/down key △▽ to raise the stylus.

2 Sample Positioning

The software reticle may be used as a reference for sample positioning. The horizontal axis of the reticle indicates the path the stylus will take along the sample surface. The sample surface will move from right to left across the CRT during the scan. Position the sample feature to be measured to the right of the reticle. The method used to position the sample varies depending upon the DEKTAK 3030 model being operated.

DEKTAK 3030 MANUAL STAGE
This model uses thumbwheels, located at the front of the stage, to position the sample. The left thumbwheel translates the stage along the X-axis (side-to-side). The right thumbwheel translates the stage along the Y-axis (front-to-back).

NOTE
The video image on the CRT is rotated 90° clockwise.

When Stage Moves...	*Video Image Moves...*
FORWARD	LEFT
BACK	RIGHT
RIGHT	DOWN
LEFT	UP

DEKTAK 3030 AUTO I
This model uses a dual speed, proportional joystick to remotely control sample positioning. The switch to the left of the joystick is used to select the stage speed.

DEKTAK 3030 AUTO II
This model is equipped with a programmable sample stage. By pressing the **FCTN** key, and the number **3** key, the sample stage may be positioned by using the arrow keys. Pressing an arrow key in combination with the **FAST** key translates the stage at high speed. **FCTN, 99** displays a "Help" menu on the **AUTO II**.

3 Programming

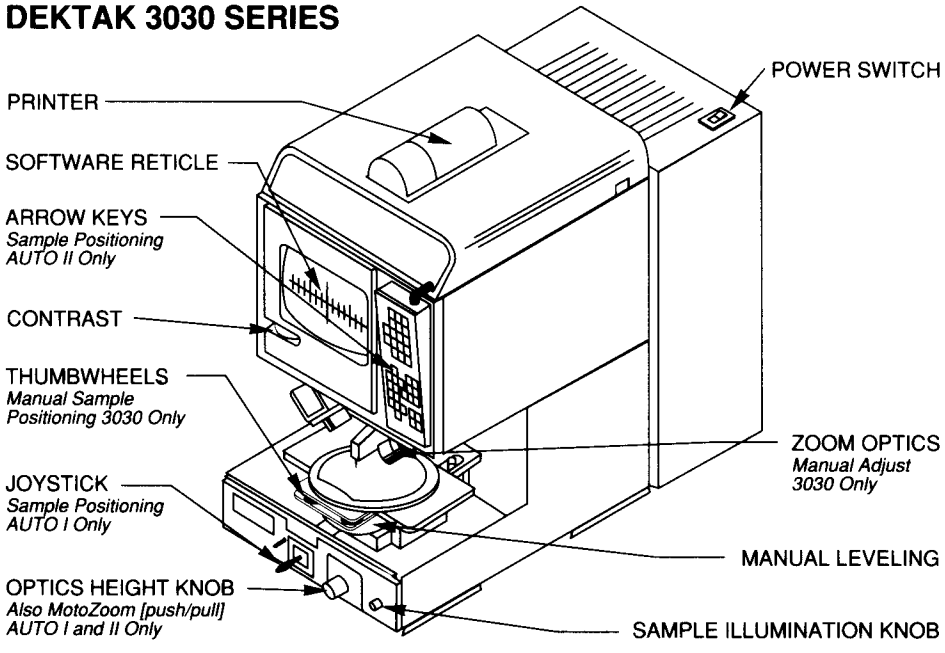
1. Press the **PRGM** key. The DEKTAK 3030 menu will appear on the CRT.
2. Move the prompt to the Scan Program Menu using the arrow keys. Press **ENTR** key. The Scan Program Menu will appear on the CRT.
3. Using arrow keys, move the prompt to the Scan Length parameter. Determine the appropriate Scan Length. Key in the length using the numeric key pad, and press **ENTR**.
4. Enter *No* for the Auto Leveling and Smoothing parameters.
5. Enter *Medium* for the Speed.
6. The Profile parameter should be ⌐¬ (hills and valleys).
7. Select the appropriate vertical Measurement Range and press the **ENTR** key.
8. Enter *Auto* for the Display Range.

The rest of the parameters should not be of concern. However, the stylus force may need to be altered.

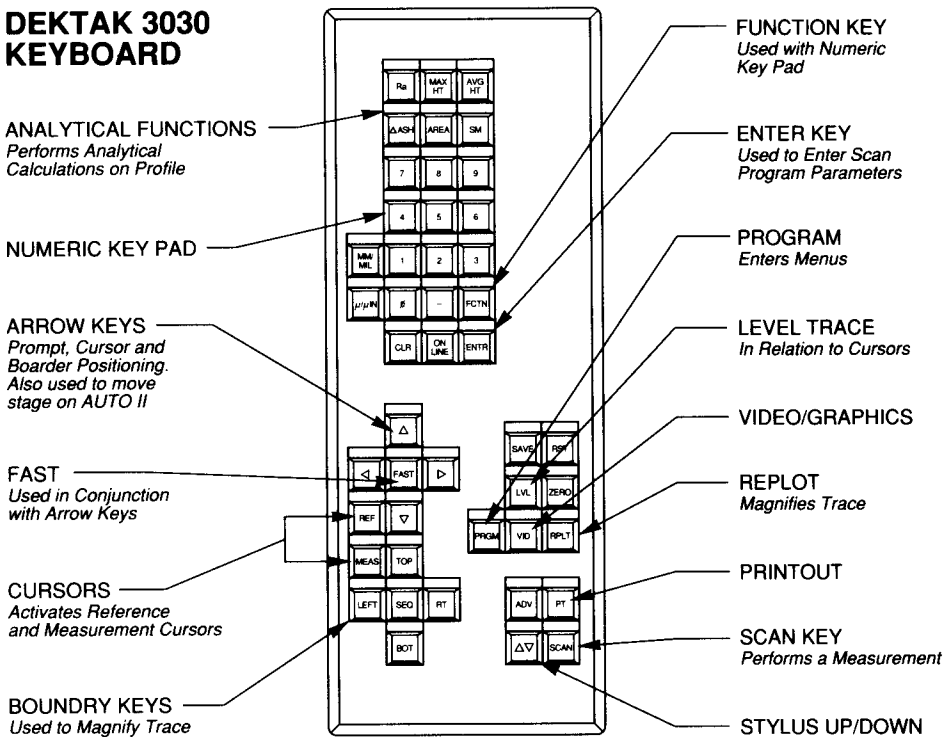
4 Making a Scan

Press the **SCAN** key. The stylus will lower and the profile will be plotted.

DEKTAK 3030 SERIES



DEKTAK 3030 KEYBOARD



5 Manual Leveling

NOTE

If the initial trace is unlevel and touches either the top or the bottom of the screen before completion of the scan, the sample must be manually leveled.

The sample stage must be level to obtain optimum instrument performance. The large, manual leveling thumbwheel is located at the front of the stage. The manual leveling procedure is as follows:

1. Press the **SCAN** key.
2. As the scan is being performed, turn the leveling thumbwheel until the profile trace is tracking in a horizontal line. Clockwise rotation raises the trace and counterclockwise lowers the trace.
3. Press the **SCAN** key again. The profile must appear totally within the graphic boundaries to achieve the minimum acceptable manual leveling. If not, repeat the manual leveling procedure above.

6 Cursor Leveling

Before accurate step height or roughness measurements can be obtained, a reference must be established. This reference is the baseline from which all measurements are made. It must be properly leveled and zeroed in software, using the Reference and Measurement cursors.

1. Press the **REF** key.
2. The Reference or R cursor may now be positioned using the arrow keys. The R cursor should be positioned somewhere along the base of the step in an area free of excess roughness.
3. Press the **MEAS** key.
4. The Measurement or M cursor may now be positioned using the arrow keys. The M cursor should be positioned on the same horizontal plane as the R cursor in an area free of excess roughness. The R and M cursors should be positioned as far apart as possible, yet still on the same plane.
5. Press the **LVL** key. The trace will be replotted with the R and M cursor/trace intercepts positioned on the horizontal zero grid line with the trace leveled.

7 Step Height Measurement

Once the trace has been leveled, an accurate measurement can be obtained.

1. Press the **MEAS** key.
2. Using the arrow keys, move the M cursor to an area free of excess roughness at the top of the step.
3. With the R cursor positioned at the base of the step height, the difference between the R and M cursor/trace intercepts is automatically displayed in the upper right of the screen, labeled *Vert*. This is the step height.

8 Magnifying A Trace

An area of interest within a surface profile trace may be magnified for more detailed analysis or manipulation.

1. Press the **LEFT** key. Use the ▷ arrow key to bring the left boundary in next to the portion of the trace to be magnified.
2. Press the **RT** key. Use the ◁ arrow key to reposition the right boundary as desired.
3. Press the **TOP** key. Use the ▽ arrow key to move the top boundary down.
4. Press the **BOT** key. Use the △ arrow key to bring the bottom boundary up.
5. Once the boundaries have been repositioned around the feature to be magnified, press the **RPLT** key.
6. The new boundaries will be replotted, with the magnified trace rescaled.
7. To restore the original boundaries, press the **RST** key and the number **0**. The initial trace will be redisplayed on the screen.

9 Printout

A printout of any CRT display can be generated, including program menus. Pressing the **PT** key, will provide a printout of the entire graphics display.

A printout of the scan summary data, minus the profile, can also be obtained, by pressing **FCTN** and then the **PT** key.

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INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Dektak 30 30ST

AUTO I REMOTE CONTROL STAGE PROFILER

P/N 172931
Revision 1.2

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

Figure 1-1. DEKTAK 3030ST AUTO I

SECTION 1

UNPACKING AND INSTALLATION

ENVIRONMENTAL CONSIDERATIONS

The DEKTAK 3030ST AUTO I is a very 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 environments recommended.

Normal Operating Conditions

The DEKTAK 3030ST 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°C and 24°C (64°F to 75°F).

Reference Operating Conditions

The DEKTAK 3030ST has internal vibration isolation. However, for very critical measurements an optional vibration isolation table, designed for use with the DEKTAK 3030ST Scan Head, is available (see Appendix A in this manual). The scan head should be covered with the environmental shield 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°C ± 1°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 3030ST is shipped in four cartons. Each carton contains an instruction sheet describing how to remove the components. These instructions are repeated below.

NOTE

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

Accessories Carton

The accessories carton contains the operation manual, the printer, environmental shield, calibration standard, assembly tools, spare lamp, printer cover, keyboard with cable. The following cables are also included: main (MEU) power cable, Scan Head power cable, printer cable, monitor cable, Scan Head cable.

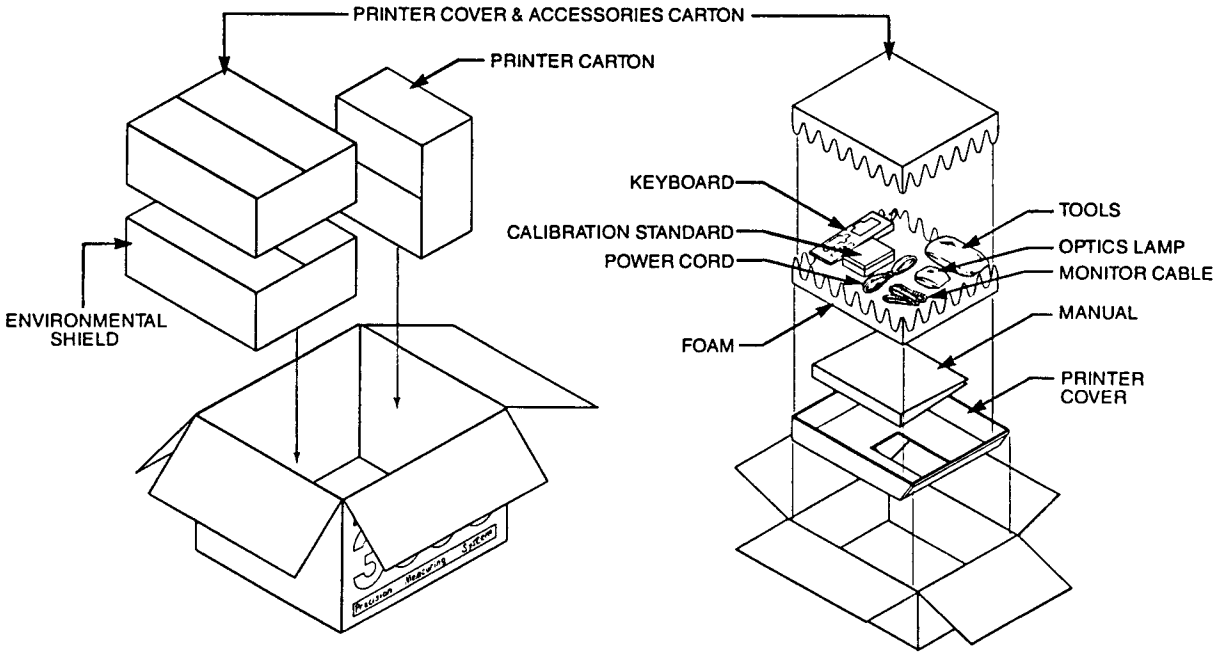


Figure 1-2. Accessories Carton

Main Electronics Unit (MEU) Carton

This carton contains the Main Electronics Unit (MEU).

To remove the MEU from the carton, reach under the MEU and lift the entire unit, along with the foam inserts, out of the carton. Remove the foam inserts and poly bag from the unit and return all packing material to the original carton for storage and future use.

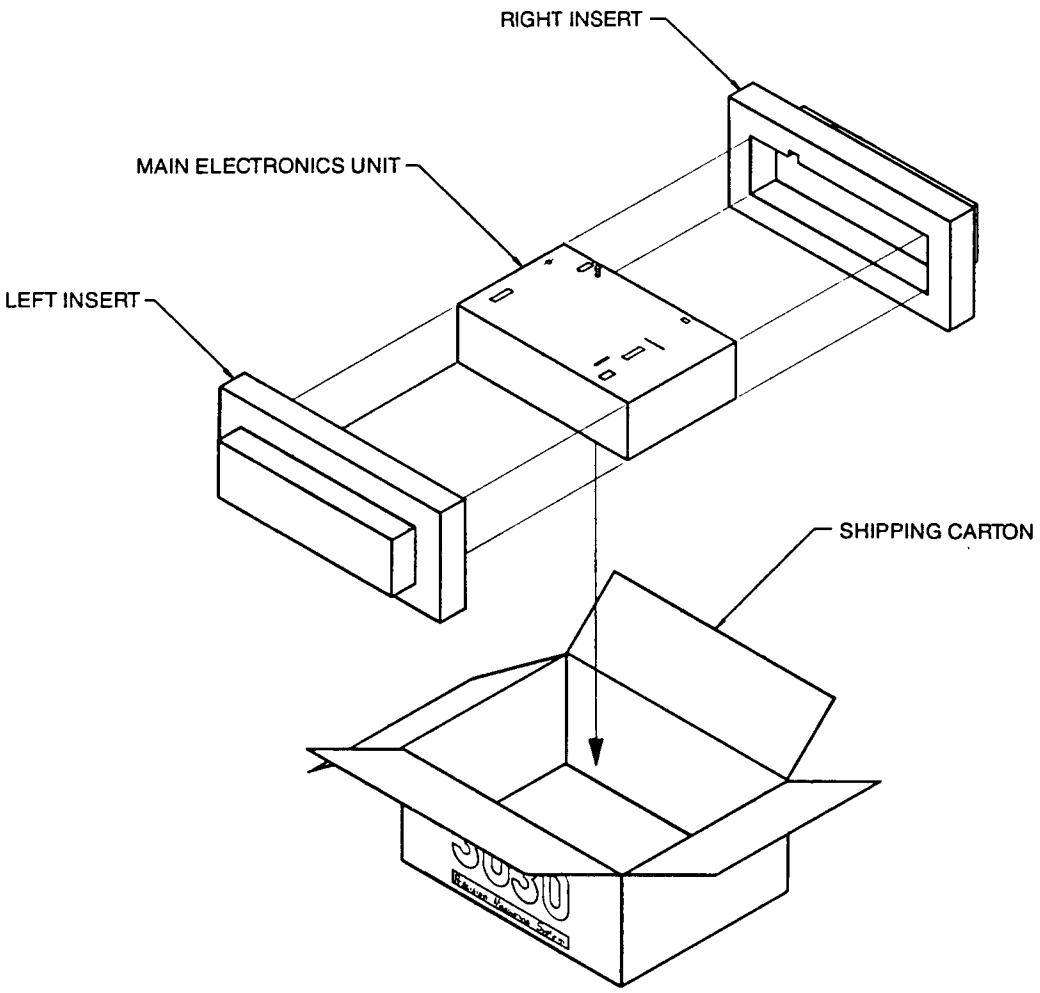


Figure 1-3. Main Electronics Unit Carton

Scan Head Carton

This carton contains the Scan Head unit and the stage. The Scan Head is the most fragile component of the DEKTAK 3030ST system. It should be unpacked with extreme care.

WARNING

The Scan Head unit weighs approximately 55 lbs. To avoid possible injury, two people should unpack the unit.

To remove the Scan Head unit from the carton, set the carton right-side-up on the floor with both top and bottom flaps open. Slide the carton up and off the packed unit. Remove the stage carton, foam inserts and the poly bag. There are handholds on each side of the Scan Head unit. These are the gaps between the corner supports on each side (see Figure 1-4). Lift the unit by the handholds and carefully set it on a flat, sturdy table. Return all packing material to the carton for storage and future use.

CAUTION

Do not remove the stage from the protective box until it is time to install it in the Scan Head.

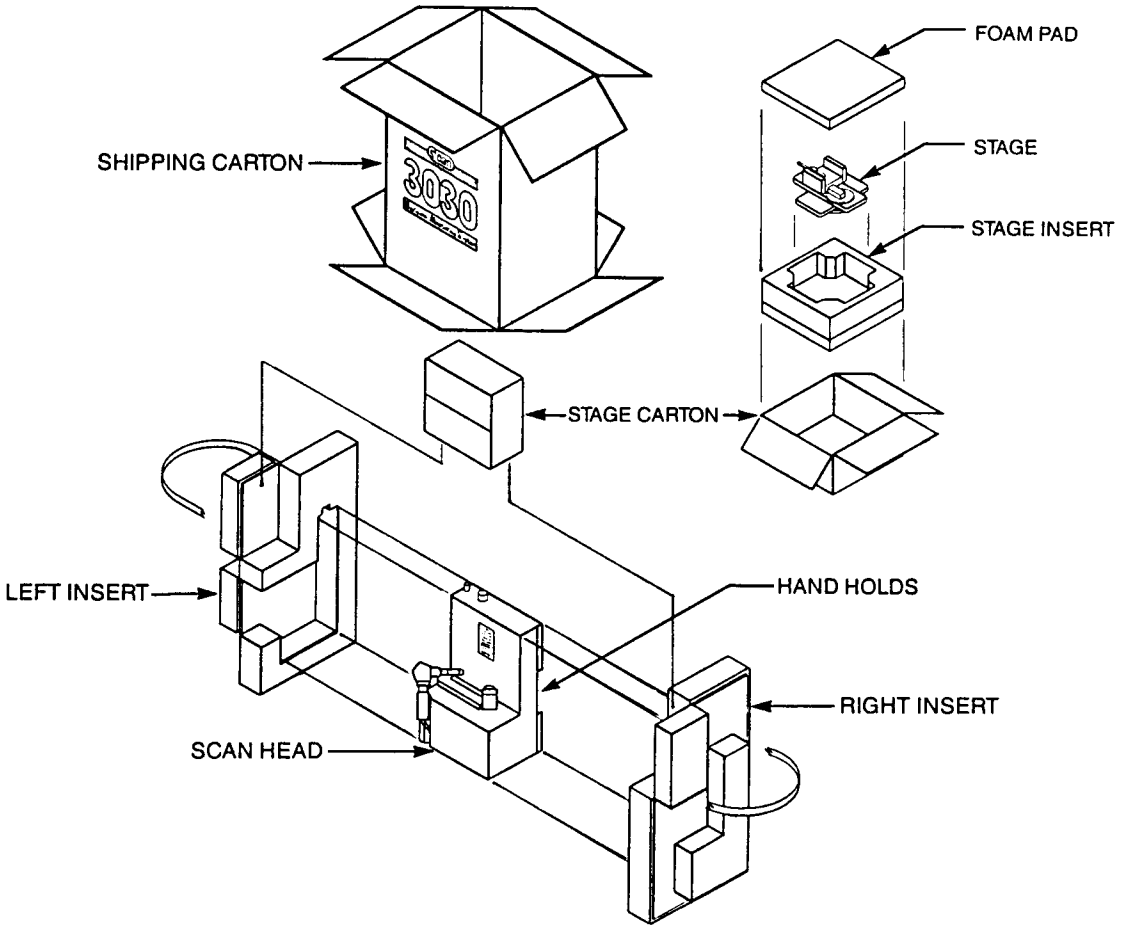


Figure 1-4. Scan Head Carton

Video Monitor Carton

This carton contains the Video Monitor. To remove, reach under the Video Monitor between the foam inserts and lift the entire unit, along with the foam inserts, out of the carton. Remove the foam inserts and poly bag from unit. Return all packing material to the carton for storage and future use.

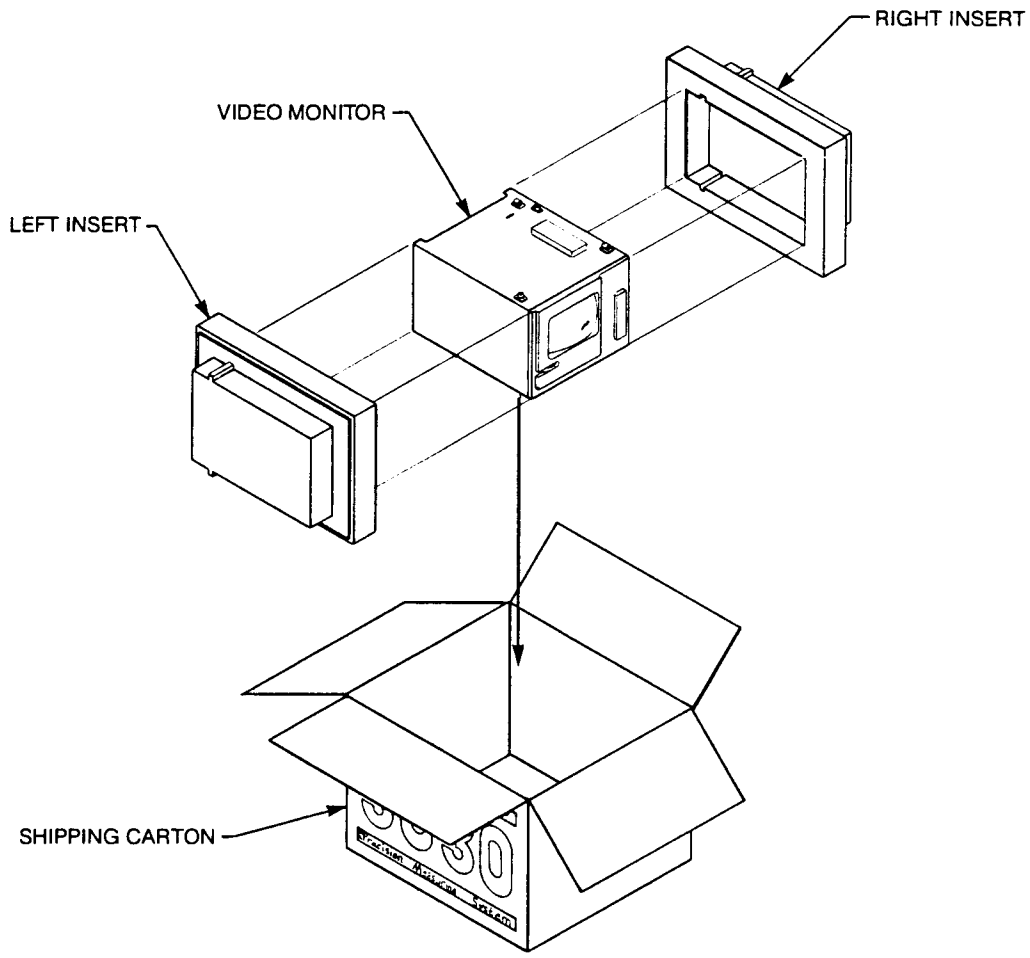


Figure 1-5. Video Monitor Carton

NOTE

Before proceeding, check each item against the shipping list. If any item is missing, contact Veeco/Sloan Customer Service at (805)963-4431. If anything appears damaged, refer to Claims for Shipment Damage (page 76).

MEU CONFIGURATION

Power Supply 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 power supply setting (see Figure 1-6). The procedure to verify or change the power supply setting is as follows:

1. Verify that the main (MEU) power switch is turned off "O" and the main power cable is disconnected from its primary power source and the MEU.

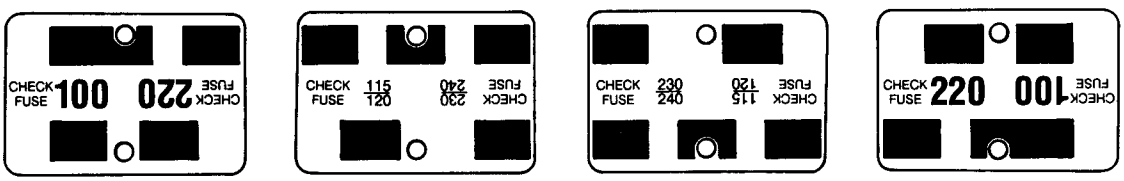
2. Once the main power cable is disconnected from the MEU, slide the clear plastic shield to the left until the fuse is exposed.

3. The voltage select card is located just below the fuse (see Figure 1-8). Verify that the voltage displayed on the left of the card is the correct voltage setting. If it is not, the voltage setting will need to be changed.

4. To change the voltage supply setting, remove the voltage select card with needle nose plyers. Firmly but gently pull the voltage card straight out of the cavity.

5. Four different voltage supply settings are available depending upon how the card is installed (see Figure 1-6). Reinsert the voltage supply card according to the desired voltage setting.

6. Once the voltage supply card has been reinstalled with the correct voltage setting displayed on the left of the card, slide the plastic shield to the right to allow the main power cable to be connected.



100 VAC | 115/120 VAC | 230/240 VAC | 220 VAC

Figure 1-6. Main AC Power Voltage Selection

Switches and Adjustments

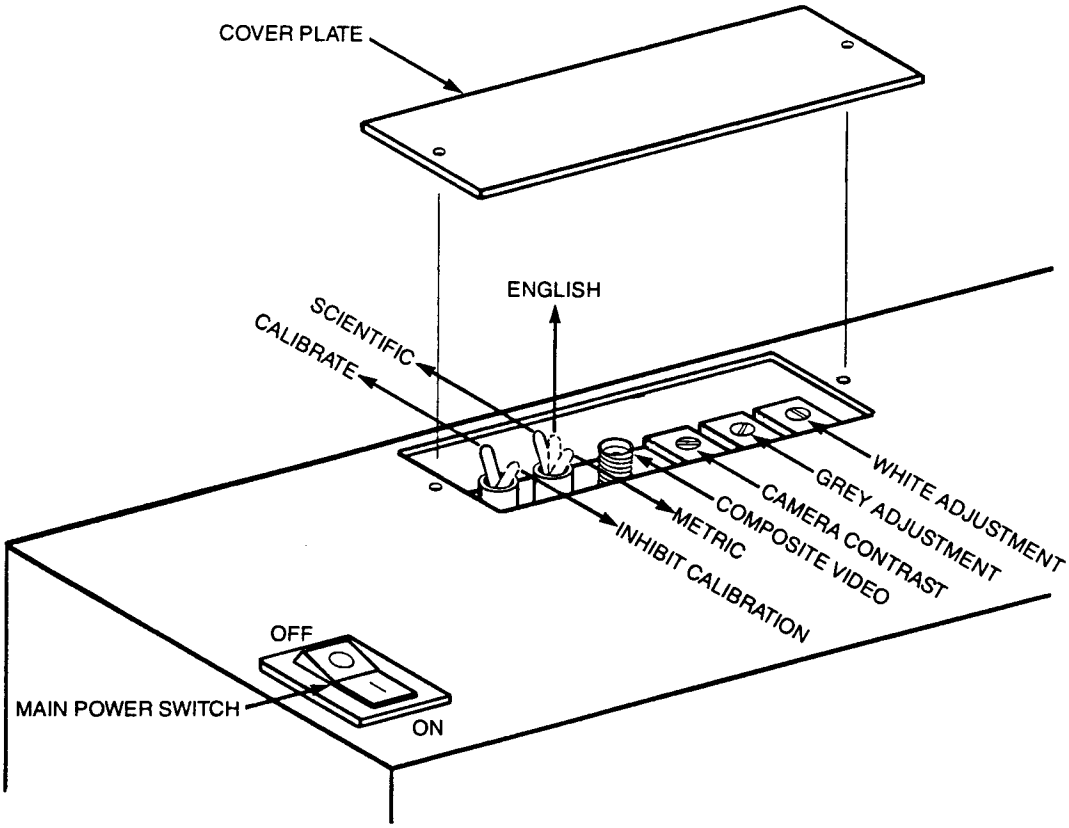


Figure 1-7. Top of the Main Electronics Unit

White Adjustment	Used to adjust the monitor's white level.
Grey Adjustment	Used to adjust the monitor's grey level.
Camera Contrast	Used to adjust the camera contrast level.
Composite Video	Allows the use of an external monitor.
Units Switch	Used to select the desired units of measure. Power must be turned off before selection.
Main Power Switch	ON/OFF power switch and circuit breaker.

AC Power and Option Slots

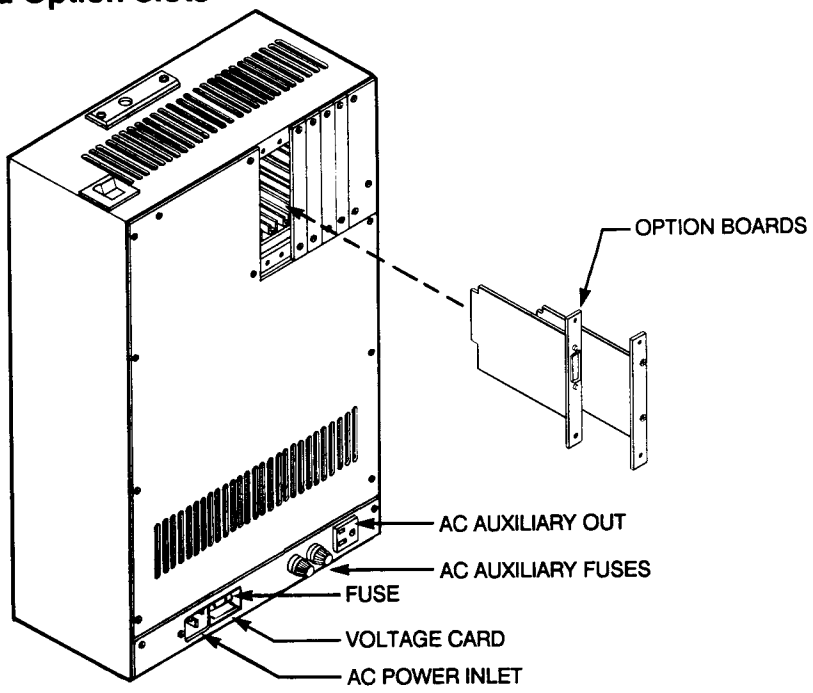


Figure 1-8. Back of the Main Electronics Unit

AC Power Inlet	Connector for the primary AC power cable.
AC Fuse	1 amp, 250 VAC fuse for the primary AC power inlet.
Voltage Card	The Voltage Select Card is used to change the power supply setting.
AC Aux. Out	Auxiliary AC power outlet. Outlet Voltage: 115VAC, 30 Watts regardless of AC Line In Voltage.
AC Aux. Fuse	1 amp, 250VAC fuses for Auxiliary AC Outlets. Output voltage is turned off by main power switch.
Option Slots	There are six option slots available. Any options that are ordered with the DEKTAK 3030ST which require option slots will be installed prior to shipment. Options ordered after shipment may be installed in any unoccupied option slot by simply removing the two screws from the cover plate, inserting the option card, and replacing the screws.

INSTALLATION

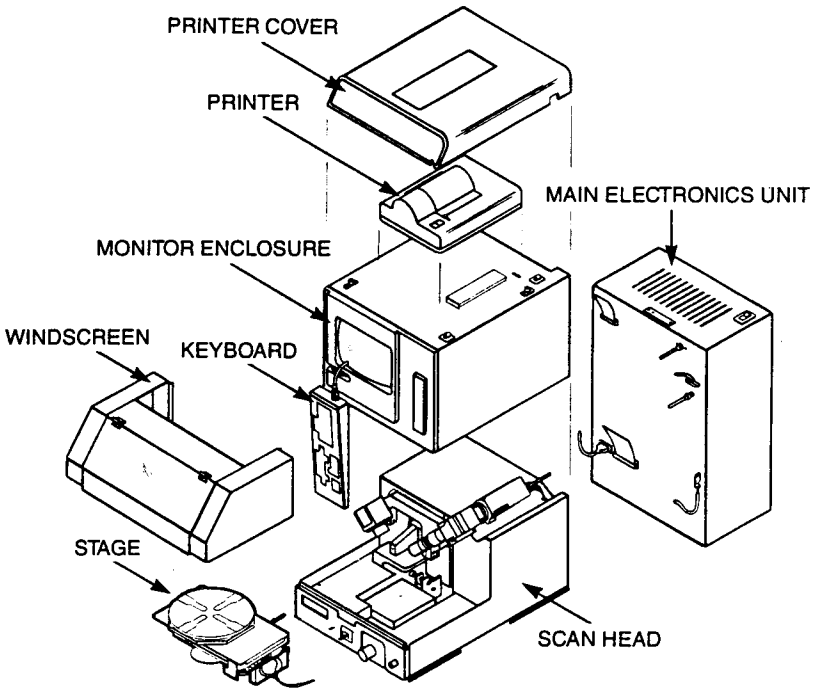


Figure 1-9. DEKTAK 3030ST System Components

Shock Mounts

The Scan Head base plate rests on three internal shock mounts. These are locked down during shipment to prevent damage and must be unlocked before operation. To unlock, unscrew the four captive screws on the bottom of the Scan Head base (see Figure 1-10). You will find it best to slide the unit over the edge of the work bench just enough to expose two of the captive screws at a time. This supports most of the weight of the unit and avoids tipping or knocking the Scan Head assembly.

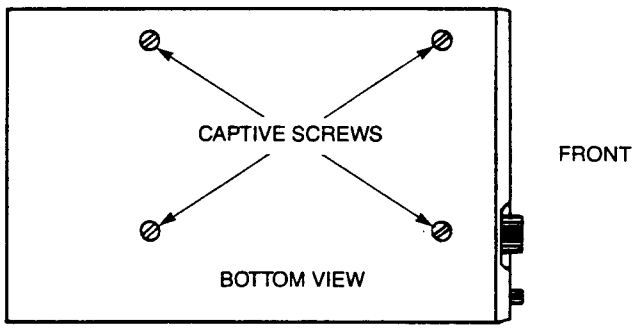


Figure 1-10. Scan Head Base

Monitor/Scan Head Assembly

1. Position the monitor as shown in Figure 1-11.

CAUTION

The front of the Video Monitor must be supported with one hand while mounting onto scan head.

2. Position the two "Dzus" fasteners over the two mounting holes. Push the fasteners down and tighten approximately one-quarter turn using a conventional slotted screwdriver. Make sure video cable is properly placed in the "channel" on top of the Scan Head.

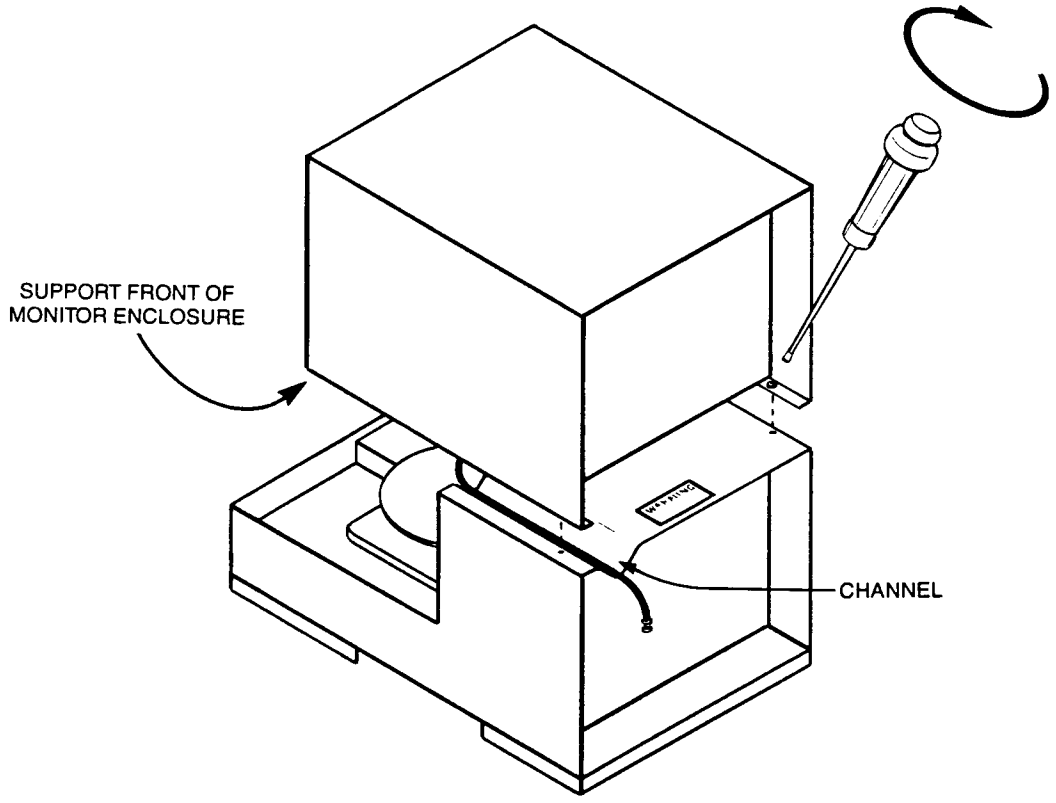


Figure 1-11. Video Monitor/Scan Head Assembly

Stylus Protection Fixture

The stylus assembly is relatively fragile. It is a precision balanced assembly and has a limited amount of vertical travel. The stylus protection fixture limits the vertical travel of the stylus and should never be removed except by a qualified Veeco Service Engineer. The stylus shipping paper is temporary and is removed after stage installation. Save the stylus shipping paper for future use when shipping.

CAUTION

The stylus shipping paper must be reinstalled whenever the Scan Head is moved or shipped.

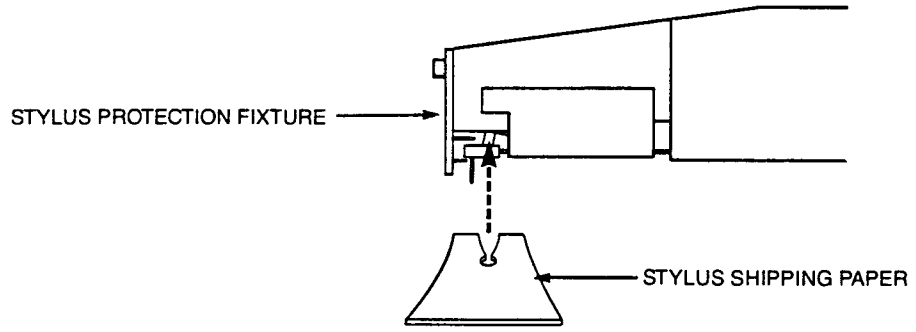


Figure 1-12. Stylus Protection Fixture

Keyboard Installation

1. The keyboard may be hand-held or mounted. To mount the keyboard, slide the keyboard into the holder on the front of the Video Monitor. Lock the keyboard cable into the cable holders on top of the monitor housing (see Figure 1-13).

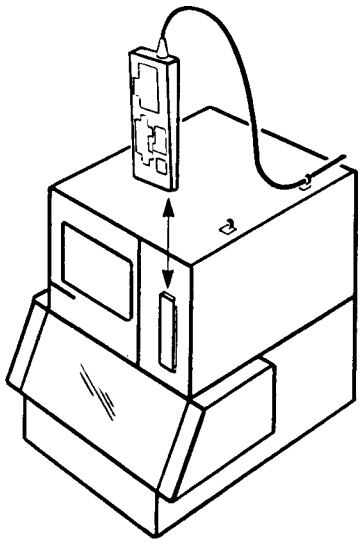


Figure 1-13. Keyboard Installation

Cable Interconnection

1. Raise the optics to uppermost position using the large black knob (optics height) on the front of the Scan Head assembly (see Figure 1-16).

2. Connect and secure all cables where indicated in Figure 1-14.

3. Plug in the main power cable to the back of the and into the proper AC voltage (see Figure 1-14).

4. Turn on the MEU power by depressing the "I" section of the red power switch on top of the MEU. The stylus arm will automatically raise to the uppermost position and stop.

5. Turn off the MEU.

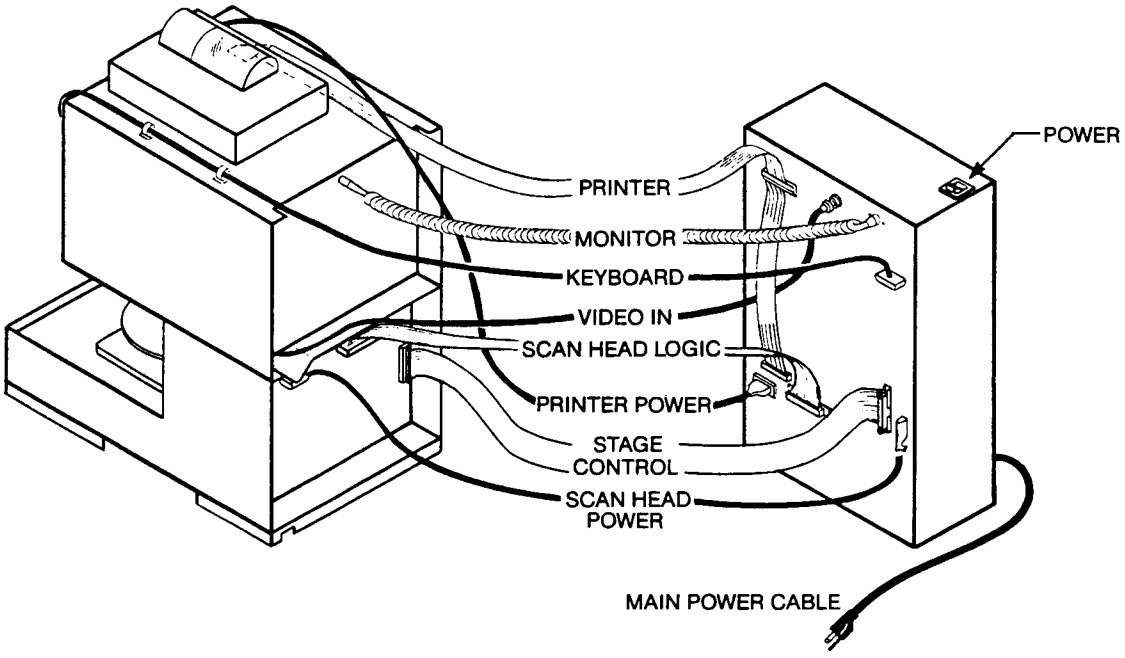


Figure 1-14. System Interconnections

Preparing Stage For Installation

Remove the stage from the protective shipping carton. Use caution in handling the stage (see Figure 1-15).

CAUTION

To avoid damage to the teflon pads, do not allow them to touch any surface other than the surface block.

The stage assembly has five teflon pads which ride on the Scan Head surface block. 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.

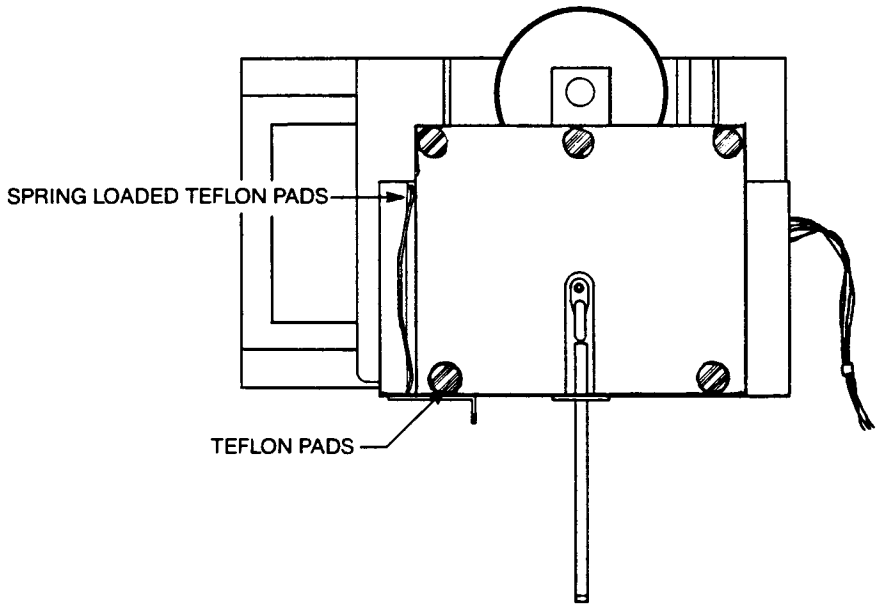


Figure 1-15. Bottom of Stage Assembly

The surface block and stage pads must be cleaned prior to installation.

Stage Cleaning

The stage pads and the surface block must be cleaned with lint-free and abrasive-free tissues moistened with deionized water or laboratory grade alcohol.

CAUTION

Other solvents, such as spectrograde acetone, SHOULD NOT be used since they may attack the adhesives used to mount the teflon pads.

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.

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. Ensure that no debris is embedded in the teflon 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.

Stage Installation

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.

1. Turn power off.

2. Referring to Figure 1-16, use a 3/32" driver to remove the four socket head screws on the Scan Head horizontal bezel.

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

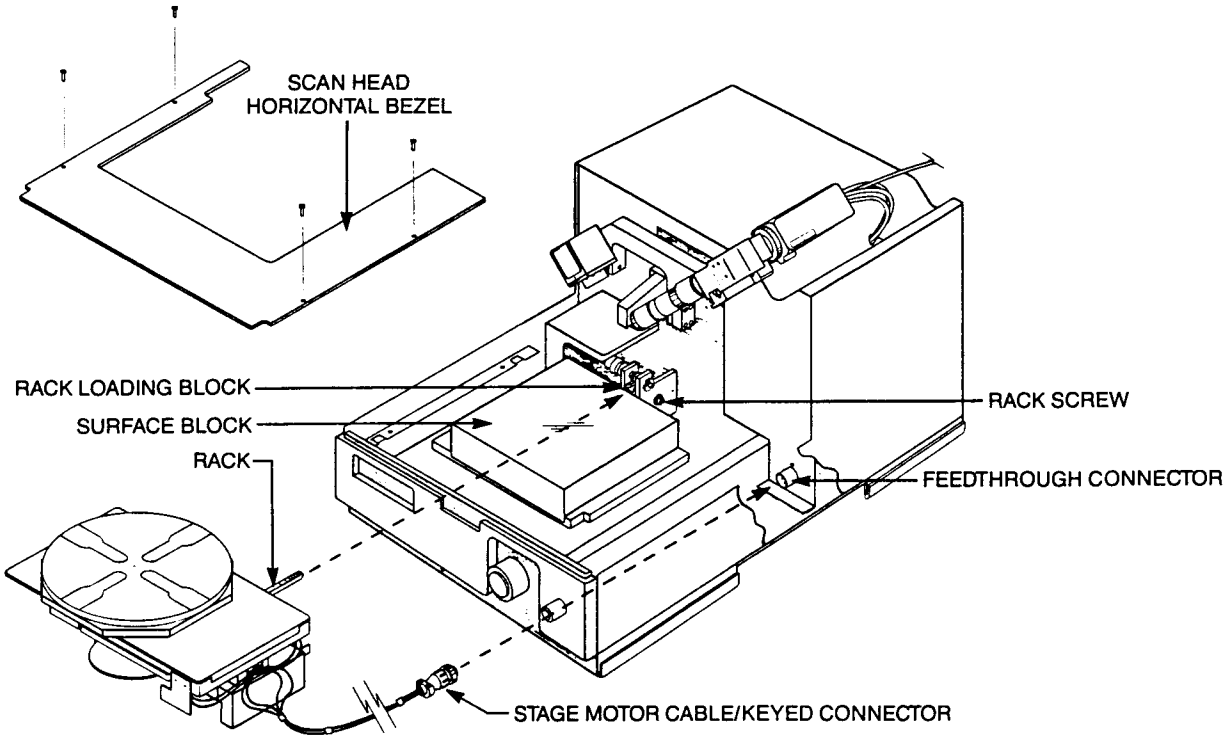


Figure 1-16. Stage Installation

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

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

7. Connect the stage/scan head interface feedthrough connector to the connector on the vertical bezel.

NOTE

If the stage is equipped with a vacuum chuck, the vacuum hose must be connected at this phase of the installation. See Appendix C.

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

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

10. Gently lift the front of the stage and slide the horizontal bezel under the stage. Do not allow the stage to fall on the surface block. Lower the stage gently onto the surface block and secure the bezel by tightening the four socket head screws.

Printer Installation and Programming

If not already done, place the printer on top of the Video Monitor and connect the printer ribbon cable to the MEU into the connector labeled "PRINTER" and plug in the printer power cable from the printer to the MEU into the outlet labeled "PRINTER POWER". (Figure 1-14)

NOTE

If you are using the External Printer Option Board, see Appendix E.

Loading Printer Paper

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

1. Pull the "Printer Head" lever forward to lift the head.

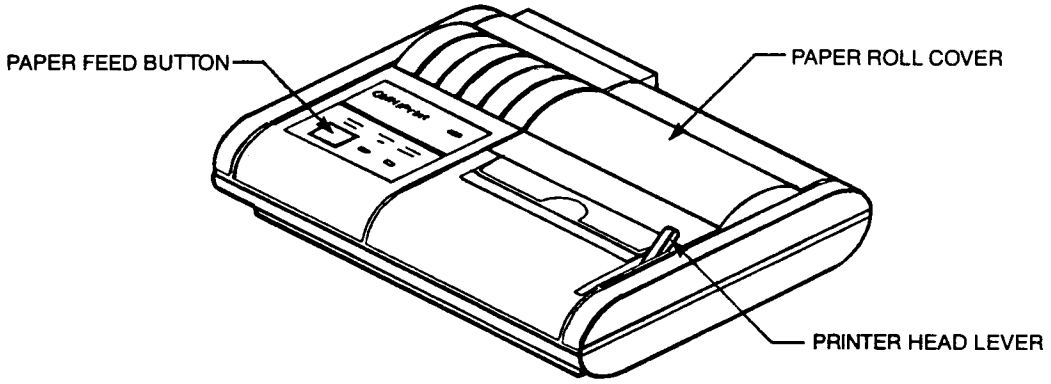


Figure 1-17. Loading Printer Paper

2. Open the paper roll cover (see Figure 1-17). Place the printer paper in the curve of the paper roll cover, with the paper rolling off the bottom of the roll toward the printer. Insert the paper under the rubber platen until the edge appears on the top of the platen.

3. Pull at least two inches of paper through the printer making sure the paper is centered on the platen. Return the "Printer Head" lever to the back position.

4. Hold the end of the threaded paper so it remains outside when closing the paper roll cover.

5. Turn on the MEU power switch. Press and hold the "Paper Feed" button and turn on the printer. The printer should begin the "Self Test" mode. The paper should feed out smoothly. Any adjustments can be made by moving the "Printer Head" lever forward and adjusting the paper position.

OPTICS CHECKOUT

The zoom optics assembly has been adjusted for parfocal length and focus at the factory. It should not require additional adjustment unless it shifted during transport. To determine if this adjustment is required, follow these instructions below:

1. Turn the system on with the MEU power switch.

2. The DEKTAK 3030ST sign on message should be displayed (see Figure 4-1). If the display is not visible, adjust the monitor brightness control thumbwheel just below the CRT.

3. Press the **PRGM** key on the keyboard. The sign on message will clear and the DEKTAK 3030ST Main Menu screen will appear (see Figure 4-2). This screen contains three program menu options.

4. Position the prompt at the Scan Program Menu by using the up/down arrow keys. Press **ENTR**. The scan program menu will be displayed (see Figure 4-3).

5. Place a substrate (sample) on the stage under the stylus. Press the **VID** key twice and adjust the optics height adjustment knob up or down until a clear image appears. If needed, adjust the image brightness using the small knob to the right of the optics height adjustment knob. Press **VID** again and the graphics display will be superimposed over the substrate display.

6. Lower the stylus by using the △▽ (stylus up/down key).

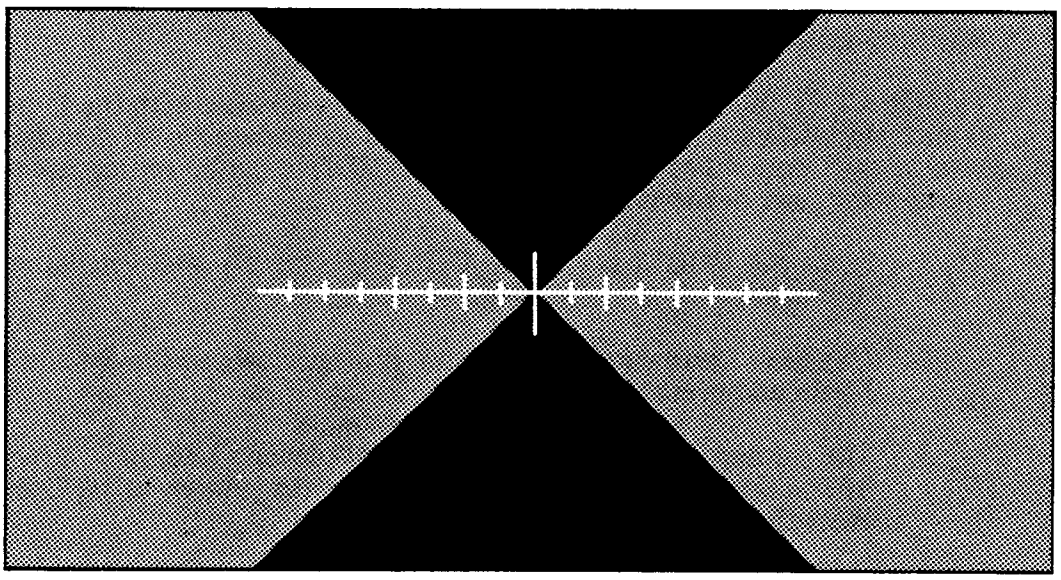


Figure 1-19. Typical Stylus/Reticle Relationship

7. Adjust the optics height adjustment knob until the stylus and the stylus shadow meet at the approximate center of the CRT.

8. Fine focus adjustments of the sample surface image may be obtained by rotating the optics focus adjustment (see Figure 1-20).

9. Press **FCTN,9,7**. A software reticle (crosshairs) will appear on the CRT. Pressing **PRGM** or **SCAN** will delete the software reticle.

10. The zoom optics is operated by a push/pull action of the optics height adjustment knob. Push the knob until the optics is a maximum magnification.

11. The software reticle may be positioned by pressing the arrow keys. Pressing an arrow key and the **FAST** key simultaneously moves the reticle at high speed. Position the software reticle so that it intersects the point where the tip of the stylus and the stylus shadow meet (Figure 1-19). Press **CLR** to delete the reticle. Pressing **FCTN,5** redisplays the reticle, yet it may not be repositioned without first pressing **FCTN,9,7**.

12. Rotate the zoom optics from maximum to minimum magnification by pulling on the MotoZoom remote control knob. If the position of the stylus tip moves more than 1/2-inch along the horizontal axis of the software reticle, adjustment is required.

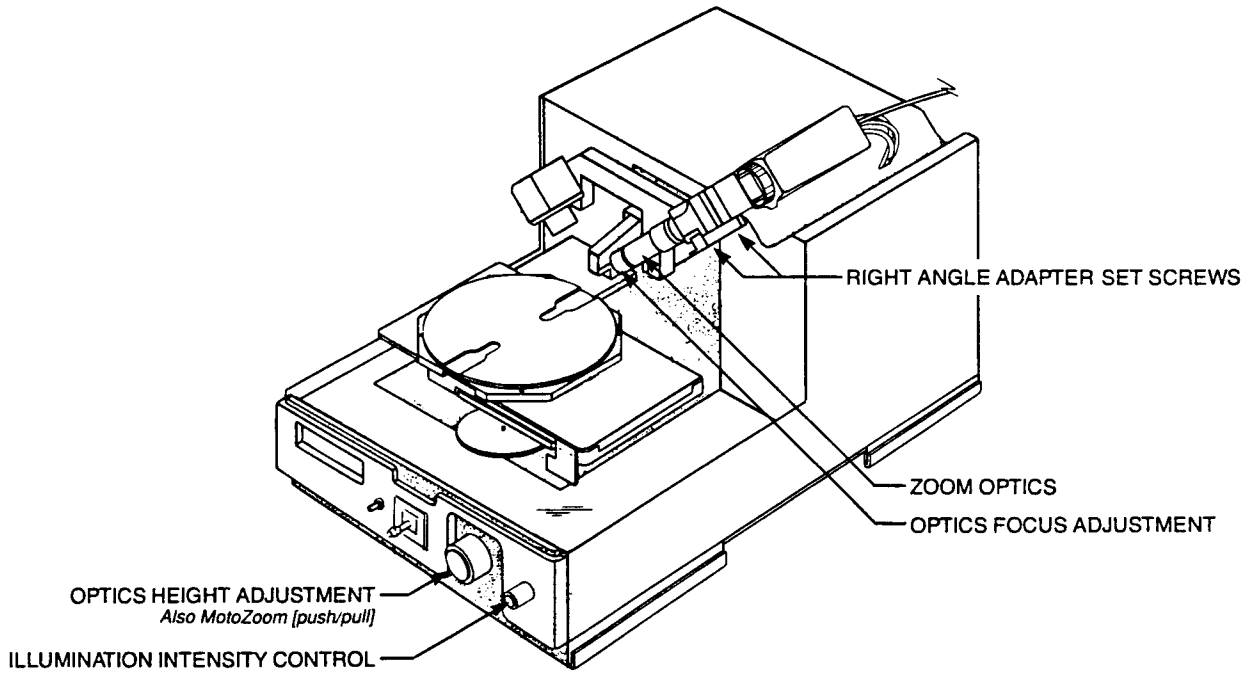


Figure 1-20. Optics Assembly

Optics Adjustments

The zoom optics assembly has been adjusted for parfocal length and focus at the factory. It should not require additional adjustment unless it shifted during transport.

1. To adjust the position of the stylus image along the horizontal axis of the software reticle, use a 9/16" hex driver to loosen the two right angle adapter set screws (see Figure 1-20).

2. Slide the right angle adapter in or out to move the position of the stylus image to the left or right on the software reticle. Retighten the set screws when satisfied with the stylus position.

CAUTION

Please call Veeco Field Service before attempting any additional adjustments in regards to the optics parafocal length, focus, mirror angle, or stylus position on the CRT.

Environmental Shield Installation

The DEKTAK 3030ST may be operated with the environmental shield either on or off. It is recommended that the shield be left on when the instrument is not in use or when performing critical measurements. The environmental shield protects the scanning area from air currents and dust that can adversely affect measurement accuracy.

To install, position the environmental shield using the guide clips on the Scan Head. Slide the shield all the way back until it fits snugly within the Scan Head.

SECTION 2
GENERAL INFORMATION

INTRODUCTION

The DEKTAK 3030ST is an advanced surface texture measuring system which accurately measures surface texture below submicro-inch and film thickness to 131 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, speed and stylus force. 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 3030ST ideal for both production and laboratory use.

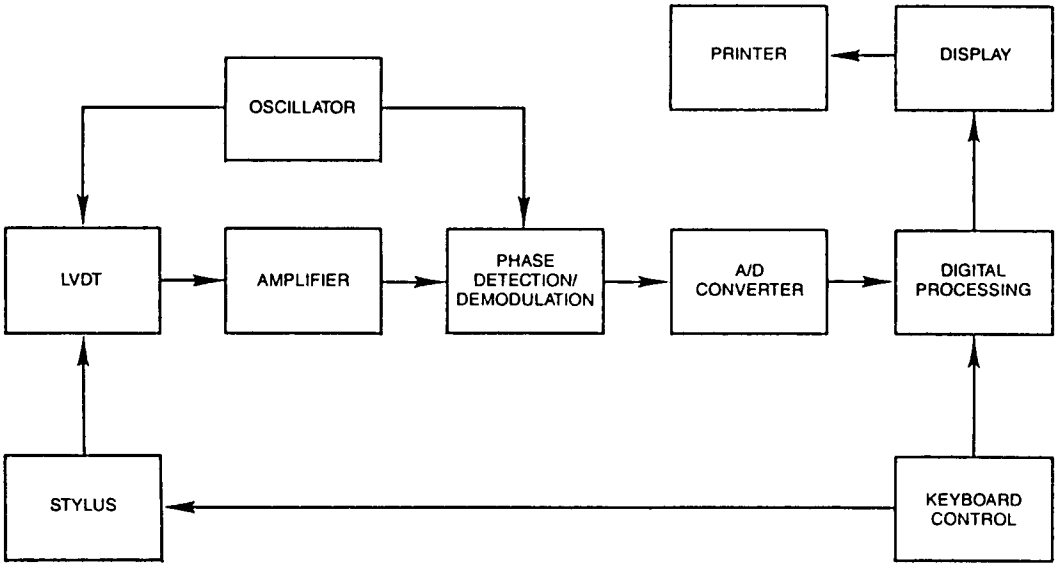


Figure 2-1. Block Diagram of DEKTAK 3030ST

CONFIGURATION

Main Electronics Unit (MEU)

The Main Electronics Unit incorporates dual microprocessor (8088) architecture and a sophisticated two-plane graphics display system. The operating system is stored in EPROM (permanent memory) with the program variables stored in battery-powered RAM . The battery is sized to retain all program parameters for at least three weeks without main power.

Video Monitor

The DEKTAK 3030ST video monitor is a 9" black and white CRT which displays programs and graphics. It can also be used to view the substrate either alone or with the graphics superimposed.

Precision Scan Head

The DEKTAK 3030ST precision Scan Head unit contains the mechanical and optical components for sample placement, sample viewing, scanning/measurement and environmental protection. The analog electronics contained in the Scan Head positions the stylus arm, drives the sample stage, and provides a signal proportional to the vertical movement of the stylus.

Motorized Video Zoom Camera

A remote controlled 35X to 200X Solid-State Video Zoom optics system and a variable intensity illuminator permits viewing of the sample in the measurement area.

AUTO I Joystick Controlled X-Y Stage

A very high precision motorized sample stage performs the scan and permits X-Y positioning to any location of measurement interest in a 3x6 inch area. 360 degree theta rotation permits access to the entire surface of wafers up to six inches in diameter. A dual-speed, proportional joystick is used to control sample positioning.

Thermal Printer

The thermal printer produces full-sized printouts in less than 17 seconds. These printouts provide a graphic record of measurement and program data for future reference and/or reproduction.

Stylus

A 2.5 micron radius, diamond tipped stylus permits accurate surface texture measurements in a wide range of applications. User programmable stylus force from 1 to 40mg allows profiling on soft or hard surfaces.

OPERATION OVERVIEW

Scan Program Menu

The DEKTAK 3030ST Scan Program Menu consists of fifteen individual parameters which are selected using the arrow keys on the keyboard. Parameters such as scan length and speed, leveling, and stylus force can all be preprogrammed. Up to nine Scan Program Menus are available to be preprogrammed and stored for various applications.

Sample Positioning

The sample is placed in the rear center of the sample stage and positioned for scanning using the video camera and the stage translation and rotation thumbwheel controls. For fast sample positioning in a production environment, user designed fixturing can be attached to the rotary stage using the four tapped holes provided.

Scanning

After a sample is positioned, the operator presses a single key which initiates and completes a scan as well as displaying the profile on the screen. 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 stage returns to the home position. The system is immediately ready for the next scan.

Profile Manipulation and Measurement

An initial profile may require 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.

User Determined Units of Measure

Profiles are plotted on a grid whose vertical scaling can be user-specified or computer-determined to best fit the profile. Measurement units are switch selectable. Scientific, Metric, and English units are available. The graphical display will automatically be scaled to reflect the specified units. The vertical scale is in angstroms, nanometers, or microinches and the horizontal scale is in microns, millimeters or microinches.

Data Display

The plotting screen displays ID#, time, date, scan length, scan speed, resolution, and stylus force. 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, and up to eight analytical function results.

Analytical Functions

The DEKTAK 3030ST has 22 analytical functions available for analysis of roughness, waviness, and geometric measurements.

Boundary Magnification

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

Printing

When the desired profile is displayed and a permanent record is desired, a printout can be made with a single keystroke. Also a summary of just the data without graphics may also be printed.

Key Sequence Program Menu

The Key Sequence Program further increases the speed and simplicity of repetitive measurements in a production setting by enabling the operator to initiate a number of operations with just one keystroke.

A Key Sequence can be defined to call a specific Scan Program, restore boundaries, execute an analytical function, print the data, and send the information to a host computer.

HORIZONTAL RESOLUTION

The horizontal resolution of the DEKTAK 3030ST is determined by the scan length, scan speed, and resolution. There are three speed and resolution ranges: Low, Medium and High. The scan length is selectable from 50 microns to 50 millimeters.

The scan data is taken at a constant rate of 40 samples per second. Therefore, the maximum time for a scan is:

	Speed	Resolution
* 3.125/seconds	High	Low (2000 data points max)
* 12.5/seconds	Medium	Medium (4000 data points max)
* 50/seconds	Low	High (8000 data points max)

The Low Speed range has a maximum of ten stage speeds; the Medium Speed range has a maximum of eight stage speeds; the High Speed range has a maximum of six stage speeds. Figure 2-2 shows the horizontal resolution for any given scan length and speed. The following formula may be used to determine the number of data points for any given scan length and speed.

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

SCAN LENGTH IN MICRONS	LOW SPEED		MEDIUM SPEED		HIGH SPEED	
	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES
50	0.025	2000	0.1	500	0.4	125
51-100	0.05	1000-2000	0.2	250-500	0.8	62-125
101-200	0.1	1000-2000	0.4	250-500	1.6	62-125
201-500	0.25	800-2000	1.0	200-500	4	50-125
501-1,000	0.5	1000-2000	2	250-500	8	62-125
1,001-2,000	1.0	1000-2000	4	250-500	16	62-125
2,001-5,000	2.5	800-2000	10	200-500	N/A	N/A
5,001-10,000	5	1000-2000	20	250-500	N/A	N/A
10,001-20,000	10	1000-2000	N/A	N/A	N/A	N/A
20,001-50,000	25	800-2000	N/A	N/A	N/A	N/A

Figure 2-2. Theoretical Horizontal Data Points - Low Resolution

SCAN LENGTH IN MICRONS	LOW SPEED		MEDIUM SPEED		HIGH SPEED	
	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES
50	0.0125	4000	0.05	1000	0.2	250
51-100	0.025	2000-4000	0.1	500-1000	0.4	124-250
101-200	0.05	2000-4000	0.2	500-1000	0.8	124-250
201-500	0.125	1600-4000	0.5	400-1000	2	100-250
501-1,000	0.25	2000-4000	1	500-1000	4	124-250
1,001-2,000	0.5	2000-4000	2	500-1000	8	124-250
2,001-5,000	1.25	1600-4000	5	400-1000	N/A	N/A
5,001-10,000	2.5	2000-4000	10	500-1000	N/A	N/A
10,001-20,000	5	2000-4000	N/A	N/A	N/A	N/A
20,001-50,000	12.5	1600-4000	N/A	N/A	N/A	N/A

Figure 2-3. Theoretical Horizontal Data Points - Medium Resolution

SCAN LENGTH IN MICRONS	LOW SPEED		MEDIUM SPEED		HIGH SPEED	
	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES	HORIZONTAL RESOLUTION (μm/SAMPLE)	NUMBER OF SAMPLES
50	0.00625	8000	0.025	2000	0.1	500
51-100	0.0125	4000-8000	0.05	1000-2000	0.2	248-500
101-200	0.025	4000-8000	0.1	1000-2000	0.4	248-500
201-500	0.0625	3200-8000	0.25	800-2000	1	200-500
501-1,000	0.125	4000-8000	0.5	1000-2000	2	248-500
1,001-2,000	0.25	4000-8000	1	1000-2000	4	248-500
2,001-5,000	0.625	3200-8000	2.5	800-2000	N/A	N/A
5,001-10,000	1.25	4000-8000	5	1000-2000	N/A	N/A
10,001-20,000	2.5	4000-8000	N/A	N/A	N/A	N/A
20,001-50,000	6.25	3200-8000	N/A	N/A	N/A	N/A

Figure 2-4. Theoretical Horizontal Data Points - High Resolution

STYLUS SIZE CONSIDERATIONS

A stylus surface profiler measures the actual physical surface of sample. In certain analyses, 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 force to be reset. Tracking force may be keyboard 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.

TECHNICAL SPECIFICATIONS

	SCIENTIFIC*	METRIC*	ENGLISH*
VERTICAL DISPLAY RANGE	100Å to 1310KÅ	10nm to 131μm	.4μin to 5200μin
VERTICAL RESOLUTION In a Selected Range	1Å/65KÅ 10Å/655KÅ 20Å/1310KÅ	0.1nm/6.5μm 1nm/65.5μm 2nm/131μm	.040μin/255μin .040μin/2574μin .080μin/5148μin
SCAN LENGTH RANGE	50μm to 50mm	50μm to 50mm	2000μin to 2000mils

A = Angstroms μm = micrometer (micron) μin = microinch nm = nanometer

*Switch selectable on top panel of Main Electronics Unit.

Scan Speed Ranges:	Low, Med, High
Resolution Ranges:	Low, Med, High
Leveling:	Manual, two-point programmable or cursor leveling
Stylus (Std):	Diamond, 2.5 micron radius
Stylus Tracking Force:	Programmable, 1-40mg (0.01 - 0.4mN-milliNewtons)
Maximum Sample Thickness:	45mm (1.75 inches)
Sample Stage Diameter:	165mm (6.5 inches)
Sample Stage Translation: (from center)	X Axis, ± 76mm (± 3 inches) Y Axis, -76mm (3.0 inches)
Sample Stage Rotation:	Theta, 360°
Maximum Sample Weight:	0.5Kg (1 lb)
Power Requirements:	100/115/220Vac ± 10%, 50-60Hz, 200VA
Warm-up Time:	15 minutes recommended for maximum stability
Operating Temperature:	21° C ± 3° C 70° F ± 5° F

Sample Viewing

Zoom Magnification:	35X to 200X
Camera:	Solid State Video
Sample Illumination:	Variable intensity white light; IR & UV blocked

Dimensions

Assembled:	13" W x 27.5" D x 24" H (33cm x 69.9cm x 61cm)
With Environmental Shild:	16" W x 27.5" D x 24" H (40.6cm x 69.9cm x 61cm)

Shipping Weights

Main Electronics Unit:	26 lbs (11.8 kg)
Scan Head Carton:	67 lbs (30.4 kg)
Monitor/Enclosure:	24 lbs (10.9 kg)
Accessories Carton:	27 lbs (12.2 kg)

OPTIONS/ACCESSORIES

See Appendix A in the back of this manual for a complete list of Options and Accessories for the DEKTAK 3030ST.

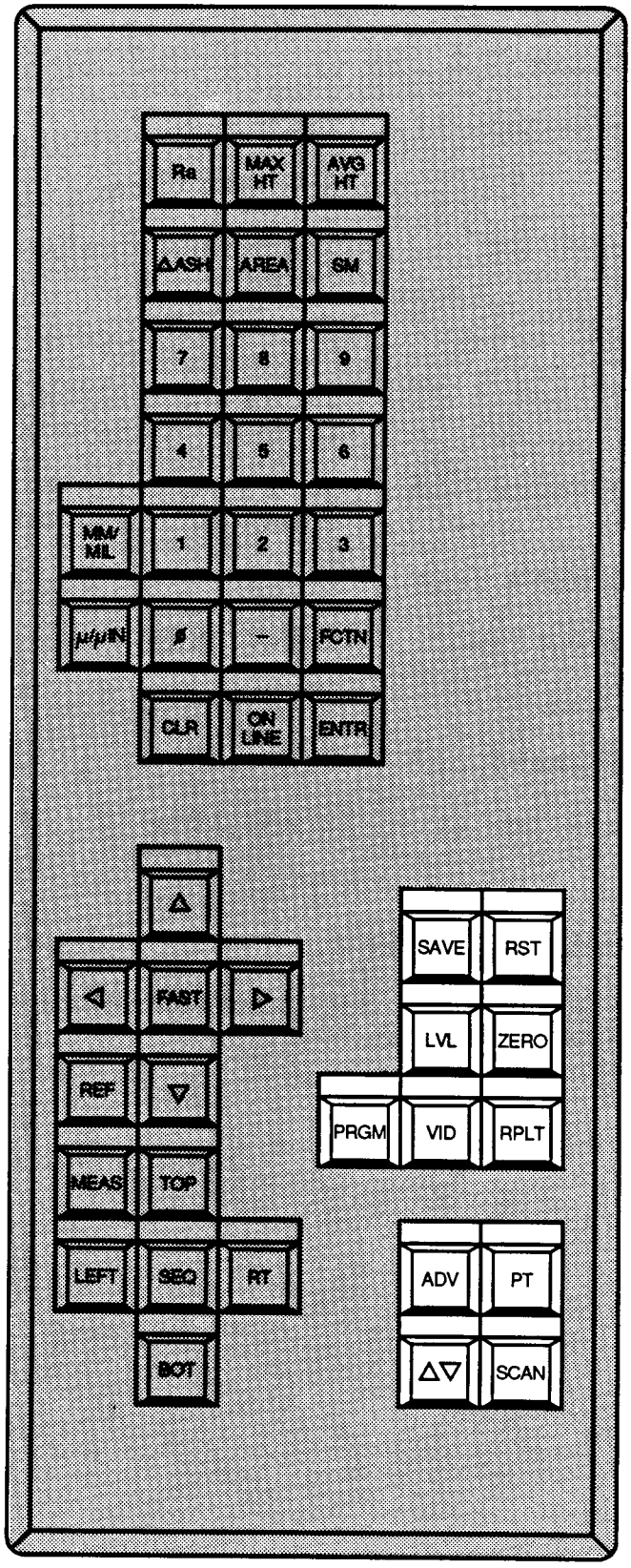


Figure 3-1. Keyboard

SECTION 3

KEYBOARD FUNCTIONS

Key	*Function*
SAVE	(SAVE) Restores up to nine plot boundaries displayed on the screen. Original boundaries will be automatically stored and saved in any order. Pressing **SAVE**, (**1** through **9**) stores a particular set of boundaries until replaced by a different set.
RST	(RESTORE) The restore key will replot the desired boundaries(1 through 9) according to the boundaries saved by the corresponding **SAVE**, (**1** through **9**) file. **RST**, **0** will display the original boundaries.
LVL	(LEVEL) Level a trace according to the R and M cursor/trace intercepts. The R cursor/ trace intercept will automatically be zeroed.
ZERO	(ZERO) Places the R cursor/trace intercept on the zero horizontal grid line.
PRGM	(PROGRAM) Used to access the program menus.
VID	(VIDEO) Controls three video display modes: video, video/graphics overlay and graphics.
RPLT	(REPLOT) Replots the trace in scale when new boundary locations are selected.
ADV	(ADVANCE) Advances the printer paper.
PT	(PRINT) Initiates a printout of the CRT display.
ΔV	(STYLUS UP/DOWN) Raises and lowers the stylus.
SCAN	(SCAN) Initiates/aborts a scan.

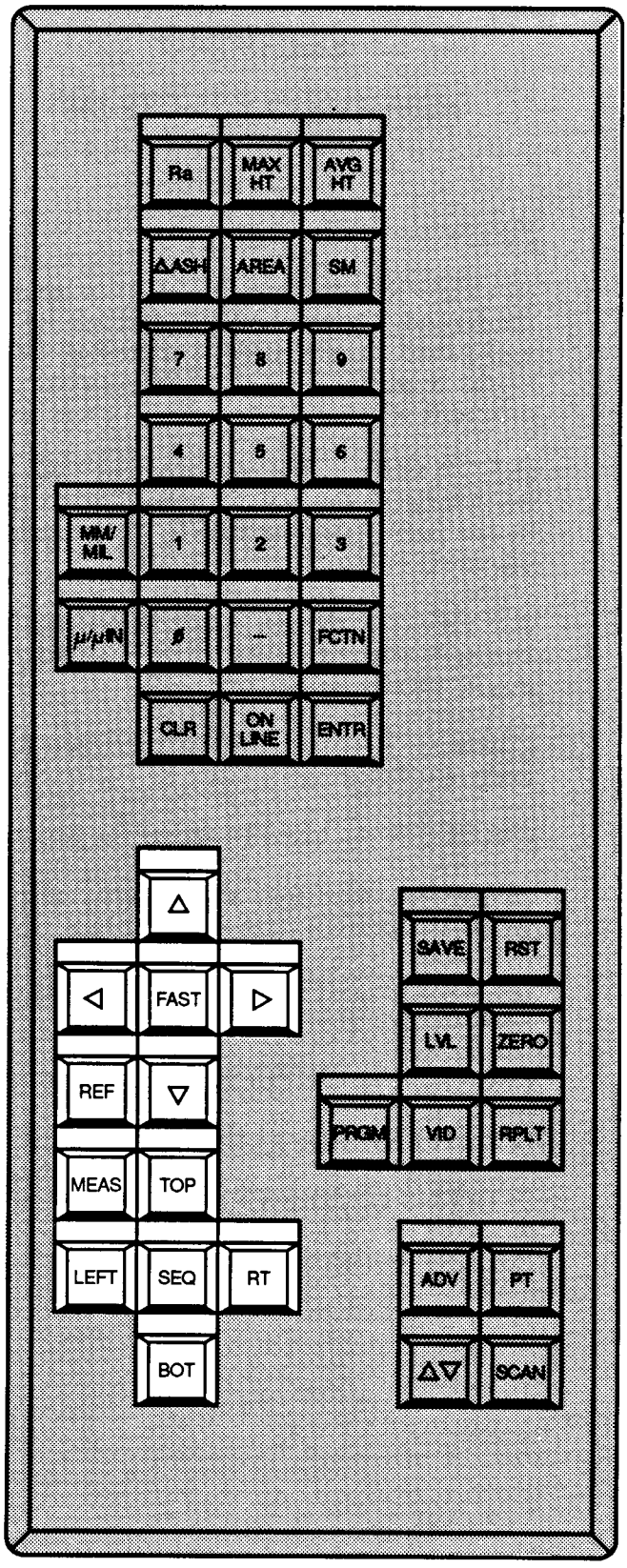


Figure 3-2. Keyboard

Key	*Function*
	(ARROW KEYS) for cursor, boundary, software reticle, and/or prompt positioning.
FAST	(FAST) Speeds up software reticle, boundary or cursor movement.

NOTE

To move software reticle, cursors or boundaries in the fast mode, press and hold the appropriate arrow key and then the FAST key.

REF	(REFERENCE) Specifies the reference cursor as the cursor to be moved. Used in conjunction with the direction keys or numeric values entered. Numerical entry will also change the value in the Scan Program Menu
MEAS	(MEASUREMENT) Specifies the measurement cursor as the cursor to be moved. Used in conjunction with the direction keys or numeric values entered. Numerical entry will also change the value in the Scan Program Menu.
TOP **LEFT RT** **BOT**	(TOP, BOTTOM, LEFT, RIGHT) Specifies a boundary for positioning. Used in conjunction with the direction keys or numeric values entered.
SEQ	(KEY SEQUENCE) Executes a key sequence program.

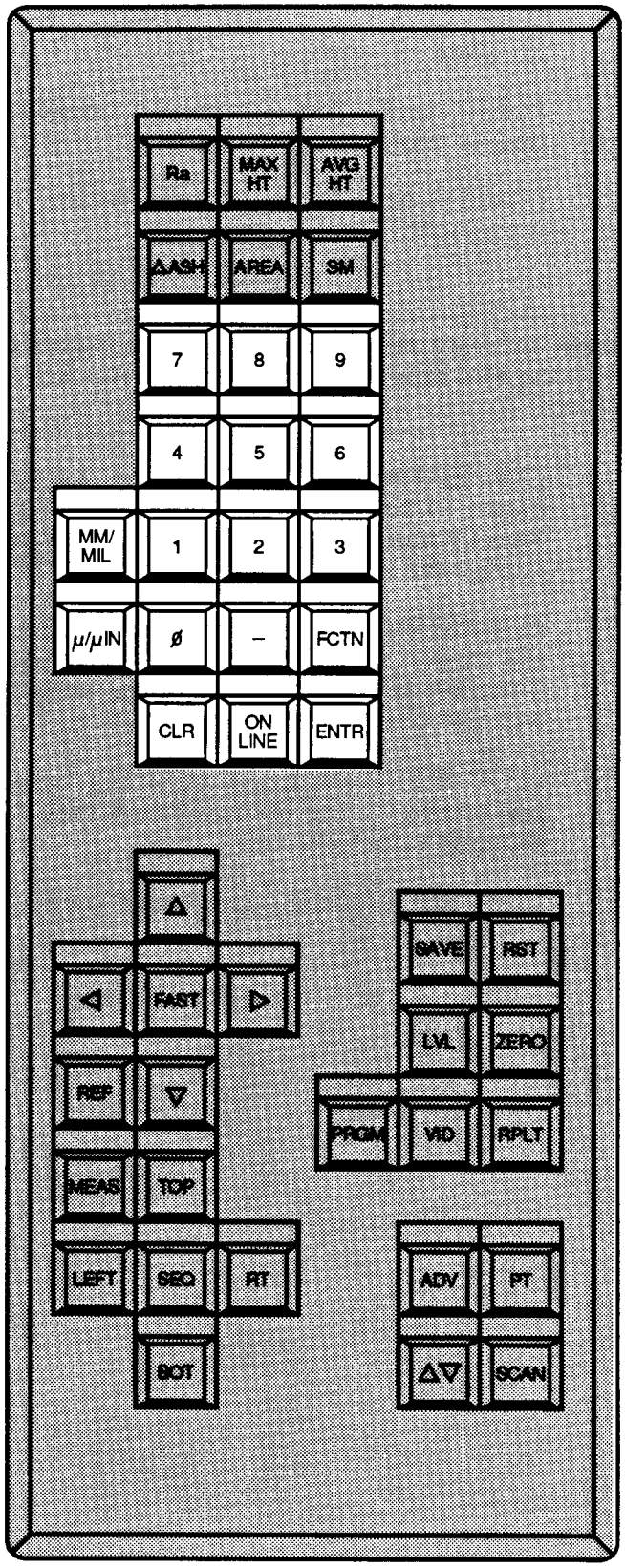


Figure 3-3. Keyboard

Key	*Function*
0-9	(ZERO-NINE) Used in specifying numeric values for programming parameters, cursors, boundaries and smoothing functions.
MM/MIL	(MILLIMETERS) When scientific or metric units are selected, enter MM after a number to indicate its value in millimeters. (MIL) When English units are selected, using this key will enter Mil after a number to indicate its value in thousandths of an inch.

NOTE

A unit of measure needs to be specified only when entering the scan length or a value for Auto Leveling, cursors or boundaries that cannot be assumed by the DEKTAK 3030ST.

μ/μIN	(MICRONS) or micrometers. When scientific or metric units are selected, enter μ after a number to indicate its value in microns. (MICROINCHES) When English units are selected, use this key to enter μin after a number to indicate its value in microinches.
-	(MINUS SIGN) Used for specifying negative values for top and bottom boundary positions.
FCTN	(FUNCTION) Used in conjunction with a number to select a special function.
CLR	(CLEAR) Erases any numeric data keyed in but not yet entered. Also deletes analytical function in Scan Program Menu.
ENTR	(ENTER) Enters specified numeric data.

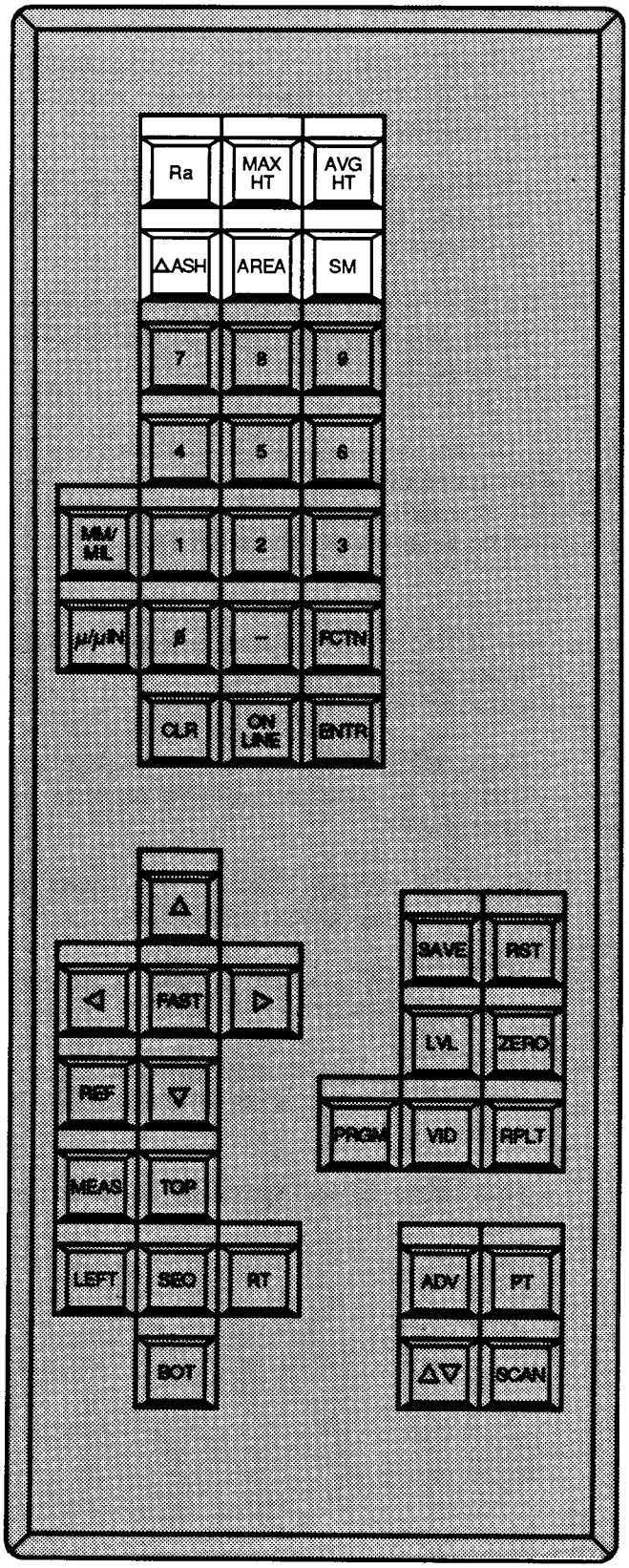


Figure 3-4. Keyboard

ANALYTICAL FUNCTIONS

The DEKTAK 3030ST is equipped with 22 Analytical Functions. These functions provide analysis of a portion of the profile trace as defined by the reference and measurement cursors. Five of the Analytical Functions are activated by pressing the assigned keys shown in Figure 3-3. The remaining functions require pressing the **FCTN** key and the assigned keystroke combination.

Key	*Function*
RA	(AVERAGE ROUGHNESS) Calculates the arithmetic average roughness of a surface between the R and M cursors. Per ANSI B46.1-1978 and NBS 902.
MAX HT	(MAXIMUM HEIGHT) Calculates the distance of the two furthest data points in the vertical dimension between the cursors.
AVG HT	(AVERAGE HEIGHT) Calculates the average height of a profile between R and M cursors.
ΔASH	(DELTA AVERAGE STEP HEIGHT) This function will calculate the step height between the two averaged heights of the trace between the R and M cursors.
AREA	(AREA) Calculates the integrated area of the profile between R and M cursors.
FCTN,3,0	(Wa) Arithmetic average of waviness.
FCTN,3,1	(Wq) Root mean square of waviness.
FCTN,3,2	(Wp) Maximum peak of waviness above the mean.
FCTN,3,3	(Wv) Maximum valley of waviness below the mean.
FCTN,3,4	(Wt) Maximum peak to valley of waviness.
FCTN,3,5	(Rp) Maximum peak of roughness above mean.
FCTN,3,6	(Rv) Maximum valley of roughness above mean.
FCTN,3,6	(Rv) Maximum valley of roughness below mean.
FCTN,3,7	(Rt) Maximum peak to valley of roughness.
FCTN,3,8	(Rz) Ten point height average of roughness.
FCTN,3,9	(R3z) Six point height average of roughness.
FCTN,4,0	(Rq) Root mean square of roughness.
FCTN,4,1	(MRa) Maximum arithmetic average roughness.

FCTN,4,2 (MDv) Maximum deviation from the mean.

FCTN,4,3 (Rad) Calculates the radius of a circle.

FCTN,4,4 (Vol) Calculates the volume of a profile.

FCTN,4,5 (Slp) Calculates the slope of a profile.

FCTN,4,6 (Cir) Calculates the profile circumference.

KEY STROKE COMBINATIONS AND FUNCTIONS

There are a number of additional multiple key functions available with the DEKTAK 3030ST.

Keys	*Function*
FCTN,O	Initiates the software calibration function.
FCTN,O,CLR	Clears the software calibration factor.
FCTN,2,n	Initiates Key Sequence Program n.
FCTN,5	Activates the software reticle. Reticle is deleted when **PRGM** or **SCAN** is pressed.
FCTN,9,7	Activates movable software reticle. Use arrow keys to position reticle. Press **CLR** to exit.
FCTN,PT	Print summary. Graphic data not included.
FCTN,ΔV	"Soft Touch" mode. The tower descent speed and stylus force are reduced to minimize stylus impact damage. When this mode is activated, the words "Soft Touch" are displayed in the lower right hand corner of the screen when the stylus is lowering.

SECTION 4

OPERATION

POWER ON

1. Power on the DEKTAK 3030ST. The following will be displayed:

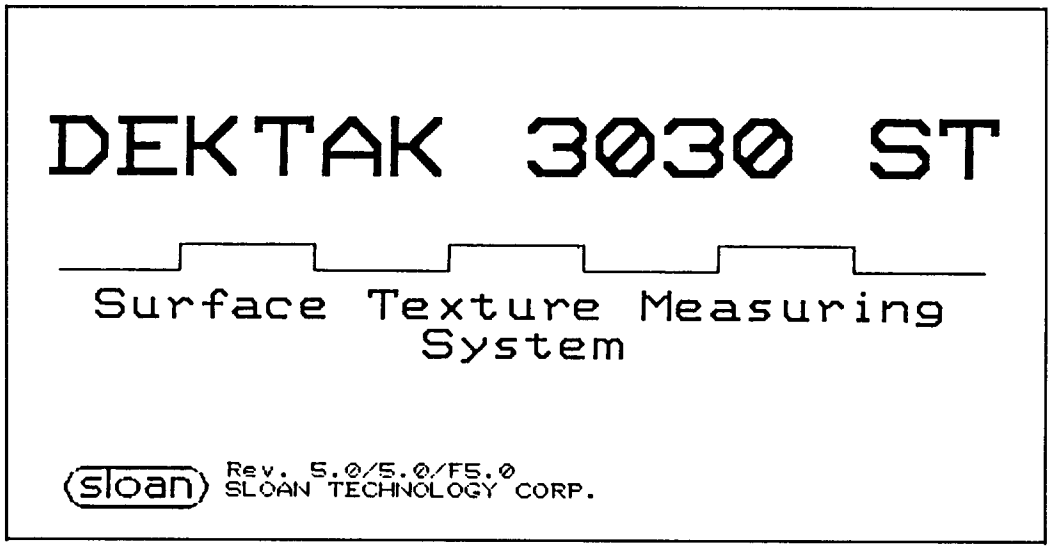


Figure 4-1. Sign on Message

If the sample or stage image appears in the background, Press **VID** until the sign-on message shows against a uniform gray background.

2. Raise the optics tower until the stylus is approximately one inch off the stage surface.

3. Press **PRGM**. The DEKTAK 3030ST Main Menu will appear (see Figure 4-2).

NOTE

To enter current time and date on main menu, move the prompt to Time & Date using the arrow keys. Set the time based on a 24-hour clock and press ENTR. Then set the current month/date/year and press ENTR. The time and date will be correctly displayed on all scan profiles.

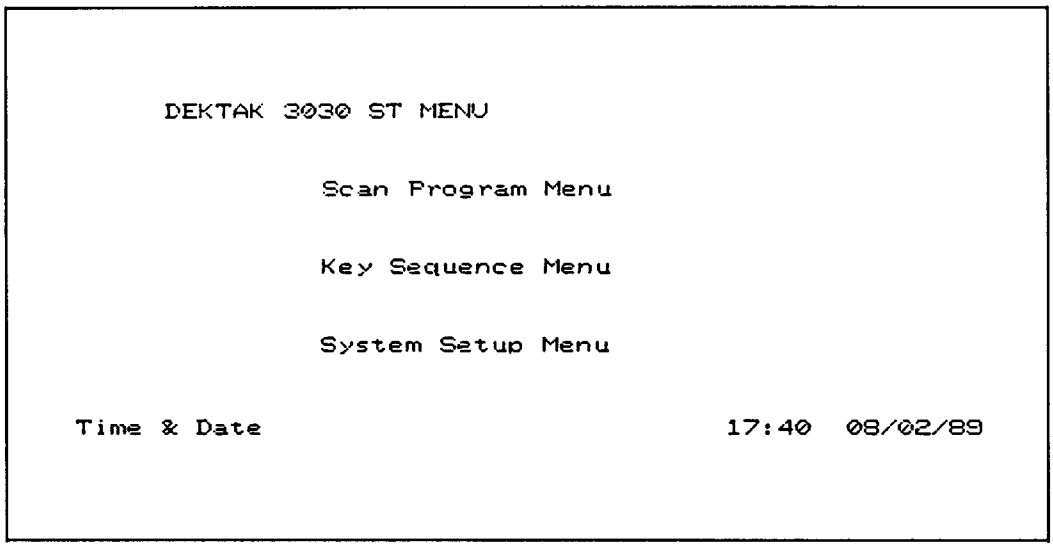


Figure 4-2. Main Menu

4. Move the prompt to the Scan Program Menu using the arrow keys. Press **ENTR**. A program menu similar to the following will appear on the screen (Figure 4-3).

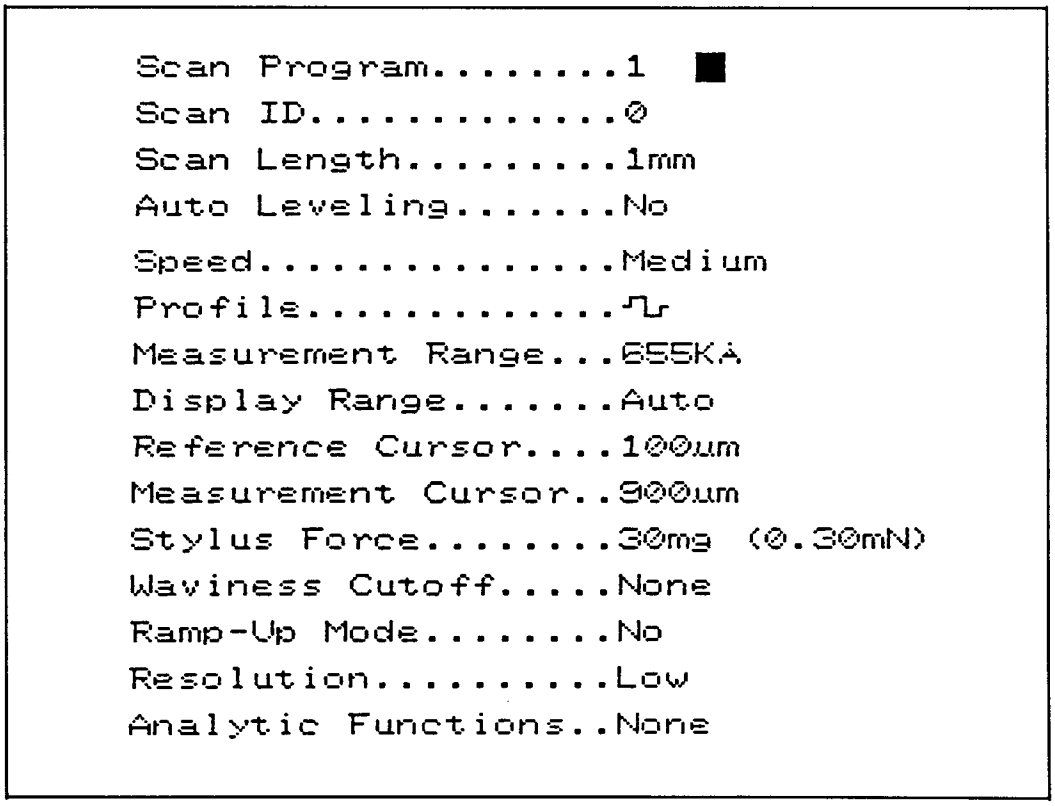


Figure 4-3. Typical Scan Program Menu

PROGRAMMING

The Scan Program Menu is the operator interface for instructing the DEKTAK 3030ST how the scan should be run, and how the results are to be presented. Up to nine different programs can be stored in the DEKTAK 3030ST. The programs are battery-backed up and remain programmed when the power is off.

Other than the SCAN ID, which is user-determined, the selection of the rest of the parameters are described in this section. Use the arrow keys to position the prompt and make the selection from the alternatives available or key-in the numeric values desired. The following pages outline step-by-step instructions for sample positioning, scan programming, and making a scan.

Scan Program

Enter a **1** into Scan Program. After each parameter is selected, press **ENTR**.

NOTE

Units of measure need not be keyed in along with the numerical value if the DEKTAK 3030ST can assume the correct units.

Scan Length

Scan lengths are available from 50 microns (um) to 50 millimeters (mm). Key in **1,ENTR.** This sets the scan length for 1mm which is ideal for a trace of the calibration standard.

Auto Leveling

This is used to automatically level a scan where two scan reference points lie on the same plane. For example, in Figure 4-7, 100um and 700um lie on the same plane, whereas 10um and 400um do not. The first two values could be used to auto level. The second two could not. For the purpose of this initial exercise on the instrument, select *No*, press **ENTR**.

Smoothing

This is an analytical function used in special applications when a high degree of noise is present on the scan profile. A detailed explanation of smoothing is provided in Section 6 of this manual. Select *No*, and press **ENTR**.

Speed

For a given scan length, the lower the speed, the greater the number of data points taken. Select *Medium* and press **ENTR**. (See Figure 2-2 for a complete list of scan lengths and speeds.)

Profile

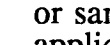
Three different profiles are available, depending upon the sample surface characteristics and the measurement range to be selected:

 (Valleys) Provides 90% of the Measurement Range below the zero horizontal grid line.

 (Hills and Valleys) Provides 50% of the Measurement Range above the zero horizontal grid line and 50% below.

 (Hills) Provides 90% of the Measurement Range above the zero horizontal grid line.

The profile setting is important. It scales the Measurement Range according to the profile selected.

If the surface characteristics of the sample are not well known, or if the stage or sample is possibly out of level, select Hills and Valleys () for most applications.

For this application, select  and press **ENTR**.

Measurement Range

The available vertical resolution depends upon the Measurement Range selected. There are three vertical height ranges to choose from. The vertical resolution corresponding to these ranges are:

65KA Range	=	1A Vertical Resolution
655KA Range	=	10A Vertical Resolution
1,310KA Range	=	20A Vertical Resolution

For this application, select the *655KA* range and depress **ENTR**.

Display Range

The DEKTAK 3030ST will automatically scale the graphic display based upon the profile data. "AUTO" is normally used, although a user may prescale the graphics by numeric entry. For this application, select *AUTO* and press **ENTR**.

Reference Cursor

This sets the horizontal position of the reference cursor and is very useful for measurements on multiple, identical samples or multiple identical measurement locations on the same sample. The cursor position can be moved later as necessary, so it is not critical to position it at this time. Key in **100** and press **ENTR**.

Measurement Cursor

This sets the horizontal value for the measurement cursor in an identical manner to the reference cursor. The measurement cursor should be set at a value greater than the reference cursor. For this application, key in **900**, and press **ENTR**.

Stylus Force

The DEKTAK 3030ST provides a keyboard programmable stylus force over a range of 1-40mg. Soft samples require less force, although better measurements are obtained with a higher stylus force. It is an application trade-off. For this application, key in **30** and press **ENTR**. (The reading in parenthesis (0.30mN) is the force in milliNewtons.)

Waviness Cut-off

Certain applications require substrate waviness be removed for a roughness measurement. For step-height applications and scans of 2mm or less the cut-off filter is not required.

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 or Medium speed with scan lengths of 500 microns or less and at High speed with scan lengths of 100 microns or less. If the Ramp-Up Mode is active and an invalid scan length or speed is selected, the Normal homing routine will be used and the Ramp-Up Mode parameter will be changed to "*No*" automatically. Since the scan length in this example scan is one millimeter, the Ramp-Up Mode cannot be entered.

Resolution

This parameter allows the user to select the number of data points to be collected during the scan. Three selections are available: Low = 2000 data points (max), Medium = 4000 data points (max), High = 8000 data points (max)

For this application select low.

Analytic Functions

This shows the analytical functions that will be calculated when the scan is complete (Analytical Functions are entered on the scan display). Analytical Functions may be deleted by moving the prompt over the Analytical Function and pressing **FCTN,CLR**.

The DEKTAK 3030ST is now fully programmed for a scan.

SAMPLE POSITIONING - CALIBRATION STANDARD

1. The stage is positioned with the joystick controller. Two stage speeds are available: High (20mm/second), and Low (4 microns/second). The switch to the left of the joystick is used to select the stage translation speed. Flip the switch to the up position to operate the stage at high speed.

2. Move the stage forward by angling the joystick to the left (see Figure 4-4). The joystick position corresponds with the stage movement across the CRT, not the actual stage movement.

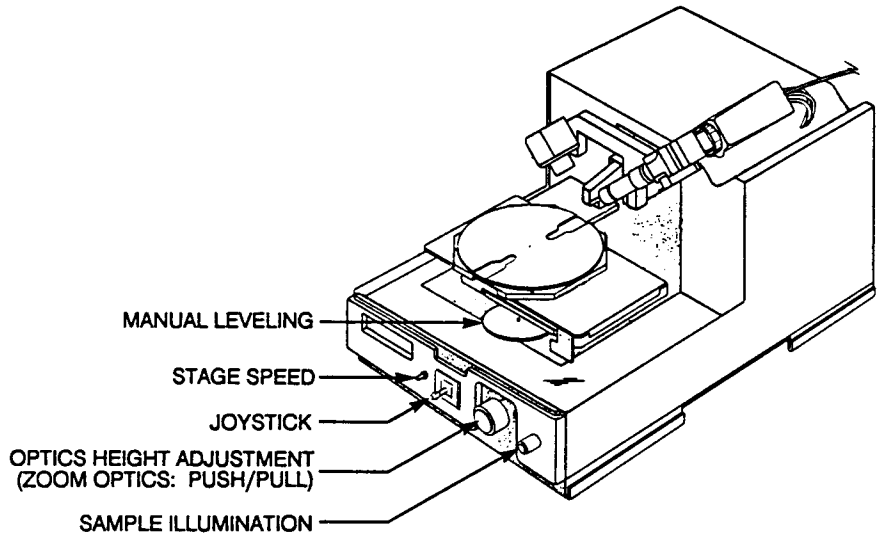


Figure 4-4. Stage

3. Place the calibration standard near the center rear of the stage.

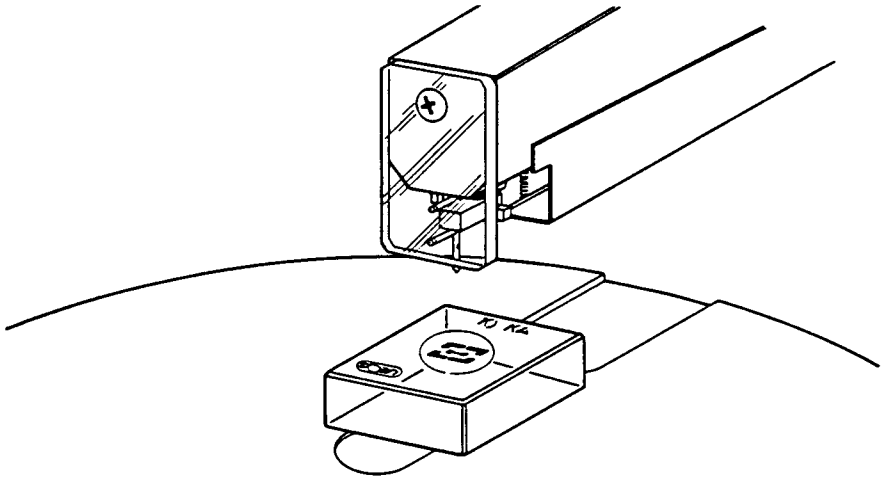


Figure 4-5. Positioning the Calibration Standard

4. Move the stage back by angling the joystick to the right. Position the stage until the calibration standard is centered below the stylus as shown in Figure 4-5.

5. Press **VID** twice. This is the video/graphics overlay mode. Press **FCTN,5**. The software reticle and the video image are displayed simultaneously.

6. The Zoom Optics is operated by a push/pull action of the optics height adjustment knob (the large, black knob on the front of the Scan Head). Pull on the knob until the optics is at minimum magnification.

7. Press **ΔV** . The stylus will lower on to the calibration standard. Adjust the optics height knob until the stylus tip is positioned on the X-axis of the reticle (Figure 4-6). Adjust the illumination to obtain the required contrast by using the small knob on the front of the Scan Head.

8. Orient the calibration standard until the video display matches Figure 4-6. During the scan the sample moves from back to front, however the screen will show it moving from right to left since the video image is optically rotated 90° clockwise.

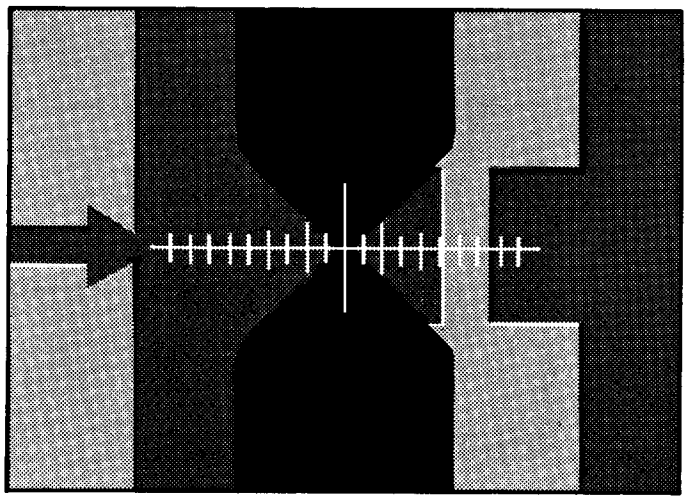


Figure 4-6. Video Display of Surface Image

9. Press **ΔV** again to raise the stylus. The instrument is now ready to make a scan.

MAKING A SCAN

Press **SCAN.**

1. The stylus will lower.
2. An initial profile will be plotted on the screen as the scan commences.
3. Upon completion of the scan, the stylus will raise automatically.
4. The sample stage will automatically return to the home position.

The DEKTAK 3030ST will immediately replot the original scan using the autoranging feature that was programmed into the Scan Program Menu. The autoranging feature scales the graphic boundaries so that the profile occupies 80% of the graphic area of the screen. (Figure 4-7.)

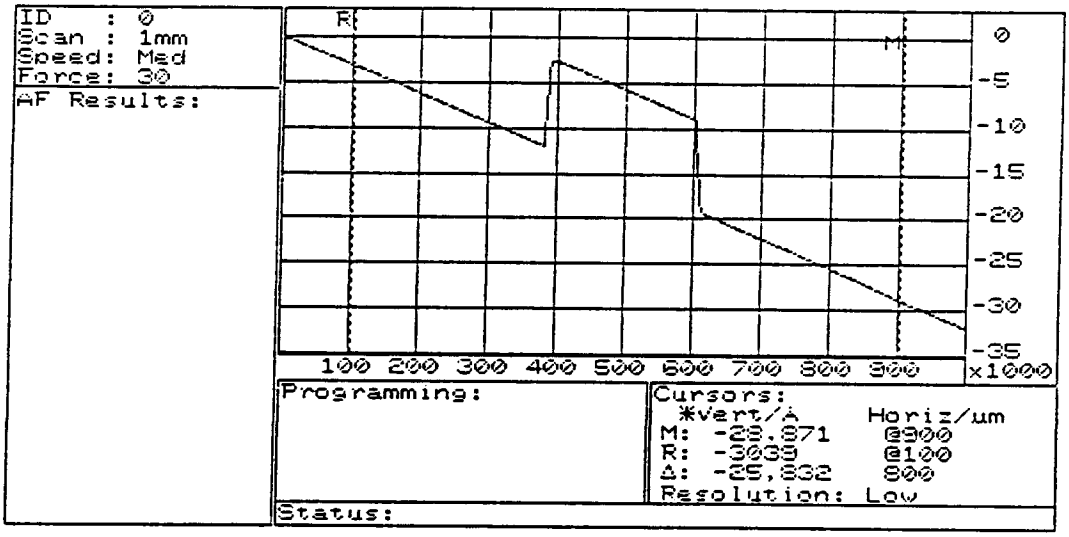


Figure 4-7. Typical Calibration Standard Profile

NOTE

If the initial trace touched either the top or the bottom of the screen before the completion of the scan, the standard is more than 327KA out of level. The stage must be manually leveled (see Page 48).

The following identifies and describes the fields displayed on a scan profile.

Field	*Description*
ID:	Scan identification number.
Scan:	Scan length (50um-50mm). An * next to SCAN indicates the unit is in the Ramp-Up Mode.
Speed:	Scan Speed (Low, Medium, or High).
Force:	Stylus force in milligrams (1-40mg).
AF Results:	Displays the results from the analytical functions performed. The horizontal locations of the Reference and Measurement cursors is also provided for each function.
Programming:	Reference and measurement cursor locations are displayed, allowing a different set of cursor positions to be programmed along with each analytical function.
Cursors:	Provides the current vertical and horizontal location of the M: Measurement cursor, R: Reference cursor, and Δ: Delta, or difference between the R and M cursor locations. The vertical location of the cursor is determined by the point where the cursor intersects the scan trace.
Status:	Displays instrument status and error messages.

LEVELING

Manual Leveling

Manual coarse leveling is an important aspect of the DEKTAK 3030ST operation. The closest possible manual leveling will ensure the best instrument performance. The manual leveling thumbwheel (see Figure 4-4) 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).

1. Press the **SCAN** key.

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.

2. Press **SCAN** again.

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 4-7.

Press **FCTN,4,5**. The slope between the intersect points of 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. Level the trace as described above and change to the intermediate range and repeat the procedure until leveled.

Cursor Leveling

Before accurate step height measurements can be made, a reference must be established. For the calibration standard, the quartz surface is used as the reference. All measurements are made in relationship to this surface. The two cursors were programmed in the beginning of our example at approximately the correct points on the quartz. If one or both cursors appear to be on a rough spot, move the cursors slightly by pressing **REF** or **MEAS** then use the arrow keys to reposition the cursor.

Press **LVL**. The screen will be replotted with both the R Cursor intercept and the M Cursor intercept positioned at the horizontal zero grid line with the trace leveled.

Auto Leveling

If two correct leveling points are known, these values can be entered into the Auto Leveling parameter of the Scan Program Menu. All scans will now be leveled at these two points automatically after the scan has been completed.

Press **PRGM**. Move the prompt to the Auto Leveling parameter. Since the scan will start on the quartz surface, go over the step, and finish on the quartz surface, leveling points can easily be determined. Since the scan starts on the quartz, the first leveling point can be 0. And since it finishes on the quartz, the second leveling point can be 1000. Enter 0 and 1000.

Press **SCAN**. The initial trace will be out of level, however, the replotted trace will be automatically leveled.

MAKING A MEASUREMENT

Once the trace has been adequately leveled, an accurate measurement can be obtained.

1. Press **MEAS**.
2. Using the left arrow key ◁, move the M Cursor to the middle of the top of the step.
3. Press **REF**.
4. Using the right arrow key ▷, move the R Cursor to the base of the step.

The difference between the R cursor and the M cursor intercept is the step height. This height is automatically displayed in the lower right corner of the CRT.

SETTING THE ZERO POINT

Any point on the trace may be selected as the zero point.

1. Press **REF**.

2. Using the right arrow key, move the R Cursor to a position on top of the step. Press **ZERO**.

The screen will replot with the trace in the original position but the vertical scale will be rescaled in the negative direction (Figure 4-8). Move the R cursor back to the base of the step and press **ZERO** again.

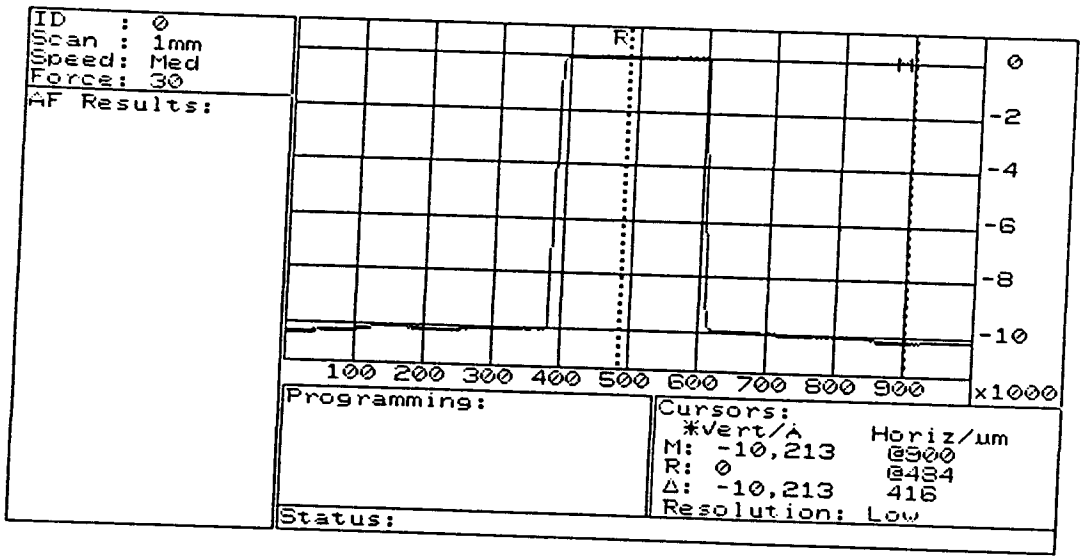


Figure 4-8. Setting the Zero Point

NUMERIC CURSOR ENTRY

Cursor positions may be entered numerically in the graphics mode (as opposed to moving it with an arrow key) for leveling, making measurements, or setting the zero point. This also changes the Reference and Measurement Cursor values in the Scan Program Menu.

1. Press **REF** and **200,ENTR**. The R Cursor will move to the 200 micron grid location and the Reference Cursor value will automatically be changed to 200 microns in the Scan Program Menu.

2. Press **MEAS** and **500,ENTR**. The M Cursor will move to the 500 micron grid location and the Measurement Cursor value will automatically be changed to 500 microns in the Scan Program Menu.

3. Press **PRGM** and notice the R and M Cursor values are the same as the values just entered.

4. Press **RPLT** to display the scan.

MAGNIFYING A TRACE

To magnify an area of interest, press **LEFT** and use the right arrow key to bring the left boundary near the leading edge of the step. Repeat the procedure using the **RT**, **BOT** and **TOP** keys along with the appropriate arrow keys until the screen looks like Figure 4-9.

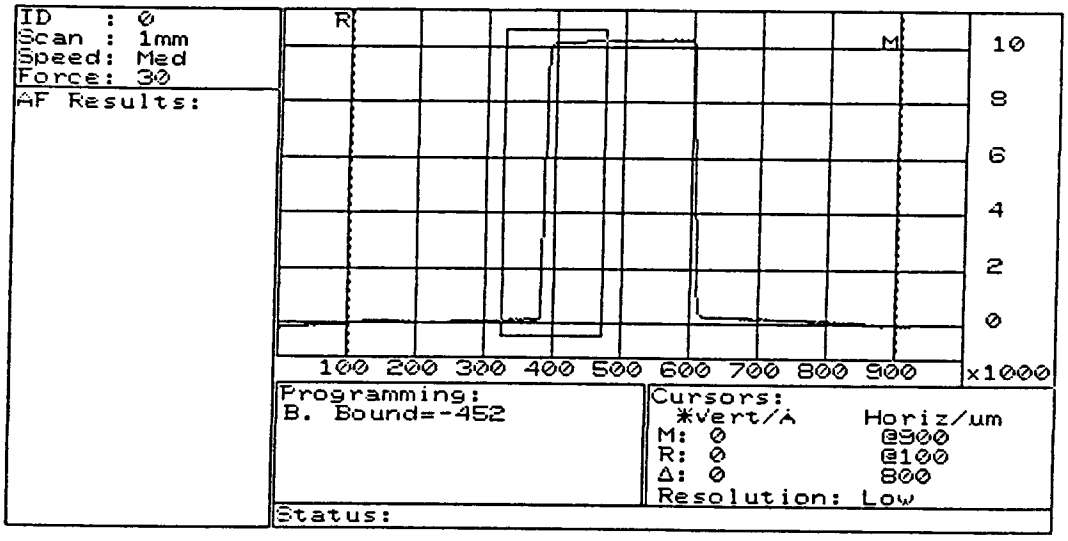


Figure 4-9. Moving the Boundaries

Press **RPLT**. Figure 4-10 shows the replotted profile of Figure 4-9. The graph is rescaled, and the profile has been magnified to allow easy measurement.

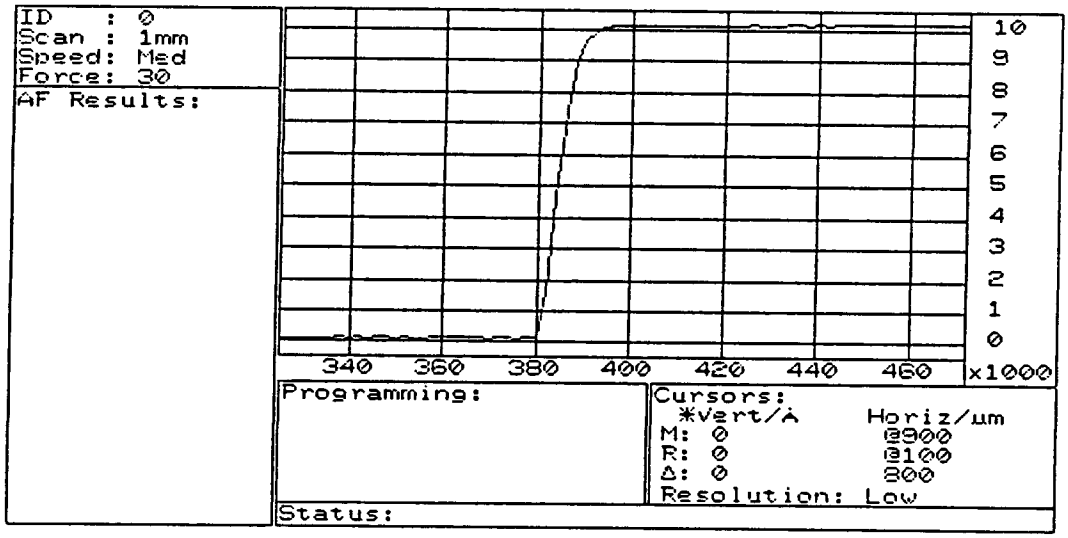


Figure 4-10. After REPLOT

Saving a Magnified Trace

The DEKTAK 3030ST has the ability to store (**SAVE**) and restore (**RST**) up to nine different boundary locations. This can be very useful when performing repetitive measurements of a specific feature on like samples. It is important to understand that the saved boundary locations are completely independent of the profile (trace) data. If the trace data is changed (new scan) it may not appear again in the same boundary. Therefore, profiling one sample, moving in the boundaries, replotting and saving those boundary locations may be meaningless when scanning a second, completely different sample and restoring the saved boundaries from the previous scan.

In this application, save the magnified trace in Figure 4-11 by pressing **SAVE,1**. After moving the boundaries you must press **RPLT** prior to saving boundaries.

Restoring a Trace

Press **RST,0**. The original saved boundaries in Figure 4-10 will be restored.

NOTE

RST,0 always restores the initial plot boundaries. This can be used effectively if the trace has been auto leveled. If the trace is cursor leveled, use RST,1-9 to save the leveled trace boundaries. (SAVE,0 cannot be used as a save location.)

Retrieving a Stored Trace

To retrieve the stored trace, Press **RST,1**. The magnified trace in Figure 4-11 should reappear on the screen.

Numeric Boundary Entry

Boundary locations can be entered numerically as well as moving them with the arrow keys.

1. Press **RST,0**. The entire leveled profile will be displayed.
2. Press **LEFT**. In the lower right-hand corner of the display, the current left boundary positions will be displayed along with a black box (prompt) below. Using the numeric key pad, program in **150** and press **ENTR**. The left boundary will be repositioned to the 150 micron position on the graph.
3. Press **RT** and enter **400**.
4. Press **RPLT**. A display similar to Figure 4-10 will be displayed.
5. Repeat steps 2-4 only entering **0** for the left boundary and **1000** for the right. The original one millimeter scan will be displayed.

The top and bottom boundaries work in the same fashion.

PRINTOUT

A printout of any CRT display can be generated by the thermal printer. Pressing **PT** will print the entire graphics display (Figure 4-11) and pressing **FCTN,PT** will print a Scan Summary (Figure 4-12).

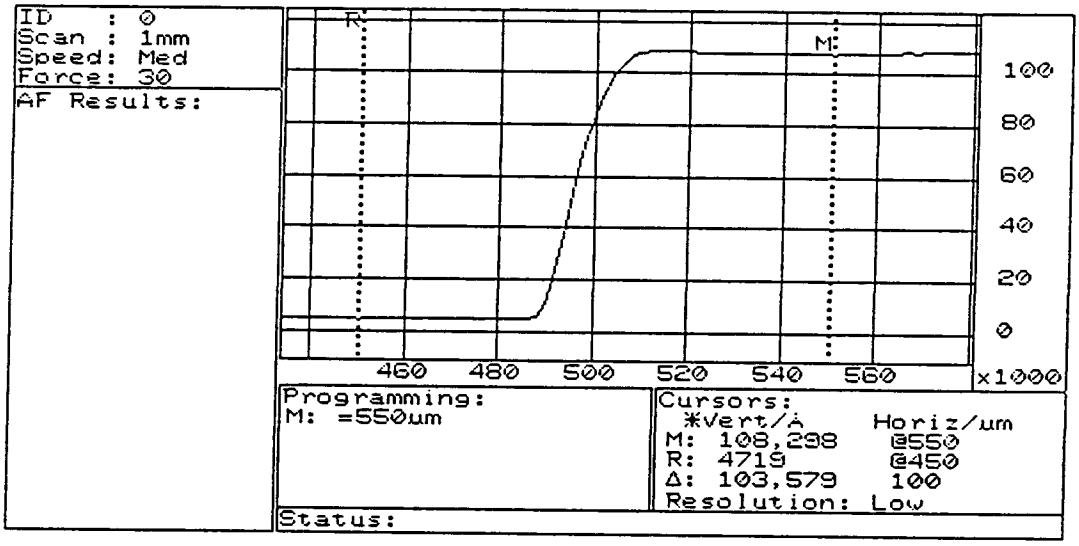


Figure 4-11. Printout Data - Full Screen

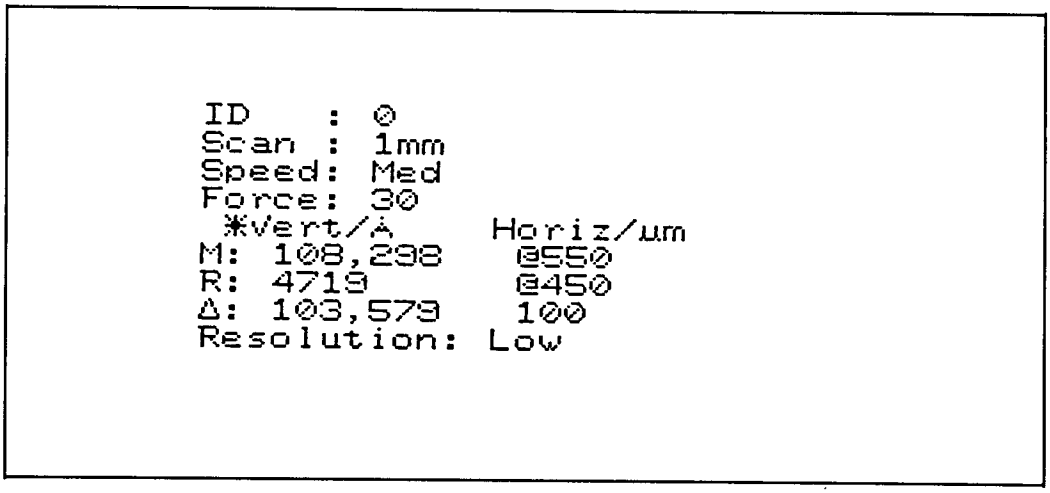


Figure 4-12. Scan Summary

The basic DEKTAK 3030ST operating procedures for sample positioning, programming, and making a scan are now complete. This general technique is used in various scan applications involving films of different hardnesses, textures, and thicknesses.

SECTION 5

KEY SEQUENCE MODE

PROGRAMMING - KEY SEQUENCE OPERATION

The ability to preprogram sequential key strokes is a very powerful feature of the DEKTAK 3030. The major benefit is that several operations may be conducted with minimal operator intervention.

The Key Sequence Program can initiate several operations with one keystroke. Nine programs are available and are stored in battery backed RAM.

Before programming a Key Sequence, a Scan Program must be set up as described in Section 4 with all desired zoom boundaries saved.

NOTE

For this example, all steps in Section 4 must have been performed in order to achieve the desired results in the Key Sequence operation.

Press **PRGM** until the DEKTAK 3030ST Main Menu appears. Move the prompt to the Key Sequence Menu and depress **ENTR**. A Key Sequence Program will appear as in Figure 5-1.

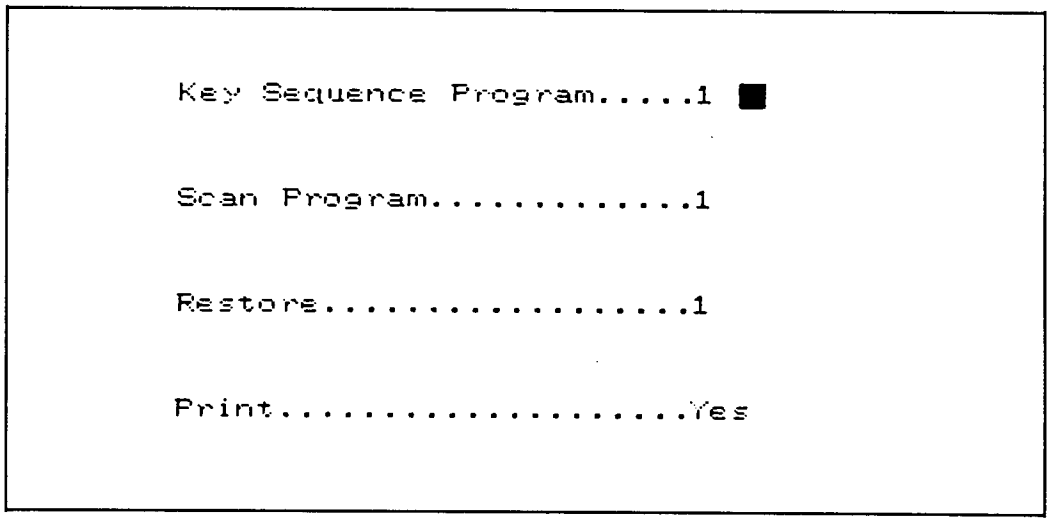


Figure 5-1. Key Sequence Program

Key Sequence Program

There are nine Key Sequence Programs available (1-9). Enter **1** at the prompt and press **ENTR**.

Scan Program

Up to nine Scan Programs (1-9) can be preprogrammed and stored in memory. Select Scan Program **1** and press **ENTR**.

Restore

The restore function permits zoom magnification of a profile feature. One of up to nine boundary locations (1-9) saved in the DEKTAK 3030ST memory can be accessed. For this example, use the saved boundary locations described in Section 4. Enter **1** and press **ENTR** (entering 0 will display the original scan).

Print

The selections available are: Yes, No, and FPrint. If Yes is selected, the entire screen will be printed, FPrint will print the summary data -- no graphics, and No will not execute a print command. Select Yes and press **ENTR**.

A Key Sequence Program can be executed in either the Scan Program mode or the Key Sequence Program mode. To activate a Key Sequence for the first time, press **FCTN,2,n** where n equals the desired Key Sequence Program number. Subsequent scans using the same Key Sequence Program can be activated by pressing the yellow **SEQ** button. To run a different Key Sequence Program press **FCTN,2,** and the desired program number. The SEQ button will now call that Key Sequence until changed.

Press **FCTN,2,1**. The following operations will be executed:

1. Scan Program 1 will be run.
2. A zoom/restore function will be displayed.
3. A printout will be generated.

By pressing **SEQ**, the above operations will be executed again.

Key Sequence Program

There are nine Key Sequence Programs available (1-9). Enter **1** at the prompt and press **ENTR**.

Scan Program

Up to nine Scan Programs (1-9) can be preprogrammed and stored in memory. Select Scan Program **1** and press **ENTR**.

Restore

The restore function permits zoom magnification of a profile feature. One of up to nine boundary locations (1-9) saved in the DEKTAK 3030ST memory can be accessed. For this example, use the saved boundary locations described in Section 4. Enter **1** and press **ENTR** (entering 0 will display the original scan).

Print

The selections available are: Yes, No, and FPrint. If Yes is selected, the entire screen will be printed, FPrint will print the summary data -- no graphics, and No will not execute a print command. Select Yes and press **ENTR**.

A Key Sequence Program can be executed in either the Scan Program mode or the Key Sequence Program mode. To activate a Key Sequence for the first time, press **FCTN,2,n** where n equals the desired Key Sequence Program number. Subsequent scans using the same Key Sequence Program can be activated by pressing the yellow **SEQ** button. To run a different Key Sequence Program press **FCTN,2,** and the desired program number. The SEQ button will now call that Key Sequence until changed.

Press **FCTN,2,1**. The following operations will be executed:

1. Scan Program 1 will be run.
2. A zoom/restore function will be displayed.
3. A printout will be generated.

By pressing **SEQ**, the above operations will be executed again.

SECTION 6
ANALYTICAL FUNCTIONS

INTRODUCTION

In many applications, it is important to know more than step height information. The DEKTAK 3030ST is equipped with 22 standard analytical functions. At the conclusion of a scan, pressing any of the dedicated analytical function keys or keystroke combinations will display the result in the "programming" area of the screen (Figure 6-1). Reference and measurement cursors are used to define the assessment area of each function. Therefore, it is important that the cursors are carefully positioned on the profile trace prior to performing an analytical function.

Analytical functions may also be preprogrammed into the Scan Program to be automatically displayed at the conclusion of a scan. Up to eight different functions can be programmed to be performed simultaneously on a single scan.

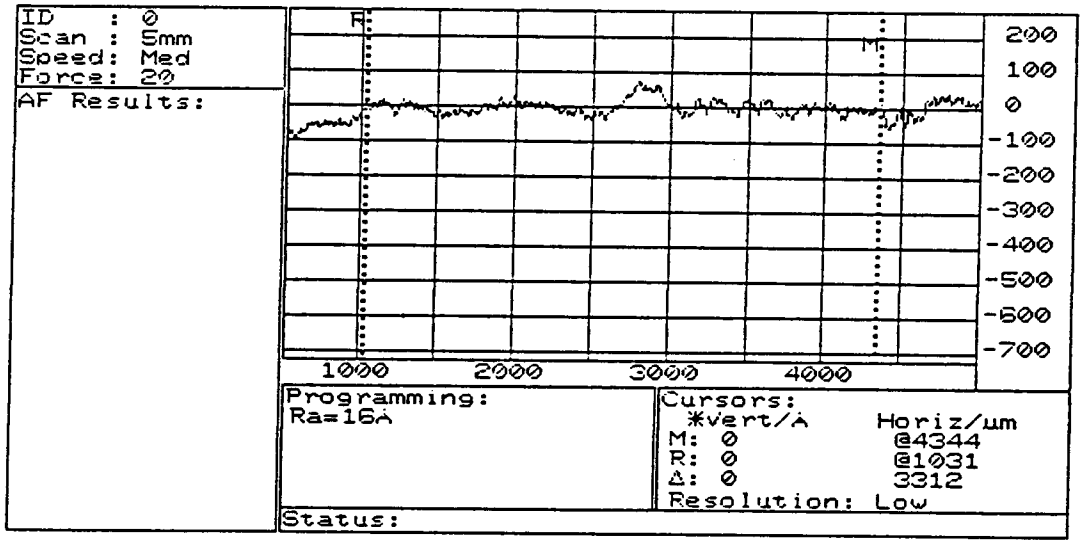


Figure 6-1. Performing a Single Analytical Function

PROGRAMMING ANALYTICAL FUNCTIONS

Prior to programming analytical functions into the scan program an initial scan must be completed. The following procedure is a guide for adding analytical functions to a scan program:

1. Perform a scan operation following the procedure described in Section 4 of this manual.

2. After the initial scan is complete, position the R and M cursors so as to define the assessment area for the particular analytical function desired.

3. Press **FCTN, PRGM**. All 22 analytical functions will be displayed in the "programming" area of the scan display.

4. Using the arrow keys, move the prompt over the desired function to be performed and press **ENTR**. The function will be added to the "AF Results" section of the display showing the R and M cursor locations and the result (Figure 6-2).

5. Repeat steps 2 through 4 to insert up to eight functions.

The programmed analytical functions will now be displayed in the Scan Program Menu. These functions will automatically be performed on all successive scans whenever this particular scan program is activated.

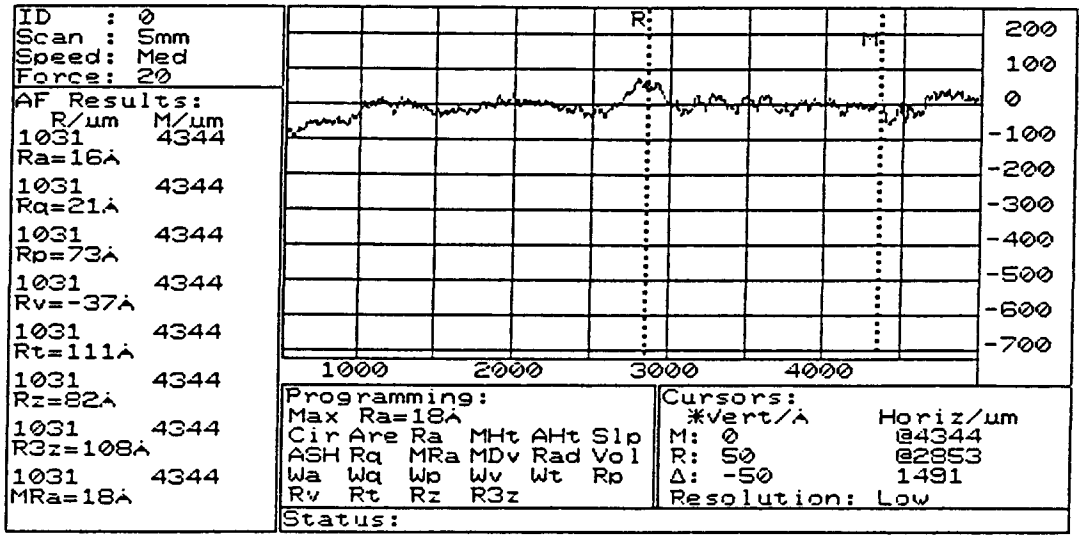


Figure 6-2. Programming Multiple Analytical Functions

EDITING ANALYTICAL FUNCTIONS

The R and M cursor locations of a preprogrammed analytical function can be changed or modified using the following procedure:

1. Press **FCTN, PRGM** then **FCTN,** ◁ (left arrow). A prompt box will appear over the first analytical function programmed in to the "AF Results" section.

2. The up/down arrow keys may be used to move the prompt over the desired function to be modified.

3. Press the R or M Cursor key depending on what coordinate is to be modified. A prompt will appear in the "Programming" area which will display the programmed location of the cursor.

4. Key in the new R and M cursor coordinates using the numeric keypad or position the cursors using the arrow keys.

5. Press **FCTN,ENT** to update the cursor position.

6. Repeat steps 2 through 4 to edit additional functions.

7. To exit the edit mode, press **FCTN,** ▷ (right arrow).

DELETING ANALYTICAL FUNCTIONS

Delete preprogrammed analytical functions using the following procedure:

1. Press **FCTN, PRGM** then **FCTN,** ◁ (left arrow). A prompt box will appear over the first analytical function programmed into the "AF Results" section.

2. The up/down arrow keys may be used to move the prompt to the function to be deleted.

3. Press the **CLR** key to delete the desired functions.

4. Press **FCTN,** ▷ (right arrow) to exit.

Analytical functions can also be deleted in the scan program menu by moving the prompt over the desired function and pressing **CLR.**

PROGRAMMABLE CUT-OFF WAVELENGTH FILTER

The DEKTAK 3030ST is equipped with a high-pass, two pole digital filter which filters out low-frequency signals. In effect, the cut-off frequency defines the intended difference between roughness and waviness spacing. It filters out waviness, permitting more accurate roughness measurements. The filter is enabled when the Ra, Rq, Rp, Rv, Rt, Rz, or MaxRa functions are activated. The filter design is in accordance with the ANSI B46.1* specification on surface texture. We suggest a copy of this specification be studied before surface analysis is undertaken.

The cut-off filter wavelength is entered in the Scan Program Menu. The cut-off wavelength may be as short as 10 microns or as long as 50,000 microns. It is recommended that the scan length be 5-10 times longer than the cut-off wavelength. The cut-off value will not be accepted if fewer than 8 data points are available per cut-off wavelength. This can be otherwise defined as:

$$\text{CUT-OFF WAVELENGTH IN MICRONS} \geq \frac{\text{SCAN SPEED IN MICRONS/SECOND}}{5}$$

The scan speeds are given in Figures 2-2, 2-3, and 2-4. If a cut-off filter is not required, enter "None" in the Scan Program Menu.

Filter Operation

Once the desired filter has been programmed into the Scan Program Menu, it is automatically accessed whenever a roughness analytical function is performed. The scan data is conditioned by the software cut-off filter and stored in a special memory file. The original, unfiltered, scan data is unaffected and is displayed on the CRT. The cut-off filter rejects waviness above the selected cut-off wavelength. Lower wavelengths (higher frequencies) representing roughness are passed through the filter.

Based on filtered data, the analytical function is computed and displayed. The position of the R and M cursors determines the section of filtered data used to calculate the function.

It is recommended that the stage be manually leveled prior to making a scan. The software cut-off filter described above behaves similarly to a hardware filter. When measuring a mechanically unleveled surface, filter charging creates distortion at the beginning of the scan. Moving the R cursor to a position with half the value of the cut-off wavelength or greater will eliminate any skewing created by the unlevel surface and provide accurate and repeatable results.

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Surface Roughness Calculations

Beginning with a displayed surface profile, an arithmetic mean Z_{avg} is defined as the sum of all height values (Z) divided by the number of data points in the profile:

$$Z_{avg} = 1/N \sum_{i=1}^{N} Z_i$$

One of the most frequently used roughness parameters is R_a. This value is the arithmetic mean of the deviations in height from the profile mean value Z_{avg}. R_a is written as:

$$R_a = 1/N \sum_{i=1}^{N} |Z_i - Z_{avg}|$$

Another frequently used figure of merit is the root-mean-square, RMS, roughness. This value is written as:

$$RMS = [1/N \sum_{i=1}^{N} |Z_i - Z_{avg}|^2]^{1/2}$$

Statistics relating to maximum peak heights include R_p and R_t. R_p is defined as the maximum height of the profile above the mean line and R_t is the maximum peak to valley height in the profile.

$$\mathbf{R_p = Z_{max} - Z_{avg}}$$

$$\mathbf{R_t = Z_{max} - Z_{min}}$$

More representative of the entire profile are the mean values of R_p and R_t.

$$R_{pm} = 1/Y \sum_{i=1}^{N} (R_p)i$$

$$R_{tm} = 1/Y \sum_{i=1}^{N} (R_t)i$$

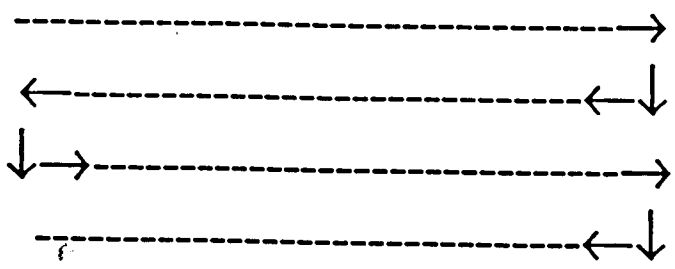
Note: Y represents the number of segments for which R_p or R_t is determined within a given profile and is typically on the order of 5. In any event Y must be reported for a specific analysis.

SA index = [(True surface area - Ideal surface area)/Ideal surface area]10^3

Note: Ideal surface area = area of least squares fitted plane

It should be noted that the roughness parameters defined for profiles can be extended to analysis of 3-d images. For such analysis one can envision connecting the individual profiles making up a completed image in a serpentine fashion and treating the resulting data as one long profile.

i.e.,



etc.

ANALYTICAL FUNCTIONS DESCRIPTION

The DEKTAK 3030ST is equipped with 22 analytical functions. Up to eight functions per scan can be programmed to be executed automatically. The functions may also be activated individually by pressing the assigned key or key combination.

The analytical functions can be categorized into four areas: roughness, waviness, geometry, and step-height parameters. The functions and their descriptions are listed below.

Roughness Parameters

Field	*Keys*	*Function*
Ra	**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.
Rq	**FCTN,4,0**	Root-mean-square (RMS): Determines the root-mean-square value of roughness corresponding to Ra.
Rp	**FCTN,3,5**	Maximum Peak: The maximum height or the highest peak of the profile roughness above the mean line, within the assessment length.
Rv	**FCTN,3,6**	Maximum Valley: The lowest point, or the maximum depth of the profile roughness below the mean line, within the assessment length.
Rt	**FCTN,3,7**	Maximum Peak to Valley: The sum total of the Maximum Peak and Maximum Valley measurements of roughness within the assessment length (Rt = Rp + Rv).
Rz	**FCTN,3,8**	ISO Ten Point Height Average: The average height difference between the five highest peaks and the five lowest valleys within the assessment length from an unfiltered profile.
R3z	**FCTN,3,9**	Six Point Height Average: The distance between the third highest peak and the third lowest valley within the assessment length.

Field	*Keys*	*Function*
MRa	**FCTN,4,1**	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.
MDv	**FCTN,4,2**	Maximum Deviation: Calculates the furthest data point above or below the mean line. The M cursor will automatically be positioned at the point of maximum deviation.

Waviness Parameters

Field	*Keys*	*Function*
Wa	**FCTN,3,0**	Arithmetic Average of Waviness: The average deviation of waviness from a mean line. Relates to a profile which roughness irregularities have been excluded (corresponds to Ra).
Wq	**FCTN,3,1**	Root-Mean-Square of Waviness: The RMS waviness value relates to the profile from which roughness irregularities have been excluded (corresponds to Rq).
Wp	**FCTN,3,2**	Maximum Peak of Waviness: The maximum height of the profile waviness above the mean line within the assessment length (corresponds to Rp).
Wv	**FCTN,3,3**	Maximum Valley of Waviness: The maximum depth of the profile waviness below the mean line within the assessment length (corresponds to Rv).
Wt	**FCTN,3,4**	Maximum Peak to Valley of Waviness: Wt = Wp + Wv the sum total of the Maximum Peak and Maximum Valley measurements of waviness within the assessment length (corresponds to Rt).

NOTE

The waviness cut-off filter must be active in order to calculate the waviness analytical functions. Waviness is calculated by: Raw data-roughness = waviness. Use the recommended cut-offs per ANSI B46.1 specification.

Geometry Parameters

Field	*Keys*	*Function*
Are	**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.
Cir	**FCTN,4,6**	Circumference: 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.
Rad	**FCTN,4,3**	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 1000Å for scans longer than 1mm.
Vol	**FCTN,4,4**	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.
Slp	**FCTN,4,5**	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.

Step-Height Parameters

Field	*Keys*	*Function*
AHT	**AVG HT**	Average Height: Calculates the average height of a step with respect to the horizontal grid line using the R and M cursors to define the area of measurement. The R and M cursors must be placed inside the leading and trailing edge of the step and the trace must be leveled for accurate results.
ASH	**ΔASH**	Delta Average Step Height: Computes the difference between two average height measurements. The R and M cursors are used to define the area of the step in which the calculation is to be made. The cursors should be placed symmetrically about the edge of the step. The horizontal distance between the cursors is considered to be 100% of the total distance. The calculation is made by using 20% of the distance from each cursor, computing an average for each, and subtracting the two averages. For example, the R cursor is placed 50um to the left of a step and the M cursor 50um to the right. The total distance between the cursors is 100um or 100% of the distance. An average over 20um to the right of the R cursor (20%) will be calculated and average of 20um to the left of the M cursor. These two averages will be subtracted resulting with a delta average step height.
Mht	**Max Ht**	Maximum Height: Calculates the vertical distance between the two furthest data points between the R and M cursors. Also known as TIR (Total Indicating Reading).

SMOOTHING

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. In the following example, a scan was run on a metallic substrate which produced the plot shown in Figure 6-3.

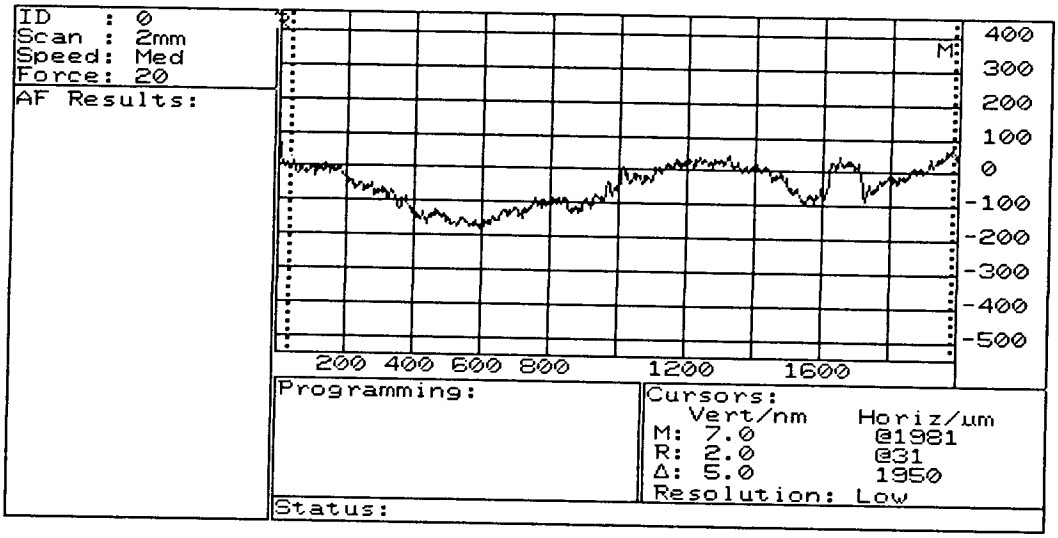


Figure 6-3. Before Smoothing

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 Program Menu. 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.

To initiate the smoothing function after a scan has been completed:

1. Press the **SM** key. The prompt area at the bottom of the screen will show the present noise band (if any) and will prompt for new parameters.

The values entered will determine the number of data points used in a user-selected vertical dimension. These data points are applied to a least squares plynomial to compute a single weighted data point.

The DEKTAK 3030ST offers three degrees of smoothing. The higher the degree, the more smoothing will be realized.

Degree 1: 5-point smoothing. Press **1,ENTR.**

Degree 2: 11-point smoothing. Press **2,ENTR.**

Degree 3: 23-point smoothing. Press **3,ENTR.**

After the degree of smoothing is selected, the 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 (**MAX HT** can easily be used to determine the noise band to be entered).

After the appropriate band is determined, use the numeric keys to enter that value and press the **ENTR** key.

The trace will then be smoothed and replotted on the screen (see Figure 6-4). In this example, the degree was set at two and the noise band was set at 500 angstroms as shown on the left of the print.

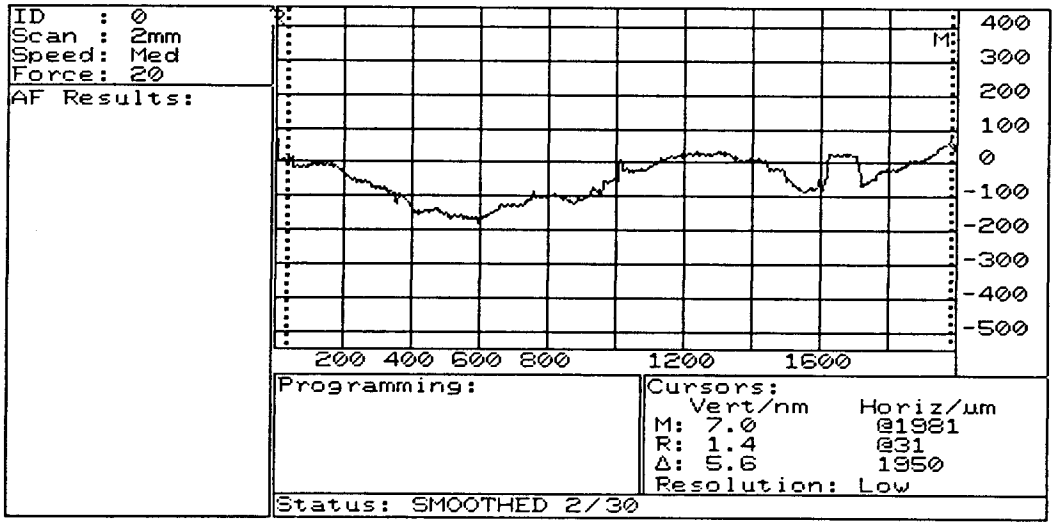


Figure 6-4. After Smoothing

NOTE

Smoothing is cumulative and needs to be cleared before new smoothing parameters are entered.

To clear the Smoothing Function, press **SM,CLR** to restore the original trace.

Description of Smoothing Function

The smoothing function smooths 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 and 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.

Noise Band Units Table

Select Units	Noise Band Units Entered	Noise Band Units Displayed	Conversion Factor	Minimum Noise Band Value
Scientific	Angstroms	Angstroms	1A = 1A	1A
Metric	Nanometers (nm)	Angstroms	1nm = 10A	1nm (10A)
English	Nanoinches (nin)	nanoinches	1000 nin = 1uin	40 nanoinches

SECTION 7

MAINTENANCE AND REPAIRS

CARE AND HANDLING

Like any precision instrument, the DEKTAK 3030ST requires care in handling and operation. The following recommendations should be followed.

1. If possible, leave the power switch ON permanently. Otherwise, allow the DEKTAK 3030ST to warm up for approximately 15 minutes after the unit has been turned on.

2. Always raise the stylus before making gross adjustments in the sample position.

3. Position the sample so that the stylus is the only part of the stylus arm that touches the sample.

4. Always keep the environmental shield installed when the DEKTAK 3030ST is not in use.

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

6. Do not lower the stylus without the stage assembly in place.

7. Do not move a sample during a scan.

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

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

Stage Cleaning

Perform the cleaning procedure at least once a month to ensure repeatable measurements. Environmental conditions may require more or less frequent cleaning. Always cover the scan head with the environmental shield, even when the DEKTAK 3030ST is not in use. See Section 1, Page 14 for cleaning procedure. The stage must be removed prior to cleaning. See Page 78 for stage removal instructions.

SOFTWARE CALIBRATION

The DEKTAK 3030ST should be calibrated periodically (at least once a month).

1. Press **PRGM** to enter the Scan Program Menu.
2. Select any scan program number and enter the following parameters.

```
Scan Program.....1
Scan ID.....0
Scan Length.....500um
Auto Leveling.....No
Speed.....Low
Profile.....
Measurement Range...65KÅ
Display Range.....Auto
Reference Cursor....100um
Measurement Cursor..200um
Stylus Force.....30mg (0.30mN)
Waviness Cutoff.....None
Ramp-Up Mode.....No
Resolution.....Low
Analytic Functions..None
```

Figure 7-1. Typical Scan Program Parameters for Calibration

NOTE

The instruments should be calibrated in the same profile ( ) in which the actual measurements are to be made.

3. Place the appropriate Calibration Standard on the sample stage, lower the stylus and position it as shown in Figure 7-2.

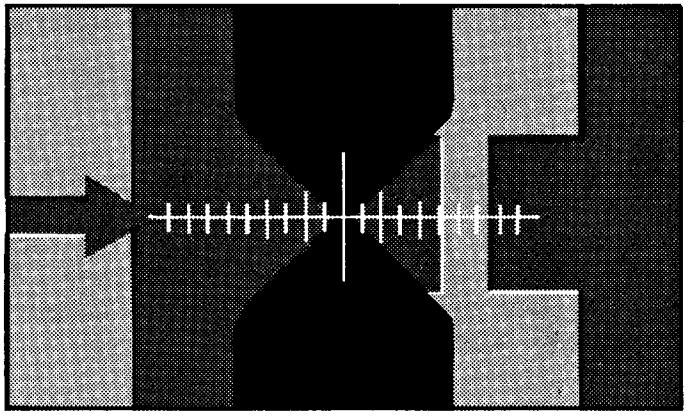


Figure 7-2. Stylus/Step Positioning

4. Raise the stylus and press **SCAN.**

5. When the scan is completed, position the cursors on the bottom of the step approximately 100 microns apart and press **FCTN,4,5** (Slope). If the slope exceeds ±0.01 degrees, the stage needs to be manually leveled (refer to Section 4, Page 50).

6. Once the stage is manually leveled to within ±0.01 degrees, press **LVL** to cursor (software) level the trace. Position the left and right boundaries as shown in Figure 7-3 and press **RPLT.**

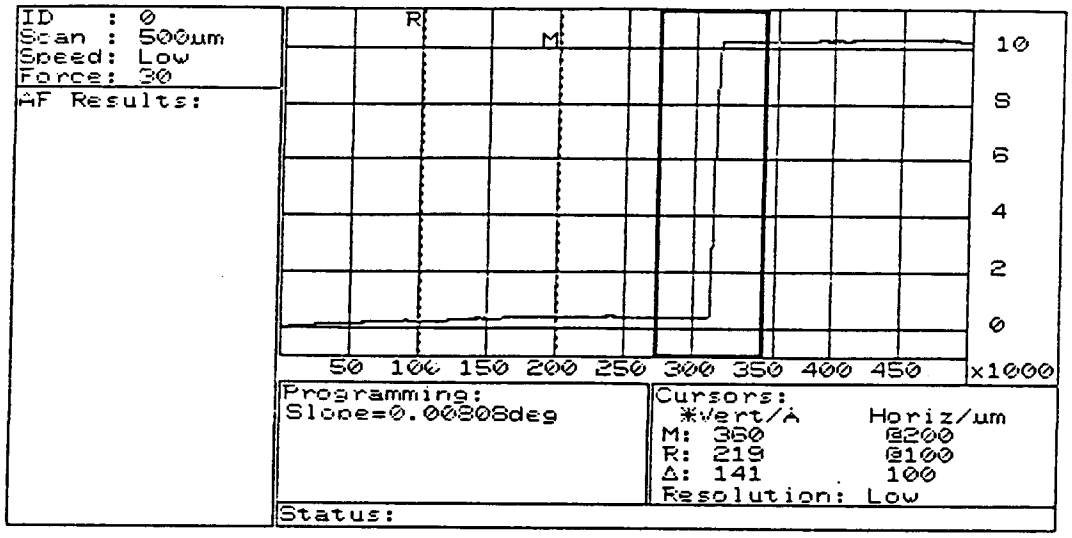


Figure 7-3. Leveled Scan

7. Position the R cursor so that it intersects the apparent midpoint of the step (Figure 7-4). Note the horizontal location of this mid-point.

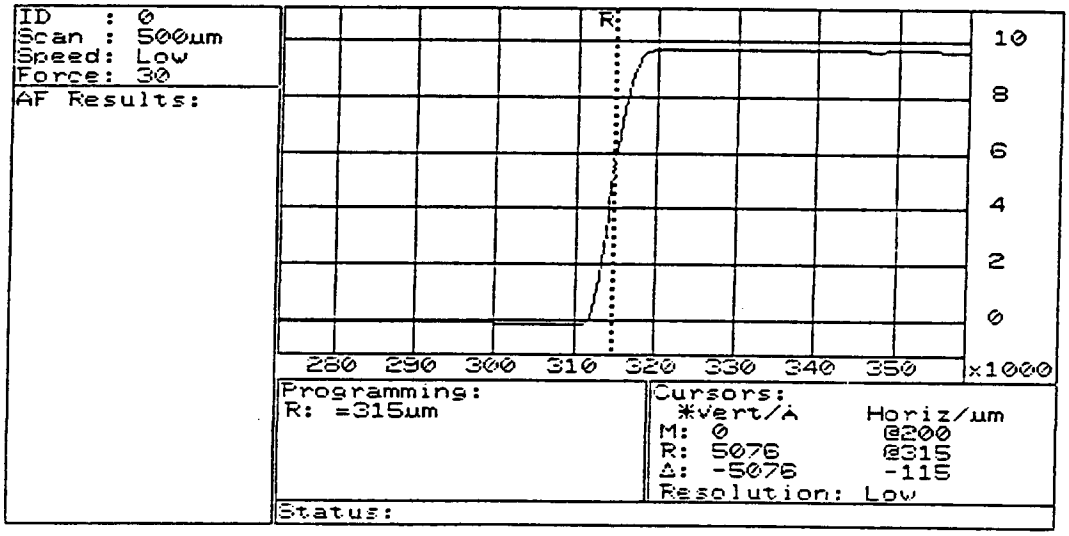


Figure 7-4. Step Midpoint

8. Program the R cursor to a position 20 microns to the left of the mid-point location.

9. Program the M cursor 40 microns to the right of the R cursor. Press **ASH** (Figure 7-5).

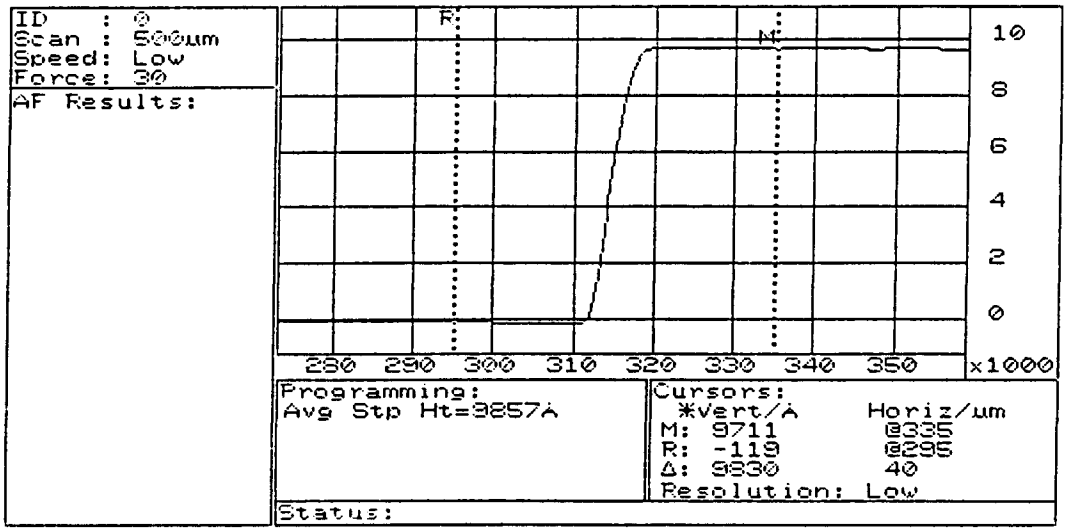


Figure 7-5. Calibrated Step Height

10. The *"Avg Stp Ht"* reading is the step height.

11. If the Delta Average Step Height differs more than 1% of the certified step height value press **FCTN,0** and enter the certified value found on the Calibration Standard case. The instrument in now calibrated.

STYLUS REPLACEMENT

All DEKTAK 3030ST styli have the same shank size. They differ only in the radius of the diamond tip. Proceed as follows to remove and/or replace a stylus.

CAUTION

The stylus suspension system is delicate.

1. Raise the stylus by raising optics to the full up position using the Optics Height Adjustment Knob.

2. Turn off the DEKTAK 3030ST.

3. Place a piece of lint-free tissue on the sample stage to catch the existing stylus.

5. Use a .035 Allen wrench to loosen the right-hand stylus retaining screw. One and one-half turns should be sufficient. The left-hand screw is factory set for stylus orientation and should not be altered.

6. If the stylus does not drop free, gently pull it straight down with a pair of tweezers.

7. Remove the replacement stylus from shipping capsule. Use a pair of tweezers to install it in the stylus arm, with the flat to the right side of the instrument. Gently push the stylus up until the top is flush with the top of the stylus holder.

CAUTION

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

8. Turn on the DEKTAK 3030ST.

CAUTION

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

ILLUMINATOR LAMP REPLACEMENT

CAUTION

Do not touch lamp while power is on. The bulb is extremely hot.

1. Raise the stylus arm by raising the optics to the full up position using Optics Height Adjustment Knob.
2. Turn off the DEKTAK 3030ST.
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 7-6). 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.

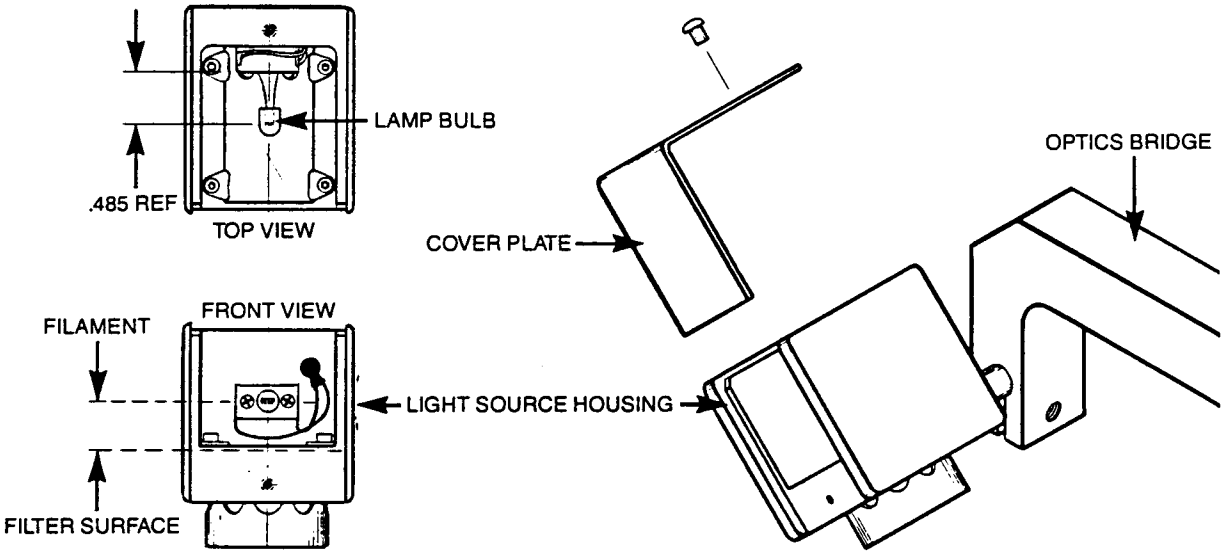


Figure 7-6. Illuminator Lamp Replacement

ERROR MESSAGES

If there are error messages on the screen at the lower right corner, try the following:

1. *"A/D Converter Timeout."* This signifies that the analog information generated by the stylus circuitry is not being converted to digital data within a specified time period. The most probable cause is that the Scan Head Cable is not connected to the Main Electronic Unit and/or the Scan Head. Check and scan again. If this error message persists on repeated scans, contact the Veeco Service Center for qualified assistance.

2. *"Stage Not Connected."* This error message appears only at power-up. The probable cause is that Scan Head Power Cable is not connected to Scan Head. Turn off the power. Check the connection, and power up.

3. *"Stage Won't Home."* The stage home sensor has not triggered within the specified time. The probable cause is that the stage rack is not properly engaged. Check and retry.

4. *"Stylus Down Timeout."* This signifies that the stylus mechanism has not stabilized on the sample surface within a predetermined time limit. Reduce the travel distance between the stylus and sample surface with the Optics Height Adjustment Knob and try again.

5. *"Stylus Position Error."* This signifies that the final analog to digital converter reading, taken after stylus mechanism stabilized, was at the end of its range. With the Optics Height Adjustment Knob, increase the distance slightly between stylus and sample surface to ensure that the "slow" tower speed is activated before the stylus touches the sample surface.

6. *"Stylus Will Not Retract."* The stylus is apparently stuck in the down position and unable to swing freely. Power off the DEKTAK 3030ST. Power up and retry.

7. *"Stylus Won't Swing Down."* The stylus is apparently stuck in the up position and unable to swing freely. Power off the DEKTAK 3030ST. Power up and retry.

8. *"Printer Timeout."* The thermal printer is not online.

   Check that:

   a. Printer power is switched on. Remove the DEKTAK 3030ST printer cover, fully depress the printer's red power switch. Retry the print function.

   b. Ensure that printer cable is connected to the printer in the proper orientation.

   c. Ensure the printer power cord is connected to the Main Electronics Unit.

9. *"External Printer Not Online."* The MEU has the External Printer Option Board plugged in but the printer is not "communicating" with the MEU.

   Check that:

   a. External printer is properly connected to the option board.

   b. Power to printer is properly connected. See Appendix E.

10. *"Data Out Of Range."* The vertical measurement range was insufficient for the sample requirement.

    Check that:

    a. The measurement range is appropriate.

    b. The programmed profile (peaks, valley, or both) is appropriate.

    c. The sample is grossly out-of-level in the first 200 microns. Level the stage/sample and retry.

MAJOR REPAIRS

WARNING

The Main Electronics Unit and/or Video Monitor should NEVER be opened when connected to the primary power source. Major service should only be performed by Veeco Service Engineers.

The DEKTAK 3030ST cannot be readily repaired after major component failures without the assistance of specialized test equipment and software routines. If the instrument cannot be repaired at the user facility, it must be shipped to a Veeco Service Center. Refer to page 75 or the Service Center address nearest your facility.

Before calling the Veeco Service Center, check the following:

1. Has the circuit breaker tripped? The DEKTAK 3030ST is on when the "1" on the power switch is down.

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

3. Is the power cord connected properly?

4. Is the monitor brightness control on the front of the Monitor properly adjusted?

5. Does the stylus move up and down when you turn the Optics Height Adjustment Knob on the front of the scan head?

RETURNS

If your instrument needs to be shipped to a Veeco Service Center, the following procedure must be followed:

Stage Removal

1. Raise the optics to the upper-most position.
2. Turn the MEU power switch off.
3. Use a slotted screw driver to disengage the rack loading mechanism.
4. Carefully lift the stage up and out being careful not to hit the stylus.

Repacking

1. Turn on the power.
2. Lower the optics to the lowest position and stop.
3. Turn off the power.
4. Raise the optics 3/4".
5. Replace the stylus shipping paper.
6. Disconnect each of the modules.
7. Disassembly the monitor from the scan head.
8. Retighten the shipping screws under the Scan Head.
9. Repack the DEKTAK 3030ST in the reverse of unpacking instructions in Section 1, Pages 2-5.

Shipping

CAUTION

Shipping the DEKTAK 3030ST with the stage installed or in any containers other than the DEKTAK 3030ST cartons will void the instrument's warranty. If the original cartons have been lost, complete shipping cartons with all packing materials can be purchased from Veeco/Sloan at a nominal charge.

1. Notify the Veeco Service Center that the unit is being returned. A Return Authorization Number (RA) will be issued. This number should be referenced on all paperwork involving the return of the instrument as well as the shipping cartons.

NOTE

Prompt notification to the Service Center prior to shipment will allow repairs to be scheduled and minimize downtime.

2. A complete description of all problems encountered in the operation of the system should be enclosed. If the unit is out of warranty, enclose a purchase order for the repairs. Make sure that the RA number is on all documents.

3. Seal the shipping cartons and ship the unit via a reliable carrier to:

EASTERN REGION

Veeco Instruments Inc.
Terminal Drive
Plainview, NY 11803
Attn: Service Center
(516)349-8300

CENTRAL REGION

Veeco Instruments Inc.
10480 Markison Road
Dallas, TX 75238
Attn: Service Center
(214)349-8482

WESTERN REGION

Veeco Instruments Inc.
3350 Scott Blvd., #3902
Santa Clara, CA 95054
Attn: Service Center
(408)982-0600

WARRANTY

All new catalog-listed standard equipment sold and/or manufactured under Veeco's labels, is warranted by Veeco 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 which are components of standard catalog items. Purchased equipment incorporated into any item supplied by Veeco 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's obligation under these warranties is limited to repairing or replacing at Veeco's option defective non-expendable parts. Veeco's obligation shall not extend to defects that do not impair service. No claim will be allowed for any defect unless Veeco 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.0.B. Factory. Within thirty days of Purchaser's receipt of Equipment, Veeco must receive notice of any defect which Purchaser could have discovered by prompt inspection of Equipment. In any event, Veeco shall have the option of inspection at Purchaser's premises or at Veeco's plant, before allowing or rejecting the claim.

Warranty Eligibility

To be eligible for the above warranties, Purchaser must perform preventative maintenance in accordance with the schedule set forth in the Operation and Maintenance Manual provided. Veeco 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's liabilities to the purchaser. Veeco does not warrant that the system can be used for any particular purpose other than that covered by the applicable specifications. Veeco 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 your nearest Veeco sales/service office, for prompt service.

WESTERN REGION

Veeco Instruments Inc.
3350 Scott Blvd., #3902
Santa Clara, CA 95054
Attn: Service Center
(408)982-0600

CENTRAL REGION

Veeco Instruments Inc.
10480 Markison Road
Dallas, TX 75238
Attn: Service Center
(214)349-8482

690-0800

Scott Hubbard
680-1034

EASTERN REGION

Veeco Instruments Inc.
Terminal Drive
Plainview, NY 11803
Attn: Service Center
(516)349-8300

APPENDIX A

DEKTAK 3030 OPTIONS, ACCESSORIES AND REPLACEMENT PARTS

OPTIONS

Item	*Description*	*Part No.*
External Printer Option Board	Provides a Centronics standard interface for an external printer. (Appendix E)	153719
Fiber Optics Illuminator	Enhances surface viewing by illuminating low or non-reflective sample surfaces, specifically hybrid samples. (Appendix D)	154010
Vibration Isolation Table	Specifically designed to isolate Scan Head from external vibration Does not require external air supply. Platform dimensions: 20"Wx25"Dx3"H	~~805620~~ 085620 $2950
Vacuum Chuck	Designed to hold wafers up to 6 inches securely in place on the sample stage (Appendix C)	154007
RS-232 Interface	Allows scan and program data to be transferred to a computer, dumb terminal, or printer with RS232 capability.	153721

2-98

ACCESSORIES

Item	*Description*		*Part No.*
	Color Code	Size	
Styli	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. Sloan 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 Sloan Calibration Standard(s)			
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
	Set of Three (90A, 440A, 4700A)		085361
	Set of Three (220A, 2250A, 4700A)		085362

REPLACEMENT PARTS

Thermal Printer Paper	085542
Clean Room Printer Paper	085556
Illuminator Lamp	140229

APPENDIX B

DEKTAK 3030ST RS-232 INTERFACE OPTION

The DEKTAK 3030ST Interface Option allows scan and program data to be transferred to a computer, dumb terminal, or printer with RS-232 capability.

INSTALLATION

The procedure for setting the baud rate on the RS-232 option board and installing the board into the DEKTAK 3030ST, is described in the following pages.

Selecting the Baud Rate

The baud rate for the RS-232 option board is preset at 4800 baud. However, the baud rate can be changed by adding or removing jumpers on the option board. The jumper locations are labeled W1, W2, W3, and W4 (see Figure B-1).

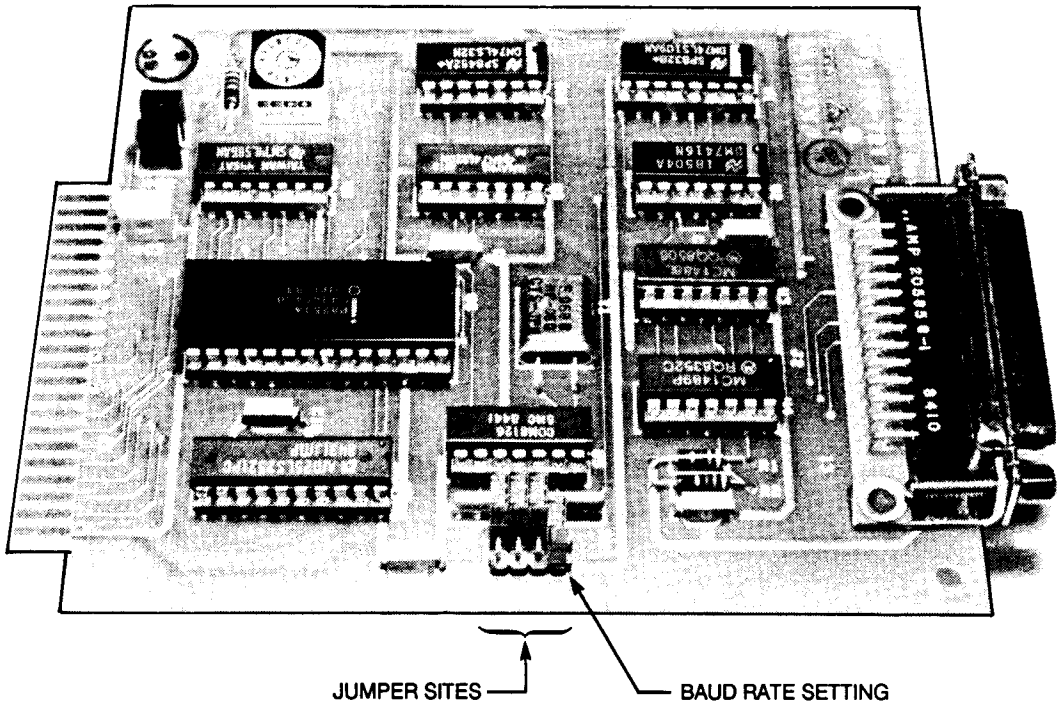


Figure B-1. Baud Rate Setting

Baud Rate Jumper Configuration

To modify the baud rate, use the following table. When reading the table, "IN" means to insert a jumper; "OUT" means to remove a jumper.

Baud Rate	W1	W2	W3	W4
50	IN	IN	IN	IN
75	OUT	IN	IN	IN
110	IN	OUT	IN	IN
134.5	OUT	OUT	IN	IN
150	IN	IN	OUT	IN
300	OUT	IN	OUT	IN
600	IN	OUT	OUT	IN
1200	OUT	OUT	OUT	IN
1800	IN	IN	IN	OUT
2000	OUT	IN	IN	OUT
2400	IN	OUT	IN	OUT
3600	OUT	OUT	IN	OUT
4800	IN	IN	OUT	OUT
7200	OUT	IN	OUT	OUT
9600	IN	OUT	OUT	OUT
19200	OUT	OUT	OUT	OUT

Figure B-2. Baud Rate Jumper Configuration Table

RS-232 Board Installation

Once the correct baud rate has been set, the RS-232 board is then installed in one of the DEKTAK 3030ST option slots.

1. Turn the main power switch off on the top of the DEKTAK 3030ST MEU.
2. Unscrew and remove the brass plat from any one of the available option slots on the back of the MEU.
3. Install the board in the slot and replace the screws.
4. Turn on the DEKTAK 3030ST.

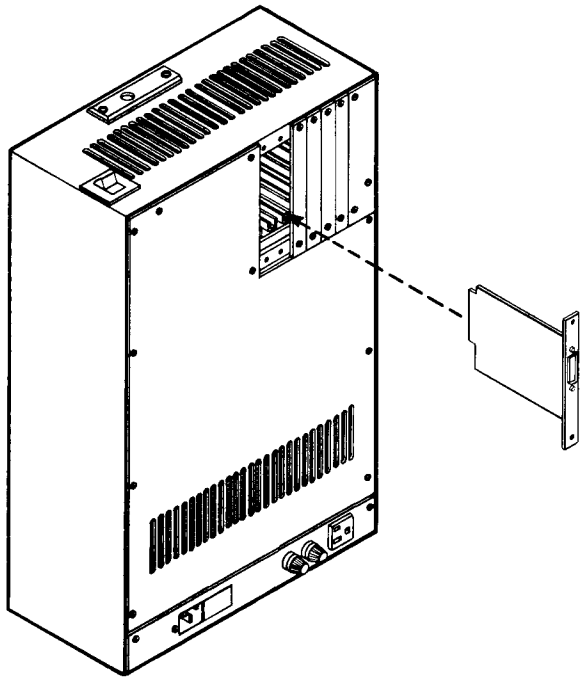


Figure B-3. Option Board Installation

DATA TRANSMISSION

The DEKTAK 3030ST RS-232-C interface is a transmit-only (Simplex/Type A) configuration. In this configuration the DEKTAK 3030ST is considered to be the "master" and the input device is considered the "slave". The data is configured in the ASCII format in variable block lengths delimited by a carriage return and line feed.

Data can be transferred from the DEKTAK 3030ST in any one of three different formats: (1) scan parameter data from the scan program menu, (2) scan data from the graphic display screen, and (3) scan data from a zoom magnified trace.

The procedure for transmitting data using these three methods is described in the following pages.

Scan Program Data Transfer

Scan parameter data can be transferred from the DEKTAK 3030ST scan program menu to the selected device via the RS-232 interface. To transmit, display the desired scan program menu on the DEKTAK 3030ST CRT and press the **FCTN,Online** keys. The scan program information will be sent as shown in Figure B-4.

```
Scan Program ..... 1
Scan ID ..... 0
Scan Length ..... 2mm
Auto Leveling ..... No
Smoothing ..... No
Speed ..... Medium
Profile ..... Hills and Valleys
Measurement Range ..... 655kA
Display Range ..... Auto
Reference Cursor ..... 184um
Measurement Cursor .... 359um
Stylus Force ..... 40mg
Waviness Cutoff ..... None
Ramp-Up Mode ..... No
Resolution ..... Low
Analytic Functions .... None
```

Figure B-4. Scan Program Data

Scan Data Transfer

Data from the just completed scan can be transferred from the DEKTAK 3030ST graphic display screen to the selected device via the RS-232 interface. To transmit, at the conclusion of a scan press **FCTN,Online**. The data from the scan measurement displayed on the DEKTAK 3030ST CRT will be sent in the format shown below.

```
                    ----- DISPLAYED SCAN DATA -----
ID:      0
LENGTH: 2mm
SPEED:   High
FORCE:   40mg
TIME AND DATE: 12:46 04/03/90
LEFT BOUND: 0
       -39       -22        15        12       -11         7        34         1
         8        15        22         0        37        44        21        28
        25        13         0         7        14         1        -2         6
         3       -10        -3        -6         1         9        16        23
         0         7        34        12         9        26        23         0
        -3        14        22        19        36        33        10        17
        25        22        -1         6        13        10        -2        25
        12        79       166       213       191       198       205       212
       189       186       194       191       178       185       132        39
        27         4         1         8        15        22         0         7
        14        21        -2        -5         3         0         7        24
        21        -2         5        13        10       -13        24         1
         8        16        23         0         7        34        11         9
        16        33         0         7        14        22        -1         6
        33        10        17        25         2        -1         6         3
       -10       -12        -5         2       -21

M CUR:   6A              @1869um
R CUR:   9A              @1219um
DELTA:   -3A              650um
ANALYTIC FUNCTIONS:
  ASH    174A             R:763um          M:1094um
  Ra     10A              R:238um          M:744um
  MHt    216A             R:756um          M:1281um
  Cir    625.0um          R:856um          M:1169um
  Area   4.2squm          R:856um          M:1169um
  Rv     -24A             R:1219um         M:1869um
  Rt     45A              R:1219um         M:1869um
  Rp     22A              R:1219um         M:1869um
RESOLUTION: Low
RIGHT BOUND: 2000
NUMBER OF POINTS: 125
```

Figure B-5. Scan Data Transfer

Magnified Scan Data Transfer

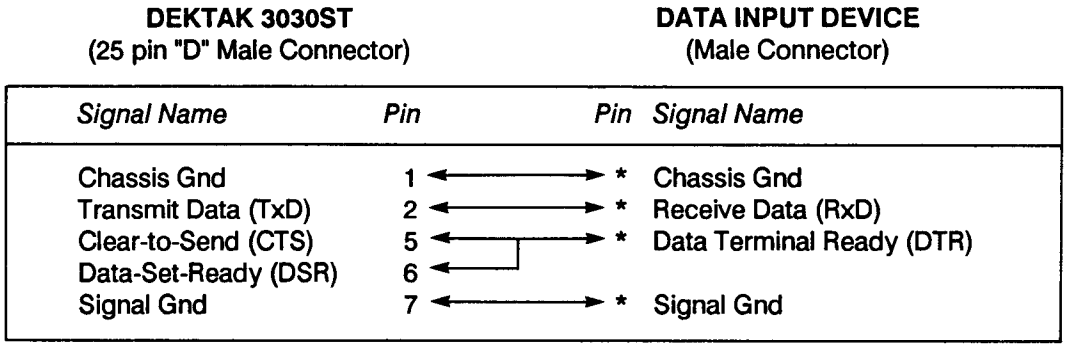
Data from a zoom magnified scan trace can be transferred via the RS-232 interface. Once the new plot boundaries have been selected, and the magnified scan has been replotted and displayed on the DEKTAK 3030ST CRT, press **FCTN,Online**. The data from the magnified scan measurement will be displayed along with the data from the original trace (see Figure B-6).

```
                    ----- DISPLAYED SCAN DATA -----
ID:      0
LENGTH: 2mm
SPEED:   High
FORCE:   40mg
TIME AND DATE: 13:06 04/03/90
LEFT BOUND: 662
        -6          0          6        -18          7         23         -1         -5
        30         16         12          8         23        -11         -5         11
        86        142        188        214        189        165        191        177
       172        168        174        180        166         91         37          3
       -21         -6        -10         -4          2         -3        -27        -31
       -25        -10        -44        -28        -22        -27        -21        -15
        -9        -34        -29

M CUR:   0A              @1244um
R CUR:   0A              @688um
DELTA:   0A               556um
ANALYTIC FUNCTIONS:
  ASH    163A            R:763um          M:1094um
  Ra     12A             R:238um          M:744um
  MHt    241A            R:756um          M:1281um
  Cir    626.0um         R:856um          M:1169um
  Area   3.8squm         R:856um          M:1169um
  Rv     -29A            R:1219um         M:1869um
  Rt     60A             R:1219um         M:1869um
  Rp     31A             R:1219um         M:1869um
RESOLUTION: Low
RIGHT BOUND: 1469
NUMBER OF POINTS: 51

                    ----- COMPLETE SCAN DATA -----
       -41        -46        -30        -24        -28        -43        -17         -1
       -25        -20         16         -8        -12          3          9         -5
         1          6         12        -12         -6         -1        -25        -29
       -23        -18        -42        -16          0         -5        -19         17
        23        -12         -6         10          6        -19        -13         13
       -11         -6          0          6        -18          7         23         -1
        -5         30         16         12          8         23        -11         -5
        11         86        142        188        214        189        165        191
       177        172        168        174        180        166         91         37
         3        -21         -6        -10         -4          2         -3        -27
       -31        -25        -10        -44        -28        -22        -27        -21
       -15         -9        -34        -28          8        -16        -21         -5
         1         -3          2         18         14        -10         -5          1
       -13         -7         -2        -16        -20        -14          1        -33
       -37        -21        -16        -20        -14         22         -3          3
         9         25         10         -4          2
NUMBER OF POINTS: 125
```

Figure B-6. Magnified Scan Data Transfer

INTERCONNECTIONS

Use the diagram below to configure a cable for RS-232 transmission.



*Consult users manual for connector type and pin assignments.

Chassis Ground

Provides common ground for both the DEKTAK 3030ST and the data input device.

Transmit Data (TxD)

Serial Data is transmitted from the DEKTAK 3030ST to the input device. Signals are held in the marking condition during intervals between characters or words and when data is being transmitted.

Receive Data (RxD)

Serial Data is received by the input device from the DEKTAK 3030ST.

Clear to Send (CTS)

Used to enable data transmission. An "off" condition will inhibit the DEKTAK 3030ST from sending data. An "on" condition indicates to the DEKTAK 3030ST that data can be transferred.

Data Set Ready (DSR)

This is a general purpose input signal that indicates the input device is ready to accept transmission.

Data Terminal Ready (DTR)

Used to indicate that the input device is ready to accept data.

Signal Ground

This is used to establish the common ground reference potential for all interchange circuits.

Electrical Signal Characteristics

For data interchange, the signal is considered in the marking condition when the voltage is more negative than -3 volts with respect to signal ground. The signal is considered in the spacing condition when the voltage is more positive than +3 volts. For timing and control signals, the function is considered "on" when the voltage is more positive than +3 volts and "off" when more negative than -3 volts.

Storage Requirements

The maximum number of bytes required for scan storage are:

Data Points	Normal Display	Zoom Display
2000	22 KBytes	42 KBytes
4000	42 KBytes	82 KBytes
8000	82 KBytes	164 KBytes

BASIC Program for Data Transfer

The following program written in BASIC can be used as a simple and quick method for transferring data to a computer file. With this program, it asks for a file name that must conform to DOS format, opens a file under that name in the logged on directory on the "C:" drive and stores the data. Note that the baud rate must be set at 4800. If set at 9600 baud, device I/O errors will occur. Once the data file is closed, you can view the file by entering "TYPE [n.e]" or "MORE<[n.e] at the DOS command line (n=filename; e=extension).

```
10 CLS
20 OPEN "COM1:4800,N,8,1,CS,DS,CD0" AS #1     'Opens ComPort1.
30 CLS
40 LINE INPUT "Enter File Name:",F$     'File Name For Scan Data.
50 OPEN F$ FOR OUTPUT AS 2     'Opens File Name F$.
60 PRINT "Press Any Key Then FCTN,ONLINE On D3030 To Collect Data"
70 KB$=INPUT$(1)
80 CLS
90 PRINT "Storing Data On Drive C: Under File Name:" F$
100 TRIES=0     'Sets End-Of-Transmission Timer To Zero
110 WHILE NOT EOF(1)     'Sets Loop To 150 Until End-Of-File Detected.
120 A$=INPUT$(LOC(1),#1)
130 PRINT #2,A$;     'Writes Data To File F$
140 TRIES=0     'Resets End-Of-Transmission Timer To Zero.
150 WEND    'If EOF=0, Loop Back To 100. If EOF=1, Goto 160.
160 TRIES=TRIES+1     'Increments End-Of-Transmission Timer.
170 IF TRIES > 2000 GOTO 190    'If Timer=2000(25sec), Close File Else GoTo 110.
180 GOTO 110
190 CLOSE #2
200 PRINT "Transmission Complete"
210 INPUT "Run Program Again? (1=Yes 0=No)",AGAIN
220 IF AGAIN = 1 GOTO 30
230 SYSTEM
```

Figure B-7. BASIC Program

ANSWERS TO COMMONLY ASKED QUESTIONS

Q: How can the host computer tell the DEKTAK 3030ST when it's ready to receive?

A: It's necessary to tie the data set ready (DSR) signal to the communications interface.

Q: Can multiple DEKTAK 3030ST's be connected to a host computer?

A: The host computer must have multiple ports, sufficient buffer storage, and be able to establish priorities.

Q: How many bits per word?

A: 8

Q: What parity is used?

A: None

Q: How many stop bits are used?

A: 1

Q: What tells the host computer that the transmission is completed?

A: No special code is used, so you'll need to time it. If more than a few milliseconds have elapsed without reception of data, it is safe to assume that transmission is over.

Q: What hardware is used for serial interface?

A: The Intel 8251 USART chip.

Q: What type of computer is used in the DEKTAK 3030ST?

A: The Intel 8086 chip.

APPENDIX C

VACUUM CHUCK OPTION

The vacuum chuck secures a sample up to six inches in diameter firmly to the stage. Adjustable alignment pins allow consistent positioning from one sample to the next. Three hundred sixty degree continuous rotation of the chuck allows accessibility to any location on the sample. Recessed slots allow access for tweezers.

NOTE

All DEKTAK 3030 AUTO I installation procedures must be completed prior to installing the Vacuum Chuck (see Section 1).

1. Power on.
2. Raise the optics to the full up position.
3. Power off.
4. Remove the monitor from the Scan Head.
5. Using the 3/32" driver supplied in the vacuum chuck tool kit, remove the four socket head screws securing the horizontal bezel (see Figure C-1). Carefully remove the bezel by slightly lifting up the front of the stage.

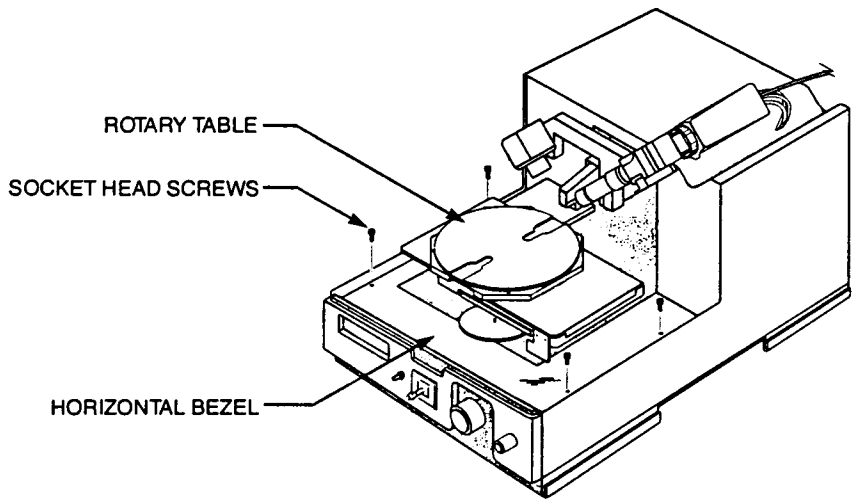


Figure C-1. Horizontal Bezel and Rotary Table

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

7. Remove spacer plate under vacuum chuck and discard spacer plate. Place the vacuum chuck on the stage with the vacuum hose on the right side and secure plate using the four socket head screws removed in Step 6.

8. Remove the protective paper from the back of the clip. Attach the clip to the top of the slide table approximately two and one half inches 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).

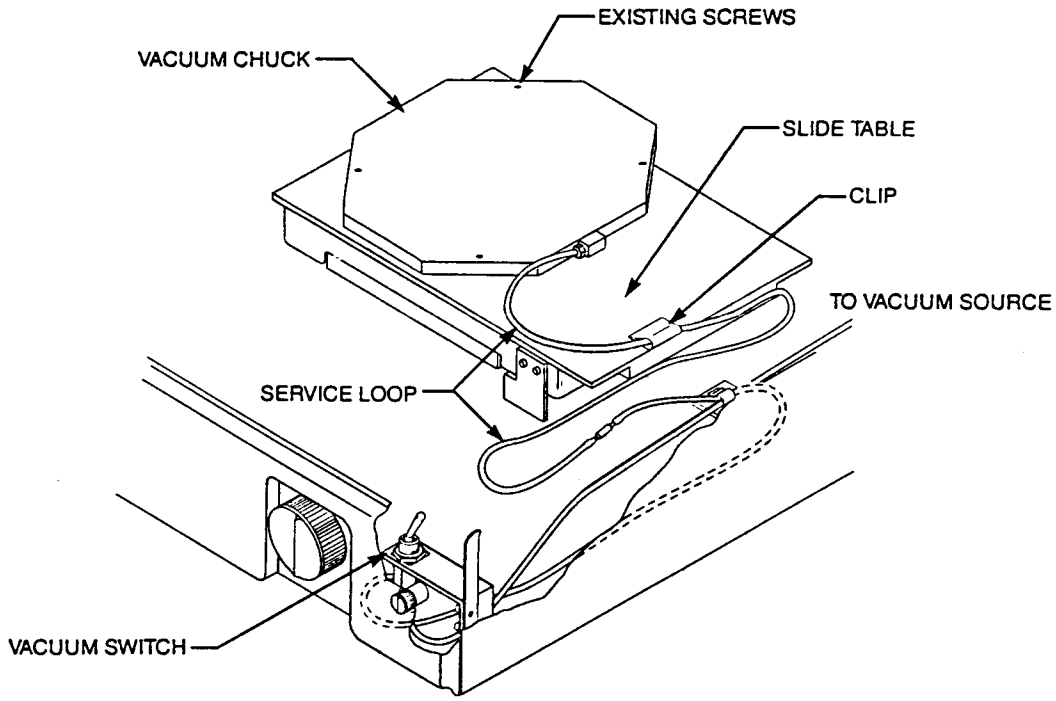


Figure C-2. AUTO I Stage and Tube Routing

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.

10. The vacuum hose to the switch should have a 12" service loop between the clip on the slide table and the cable clamp that holds the light contrast cable to the baseplate. Open the cable clamp and feed the hose through the clamp so that 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.

12. 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.

13. With the 3/32" driver, remove the two 4-40 x 1/4" socket head screws from the environmental shield retainer mounted inside the right front of the scan head (see Figure C-3).

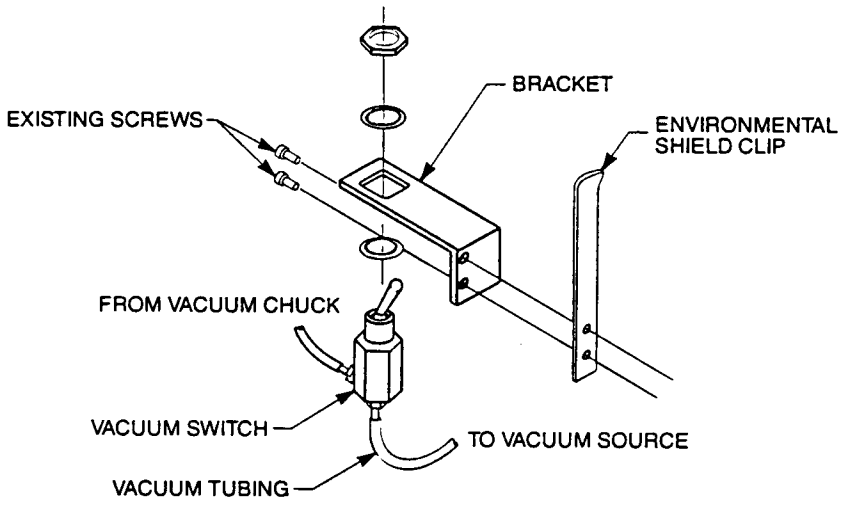


Figure C-3. Vacuum Switch Assembly

14. Line up the mounting holes on the vacuum switch bracket with the mounting holes in the environmental shield retainer and secure with the screws. Re-install the washers as required.

15. After completing the hose routing, run two or three scans to check that the hose does not interfere with the stage cable or stage movement. When assured that the installation is correct, replace and secure the horizontal bezel.

APPENDIX D

FIBER OPTICS ILLUMINATOR OPTION

The Fiber Optics Illuminator enhances sample viewing of low or non-reflective sample surfaces such as hybrid circuit patterns printed on ceramic substrates. The option kit provides front mount and side mount assemblies, for various application requirements.

Front Mount Assembly

1. Remove monitor assembly from the Scan Head by loosening the two Dzus fasteners.

2. Remove the #6-32 screw and washer that hold the light cable at the center of the optics bridge and set aside. This cable should be left connected so the standard DEKTAK 3030ST illumination can be controlled with the contrast knob.

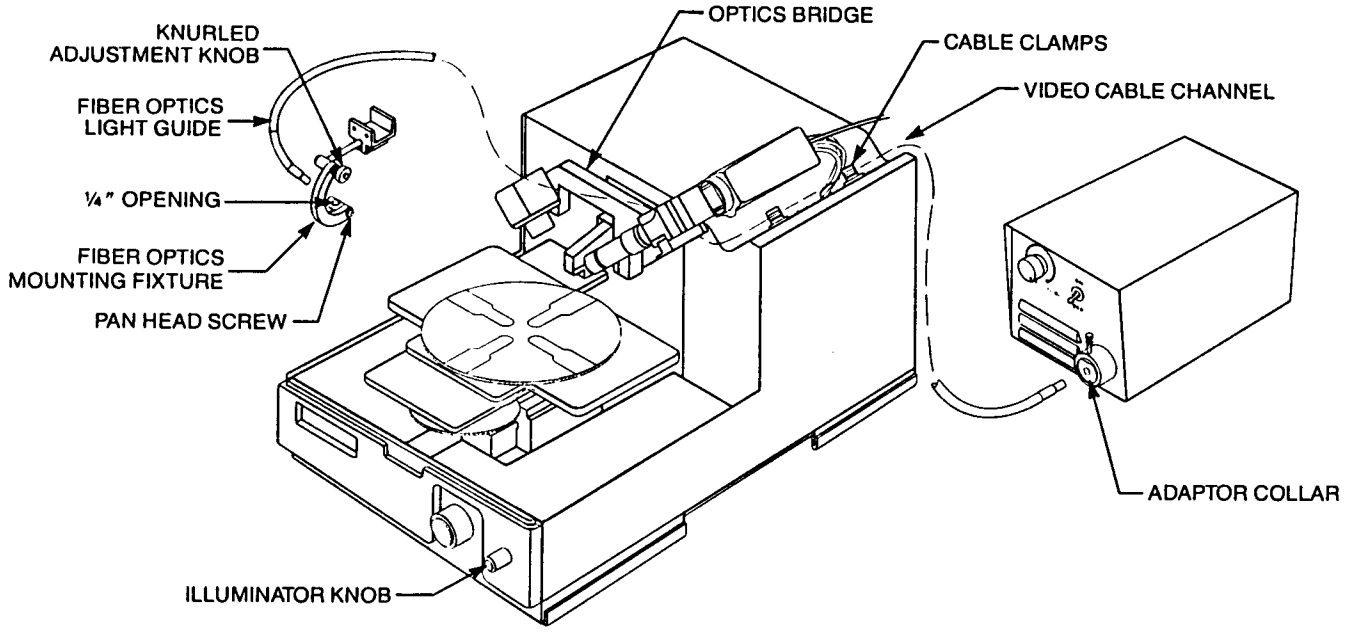


Figure D-1. Front Mount Assembly

3. Attach the fiber optics mounting fixture to the optical bridge with 5/64 hex driver and two #8-32 set screws (See Figure D-1). The fiber optics mounting fixture should be positioned on the optics bridge with the stylus centered in the 1/4" diameter opening of the fiber light clamp when viewed from the front of the Scan Head.

4. Place the fiber optic light guide into the 1/4" diameter opening of the fiber light clamp and secure it by tightening the set screw (use 1/16" hex driver).

5. Adjust the forward placement of the fiber optics fixture by rotating the arm of the fiber optics mounting fixture. It must not interfere with the vertical travel of the sensor head. When placement is satisfactory, secure by turning the knurled adjustment knob on the fiber optics mounting fixture.

Side Mount Assembly

1. Turn main power off.

2. Remove monitor assembly from the Scan Head by loosening the two Dzus fasteners.

3. Remove the two #6-32 screws and washers that hold the light cable to the back of the optics bridge, and disconnect the cable.

4. Loosen the set screw on the side of the optics bridge and remove the standard illuminator light housing.

WARNING

The standard illuminator light housing may be hot -- handle with care.

5. Install the fiber optics side mount assembly as shown in Figure D-2. Retighten the set screw on the side of the optics bridge.

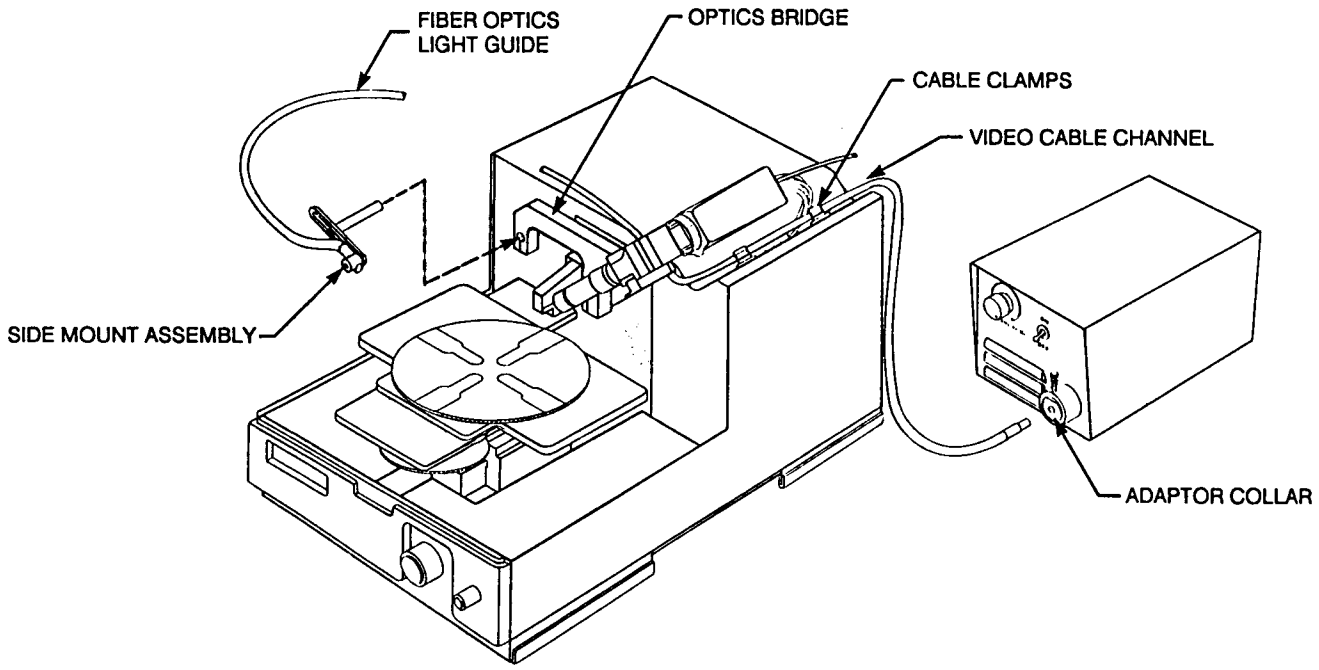


Figure D-2. Side Mount Assembly

6. Place the fiber optics light guide into the 1/4" diameter opening of the fiber light clamp and secure it by tightening the set screw (use 1/16" hex driver).

7. Adjust the forward placement of the side mount assembly until satisfactory and tighten screw to secure the arm in place. The fiber optics side mount assembly must not interfere with the vertical travel of the sensor head.

Fiber Optics Illuminator Assembly

1. Route the light guide along the scan head bridge video cable channel and attach two cable clamps to hold it in place.

2. Place adaptor collar over fiber optics light guide, then connect into the opening of Dolan-Jenner Fiber Optics Illuminator.

WARNING

Do not plug Fiber Optics Illuminator power cable into the auxiliary outlets on the back of the DEKTAK 3030ST Main Electronics Unit.

3. Plug in Fiber Optics illuminator power cable into a standard 110/120 VAC power outlet.

4. Turn DEKTAK 3030ST main power on.

5. Position a low or nonreflective sample on the DEKTAK 3030ST stage below the stylus.

6. Press VID key on DEKTAK 3030ST twice to make graphic display disappear.

7. Turn DEKTAK 3030ST illuminator knob full counter-clockwise until light is off.

8. Turn Fiber Optics Illuminator on.

9. Use optics height adjustment knob to lower stylus arm until sample is visible on video monitor.

10. Adjust Hi-Lo intensity knob on Fiber Optics Illuminator to desired brightness.

11. Adjust the angle of light by rotating the fiber light clamp. Use P75 3mm metric hex driver to loosen and tighten #6-32 pan head screw.

APPENDIX E

EXTERNAL PRINTER INTERFACE OPTION BOARD

The External Printer Interface Option Board is a Centronics-compatible plug-in module which will allow the use of a Centronics-compatible printer such as the Hewlett-Packard ThinkJet or any compatible 132 column printer. To increase the throughput of the DEKTAK 3030ST, a printer buffer such as the Intellicom Quick-Link* should be installed between the DEKTAK 3030ST and the printer. When the External Printer Interface Option Board is installed, the standard DEKTAK 3030ST printer is automatically disabled and all print information is directed to the option board. To redirect the print information back to the standard printer, the option board must be removed.

To install the option board perform the following:

1. Turn the DEKTAK 3030ST main power switch off.
2. Remove any unused blank-off plate from the rear of the MEU (Figure 1-8, Page 8).
3. Insert the option board and re-install the two screws.
4. Connect a Centronics-compatible cable from the option card to a printer buffer and/or printer.
5. Turn the DEKTAK 3030ST main power switch on.

Due to the large number of printers available, it is impossible to give configurations for all printers. However, the printer must have the capability of issuing an automatic line feed upon receiving a carriage return (CR) command from the DEKTAK 3030ST. The following diagram shows the mode switch setting for the H/P ThinkJet printer. To configure other printers, consult the printer's operations manual.

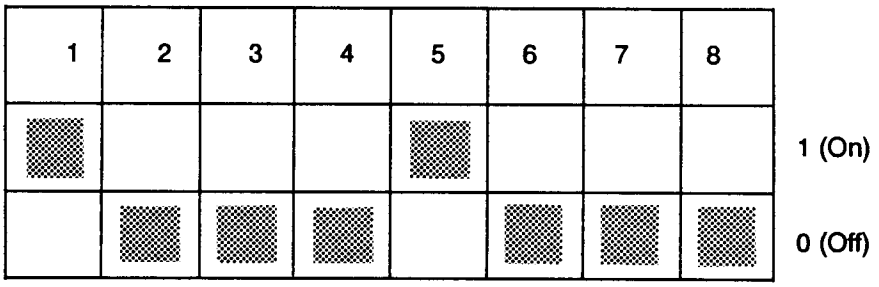


Figure E-1. H-P ThinkJet Switch Settings

NOTE

Some printers will automatically issue a line feed command when a carriage return is issued. If the printout is double spaced, check that the auto line feed mode switch setting is off.

---

*Information regarding the Quick-Link can be obtained through:

Intellicom
9259 Eaton Ave.
Chatsworth, CA 91311
Inside Calif.: 1-800-422-4428
Outside Calif.: 1-800-992-2882
Model: Parallel-to-Parallel, 128K
Part Number: 500-0021

INDEX

ITEM PAGE